EV238FHM-N12 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	EV238FHM-N12

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2018-11-29	SF.Wang

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

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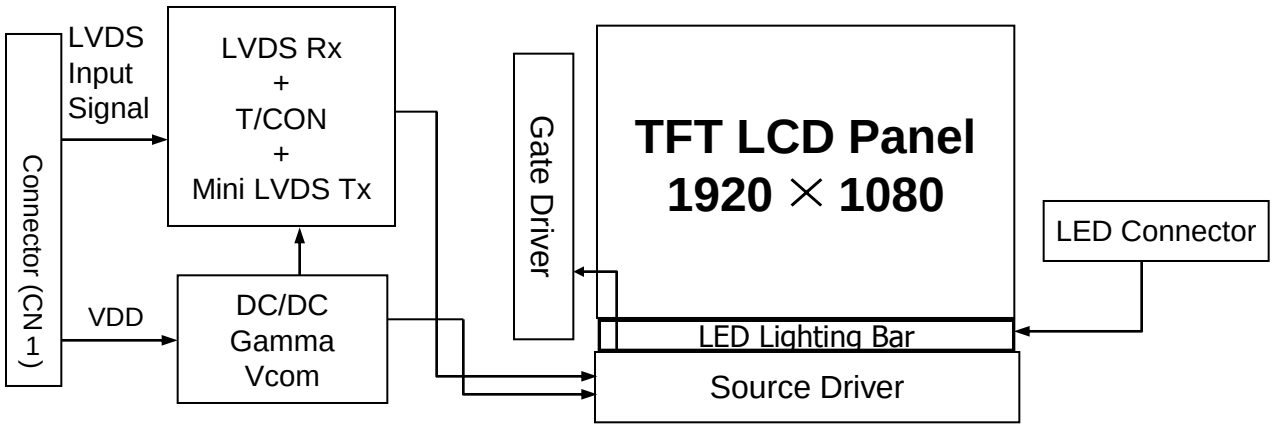
1.0 GENERAL DESCRIPTION

1.1 Introduction

EV238FHM-N12 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 **23.8** inch diagonally measured active area with **FHD** resolutions (**1920** horizontal by **1080** vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display **16.7M colors.**



1.2 Features

- Forward Type;
- LVDS Interface with 2 pixel/clock;
- 6-bit(Hi-FRC) color depth, display 16.7M colors;
- DE (Data Enable)only;

1.3 Application

- Desktop Type of PC & Workstation Use
- Display Terminals for Control System
- Monitors for Process Controller

1.4 General Specification

The followings are general specifications at the model EV238FHM-N11

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	527.04(H)*296.46(V)	mm	
Number Of Pixels	1920(H)×1080(V)	pixels	
Pixel Pitch	0.00915(H)×RGB×0.2745(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally Black		
Display Colors	16.7M(6Bits+Hi-FRC)	colors	
Display Mode	Normally Black		
Surface Treatment	HC		
Contrast Ratio	1200:1(typ.)		
Viewing Angle(CR>10)	89/89/89/89(typ.)	deg.	
Response Time	20(typ.)	ms	
Color Gamut	72%		NTSC
Brightness	240(min)/300(typ)	cd/m2	
Brightness Uniformity	9 point: min 75% 、 typ 80%		
Power Consumption	LCD: 4.2W(Max.)(White Pattern) BLU: 16.2W(Max.)(w/o Driver)	watt	
Outline Dimension	543.1(H)*317.5(V)*11.1(typ)(LCM)	mm	
Weight	2390(max.)	gram	

2.0 ABSOLUTE MAXIMUM RATINGS

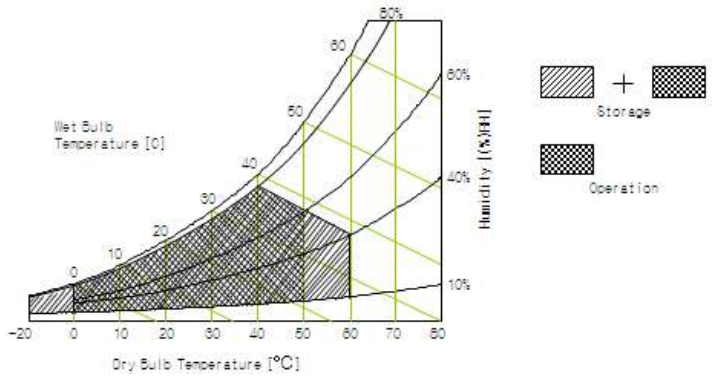
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

< Table 2. Absolute Maximum Ratings>

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	GND-0.3	6	V	Ta = 25 ℃
Logic Supply Voltage	V_{IN}	VSS-0.3	V_{DD}+0.3	V	
Operating Temperature	T_{OP}	0	+50	℃	
Storage Temperature	T_{ST}	-20	+60	℃	

Note:

1. These range above is maximum value not the actual operating temperature . Actual Operating temperature is no more than 40℃ and temperature refers to the LCM surface temperature ; Length of operation: No more than 8 hours per day, and no more than 4 hours of continuous use one time.
2. BOE is not responsible for product problems beyond the use conditions.
3. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be 39 ℃ max. and no condensation of water.



