



Document Version: 1

Date: 2004/12/10

Product Functional Specification

**12.1 inch WXGA Color TFT LCD Module
Model Name : B121EW02 V0**

Final Specification

Note: This Specification is subject to change without notice.

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II Record of Revision

Version and Date	Page	Old description	New Description	Remark
V1 2004/12/10	All	First Release	NA	

1.0 Handling Precautions

- 1) Do not press or scratch the surface harder than a HB pencil lead because the polarizers are very fragile and could be easily damaged.
- 2) Be sure to turn off power supply when inserting or disconnecting from input connector.
- 3) Wipe off water droplets or oil immediately. Long contact with the droplets 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) Protect the module from static electricity and insure proper grounding when handling. Static electricity may cause damage to the CMOS Gate Array IC.
- 7) Do not disassemble the module.
- 8) Do not press the reflector sheet at the back of the module.
- 9) Avoid damaging the TFT module. Do not press the center of the CCFL Reflector when it was taken out from the packing container. Instead, press at the edge of the CCFL Reflector softly.
- 10) Do not rotate or tilt the signal interface connector of the TFT module when you insert or remove other connector into the signal interface connector.
- 11) Do not twist or bend the TFT module when installation of the TFT module into an enclosure (Notebook PC Bezel, for example). It should be taken into consideration that no bending/twisting forces are applied to the TFT module from outside when designing the enclosure. Otherwise the TFT module may be damaged.
- 12) Cold cathode fluorescent lamp in LCD contains a small amount of mercury. Please follow local regulations for disposal.
- 13) The LCD module contains a small amount of material that has no flammability grade, so it should be supplied by power complied with requirements of limited power source (2.11, IEC60950 or UL1950).
- 14) The CCFL in the LCD module is supplied with Limited Current Circuit (2.4, IEC60950 or UL1950). Do not connect the CCFL in Hazardous Voltage Circuit.

2.0 General Description

This specification applies to the 12.1 inch wide Color TFT/LCD Module B121EW02 V0

This module is designed for a display unit of notebook style personal computer.

The screen format is intended to support the WXGA (1280(H) x 800(V)) screen and 262k colors (RGB 6-bits data driver).

All input signals are LVDS interface compatible.

This module does not contain an inverter card for backlight.

