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HT18E22-100

Product Specification

Rev. 0

LCD SBU

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REVISION HISTORY

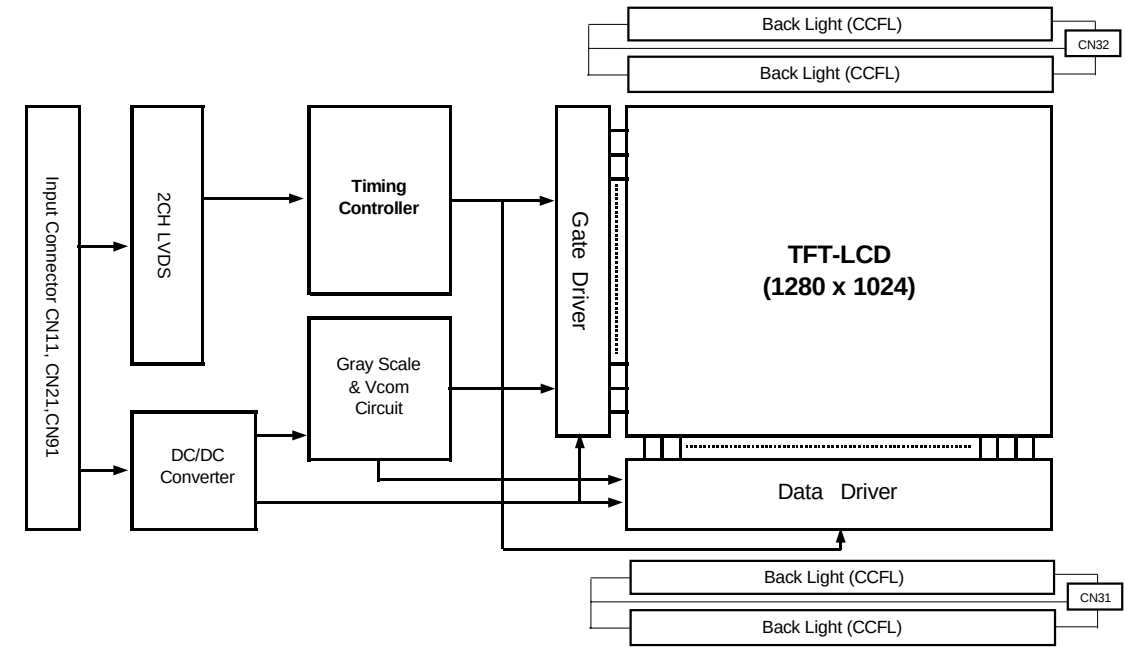
REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
0		Initial Release	00.06.20	J.Y.JEONG

Contents

1.0 GENERAL DESCRIPTIONS

1.1 Introduction

HT18E22-100 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 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

- FFS (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 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 HT18E22-100. (listed in Table 1)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	359.040 (H) × 287.232 (V)	mm	
Number of pixels	1280 (H) × 1024 (V)	pixels	
Pixel pitch	0.2805 (H) × 0.2805 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16,777,216	colors	
Display mode	Normally Black		
Outline dimension	414.0(H) × 335.0(V) × 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 = ±0.5mm / D = ±0.3mm

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_{DD}	-0.3	4.0	V	Ta = 25℃
	V_{AA}	-0.3	13.0	V	
Back-light lamp Current	I_L	3.0	8.0	mArms	
Logic Input Voltage	V_{IN}	-0.3	4.0	V	
Operating Temperature (Humidity)	T_{OP} RH	10	+40 75	℃ %	≤40℃
Storage Temperature (Humidity)	T_{ST} RH	-20	+60 95	℃ %	≤40℃

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Characteristics

< Table 3. Electrical specifications > (Ta = 25℃)

Parameter		Symbol	Min.	Typ.	Max.	Unit	Remark
Power Supply	Voltage	V_{DD}	3.0	3.3	3.6	V	
		V_{AA}	11.5	12.0	12.5	V	
	Current	I_{DD}	-	91	698	mA	Note 1
		I_{AA}	-	345	450	mA	
Differential Input Voltage	Low	V_{IL}			-100	mV	Note 2
	High	V_{IH}	100			mV	
Back-Light Lamp	Voltage	V_{BL}		800		Vrms	
	Current	I_{BL}		6		mArms	Per CCFL
	Frequency	F_L		50		KHz	Note
	Start Voltage	V_S		1200	1550	Vrms	0℃, Note 4
				900	1100	Vrms	25℃, Note 4
	Life Time	Hr	-	30,000		Hours	
Power Consumption		P_{DD}	-	0.31	-	W	
		P_{AA}	-	4.14	-	W	
		P_{BL}	-	19.2	-	W	Note5
		P_{total}	-	23.65	-	W	

