( ) Preliminary Specifications
(✓) Final Specifications

Module	**15.6"HD 16:9 Color TFT-LCD with LED Backlight design**
Model Name	B156XTN03.2 (H/W: 1A)
Note ( )	***LED Backlight with driving circuit design***

Customer	**Date**	**Approved by**	**Date**
		BuffyChen	04/01/2012
Checked & Approved by	**Date**	**Prepared by**	**Date**
		Derek CW Liu	04/01/2012
Note: This Specification is subject to change without notice.		**NBBU Marketing Division AU Optronics corporation**	

Contents

Record of Revision

Version and Date	Page	Old description	New Description	Remark
0.1 2011/12/20	All	First Edition for Customer		
1.0 2012/02/19	All		Final Edition for Customer	
1.0 2012/03/30	25		Packing description chaned	
1.0 2012/04/01	5	Weight:380g	Weight change to 350g	

1. Handling Precautions

1) Since front polarizer is easily damaged, pay attention not to scratch it.
2) Be sure to turn off power supply when inserting or disconnecting from input connector.
3) Wipe off water drop immediately. Long contact with water may cause discoloration or spots.
4) When the panel surface is soiled, wipe it with absorbent cotton or other soft cloth.
5) Since the panel is made of glass, it may break or crack if dropped or bumped on hard surface.
6) Since CMOS LSI is used in this module, take care of static electricity and insure human earth when handling.
7) Do not open nor modify the Module Assembly.
8) Do not press the reflector sheet at the back of the module to any directions.
9) At the insertion or removal of the Signal Interface Connector, be sure not to rotate nor tilt the Interface Connector of the TFT Module.
11) After installation of the TFT Module into an enclosure (Notebook PC Bezel, for example), do not twist nor bend the TFT Module even momentary. At designing the enclosure, it should be taken into consideration that no bending/twisting forces are applied to the TFT Module from outside. Otherwise the TFT Module may be damaged.
12) Small amount of materials having no flammability grade is used in the LCD module. The LCD module should be supplied by power complied with requirements of Limited Power Source (IEC60950 or UL1950), or be applied exemption.
13) Disconnecting power supply before handling LCD modules, it can prevent electric shock, DO NOT TOUCH the electrode parts, cables, connectors and LED circuit part of TFT module that a LED light bar build in as a light source of back light unit. It can prevent electronic breakdown.

2. General Description

B156XTN03.2 is a Color Active Matrix Liquid Crystal Display composed of a TFT LCD panel, a driver circuit, and LED backlight system. The screen format is intended to support the 16:9 HD, 1366(H) x768(V) screen and 262k colors (RGB 6-bits data driver) with LED backlight driving circuit. All input signals are LVDS interface compatible.

B156XTN03.2 is designed for a display unit of notebook style personal computer and industrial machine.

2.1 General Specification

The following items are characteristics summary on the table at 25 ℃ condition:

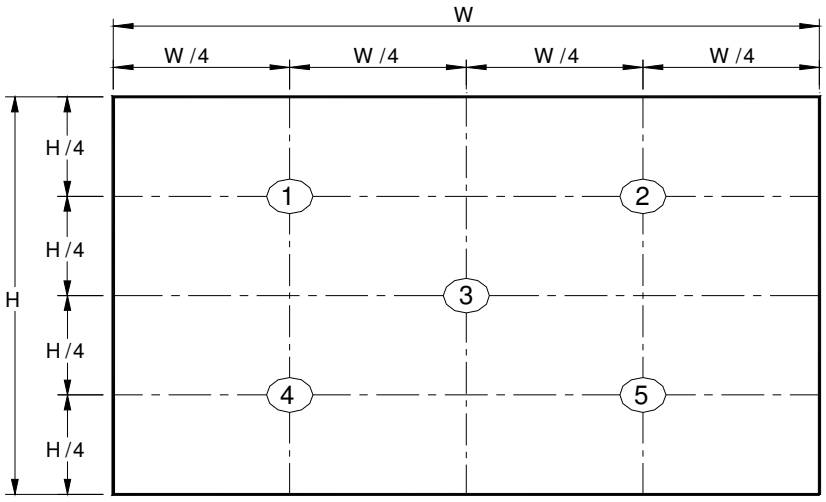
Items	**Unit**	**Specifications**			
Screen Diagonal	[mm]	394.9			
Active Area	[mm]	344.2 X193.5			
Pixels H x V		1366x3(RGB) x 768			
Pixel Pitch	[mm]	0.252X0.252			
Pixel Format		R.G.B. Vertical Stripe			
Display Mode		Normally White			
White Luminance (ILED=20mA) **(Note: ILED is LED current)**	[cd/m^2]	200 typ. (5 points average) 170 min. (5 points average)			
Luminance Uniformity		1.25 max. (5 points)			
Contrast Ratio		500 typ.			
Response Time	[ms]	8 typ/16 Max			
Nominal Input Voltage VDD	[Volt]	+3.3 typ.			
Power Consumption	[Watt]	3.6 max. (Include Logic and Blu power)			
Weight	[Grams]	350 max.			
Physical Size **Include bracket**	[mm]		Min.	Typ.	Max.
		Length	359.0	359.5	360.0
		Width	223.3	223.8	224.3
		Thicknessss	-	-	3.2
Electrical Interface		1 channel LVDS			
Glass Thickness	[mm]	0.4			
Surface Treatment		Glare, hardness 3H			
Support Color		262K colors (RGB 6-bit)			
Temperature Range Operating Storage (Non-Operating)	[°C] [°C]	0 to +50 -20 to +60			
RoHS Compliance		RoHS Compliance			

2.2 Optical Characteristics

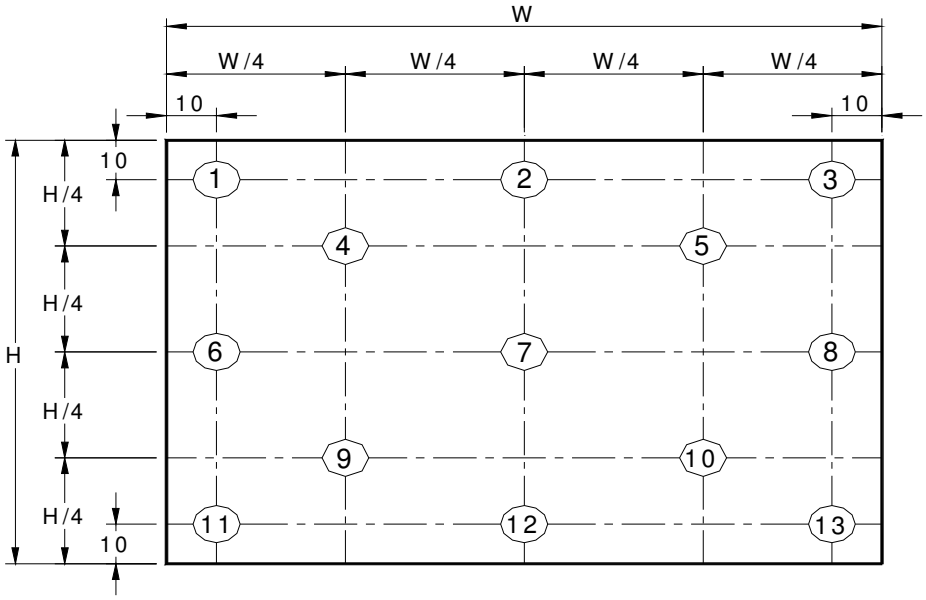
The optical characteristics are measured under stable conditions at 25℃ (Room Temperature) :

