SPECIFICATION
FOR
APPROVAL

(●) Preliminary Specification
( ) Final Specification

Title	3.54” (640xRGBx960) TFT LCD

BUYER	
MODEL	

SUPPLIER	LG Display Co., Ltd.
*MODEL	LH35WS1
SUFFIX	SH02

*When you obtain standard approval,
please use the above model name without suffix.

SIGNATURE	DATE
/	
/	
/	

Please return 1 copy for your confirmation with your signature and comments.

APPROVED BY	DATE
REVIEWED BY	
PREPARED BY	

Product Engineering Dept.
LG Display Co., Ltd

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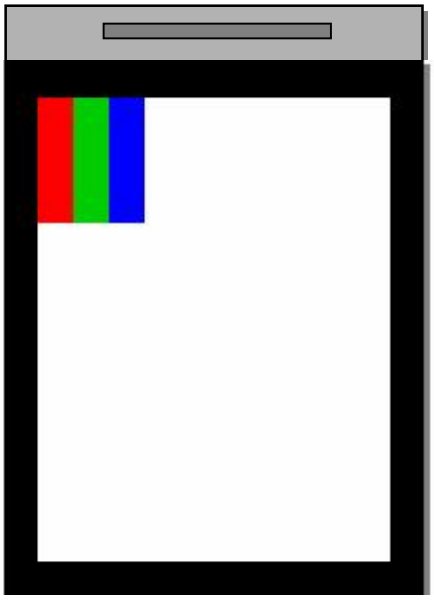
RECORD OF REVISIONS

Revision No.	Revision Date	Page	Summary
1.0	April. 18. 2011		

Product Specification

1. General Description

The **LH350WS1-SH02** model is a Thin Film Transistor-Liquid Crystal Display without polarizer.
The matrix compose poly-Si Thin Film Transistor as a active element.
It is a transmissive type display operating in the normally black mode. This TFT-LCD has 3.54 inch diagonally measured active display area with 2VGA resolution(640×RGB×960 pixels).
Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes.



General Features

Item	Specification
Active Screen Size	3.54” diagonal
Outline Dimension	54.85(H) x 82.93(V) x 0.4(T), Only panel without polarizers
Pixel Pitch	0.078(H) x 0.078(V)
Pixel Format	640(H) x 960(V) (RGB Stripe)
Color Gamut	NTSC 50%
Transmittance (with POL)	4.0% (Typ.)
Weight (without POL)	4.2 g (Typ.)± 0.4 g
Viewing Direction	6:00 o’clock (Non-inversion)
D-IC	R63303
Display operating mode	Transmissive Mode, Normally black

2. Absolute Maximum Ratings

The following are maximum values which, if exceeded, may cause faulty operation or damage to the unit.

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Values		Units	Notes
		Min.	Max		
LC Operating Voltage *1)	V_{OP}	3.9 V		V	@ 25±5 ℃
Operating Temperature	T_{OP}	-20	70	°C	2
Storage Temperature	T_{ST}	-30	80	°C	3
Humidity *2)	H_{OP}	5	90	%RH	2

Notes:
*1) Liquid Crystal driving voltage (only LC Material characteristic) is 3.3V.
Due to the characteristics of LC Material, this voltage vary with environmental temperature.
Recommended Data Swing Voltage = 4.0V (For the optimum Display Quality)
*2) Non-condensation.

3. Electrical Specifications

3-1. Electrical Characteristics

Table 2. ELECTRICAL CHARACTERISTICS @ 25 ±5°C

Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
TFT Gate ON Voltage	VGH *2)		11.6		V	
TFT Gate OFF Voltage	VGL *1)		-7		V	
TFT Common Electrode Voltage	VcomH	4.6	4.8	5.0	V	
	VcomL	0.5	0.68	0.85	V	
TFT Kick-Back Voltage	ΔV_P	0.2	0.35	0.5	V	

Notes:

*1) VGL is TFT Gate Operating Voltage.

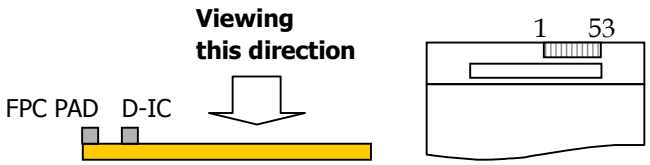
*2) VGH is TFT Gate Operating Voltage

We just kindly recommend the setting-voltage as the reference value.

In order to get the optimized display quality, the setting-voltage should be changed as based on customer's developing condition.
(The display quality could be changed by customer's setting-voltage.)

