Product Specification

SPECIFICATION
FOR
APPROVAL

() Preliminary Specification
(●) Final Specification

Title	N070ICE-GB2 Product Specification

Customer	
Part Number	

SUPPLIER	Innolux
MODEL	N070ICE-GB2
Version	01

SIGNATURE	DATE
/	
/	
/	

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

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Product Specification

CONTENT LIST

Product Specification

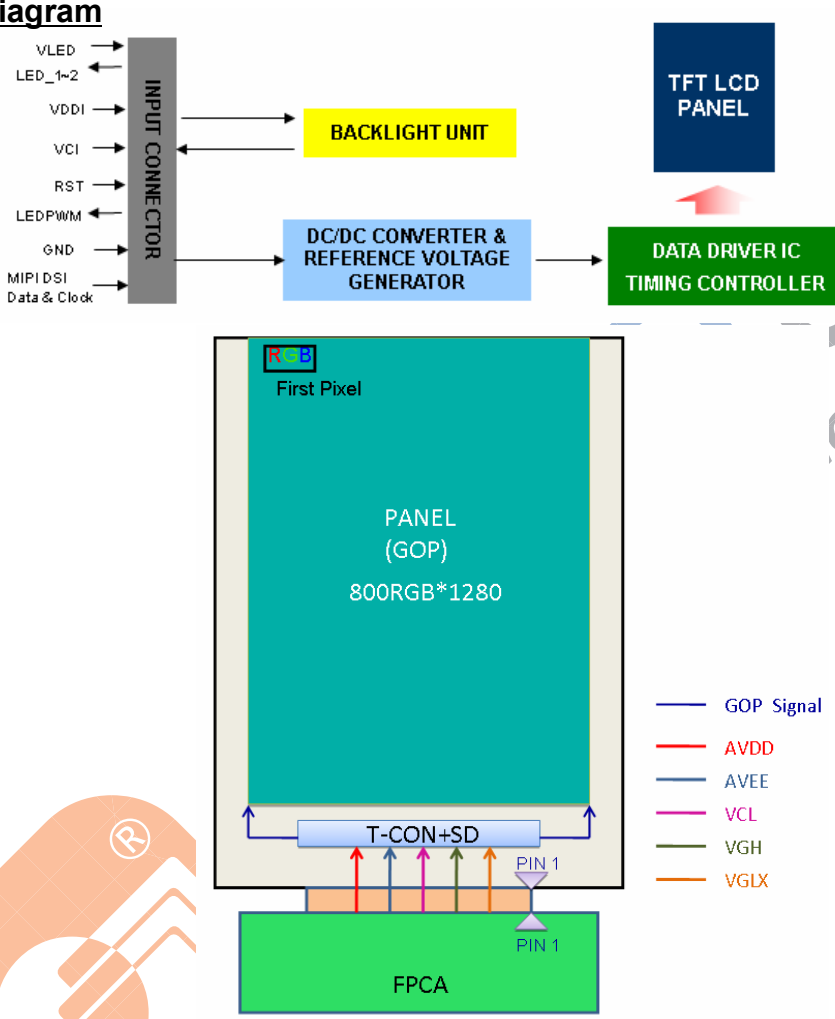
RECORD OF REVISIONS

Revision No.	Revision Date	Page	Description

1-1. GENERAL DESCRIPTION

N070ICE-GB2 is a 7” (7” diagonal) TFT Liquid Crystal Display module with LED Backlight unit and 31 pins MIPI interface. This module supports 800 x 1280 WXGA mode.

Block Diagram



Features

Item	Specification	Unit	Note
Screen Size	7″ diagonal		
Driver Element	a-si TFT active matrix	-	-
Pixel Number	800 x R.G.B. x 1280	pixel	-
Pixel Pitch	0.11775 (H) x 0.11775 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	16,777,216 (8bit color depth)	color	-
Transmissive Mode	Normally black	-	-
Surface Treatment	Hard coating (3H), Glare	-	-
Luminance, White	450	Cd/m2	
Power Consumption	*Total 1.6 W (Max.) (panel 0.4 W (Max.), BL 1.2 W (Max.))*		

Product Specification

1-2. General Spec

No	Item	Specification	unit	Remark
1	Screen Size	7” diagonal	inch	
2	Active Area	94.2 x 150.72	mm	
3	Panel Size	101.5 x 159.65	mm	
4	Outline Dimension	103.5 x 162.15	mm	
5	Display Resolution	800 x R.G.B. x 1280	pixel	
6	Pixel Pitch	0.11775 (H) x 0.11775 (V)	um	
7	Display Method	a-si	-	a-si/LTPS
8	Display Mode	IPS	-	TN/VA/IPS
9	Display Color	16,777,216 (8bit color depth)	-	
10	Color Gamut	60	%	max
11	Luminance	450	nit	typ
12	Contrast Ratio	(1000)	-	typ
13	Viewing Angle	8585/85/85	°	CR>10(U/D/L/R)
14	Pol Surface Treatment	HC	-	HC/AG
15	Weight	60	g	max
16	D-IC	NT35521 / Novatek	-	
17	Inversion Method	Column Inversion		Dot/Column
18	LED Q’ty	6Strings * 3Parallels	ea	String*Parallel
19	Power Consumption	1600mW (note 1)	mw	Backlight + Logic

Note 1: at VCI = 3.3 V, VDDI= 1.8V, fv = 60 Hz, Brightness = 450nits, IF_LED = 20mA and Ta= 25 ± 2 ºC, whereas white pattern is displayed

1-3-2. FPC Pin Assignment

Please pay attention that IC bump down(TFT glass up and C/F glass down

Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol	Pin No.	Symbol
1	DUMMY	30	VDDI	59	GND	88	AVDD
2	DUMMY	31	DUMMY	60	GND	89	GND
3	DUMMY	32	DUMMY	61	GND	90	C41P
4	DUMMY	33	DVDD	62	VDDI	91	C41N
5	VCOM	34	GND	63	VDDI	92	C42P
6	GND	35	DUMMY	64	GND	93	C42N
7	GND	36	GND	65	VDDI	94	VGH
8	MVDDL	37	GND	66	DVDD	95	VRGH
9	GND	38	GND	67	GND	96	AVEE
10	HSSI_D0_N	39	AVDD	68	AVDD	97	AVEE
11	HSSI_D0_P	40	AVDD	69	EXTP	98	C51P
12	GND	41	AVEE	70	EXTN	99	C51N
13	HSSI_D1_N	42	AVEE	71	VGL_REG2	100	VGLX
14	HSSI_D1_P	43	DUMMY	72	VGL_REG	101	AVDD
15	GND	44	DUMMY	73	GND	102	AVDD
16	HSSI_CLK_N	45	GND	74	GND	103	VCI
17	HSSI_CLK_P	46	GND	75	GND	104	VCI
18	GND	47	GND	76	AVDD	105	GND
19	HSSI_D2_N	48	VDDI	77	AVEE	106	NC(MTP)
20	HSSI_D2_P	49	LEDPWM	78	VGMP	107	VCOM
21	GND	50	TE	79	VGMN	108	VGLX
22	HSSI_D3_N	51	TE1	80	VREF	109	VCOM
23	HSSI_D3_P	52	RESX	81	VEQP_SD	110	VCOM
24	GND	53	VDDI	82	VCL	111	VCOM_FB
25	MVDDA	54	VDDI	83	VEQN_SD	112	GND
26	DUMMY	55	VDDI	84	C31P	113	DUMMY
27	VCI	56	VDDI	85	C31N	114	DUMMY
28	VCI	57	VDDI	86	C32P	115	DUMMY
29	VDDI	58	GND	87	C32N		