3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Module

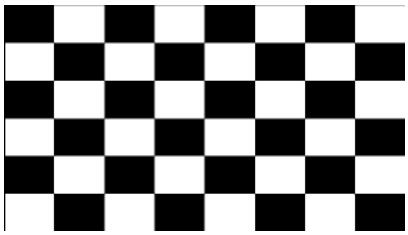
< Table 3. LCD Module Electrical specifications >

[Ta =25±2 ℃]

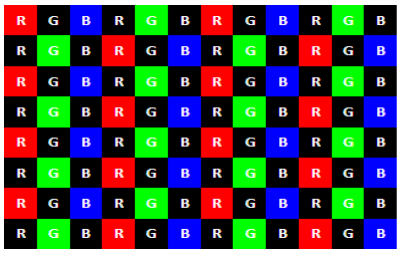
Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	4.5	5	5.5	V	Note1
Power Supply Current	I_{DD}	-	TBD	TBD	mA	
In-Rush Current	I_{RUSH}	-	-	3.0	A	Note 2
Permissible Input Ripple Voltage	V_{RF}	-	-	400	mV	Note1,3
High Level Differential Input Threshold Voltage	V_{IH}	+100	-	+300	mV	
Low Level Differential Input Threshold Voltage	V_{IL}	-300	-	-100	mV	
Differential input voltage	$\|V_{ID}\|$	200	-	600	mV	
Differential input common mode voltage	Vcm	1.0	1.2	1.5		V_{IH}=100mV, V_{IL}=-100mV
Power Consumption	P_D	-	TBD	TBD	W	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VBAT=3.8V, Frame rate f_V=60Hz and Clock frequency = 156.8MHz. Test Pattern of power supply current

a) Typ : Mosaic 8 x 6 Pattern(L0/L255)



b) Max : skip 1H1V dot(L0/L255)



2. The duration of rush current is about 2ms and rising time of Power Input is 1ms(min)

3.1 Back-Light Unit

Table 4. LED Driver Electrical Specifications > [Ta =25±2 ℃]

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Driver Voltage Input		VLED	11.2	14	20	V	Duty 100%
LED Driver Current Input		ILED	1.6A	-	-	mA	
LED Power Consumption		P_{BL}	17.9	-	-	W	
BLU on/off Level		BLU on	2.5		3.6	V	
		BLU off	0		0..5	V	
PWM	Level	High Level	2.5		3.6	V	
		Low Level	0		0.5	V	
	Frequency	FPWM	180	200	300	Hz	
	Duty	DPWM	5	-	100	%	
LED Life-Time		-	30,000	-		Hrs	Note 2

Note1: There are one light bar ,and the specified current is input LED chip 100% duty current

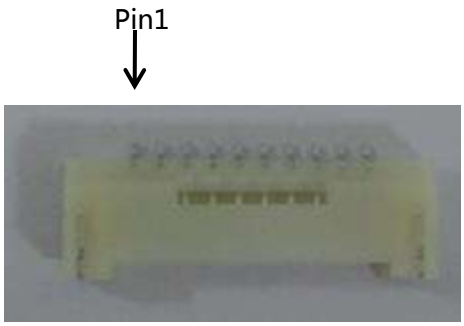
Note2: The lifetime is determined as the time at which luminance of LED become 50% of the initial brightness operating at 25 ±2° C

3.2 Pin assignment for LED Bar

Connector : CI0114M1HR0-NH瀚荃or equivalent

< Table8. Pin assignment for LED Bar >

Pin No	Symbol	Description
1	VLED	DC 14V Power Supply
2	VLED	
3	VLED	
4	NC	NC
5	BL ON	LED Enable
6	PWM	LED PWM
7	GND	Ground
8	GND	
9	GND	
10	GND	



3.3 INTERFACE CONNECTION.

3.3.1 Electrical Interface Connection

- CN1 Module Side Connector : IS100-L30O-C23

Pin No	Symbol	Function	Remark
1	RXO0N	Negative LVDS differential data input	
2	RXO0P	Positive LVDS differential data input	
3	RXO1N	Negative LVDS differential data input	
4	RXO1P	Positive LVDS differential data input	
5	RXO2N	Negative LVDS differential data input	
6	RXO2P	Positive LVDS differential data input	
7	GND	Ground	Note 1
8	RXOCN-	Negative LVDS differential clock input	
9	RXOCP	Positive LVDS differential clock input	
10	RXO3N	Negative LVDS differential data input	
11	RXO3P	Positive LVDS differential data input	
12	RXE0N	Negative LVDS differential data input	
13	RXE0P	Positive LVDS differential data input	
14	GND	Ground	
15	RXE1N	Negative LVDS differential data input	
16	RXE1P	Positive LVDS differential data input	
17	GND	Ground	
18	RXE2N	Negative LVDS differential data input	
19	RXE2P	Positive LVDS differential data input	
20	RXECN	Negative LVDS differential clock input	
21	RXECP	Positive LVDS differential clock input	
22	RXE3N	Negative LVDS differential data input	
23	RXE3P	Positive LVDS differential data input	
24	GND	Ground	
25	SDA	I2C Data (For VCOM tuning)	
26	SCL	I2C Clock (For VCOM tuning)	
27	NC	NC	
28	VIN	Power Supply 5V	
29	VIN	Power Supply 5V	
30	VIN	Power Supply 5V	

3.3.3 LVDS Interface

	Input Signal	Transmitter		Interface		HR230WU-400 (CN11)	Remark
		Pin No.	Pin No.	System (Tx)	TFT-LCD (Rx)	Pin No.	
LVDS	OR0	51	48 47	OUT0- OUT0+	RXO0- RXO0+	1 2	
	OR1	52					
	OR2	54					
	OR3	55					
	OR4	56					
	OR5	3					
	OG0	4					
	OG1	6	46 45	OUT1- OUT1+	RXO1- RXO1+	3 4	
	OG2	7					
	OG3	11					
	OG4	12					
	OG5	14					
	OB0	15					
	OB1	19					
	OB2	20	42 41	OUT2- OUT2+	RXO2- RXO2+	5 6	
	OB3	22					
	OB4	23					
	OB5	24					
	Hsync	27					
	Vsync	28					
	DE	30					
	MCLK	31	40 39	CLK OUT- CLK OUT+	RXO CLK- RXO CLK+	8 9	
	OR6	50	38 37	OUT3- OUT3+	RXO3- RXO3+	10 11	
	OR7	2					
	OG6	8					
	OG7	10					
	OB6	16					
	OB7	18					
	RSVD	25					

Note: The order of even data is same with old data.

3.4 SIGNAL TIMING SPECIFICATION

The EV238FHM is operated by the DE only.

