TITLE : NV156FHM-T05

Product Specification

Rev. 0

(DELL DPN : 0HN21W)

BOE Technology Group Co., Ltd

REVISION HISTORY

(√)preliminary specification
( )Final specification

Revision No.	Page	Description of changes	Date	Prepared
P0	-	Initial Release	2018.08.13	Liu Xinghong
P1	35~38	Update EDID	2018.11.08	Liu Xinghong
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Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

NV156FHM-T05 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 15.6inch 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 262k(6bit) 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.

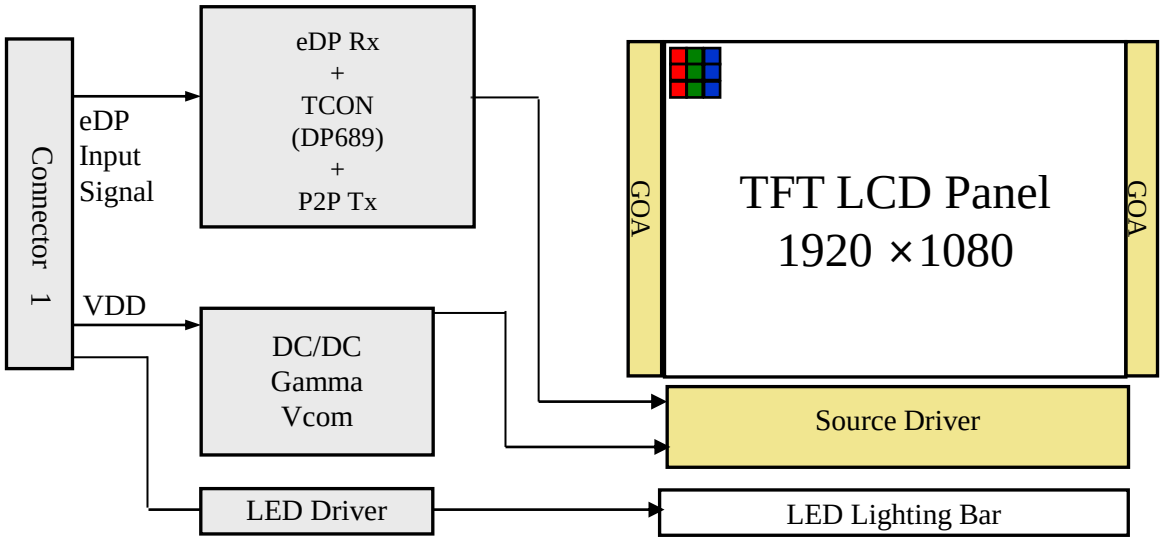


Figure 1. Drive Architecture

1.2 Features

- 2 lane eDP interface with 2.7Gbps link rates
- Thin and light weight
- 262k(6bit) color depth, color gamut 45%
- Single LED lighting bar (Bottom side/Horizontal Direction)
- Data enable signal mode
- Side mounting frame
- 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 NV156FHM-T05. (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) X 179.25 (V)	um	
Pixel arrangement	RGB Vertical stripe		
Display colors	262k(6bit)		
Color gamut	45%		
Display mode	Normally Black		
Dimensional outline	350.66(H typ)*205.69(V typ) (Body)* 5.4(D Max with PCB)	mm	
Weight	380(max)	g	
Surface treatment	AG		
Surface hardness	3H		
Back-light	Bottom edge side, 1-LED Lighting Bar type		Note 1
Power consumption	P_D : 0.9	W	@Mosaic
	P_{BL} : 3.0 max	W	
	P_{Total} : 3.9	W	@Mosaic

Notes : 1. LED Lighting Bar (40*LED Array)

1.5.General Touch Specification

The followings are general specifications for Touch at the model NV156FHM-T05. (listed in Table 2)

<Table 2. General Touch Specifications>

Parameter	Specification	Unit	Remarks
Type of Touch Sensor	Self Capacitance		
Touch Structure	On Cell		
Panel Size	15.6”	inch	
Outline Dimension	N/A(Cover Lens Free)	mm	
TP View Area	N/A(Cover Lens Free)	mm	
TP Active Area	344.18(H)*193.62(V)	mm	
Total Thickness	N/A(Cover Lens Free)	mm	
Interface	IIC		
Report Rate	Follow win8/10 ≥ 100	Hz	
Multi-Touch Point	10 points		
Input method	Finger		
Touch panel sensor IC	G7500		G2 Touch
Channel	1500		
Surface treatment	AG		
Surface Hardness	3	H	
Support OS	Win8.x and Win10 compliant		
TP Power Consumption	0.3max.	W	@ 5 finger

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 3.

< Table 3. Absolute Maximum Ratings>

Ta=25+/-2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.3	4.0	V_{DD}	Note 1
Logic Supply Voltage	V_{IN}	V_{SS}-0.3	V_{DD}+0.3	V_{IN}	
Operating Temperature	T_{OP}	0	+50	°C	Note 2
Storage Temperature	T_{ST}	-20	+60	°C	

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. (40 °C ≥ Ta) Maximum wet-bulb temperature at 39°C or less. (Ta > 40°C)No condensation.

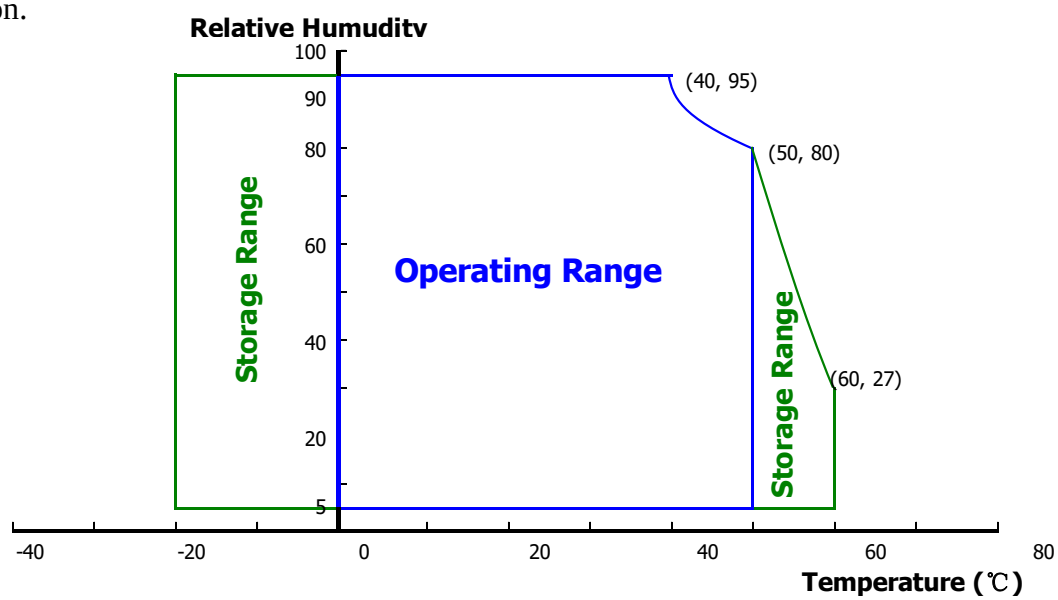


Figure 2. Temperature and Relative Humidity Range

3.0 ELECTRICAL SPECIFICATIONS

3.1 Electrical Specifications

3.1.1 LCM Electrical Specifications

< Table 4. 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	V_{RF}	-10%*V_{DD}	-	10%*V_{DD}	mV	Note4
BIST Control Level	High Level	2	-	3.6	V	
	Low Level	0	-	0.6	V	
CABC enable	High Level	2	-	3.6	V	
	Low Level	0	-	0.6	V	
Power Supply Current	I_{DD}		273	409	mA	Note 1
Power Supply Inrush Current	Inrush	-	-	2	A	Note3
Power Consumption	P_D	-	0.9	1.35	W	Note 1
	P_{BL}	-	-	3.0	W	Note 2
	P_{total}	-	3.9	4.35	W	Note1

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 : R/G/B patterns

(a)

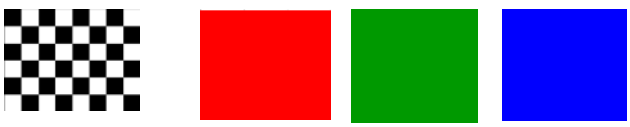


Figure 3. Power Measure Patterns

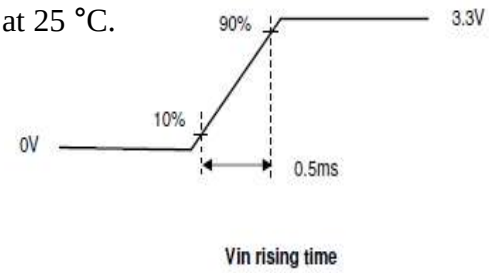


Figure 4. Inrush Measure Condition

2. Calculated value for reference (V_{LED} × I_{LED})
3. Measure condition (Figure 4)
4. Input voltage range: 3.0~3.6V. Test condition :Oscilloscope bandwidth 20MHz，Ac coupling