3. Electrical Specifications

3-2. Interface Connections



1) FPC to D-IC information

Table3. Panel PIN CONFIGURATION

No	Text
1	AGND
2	DPHYGND
3	DSID3N
4	DSID3P
5	DPHYGNDM1
6	DSID2N
7	DSID2P
8	DPHYGNDM2
9	DSICLKN
10	DSICLKP
11	DPHYGNDM3
12	DSID1N
13	DSID1P
14	DPHYGNDM4
15	DSID0N
16	DSID0P
17	DPHYGND
18	PIFA
19	STSTB
20	HIFA
21	RESETB
22	PWREN
23	VDDLP
24	DPHYVDD
25	DVDD
26	VDD
27	GND

No	Text
28	GND
29	GVDD
30	GVDD
31	AVDDH
32	AVDDH
33	AVDDL
34	AGND
35	VGS
36	VREG
37	VCOMH
38	VCOMH
39	VCOML
40	VCOML
41	VCL
42	C41M
43	C41P
44	GND
45	C21M
46	C21P
47	C22M
48	C22P
49	VGH
50	VLOUT2
51	VGL
52	VLOUT3
53	AGND

4. Optical Characteristics

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 50cm from the TFT-LCD surface at a viewing angle of Φ and Θ equal to 0 °.

Measurement condition: Refer to next pages Note1. (C-light source, Halogen Lamp)

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing Angle Range	ΘUP	CR ≥10	80	-	-	°(degree)	
	ΘDOWN		80	-	-	°(degree)	
	ΘLEFT		80	-	-	°(degree)	
	ΘRIGHT		80	-	-	°(degree)	
Contrast Ratio	CR	Optimal	600	1000	-		
Response time	τ_f	Θ =0 ° Ta =25 °C		20	25	ms	
	τ_r			20	25	ms	
Color Gamut	NTSC	-	-	50	-	%	
White Chromaticity	x	CIE 1931		0.309			
	y			0.329			
Red Chromaticity	x	CIE 1931		0.610			
	y			0.345			
Green Chromaticity	x	CIE 1931		0.315			
	y			0.555			
Blue Chromaticity	x	CIE 1931		0.150			
	y			0.120			

1. Optical Test Equipment & Method Refer to Note 1,2,3,4.

[Note 1] Optical Test Equipment Setup

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25°C. The values specified are at an approximate distance 50cm from the LCD surface. In case of backlight on, measured on the center area of the panel by PHOTO RESEARCH photometer PR-880&PR650 or Equivalent.

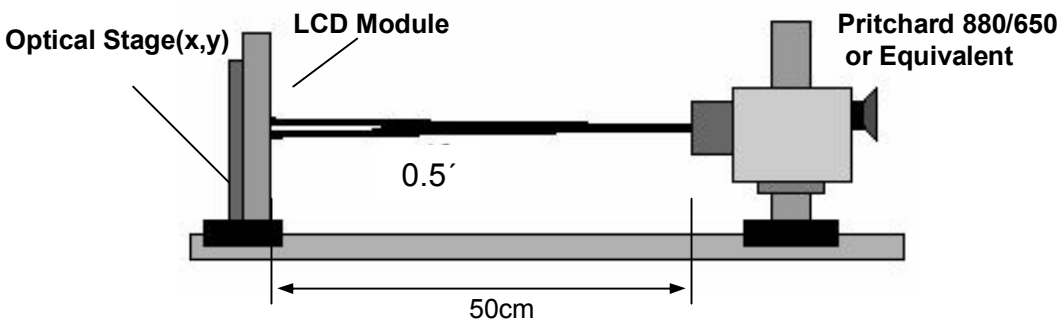


Fig 4.1. Optical Characteristic Measurement Equipment and Method

[Note 2]

Contrast Ratio is defined as follows ;

$$\text{Contrast Ratio(CR)} = \frac{\text{Photo detector output with LCD being “White”}}{\text{Photo detector output with LCD being “Black”}}$$

[Note 3]

Viewing Angle Range is defined as follows;

