TITLE ：NE156FHM-NS0

Customer: SEC

Product Specification

Rev. P1

BOE Optoelectronics Technology Co., Ltd

REVISION HISTORY

(√)Preliminary Specification

( )Final Specification

Revision No.	Page	Description of Changes	Date	Prepared
P0	36	Initial Release	2021.03.03	Bao Jiangli
P1	36	Tcon clock&EDID&Label&Colors& Luminance of White&Signal Connecto r change	2021.05.25	Bao Jiangli

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Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

NE156FHM-NS0 is a color active matrix TFT LCD module using Oxide TFT's (Thin Film Transistors) as an active switching devices. This module has a 15.6 inch diagonally measured active area with Full-HD 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(6bits+2FRC) colors and color gamut 45%. The TFT-LCD panel used for this module is a low reflection and higher color type. Therefore, this module is suitable for Notebook PC. The LED driver for back-light driving is built in this model.
All input signals are eDP1.2 interface compatible.

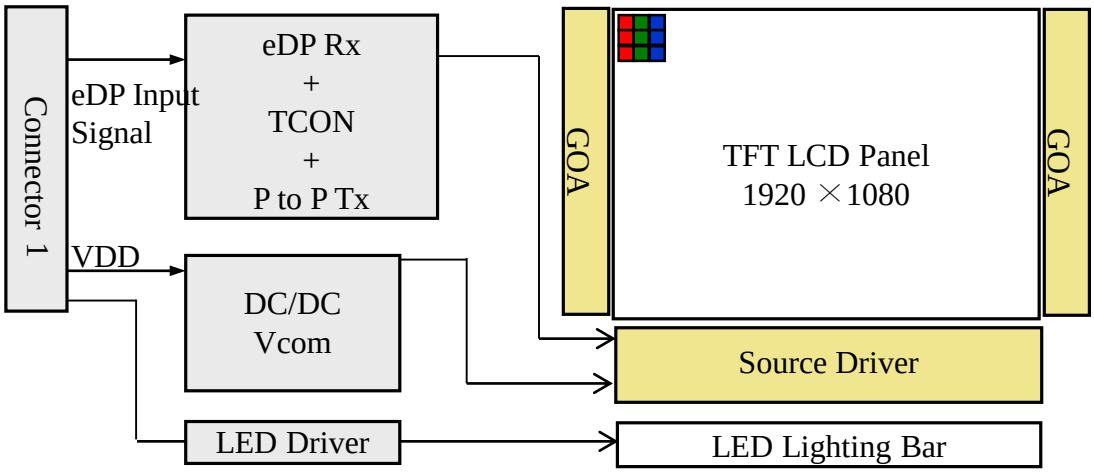


Figure 1. Drive Architecture

1.2 Features

- 2 lane eDP interface with 2.7Gbps link rates
- Thin and light weight
- 16.7M(6bits+2FRC) color depth, color gamut 45%
- Single LED lighting bar (Bottom side/Horizontal Direction)
- Green product (RoHS & Halogen free product)
- On board LED driving circuit
- Low driving voltage and low power consumption
- On board EDID chip

1.3 Application

- Notebook PC (Wide type)

1.4 General Specification

The followings are general specifications at the model NE156FHM-NS0. (listed in Table 1)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	344.16(H) ×193.59(V)	mm	
Number of pixels	1920 (H) ×1080 (V)	pixels	
Pixel pitch	179.25(H) ×179.25(V)	um	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M(6bits+2FRC)		
Color gamut	45%		
Display mode	Normally Black		
Dimensional outline	350.66±0.3(H)*216.15±0.5(V) (W/PCB)*3.0 ±0.2(W/O PCB) 350.66±0.3(H)*216.15±0.5(V) (W/PCB)*3.2 (Max) (W/PCB)	mm	
Weight	370 (max)	g	
Surface treatment	Anti-glare coating		
Surface hardness	3H		
Back-light	Bottom edge side, 1-LED lighting bar type		Note 1
Power consumption	P_D : 0.7	W	@Mosaic
	P_{BL} : 3.45(max)	W	
	P_{Total} : 4.15	W	@Mosaic

Notes : 1. LED Lighting Bar (45*LED Array)

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>

Ta=25+/-2˚C

Parameter	Symbol	Condition	Ratings		Unit	Remark
			Min.	Max.		
+3.3V supply voltage	VDD	Ta=25°C	-0.3	+4.0	V	
Back Light supply voltage	VBL	Ta=25°C	-0.3	+26.5	V	
Input voltage(eDP)	VI	Ta=25°C	-0.3	+1.5	V	Note 1
Input voltage(BL)	VBL_I	Ta=25°C	-0.3	VDD+0.3	V	Note 2
Operation temperature	TOPR	-	0	+50	°C	Note 3
Storage temperature	TSTG	-	-20	+60	°C	

Notes :

1. eDP signal
2.Backlight control signals(BL_ENABLE,BL_PWM_DIM)
3. Humidity: 90%RH Max.（Ta≦+40℃）.Maximum wet-bulb temperature at +39 C or less at Ta>+40 ℃, No condensation.

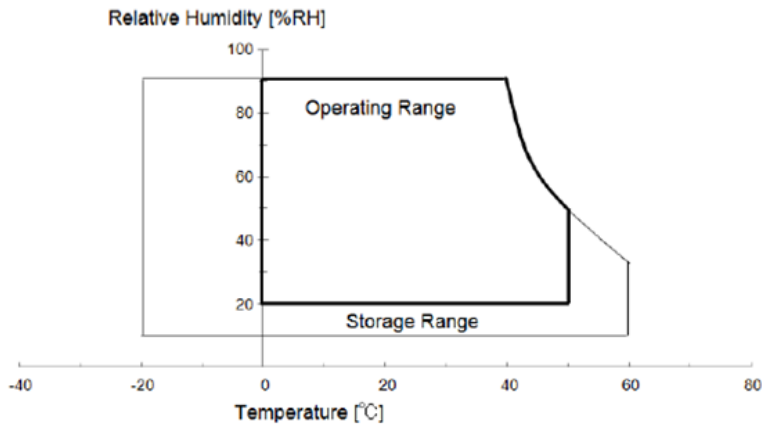


Figure 2. Temperature and Relative Humidity Range

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

< Table 3. Electrical Specifications > Ta=25+/-2°C

Parameter		Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	3.0	3.3	3.6	V	Note 1
Permissible input ripple voltage	VRP	-	-	100	mVp-p	VDD=+3.3V
CABC Control Level	High Level	1.25	-	3.6	V	
	Low Level	0	-	0.3	V	
BIST Control Level	High Level	1.25	-	3.6	V	
	Low Level	0	-	0.3	V	
Current dissipation	IDD	-	240	360	mA	Note 1
Power Supply Inrush Current	Inrush	-	-	2	A	Note3
Power Consumption	PD	-	0.7	0.9	W	Note 1
	PBL	-	-	3.45	W	Note 2
	Ptotal	-	4.15	4.35	W	Note 1

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 ˚C.
   a) Typ : Mosaic pattern 8*8
   b) Max :

(a) (b)

