TFT LCD Approval Specification

MODEL NO.: N150X6 - L01

Customer:

Approved by:

Note:

Liquid Crystal Display Division	
QRA Dept.	PDD I Dept.
Approval	Approval
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REVISION HISTORY

Version	Date	Page (New)	Section	Description
Ver 0.0	Apr. 29,'03	All	All	Tentative Specification was first issued.
Ver 1.0	Jun. 18, '03	5	1.5	Modify Module Size of "Mechanical Specification" Vertical(V) min 252.83 instead of 254.4 Typ. 253.33 instead of 254.9 Max. 254.03 instead of 255.4 Modify typ. of Weight from 540 to 535; max. from 555 to 550
		15	7.2	Add "Average Luminance of White"= 200; modify typ.220 instead of 200
Ver 2.0	Oct. 16, '03	5	1.5	Modify typ. of "Weight" from 535 to 540; max from 550 to 555
		7	3.1	Modify max. of Power Supply Current – White from 350 to 360
		19	6.4.1	Change item2 of Absolute Maximum Ratings from FPVEE/SMBC/SMBD(V) to FPBACK/SMB_CLK/SMB_DAT(V)
			6.4.2	Modify min. of input signal level for 5VSUS, 5VALW from 4.75 to 4.85 Eliminate input power Modify Lamp Voltage's condition from 6.0mA to 6.3mA Modify Remark item 2 – condition (FPVEE) to condition (FPBACK)
		21	7.1	Modify min frequency of "DCLK" from "20" to "50"
		22	7.2	Modify t1 of Timing Specification from "0<t1≦10 msec" to "0.47<t1≦10 msec

1. GENERAL DESCRIPTION

1.1 OVERVIEW

N150X6 - L01 is a 15.0" TFT Liquid Crystal Display module with burst mode inverter assemblies. This module supports 1024 x 768 XGA mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction.

1.2 FEATURES

- Thin and Light Weight
- XGA (1024 x 768 pixels) resolution
- DE only mode
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 1 pixel/clock
- SPWG (Standard Panel Working Group) Style B compatible
- Single CCFL
- with Inverter

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATI0NS

Item	Specification	Unit	Note
Active Area	304.1 (H) x 228.1 (V) (15.0" diagonal)	mm	(1)
Bezel Opening Area	307.8 (H) x 231.6 (V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1024 x R.G.B. x 768	pixel	-
Pixel Pitch	0.297 (H) x 0.297 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (3H), Anti-glare (Haze 25)	-	-

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	242.5	mm	(1), (2)
		252.83	253.33	254.03	mm	(1), (3)
	Depth(D)	-	5.7	6.0	mm	(1)
Weight		-	540	555	g	-

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

Note (2) Module vertical size without inverter.

Note (3) Module vertical size with inverter.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T_{ST}	-20	+60	ºC	(1)
Storage Humidity	H_{ST}	5	95	%RH	(1)
Operating Ambient Temperature	T_{OP}	0	+50	ºC	(1), (2)
Operating Ambient Humidity	H_{OP}	8	95	%RH	(1)
Shock (Non-Operating)	S_{NOP}	-	50/18 220/2	G/ms	(3), (4), (5)
Vibration (Non-Operating)	V_{NOP}	-	1.5/10-200	G/Hz	(4), (5)

Note (1) (a) 90 %RH Max. (Ta ≦ 40 ºC).

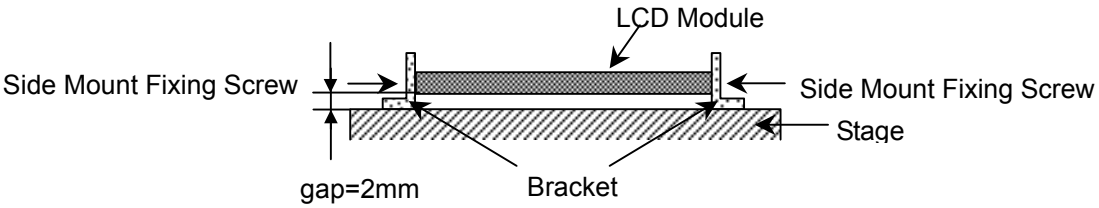
(b) Wet-bulb temperature should be 39 ºC Max. (Ta > 40 ºC).

(c) No condensation.

Note (2) The temperature of panel surface should be 0℃ min. and 50 ℃ max.

Note (3) Condition for 50/18 G/ms is Rectangle Wave. Condition for 220/2 G/ms is Half Since Wave.

Note (4) The fixing condition is shown as below:



Note (5) 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.

2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V_{CC}	-0.3	+4.0	V	(1)
Logic Input Voltage	V_{IN}	-0.3	V_{CC}+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	-	(7.5)	mA_{RMS}	(1), (2)
Lamp Frequency	F_L	-	(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 3.2 for further information).

3. ELECTRICAL CHARACTERISTICS

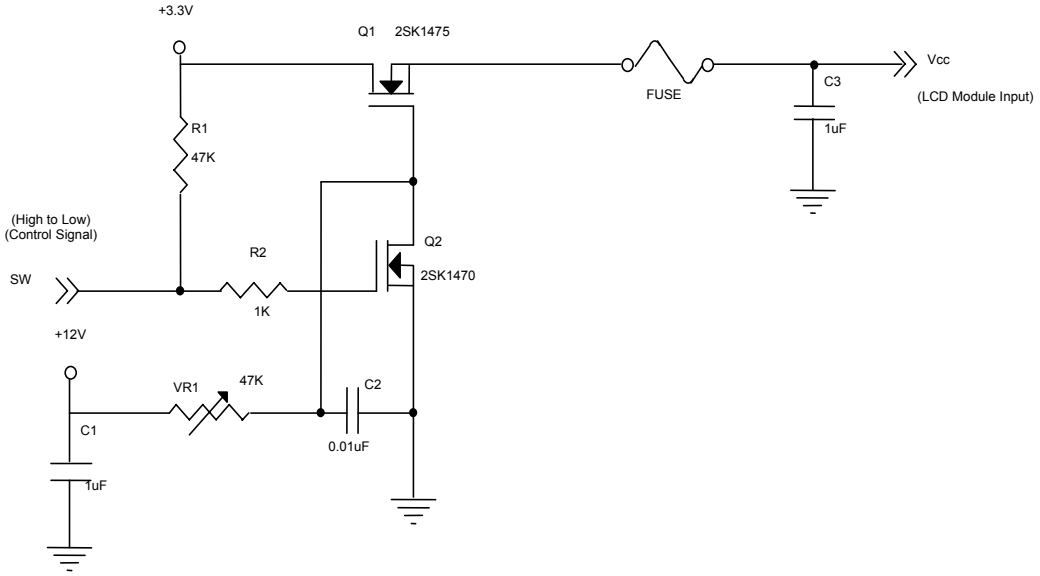
3.1 TFT LCD MODULE

Ta = 25 ± 2 ºC

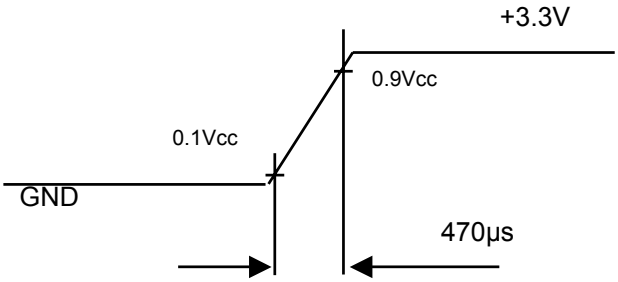
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		Vcc	3.0	3.3	3.6	V	-
Ripple Voltage		V_{RP}	-	50	-	mV	-
Rush Current		I_{RUSH}	-	-	1.5	A	(2)
Power Supply Current	White	Lcc	-	320	360	mA	(3)a
	Black		-	440	480	mA	(3)b
Logical Input Voltage (LVDS)	"H" Level	V_{IL}	-	-	+100	mV	-
	"L" Level	V_{IH}	-100	-	-	mV	-
Terminating Resistor		R_T	-	100	-	Ohm	-