Item	Symbols		Min	Typ	Max	Unit	Note
DCLK	Period	tCLK	11.8	12.1	13.05	ns	
	Frequency	fCLK	76.57	81.972	84.5	MHz	
Hsync	Period	tHP	1050	1100	1120	tCLK	
	Horizontal Valid	tHV	960	960	960	tCLK	
	Horizontal Blank	tHB	90	140	160	tCLK	tWH+tHBP+tHFP
	Frequency	fH	-	74.52	-	KHz	
	Width	tWH	32	32	32	tCLK	
	Horizontal Back Porch	tHBP	28	50	60		
	Horizontal Front Porch	tHFP	30	58	68		
Vsync	Period	tVP	1236	1242	1248	tHP	
	Vertical Valid	tVV	1200	1200	1200	tHP	
	Vertical Blank	tVB	36	42	48	tHP	tWV+tVBP+tVFP
	Frequency	fV	59	60	61	Hz	
	Width	tWV	6	6	6	tHP	
	Vertical Back Porch	tVBP	27	33	39	tHP	
	Vertical Front Porch	tVFP	3	3	3	tHP	
LVDS Receiver clock	Input spread spectrum ratio	SSr	-3	-	+3	%	

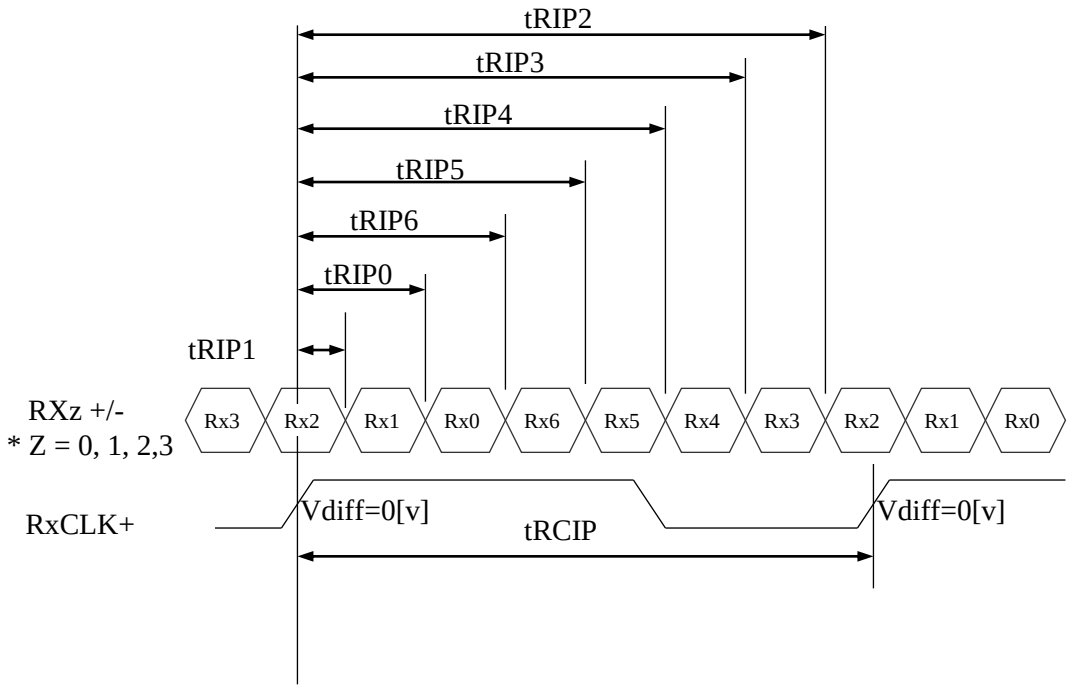
TBD

3.5 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 7.

<Table 7. LVDS Rx Interface Timing Specification>

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	11.8	12.1	13.05	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 ×tRCIP/7-0.4	2 ×tRCIP/7	2 ×tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 ×tRCIP/7-0.4	3 ×tRCIP/7	3 ×tRCIP/7+0.4	nsec	
Input Data 4	tRIP4	4 ×tRCIP/7-0.4	4 ×tRCIP/7	4 ×tRCIP/7+0.4	nsec	
Input Data 5	tRIP3	5 ×tRCIP/7-0.4	5 ×tRCIP/7	5 ×tRCIP/7+0.4	nsec	
Input Data 6	tRIP2	6 ×tRCIP/7-0.4	6 ×tRCIP/7	6 ×tRCIP/7+0.4	nsec	

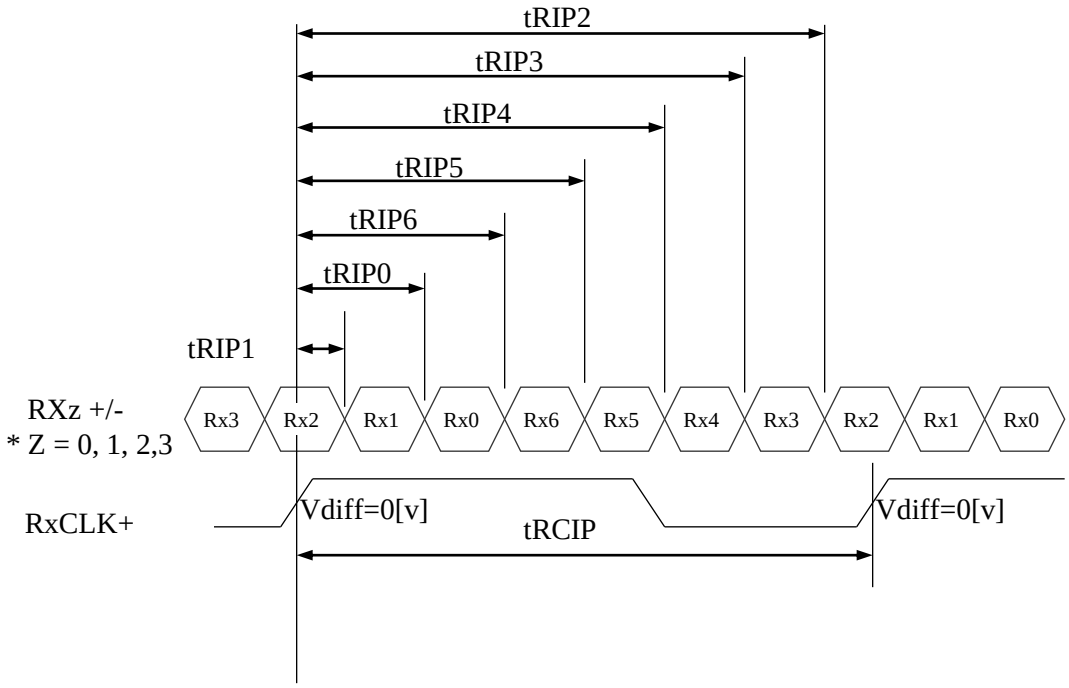


* Vdiff = (RXz+)-(RXz-),…. ,(RXCLK+)-(RXCLK-)

