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TITLE : HT12X12-100 Product Specification

Rev. A

Hyundai Display Technology Inc.

REVISION HISTORY

REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
0		Initial Release	2001/04/04	D.Y. Jang
A	E105-F006	Optical Specification Change (Page 7)	2001/05/28	D.Y. Jang

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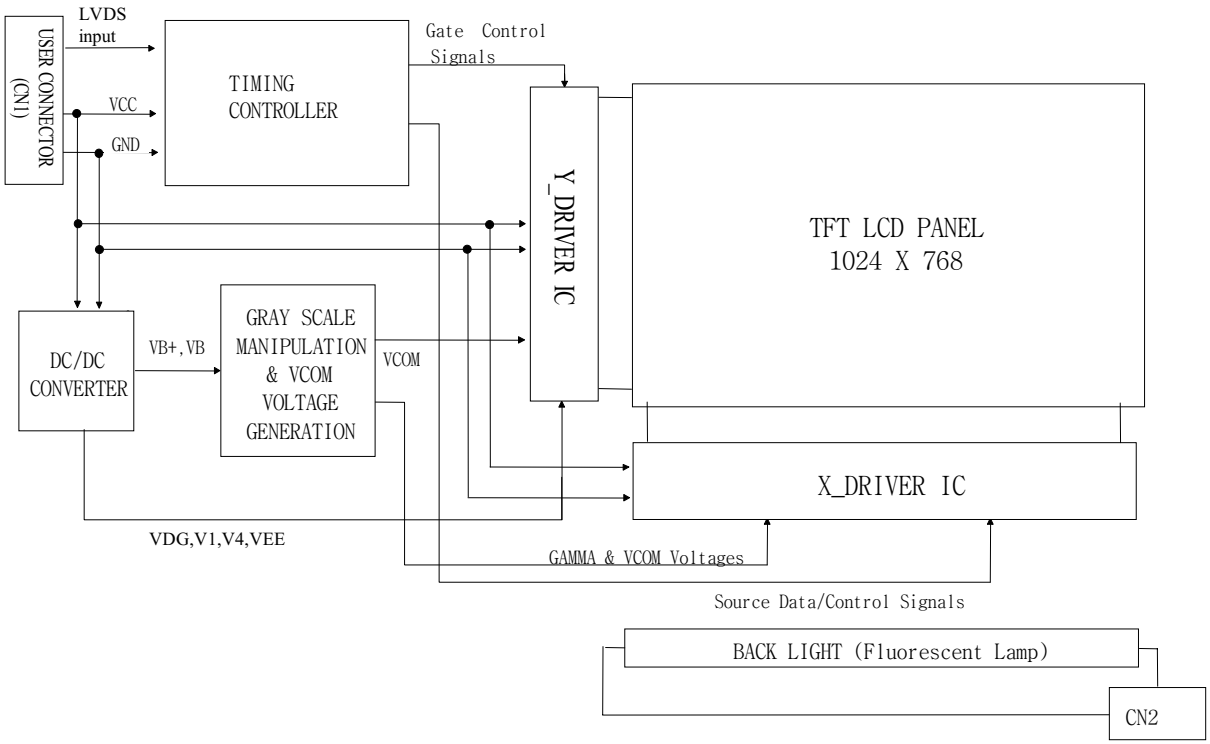
1.0 GENERAL DESCRIPTION

1.1 Introduction

HT12X12-100 is a color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 12.1 inch diagonally measured active area with XGA resolutions (1024 horizontal by 768 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 262,144 colors. The TFT-LCD panel used for this module is a low reflection and higher color type. Therefore, this module is suitable for notebook PC. The DC/AC inverter for back-light driving is not built in this model.



1.2 Features

- Low driving voltage and low power consumption
- Thin and light weight
- 3.3 V power supply
- 1 Channel LVDS Interface
- Single CCFL (Bottom side/Horizontal Direction)
- 262,144 colors
- Data enable signal mode
- Side Mounting Frame

1.3 General Specification

<Table 1. General Specification>

Parameter	Specification	Unit	Remarks
Active area	245.8 (H) * 184.3 (V)	mm	
Number of pixels	1024 (H) * 768 (V)	pixels	
Pixel pitch	0.240 (H) * 0.240 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	262,144	colors	
Display mode	Normally white		
Dimensional outline	261.0 ± 0.5 (H) * 199.0 ± 0.5 (V) * 5.2 (D) typ./ 5.5 (D) max.	mm	Note 1
Weight	380 typ., 390 max.	g	
Back-light	CCFL, Horizontal-lamp type		Note 1

Note 1: CCFL (Cold Cathode Fluorescent Lamp)

2.0 ABSOLUTE MAXIMUM RATINGS

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

< Table 2. Absolute Maximum Ratings>

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage	V_{DD}	- 0.3	+ 4.6	V
Logic Supply Voltage	V_{IN}	- 0.3	V_{DD} + 0.3	V
Operating Temperature	T_{OP}	0	+ 50	℃
Storage Temperature	T_{SP}	- 20	+ 60	℃

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

< Table 3. Electrical specifications >

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Note1
Power Supply Current	I_{DD}		300		mA	Note1
High Level Input Differential Voltage	V_{IH}			+100	mV	@V_{CM} = 1.2V
Low Level Input Differential Voltage	V_{IL}	-100			mV	@V_{CM} = 1.2V
LVDS Input Common Mode Voltage	V_{CM}	1.125	1.25	1.375	V	
Back-light Lamp Voltage	V_{BL}		600		V_{rms}	Note2
Back-light Lamp Current	I_{BL}		5.0		mA_{rms}	
Back-light Lamp operating frequency	F_L	50	60	70	KHz	Note3 One Lamp
Lamp Start Voltage			570	750	V_{rms}	At Ta = 25℃
			795	1080	V_{rms}	At Ta = 0℃
Lamp Life		10,000	15,000		Hrs	
Power Consumption	P_D		1		W	Typ. @ Color Bar
	P_{BL}		3		W	Note4
	P_{total}		4.0		W	

Notes :1. The supply voltage is measured and specified at the interface connector of LCM. The current draw and power consumption specified is for 3.3V at 25℃.

