Document Version: 1.5
Date: 2009/09/01

Product Functional Specification

46” Full HD Color TFT-LCD Module
Model Name: T460HW03 V5

() Preliminary Specification
(*) Final Specification

Contents

Record of Revision

Version	Data	Page.	Old Description	New Description	Remark
0.0	2009/02/20	-	First release	N/A	N/A
0.1	2009/03/18	18,19	N/A	MEMC section update	N/A
0.2	2009/04/01	15	N/A	Power sequence spec update	N/A
0.2	2009/04/01	16	N/A	BLU spec update	N/A
0.2	2009/04/01	12	Horizontal front porch: 48	Horizontal front porch: 88	N/A
1.0	2009/04/16		N/A	Final version release	N/A
1.1	2009/04/17	15	N/A	Power sequence spec update (t3)	N/A
1.2	2009/04/29	16	N/A	Update Min starting voltage	N/A
1.3	2009/05/18	18	N/A	BLU spec update	N/A
1.4	2009/07/01	10	N/A	Modified LVDS pin define	N/A
1.5	2009/09/01	18	N/A	BLU spec update	N/A

1. General Description

This specification applies to the 46 inch Color TFT-LCD Module T460HW03 V5. This LCD module has a TFT active matrix type liquid crystal panel 1920x1080 pixels, and diagonal size of 46 inch. This module supports Full HD mode (Non-interlace) as well as 120Hz MEMC function.

Each pixel is divided into Red, Green and Blue sub-pixels or dots which are arranged in vertical stripes. Gray scale or the brightness of the sub-pixel color is determined with a 10-bit gray scale signal for each dot.

The T460HW03 V5 has been designed to apply the 10-bit 2 channel LVDS interface method. It is intended to support displays where high brightness, EBU Gamut (72% NTSC), wide viewing angle, and high color depth are very important.

The T460HW03 V5 backlight unit is using inverter-less solution (inductor type balance board), and need to be powered by integrated power system by customers.

* General Information

Items	Specification	Unit	Note
Active Screen Size	46	inches	Diagonal
Display Area	1018.08(H) x 572.67(V)	mm	
Outline Dimension	1083.0(H) x 627.0(V) x 54.1(D)	mm	With Balance Board
Driver Element	a-Si TFT active matrix		
Display Colors	1.07B	Colors	
Color Gamut	72	%	NTSC
Number of Pixels	1920 x 1080	Pixel	
Pixel Arrangement	RGB vertical stripe		
Pixel Pitch	0.53025	mm	
Display Mode	Normally Black		
Surface Treatment	Haze 13%, 3H		
RoHS	RoHS compliance		

2. Absolute Maximum Ratings

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

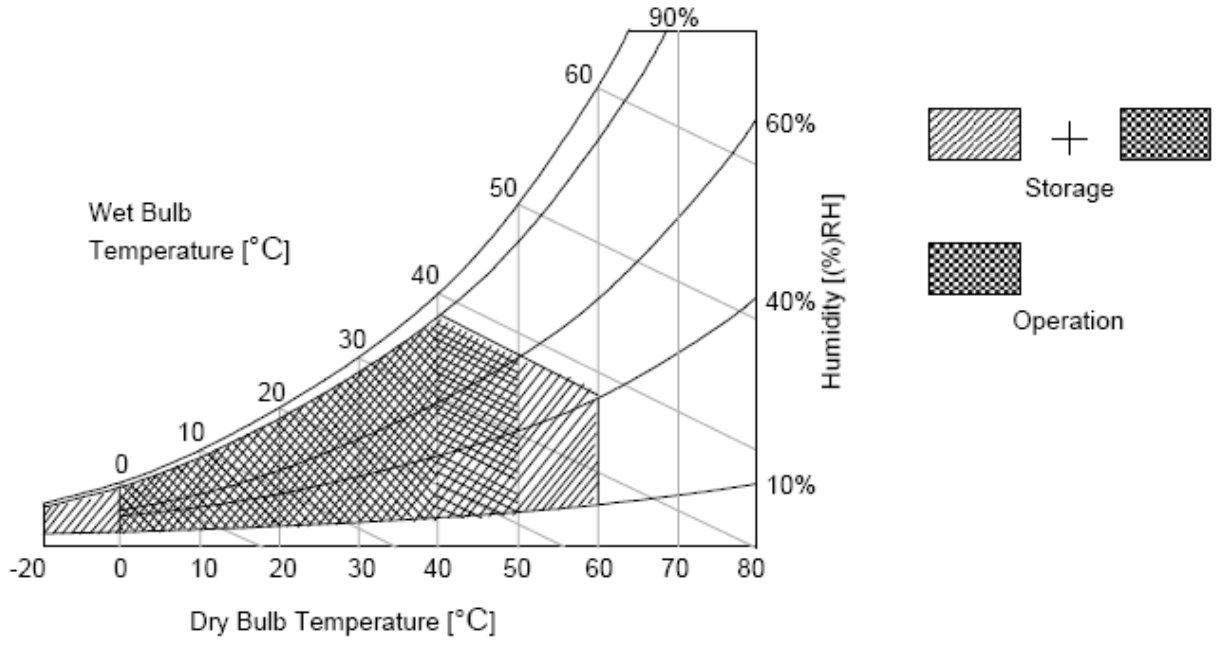
Item	Symbol	Min.	Max	Unit	Note
Logic/LCD Drive Voltage	V_{DD}	-0.3	14.0	V_{DC}	1
Input Voltage of Signal	V_{IN}	-0.3	4	V_{DC}	1
Operating Temperature	T_{OP}	0	+50	℃	2
Operating Humidity	H_{OP}	10	90	%RH	2
Storage Temperature	T_{ST}	-20	+60	℃	2
Storage Humidity	H_{ST}	10	90	%RH	2
Panel Surface Temperature	T_{SUR}	--	+65	℃	2
Shock (non-operation)	±x, ±y	--	40	G	3
Shock (non-operation)	±z	--	30	G	3
Vibration (non-operation)		--	1.5	G	4

Note 1: Duration = 50ms

Note 2: Maximum Wet-Bulb should be 39℃ and no condensation. The relative humidity must not exceed 90% non-condensing at temperatures of 40℃ or less. At temperatures greater than 40℃, the wet bulb temperature must not exceed 39℃.

Note 3: Sine wave, 11ms, direction: ±x, ±y, ±z (one time each direction)

Note 4: Wave form: random, vibration level: 1.5G RMS, Bandwidth: 10--300Hz
Duration: X, Y, Z 30min (one time each direction)



3. Electrical Specification

The T460HW03 V5 requires two power inputs. One is employed to power the LCD electronics and to drive the TFT array and liquid crystal. The second input, which powers the CCFL, is typically generated by an integrate power (I/P) system.

3.1 Electrical Characteristics

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max		
Power Supply Input Voltage		V_{DD}	10.8	12.0	13.2	V_{DC}	
Power Supply Input Current		I_{DD}	--	1.1	1.6	A	1
Power Consumption		P_C	--	13.2	19.2	Watt	1
Inrush Current		I_{RUSH}	--	--	4.5	A	5
LVDS Interface	Differential Input High Threshold Voltage	V_{TH}	--	--	+100	mV_{DC}	4
	Differential Input Low Threshold Voltage	V_{TL}	-100	--	--	mV_{DC}	4
	Common Input Voltage	V_{CIM}	1.10	1.20	1.40	V_{DC}	
CMOS Interface	Input High Threshold Voltage	V_{IH} (High)	2.4	--	3.3	V_{DC}	
	Input Low Threshold Voltage	V_{IL} (Low)	0	--	0.7	V_{DC}	
Backlight Power Consumption (ref.)		P_{BL}	182.4	201.6	216	Watt	2
Life Time			50000	--	--	Hours	3

The performance of the Lamp in LCD panel, for example life time or brightness, is extremely influenced by the characteristics of the balance board and I/P board. All the parameters should be carefully designed as not to produce too much leakage current from high-voltage output. While design or order balance board, please make sure unwanted lighting caused by the mismatch of the lamp and balance board (no lighting, flicker, etc) never occurs. After confirmation, the LCD Panel should be operated in the same condition as installed in your instrument.