Figure 3. Power Measure Patterns

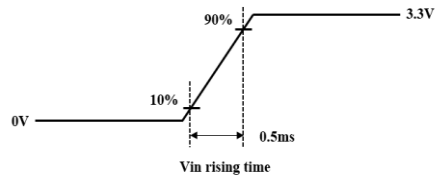


Figure 4. Inrush Measure Condition

2. Calculated value for reference (VLED × ILED)
3. Measure condition (Figure 4)
4. Input voltage range:3.0~3.6V.Test condition: Oscilloscope bandwidth 20MHz, AC coupling

3.2 Backlight Unit

< Table 4. LED Driving Guideline Specifications > Ta=25+/-2°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
Supply voltage	V_{BL}	5.0	12.0	21.0	V	
Current dissipation	I_{BL}	-	285	298	mA	V_{BL} =12.0V Duty Ratio =100%
Modulated light signal voltage	$V_{PWM}H$	1.85	-	VDD	V	
	$V_{PWM}L$	0	-	0.7	V	
Brightness Control Duty Ratio	Duty	1	-	100	%	Note 1
Brightness Control pulse width	T_{PWM}	5	-	-	us	Note 2
Brightness Control frequency	f_{PWM}	200	-	2000	Hz	
LED-BL ON/OFF High voltage	$V_{CNT}H$	1.3	-	VDD	V	Note 3
LED-BL ON/OFF Low voltage	$V_{CNT}L$	0	-	0.5	V	
Input signal (H level) pin current	I_{IN}	-	-	V_{IN}/56KΩ	μA	BL_ENABLE, BL_PWM_DIM
LED lifetime	-	15000	-	-	h	LED
LED Current	I_L	-	22	-	mA	LED

Notes :

1. VPWM Input : 100%= Max luminance 1%= Min luminance
2. The minimum value of the dimming signal pulse width is assumed regulations of the width of h igh and the width of low.
3. VCNT Input : High = BL turn on, Low or OPEN =BL turn off

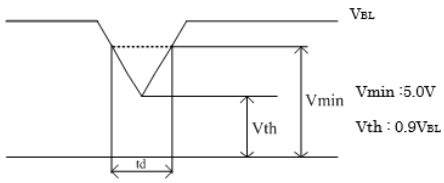


Figure 5. VBL-dip conditions

1) Vth≦VBL ＜Vmin : td ≦20ms
2) VBL ＜Vth : The condition of instantaneous voltage drop is apply to input voltage sequences

3.3 LED Structure

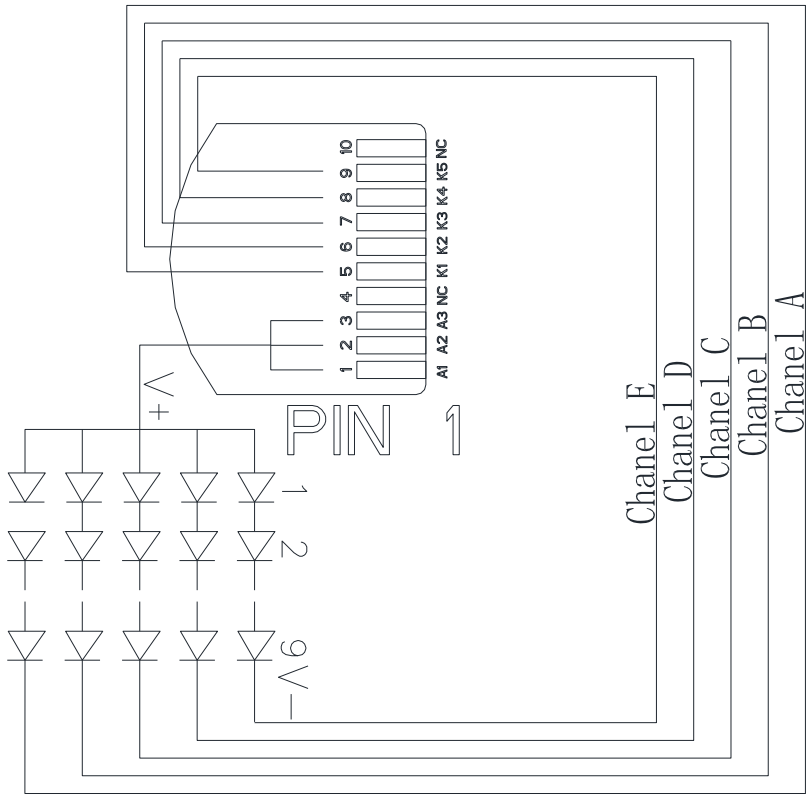


Figure 6. LED Structure

4.0 OPTICAL SPECIFICATION

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 (SR-UL1R) 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 θand/or Ø, the center of the measuring spot on the display surface shall stay fixed. The backlight should be operating for 30 minutes prior to measurement. VDD shall be 3.3+/- 0.3V at 25°C. Optimum viewing angle direction is 6 'clock.

4.2 Optical Specifications

<Table 5. Optical Specifications>

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle Range	Horizontal	Θ_3	CR > 10	80	85	-	Deg.	Note 1
		Θ_9		80	85	-	Deg.	
	Vertical	Θ_{12}		80	85	-	Deg.	
		Θ_6		80	85	-	Deg.	
Luminance Contrast Ratio		CR	Θ = 0°	600	800	1000		Note 2
Luminance of White	Center Points	Y_w	Θ = 0°	240	300	360	cd/m^2	Note 3
White Luminance Uniformity	5 Points	ΔY5		-	-	-		Note 4
	13 Points	ΔY13		70%	-	-		
White balance		CT	Θ = 0°	6300	7000	8000		Note 5
		△uv		-0.0025	0.005	0.015		
White Chromaticity		W_x	Θ = 0°	0.275	0.305	0.335		
		W_y		0.292	0.322	0.352		
Reproduction of Color	Red	R_x	Θ = 0°	-0.03	0.594	+0.03		
		R_y			0.361			
	Green	G_x			0.340			
		G_y			0.548			
	Blue	B_x			0.156			
		B_y			0.106			
Color Gamut				-	45	-	%	
Response Time (Rising + Falling)		T_{RT}	Ta= 25℃ Θ = 0°	-	25	35	ms	Note 6
Cross Talk		CT	Θ = 0°	-	-	2.0	%	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 7).

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 7) 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 luminance values of 5 point average 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 8 for a total of the measurements per display.

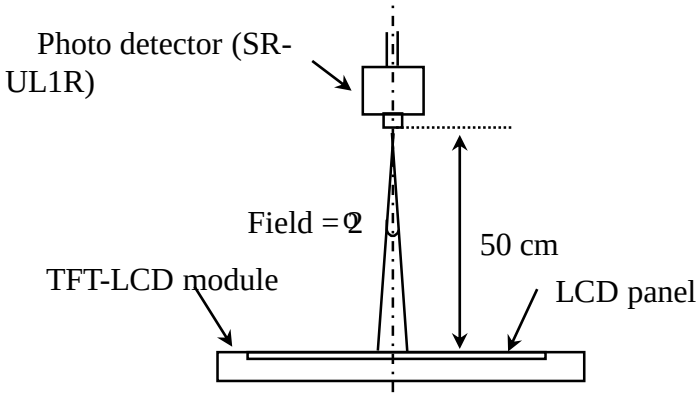
4. The White luminance uniformity on LCD surface is then expressed as : ΔY =Minimum Luminance of 5(or 13) points / Maximum Luminance of 5(or 13) points.(see Figure 8 and Figure 9).

