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HT18E22-200
Product Specification

Rev.0

Hyundai Display Technology, Inc.

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S864-1088	TFT-LCD PRODUCT	0	2002.02.21	1 OF 21



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REVISION HISTORY

REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
0		Initial Release for 12V(V _{AA}) only input and IQT EMI solution	2002/2/21	H.D.KIM

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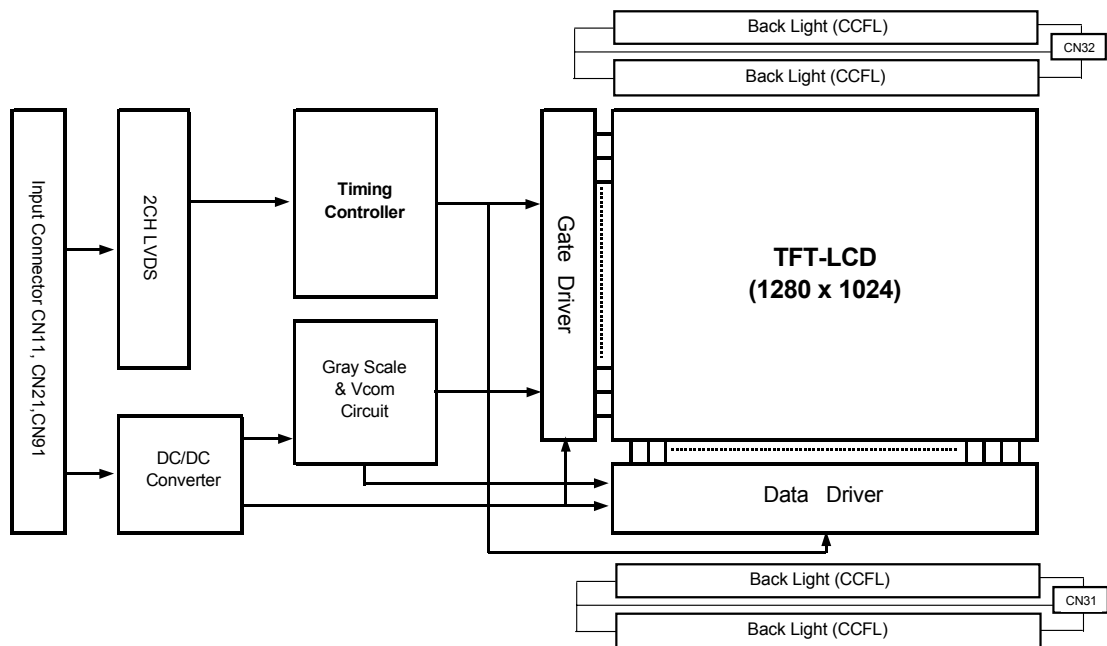
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1.0 GENERAL DESCRIPTIONS

1.1 Introduction

HT18E22-201 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 18.1 inch diagonally measured active area with SXGA resolutions (1280 horizontal by 1024 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16,777,216 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.



1.2 Features

- UFFS (Ultra Fringe Field Switching) Mode
- High speed response
- 256 Gray Scale (8 bits)
- Incorporated edge type back-light (4 lamps)
- High luminance and Low reflection & wide viewing angle (Using Ultra FFS Tech.)
- DE (Data Enable) only Mode
- 2CH LVDS Interface
- Monitor for Workstation & Desktop PC use
- Display terminals for control system
- Monitors for process controller

1.4 General Specifications

The following are general specifications at the model HT18E22-200. (listed in Table 1)

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<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	359.040 (H) X 287.232 (V)	mm	
Number of pixels	1280 (H) X 1024 (V)	pixels	
Pixel pitch	0.2805 (H) X 0.2805 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16,777,216	colors	
Display mode	Normally Black		
Outline dimension	414.0(H) X 335.0(V) X 18.6(D)	mm	Note 1
Weight	2600 Typ	g	Note 2
Back-light	Top/Bottom edge side 4-CCFL type		Note 3

Notes : 1. General tolerance : H & V = $\pm 0.5\text{mm}$ / D = $\pm 0.3\text{mm}$

2. 2700 Max.