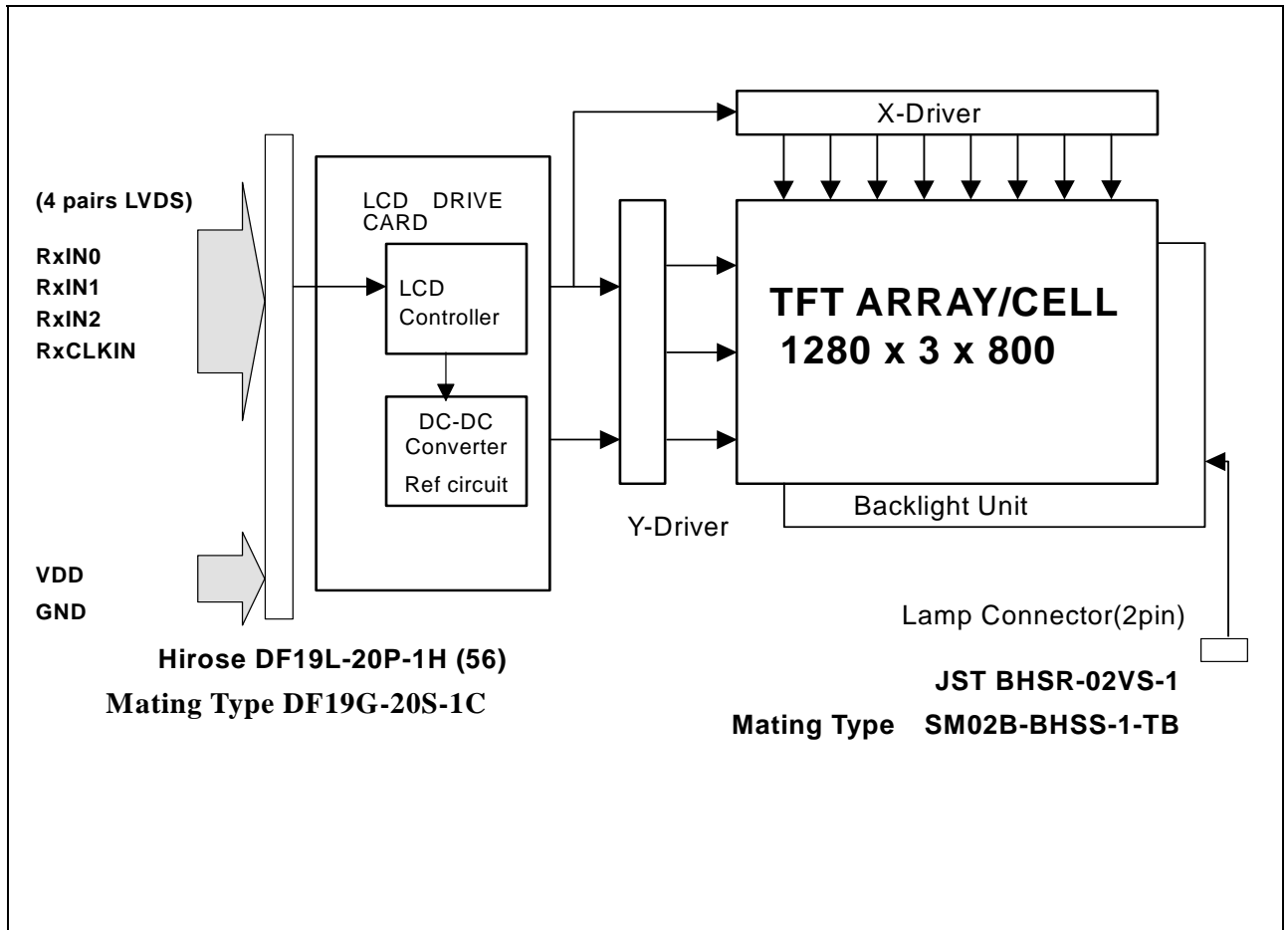
2.1 Display Characteristics

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

ITEMS	Unit	SPECIFICATIONS
Screen Diagonal	[mm]	307.9(12.1" wide)
Active Area	[mm]	261.12(H) x163.2(V)
Pixels H x V		1280(x3) x 800
Pixel Pitch	[mm]	0.204(per one triad) x 0.204
Pixel Arrangement		R.G.B. Vertical Stripe
Display Mode		Normally White
Typical White Luminance(CCFL=6.0mA)	[cd/m ²]	200 Typ.(5 point avg)
Contrast Ratio		300 : 1 Min
ResponseTime	[msec]	25 Typ.
Nominal Input Voltage VDD	[Volt]	+3.3 Typ.
Typical Power Consumption (VDD line + VCFL line)	[Watt]	5.0 Watt (w/o Inverter, All black pattern)@LCM circuit 1.5 Watt(typ.),B/L input 3.5 Watt(typ.)
Weight	[Grams]	315gmax. (w/o Inverter)
Physical Size	[mm]	275.82(W) x 178(H) x 5.5(D) Max.
Electrical Interface		R/G/B Data, 2 Sync, Signals, Clock (4 pairs LVDS) , DSPTMG
Support Color		Native 262K colors (RGB 6-bit data driver)
Temperature Range		
Operating	[°C]	0 to +50
Storage (Shipping)	[°C]	-40 to +65

2.2 Functional Block Diagram

The following diagram shows the functional block of the 12.1 inches Color TFT/LCD Module:



3.0 Absolute Maximum Ratings

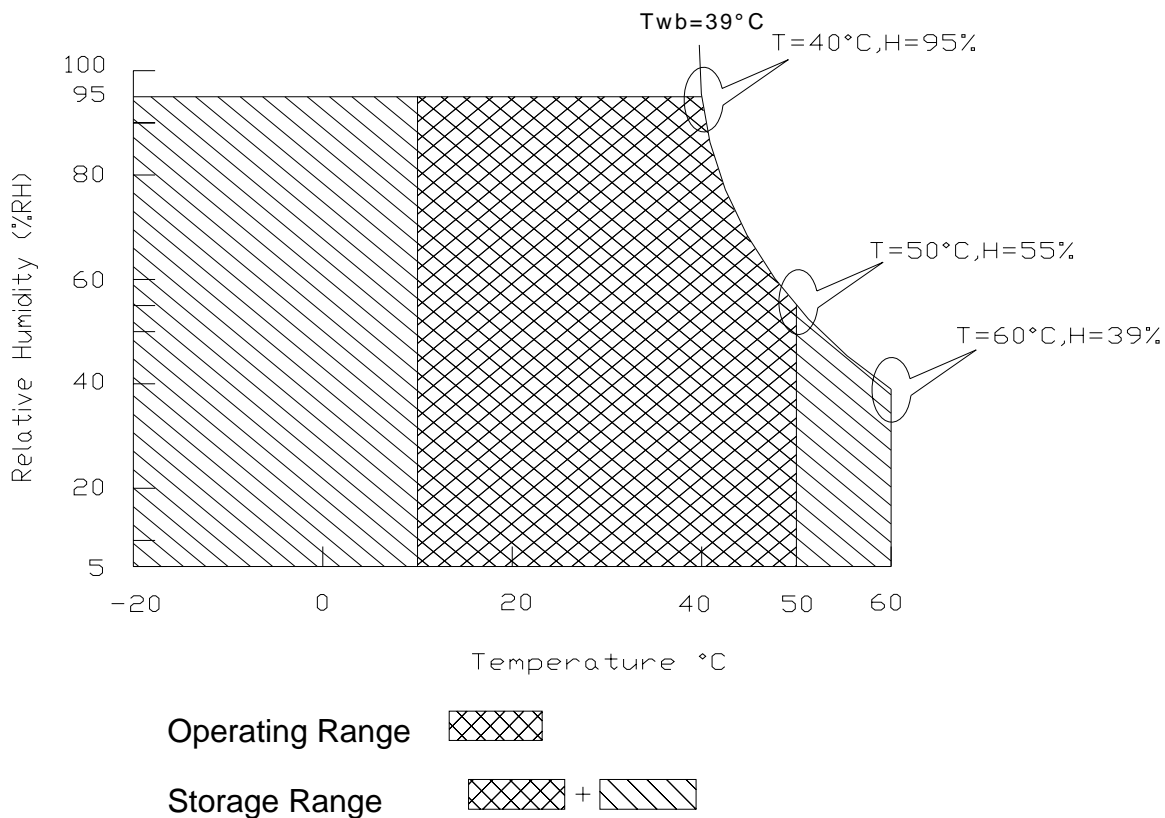
Absolute maximum ratings of the module is as following:

Item	Symbol	Min	Max	Unit	Conditions
Logic/LCD Drive Voltage	VDD	-0.3	+4.0	[Volt]	
Input Voltage of Signal	Vin	-0.3	VDD+0.3	[Volt]	
CCFL Current	ICFL	-	7	[mA] rms	
CCFL Ignition Voltage	Vs	-	1160(25°C)	Vrms	Note 1
Operating Temperature	TOP	0	+50	[°C]	Note 2
Operating Humidity	HOP	5	95	[%RH]	Note 2
Storage Temperature	TST	-40	+65	[°C]	
Storage Humidity	HST	5	95	[%RH]	Note 2
Vibration			1.5 10-500	[G Hz]	
Shock			200 , 3	[G ms]	Half sine wave

Note 1 : Duration = 50msec

Note 2 : Maximum Wet-Bulb should be 39 and No condensation.

Wet bulb temperature chart

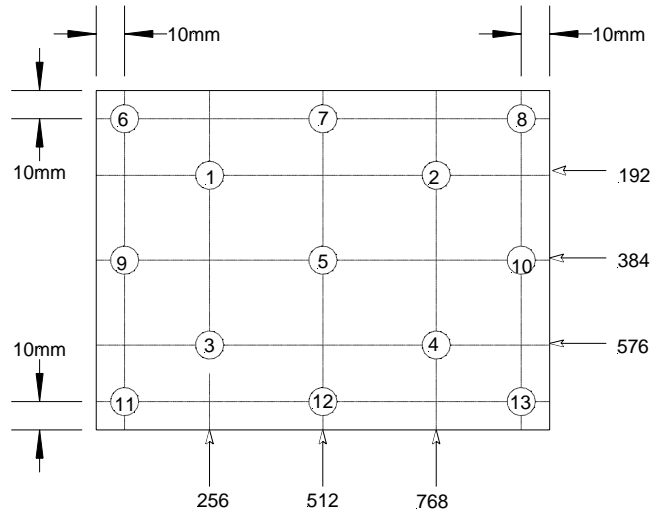


4.0 Optical Characteristics

The optical characteristics are measured under stable conditions as follows under 25 condition:

Item	Unit	Conditions	Min.	Typ.	Max.
Viewing Angle	[degree]	Horizontal (Right) CR = 10 (Left)	60 60	65 65	- -
CR: Contrast Ratio	[degree] [degree]	Vertical (Upper) CR = 10 (Lower)	45 45	50 50	- -
Uniformity		5 Points			1.25
Uniformity		13 Points			1.6
Contrast ratio			300		-
Response Time	[msec] [msec]	Rising Falling	- -	10 15	15 20
Color / Chromaticity Coordinates (CIE)		Red x	0.564	0.594	0.624
		Red y	0.305	0.335	0.365
		Green x	0.298	0.328	0.358
		Green y	0.501	0.531	0.561
		Blue x	0.122	0.152	0.182
		Blue y	0.113	0.143	0.173
		White x	0.283	0.313	0.343
		White y	0.299	0.329	0.359
White Luminance CCFL 6.0mA	[cd/m ²]	5 points average	180	200	-

Note 1: 5 & 13 points position (Display area: 261.12mm x 163.2mm)



Note 2: Definition of white uniformity:

White uniformity is defined as the following with five/thirteen measurements (1~13) at Figure in Note (1).

$$w_5 = \frac{\text{Maximum Brightness of five (1,2,3,4,5) points}}{\text{Minimum Brightness of five (1,2,3,4,5) points}}$$

$$w_{13} = \frac{\text{Maximum Brightness of thirteen points}}{\text{Minimum Brightness of thirteen points}}$$

Note 3: 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

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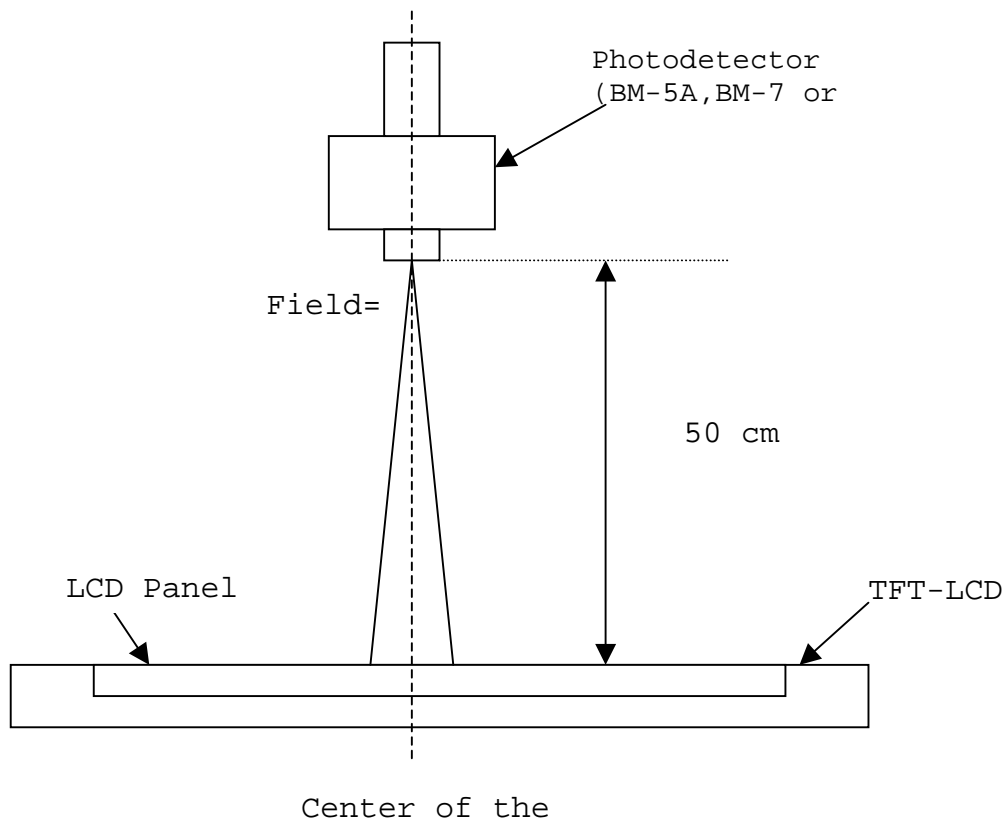
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for 30 minutes in a stable, windless and dark room.



Note 4: 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 5: 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.

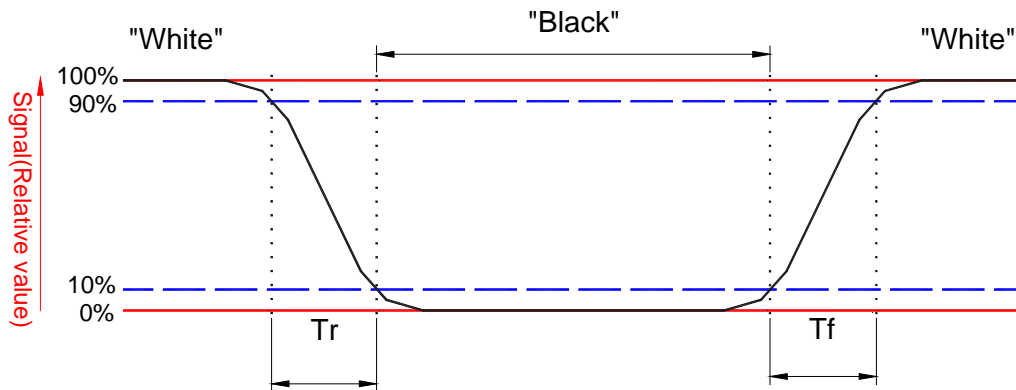
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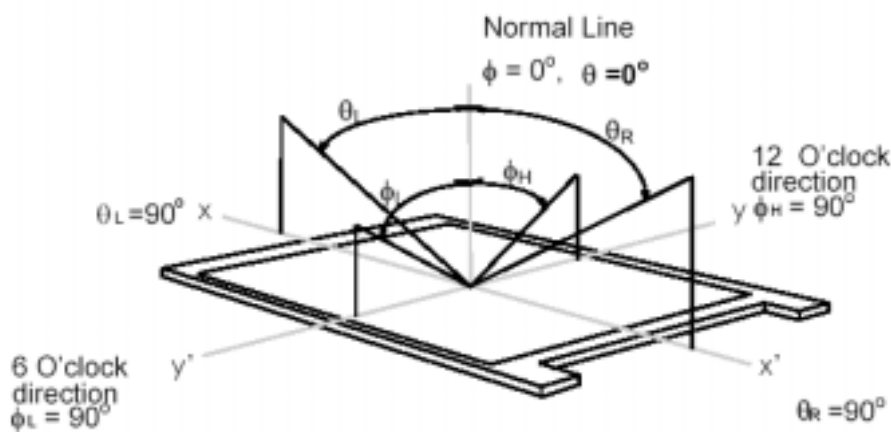
Note 6. Definition of contrast ratio:

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 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° () horizontal left and right and 90° () 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.