Do not attach a conducting tape to lamp connecting wire. If the lamp wire attach to conducting tape, TFT-LCD Module has a low luminance and the inverter has abnormal action, because leakage current occurs between lamp wire and conducting tape.

When operate at low temperatures, the brightness of CCFL will drop and the lifetime of CCFL will be reduced.

Note:

1. V_{DD}=12.0V, f_V=60Hz, f_{CLK}=74.25Mhz, 25℃, V_{DD} duration time=400μs, test pattern: white pattern
2. The backlight power consumption shown above is tested by lamp current I_L=7.6mA.
3. The life is determined as the time at which luminance of the lamp is 50% compared to that of initial value at the typical lamp current on condition of continuous operating at 25±2℃.
4. V_{CIM}=1.20V

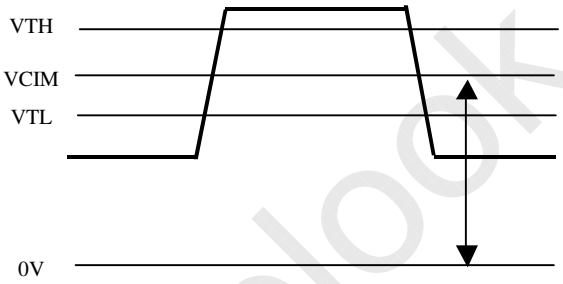
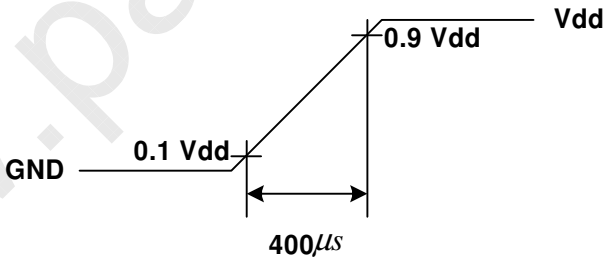


Figure: LVDS Differential Voltage

5. Measurement condition: rising time=400μs



3.2 Interface Connections

- LCD connector: FI-RE51S-HF (JAE)
- Mating connector: FI-RE51S-HL (JAE)

PIN #	Signal Name	Description
1	V_{DD}	Operating voltage supply, +12V DC regulated
2	V_{DD}	Operating voltage supply, +12V DC regulated
3	V_{DD}	Operating voltage supply, +12V DC regulated
4	V_{DD}	Operating voltage supply, +12V DC regulated
5	V_{DD}	Operating voltage supply, +12V DC regulated
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	GND	Ground
10	RO_0-	LVDS Channel 1, pair 0, negative
11	RO_0+	LVDS Channel 1, pair 0, positive
12	RO_1-	LVDS Channel 1, pair 1, negative
13	RO_1+	LVDS Channel 1, pair 1, positive
14	RO_2-	LVDS Channel 1, pair 2, negative
15	RO_2+	LVDS Channel 1, pair 2, positive
16	GND	Ground
17	RO_CLK-	LVDS Clock, Channel 1, negative
18	RO_CLK+	LVDS Clock, Channel 1, positive
19	GND	Ground
20	RO_3-	LVDS Channel 1, pair 3, negative
21	RO_3+	LVDS Channel 1, pair 3, positive
22	RO_4-	LVDS Channel 1, pair 4, negative
23	RO_4+	LVDS Channel 1, pair 4, positive
24	GND	Ground
25	RE_0-	LVDS Channel 2, pair 0, negative
26	RE_0+	LVDS Channel 2, pair 0, positive
27	RE_1-	LVDS Channel 2, pair 1, negative
28	RE_1+	LVDS Channel 2, pair 1, positive
29	RE_2-	LVDS Channel 2, pair 2, negative
30	RE_2+	LVDS Channel 2, pair 2, positive
31	GND	Ground

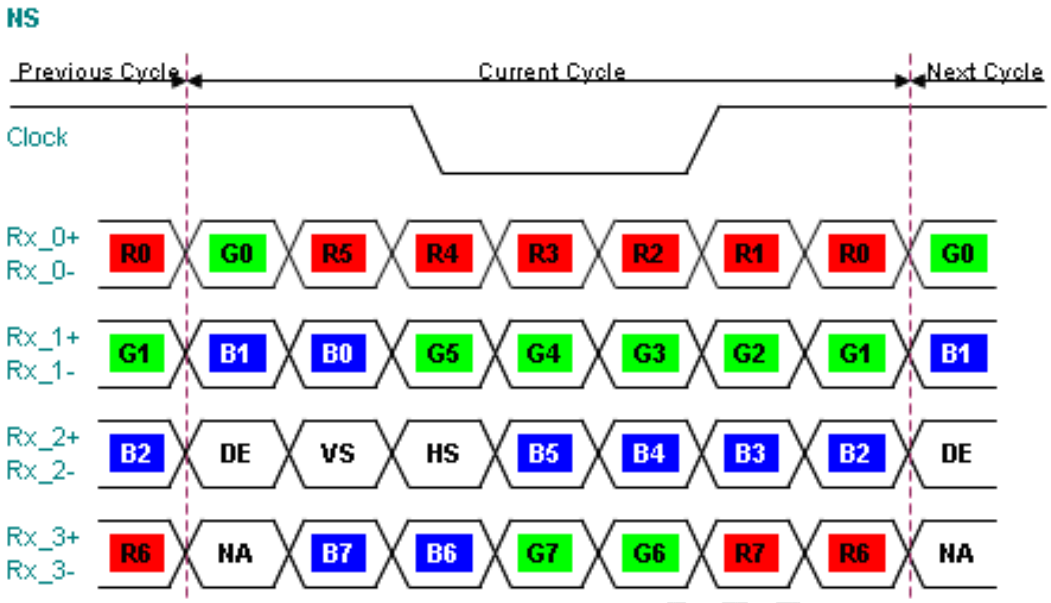
32	RE_CLK-	LVDS Clock, Channel 2, negative
33	RE_CLK+	LVDS Clock, Channel 2, positive
34	GND	Ground
35	RE_3-	LVDS Channel 2, pair 3, negative
36	RE_3+	LVDS Channel 2, pair 3, positive
37	RE_4-	LVDS Channel 2, pair 4, negative
38	RE_4+	LVDS Channel 2, pair 4, positive
39	GND	Ground
40	NC (reserved)	No Connection (AUO internal use)
41	NC (reserved)	No Connection (AUO internal use)
42	NC (reserved)	No Connection (AUO internal use)
43	NC (reserved)	No Connection (AUO internal use)
44	MEMC_ON	MEMC ON/OFF Selection Low: MEMC OFF High/Open: MEMC ON
45	LVDS_FORMAT	Low: Support JEIDA Mode 10/8bits only
46	SCL_E	External I2C from customer's comment
47	NC (reserved)	No Connection (AUO internal use)
48	SDA_E	External I2C from customer's comment
49	NC (reserved)	No Connection (AUO internal use)
50	NC (reserved)	No Connection (AUO internal use)
51	NC (reserved)	No Connection (AUO internal use)

Note 1: All GND (ground) pins should be connected together and should also be connected to the LCD's metal frame.

Note 2: All V_{DD} (power input) pins should be connected together.