3. 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 _{AA}	-0.3	13.0	V	
Back-light lamp Current	I _L	3.0	8.0	mArms	
Operating Temperature (Humidity)	T _{OP} RH	10	+40 75	°C %	≤40°C
Storage Temperature (Humidity)	T _{ST} RH	-20	+60 95	°C %	≤40°C

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Characteristics

< Table 3. Electrical specifications >

(Ta = 25°C)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Power Input Voltage	V _{AA}	11.5	12.0	12.5	V	
Power Input Current	I _{AA}	-	340	560	mA	Note 1
“H” level Differential input	V _{IL}	100			mV	Note 2
“L” level Differential input	V _{IH}			-100	mV	
Back-light lamp Voltage	V _{BL}		800		V _{rms}	
Back-light lamp Current	I _{BL}		6		mArms	Per CCFL
Back-light Lamp Operating Frequency	FL		50		KHz	Note
Lamp Start Voltage	V _S		1200	1550 (0°C)	V _{rms}	Note 4
			900	1100 (25°C)	V _{rms}	
Lamp Life	Hr	-	30,000		Hours	
Power Consumption	P _{AA}	-	4.08	-	W	
	P _{BL}	-	19.2	-	W	Note5
	P _{total}	-	23.28	-	W	

Notes :

1. Test Pattern of power supply current
 - Typ : Vertical color bar
 - Max : Vertical 2 line skip (@L255)
2. LVDS Receiver common mode voltage, V_{CM} = 1.2V
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 shown above 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} X I_{BL}) X 4 excluding inverter loss.

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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 = $25 \pm 2^\circ\text{C}$) with the equipment of Luminance meter system (Goniometer system and TOPCON 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 $\theta_{0=0}$ ($=\theta_3$) as the 3 o'clock direction (the "right"), $\theta_{0=90}$ ($=\theta_{12}$) as the 12 o'clock direction ("upward"), $\theta_{0=180}$ ($=\theta_9$) as the 9 o'clock direction ("left") and $\theta_{0=270}$ ($=\theta_6$) as the 6 o'clock direction ("bottom"). While scanning θ and/or Φ , the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed 30 minutes after lighting at rating with the back-light CCFL being run at a 6 mArms current after 30 minutes warm-up period. 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	80			Deg.	Note 1
		θ_9		80			Deg.	
	Vertical	θ_{12}		80			Deg.	
		θ_6		80			Deg.	
Contrast ratio		CR	$\theta = 0^\circ$		300			Note 2
Average Luminance of White		Y_w	$\theta = 0^\circ$	190	210		cd/m ²	Note 3
White luminance uniformity		ΔY	IBL = 6.0mA			1.45		Note 4
Reproduction Of color	White	X_w	$\theta = 0^\circ$	0.301	0.321	0.341		Note 5
		Y_w		0.321	0.341	0.361		
	Red	X_R		0.626	0.646	0.666		
		Y_R		0.322	0.342	0.362		
	Green	X_G		0.271	0.291	0.311		
		Y_G		0.590	0.610	0.630		
	Blue	X_B		0.124	0.144	0.164		
		Y_B		0.088	0.108	0.128		
Response Time (Rise + Decay)		T_{total}		-	27	31	ms	Note 6
Cross Talk		CT				4.0	%	Note 7

Notes :

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 FIGURE 1 shown in Appendix).
2. Contrast measurements shall be made at viewing angle of $\theta = 0^\circ$ 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 : $\Delta Y = \text{Maximum Luminance of five points} / \text{Minimum Luminance of five points}$ (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 10% to 90% is Tr and 90% to 10% is Td.
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

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The module-side connector : FI - SEB20P – HF (JAE) or Equivalent

The user-side connector : FI – SE20M/FI – S20S (JAE) or Equivalent

<Table 5. Pin Assignment for Receiver Interface Connection>

CN11 Pin Assignment
CN21 Pin Assignment

Pin No.	Symbol	Description	Pin No.	Symbol	Description
20	NC	N.C.	20	NC	N.C.
19	NC		19	NC	
18	Vss	GND 1)	18	Vss	GND 1)
17	Vss		17	Vss	
16	RAIN0-	Odd Pixel Data 2)	16	RBIN0-	Even Pixel Data 2)
15	RAIN0+		15	RBIN0+	
14	Vss	GND	14	Vss	GND
13	RAIN1-	Odd Pixel Data	13	RBIN1-	Even Pixel Data
12	RAIN1+		12	RBIN1+	
11	Vss	GND	11	Vss	GND
10	RAIN2-	Odd Pixel Data	10	RBIN2-	Even Pixel Data
9	RAIN2+		9	RBIN2+	
8	Vss	GND	8	Vss	GND
7	RACLKIN-	Odd Pixel CLK	7	RBCLKIN-	Even Pixel CLK
6	RACLKIN+		6	RBCLKIN+	
5	Vss	GND	5	Vss	GND
4	RAIN3-	Odd Pixel Data	4	RBIN3-	Even Pixel Data
3	RAIN3+		3	RBIN3+	
2	Vss	GND	2	Vss	GND
1	RSVD	N.C.	1	RSVD	N.C.

