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

HYG1223204C-YF61L-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	2011-11-20	

CONTENTS

1. 0 GENERAL DESCRIPTION

The HYG1223204C-YF61L-VA is a 122x32 dots dot-matrix LCD module. It has a STN panel composed of 122 segments and 32 commons. The LCM can be easily accessed by microcontroller via 6800 series interface.

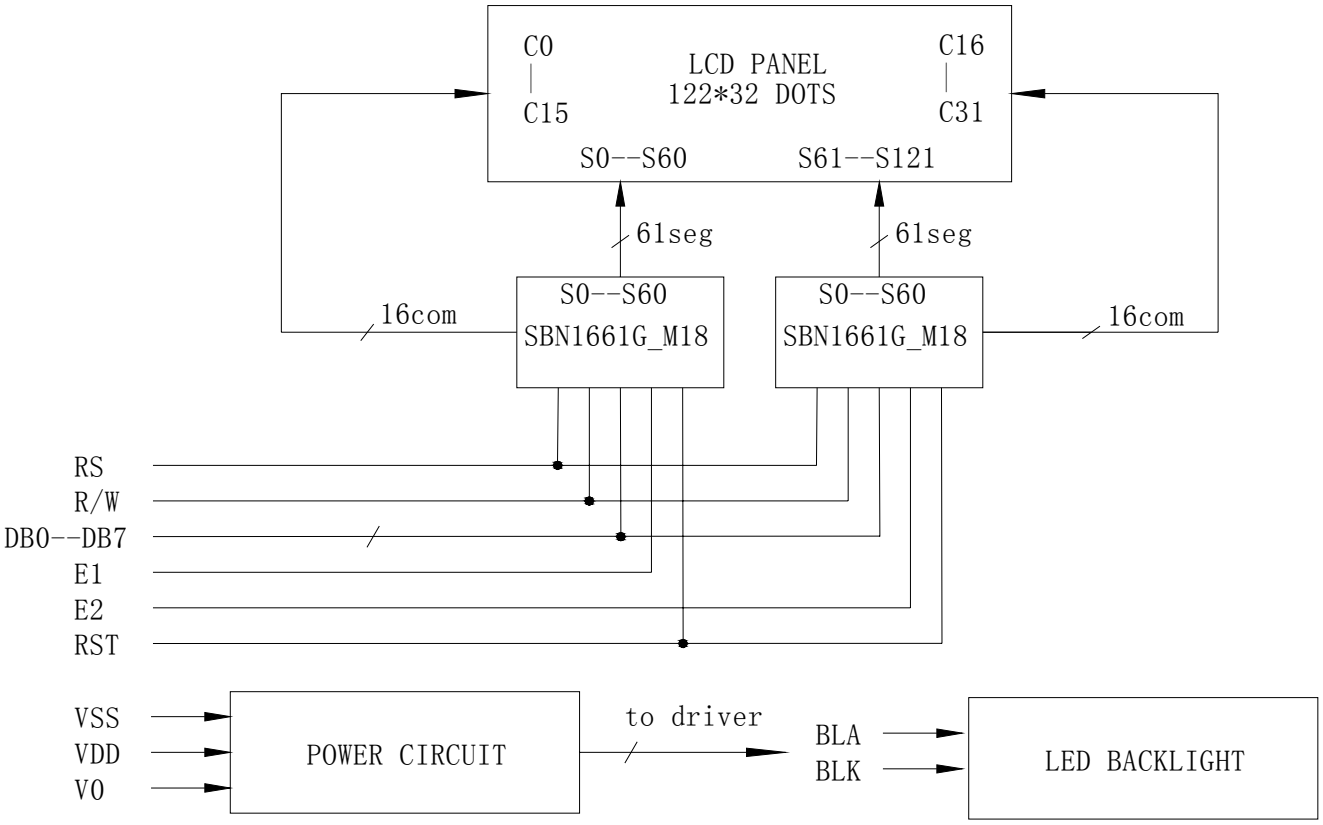
2. 0 FEATURES

Display Format	122 x 32 dots
LCD Type	STN-Y/G-POSITIVE
Polarizer Mode	TRANSFLECTIVE
Drive Method	1/32 Duty, 1/4 Bias
Viewing Direction	6 O'clock
Controller	SBN1661G-M18
Interface	8-Bit Parallel Interface （6800 Series）
Backlight	Y/G LED Backlight