Notes :

1. Test Pattern of power supply current
   - ● Typ : Vertical color bar
   - ● Max : Vertical 2 line skip (I_{DD})
     L255 Gray Scale (I_{AA})
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}× I_{BL}) ×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 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 $\theta_{Ø=0}$ (= 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 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	Θ = 0°	350	400			Note 2
Average Luminance of White		Y_w	Θ = 0°	190	200		cd/m^2	Note 3
White luminance uniformity		ΔY	IBL = 6.0mA			1.45		Note 4
Reproduction Of color	White	XW	Θ = 0°	0.282	0.312	0.342		Note 5
		YW		0.296	0.326	0.356		
	Red	XR		0.600	0.630	0.660		
		YR		0.305	0.335	0.366		
	Green	XG		0.256	0.286	0.316		
		YG		0.577	0.607	0.637		
	Blue	XB		0.111	0.141	0.171		
		YB		0.058	0.088	0.118		
Response Time	Rise	T_r	Ta= 25° C Θ = 0°		25	30	ms	Note 6
	Decay	T_d			30	35	ms	
Cross Talk		CT	Θ = 0°			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 $\Theta = 0°$ 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 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 (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. (See FIGURE 4 shown in Appendix).

5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

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	VDD	Logic Power (Typ. 3.3V) 1)	20	VDD	Logic Power (Typ. 3.3V) 1)
19	VDD		19	VDD	
18	Vss	GND 2)	18	Vss	GND 2)
17	Vss		17	Vss	
16	RAIN0-	Odd Pixel Data 3)	16	RBIN0-	Even Pixel Data 3)
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-	Evev 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	VAA	12.0V

Notes 1) All VAA pins should be connected to 12.0V (typ.)

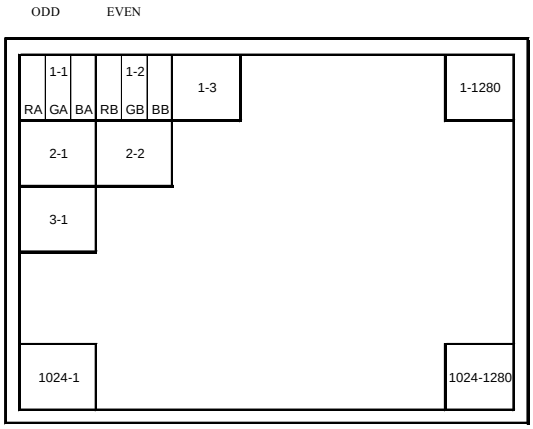
2) All Vss pins should be grounded. Shield Case is internally connected to Vss.