2. Reference value, which is measured with Samsung Electric SIC-180 Inverter. (V_{BLMIN} is value at I_{BLMIN} and V_{BLMAX} is value at I_{BLMAX})

3. The lamp frequency should be selected as different as possible from the horizontal synchronous frequency and its harmonics to avoid interference which may cause line flow on the display

4. Calculated value for reference (V_{BL} × I_{BL})

4.0 OPTICAL SPECIFICATIONS

4.1 Overview

The test of optical specifications shall be measured in a dark room (ambient luminance ≤ 1 lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCONE BM-5) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to $\theta_{Ø=0}$ (=θ_3) as the 3 o'clock direction (the "right"), $\theta_{Ø=90}$ (=θ_{12}) as the 12 o'clock direction ("upward"), $\theta_{Ø=180}$ (=θ_9) as the 9 o'clock direction ("left") and $\theta_{Ø=270}$(=θ_6) as the 6 o'clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. VDD shall be 3.3+/- 0.15V at 25°C. Optimum viewing angle direction is 6 o'clock.

4.2 Optical Specifications

<Table 4. Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10		45		Deg.	Note 1
		Θ_9			45		Deg.	
	Vertical	Θ_{12}			15		Deg.	
		Θ_6			30		Deg.	
Luminance Contrast ratio		CR	Θ = 0°		200:1			Note 2
Average Luminance of white		Y_w	Θ = 0° IBL = 5mA	130	150		cd/m^2	Note 3
White luminance uniformity		Δ Y	IBL = 5mA		1.17	1.33		Note 4
White Chromaticity		x_w	Θ = 0°	0.285	0.315	0.345		Note 5
		y_w		0.302	0.332	0.362		
Reproduction Of color	Red	x_R	Θ = 0°	0.541	0.571	0.601		
		y_R		0.301	0.331	0.361		
	Green	x_G		0.279	0.309	0.339		
		y_G		0.492	0.522	0.552		
	Blue	x_B		0.119	0.149	0.179		
		y_B		0.102	0.132	0.162		
Response Time	Rise + Decay	T_r + T_d	Ta= 25° C Θ = 0°		50		ms	Note 6
Cross Talk		CT	Θ = 0°			2.0	%	Note 7

Note:

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface. (see FIGURE1 shown in Appendix).
2. Contrast measurements shall be made at viewing angle of Θ= 0° and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state . (see FIGURE1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically as CR = Luminance when displaying a white raster / Luminance when displaying a black raster.
3. Average Luminance of white is defined as arithmetic mean of five measurement points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.
4. The White luminance uniformity on LCD surface is then expressed as : Δ Y = Maximum Luminance of five points / Minimum Luminance of five points. (see FIGURE 3).
5. The color chromaticity coordinates specified in Table 4. shall be calculated from the spectral data measured with all pixels first in red, green, blue, and white. Measurements shall be made at the center of the panel.
6. The electro-optical response time measurements shall be made as shown in FIGURE 4 (shown in Appendix)by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Td and 90% to 10% is Tr.
7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (YA) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (YB) of that same area when any adjacent area is driven dark (Refer to FIGURE 5).

5.0 INTERFACE CONNECTION

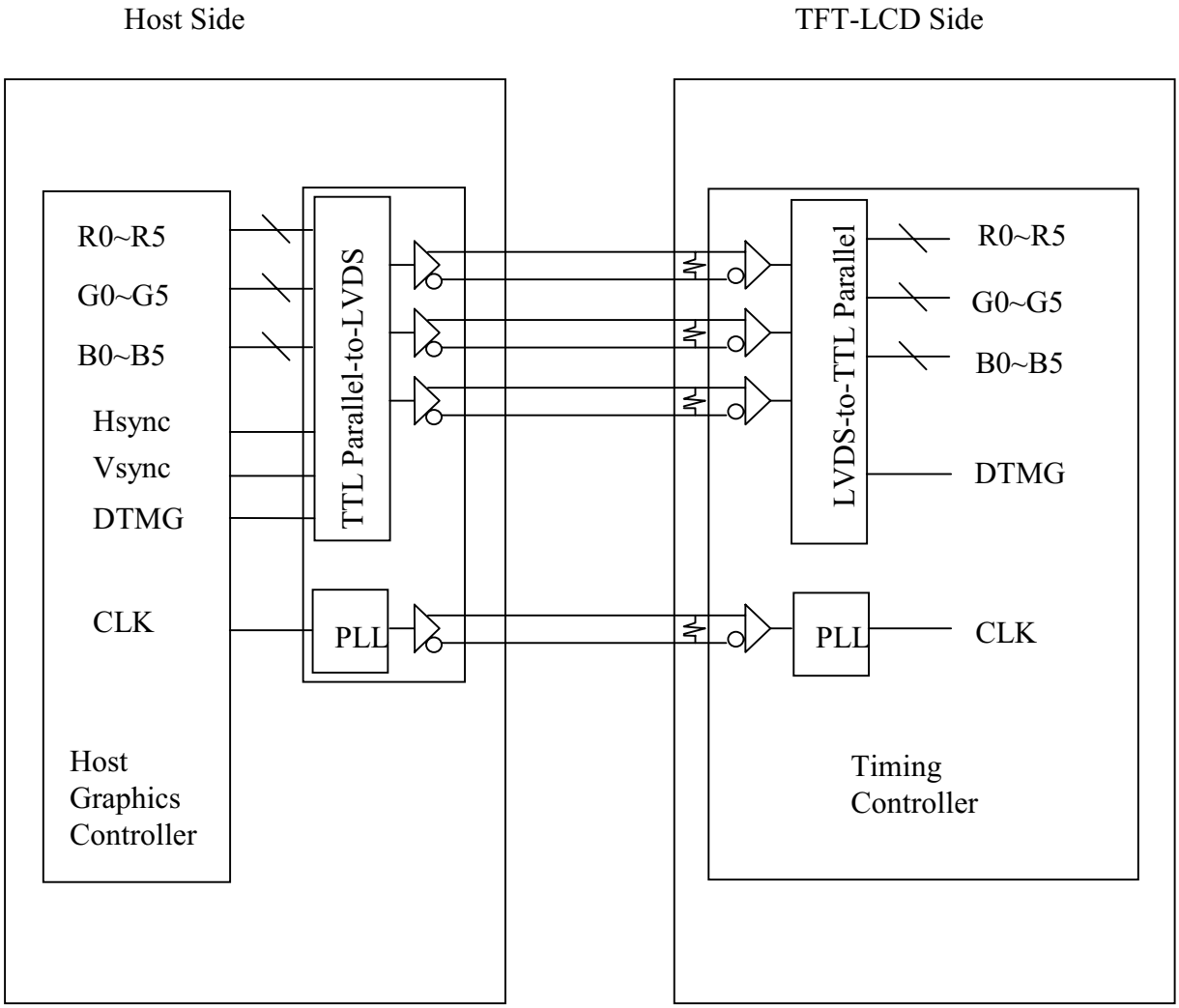
5.1 Electrical Interface Connection

The electronics interface connector is a model DF19L-20P-1H manufactured by Hirose or equivalent.