3.1.2 Touch Electrical Specifications

< Table 5. Electrical specifications >

Parameter			Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage		V_{DD}	4.5	5	5.5	V	Note 1
Permissible Input Ripple Voltage		V_{RF}	-10%*V_{DD}	-	10%*V_{DD}	mV	Note 2
Power Supply Current		I_{DD}	-	-	60	mA	
Power Consumption	Active Mode	P_T	-	-	0.3	W	
	Idle Mode		-	-	0.15	W	
TP_EN	High Level		2.4	-	3.6	V	
	Low Level		0	-	0.6	V	
IIC Signal CLK/DATA	High Level	V_{OH}	2.4	-	3.6	V	
	Low Level	V_{OL}	0	-	0.6	V	

Notes : 1. The ambient temperature is Ta=25±2℃
2. Input voltage range:4.5~5.5V. Test condition: Oscilloscope bandwidth 20MHz, AC coupling

3.2 Backlight Unit

< Table 6. LED Driving Guideline Specifications> Ta=25+/-2°C

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage		V_F	-	-	2.9	V	-
LED Forward Current		I_F	-	20	-	mA	-
LED Power Consumption		P_{LED}	-	-	3.0	W	Note 1
LED Life-Time		N/A	15,000	-	-	Hour	I_F = 20mA Note2
Power supply voltage for LED Driver		V_{LED}	5	12	21	V	
Power supply voltage for LED Driver Inrush		Iled inrush	-	-	2	A	Note4
EN Control Level	Backlight on		2	-	3.6	V	
	Backlight off		0	-	0.6	V	
PWM Control Level	PWM High Level		2	-	3.6	V	
	PWM Low Level		0	-	0.6	V	
PWM Control Frequency		F_{PWM}	200	-	2,000	Hz	
Duty Ratio		-	5	-	100	%	Note 3

Notes :

1. Power supply voltage12V for LED driver.
   Calculator value for reference IF × VF ×40 /driver efficiency = PLED
2. The LED life-time define as the estimated time to 50% degradation of initial luminous.
3. 1% duty cycle is achievable with a dimming frequency less than 1KHz.
4. Measure condition (Figure 5)

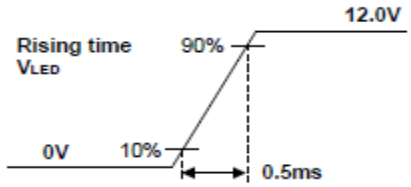


Figure 5. Inrush Measure Condition

3.3 LED structure

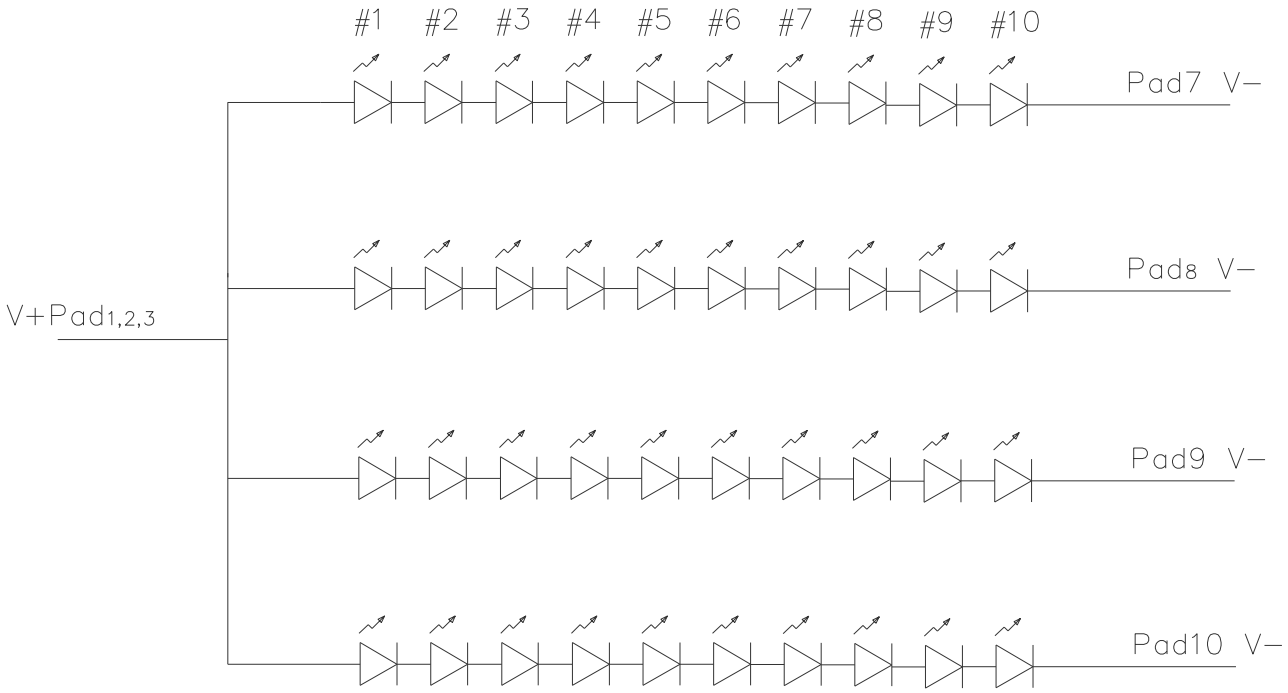


Figure 6. LED structure

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 (PR730&PR810) 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 7. 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	-		Note 2
Luminance of White	5 Points	Y_w	Θ = 0° I_{LED} = 22mA	187	220	-	cd/m^2	Note 3
White Luminance Uniformity	5 Points	ΔY5		80%	-	-		Note 4
	13 Points	ΔY13		65%	-	-		
White Chromaticity		W_x	Θ = 0°	0.283	0.313	0.343		Note 5
		W_y		0.299	0.329	0.359		
Reproduction of Color	Red	R_x	Θ = 0°	Typ-0.03	0.586	Typ+0.03		
		R_y			0.366			
	Green	G_x			0.348			
		G_y			0.574			
	Blue	B_x			0.161			
		B_y			0.121			
Color Gamut				42	45	-	%	
Response Time (Rising + Falling)		T_{RT}	Ta= 25℃ Θ = 0°	-	30	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 $\Theta = 0$ and at the center of the LCD surface. Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state . (see Figure 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.

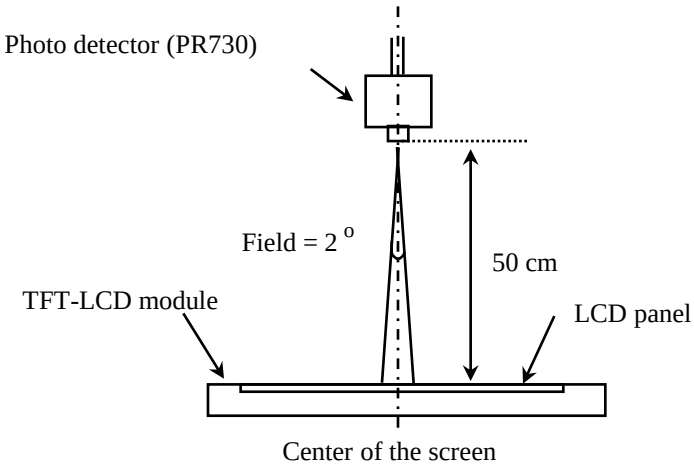
4. The White luminance uniformity on LCD surface is then expressed as : ΔY =Minimum Luminance of 5(or 13) points / Maximum Luminance of 5(or 13) points.(see Figure 8 and Figure 9).

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 T_r, and 90% to 10% is T_f.