Item		Symbol	Conditions	Min.	Typ.	Max.	Unit	Note
White Luminance ILED=20mA			5 points average	170	200	-	cd/m²	1, 4, 5.
Viewing Angle		θ_R θ_L	Horizontal (Right) CR = 10 (Left)	40 40	45 45	- -	degree	4, 9
		ψ_H ψ_L	Vertical (Upper) CR = 10 (Lower)	10 30	15 35	- -		
Luminance Uniformity		δ_{5P}	5 Points	-	-	1.25		1, 3, 4
Luminance Uniformity		δ_{13P}	13 Points	-	-	1.60		2, 3, 4
Contrast Ratio		CR		400	500	-		4, 6
Cross talk		%				4		4, 7
Response Time		T_{RT}	Rising + Falling	-	8	16		
Color / Chromaticity Coodinates	Red	Rx	CIE 1931	0.550	0.580	0.610		4
		Ry		0.305	0.335	0.365		
	Green	Gx		0.300	0.330	0.360		
		Gy		0.535	0.565	0.595		
	Blue	Bx		0.125	0.155	0.185		
		By		0.110	0.140	0.170		
	White	Wx		0.283	0.313	0.343		
		Wy		0.299	0.329	0.359		
NTSC		%		-	45	-		

Note 1: 5 points position (Ref: Active area)



Note 2: 13 points position (Ref: Active area)



Note 3: The luminance uniformity of 5 or13 points is defined by dividing the maximum luminance values by the minimum test point luminance

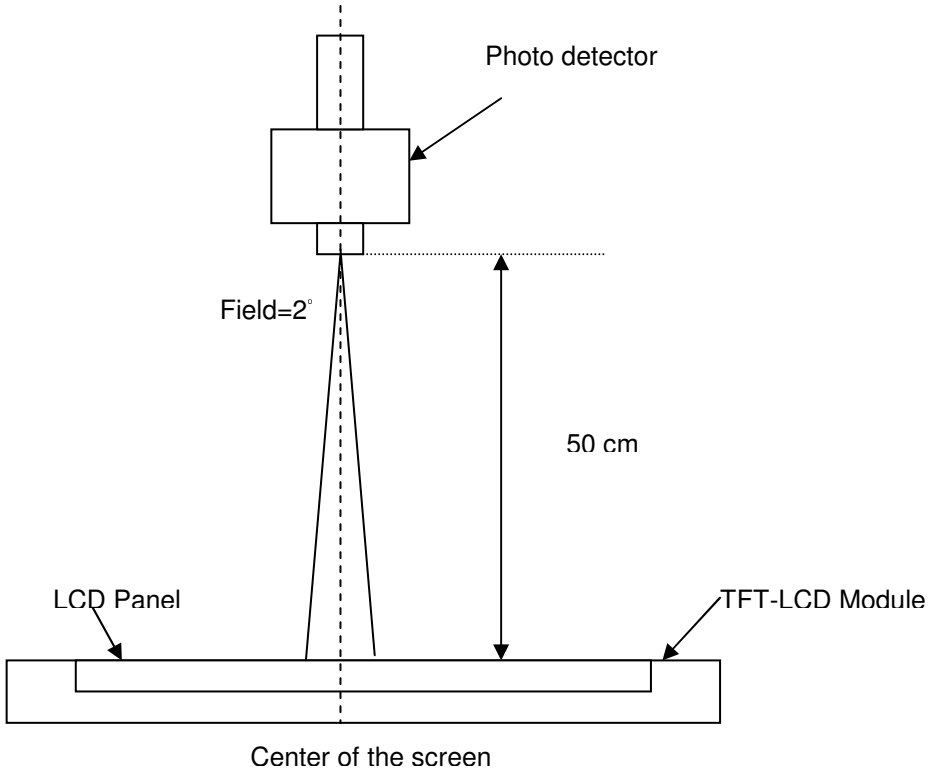
$$\delta_{W5} = \frac{\text{Maximum Brightness of five points}}{\text{Minimum Brightness of five points}}$$

$$\delta_{W13} = \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$

Note 4: Measurement method

The LCD module should be stabilized at given temperature for 30 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after

lighting Backlight for 30 minutes in a stable, windless and dark room, and it should be measured in the center of screen.



Note 5： Definition of Average Luminance of White (Y_L):

Measure the luminance of gray level 63 at 5 points，Y_L = [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 (1).

Note 6： Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "White" state}}{\text{Brightness on the "Black" state}}$$

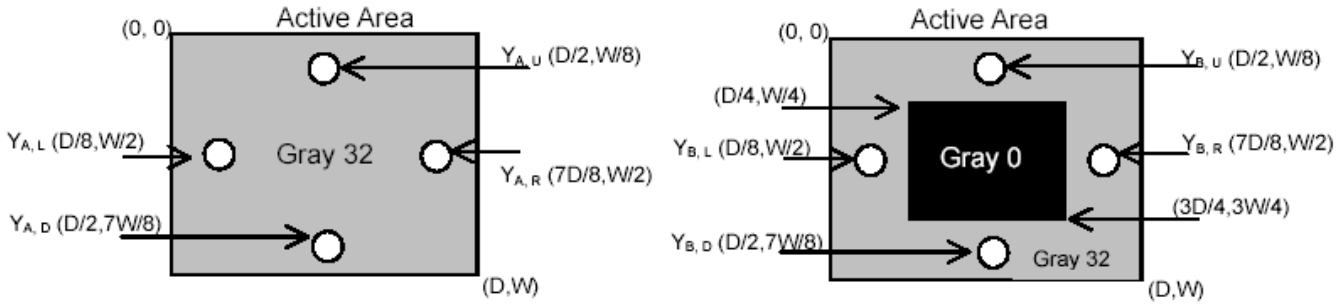
Note 7： Definition of Cross Talk (CT)

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

Where

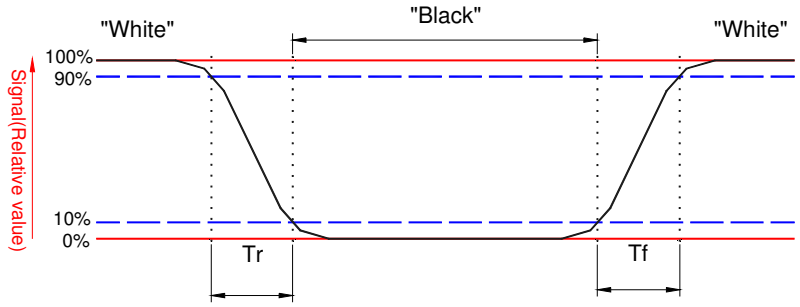
Y_A = Luminance of measured location without gray level 0 pattern (cd/m2)

Y_B = Luminance of measured location with gray level 0 pattern (cd/m2)



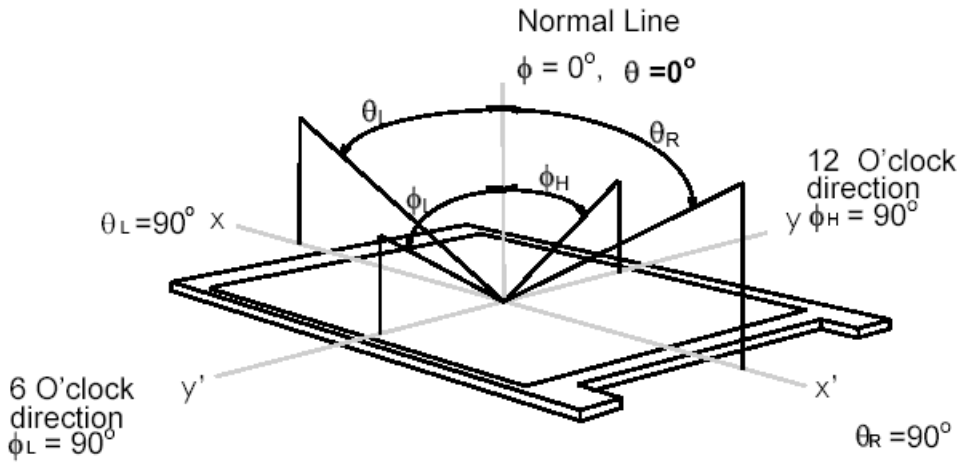
Note 8: Definition of response time:

The output signals of BM-7 or equivalent are measured when the input signals are changed from "Black" to "White" (falling time) and from "White" to "Black" (rising time), respectively. The response time interval between the 10% and 90% of amplitudes. Refer to figure as below.