3.6 Interface timing Parameter

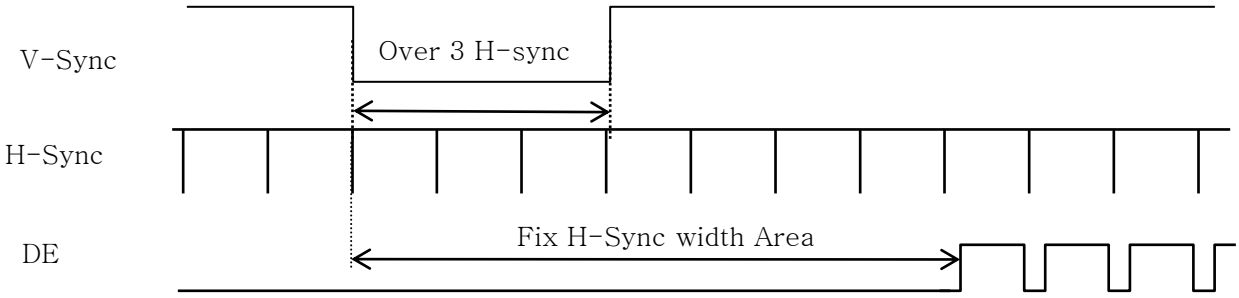
< Table8. Timing Parameter >

Item	Symbol	Min	Typ	Max	Unit	Remark
CLKIN Period	tRCIP	11.8	12.1	13.05	nsec	
Input Data 0	tRIP1	-0.4	0.0	+0.4	nsec	
Input Data 1	tRIP0	tRCIP/7-0.4	tRCIP/7	tRCIP/7+0.4	nsec	
Input Data 2	tRIP6	2 ×tRCIP/7-0.4	2 ×tRCIP/7	2 ×tRCIP/7+0.4	nsec	
Input Data 3	tRIP5	3 ×tRCIP/7-0.4	3 ×tRCIP/7	3 ×tRCIP/7+0.4	nsec	
Input Data 4	tRIP4	4 ×tRCIP/7-0.4	4 ×tRCIP/7	4 ×tRCIP/7+0.4	nsec	
Input Data 5	tRIP3	5 ×tRCIP/7-0.4	5 ×tRCIP/7	5 ×tRCIP/7+0.4	nsec	
Input Data 6	tRIP2	6 ×tRCIP/7-0.4	6 ×tRCIP/7	6 ×tRCIP/7+0.4	nsec	



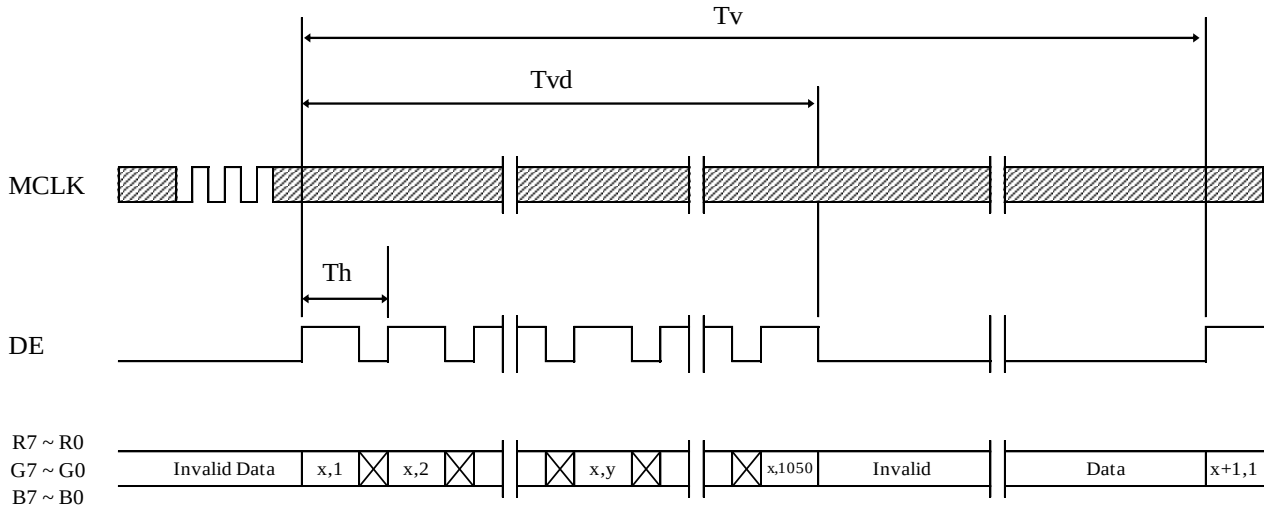
3.7 SIGNAL TIMING WAVEFORMS OF INTERFACE SIGNAL