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

5.2 2CH LVDS(Rx : THC63LVDF84A) Interface

	INPUT SIGNAL	TRANSMITTER Pin No.	TRANSMITTER INPUT	INTERFACE SYSTEM	INTERFACE TFT-LCD	RECEIVER Pin No.	RECEIVER OUTPUT	OUTPUT SIGNAL
	RA2	51	TAIN0			27	RAOUT0	RA
	RA3	52	TAIN1			29	RAOUT1	RA3
	RA4	54	TAIN2			30	RAOUT2	RA4
	RA5	55	TAIN3	TAOUT0+	RAIN0+	32	RAOUT3	RA5
	RA6	56	TAIN4	TAOUT0-	RAIN0-	33	RAOUT4	RA6
	RA7	3	TAIN6			35	RAOUT6	RA7
	GA2	4	TAIN7			37	RAOUT7	GA2
	GA3	6	TAIN8			38	RAOUT8	GA3
L	GA4	7	TAIN9			39	RAOUT9	GA4
	GA5	11	TAIN12			43	RAOUT12	GA5
V	GA6	12	TAIN13	TAOUT1+	RAIN1+	45	RAOUT13	GA6
	GA7	14	TAIN14	TAOUT1-	RAIN1-	46	RAOUT14	GA7
D	BA2	15	TAIN15			47	RAOUT15	BA2
	BA3	19	TAIN18			51	RAOUT18	BA3
S	BA4	20	TAIN19			53	RAOUT19	BA4
	BA5	22	TAIN20			54	RAOUT20	BA5
	BA6	23	TAIN21			55	RAOUT21	BA6
O	BA7	24	TAIN22	TAOUT2+	RAIN2+	1	RAOUT22	BA7
	HSYNC	27	TAIN24	TAOUT2-	RAIN2-	3	RAOUT24	HSYNC
D	VSYNC	28	TAIN25			5	RAOUT25	VSYNC
	DE	30	TAIN26			6	RAOUT26	DE
D	RA0	50	TAIN27			7	RAOUT27	RA0
	RA1	2	TAIN5			34	RAOUT5	RA1
	GA0	8	TAIN10			41	RAOUT10	GA0
	GA1	10	TAIN11	TAOUT3+	RAIN3+	42	RAOUT11	GA1
	BA0	16	TAIN16	TAOUT3-	RAIN3-	49	RAOUT16	BA0
	BA1	18	TAIN17			50	RAOUT17	BA1
	RSVD	25	TAIN23			2	RAOUT23	RSVD
	MCLK	31	TCLKAIN	TCLKAOUT+ TCLKAOUT-	RCLKAIN+ RCLKAIN-	26	RCLKAOUT	MCLK
	RB2	51	TBIN0			27	RBOUT0	RB2
	RB3	52	TBIN1			29	RBOUT1	RB3
	RB4	54	TBIN2			30	RBOUT2	RB4
	RB5	55	TBIN3	TBOUT0+	RBIN0+	32	RBOUT3	RB5
	RB6	56	TBIN4	TBOUT0-	RBIN0-	33	RBOUT4	RB6
	RB7	3	TBIN6			35	RBOUT6	RB7
	GB2	4	TBIN7			37	RBOUT7	GB2
	GB3	6	TBIN8			38	RBOUT8	GB3
	GB4	7	TBIN9			39	RBOUT9	GB4
L	GB5	11	TBIN12			43	RBOUT12	GB5
	GB6	12	TBIN13	TBOUT1+	RBIN1+	45	RBOUT13	GB6
V	GB7	14	TBIN14	TBOUT1-	RBIN1-	46	RBOUT14	GB7
	BB2	15	TBIN15			47	RBOUT15	BB2
D	BB3	19	TBIN18			51	RBOUT18	BB3
	BB4	20	TBIN19			53	RBOUT19	BB4
S	BB5	22	TBIN20			54	RBOUT20	BB5
	BB6	23	TBIN21			55	RBOUT21	BB6
	BB7	24	TBIN22	TBOUT2+	RBIN2+	1	RBOUT22	BB7
E	RSVD	27	TBIN24	TBOUT2-	RBIN2-	3	RBOUT24	RSVD
	RSVD	28	TBIN25			5	RBOUT25	RSVD
V	RSVD	30	TBIN26			6	RBOUT26	RSVD
	RB0	50	TBIN27			7	RBOUT27	RB0
E	RB1	2	TBIN5			34	RBOUT5	RB1
	GB0	8	TBIN10			41	RBOUT10	GB0
N	GB1	10	TBIN11	TBOUT3+	RBIN3+	42	RBOUT11	GB1
	BB0	16	TBIN16	TBOUT3-	RBIN3-	49	RBOUT16	BB0
	BB1	18	TBIN17			50	RBOUT17	BB1
	RSVD	25	TBIN23			2	RBOUT23	RSVD
	MCLK	31	TCLKAIN	TCLKBOUT+	RCLKBIN+	26	RCLKAOUT	MCLK
				TCLKBOUT-	RCLKBIN-			

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.