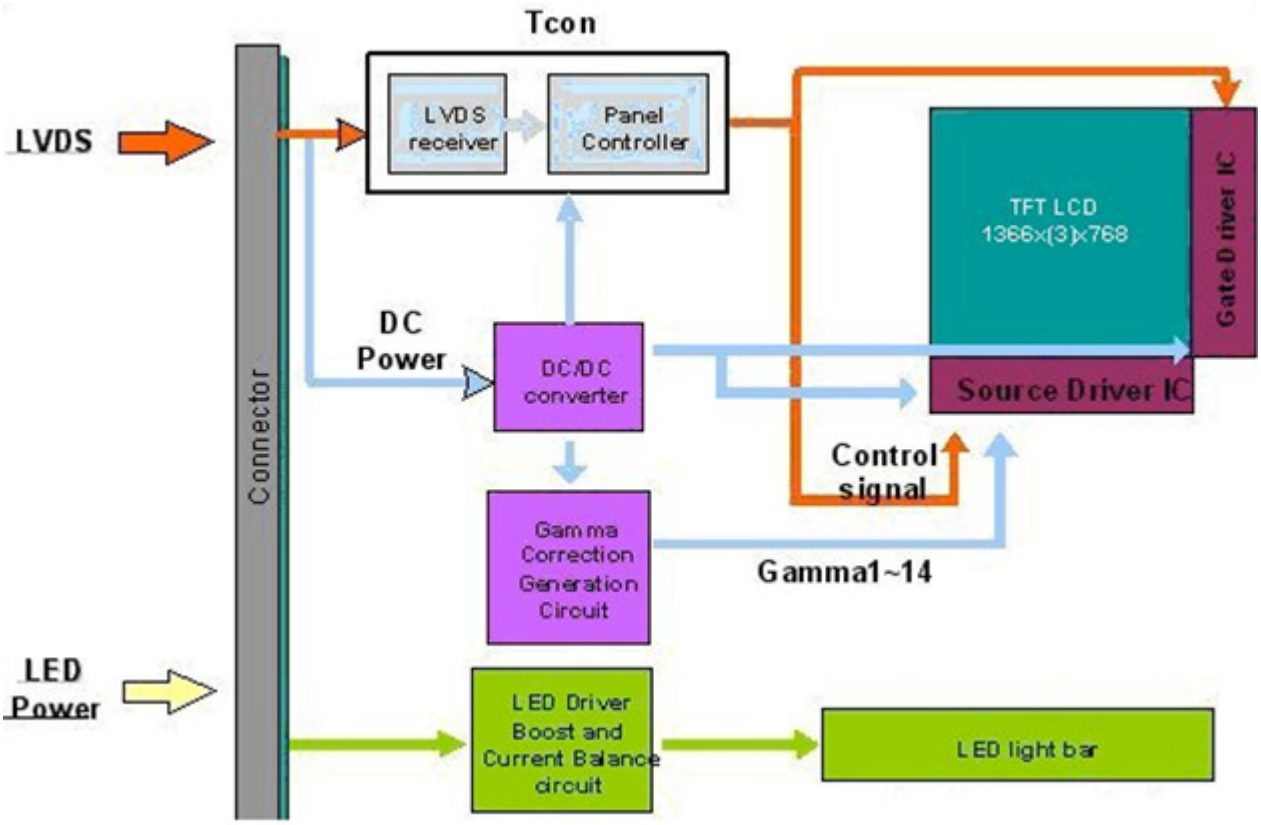
Note 9. Definition of viewing angle

Viewing angle is the measurement of contrast ratio ≧10, at the screen center, over a 180° horizontal and 180° vertical range (off-normal viewing angles). The 180° viewing angle range is broken down as follows; 90° (θ) horizontal left and right and 90° (Φ) vertical, high (up) and low (down). The measurement direction is typically perpendicular to the display surface with the screen rotated about its center to develop the desired measurement viewing angle.



3. Functional Block Diagram

The following diagram shows the functional block of the 15.6 inches wide Color TFT/LCD 40 Pin (One CH/connector Module)



4. Absolute Maximum Ratings

An absolute maximum rating of the module is as following:

4.1 Absolute Ratings of TFT LCD Module

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive	Vin	-0.3	+4.0	[Volt]	Note 1,2

4.2 Absolute Ratings of Environment

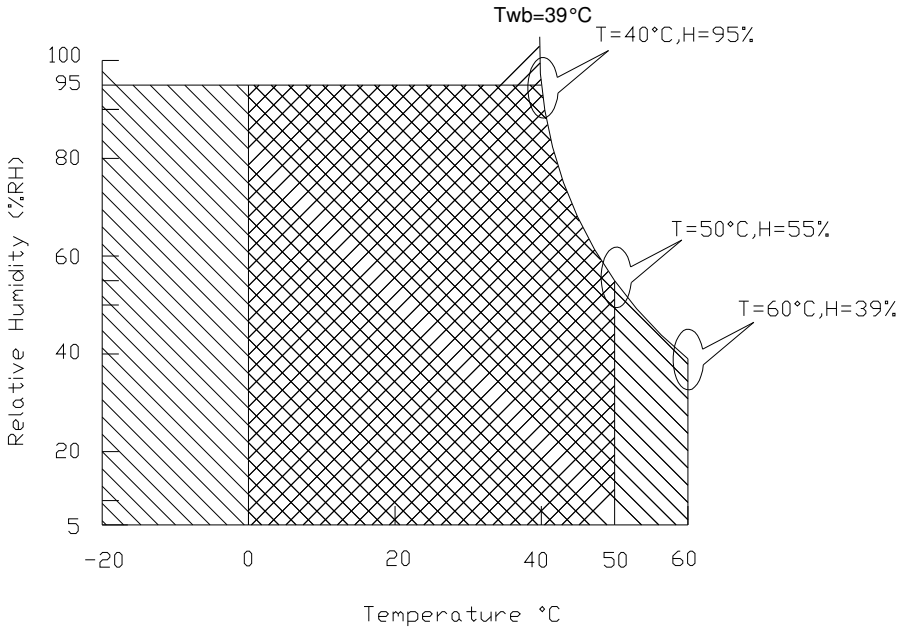
Item	Symbol	Min	Max	Unit	Conditions
Operating	TOP	0	+50	[°C]	Note 4
Operation Humidity	HOP	5	95	[%RH]	Note 4
Storage Temperature	TST	-20	+60	[°C]	Note 4
Storage Humidity	HST	5	95	[%RH]	Note 4

Note 1: At Ta (25℃)

Note 2: Permanent damage to the device may occur if exceed maximum values

Note 3: LED specification refer to section 5.2

Note 4: For quality performance, please refer to AUO IIS (Incoming Inspection Standard).



Operating Range Storage Range +

5. Electrical Characteristics

5.1 TFT LCD Module

5.1.1 Power Specification

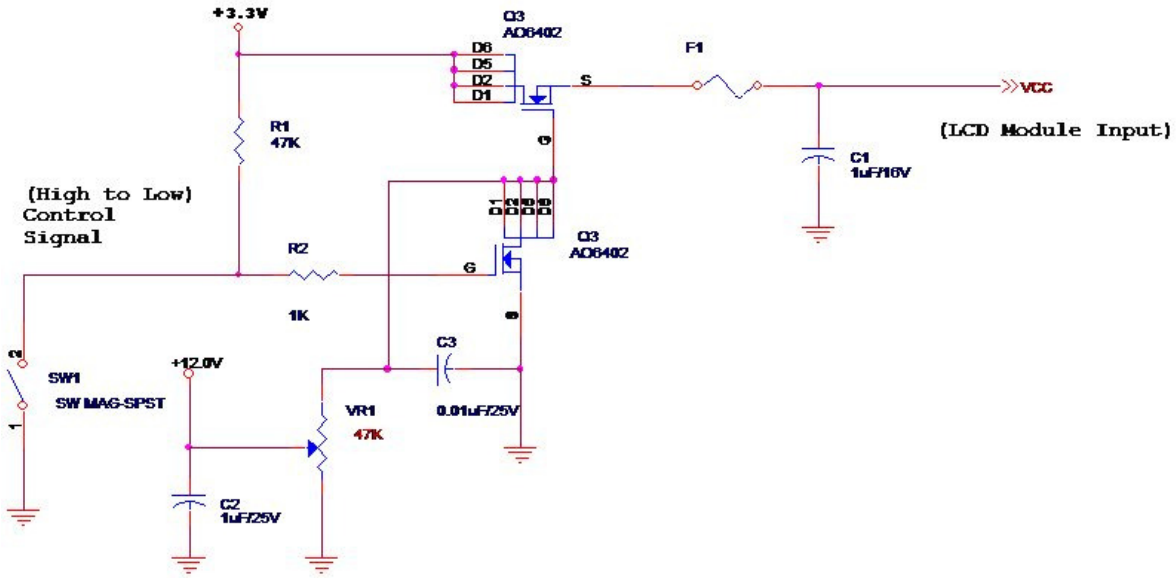
Input power specifications are as follows;

