DATA MODUL

SPECIFICATION

BOE

DV133FHM-NN0

13,3” TFT - FHD - LVDS

Version: 0.0
Date: 23.09.2019

Note: This specification is subject to change without prior notice

DV133FHM-NN0

Product Specification

Rev. 0

CHONGQING BOE OPTOELECTRONICS TECHNOLOGY CO.,LTD

REVISION HISTORY

REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0	-	Initial Release	2019/5/22	Wang Xin
P1	-	Circuit data update	2019/7/23	Feng Tianyi
0	-	Final Spec	2019/9/23	Wang Xin

Contents

1.0 General Description

1.1 Application

- Commercial Digital Display
- Display Terminals for Control System
- Landscape and Portrait Display

1.2 General Specification

1.2.1.General LCM Specification(Table 1.)

<Table 1. General Specifications>

Parameter	Specification	Unit	Remarks
Active area	293.76(H) x 165.24(V)	mm	13.3”
Number of pixels	1920 (H) x 1080 (V)	pixels	FHD
Pixel pitch	0.153 (H) x 0.153 (V)	mm	
Pixel arrangement	RGB Vertical stripe		
Display colors	16.7M	colors	
Display mode	Normally Black		
Dimensional outline	299.46 (H) x 177.64 (V) x 2.6(B)(Max.)	mm	
Weight	220	g	
Surface Treatment	Hard coating(3H), Anti-glare -glare		
Back-light	Bottom edge side, 1-LED Lighting Bar type		Note 1
Power consumption	P_D : 2.0(max.)	W	@mosaic pattern
	P_{BL} :3.9(max.)	W	
	5.9(max.)	W	

Notes : 1. LED Lighting Bar (48*LED Array)

2.0 ABSOLUTE MAXIMUM RATINGS

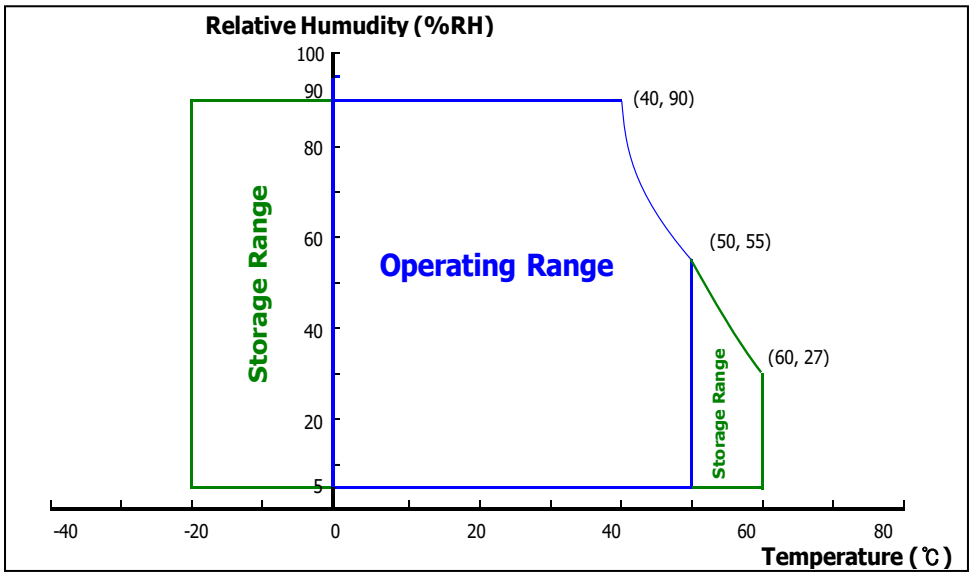
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2.

< Table 2. Absolute Maximum Ratings> Ta=25+/-2°C

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	-0.5	4.0	V	Note 1
Logic Supply Voltage	V_{IN}	V_{ss}-0.3	V_{DD}+0.3	V	
Operating Temperature	T_{OP}	0	+50	℃	Note 2
Storage Temperature	T_{ST}	-20	+60	℃	

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.
90 % RH Max. (40 ^{O}C ≥ Ta)
Maximum wet - bulb temperature at 39 ^{O}C or less. (Ta > 40 ^{O}C) No condensation.



