SPECIFICATION
OF
LCD MODULE

MODULE NO.: HL035T004-01

Customer Approval:

☐ **Accept**	☐ **Reject**

	SIGNATURE	DATE
PREPARED BY		
CHECKED BY		
APPROVED BY		

CONTENTS

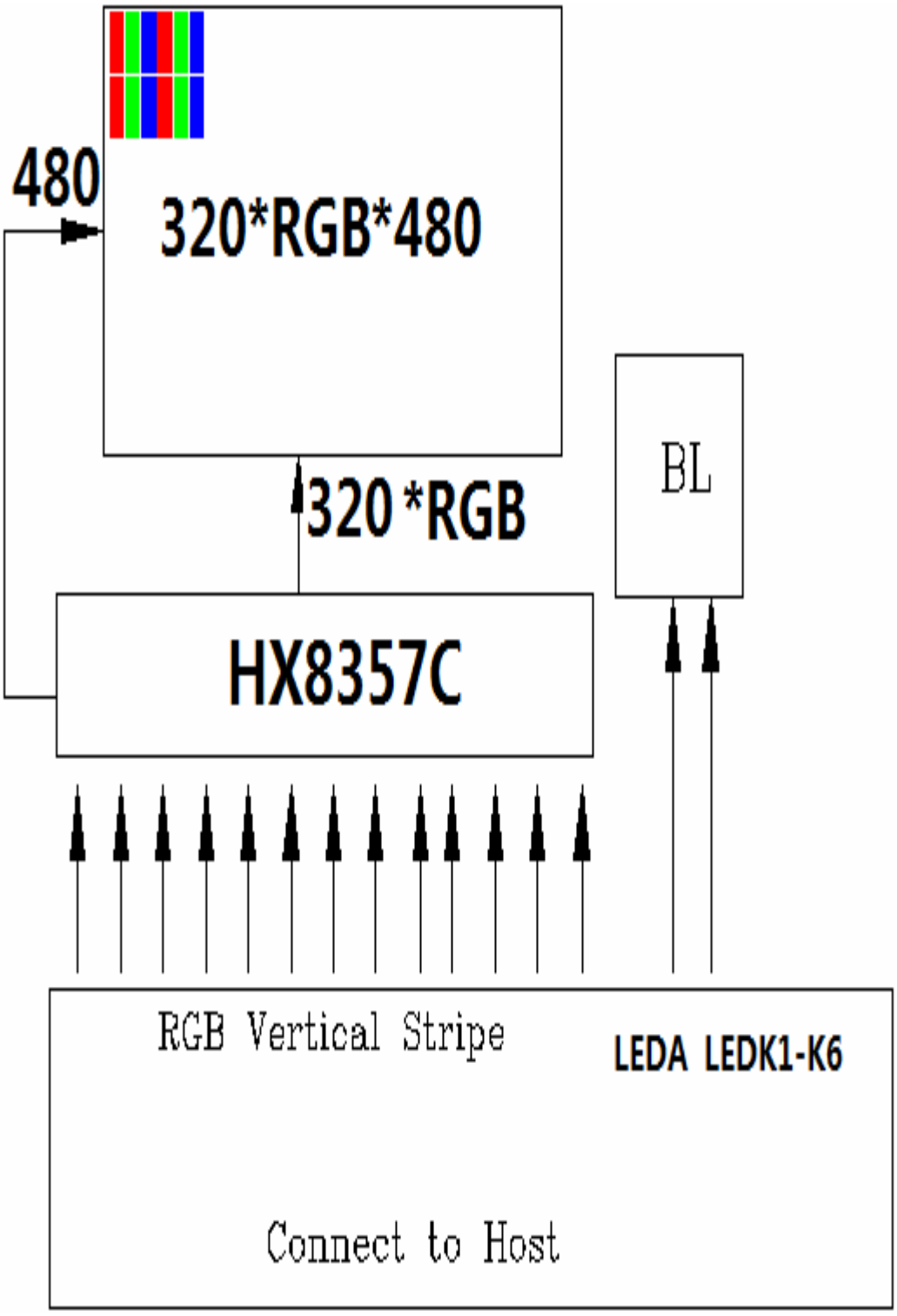
List	Description	Page No.
1	GENERAL DESCRIPTION	4
	MECHANICAL SPECIFICATIONS	4
2	BLOCK DIAGRAM	5
3	DIMENSIONAL OUTLINE	6
4	PIN DESCRIPTION	7
5	ELECTRICAL CHARACTERISTICS	9
6	OPTICAL CHARACTERISTICS	10
7	PACKAGE	11
8	TANDARD SPECIFICATION FOR RELIABILTY	14
9	SPECIFICATION OF QUALITY ASSURANCE	15
10	GENERAL PRECAUTIONS	24