5. The color chromaticity coordinates specified in Table 5 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 10 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 Tf.

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 11).

4.3 Optical Measurements



Optical characteristics measurement setup

Figure 7. Measurement Set Up

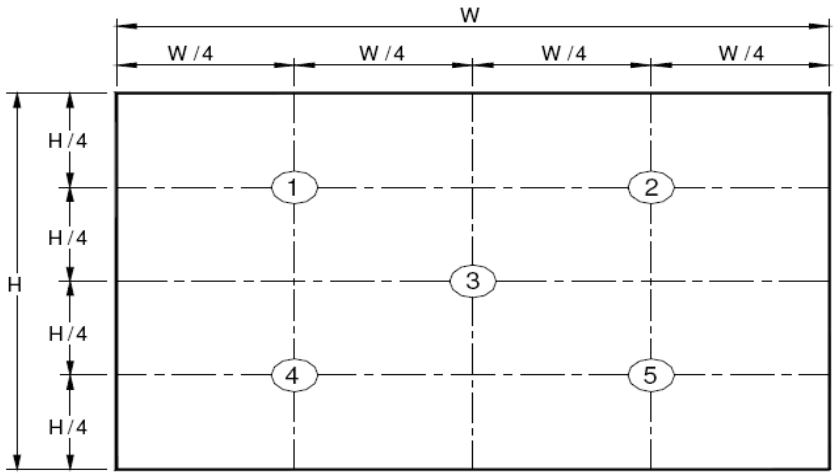


Figure 8. White Luminance and Uniformity Measurement Locations (5 points)

Center Luminance of white is defined as luminance values of center 5 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 8 for a total of the measurements per display.

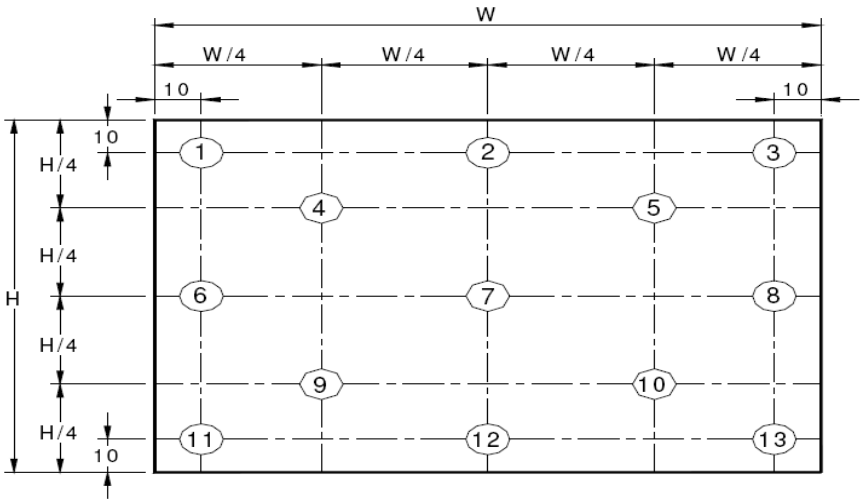


Figure 9. Uniformity Measurement Locations (13 points)

The White luminance uniformity on LCD surface is then expressed as : ΔY5 = Minimum Luminance of five points / Maximum Luminance of five points (see Figure 8) , ΔY13 = Minimum Luminance of 13 points /Maximum Luminance of 13 points (see Figure 9).

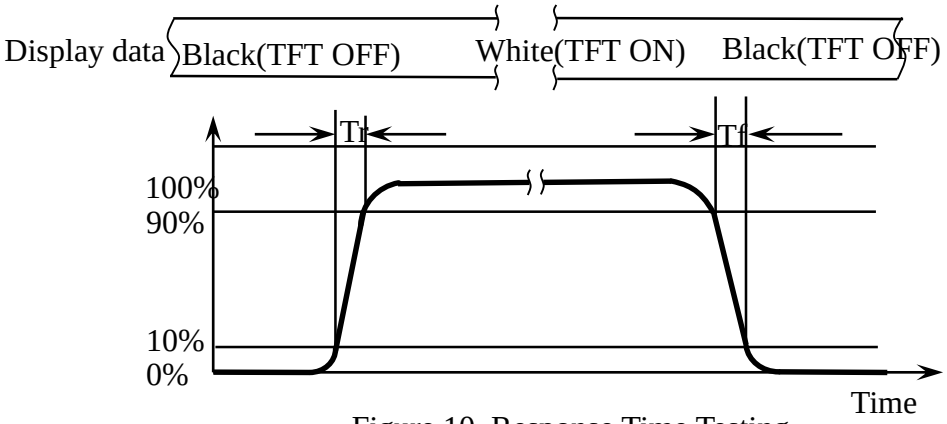
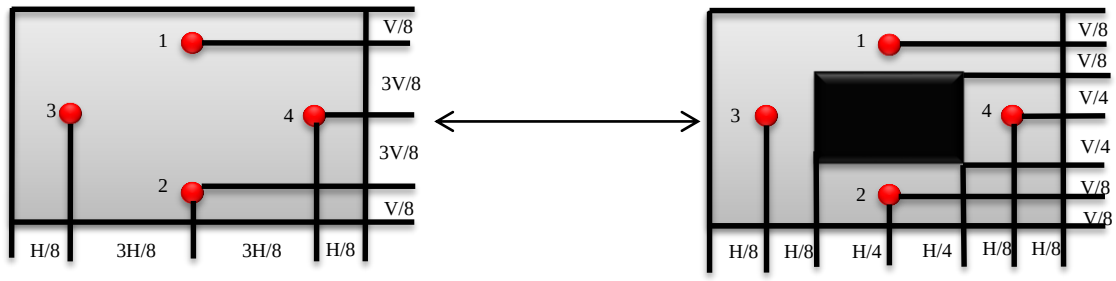


Figure 10. Response Time Testing

The electro-optical response time measurements shall be made as shown in Figure 10 by switching the “data” input signal ON and OFF. Tf: The luminance to change from 90% to 10% ,Tr: The luminance to change from 10% to 90% .

The test system : SR-UL1R



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

Figure 11. Cross Talk Modulation Test Description

Where:

Y_A = Initial luminance of measured area (cd/m^2)

Y_B = Subsequent luminance of measured area (cd/m^2)

The location 1/2/3/4 measured will be exactly the same in both patterns. The test background gray is from L64 to L192.Take the largest data as the result.

