深圳市华远显示器件有限公司

SHENZHEN HUAYUAN DISPLAY CO.,LTD.

液晶显示模块规格书

Specification for Liquid Crystal Display Module

HYG2406408C-bT62L-VA

Prepared By	Reviewed By	Approved By
Date:	Date:	Date:

REVISION HISTORY

The following table tracks the history of the changes made to this document.

SN	Rev.	Content	Date	Design
1	R00	Origin Released	2011-08-31	

CONTENTS

1. 0 GENERAL DESCRIPTION

The HYG2406408C-bT62L-VA is a 240x64 dots dot-matrix LCD module. It has a STN panel composed of 240 segments and 64 commons. The LCM can be easily accessed by microcontroller via 6800 series MPU interface.

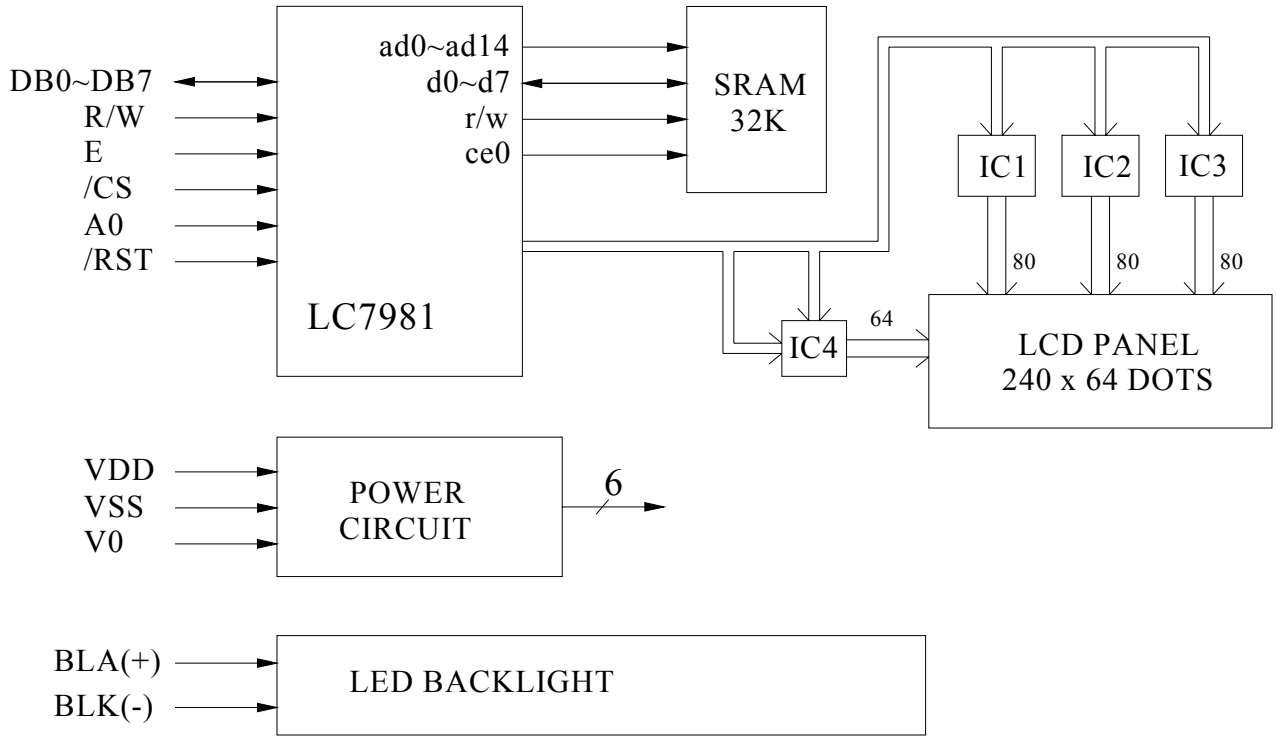
2. 0 FEATURES

Display Format	240 x 64 dots
LCD Type	STN-BLUE-NEGATIVE
Polarizer Mode	TRANSMISSIVE
Drive Method	1/64 Duty, 1/9 Bias
Viewing Direction	6 O'clock
Controller	LC7981
Interface	6800 Series 8-Bit Parallel Interface
Backlight	White LED Backlight

