BOE

SPEC. NUMBER	PRODUCT GROUP	REV.	ISSUE DATE	PAGE
S8-*	TFT- LCD	P0	2019-7-5	1 OF 26

B3 EV156FHM-N11 Product Specification Rev.P0

BUYER	
SUPPLIER	HEFEI BOE Optoelectronics Technology CO., LTD
FG-Code	EV156FHM-N11

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

PRODUCT GROUP	REV	ISSUE DATE	BOE
TFT- LCD PRODUCT	P0	2019-7-5	

SPEC. NUMBER	SPEC . TITLE	PAGE
S8-*	B3 EV156FHM-N11 Product Specification	2 OF 26

REVISION HISTORY

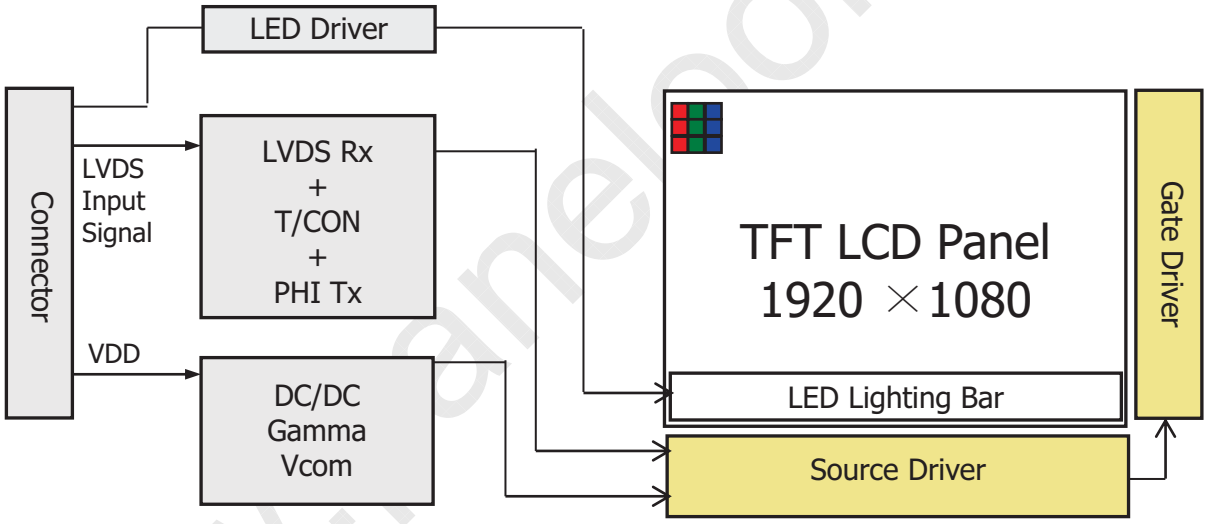
REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2019-7-5	刘正道

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

EV156FHM-N11 is a color active matrix TFT LCD module using amorphous silicon TFT 's (Thin Film Transistors) as an active switching devices. This module has a 15.6 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

- 2 Port LVDS Interface
- 6-bit + Hi-FRC color depth, display 16.7M colors
- LED Driving circuit On board
- Reverse Type

1.3 Application

- Medical & Industrial products

1.4 General Specification

The followings are general specifications of the module EV156FHM-N11.

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	344.16(H)*193.59(V)	mm	
Number Of Pixels	1920(H)×1080(V)	pixels	
Pixel Pitch	0.05975(H)×0.17925(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Colors	16.7M(6bits+Hi FRC)	colors	
Display Mode	Normally Black		
Surface Treatment	高精细AG25		
Contrast Ratio	1200:1(typ.)		
Viewing Angle(CR>10)	89/89/89/89(typ.)	deg.	
Response Time	25(typ.)	ms	
Color Gamut	72%(Min)/78%(Typ)		NTSC
Brightness	425(Min)/500(Typ)	cd/m2	
Power Consumption	LCD: 2.8W(Typ) BLU: 8.7W(Max.)	watt	
Outline Dimension	363.8(H)*216(V)*9.6(Typ) (LCM)	mm	
Weight	850(max.)	gram	