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

Note (2) Measurement Conditions:



Vcc rising time is 470μs



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

a. White Pattern

Active Area

b. Black Pattern

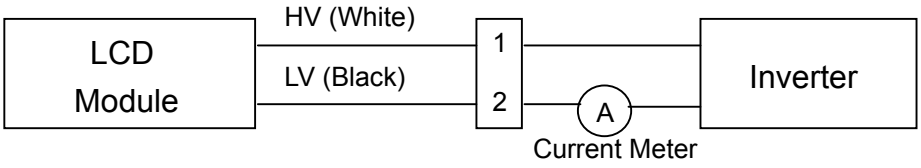
Active Area

3.2 BACKLIGHT UNIT

Ta = 25 ± 2 ºC

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
Lamp Input Voltage	V_L		660		V_{RMS}	I_L = 6.0 mA
Lamp Current	I_L	2.0	6.0	6.5	mA_{RMS}	(1)
Lamp Turn On Voltage	V_S	-		1130 (25 °C)	V_{RMS}	(2)
		-		1355 (0 °C)	V_{RMS}	(2)
Operating Frequency	F_L	(45)	60	(80)	KHz	(3)
Lamp Life Time	L_{BL}	15,000		-	Hrs	(5)
Power Consumption	P_L	-	3.96	-	W	(4), I_L = 6.0 mA

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



Note (2) The voltage shown above 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 produce 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 can be defined as the time in which it continues to operate under the condition Ta = 25 ±2 °C and I_L = 6.0 mArms until one of the following events occurs:

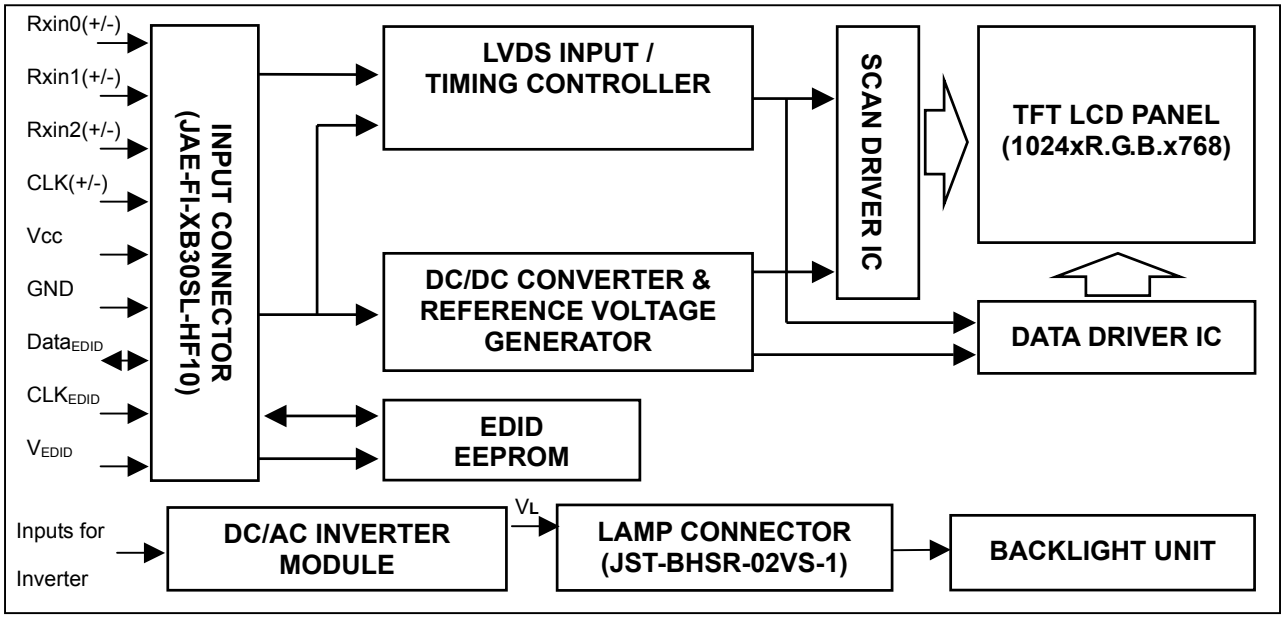
(a) When the brightness becomes or lower than 50% of its original value.

(b) When the effective ignition length becomes or lower than 80% of its original value. (Effective ignition length is defined as an area that has less than 70% brightness compared to the brightness in 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 producing 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.

4. BLOCK DIAGRAM

TFT LCD MODULE w/ INVERTER



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 (typical)		
3	Vcc	Power Supply +3.3 V (typical)		
4	V_{EDID}	DDC 3.3V Power		
5	BIST	Panel BIST Enable		
6	CLK_{EDID}	DDC Clock		
7	$DATA_{EDID}$	DDC Data		-
8	Rxin0-	LVDS Differential Data Input	Negative	R0~R5,G0
9	Rxin0+	LVDS Differential Data Input	Positive	-
10	Vss	Ground		
11	Rxin1-	LVDS Differential Data Input	Negative	G1~G5,B0,B1
12	Rxin1+	LVDS Differential Data Input	Positive	-
13	Vss	Ground		
14	Rxin2-	LVDS Differential Data Input	Negative	B2~B5,DE,Hsync,Vsync
15	Rxin2+	LVDS Differential Data Input	Positive	
16	Vss	Ground		
17	CLK-	LVDS Clock Data Input	Negative	LVDS Level Clock
18	CLK+	LVDS Clock Data Input	Positive	
19	Vss	Ground		
20	NC	Non-Connection		
21	NC	Non-Connection		
22	Vss	Ground		
23	NC	Non-Connection		
24	NC	Non-Connection		

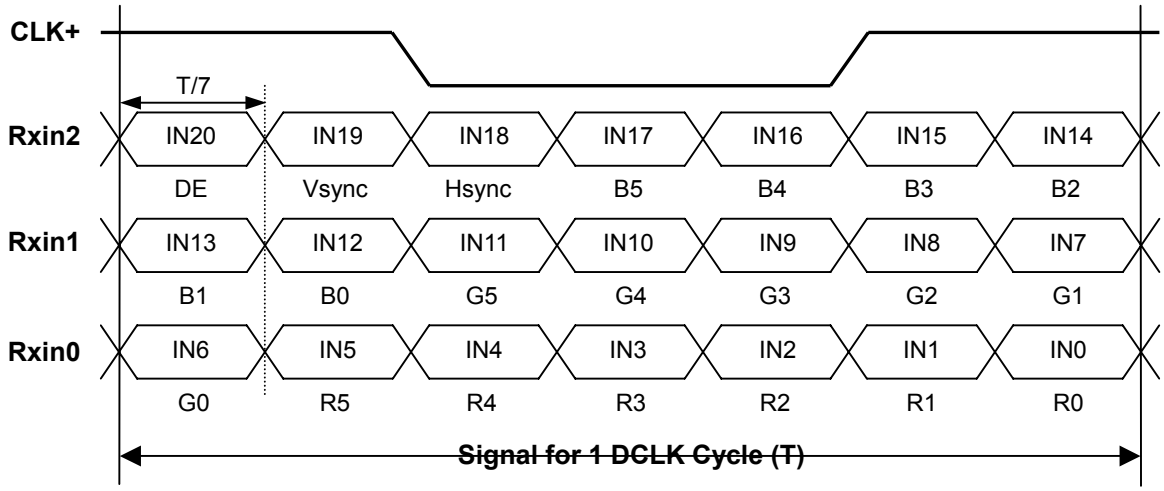
25	Vss	Ground		
26	NC	Non-Connection		
27	NC	Non-Connection		
28	Vss	Ground		
29	NC	Non-Connection		
30	NC	Non-Connection		

Note (1) Connector Part No.: JAE-FI-XB30SL-HF10 or equivalent

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

Note (3) The first pixel is even.