CN91 Pin Assignment

The module-side connector : 53261-0890 (Molex)

The user-side connector : 51021-0800 (Molex) or Equivalent

Pin No.	Symbol	Description
1	N.C	No Connection
2, 3, 4	Vss	GND
5, 6, 7, 8	V _{AA}	12.0V

Notes 1) All Vss pins should be grounded. Shield Case is internally connected to Vss.

2) RnINm+ and RnINm- (n = A,B, m = 0,1,2,3) should be wired by twist – pairs or side by side FPC patterns, respectively



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5.2 2CH LVDS(Rx : THC63LVDF84A) Interface

	INPUT SIGNAL	TRANSMITTER		INTERFACE		RECEIVER		OUTPUT SIGNAL
		Pin No.	INPUT	SYSTEM	TFT-LCD	Pin No.	OUTPUT	
L V D S O D D	RA2	51	TAIN0	TAOUT0+ TAOUT0-	RAIN0+ RAIN0-	27	RAOUT0	RA
	RA3	52	TAIN1			29	RAOUT1	RA3
	RA4	54	TAIN2			30	RAOUT2	RA4
	RA5	55	TAIN3			32	RAOUT3	RA5
	RA6	56	TAIN4			33	RAOUT4	RA6
	RA7	3	TAIN6			35	RAOUT6	RA7
	GA2	4	TAIN7	TAOUT1+ TAOUT1-	RAIN1+ RAIN1-	37	RAOUT7	GA2
	GA3	6	TAIN8			38	RAOUT8	GA3
	GA4	7	TAIN9			39	RAOUT9	GA4
	GA5	11	TAIN12			43	RAOUT12	GA5
	GA6	12	TAIN13			45	RAOUT13	GA6
	GA7	14	TAIN14			46	RAOUT14	GA7
	BA2	15	TAIN15	TAOUT2+ TAOUT2-	RAIN2+ RAIN2-	47	RAOUT15	BA2
	BA3	19	TAIN18			51	RAOUT18	BA3
	BA4	20	TAIN19			53	RAOUT19	BA4
	BA5	22	TAIN20			54	RAOUT20	BA5
	BA6	23	TAIN21			55	RAOUT21	BA6
	BA7	24	TAIN22			1	RAOUT22	BA7
	HSYNC	27	TAIN24	TAOUT3+ TAOUT3-	RAIN3+ RAIN3-	3	RAOUT24	HSYNC
	VSYNC	28	TAIN25			5	RAOUT25	VSYNC
	DE	30	TAIN26			6	RAOUT26	DE
	RA0	50	TAIN27			7	RAOUT27	RA0
	GA0	8	TAIN10			34	RAOUT5	GA0
	GA1	10	TAIN11			41	RAOUT10	GA1
	BA0	16	TAIN16	42	RAOUT11	BA0		
	BA1	18	TAIN17	49	RAOUT16	BA1		
RSVD	25	TAIN23	50	RAOUT17	RSVD			
MCLK	31	TCLKAIN	2	RAOUT23	MCLK			
			TCLKAOUT+ TCLKAOUT-	RCLKAIN+ RCLKAIN-	26	RCLKAOUT	MCLK	
L V D S E V E N	RB2	51	TBIN0	TBOUT0+ TBOUT0-	RBIN0+ RBIN0-	27	RBOUT0	RB2
	RB3	52	TBIN1			29	RBOUT1	RB3
	RB4	54	TBIN2			30	RBOUT2	RB4
	RB5	55	TBIN3			32	RBOUT3	RB5
	RB6	56	TBIN4			33	RBOUT4	RB6
	RB7	3	TBIN6			35	RBOUT6	RB7
	GB2	4	TBIN7	TBOUT1+ TBOUT1-	RBIN1+ RBIN1-	37	RBOUT7	GB2
	GB3	6	TBIN8			38	RBOUT8	GB3
	GB4	7	TBIN9			39	RBOUT9	GB4
	GB5	11	TBIN12			43	RBOUT12	GB5
	GB6	12	TBIN13			45	RBOUT13	GB6
	GB7	14	TBIN14			46	RBOUT14	GB7
	BB2	15	TBIN15	TBOUT2+ TBOUT2-	RBIN2+ RBIN2-	47	RBOUT15	BB2
	BB3	19	TBIN18			51	RBOUT18	BB3
	BB4	20	TBIN19			53	RBOUT19	BB4
	BB5	22	TBIN20			54	RBOUT20	BB5
	BB6	23	TBIN21			55	RBOUT21	BB6
	BB7	24	TBIN22			1	RBOUT22	BB7
	RSVD	27	TBIN24	TBOUT3+ TBOUT3-	RBIN3+ RBIN3-	3	RBOUT24	RSVD
	RSVD	28	TBIN25			5	RBOUT25	RSVD
	RSVD	30	TBIN26			6	RBOUT26	RSVD
	RB0	50	TBIN27			7	RBOUT27	RB0
	RB1	2	TBIN5			34	RBOUT5	RB1
	GB0	8	TBIN10			41	RBOUT10	GB0
	GB1	10	TBIN11	42	RBOUT11	GB1		
	BB0	16	TBIN16	49	RBOUT16	BB0		
BB1	18	TBIN17	50	RBOUT17	BB1			
RSVD	25	TBIN23	2	RBOUT23	RSVD			
MCLK	31	TCLKAIN	TCLKBOUT+ TCLKBOUT-	RCLKBIN+ RCLKBIN-	26	RCLKAOUT	MCLK	

