

Product Specification

**SPECIFICATION
FOR
APPROVAL**

() Preliminary Specification
(●) Final Specification

Title	3.5" hVGA TFT-LCD
-------	--------------------------

BUYER	H&H
MODEL	LH350H05-SH01

SUPPLIER	LG Display Co., Ltd.
*MODEL	LH350H05
SUFFIX	SH01

*No limit condition about Horizontal Dim by EOL

*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
S.D. Jung / Team Leader	 2012. 1. 30
REVIEWED BY	
Y. I. Bang / Part Leader	 2012. 1. 30
S. B. Ko / Part Leader	 2012. 1. 30
PREPARED BY	
M. C. Kim / Research Engineer	 2012. 1. 30

Mobile Panel Design Team.
LG Display Co., Ltd.

Product Specification

No.	ITEM	Page
-	COVER	1
-	CONTENTS	2
	RECORD OF REVISIONS	3
1	GENERAL DESCRIPTION	4
2	ABSOLUTE MAXIMUM RATINGS	5
3	ELECTRICAL SPECIFICATIONS	6
4	OPTICAL SPECIFICATIONS	7
5	MECHANICAL CHARACTERISTICS	11
6	RELIABILITY TEST	13
7	FPC Pin Assignment	14
8	PACKING FORM	15
9	PRECAUTIONS	16

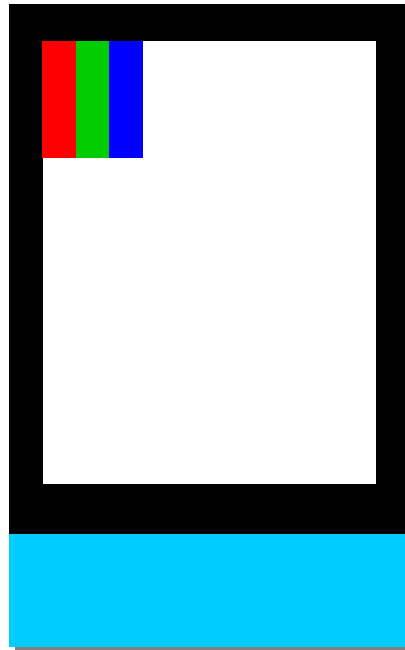
Product Specification**RECORDS OF REVISIONS**

Revision No	Revision Date	Page	DESCRIPTION
Ver. 0.1	Jan. 30, 2012		Ver.0.1 was Released.

Product Specification

1. General Description

The **LH350H05-SH01** model is a Thin Film Transistor- Liquid Crystal Display without polarizer. The matrix compose a-Si Thin Film Transistor as a active element. It is a transmissive type display operating in the normally black mode. This TFT-LCD has **3.5 inch** diagonally measured active display area with hVGA resolution(320×RGB×480 pixels). Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. The LH350H05-SH01 has been designed to apply the interface method that enables low power. The LH350H05-SH01 is intended to support applications where thin thickness, low power are critical factors and graphic display are important. In combination with the vertical arrangement of the sub-pixels, the LH350H05-SH01 characteristics provide a high quality display for mobile phone application.



General Features

Active Screen Size	3.5 inch diagonal
Outline Dimension	51.96(H) X 80.67(V) x 0.4(D) mm(Typ.) , Only panel without polarizer
Dot Pitch	0.051 mm X 0.153mm
Pixel Format	320×RGB×480 Pixels (RGB Stripes Arrangement)
Color Gamut	72 %(Typ.) , Only CF
Transmittance (with POL)	4.3 % (Typ.)
Weight (without POL)	3.9g (Typ.)± 0.39g
Rubbing Direction	80/80/80/80 deg (U/D/L/R @ C/R>10)
D-IC	R61529, R61581, ILI9481, ILI9486 (Note1)
Display Operating Mode	Transmissive Mode, Normally black

Note1) All D-IC can be enabled. But, we guarantee only R61529.