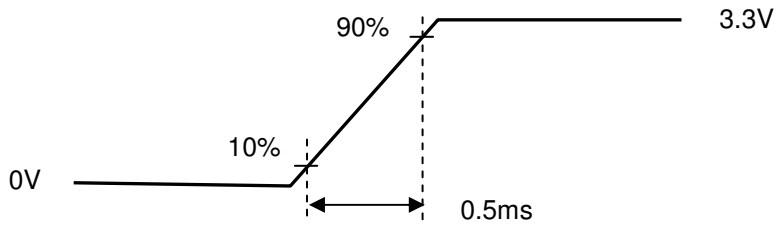
The power specification are measured under 25℃ and frame frenquency under 60Hz

Symble	Parameter	Min	Typ	Max	Units	Note
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	
PDD	VDD Power	-	-	0.8	[Watt]	Note 1
IDD	IDD Current	-	-	166	[mA]	Note 1
IRush	Inrush Current	-	-	2000	[mA]	Note 2
VDDrp	Allowable Logic/LCD Drive Ripple Voltage	-	-	100	[mV] p-p	

Note 1 : Maximum Measurement Condition : Black Pattern at 3.3V driving voltage. ($P_{max}=V_{3.3} \times I_{black}$)

Note 2 : Measure Condition





Vin rising time

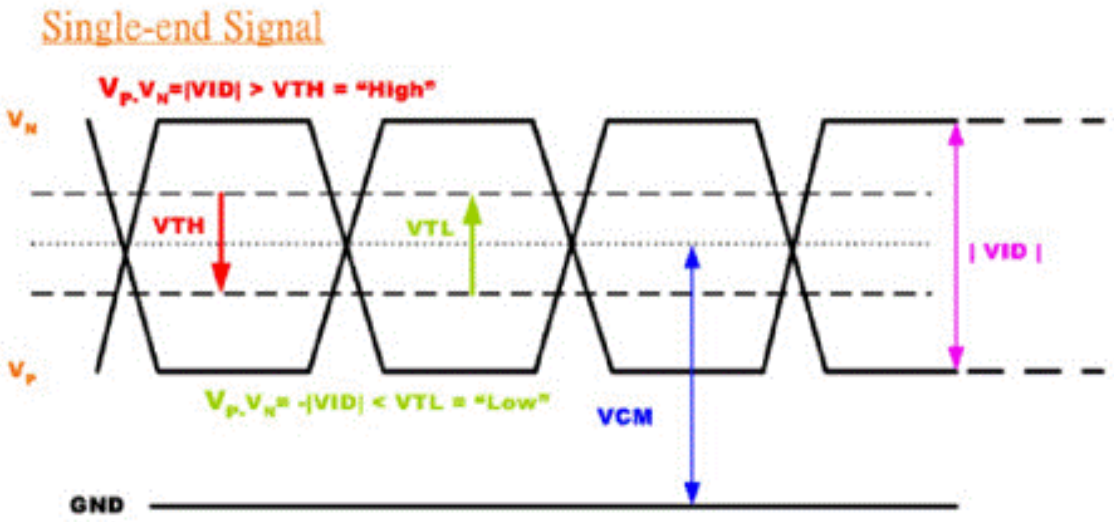
5.1.2 Signal Electrical Characteristics

Input signals shall be low or High-impedance state when VDD is off.

Signal electrical characteristics are as follows;

Parameter	Condition	Min	Max	Unit
V_{TH}	Differential Input High Threshold (Vcm=+1.2V)		100	[mV]
V_{TL}	Differential Input Low Threshold (Vcm=+1.2V)	-100	-	[mV]
$\lvert V_{ID} \rvert$	Differential Input Voltage	100	600	[mV]
V_{CM}	Differential Input Common Mode Voltage	1.125	1.375	[V]

Note: LVDS Signal Waveform



5.2 Backlight Unit

5.2.1 LED characteristics

Parameter	Symbol	Min	Typ	Max	Units	Condition
Backlight Power Consumption	PLED	-	-	2.8	[Watt]	(Ta=25℃), Note 1 Vin =12V
LED Life-Time	N/A	15000	-	-	Hour	(Ta=25℃), Note 2 I_F=20 mA

Note 1: Calculator value for reference P_{LED} = V_F (Normal Distribution) * I_F (Normal Distribution) / Efficiency

Note 2: The LED life-time define as the estimated time to 50% degradation of initial luminous.

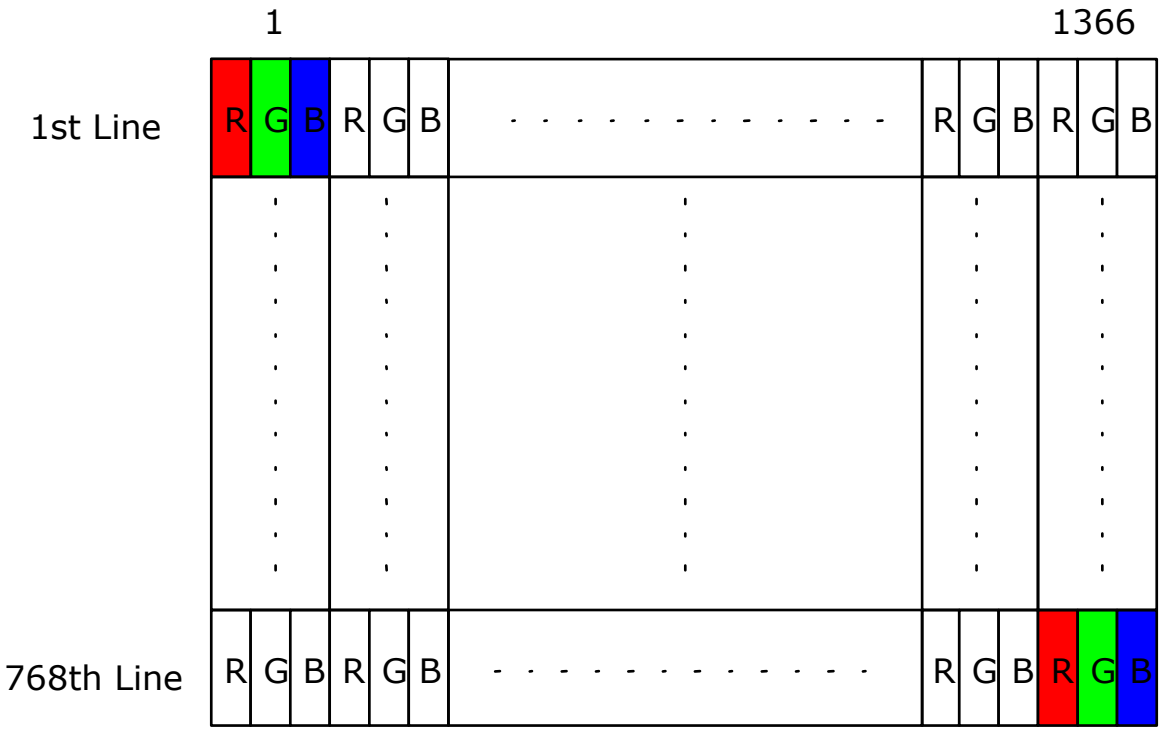
5.2.2 Backlight input signal characteristics

Parameter	Symbol	Min	Typ	Max	Units	Remark
LED Power Supply	VLED	6.0	12.0	21.0	[Volt]	Define as Connector Interface (Ta=25℃)
LED Enable Input High Level	VLED_EN	2.5	-	5.5	[Volt]	
LED Enable Input Low Level		-	-	0.8	[Volt]	
PWM Logic Input High Level	VPWM_EN	2.5	-	5.5	[Volt]	
PWM Logic Input Low Level		-	-	0.8	[Volt]	
PWM Input Frequency	FPWM	200	1K	10K	Hz	
PWM Duty Ratio	Duty	5	--	100	%	

6. Signal Interface Characteristic

6.1 Pixel Format Image

Following figure shows the relationship of the input signals and LCD pixel format.