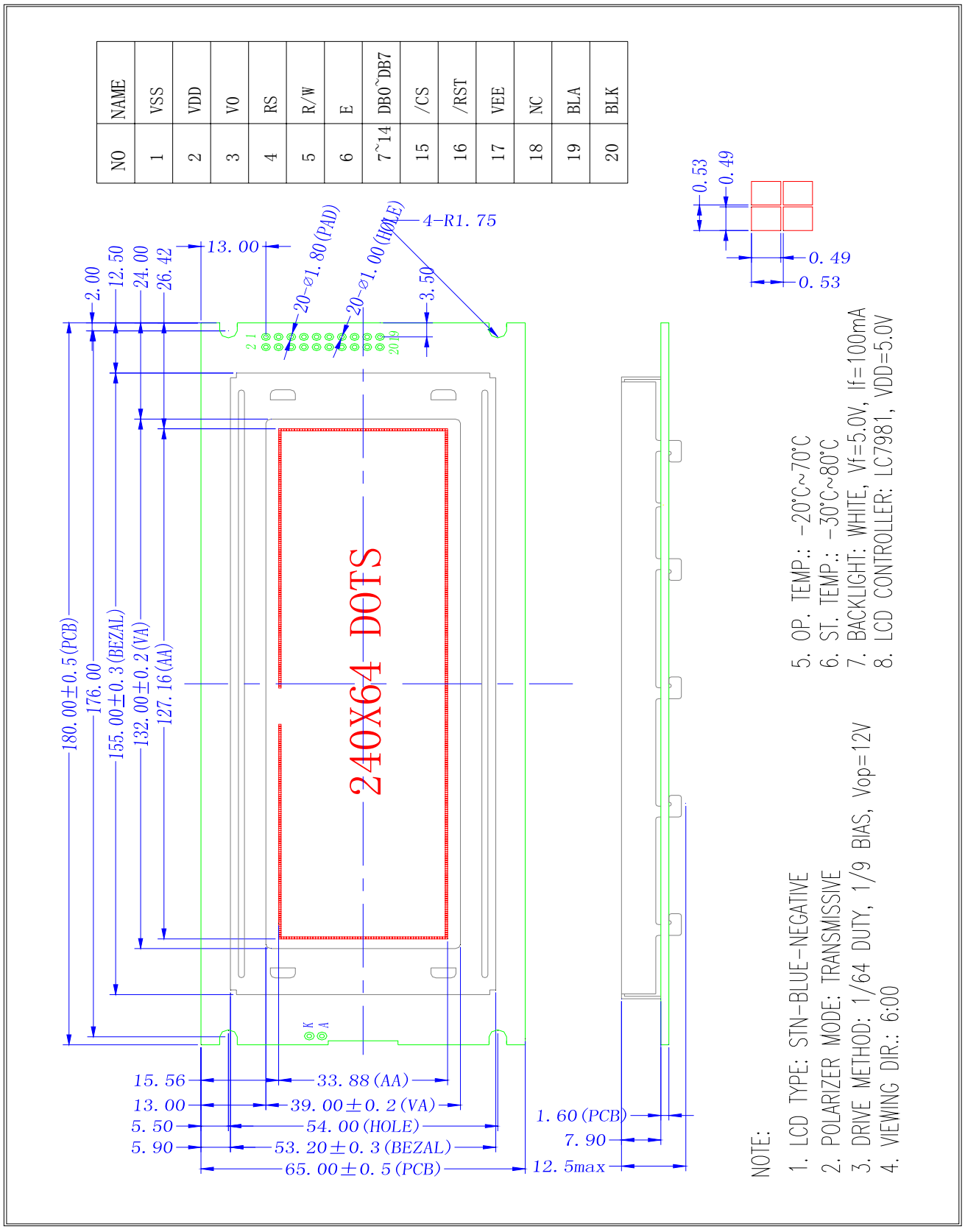
3. 0 MECHANICAL SPECIFICATION

Item	Description	Unit
Module Dimension	180.0(W) × 65.0(H) × 12.5(Max)(T)	mm
Viewing Area	132.0(W) × 39.0(H)	mm
Active Area	127.16(W) × 33.88(H)	mm
Dot Size	0.49(W) × 0.49(H)	mm
Dot Pitch	0.53(W) × 0.53(H)	mm
Character Size	——	mm

4. 0 BLOCK DIAGRAM



5. 0 EXTERNAL DIMENSIONS



6. 0 INTERFACE PIN DESCRIPTIONS

PIN No.	Symbol	Level	Description
1	V_{SS}	P	Ground
2	V_{DD}	P	Power supply for logic(+5.0V)
3	V0	P	Power supply for LCD
4	RS	H/L	Register select: RS = 1: Instruction register RS = 0: Data register
5	R/W	H/L	Read/Write: R/W = 1: MPU ← LC7981 R/W = 0: MPU → LC7981
6	E	H/L	Enable: Data is written at the fall of E Data can be read while E is 1
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7
15	/CS	H/L	Chip select: Selection allowed when /CS = 0
16	/RST	H/L	Reset: Reset = 0 results in display off, slave mode and Hp = 6
17	VEE	P	Built-in Negative Voltage Output
18	NC		No Connection
19	BLA	P	Power supply for LED Backlight (+5.0V)
20	BLK	P	Power supply for LED Backlight (0V)

7. 0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}	-0.3	7.0	V
Supply Voltage (LCD)	V_{DD}-V5	--	14.0	V
Input Voltage	VI	-0.3	V_{DD}+0.3	V
Operating Temperature	Topr	-20	70	℃
Storage Temperature	Tstg	-30	80	℃

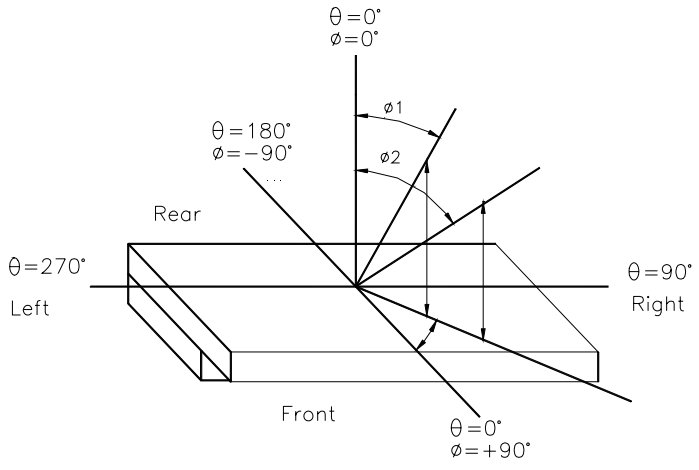
8. 0 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for Logic	V_{DD}	--	4.75	5.0	5.25	V
LCD Operating Voltage	V_{DD}-V5	-20℃				V
		+25℃	9.7	10.0	10.2	V
		+70℃				V
Input voltage H level	V_{IH}	For all inputs	2.2	---	V_{DD}	V
Input voltage L level	V_{IL}	For all inputs	0	---	0.8	V
Output High Voltage	V_{OH}	I_{OH}=-0.6mA	2.4	---	V_{DD}	V
Output Low Voltage	V_{OL}	I_{OL}=1.6Ma	0	---	0.4	V
Clock OSC Frequency	Fosc	Cf=15pF Rf=39K	500	600	700	KHz