Product Specification
2. Absolute Maximum Ratings

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

Table 1. ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Value		Unit	Notes
		Min.	Max.		
LC Operating Voltage *1)	V_{OP}	4.5 (Typ.)		V	@ 25±5 °C
Operating Temperature	T_{OP}	-20	70	°C	
Storage Temperature	T_{ST}	-30	80	°C	
Operating Ambient Humidity *2)	H_{OP}	10	*3)	%RH	
Storage Humidity *2)	H_{ST}	10	*4)	%RH	

Notes:

*1) Liquid Crystal driving voltage.

Due to the characteristics of LC Material, this voltage vary with environmental temperature.

*2) Non-condensation.

*3) Temp. ≤ 60 °C , 90% RH MAX.

*4) Temp. > 60 °C , Absolute humidity shall be less than 90% RH at 60 °C

Product Specification
3. Electrical Specifications
Table 2. Recommend Parameters for Electrical Characteristics

@ 25 ± 5°C

Parameter	Symbol	Value			Unit	Notes
		Min.	Typ.	Max.		
TFT Gate ON Voltage	VGH *1)	11.17	13.55	13.55	V	*3)
TFT Gate OFF Voltage	VGL *2)	-9.85	-9.85	-9.0	V	
TFT Common Electrode Voltage	Vcom	-	-0.7	-	v	
TFT Kick-Back Voltage Max.	ΔV_p Max	0.2	-	0.6	V	
TFT Kick-Back Voltage Min.	ΔV_p Min					

Notes:

*1) VGH is TFT Gate Operating Voltage.

 *2) VGL is TFT Gate Operating Voltage
 The low voltage level of VGL signal must be fluctuated with same phase as Vcom,
 in case of Cadd (Storage on Gate) structure.
 The storage capacitance structure of **LH350H05-SH01** is Cst (Storage on Common)

*3) Vcom must be adjusted to optimize display quality: Cross-talk, Contrast Ratio and etc.

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.)

Product Specification
4. Optical Specification

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 50 cm from the TFT-LCD surface at a viewing angle of Φ and θ equal to 0 °.

Measurement condition: Refer to next pages (LED back light with 20 mA/1 ea)

*1): with LPL Polarizer

*2): Only Color Filter glass

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
*1) Threshold Voltage	Vsat	3.65	3.9	4.15	V	Fig.2
	Vth	1.8	2.0	2.2	V	
*1) Transmittance	T(%)	3.65	4.30	-	%	Fig.1
*1) Contrast Ratio	C/R	300	500	-		
*1) Response Time	Tr+Tf	-	35	45	msec	Fig.3
*2) CIE Color Coordinate	Rx	0.640	0.660	0.680		
	Ry	0.297	0.317	0.337		
	Gx	0.240	0.260	0.280		
	Gy	0.555	0.575	0.595		
	Bx	0.120	0.140	0.160		
	By	0.055	0.075	0.095		
	Wx	0.278	0.298	0.318		
	Wy	0.304	0.324	0.344		
*1) Viewing Angle	Θ_l	-	80	-	Degree	C/R>10 Fig.4
	Θ_r	-	80	-		
	Θ_u	-	80	-		
	Θ_d	-	80	-		

Product Specification

Notes : 1. Contrast Ratio(CR) is defined mathematically as :

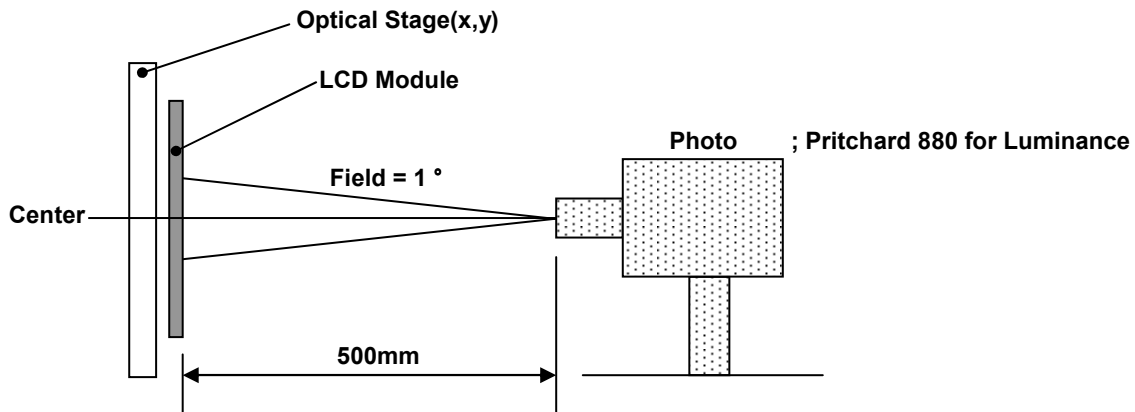
$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