5.2 TIMING DIAGRAM OF LVDS INPUT SIGNAL



5.3 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

5.4 EDID DATA

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 (N150X6)	02	00000010
11	0B	ID product code (hex LSB first; N150X6)	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)	0E	00001110
17	11	Year of manufacture (fixed)	0D	00001101
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 (“30.4128 cm”)	1E	00011110
22	16	Max V image size (“22.8096 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)	77	01110111
26	1A	Blue/White (Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0)	F1	11110001
27	1B	Red-x (Rx = “0.626”)	A0	10100000
28	1C	Red-y (Ry = “0.355”)	5A	01011010
29	1D	Green-x (Gx = ”0.294”)	4B	01001011
30	1E	Green-y (Gy = ”0.589”)	96	10010110
31	1F	Blue-x (Bx = ”0.144”)	24	00100100
32	20	Blue-y (By = ”0.097”)	18	00011000
33	21	White-x (Wx = ”0.309”)	4F	01001111
34	22	White-y (Wy = ”0.329”)	54	01010100
35	23	Established timings 1	00	00000000
36	24	Established timings 2 (1024x768@60Hz)	08	00001000
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

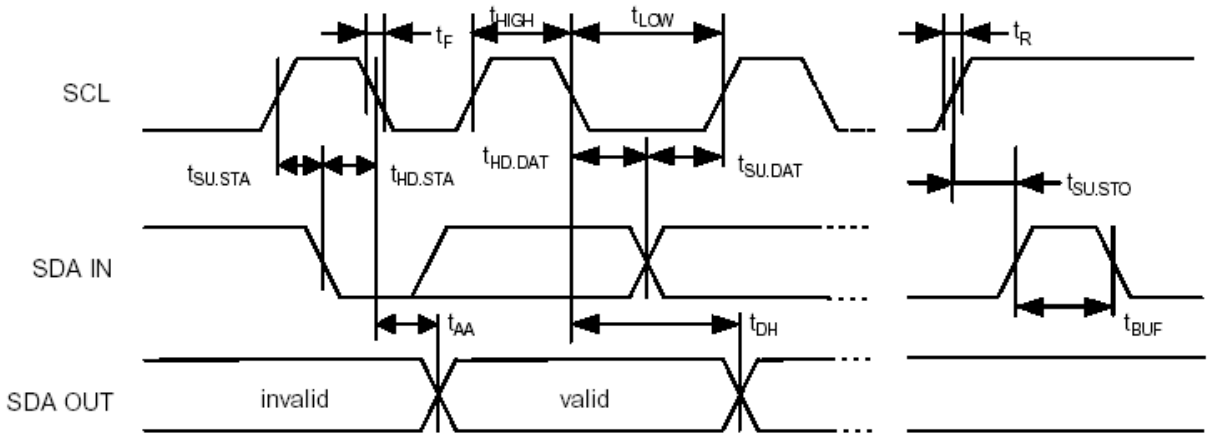
42	2A	Standard timing ID # 3	01	00000001
43	2B	Standard timing ID # 3	01	00000001
44	2C	Standard timing ID # 4	01	00000001
45	2D	Standard timing ID # 4	01	00000001
46	2E	Standard timing ID # 5	01	00000001
47	2F	Standard timing ID # 5	01	00000001
48	30	Standard timing ID # 6	01	00000001
49	31	Standard 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 (“65 MHz”)	64	01100100
55	37	# 1 Pixel clock (hex LSB first)	19	00011001
56	38	# 1 H active (“1024”)	00	00000000
57	39	# 1 H blank (“320”)	40	01000000
58	3A	# 1 H active : H blank (“1024 : 320”)	41	01000001
59	3B	# 1 V active (”768”)	00	00000000
60	3C	# 1 V blank (”38”)	26	00100110
61	3D	# 1 V active : V blank (”768 : 38”)	30	00110000
62	3E	# 1 H sync offset (”24”)	18	00011000
63	3F	# 1 H sync pulse width (”136”)	88	10001000
64	40	# 1 V sync offset : V sync pulse width (”3 : 6”)	36	00110110
65	41	# 1 H sync offset : H sync pulse width : V sync offset : V sync width (”24 : 136 : 3 : 6”)	00	00000000
66	42	# 1 H image size (”304.128 mm”)	30	00110000
67	43	# 1 V image size (”228.096 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 Flags (”Non-Interlace, Non-Stereo, Digital Separate”)	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 “N150X3”, ASCII)	FE	11111110
76	4C	# 2 Flag	00	00000000
77	4D	# 2 1st character of string (“N”)	4E	01001110
78	4E	# 2 2nd character of string (“1”)	31	00110001
79	4F	# 2 3rd character of string (“5”)	35	00110101
80	50	# 2 4th character of string (“0”)	30	00110000
81	51	# 2 5th character of string (“X”)	58	01011000
82	52	# 2 6th character of string (“6”)	36	00110110
83	53	# 2 New line character # 2 indicates end of ASCII string	20	00100000
84	54	# 2 Padding with “Blank” character	20	00100000
85	55	# 2 Padding with “Blank” character	20	00100000
86	56	# 2 Padding with “Blank” character	20	00100000
87	57	# 2 Padding with “Blank” character	20	00100000

88	58	# 2 Padding with “Blank” character	20	00100000
89	59	# 2 Padding with “Blank” character	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 (Model Name “N150X3”, ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# 3 1st character of string (“N”)	4E	01001110
96	60	# 3 2nd character of string (“1”)	31	00110001
97	61	# 3 3rd character of string (“5”)	35	00110101
98	62	# 3 4th character of string (“0”)	30	00110000
99	63	# 3 5th character of string (“X”)	58	01011000
100	64	# 3 6th character of string (“6”)	36	00110110
101	65	# 3 New line character # 3 indicates end of ASCII string	20	00100000
102	66	# 3 Padding with “Blank” character	20	00100000
103	67	# 3 Padding with “Blank” character	20	00100000
104	68	# 3 Padding with “Blank” character	20	00100000
105	69	# 3 Padding with “Blank” character	20	00100000
106	6A	# 3 Padding with “Blank” character	20	00100000
107	6B	# 3 Padding with “Blank” character	20	00100000
108	6C	Detailed timing description # 4	00	00000000
109	6D	# 4 Flag	00	00000000
110	6E	# 4 Reserved	00	00000000
111	6F	# 4 FE (hex) defines Monitor name (“Color LCD”, ASCII)	FE	11111100
112	70	# 4 Flag	00	00000000
113	71	SMBUS value @ 20nits = 237d	ED	11101101
114	72	SMBUS value @ 28nits = 201d	C9	11001001
115	73	SMBUS value @ 40nits = 178d	B2	10100010
116	74	SMBUS value @ 56nits = 157d	9D	10011101
117	75	SMBUS value @ 79nits = 132d	84	10000100
118	76	SMBUS value @ 111nits = 98d	62	01100010
119	77	SMBUS value @ 156nits = 61d	3D	00111101
120	78	SMBUS value @ 220nits = 0d	00	00000000
121	79	Numbers of LVDS Recevier chip = 1	01	00000001
122	7A	# 4 New line character # 4 indicates end of Monitor name	00	00000000
123	7B	# 4 Padding with “Blank” character	0A	00001010
124	7C	# 4 Padding with “Blank” character	20	00100000
125	7D	# 4 Padding with “Blank” character	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	2C	00101100

5.5 EDID SIGINAL SPECIFICATION

(1) EDID Power

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power supply voltage	Vcc	Read Operation	2.2	—	5.5	V



(2) DC characteristics

		Symbol	Min.	Max.	Unit	Index
SCL, SDA terminal input voltage	High Voltage	VIH	0.7×Vcc	—	V	
	Low Voltage	VIL	—	0.3×Vcc	V	
Hysteresis Voltage		VHYS	0.05 VCC	—	V	
Output Voltage		VOL1 VOL2	—	0.4 0.6	V	IOL=3mA, CC=2.5V IOL=6mA, CC=2.5V
Input Leak current (Vin =0.1V~VCC)		ILI	-10 -10	10 50	uA	WP=VSS WP=VCC
Output Leak current		ILO	-10	10	uA	Vout =0.1V~VCC, WP=VSS
Terminal capacity(Input, Output)		Cin, Cout	—	10	pF	VCC=5.0V Ta=25^{0}C, Fclk=1.0MHz
Operating current		ICC Write ICC Read	—	3 1	mA	VCC=5.5V, SCL=400KHz
Stillness current (SDA=SCL=VCC) (WP=VSS,A0,A1,A2=VSS)		ICCS	—	30 100	uA	VCC=3.0V VCC=5.5V