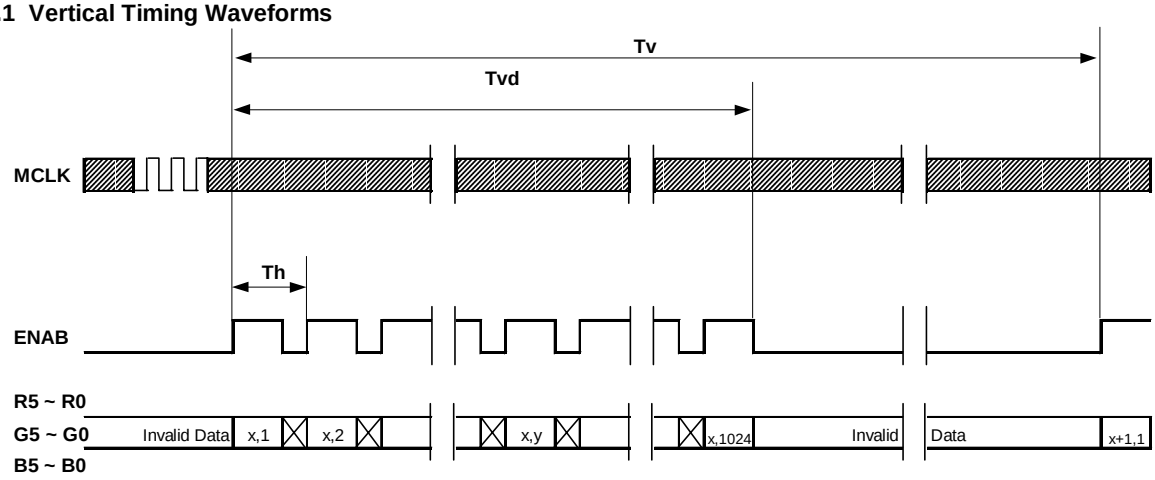
The HT18E22-100 is operated by DE only mode

<Table 7. Signal Timing Specifications>

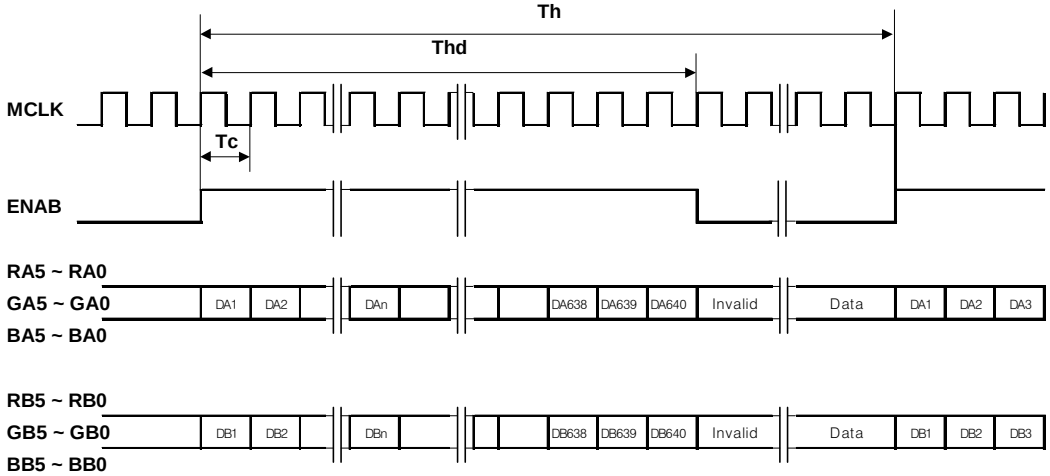
ITEM		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	1/Tc	42.5	54	54	MHz
	High time	Tch	5	-	-	ns
	Low time	Tcl	5	-	-	ns
Data	Setup time	Tds	4	-	-	ns
	Hold time	Tdh	4	-	-	ns
Data Enable setup time		Tes	4	-	-	ns
Frame period		Tv	1032	1066	1066	Lines
Vertical display period		Tvd	1024	1024	1024	Lines
One line scanning period		Th	665	844	844	Clocks
Horizontal display period		Thd	640	640	640	Clocks

