TITLE : HT15X11-200 Product Specification

Rev. 0

LCD SBU
Hyundai Electronics Industries Co., Ltd.

REVISION HISTORY

REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
0		Initial Release	00.06.08	YI . KIM

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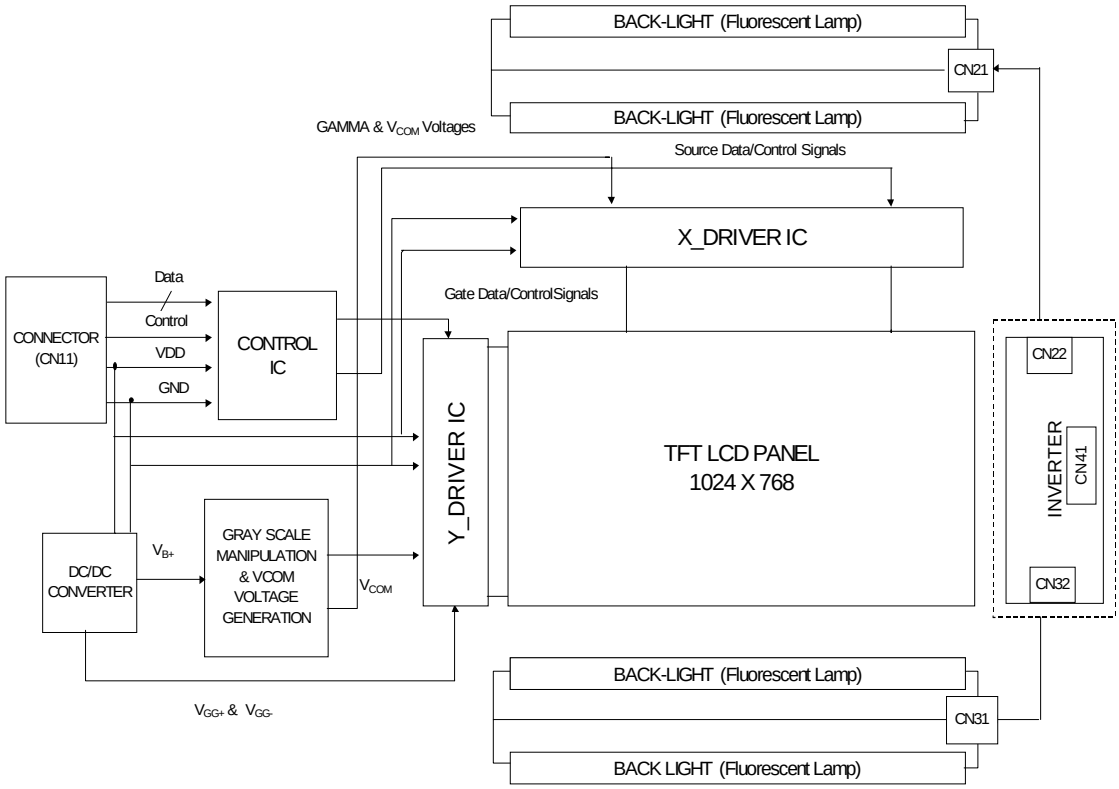
1.0 GENERAL DESCRIPTION

1.1 Introduction

HT15X11-200 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 15.0 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 Desk-top type of PC. The DC/AC inverter for back-light driving is not built in this model.



1.2 Features

- Desk-top type of PC
- Display terminals for control system
- Monitors for process controller
- CMOS RGB Interface
- High speed response
- 64 Gray Scale (6 bits)
- Incorporated edge type back-light (Four lamps, Inverter optional)
- High luminance and Contrast ratio, Low reflection and wide viewing angle
- DE (Data Enable) Mode only

1.3 General Specifications

The followingsare general specifications at the model HT15X11-200. (listed in Table 1)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	304.128 (H) x 228.096(V)	mm	
Number of pixels	1024(H) x 768(V)	pixels	
Pixel pitch	0.297(H) x 0.297(V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	262,144	colors	
Display mode	Normally white		
Dimensional outline	350.0±0.5(H)x266.5±0.5(V)x17.2(D) Typ.	mm	Note 1
Weight	1500 Max.	g	Note 1
Back-light	Top/Bottom edge side 4-CCFL type		Note 2

Note : 1. Excluding Back-light inverter

2. 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. The operational and non-operational maximum voltage and current values are listed in Table 2.