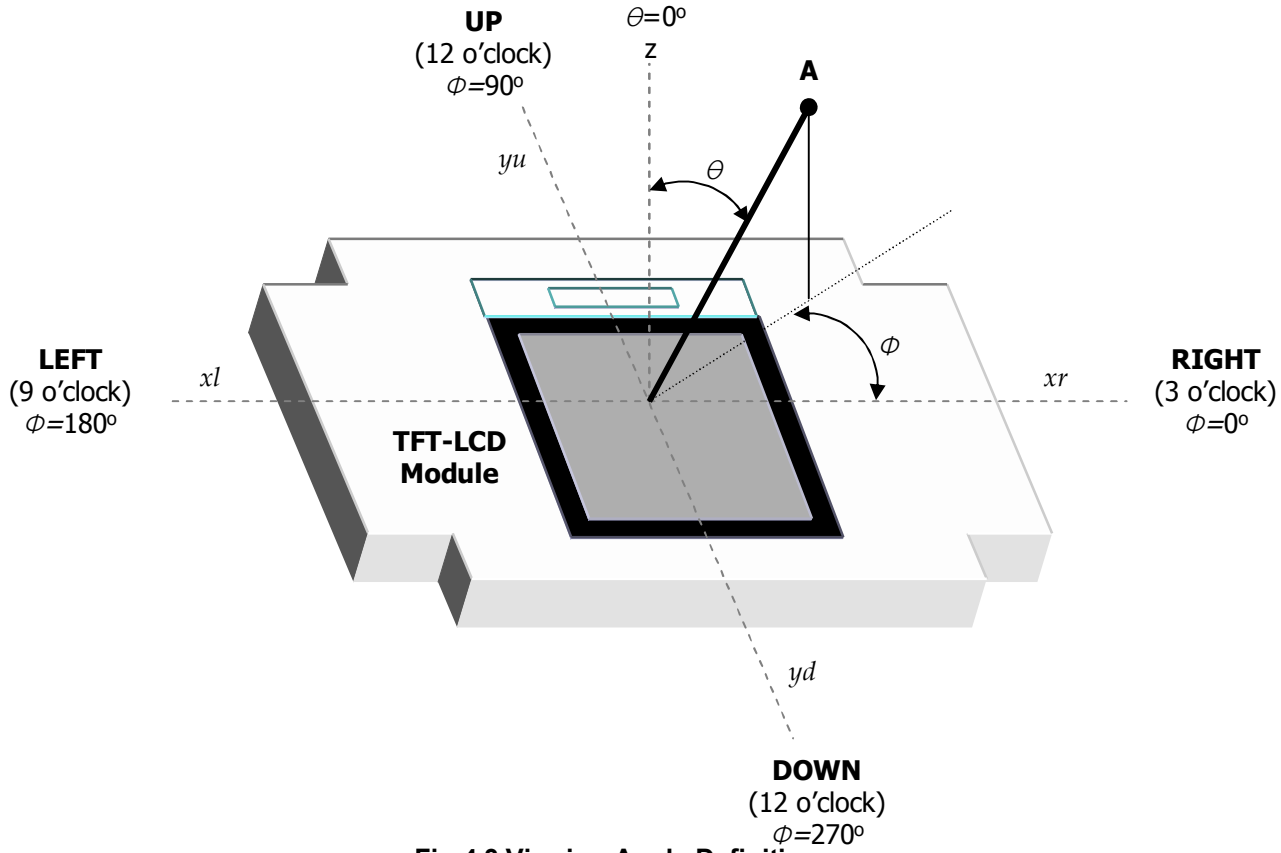


Fig 4.3 Viewing Angle Definitions

[Note 4]

Response time is obtained by measuring the transition time of photo detector output, when input signals are applied so as to make the area “black” to and from “white”.