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.(Refer to Figure 11)
The test system: PR730

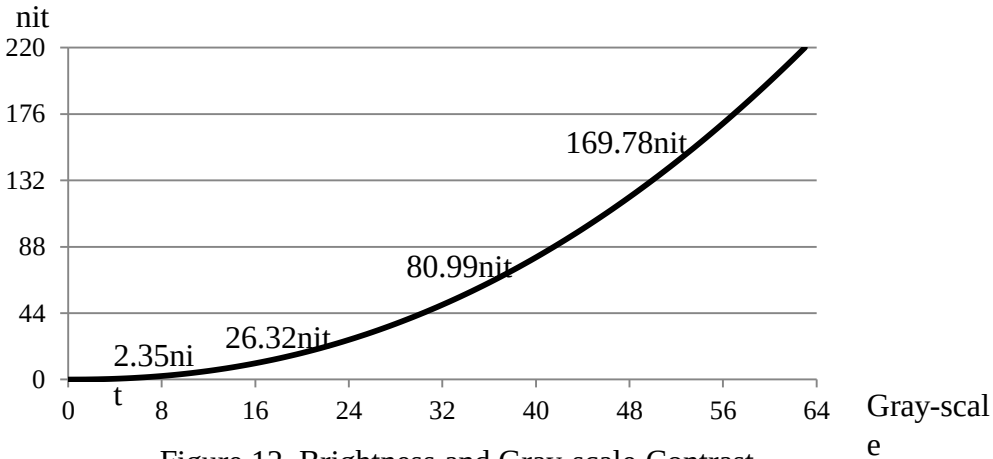


Figure 12. Brightness and Gray-scale Contrast

5.0 INTERFACE CONNECTION

5.1 Electrical Interface Connection

The connector interface pin assignments are listed in Table 6.

<Table 6. Pin Assignments for the Interface Connector>

Pin No.	Symbol	Description
1	DBC	Reserved for DBC control,DBC from 2.5V to 3.3V,and disable on Grounding.
2	H_GND	High Speed Ground
3	Lane1_N	Complement Signal Link Lane 1
4	Lane1_P	True Signal Link Lane 1
5	H_GND	High Speed Ground
6	Lane0_N	Complement Signal Link Lane 0
7	Lane0_P	True Signal Link Lane 0
8	H_GND	High Speed Ground
9	AUX_CH_P	True Signal Auxiliary Channel
10	AUX_CH_N	Complement Signal Auxiliary Channel
11	H_GND	High Speed Ground
12	LCD_VCC	LCD logic and driver power(3.3V)
13	LCD_VCC	LCD logic and driver power(3.3V)
14	BIST	Build in self test function pin
15	LCD_GND	LCD logic and driver ground
16	LCD_GND	LCD logic and driver ground
17	HPD	HPD Signal
18	BL_GND	Backlight ground
19	BL_GND	Backlight ground
20	BL_GND	Backlight ground
21	BL_GND	Backlight ground
22	BL_ENABLE	Backlight on/off
23	BL_PWM_DIM	System PWM
24	NC	Reserved for LCD for manufacturer’s use
25	NC	Reserved for LCD for manufacturer’s use
26	BL_PWR	Backlight power(5V~21V)Typ.
27	BL_PWR	Backlight power(5V~21V)Typ.
28	BL_PWR	Backlight power(5V~21V)Typ.
29	BL_PWR	Backlight power(5V~21V)Typ.
30	NC	Reserved for LCD for manufacturer’s use

5.2 eDP Interface

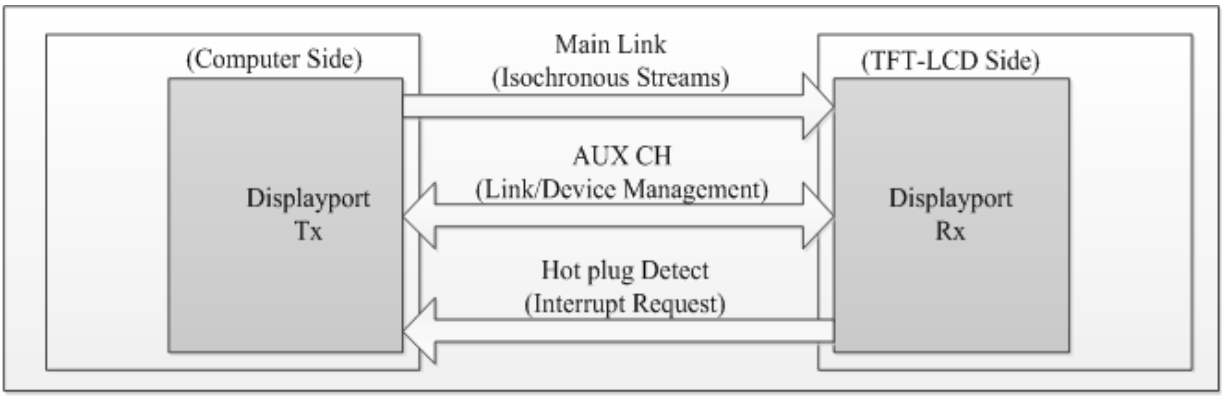


Figure 13. eDP Interface Architecture

Note:
Transmitter is not contained in module.

5.3 Data Input Format

Figure 14. Display Position of Input Data (V-H)

5.4 Back-light & LCM Interface Connection

BLU Interface Connector: I-PEX 20542-010E-01

<Table 7. Pin Assignments for the BLU Connector>

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	Vout	LED anode connection	6	LED	LED cathode connection
2	Vout	LED anode connection	7	LED	LED cathode connection
3	Vout	LED anode connection	8	LED	LED cathode connection
4	NC	No Connection	9	LED	LED cathode connection
5	LED	LED cathode connection	10	NC	No Connection

6.0 SIGNAL TIMING SPECIFICATION

6.1 The NE156FHM-NS0 Is Operated By The DE Only

< Table 8. Signal Timing Specification >

Parameter		Symbol	Min.	Typ.	Max.	Unit
Clock	Frequency	$1/T_C$	-	138.65	-	MHz
Data enable signal	Horizontal period	TH		2080	2400	clock
			-	15.01	-	μs
	Horizontal period (High)	THd	-	1920	-	clock
	Vertical period	TV	-	1111	-	line
			-	16.67	-	ms
	Vertical period (High)	TVd	–	1080	–	line

Note : The above is as optimized setting.

6.2 eDP Rx Interface Timing Parameter

The specification of the eDP Rx interface timing parameter is shown in Table 9.

<Table 9. eDP Main-Link RX TP4 Package Pin Parameters>

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	ssc	0	-	0.5	%	
Differential peak-to-peak input voltage at HBR RX package pins	VRX-DIFFp-p	120	-	1200	mV	
Differential peak-to-peak input voltage at RBR RX package pins	VRX-DIFFp-p	40	-	1200	mV	
Rx input DC common mode voltage	VRX_DC_CM	0	-	2	V	
Differential termination resistance	RRX-DIFF	80	-	120	Ω	
Single-ended termination resistance	RRX-SE	40	-	60	Ω	
Rx short circuit current limit	IRX_SHORT	-	-	50	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	LRX_SKEW_INTRA_PAIR	-	-	60	ps	