2. Surface luminance is the center point across the TFT-LCD surface 240 mm from the surface with all pixels displaying white. For more information see FIG 1.
3. Response time is the time required for the display to transition from black to white(Rise Time, Tr) and from white to black(Falling Time, Tf). For additional information see FIG 3.
4. Viewing angle is the angle at which the contrast 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 TFT-LCD surface. For more information see FIG 4.
5. Optimum contrast is obtained by adjusting the TFT-LCD Threshold voltage(Vth & Vsat)

FIG. 1 Optical Characteristic Measurement Equipment and Method

Pritchard 880 System

[Test Equipment Set Up]



- Measuring Condition ;
 - Measuring surroundings : Dark Room
 - Measuring temperature : $T_a=25^\circ\text{C}$
 - Adjust operating voltage to get optimum contrast at the center of the display.
 - Measured value at the center point of LCD panel after more than 30 minutes while backlight turning on.

Product Specification

FIG. 2 The definition of V_{th} and V_{sat}

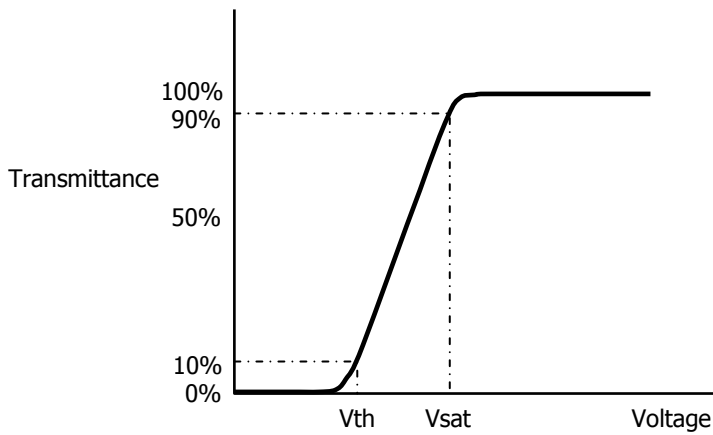
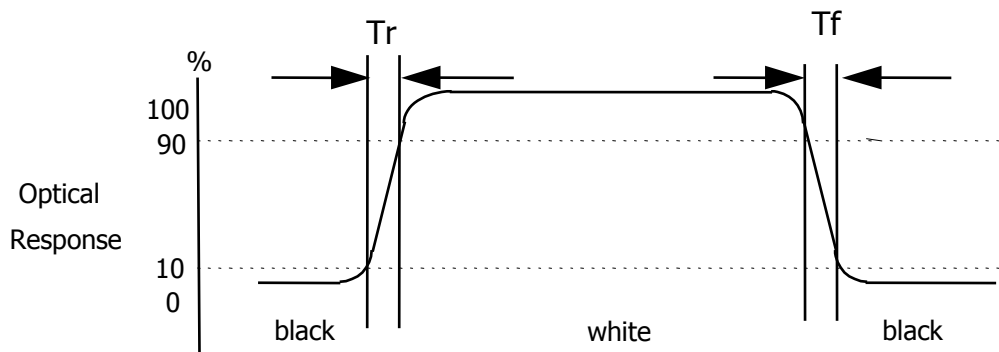


FIG. 3 The definition of Response Time

The response time is defined as the following figure and shall be measured by switching the input signal for "black" and "white".



