TFT LCD Approval Specification

CMO MODEL NO.: N150P5 - L04
Toshiba Part NO: G33C0003S110

Customer : Toshiba
Approval by

Approval by

記錄	工作	審核	角色	投票
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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 3.0	Aug. 21. '06	All	All	Approval specification was first issued.

1. GENERAL DESCRIPTION

1.1 OVERVIEW

N150P5 is a 15.0" TFT Liquid Crystal Display module with single CCFL Backlight unit and 30 pins LVDS interface. This module supports 1400x 1050 SXGA+ mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The inverter module for Backlight is not built in.

1.2 FEATURES

- Thin and light weight
- SXGA+ (1400 x 1050 pixels) resolution
- DE (Data Enable) only mode
- 2 channel 3.3V LVDS (Low Voltage Differential Signaling) interface
- RoHS compliance

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	304.5 (H) x 228.375 (V) (15" diagonal)	mm	(1)
Bezel Opening Area	308.1 (H) x 232 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1400 x R.G.B. x 1050	pixel	-
Pixel Pitch	0.2175 (H) x 0.2175 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hardness (3H), Anti-glare (Haze 25) Reflection (less than 4%)	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	316.8	317.3	317.8	mm	(1)
	Vertical(V)	241.5	242.0	242.5	mm	
	Depth(D)	-	5.7	6.0	mm	
Weight		-	530	550	g	-

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

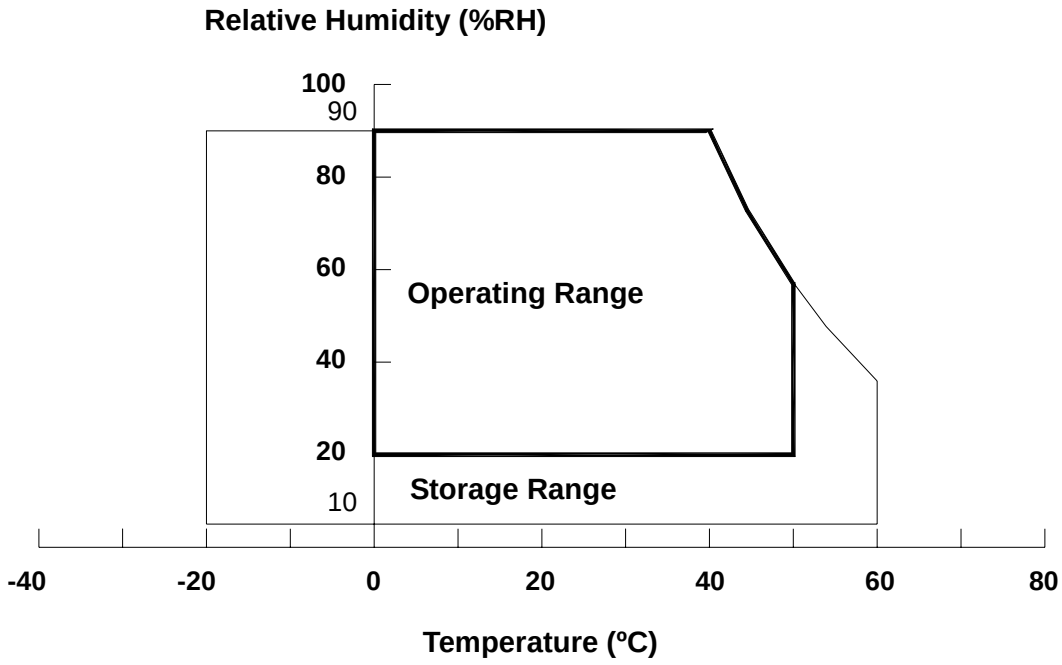
Item	Symbol	Min.	Max.	Unit	Note
Operating Ambient Temperature	T_{OP}	0	+50	°C	-
Operating Temperature for Panel	-	0	+60	°C	(2)
Storage Temperature	T_{STG}	-20	+60	°C	-
Operating Ambient Humidity	H_{OP}	20	90	%RH	(1)
Storage Humidity	H_{STG}	10	90	%RH	(1)
Air Pressure	-	70.0	-	kPa	Operation
Air Pressure	-	12.0	-	kPa	Non-Operation
Altitude	-	-	4572	m	Operation
Altitude	-	-	15240	m	Non-Operation

Note (1) (a) 90 %RH Max. (Ta $\leqq$ 40 ºC).

(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

(c) No condensation.

Note (2) the temperature of panel display surface area should be 0 ºC Min. and 60 ºC Max.



2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	Vcc	-0.3	+4.0	V	(1)
Logic Input Voltage	V_{IN}	-0.3	Vcc+0.3	V	

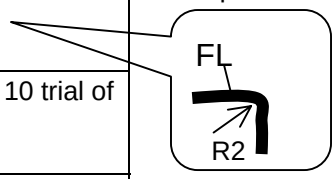
2.2.2 BACKLIGHT UNIT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Lamp Voltage	V_L	-	2.5K	V_{RMS}	(1), (2), I_L = (6.0) mA
Lamp Current	I_L	2.0	7.0	mA_{RMS}	(1), (2)
Lamp Frequency	F_L	45	80	KHz	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to Section 3.2 for further information).

2.3 MECHANICAL RATINGS

Item	Test Conditions		Note
Mechanical Vibration	Frequency Range 10~200Hz, 14.7m/s^2 (1.5G) constant, 0.5Hrs each axis (X, Y, Z direction)		Non Operation
	Frequency Range10~200Hz, 4.9m/s^2 (0.5G) constant, 0.5Hrs each axis (X, Y, Z direction)		Operation
Mechanical Shock	2548m/s^2 (260G), Pulse width 2ms, Half-Sine Wave, ±X, ±Y, ±Z direction, each 1 time		Operation & Non Operation
	686m/s^2 (70G), Pulse width 11 ms, Half-Sine Wave, ±X, ±Y, ±Z direction, each 3 times.		Non Operation
Pressure Resistance	No Destruction with the force 196 N (20 kgf, 16 mm in diameter) to the display surface at the vertical direction		Non Operation (1) Fig 2-3-1 (2) Fig 2-3-2 (3) Fig 2-3-3
	No Destruction with the force 294.2 N (30 kgf, 30 mm in diameter) to the back of the display surface at the vertical direction		
Strength of FL Cable	Strength of rotation force	Cable: No disconnection of cable to the 5 trial of 360° rotation. See a bent state of cable.	Non Operation 
		Connector: No disconnection of cable to 10 trial of 180° rotation. See a bent state of cable.	
	Lead pull test	Soldering portion: 14.7N (1.5kgf), 1min	
		Connector: 14.7N (1.5kgf), 1 sec	
Connector tension test	Input connector: With 50 times of connector trial there must be no damage to the shape and functional.		Non Operation
	Back light connector: With 50 times of connector trial there must be no damage to the shape and functional.		
Assured torque value at side-mount part	245 mN·m (2.5 kgf·cm)		Non Operation
Re-screwed test	10 times under 245.0 mN·m (2.5 kgf·cm)		Non Operation
Tapping test	Test " Ripple " Phenomenon.		Operation

General definitions of failure for judgment shall be as follows:

(1) Function of the module should be maintained.

(2) Current consumption should be smaller than the specified value.

(3) Appearance and display quality should not have distinguished degradation.

(4) Luminance should be larger than the minimum value specified in optical specification.

Note (1) The compression condition of front side

(a) Compression point: 12 points (refer to Fig 2-2-1)

(b) Compression condition: Time 3 sec, Tool diameter: 16 mm in diameter (refer to Fig 2-2-3)

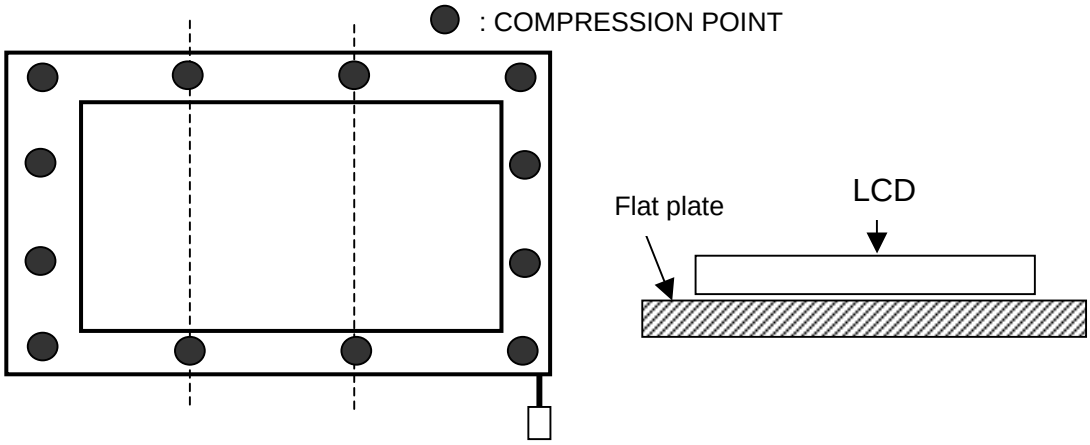


Fig 2-3-1

Note (2) The compression condition of rear side

(a) Compression point : 21 points (refer to Fig 2-3-2)

(b) Compression condition : Time 3 sec, Tool redius: 30 mm in diameter (refer to Fig 2-2-3)