3.7.1 Sync Timing Waveforms

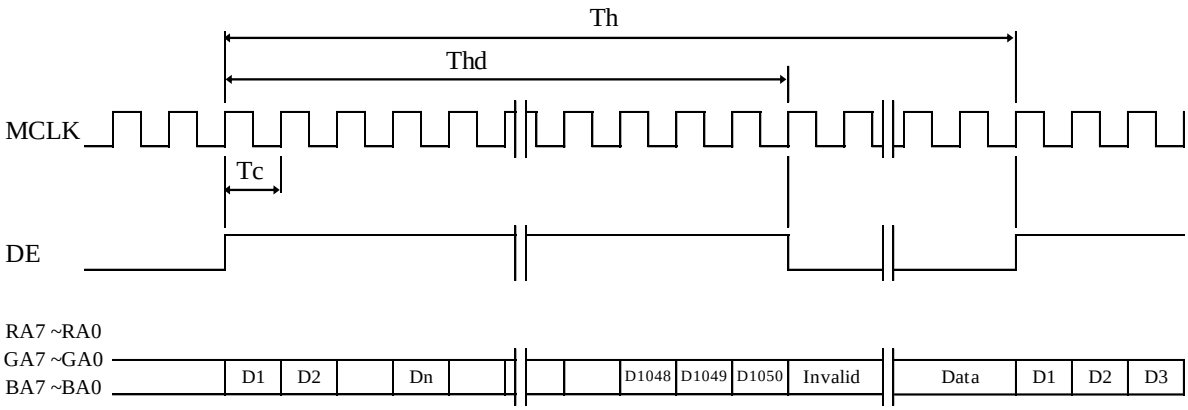


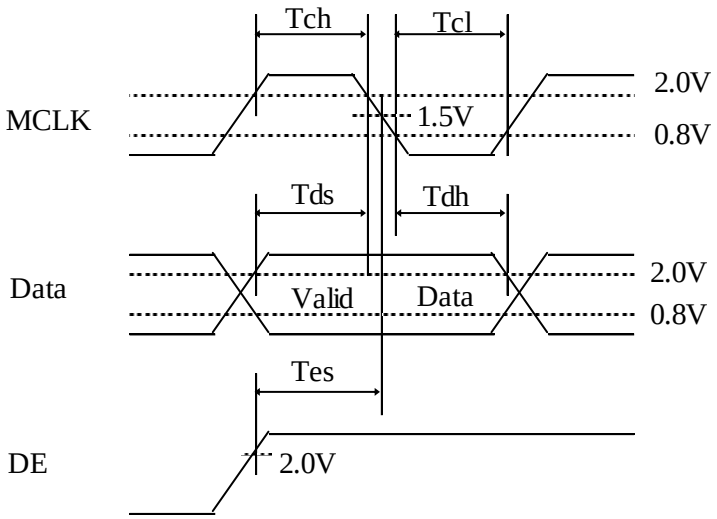
1) Need over 3 H-sync during V-Sync Low
2) Fix H-Sync width from V-Sync falling edge to first rising edge

3.7.2 Vertical Timing Waveforms



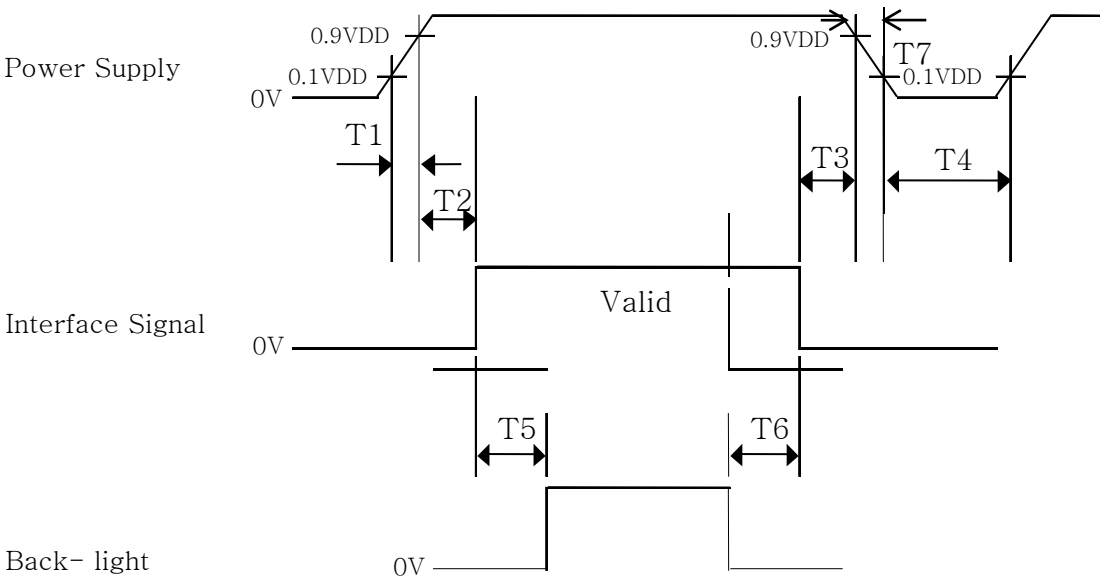
3.7.3 Horizontal Timing Waveforms





3.7.4 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



- 0.5 ms ≤ T1 ≤ 10 ms
- 0 ≤ T2 ≤ 50 ms
- 0 ≤ T3 ≤ 50 ms
- 1 sec ≤ T4
- 200 ms ≤ T5
- 200 ms ≤ T6

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or keep high impedance.
2. Do not keep the interface signal high impedance when power is on.
3. Back Light must be turn on after power for logic and interface signal are valid.
4. T7 decreases smoothly, there is none re-bouncing voltage.

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 θØ=0 (=θ3) as the 3 o′ clock direction (the "right"), θØ=90 (= θ12) as the 12 o′ clock direction ("upward"), θØ=180 (= θ9) as the 9 o′ clock direction ("left") and θØ=270(= θ6) 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 5.0V +/-10% at 25°C. Optimum viewing angle direction is 6 ′ clock.