* Voltage conditions for Response time
 V_{gate} : 20V DC
 V_{data} : 0V~5V DC
 V_{com} : 0V (Ground)

Product Specification

FIG. 4 The definition of viewing angle

<dimension of viewing angle range>

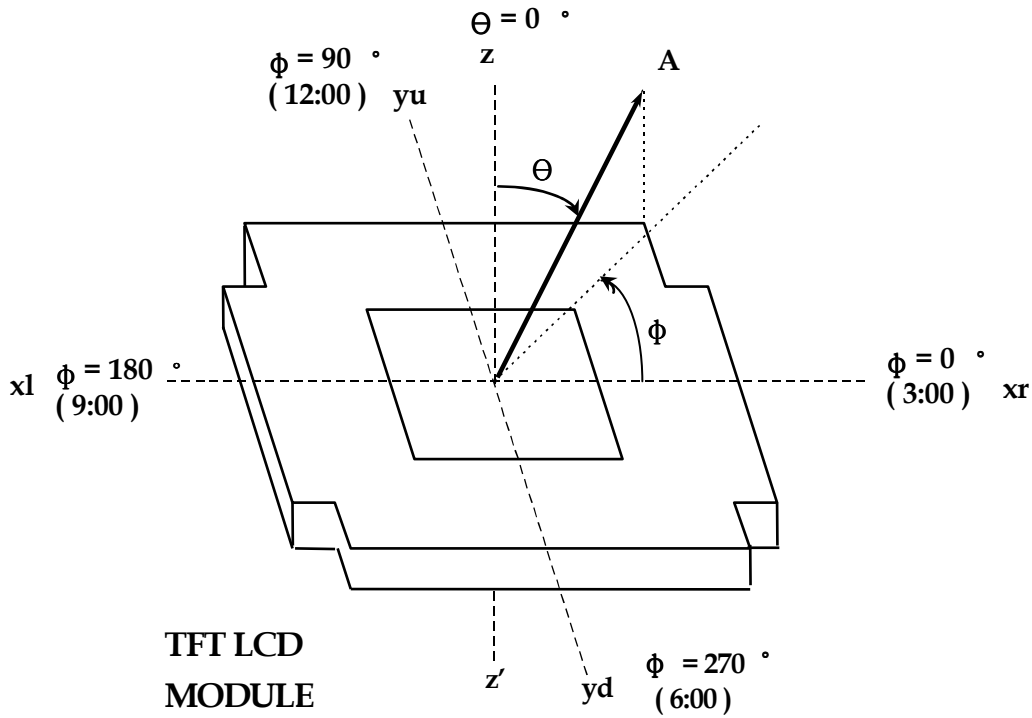
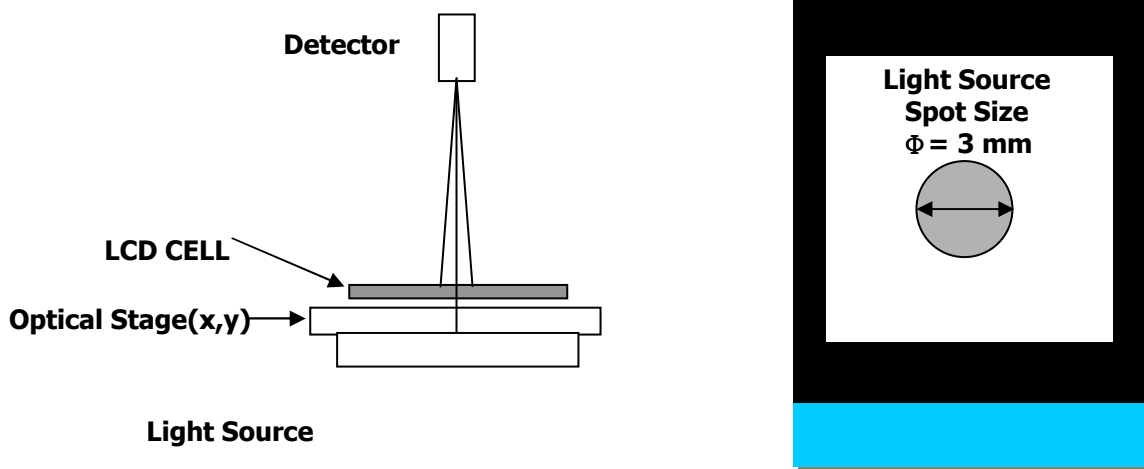