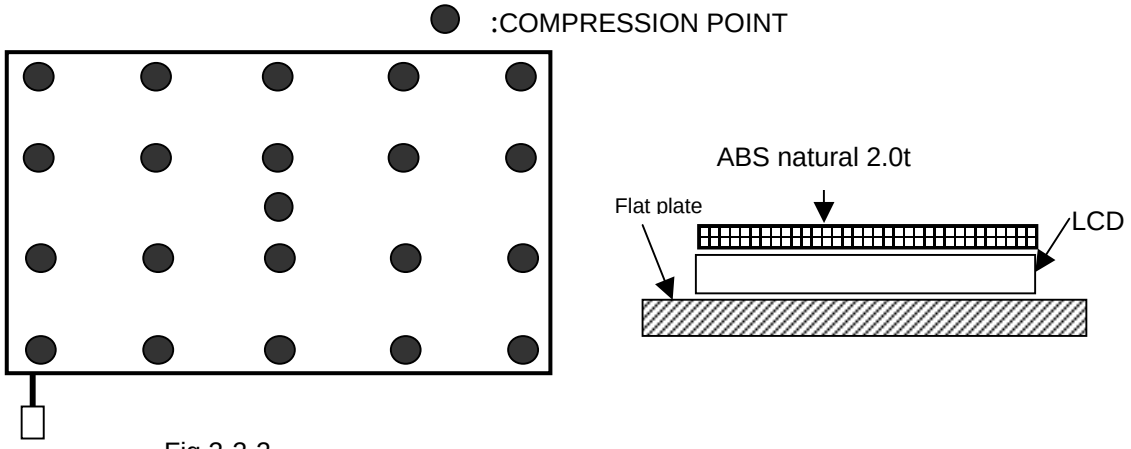


Fig 2-2-2

Note (3) Dimension of the compression jig

(a) Compression jig for front side A = 16 mm in diameter

B = 16 mm in diameter

(b) Compression jig for rear side A = 30 mm in diameter

B = 28 mm in diameter

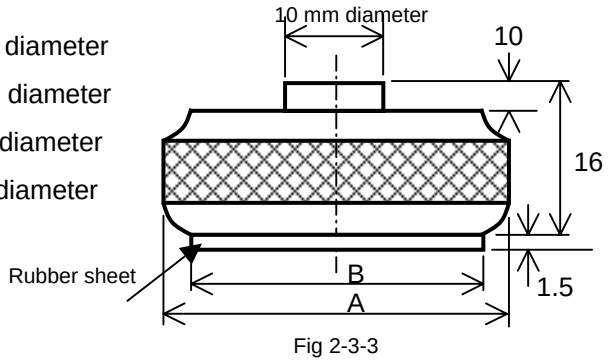


Fig 2-3-3

2.4 OTHER RATING

2.4.1 STATIC ELECTRICITY PRESSURE RESISTANCE

Items	Testing conditions	Operation	Non Operation
Contact discharge	150pF, 330 ohm	±10 kV	±10 kV
Air discharge	150pF, 330 ohm	±20 kV	±20 kV

ESD Acceptance Definition:

Temporary performance degradation. Recovery by operator is acceptable. No hardware failure.

2.4.2 SOUND NOISE

There should be no uncomfortable noise.

Being used under whatever surrounds, when power on/off, the panel should not generate uncomfortable noise.

2.4.3 OPEN/SHORT

No smoke, no firery at any open/ short test

2.4.4 MTBF: 50000 Hours (except for backlight lamp)

3. ELECTRICAL CHARACTERISTICS

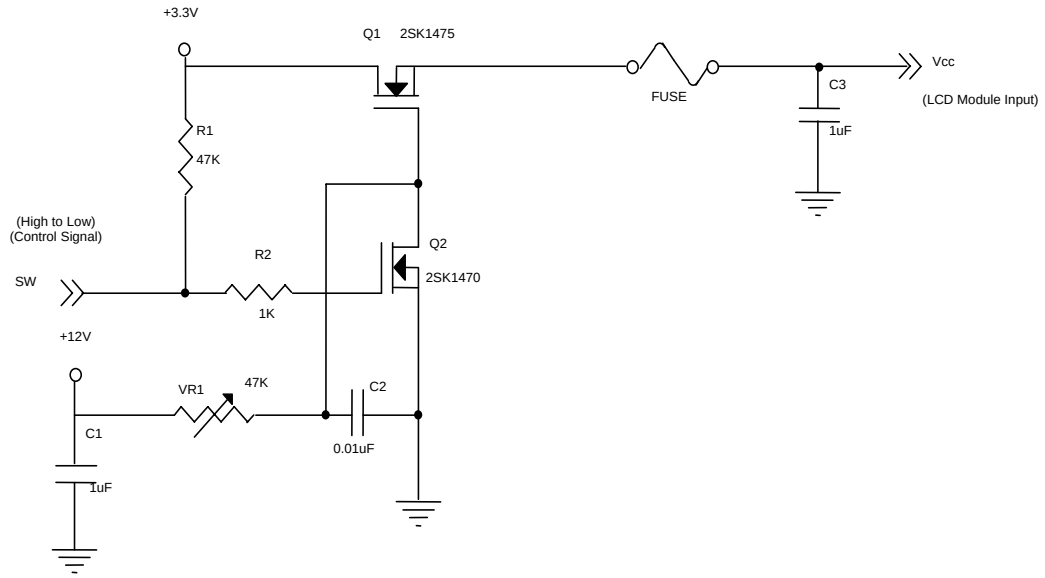
3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

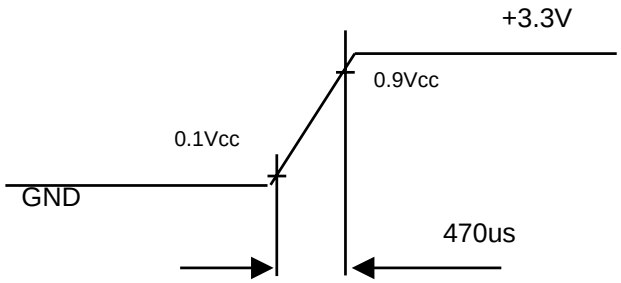
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-	50	-	mV	-
Rush Current		I_{RUSH}	-	-	1.5	A	(2)
Power Supply Current	White	Icc	-	400	450	mA	(3)a
	Black		-	530	580		(3)b
	2V1H		-	430	480		(3)c
Differential Input Voltage for LVDS Receiver Threshold	"H" Level	V_{IH}	-	-	+100	mV	-
	"L" Level	V_{IL}	-100	-	-	mV	-
Terminating Resistor		R_T	-	100	-	Ohm	-
Power per EBL WG		P_{EBL}	-	3.42	-	W	(4)

Note (1) The module should be always operated within above ranges.

Note (2) Measurement Conditions:

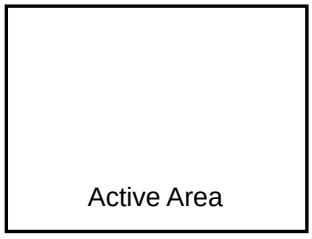


Vcc rising time is 470us



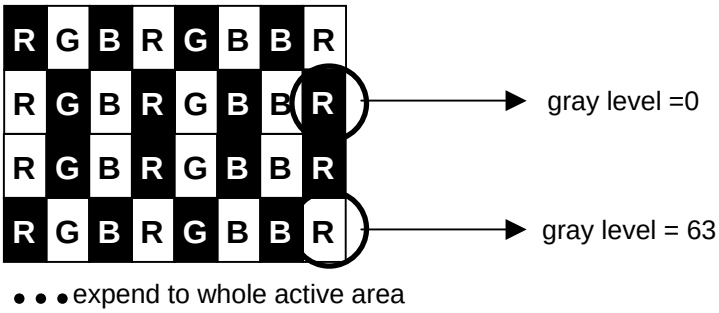
Note (3) The specified power supply current is under the conditions at Vcc = 3.3 V, Ta = 25 ± 2 ºC, DC Current and f_v = 60 Hz, whereas a power dissipation check pattern below is displayed.

a. White Pattern



b. Black Pattern

c. Maximum pattern (Zoom in)



Note (4) The specified power are the sum of LCD panel electronics input power and the inverter input power. Test conditions are as follows.

(a) Vcc = 3.3 V, Ta = 25 ± 2 ºC, f_v = 60 Hz,

(b) The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.

(c) Luminace: 60 nits.

(d) The inverter used is provided from Sumida. Please contact Sumida for detail information. CMO doesn't provide the inverter in this product.

3.2 MATERIAL LIST CONCERNING EMI REGULATIONS

(1) EMI Regulations: "N150P5-L04" which is assembled inside Toshiba's Satellite model should be met to the regulations as below:

CISPR: Pub.22 Class B

FCC: Part 15 Class B

VCCI: Class B

(2) Safety regulation (CMO TFT-LCD module only): UL 1950

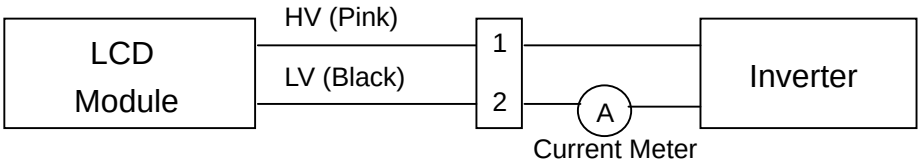
1. EMI Filter	**Silk**	**Product Code**	**Rating**	**Maker**
Bead	L2	MCB1608S601EA	0603,+-25%,600ohm,0.2 A	INPAQ
2. DC/DC Converter	**Silk**	**Product Code**	**Rating(OSC. Freq.)**	**Maker**
PWM IC	U41	AT1780M_GRE	Typ 1.2 MHz	AIMTRON

3.3 BACKLIGHT UNIT

LAMP:Sanken,SS18C3075N6380C2862680S,1.8φ Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L	641	675	709	V_{RMS}	I_L = 6.0 mA
Lamp Current	I_L	2.0	6.0	7.0	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	-	-	1150 (25 °C)	V_{RMS}	(2)
		-	-	1385 (0 °C)	V_{RMS}	(2)
Operating Frequency	F_L	45	65	80	KHz	(3)
Power Consumption	P_L	-	4.05	-	W	(4), I_L = 6.0 mA
Lamp Life Time	L_{BL}	15,000	-	-	Hrs	(5)

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:



Note (2) The voltage that must be larger than Vs should be applied to the lamp for more than 1 second after startup. Otherwise the lamp may not be turned on.

Note (3) The lamp frequency may generate interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (4) $P_L = I_L \times V_L$

Note (5) The lifetime of lamp is defined as the time when it continues to operate under the conditions at Ta = 25 ±2 °C and I_L = 6.0 mA_{RMS} until one of the following events occurs:

(a) When the brightness becomes ≦ 50% of its original value.

(b) When the effective ignition length becomes ≦ 80% of its original value. (Effective ignition

length is defined as an area that the brightness is less than 70% compared to the center point.)

Note (6) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid generating too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

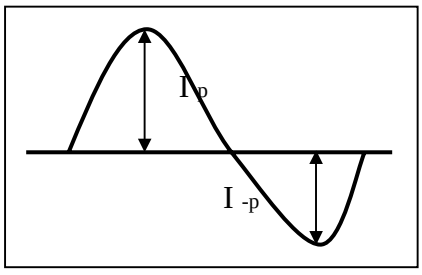
The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform.(Unsymmetrical ratio is less than 10%) Please do not use the inverter which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

a. The asymmetry rate of the inverter waveform should be 10% below.

b. The distortion rate of the waveform should be within $\sqrt{2} \pm 10\%$.

c. The ideal sine wave form shall be symmetric in positive and negative polarities.