< Table 2. Absolute Maximum Ratings>

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Input Voltage	V_{DD}	-0.3	6.0	V	Ta = 25℃
Backlight Power Supply Voltage	V_{DDB}	-0.3	14	V	
Logic Input Voltage	V_{IN}	-0.3	4.6	V	
Operating Temperature (Humidity)	T_{OP} RH	0	+50 80	℃ %	≤ 40 ℃
Storage Temperature (Humidity)	T_{SP} RH	-20	+60 95	℃ %	≤40 ℃

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Characteristics

< Table 3. Electrical specifications > Ta = 25±2℃

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	4.5	5.0	5.5	V	
Power Supply Current	I_{DD}		290	650	mA	Note 1
"Low" Input Voltage	V_{IL}	0		0.8	V	Note 2
"High" Input Voltage	V_{IH}	2.0		3.6	V	
Back-light Lamp Voltage	V_{BL}		630	775	V_{rms}	
Back-light Lamp Current	I_{BL}	3.0	6.0	7.0	mA_{rms}	per CCFL
Back-light Lamp operating frequency	F_L		45		KHz	Note 3
Lamp Start Voltage	V_S			(780) (25℃)	V_{rms}	Note 4
				(1160) (0℃)		
Lamp Life	Hr	25,000			hrs	
Power Consumption	P_D		1.4		W	
	P_{BL}		15.1		W	Note 5
	P_{total}		16.5		W	

Notes : 1. Test Pattern of power supply current

a) Typ : Vertical color bar pattern

b) Max : Vertical 2 line pattern

2. Input signals are DE,I_{CLK},RA[5:0],GA[5:0],BA[5:0],RB[5:0],GB[5:0], BB[5:0]

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. The voltage above this value should be applied to the lamps for more than 1 second to startup. Otherwise the lamps may not to be turned on.

5. Calculated value for reference (V_{BL} × I_{BL}) x 4 excluding inverter loss.

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 measurement shall be executed after 30 minutes warm-up period. VDD shall be 5.0+/-10% 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	50			Deg.	Note 1
		Θ_9		50			Deg.	
	Vertical	Θ_{12}		25			Deg.	
		Θ_6		50			Deg.	
Luminance Contrast ratio		CR	Θ = 0°	150	200			Note 2
Average Luminance of White		Y_w	Θ = 0°	180	200		cd/m^2	Note 3
White luminance uniformity		ΔY	IBL = 6.0.mA			1.45		Note 4
Reproduction Of color	White	x_w	Θ = 0°	0.283	0.313	0.343		Note 5
		y_w		0.300	0.330	0.360		
	Red	x_R		0.602	0.632	0.662		
		y_R		0.301	0.331	0.361		
	Green	x_G		0.257	0.287	0.317		
		y_G		0.578	0.608	0.638		
	Blue	x_B		0.115	0.145	0.175		
		y_B		0.073	0.103	0.133		
Response Time (Rise + Decay)		Ttotal	Ta= 25° C Θ = 0°		40	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 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 FIGURE 1 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 FIGURE 1 shown in Appendix) Luminance Contrast Ratio (CR) is defined mathematically .

$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

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 : ΔY = Maximum Luminance of five points / Minimum Luminance of five points (see FIGURE 2 shown in Appendix).
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 FIGURE 3 shown in Appendix by switching the “data” input signal ON and OFF. The times needed for the luminance to change from 0% to 90% is Td, and 100% to 10% is Tr.
7. Cross-Talk of one area of the LCD surface by another shall be measured by comparing the luminance (Y_A) of a 25mm diameter area, with all display pixels set to a gray level, to the luminance (Y_B) of that same area when any adjacent area is driven dark. (see FIGURE 4 shown in Appendix).

5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

CN11 The module-side connector : FX8-80S-SV (HIROSE Electric Co.)