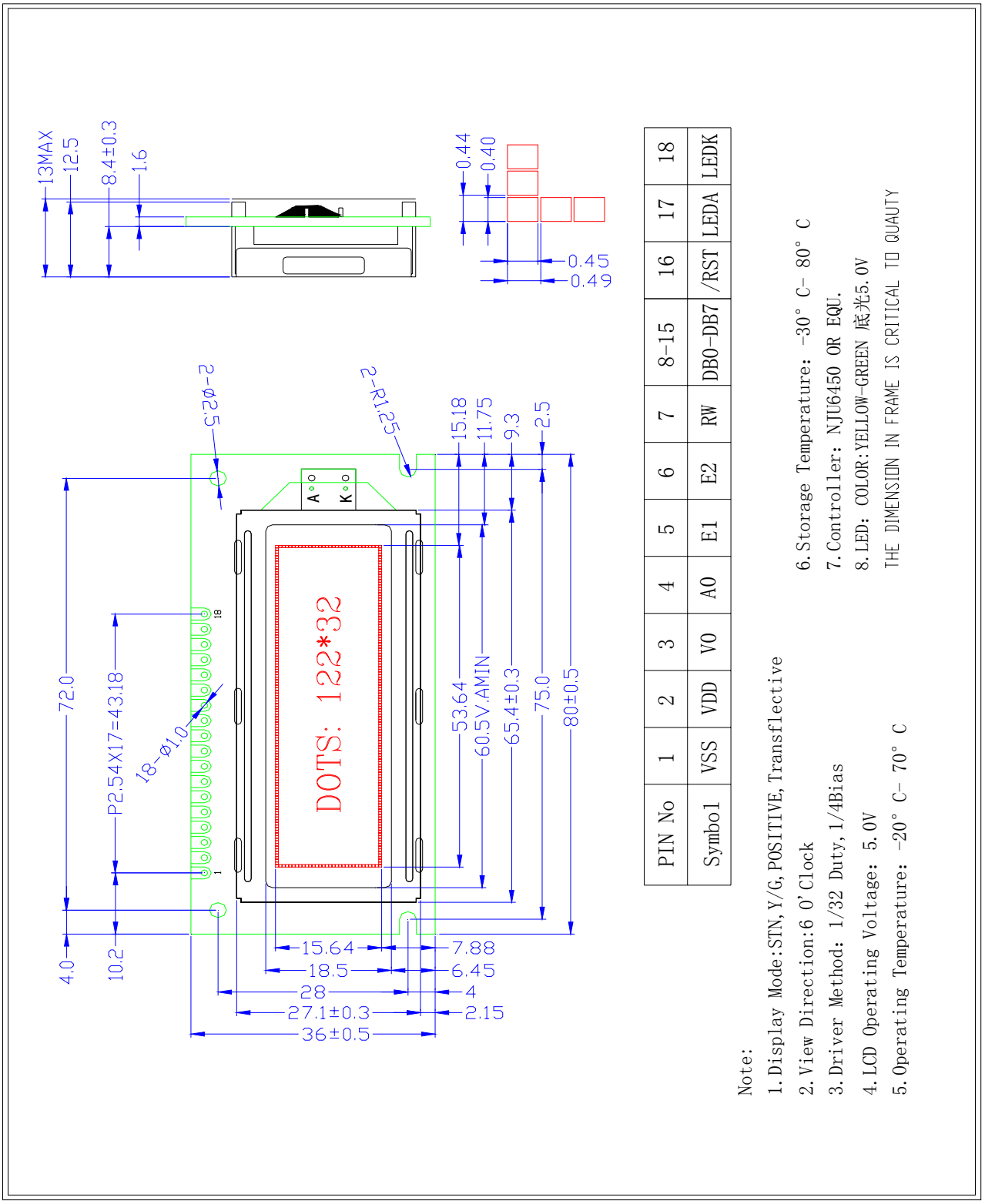
3. 0 MECHANICAL SPECIFICATION

Item	Description	Unit
Module Dimension	80.0(W) × 36.0(H) × 13.5(Max)(T)	mm
Viewing Area	60.5(W) × 18.0(H)	mm
Active Area	53.64(W) × 15.64(H)	mm
Dot Size	0.40(W) × 0.45(H)	mm
Dot Pitch	0.44(W) × 0.49(H)	mm
Character Size	——	mm

4. 0 BLOCK DIAGRAM



5. 0 EXTERNAL DIMENSIONS



PIN No	1	2	3	4	5	6	7	8-15	16	17	18
Symbol	VSS	VDD	V0	A0	E1	E2	RW	DB0-DB7	/RST	LEDA	LEDK

Note:

1. Display Mode:STN,Y/G,POSITIVE,Transflective
2. View Direction:6 O'Clock
3. Driver Method: 1/32 Duty,1/4Bias
4. LCD Operating Voltage: 5.0V
5. Operating Temperature: -20° C- 70° C
6. Storage Temperature: -30° C- 80° C
7. Controller: NJU6450 OR EQU.
8. LED: COLOR:YELLOW-GREEN 成光5.0V

THE DIMENSION IN FRAME IS CRITICAL TO QUAUTY

6. 0 INTERFACE PIN DESCRIPTIONS

PIN No.	Symbol	Level	Description
1	V_{SS}	P	Power Ground
2	V_{DD}	P	Power supply for logic(+5.0V)
3	V0	P	Power supply for LCD
4	A0	H/L	Select registers. 0: Instruction register (for write) Busy flag:address counter (for read) 1: Data register (for write and read)
5	E1	H,H→L	Starts data read/write for Left half Read data when E1 is “H” ; Write data at the falling edge of E1
6	E2	H,H→L	Starts data read/write for Right half Read data when E2 is “H” ; Write data at the falling edge of E2
7	R/W	H/L	Select read or write. 0: Write 1: Read
8	DB0	H/L	Data Bit0
9	DB1	H/L	Data Bit1
10	DB2	H/L	Data Bit2
11	DB3	H/L	Data Bit3
12	DB4	H/L	Data Bit4
13	DB5	H/L	Data Bit5
14	DB6	H/L	Data Bit6
15	DB7	H/L	Data Bit7
16	RST	H/L	Hardware RESET and interface type selection. A positive RESET pulse selects the 80-type Microcontroller for interface and a negative RESET pulse selects the 68-type microcontroller for interface.
17	BLA	P	Power supply for LED Backlight (＋5.0V)
18	BLK	P	Power supply for LED Backlight (0V)

7. 0 ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Min.	Max.	Unit
Supply Voltage (Logic)	V_{DD}-V_{SS}	-0.3	7.0	V
Supply Voltage (LCD)	V_{DD}-V0		13.0	V
Input Voltage	VI	-0.3	V_{DD}+0.3	V
Operating Temperature	Topr	-10	+60	℃
Storage Temperature	Tstg	-20	+70	℃

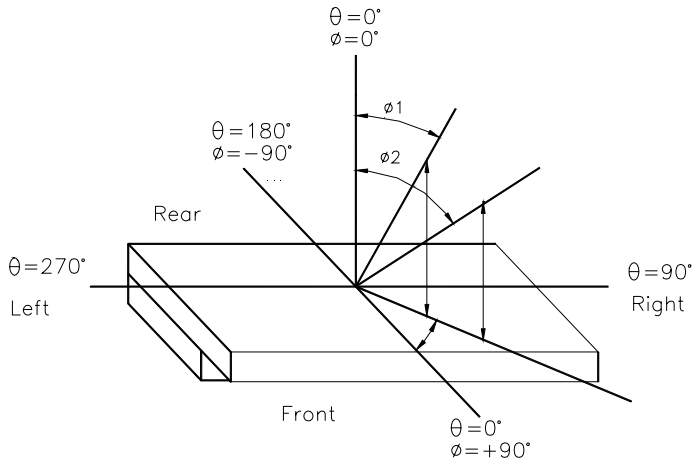
8. 0 ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Supply voltage for Logic	V_{DD}	--	4.8	5.0	5.2	V
Supply current for Logic	I_{DD}	Rf=1 MΩ	--	12.3	15.6	uA
LCD Operating Voltage	V_{DD} –V0	-20℃				V
		+25℃	4.7	5.0	5.2	V
		+70℃				V
Input voltage H level	V_{IH}	For all inputs	V_{DD}-1.2	---	V_{DD}	V
Input voltage L level	V_{IL}	For all inputs	0	---	0.8	V
Output High Voltage	V_{OH}	For all outputs	V_{DD}-0.3	---	V_{DD}	V
Output Low Voltage	V_{OL}	For all outputs	0	---	0.3	V
Frame Frequency	Fr			70	85	Hz