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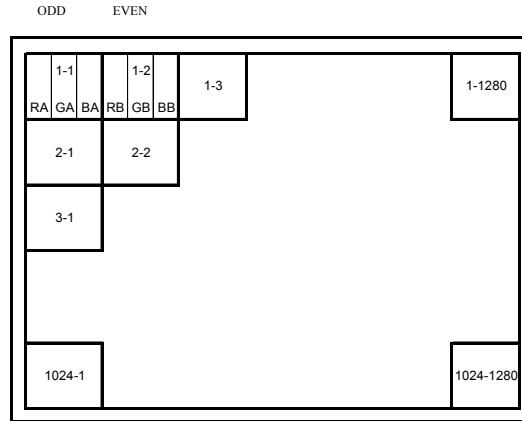
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5.3 Data Input Format



Display Position of Input Data(V-H)

5.4 Back-light Interface

5.4.1 The connector interface pin assignments (CN31,CN32)

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>

Pin No.	INPUT	Color	Function
1	HOT 1	Pink	High Voltage
2	HOT 2	Pink	High Voltage
3	N.C	-	No Connection
4	COLD	White	GND

6.0 SIGNAL TIMING SPECIFICATIONS

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

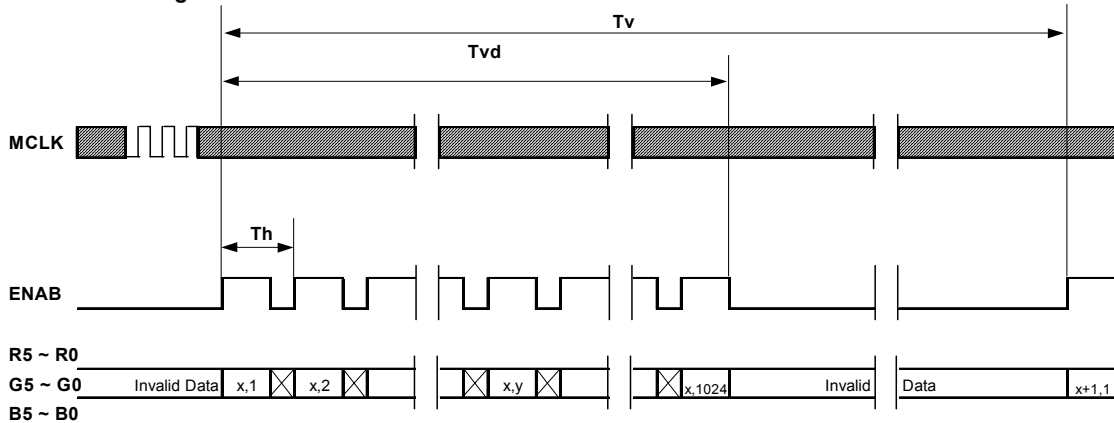
The HT18E22-201 is operated by DE only mode