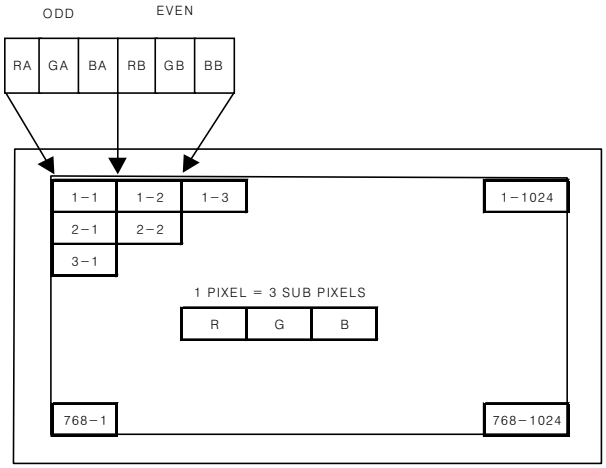
The user-side connector : FX8-80P-SV (HIROSE Electric Co.)

<Table 5. Pin Assignment for Receiver Interface Connection>

Pin No	Symbol	Function	Pin No	Symbol	Function
1	GND	Ground	41	GND	Ground
2	NC	No Connection	42	NC	No Connection
3	NC	No Connection	43	NC	No Connection
4	RA0	Red Odd data LSB	44	GB0	Green Even data LSB
5	RA1	“	45	GB1	“
6	GND	Ground	46	GND	Ground
7	RA2	Red Odd data	47	GB2	Green Even data
8	RA3	“	48	GB3	“
9	RA4	“	49	GB4	“
10	RA5	Red Odd data MSB	50	GB5	Green Even data MSB
11	GND	Ground	51	GND	Ground
12	NC	No Connection	52	NC	No Connection
13	NC	No Connection	53	NC	No Connection
14	GA0	Green Odd data LSB	54	BB0	Blue Even data LSB
15	GA1	“	55	BB1	“
16	GND	Ground	56	GND	Ground
17	GA2	Green Odd data	57	BB2	Blue Even data
18	GA3	“	58	BB3	“
19	GA4	“	59	BB4	“
20	GA5	Green Odd data MSB	60	BB5	Blue Even data MSB
21	GND	Ground	61	GND	Ground
22	NC	No Connection	62	GND	"
23	NC	No Connection	63	CLK	Clock
24	BA0	Blue Odd data LSB	64	GND	Ground
25	BA1	“	65	GND	Ground
26	GND	Ground	66	NC	No Connection
27	BA2	Blue Odd data	67	GND	Ground
28	BA3	“	68	GND	Ground
29	BA4	“	69	DE	Data Enable

30	BA5	Blue Odd data MSB	70	NC	No Connection
31	GND	Ground	71	VDD	+5V Power Supply
32	NC	No Connection	72	VDD	“
33	NC	No Connection	73	VDD	“
34	RB0	Red Even data LSB	74	VDD	“
35	RB1	“	75	VDD	“
36	GND	Ground	76	NC	No Connection
37	RB2	Red Even data	77	NC	"
38	RB3	“	78	NC	"
39	RB4	“	79	NC	"
40	RB5	Red Even data MSB	80	GND	Ground

5.2 Data Input Format



Display Position of Input Data

5.3 Back-light Interface

5.3.1 The connector interface pin assignments (CN21,CN31)

The Back-light interface connector is a model BHR-04VS-1 manufactured by JST or equivalent. Connector pin assignment is listed in Table 6.

<Table 6. Back-light Electrical Interface>

Terminal No.	INPUT[CN21],[CN31]	Color	Function
1	HOT 1	Pink	High Voltage
2	HOT 2	Pink	High Voltage
3	N.C	-	No Connection
4	COLD	White	Ground

6.0 SIGNAL TIMING SPECIFICATIONS

The specification of the signal timing parameter is listed in Table 7.