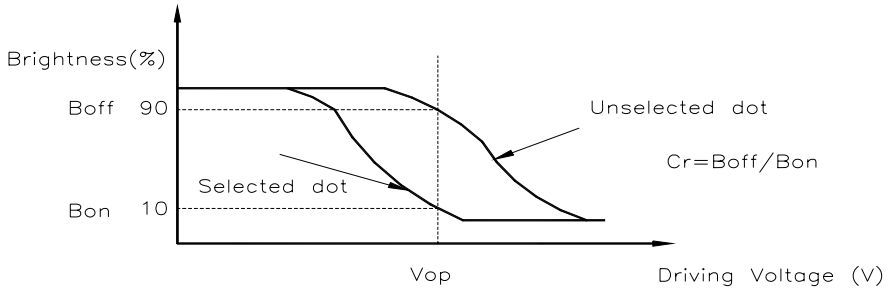
9. 0 OPTICAL CHARACTERISTICS

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)	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		---

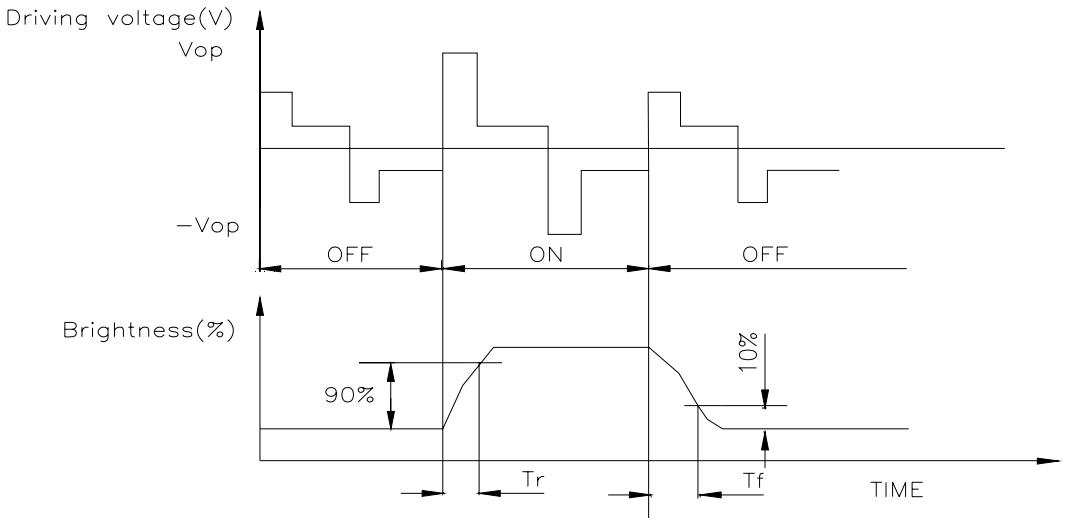
9.1 Viewing Angle θ , Ø and Viewing Angle Range: Δ Ø =|Ø2-Ø1|



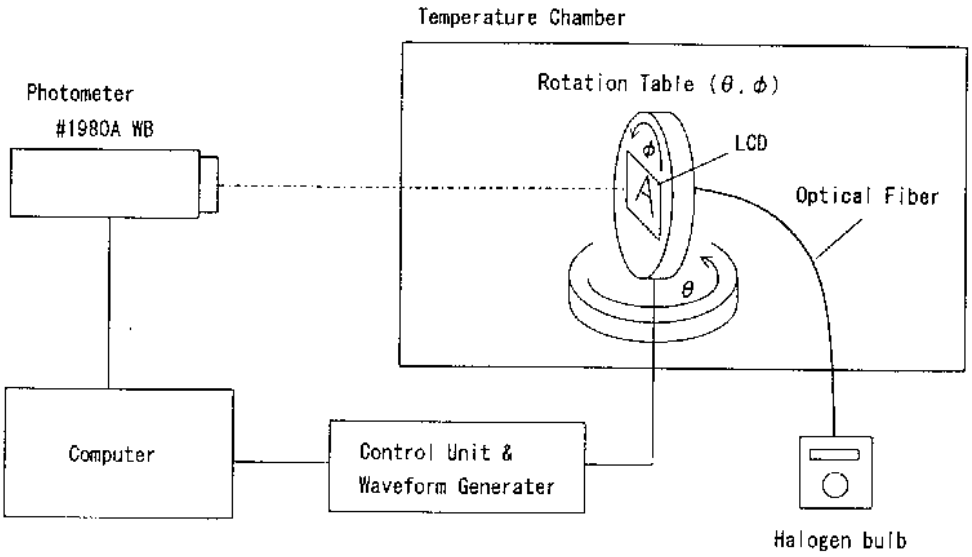
9.2 Contrast ratio(CR)