2.0 ABSOLUTE MAXIMUM RATINGS

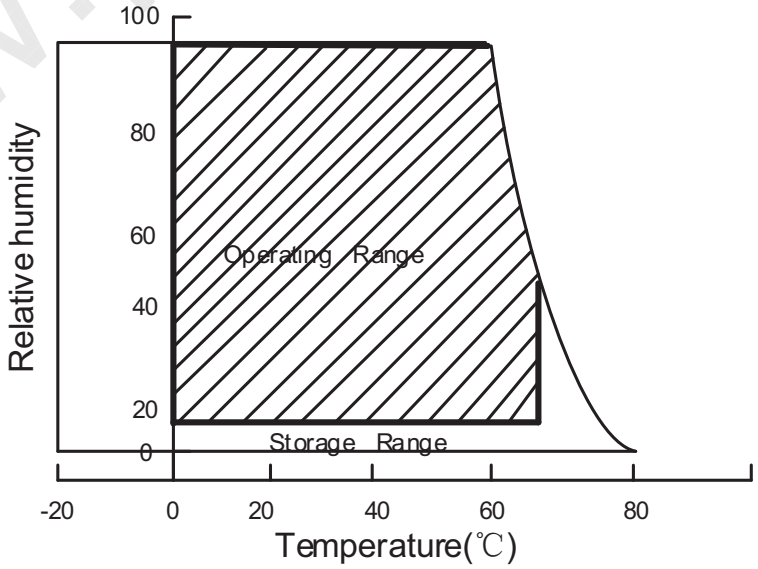
The followings are maximum values which , if exceed, may cause faulty operation or damage to the unit.

< Table 2. Absolute Maximum Ratings>

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	4.0	V	Note 1
Logic Supply Voltage	V_{IN}	V_{ss}-0.3	V_{DD}+0.3	V	
Operating Temperature	T_{OP}	0	+70	℃	Note 2
Storage Temperature	T_{ST}	-20	+80	℃	

Notes : 1. Permanent damage to the device may occur if maximum values are exceeded functional operation should be restricted to the condition described under normal operating conditions.

2. Temperature and relative humidity range are shown in the figure below.
95 % RH Max. (Ta≤40℃)
Maximum wet - bulb temperature at 39 OC or less. (Ta > 40℃) No condensation.



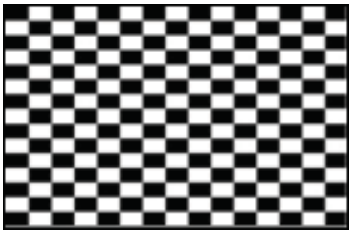
3.0 ELECTRICAL SPECIFICATIONS

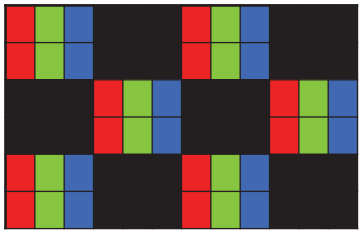
3.1 TFT LCD Module

< Table 3. LCD Module Electrical specifications > [Ta =25±2 ℃]

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Note 1
Permissible Input Ripple Voltage	V_{RF}	-	-	100	mV	At V_{DD} = 3.3V
Power Supply Current	I_{DD}	-	900	-	mA	Note 1
Positive-going Input Threshold Voltage	V_{IT+}	-	-	100	mV	V_{cm} = 1.2V typ.
Negative-going Input Threshold Voltage	V_{IT-}	-100	-	-	mV	
Differential Input Voltage	V_{ID}	200	-	600	mV	
Power Consumption	P_D	-	-	4.5	W	Note 1
	P_{BL}	-	-	8.8	W	Note 2
	P_{total}	-	-	13.3	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 3.3V at 25℃.
a) Typ : Mosaic Pattern
b) Max : R/G/B Pattern





2. Calculated value for reference (VLED × ILED)

3.2 Back-Light Unit

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

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage		V_F	-	3.0	3.3	V	-
LED Forward Current		I_F	-	60		mA	-
LED Power Consumption		P_{LED}		7.8	8.8	W	Note 1
LED Life-Time		N/A	50,000	-	-	Hour	I_F = 60mA
Power supply voltage for LED Driver		V_{LED}	10.8	12	13.2	V	
EN Control Level	Backlight on		2.5		5.0	V	
	Backlight off		0		0.8	V	
PWM Control Level	PWM High Level		2.5		5.0	V	
	PWM Low Level		0		0.8	V	
PWM Control Frequency		F_{PWM}	180	-	10,000	Hz	
Duty Ratio		-	10	-	100	%	

Notes: 1. PLED = VLED ×ILED (Without LED converter transfer efficiency)

2. The life time of LED, 50,000Hrs, is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.

3.3 INTERFACE CONNECTION.

3.3.1 Electrical Interface Connection

The electronics interface connector is I-PEX 20455-040E-66 or Compatible.
The connector interface pin assignments are listed in Table 5.