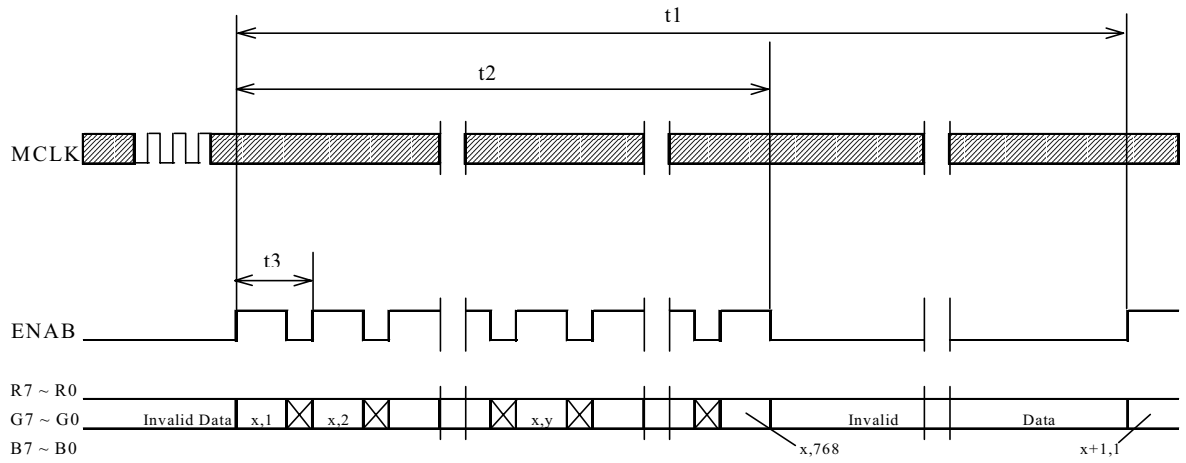
Basically , there are two signal timing methods to be operated. These are Data Enable Mode and SYNC Mode. The HT15X11-200 is operated by the Data Enable Mode. (not used SYNC Mode)

<Table 7. Signal Timing Specifications>

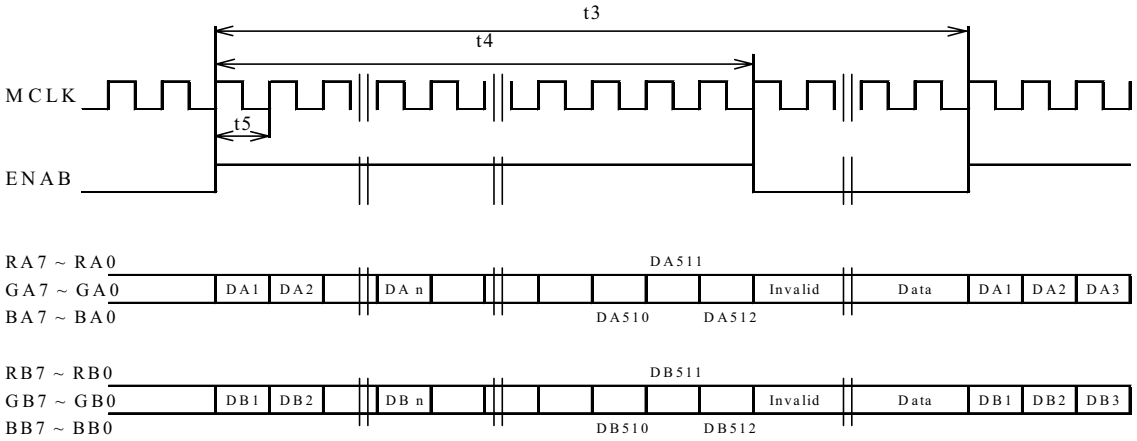
Items	Symbol	Min	Typ	Max	Unit
Frame Period	t1	778 X t3 –	806 X t3 16.67	860 X t3 –	– ms
Vertical Display Period	t2	768 X t3 –	768 X t3 15.88	768 X t3 –	– ms
One Line Scanning Period	t3	592 X t5 16.66	672X t5 20.68	682X t5 –	– us
Horizontal Display Term	t4	512 X t5 –	512 X t5 15.75	512 X t5 –	– us
Clock Frequency	t5	–	32.5	40.0	MHz
Clock "L" Time	t6	9	–	–	ns
Clock "H" Time	t7	9	–	–	ns
Set up Time	t8	8	–	–	ns
Hold Time	t9	8	–	–	ns