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

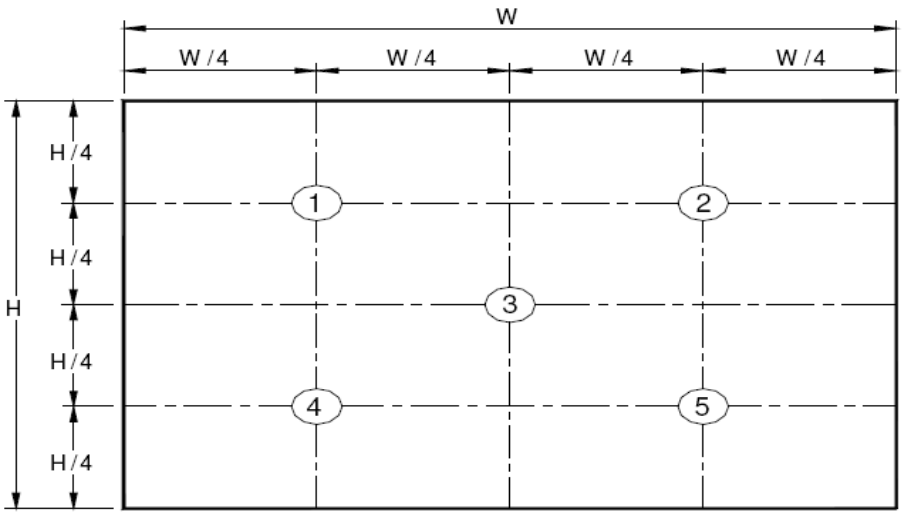


Figure 8. White Luminance and Uniformity Measurement Locations (5 points)

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 7 for a total of the measurements per display.

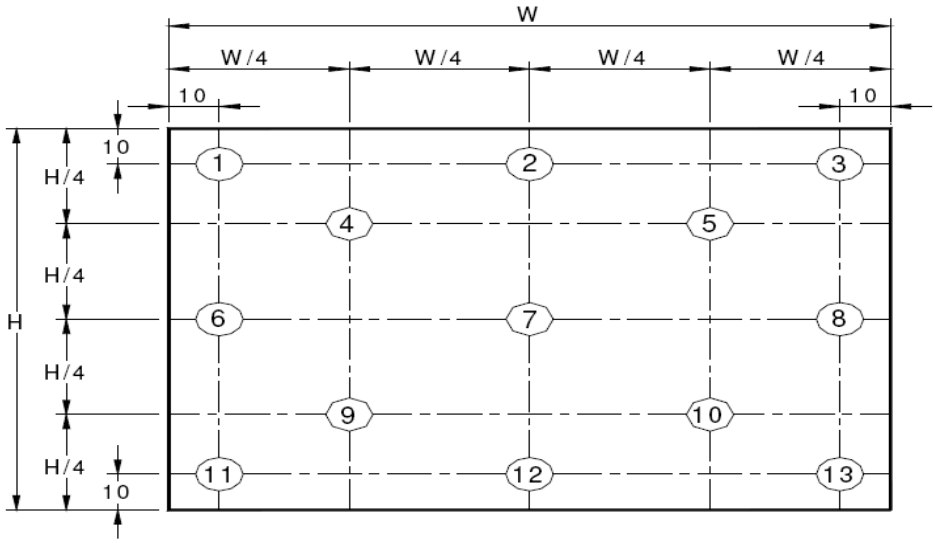


Figure 9. Uniformity Measurement Locations (13 points)

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).

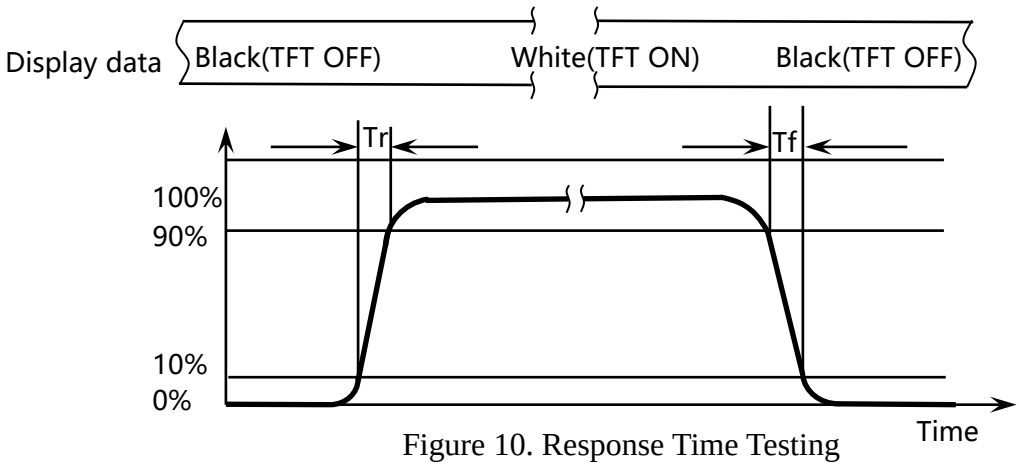
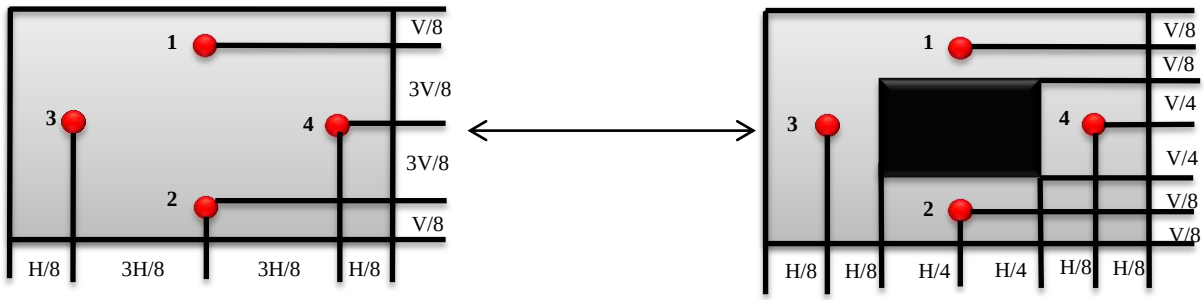


Figure 10. Response Time Testing

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 : PR810



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

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

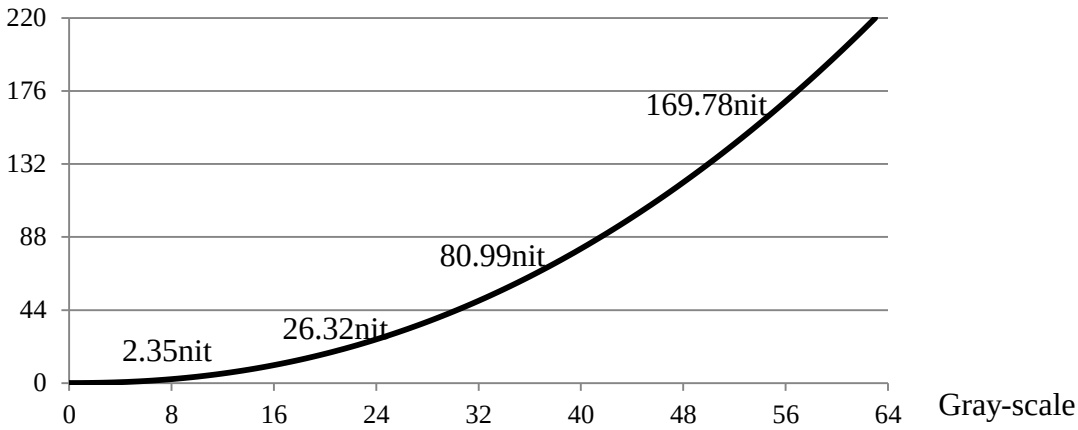


Figure 12. Brightness and Gray-scale Contrast

5.0 INTERFACE CONNECTION.

5.1 Electrical Interface Connection

The electronics interface connector is IPEX 20455-040E or Compatible.
The connector interface pin assignments are listed in Table 8.

<Table 8. Pin Assignments for the Interface Connector>

Pin NO	Symbol Function	Description	Pin NO	Symbol Function	Description
1	DCR Enable Function	DCR Enable Function	21	BL_GND	Backlight ground
2	H_GND	High Speed Ground	22	BL_Enable	Backlight On / Off
3	Lane1_N	Comp Signal Link Lane 1	23	BL_PWM_DIM	System PWM signal Input
4	Lane1_P	True Signal Link Lane 1	24	NC	No connect (Reverse for TEST only)
5	H_GND	High Speed Ground	25	NC	No connect (Reverse for TEST only)
6	Lane0_N	Comp Signal Link Lane 0	26	BL_PWR	Backlight power (5V~21V)
7	Lane0_P	True Signal Link Lane 0	27	BL_PWR	Backlight power (5V~21V)
8	H_GND	High Speed Ground	28	BL_PWR	Backlight power (5V~21V)
9	AUX_CH_P	True Signal Auxiliary Ch.	29	BL_PWR	Backlight power (5V~21V)
10	AUX_CH_N	Comp Signal Auxiliary Ch.	30	NC	No Connect (Reserved for CM)
11	H_GND	High Speed Ground	31	TP_D-	Reserved for USB DATA- For Touch
12	LCD_VCC	LCD logic and driver power	32	TP_D+	Reserved for USB DATA+ For Touch
13	LCD_VCC	LCD logic and driver power	33	GND	Ground Shield
14	LCD_Self_Test or NC	LCD Panel Self Test Enable (Optional)	34	VTSP	Touch panel power supply (5V)
15	LCD_GND	LCD logic and driver ground	35	VTSP	Touch panel power supply (5V)
16	LCD_GND	LCD logic and driver ground	36	TP_EN	Touch Function Enable Pin
17	HPD	HPD signal pin	37	TP_CLK	I2C Clock for Touch
18	BL_GND	Backlight ground	38	TP_Data	I2C Data for Touch
19	BL_GND	Backlight ground	39	INT	Interrupt for Touch
20	BL_GND	Backlight ground	40	RST	Reset for Touch