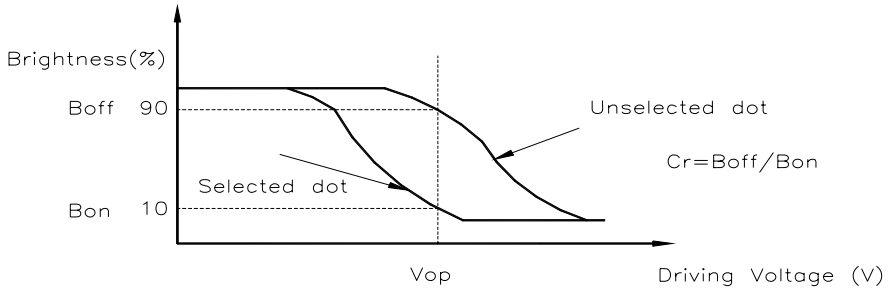
9. 0 OPTICAL CHARACTERISTICS

Item	Symbol	Condition		Min	Typ	Max	Unit
Response time	Ton	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃			--		ms
		θ=0 ° and Ta=+70℃			--		ms
	Toff	θ=0 ° and Ta=-20℃			--		ms
		θ=0 ° and Ta=+25℃			--		ms
		θ=0 ° and Ta=+70℃			--		ms
Contrast ration	Cr(MAX)	Ta=25℃		5	10		---
Viewing Angle	Ø	Deg θ=0 °	CR≥2.0 Ta=25℃		50		Deg
		Deg θ=90 °			35		
		Deg θ=180 °			30		
		Deg θ=270 °			35		
Crosstalk		Ta=25℃			1.2		---

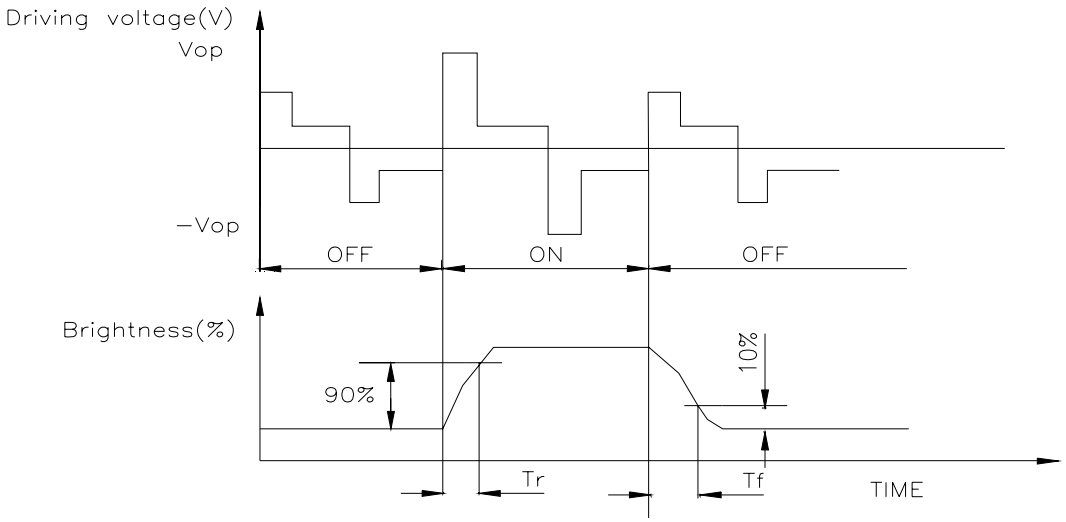
9.1 Viewing Angle θ , Ø and Viewing Angle Range: Δ Ø =|Ø2-Ø1|



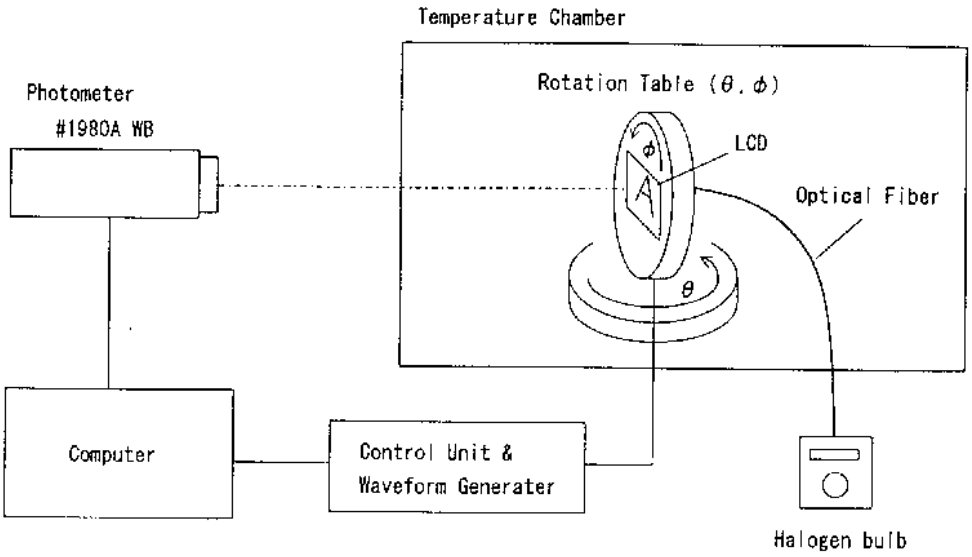
9.2 Contrast ratio(CR)