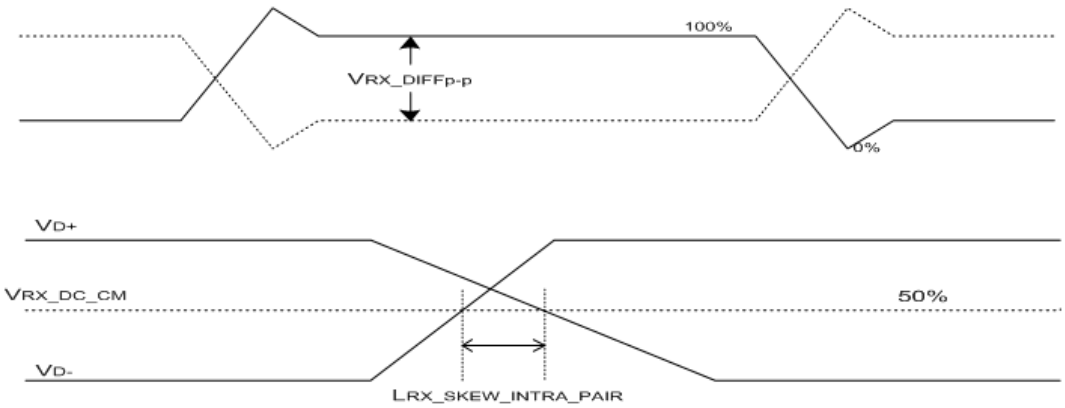


Figure 15. VRX-DIFFp-p & LRX_SKEW_INTRA_PAIR

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

<Table 10. Input Signal & 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

8.0 POWER SEQUENCE

To prevent a latch-up or DC operation of the LCD module, the power on/off sequence shall be a s shown in below.

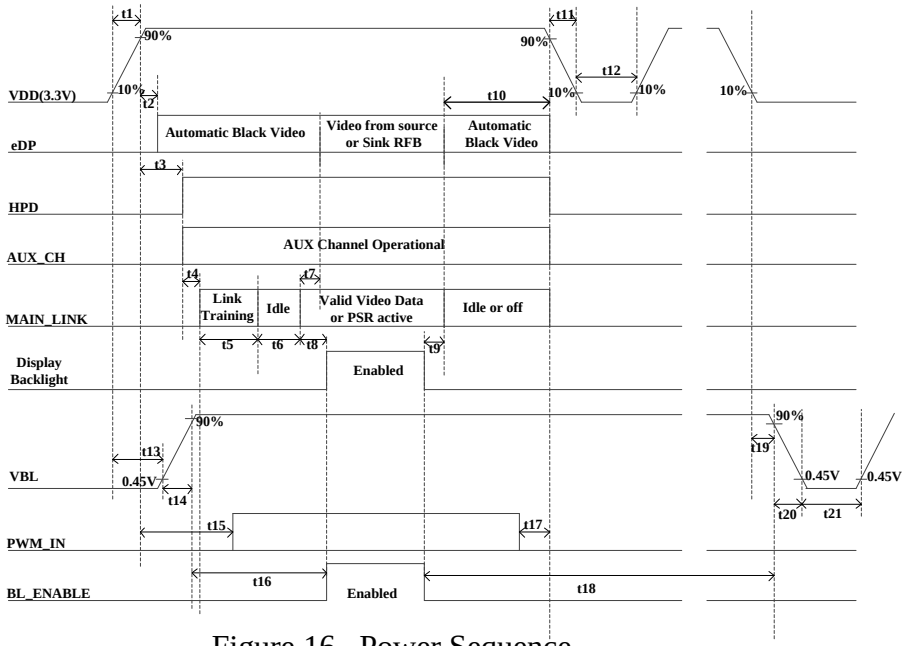


Figure 16. Power Sequence

Symbol	Min	Max	Unit	Symbol	Min	Max	Unit
t1	0.5	10	ms	t12	500	-	ms
t2	0	200	ms	t13	-	-	ms
t3	0	200	ms	t14	0.5	10	ms
t4	-	-	ms	t15	100	-	ms
t5	-	-	ms	t16	0	-	ms
t6	-	-	ms	t17	0	-	ms
t7	0	50	ms	t18	-	-	ms
t8	-	-	ms	t19	-	-	ms
t9	-	-	ms	t20	0.1	-	ms
t10	0	500	ms	t21	100	-	ms
t11	1	50	ms				

Notes:

1. As for the power off sequence for VDD (t11), be sure to keep above mentioned timing.
If the VDD power off sequence timing is other than shown above, LCD may cause permanent da mage.As for the power sequence for backlight, it is recommended to apply above mentioned input timing.If the backlight is light on and off at a timing other than shown above displaying image ma ybe get disturbed.

9.0 Connector Description

Physical interface is described as for the connector on LCM.
These connectors are capable of accommodating the following signals and will be following components.

9.1 TFT LCD Module

< Table 11. Signal Connector >

Connector Name /Description	For Signal Connector
Manufacturer	I-pex or Compatible
Type/ Part Number	I-PEX 20455-030E-01or Compatible
Mating Housing/ Part Number	I-PEX 20453-030E-76 or Compatible

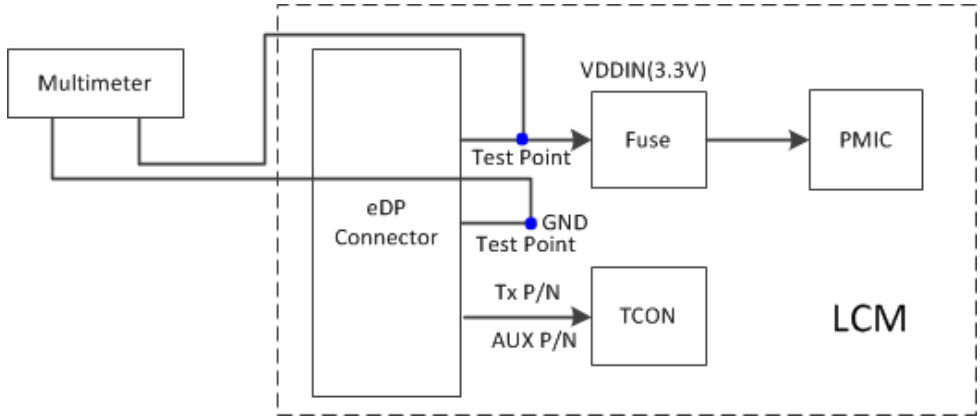
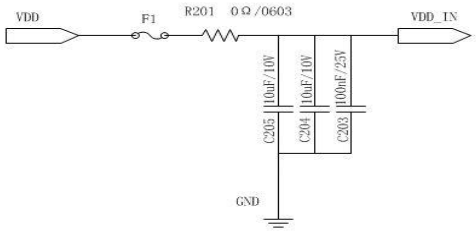


Figure 17. RC Loading test schematic diagr
am



Item	RC Loading	
T1WD3	R	C
	7.75K	36uF

Figure 18. VCC Loop R/C Loading Parameter

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

Figure 23 shows mechanical outlines for the model NE156FHM-NS0
Other parameters are shown in Table 12.

<Table 12. Dimensional Parameters>

Parameter	Specification	Unit
Active Area	344.16 (H) ×193.59 (V)	mm
Number of pixels	1920 (H) X 1080 (V) (1 pixel = R + G + B dots)	pixels
Pixel pitch	179.25 (H) X 179.25 (V)	um
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M(6bits+2FRC)	
Display mode	Normally Black	
Dimensional outline	350.66±0.3(H)*216.15±0.5(V) (W/PCB)*3.0±0.2(W/O PCB) 350.66±0.3(H)*216.15±0.5(V) (W/PCB)*3.2(Max) (W/PCB)	mm
Weight	370(Max)	g

10.2 Mounting

See Figure 23.