<Table 5. Pin Assignment for the Interface Connector>

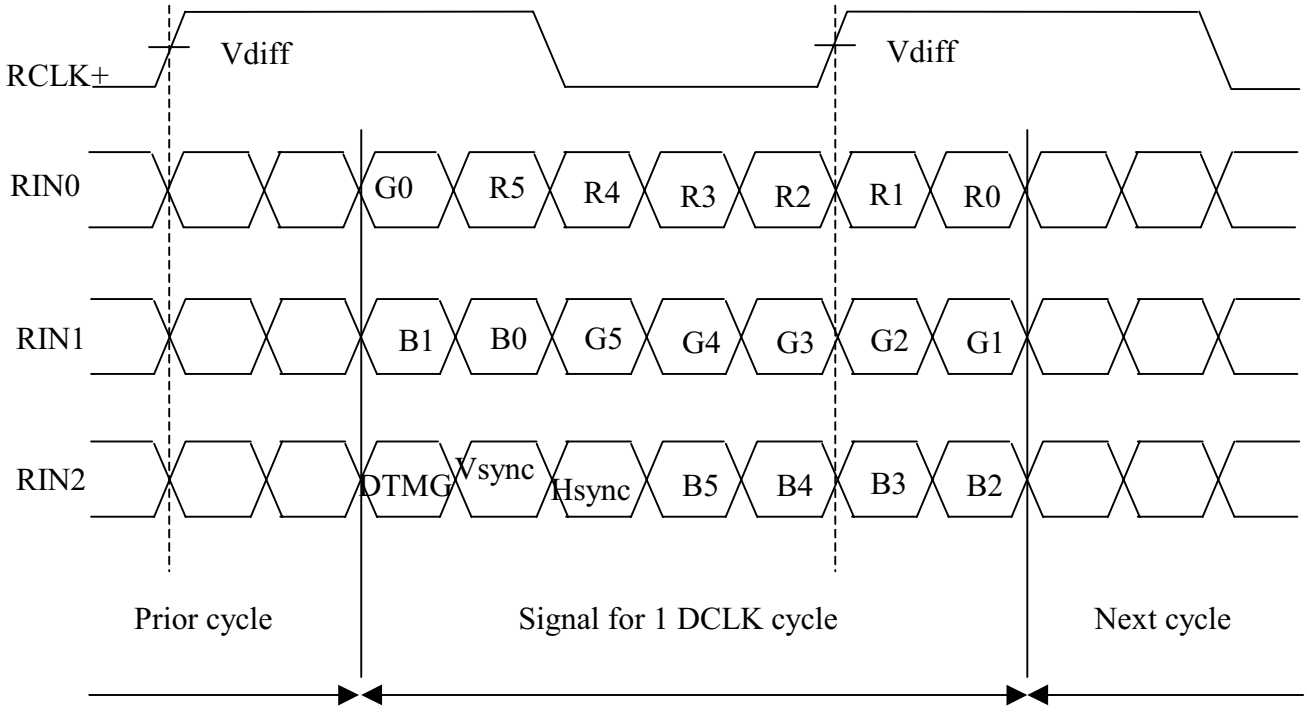
Terminal NO.	Symbol	Function
1	VDD1	Power Supply : +3.3V
2	VDD2	Power Supply : +3.3V
3	VSS1	Ground
4	VSS2	Ground
5	RIN0-	Transmission Data of 0 Negative -
6	RIN0+	Transmission Data of 0 Positive +
7	VSS3	Ground
8	RIN1-	Transmission Data of 1 Negative -
9	RIN1+	Transmission Data of 1 Positive +
10	VSS4	Ground
11	RIN2-	Transmission Data of 2 Negative -
12	RIN2+	Transmission Data of 2 Positive +
13	VSS5	Ground
14	RCLK-	Sampling Clock of Negative -
15	RCLK+	Sampling Clock of Positive +
16	VSS6	Ground
17	NC1	No Connection
18	NC2	No Connection
19	NC3	No Connection
20	NC4	No Connection

5.2 LVDS Interface



NOTE : 1) LVDS cable impedance is 100 ohms per signal line
when two are used differentially.
2) Transmitter : TI SN75LVDS84, or equivalent.
Transmitter is not contained in Module.

5.3 LVDS Input signal



<Table 6. Pin connection in case of using TI SN75LVDS84 >

Input signal	Transmitter	Input signal	Transmitter
DCLK	CLK IN(26)	G4	IN10(10)
R0	IN0(44)	G5	IN11(12)
R1	IN1(45)	B0	IN12(13)
R2	IN2(47)	B1	IN13(15)
R3	IN3(48)	B2	IN14(16)
R4	IN4(1)	B3	IN15(18)
R5	IN5(3)	B4	IN16(19)
G0	IN6(4)	B5	IN17(20)
G1	IN7(6)	Hsync	IN18(22)
G2	IN8(7)	Vsync	IN19(23)
G3	IN9(9)	DTMG	IN20(25)

5.4 BACK-LIGHT INTERFACE

The Back-light interface connector is a model BHSR-02VS-1 manufactured by JST or equivalent.

<Table 8. Back-light Electrical Interface>

Terminal No.	Symbol	Function
1	VL	CCFL Power Supply (High Voltage)
2	GL	CCFL Power Supply (GND Side)