<Table 7. Signal Timing Specifications>

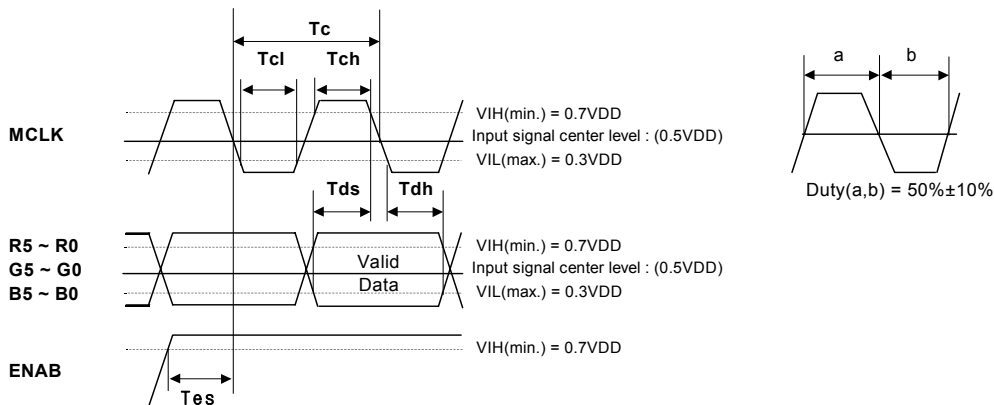
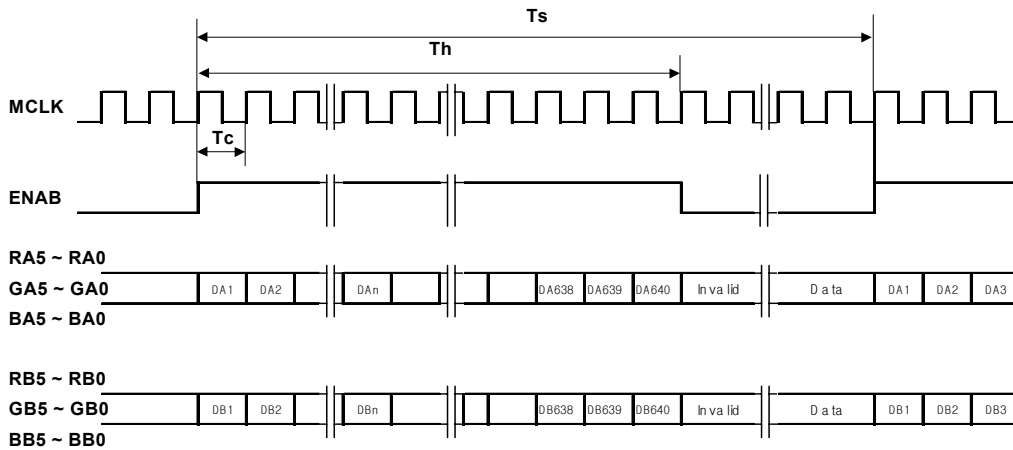
ITEM		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	42.5	46	46	MHz
	High time	Tch	5	-	-	ns
	Low time	Tcl	5	-	-	ns
Data	Setup time	Tds	4	-	-	ns
	Hold time	Tdh	4	-	-	ns
Data Enable setup time		Tes	4	-	-	ns
Frame period		Tv	1032	1066	1066	Lines
Vertical display period		Tvd	1024	1024	1024	Lines
One line scanning period		Th	665	720	844	Clocks
Horizontal display period		Thd	640	640	640	Clocks