1. MECHANICAL SPECIFICATIONS:

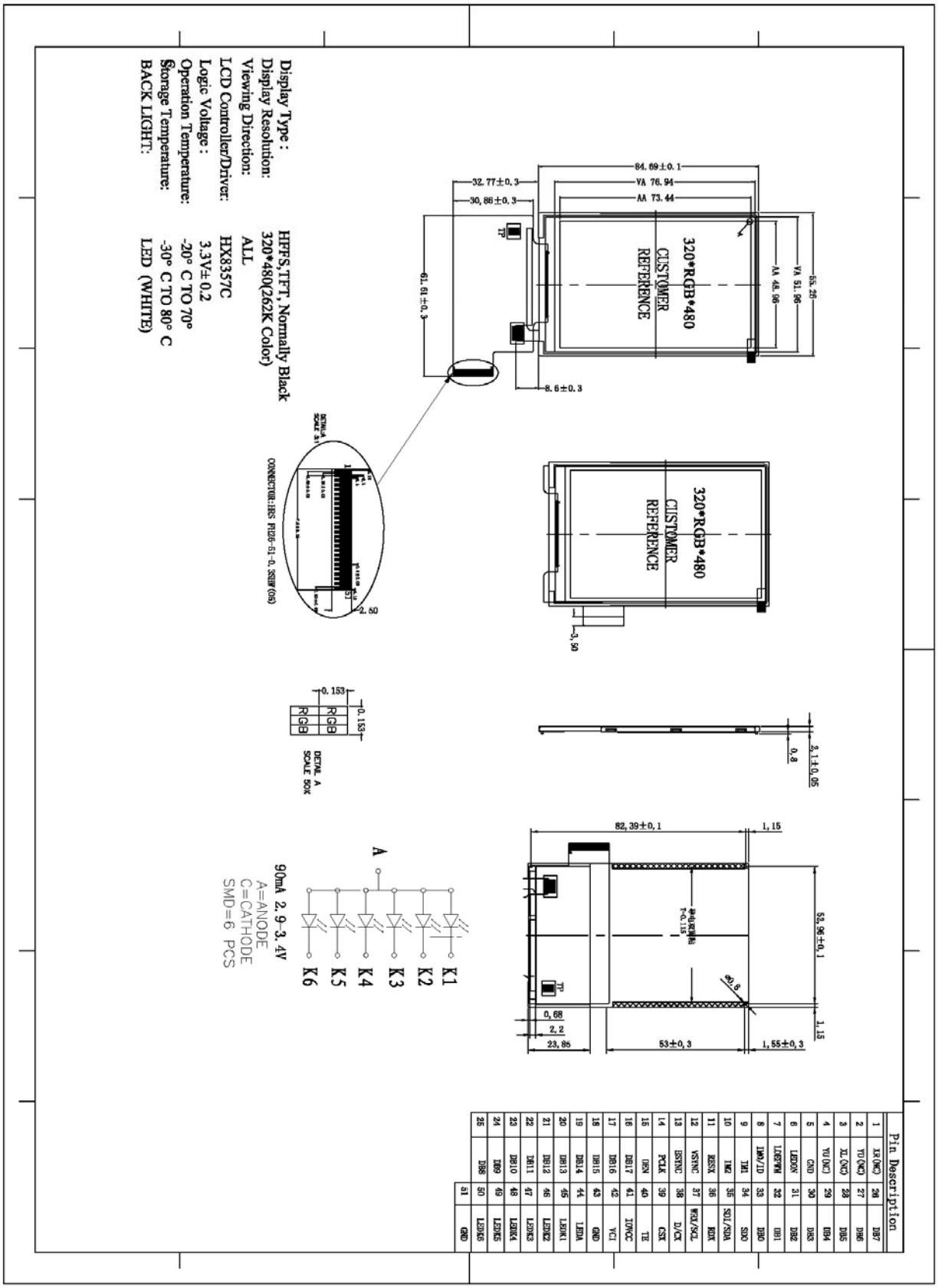
ITEM	SPECIFICATION	UNIT
OUTLINE DIMEMSIONS	55.26(W) X84.69 (H) X2.1(D)	mm
DISPLAY SIZE	3.5	inch
DOT PITCH	0.153mmX0.153mm	mm
NUMBER OF DOTS	320*（RGB）*480	-
DRIVER IC	HX8357C	-
LCD TYPE	TFT(262K) TRANSMISSIVE	-
BACKLIGHT TYPE	LED White	-
VIEWING DIRECTION	ALL	-
INTERFACE TYPE	Parallel interface/SPI+RGB	

***See attached drawing for details.**

2.BLOCK DIAGRAM:



3.DIMENSI



Pin Description			
1	XR(NC)	28	D17
2	YU(NC)	27	D16
3	XL(NC)	26	D15
4	YU(NC)	25	D14
5	GND	24	D13
6	LEDON	23	D12
7	LEDPWM	22	D11
8	IM0/ID	21	D10
9	IM1	20	SDO
10	IM2	19	SDI/SDA
11	RESX	18	RDX
12	VSYNC	17	WRX/SCL
13	HSYNC	16	D/CX
14	PCLK	15	CSX
15	DEN	14	TE
16	D17	13	IOVCC
17	D16	12	YCI
18	D15	11	GND
19	D14	10	LEDA
20	D13	9	LEDK1
21	D12	8	LEDK2
22	D11	7	LEDK3
23	D10	6	LEDK4
24	D09	5	LEDK5
25	D08	4	LEDK6
51	GND		