* Asymmetry rate:

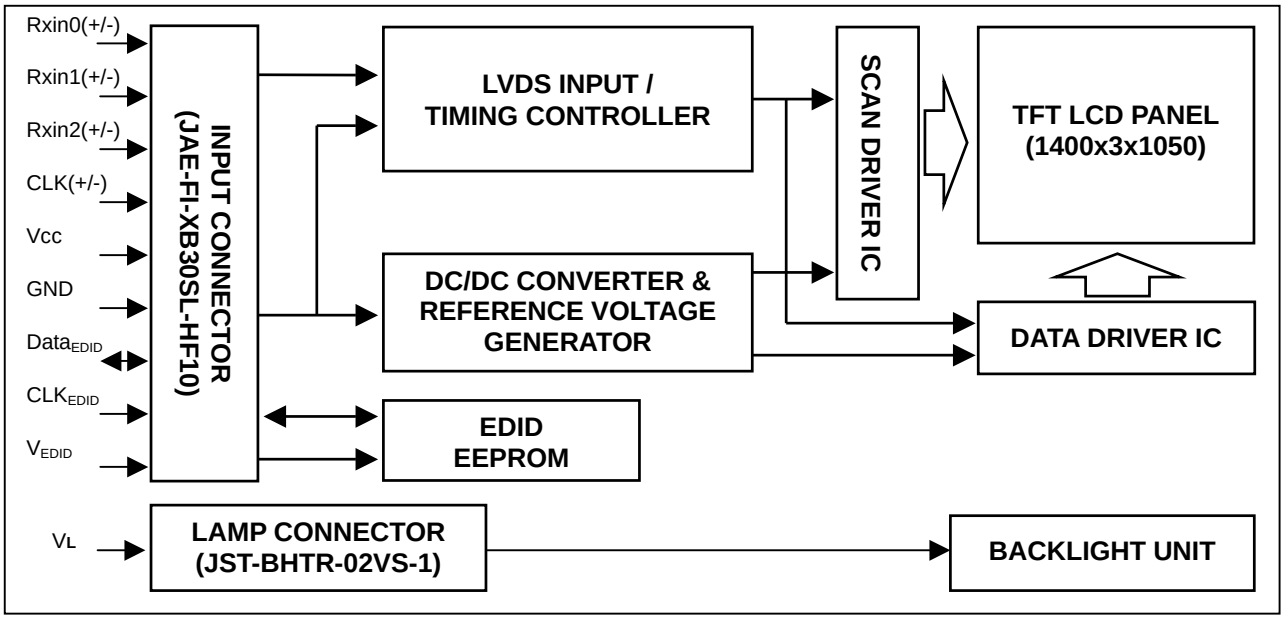
$| I_p - I_{-p} | / I_{rms} * 100\%$

* Distortion rate

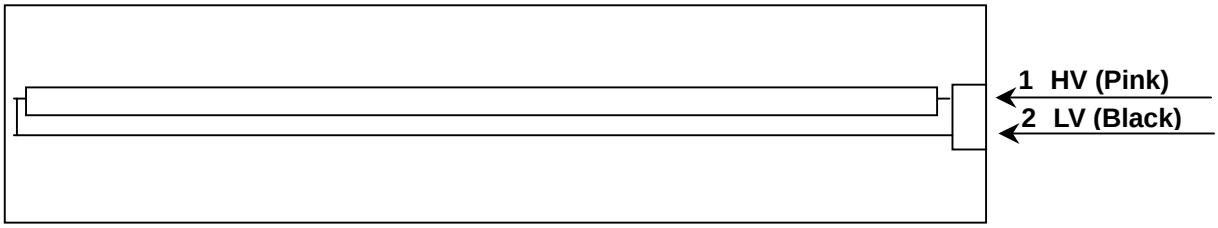
I_p (or I_{-p}) / I_{rms}

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



4.2 BACKLIGHT UNIT



5. INPUT TERMINAL PIN ASSIGNMENT

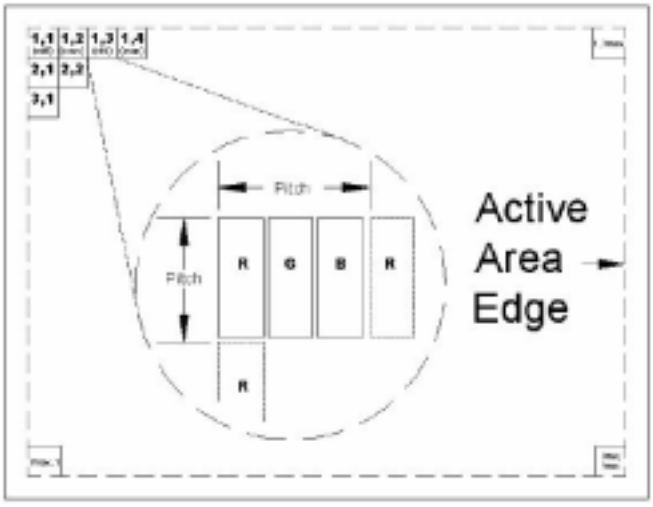
5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	Vss	Ground		-
2	Vcc	Power Supply +3.3 V		-
3	Vcc	Power Supply +3.3 V		-
4	V_{EDID}	DDC +3.3V		-
5	NC	Non-Connection		-
6	CLK_{EDID}	DDC Clock		-
7	$DATA_{EDID}$	DDC Data		-
8	RXO0-	LVDS Differential Data Input (Odd)	Negative	R0~R5,G0
9	RXO0+	LVDS Differential Data Input (Odd)	Positive	
10	Vss	Ground		-
11	RXO1-	LVDS Differential Data Input (Odd)	Negative	G1~G5,B0,B1
12	RXO1+	LVDS Differential Data Input (Odd)	Positive	
13	Vss	Ground		-
14	RXO2-	LVDS Differential Data Input (Odd)	Negative	B2~B5,DE,Hsync,Vsync
15	RXO2+	LVDS Differential Data Input (Odd)	Positive	
16	Vss	Ground		-
17	RXOC-	LVDS Clock Data Input (Odd)	Negative	LVDS Level
18	RXOC+	LVDS Clock Data Input (Odd)	Positive	
19	Vss	Ground		-
20	RxE0-	LVDS Differential Data Input (Even)	Negative	R0~R5,G0
21	RxE0+	LVDS Differential Data Input (Even)	Positive	
22	Vss	Ground		-
23	RxE1-	LVDS Differential Data Input (Even)	Negative	G1~G5,B0,B1
24	RxE1+	LVDS Differential Data Input (Even)	Positive	
25	Vss	Ground		-
26	RxE2-	LVDS Differential Data Input (Even)	Negative	B2~B5,DE,Hsync,Vsync
27	RxE2+	LVDS Differential Data Input (Even)	Positive	
28	Vss	Ground		-
29	RXEC-	LVDS Clock Data Input (Even)	Negative	LVDS Level
30	RXEC+	LVDS Clock Data Input (Even)	Positive	

Note (1) Connector Part No.: JAE-FI-XB30SRL-HF11

Note (2) User's connector Part No: JAE-FI-X30C2L

Note (3) The first pixel is odd as shown in the following figure.



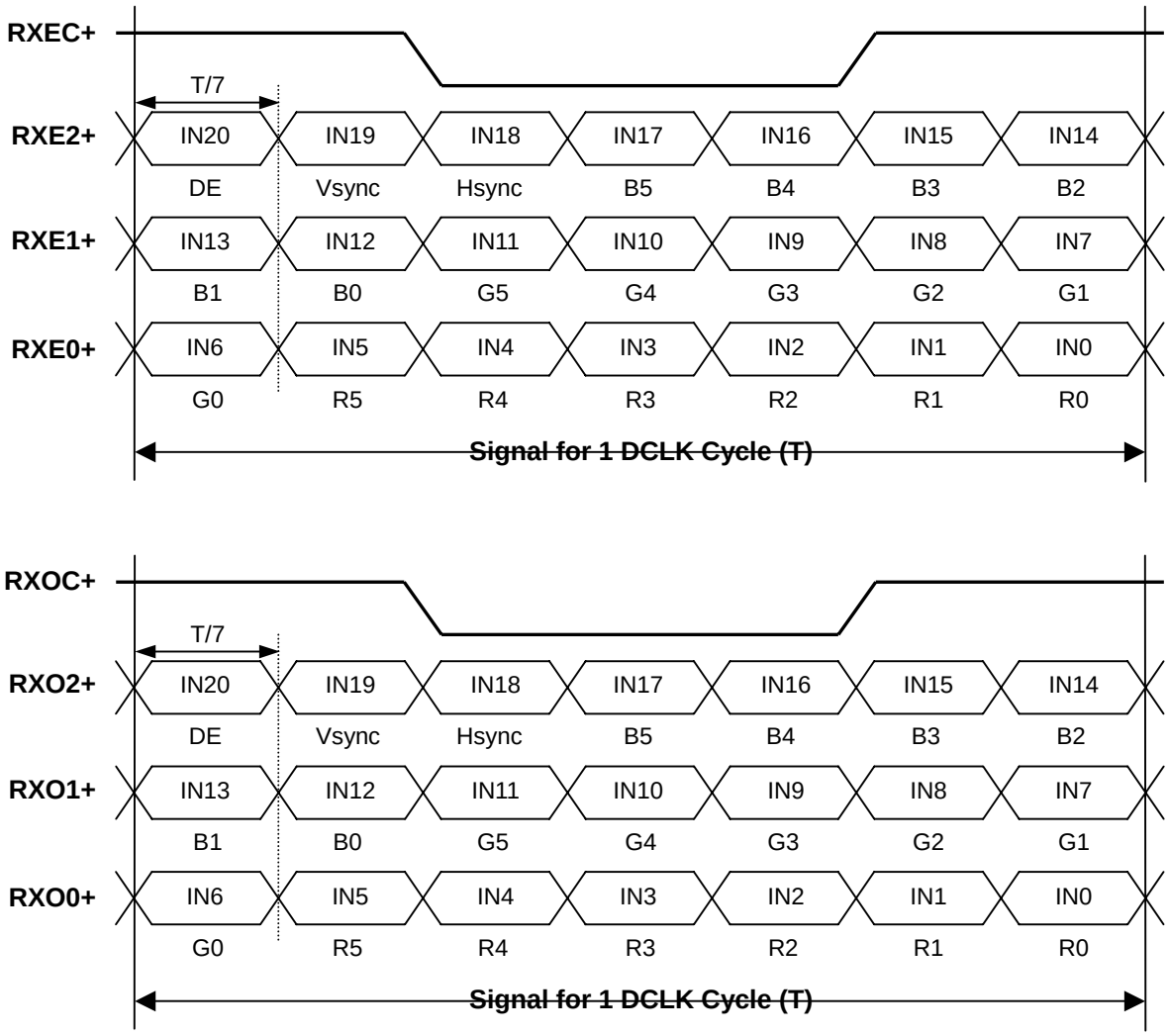
5.2 BACKLIGHT UNIT

Pin	Symbol	Description	Color
1	HV	High Voltage	Pink
2	LV	Ground	Black

Note (1) Connector Part No.: JST-BHTR-02VS-1 or equivalent

Note (2) User's connector Part No.: JST-SM02B-BHTS-B-TB or equivalent

5.3 TIMING DIAGRAM OF LVDS INPUT SIGNAL



5.4 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
Basic	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
Colors	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Gray	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Scale	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Of	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Red	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Gray	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Scale	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Of	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Green	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
	Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Gray	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Scale	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Of	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Blue	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
	Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1

Note (1) 0: Low Level Voltage, 1: High Level Voltage

5.5 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPDI standards.