(3) AC characteristics (VCC=2.5~5.5V standard operation mode)

Item	Symbol	VCC=2.5V-5.5V (Standard operation mode)		VCC=4.5V-5.5V (High-speed operation mode)			
		Min.	Max.	Min.	Max.	Unit	Index
Clock frequency	Fclk	—	100	—	400	KHz	
Clock High Time	THIGH	4000	—	900	—	ns	
Clock Low Time	TLOW	4700	—	1300	—	ns	
SDA, SCL falling time	TR	—	1000	—	300	ns	
SDA, SCL rising time	TF	—	300	—	300	ns	
START hold time	THD: STA	4000	—	600	—	ns	
START setup time	TSU: STA	4700	—	600	—	ns	
Data input hold time	THD: Data	0	—	0	—	ns	
Data input setup time	TSU: Data	250	—	100	—	ns	
STOP setup time	TSU: STO	4700	—	600	—	ns	
Output decision time from a clock	TAA	—	3500	100	900	ns	
Bus free time	TBUF	4700	—	1300	—	ns	
Rising time of Min VIH, VIL	TOF	—	250	20	250	ns	CB≦100pF
Spike oppression	TSP	—	50	—	50	ns	
A write-in cycle time	TWR	—	10	—	10	ms	Byte and page mode
The number of times of data rewriting	—	1M	—	1M	—	cycles	VCC=5.0V Ta=25^{0}C,

6. INVERTER SPECIFICATION

6.1 TYPE OF INVERTER CONNECTOR

Input connector: LVC-D20SFYG (HONDA)

Output connector: JST SM02B-BHSS-1-TB (JST)

6.2 BUILT-IN INVERTER INPUT PIN ASSIGNMENT

Input connector		**Comments**
HONDA	**LVC-D20SFYG**	
Pin	**Function**	
1	INV_SRC	This power rail should be used as a power rail to drive the backlight DC-AC converter
2	INV_SRC	This power rail should be used as a power rail to drive the backlight DC-AC converter
3	INV_SRC	This power rail should be used as a power rail to drive the backlight DC-AC converter
4	NC	No Connection
5	GND	Ground
6	5VSUS	This should be used as power source for the control circuitry on the inverter
7	5VALW	This should be used as power source that stores the brightness/contrast values & the circuit that interfaces with SMB_CLK & SMB_DAT
8	GND	Ground
9	SMB_DAT	SMBus interface for sending brightness & contrast information to the inverter/panel
10	SMB_CLK	SMBus interface for sending brightness & contrast information to the inverter/panel
11	GND	Ground
12	FPBACK	Control signal input into the inverter to turn the backlight ON & OFF (1 - ON, 0 – OFF)
13	GND	Ground
14	LAMP_STAT	Lamp status (Feedback, Lamp On = 5v, Lamp Off 0v), from control chip
15 ~ 20	NC	No Connection

6.3 BUILT-IN INVERTER OUTPUT PIN ASSIGNMENT

Output connector		Comments
JST	SM02B-BHSS-1-TB	
Pin	Function	
1	CFL-High	High-voltage output to the CCFL
2	CFL-Low	Low-voltage output to the CCFL

6.4 GENERAL ELECTRICAL SPECIFICATION

6.4.1 Absolute Maximum Ratings

Items	Absolute max. ratings	Note
INV_SRC(V)	-1.0~23.5	
FPBACK/SMB_CLK/SMB_DAT(V)	-1.0~5.5	

6.4.2 Electrical Characteristics

No.	Item	Symbol	Condition	Min.	Typ.	Max.	Uint
1	Input Voltage	INV_SRC		7.5	14.4	21	V
2	Input Signal Level for 5VSUS, 5VALW			4.85	5	5.2	V
3	Backlight ON/OFF Control	ON	FPBACK=Hi, enable the inverter.	2.0	-	5.25	V
		OFF	FPBACK=Lo, disable the inverter.	-0.3	-	0.8	V
4	Brightness Adjust (Lamp Current Control)	SMB_Data	Control by SMBus	FFH	-	00H	-
5	Lamp Voltage	VL	IL = 6.3mA(typ)	627	660	693	Vrms
6	Output Current	Iout (Min)	SMB_DAT=FFH Ta=25℃, after running 30 min.	1.7	2.0	2.3	mArms
		Iout (Max)	SMB_DAT=00H Ta=25℃, after running 30 min.	6.0	6.3	6.6	mArms
7	Operation Frequency	Freq	Vin=7.5V~21V	45	-	65	KHz
8	Burst mode frequency		Vin=7.5~21V	200	-	220	Hz
9	Open Lamp Voltage	Vopen	No Load	1400	-	1800	Vrms
10	Striking Time	Ts	No Load	0.6	1	1.4	Sec
11	Efficiency	η	Vin=21V, Iout=Max (RES LOAD=100K ohm)	80	-	-	%

Remarks:

(1) Input Voltage

The operating input voltage of inverter shall be defined.

The inverter shall be igniting the CCFL lamp at minimum input voltage at any environment conditions.

(2) On/Off control

Enable: At “ON” condition (FPBACK=Hi), enable the inverter.

Disable: At “OFF” condition (FPB ACK=Lo), disable the inverter.

(3) Quiescent current

At the inverter “OFF” condition, input quiescent should be less than 0.1mA.

(4) Open lamp voltage

The inverter start-up output voltage will be above “Vopen” for “Ts” minimum at any condition under specify until lamp to be ignited. The inverter should be shutdown if lamp ignition was failed in “Ts” maximum. The inverter shall be capable of withstanding the output connections open without component over-stress / fire / smoke /arc.

(5) Burst mode frequency

The burst mode frequency should be in specification in any environment condition and electrical condition.

(6) Power up Overshoot & Undershoot

Overshoot & Undershoot at power up should not exceed the following limits.

Vin	Output current Io(rms)	Io (dI) Overshoot/Undershoot	Settling time (dT)
0→Vin(min.)	Iout(max.)	150% / 50%	5 ms max.
	Iout(min.)		
0→Vin(typ.)	Iout(max.)	150% / 50%	5 ms max.
	Iout(min.)		
0→Vin(max.)	Iout(max.)	150% / 50%	5 ms max.
	Iout(min.)		

dI=Imax.-Io or dI=(Io-Imin.)/Io

(7) Output connections short protection

The inverter shall be capable of withstanding the output connections short without damage or over-stress. And the inverter maximum input power shall be limited within 1W.