9.3 Response Time



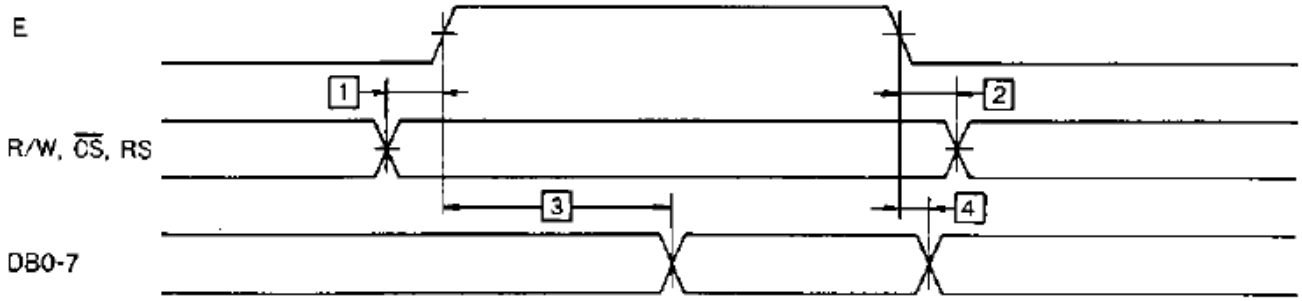
9.4 Optical Measurement System



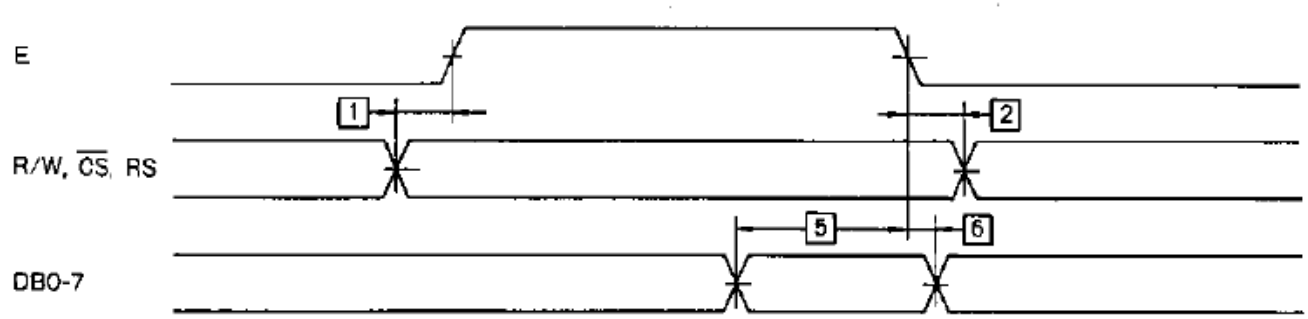
10. 0 TIMING CHARACTERICS

10.1 Microcontroller interface timing for read/write

- **READ CYCLE**



- **WRITE CYCLE**



No	Symbol	Parameter	Min.	Typ	Max	Conditions	Unit
1	tAS	Address set-up time	90				ns
2	tAH	Address hold time	10				
3	tDDR	Data delay time (read)			140	CL=50pF	
4	tDHR	Data hold time (read)	10				
5	tDSW	Data set-up time (write)	220				
6	tDHW	Data hold time (write)	20				

11. 0 BACKLIGHT CHARACTERISTICS

11.1 ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

Item	Symbol	Condition	Rating	Unit
Reverse Voltage	Vr		5.0	V
Absolute maximum forward current	Ifm		150	mA
Forward Current	If	Vf=5.0V	100	mA
Power Description	Pd		300	mW
Operating temperature range	Topr		-20~+70	^{0}C
Storage temperature range	Tst		-30~+80	^{0}C

11.2 ELECTRICAL/OPTLCAL CHARACTERISTICS

(Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	Vf	4.8	5.0	5.1	V	If=100 mA
Reverse Current	Ir		50		uA	Vr=5.0 V
Dominant wave length	λp				nm	If=100 mA
Spectral Line Half width	Δ λ					If=100 mA
Luminance	Lv				cd/m^2	If=100 mA
Color Coordinate	X		WHITE			If=100 mA
	Y					

12. 0 OPERATING PRINCIPLES & METHODS

12.1 CGRAM FONTS

13. 0 INSTRUCTION DESCRIPTION

13.1 DISPLAY CONTROL INSTRUCTION

Display is controlled by writing data into the instruction registers and 13 data registers. The instruction register and the data register are distinguished by the RS signal. First, write 4-bit data in the instruction register when RS=1, then specify the code of the data register. Next, with RS=0, write 8-bit data in the data register, which executes the specified instruction.

A new instruction cannot be accepted while an old instruction is being executed. As the Busy flag is set under this condition, write an instruction only after reading the BUSY flag and making sure that it is 0.

However, the next instruction can be executed without checking the BUSY flag when the maximum read cycle time or the write cycle time has been exceeded after execution of the previous data read instruction or the data write instruction. The BUSY flag does not change when data is written into the instruction register (RS=1). Therefore, the BUSY flag need not be checked immediately after writing data into the instruction register.