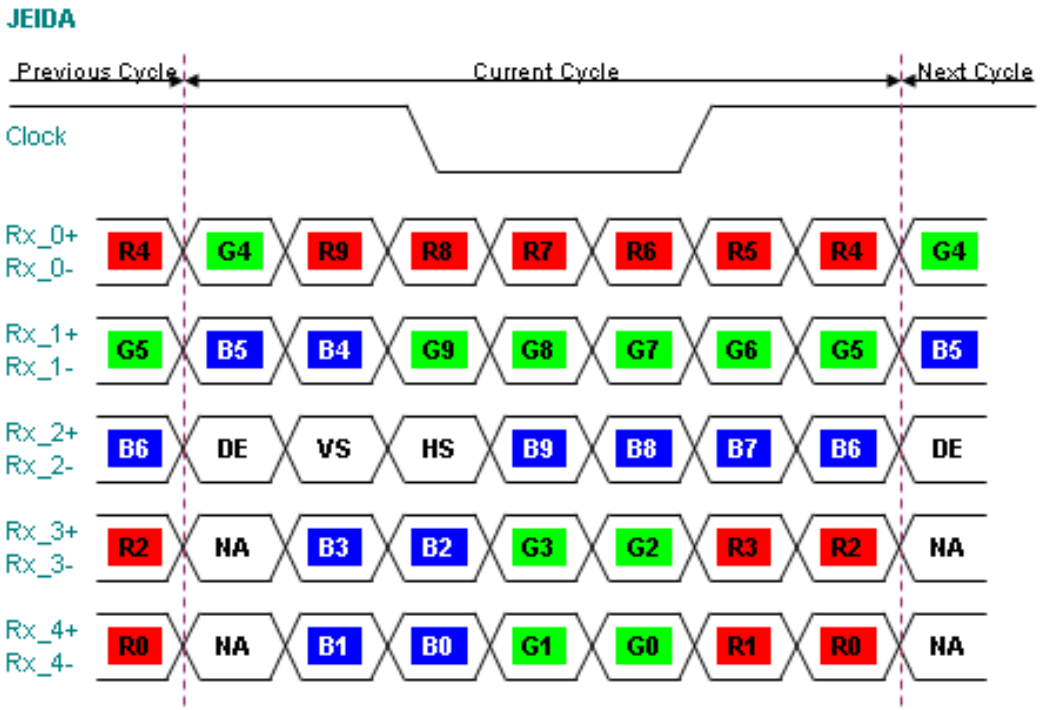
Note 3: All NC (no connection) pins should be open without voltage input.

LVDS Option = High/Open➔NS



(X = O E)

LVDS Option = Low➔JEIDA



(X = O E)

3.3 Signal Timing Specification

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 for its proper operation.

Timing Table

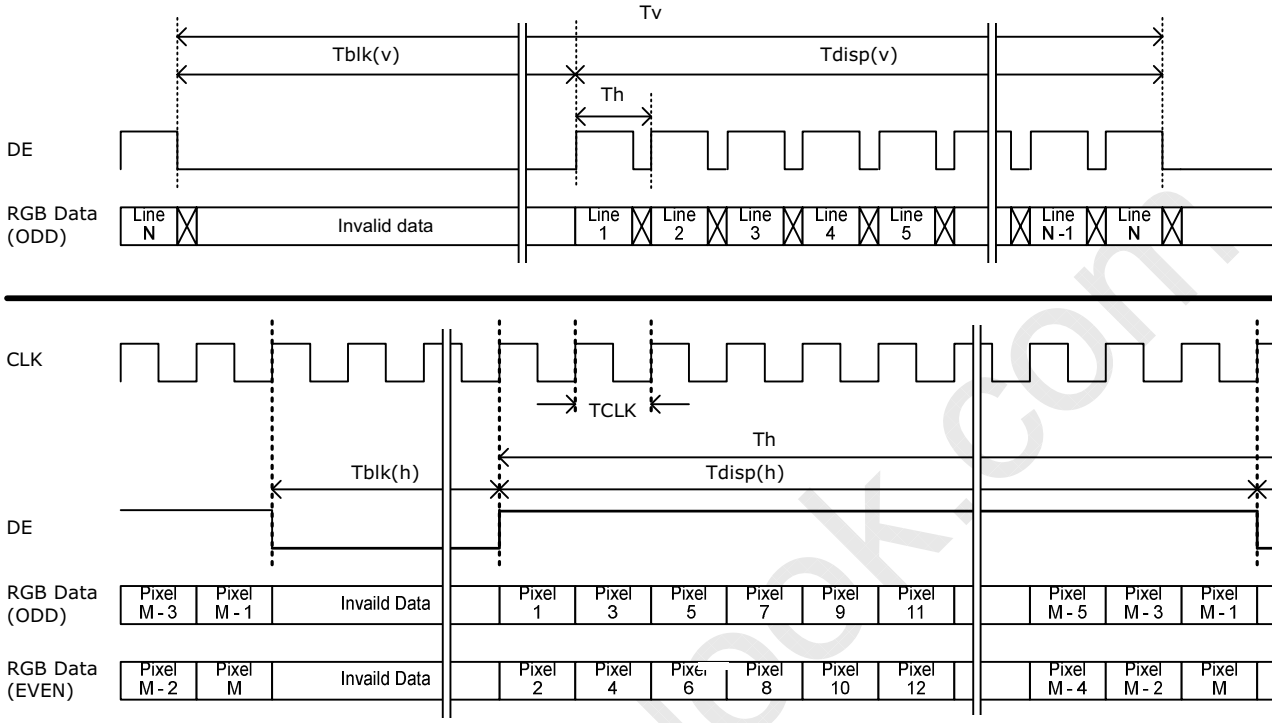
Vertical Frequency Range (60Hz)

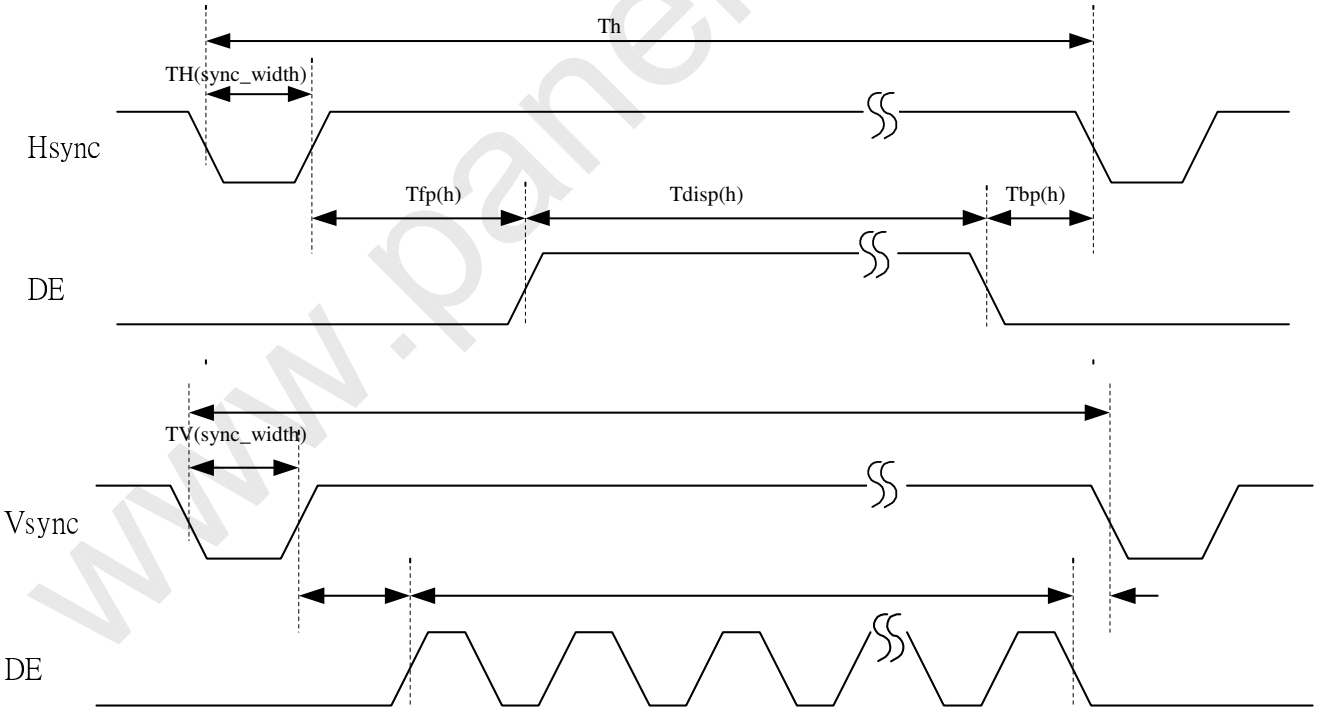
Signal	Item	Symbol	Min.	Typ.	Max	Unit
Vertical Section	Period	T_V	1100	1125	1200	T_H
	Active	T_{DISP} (V)		1080		T_H
	Blanking	T_{BLK} (V)	20	45	120	T_H
	Front porch	Tfp(V)	1	4	110	T_H
	Back porch	Tbp(V)	1	36	110	T_H
	V_sync	TVsync_wdth	2	5	110	T_H
Horizontal Section	Period	T_H	1050	1100	1150	T_{CLK}
	Active	T_{DISP} (H)		960		T_{CLK}
	Blanking	T_{BLK} (H)	90	140	190	T_{CLK}
	Front porch	Tfp(H)	5	44	180	T_{CLK}
	Back porch	T(H)	5	74	180	T_{CLK}
	H_sync	THsync_wdth	5	22	180	T_{CLK}
LVDS Clock	Period	T_{CLK}		13.47		ns
	Frequency	F_{CLK}	70.875	74.25	76	MHz
Vertical Frequency	Frequency	F_V	59.5	60	60.5	Hz
Horizontal Frequency	Frequency	F_H	66	67.5	72	KHz

Note 1: T_{BLK} (V) = Tfp(V) + TVsync_wdth + Tbp(V)

T_{BLK} (H) = Tfp(H) + THsync_wdth + T(H)

3.4 Signal Timing Waveforms





3.5 Color Input Data Reference

The brightness of each primary color (red, green and blue) is based on the 10 bit gray scale data input for the color; the higher the binary input, the brighter the color. The table below provides a reference for color versus data input.