7.0 SIGNAL TIMING WAVEFORMS

7.1 Vertical Timing Waveforms



7.2 Horizontal Timing Waveforms



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

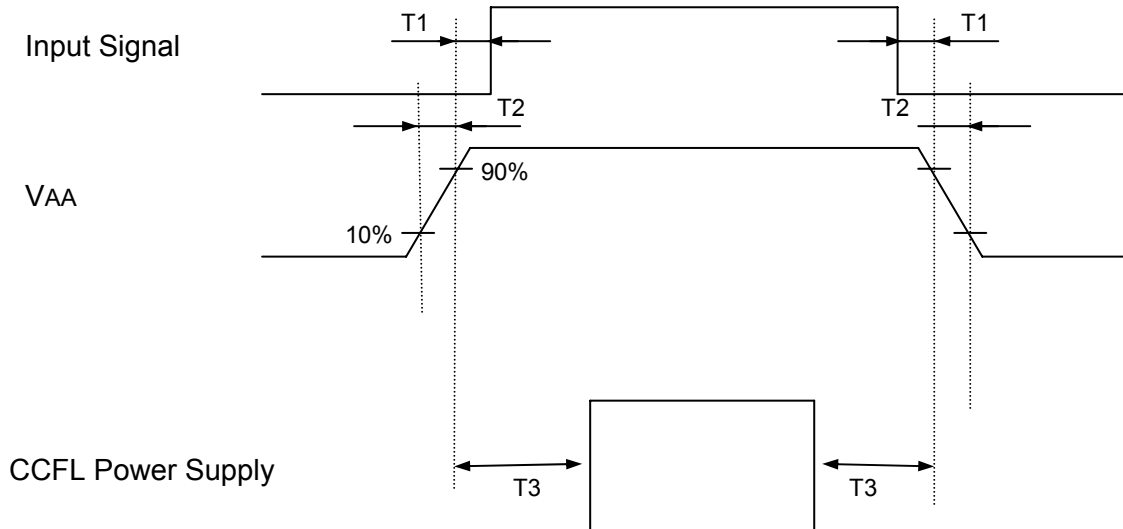
Each color is displayed in 16.7 Million gray scales from 8bit data signal inputs. Table 8 shows the 8bit input signals for basic display colors and gray scale.

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

	Data Signal	RA7 RA6 RA5 RA4 RA3 RA2 RA1 RA0								GA7 GA6 GA5 GA4 GA3 GA2 GA1 GA0								BA7 BA6 BA5 BA4 BA3 BA2 BA1 BA0							
		ODD	RB7	RB6	RB5	RB4	RB3	RB2	RB1	RB0	GB7	GB6	GB5	GB4	GB3	GB2	GB1	GB0	BB7	BB6	BB5	BB4	BB3	BB2	BB1
Basic Colors	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Light Blue	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Purple	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	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	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	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△																								
	▽																								
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	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	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	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△																								
	▽																								
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	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	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	0	0	0	0	0	1	0
	△																								
	▽																								
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
Gray Scale Of White	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	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	▽	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△																								
	▽																								
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
White	1	1	1	1	1	1	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 should be as shown in below



- $T1 \leq 50 \text{ (ms)}$
- $T2 \leq 30 \text{ (ms)}$
- $100 \leq T3 \leq 200 \text{ (ms)}$

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

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

FIGURE 5 & 6, shown in Appendix, shows mechanical outlines for the model HT18E22-201

. Other parameters are shown in Table 10.

<Table 10. Dimensional Parameters>

Parameter	Specification	Unit	Remark
Active area	359.04 (H) X 287.23 (V)	mm	
Number of pixels	1280 (H) X 1024 (V)	pixels	
	(1 pixel = R + G + B dots)		
Pixel pitch	0.2805 (H) X 0.2805 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16,777,216	colors	
Display mode	Normally Black		
Outline dimension	414.0 (H) X 335.0 (V) X 18.6(D)	mm	1)
Weight	2600 Typ.	gram	2)
Back-light	Top/Bottom edge side 4-CCFL type		

1). General tolerance : H & V = $\pm 0.5\text{mm}$ / D = $\pm 0.3\text{mm}$

2). 2700 Max.

10.2 Mounting

See FIGURE 5 & 6, 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 300lux.

11.0 RELIABILITY TEST

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

<Table 11. Reliability test>

No.	Test Items	Conditions
1	High temperature storage test	Ta = 60 °C, 240 hrs
2	Low temperature storage test	Ta = -20 °C, 240 hrs
3	High temperature & high humidity	Ta = 40 °C, 75 %RH, 240 hrs
4	High temperature operation test	Ta = 40 °C, 240 hrs
5	Low temperature operation test	Ta = 10 °C, 240 hrs
6	Thermal shock	Ta = 0 °C ↔ 50 °C (0.5 hr), 100 cycle
7	Vibration test (non-operating)	Frequency : 10 ~ 300 Hz, SW10min Gravity/AMP : 1.0G Period : X,Y,Z 2hrs
8	Shock test (non-operating)	Gravity : 100G Pulse width : 6 ms, half sine wave Direction : ±X, ±Y, ±Z once for each direction
9	Electrostatic discharge test	Contact : 150 pF, 330Ω, 8KV 5 times Air : 150 pF, 330Ω, 15KV 5 times

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 MCLK, 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