FIG. 5 Response Time Measurement Equipment and Method

DMS 803 System



<Transmissive Mode>

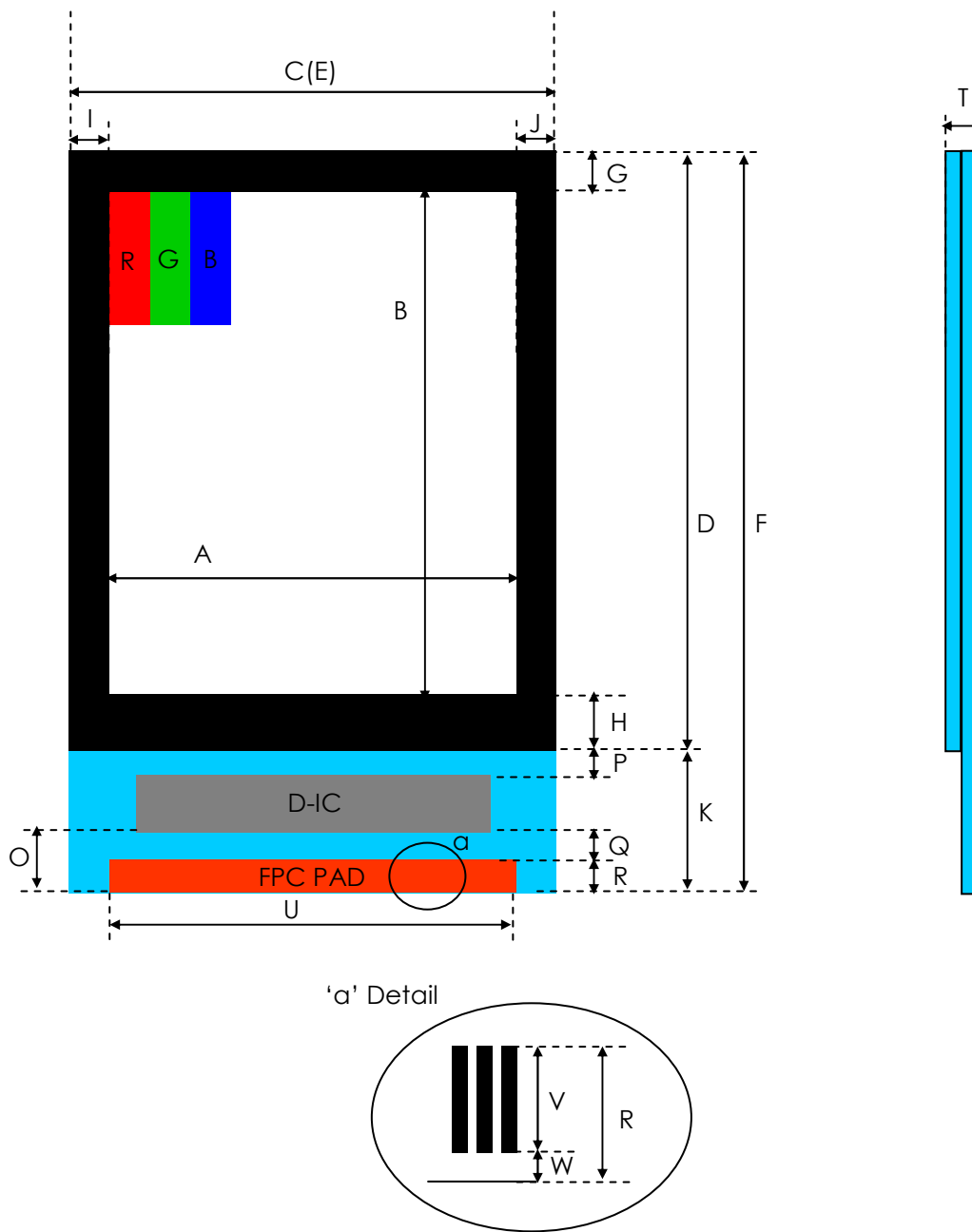
Product Specification
5. Mechanical Characteristics

The contents provide general mechanical characteristics for the model **LH350H05-SH01**. In addition the figures in the following page are detailed mechanical drawing of the TFT-LCD. (R61529)