COLOR DATA REFERENCE

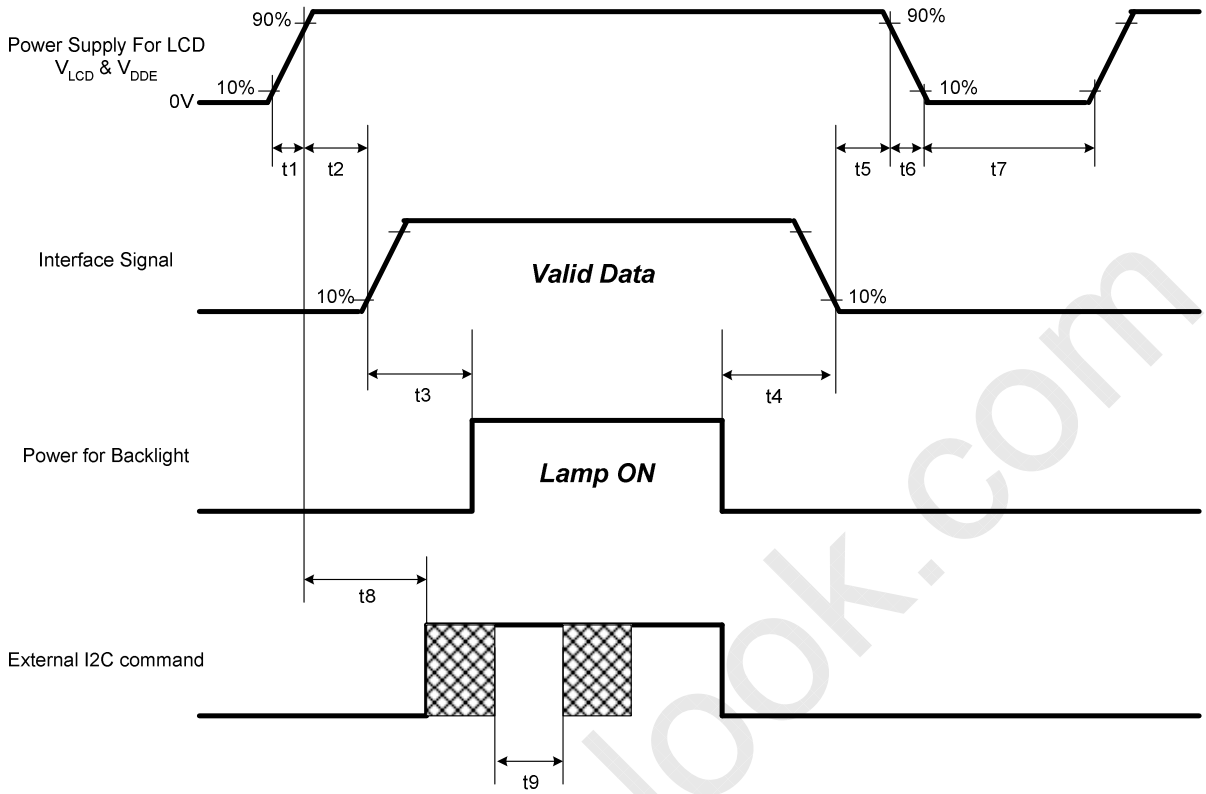
Color		Input Color Data																													
		RED										GREEN										BLUE									
		MSB									LSB	MSB									LSB	MSB									LSB
		R9	R8	R7	R6	R5	R4	R3	R2	R1	R0	G9	G8	G7	G6	G5	G4	G3	G2	G1	G0	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
	Blue(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	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	1	1	1	1	0	0	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	1	1	1	1	1	1
RED	RED(000)	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
	RED(001)	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

	RED(1022)	1	1	1	1	1	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
	RED(1023)	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN	GREEN(000)	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
	GREEN(001)	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

	GREEN(1022)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
	GREEN(1023)	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0
BLUE	BLUE(000)	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
	BLUE(001)	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

	BLUE(1022)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0
	BLUE(1023)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1

3.6 Power Sequence



Parameter	Values			Unit
	Min.	Typ.	Max.	
t1	0.4	--	30	ms
t2	2480	--	2980	ms
t3	1300	--	--	ms
t4	10	--	--	ms
t5	0.1	--	50	ms
t6	--	--	300	ms
t7	500	--	--	ms
t8	2500	--	--	ms
t9	100	--	--	ms

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.

Caution: The above on/off sequence should be applied to avoid abnormal function in the display. In case of handling, make sure to turn off the power when you plug the cable into the input connector or pull the cable out of the connector.

3.7 Backlight Power Specification

Specification

(Ta=25±5°C, Turn-on after 60mins)

	Item	Symbol	Specification			Unit	Note
			Min.	Typ.	Max		
1	High Voltage (HV) Input	HV1/ HV2	-	680	-	V_{RMS}	BL single side operating voltage at dimming ratio 100%
2	Input Current of each HV	I_{HV}	135	150	165	mA_{RMS}	Single side total input current with I_L=7.6mA_{RMS},
3	High Voltage (HV) Output	V_{OUT}	-	1360	-	V_{RMS}	BL two side operating voltage Lamp voltage between each side
4	Output Lamp Current	I_{OUT}	7.3	7.6	7.9	mA_{RMS}	1pcs lamp current when operating at PWM dimming =100%
5	Operating Frequency	F_{OP}	43	45	47	KHz	Lamp frequency stable status
6	PWM Dimming Frequency	F_{PWM}	140	150	160	Hz	(Recommend)
7	Dimming Duty Ratio	D_{PWM}	20	--	100	%	Lamp brightness adjust range
8	Lamp Type		Straight				
9	Number of Lamps		20			pcs	
17	Starting Voltage	Vs	1000	--	1200	V_{RMS}	Ta=25°C, BL single side striking voltage Measurement by disconnected IPB & BL
			1100	--	1300	V_{RMS}	Ta=0°C, BL single side striking voltage Measurement by disconnected IPB & BL

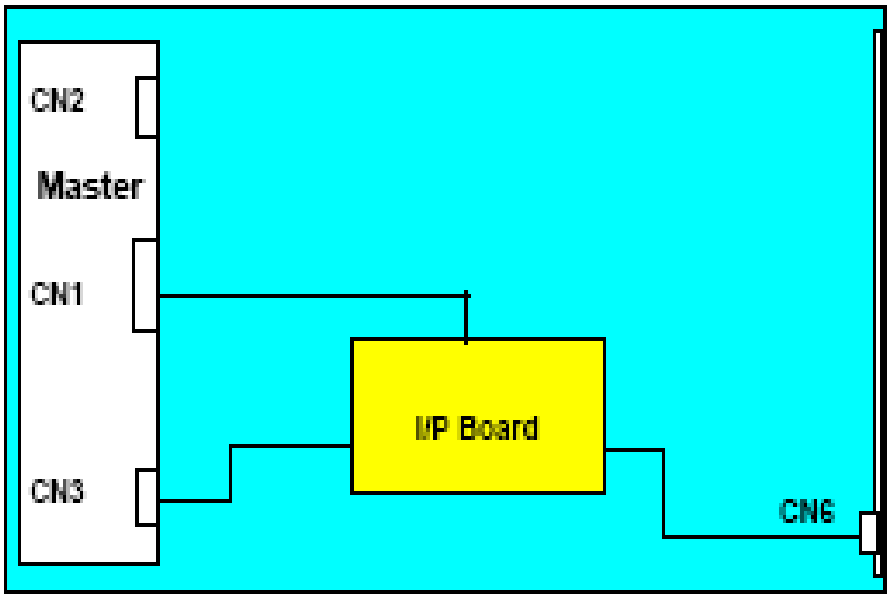
Protection Circuit (Feedback Signal):