5.2 eDP Interface

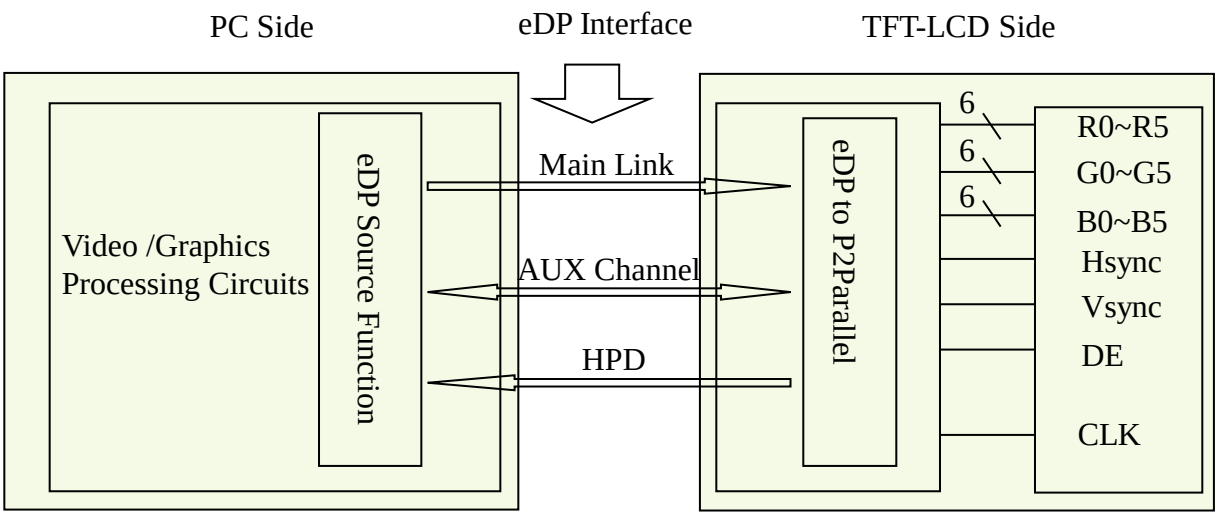


Figure 13. eDP Interface Architecture

Note:
Transmitter : Parade DP501 or equivalent.
Transmitter is not contained in module.

5.3 Data Input Format

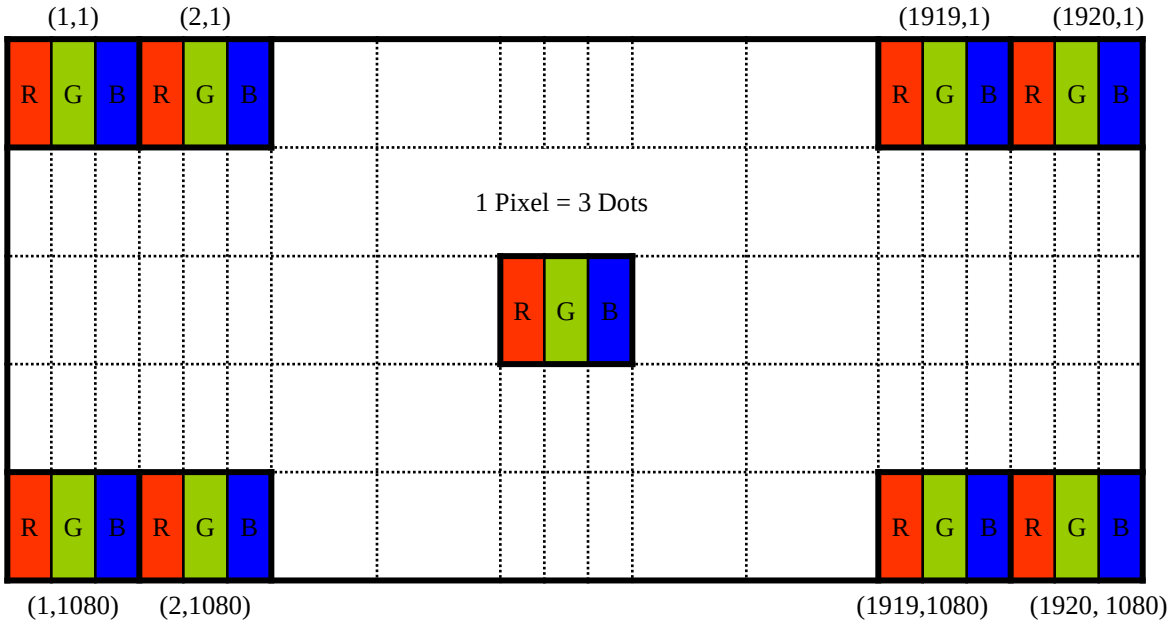


Figure 14.Display Position of Input Data (V-H)

5.4 Back-light & LCM Interface Connection

BLU Interface Connector: STM MSK24022P10 or Compatible.

<Table 9. Pin Assignments for the BLU Connector>

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

6.0 SIGNAL TIMING SPECIFICATION

6.1 The NV15.6FHM-T05 is operated by the DE Only

< Table10. Signal Timing Specification >

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	139.6	143.9	148.2	MHz
Frame Period		Tv	1112	1120	1128	lines
			-	60	-	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2092	2142	2190	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

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 11.

<Table 11. eDP Main-Link RX TP4 Package Pin Parameters>

Item	Symbol	Min	Typ	Max	Unit	Remark
Spread spectrum clock (Link clock down-spreading)	ssc	-	0.5	-	%	
Differential peak-to-peak input voltage at package pins	$V_{RX-DIFF\ p-p}$	100	-	1320	mV	
Rx input DC common mode voltage	$V_{RX\_DC\_CM}$	-	GND	-	V	
Differential termination resistance	$R_{RX-DIFF}$	80	100	120	Ω	
Single-ended termination resistance	R_{RX-SE}	40	-	60	Ω	
Rx short circuit current limit	I_{RX_SHORT}	-	-	20	mA	
Intra-pair skew at Rx package pins (HBR) RX intra-pair skew tolerance at HBR	$L_{RX\_SKEW\_INTRA\_PAIR}$	-	-	150	ps	

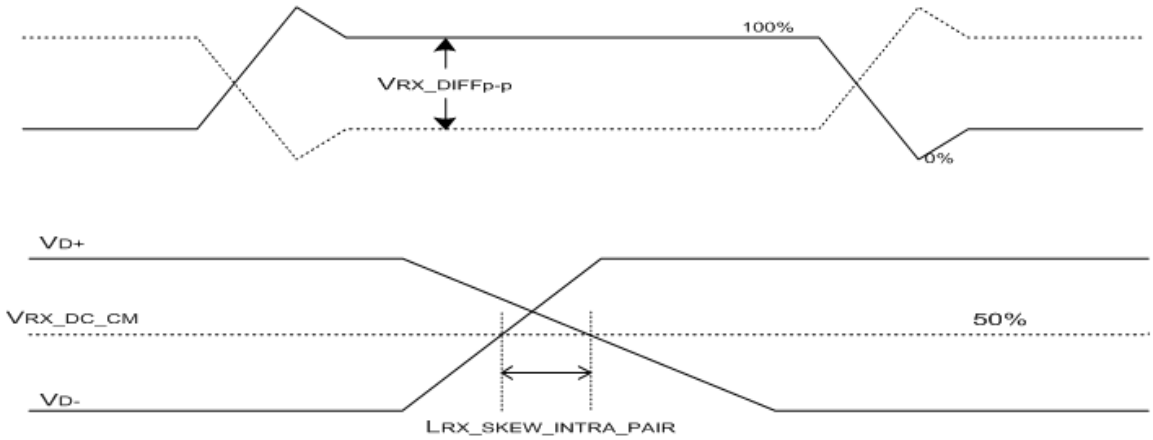


Figure 15. VRX-DIFF p-p & LRX_SKEW_INTRA_PAIR

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

<Table 12. 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 as shown in below.