9.3 Response Time

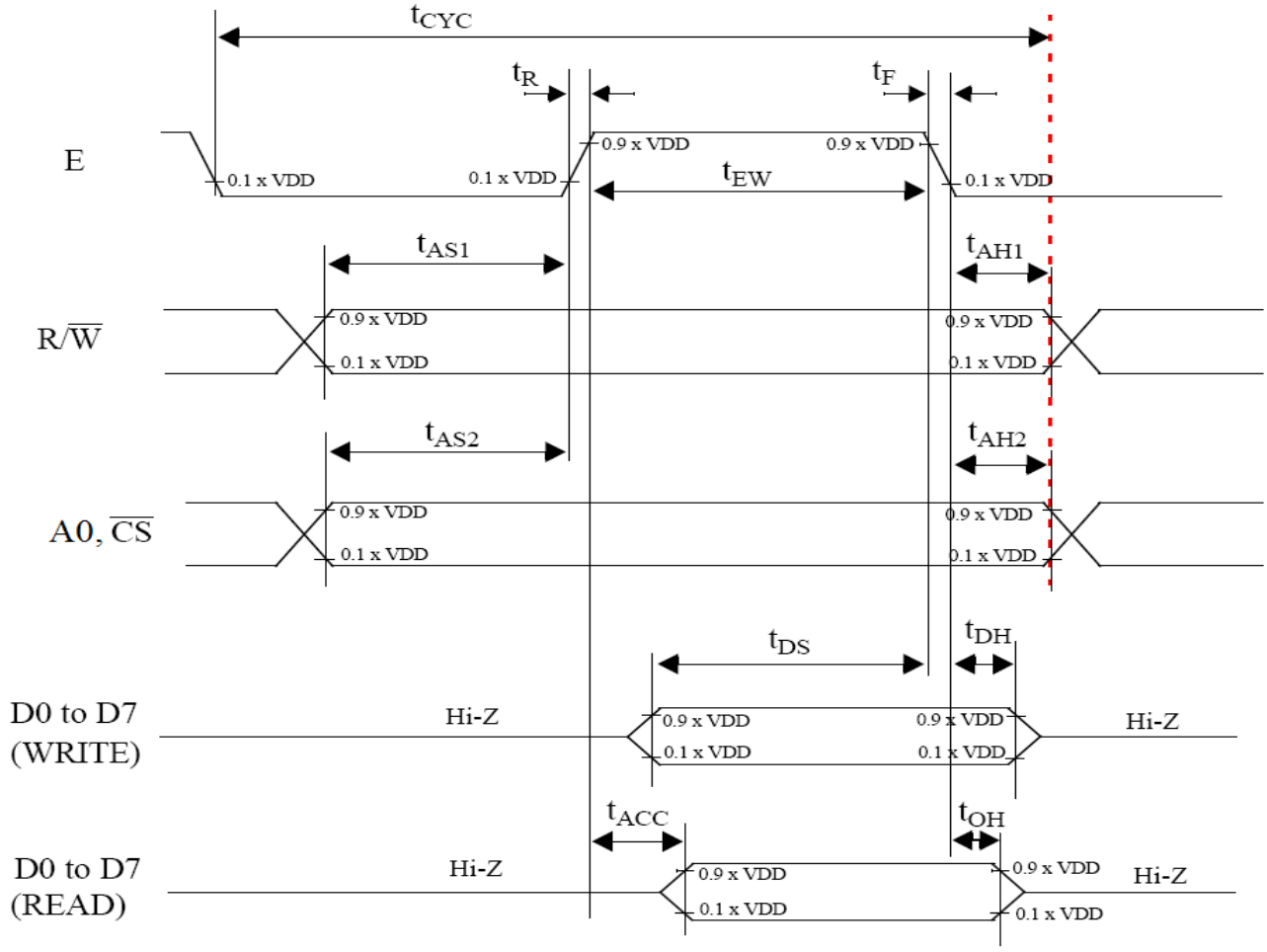


9.4 Optical Measurement System



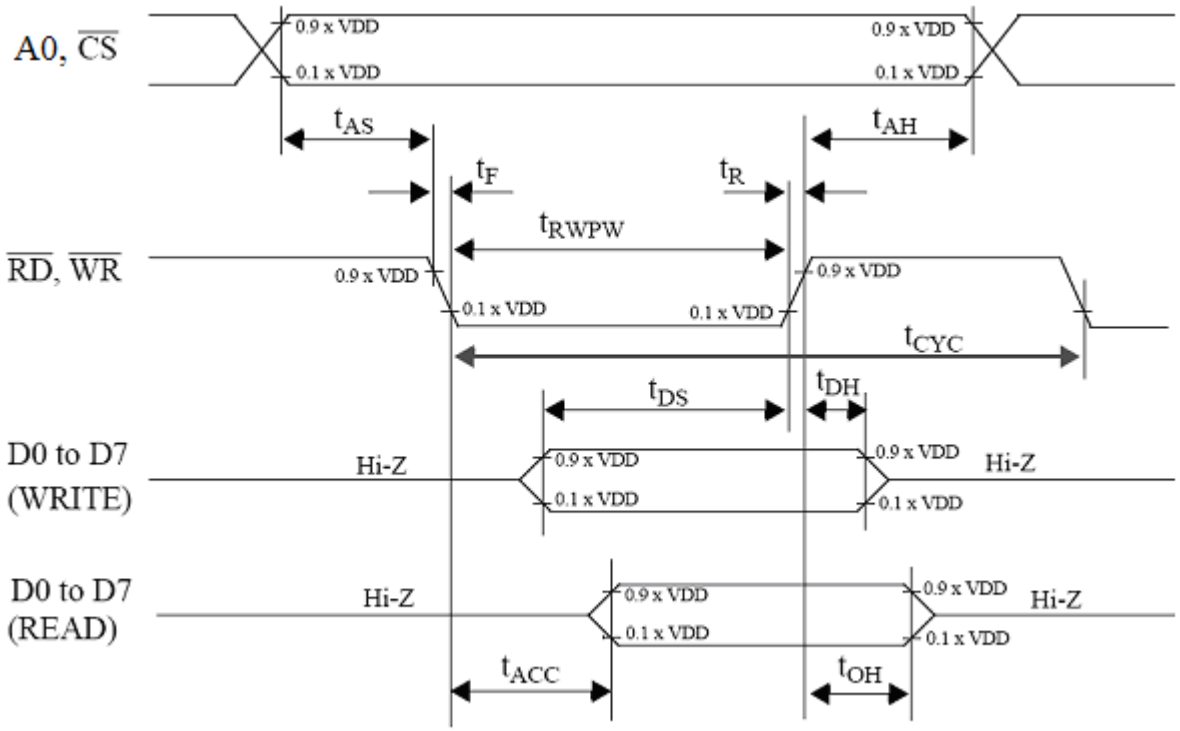
10. 0 TIMING CHARACTERICS

10.1 AC timing for interface with a 6800-type microcontroller

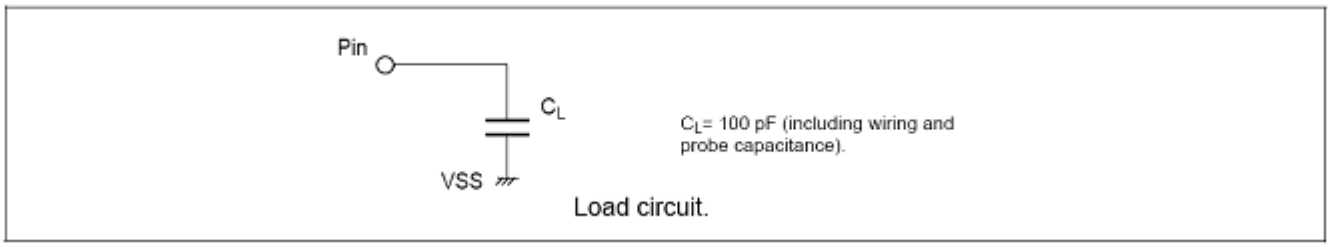


Symbol	Parameter	Min.	Max.	Test conditions	Unit
tAS1	Address set-up time with respect to R/W	20			ns
tAS2	Address set-up time with respect to C/D, CS	20			ns
tAH1	Address hold time with respect to R/W	10			ns
tAH2	Address hold time respect with to C/D, CS	10			ns
tF, tR	Enable (E) pulse falling/rising time		15		ns
tCYC	System cycle time	1000		Note 1	ns
tEWR	Enable pulse width for READ	100			ns
tEWW	Enable pulse width for WRITE	80			ns
tDS	Data setup time	80			ns
tDH	Data hold time	10			ns
tACC	Data access time		90	CL= 100 pF.	ns
tOH	Data output hold time	10	60		ns