< Table5. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description
1	BL_POWER	+12V Vi power supply
2	BL_POWER	+12V Vi power supply
3	BL_POWER	+12V Vi power supply
4	BL_POWER	+12V Vi power supply
5	GND	Ground
6	GND	Ground
7	GND	Ground
8	GND	Ground
9	LED_EN	Enable pin
10	LED_PWM	Backlight Adjust
11	LCD_VCC	LCD Power 3.3V
12	LCD_VCC	LCD Power 3.3V
13	LCD_VCC	LCD Power 3.3V
14	NC	Not Connection , this pin should be open
15	NC	Not Connection , this pin should be open
16	NC	Not Connection , this pin should be open
17	LCD_GND	LCD Ground
18	RXO_0-	Negative LVDS differential data input Channel O0(Odd)
19	RXO_0+	Positive LVDS differential data input Channel O0(Odd)
20	RXO_1-	Negative LVDS differential data input Channel O1(Odd)
21	RXO_1+	Positive LVDS differential data input Channel O1(Odd)
22	RXO_2-	Negative LVDS differential data input Channel O2(Odd)
23	RXO_2+	Positive LVDS differential data input Channel O2(Odd)
24	LCD_GND	LCD Ground
25	RXO_C-	Negative LVDS differential clock input(Odd)
26	RXO_C+	Positive LVDS differential clock input (Odd)
27	LCD_GND	LCD Ground
28	RXO_3-	Negative LVDS differential data input Channel O3(Odd)
29	RXO_3+	Positive LVDS differential data input Channel O3(Odd)
30	RXE_0-	Negative LVDS differential data input Channel E0(Even)
31	RXE_0+	Positive LVDS differential data input Channel E0(Even)
32	RXE_1-	Negative LVDS differential data input Channel E1(Even)
33	RXE_1+	Positive LVDS differential data input Channel E1(Even)
34	LCD_GND	LCD Ground
35	RXE_2-	Negative LVDS differential data input Channel E2(Even)
36	RXE_2+	Positive LVDS differential data input Channel E2(Even)
37	RXE_C-	Negative LVDS differential clock input(Even)
38	RXE_C+	Positive LVDS differential clock input (Even)
39	RXE_3-	Negative LVDS differential data input Channel E3(Even)
40	RXE_3+	Positive LVDS differential data input Channel E3(Even)

3.4 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					

3.5 Signal Timing Specification

3.5.1 The EV156FHM-N11 is operated by the DE only.

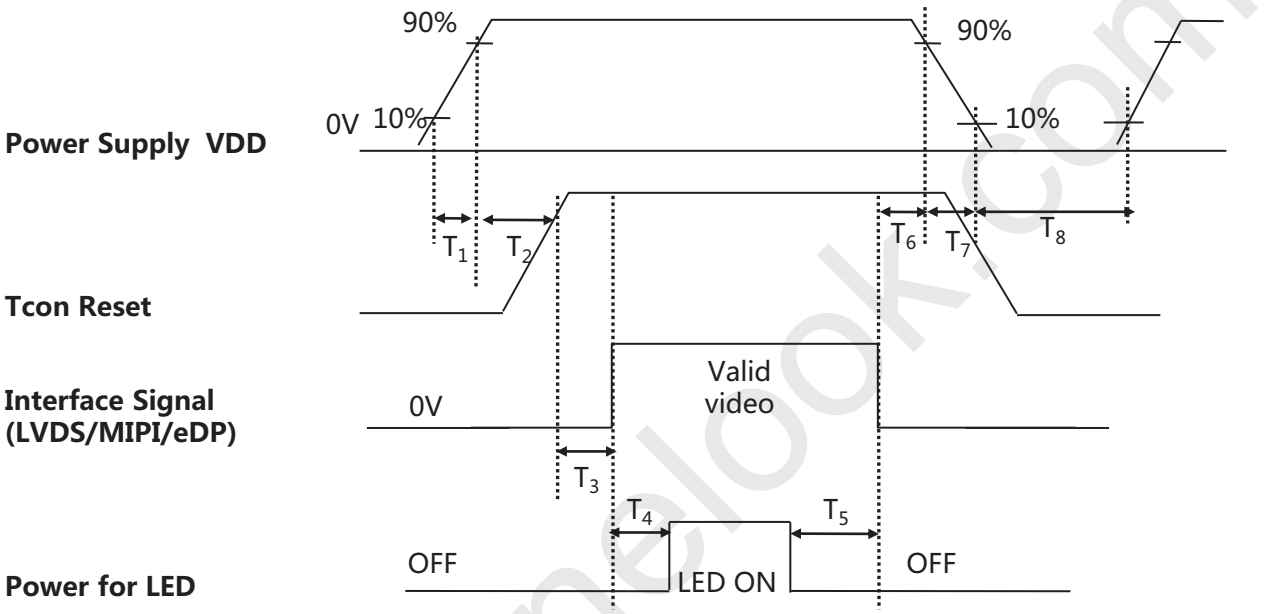
Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	100	147.8	160	MHz
	High Time	Tch	-	4/7Tc	-	Tc
	Low Time	Tcl	-	4/7Tc	-	Tc
Frame Period		Tv	1112	1125	1238	lines
			40	60	66	Hz
			25	16.67	15.15	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2080	2200	2400	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