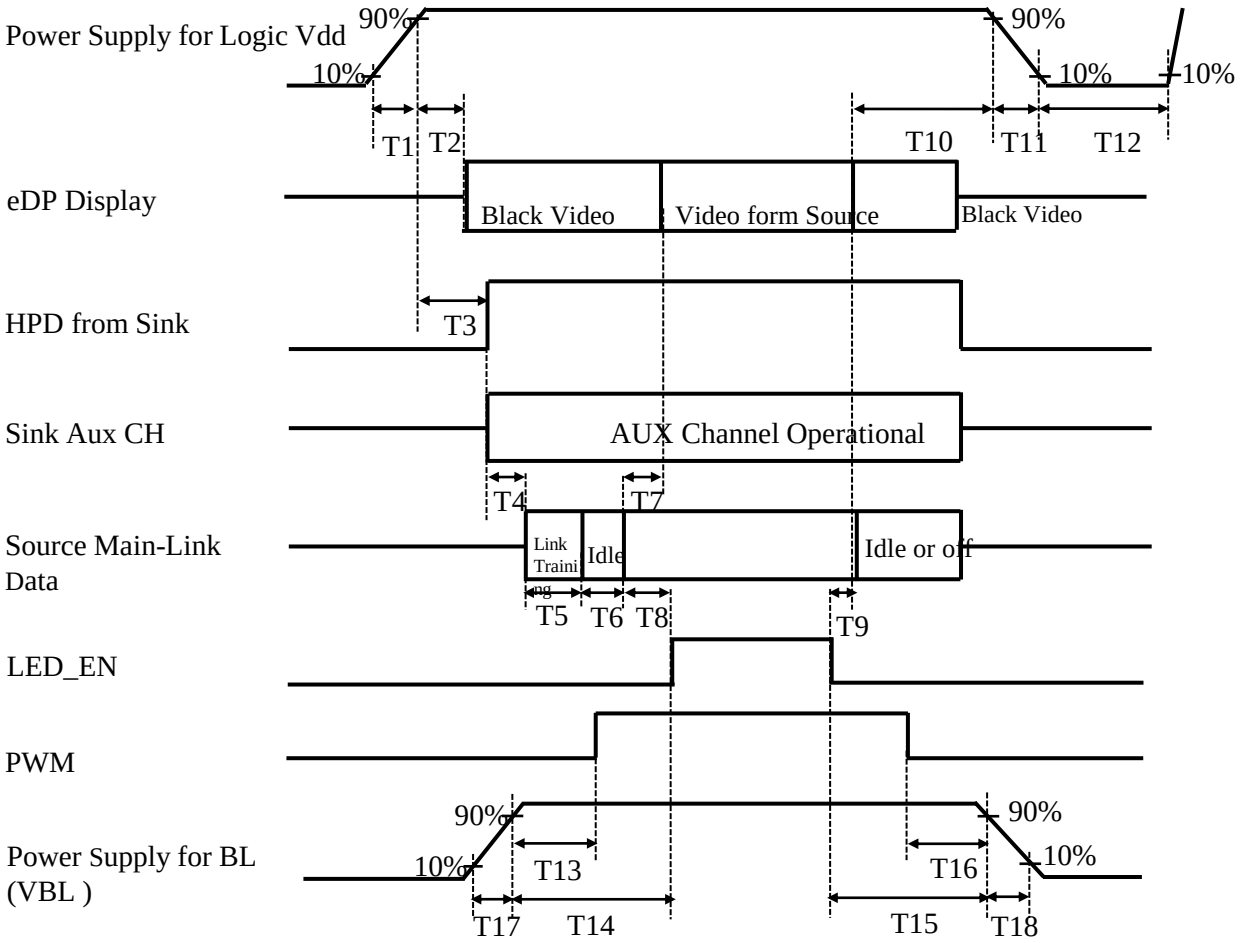


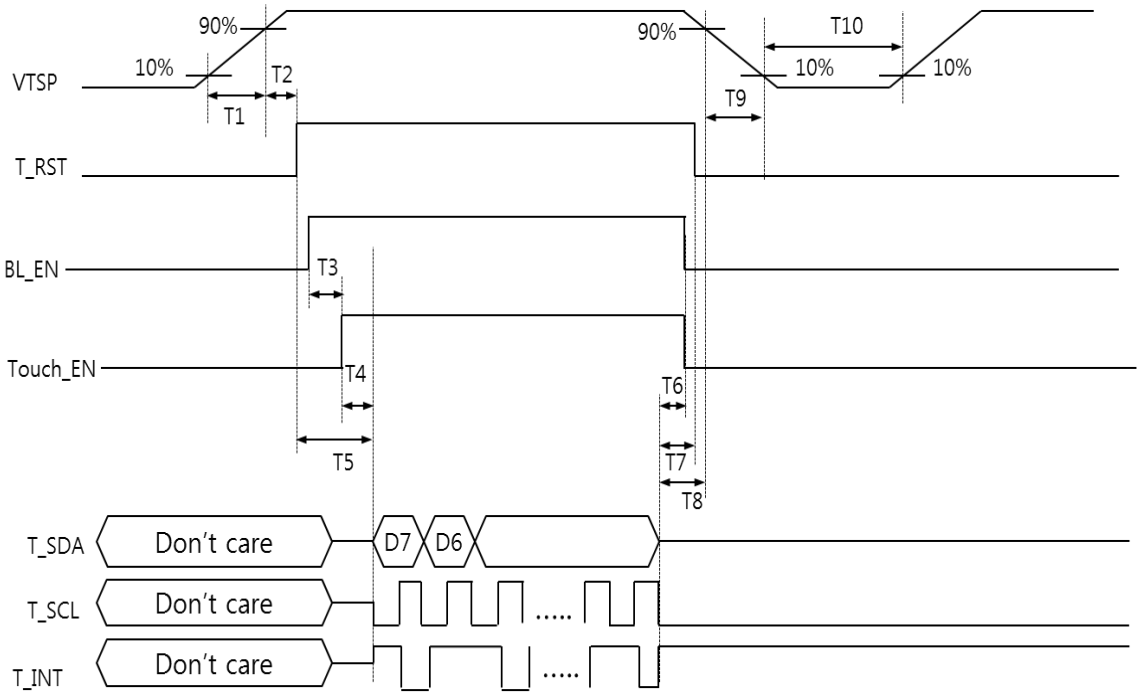
Figure 16. LCM Power Sequence

- 0.5ms ≤ T1 ≤ 10 ms
- 0ms < T2 ≤ 200 ms
- 0ms < T3 ≤ 200 ms
- T3+T4+T5+T6+T8>200ms
- 0ms < T7 ≤ 50ms
- 50ms < T8
- 0ms < T9
- 0ms < T10 < 500 ms
- 0.5ms ≤ T11 ≤ 10 ms
- 500ms ≤ T12
- 0ms < T13
- 0ms < T14
- 0ms < T15
- 0ms < T16
- 0.5ms ≤ T17
- 0.5ms ≤ T18

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. Back Light must be turn on after power for logic and interface signal are valid.

To prevent a latch-up or DC operation of the TLCM module, the power on/off sequence of Touch shall be as shown in below



- 0ms ≤ T1
- 400us ≤ T2
- 0ms ≤ T3 ≤ 50ms
- 325ms ≤ T4
- 425ms ≤ T5
- 0ms ≤ T6
- 5ms ≤ T7/T8
- 50us ≤ T9
- 12us ≤ T10

Figure 17. Touch Power Sequence

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 13. Signal Connector >

Connector Name /Description	For Signal Connector
Manufacturer	IPEX
Type/ Part Number	20455-040E
Mating Housing/ Part Number	20454-30T