4. PIN DESCRIPTION:

NO.	PIN NAME	I/O Or Connect To	Description
1	XR(NC)	NC	No Connection
2	YD(NC)	NC	No Connection
3	XL(NC)	NC	No Connection
4	YU(NC)	NC	No Connection
5	GND	Power Supply	Ground
6	LEDON	LED Driver	LED Driver Enable Control Pin. If not used, please open this pin.
7	LEDPWM	LED Driver	Control signal for brightness of LED backlight. PWM signal's width is selected from 256 values between 0% (Low) and 100% (High). If not used, please open this pin.
8	IM0/ID	I	Interface select signal. Select from DBI Type B (18/16/9/8 bits) and Type C (Option 1 / Option3). For the details,please refer to NOTE1.
9	IM1		
10	IM2		
11	RESX	I	Reset pin. The module is initialized when RESX is Low. Make sure to execute power-on reset when turning the power supply on.
12	VSYNC	I	Frame synchronous signal. Low active. If not used, please connect this pin to IOVCC or GND.
13	HSYNC	I	Line synchronous signal. Low active. If not used, please connect this pin to IOVCC or GND.
14	PCLK	I	Pixel clock signal. The data input timing is set on the rising edge. If not used, please connect this pin to IOVCC or GND.
15	DEN	I	Data enable signal in DPI operation. Low: Select (Accessible) High: Not select (inaccessible) If not used, please connect this pin to IOVCC or GND.
16--33	DB17 -DB0	I/O	18-bit bi-directional data bus in DBI Type B operation. 8-bit interface: Use DB [7:0] 9-bit interface: Use DB[8:0: 16-bit interface: Use DB [15:0] 18-bit interface: Use DB[17:0] Abnormal current (through current) does not occur when CSX is High and the data bus is Hi-z. 18-bit input data bus in DPI operation. 16-bit interface: Use DB[15:0] 18-bit interface: Use DB[17:0] If not used, please connect this pin to GND.
34	SDO	I	Serial data output pin in DBI Type C operation to input data on the falling edge of SCL signal. If not used, please open this pin.
35	SDI/SDA	-	Serial data input pin in DBI Type C operation to

			input data on the rising edge of SCL signal. If not used, please connect this pin to IOVCC or GND.
36	RDX	P	Read strobe signal. Read out data when RDX is Low. If not used, please connect this pin to IOVCC
37	WRX/SCL	O	Write strobe signal in DBI Type B operation. Write data when WRX is Low. Synchronous clock signal in DBI Type C operation.
38	D/CX	O	Command/data select signal Low: Select command High: Select data If not used, please connect this pin to IOVCC
39	CSX	O	Chip select signal. Low: Select (Accessible) High: Not select (Inaccessible) Make sure to connect to host processor. Follow AC timing to control the signal.
40	TE	O	Tearing Effect output signal If not used, please open this pin.
41	IOVCC	Power supply	Power supply to interface pins and internal VDD regulator.AMP:1.65V~3.3V,TYPE:2.8V
42	VCI	Power supply	Power supply to liquid crystal power supply analog circuit.AMP:2.5V~3.3V,TYPE:2.8V
43	GND	Power supply	Ground
44	LEDA	LED driver	LED ANODE
45-50	LEDK1 ---K6	LED driver	LEDK1-6(CATHODE)
51	GND	Power supply	Ground

NOTE1:

IM2	IM1	IM0	Interface	Used pin	Available color number
0	0	0	DBI Type B 18 bits	DB[17:0]	262,144
0	0	1	DBI Type B 9 bits	DB[8:0]	262,144
0	1	0	DBI Type B 16 bits	DB[15:0]	65,536 / 262,144
0	1	1	DBI Type B 8 bits	DB[7:0]	65,536 / 262,144

5.ELECTRICAL CHARACTERISTICS

5.1 ABSOLUTE MAXIMUM RATINGS

Parameter of absolute maximum ratings	Symbol	Min	Max	Unit
Supply voltage for logic	VCI/IOVCC	-0.3	4.6	V
Input voltage	VIN	-0.3	IOVCC+0.3	V
Operating temperature	Top	-20	70	?C
Storage temperature	TST	-30	80	?C
Humidity	RH	-	90%(Max60 °C)	RH

5.2 DC CHARACTERISTICS

Parameter of DC characteristics	Symbol	Min	Typ	Max	Unit
Supply voltage for logic	VCI	2.5	2.8	3.3	V
I/O power supply	IOVCC	1.65	1.8/2.8	3.3	V
Input Current	Idd	-	33.25	66.50	mA
Input voltage 'H' level	VIH	0.8IOVCC	-	IOVCC	V
Input voltage 'L' level	VIL	0	-	0.2IOVCC	V
Output voltage 'H' level	VOH	0.8IOVCC	-	-	V
Output voltage 'L' level	VOL	-	-	0.2IOVCC	V

5.3 BACKLIGHT CHARACTERISTICS

Item of backlight characteristics	Symbol	Min.	Typ.	Max.	Unit	Condition
Forward voltage	Vf	2.9	3.2	3.4	V	If=90mA Ta=25
Luminance	Lv	3800	4200	4500	cd/m^2	
Number of LED	N	-	6	-	Piece	-
Connection mode	P/S	-	parallel	-	-	-

Using condition: constant current driving method If=90mA(+/-10%).