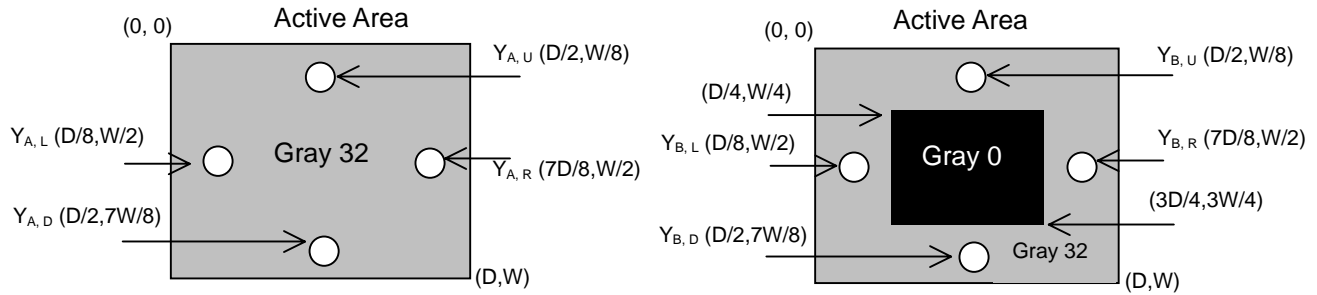
location with gray level 0 pattern (cd/m²)

Note 8. Definition of Cross Talk:

$$\text{Cross Talk} = \frac{|Y_B - Y_A|}{Y_A} \times 100 (\%)$$

Where:

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



5.0 Signal Interface

5.1 Connectors

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	Hirose
Type / Part Number	DF19L-20P-1H (56)
Mating Housing/Part Number	DF19G-20S-1C
Mating Contact/Part Number	DF19-2830 SCFA

Connector Name / Designation	For Lamp Connector
Manufacturer	JST
Type / Part Number	BHSR-02VS-1
Mating Type / Part Number	SM02B-BHSS-1-TB

5.2 Signal Pin

Pin#	Signal Name	Pin#	Signal Name
1	GND	2	VDD
3	VDD	4	VDD _{EDID}
5	AGING	6	CLK _{EDID}
7	DATA _{EDID}	8	RxIN0N
9	RxIN0P	10	GND
11	RxIN1N	12	RxIN1P
13	GND	14	RxIN2N
15	RxIN2P	16	GND
17	RxCLKINN	18	RxCLKINP
19	GND	20	GND

5.3 Signal Description

The module uses a LVDS receiver embedded in AUO's ASIC. LVDS is a differential signal technology for LCD interface and high-speed data transfer device.

Signal Name	Description
RxIN0N, RxIN0P	LVDS differential data input(Red0-Red5, Green0)
RxIN1N, RxIN1P	LVDS differential data input(Green1-Green5, Blue0-Blue1)
RxIN2N, RxIN2P	LVDS differential data input(Blue2-Blue5, Hsync, Vsync, DSPTMG)
RxCLKINN, RxCLKINOP	LVDS differential clock input
VDD	+3.3V Power Supply
GND	Ground

Note: Input signals shall be in low status when VDD is off.

Internal circuit of LVDS inputs are as following.

Signal Name	Description	
+RED5 +RED4 +RED3 +RED2 +RED1 +RED0	Red Data 5 (MSB) Red Data 4 Red Data 3 Red Data 2 Red Data 1 Red Data 0 (LSB) Red-pixel Data	Red-pixel Data Each red pixel's brightness data consists of these 6 bits pixel data.
+GREEN 5 +GREEN 4 +GREEN 3 +GREEN 2 +GREEN 1 +GREEN 0	Green Data 5 (MSB) Green Data 4 Green Data 3 Green Data 2 Green Data 1 Green Data 0 (LSB) Green-pixel Data	Green-pixel Data Each green pixel's brightness data consists of these 6 bits pixel data.
+BLUE 5 +BLUE 4 +BLUE 3 +BLUE 2 +BLUE 1 +BLUE 0	Blue Data 5 (MSB) Blue Data 4 Blue Data 3 Blue Data 2 Blue Data 1 Blue Data 0 (LSB) Blue-pixel Data	Blue-pixel Data Each blue pixel's brightness data consists of these 6 bits pixel data.
-DTCLK	Data Clock	The typical frequency is 65.0 MHz. The signal is used to strobe the pixel data and DSPTMG signals. All pixel data shall be valid at the falling edge when the DSPTMG signal is high.
DSPTMG	Display Timing	This signal is strobed at the falling edge of -DTCLK. When the signal is high, the pixel data shall be valid to be displayed.
VSUNC	Vertical Sync	The signal is synchronized to -DTCLK .
HSUNC	Horizontal Sync	The signal is synchronized to -DTCLK .

Note: Output signals from any system shall be low or Hi-Z state when VDD is off.

5.4 Signal Electrical Characteristics

Input signals shall be in low status when VDD is off.