3.6 Input SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

	Colors & Gray scale	Data signal		
		R0 R1 R2 R3 R4 R5	G0 G1 G2 G3 G4 G5	B0 B1 B2 B3 B4 B5
Basic colors	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
	Light Blue	0 0 0 0 0 0	1 1 1 1 1 1	1 1 1 1 1 1
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
	Purple	1 1 1 1 1 1	0 0 0 0 0 0	1 1 1 1 1 1
	Yellow	1 1 1 1 1 1	1 1 1 1 1 1	0 0 0 0 0 0
	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1
Gray scale of Red	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	1 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	Darker	0 1 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	1 0 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
	▽	0 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
	Red	1 1 1 1 1 1	0 0 0 0 0 0	0 0 0 0 0 0
Gray scale of Green	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	0 0 0 0 0 0	1 0 0 0 0 0	0 0 0 0 0 0
	Darker	0 0 0 0 0 0	0 1 0 0 0 0	0 0 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0	1 0 1 1 1 1	0 0 0 0 0 0
	▽	0 0 0 0 0 0	0 1 1 1 1 1	0 0 0 0 0 0
	Green	0 0 0 0 0 0	1 1 1 1 1 1	0 0 0 0 0 0
Gray scale of Blue	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	0 0 0 0 0 0	0 0 0 0 0 0	1 0 0 0 0 0
	Darker	0 0 0 0 0 0	0 0 0 0 0 0	0 1 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	0 0 0 0 0 0	0 0 0 0 0 0	1 0 1 1 1 1
	▽	0 0 0 0 0 0	0 0 0 0 0 0	0 1 1 1 1 1
	Blue	0 0 0 0 0 0	0 0 0 0 0 0	1 1 1 1 1 1
Gray scale Of White & Black	Black	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0
	△	1 0 0 0 0 0	1 0 0 0 0 0	1 0 0 0 0 0
	Darker	0 1 0 0 0 0	0 1 0 0 0 0	0 1 0 0 0 0
	△	↑	↑	↑
	▽	↓	↓	↓
	Brighter	1 0 1 1 1 1	1 0 1 1 1 1	1 0 1 1 1 1
	▽	0 1 1 1 1 1	0 1 1 1 1 1	0 1 1 1 1 1
	White	1 1 1 1 1 1	1 1 1 1 1 1	1 1 1 1 1 1

3.7 Power Sequence

[Ta =25±2 ℃]



< Table6. Sequence Table >

Parameter	Value			Units
	Min.	Typ.	Max.	
T1	0.1	-	5	(ms)
T2	10	-	30	(ms)
T3	5	-	100	(ms)
T4	200	-	-	(ms)
T5	200	-	-	(ms)
T6	0	-	50	(ms)
T7	0	-	10	(ms)
T8	500	-	-	(ms)

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 3.3+/- 0.3V at 25°C. Optimum viewing angle direction is 6 ' clock.