7. INTERFACE TIMING

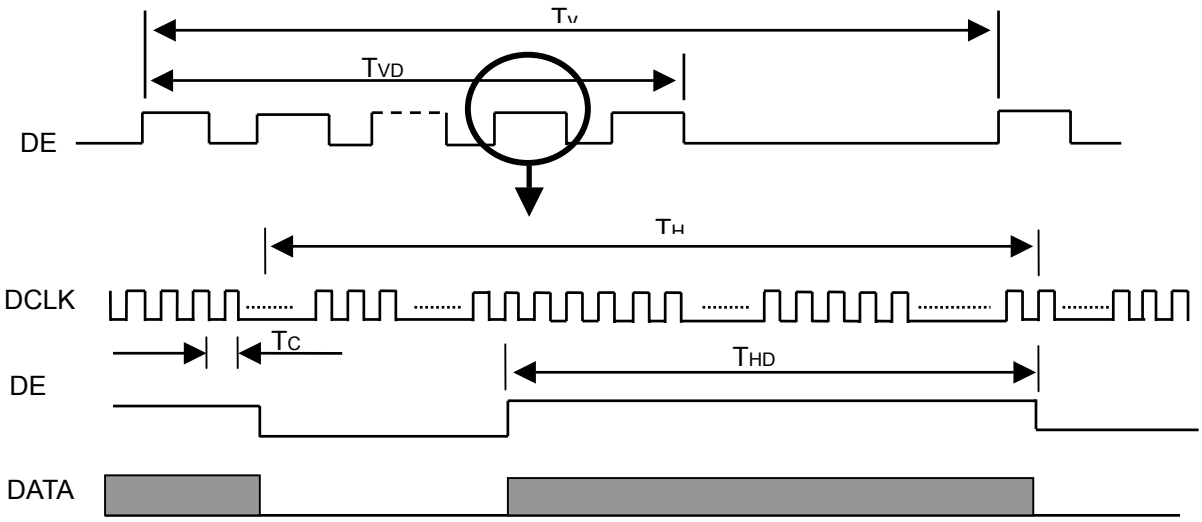
7.1 INPUT SIGNAL TIMING SPECIFICATIONS

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

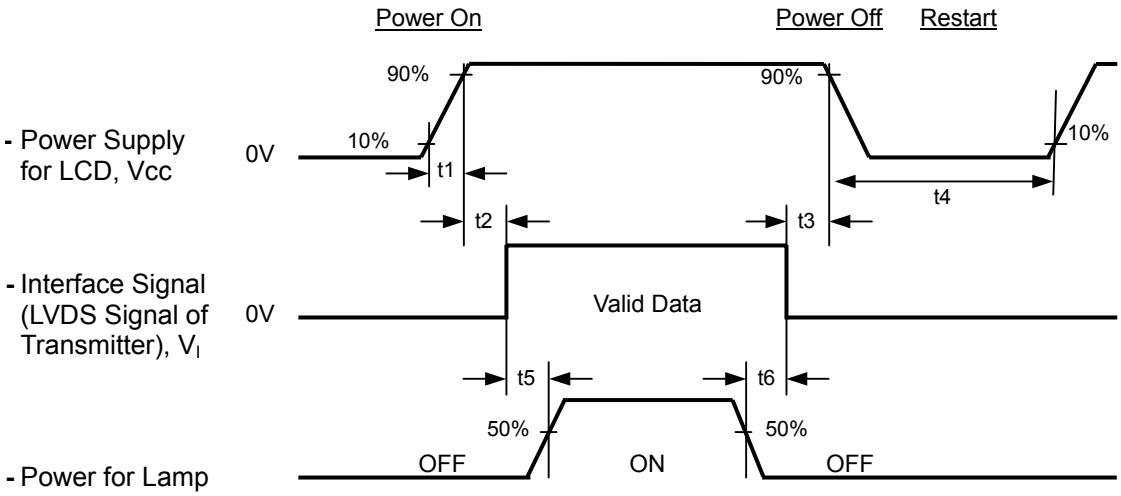
Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	50	65	68	MHz	-
DE	Frame Time Cycle	TV	771	806	850	TH	-
	Vertical Active Display Period	TVD	768	768	768	TH	-
	One Line Scanning Time Cycle	TH	1200	1344	1600	Tc	-
	Horizontal Active Display Period	THD	1024	1024	1024	Tc	-

Note (1) Because this module is operated by DE only mode, Hsync and Vsync input signals should be set to low logic level or ground. Otherwise, this module would operate abnormally.

INPUT SIGNAL TIMING DIAGRAM



7.2 POWER ON/OFF SEQUENCE



Timing Specifications:

0.47	<	t1	≦	10 msec
0	<	t2	≦	50 msec
0	<	t3	≦	50 msec
		t4	≧	500 msec
		t5	≧	200 msec
		t6	≧	200 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.

8. OPTICAL CHARACTERISTICS

8.1 TEST CONDITIONS

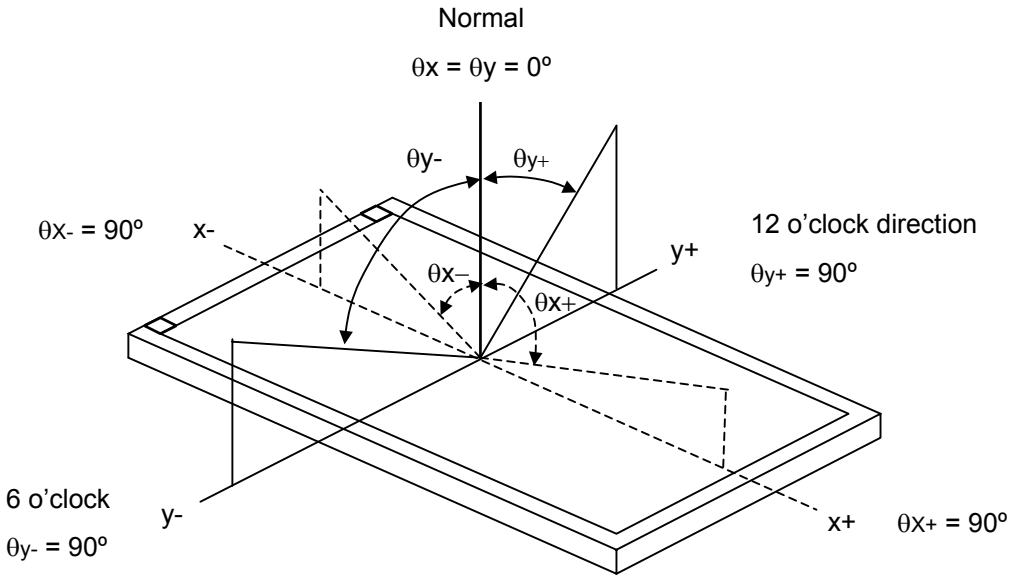
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V_{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
Inverter Current	I_L	6.0	mA
Inverter Driving Frequency	F_L	(50)	KHz
Inverter	TBD		

The relative measurement methods of optical characteristics are shown in 6.2. The following items should be measured under the test conditions described in 6.1 and stable environment shown in Note (6).

8.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	θ_x=0°, θ_Y =0° Viewing Normal Angle	300	-	-	-	(2), (6)
Response Time		T_R		-	6	10	ms	(3)
		T_F		-	17	25	ms	
Average Luminance of White		L_{AVE}		200	220	-	cd/m^2	(4), (6)
White Variation		δW		-	-	1.25	-	(6), (7)
Cross Talk		CT		-	-	3.0	%	(5), (6)
Color Chromaticity	Red	Rx		Typ -0.03	(0.594)	Typ +0.03	-	(1), (6)
		Ry			(0.342)		-	
	Green	Gx			(0.317)		-	
		Gy			(0.530)		-	
	Blue	Bx			(0.150)		-	
		By			(0.130)		-	
	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-		35	40	-		

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

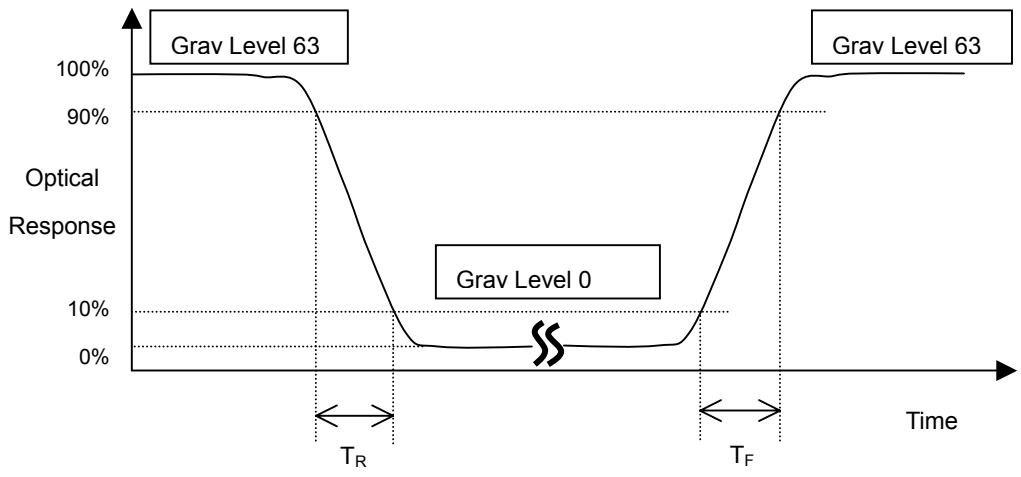
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

CR = CR (5)

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).