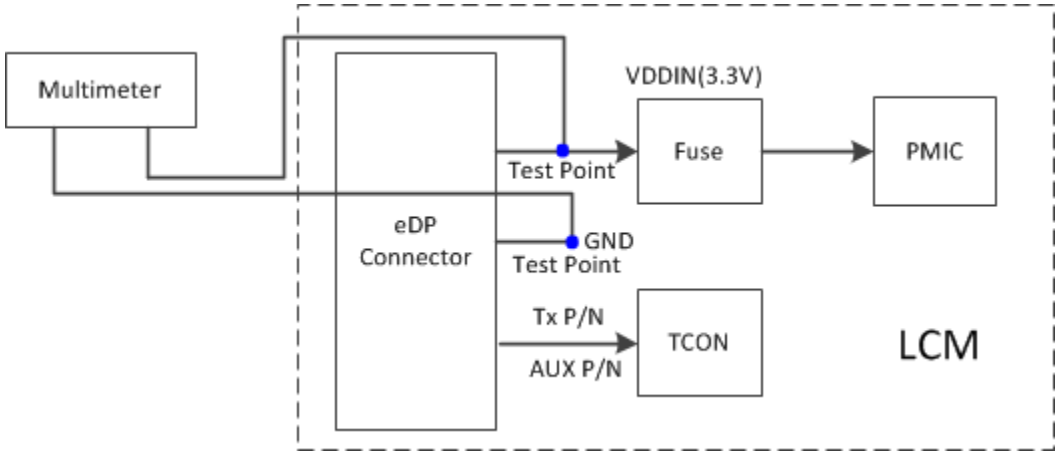
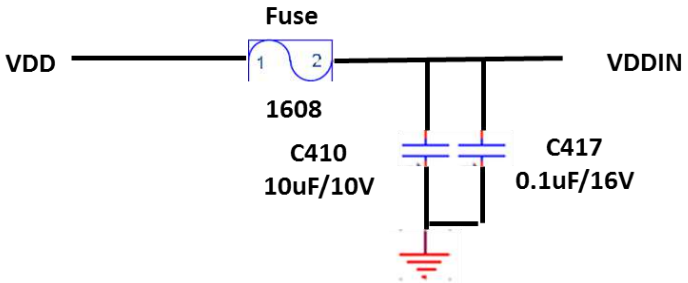


Figure 18. RC Loading test schematic diagram



Item	RC Loading	
0HN21W	R	C
	17.7kΩ	28.9uF

Figure 19. VCC Loop R/C Loading Parameter

10.0 MECHANICAL CHARACTERISTICS

10.1 Dimensional Requirements

Figure 24 shows mechanical outlines for the model NV156FHM-T05.
Other parameters are shown in Table 14.

<Table 14. 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	262K(6bit)	
Display mode	Normally Black	
Dimensional outline	350.66(H typ)*205.69(V typ) (Body)* 5.4(D Max with PCB)	mm
Weight	380(Max)	g

10.2 Mounting

See Figure 24.

10.3 Anti-Glare and Polarizer Hardness.

The surface of the LCD has an Anti-Glare coating to minimize reflection and to reduce scratching.

The polarizer Hardness is 3H.

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 15. Reliability Test>

No	Test Items	Conditions
1	High temperature storage test	Ta = 60℃ , 60%RH, 240 hrs
2	Low temperature storage test	Ta = -20℃ , 240 hrs
3	High temperature & high humidity operation test	Ta = 50℃ , 80%RH, 240 hrs
4	High temperature operation test	Ta = 50℃ , 60%RH, 240 hrs
5	Low temperature operation test	Ta = 0℃ , 240 hrs
6	Thermal shock	Ta = -20 ℃ ↔ 60 ℃ (0.5 hr), 60%±3%RH, 100 cycle
7	Vibration test (non-operating)	Ta = 25℃ , 60%RH, 1.5G, 10~500Hz, Sine X,Y,Z / Sweep rate : 1 hour
8	Shock test (non-operating)	Ta = 25℃ , 60%RH, 220G, Half Sine Wave 2msec ±X, ±Y, ±Z Once for each direction
9	Electro-static discharge test (operating)	Air : 150 pF, 330Ω, 15 KV Contact : 150 pF, 330Ω, 8 KV Ta = 25℃ , 60%RH,

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, ENABLE 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

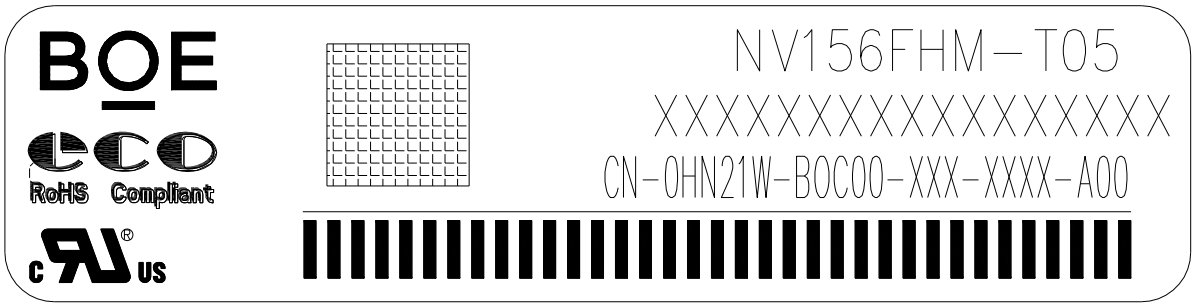


Figure 20. Product Label

Module ID Naming Rule:

<Table 16. Module ID Naming Rule>

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	B	9	A	F	1	7	8	8	D	3	8	0	0	0	0	6	8
Description	Product Name		Product Grade	B8	Year		Month	Model Extension Code (Last 4 Digits of FG CODE)				Serial No. 00001-ZZZZZZ					

(2) High voltage caution label

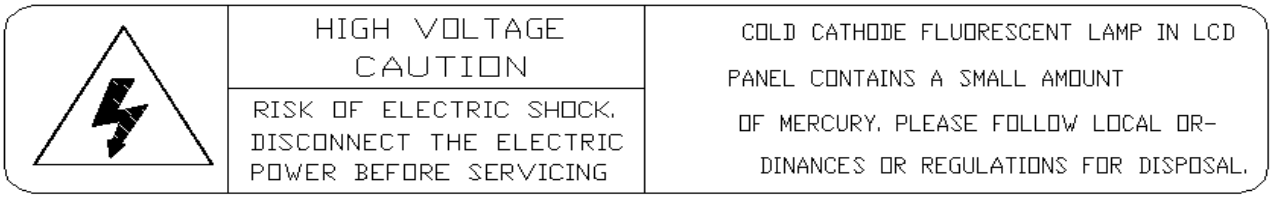


Figure 21. High Voltage Caution Label

(3) Box label

Figure 22. Box Label

Serial number marked part needs to print, show as follows:

1. FG-CODE(Before 12 bit)
2. Product quantity
3. Box ID
4. Date
5. The client section material number(The client)
6. FG-Code After four
7. The supplier code