13.1.1 Mode Control

Write code “00H” (in Hexadecimal notation) in the instruction register and specify the mode control register.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	0	0	0	0
Mode control reg.	0	0	0	0	Mode data					

DB5	DB4	DB3	DB2	DB1	DB0	Cursor/blink	CG	Graphic/character display
1/0	1/0	0	0	0	0	Cursor off	Internal CG	Character display (Character mode)
		0	1			Cursor on		
		1	0			Cursor off, character blink		
		1	1			Cursor blink		
		0	0		1	Cursor off	External CG	
		0	1			Cursor on		
		1	0			Cursor off, character blink		
		1	1			Cursor blink		
		0	0	1	0			Graphic mode
Display ON/OFF	Master/slave	Blink	Cursor	Graphic/character mode	Ext./Int. CG			

1: Master mode
0: Slave mode

1: Display ON
0: Display OFF

13.1.2 Set Character Pitch

Vp indicates the number of vertical dots per character. The space between the vertically-displayed characters is included in the determination. This value is meaningful only during character display (in the character mode) and becomes invalid in the graphic mode.

Hp indicates the number of horizontal dots per character in display, including the space between horizontally-displayed characters. In the graphic mode, the Hp indicates the number of bits of 1-byte display data to be displayed.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	0	0	0	1
Character pitch reg.	0	0	(Vp – 1) binary				0	(Hp – 1) binary		

Hp must take one of the following three values.

Hp	DB2	DB1	DB0	Horizontal Character Pitch
6	1	0	1	6
7	1	1	0	7
8	1	1	1	8

13.1.3 Set Number of Characters

Hn indicates the number of horizontal characters in the character mode or the number of horizontal bytes in the graphic mode. If the total sum of horizontal dots on the screen is taken as n,

n = Hp × Hn

Hn can be set to an even number from 2 to 128 (decimal).

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	0	0	1	0
Number-of-characters reg.	0	0	0	(Hn – 1) binary						

13.1.4 Set Number of Time Divisions (Inverse of Display Duty Ratio)

Nx indicates the number of time divisions in multiplex display.

1/Nx is the display duty ratio.A value of 1 to 128 (decimal) can be set to NX.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	0	0	1	1
Number-of-time-divisions reg.	0	0	0	(Nx – 1) binary						

13.1.5 Set Cursor Position

Cp indicates the position in a character where the cursor is displayed in the character mode. For example, in 5 × 7 dot font, the cursor is displayed under a character by specifying Cp = 8 (decimal). The cursor horizontal length is equal to the horizontal character pitch H p. A value of 1 to 16 (decimal) can be set to Cp. If a smaller value than the vertical character pitch Vp is set (Cp ≤ Vp), and a character overlaps with the cursor, the cursor has higher priority of display (at cursor display on). If Cp is greater than Vp, no cursor is displayed. The cursor horizontal length is equal to Hp.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	0	1	0	0
Cursor position reg.	0	0	0	0	0	0	(Cp – 1) binary			

13.1.6 Set Display Start Low Order Address

Cause display start addresses to be written in the display start address registers. The display start address indicates a RAM address at which the data displayed at the top left end on the screen is stored. In the graphic mode, the start address is composed of high/low order 16 bits. In the character display, it is composed of the lower 4 bits of high order address (DB3–DB0) and 8 bits of low order address. The upper 4 bits of high order address are ignored.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	1	0	0	0
Display start address reg. (low order byte)	0	0	(Start low order address) binary							

13.1.7 Set Display Start High Order Address

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	1	0	0	1
Display start address reg. (low order byte)	0	0	(Start low order address) binary							

13.1.8 Set Cursor Address (Low Order) (RAM Write Low Order Address)

Cause cursor addresses to be written in the cursor address counters. The cursor address indicates an address for sending or receiving display data and character codes to or from the RAM.

That is, data at the address specified by the cursor address are read/written. In the character mode, the cursor is displayed at the character specified by the cursor address.

A cursor address consists of the low-order address (8 bits) and the high-order address (8 bits). Satisfy the following requirements setting the cursor address (Table 2).

The cursor address counter is a 16-bit up-counter with set and reset functions. When bit N changes from 1 to 0, bit N + 1 is incremented by 1. When setting the low order address, the LSB (bit 1) of the high order address is incremented by 1 if the MSB (bit 8) of the low order address changes from 1 to 0. Therefore, set both the low order address and the high order address as shown in the Table.

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	1	0	1	0
Cursor address counter (low order byte)	0	0	(Cursor low order address) binary							

13.1.9 Set Cursor Address (High Order) (RAM Write High Order Address)

Register	R/W	RS	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
Instruction reg.	0	1	0	0	0	0	1	0	1	1
Cursor address counter (high order byte)	0	0	(Cursor high order address) binary							

Condition	Requirement
When you want to rewrite (set) both the low order address and the high order address.	Set the low order address and then set the high order address.
When you want to rewrite only the low order address.	Do not fail to set the high order address again after setting the low order address.
When you want to rewrite only the high order address	Set the high order address. You do not have to set the low order address again.

Table 13-1 : Cursor Address Setting

14. 0 QUALITY GUARANTEE

14.1 ACCEPTABLE QUALITY LEVEL

Inspection items	Sampling procedures	AQL
Visual-operating (Electro-optical)	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	0.65
Visual-not operating	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5
Dimension measurement	GB2828-81 Inspection level Ⅱ Normal inspection Single sample inspection	1.5

14.2 Conditions of Cosmetic Inspection

- Environmental condition

The inspection should be performed at the 1m of height from the LCD module under 2 pieces of 40W white fluorescent lamps (Normal temperature 20~25℃ and normal humidity 60±15%RH).

- Inspection method

The visual check should be performed vertically at more than 30cm distance from the LCD panel.