4.2 Optical Specifications

[**VDD = 3.3V**, Frame rate = 60Hz, Clock = 74.25MHz, I_{BL} = 240mA, Ta =25 ± 2 ℃]

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 10	80	89	-	Deg.	Note 1
		Θ_9		80	89	-	Deg.	
	Vertical	Θ_{12}		80	89	-	Deg.	
		Θ_6		80	89	-	Deg.	
Luminance Contrast ratio		CR		1000	1200			Note 2
Luminance of White		Y_w		425	500		cd/m²	Note 3
White luminance uniformity		ΔY		75	80		%	Note 4
Reproduction of color	White	W_x	Θ = 0° (Center) Normal Viewing Angle	0.283	0.313	0.343	-	Note 5
		W_y		0.299	0.329	0.359	-	
	Red	R_x		0.622	0.652	0.682	-	
		R_y		0.299	0.329	0.359	-	
	Green	G_x		0.265	0.295	0.325	-	
		G_y		0.605	0.635	0.665	-	
	Blue	B_x		0.118	0.148	0.178	-	
		B_y		0.035	0.065	0.095	-	
Response Time	GTG	T_g			25	30	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.

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

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 the table above. 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

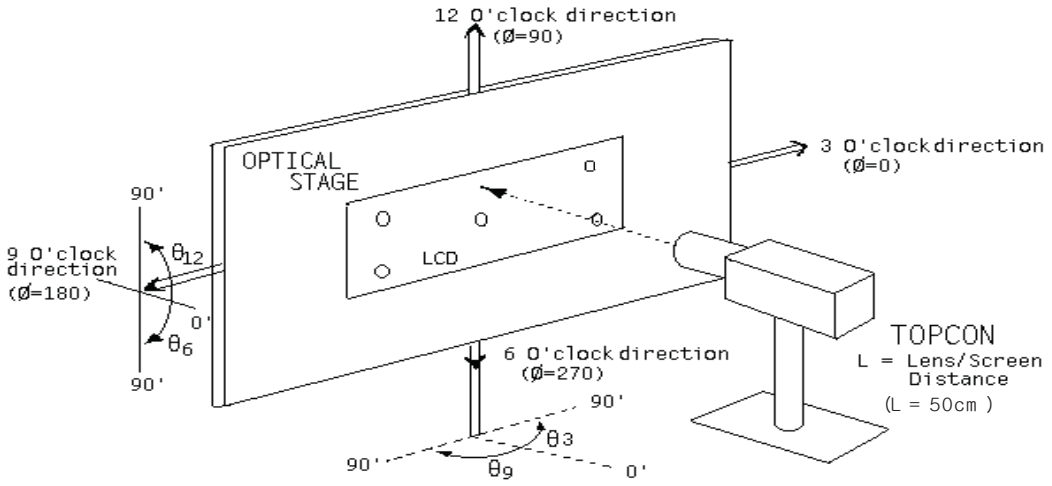


Figure 2. White Luminance and Uniformity Measurement Locations (9 points)

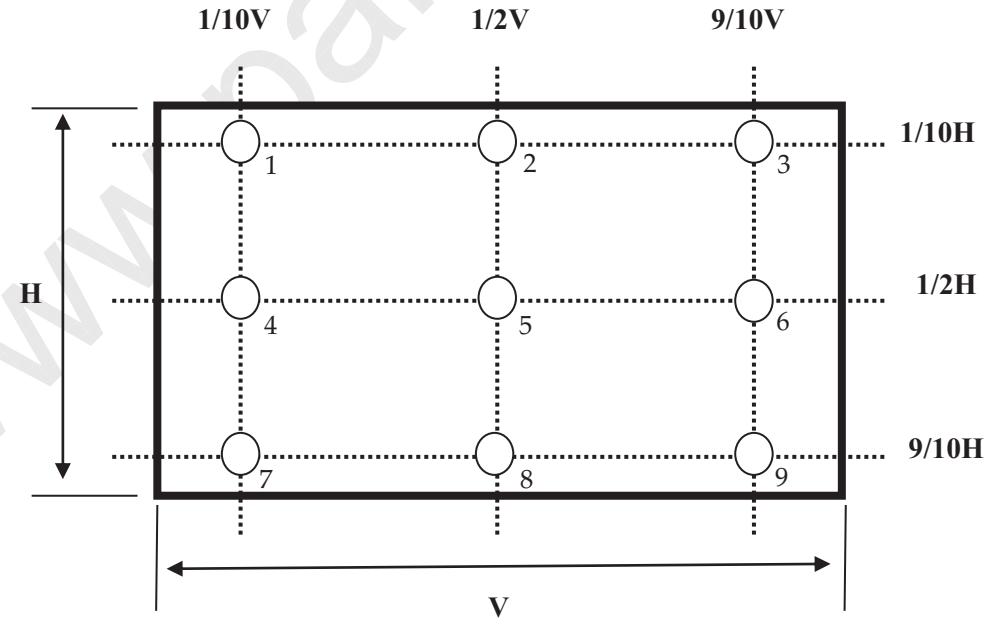
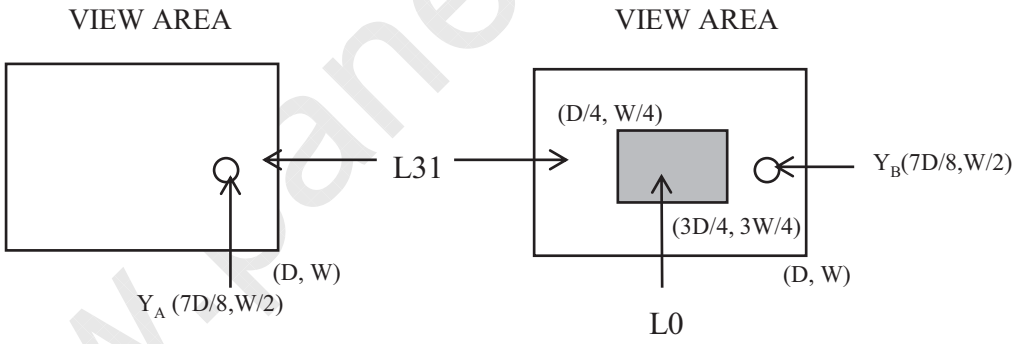