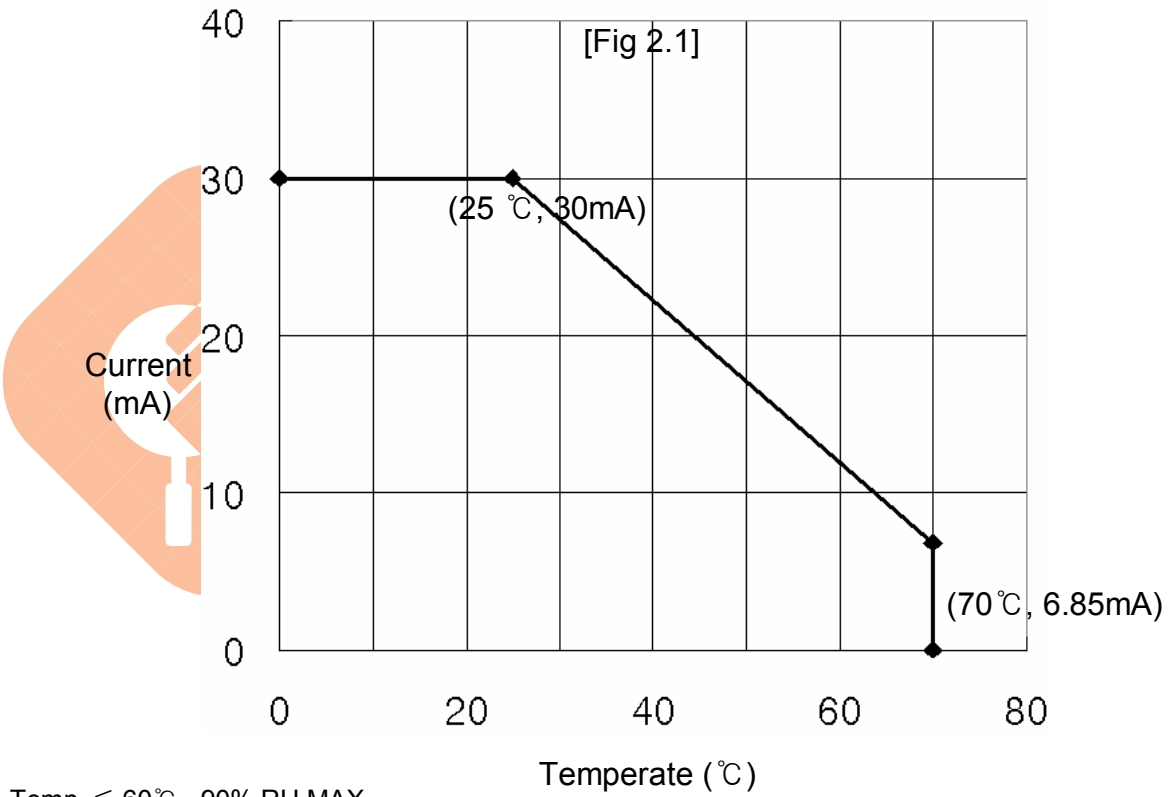
2-1. Absolute Maximum Ratings

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

Table 2.1 Absolute Maximum Ratings

Parameter	Symbol	Values		Units	Notes
		Min	Max		
LCD Analog Voltage	VCC	-0.3	+5.0	V	
LCD I/O Voltage	IOVCC	-0.3	+2.0	V	
Operating Temperature	Top	-20	+70	℃	
Storage Temperature	Tstg	-10	+60	℃	
LED Power Consumption	P_{LED}			mW	1.2mW
LED Current	I_{LED}			mA	20mA

Notes:
1. Applies to each LED individually. (@25 ℃, 30mA)
2. Allowable forward current is refer to Fig 2.1



3. Temp. ≤ 60℃ , 90% RH MAX.
   Temp. ＞60℃ , Absolute humidity shall be less than 90% RH at 60℃.

3-1. ELECTRICAL CHARACTERISTICS

Table 3.1 Electrical Characteristics Of TFT-LCD Module

Parameter		Symbol	Values			Units	Notes
			Min	Typ	Max		
LCD Input Analog Voltage		VCC-Vss	+3.0	+3.3	+3.6	V	If necessary
Positive Step-up Voltage		VSP	+5.8	+6.0	+6.2	V	If necessary
Negative Step-up Voltage		VSN	-6.2	-6.0	-5.8	V	If necessary
LCD Logic I/O Voltage		IOVCC-Vss	+1.7	+1.8	+1.9	V	
LED Input Current		I_{LED}	---	20	---	mA	
"H" Level Input Voltage		V_{IH}	0.7*IOVCC		IOVCC	V	
"L" Level Input Voltage		V_{IL}	Vss		0.3*IOVCC	V	
"H" Level Output Voltage		V_{OH}	0.8*IOVCC		IOVCC	V	
"L" Level Output Voltage		V_{OL}	Vss		0.2*IOVCC	V	
LCD Power Consumption	Normal	P_N			400	mW	1
	Deep standby	P_D			270	uW	
	BLU	P_B			1200	mW	2

Notes:
(1) The specified current and power consumption are under the conditions at VCC = 3.3V(or VSP=6V, VSN=-6V),IOVCC = 1.8V, T = 25°C, and fv = 60 Hz, at white pattern
(2) LED Backlight assumptions: 3.3 Vf, 20 mA,

3-2. Logic Power Consumption

Parameter	Symbol	Values		Units	Notes
		Typ	Max		
Normal Mode	I_{IOVCC}	30	60	mA	White Pattern
	I_{VCC}	46	90	mA	If necessary
	I_{VSN}	7	13	mA	If necessary
	I_{VSP}	16	32	mA	If necessary
Sleep Mode	I_{IOVCC}	20	40	mA	White Pattern
	I_{VCC}	35	70	uA	If necessary
	I_{VSN}	5	10	uA	If necessary
	I_{VSP}	8	18	uA	If necessary

3-3. BACK LIGHT UNIT

3-3-1 The edge-lighting type of back light unit consists of 6Strings * 3Parallels LEDs which is connected in serial.

Table 2-3-1 Electrical Characteristics Of Back Light Unit

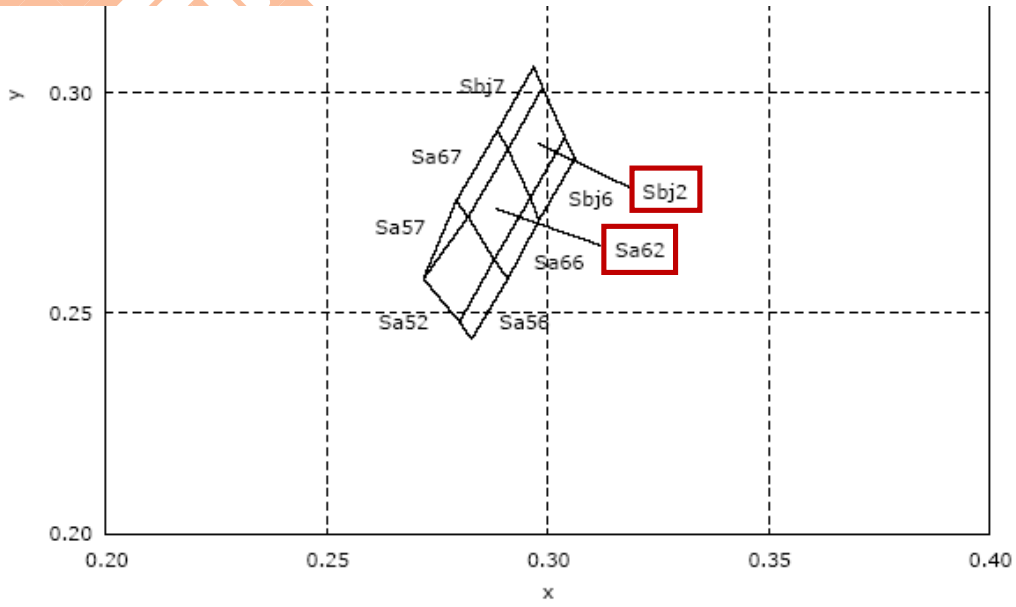
Parameter	Symbol	Values			Units	Notes
		Min	Typ.	Max		
LED Current	I_{LED}		20		mA	
LED Forward Voltage	V_{LED}	2.6	3.0	3.2	V	