10.3 Anti Glare and Polarizer Hardness

The surface of the LCD has an Anti-Glare coating to minimize reflection and 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 50cm 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 13. Reliability Test>

No	Test Items	Conditions
1	High temperature storage test	Ta = 60˚C , 240 hrs
2	Low temperature storage test	Ta = -20˚C , 240 hrs
3	High temperature & high humidity operation test	Ta = 40˚C , 95%RH, 240 hrs
4	High temperature operation test	Ta = 50˚C , 240 hrs
5	Low temperature operation test	Ta = 0˚ C , 240 hrs
6	Vibration test (non-operating)	Frequency:5~50Hz/ Vibration width：1.54mm :22~500Hz/ Acceleration: 12.25m/s2.Sweep time:3minutes Test period:15 minutes for the direction of X 15 minutes for the direction of Y 1 hour for the direction of Z (Total 1.5 hours)
7	Shock test (non- operating)	Max acceleration: 686m/s2,Pulse width:11ms Max acceleration: 2352 m/s2,Pulse width:2ms Half sine wave direction:±X, ±Y, ±Z Once for each direction
8	ESD	150pF[330Ω] Panel center, Around the module: One time for each position <Contact: non-operation>±10KV <Contact: operation>±8KV <Air : non-operation>±20KV <Air : operation>±15KV

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 CLK, ENAB 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 LABEL

(1) Product Label

1. FG-Code
2. Module ID Barcode
3. Module ID

Figure 19. Product Label

Module ID Naming Rule:

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Description	Product Name		Product Grade	Facility Code	Year		Month	Model Extension Code (Last 4 Digits FG Code)				Serial NO.					

<Table 14. Module ID Naming Rule>

(2) Box label
1. FG-CODE(Before 12 bit)
2. Product Quantity(XX pcs/Carton)
3. Box ID
4. Date of Packing
5.Barcode (Box ID)
6.Customer NO.
7.FG-Code After four

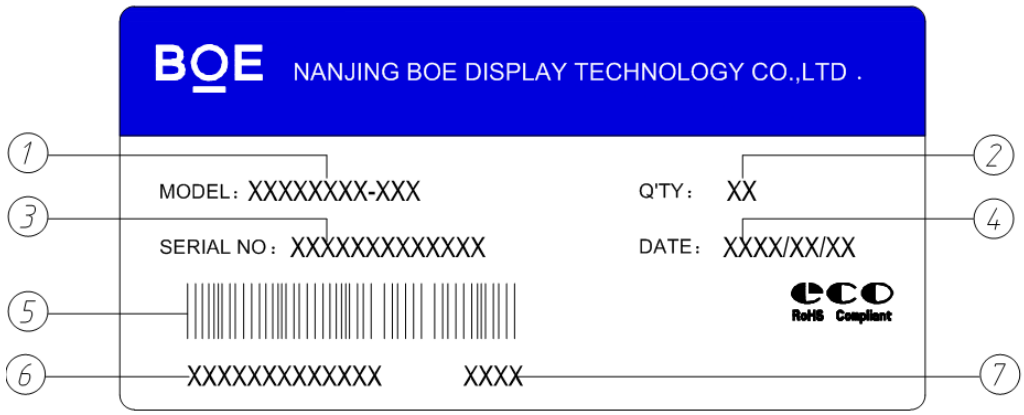


Figure20. Product Label

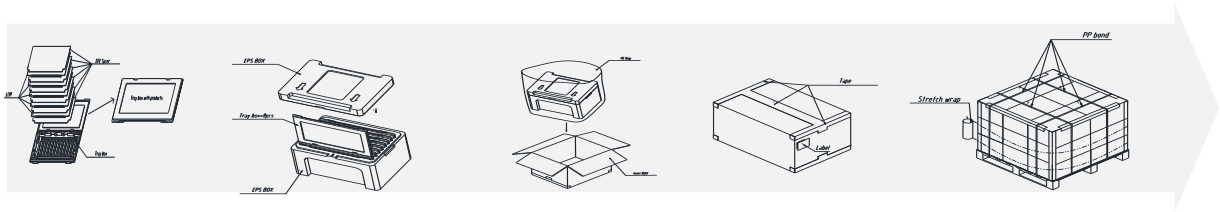
BOX ID Naming Rule:

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	X	X	X	X	X	X	X	X	X	X	X	X	X
Description	Product Name		Product Grade	Facility Code	Year		Month	Revision	Box Serial NO.				

<Table 15. BOX ID Naming Rule>

14.0 PACKING INFORMATION

14.1 Packing Order



1. Put 1pcs EPE Spacer, 1pcs LCM, 1pcs EPE Spacer … , Totally 5pcs LCM and 6 pcs EP E Spacer in one Tray box.
   Capacity:5pcs LCM/Tray box, 6pcs EPE Spacer/Tray Box;
2. Put the tray box in EPS Box. Totally 8 pcs Tray box/EPS Box.
   Capacity:40pcs LCM/EPS box, 8pcs Tray box/EPS box;
3. Put 1pcs EPS box in the PE Bag and put it in the inner box together.
   Capacity: 8pcs Tray box/PE bag, 1pcs PE bag/ Inner box;
4. Use Packing Tape to Seal inner box,Stick the box label onto inner box and align it to th e label mark.

5. Put 18 Inner box on the Pallet , Secure with strapping tape, wrap around film, paper pro tection Angle.

   Capacity:6 Inner box/Layer, 3Layer, 720pcs LCM/Pallet

15.0 MECHANICAL OUTLINE DIMENSION

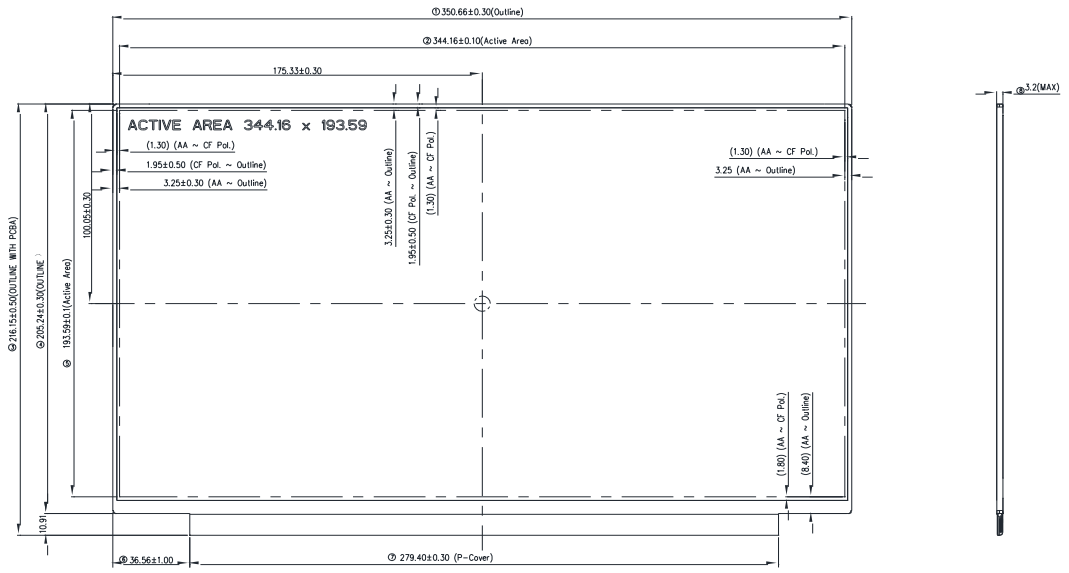


Figure 21. TFT-LCD Module Outline Dimension (Front View)

Note:

1.PCB side is lower than top polarizer and other PCB component is lower than top polarizer

2.Warps and deformation are 0≤d≤0.5mm.