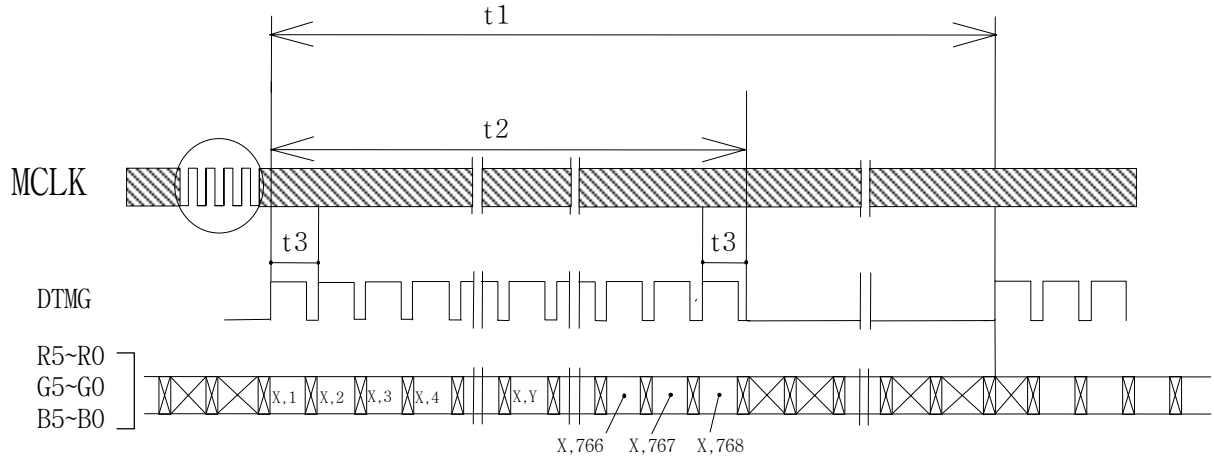
6.0 SIGNAL TIMING SPECIFICATION

<Table 9. Signal Timing Specification.>

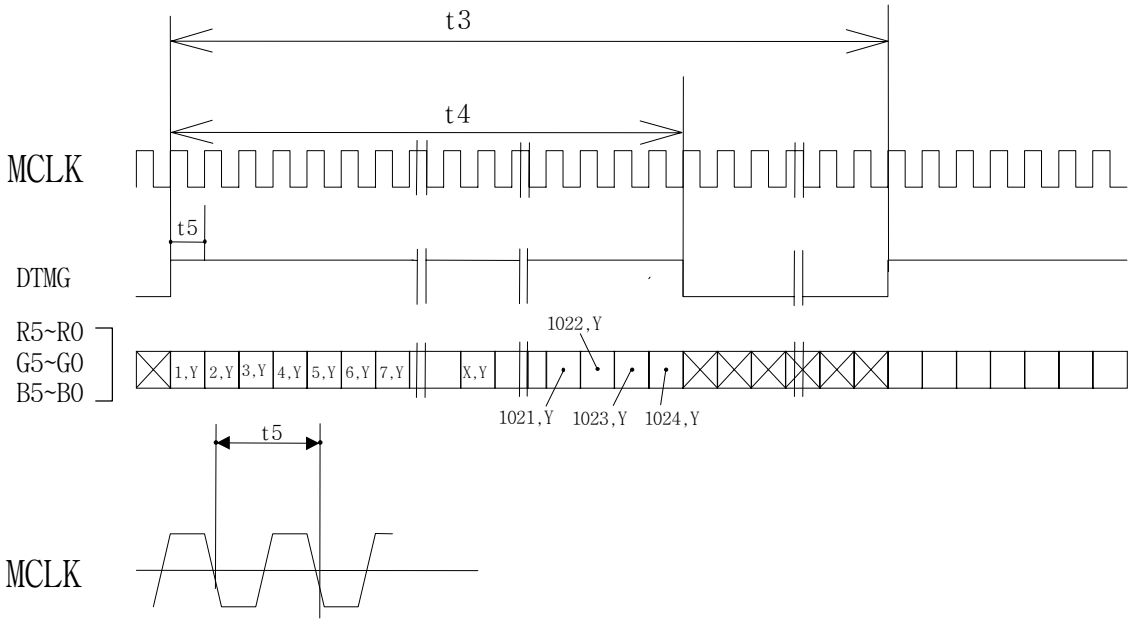
ITEM	SYMBOL	Min.	Typ.	Max.	Unit	Remarks
Frame Period	t1	801 × t3	806 × t3	812 × t3	--	60 Hz
			16.67		ms	
Vertical Display Term	t2	768 × t3	768 × t3	768 × t3	--	
			15.88		ms	
One Line Scanning Time	t3	1280 × t5	1344 × t5	1364 × t5	--	48.38 kHz
			20.67		us	
Horizontal Display Term	t4	1024 × t5	1024 × t5	1024 × t5	--	
			15.75		us	
Clock Period	t5	14.00	15.38		ns	65 MHz

7.0 SIGNAL TIMING WAVEFORMS

7.1 Vertical Timing Waveforms



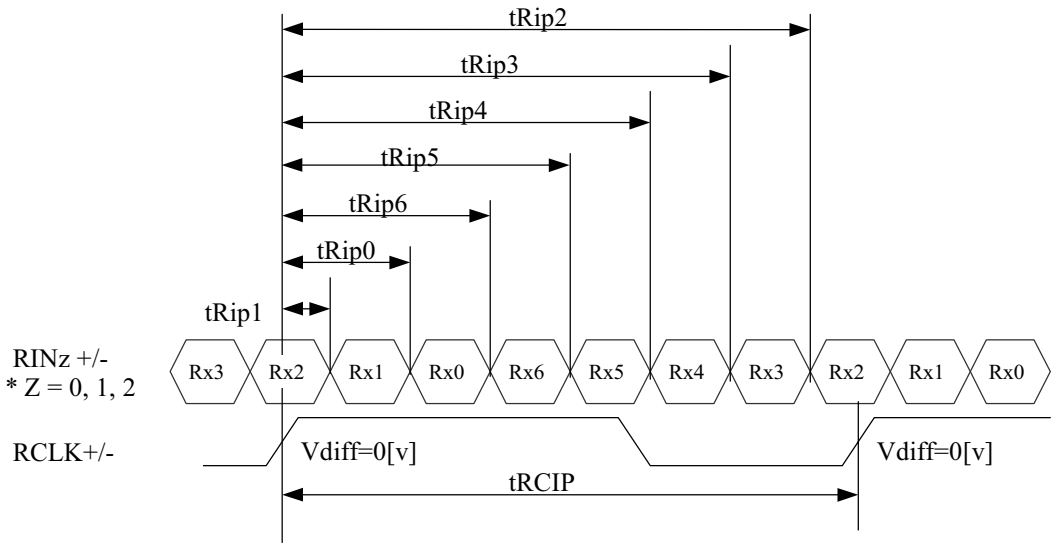
7.2 Horizontal Timing Waveforms



7.3 LVDS Rx Interface Timing Parameter

<Table 10. LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
PLL Set	tRPLL	-	-	10.0	msec	
RCLK Period	tRCIP		15.38		nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRICP/7 - 0.4	tRICP/7	tRICP/7 + 0.4	nsec	
Input Data 2	tRIP6	2 × tRICP/7 - 0.4	2 × tRICP/7	2 × tRICP/7 + 0.4	nsec	
Input Data 3	tRIP5	3 × tRICP/7 - 0.4	3 × tRICP/7	3 × tRICP/7 + 0.4	nsec	
Input Data 4	tRIP4	4 × tRICP/7 - 0.4	4 × tRICP/7	4 × tRICP/7 + 0.4	nsec	
Input Data 5	tRIP3	5 × tRICP/7 - 0.4	5 × tRICP/7	5 × tRICP/7 + 0.4	nsec	
Input Data 6	tRIP2	6 × tRICP/7 - 0.4	6 × tRICP/7	6 × tRICP/7 + 0.4	nsec	