3-3-2 LED Rank

Luminous Flux Rank Chart

Item	Rank	Min	Max	Unit
Luminous Flux	NW850	8.50	8.75	lm
	NW825	8.25	8.50	
	NW800	8.00	8.25	
	NW775	7.75	8.00	
	NW750	7.50	7.75	
	NW725	7.25	7.50	

Color Rank Chart



3-4. LCD INTERFACE CONNECTIONS

Interface Connector: AYF333135 (Panasonic)

Table 3.4 LCD Connector Pin Configuration

Pin No.	Symbol	I/O	Description
1	VLED	P	Anode for light bar
2	NC(MTP)	---	No connection, please keep it floating
3	LED1	P	1st Cathode for light bar
4	LED2	P	2nd Cathode for light bar
5	LED3	P	3rd Cathode for light bar
6	ID	---	Ground
7	GND	P	Ground
8	D0_N	I	MIPI differential data0 input (Negative)
9	D0_P	I	MIPI differential data0 input (Positive)
10	GND	P	Ground
11	D1_N	I	MIPI differential data1 input (Negative)
12	D1_P	I	MIPI differential data1 input (Positive)
13	GND	P	Ground
14	CLK_N	I	MIPI differential clock input (Negative)
15	CLK_P	I	MIPI differential clock input (Positive)
16	GND	P	Ground
17	D2_N	I	MIPI differential data2 input (Negative)
18	D2_P	I	MIPI differential data2 input (Positive)
19	GND	P	Ground
20	D3_N	I	MIPI differential data3 input (Negative)
21	D3_P	I	MIPI differential data3 input (Positive)
22	GND	P	Ground
23	VDDI (IOVCC)	P	1.8V input
24	VDDI (IOVCC)	P	1.8V input
25	RST	I	Device reset signal
26	GND	P	Ground
27	LEDPWM	O	PWM control signal for LED driver (CABC)
28	GND	P	Ground
29	VCI (VCC)	P	3.3V input
30	VCI (VCC)	P	3.3V input
31	GND	P	Ground

3-5. SIGNAL TIMING SPECIFICATIONS

Signal	Item	Symbol	Min.	Typ.	Max.	Unit
DCLK	Frequency	1/Tc	-	69.3	-	MHz
DE	Vertical Total Time	TV	-	1306	-	TH
	Vertical Active Display Period	TVD	-	1280	-	TH
	Vertical Front Porch Period	TVFP		10		TH
	Vertical Sync. Period	TVS		4		TH
	Vertical Back Porch Period	TVBP		12		TH
	Horizontal Total Time	TH	-	884	-	Tc
	Horizontal Active Display Period	THD	-	800	-	Tc
	Horizontal Front Porch Period	THFP		40		Tc
	Horizontal Sync. Period	THS		4		Tc
	Horizontal Back Porch Period	THBP		40		Tc

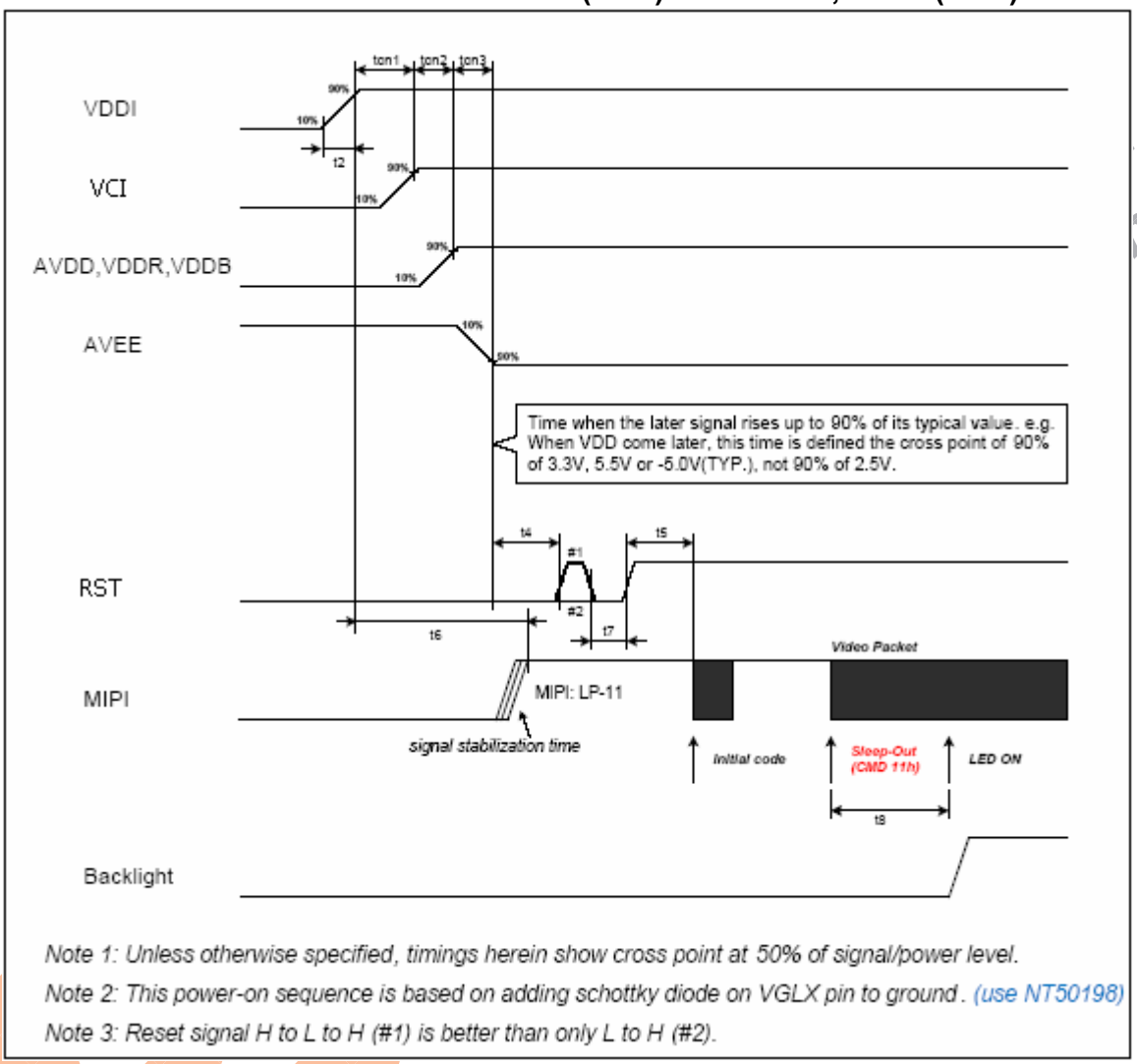
3-6. MIPI Data&CLK Line Impedance Test Result

Microsoft Excel
工作表

TRACE Connection Info.	Z DIFF PAIR Impedance Spec.	Trace Impedance Maximum	Trace Impedance Minimum	Trace Impedance (Ohm)	Judgment
MIPI_D0 SN1	100±10%	90	110	99.48	OK
MIPI_D0 SN2	100±10%	90	110	99.81	OK
MIPI_D0 SN3	100±10%	90	110	99.46	OK
MIPI_D0 SN4	100±10%	90	110	98.68	OK
MIPI_D0 SN5	100±10%	90	110	101.6	OK
MIPI_D1 SN1	100±10%	90	110	98.82	OK
MIPI_D1 SN2	100±10%	90	110	98.71	OK
MIPI_D1 SN3	100±10%	90	110	97.97	OK
MIPI_D1 SN4	100±10%	90	110	97.30	OK
MIPI_D1 SN5	100±10%	90	110	100.49	OK
MIPI_CLK SN1	100±10%	90	110	99.20	OK
MIPI_CLK SN2	100±10%	90	110	98.86	OK
MIPI_CLK SN3	100±10%	90	110	98.37	OK
MIPI_CLK SN4	100±10%	90	110	97.80	OK
MIPI_CLK SN5	100±10%	90	110	100.69	OK
MIPI_D2 SN1	100±10%	90	110	98.61	OK
MIPI_D2 SN2	100±10%	90	110	98.44	OK
MIPI_D2 SN3	100±10%	90	110	97.41	OK
MIPI_D2 SN4	100±10%	90	110	96.97	OK
MIPI_D2 SN5	100±10%	90	110	100.24	OK
MIPI_D3 SN1	100±10%	90	110	98.99	OK
MIPI_D3 SN2	100±10%	90	110	98.00	OK
MIPI_D3 SN3	100±10%	90	110	97.72	OK
MIPI_D3 SN4	100±10%	90	110	97.10	OK
MIPI_D3 SN5	100±10%	90	110	100.50	OK

3-7. Power On/Off Sequence

VDDI(IOVCC)=1.7V~1.9V, VCI(VCC)=3.0V~3.6V, AVDD(VSP)=5.8V~6.2V, AVEE(VSN)=-6.2V~-5.8V



Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal/power level.