3.Top POL is the highest surface.

4.No light leakage from all 4 corners of LCM.

5.Critical sizes :①-⑭

CPK controlled sizes :①②③⑨⑩

6.Sizes measured by vernier caliper :①③⑨⑩

Sizes measured by 3D :②④⑤⑧⑪⑫⑭

Sizes measured by thickness gauge : ⑬

7. Cell Tape arch height :Y direction ≤0.8mm

Z direction(front) ≤1.8mm

Z direction (behind) ≤1.5mm

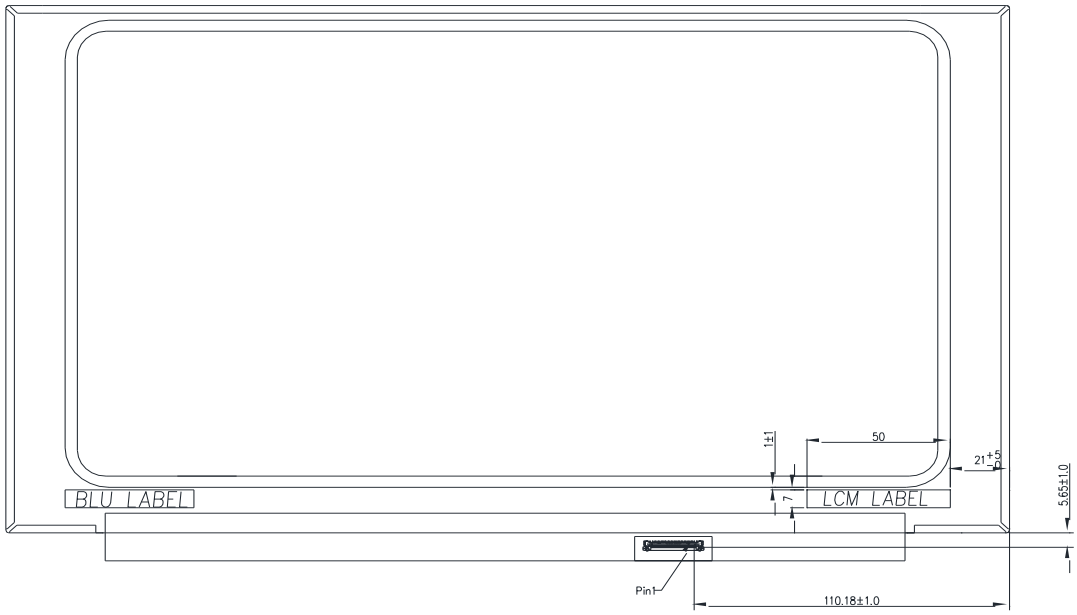


Figure 22. TFT-LCD Module Outline Dimensions (Rear view)

Note:
1.PCB side is lower than top polarizer and other PCB component is lower than top polarizer
2.Warps and deformation are 0≤d≤0.5mm.
3.Top POL is the highest surface.
4.No light leakage from all 4 corners of LCM.
5.Critical sizes :①-⑭
CPK controlled sizes :①②③⑨⑩
6. Sizes measured by vernier caliper :①③⑨⑩
Sizes measured by 3D : ②④⑤⑧⑪⑫⑭
Sizes measured by thickness gauge : ⑬
7. Cell Tape arch height :Y direction ≤0.8mm
Z direction(front) ≤1.8mm
Z direction (behind) ≤1.5mm

16.0 EDID Table

Byte (decimal)	Byte (hex)	Field Name and Comments	Value (hex)	Value (binary)
0	00	Header	00	00000000
1	01	Header	FF	11111111
2	02	Header	FF	11111111
3	03	Header	FF	11111111
4	04	Header	FF	11111111
5	05	Header	FF	11111111
6	06	Header	FF	11111111
7	07	Header	00	00000000
8	08	EISA manufacture code =BOE	09	00001001
9	09	EISA manufacture code (Compressed ASCII)	E5	11100101
10	0A	Product code (NE156FHM-NS0: 2566)	06	00000110
11	0B	Product code (hex,LSB first)	0A	00001010
12	0C	LCD Serial No (fixed “0”)	00	00000000
13	0D	LCD No (fixed “0”)	00	00000000
14	0E	LCD No (fixed “0”)	00	00000000
15	0F	LCD No (fixed “0”)	00	00000000
16	10	Week of manufacture	01	00000001
17	11	Year of manufacture - 1990 (ex 2000 – 1990 = 10) 2021-1990 = 31	1F	00011111
18	12	EDID structure version # = 1	01	00000001
19	13	EDID revision # = 4	04	00000100
20	14	Video i/p definition = Digital 8bit DP support	A5	10100101
21	15	Max H image size(cm) = 34cm	22	00100010
22	16	Max V image size(cm) = 19cm	13	00010011
23	17	Display gamma (2.2×100) – 100 = 120	78	01111000
24	18	Feature support(stanby,suspend,RGB color/Prefer Time)	02	00000010
25	19	Red/Green Low bit(RxRy/GxGy)	21	00100001
26	1A	Blue/White Low bit(BxBy/WxWy)	12	00010010
27	1B	Red X(Rx) (written value 0.594)	98	10011000
28	1C	Red Y(Ry) (written value 0.361)	5C	01011100
29	1D	Green X(Gx) (written value 0.340)	57	01010111
30	1E	Green Y(Gy) (written value 0.548)	8C	10001100
31	1F	Blue X(Bx) (written value 0.156)	28	00101000
32	20	Blue Y(By) (written value 0.106)	1B	00011011
33	21	White X(Wx) (written value 0.305)	4E	01001110
34	22	White Y(Wy) (written value 0.324)	53	01010011
35	23	Established timings 1	00	00000000
36	24	Established timings 2	00	00000000
37	25	Established timings 3(Manufacture’s reserved timing)	00	00000000
38	26	Standard timing ID1	01	00000001
39	27	Standard timing ID1	01	00000001
40	28	Standard timing ID2	01	00000001