Figure 3. Response Time Testing

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 7. Reliability Test Parameters >

No	Test Items	Conditions	
1	High temperature storage test	Ta = 80 ℃, 240 hrs	
2	Low temperature storage test	Ta = -20 ℃, 240 hrs	
3	High temperature & high humidity operation test	Ta = 50 ℃, 80%RH, 240hrs	
4	High temperature operation test	Ta = 70 ℃, 240hrs	
5	Low temperature operation test	Ta = 0℃, 240hrs	
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 100 cycle	
7	Vibration test (non-operating)	Frequency Gravity / AMP Period	10 ~ 500 Hz, half sine 1.5 Grms X, Y, Z /Sweep rate:1hour
8	Shock test (non-operating)	Gravity	220G
		Pulse width	Half sine wave 2msec
		Direction	±X, ±Y, ±Z Once for each
9	Electro-static discharge test (non-operating)	Air : 150 pF, 330Ω, 15 KV Contact : 150 pF, 330Ω, 8 KV	

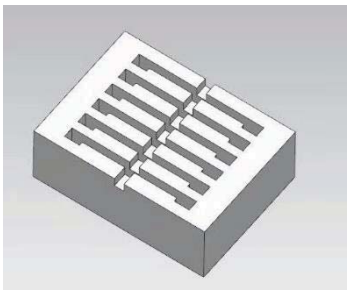
6.0 PACKING INFORMATION

Packing procedure:

-. 将1片产品竖向放入PE Bag，
PCB侧朝下，PE Bag开口反折

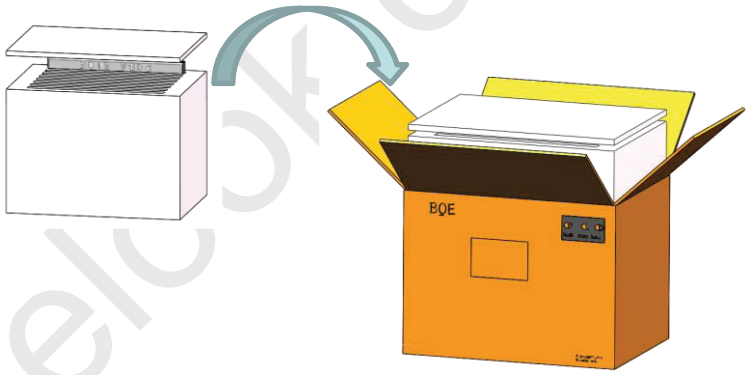
-. 将产品竖向插入卡槽内(1卡槽1片产品)，PCB朝下

-. 9pcs 产品/白色EPE Box

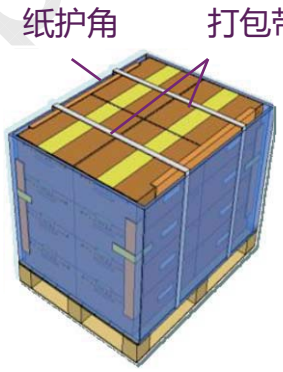


-. 将EPE Bottom 放入纸箱后
上层放置EPE Cover

-. 9pcs 产品/纸箱



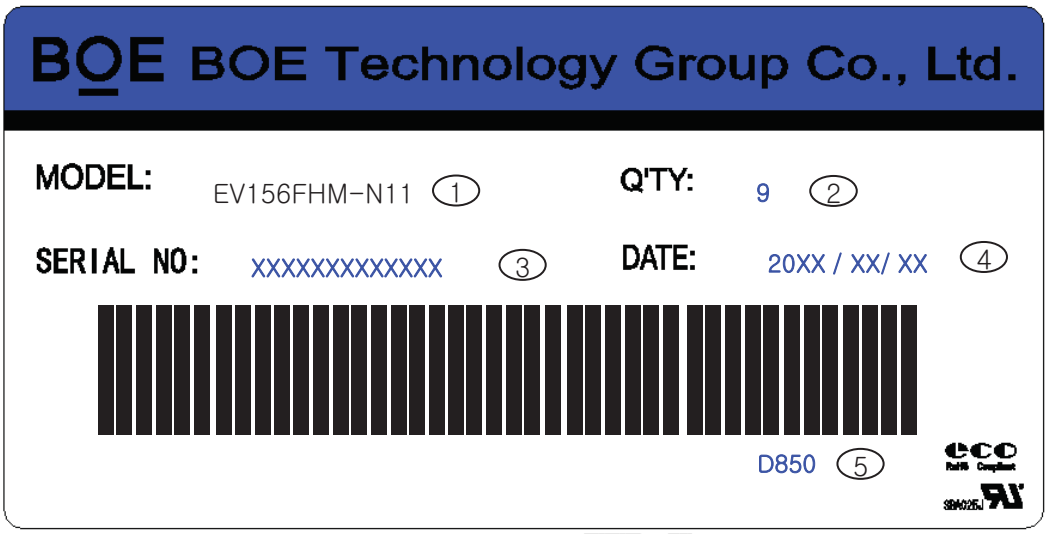
-. 每个Pallet上放3层Box
1层4箱,共计12ea Box
-. Pallet外进行缠膜包装
-. 108pcs LCM/ Pallet



6.1 Packing Note

- Box Dimension: 496mm(W) x 396mm(D) x 290mm(H)
- Package Quantity in one Box: 9pcs

6.2 Box label



The blue font is a post-printed logo, wh
ich is illustrated as follows:

Label Size: 110 mm*55 mm
FG-CODE
Quantity of Box Products
Box ID, encoding rules are as follows
Box Packing Date

Item	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	X	X	S	3	1	8	B	0	0	0	1	H	D
Description	Products GBN		Grade	B3	Year		Month	Revision code	Serial No				

7.0 Product Label

SIZE：48 *12mm/Thickness：0.8mm

1. FG-CODE Top 12: EV156 FHM-N11
2. MDL ID
3. MDL ID 条形码
4. 客户料号—暂不打印

MDL ID Rule

Item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	4	F	P	3	1	2	7	3	8	0	0	0	0	1	E	E	J
Description	GBN		Grade	B3	Y		M	Last 4 digit of FG Code				Seriers Number					

8.0 Handling & Cautions

8.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizers which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

8.2 Caution of LCD Handling and Cleaning

- Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration,and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
- The polarizers on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizers or it leads the polarizers to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent (recommended below) to clean the LCD ‘s surface with wipe lightly.
  -IPA(Isopropyl Alcohol), Ethyl Alcohol, Trichlorotriflorothane
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizers and others. Do not use the following solvent.
  -Water, Ketone, Aromatics
- It is recommended that the LCD be handled with soft gloves during assembly, etc. The polarizers on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.
- Do not drop water or any chemicals onto the LCD's surface.
- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.
- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC,Soldering flux,Chlorine,Sulfur,saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

8.3 Caution Against Static Charge

- The LCD modules use C-MOS drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

8.4 Caution For operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature (hot to cold or cold to hot) ,the LCD may be affected; Specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.