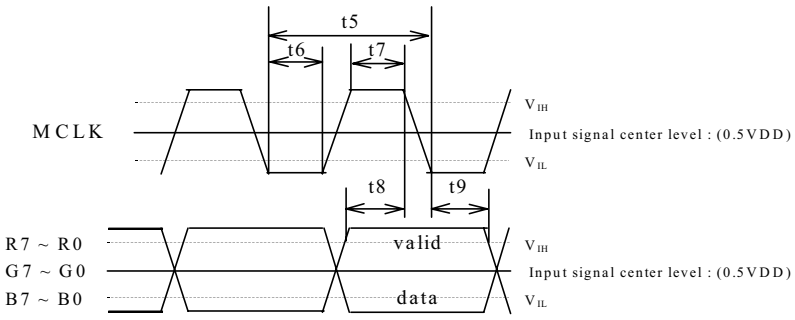
7.0 SIGNAL TIMING WAVEFORMS

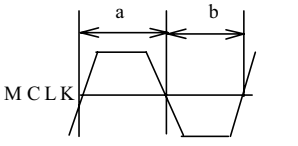
7.1 Vertical Timing Waveforms



7.2 Horizontal Timing Waveforms







Duty(a,b) = 50%±10%

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

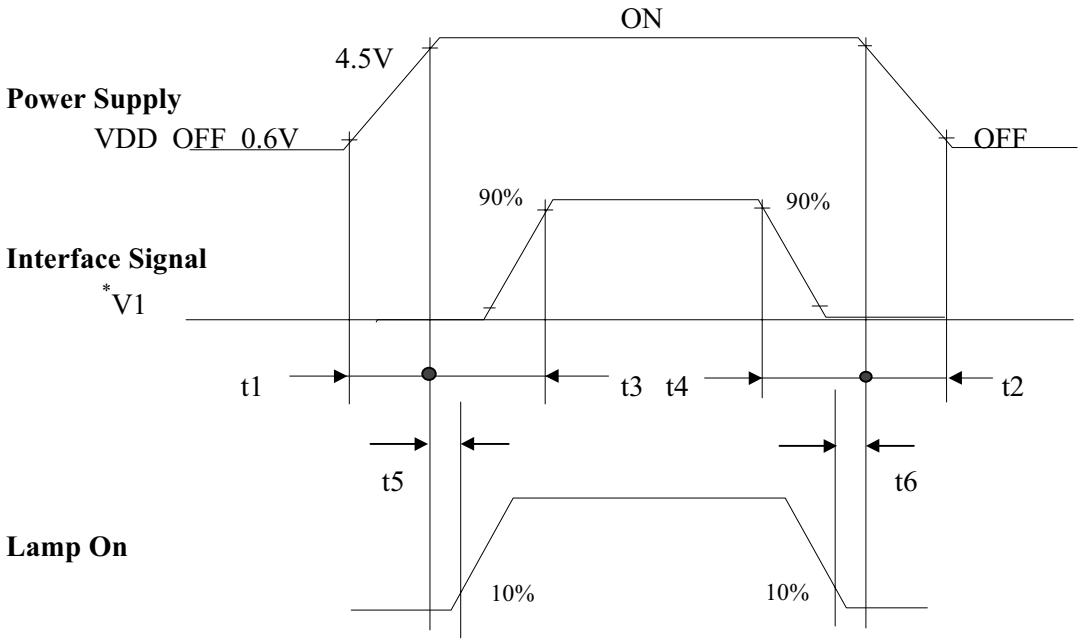
Each color is displayed in 262,144 gray scales from 6 bits data signal input. Table 8 shows the 6 bits input signals for basic display colors and gray scale.

<Table 8. 6 Bits Input signals, basic display colors and gray scale for each color>

		Data signal		
	ODD	RA5 RA4 RA3 RA2 RA1 RA0	GA5 GA4 GA3 GA2 GA1 GA0	BA5 BA4 BA3 BA2 BA1 BA0
	EVEN	RB5 RB4 RB3 RB2 RB1 RB0	GB5 GB4 GB3 GB2 GB1 GB0	BB5 BB4 BB3 BB2 BB1 BB0
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
	△	0 0 0 0 0 1	0 0 0 0 0 0	0 0 0 0 0 0
	Darker	0 0 0 0 1 0	0 0 0 0 0 0	0 0 0 0 0 0
	△ ↓ ▽	↓ ↓	↓ ↓	↓ ↓
	Brighter	1 1 1 1 0 1	0 0 0 0 0 0	0 0 0 0 0 0
	▽	1 1 1 1 1 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	0 0 0 0 0 1	0 0 0 0 0 0
	Darker	0 0 0 0 0 0	0 0 0 0 1 0	0 0 0 0 0 0
	△ ↓ ▽	↓ ↓	↓ ↓	↓ ↓
	Brighter	0 0 0 0 0 0	1 1 1 1 0 1	0 0 0 0 0 0
	▽	0 0 0 0 0 0	1 1 1 1 1 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	0 0 0 0 0 1
	Darker	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 1 0
	△ ↓ ▽	↓ ↓	↓ ↓	↓ ↓
	Brighter	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 0 1
	▽	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 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
	△	0 0 0 0 0 1	0 0 0 0 0 1	0 0 0 0 0 1
	Darker	0 0 0 0 1 0	0 0 0 0 1 0	0 0 0 0 1 0
	△ ↓ ▽	↓ ↓	↓ ↓	↓ ↓
	Brighter	1 1 1 1 0 1	1 1 1 1 0 1	1 1 1 1 0 1
	▽	1 1 1 1 1 0	1 1 1 1 1 0	1 1 1 1 1 0
	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