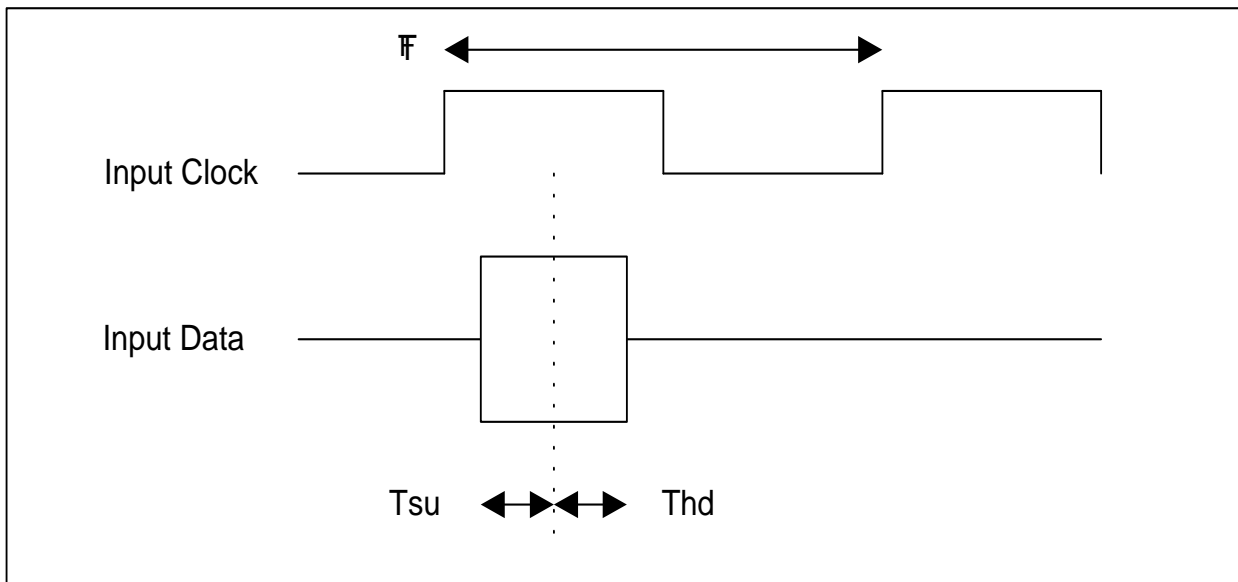
It is recommended to refer the specifications of SN75LVDS86DGG (Texas Instruments) in detail.

Signal electrical characteristics are as follows;

Parameter	Condition	Min	Max	Unit
Vth	Differential Input High Voltage(Vcm=+1.2V)		100	[mV]
Vtl	Differential Input Low Voltage(Vcm=+1.2V)	-100		[mV]

LVDS Macro AC characteristics are as follows:

	Min.	Max.
Clock Frequency (F)	20MHz	85MHz
Data Setup Time (Tsu)	600ps	
Data Hold Time (Thd)	600ps	

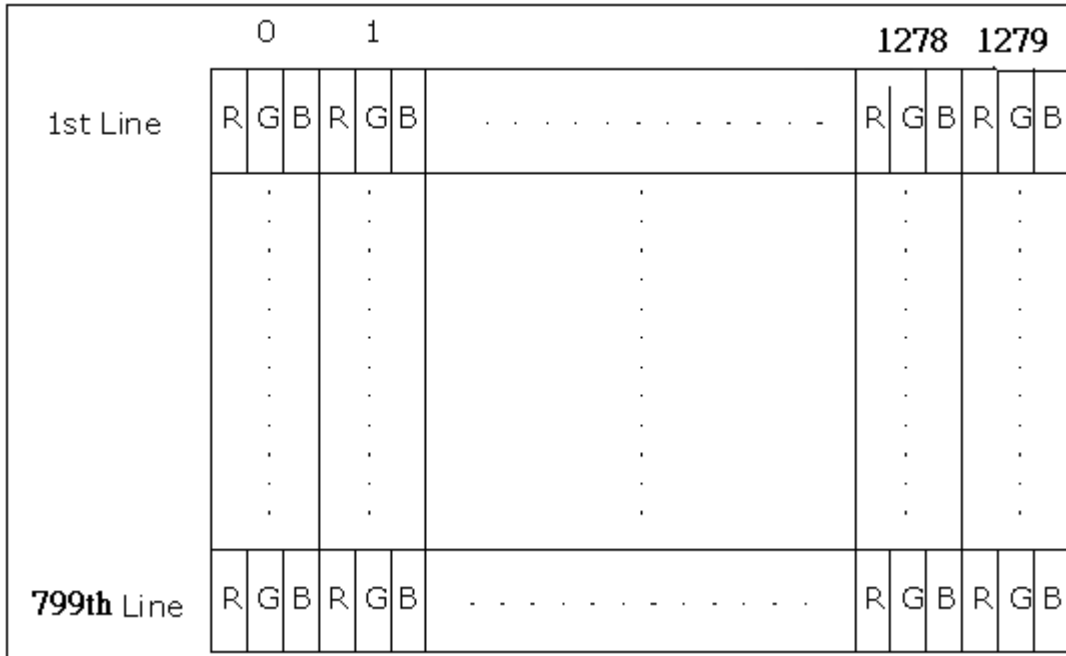


5.5 Signal for Lamp connector

Pin #	Signal Name
1	Lamp High Voltage
2	Lamp Low Voltage

6.0 Pixel Format Image

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



7.0 Parameter guide line for CCFL Inverter

Parameter	Min	DP-1	Max	Units	Condition
White Luminance 5 points average	180	200	—	[cd/m ²]	(Ta=25)
CCFL current(ICFL)	5.5	6.0	6.5	[mA] rms	(Ta=25) Note 2
CCFL Frequency(FCFL)	50		70	[KHz]	(Ta=25) Note 3
CCFL Ignition Voltage(Vs)	1400	—	—	[Volt] rms	(Ta= 0) Note 4
CCFL Voltage (Reference) (VCFL)	—	580	—	[Volt] rms	(Ta=25) Note 5
CCFL Power consumption (PCFL)	—	3.5	—	[Watt]	(Ta=25) Note 5

Note 1: DP-1 are AUO recommended Design Points.

*1 All of characteristics listed are measured under the condition using the AUO Test inverter.

*2 In case of using an inverter other than listed, it is recommended to check the inverter carefully. Sometimes, interfering noise stripes appear on the screen, and substandard luminance or flicker at low power may happen.

*3 In designing an inverter, it is suggested to check safety circuit ver carefully. Impedance of CCFL, for instance, becomes more than 1 [M ohm] when CCFL is damaged.

*4 Generally, CCFL has some amount of delay time after applying start-up voltage. It is recommended to keep on applying start-up voltage for 1 [Sec] until discharge.

*5 The CCFL inverter operating frequency must be carefully chosen so that no interfering noise stripes on the screen were induced.

*6 Reducing CCFL current increases CCFL discharge voltage and generally increases CCFL discharge frequency. So all the parameters of an inverter should be carefully designed so as not to produce too much leakage current from high-voltage output of the inverter.

Note 2: It should be employed the inverter, which has "Duty Dimming", if ICCFL is less than 4mA.

Note 3: The CCFL inverter operating frequency should be carefully determined to avoid interference between inverter and TFT LCD.