8.5 Packaging

- Modules use LCD element, and must be treated as such.
  -Avoid intense shock and falls from a height.
  -To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

8.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCD' s surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizers.
- Do not store the LCD near organic solvents or corrosive gasses.
- Keep the LCD safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
  -Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
  -Store in a dark place where neither exposure to direct sunlight nor light is.
  -Keep temperature in the specified storage temperature range.
  -Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

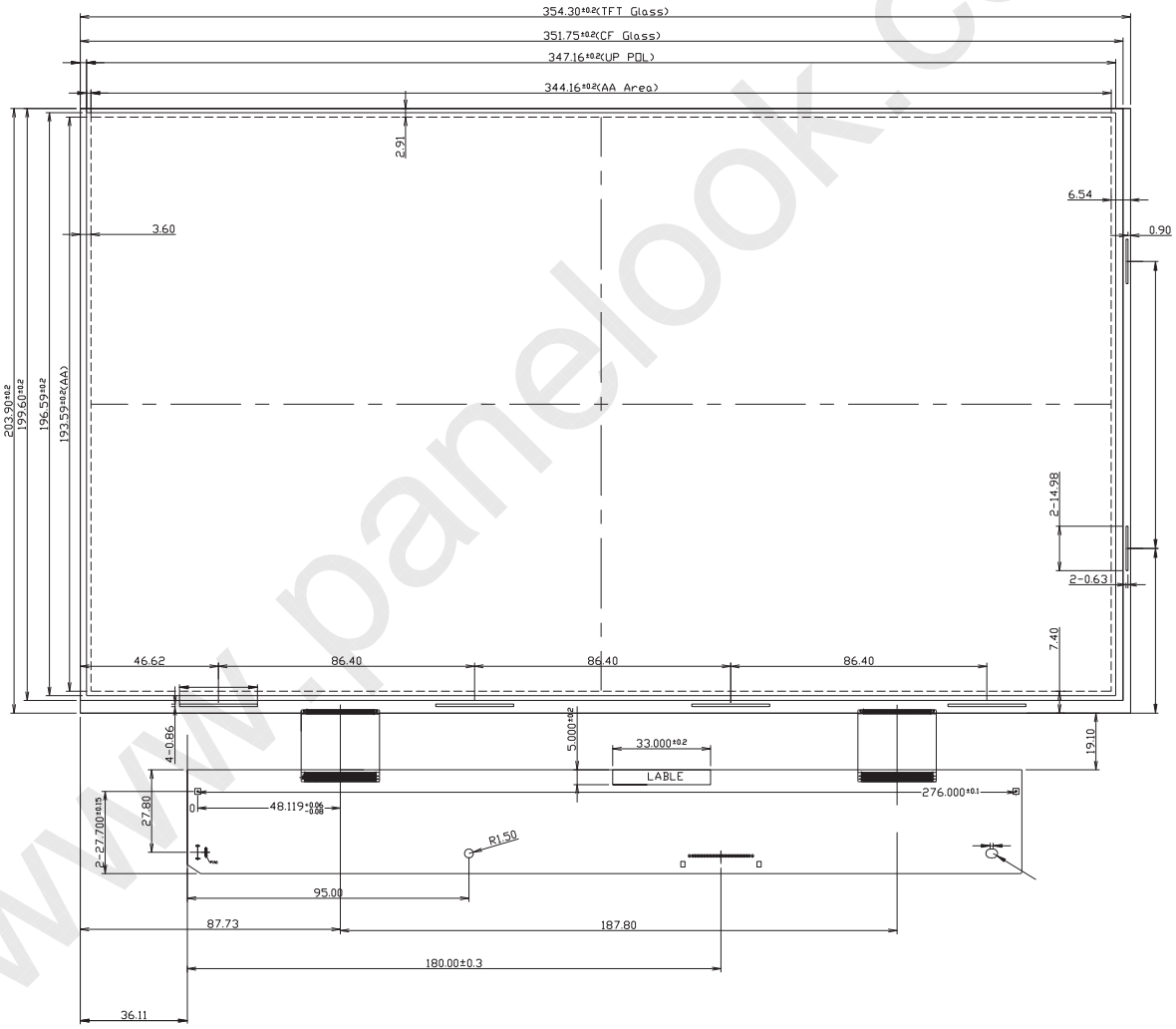
8.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.
- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.
- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.
- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

9.0 APPENDIX

Mechanical Drawing

Drawing Attachment: Front



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Mechanical Drawing
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