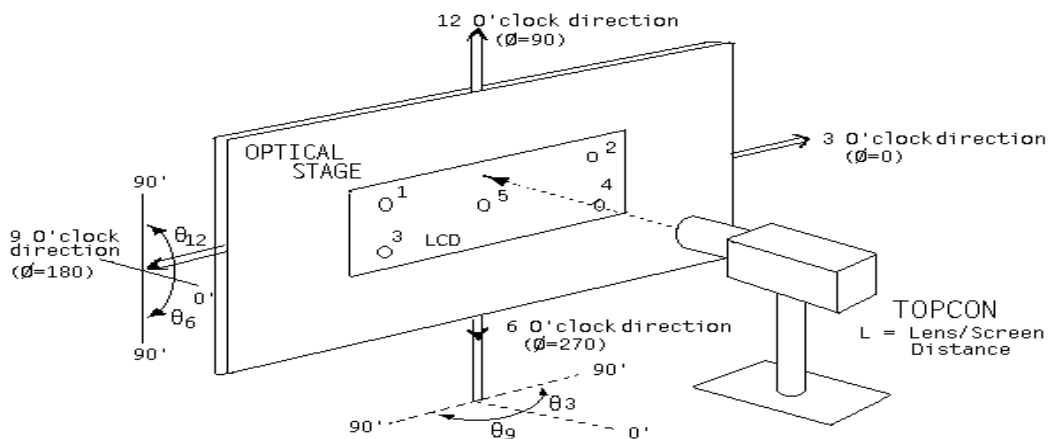


Figure 2. Average Luminance & Uniformity Measurement Locations

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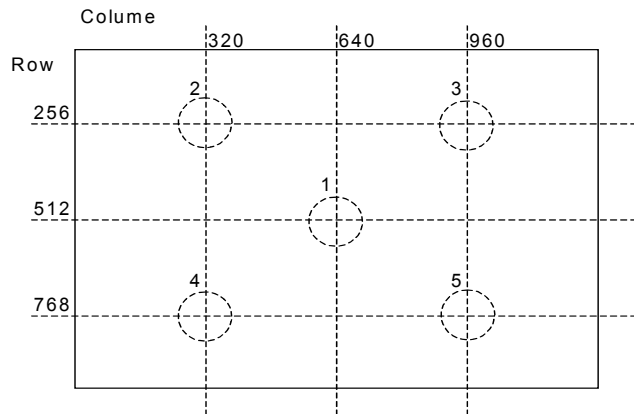


Figure 3. Response Time Testing

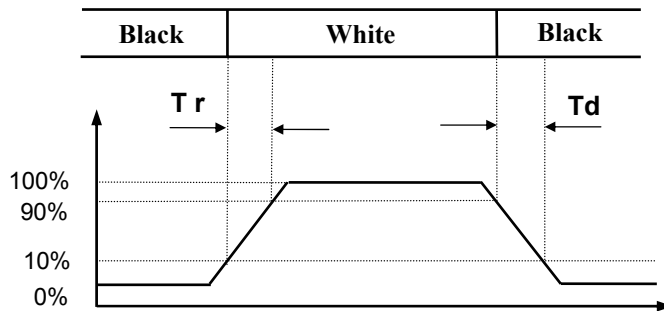
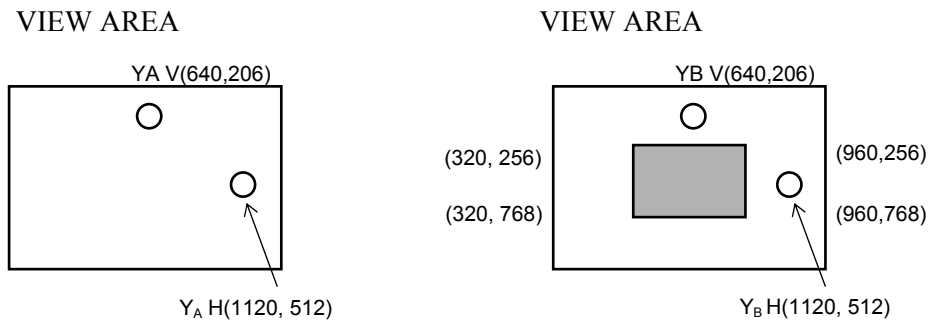


Figure 4. Cross Modulation Test Description



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

Where:

Y_A = Initial luminance of measured area (cd/m²)

Y_B = Subsequent luminance of measured area (cd/m²)