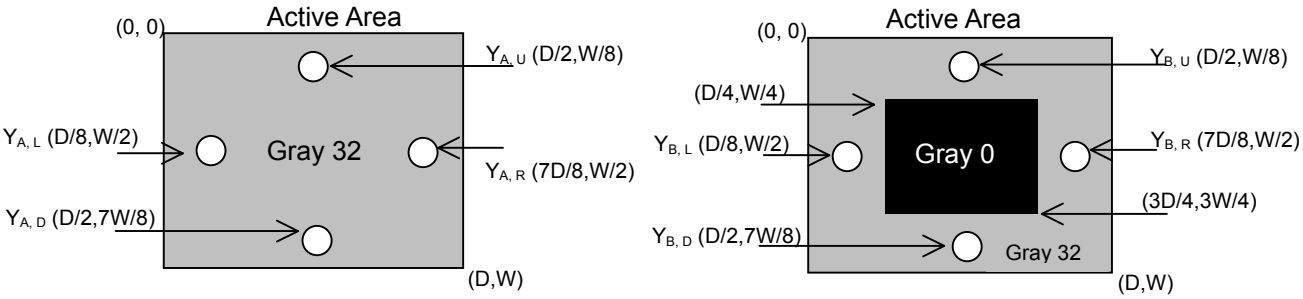
Note (5) Definition of Cross Talk (CT):

$CT = | Y_B – Y_A | / Y_A \times 100$ (%)

Where:

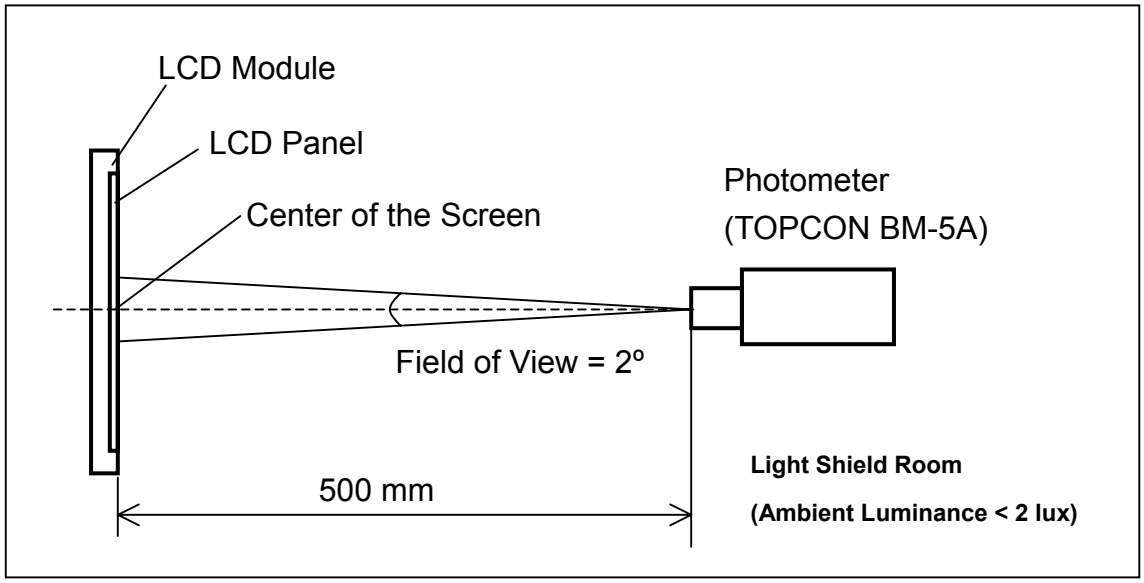
Y_A = Luminance of measured location without gray level 0 pattern (cd/m^2)

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



Note (6) Measurement Setup:

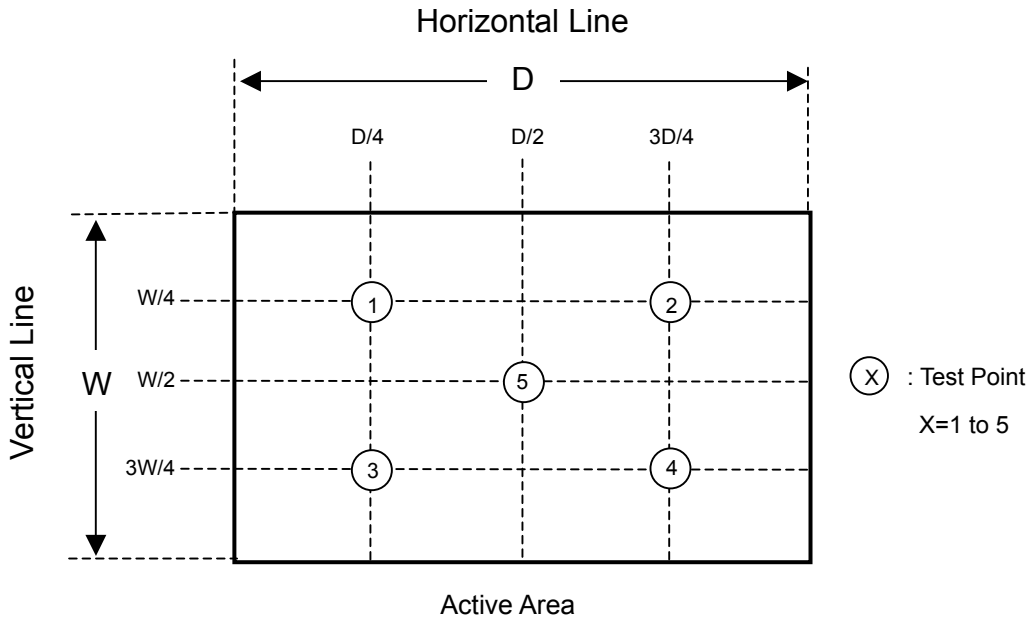
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.



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

Measure the luminance of gray level 63 at 5 points

δW = Maximum [L (1), L (2), L (3), L (4), L (5)] / Minimum [L (1), L (2), L (3), L (4), L (5)]



9. PRECAUTIONS

9.1 ASSEMBLY AND HANDLING PRECAUTIONS

(1) Do not apply rough force such as bending or twisting to the module during assembly.

(2) To assemble or install module into user's system can be only in clean working areas. The dust and oil may cause electrical short or worsen the polarizer.

(3) It's not permitted to have pressure or impulse on the module because the LCD panel and Backlight will be damaged.

(4) Always follow the correct power sequence when LCD module is connecting and operating. This can prevent damage to the CMOS LSI chips during latch-up.

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

(6) Do not disassemble the module.

(7) Use a soft dry cloth without chemicals for cleaning, because the surface of polarizer is very soft and easily scratched.

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

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

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

9.2 SAFETY PRECAUTIONS

(1) 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.

(2) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.

(3) After the module's end of life, it is not harmful in case of normal operation and storage.

10. DEFINITION OF LABELS

10.1 CMO MODULE LABEL

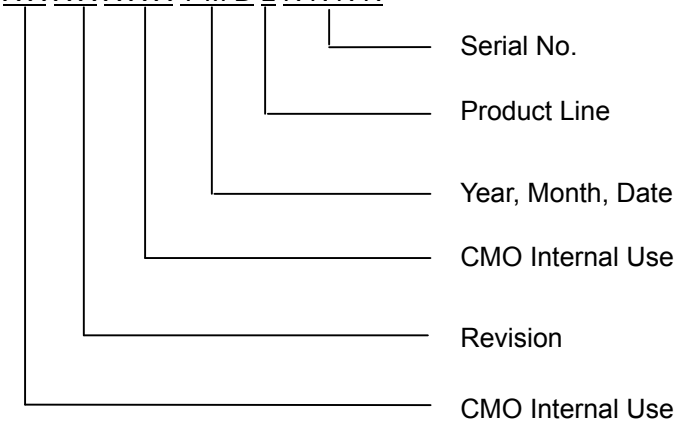
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.