6.2 Integration Interface Requirement

6.2.1 Connector Description

Physical interface is described as for the connector on module.

These connectors are capable of accommodating the following signals and will be following components.

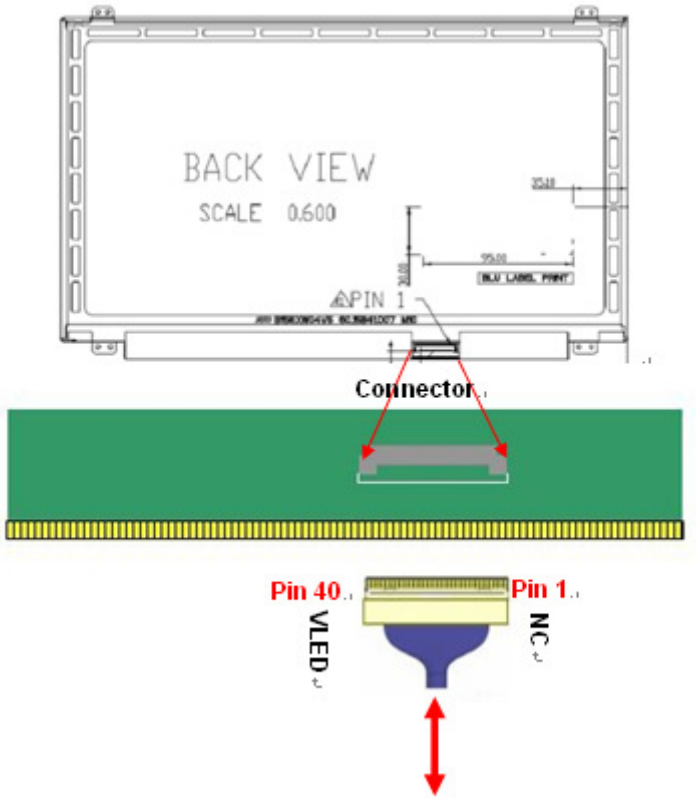
Connector Name / Designation	For Signal Connector
Manufacturer	IPEX or compatible
Type / Part Number	IPEX 20455-040E-12R or compatible
Mating Housing/Part Number	IPEX 20453-040T-01 or compatible

6.2.2 Pin Assignment

LVDS is a differential signal technology for LCD interface and high speed data transfer device.

PIN#	Signal Name	Description
1	NC	No Connection (Reserve)
2	VDD	Power Supply +3.3V
3	VDD	Power Supply +3.3V
4	VEDID	EDID +3.3V Power
5	NC	No Connect (Reserve)
6	CLK_EDID	EDID Clock Input
7	DAT_EDID	EDID Data Input
8	RxOIN0-	-LVDS Differential Data INPUT(Odd R0-R5,G0)
9	RxOIN0+	+LVDS Differential Data INPUT(Odd R0-R5,G0)
10	VSS	Ground
11	RxOIN1-	-LVDS Differential Data INPUT(Odd G1-G5,B0-B1)
12	RxOIN1+	+LVDS Differential Data INPUT(Odd G1-G5,B0-B1)
13	VSS	Ground
14	RxOIN2-	-LVDS Differential Data INPUT(Odd B2-B5,HS,VS,DE)
15	RxOIN2+	+LVDS Differential Data INPUT(Odd B2-B5,HS,VS,DE)
16	VSS	Ground
17	RxOCKIN-	-LVDS Odd Differential Clock INPUT
18	RxOCKIN+	+LVDS Odd Differential Clock INPUT
19	NC	No connection (Reserve)
20	NC	No connection
21	NC	No connection

22	GND	Ground-Shield
23	NC	No connection
24	NC	No connection
25	GND	Ground-Shield
26	NC	No connection
27	NC	No connection
28	GND	Ground-Shield
29	NC	No connection
30	NC	No connection
31	VLED_GND	LED Ground
32	VLED_GND	LED Ground
33	VLED_GND	LED Ground
34	NC	No Connection (Reserve)
35	VPWM_EN	PWM logic input level
36	VLED_EN	LED enable input level
37	NC	No connection (Reserve)
38	VLED	LED Power Supply
39	VLED	LED Power Supply
40	VLED	LED Power Supply



Note1：start from right side
Note2：Input signals shall be low or High-impedance state when VDD is off.

6.3 Interface Timing

6.3.1 Timing Characteristics

Basically, interface timings should match the 1366x768 /60Hz manufacturing guide line timing.

Parameter		Symbol	Min.	Typ.	Max.	Unit
Frame Rate		-	-	60	-	Hz
Clock frequency		1/ T_{Clock}	65	72	80	MHz
Vertical Section	Period	T_V	780	790	768+A	T_{Line}
	Active	T_{VD}	768			
	Blanking	T_{VB}	12	22	A	
Horizontal Section	Period	T_H	1426	1426	1366+B	T_{Clock}
	Active	T_{HD}	1366			
	Blanking	T_{HB}	60	96	B	

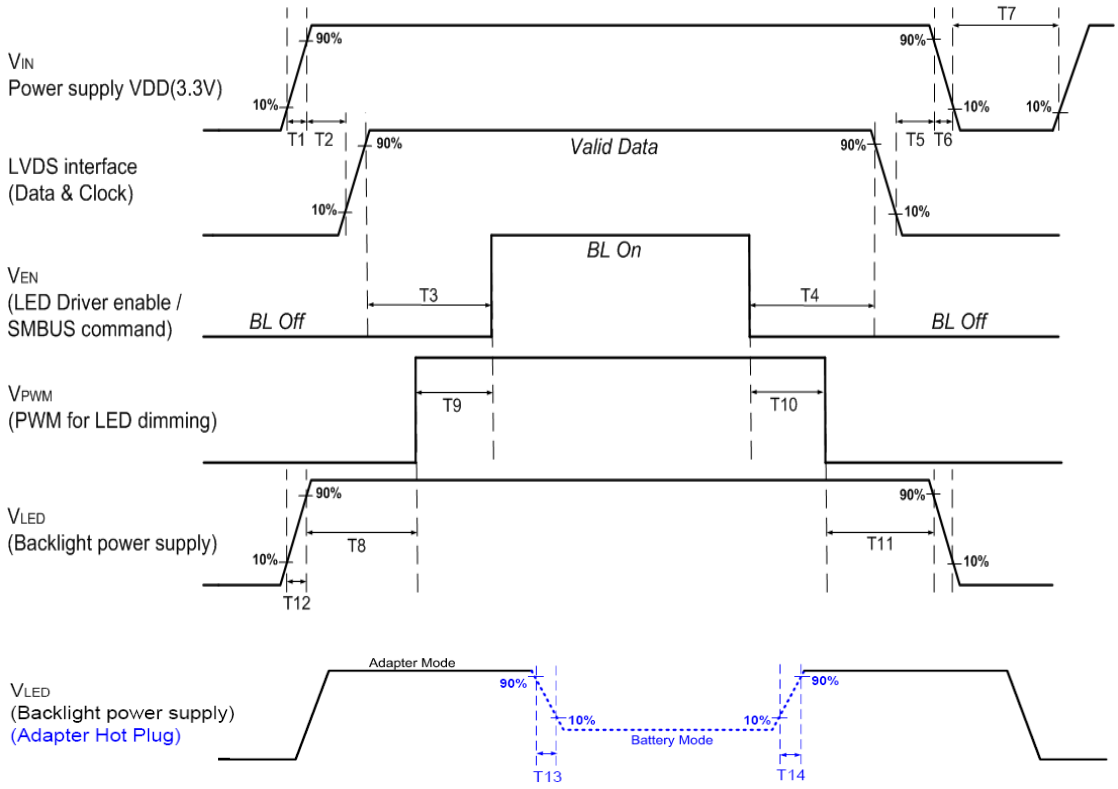
Note 1 : The above is as optimized setting