Note 4: The inverter open voltage should be designed larger than the lamp starting voltage at T=0°C, otherwise backlight may be blinking for a moment after turning on or not be able to turn on. The open voltage should be measured after ballast capacitor. If an inverter has shutdown function it should keep its open voltage. for longer than 1 second even if lamp connector is open.

Note 5: Calculator value for reference (ICFL×VCFL=PCFL)

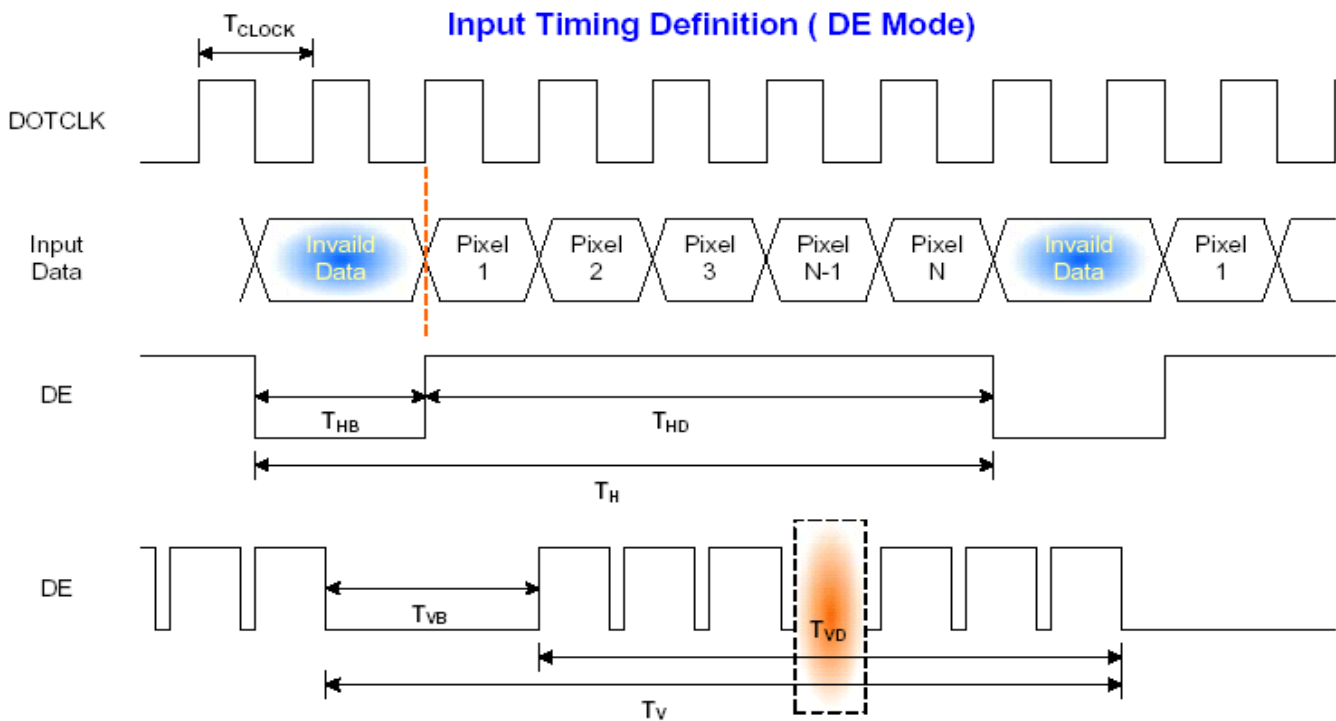
8 Timing Control

8.1 Timing Characteristics

This is the signal timing required at the input of the user connector . All of the interface signal timing should be satisfied with the following specifications .

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
Clock frequency	$1/T_{\text{Clock}}$	62	68.9	83	MHz	
Vertical Section	Period	T_V	803	816	864	T_{Line}
	Active	T_{VD}	800	800	800	
	Blanking	T_{VB}	3	16	64	
Horizontal Section	Period	T_H	1302	1408	1600	T_{Clock}
	Active	T_{HD}	1280	1280	1280	
	Blanking	T_{HB}	22	128	320	
End-frame checking period	tEF	2			T_{Line}	
DE checking period	tDE	6400			T_{Line}	8 Frames

8.2 Timing Definition



9.0 Power Consumption

Input power specifications are as follows:

Symbol	Parameter	Min	Typ	Max	Units	Condition
Module						
VDD	Logic/LCD Drive Voltage	3.0	3.3	3.6	[Volt]	Load Capacitance 20uF
PDD	VDD Power		1.2		[Watt]	All Black Pattern
PDD Max	VDD Power max			1.5	[Watt]	Max Pattern Note
IDD	IDD Current		400		mA	64 Grayscale Pattern
IDD Max	IDD Current max			420	mA	Vertical stripe line Pattern Note
VDDrp	Allowable Logic/LCD Drive Ripple Voltage			500	[mV] p-p	
VDDns	Allowable Logic/LCD Drive Ripple Noise			100	[mV] p-p	
Lamp						
ICFL	CCFL current	3.0 (Note 2)	6.0	6.5	[mA] rms	(Ta=25)
VCFL	CCFL Voltage (Reference)	—	580	—	[Volt] rms	(Ta=25)
PCFL	CCFL Power consumption	—	3.5	—	[Watt]	(Ta=25)
Total Power Consumption	5. Watt (w/o Inverter, All black pattern)@LCM circuit 1.5 Watt(typ.),B/L input 3.5 Watt(typ.)					