6. ELECTRO-OPTICAL CHARACTERISTICS

Item of electro-optical characteristics	Symbol	Condition	Min	Typ	Max	Unit	Remark	Note
Response time	Tr+ Tf		-	53	79.5	ms	Fig.1	4
Contrast ratio	Cr	θ=0° ∅=0° Ta=25℃	300	634	-	---	FIG 2.	1
Luminance uniformity	δ WHITE		81	90	-	%	FIG 2.	3
Surface Luminance	Lv		199	249	-	cd/m^2	FIG 2.	2
Viewing angle range	θ	∅= 90°	70	80	-	deg	FIG 3.	6
		∅ = 270°	70	80	-	deg	FIG 3.	
		∅ = 0°	70	80	-	deg	FIG 3.	
		∅ = 180°	70	80	-	deg	FIG 3.	
CIE (x, y) chromaticity	Red x	θ=0° ∅=0° Ta=25℃	0.5754	0.6254	0.6754	-	FIG 2.	5
	Red y		0.3025	0.3525	0.4025	-		
	Green x		0.2873	0.3373	0.3873	-		
	Green y		0.5578	0.6078	0.6578	-		
	Blue x		0.0923	0.1423	0.1923	-		
	Blue y		0.0298	0.0798	0.1298	-		
	White x		0.2367	0.2967	0.3567	-		
	White y		0.2604	0.3204	0.3804	-		

Note1. Contrast Ratio(CR) is defined mathematically by the following formula.For more information see FIG 2.:

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P 1,P2, P 3,P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P 3,P4, P5)}}$$

Note2.

Surface luminance is the LCD surface from the surface with all pixels displaying white.For more information see FIG 2.

Lv = Average Surface Luminance with all white pixels (P1, P2, P 3,P4, P5)

Note3.

The uniformity in surface luminance （δ WHITE） is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see FIG 2.

$$\delta\ \mathbf{WHITE} = \frac{\textbf{Minimum Surface Luminance with all white pixels } \mathbf{(P_1, P_2, P_3, P_4, P_5)}}{\textbf{Maximum Surface Luminance with all white pixels } \mathbf{(P_1, P_2, P_3, P_4, P_5)}}$$

Note4.

Response time is the time required for the display to transition from White to black(Rise Time, Tr) and from black to white(Decay Time, Tf). For additional information see FIG 1..

Note5.

CIE (x, y) chromaticity ,The x,y value is determined by screen active area position 5. For more information see FIG 2.

Note6.

Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the

conrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see FIG 3.

Note7.

For Viewing angle and response time testing, the testing data is base on Autronic-Melchers's ConoScope. Series Instruments. For contrast ratio, Surface Luminance, Luminance uniformity and CIE，the testing data is base on TOPCON's BM-5 photo detector.

Note8.

For TFT transmissive module, Gray scale reverse occurs in the direction of panel viewing angle.

FIG.1. The definition of Response Time

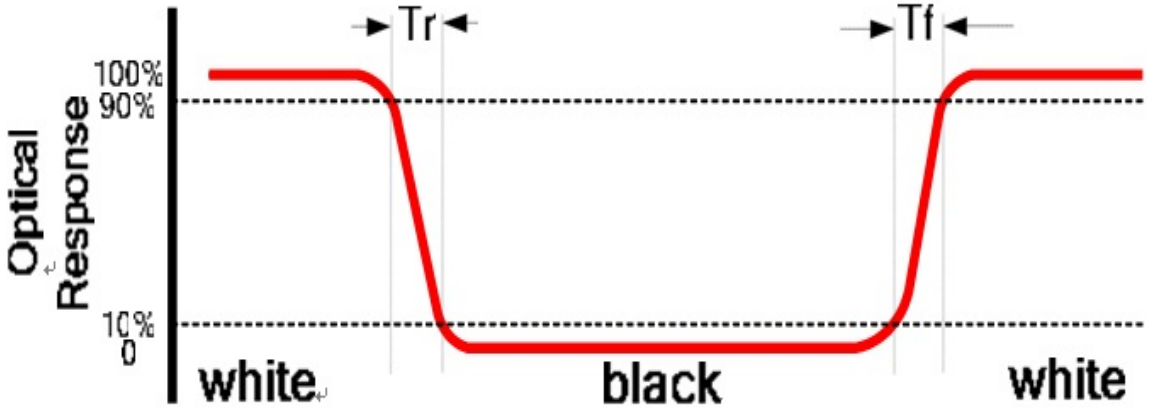


FIG.2. Measuring method for Contrast ratio,surface luminance, Luminance uniformity,CIE (x, y) chromaticity