8.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

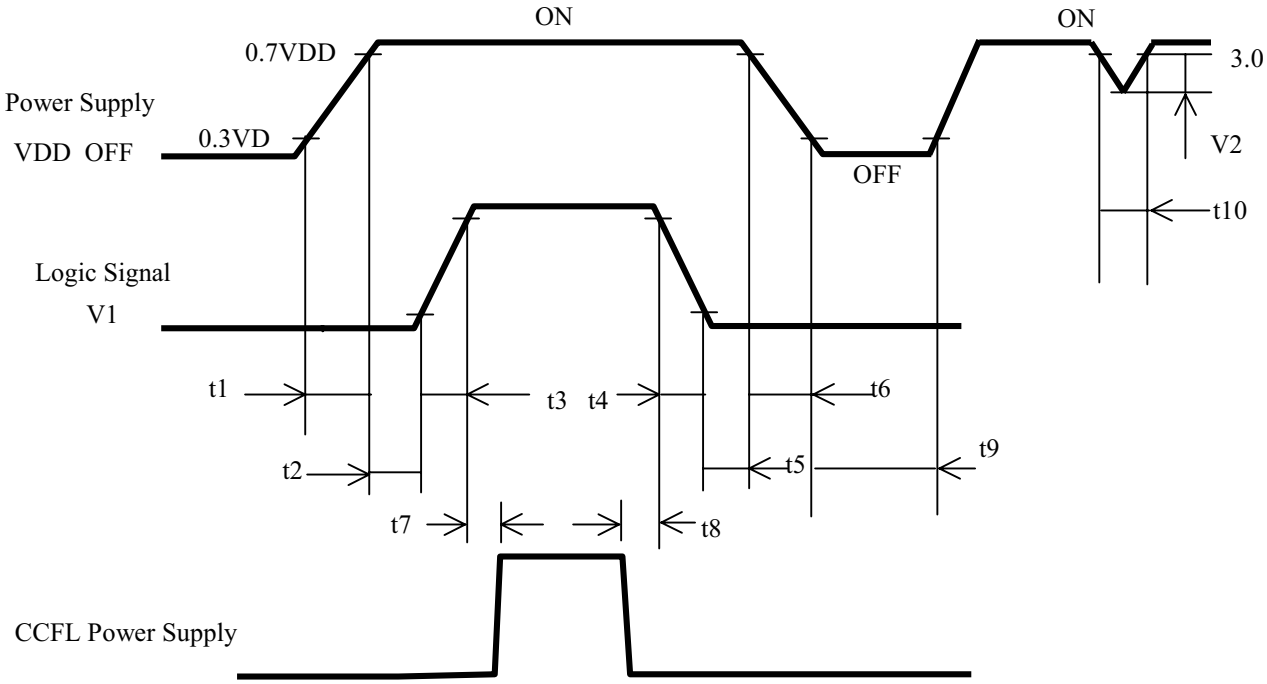
Each color is displayed in sixty-four gray scales from a 6 bit data signal input. A total of 262,144 colors are derived from the resultant 18 bit data.

<Table 11. Input signals, Basic display colors and Gray scale of colors.>

Colors & Gray Scale		Data Signal		
		R0 R1 R2 R3 R4 R5	G0 G1 G2 G3 G4 G5	B0 B1 B2 B3 B4 B5
Basic Colors	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
	Light Blue	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 1 1
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
	Purple	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
Gray Scale of Red	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Darker	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	↓	↓	↓
	▽	↓	↓	↓
	Brighter	1 0 1 1 1 1	0 0 0 0 0 0	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
Gray Scale of Green	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	0 0 0 0 0 0	1 0 0 0 0 0	0 0 0 0 0 0
	Darker	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0
	△	↓	↓	↓
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0	1 0 1 1 1 1	0 0 0 0 0 0
	▽	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
Gray Scale of Blue	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 0 0 0
	Darker	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0
	△	↓	↓	↓
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 1 1 1
	▽	0 0 0 0 0 0	0 0 0 0 0 0	↓
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1
Gray Scale of White & Black	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	1 0 0 0 0 0	1 0 0 0 0 0	1 0 0 0 0 0
	Darker	0 1 0 0 0 0	0 1 0 0 0 0	0 1 0 0 0 0
	△	↓	↓	↓
	▽	↓	↓	↓
	Brighter	1 0 1 1 1 1	1 0 1 1 1 1	1 0 1 1 1 1
	▽	↓	↓	↓
	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1

9.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be as shown in below



t1 ≤ 10 ms	0 ≤ t4 ≤ 50 ms
0 ≤ t2 ≤ 50 ms	0 ≤ t5 ≤ 50 ms
0 ≤ t3 ≤ 50 ms	t6 ≤ 10 ms
t7 ≥ 100 ms	t8 ≥ 200 ms
t9 ≥ 1 s	t10 ≤ 10 ms (Note2.)

2.4 V ≤ V2 ≤ 3.0V (Note3.)

* SET 0V ≤ V1(t) ≤ VDD(t)
HERE, V1(t), VDD(t) indicate the transitive state of V1, VDD
when the power supply is turned ON or OFF
Note1. : Do not keep the interface signal high-impedance when power is on.
Note2. : Momentary Voltage Drop Time.
Note3. : Momentary Drop Voltage.

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

<Table 12. Dimensional Parameters.>

Parameter	Specification	Unit
Active area	245.8 (H) * 184.3 (V)	mm
Number of pixels	1024 (H) * 768 (V)	pixels
	(1 pixel = R + G + B dots)	
Pixel pitch	0.240 (H) * 0.240 (V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	262,144	colors
Display mode	Normally white	
Dimensional outline	261.0 ± 0.5(H) * 199.0 ± 0.5(V) * 5. 2 (D) typ. / 5.5 (D) max.	mm
Weight	380 Typ., 390 max.	gram
Back-light	CCFL, Horizontal-lamp type	

See FIGURE 6. (shown in Appendix)

10.2 Mounting

See FIGURE 7. (shown in Appendix)

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an anti-glare coating to minimize reflection and a coating to reduce scratching.