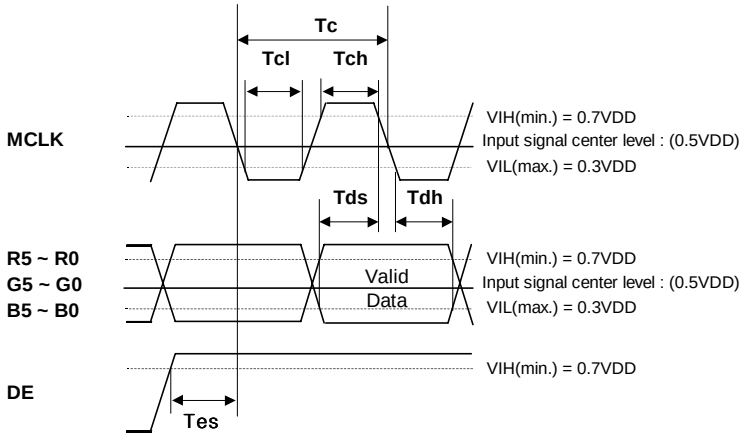
7.0 SIGNAL TIMING WAVEFORMS

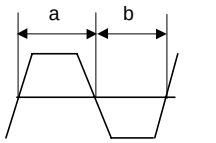
7.1 Vertical Timing Waveforms



7.2 Horizontal Timing Waveforms







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

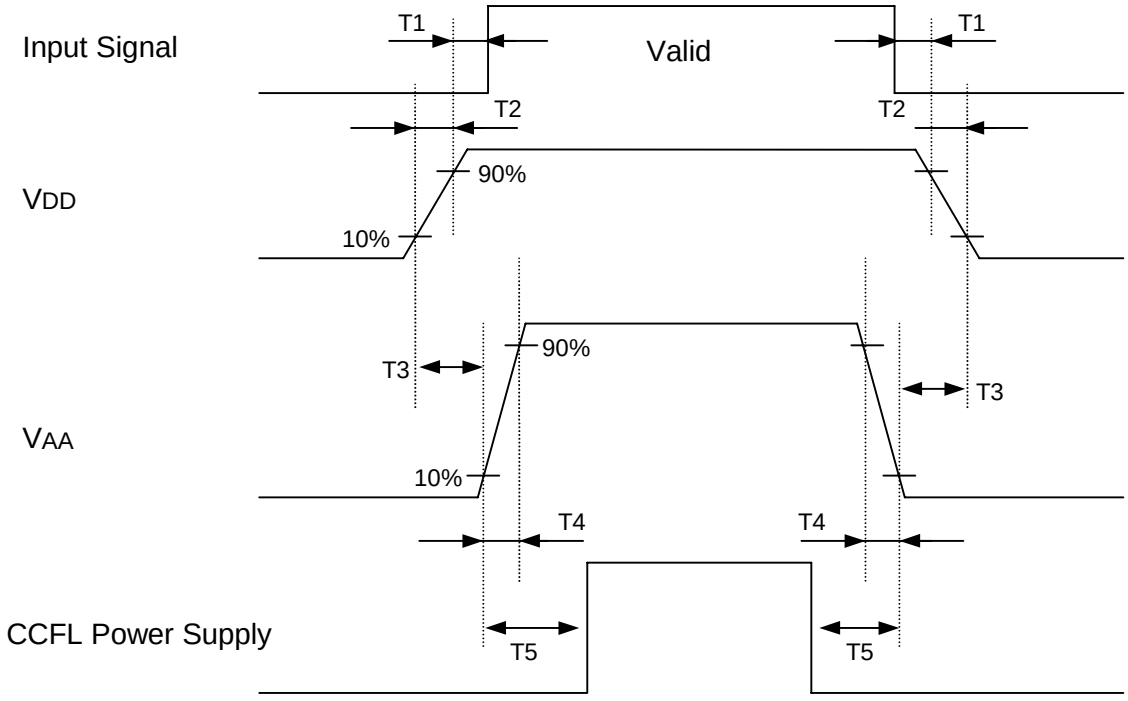
Each color is displayed in 16.7 Million gray scales from 8bit data signal inputs. Table 8 shows the 8bit input signals for basic display colors and gray scale.

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

Colors & Gray Scale		Data Signal																							
		Red								Green								Blue							
	Odd & Even	R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
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
	Cyan	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
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	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	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
	Darker	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
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	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
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
	Darker	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
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	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
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
	Darker	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
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	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
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	0
	△	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	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
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	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	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 ≤ 50 max (ms)
- 0 ≤ T2 ≤ 50 max (ms)
- 50 ≤ T3 (ms)
- T4 ≤ 30 (ms)
- 100 ≤ T5 ≤ 200 (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 HT18E22-100 . Other parameters are shown in Table 10.

<Table 10. Dimensional Parameters>

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

1). General tolerance : H & V = ±0.5mm / D = ±0.3mm
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 350lux.