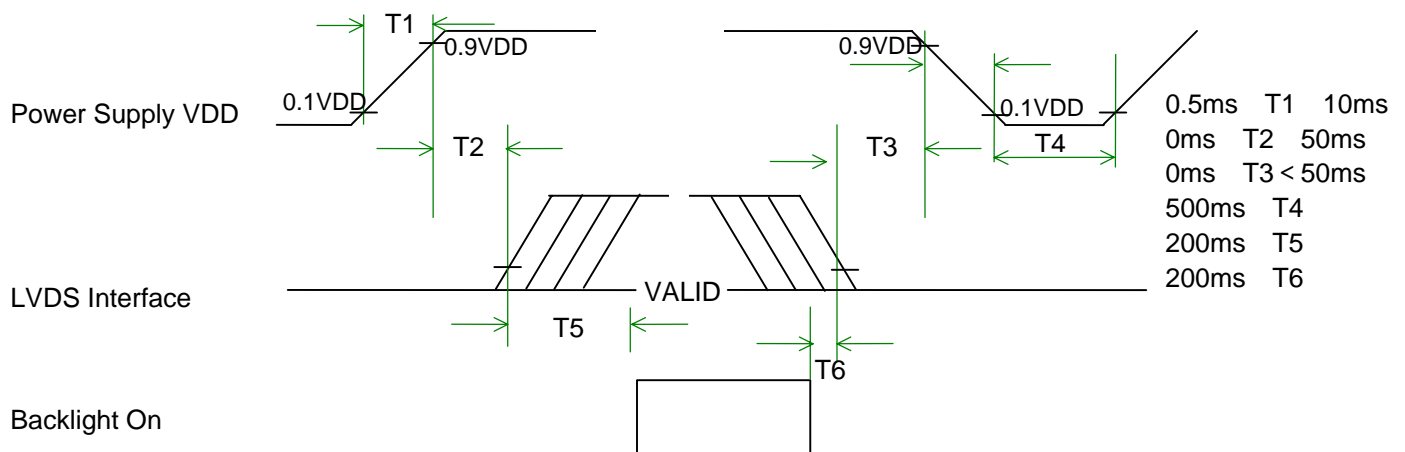
Note 1 : VDD=3.3V

Note 2 : If inverter with PWM mode that can define lamp min current is 2.5 mA.

10.0 Power ON/OFF Sequence

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

Sequence of Power-on/off and signal-on/off



Apply the lamp voltage within the LCD operating range. When the backlight turns on before the LCD operation or the LCD turns off before the backlight turns off, the display may momentarily become abnormal.

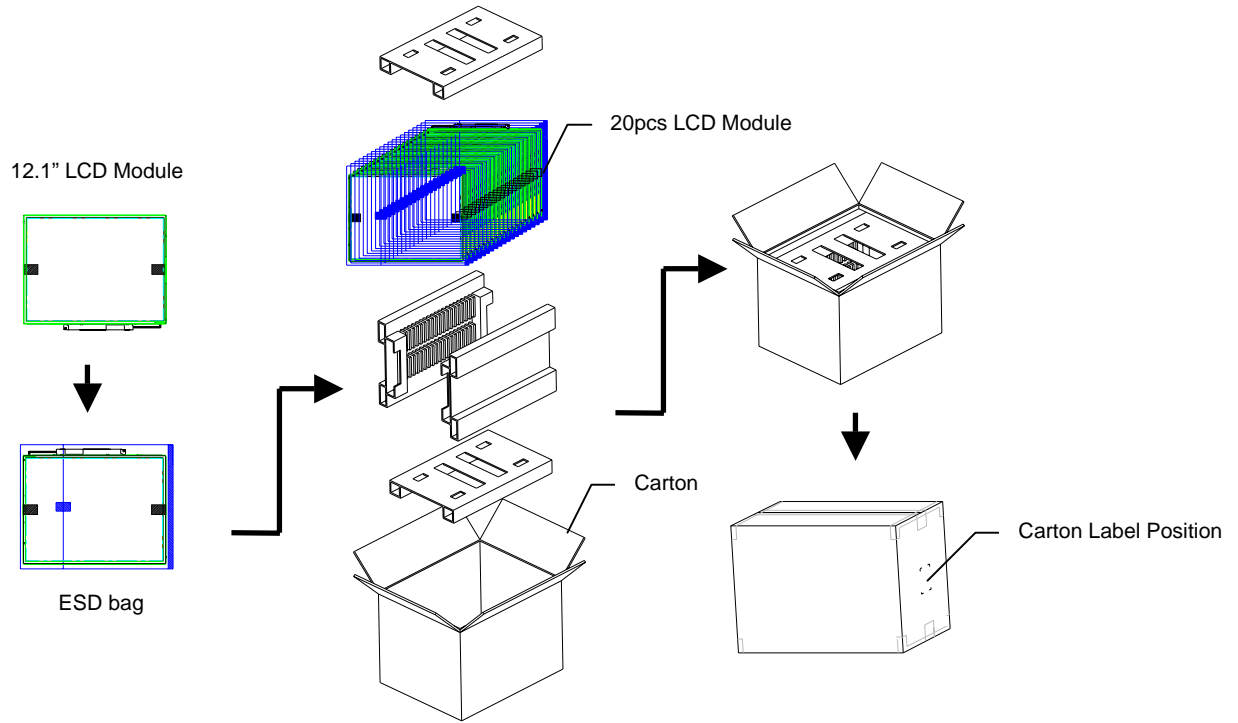
11.0 Reliability /Safety Requirement

Items	Required Conditions
Operating Life – High Temp.	Temp.= +50°C, Dynamic. 250 Hours, Humidity 20%
Operating Life – Low Temp.	Temp.= 0°C, Dynamic, 250 Hours, Humidity 20%
High Temp. Storage Life – Non-Operating	Temp.= +65°C, Non-Operating, 250 Hours, Humidity 20%
Low Temp. Storage Life – Non-Operating	Temp.= -25°C, Non-Operating, 250 Hours
High Temp & High Humidity Operating Life	Temp.= +40°C, Dynamic, Humidity 95%(Non-Condensing), 250 Hours
Shock – Non-Operating	220g's, 2.0 ms, Half Sine Wave ± 3 Axis (+X, -X, +Y, -Y, +Z, -Z) 3 Shocks per direction
Vibration – Non-Operating	1.5 Grms, 30 min/side, PSD Spectrum Break Points, 26 Hz $G^2/Hz=0.316$, 50 Hz $G^2/Hz=0.007$, 222 Hz $G^2/Hz=0.0018$, 500Hz $G^2/Hz=0.0001$
Temp. Cycle – Operating	0°C to+40°C, Ramp $\leq 20^\circ\text{C}/\text{min}$, Duration at Temp. = 30min, Test Cycles = 160
Temp. Cycle – Non-Operating	-25°C to +65°C, Ramp $\leq 20^\circ\text{C}/\text{min}$, Duration at Temp. = 30min, Test Cycles = 50