Note 2 : DE mode only

Note 3 : The maximum clock frequency = (1366+B)*(768+A)*60<80MHz

6.4 Power sequence

Power on/off sequence is as follows. Interface signals and LED on/off sequence are also shown in the chart. Signals from any system shall be Hi-Z state or low level when VDD is off



Power Sequence Timing			
	Value		
Parameter	Min.	Max.	Units
T1	0.5	10	ms
T2	0	50	
T3	200	-	
T4	200	-	
T5	0	50	
T6	0	10	
T7	500	-	
T8	10	-	
T9	10	-	
T10	10	-	
T11	10	-	
T12	0.5	10	
T13	1*	-	
T14	1*	-	

Note 1 : If T3<200ms, the display garbage may occur. (T3>200ms is recommended)

Note 2 : If T1 or T12<0.5ms, the inrush current may cause the damage of fuse. If T1 or T12<0.5ms, the inrush current I^2t is under typical melt of fuse Spec, there is no mentioned problem.

7. Panel Reliability Test

7.1 Vibration Test

Test Spec:

- Test method: Non-Operation
- Acceleration: 1.5 G
- Frequency: 10 - 500Hz Random
- Sweep: 30 Minutes each Axis (X, Y, Z)

7.2 Shock Test

Test Spec:

- Test method: Non-Operation
- Acceleration: 220 G , Half sine wave
- Active time: 2 ms
- Pulse: X,Y,Z .one time for each side

7.3 Reliability Test

Items	Required Condition	Note
Temperature Humidity Bias	Ta= 40℃, 90%RH, 300h	
High Temperature Operation	Ta= 50℃, Dry, 300h	
Low Temperature Operation	Ta= 0℃, 300h	
High Temperature Storage	Ta= 60℃, 35%RH, 300h	
Low Temperature Storage	Ta= -20℃, 50%RH, 250h	
Thermal Shock Test	Ta=-20℃to 60℃, Duration at 30 min, 100 cycles	
ESD	Contact : ±8 KV Air : ±15 KV	Note 1

Note1: According to EN 61000-4-2 , ESD class B: Some performance degradation allowed. Self-recoverable.

No data lost, No hardware failures.

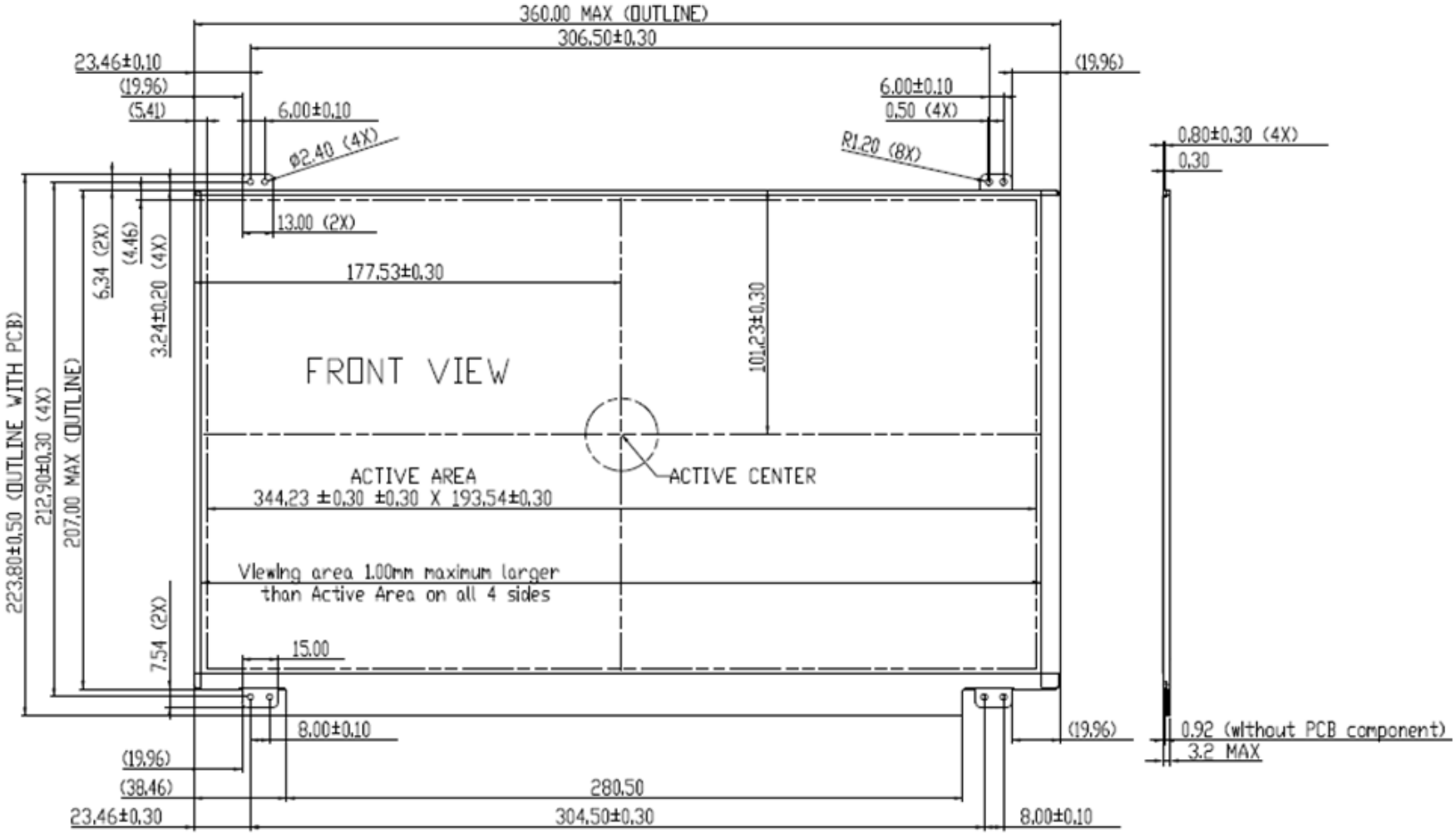
Remark: MTBF (Excluding the LED): 30,000 hours with a confidence level 90%