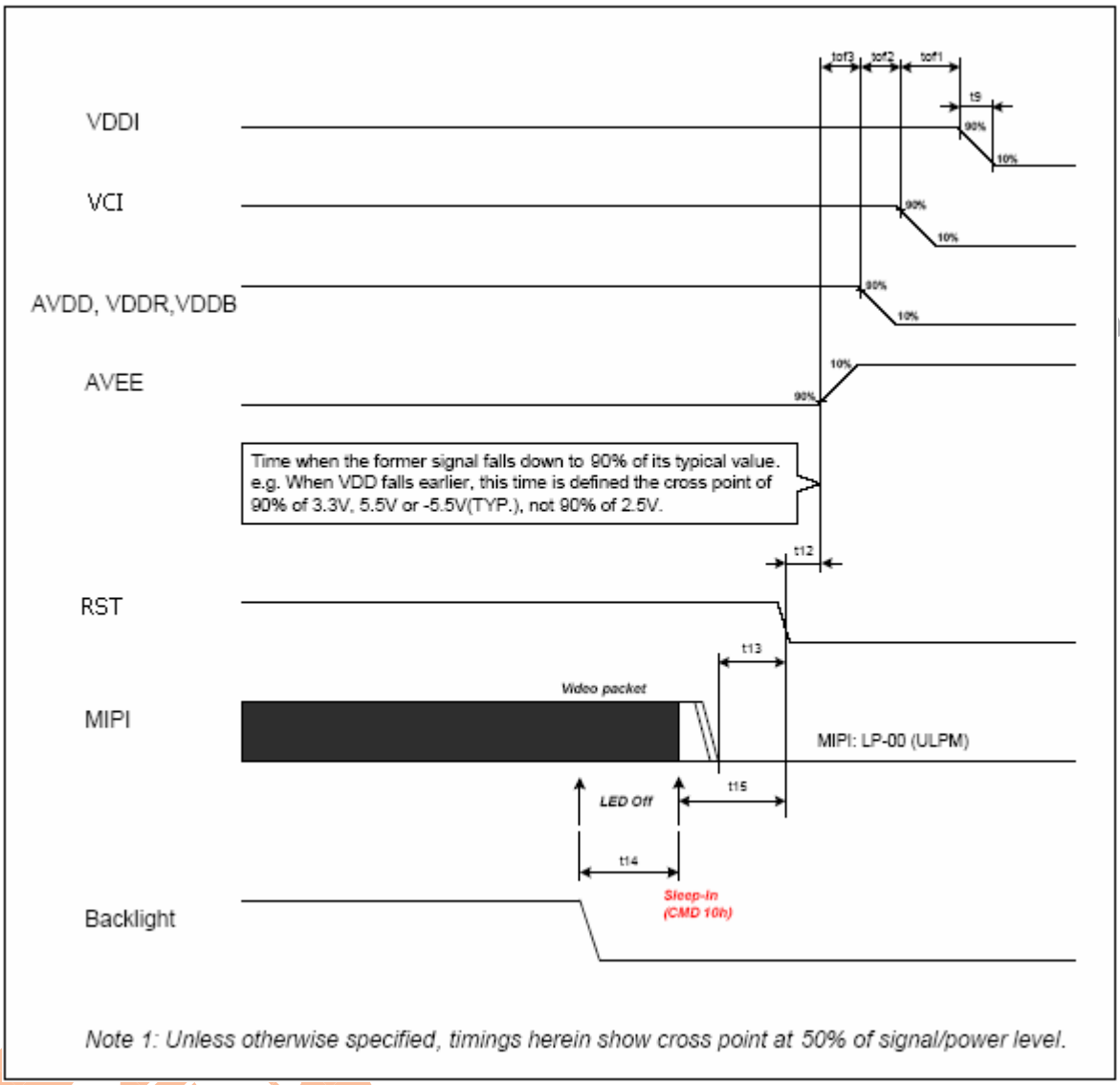
Note 2: This power-on sequence is based on adding schottky diode on VGLX pin to ground. (use NT50198)

Note 3: Reset signal H to L to H (#1) is better than only L to H (#2).

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
ton1	0	-	-	ms	
ton2	0	-	-	ms	
ton3	0	-	-	ms	
ton4	0	-	-	ms	
t2	-	No limit	-	μs	
t4	40	-	-	ms	
t5	20	-	-	ms	
t6	0	-	t4	ms	
t7	10	-	-	μs	
t8	8	-	-	VS	Keep data more than 8 frames (VS)

Note: 1 frame=16.67ms

Product Specification



Note 1: Unless otherwise specified, timings herein show cross point at 50% of signal/power level.

Symbol	Value			Unit	Remark
	Min.	Typ.	Max.		
t9	150	-	-	μs	
tof1	0	-	-	ms	
tof2	0	-	-	ms	
tof3	0	-	-	ms	
tof4	0	-	-	ms	
t12	0	-	-	ms	
t13	0	-	-	ms	
t14	0	-	-	ms	
t15	100	-	-	ms	

3-11. Power Consumption

	Parameter	Symbol	Typ	Unit	Remarks
CABC off	Logic Power	L0	185	mW	
		L32	190	mW	
		L64	190	mW	
		L96	195	mW	
		L127	195	mW	
		L160	195	mW	
		L192	195	mW	
		L224	195	mW	
		L256	195	mW	
		R255	340	mW	
		G255	340	mW	
		B255	340	mW	
		8 color bar	280	mW	
		0-255 Gray Transition	195	mW	
		Lenovo UI	NA	mW	Lenovo will send pic.
		Icon Interface	NA	mW	
	BLU	25% on	245	mW	
		50% on	505	mW	
		75% on	790	mW	
		100% on	1080	mW	

4. OPTICAL CHARACTERISTICS

4-1. Optical Characteristics – Backlight 100%

Parameter	Symbol	Condition	Min	Typ	Max	Unit	Remarks
Viewing Angle	Θ12	CR >10		85	-	°	Note 1
	Θ6			85	-	°	Note 1
	Θ9			85	-	°	Note 1
	Θ3			85	-	°	Note 1
	Θ1	CR>10		50	-	°	Note 1
	Θ4			50	-	°	Note 1
	Θ7			50	-	°	Note 1
	Θ11			50	-	°	Note 1
Contrast Ratio	CR	Optimal	(800)	(1000)	-	-	Note 1,4
Brightness	Lv	Optimal	380	450	-	Cd/m^2	Note 1
Brightness Uniformity (13P)	Y	Optimal	67	-	-	%	Note 1,7
Flicker					-28	dB	Note 1,2
Crosstalk					2	%	Note 1,3
Response time	τ_f or τ_r	Θ =0 ° Ta =25 °C	-	25	50	ms	Note 1,6
Color Gamut	NTSC	-		60	-	%	Note 1
White Chromaticity	x	CIE 1931	0.283	0.313	0.343	-	Note 1
	y		0.299	0.329	0.359	-	Note 1
Red Chromaticity	x	CIE 1931	0.579	0.609	0.639	-	Note 1
	y		0.315	0.345	0.375	-	Note 1
Green Chromaticity	x	CIE 1931	0.276	0.306	0.336	-	Note 1
	y		0.588	0.618	0.648	-	Note 1
Blue Chromaticity	x	CIE 1931	0.121	0.151	0.181	-	Note 1
	y		0.068	0.098	0.128	-	Note 1

4-2. Cell&BLU Optical Characteristics

Parameter	min	Unit	Remarks
Panel Trans.	5.42	%	with APF
BLU Luminance	7020	Cd/m^2	Center
BLU Luminance	70	%	Note1,7

[Note 1] Optical Test Equipment Setup

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting backlight for 20 minutes in a windless room.