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	0	Header	00	00000000
1	1	Header	FF	11111111
2	2	Header	FF	11111111
3	3	Header	FF	11111111
4	4	Header	FF	11111111
5	5	Header	FF	11111111
6	6	Header	FF	11111111
7	7	Header	00	00000000
8	8	EISA ID manufacturer name (“CMO”)	0D	00001101
9	9	EISA ID manufacturer name (Compressed ASCII)	AF	10101111
10	0A	ID product code	44	01000100
11	0B	ID product code	15	00010101
12	0C	ID S/N (fixed “0”)	00	00000000
13	0D	ID S/N (fixed “0”)	00	00000000
14	0E	ID S/N (fixed “0”)	00	00000000
15	0F	ID S/N (fixed “0”)	00	00000000
16	10	Week of manufacture (fixed week code)	23	00100011
17	11	Year of manufacture (fixed year code)	10	00010000
18	12	EDID structure version # (“1”)	01	00000001
19	13	EDID revision # (“3”)	03	00000011
20	14	Video I/P definition (“digital”)	80	10000000
21	15	Max H image size (“30.45 cm”)	1E	00011110
22	16	Max V image size (“22.837 cm”)	17	00010111
23	17	Display Gamma (Gamma = ”2.2”)	78	01111000
24	18	Feature support (“Active off, RGB Color”)	0A	00001010
25	19	Red/Green (Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0)	0A	00001010
26	1A	Blue/White (Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0)	B5	10110101
27	1B	Red-x (Rx = “0.590”)	97	10010111
28	1C	Red-y (Ry = “0.340”)	57	01010111
29	1D	Green-x (Gx = ”0.318”)	51	01010001
30	1E	Green-y (Gy = ”0.537”)	89	10001001
31	1F	Blue-x (Bx = ”0.150”)	26	00100110
32	20	Blue-y (By = ”0.120”)	1E	00011110
33	21	White-x (Wx = ”0.313”)	50	01010000
34	22	White-y (Wy = ”0.329”)	54	01010100
35	23	Established timings 1	00	00000000
36	24	Established timings 2	00	00000000
37	25	Manufacturer’s reserved timings	00	00000000
38	26	Standard timing ID # 1	01	00000001
39	27	Standard timing ID # 1	01	00000001
40	28	Standard timing ID # 2	01	00000001
41	29	Standard timing ID # 2	01	00000001

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
42	2A	Standard timing ID # 3	01	00000001
43	2B	Standard timing ID # 3	01	00000001
44	2C	Standard timing ID # 4	01	00000001
45	2D	Standard timing ID # 4	01	00000001
46	2E	Standard timing ID # 5	01	00000001
47	2F	Standard timing ID # 5	01	00000001
48	30	Standard timing ID # 6	01	00000001
49	31	Standard timing ID # 6	01	00000001
50	32	Standard timing ID # 7	01	00000001
51	33	Standard timing ID # 7	01	00000001
52	34	Standard timing ID # 8	01	00000001
53	35	Standard timing ID # 8	01	00000001
54	36	Detailed timing description # 1 Pixel clock (“108 MHz”)	30	00110000
55	37	# 1 Pixel clock (hex LSB first)	2A	00101010
56	38	# 1 H active (“1400”)	78	01111000
57	39	# 1 H blank (“288”)	20	00100000
58	3A	# 1 H active : H blank (“1400 : 288”)	51	01010001
59	3B	# 1 V active (”1050”)	1A	00011010
60	3C	# 1 V blank (”16”)	10	00010000
61	3D	# 1 V active : V blank (”1050 : 16”)	40	01000000
62	3E	# 1 H sync offset (”48”)	30	00110000
63	3F	# 1 H sync pulse width (”112”)	70	01110000
64	40	# 1 V sync offset : V sync pulse width (”3 : 4”)	34	00110100
65	41	# 1 H sync offset : H sync pulse width : V sync offset : V sync width (”48 : 112 : 3 : 4”)	00	00000000
66	42	# 1 H image size (”304.5 mm”)	30	00110000
67	43	# 1 V image size (”228.37 mm”)	E4	11100100
68	44	# 1 H image size : V image size (”304 : 228”)	10	00010000
69	45	# 1 H boarder (”0”)	00	00000000
70	46	# 1 V boarder (”0”)	00	00000000
71	47	# 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives	18	00011000
72	48	Detailed timing description # 2	00	00000000
73	49	# 2 Flag	00	00000000
74	4A	# 2 Reserved	00	00000000
75	4B	# 2 FE (hex) defines ASCII string (Model Name “N150P5-L04”, ASCII)	FE	11111110
76	4C	# 2 Flag	00	00000000
77	4D	# 2 1st character of name (“N”)	4E	01001110
78	4E	# 2 2nd character of name (“1”)	31	00110001
79	4F	# 2 3rd character of name (“5”)	35	00110101
80	50	# 2 4th character of name (“0”)	30	00110000
81	51	# 2 5th character of name (“P”)	50	01010000
82	52	# 2 6th character of name (“5”)	35	00110101
83	53	# 2 7th character of name (“-”)	2D	00101101
84	54	# 2 8th character of name (“L”)	4C	01001100

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value (hex)	Value (binary)
85	55	# 2 9th character of name (“0”)	30	00110000
86	56	# 2 10th character of name (“4”)	34	00110100
87	57	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010
88	58	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
89	59	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
90	5A	Detailed timing description # 3	00	00000000
91	5B	# 3 Flag	00	00000000
92	5C	# 3 Reserved	00	00000000
93	5D	# 3 FE (hex) defines ASCII string (Vendor “CMO”, ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# 3 1st character of string (“C”)	43	01000011
96	60	# 3 2nd character of string (“M”)	4D	01001101
97	61	# 3 3rd character of string (“O”)	4F	01001111
98	62	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010
99	63	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
100	64	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
101	65	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
102	66	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
103	67	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
104	68	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
105	69	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
106	6A	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
107	6B	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
108	0A	Detailed timing description # 4	00	00000000
109	6D	# 4 Flag	00	00000000
110	6E	# 4 Reserved	00	00000000
111	6F	# 4 FE (hex) defines ASCII string (Model Name“N150P5-L04”, ASCII)	FE	11111110
112	70	# 4 Flag	00	00000000
113	71	# 4 1st character of name (“N”)	4E	01001110
114	72	# 4 2nd character of name (“1”)	31	00110001
115	73	# 4 3rd character of name (“5”)	35	00110101
116	74	# 4 4th character of name (“0”)	30	00110000
117	75	# 4 5th character of name (“P”)	50	01010000
118	76	# 4 6th character of name (“5”)	35	00110101
119	77	# 4 7th character of name (“-”)	2D	00101101
120	78	# 4 8th character of name (“L”)	4C	01001100
121	79	# 4 9th character of name (“0”)	30	00110000
122	7A	# 4 10th character of name (“4”)	34	00110100
123	7B	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010
124	7C	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
125	7D	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	24	00100100