8. Mechanical Characteristics

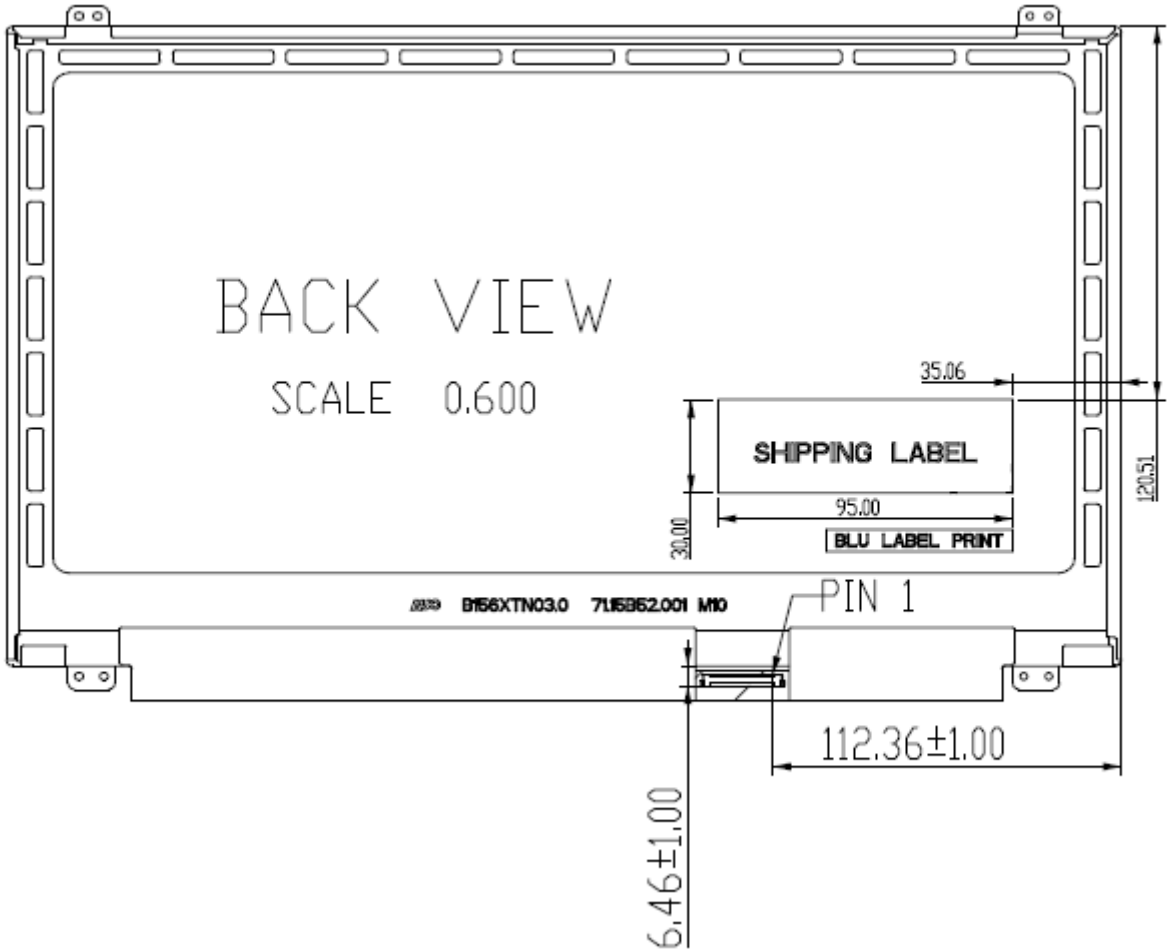
8.1 LCM Outline Dimension

8.1.1 Standard Front View

The drawing following 2D standard drawing and remark.