- Driving voltage

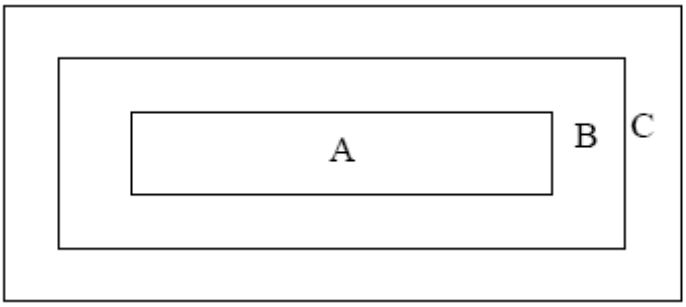
The V0 value which the most optimal contrast can be obtained near the specified V0 in the specification. (Within ±0.5V of the typical value at 25℃.).

14.3 Definition of inspection zone in LCD

Zone A: character/Digit area

Zone B: viewing area except Zone A (ZoneA+ZoneB=minimum Viewing area)

Zone C: Outside viewing area (invisible area after assembly in customer's product)



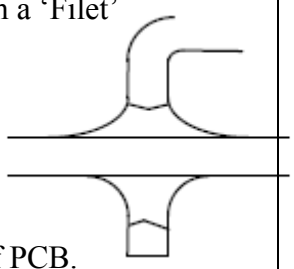
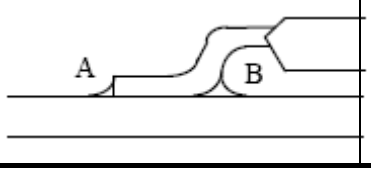
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

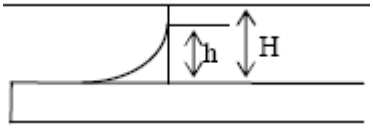
14.4 Inspection Standard

- **Major Defect**

Item No	Items to be inspected	Inspection Standard	Classification of defects
1	All functional defects	1) No display 2) Display abnormally 3) Missing vertical，horizontal segment 4) Short circuit 5) Back-light no lighting, flickering and abnormal lighting.	Major
2	Missing	Missing component	
3	Outline dimension	Overall outline dimension beyond the drawing is not allowed.	

- **Module Cosmetic Criteria**

No.	Item	Judgment Criterion	Partition
1	Difference in Spec.	None allowed	Major
2	Pattern peeling	No substrate pattern peeling and floating	Major
3	Soldering defects	No soldering missing No soldering bridge No cold soldering	Major Major Minor
4	Resist flaw on substrate	Invisible copper foil (∅0.5mm or more) on substrate pattern	Minor
5	Accretion of metallic Foreign matter	No soldering dust No accretion of metallic foreign matters (Not exceed ∅0.2mm)	Minor Minor
6	Stain	No stain to spoil cosmetic badly	Minor
7	Plate discoloring	No plate fading, rusting and discoloring	Minor
8	Solder amount 1. Lead parts	a. Soldering side of PCB Solder to form a ‘Filet’ all around the lead. Solder should not hide the lead form perfectly. (too much) b. Components side (In case of ‘Through Hole PCB’) Solder to reach the Components side of PCB. 	Minor
	2. Flat packages	Either ‘Toe’ (A) or ‘Seal’ (B) of the lead to be covered by ‘Filet’. Lead form to be assume over solder. 	Minor

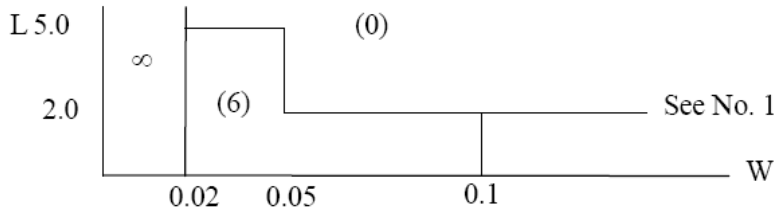
No.	Item	Judgment Criterion	Partition
8	3. Chips	(3/2) H ≥ h ≥ (1/2) H 	Minor

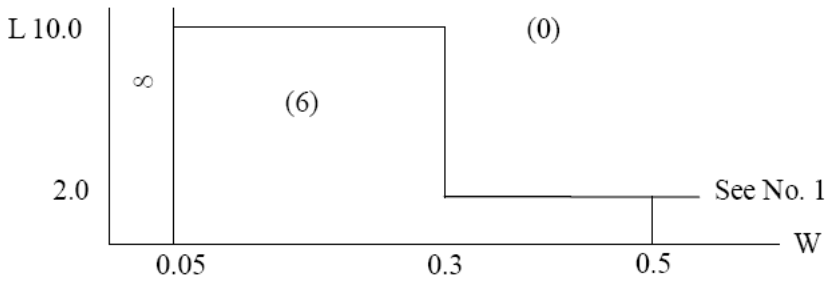
● Screen Cosmetic Criteria (Non-Operating)

No.	Defect	Judgement Criterion	Partition
1	Spots	In accordance with *Screen Cosmetic Criteria (Operating) No.1*.	Minor
2	Lines	In accordance with *Screen Cosmetic Criteria (Operating) No.2*.	Minor
3	Bubbles in polarizer	<table><tr><td>Size : d</td><td>mm</td><td>Acceptable Qty in active area</td></tr><tr><td>d</td><td>≤ 0.3</td><td>Disregard</td></tr><tr><td>0.3 < d</td><td>≤ 1.0</td><td>3</td></tr><tr><td>1.0 < d</td><td>≤ 1.5</td><td>1</td></tr><tr><td>1.5 < d</td><td></td><td>0</td></tr></table>	Minor
4	Scratch	In accordance with spots and lines operating cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
5	Allowable density	Above defects should be separated more than 30mm each other.	Minor
6	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-lit type should be judged with back-lit on state only.	Minor
7	Contamination	Not to be noticeable.	Minor

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating)