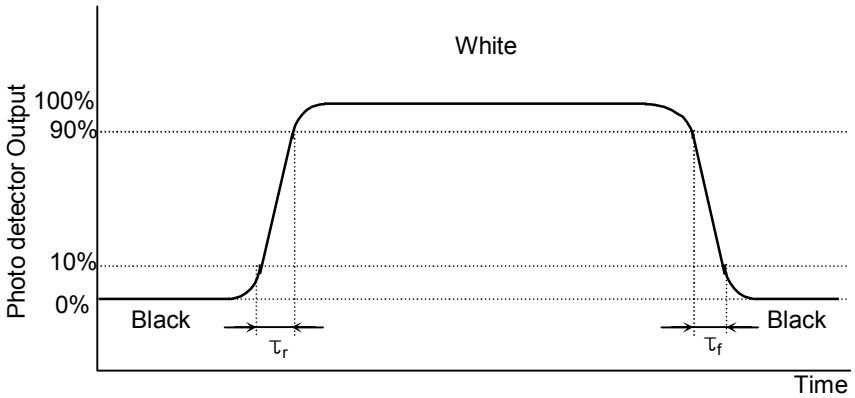
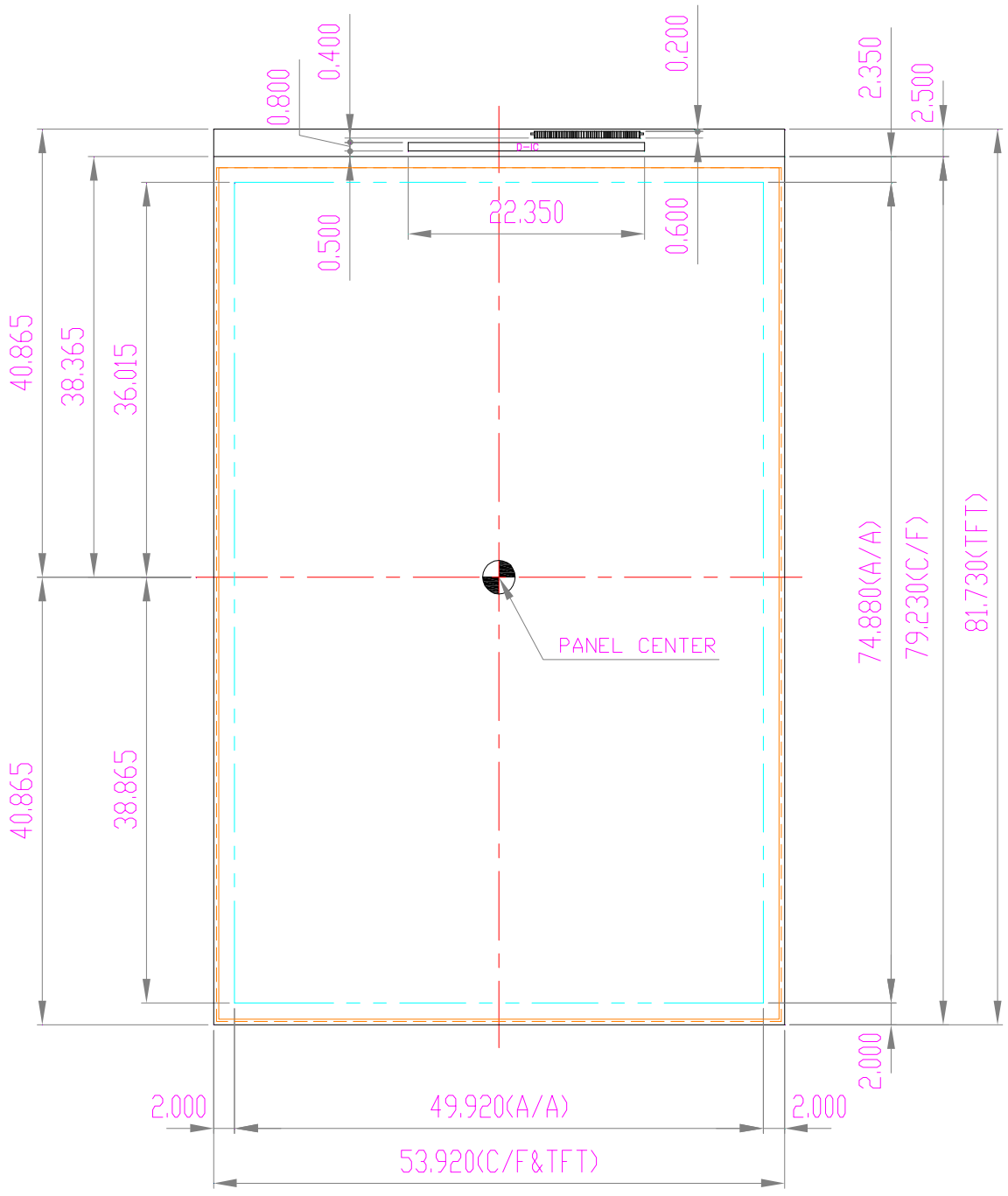