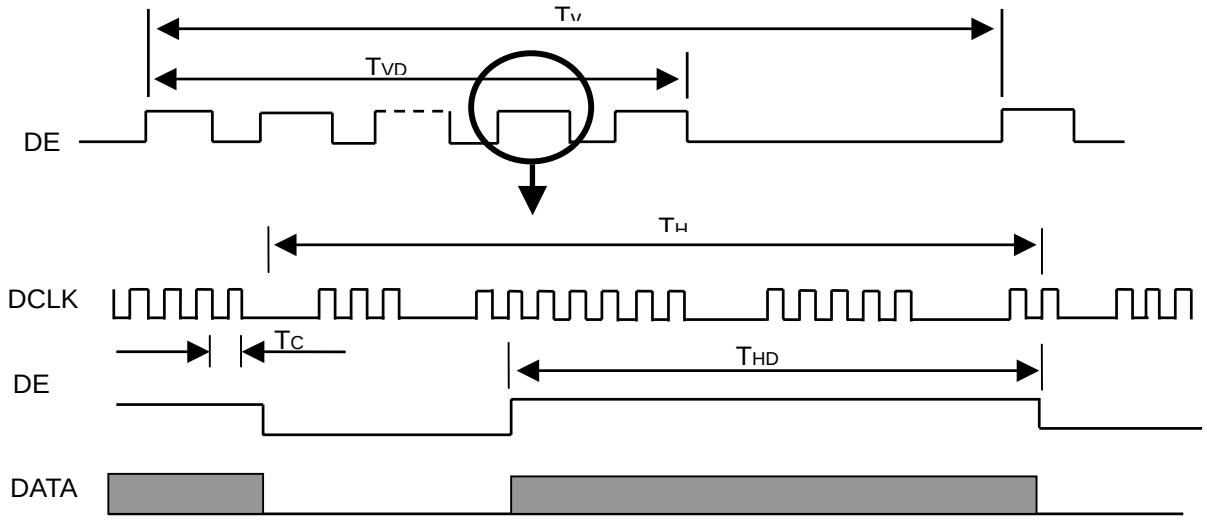
6. INTERFACE TIMING

6.1 INPUT SIGNAL TIMING SPECIFICATIONS

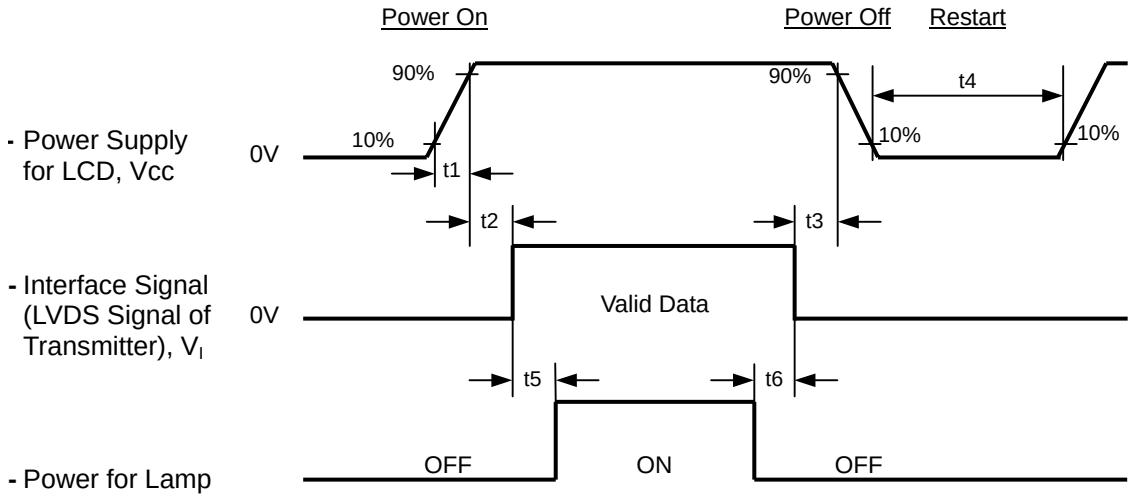
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	51	54	57	MHz	-
DE	Vertical Total Time	TV	1058	1066	2046	TH	-
	Vertical Addressing Time	TVD	1050	1050	1050	TH	-
	Horizontal Total Time	TH	762	844	1023	Tc	-
	Horizontal Addressing Time	THD	700	700	700	Tc	-

INPUT SIGNAL TIMING DIAGRAM



6.2 POWER ON/OFF SEQUENCE



Timing Specifications:

0 ≦ t1 ≦ 10 msec

0 < t2 ≦ 50 msec

0 < t3 ≦ 50 msec

t4 ≧ 200 msec

t5 ≧ 200 msec

t6 ≧ 120 msec

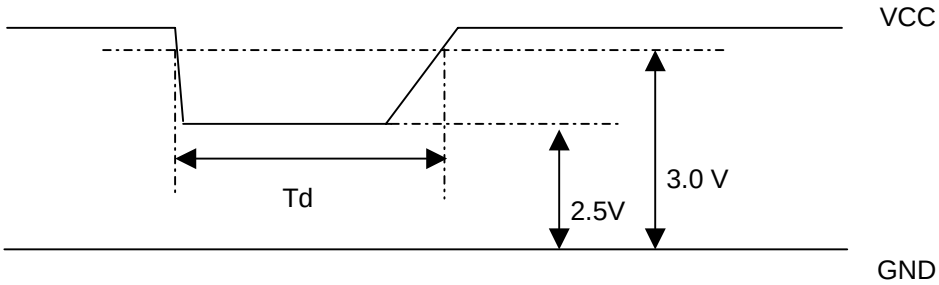
Note (1) Please avoid floating state of interface signal at invalid period.

Note (2) When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time had better to follow t7 ≧ 5 msec

6.3 VCC DIP CONDITIONS



(1) 2.5V≦ VCC< 3.0V

Td≦20 ms

(2) VCC< 2.5V

Vcc-Dip conditions also follow the power up/down conditions for supply voltage.

7. OPTICAL CHARACTERISTICS

7.1 TEST CONDITIONS

Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	6.0	mA
Inverter Driving Frequency	F_L	61	KHz
Inverter	Sumida H05-4915		

The measurement methods of optical characteristics are shown in Section 7.2. The following items should be measured under the test conditions described in Section 7.1 and stable environment shown in Note (6).

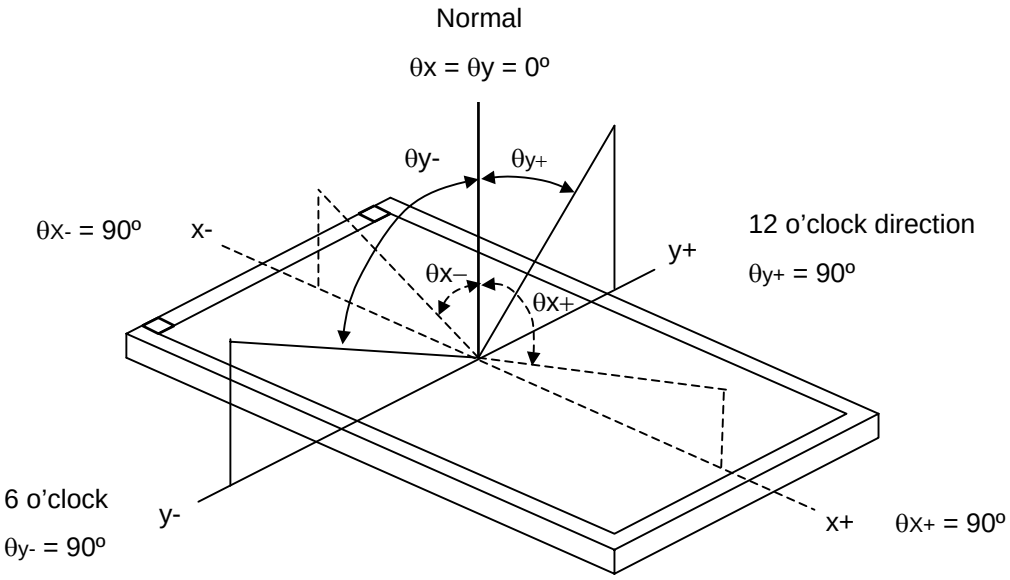
7.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Normal Angle	300	400	-	-	(2), (6)
Response Time		T_R		-	5	10	ms	(3)
		T_F		-	11	16	ms	
Average Luminance of White (5 points)		L_{AVE}		170	200	-	cd/m^2	(4), (6)
Cross Modulation		D_{sha}		--	--	2	%	(5), (6)
13 Points White Variation		δ W		--	--	2	--	(6), (7)
13 Points CR Variation		C_{VER}		--	--	2.0	--	(6), (7)
White Variation		dL		--	--	1.5	%/mm	(6), (8)
Color Chromaticity	Red	Rx		TYP -0.03	0.590	TYP +0.03	--	(1), (6)
		Ry			0.340		--	
	Green	Gx			0.318		--	
		Gy			0.537		--	
	Blue	Bx			0.150		--	
		By			0.120		--	
	White	Wx			0.313		--	
		Wy			0.329		--	
Viewing Angle	Horizontal	θ_x+	CR≥10	40	45	-	Deg.	
		θ_x-		40	45	-		
	Vertical	θ_Y+		15	20	-		
		θ_Y-		40	45	-		
Viewing Angle	Horizontal	θ_x+	CR≥5	50	60	--	Deg.	
		θ_x-		50	60	--		
	Vertical	θ_Y+		20	30	--		
		θ_Y-		45	55	--		

Item	Symbol	Conditions	Specifications			Unit	Note
			Min.	Typ.	Max.		
Gamma	63	θ_X = θ_Y =0°	100	100	100	%	8. (6) at center of Viewing area
	60		83.4	89.8	96.9		
	56	Viewing normal angle	65.6	77.2	91.3		

	52		51.7	65.6	83.6		center only
	48		40.4	55.0	74.8		
	44		32.1	45.4	66.4		
	40		25.0	36.8	57.5		
	36		19.1	29.2	48.4		
	32		14.2	22.5	39.4		
	28		10.5	16.8	31.4		
	24		7.4	12.0	23.6		
	20		4.8	8.0	16.4		
	16		2.8	4.9	10.1		
	12		1.4	2.6	5.3		
	8		0.5	1.1	2.5		
	4		0.1	0.2	0.8		
	0		0	0	0		

Note (1) Definition of Viewing Angle (θx, θy):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

Contrast Ratio (CR) = L63 / L0

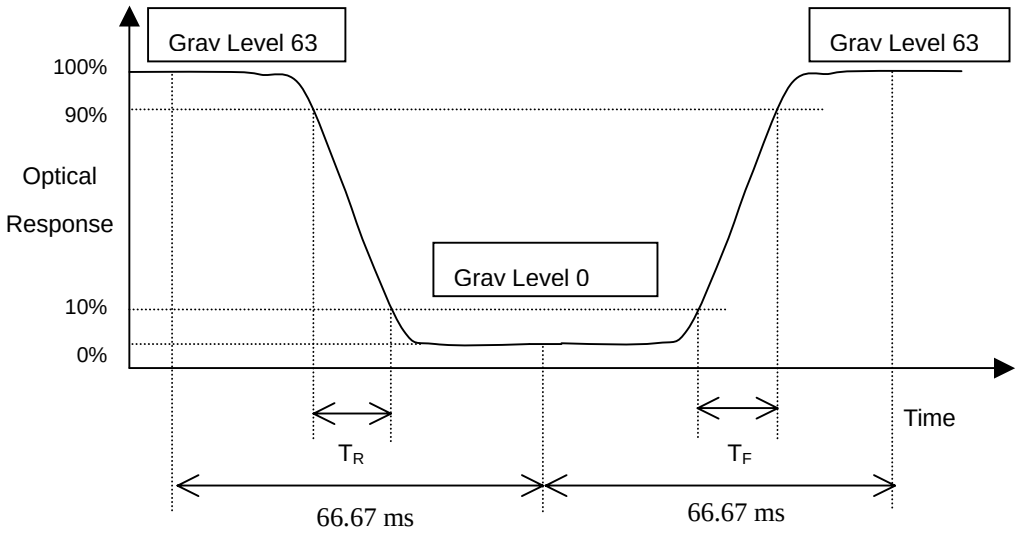
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (1)

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (7).