Power ON	Power OFF
t1 < 5 ms	t2 < 1 second
t3 ≤ 50 ms	t4 ≤ 50 ms
t5 > 140 ms	t6 > 0 ms

* 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

Note : Do not keep the interface signal high-impedance when power is on.

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 6 shown in appendix shows mechanical outlines for the model HT15X11-200. Other parameters are shown in Table 9.

<Table 9. Dimensional Parameters>

Parameter	Specification	Unit
Active area	304.128 (H) x 228.096(V)	mm
Number of pixels	1024(H) x 768(V)	pixels
	(1 pixel = R + G + B dot)	
Pixel pitch	0.297(H) x 0.297(V)	mm
Pixel arrangement	RGB Vertical stripe	
Display colors	262,144	colors
Display mode	Normally white	
Dimensional outline (Excluding Inverter)	350.0±0.5(H) x 266.5±0.5(V) x 17.2(D) Typ.	mm
Weight	1500Max. (Without Inverter)	gram
Back-light	Top/Bottom edge side 4-CCFL type	

10.2 Mounting

See FIGURE 5 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 50 cm from the screen with an overhead light level of 350lux.

The manufacture shall furnish limit samples of the panel showing the most light leakage acceptable.

11.0 RELIABILITY TEST

The Reliability test items and its conditions are shown in below.

<Table 10. 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 ℃ (30 min), 100 cycle
7	Vibration test (non-operating)	Frequency : 10 ~ 500 Hz Gravity/AMP : 1.5G Period : X,Y,Z 30 min
8	Shock test (non-operating)	Gravity : 70G Pulse width : 11 ms, half sine wave Direction : ±X, ±Y, ±Z Once for each direction
9	Electrostatic discharge test	Air : 150 pF, 330Ω, 15KV Contact : 150 pF, 330Ω, 8KV

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 ICLK, DE 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 APPENDIX

Figure 1. Measurement Set Up

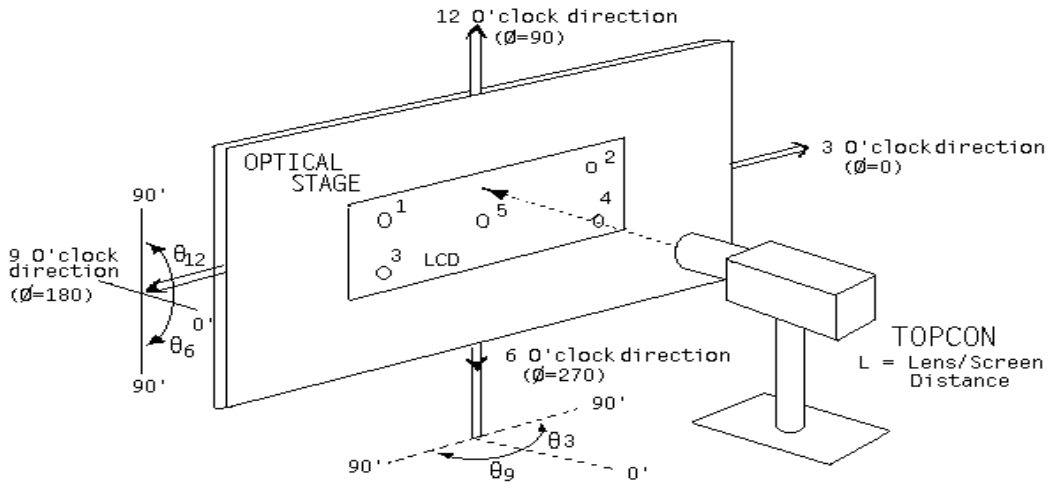


Figure 2. Average Luminance Measurement Locations & Uniformity Measurement Locations