10	Supply Voltage	V_{CC}	10	12	15	V_{DC}	Need to be connected with IPB for feedback purpose
11	Supply Current	I_{CC}	--	20	40	mA_{DC}	
12	Current Feedback Signal	V_{FB}	2.0	2.20	2.4	V_{RMS}	
13	Lamp Detection (OLP)	V_{LD}(H)	10	12	12.6	V_{DC}	Lamp normal status, Need to be connected with IPB for feedback purpose
		V_{LD}(L)	0	--	0.8	V_{DC}	Lamp protection status, Need to be connected with IPB for feedback purpose

Lamp Specification:

14	Output Working Voltage	V_L	1224	1360	1496	V_{RMS}	I_L=7.6mA_{RMS}, Ta=25°C
15	Output Current	I_L	4	7.6	8.1	mA_{RMS}	
16	Lamp Frequency	F_{LAMP}	40	--	80	KHz	
17	Starting Voltage	Vs	1000	--	1200	V_{RMS}	Ta=25°C, BL single side striking voltage
			1100	--	1300	V_{RMS}	Ta=0°C, BL single side striking voltage

Connector Pin Assignment



CN2 or CN3: YeonHO_130001WR-02E (LF)

PIN #	Symbol	Description
1	HV1+	I/P board high voltage supply
2	HV1+	I/P board high voltage supply

CN6: YeonHO_130001WR-02E (LF)

PIN #	Symbol	Description
1	HV2 -	I/P board high voltage supply
2	HV2-	I/P board high voltage supply

CN1: HIROSE_KN30-7P-1.25H

PIN #	Symbol	Description
1	VCC	Power Supply for Protection Circuit
2	N/A	NC (Must include feedback circuit design in IPB)
3	N/A	NC (Must include feedback circuit design in IPB)
4	GND	Signal Ground
5	GND	Signal Ground
6	LD	Lamp detection
7	LD	Lamp detection

3.8 MEMC Function Specification

3.8.1 Setting by hardware

Pin name	Input/ output	Content	Note	Default
MEMC_ON *1	I	MEMC ON/OFF Selection 0: MEMC OFF 1: MEMC ON	MEMC ON: 10 frames latency (~170ms) for film FLC, MBR + video MBR MEME OFF: 1 frame latency (~16.7ms)	1
LVDS_FORMAT	I	LVDS Format Selection 0: JEIDA Mode 10/8bits 1: NS Mode 8bits		1
SDA_MCU	I/O	Internal I2C to control MEMC		1
SCL_MCU	I/O	Internal I2C to control MEMC		
SDA_E *2	I/O	External I2C from customer's comment	When MCU gets external I2C signals from customer's comment, MCU will download register setting for MEMC chip by MCU_SDA and MCU_SCL. The sheet of register map shows detail register setting.	1
SCL_E *2	I/O	External I2C from customer's comment		

Note 1.
MEMC ON/OFF can also control by external I2C. If users want to change the setting, only need to change hardware setting or provide external I2C command. Ex: When MEMC_ON of the hardware is L for MEMC OFF, external I2C can set address=0x79 and data=0x00 for MEMC ON.

Note 2.
The next figure shows the I2C format of customer's single-byte command. Ex. Address : 0x65.

START	0XE4 (*1)	ACK (*2)	Address	ACK	Data	ACK	STOP (*3)

The next figure shows the I2C format of customer's multi-byte command. Because of MCU buffer capacity multi-byte command has 20 bytes limitation per one time. Ex. Address : 0x23.

START	0XE4	ACK	Address	ACK	Data (Byte 0)	ACK	Data (Byte 1)	ACK	Data (Byte 2)	ACK	Data (Byte 3)	ACK	STOP (*3)

Note (1)
Slave address of MEMC chip is 0x72 plus the least significant bit indicating a write (0xE4).
Note (2)
Shaded items are issued by the slave (MEMC chip).
Note (3)
The interval time between the two commands must longer than 100ms.

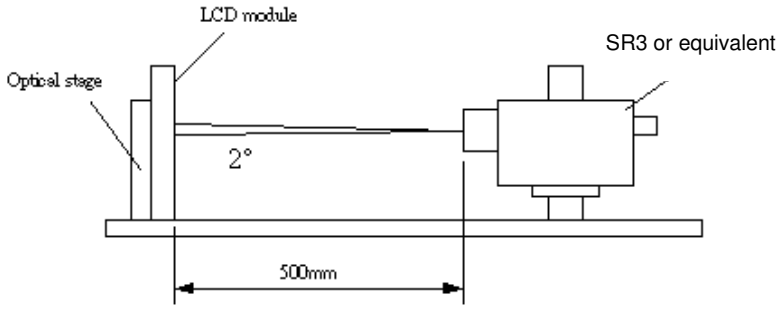
3.8.2 Setting by External I2C

Address (Hex)	Byte	Bit	Description	Note	Default
1B	0	7:0	Output black data 0x00: unblank (normal display) 0x01: blank (output black data)	Initial state is unblanked.	0x00
79	0	7:0	MEMC ON/OFF Selection 0x00: MEMC ON 0x02: MEMC OFF	MEMC ON: 10 frames latency (~170ms) for film FLC, MBR + video MBR MEME OFF: 1 frame latency (~16.7ms)	0x00
65	0:1	15:0	Control the demo option 0x0000: Demo OFF. 0x0004: Demo ON.	Demo OFF : Normal display; Demo ON : MEMC enable at Left side, and MEMC disable at right side.	0x0000
59	0	7:0	OSD ON/OFF control 0x00: OSD OFF 0x04: OSD ON	OSD On/Off Control	0x00
23	0:1	15:0	OSD width define (Unit: pixel ; range 0~1920)	1. OSD Protection Size Define (Width, height, x, y) 2. Usable in OSD ON status. (The data of address 0x59 must be 0x04.)	0x0000
	2:3	15:0	OSD height define (Unit: pixel ; range 0~1080)		0x0000
	4:5	15:0	The amount of H pixels that the left upper corner of the OSD is from the left top corner of the output window (Unit: pixel ; range 0~1920)		0x0000
	6:7	15:0	The amount of V pixels that the left upper corner of the OSD is from the left top corner of the output window (Unit: pixel ; range 0~1080)		0x0000
25	0	6:0	Thickness of the OSD left and right border (Unit: pixel ; range 0~127)	1. OSD border width and color decision 2. Usable in OSD ON status. (The data of address 0x59 must be 0x04.)	0x00
	1	6:0	Thickness of the OSD top and bottom border (Unit: pixel ; range 0~127)		0x00
	2:4	7:0	Red component of the OSD border color		0x00
		7:0	Green component of the OSD border color		0x00
		7:0	Blue component of the OSD border color (Unit: 8 bit level ; range 0~255)		0x00

6E	0	7:0	Different MEMC level selection 0x00: Normal MEMC level 0x01: Strong MEMC level 0x03: Weak MEMC level	Usable in MEMC ON status. (The data of address 0x79 must be 0x00.)	0x00

4. Optical Specification

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 60 minutes in a dark environment at 25℃. The values specified are at an approximate distance 50cm from the LCD surface at a viewing angle of φ and θ equal to 0°.



Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max		
Contrast Ratio	CR	4000	5000	--		1
Surface Luminance (White)	L_{WH}	400	500	--	cd/m^2	2
Luminance Variation	$\delta_{WHITE(9P)}$	--	--	1.3		3
Response Time (Average)	Tγ	--	5.5	--	ms	4 (Gray to Gray)
Color Coordinates						
Red	R_X	Typ.-0.03	0.640	Typ.+0.03		
	R_Y		0.330			
Green	G_X		0.290			
	G_Y		0.600			
Blue	B_X		0.150			
	B_Y		0.060			
White	W_X		0.280			
	W_Y		0.290			
Viewing Angle						(Contrast Ratio>10)
x axis, right(φ=0°)	θ_r	--	89	--	degree	5
x axis, left(φ=180°)	θ_l	--	89	--	degree	5
y axis, up(φ=90°)	θ_u	--	89	--	degree	5
y axis, down (φ=270°)	θ_d	--	89	--	degree	5

Note:

1. Contrast Ratio (CR) is defined mathematically as:

$$\text{Contrast Ratio (CR)} = \frac{\text{Brightness of the "white" state}}{\text{Brightness of the "black" state}}$$

2. Surface Luminance is luminance value at point 5 with 100% dimming across the LCD surface 50cm from the surface with all pixels displaying white. For more information see Fig. 4-2. When lamp current I_L=7.6mA, $L_{WH}=L_{on5}$, where L_{on5} is the luminance with all pixels displaying white at center 5 location.

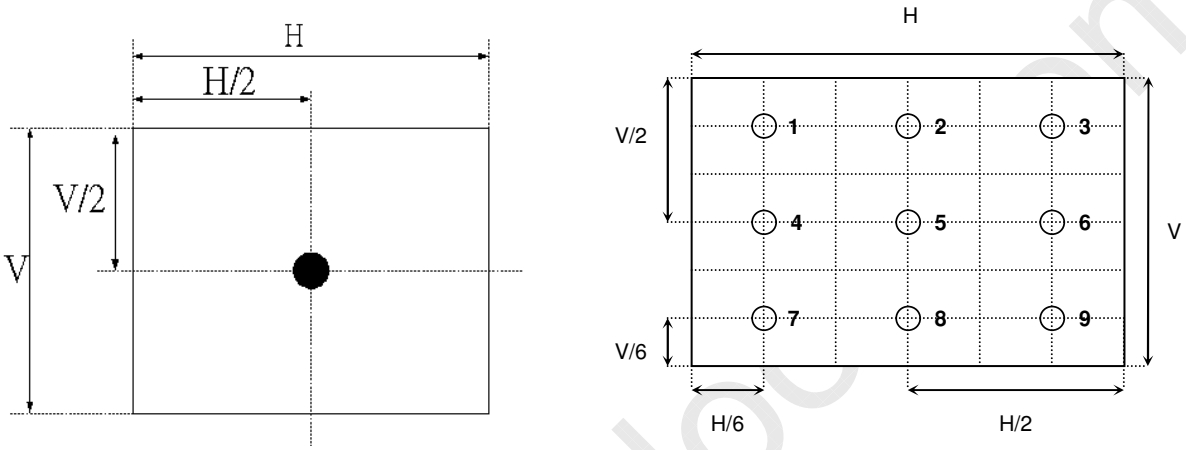


Fig.4-2 Optical measurement point

3. The variation in surface luminance, $\delta_{WHITE(9P)}$ is defined under brightness of I_L=7.6mA as:

$$\delta_{WHITE(9P)} = \text{Maximum}(L_{on1}, L_{on2},\ldots,L_{on9})/\text{Minimum}(L_{on1}, L_{on2},\ldots L_{on9})$$

4. Response time Tγ is the average time required for display transition by switching the input signal for five luminance ratio (0%, 25%, 50%, 75%, 100% brightness matrix)and is based on f_v=60Hz to optimize.

.

	0%	25%	50%	75%	100%
0%		t:0%-25%	t:0%-50%	t:0%-75%	t:0%-100%
25%	t:25%-0%		t:25%-50%	t:25%-75%	t:25%-100%
50%	t:50%-0%	t:50%-25%		t:50%-75%	t:50%-100%
75%	t:75%-0%	t:75%-25%	t:75%-50%		t:50%-100%
100%	t:100%-0%	t:100%-25%	t:100%-50%	t:100%-75%	

5. Viewing angle is the angle at which the contrast ratio is greater than 10. The angles are determined for the horizontal (or x-axis) and the vertical (or y-axis) with respect to the z-axis which is normal to the LCD surface. For more information see Fig. 4-4.