10.2 AC timing for interface with a 8080-type microcontroller



Symbol	Parameter	Min.	Max.	Test conditions	Unit
tAS	Address set-up time	20			ns
tAH	Address hold time	10			ns
tF, tR	Read/Write pulse falling/rising time		15		ns
tRWPW	Read/Write pulse width	200			ns
tCYC	System cycle time	1000			ns
tDS	Data setup time	80			ns
tDH	Data hold time	10			ns
tACC	Data READ access time		90	CL= 100 pF.	ns
tOH	Data READ output hold time	10	60		ns



11. 0 BACKLIGHT CHARACTERISTICS

11.1 ABSOLUTE MAXIMUM RATINGS

(Ta=25℃)

Item	Symbol	Condition	Rating	Unit
Reverse Voltage	Vr		10	V
Absolute maximum forward current	Ifm		135	mA
Forward Current	If	Vf=5.0V	90	mA
Power Description	Pd		360	mW
Operating temperature range	Topr		-20~+70	^{0}C
Storage temperature range	Tst		-30~+80	^{0}C

11.2 ELECTRICAL/OPTLCAL CHARACTERISTICS

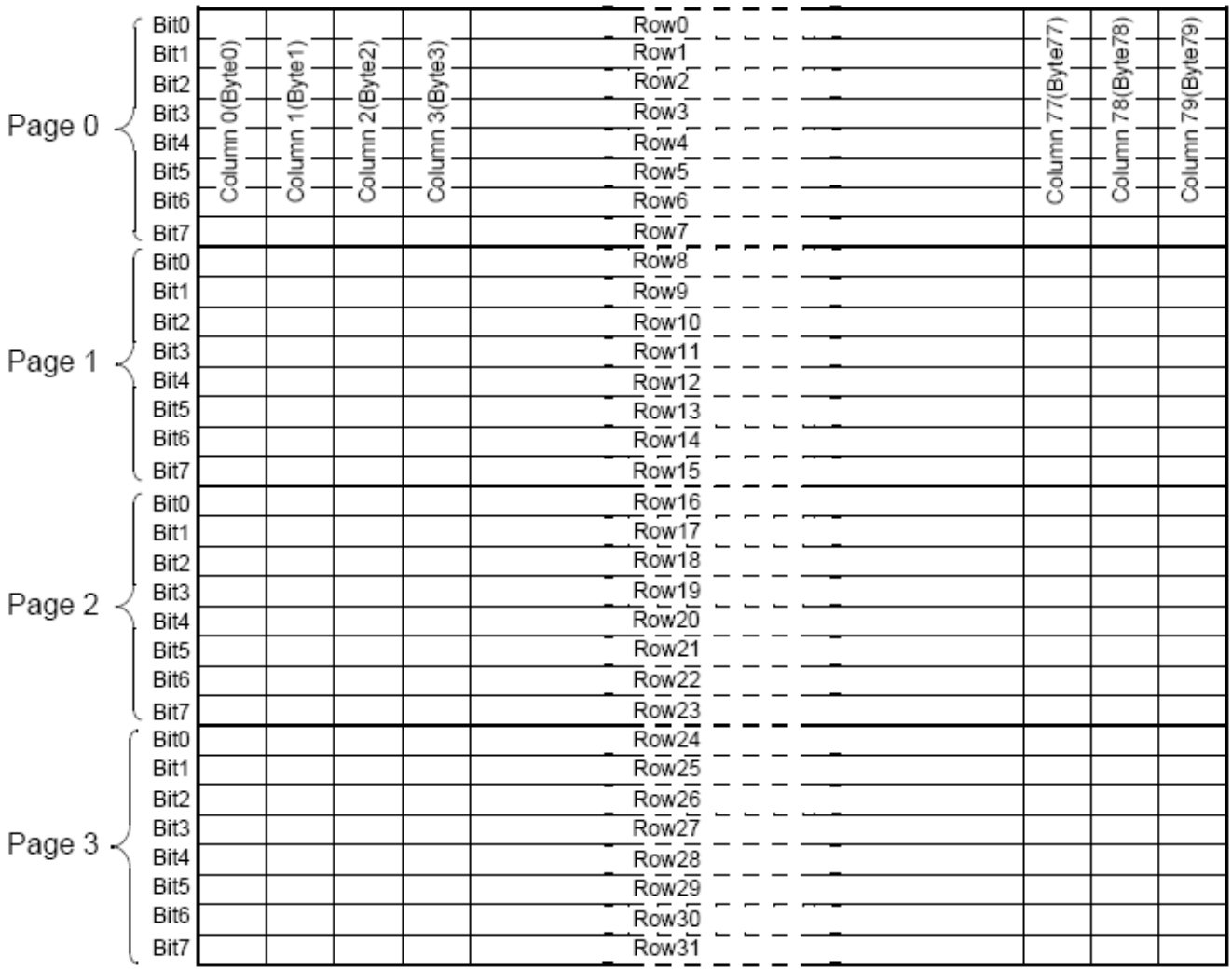
(Ta=25℃)

Item	Symbol	Min	Typ	Max	Unit	Condition
Forward Voltage	Vf	4.8	5.0	5.1	V	If=90mA
Reverse Current	Ir		90		uA	Vr=10 V
Dominant wave length	λp	568	572	575	nm	If=90mA
Spectral Line Half width	Δ λ		30			If=90mA
Luminance	Lv	160	230		cd/m^2	If=90mA
Color Coordinate	X					If= 90mA
	Y					

12. 0 OPERATING PRINCIPLES & METHODS

12.1 Display Data Memory Page and the Page Address

The on-chip Display Data Memory is divided into 4 pages: Page 0, Page 1, Page 2, and Page 3, with each page having 80 bytes in horizontal direction. Page 0 is from Row 0 to Row 7, Page 1 from Row 8 to Row 15, Page 2 from Row 16 to Row 23, and Page 3 from Row 24 to Row 31, as shown in Fig 12. When the host microtroller intends to perform a READ/WRITE operation to the Display Data Memory, it has to program the Page Address Register to indicate which page it intends to access.