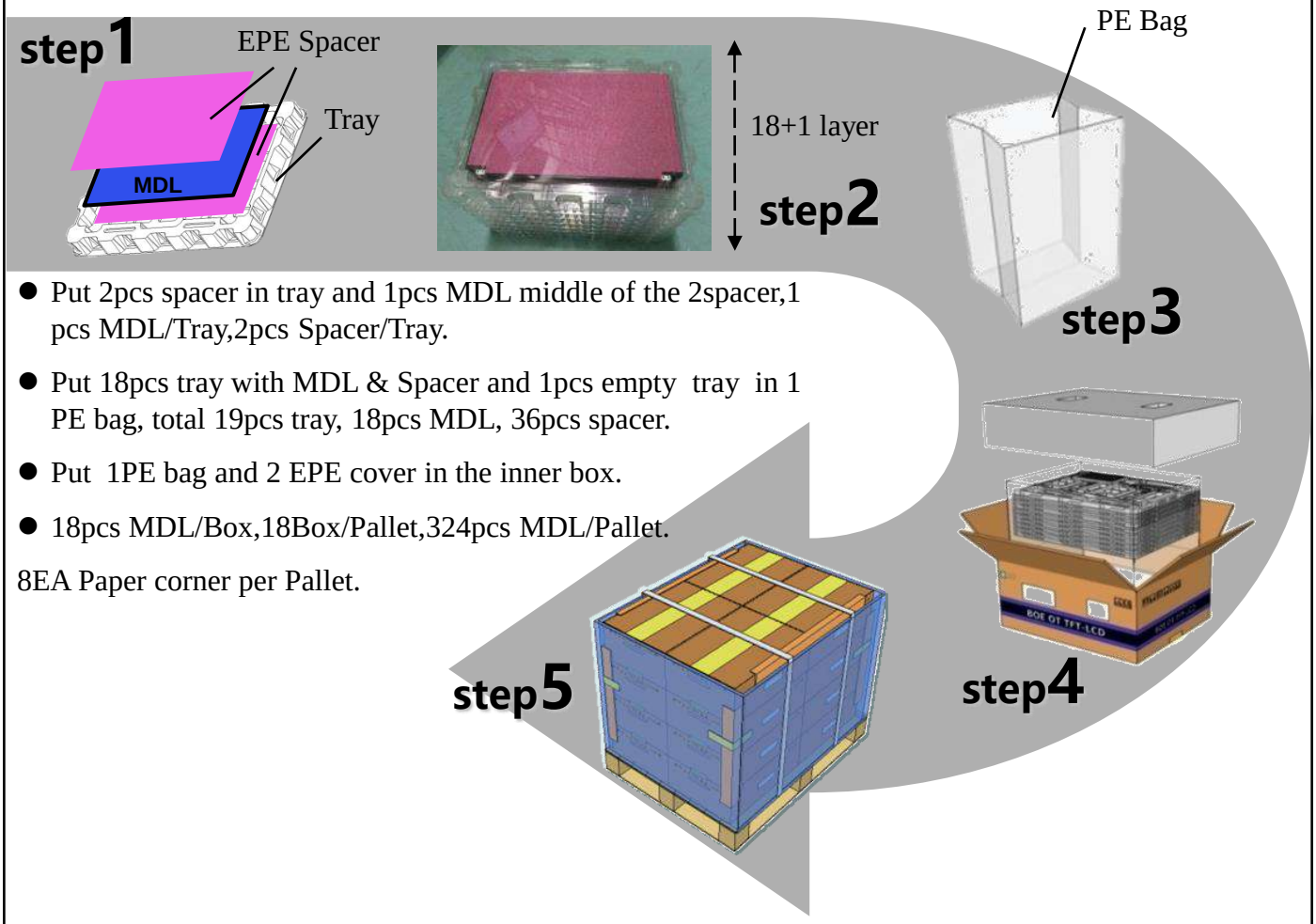
Total Size:100×50mm

<Table 17. Box Label Naming Rule >

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13
Code	B	9	A	F	1	7	8	N	0	0	3	2	7
Description	Product Name		Product Grade	B8	Year		Month	Revision	BOX Serial Number				

14.0 PACKING INFORMATION

14.1 Packing order



- Put 2pcs spacer in tray and 1pcs MDL middle of the 2spacer,1 pcs MDL/Tray,2pcs Spacer/Tray.
- Put 18pcs tray with MDL & Spacer and 1pcs empty tray in 1 PE bag, total 19pcs tray, 18pcs MDL, 36pcs spacer.
- Put 1PE bag and 2 EPE cover in the inner box.
- 18pcs MDL/Box,18Box/Pallet,324pcs MDL/Pallet.

8EA Paper corner per Pallet.

Figure 23. Packing Order

14.2 Note

- Box dimension: 480mm*350mm*285mm
- Package quantity in one box: 18pcs
- Total weight: 12.14kg/Box

15.0 MECHANICAL OUTLINE DIMENSION

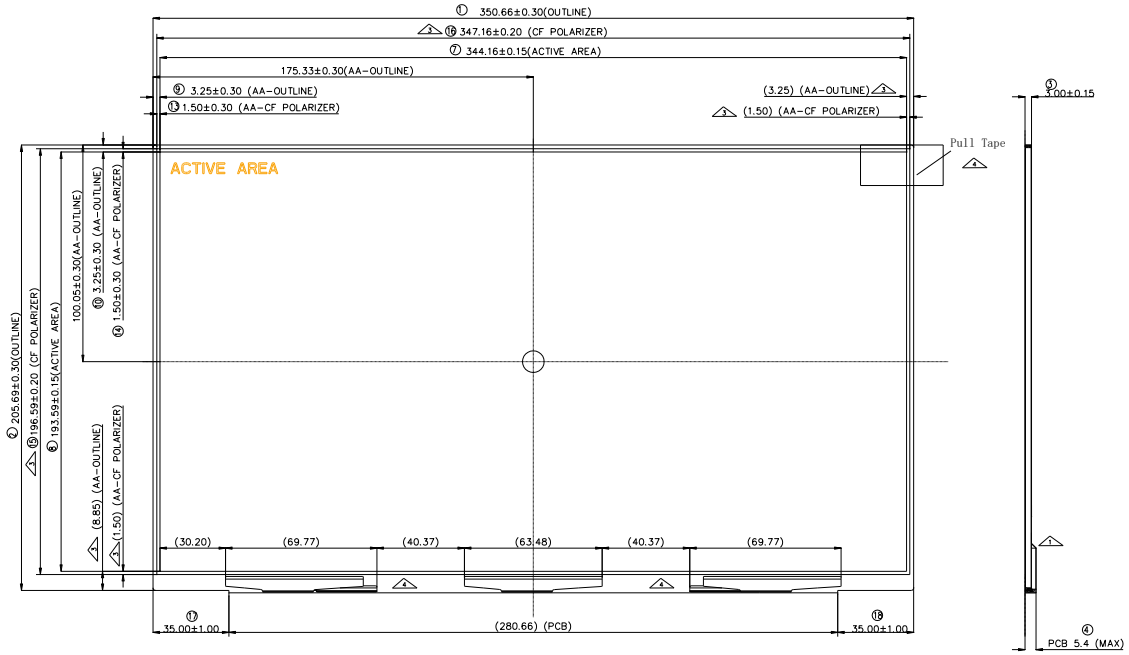


Figure 24. TFT-LCD Module Outline Dimension (Front View)

Notes:

1.Warpage and deformation Spec: 0.5mm Max.(12)

2.Edp connector is measured AT pin 1and mating.

3.Unspecified tolerance refer to grade "2".

4.The module border tolerance test tool is A vernier caliper.

5.Critical dimension:(1) ~(26)

CPK: (1)~ (5)

6.Top Polarizer is the highest part.

7.Please refer to the product specification for dimension method.

8.For hight difference, cell tape has slope on PCB (45° for reference). ③

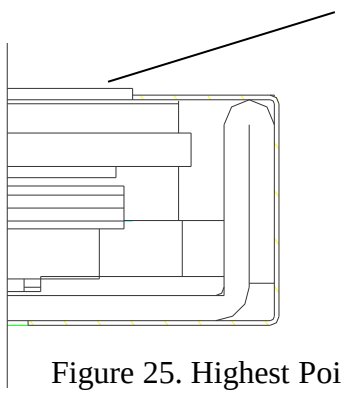


Figure 25. Highest Point Position

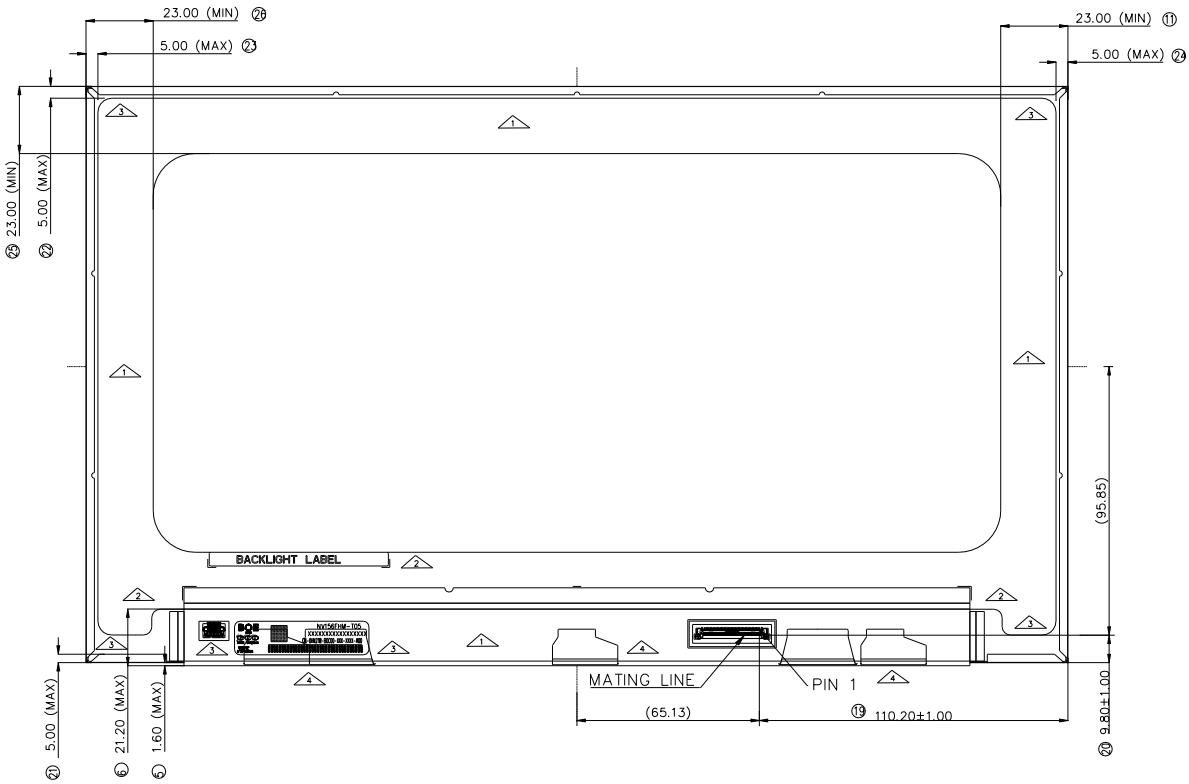


Figure 26. TFT-LCD Module Outline Dimensions (Rear view)