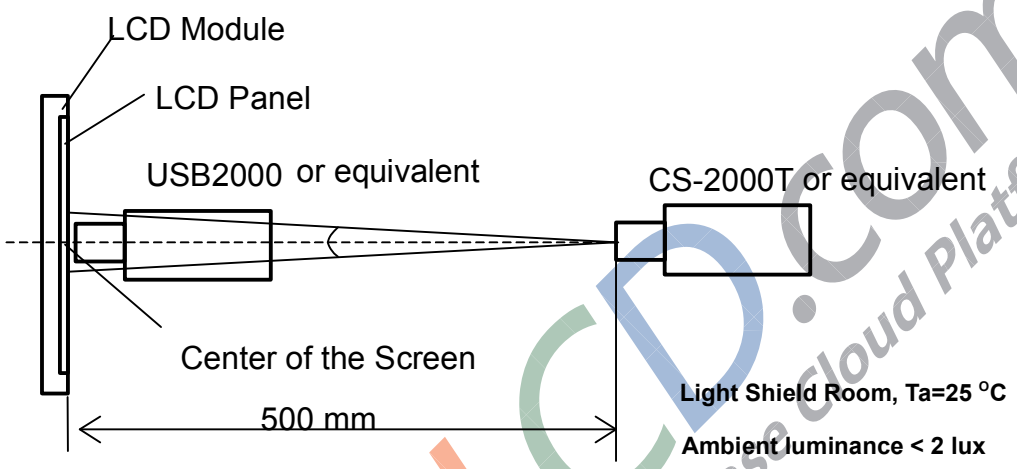
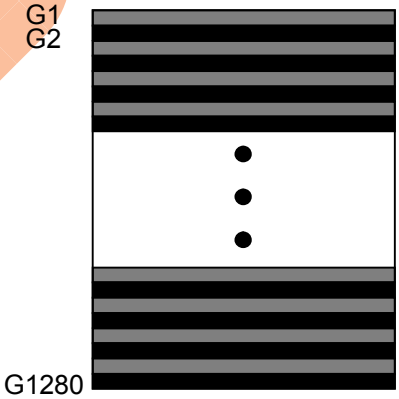


Fig 4.1. Optical Characteristic Measurement Equipment and Method

[Note 2] Flicker

The flicker level should be measured with horizontal gray/black stripes. The flicker is essentially a ratio of the powers in the frequency spectrum at 30 Hz (P_X) and 0 Hz (P_{0-} DC level).

$$F = 20 \text{ Log } (P_X / P_0)$$



[Note 3] Crosstalk

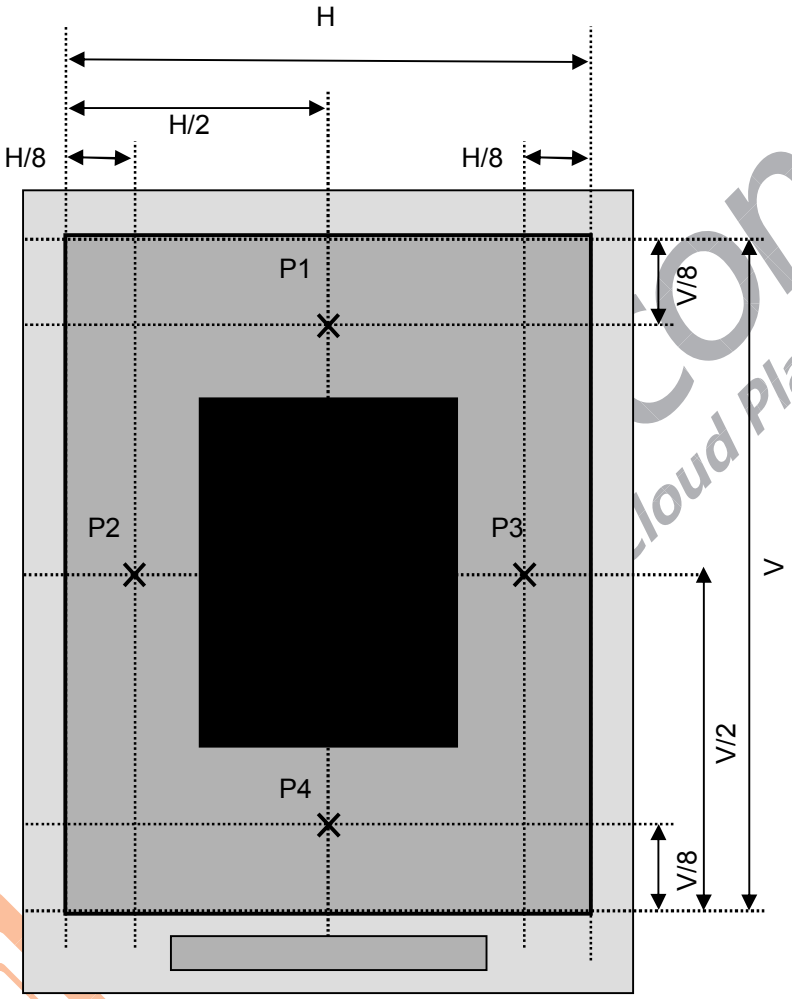


Fig 2-5. Crosstalk measurement points

A: Luminance for P1 ~ P4 with all 127gray pixels

B: Luminance for P1 ~ P4 with 127gray pixels when the black box is applied

$$\text{Crosstalk [\%]} = \text{Maximum}\left[\text{Absolute}\left(\frac{A - B}{A}\right)\right]$$

[Note 4]

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 5]

Viewing Angle Range is defined as follows;