Note (3) Definition of Response Time (T_R, T_F):



Note (4) Definition of Average Luminance of White (L_{AVE}):

Measure the luminance of gray level 63 at 5 points

L_{AVE} = [L (1)+ L (2)+ L (3)+ L (4)+ L (5)] / 5

L (x) is corresponding to the luminance of the point X at Figure in Note (7)

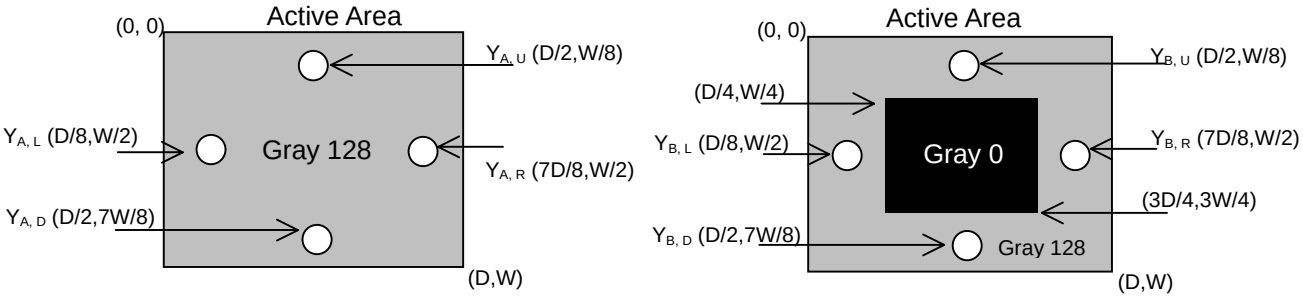
Note (5) Definition of Cross Modulation (D_{SHA})

$D_{SHA} = | Y_B – Y_A | / Y_A \times 100$ (%)

Where:

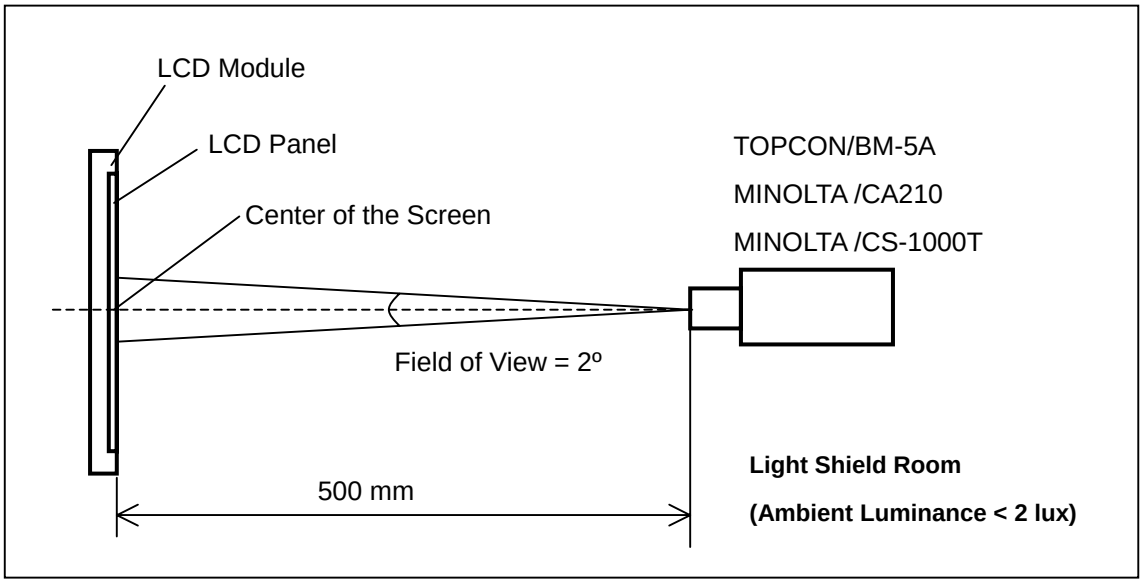
Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m^2)



Note (6) Measurement Setup:

The LCD module should be stabilized at given temperature for 15 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 15 minutes in a windless room.

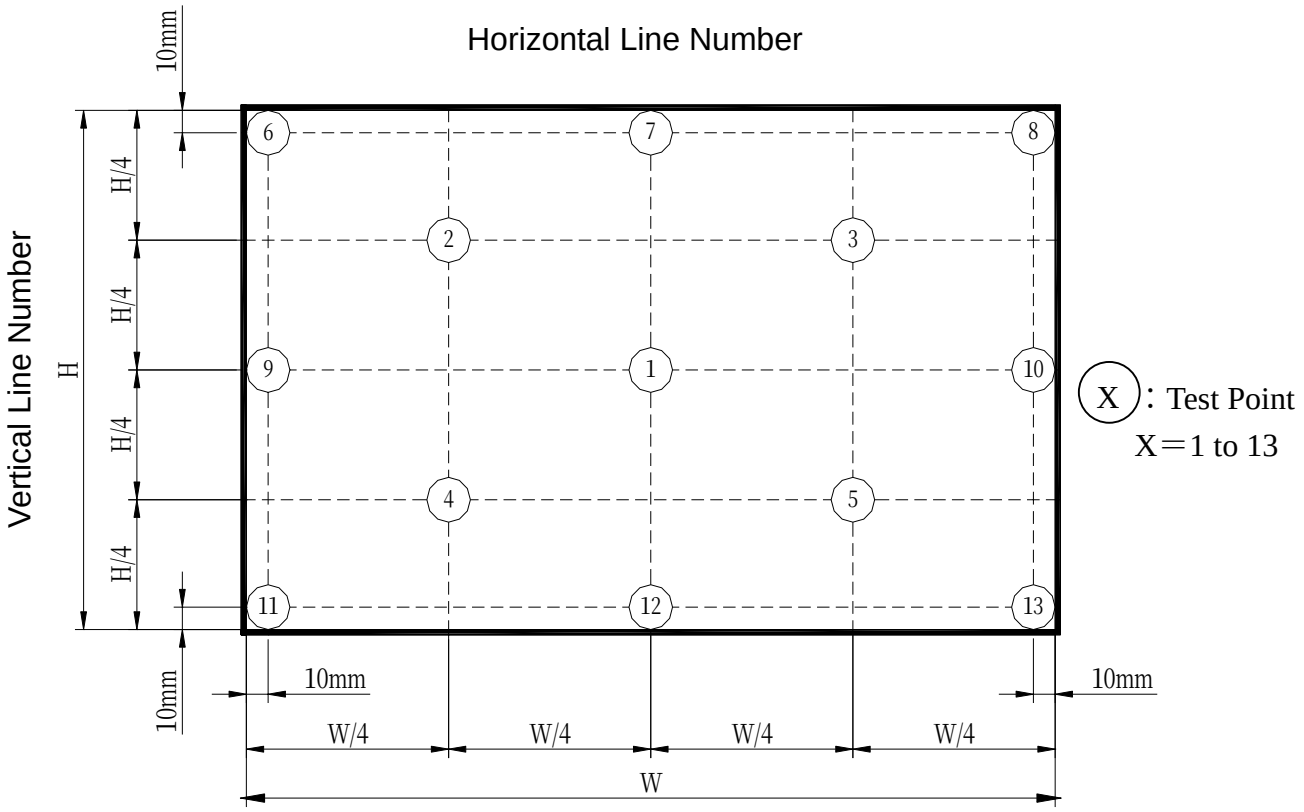


Note (7) Definition of White Variation (δW):

Measure the luminance of gray level 63 at 13 points

δW = Maximum [L (1) ~ L (13)] / Minimum [L (1) ~ L (13)]

C_{VER} = Maximum [CR (1) ~ CR (13)] / Minimum [CR (1) ~ CR (13)]



Note (8) Definition of Luminance Variation (dL):

Measure the luminance of gray level 63 along the 5 lines in Horizontal and Vertical direction which is described in below picture. The distance between measured point to next point is 5mm.

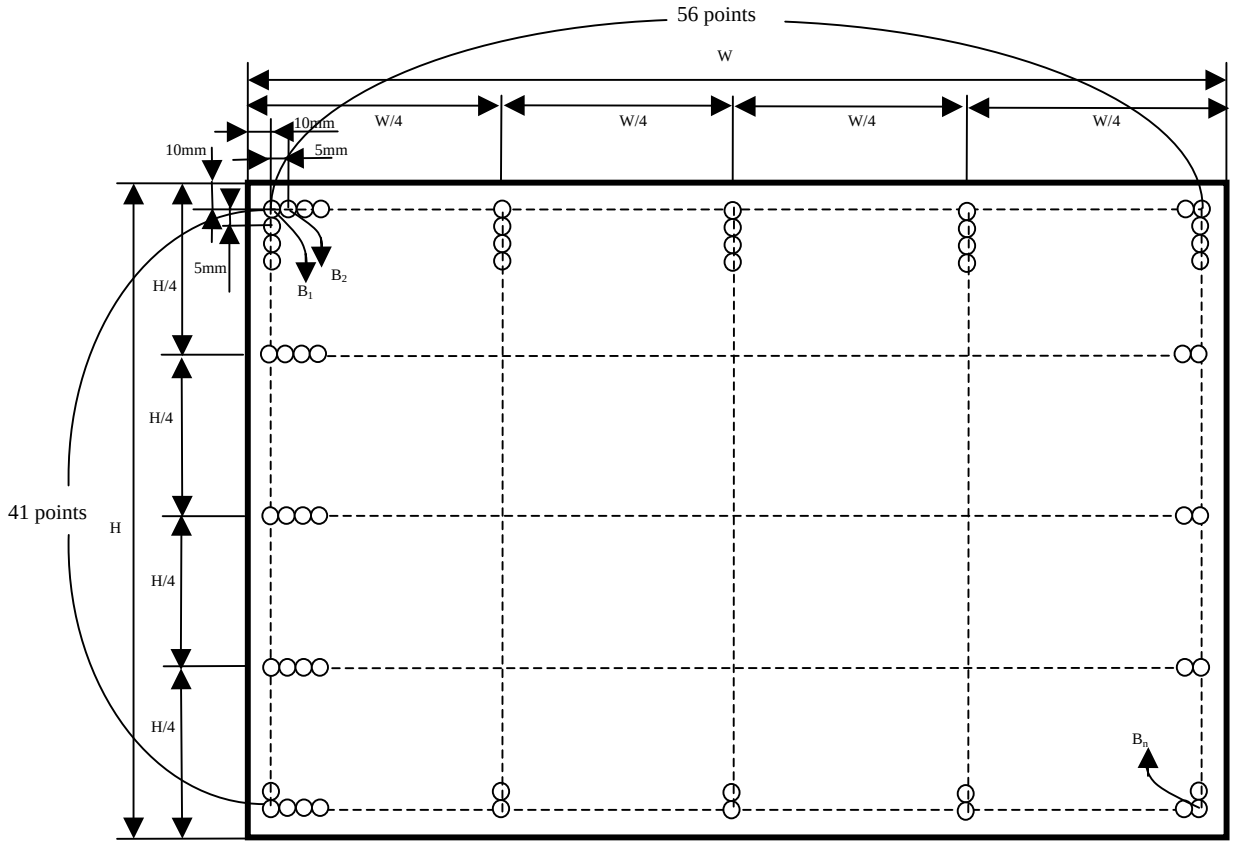
$dL = | B_{m-1} – B_m | / \{5 \times (B_1 + B_2 \cdots B_{n-1} + B_n)/n\} \times 100\ \%$

Where:

B_x = Luminance of measured location x , x =1~n

$2 \leqq m \leqq n$ where n ,m is an integer.