The location measured will be exactly the same in both patterns

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

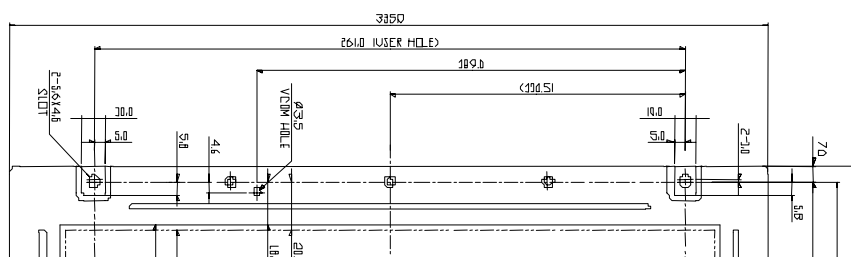
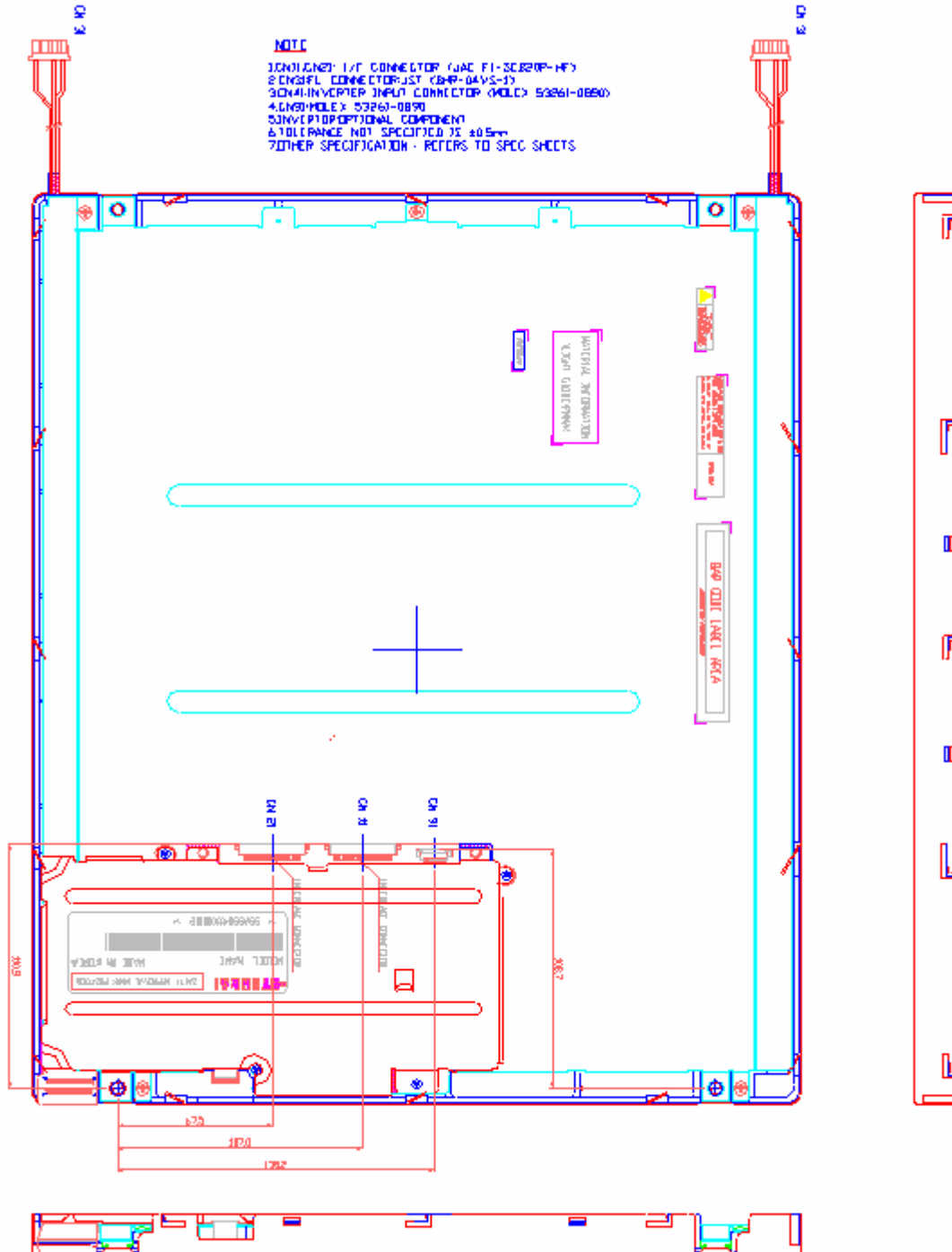


Figure 6. TFT-LCD Module Outline Dimensions (Back view)



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