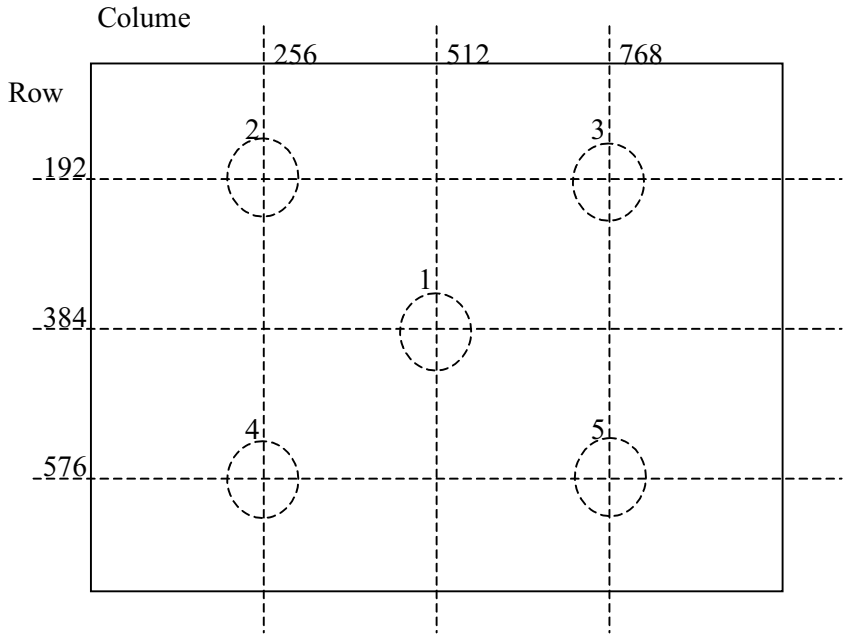


Figure 3. Response Time Testing

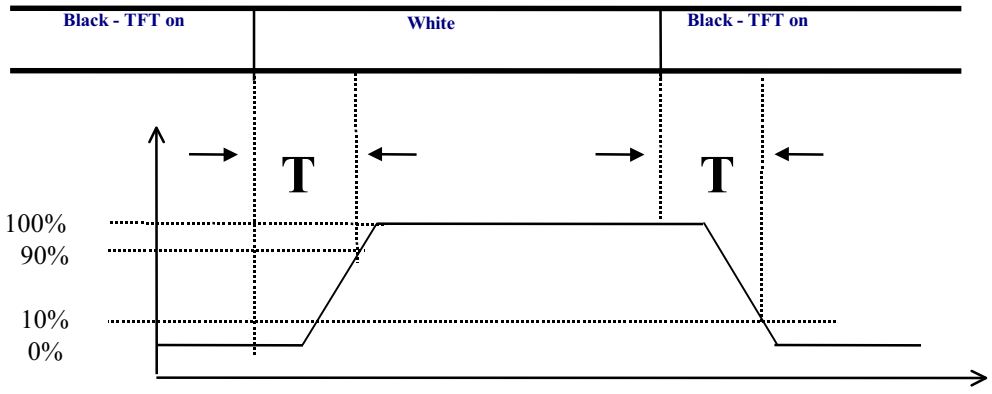
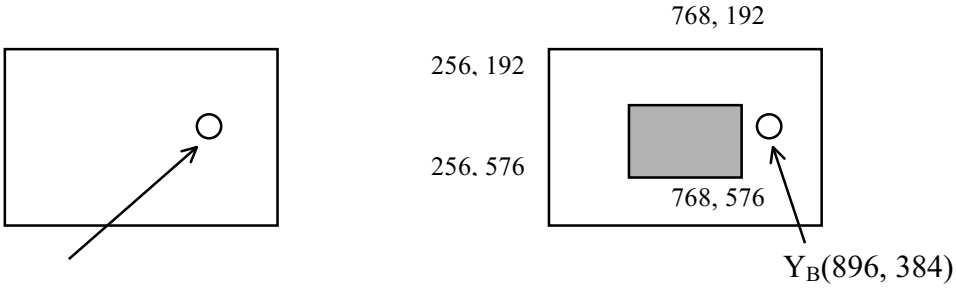