The distance between B_{m-1} and B_m is 5mm


56 points
W
W/4
W/4
W/4
W/4
10mm
10mm
5mm
5mm
H/4
H/4
H/4
H/4
41 points
H
B1
B2
Bn

8. PRECAUTIONS

8.1 HANDLING PRECAUTIONS

(1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.

(2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.

(3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.

(4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.

(5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.

(6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.

(9) Do not disassemble the module.

(10) Do not pull or fold the lamp wire.

(11) Pins of I/F connector should not be touched directly with bare hands.

8.2 STORAGE PRECAUTIONS

(1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.

(2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.

(3) It may reduce the display quality if the ambient temperature is lower than 10 ºC. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

8.3 OPERATION PRECAUTIONS

(1) Do not pull the I/F connector in or out while the module is operating.

(2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.

(3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with inverter. Do not disassemble the module or insert anything into the Backlight unit.

9. PACKING

9.1 PACKING SPECIFICATIONS

(1) 20 LCD modules / 1 Box

(2) Box dimensions: 500(L) X 600(W) X 362(H) mm

(3) Weight: approximately 13 Kg (20 modules per box)

9.2 PACKING METHOD

(1)Carton Packing should have no failure in the following reliability test items.

Test Item	Test Conditions	Note
Vibration	Frequency Range: 2 – 200 Hz, Random, +X: 10min,+Y: 10min,+Z: 10min,-Z: 30 min follow ISTA standard.	Non Operation
Dropping Test	1 Angle, 3 Edge, 6 Face, 60cm	Non Operation

9.2.1 CARTON

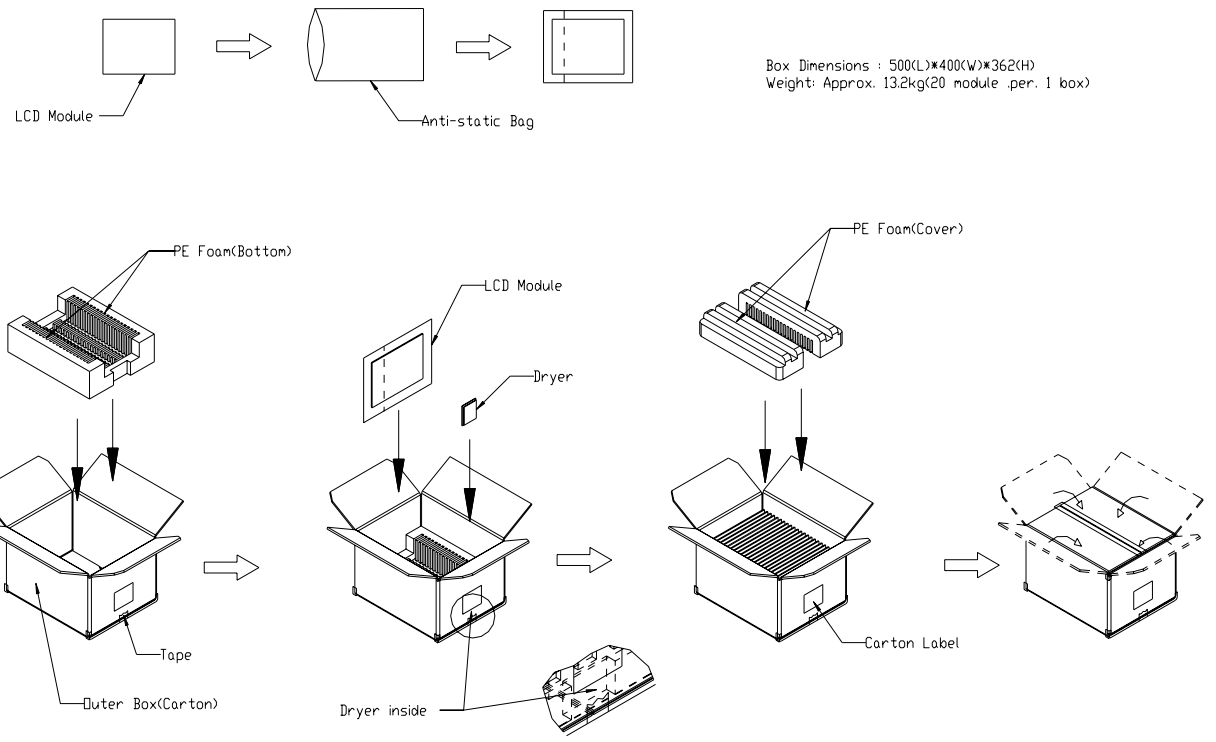


Figure. 9.2.1 Packing method

9.2 PALLET

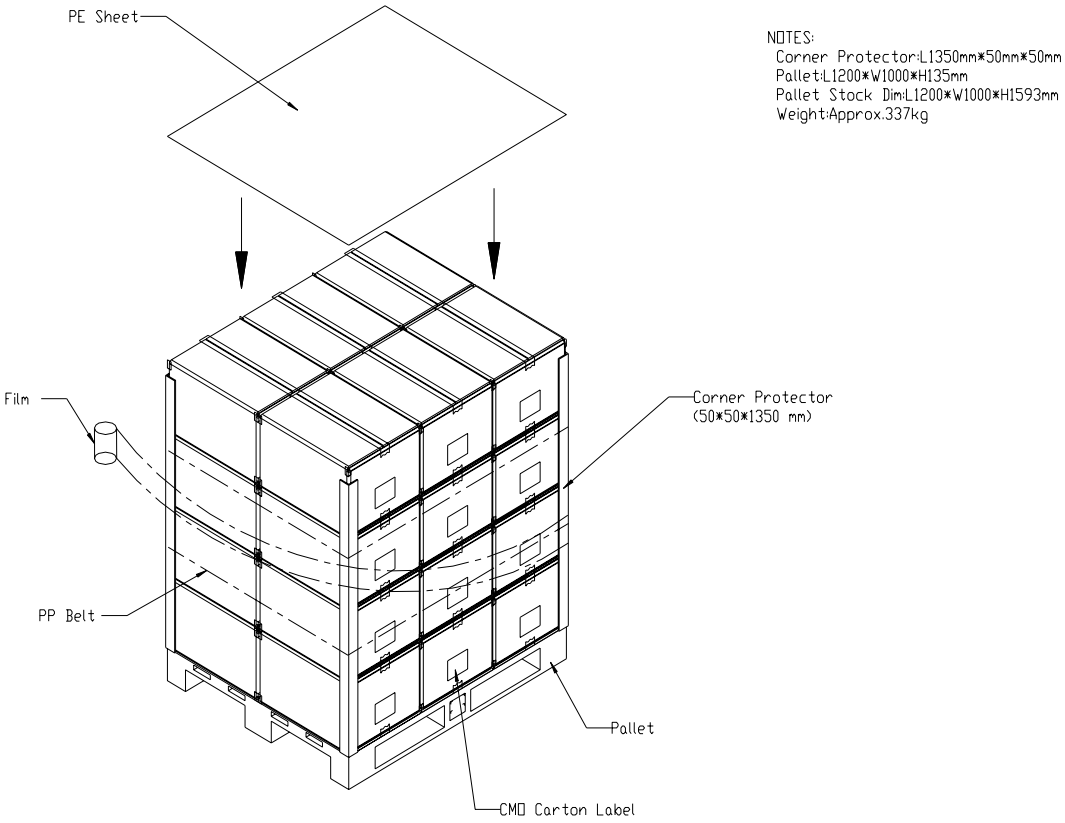


Figure. 9.2.2 Packing method

10. DEFINITION OF LABELS

10.1 CMO MODULE LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.

(a) Toshiba consigned product ID:

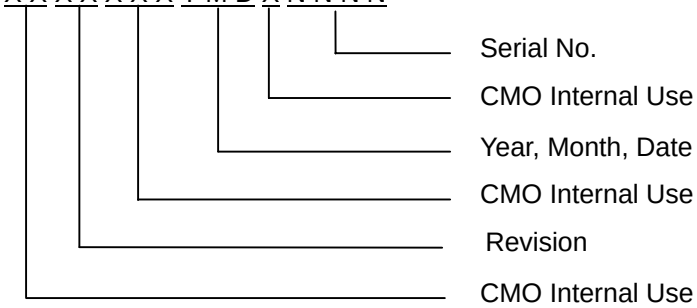
i. CS stage: G33C0003SA10

ii. MP stage: G33C0003S110

(b) Model Name: N150P5 - L04

(c) Revision: Rev. XX, for example: A1, …, C1, C2 …etc.

(d) Serial ID: X X X X X X Y M D X N N N N



Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I , O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

10.2 CARTON LABEL

The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.