A: 5 mm

B : 5 mm

H,V : Active Area

Light spot size ∅=5mm, 500mm distance from the LCD surface to detector lens

measurement instrument is TOPCON's luminance meter BM-5

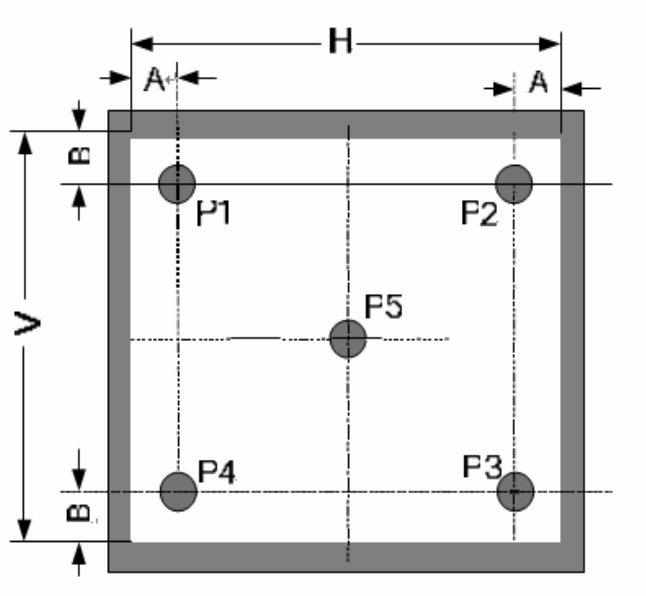
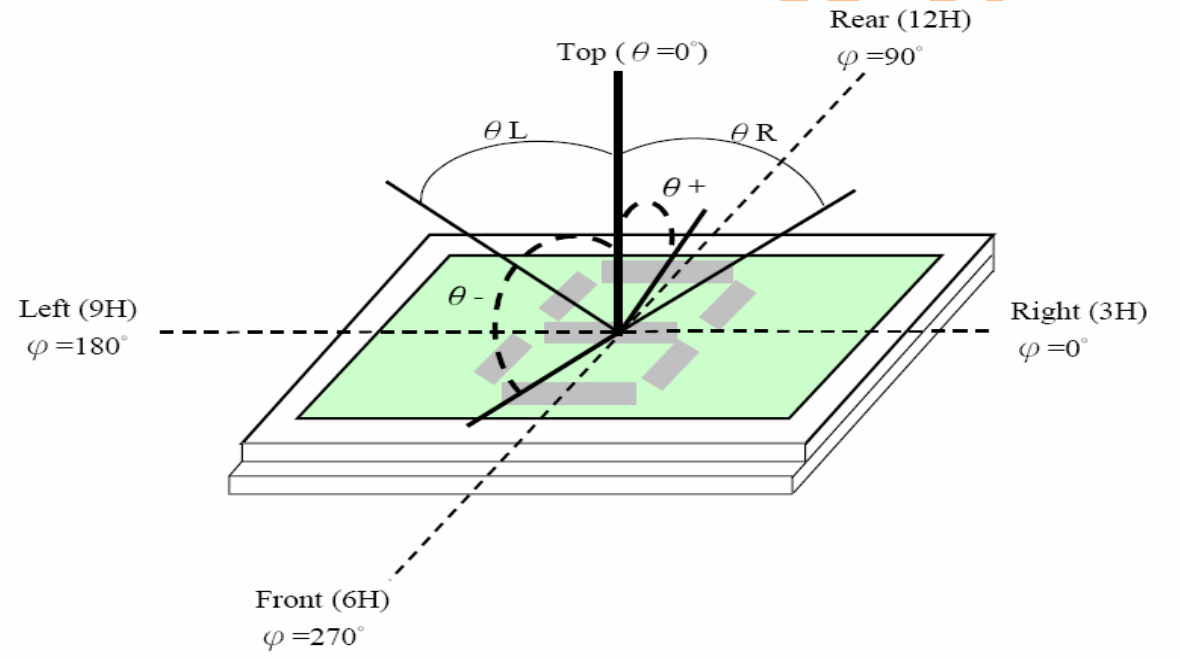
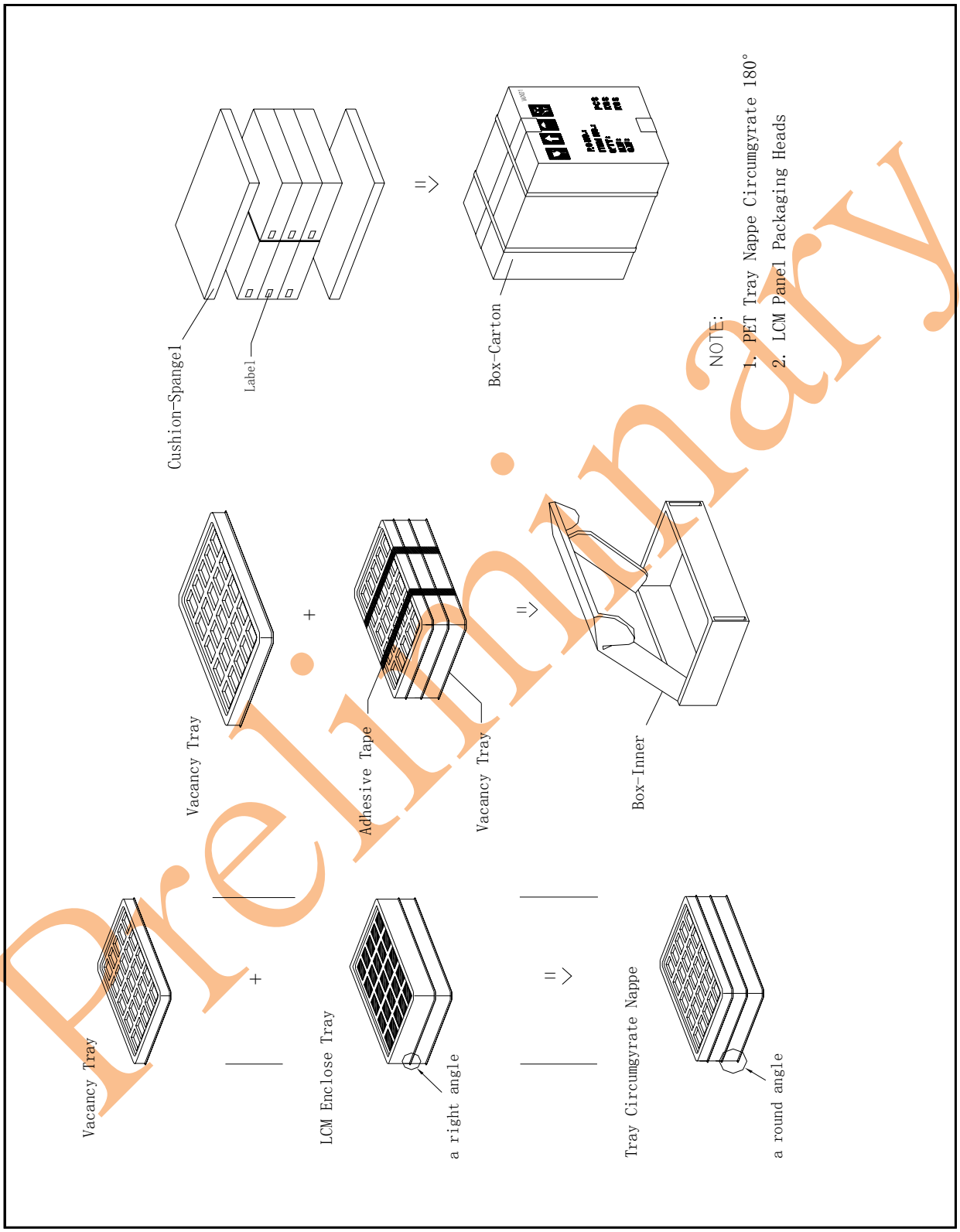