Figure 4. Cross Modulation Test Description



Y_A (896, 384)

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

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 5. TFT-LCD Module Outline Dimensions (Front view)

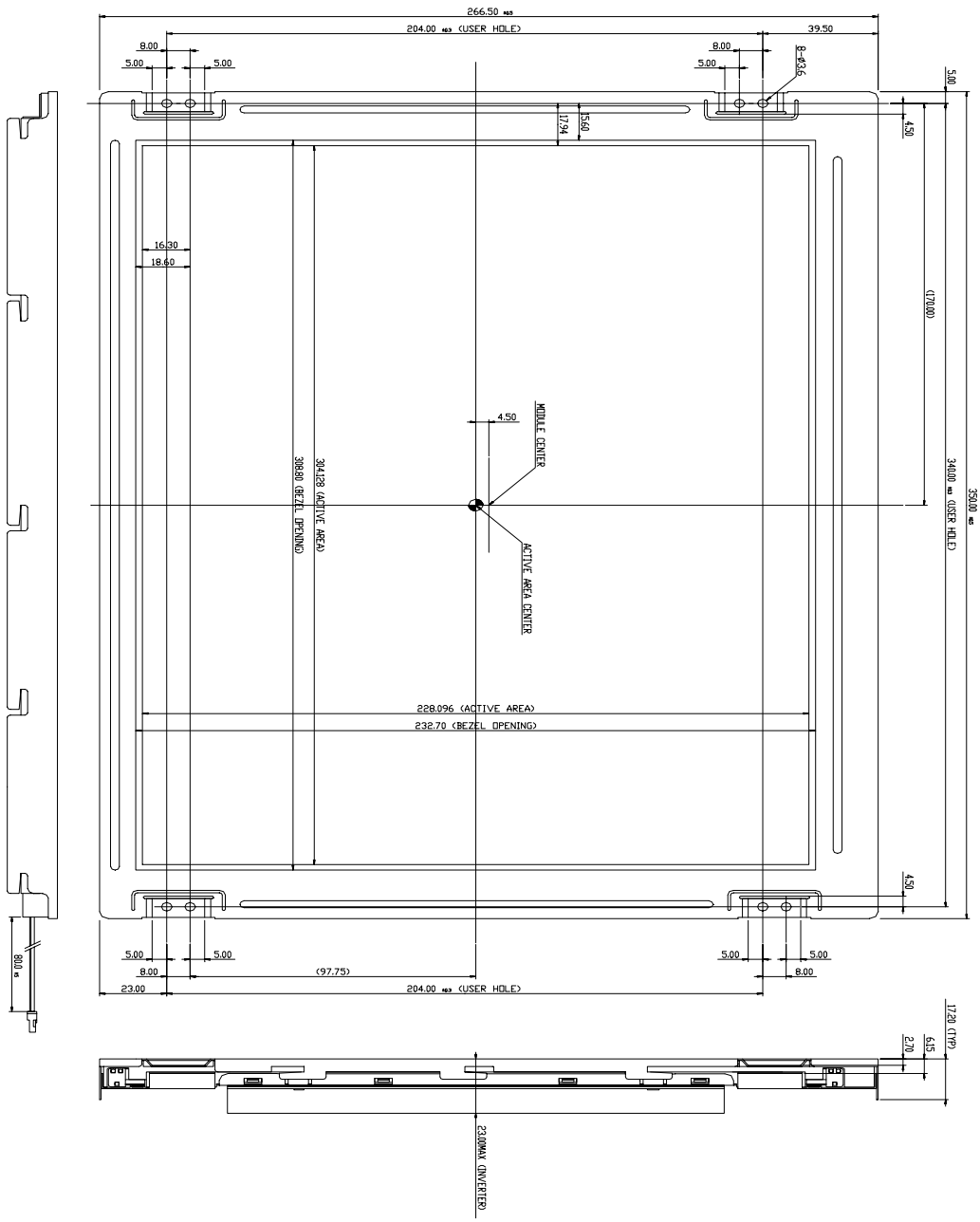


Figure 6. TFT-LCD Module Outline Dimensions (back view)