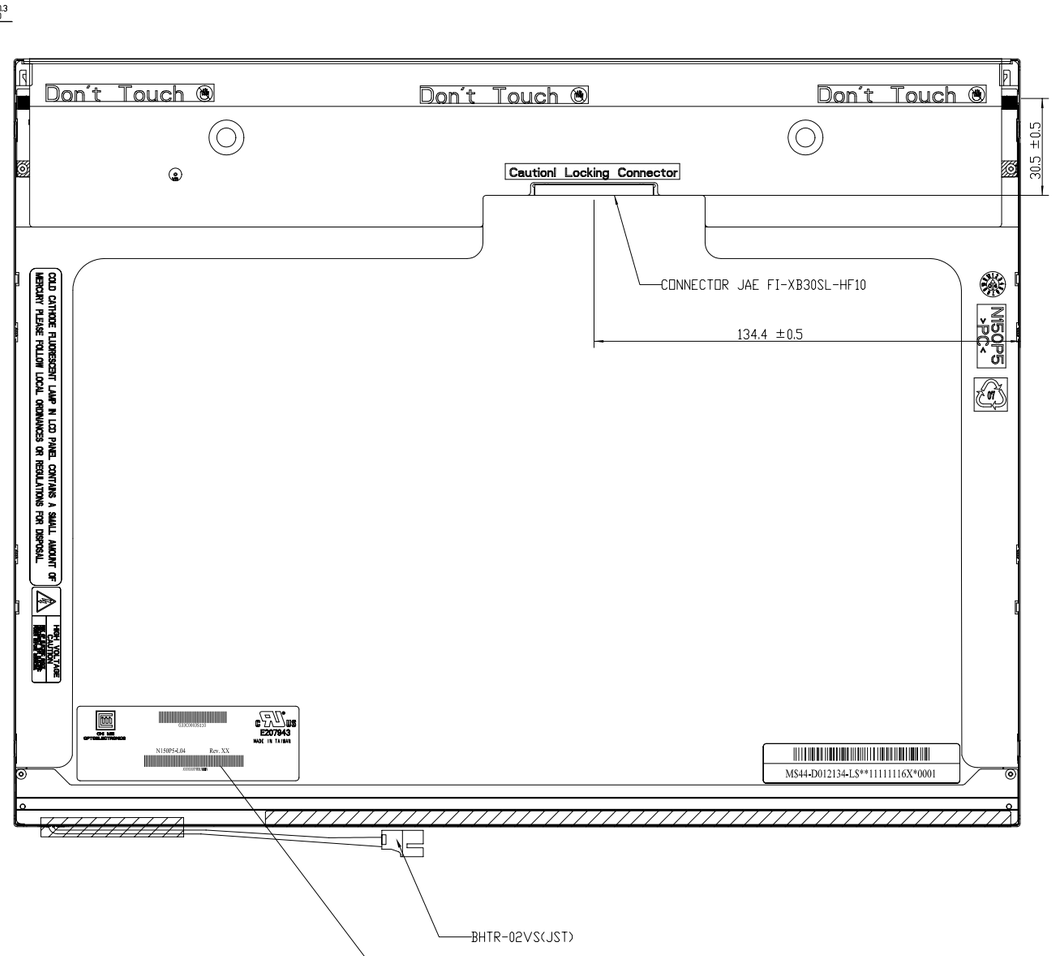
(a) PO. NO.: Printed by customer request

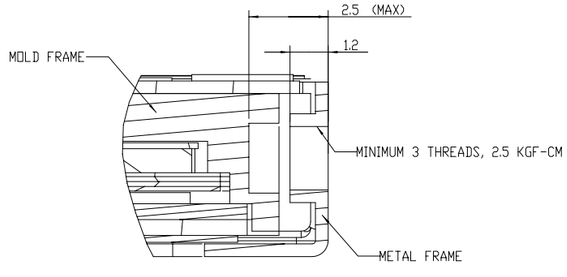
(b) Part ID. : G33C0003S110 (Toshiba Part Number)

(c) Model Name: N150P5-L04

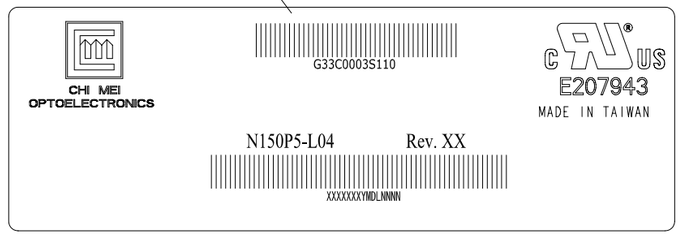
(d) Carton ID. : Packing sequence of product

(e) Quantity: Total shipping quantity by the order





SECTION USER_HOLE-USER_HOLE
SCALE 10:1



NOTES:
1. GENERAL TOLERANCE: ±0.5mm MAX
2. SCREW TORQUE FOR MOUNTING SHOULD NOT EXCEED 2.5 KGF-CM

Mark	Description	Date	Changed_By	Approved_By	ECN No.	Remark

TITLE	OUTLINE DRAWING N150P5-L04 (TOSHIBA)					2D REV.	A
						3D REV.	
Approved	BILL SHEU	Drawing No.	N15094107A				
Checked	CLIFF TSAI	Part No.	TBD				
Drawer	CHI TSAI	Material	TBD		Sheet	1 / 2	A1
Designer	CHI TSAI	Date	20-Jun-2006	Scale	1:1	Unit:mm	

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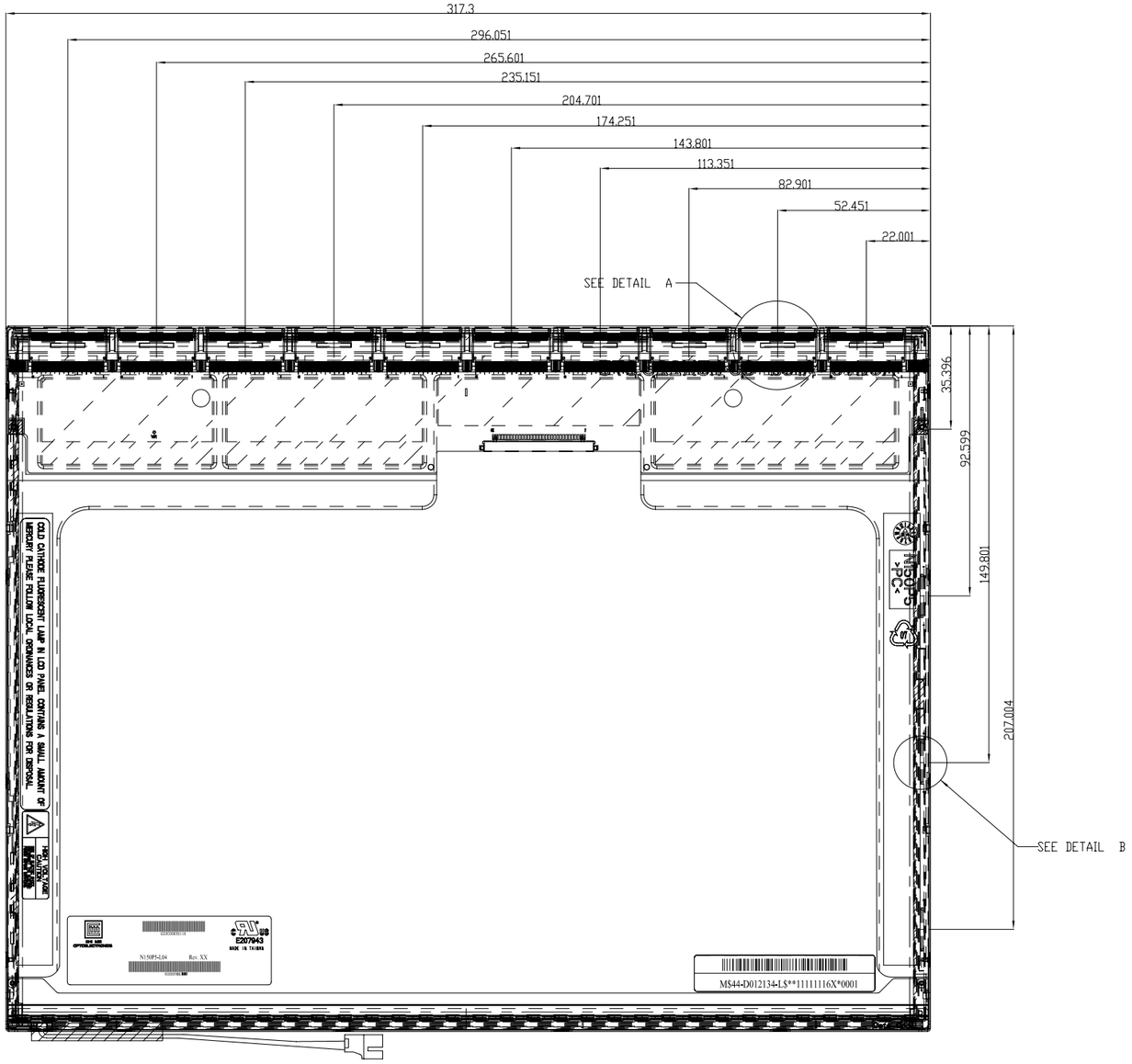
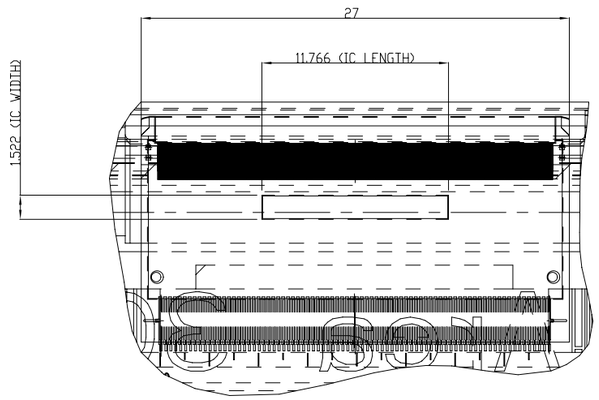
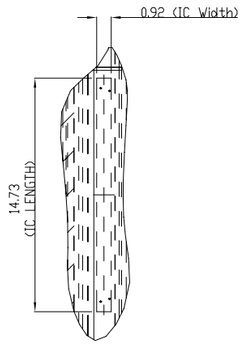




DETAIL A
SCALE 5:1



DETAIL B
SCALE 5:1

Mark	Description	Date	Changed_By	Approved_By	ECN No.	Remark

TITLE	OUTLINE DRAWING N150P5-L04 (TOSHIBA)						2D REV.	A
							3D REV.	
Approved	BILL SHEU	Drawing No.	N15094107A					
Checked	CLIFF TSAI	Part No.	TBD					
Drawer	CHI TSAI	Material	TBD			Sheet	2 / 2	A1
Designer	CHI TSAI	Date	20-Jun-2006	Scale	1:1	Unit	mm	

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