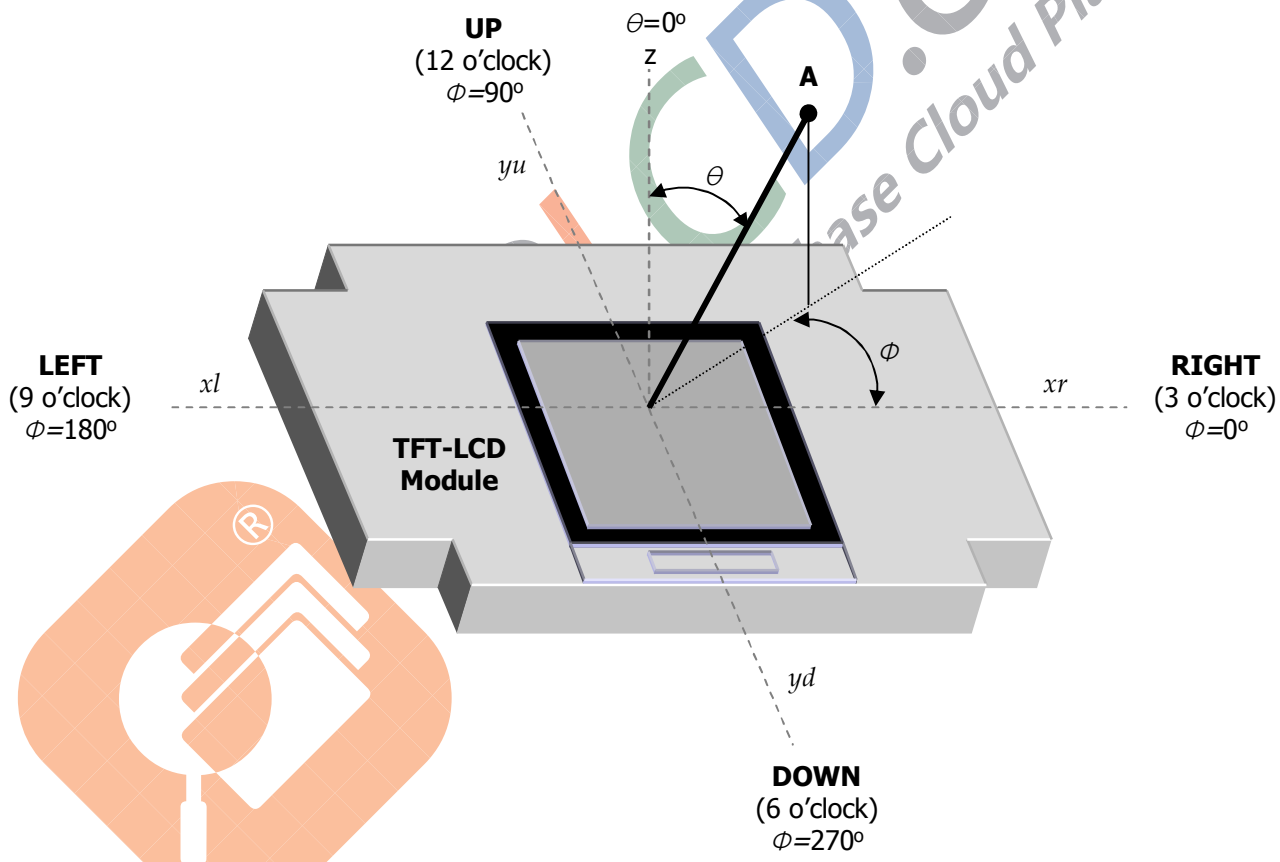


Fig 4.2 Viewing Angle Definitions

[Note 6]

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”.

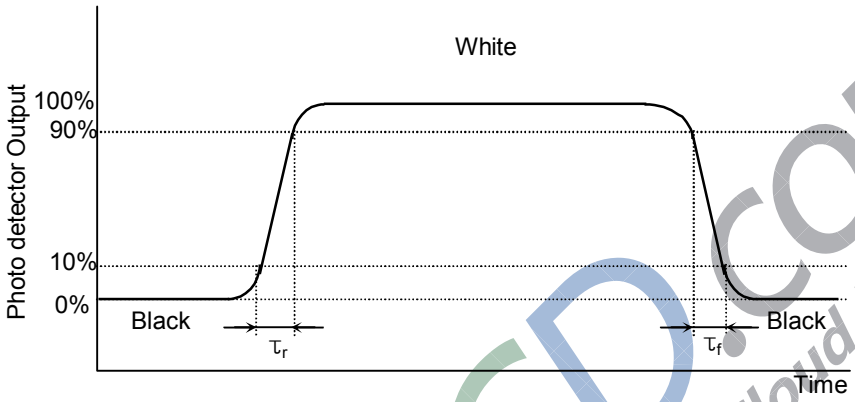


Fig 4.3 Response Time Definition

[Note 7]

The brightness measurement is taken at point 5.

$$\text{Brightness Uniformity} = \frac{\text{Minimum Photo detector output for 1-13 with all pixels white}}{\text{Maximum Photo detector output for 1-13 with all pixels white}} \times 100$$