Parameter	Symbol	Specification	Unit	Notes
Active Area	A	48.96	mm	
	B	73.44	mm	
Upper Glass Size	C	51.96±0.15	mm	
	D	76.94±0.15	mm	
Bottom Glass Size	E	51.96±0.15	mm	
	F	80.67±0.15	mm	
Panel thickness	T	0.4±0.05	mm	
Cell Margin	G	1.5±0.1	mm	
	H	2.0±0.1	mm	
	I	1.5±0.1	mm	
	J	1.5±0.1	mm	
COG PAD Area	K	3.73±0.2	mm	
Upper Glass Edge to D-IC	P	1.17±0.1	mm	
Bottom Glass Edge to D-IC	O	1.5±0.1	mm	
D-IC to FPC	Q	0.7	mm	
FPC to Glass Edge	R	0.8±0.1	mm	
FPC Length	U	24.57	mm	
FPC Pad Length(Metal)	V	0.6	mm	
FPC Pad(metal area) to Glass Edge	W	0.2±0.1	mm	
Weight		3.9±0.39	g	

Product Specification

FIG. 5 Outline Dimension of TFT-LCD Cell



Product Specification

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	
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 *1)	
5	High Temp. and High Humidity Operating	T = 60℃ /90% for 240hr (But no condensation dew)	
6	Thermal Shock	-30 ~ 80℃, 100cycle	Packing
7	Packing Shock	1coner, 3edge, 6face / 76cmDrop	
8	Packing Vibration	Random 1.5Grms Z direction 1hr.	

Notes :

No.1~ No.6 : No guarantee for panel, only for module with the above test conditions.

No.7~ No.8 : Refer to 7-1) Packing Ass'y on page 14.

*1) But no condensation of dew

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.

Product Specification
7. FPC Pin Assignment

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	DUMMY	48	AGNDDUM13	95	AGND	143	DB0
2	DUMMY	49	AGND	96	AGND	144	DB1
3	ITO_GND PAD	50	VCI	97	AGND	145	DB2
4	VCOM	51	VCI	98	VCL	146	DB3
5	VCOM	52	VCI	99	VCL	147	DB4
6	VCOM	53	VCI	100	AGNDDUM8	148	DB5
7	VCOM	54	VCI	101	C42P	149	DB6
8	VCOM	55	VSP	102	C42P	150	DB7
9	VPP1	56	VSP	103	C42P	151	DB8
10	VPP1	57	VSP	104	C42M	152	DB9
11	GND	58	AGND	105	C42M	153	DB10
12	GND	59	AGND	106	C42M	154	DB11
13	GND	60	C14P	107	VCOMDC	155	DB12
14	VGH	61	C14P	108	VCOMDC	156	DB13
15	VGH	62	C14M	109	VREFM	157	DB14
16	DUMMY	63	C14M	110	VREFD	158	DB15
17	C21P	64	VSN	111	VREFC	159	DB16
18	C21M	65	VSN	112	VPLVL	160	DB17
19	C21M	66	VSN	113	VNLVL	161	DE
20	DUMMY	67	C13P	114	VCOM	162	PCLK
21	DUMMY	68	C13P	115	VCOM	163	HSYNC
22	C22P	69	C13M	116	VCOM	164	VSYNC
23	C22P	70	C13M	117	VCOM	165	RESX
24	C22M	71	AGND	118	AGND	166	IM3
25	C23P	72	AGND	119	AGND	167	IM2
26	C23M	73	AGND	120	AGND	168	IM1
27	DUMMY	74	VCI	121	AGND	169	IM0
28	DUMMY	75	VCI	122	VGS	170	DB18
29	VGL	76	VCI	123	GND	171	DB19
30	VGL	77	VCI	124	GND	172	DB20
31	VGL	78	VCI	125	GND	173	DB21
32	AGND	79	VCI	126	GND	174	DB22
33	AGND	80	VCI	127	VDD	175	DB23
34	AGND	81	VCI	128	VDD	176	STB_CLKP
35	C11P	82	VCI	129	VDD	177	STB_CLKN
36	C11P	83	VCI	130	VDD	178	DATA0P
37	C11P	84	AGNDDUM11	131	VREF	179	DATA0N
38	C11M	85	AGNDDUM10	132	VDDTEST	180	IOVCC2
39	C11M	86	C41P	133	IOVCC1	181	DGND
40	C11M	87	C41P	134	IOVCC1	182	LEDPWM
41	C12P	88	C41P	135	IOVCC1	183	GND
42	C12P	89	C41P	136	TE	184	GND
43	C12P	90	C41M	137	CSX	185	GND
44	C12M	91	C41M	138	DCX	186	VCOM
45	C12M	92	C41M	139	WRX	187	VCOM
46	C12M	93	C41M	140	RDX	188	VCOM
47	AGNDDUM14	94	AGND	141	DIN	189	ITO_GND PAD
				142	DOUT	190	DUMMY