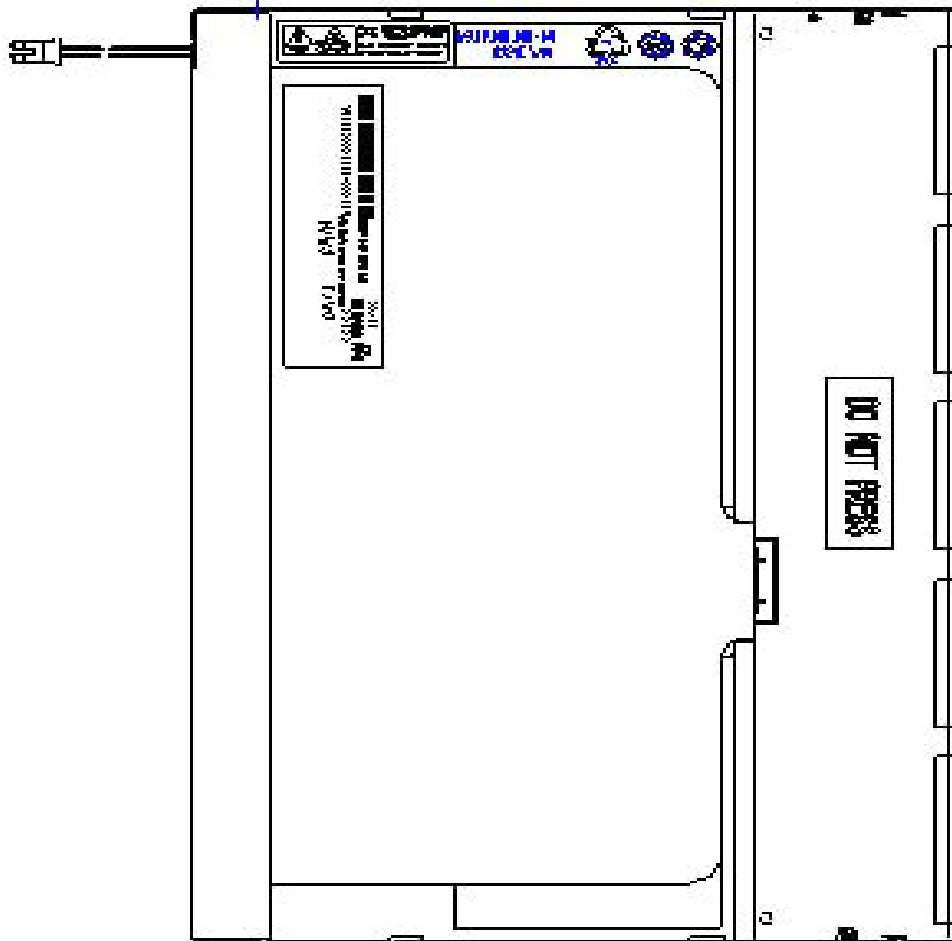
11.2 Safety

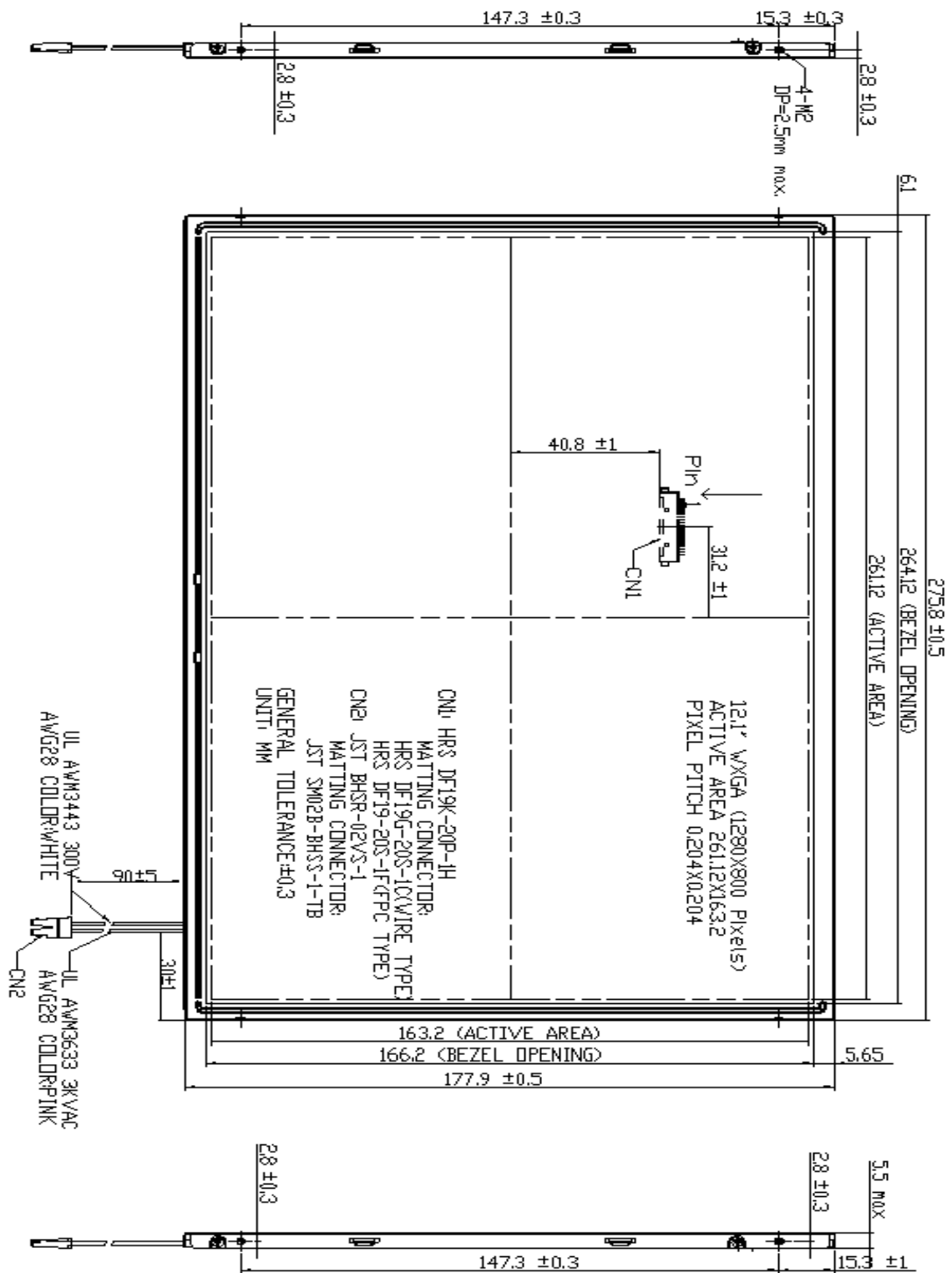
UL 60950

12.0 Packing dimension



13.0 Mechanical Characteristics





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13.1 Screw Hole Depth and Center Position

Max screw depth size is 1.8mm.

Screw Torque: Maximum 2.5 kgf-cm