11.0 RELIABILITY TEST

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 ℃, 240 hrs
2	Low temperature storage test	Ta = -20 ℃, 240 hrs
3	High temperature & high humidity	Ta = 40 ℃, 75 %RH, 240 hrs
4	High temperature operation test	Ta = 40 ℃, 240 hrs
5	Low temperature operation test	Ta = 10 ℃, 240 hrs
6	Thermal shock	Ta = 0 ℃ ↔ 50 ℃ (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

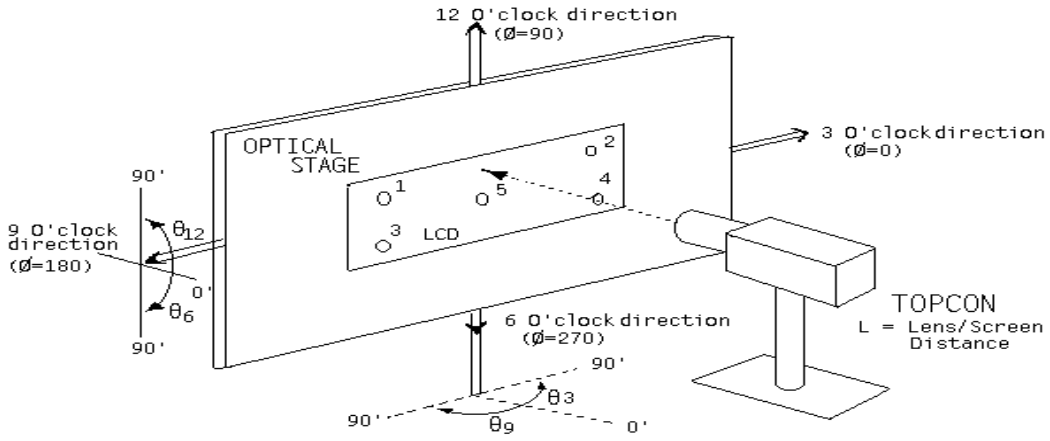


Figure 2. Average Luminance & Uniformity Measurement Locations

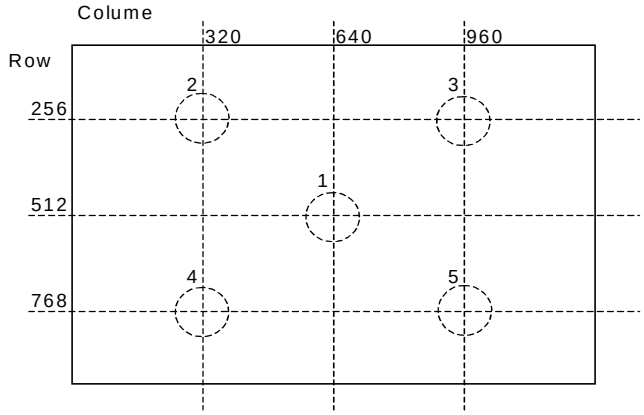


Figure 3. Response Time Testing

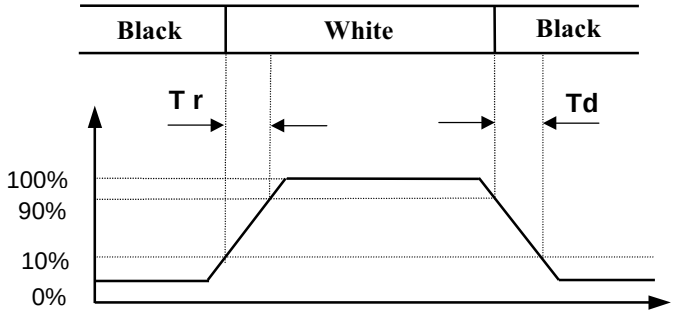
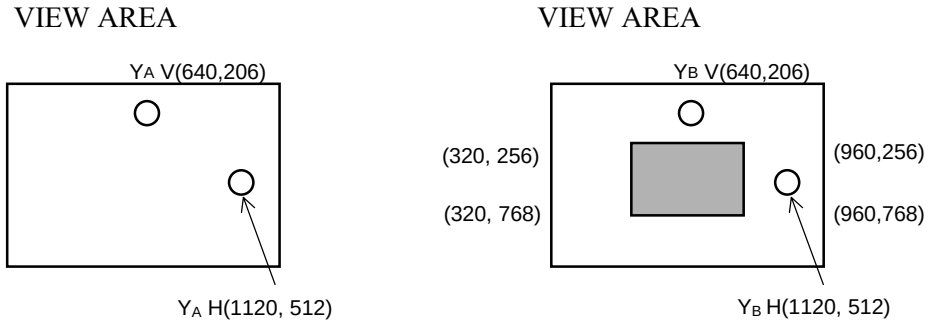