(a) Model Name: N150X6 - L01

(b) Revision: Rev. XX: WS, ES : A1, A2, A3,…, etc.
CS & MP : C1, C2, C3,…,etc.

Note: It will happen that revision code changed without product changed in developing duration because of CMO internal stage change, for example: AX → B1, BX → C1.

(c) Serial ID: X X X X X X Y M D L N N N N



Serial ID includes the information as below:

(a) Manufactured Date: Year: 0 ~ 9, for 2000 ~ 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 changes.

(c) Serial No.: Manufacturing sequence of product.

(d) Product Line: 1 -> Line1, 2 -> Line 2, …etc.

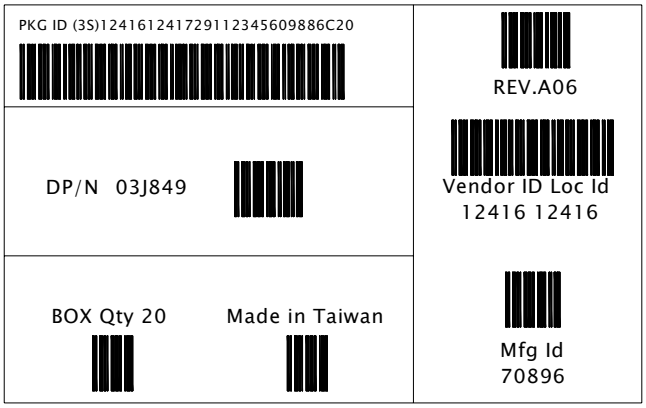
10.2. Dell LABEL

10.2.1 MAL PPID LABEL

Type E Label

- Verdana font, bold
- 6pt.,-all fields
- 300 DPI printer minimum
- Code 128B
- 5-10 mil minimum narrow bar
- .12"minimum barcode height
- .10" or greater quiet zone
- 2" x .50" label size
- Brady THT -53-423-10 polyester stock or equivalent
- Brady B478 or B497 polyimide or equivalent polyimide where high temperature label
- Brady R6000 ribbon or equivalent

10.2.2 CARTON LABEL



Type J Label

- Verdana font or equivalent,bold
- 20pt.-all fields
- 203 DPI printer minimum
- Code 128B
- 10-15 mil minimum narrow bar
- .75"minimum barcode height
- .10" or greater quiet zone
- 4.0" x 6.0" label size
- Brady THT -25-402-1 or equivalent
- Brady R6107 series ribbon or equivalent

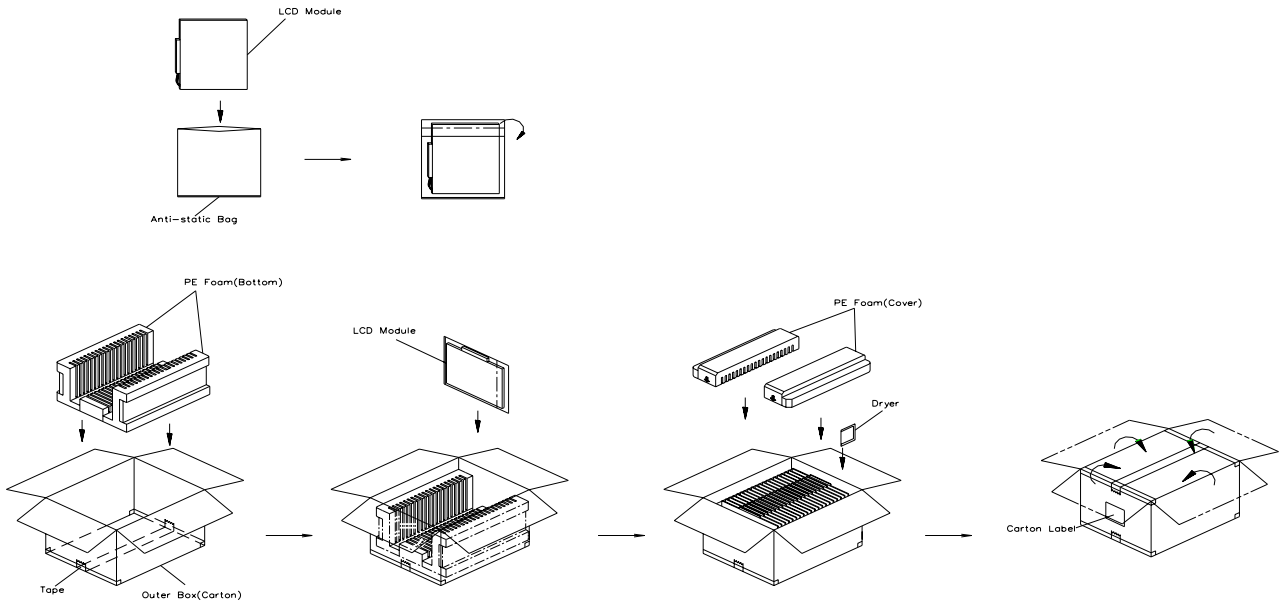
10.2.3 PALLET LABEL

Type K Label

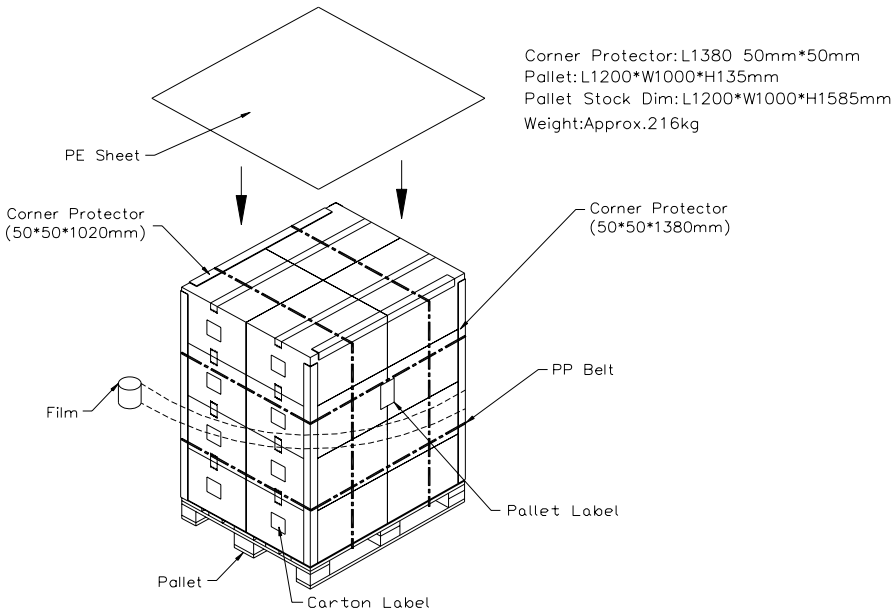
- Verdana font or equivalent,bold
- 12pt.–all descript fields
- 10pt.–all data fields
- 203 DPI printer minimum
- Code 128B
- 10 mil minimum narrow bar
- .30–,50"minimum barcode height
- .10" or greater quiet zone
- 4.0" x 6.5" label size
- Brady THT –78–402–.9 or equivalent
- Brady R6107 series ribbon or equivalent