FIG.3. The definition of viewing angle



7.PACKAGE.



8. STANDARD SPECIFICATION FOR RELIABILITY:

Item	Condition		Time (hrs)	Assessment
High temp. Storage	70°C		120	No abnormalities in functions and appearance
High temp. Operating	60°C		120	
Low temp. Storage	-20°C		120	
Low temp. Operating	-10°C		120	
Humidity	40°C/ 90%RH		120	
Thermal Shock Temp. Cycle	-30°C ← →70°C (0.5hour ← → 0.5 hour)		10cycles	
ESD Testing	HBM:	±8KV		330Ω/150PF
	MM:	±200V		200PF/0Ω

Functions, performance, appearance, etc. shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (25±10℃), normal humidity (45±20% RH), and in area not exposed to direct sun light. (Life time of backlight, please refer to Data about backlight.)

Testing Conditions and Inspection Criteria:

For the final test the testing sample must be stored at room temperature for 24 hours, after the tests listed in up Table, Standard specifications for Reliability have been executed in order to ensure stability.

Item	**Test Model**	**In section Criteria**
Current Consumption	Refer To Specification	The current consumption should conform to the product specification.
Contrast	Refer To Specification	After the tests have been executed, the contrast must be larger than half of its initial value prior to the tests.
Appearance	Visual inspection	Defect free.

9.SPECIFICATION OF QUALITY ASSURANCE:

9-1 Purpose

This standard for Quality Assurance should affirm the quality of LCD Module products to supply

9-2 Standard for Quality Test

a. Inspection:

Before delivering, the supplier should take the following tests, and affirm the quality of product.

b. Electro-Optical Characteristics:

According to the individual specification to test the product.

c. Test of Appearance Characteristics:

According to the individual specification to test the product.

d. Test of Reliability Characteristics:

According to the definition of reliability on the specification for testing products.

e. Delivery Test:

Before delivering, the supplier should take the delivery test.

(i) Test method: According to MIL-STD105E.General Inspection Level Ⅱ take a single time.

(ii) The defects classify of AQL as following:

Major defect: AQL = 0.65

Minor defect: AQL = 2.5

Total defects: AQL = 2.5

9-3. Nonconforming Analysis & Deal With Manners

a. Nonconforming Analysis:

(i) Purchaser should supply the detail data of non- conforming sample and the non- conforming.

(ii) After accepting the detail data from purchaser, the analysis of nonconforming should be finished in two weeks.

(iii) If supplier can not finish analysis on time, must announce purchaser before two weeks.

b. Disposition of nonconforming:

(i) If find any product defect of supplier during assembly time, supplier must change the good product for every defect after recognition.

(ii) Both supplier and customer should analyze the reason and discuss the disposition of nonconforming when the reason of nonconforming is not sure.

9-4. Agreement items

Both sides should discuss together when the following problems happen.

a. There is any problem of standard of quality assurance, and both sides think that it must be modified.

b. There is any argument item which does not record in the standard of quality assurance.

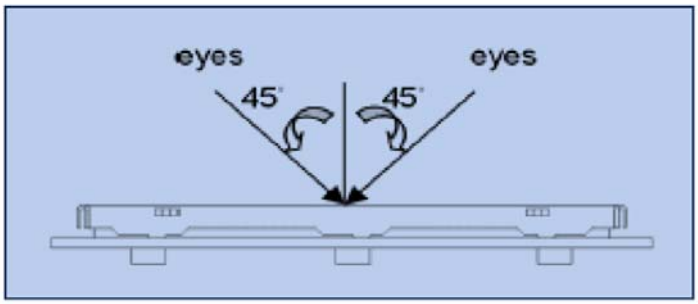
c. Any other special problem.