4.2 Optical Specifications

< Table9. Optical Table >

[VDD = 5.0V, Frame rate = 60Hz, Clock = 74.25MHz, I_{BL} = 360mA, Ta =25±2 ℃]

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	85	89	-	Deg.	Note 1
		Θ_9		85	89	-	Deg.	
	Vertical	Θ_{12}		85	89	-	Deg.	
		Θ_6		85	89	-	Deg.	
Luminance Contrast ratio		CR	Θ = 0° (Center) Normal Viewing Angle	1000	1200			Note 2
Luminance of White		Y_w		240	300		cd/m²	Note 3
White luminance uniformity		ΔY		75	80		%	Note 4
Reproduction of color	White	W_x		0.283	0.313	0.343	-	Note 5
		W_y		0.299	0.329	0.359	-	
	Red	R_x		0.605	0.635	0.665	-	
		R_y		0.303	0.333	0.363	-	
	Green	G_x		0.268	0.298	0.328	-	
		G_y		0.580	0.610	0.640	-	
	Blue	B_x		0.122	0.152	0.182	-	
		B_y		0.035	0.065	0.095	-	
Response Time	GTG	T_g		-	20	25	ms	Note 6
Cross Talk		CT		-	-	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.
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.

   Luminance when displaying a white raster
   Luminance when displaying a black raster

3. Center Luminance of white is defined as 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 = (Minimum Luminance of 9points / Maximum Luminance of 9points) * 100
   (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. Response time Tg is the average time required for display transition by switching the input signal as below table and is based on Frame rate fV =60Hz to optimize.
   Each time in below table is defined as Figure 3and shall be measured by switching the input signal for "any level of gray(bright)"and "any level of gray(dark)".
   (See FIGURE 3 shown in Appendix).
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).

Figure 1. Measurement Set Up

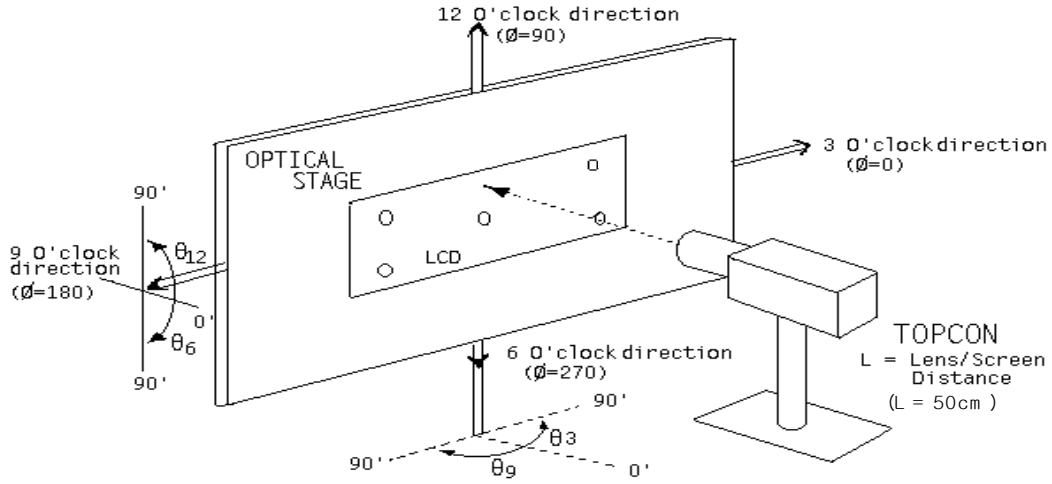


Figure 2. White Luminance and Uniformity Measurement Locations (9 points)

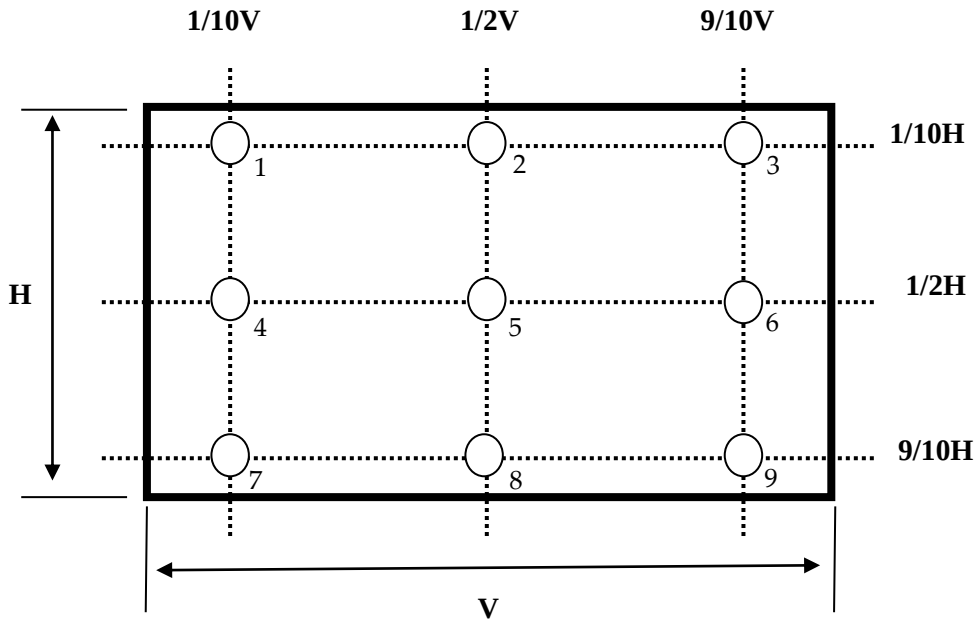
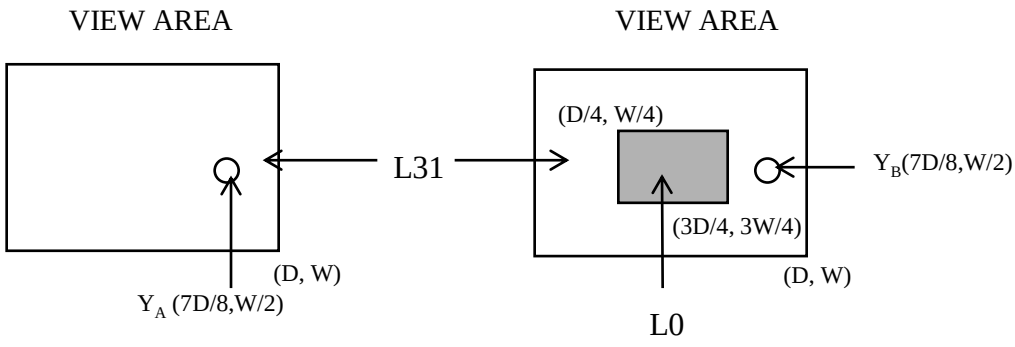