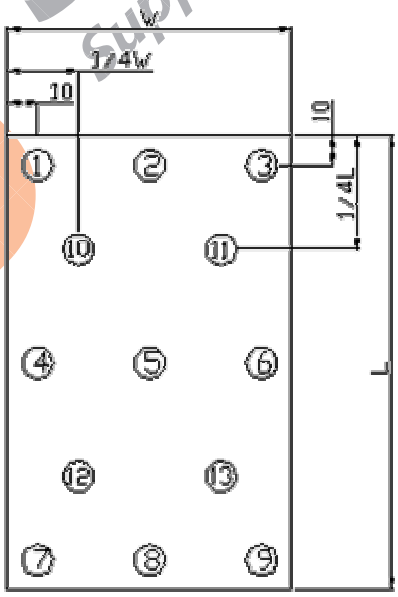


Fig 4.4 Brightness Measurement Points

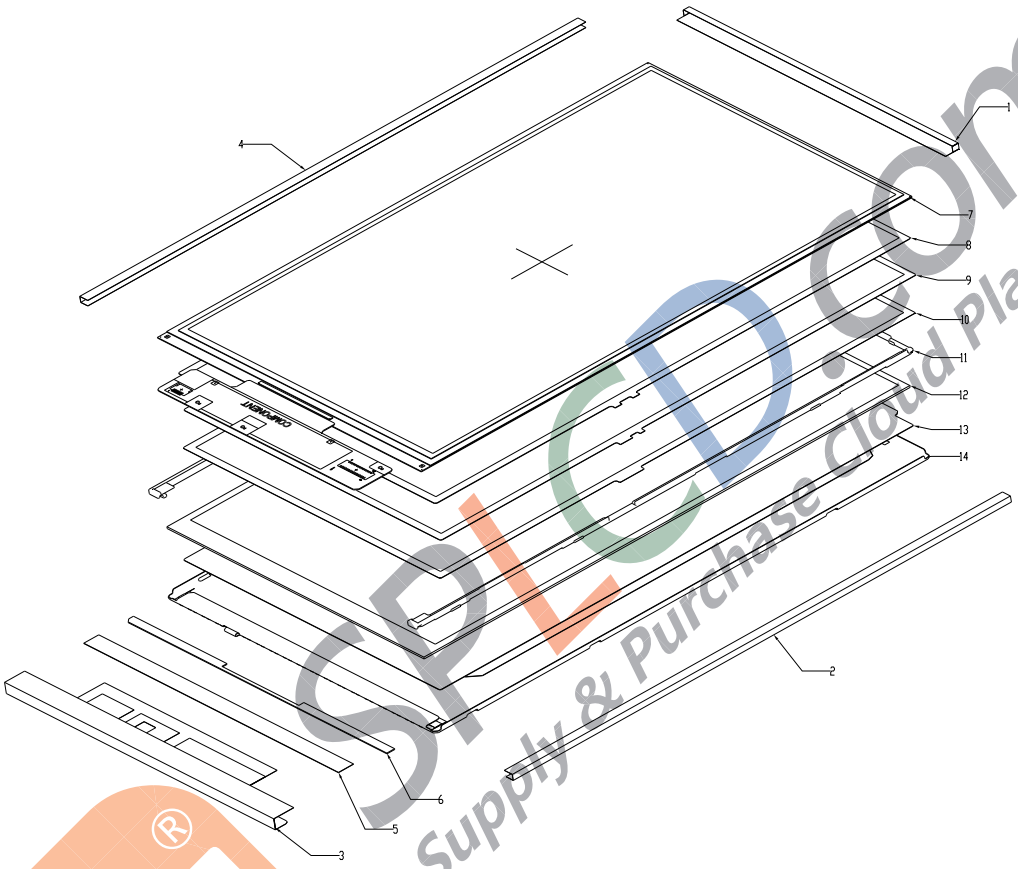
5. MECHANICAL CHRACTERISTICS

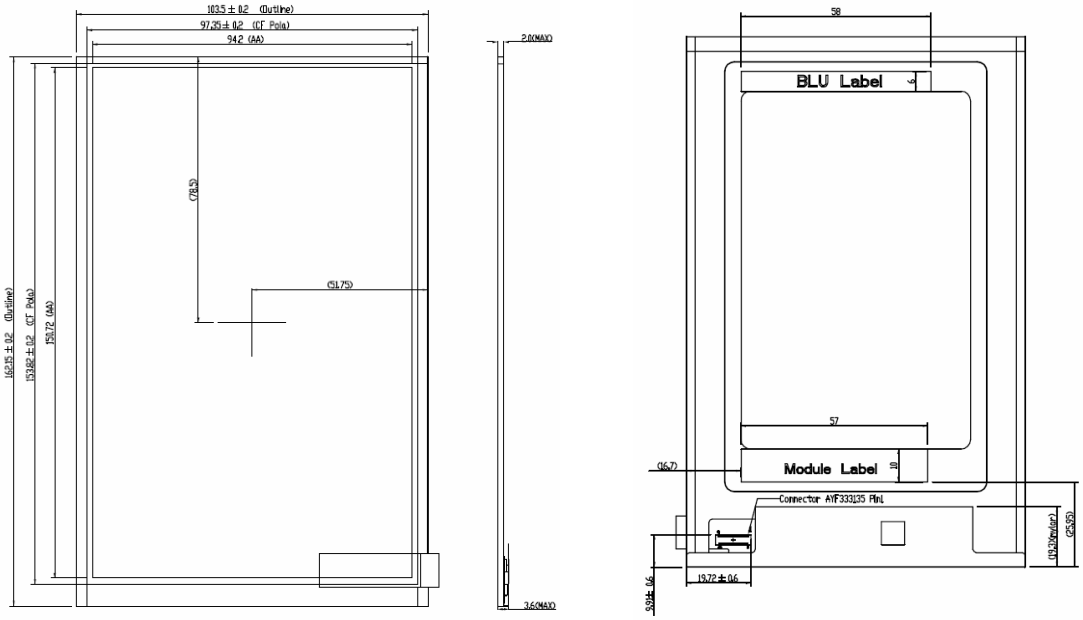
The contents provide general mechanical characteristics for the model.
In addition the figures in the next page are detailed mechanical drawing of the LCD.

Items	Dimension	Typ.	Tolerance	Unit
Mother Glass	Size	1100*1300	-	mm
Q-Panel	Size	-	-	mm
C/F and TFT thickness after slimming		0.2t/0.2t		mm
Panel	A/A	94.2 x 150.72		mm
	C/F	101.5 x 156.6		mm
	TFT	101.5 x 159.65		mm
	BM(U/D/L/R)	1.88 / 3.67 / 3.50 / 3.50		mm
	IC Bonding Area	27.59 x 1.07		mm
	Pol Size	97.35 x 153.82 100.9 x 153.45	-	mm
	Gap Between CF Pol~ TFT Glass(U/D/L/R)	0.78/5.05/2.075/ 2.075	-	mm
Module	Horizontal	103.5	±0.2	mm
	Vertical	162.15	±0.2	mm
	Thickness	1.85 (w/o FPCA) 3.4 (w/ FPCA)	±0.15 (w/o FPCA) ±0.2 (w/ FPCA)	mm

5.1 LCM & BLU Drawing

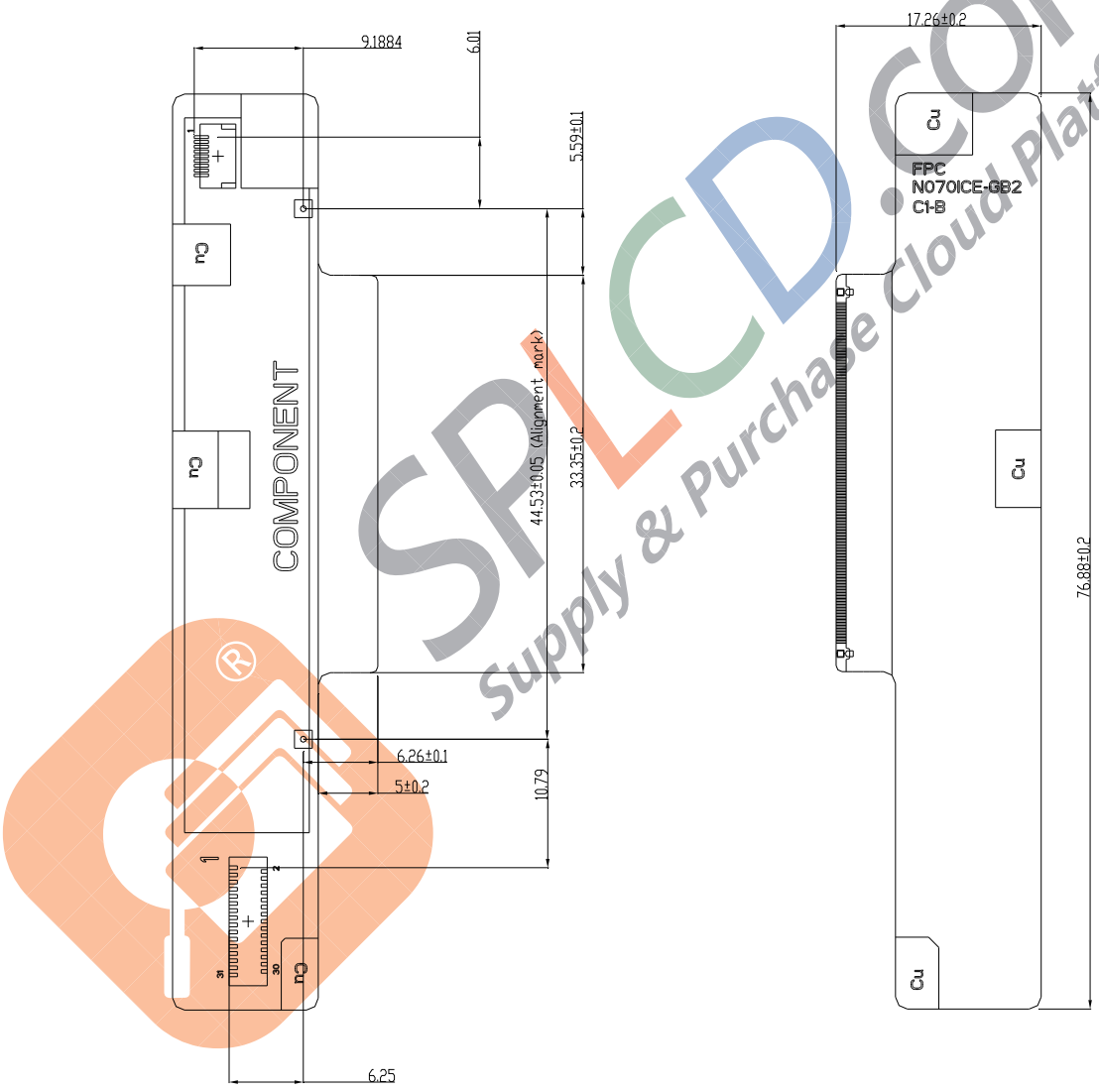
Folded and unfolded status





5.2 Panel Outline Dimension

5.3 FPCA Outline Dimension



6. RELIABLITY TEST

Must be accordance with Lenovo RA test items
Following is Innolux internal control RA test=>Still have to discuss with INX Q& FAE

Test Item	Test Condition	Note
High Temperature Storage Test	70ºC, 240 hours	(1) (2)
Low Temperature Storage Test	-20ºC, 240 hours	
Thermal Shock Storage Test	-20ºC, 0.5hour←→60℃, 0.5hour; 100cycles, 1hour/cycle	
High Temperature Operation Test	60ºC, 240 hours	
Low Temperature Operation Test	-10ºC, 240 hours	
High Temperature & High Humidity Operation Test	60ºC, RH 90%, 240hours	
ESD Test (Operation)	150pF, 330Ω, 1sec/cycle Condition 1 : Contact Discharge, ±4KV Condition 2 : Air Discharge, ±8KV	(1)
Shock (Non-Operating)	220G, 2ms, half sine wave,1 time for each direction of ±X,±Y,±Z	(1)(3)
Vibration (Non-Operating)	1.5G / 10-500 Hz, Sine wave, 30 min/cycle, 1cycle for each X, Y, Z	(1)(3)

Note (1) criteria : Normal display image with no obvious non-uniformity and no line defect.
Note (2) Evaluation should be tested after storage at room temperature for more than two hour
Note (3) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