10.4 Light Leakage

There shall not be visible light from the back-lighting system around the edges of the screen as seen from a distance 50cm from the screen with an overhead light level of 350lux.

11.0 RELIABILITY TEST

<Table 13. Reliability test>

No	Test Items	Conditions
1	High temperature storage test	Ta = 60 ℃, 240 hrs
2	Low temperature storage test	Ta = -20 ℃, 240 hrs
3	High temperature & high humidity operation test	Ta = 50 ℃, 80 %RH, 240 hrs
4	High temperature operation test	Ta = 50 ℃, 240 hrs
5	Low temperature operation test	Ta = 0 ℃, 240 hrs
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 100 cycle
7	Vibration test (non-operating)	Frequency : 10 ~ 500 Hz Gravity/AMP : 1.5G X,Y,Z Period : 30 min
8	Shock test (non-operating)	Gravity : 220 G Pulse width : 2 ms, half sine wave Direction : ±X, ±Y, ±Z twice for each direction
9	Electrostatic discharge test	Air : 150 pF, 330Ω , 15 KV Contact : 150 pF, 330Ω , 8 KV

Result Evaluation Criteria

Under the display quality test conditions with normal operation state, there shall be no change which may affect practical display function.

12.0 HANDLING & CAUTIONS

(1) Cautions when taking out the module
• Pick the pouch only, when taking out module from a shipping package.

(2) Cautions for handling the module
• As the electrostatic discharges may break the LCD module, handle the LCD module with care. Peel a protection sheet off from the LCD panel surface as slowly as possible.
• As the LCD panel and back - light element are made from fragile glass material, impulse and pressure to the LCD module should be avoided.
• As the surface of the polarizer is very soft and easily scratched, use a soft dry cloth without chemicals for cleaning.
• Do not pull the interface connector in or out while the LCD module is operating.
• Put the module display side down on a flat horizontal plane.
• Handle connectors and cables with care.

(3) Cautions for the operation
• When the module is operating, do not lose CLK, ENAB signals. If any one of these signals is lost, the LCD panel would be damaged.
• Obey the supply voltage sequence. If wrong sequence is applied, the module would be damaged.

(4) Cautions for the atmosphere
• Dew drop atmosphere should be avoided.
• Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(5) Cautions for the module characteristics
• Do not apply fixed pattern data signal to the LCD module at product aging.
• Applying fixed pattern for a long time may cause image sticking.

(6) Other cautions
• Do not disassemble and/or re-assemble LCD module.
• Do not re-adjust variable resistor or switch etc.
• When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

13.0 PACKING INFORMATION

HEI provides the standard shipping container for customers, unless customer specifies their packing information. (TBD)