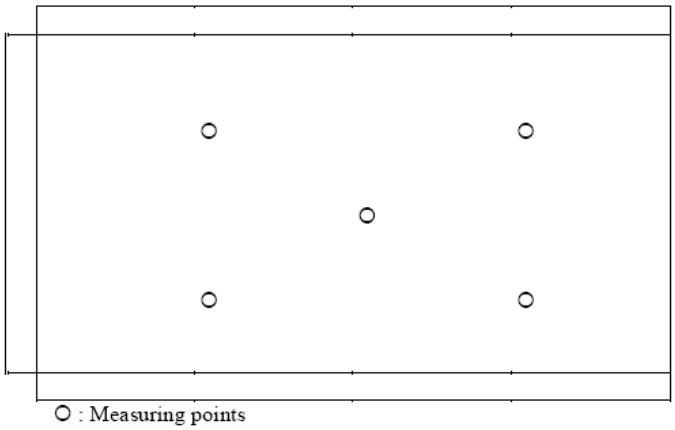
<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.1</td><td>Disregard</td></tr>
<tr><td>0.1 < d ≤ 0.2</td><td>6</td></tr>
<tr><td>0.2 < d ≤ 0.3</td><td>2</td></tr>
<tr><td>0.3 < d</td><td>0</td></tr>
</table>
Note : Including pin holes and defective dots which must be within one pixel size.
B) Unclear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.2</td><td>Disregard</td></tr>
<tr><td>0.2 < d ≤ 0.5</td><td>6</td></tr>
<tr><td>0.5 < d ≤ 0.7</td><td>2</td></tr>
<tr><td>0.7 < d</td><td>0</td></tr>
</table></td><td>Minor</td></tr>
<tr><td>2</td><td>Lines</td><td>A) Clear
 

Note :
( ) - Acceptable Qty in active area
L - Length (mm)
W - Width (mm)
∞ - Disregard
B) Unclear
 

‘Clear’ = The shade and size are not changed by Vop.
‘Unclear’ = The shade and size are changed by Vop.</td><td>Minor</td></tr>
</table>

Note: Size : d = (long length + short length) / 2

● Screen Cosmetic Criteria (Operating) (Continued)

No.	Defect	Judgment Criterion	Partition
3	Rubbing line	Not to be noticeable.	Minor
4	Allowable density	Above defects should be separated more than 10mm each other.	Minor
5	Rainbow	Not to be noticeable.	Minor
6	Dot size	To be 95% ~ 105% of the dot size (Typ.) in drawing. Partial defects of each dot (ex. pin-hole) should be treated as pot'. (see *Screen Cosmetic Criteria (Operating) No.1*)	Minor
7	Uneven brightness (only back-lit type module)	Uneven brightness must be BMAX / BMIN ≤ 2 - BMAX : Max. value by measure in 5 points - BMIN : Min. value by measure in 5 points Divide active area into 4 vertically and horizontally. Measure 5 points shown in the following figure.  	Minor

Note :

(1) The limit samples for each item have priority.

(2) Complex defects are defined item by item, but if the numbers of defects are defined in above table, the total number should not exceed 10.

(3) In case of 'concentration', even the spots or the lines of 'disregarded' size should not allowed. Following three situations should be treated as 'concentration'.

- 7 or over defects in circle of Æ5mm.
- 10 or over defects in circle of Æ10mm.
- 20 or over defects in circle of Æ20mm.

15. 0 RELIABILITY

15.1 Content of Reliability Test

No.	Test Item	Test Condition	Inspection after test
1	High Temperature Storage	80℃±2℃/200 hours	Inspection after 2~4hours storage at room temperature, the sample shall be free from defects: 1.Air bubble in the LCD; 2.Sealleak; 3.Non-display; 4.missing segments; 5.Glass crack; 6.Current Idd is twice higher than initial value.
2	Low Temperature Storage	-30℃±2℃/200 hours	
3	High Temperature Operating	70℃±2℃/120 hours	
4	Low Temperature Operating	-20℃±2℃/120 hours	
5	Temperature Cycle	-20℃±2℃~25~70℃±2℃×10cycles (30min.) (5min.) (30min.)	
6	High Temperature / Humidity operation	50℃±5℃×90%RH/120 hours	
7	Vibration Test	Frequency ： 10Hz~55Hz~10Hz Amplitude： 1.5mm, X， Y， Z direction for total 3hours (Packing condition)	
8	Drooping test	Drop to the ground from 1m height, one time, and every side of carton. (Packing condition)	
9	Static electricity test	Voltage:±8KV R: 330Ω C: 150pF Air discharge, 10time	

Remark:

1. The test samples should be applied to only one test item.
2. Sample size for each test item is 5~10pcs.
3. For Damp Proof Test, Pure water(Resistance＞10MΩ) should be used.
4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part.
5. EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence EL has.
6. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.

16. 0 PRECAUTIONS FOR USING LCD MODULES

16.1 Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.

(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.

(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

16.2 Storage Precautions

When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

16.3 Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections.

17. 0 USING LCD MODULES

17.1 About Liquid Crystal Display Modules

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizer with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizer and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropyl alcohol.

(4) When the display surface becomes dusty, wipe gently with absorbent cotton or other soft material like chamois soaked in petroleum benzin. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizer. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

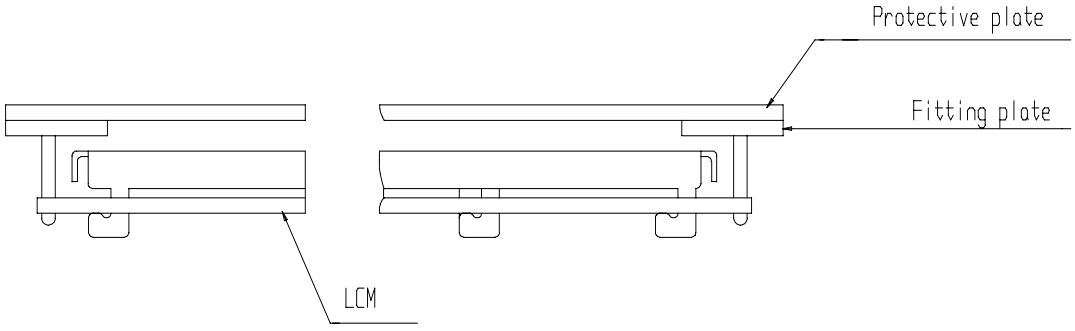
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinate to the polarizer).