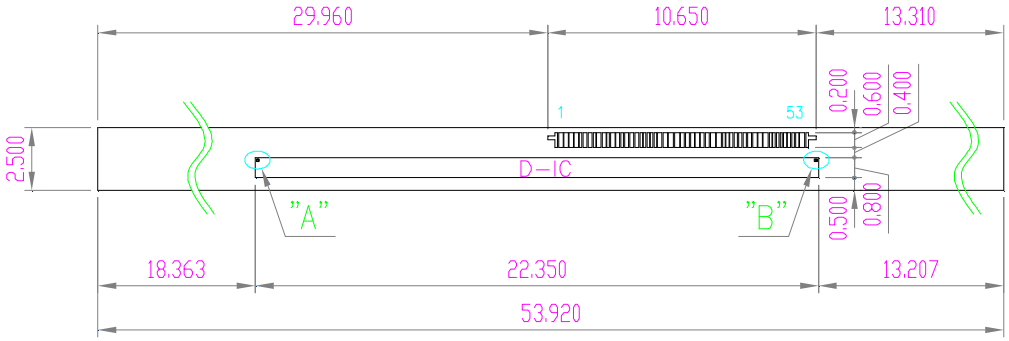
Fig 4.4 Response Time Definition

5. Mechanical Characteristics

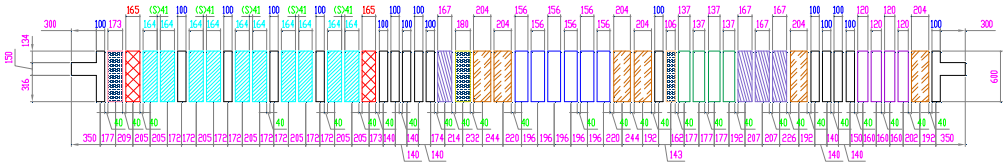
The contents provide general mechanical characteristics for the model LH350WS1-SH02.
In addition the figures in the next page are detailed mechanical drawing of the LCD.

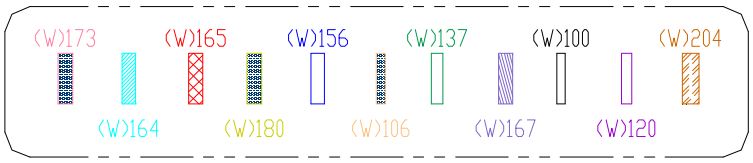


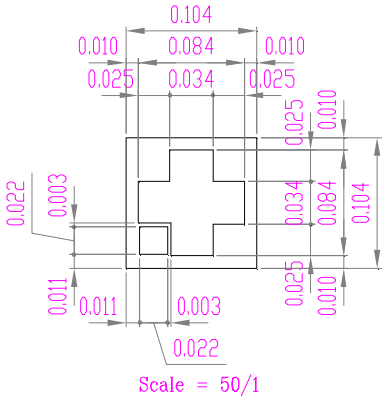
[Outline Dimension of TFT-LCD Cell FPC Pad]

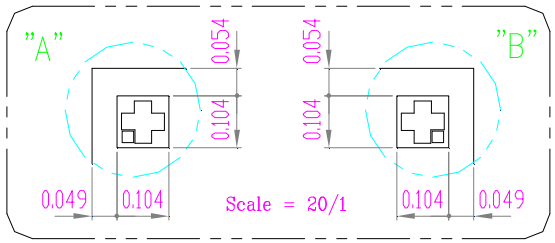


<FPC PAD Detail> Scale = 10/1
[Unit = um]









<PAD 위치 Detail> Scale = 3/1

6. Reliability Test

Absolute Maximum Conditions

No.	Parameter	Condition
1	Operating Temperature	-20 ~ 70℃
2	Storage Temperature	-30 ~ 80℃

Reliability test conditions (Polarizer characteristics null)

No.	Test Items	Test Condition	Remarks
1	High Temperature Storage	T = 80℃ for 240hr	Module (Without Contamination)
2	Low Temperature Storage	T = -30℃ for 240hr	
3	High Temperature Operating	T = 70℃ for 240hr	
4	Low Temperature Operating	T = -20℃ for 240hr (But no condensation of dew)	
5	High Temp. and High Humidity Operating	T = 60℃ /90% for 240hr (But no condensation dew)	
6	Thermal Shock	-30 ~ 80℃, 10cycle	
7	Packing Shock	1corner, 3edge, 6face / 76cmDrop	Packing
8	Packing Vibration	Random 1.5Grms Z direction 60 min.	

※ 1) No.1~ No.6 : No guarantee for panel, only for module with the above test conditions.
2) No.7~ No.8 : Refer to 7. Packing Ass'y on page 16.