14.0 APPENDIX

Figure 1. Measurement Set Up

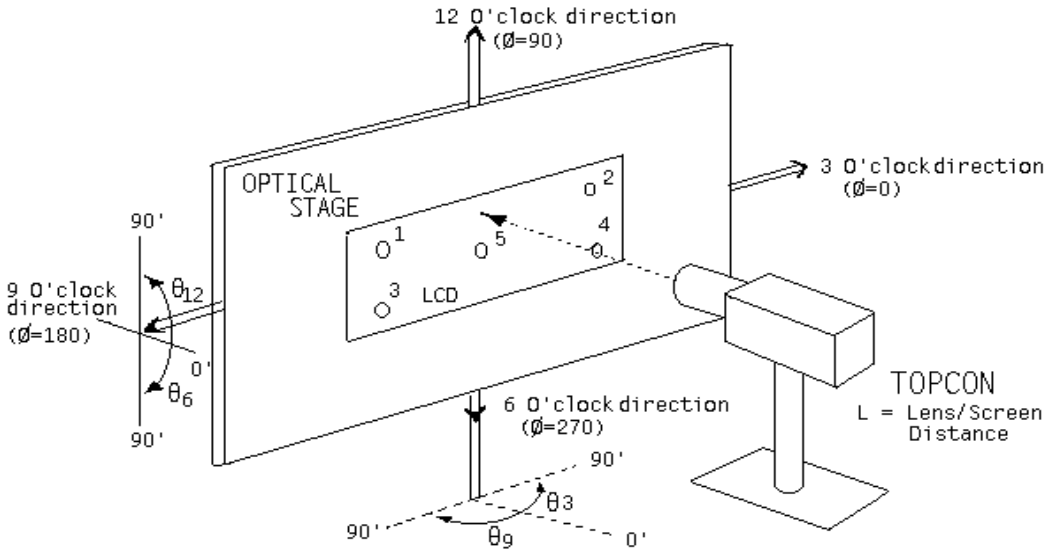


Figure 2. Average Luminance Measurement Locations

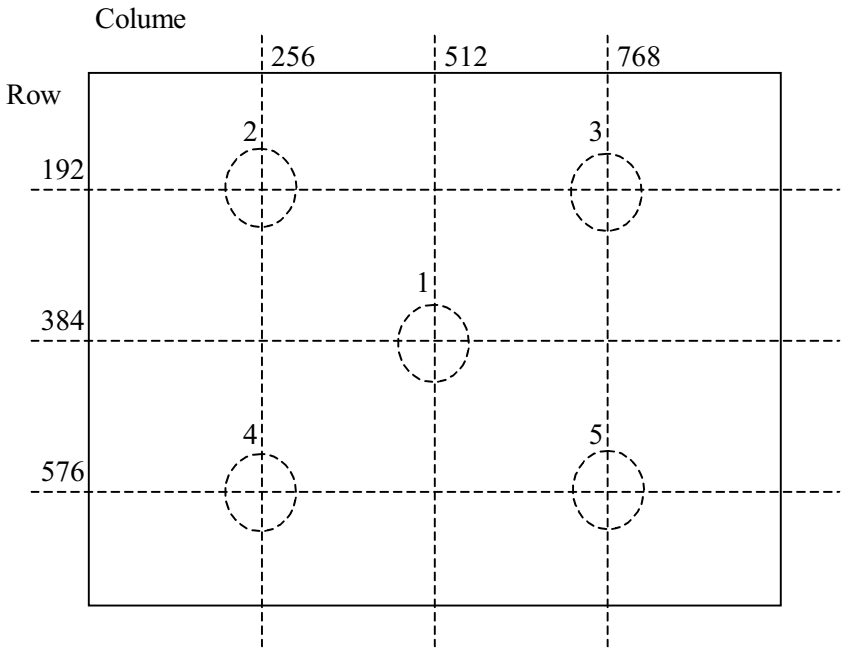


Figure 3. Uniformity Measurement Locations

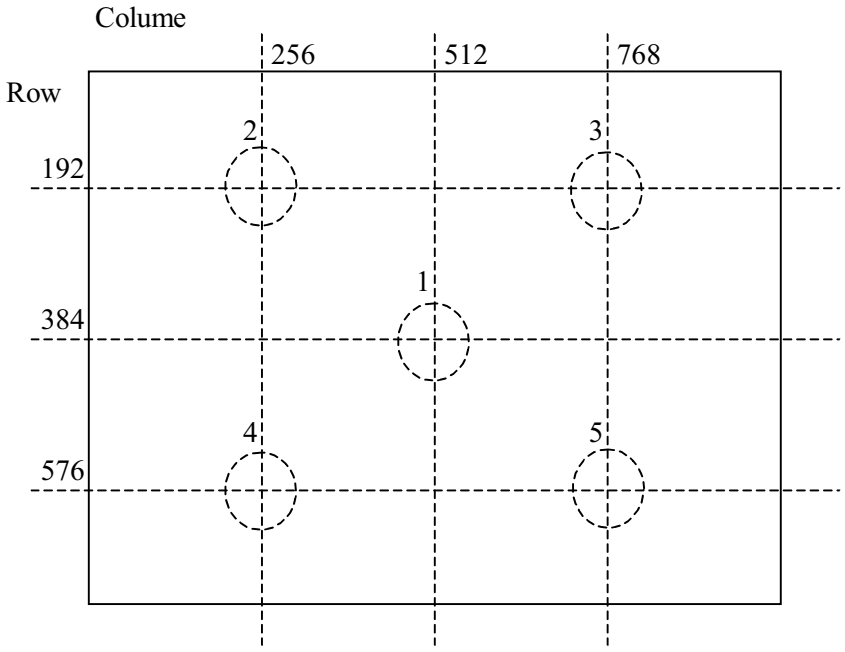


Figure 4. Response Time Testing

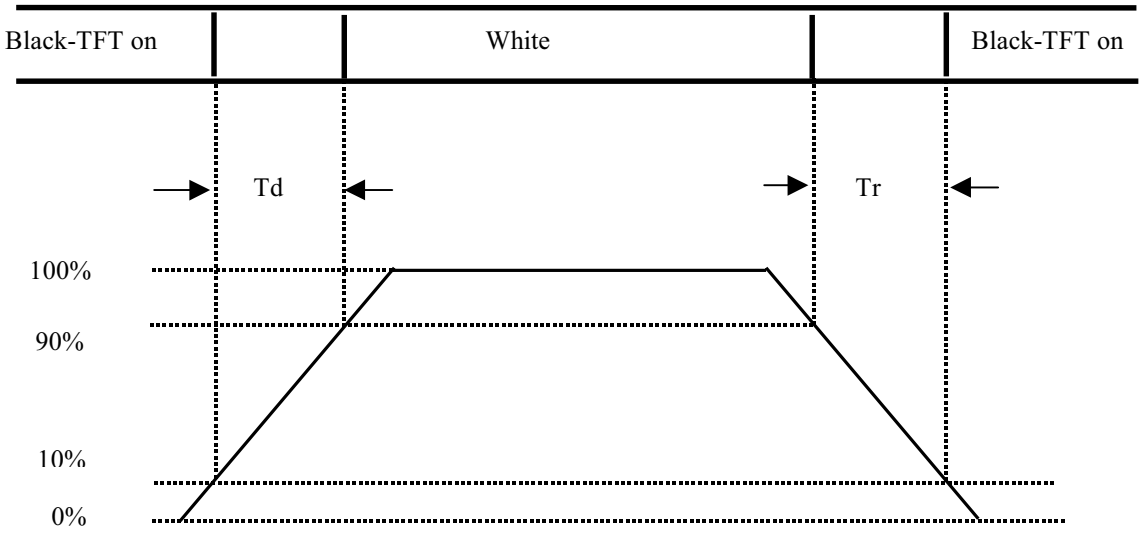
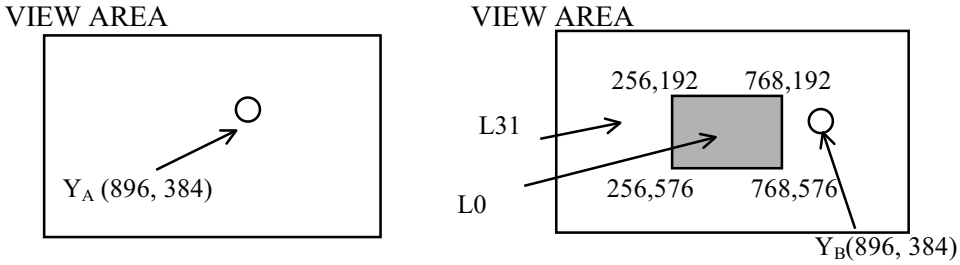


Figure 5. Cross Modulation Test Description



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

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (cd/m^2)

The location measured will be exactly the same in both patterns

Figure 6. TFT-LCD Module Outline Dimensions (Front view)