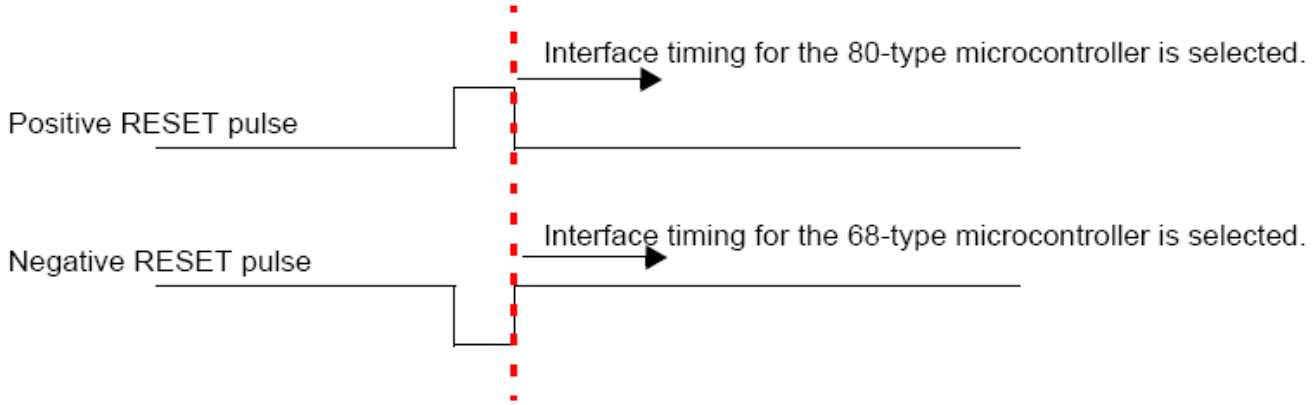


12.2 Selection of interface type by use of the RST pin(pad)

The SBN1661G series can accept two types of interface timing for two types of microcontrollers: the 68-type microcontrollers and the 80-type microcontrollers. Selection of interface type is by use of the dual-function RST pin(pad).

If the voltage at the RST pin(pad) stays at HIGH after RESET pulse, then the 68-type interface timing is selected. If the voltage at the RST pin(pad) stays at LOW after RESET pulse, then the 80-type interface timing is selected.

The RST of the SBN1661G is edge-sensitive, instead of level-sensitive. That is, a pulse on the RST input triggers reset only on the rising edge and falling edge of the pulse. The voltage level after the RST pulse is used to select interface type.



13. 0 INSTRUCTION DESCRIPTION

13.1 INSTRUCTION TABLE

Instruction	Instruction Code										Description Instruction Code
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	Switches the entire display ON or OFF, regardless of the Display RAM' s data or the internal status.
Display START Line	0	0	1	1	0	A4	A3	A2	A1	A0	Determines the line of RAM data to be displayed at the display's top line (COM0).
Page Address Set	0	0	1	0	1	1	1	0	R1	R0	Sets the page of the Display RAM in the page address register.
Column (Segment) Address Set	0	0	0	C6	C5	C4	C3	C2	C1	C0	Sets the column address of the Display RAM in the column address register.
Status Read	0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0	Reads the status. **BUSY** 1: Busy (internal processing) 0: READY status **ADC** 1: Rightward (forward) output 0: Leftward (reverse) output **ON/OFF** 1: Display OFF 0: Display ON RESET 1: Resetting 0: Normal
Write Display Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Writes the data on the data bus to RAM
Read Display Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Reads data from the Display RAM onto the data bus.
ADC Select	0	0	1	1	0	1	0	0	0	ADC	Used to reverse the correspondence between the Display RAM 's column addresses and segment driver output ports 0: Rightward (forward) output 1: Leftward (reverse) output

Instruction	Instruction Code										Description Instruction Code
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Static Drive ON/OFF	0	0	1	0	1	0	0	1	0	STATIC	Selects normal display operation or static all-lit drive display operation. 1: Static drive (Power Save) 0: Normal display operation
Duty Select	0	0	1	0	1	0	1	0	0	DUTY	Selects the duty factor for driving LCD cells. 1: 1/32 duty 0: 1/16 duty
Read Modify Write	0	0	1	1	1	0	0	0	0	0	Increments the column address counter by one only when display data is written but not when it is read.
End	0	0	1	1	1	0	1	1	1	0	Cancels the Ready Modify Write mode.
Reset	0	1	1	1	1	0	0	0	1	0	Resets the Display START line to the 1st line in the register. Resets the column address counter to 0 and page address register to 3.

13.2 DESCRIPTION OF INSTRUCTION

1) Display ON/OFF (AEh ~ AFh)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	0	1	1	1	D

This command turns the display on or off
■D=1: Display on
■D=0: Display off

2) Display Start Line (C0h ~ DFh)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	0	A4	A3	A2	A1	A0

This command specifies the line address shown and indicates the display line that corresponds to COM0. The display area begins at the specified line address and continues in the line address increment direction. This area having the number of lines of the specified display duty is displayed. If the line address is changed dynamically by this command, the vertical smooth scrolling and paging can be used.

This command loads the display start line register. See as below

A4	A3	A2	A1	A0	Line Address
0	0	0	0	0	0
0	0	0	0	1	1
↓	↓	↓	↓	↓	↓
1	1	1	1	0	30
1	1	1	1	1	31

3) Set Page Address (B8h ~ BBh)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	0	R1	R0

This command specified the page address that corresponds to the low address of the display RAM when it is accessed by the MPU. Any bit of the display data RAM can be accessed when its page address and column address are specified. The display status is not changed even when the page address is changed.

This command loads the page address register. See as below.

R1	R0	Page
0	0	0
0	1	1
1	0	2
1	1	3

4) Set Column Address (00h ~ 4Fh)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	C6	C5	C4	C3	C2	C1	C0

This command specifies a column address of the display data RAM. When the display data RAM is accessed by the MPU continuously, the column address is increment by 1 each time it is accessed from the set address. Therefore, the MPU can access to data continuously. The column address stops to be incremented at address 80 and the page address is not changed continuously.

This command loads the column address register.

5) Read Status

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BUSY	ADC	ON/OFF	RESET	0	0	0	0

Reading the command I/O register (A0=0) yields system status information.

■The BUSY bit indicates whether the driver will accept a command or not.

BUSY=1: The driver is currently executing a command or is resetting. No new command will be accepted.

BUSY=0: The driver will accept a new command.

■The ADC bit indicates the way column addresses are assigned to segment drivers.

ADC=1: forward. Column address 0 →segment driver n.

ADC=0: backward. Column address 79-n → segment driver n.

■The ON/OFF bit indicates the current status of the display.

It is the inverse of the polarity of the display ON/OFF command.

ON/OFF=1: Display off

ON/OFF=0: Display on

■The RESET bit indicates whether the driver is executing a hardware or software reset or if it is in normal operating mode.

RESET=1: Currently executing reset command

RESET=0: Normal operation

6) Write Display Data

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Writes 8-bits of data into the display data RAM, at a location specified by the contents of the column address and page address registers and then increments the column address register by one.