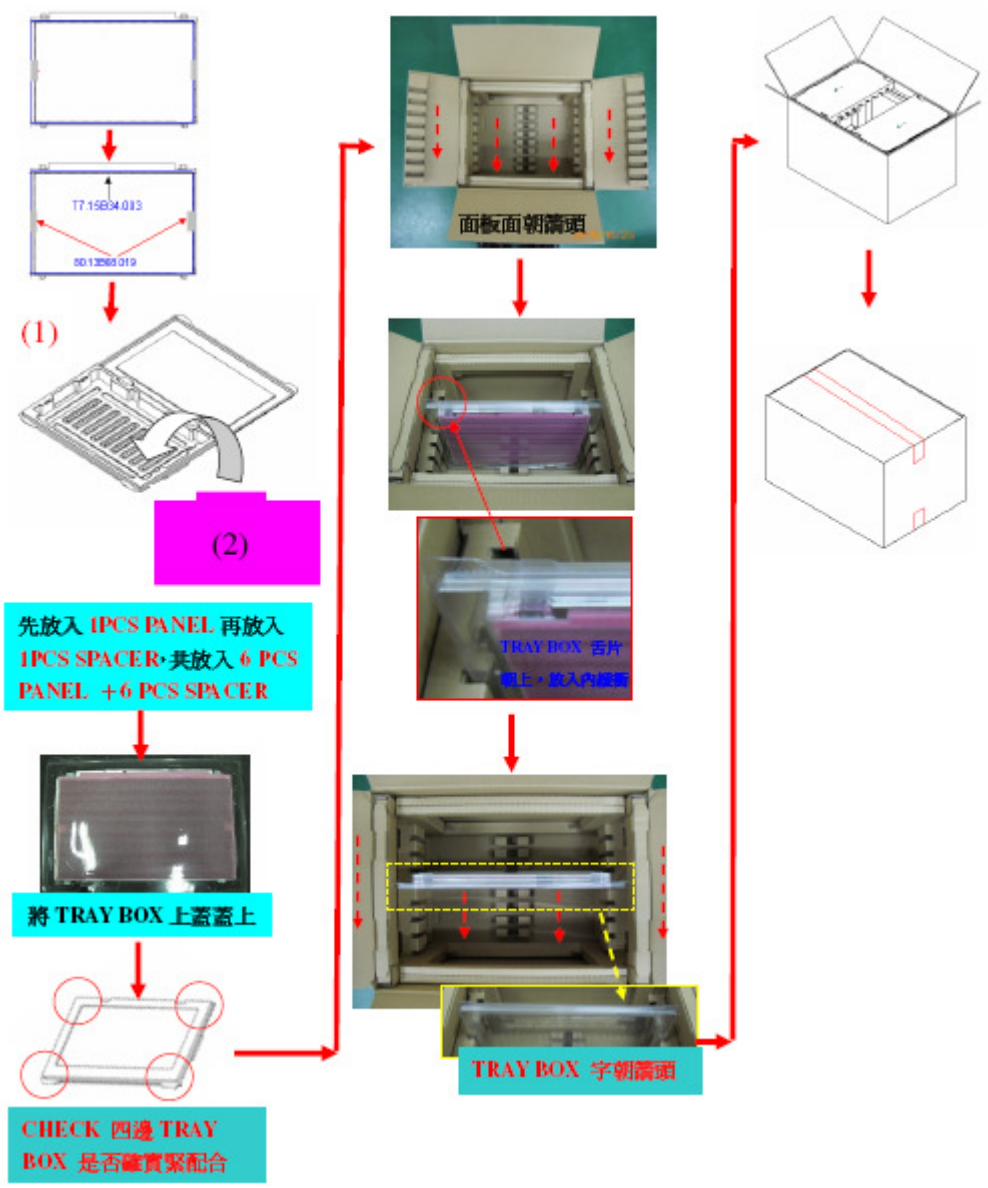
8.1.2 Standard Rear View



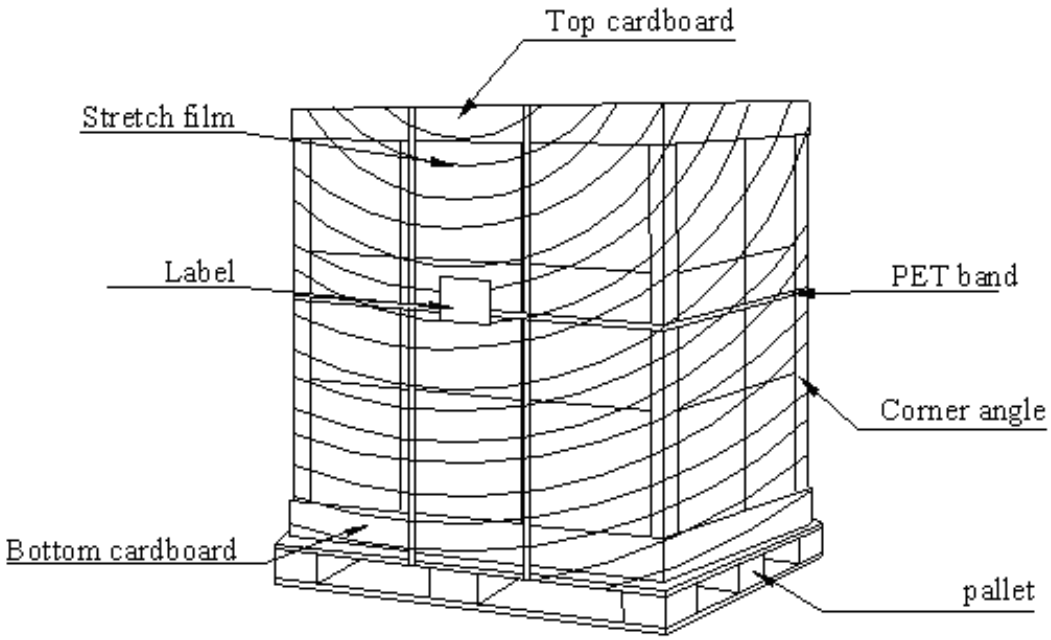
9. Shipping and Package

9.1 Shipping Label Format

9.2 Carton Package



9.3 Shipping Package of Palletizing Sequence



10. Appendix: EDID Description

Address	FUNCTION	Value	Value	Value	Note
HEX		HEX	BIN	DEC	
00	Header	00	00000000	0	
01		FF	11111111	255	
02		FF	11111111	255	
03		FF	11111111	255	
04		FF	11111111	255	
05		FF	11111111	255	
06		FF	11111111	255	
07		00	00000000	0	
08	EISA Manuf. Code LSB	06	00000110	6	
09	Compressed ASCII	AF	10101111	175	
0A	Product Code	EC	11101100	236	
0B	hex, LSB first	32	00110010	50	
0C	32-bit ser #	00	00000000	0	
0D		00	00000000	0	
0E		00	00000000	0	
0F		00	00000000	0	
10	Week of manufacture	00	00000000	0	

11	Year of manufacture	15	00010101	21	
12	EDID Structure Ver.	01	00000001	1	
13	EDID revision #	04	00000100	4	
14	**Video input def. (digital I/P, non-TMDS, CRGB)**	90	10010000	144	
15	**Max H image size (rounded to cm)**	22	100010	34	
16	**Max V image size (rounded to cm)**	13	00010011	19	
17	**Display Gamma (=(gamma*100)-100)**	78	01111000	120	
18	**Feature support (no DPMS, Active OFF, RGB, tmg Blk#1)**	02	00000010	2	
19	Red/green low bits (Lower 2:2:2:2 bits)	BB	10111011	187	
1A	Blue/white low bits (Lower 2:2:2:2 bits)	F5	11110101	245	
1B	Red x (Upper 8 bits)	94	10010100	148	
1C	Red y/ highER 8 bits	55	01010101	85	
1D	Green x	54	01010100	84	
1E	Green y	90	10010000	144	
1F	Blue x	27	00100111	39	
20	Blue y	23	00100011	35	
21	White x	50	01010000	80	
22	White y	54	01010100	84	
23	Established timing 1	00	00000000	0	
24	Established timing 2	00	00000000	0	
25	Established timing 3	00	00000000	0	
26	Standard timing #1	01	00000001	1	
27		01	00000001	1	
28	Standard timing #2	01	00000001	1	
29		01	00000001	1	
2A	Standard timing #3	01	00000001	1	
2B		01	00000001	1	
2C	Standard timing #4	01	00000001	1	
2D		01	00000001	1	
2E	Standard timing #5	01	00000001	1	
2F		01	00000001	1	
30	Standard timing #6	01	00000001	1	
31		01	00000001	1	
32	Standard timing #7	01	00000001	1	
33		01	00000001	1	
34	Standard timing #8	01	00000001	1	
35		01	00000001	1	
36	Pixel Clock/10000 LSB	CE	11001110	206	
37	Pixel Clock/10000 USB	1D	00011101	29	

38	Horz active Lower 8bits	56	01010110	86	
39	Horz blanking Lower 8bits	C0	11000000	192	
3A	HorzAct:HorzBlnk Upper 4:4 bits	50	01010000	80	
3B	Vertical Active Lower 8bits	00	00000000	0	
3C	Vertical Blanking Lower 8bits	30	00110000	48	
3D	Vert Act : Vertical Blanking (upper 4:4 bit)	30	00110000	48	
3E	HorzSync. Offset	08	00001000	8	
3F	HorzSync.Width	0A	00001010	10	
40	VertSync.Offset : VertSync.Width	31	00110001	49	
41	Horz&Vert Sync Offset/Width Upper 2bits	00	00000000	0	
42	Horizontal Image Size Lower 8bits	58	01011000	88	
43	Vertical Image Size Lower 8bits	C1	11000001	193	
44	Horizontal & Vertical Image Size (upper 4:4 bits)	10	00010000	16	
45	Horizontal Border (zero for internal LCD)	00	00000000	0	
46	Vertical Border (zero for internal LCD)	00	00000000	0	
47	Signal (non-intr, norm, no stero, sep sync, neg pol)	18	00011000	24	
48	Pixel Clock/10,000 (LSB)	DF	11011111	223	40Hz frame rate
49	Pixel Clock/10,000 (MSB)	13	00010011	19	
4A	Horizontal Addressable Pixels, lower 8 bits	56	01010110	86	
4B	Horizontal Blanking Pixels, lower 8 bits	C0	11000000	192	
4C	H Pixels, upper nibble : H Blanking, upper nibble	50	01010000	80	
4D	Vertical Addressable Lines, lower 8 bits	00	00000000	0	
4E	Vertical Blanking Lines, lower 8 bits	30	00110000	48	
4F	V lines, upper nibble : V blanking, upper nibble	30	00110000	48	
50	Horizontal Front Porch, lower 8 bits	08	00001000	8	
51	Horizontal Sync Pulse, lower 8 bits	0A	00001010	10	
52	V Front Porch, lower nibble : V Sync Pulse, lower nibble	31	00110001	49	
53	VFP, 2 bits: VSP 2 bits: HFP 2 bits: HFP 2 bits	00	00000000	0	
54	Horizontal Image Size in mm, lower 8 bits	58	01011000	88	
55	Vertical Image Size in mm, lower 8 bits	C1	11000001	193	
56	H Image Size, upper nibble : V Image Size, upper nibble	10	00010000	16	
57	Horizontal Border	00	00000000	0	
58	Vertical Border	00	00000000	0	
59	Bit Encode Sync Information	18	00011000	24	
5A	DC	00	00000000	0	nVDPS Reserved 00
5B	HTOTAL	00	00000000	0	
5C	HA	00	00000000	0	

5D	HBL	00	00000000	0	
5E	HFP	00	00000000	0	
5F	HFPe	00	00000000	0	
60	HBP	00	00000000	0	
61	HB	00	00000000	0	
62	HSO	00	00000000	0	
63	HS	00	00000000	0	
64	VTOTAL	00	00000000	0	
65	VA	00	00000000	0	
66	VBL	00	00000000	0	
67	VFP	00	00000000	0	
68	VBP	00	00000000	0	
69	VB	00	00000000	0	
6A	VSO	00	00000000	0	
6B	VS	00	00000000	0	
6C	Detail Timing Description #4	00	00000000	0	Header
6D	Flag	00	00000000	0	
6E	Reserved	00	00000000	0	
6F	For Brightness Table and Power Consumption	02	00000010	2	
70	Flag	00	00000000	0	
71	PWM % [7:0] @ Step 0	0C	00001100	12	Brightness Table
72	PWM % [7:0] @ Step 5	33	00110011	51	
73	PWM % [7:0] @ Step 10	F9	11111001	249	
74	Nits [7:0] @ Step 0	0A	00001010	10	
75	Nits [7:0] @ Step 5	3C	00111100	60	
76	Nits [7:0] @ Step 10	64	01100100	100	
77	Panel Electronics Power @ 32x32 Chess Pattern =	1F	00011111	31	Power Consumption
78	Backlight Power @ 60 nits =	14	00010100	20	
79	Backlight Power @ Step 10 =	22	00100010	34	
7A	Nits @ 100% PWM Duty =	6E	01101110	110	
7B	Flag	20	00100000	32	
7C	Flag	20	00100000	32	
7D	Flag	20	00100000	32	
7E	Extension Flag	00	00000000	0	
7F	Checksum	E7	11100111	231	