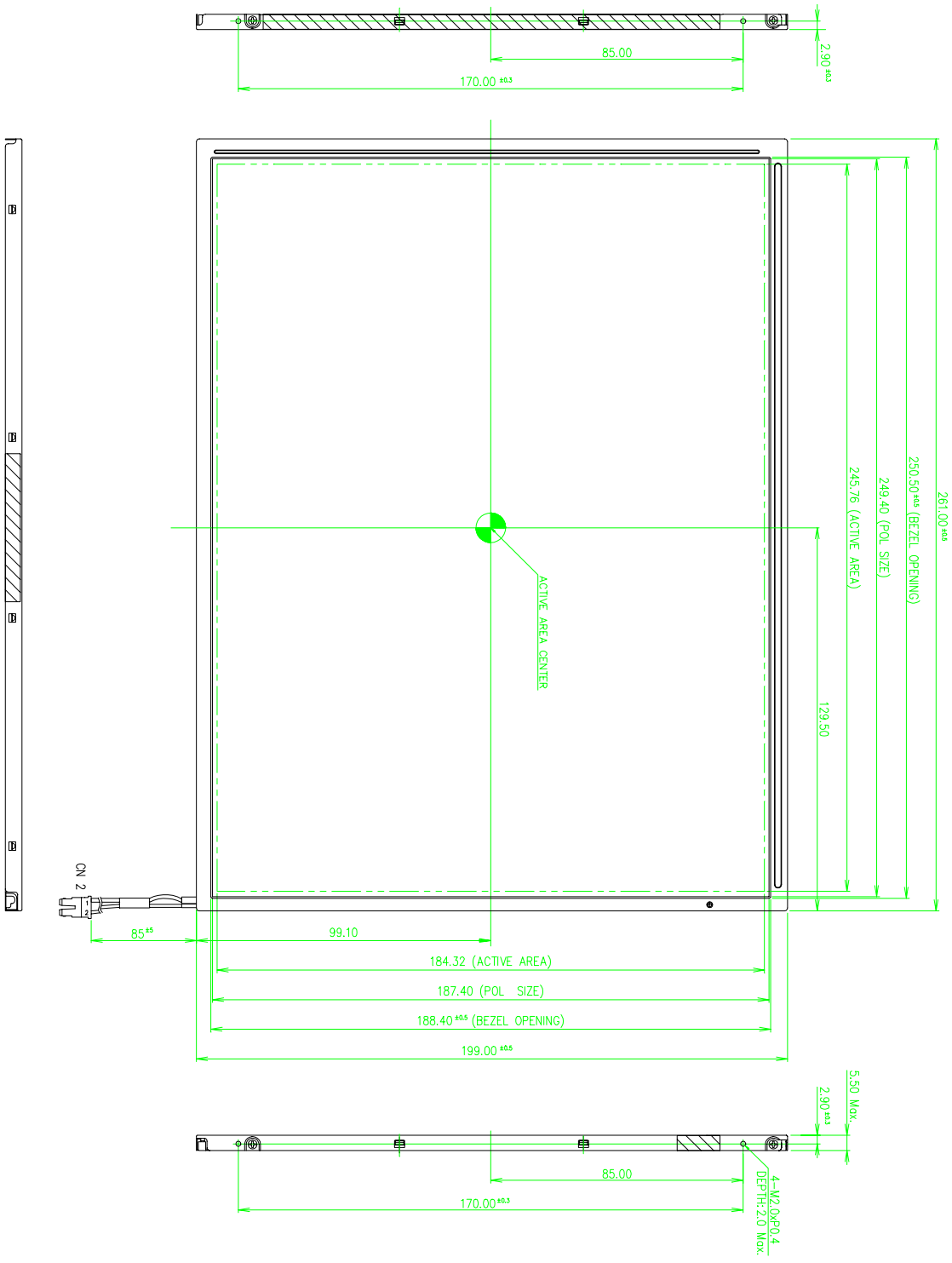
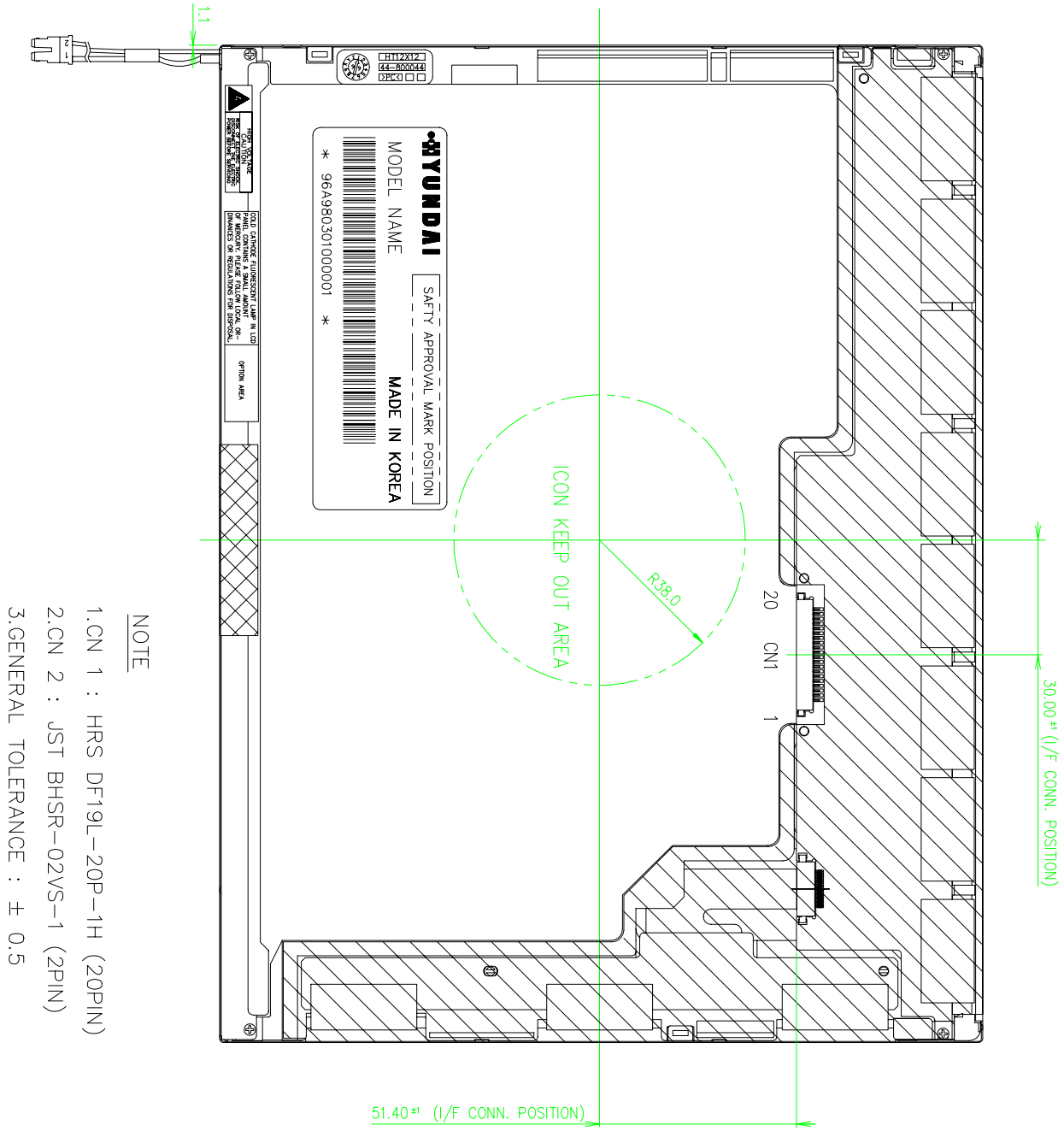



Figure 7. TFT-LCD Module Outline Dimensions (Back view)