Figure 3. Response Time Testing

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

5.0 RELIABLITY TEST

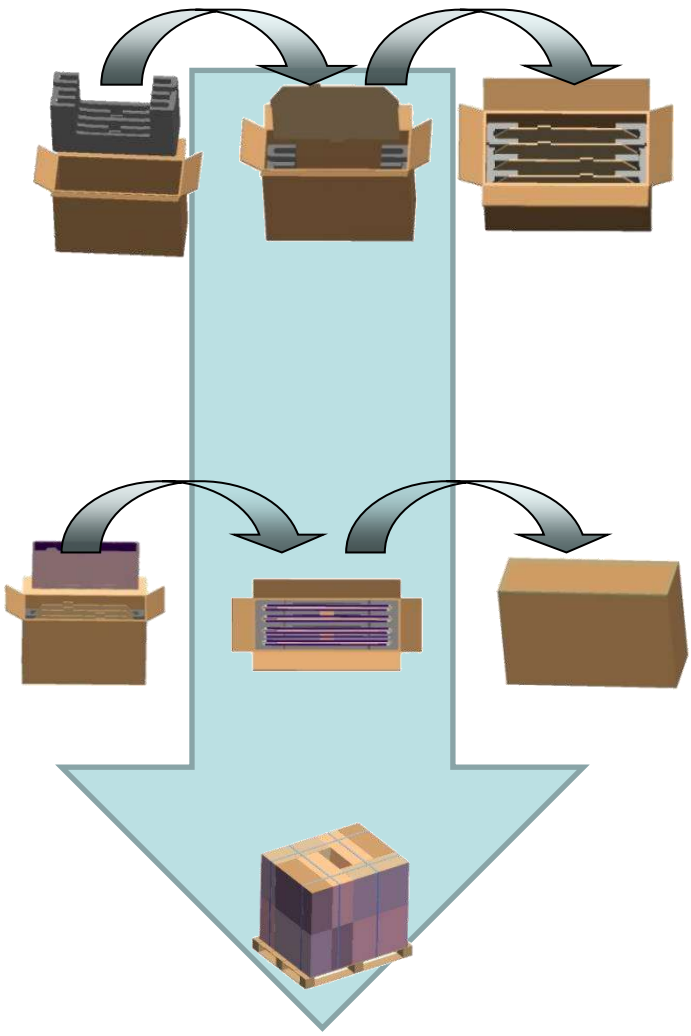
The Reliability test items and its conditions are shown in below.

<Table 10. Reliability Test Parameters >

No	Test Items	Conditions
1	High temperature storage test	60℃，240hr storage
2	Low temperature storage test	-20℃，240hr storage
3	High temperature & high humidity (operation test)	50℃ 80%RH，240hr operation
4	Low temperature operation test	0℃，240hr operation
5	High temperature operation test	50℃，240hr operation
6	Thermal Shock Test	-20℃~60℃（0.5hr），100cycles

6.0 PACKING INFORMATION(产品形态：)

Packing procedure:



-.将2ea EPS Pad、1ea EPS Bottom放入纸箱中
-.将Paper Pad放入Bottom的槽中
容量: 1pcs Paper Pad/槽,4pcs Paper Pad/Inner Box

-.先将Panel装入PE Bag中,然后将其放置于Paper Pad两侧,贴附有保护膜的Panel一侧与Paper Pad相贴,依次装满整箱
-.将EPS Cover盖上,并封箱
-.容量: 2pcs Panel/槽,8pcs Panel/Box

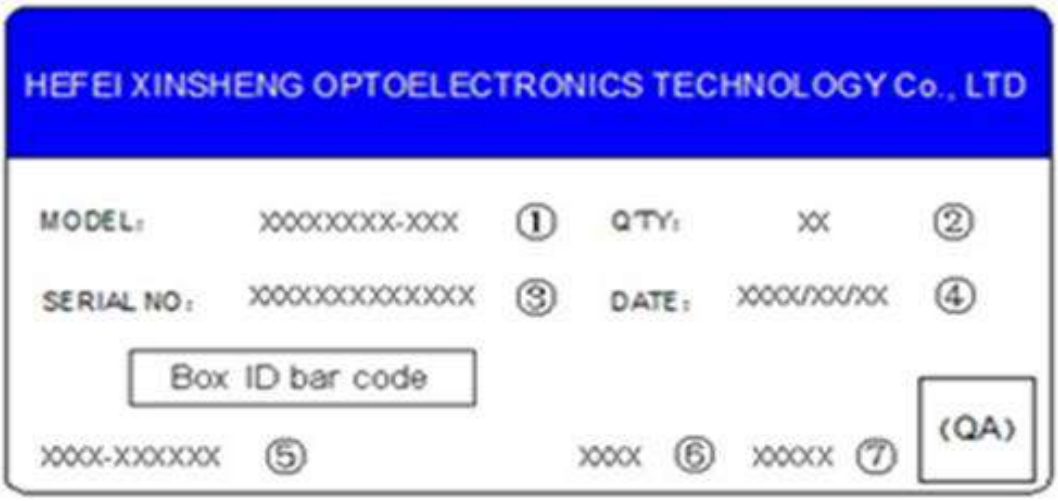
-. 单Pallet上旋转放6eaBox/层, 共2层,共计12ea Box
-. 单Pallet 用8ea纸护角防护, 缠绕膜裹包
容量:96pcs Panel/Pallet

6.1 Packing Note(产品形态：LCM)

- Box Dimension: 619mm(W) x 238mm(D) x 448mm(H)
- Package Quantity in one Box: 8pcs