7) Read Display Data

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read 8-bits of data from the data I/O latch, updates the contents of the I/O latch with display data from the display data RAM location specified by the contents of the column address and page address registers and then increments the column address register. After loading a new address nto the column address register one dummy read is required before valid data is obtained.

8) Select ADC (A0h ~ A1h)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	0	1	0	0	0	ADC

This command selects the relationship between display data RAM column addresses and segment drivers.

This command is provided to reduce restrictions on the placement of driver ICes and routing of traces during PCB design. See Fig-6 for a table of segment and column ad- dresses for the two values of ADC.

■ADC=1: SEG0 ← column address 4Fh (inverted)

■ADC=0: SEG0 ← column address 00h (normal)

9) Static Drive ON/OFF (A4h ~ A5h)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	0	0	1	0	STATIC

All common outputs to be selected.

■STATIC =1: static drive on(Power Save mode)

■STATIC =0: static drive off

The Power Save mode is selected if the static drive is turned ON when the display is OFF. The current consumption can be reduced to almost the static current level. In the Power Save mode:

(a) The LCD drive is stopped, and the segment and common drive outputs are set to the VDD level.

(b) The external oscillation clock input is inhibited.

(c) The display and operation modes are kept.

10) Select Duty (A8h ~ A9h)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	0	1	0	0	DUTY

This command set the duty of the LCD drive. The duty cycle is determined by the externally generated FR signal.

■DUTY =1: 1/32 duty

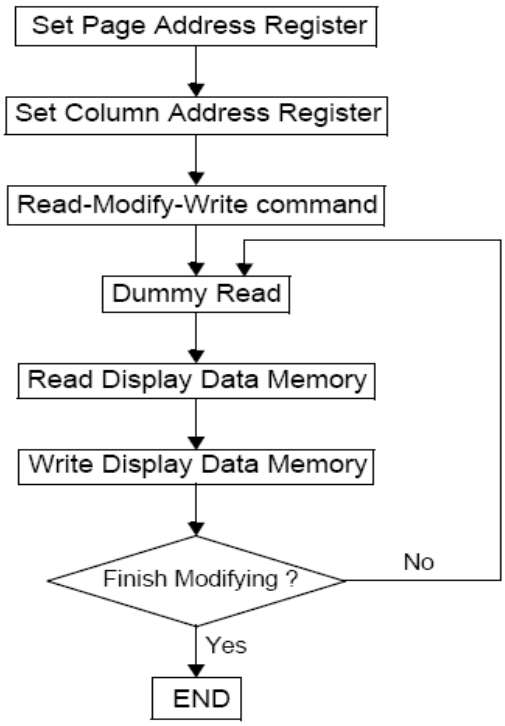
■DUTY =0: 1/16 duty

11) Read-Modify-Write (E0h)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	1	0	0	0	0	0

This command defeats column address register auto-increment after data reads. The current contents of the column address register are saves. This mode remains active until an End command is received.

When the End command is entered, the column address is returned to the one used during input of Read-Modify-Write command. This function can reduce the load of MPU when data change is required at a specific display area such as cursor blinking. Any command other than Data Read or Data Write can be used in the Read-Modify-Write mode. However, the Column Address Set command cannot be used.



12) End (EEh)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	1	0	1	1	1	0

This command cancels Read-Modify-Write mode and restores the contents of the column address register to their value prior to the receipt of the Read-Modify-Write command.

13) Reset (E2h)

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	1	1	1	0	0	0	1	0

This command clears the display start line register and set page address register to page 3. It does not affect the contents of the display data RAM. When the power supply is turned on, a Reset signal is entered in the /RES pin. The Reset command cannot be used instead of this Reset signal.

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

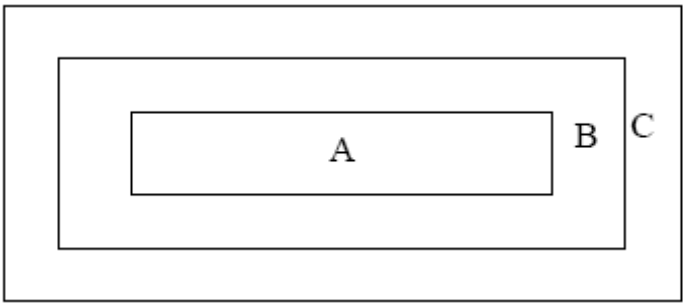
The V0 value which the most optimal contrast can be obtained near the specified V0 in the specification. (Within ±0.5V of the typical value at 25℃.).

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)



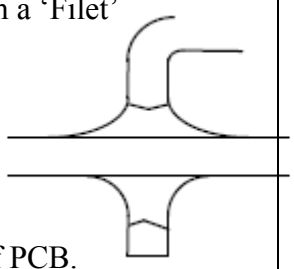
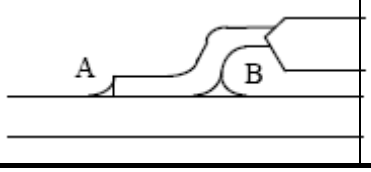
Note: As a general rule, visual defects in Zone C are permissible, when it is no trouble for quality and assembly of customer's product.

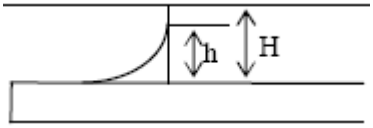
14.4 Inspection Standard

- **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

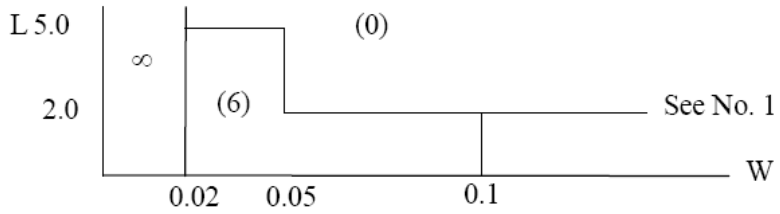
No.	Item	Judgment Criterion	Partition
8	3. Chips	(3/2) H ≥ h ≥ (1/2) H 	Minor

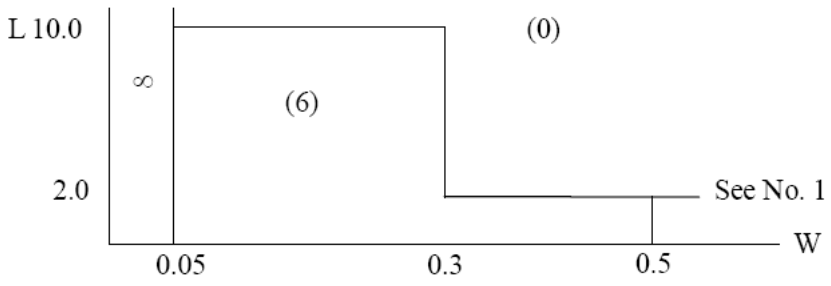
● Screen Cosmetic Criteria (Non-Operating)