9-5 Standard of The Product Appearance Test

a. Manner of appearance test: This specification should be applied for both light on and off situation.

(i) The test must be under 20W × 2 or 40W fluorescent light, and the distance of view must be at 30±5cm.

(ii) When test the model of transmissive product must add the reflective plate.
(iii)The test direction is base on about around 10° of vertical line (Left graph)
(iiii)Temperature: 25±5℃ Humidity: 65±10%RH



(iv) Definition of area (Right graph)
A. Area: Viewing area. B. Area: Out of viewing area.(Outside viewing area)
b. Basic principle:
(i) It will accord to the AQL when the standard can not be described.
(ii) The sample of the lowest acceptable quality level must be discussed by both supplier and customer when any dispute happened.
(iii) Must add new item on time when it is necessary.
c. Standard of inspection: (Unit: mm)

Allowable limits defined in follow Dot defect Table should be met for each white, black , R, G, B raster. The limits apply to the entire area. Missing white in 60% or more of typical (one color, R or G or B) pixel aperture is defined as a bright defect, less than 60% is acceptable .Black spot in 60% or more of typical pixel aperture is defined as a dark defect, less than 60% is acceptable.

Dot defect table:

Item		White dot defect	Black dot defect	Total
1	Defect counts	3	3	3
2	Combined defect Counts	No combined dot defect allowed. Two Single dot defect that within 5mm during each dot defect should becounted as combined dot defect.		

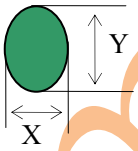
9-6 Inspection specification

AQL inspection standard

Sampling method: MIL-STD-105E, Level II, single sampling

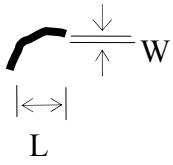
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		Contrast defect (dim, ghost)		
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
		Wrong Back-light	7	
	Non-display	Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	2.5
		Black spot and dust	3	
		Line defect	4	
		Scratch		
		Rainbow	5	
		Pin hole	6	
	Polarizer	Bubble and foreign material	3	
		Scratch	4	
	PCB,FPC	Scratch	4	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	
	LCD	CHIP OUT	11	

Note on defect classification:

No.	Item	Criterion
1	**Short or open circuit**	Not allow
	LC leakage	
	Flickering	
	No display	
	Wrong viewing direction	
	Wrong Back-light	
2	**Contrast defect**	Refer to approval sample
	Background color deviation	
3	**Point defect, Black spot, dust (incl. Polarizer) ex.: dirt under polarizer, Pinhole of reflector ,glass scratch, dirt under glass,scratch on polarizer** **ϕ = (X+Y)/2**	

Point Size	Acceptable Qty.
ϕ≤0.20	Disregard
0.20<ϕ≤0.25	3
0.25<ϕ≤0.30	2
ϕ>0.30	0

Unit：mm

4	**Line defect**	

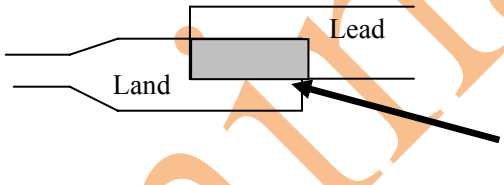
	Line	Acceptable Qty.
L	W	
---	0.015≥W	Disregard
3.0≥L	0.03≥W	2
2.0≥L	0.05≥W	
1.0≥L	0.1＞W	1
---	0.05<W	Applied as point defect

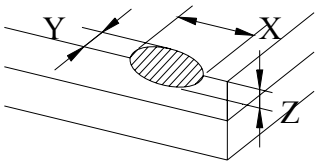
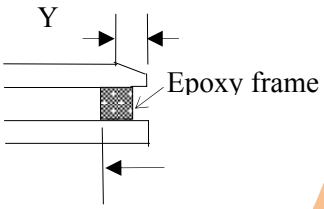
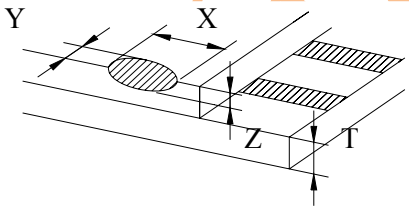
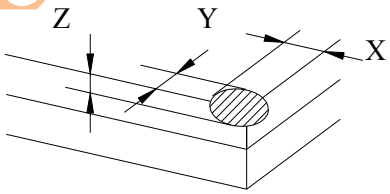
Unit: mm