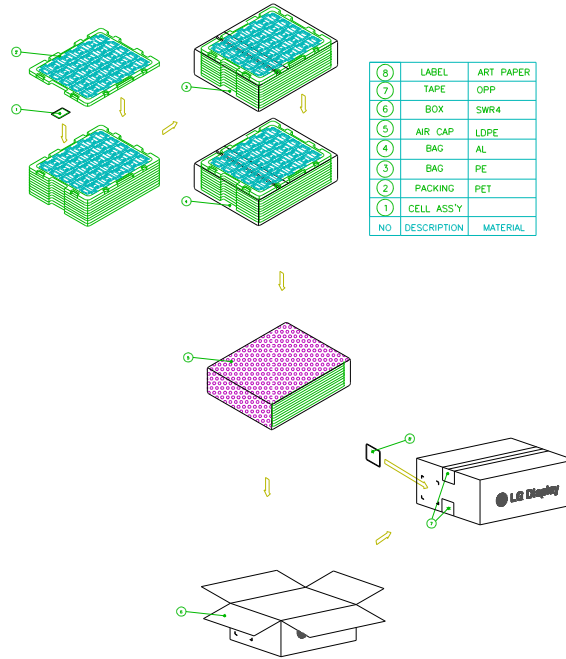
Note : No.1 is left side (Top view, PAD's direction : 6 O'clock)

Product Specification

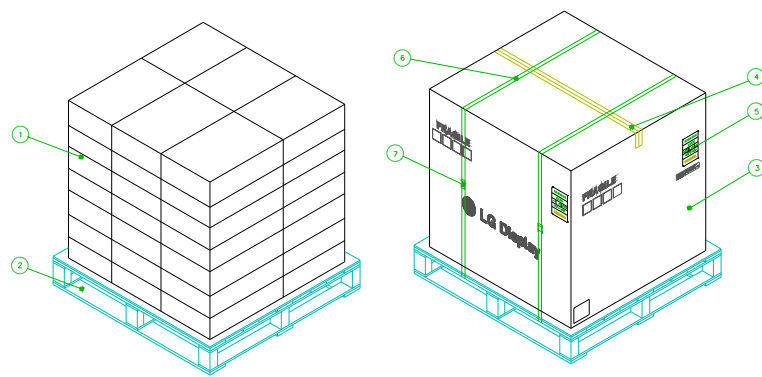
8. Packing Form

- a) Package quantity in one box : 180 pcs
- b) Box Size : 393mm X 339mm X 135mm

8-1) PACKING ASS'Y



8-2) PALLET ASS'Y



42 BOXES / 1 PALLET

Product Specification**9. PRECAUTIONS**

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

9-1. MOUNTING 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) Do not leave at the high temperature and high humidity in long time.
- 4) Do not leave the TFT-LCD panel from direct sunlight.
- 5) Do not contact with water to avoid Metal corrosion.
- 6) The TFT-LCD Panel shall be installed flat, without twisting or bending

9-2. OPERATING PRECAUTIONS

- 1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage :
 $V = \pm 200\text{mV}$ (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 panel at below(beyond) the limit specified,It may cause damage or image degradation.
This phenomenon may not recover.

9-3. 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.

Product Specification**9-4. PRECAUTIONS FOR STRONG LIGHT EXPOSURE**

Strong light exposure causes degradation of color filter. It may not recover

9-5. STORAGE

When storing TFT-LCD panel as spares for a long time, the following precautions are necessary.

- 1) Store them in a dark place. Do not expose 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%)
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.**

9-6. HANDLING PRECAUTIONS FOR TFT-LCD Glass

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