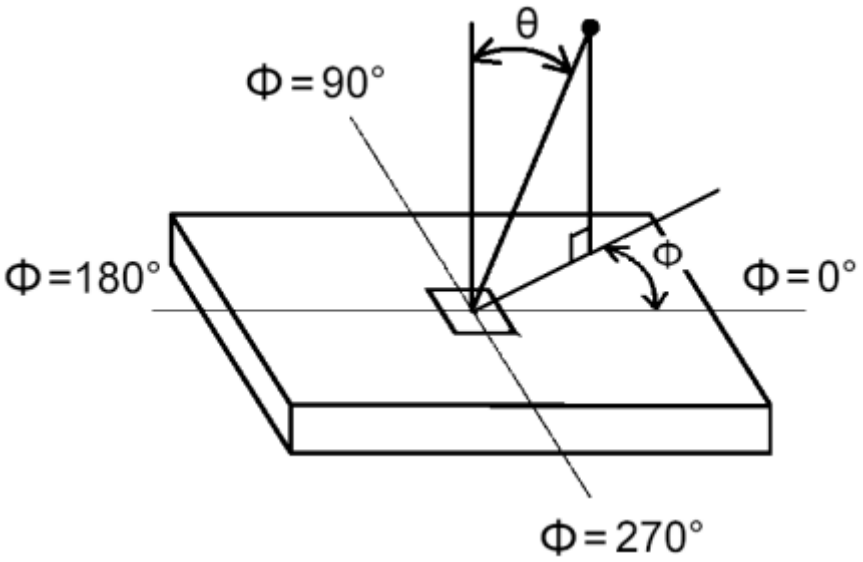


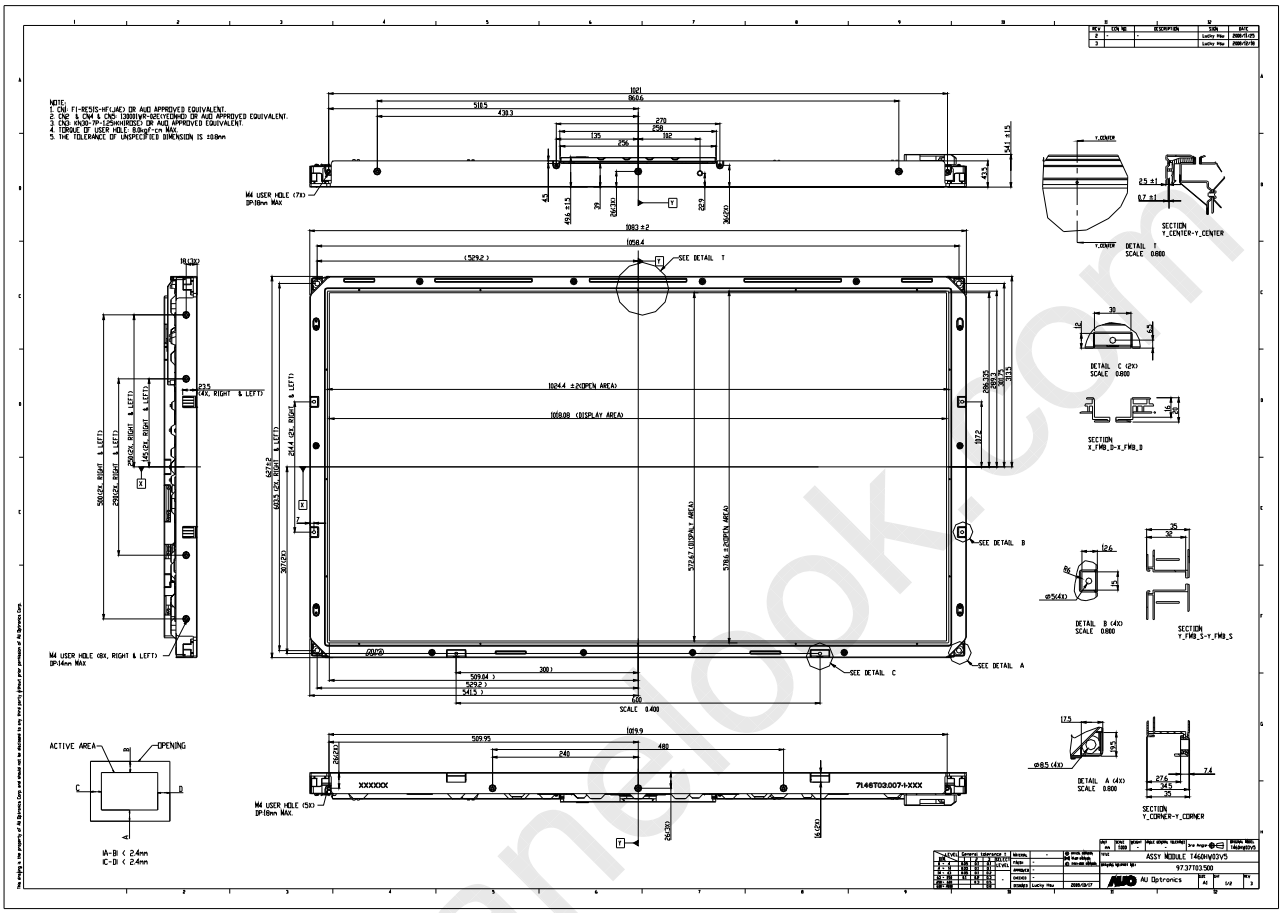
Fig.4-4 Viewing angle definition

5. Mechanical Characteristics

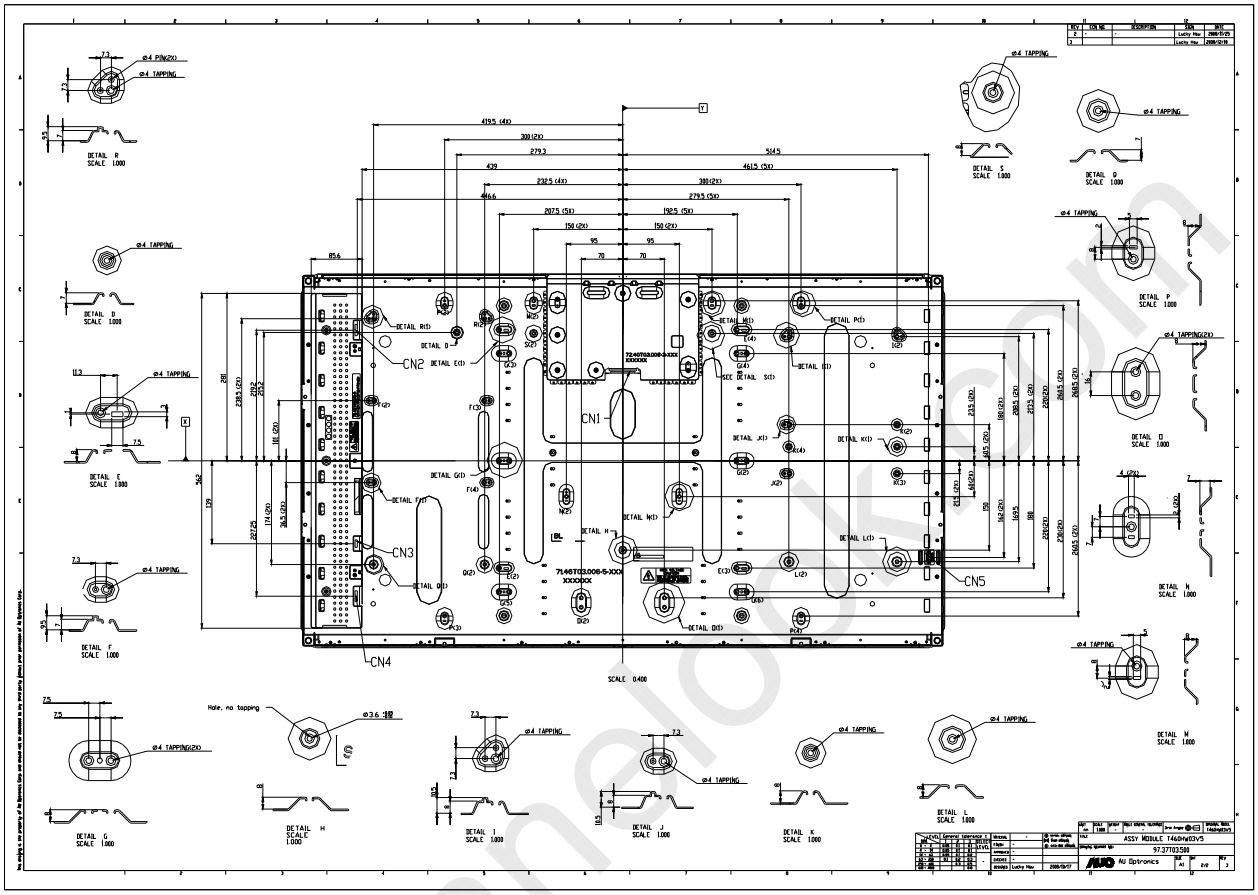
The contents provide general mechanical characteristics for the model T460HW03. In addition the figures in the next page are detailed mechanical drawing of the LCD.

Outline Dimension	Horizontal (typ.)	1083.0 mm
	Vertical (typ.)	627.0 mm
	Depth (typ.)	54.1 mm (with balance board)
Bezel Area	Horizontal (typ.)	1024.4 mm
	Vertical (typ.)	578.6 mm
Active Display Area	Horizontal	1018.08 mm
	Vertical	572.67 mm
Weight	15500g (Max)	
Surface Treatment	Haze 13%, 3H	

2D Drawing (Front)



2D Drawing (Rear)



6. Reliability

Panel condition in RA test

Brightness: 500nits

Lamp Current (Hot side): 7.6mA

No	Test Item	Condition
1	High temperature storage test	Ta=60℃ 300h
2	Low temperature storage test	Ta= -20℃ 300h
3	High temperature operation test	Ta=50℃ 300h
4	Low temperature operation test	Ta=-5℃ 300h
5	Vibration test (non-operating)	waveform : random Bandwidth & Level : Frequency PSD(g2/Hz) 10~300Hz 0.0075 301~500Hz 0.0045 Duration : X,Y,Z 30min XY: Horizontal, Z: face up One time each direction
6	Shock test (non-operating)	Shock level: 50G Waveform: half since wave, 20ms Direction: ±X, ±Y, ±Z One time each direction
7	Vibration test (with carton)	Wave form: random Vibration level: 1.5G RMS Bandwidth: 10-200Hz, Duration: X, Y, Z 30min One time each direction
8	Drop test (with carton)	Height: 25cm 6 flats

Result Evaluation Criteria }

There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

7. International Standard

7-1. Safety

(1) UL6500, UL 60065 Underwriters Laboratories, Inc. (AUO file number: E204356)
Standard for Safety of Information Technology Equipment Including electrical Business Equipment.

(2) CAN/CSA C22.2 No. 950-95 Third Edition, Canadian Standards Association, Jan. 28, 1995
Standard for Safety of Information Technology Equipment Including Electrical Business Equipment.

(3) EN60950: 1992+A2: 1993+A2: 1993+C3: 1995+A4: 1997+A11: 1997
IEC 950: 1991+A1: 1992+A2: 1993+C3: 1995+A4:1996
IEC 60065: version 7th
European Committee for Electro technical Standardization (CENELEC)
EUROPEAN STANDARD for Safety of Information Technology Equipment Including Electrical Business Equipment.

7-2. EMC

(1) ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electrical Equipment in the Range of 9kHz to 40GHz. “American National standards Institute(ANSI), 1992

(2) C.I.S.P.R “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” International Special committee on Radio Interference.