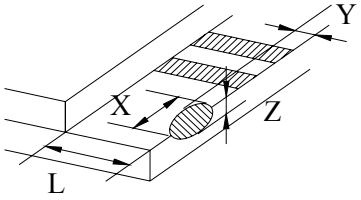
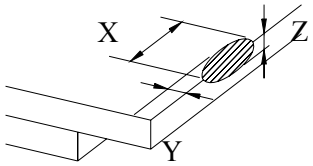
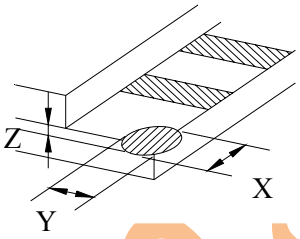
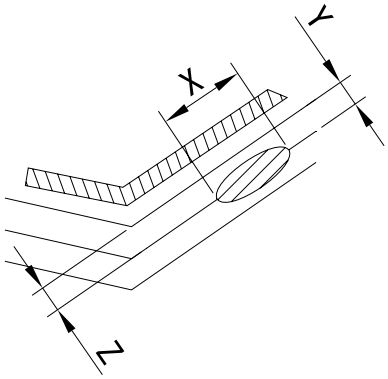
5	**Rainbow**	Not more than two color changes across the viewing area

No.	Item	Criterion
6	**Segment pattern**	**(1) Pin hole**

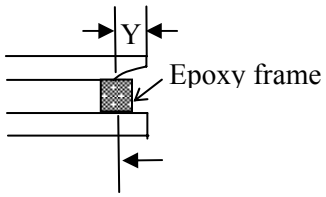
Point Size	Acceptable Qty

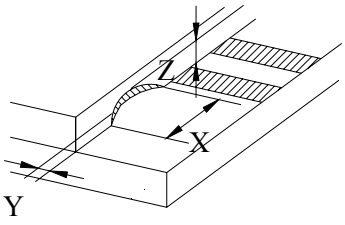
	W = Segment width **ϕ = (X+Y)/2**	ϕ < 0.10mm is acceptable.
7	**Back-light**	(1) The color of backlight should correspond its specification. (2) Not allow flickering
8	**Soldering**	(1) Not allow heavy dirty and solder ball on PCB or FPC. (The size of dirty refer to point and dust defect) (2) Over 50% of lead should be soldered on Land. 
9	**Wire**	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.
10	**PCB,FPC**	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.

11	LCD	**2.1.1 chip on the surface**     Note: A:LCD Length X / Y / Z >1/8A: ≤0.3mm: ≤1/2T ≤1/8A: Not enter into epoxy frame: ≤T ≤1/8A: Not enter into the inner edge of epoxy: ≤1/2T

11	**LCD**	**2.1.2 Chip on the terminal**    X ≤1/8A ≤1/8A&≤1mm ≤1/8A&≤2mm Y >0.3mm ≤1/2L ≤L ≤L Z ≤1/2T ≤T ≤T ≤1/2T Note: A:LCD Length. the distance between crack and contact pad must be greater than the width of 1st contact pad. **2.1.3 Chip out on between side** 

11	**LCD**	

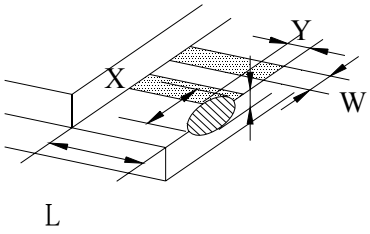




X	Y	Z
≤ 1/8A	Not enter into epoxy frame	Z≤2T
	Not enter into 1/2 epoxy frame	Z≤1/2T

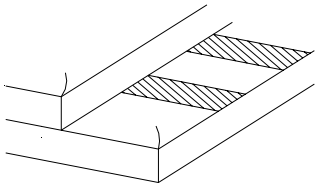
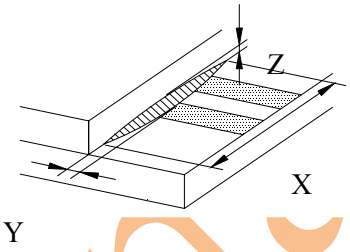
Note: A : LCD Length

2.1.4 including corner chip and side chip



Note: A:LCD Length

X	Y	Z
>1/8A	≤1/6L	≤1/2T
≤1/8A	≤1/3L	
≤1/4W	≤2/3L	

<table>
<tr><td rowspan="2">11</td><td rowspan="2">LCD</td><td>2.2 Chip out
 
1) Chip out is that crackles extend to inner edge.
2) Crackles round epoxy frame will be rejected.
3) Chip out on the terminal will be rejected: Z=T length >1mm or Z<T length >2mm
4) The chip out at ITO will be rejected.</td></tr>
<tr><td>2.3 Poor cutting
 

<table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>>1/8 A</td><td rowspan="2">≤0.3</td><td>≤1/2T</td></tr><tr><td>≤1/8 A</td><td>According to drawing</td><td>1/2T≤Z≤T</td></tr></table>Note : A: LCD Length.</td></tr>
<tr><td>12</td><td>SMT</td><td>According to the <Acceptable of electronic assemblies> IPC-A-610C class 2 stander. Component missing or function defect are Major defect ,the others are Minor defect.</td></tr>
<tr><td colspan="3">Any one out of the specification will be rejected.</td></tr>
</table>

10. GENERAL PRECAUTIONS

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichlorotrifloroethane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface. Do not use the following solvent:

- Water
- Ketone
- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging

Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.

- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them.

However those phenomena do not mean malfunction or out of order with LCD's which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- As light dew depositing on terminals is a cause for electro-chemical reaction resulting in

terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is required.

(6) Storage

In the case of storing for a long period of time (for instance, for years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is.

Keeping temperature in the specified storage temperature range.

- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol which should be burned up later.
- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.