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)

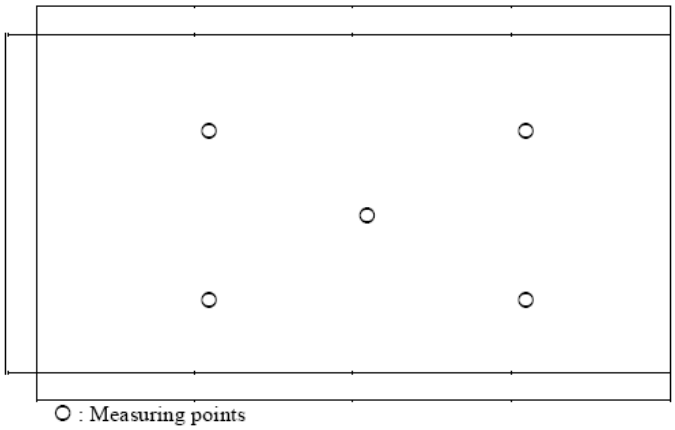
<table>
<tr><th>No.</th><th>Defect</th><th>Judgment Criterion</th><th>Partition</th></tr>
<tr><td>1</td><td>Spots</td><td>A) Clear
<table>
<tr><th>Size : d mm</th><th>Acceptable Qty in active area</th></tr>
<tr><td>d ≤ 0.1</td><td>Disregard</td></tr>
<tr><td>0.1 < d ≤ 0.2</td><td>6</td></tr>
<tr><td>0.2 < 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	+70℃±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	-20℃±2℃/200 hours	
3	High Temperature Operating	+60℃±2℃/120 hours	
4	Low Temperature Operating	-10℃±2℃/120 hours	
5	Temperature Cycle	-10℃±2℃~25~60℃±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.

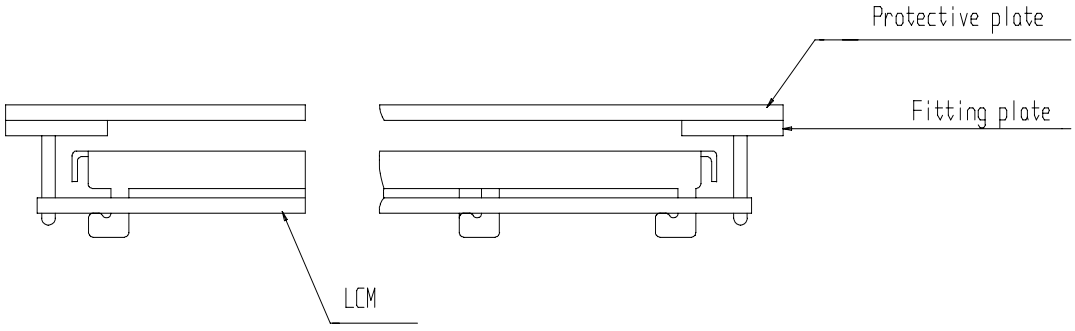
(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinate to the polarizer).

(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.

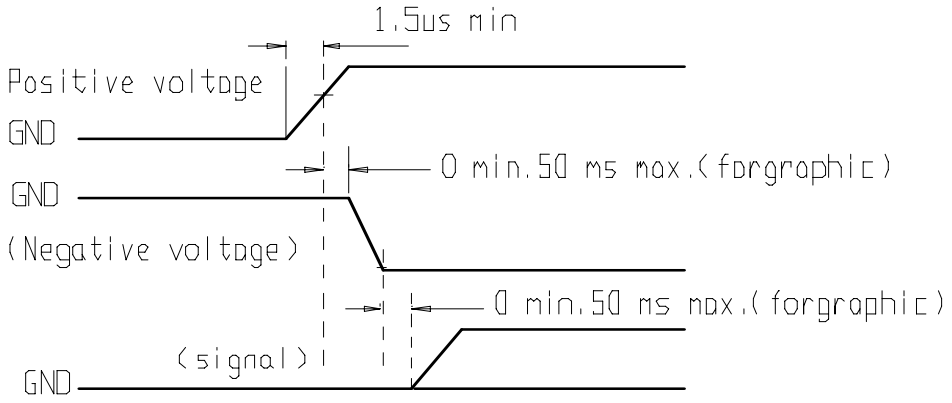
(3) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(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

```
//Write Diaply data
#pragma disable
void wr_dat_m(uchar uc_dat)
{
    LCD_RS = 1;
    LCD_RW = 0;

    DataPort = uc_dat;
    LCD_E1 = 0;
    LCD_E1 = 1;
}

#pragma disable
void wr_dat_s(uchar uc_dat)
{

    LCD_RS = 1;
    LCD_RW = 0;

    DataPort = uc_dat;
    LCD_E2 = 0;
    LCD_E2 = 1;
}

//Write Instruction Data
#pragma disable
void wr_cmd(uchar uc_cmd)
{

    LCD_RS = 0;
    LCD_RW = 0;

    DataPort = uc_cmd;
    LCD_E1 = 0;
    LCD_E2 = 0;

    LCD_E1 = 1;
    LCD_E2 = 1;
}
```

```
#pragma disable
void wr_cmd_m(uchar uc_cmd)
{
    LCD_RS = 0;
    LCD_RW = 0;

    DataPort = uc_cmd;
    LCD_E1 = 0;
    LCD_E1 = 1;
}

#pragma disable
void wr_cmd_s(uchar uc_cmd)
{

    LCD_RS = 0;
    LCD_RW = 0;

    DataPort = uc_cmd;
    LCD_E2 = 0;
    LCD_E2 = 1;
}

//ST7565P Initialization
#pragma disable
void Initial()
{
    LCD_RST =0;
    Delay(250);
    Delay(250);

    LCD_RST =1;
    Delay(250);
    Delay(250);


    wr_cmd(0xAE); // Display OFF

    wr_cmd(0xA4);  // Set Static driving operation (Normal driving

    wr_cmd(0xC0); // Set Display Start Line 0

    wr_cmd(0xA0);  // Set ADC
```

```
    wr_cmd(0xA9); // Set Duty (1/32)

    wr_cmd(0xB8); // Set Page Address (0)

    wr_cmd(0x00); // Set Column Address(00)

    wr_cmd(0xAF); // Display ON

}
```

18.2 Power Supply Circuit Diagram