Notes:
1.Warpage and deformation Spec: 0.5mm Max.⑫
2.Edp connector is measured AT pin 1and mating.
3.Unspecified tolerance refer to grade "2".
4.The module border tolerance test tool is A vernier caliper.
5.Critical dimension:①~㉖
CPK: ①~⑤
6.Top Polarizer is the highest part.
7.Please refer to the product specification for dimension method.
8.For hight difference, cell tape has slope on PCB (45° for reference). △1

15.1 THE MEASUREMENT METHODS FOR THE DIMENSIONS OF MODULE

1.Caliper:
- a. Length of outline
- b. Width of outline (without/with PCB)
- c. Thickness of outline (without/ with PCB)

2.Coordinate measuring machine:
- a.CF polarizer size
- b. Active area size
- c. Active area to outline (without tape wrinkle or bulged)
- d. Active area to CF polarizer
- e. The distance of bracket holes
- f. P-Cover to outline (without tape wrinkle or bulged)
- g. Length of p-cover
- h. Connector pin 1 to outline (without tape wrinkle or bulged)

3. Height gauge: the different height of root and top on the bracket
(need to calculate from bracket angle spec.)

4. Feeler gauge: the warpage spec. of module

Notes:

Except the critical dimensions as above, other dimensions are measured by coordinate measuring machine if necessary.

16.0 EDID Table

Address (HEX)	Function	Hex	Dec	crc	Input values.	Notes
00	Header	00	0	-	0	EDID Header
01		FF	255	-	255	
02		FF	255	-	255	
03		FF	255	-	255	
04		FF	255	-	255	
05		FF	255	-	255	
06		FF	255	-	255	
07		00	0	-	0	
08	ID Manufacturer Name	09	9	-	BOE	ID = BOE
09		E5	229	-		
0A	ID Product Code	F2	242	-	2034	ID = 2034
0B		07	7	-		
0C	32-bit serial No.	00	0	-	0	
0D		00	0	-	0	
0E		00	0	-	0	
0F		00	0	-	0	
10	Week of manufacture	01	1	-	1	
11	Year of Manufacture	1C	28	-	2018	Manufactured in 2018
12	EDID Structure Ver.	01	1	-	1	EDID Ver 1.0
13	EDID revision #	04	4	-	4	EDID Rev. 0.4
14	Video input definition	95	149	-	-	Refer to right table
15	Max H image size	22	34	-	34	34 cm (Approx)
16	Max V image size	13	19	-	19	19 cm (Approx)
17	Display Gamma	78	120	-	2.2	Gamma curve = 2.2
18	Feature support	02	2	-	-	Refer to right table
19	Red/Green low bits	23	35	-	-	Red / Green Low Bits
1A	Blue/White low bits	30	48	-	-	Blue / White Low Bits
1B	Red x high bits	96	150	600	0.586	Red (x) = 10010110 (0.586)
1C	Red y high bits	5D	93	374	0.366	Red (y) = 01011101 (0.366)
1D	Green x high bits	59	89	356	0.348	Green (x) = 01011001 (0.348)
1E	Green y high bits	93	147	587	0.574	Green (y) = 10010011 (0.574)
1F	Blue x high bits	29	41	164	0.161	Blue (x) = 00101001 (0.161)
20	BLue y high bits	1F	31	123	0.121	Blue (y) = 00011111 (0.121)
21	White x high bits	50	80	320	0.313	White (x) = 01010000 (0.313)
22	White y high bits	54	84	336	0.329	White (y) = 01010100 (0.329)
23	Established timing 1	00	0	-	-	Refer to right table
24	Established timing 2	00	0	-	-	
25	Established timing 3	00	0	-	-	

26	Standard timing #1	01	1	-	-	Not Used
27		01	1	-	-	
28	Standard timing #2	01	1	-	-	Not Used
29		01	1	-	-	
2A	Standard timing #3	01	1	-	-	Not Used
2B		01	1	-	-	
2C	Standard timing #4	01	1	-	-	Not Used
2D		01	1	-	-	
2E	Standard timing #5	01	1	-	-	Not Used
2F		01	1	-	-	
30	Standard timing #6	01	1	-	-	Not Used
31		01	1	-	-	
32	Standard timing #7	01	1	-	-	Not Used
33		01	1	-	-	
34	Standard timing #8	01	1	-	-	Not Used
35		01	1	-	-	
36	Detailed timing/monitor descriptor #1	3A	58	-	143.9	143.9424MHz Main clock
37		38	56	-		
38		80	128	-	1920	Hor Active = 1920
39		DE	222	-	222	Hor Blanking = 222
3A		70	112	-	-	4 bits of Hor. Active + 4 bits of Hor. Blanking
3B		38	56	-	1080	Ver Active = 1080
3C		28	40	-	40	Ver Blanking = 40
3D		40	64	-	-	4 bits of Ver. Active + 4 bits of Ver. Blanking
3E		30	48	-	48	Hor Sync Offset = 48
3F		20	32	-	32	H Sync Pulse Width = 32
40		36	54	-	3	V sync Offset = 3 line
41		00	0	-	6	V Sync Pulse width : 6 line
42		58	88	-	344	Horizontal Image Size = 344.16 mm (Low 8 bits)
43		C1	193	-	194	Vertical Image Size = 193.59 mm (Low 8 bits)
44		10	16	-	-	4 bits of Hor Image Size + 4 bits of Ver Image Size
45		00	0	-	0	Hor Border (pixels)
46		00	0	-	0	Vertical Border (Lines)
47		1A	26	-	-	Refer to right table

48	Detailed timing/monitor descriptor #2	FB	251	-	115.2	115.15392MHz Main clock
49		2C	44	-		
4A		80	128	-	1920	Hor Active = 1920
4B		DE	222	-	222	Hor Blanking = 222
4C		70	112	-	-	4 bits of Hor. Active + 4 bits of Hor. Blanking
4D		38	56	-	1080	Ver Active = 1080
4E		28	40	-	40	Ver Blanking = 40
4F		40	64	-	-	4 bits of Ver. Active + 4 bits of Ver. Blanking
50		30	48	-	48	Hor Sync Offset = 48
51		20	32	-	32	H Sync Pulse Width = 32
52		36	54	-	3	V sync Offset = 3 line
53		00	0	-	6	V Sync Pulse width : 6 line
54		58	88	-	344	Horizontal Image Size = 344.16 mm (Low 8 bits)
55		C1	193	-	194	Vertical Image Size = 193.59 mm (Low 8 bits)
56		10	16	-	-	4 bits of Hor Image Size + 4 bits of Ver Image Size
57		00	0	-	0	Hor Border (pixels)
58		00	0	-	0	Vertical Border (Lines)
59		1A	26	-	-	Refer to right above table
5A	Detailed timing/monitor descriptor #3	00	0	-	-	ASCII Data Sting Tag
5B		00	0	-	-	
5C		00	0	-	-	
5D		FE	254	-	-	
5E		00	0	-	-	
5F		48	72	-	H	Dell P/N:HN21W
60		4E	78	-	N	
61		32	50	-	2	
62		31	49	-	1	
63		57	87	-	W	
64		80	128	-	10000000	EDID Revison:A00
65		4E	78	-	N	BOE PN
66		56	86	-	V	
67		31	49	-	1	
68		35	53	-	5	
69		54	84	-	T	
6A		30	48	-	0	
6B		35	53	-	5	

6C	Detailed timing/monitor descriptor #4	00	0	-	-	Flag
6D		00	0	-	-	
6E		00	0	-	-	
6F		00	0	-	-	Data Type Tag: Manufacturer Specified Data 00
70		00	0	-	-	Flag
71		00	0	-	-	6-bit Color Depth & no FRC
72		41	65	-	-	WLED & singal light bar & one light bar
73		01	1	-	-	Frame rate 40Hz~65Hz
74		96	150	-	-	Light Controller:PWM & Max. Luminance220
75		00	0	-	-	Front Surface:Anti-Glare & RGB v-stripe
76		10	16	-	-	with DBC
77		00	0	-	-	no Motion Blur & no Active Gamma
78		00	0	-	-	no Wireless Enhancement & no In-Cell Scanner
79		0A	10	-	-	2 Lane edp
7A		01	1	-	-	Built-In Self Test
7B		0A	10	-	-	Format： terminate with ASCII code 0Ah and pad field with ASCII code 20h
7C		20	32	-	-	
7D		20	32	-	-	
7E	Extension flag	00	0	-	1	0 ：1個EDID；N-1：N个EDID
7F	Checksum	B6	182	182	-	