Figure 4. Cross Modulation Test Description



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

Where:

Y_A = Initial luminance of measured area (cd/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)

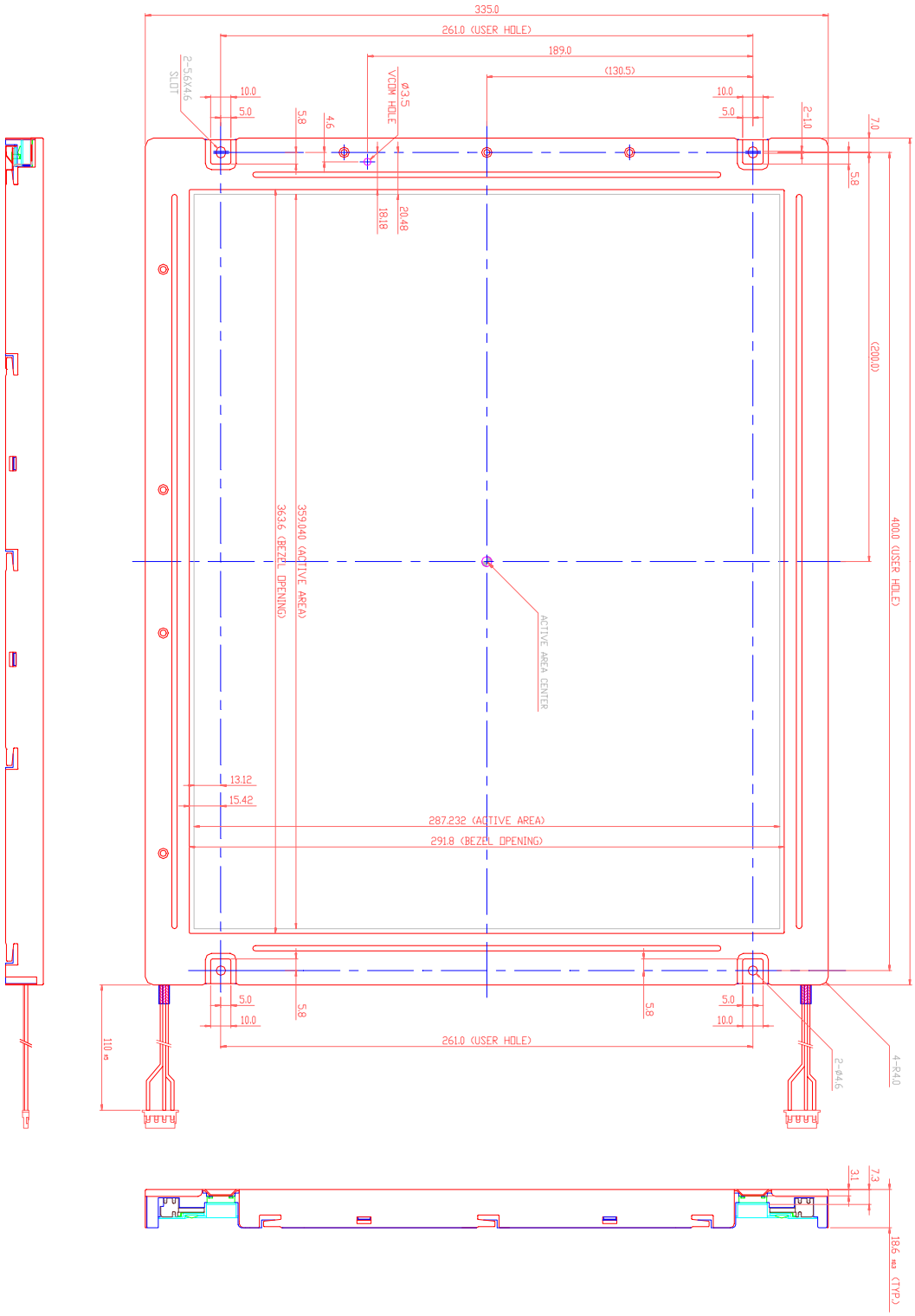


Figure 6. TFT-LCD Module Outline Dimensions (Rear view)