41	29	Standard timing ID2	01	00000001
42	2A	Standard timing ID3	01	00000001
43	2B	Standard timing ID3	01	00000001
44	2C	Standard timing ID4	01	00000001
45	2D	Standard timing ID4	01	00000001
46	2E	Standard timing ID5	01	00000001
47	2F	Standard timing ID5	01	00000001
48	30	Standard timing ID6	01	00000001
49	31	Standard timing ID6	01	00000001
50	32	Standard timing ID7	01	00000001
51	33	Standard timing ID7	01	00000001
52	34	Standard timing ID8	01	00000001
53	35	Standard timing ID8	01	00000001
54	36	Detailed timing descriptor#1 fck/10000 (=142.65MHz/10000=14265=37B9h)	B9	10111001
55	37	#1 fck	37	00110111
56	38	#1 Horizontal active 1920=780h 80h	80	10000000
57	39	#1 Horizontal blanking 160=0A0h A0h	A0	10100000
58	3A	#1 Horizontal active/Horizontal blanking 70h	70	01110000
59	3B	#1 Vertical active 1080=438h 38h	38	00111000
60	3C	#1 Vertical blanking 31=01Fh 1Fh	1F	00011111
61	3D	#1 Vertical active/Vertical blanking 40h	40	01000000
62	3E	#1 Horizontal sync , offset(Thfp)48=030h 30h	30	00110000
63	3F	#1 Horizontal sync , width 32=020h 20h	20	00100000
64	40	#1 Vertical sync,offset / Vertical sync,width (offset=3h/width=5h)	35	00110101
65	41	#1 Horizontal sync offset/width/Vertical sync offset/width	00	00000000
66	42	#1 Horizontal image size 344.16mm=158h 58h	58	01011000
67	43	#1 Vertical image size 193.59mm=0C2h C2h	C2	11000010
68	44	#1 Horizontal image size / Vertical image size 10h	10	00010000
69	45	Horizontal boarder	00	00000000
70	46	Vertical boarder	00	00000000
71	47	Flags(Non-interlaced=0/non 3D=00/Digital separate=11/Vsync polarity/Hsycpolarity=01/Reserved For Stereo Mode=0)	1A	00011010
72	48	#2 Main Clock=0MHz	00	00000000
73	49	#2 Hor Active =0	00	00000000
74	4A	#2Hor Blanking =0	00	00000000
75	4B	#2 Horizontal blanking =0	00	00000000
76	4C	#2 Horizontal active/Horizontal blanking 00h	00	00000000
77	4D	#2 Vertical active =0	00	00000000
78	4E	#2 Vertical blanking=0	00	00000000
79	4F	#2 Vertical active/Vertical blanking 00h	00	00000000
80	50	#2 Horizontal sync , offset(Thfp) =0	00	00000000
81	51	#2 Horizontal sync , width=0	00	00000000
82	52	#2 Vertical sync, offset / Vertical sync, width =0	00	00000000
83	53	#2 Horizontal sync offset/width/Vertical sync offset/width	00	00000000
84	54	#2 Horizontal image size =0	00	00000000

85	55	#2 Vertical image size =0	00	00000000
86	56	#2 Horizontal image size / Vertical image size 00h	00	00000000
87	57	Horizontal boarder	00	00000000
88	58	Vertical boarder	00	00000000
89	59	Flags(Non-interlaced=0/non 3D=00/Digital separate=11/Vsync polarity/Hsycpolarity=01/Reserved For Stereo Mode=0)	1A	00011010
90	5A	Flag	00	00000000
91	5B	Flag	00	00000000
92	5C	Flag	00	00000000
93	5D	Data Type Tag: Alphanumeric Date String(ASCII)	FE	11111110
94	5E	Flag	00	00000000
95	5F	Manufacturer Name 1st Character(B)	42	01000010
96	60	Manufacturer Name 2nd Character(O)	4F	01001111
97	61	Manufacturer Name 3rd Character(E)	45	01000101
98	62	Flag	20	00100000
99	63	Manufacturer Name 4th Character(1)	31	00110001
100	64	Manufacturer Name5th Character(8)	38	00111000
101	65	Manufacturer Name 6th Character()	0A	00001010
102	66	Manufacturer Name 6th Character()	20	00100000
103	67	Manufacturer Name 6th Character()	20	00100000
104	68	Flag	20	00100000
105	69	Flag	20	00100000
106	6A	Flag	20	00100000
107	6B	Flag	20	00100000
108	6C	Flag	00	00000000
109	6D	Flag	00	00000000
110	6E	Flag	00	00000000
111	6F	Data Type Tag: Manufacturer Specified Data 00	FE	11111110
112	70	Flag	00	00000000
113	71	Manufacturer PN 1st Character(N)	4E	01001110
114	72	Manufacturer PN 2nd Character(E)	45	01000101
115	73	Manufacturer PN 3rd Character(1)	31	00110001
116	74	Manufacturer PN 4th Character(5)	35	00110101
117	75	Manufacturer PN 5th Character(6)	36	00110110
118	76	Manufacturer PN 6th Character(F)	46	01000110
119	77	Manufacturer PN 7th Character(H)	48	01001000
120	78	Manufacturer PN 8th Character(M)	4D	01001101
121	79	Manufacturer PN 9th Character(-)	2D	01001101
122	7A	Manufacturer PN 10th Character(N)	4E	01001110
123	7B	Manufacturer PN 11th Character(S)	53	01010011
124	7C	Manufacturer PN 12th Character(0)	30	00110000
125	7D	Flag	0A	00001010
126	7E	Extension flag	00	00000000
127	7F	Checksum	26	00100110

17.0 GENERAL PRECAUTIONS

17.1 HANDLING

(1) When the module is assembled, It should be attached to the system firmly using every mounting holes. Be careful not to twist or bend the modules.

(2) Refrain from strong mechanical shock or any force to the module. Otherwise, it may cause improper operation or damage to the module.

(3) Note that polarizers are very fragile and could be easily damaged. Do not press or scratch the surface harder than 1 HB pencil lead.

(4) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, Staining and discoloration may occur.

(5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.

(6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage to the polarizer due to chemical reaction.

(7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth .In case of contact with hands, legs or clothes, it must be washed away thoroughly with soap.

(8) Protect the module from static , it may cause damage to the module.

(9) Use fingerstalls with soft gloves to keep display clean during the incoming inspection and assembly process.

(10) Do not disassemble the module.

(11) Do not pull or fold the LED FPC.

(l2) Do not touch any component which is located on the back side.

(13) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.

(14) Pins of connector shall not be touched directly with bare hands.

17.2 STORAGE

(1) Do not leave the module in high temperature, and high humidity for a long time. It is highly recommended to store the module with temperature from 0 to 35℃ and relative humidity of less than 70%.

(2) Do not store the TFT-LCD module in direct sunlight.

(3) The module shall be stored in a dark place. It is prohibited to apply sunlight or fluorescent light during the store.

17.3 OPERATION

(1) Do not connect, disconnect the module in the " Power On" condition.

(2) Power supply should always be turned on/off by following item 8.0 " Power on/off sequence ".

(3) 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 interference.

(4) The standard limited warranty is only applicable when the module is used for general notebook applications. If used for purposes other than as specified, BOE is not to be held reliable for the defective operations. It is strongly recommended to contact BOE to find out fitness for a particular purpose.

17.4 OTHERS

(1) Avoid condensation of water. It may result in improper operation or disconnection of electrode.

(2) Do not exceed the absolute maximum rating value. (the supply voltage variation, input voltage variation, Variation in part contents and environmental temperature, so on) Otherwise the module may be damaged.

(3) If the module displays the same pattern continuously for a long period of time, it can be the situation when The " image sticks" to the screen.

(4) This module has its circuitry PCB's on the rear or bottom side and should be handled carefully to avoid being stressed.