11.PACKING

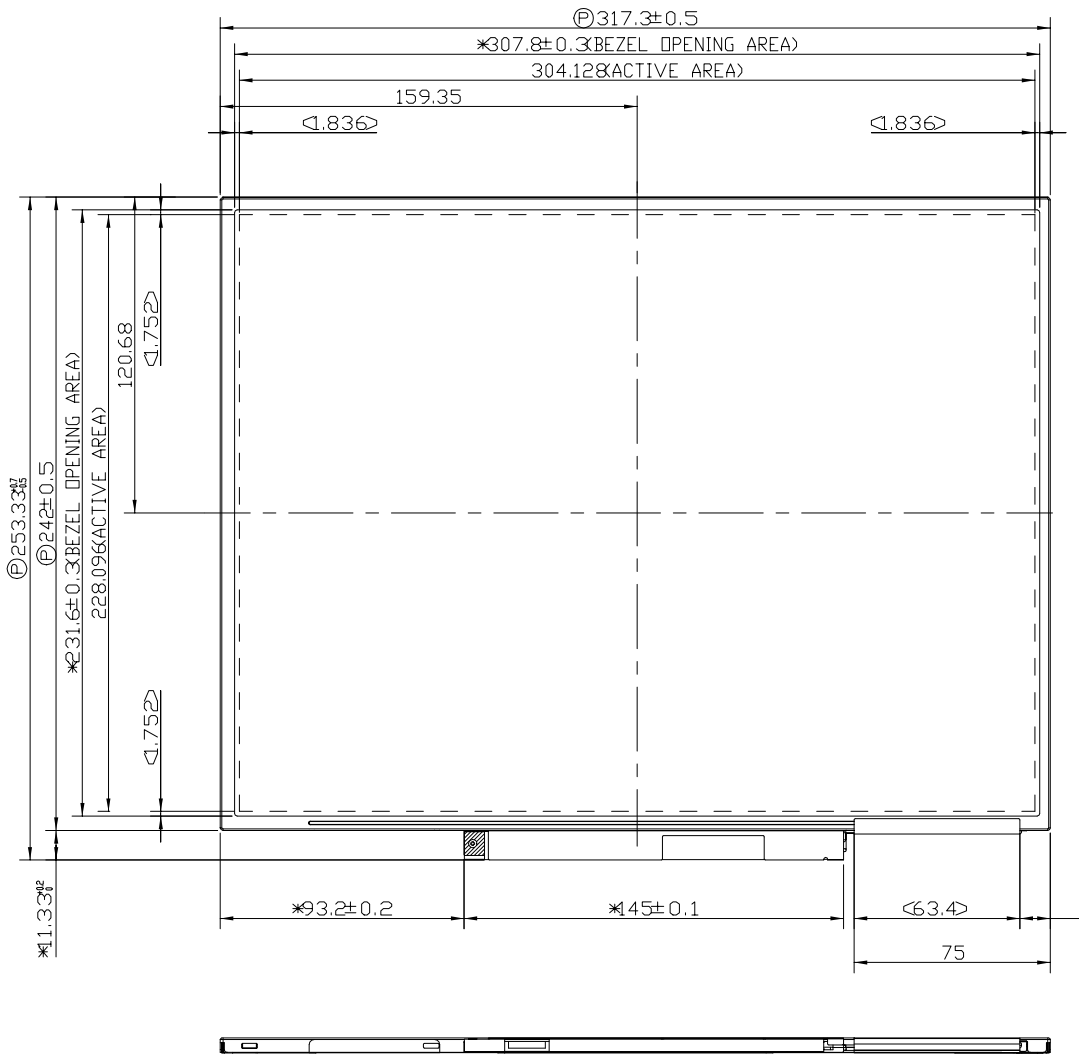
11.1 CARTON

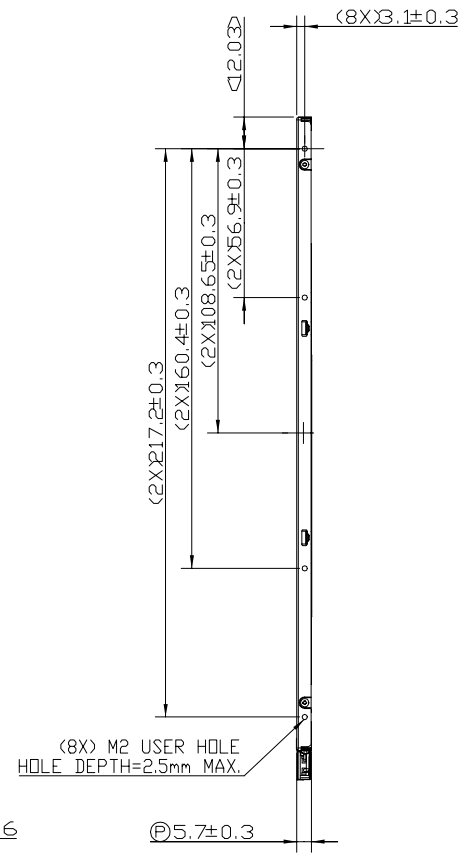


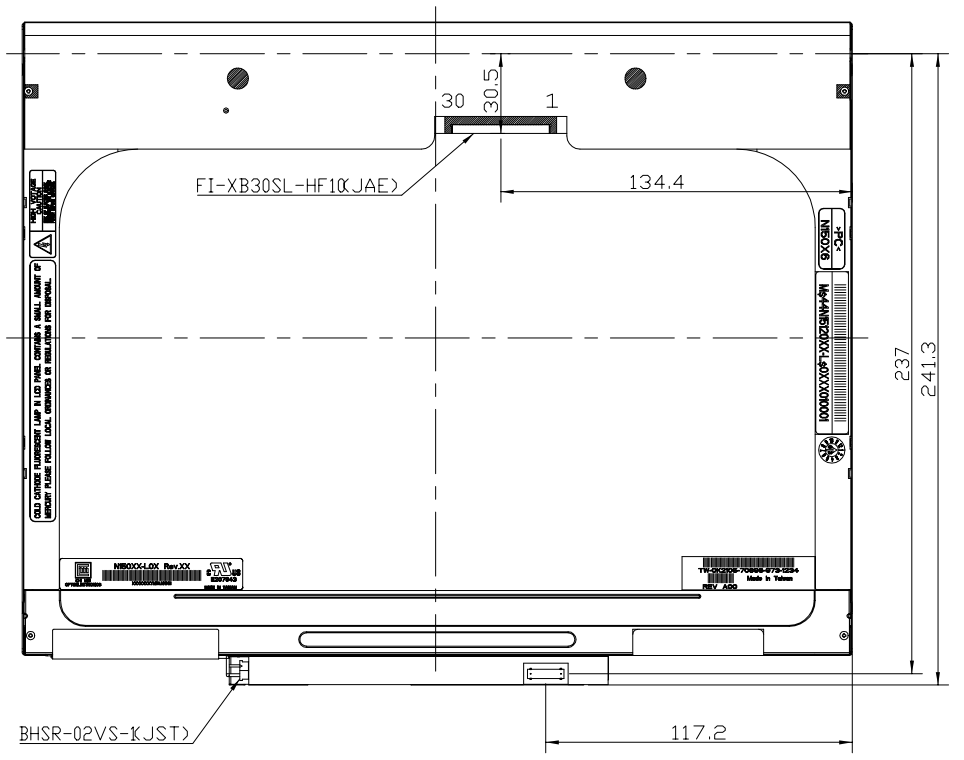
11.2 PALLET



X64102A







NOTE:

1. GENERAL TOLERANCE: ±0.5mm
2. SCREW TORQUE FOR MOUNTING SHOULD NOT EXCEED 2.0kgf-cm
3. "*" MARKS THE DESIGN CRITICAL DIMENSION
4. "Ⓟ" MARKS THE PROCESS CRITICAL DIMENSION

MARK	DESCRIPTION	DATE	CHANGE BY	APPROVAL BY	ECN NO.

CHI MEI 奇美電子股份有限公司
OPTOELECTRONICS CORP.

APPROVED: BILL SHEU	DWG NO.: N150064102A				
CHECKED: YULE LIN	DATE: 09/29/2003				
DESIGNER: S N CHANG	PART NO.:				
DRAWER: S N CHANG	REV.: A	UNIT:	SCALE:	SHEET:	
TITLE: OUTLINE N150X6		MM	1/2	1/1	

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