8. Package

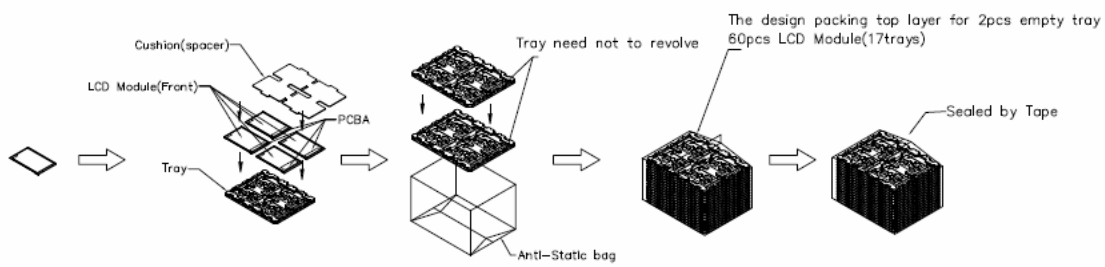
8.1. Packing Description

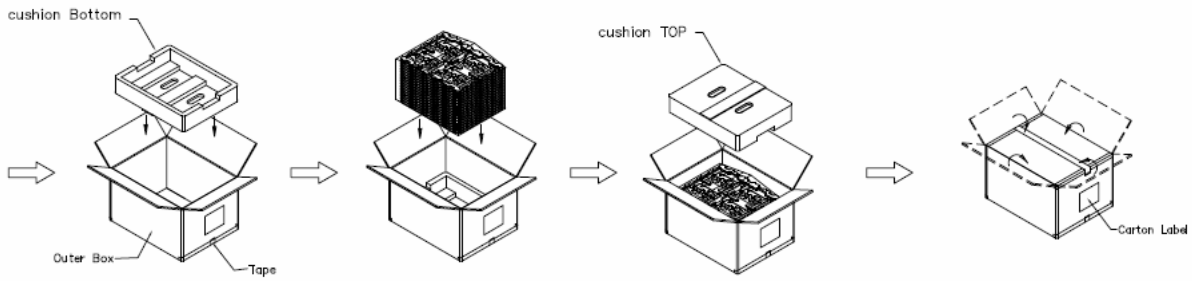
1. The stacked tray per a box : 17pcs tray

   → Full (LCD Included) tray 15pcs + Empty tray 2pcs (LCM Ass'y –60 pcs/1 box)

2. Stacking Method of Trays : same direction stack

3. Box Dimension : 435mm(L)*350mm(W)*275mm(H)



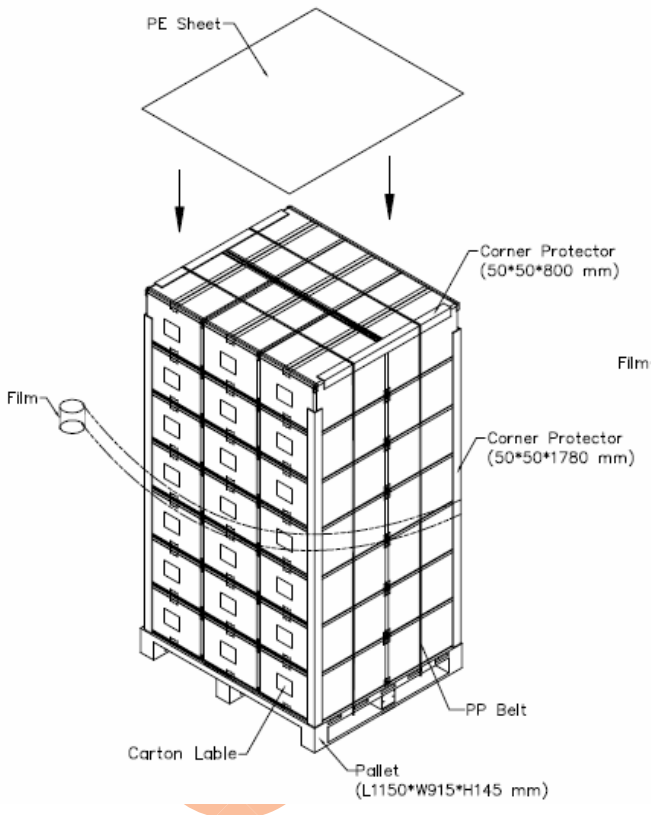


NO.	Description	Material
1	LCM	NA
2	Packing Tray	PET
3	Bag	PE
4	Carton Box	Paper
5	Tape	NA
6	Label	ART Paper

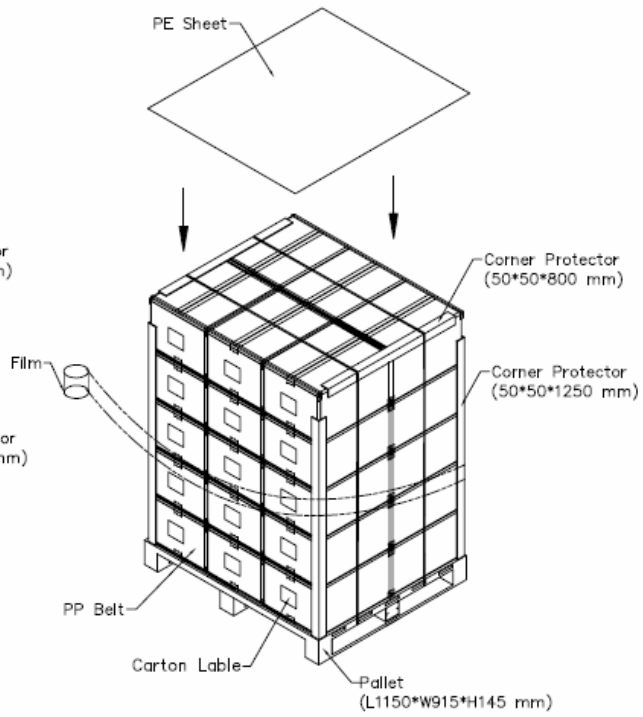
8.2. Description of Packing Box

1. Pallet Dimension : 1150mm(L)*915mm(W)*145mm(H)
2. Stacking Description : 42 Boxes / pallet
3. Stacking Method : 6 boxes / layer ; 7 layers / pallet
4. Packing Box Dimension [Sea & Land] : 1150mm(L)*915mm(W)*2070mm(H)
5. Packing Box Dimension [Air] : 1150mm(L)*915mm(W)*1520mm(H)

Sea & Land Transportation



Air Transportation



10. Checklist

	Description	Request	Value
Connection	MIPI Impedance	100±10Ω	
	B2B CNT	FR4, 0.3mm	
	Pin definition	LED+/- isn't next to TE/VCC/IOVCC	
	ID Pin	1st source: GND 2nd source: 1.8V(different cell) 2nd source: GND(same cell+IC)	
IC	Protection	Shielding tape on IC	
FPC	Bending Area	Not exceed M/F	
	FPC layer	Single layer FPC where add adhesive tape	
	FPC status	Unfolded while direct bonding	
	GND Area	Need GND area to connect SUS	
	Test Points	Need shieling tape on it	
	Bending Area	Single layer	
	Via Hole	2 holes on ending area, Φ>1.7mm	
SUS	4 Corner side	At lease 1.2mm	
Protective Film	Size	Length: 10mm+10mm; Width: 8mm	
Panel	Glass Generation	G5?G6?	
	Cutting Q'ty	Q-panel and panel Q'ty	
	Display mode	VA/IPS	
	Mask Q'ty	Array mask	
	Pixel Domain	1 or 2?	
	ITO@C/F	ITO square resistance, thickness	
	Scan direction	Single scan or dual scan	
	PS Parameter	Main/Sub PS density and size	
	Cell gap	Center point	
	LC injection	Vacuum injection or ODF	
	LC Margin	>6%	
	Pol compensation	A+C/B+B/None compensation film	
	UV Glue	Fill out at IC around	
	Pol surf. Treatment	Direct bonding: HC+Glare Air bonding: Haze44+glare(>4inch)	
	Pol position	Direct bonding: pol is higher 0.05mm than M/F Air bonding: pol is lower 0.05mm than M/F	
Package	Surface resistance	10^4~10^9Ω	
	Friction voltage	≦100V	
	Layer in one Box	<10layer	