(3) EN 55022 “Limits and Methods of Measurement of Radio Interface Characteristics of Information Technology Equipment.” European Committee for Electrotechnical Standardization. (CENELEC), 1998

7-3. Green Mark Description

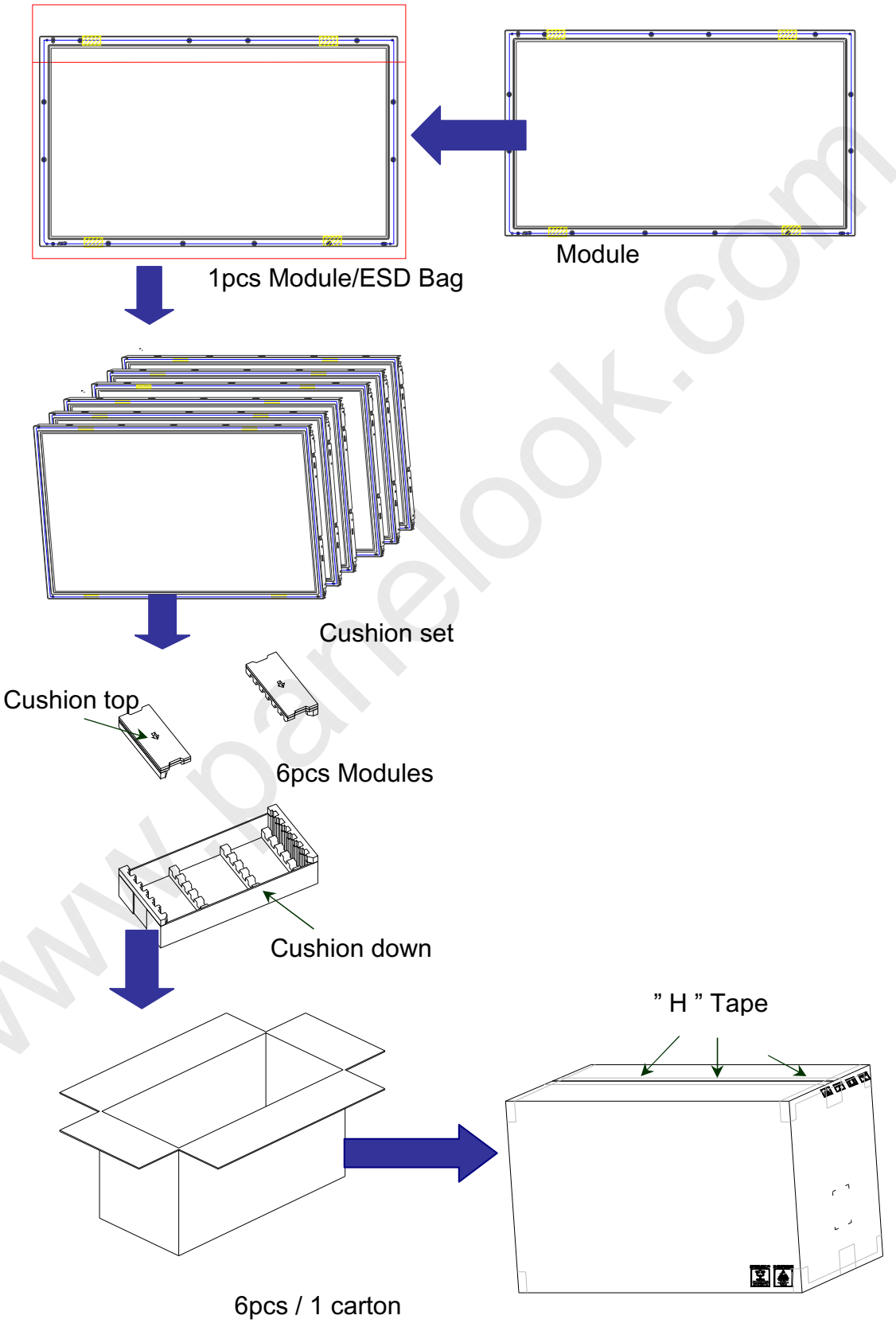
(1) For Pb Free products, AUO will add Pb for identification.

(2) For RoHS compatible products, AUO will add RoHS for identification.

Note. The Green Mark will be present only when the green documents have been ready by AUO Internal Green Team. (The definition of green design follows the AUO green design checklist.)

8. Packing

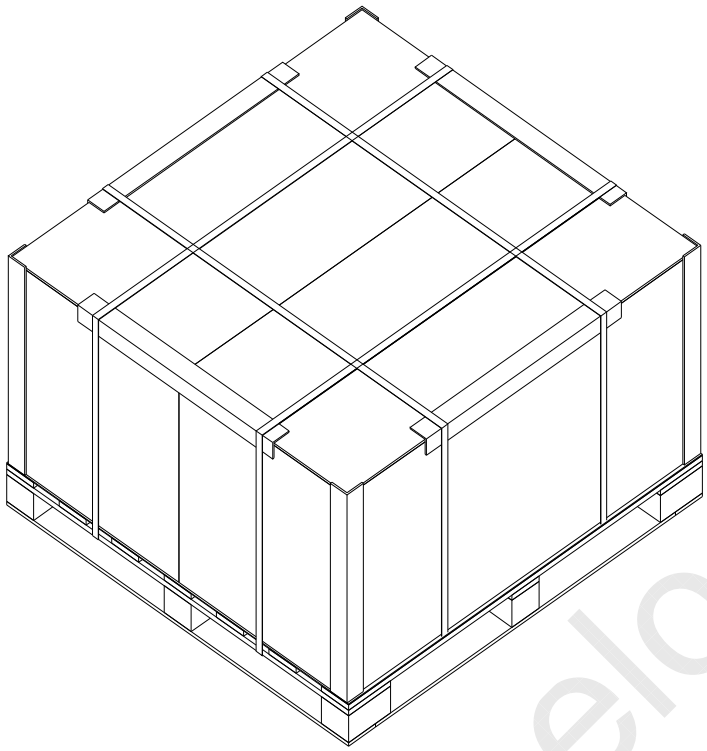
Packing Instruction



Pallet information

By air cargo: (2 x 1) x 1 layers, one pallet put 2 boxes, total 12 pcs module.

Dimension: 1140 x 1180 x 818mm



By sea: (2 x 1) x 1 layers, one pallet put 2 boxes, 40ft HQ stack 3 pallet, total 36 pcs module.

Pallet dimension: 1140 x 1180 x 138mm

Panel Label

Carton Label

9. Precautions

Please pay attention to the followings when you use this TFT LCD module.

9-1 MOUNTING PRECAUTIONS

(1) You must mount a module using holes arranged on back side of panel

(2) You should consider the mounting structure so that uneven force (ex. Twisted stress) is not applied to module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.

(3) Please attach the surface transparent protective plate to the surface in order to protect the polarizer. Transparent protective plate should have sufficient strength in order to the resist external force.

(4) You should adopt radiation structure to satisfy the temperature specification.

(5) Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.

(6) Do not touch, push or rub the exposed polarizer with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment. Do not touch the surface of polarizer for bare hand or greasy cloth. (Some cosmetics are detrimental to the polarizer.)

(7) When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzene. Normal-hexane is recommended for cleaning the adhesives used to attach front/ rear polarizer. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.

(8) Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading.

(9) Do not open the case because inside circuits do not have sufficient strength.

9-2 OPERATING PRECAUTIONS

(1) The spike noise causes the mis-operation of circuits. It should be lower than following voltage: V=±200mV (Over and under shoot voltage)

(2) Response time depends on the temperature. (In lower temperature, it becomes longer.)

(3) Brightness depends on the temperature. (In lower temperature, it becomes lower.) And in lower temperature, response time (required time that brightness is stable after turned on) becomes longer.

(4) Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.

(5) When fixed patterns are displayed for a long time, remnant image is likely to occur.

(6) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interface.

(7) The device listed in the product specification sheets was designed and manufactured for TV application.

9-3 ELECTROSTATIC DISCHARGE CONTROL

Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc. And don't touch interface pin directly.

9-4 PRECAUTIONS FOR STRONG LIGHT EXPOSURE

Strong light exposure causes degradation of polarizer and color filter.

9-5 STORAGE

When storing modules as spares for a long time, the following precautions are necessary.

(1) Store them in a dark place. Do not expose the module to sunlight or fluorescent light. Keep the temperature between 5℃ and 35℃ at normal humidity.

(2) The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.

9-6 HANDLING PRECAUTIONS FOR PROTECTION FILM

(1) The protection film is attached to the bezel with a small masking tape. When the protection film is peeled off, static electricity is generated between the film and polarizer. This should be peeled off slowly and carefully by people who are electrically grounded and with well ion-blown equipment or in such a condition, etc.

(2) When the module with protection film attached is stored for a long time, sometimes there remains a very small amount of flue still on the Bezel after the protection film is peeled off.

(3) You can remove the glue easily. When the glue remains on the Bezel or its vestige is recognized, please wipe them off with absorbent cotton waste or other soft material like chamois soaked with normal-hexane.