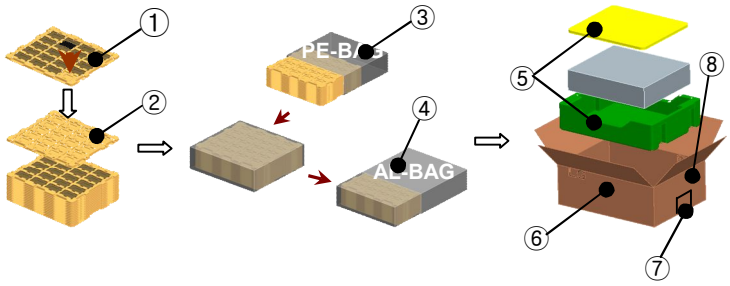
Result Evaluation Criteria
TFT- LCD Panel should be at room temperature for 2 hours when the display quality test is over.
There should be no particular change which might affect the practical display function
and the display quality test should be conducted under normal operating condition.

7. Packing Form

a) Package quantity in one box : 180 pcs

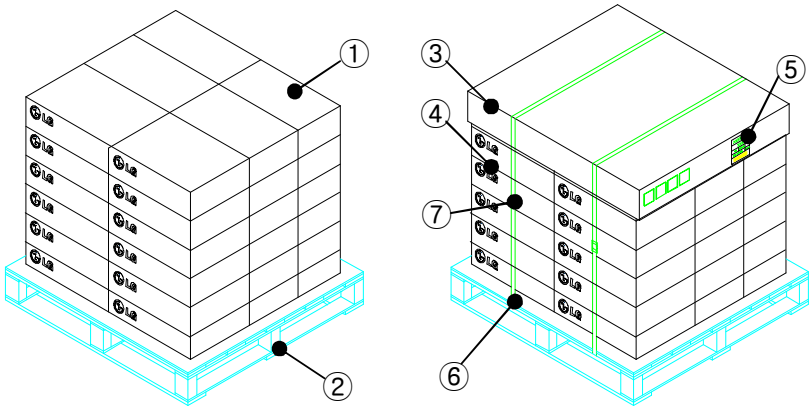
b) Box Size : 478mm X 365mm X 162mm

7-1) Packing Ass'y



NO.	Description	Material
1	Cell	
2	Packing Tray	PET
3	BAG	PE
4	Bag	AL
5	Packing	EPS
6	Carton Box	SWR4
7	Tape	OPP 70MMx300m
8	Label	ART Paper 100x70

7-2) Pallet Ass'y



NO.	Description	Material
1	Packing Assy	
2	Pallet	PLYWood
3	Angle Cover	SW
4	Wrap	LLDPE
5	Label	ART Paper
6	Band, Packing	PP
7	Band, Clip	STEEL

36 Boxs / 1 Pallet

8. PRECAUTIONS

Please pay attention to the following when you use this TFT LCD

8-1. ASSEMBLING PRECAUTIONS

1) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials.
2) Since a TFT-LCD Panel is composed of electronic circuits, it is not strong to electrostatic discharge.Make certain that treatment persons are connected to ground through wrist band etc.
3) Keep the ESD condition under 200V during assembling, moving even manual handling the product. It may cause serious malfunction to exceed over 2kV ESD.
4) Do not leave at the high temperature and high humidity in long time.
5) Do not leave the TFT-LCD panel from direct sunlight.
6) Do not contact with water to avoid Metal corrosion.6) The TFT-LCD Panel shall be installed flat, without twisting or bending

8-2. OPERATING PRECAUTIONS

1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage : V=±200mV(Over and under shoot voltage)
2) Response time depends on the temperature.(In lower temperature, it becomes longer.)
3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time(required time that brightness is stable after turned on) becomes longer.
4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
5) When fixed patterns are displayed for a long time, remnant image is likely to occur.
6) The TFT-LCD shall be operated within the temperature limits specified. when you operate the TFT-LCD panelat below(beyond) the limit specified,It may cause damage or image degradation.This phenomenon may not recover.

8-3. ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

8-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

8-5. STORAGE

When storing this TFT-LCD as spares for a long time, the following precautions are necessary.
(1) Store them in a dark place. Do not expose the model to sunlight or fluorescent light. Keep the temperature between 5°C and 35°C at normal humidity.
(2) The TFT-LCD glass surface should not come in contact with any other object.
It is recommended that they be stored in the container in which they were shipped.
(3) As TFT-LCD panels are packed in a vacuum with PE bag and Al bag in Nitrogen gas environment.

Customer is required to keep the product under a good condition(25 degree, 50%RH) to prevent any of unwanted damage from the moisture, and chemicals, etc. And recommended to use it in a short-time period, after it's unpacked.

8-6. HANDLING PRECAUTIONS FOR TFT-LCD Glass

Be careful when TFT-LCD panel is broken.(TFT-LCD is made of glass)