6.2 Box label (产品形态：)

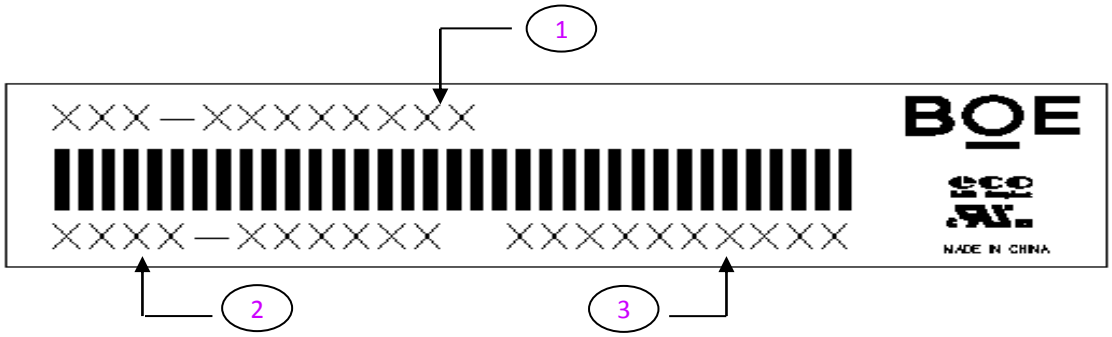
序列号标注部分需打印, 说明如下:
1.FG-CODE(前12位)
2. 产品数量
3. Box ID
4. 包装日期
5.客户端物料号(客户端)----暂不打印
6.FG-Code后四位
7.供应商代码 ----暂不打印
Total Size:110×55mm



Box ID编码规则

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	S	L	S	5	1	2	3	D	0	0	0	6	8
Description	Products GBN		Grade	Line	Year		Month	Revision Code	Serial No				

7.0 Product Label



序列号标注部分需打印, 说明如下:

1. **FG-CODE(前12位)**
2. **PPID - - 暂不打印**
3. **MDL ID 及其条形码**

Total Size:48×12mm

Remark:

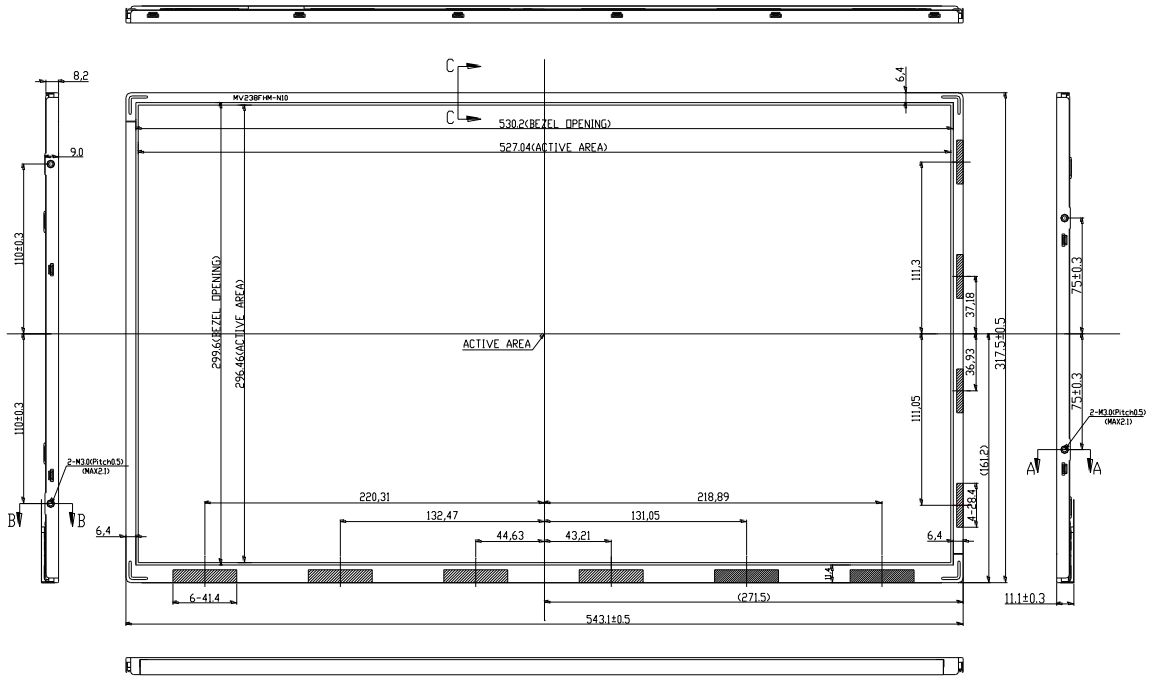
具体标签格式，详见CIM系统维护内容

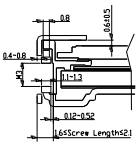
MDL ID编码规则

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	S	L	S	5	1	2	3	5	9	0	0	0	0
Description	Model Code /GBN		Grade	Line	Year		Month	Model Extension Code		Serial No 00001-ZZZZZZ			

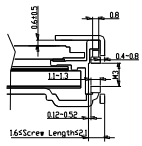
8.0 APPENDIX

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

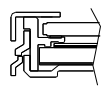




SECTION A-A
SCALE 5/1

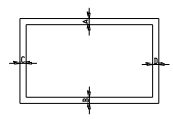


SECTION B-B
SCALE 5/1



SECTION C-C
SCALE 5/1

NOTE:
1. I/F CONNECTOR SPECIFICATION
   IS100-L300-C23(UJU)
2. LED CONNECTOR SPECIFICATION
   3708K-006N-00L(ENTERY)
3. Torque of userhole:3.0~4.0kgf-cm.
4. Tilt and partial desposition tolerance of display area as following:
   (1) Y-direction: | A-B | ≤1.4
   (2) X-direction: | C-D | ≤1.4



5. Unspecified tolerances to be ±0.5mm.
6. The COFarea is weak & sensive,so don't press the COF area.

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