(10) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

17.2 Installing LCD Modules

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be ±0.1mm.

17.3 Electro-Static Discharge Control

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handing LCM.

(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.

(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.

(4) When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutation of the motor.

(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.

(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

17.4 Soldering to the LCM

(1) Observe the following when soldering lead wire, connector cable and etc. to the LCM.

- Soldering iron temperature : 280°C ± 10°C.
- Soldering time : 3-4 sec.
- Solder : eutectic solder.

If soldering flux is used, be sure to remove any remaining flux after finishing to soldering operation. (This does not apply in the case of a non-halogen type of flux.) It is recommended that you protect the LCD surface with a cover during soldering to prevent any damage dur to flux spatters.

(2) When soldering the electroluminescent panel and PC board, the panel and board should not be detached more than three times. This maximum number is determined by the temperature and time conditions mentioned above, though there may be some variance depending on the temperature of the soldering iron.

(3) When remove the electroluminescent panel from the PC board, be sure the solder has completely melted, the soldered pad on the PC board could be damaged.

17.5 Operation

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

(2) Driving the LCD in the voltage above the limit shortens its life.

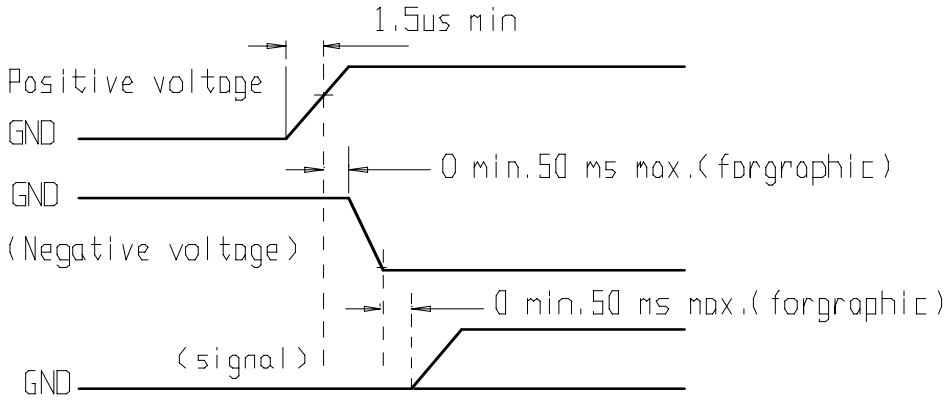
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(4) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(5) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit.

Therefore, it must be used under the relative condition of 40°C , 50% RH.

(6) When turning the power on, input each signal after the positive/negative voltage becomes stable.



17.6 Storage

When storing LCDs as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

(3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 168hrs. at 60°C.
- Should not be left for more than 48hrs. at -20°C.

17.7 Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

17.8 Limited Warranty

Unless agreed between HYDISPLAY and customer, HYDISPLAY will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with HYDISPLAY LCD/LCM acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to HYDISPLAY within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of HYDISPLAY limited to repair and/or replacement on the terms set forth above. HYDISPLAY will not be responsible for any subsequent or consequential events.

17.9 Return LCM under warranty

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- PCB eyelet's damaged or modified.
- PCB conductors damaged.
- Circuit modified in any way, including addition of components.
- PCB tampered with by grinding, engraving or painting varnish.
- Soldering to or modifying the bezel in any manner.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB eyelet, conductors and terminals.

18. 0 APPENDIX

18.1 Initialization Code

```
void wr_cmd(uchar uc_cmd)
{
    LCD_E   = 0;
    LCD_RS   = 1;
    LCD_RW   = 0;

    LCD_CS   = 0;

    LCD_E   = 1;
    DATAPORT = uc_cmd;
    _nop_();
    LCD_E   = 0;

    LCD_CS   = 1;
}

void wr_dat(uchar uc_dat)
{
    LCD_E   = 0;
    LCD_RS   = 0;
    LCD_RW   = 0;

    LCD_CS   = 0;

    LCD_E = 1;
    DATAPORT = uc_dat;
    _nop_();
    LCD_E = 0;

    CS_PORT = 1;
}

void init()
{
    wr_cmd(0x00);
    wr_dat(0x32);//Diaplay On/Master/Graphy Mode

    wr_cmd(0x01);
    wr_dat(0x77);//Set Character Pitch,Vp=8,Hp=8
```

```
wr_cmd(0x02);
wr_dat(0x1D);//Set the number of Characters,Hn=30 (240dots)

wr_cmd(0x03);
wr_dat(0x3F);//Set display duty (1/64)

wr_cmd(0x04);
wr_dat(0x07);//Set the Cursor position, Cp=8

wr_cmd(0x08);//Set the Display start Address: Lower
wr_dat(0x00);
wr_cmd(0x09);//Set the Display start Address: Upper
wr_dat(0x00);

wr_cmd(0x0A);//Set Cursor start Address: Lower
wr_dat(0x00);
wr_cmd(0x0B);//Set Cursor start Address: Upper
wr_dat(0x00);
```

18.2 Power Supply Circuit Diagram