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	V_{RF}	-	-	100	mV	At V_{DD} = 3.3V
Power Supply Current	I_{DD}	-	TBD	-	mA	Note 1
Differential Input Low Threshold Voltage	VLVTL	-300		-100	mV	
Differential Input High Threshold Voltage	VLVTH	+100		+300	mV	
Common Input Voltage	VLVC	1.0	1.2	1.4	V	
Power Consumption	P_D	-	1.4	2.0	W	Note 1
	P_{BL}	-	-	3.9	W	Note 2
	P_{total}	-	-	5.9	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. $I_F \times V_F \times 32$/ efficiency = P_{LED}

3.2 Backlight Unit

< Table 4. 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		IF	-	20.6	-	mA	
LED Power Consumption		P_{LED}	-	-	3.3	W	Note 1
LED Life-Time		N/A	30,000	-	-	Hour	IF = 20.6mA
Power supply voltage for LED Driver		V_{LED}	5	12	21	V	
Power supply voltage for LED Driver Inrush		Iled inrush	-	-	2	A	Note 4
EN Control Level	Backlight on		2.1	-	-	V	
	Backlight off		-	-	0.8	V	
PWM Control Level	PWM High Level		2.1	-	-	V	
	PWM Low Level		-	-	0.8	V	
PWM Control Frequency		F_{PWM}	-	20,000	-	Hz	
Duty Ratio		-	1	-	100	%	

Notes :

1. Power supply voltage12V for LED driver.
   Calculator value for reference IF × VF ×48/driver efficiency = PLED
2. The LED life-time define as the estimated time to 50% degradation of initial luminous.
3. Measure condition (Figure 5)

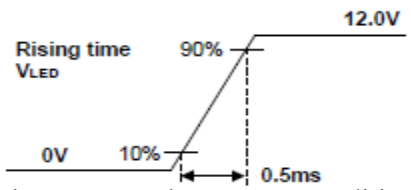
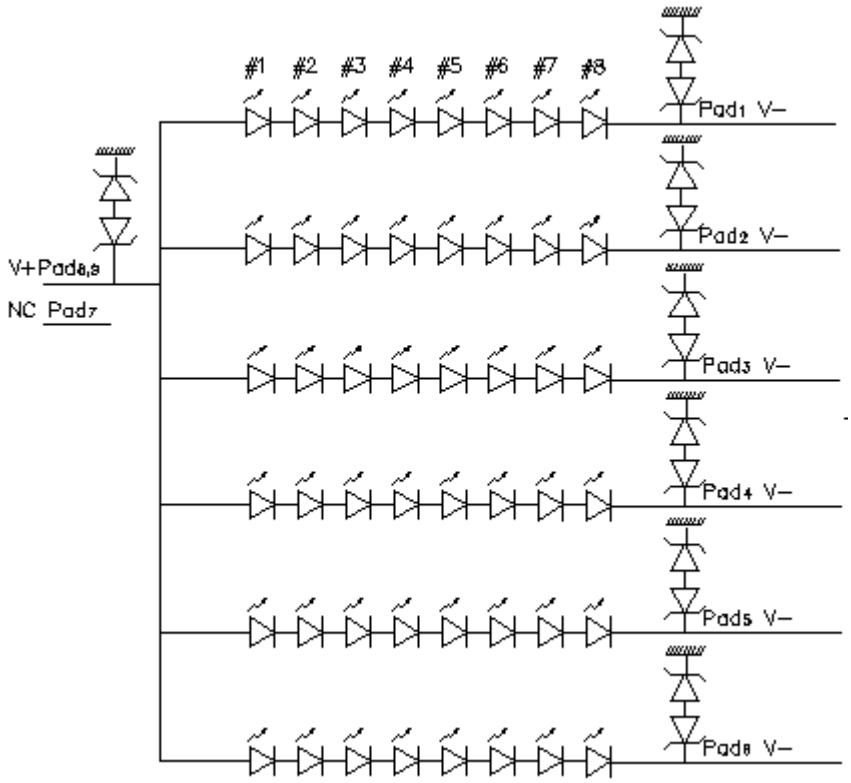


Figure 5. Inrush Measure Condition

3.3 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 (Goniometer system and TOPCON 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 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	-	85	-	Deg.	Note 1
		Θ_9		-	85	-	Deg.	
	Vertical	Θ_{12}		-	85	-	Deg.	
		Θ_6		-	85	-	Deg.	
Luminance Contrast ratio		CR	Θ = 0°	600	800	-	-	
Luminance of White	Center	Y_w	Θ = 0° I_{LED} = 20.6mA	270	300	-	-	
White Luminance uniformity	9 Points	ΔY9		-	75%	-	-	Type.
White Chromaticity		x_w	Θ = 0°	0.283	0.313	0.343	-	
		y_w		0.299	0.329	0.359	-	
Reproduction of color	Red	x_R	Θ = 0°	-0.03	0.590	+0.03	-	
		y_R			0.366		-	
	Green	x_G			0.347		-	
		y_G			0.574		-	
	Blue	x_B			0.160		-	
		y_B			0.124		-	
Gamut		-	-	-	45	-	%	
Response Time (Rising + Falling)		T_{RT}	Ta= 25° C Θ = 0°	-	30	35	ms	Note 6
Cross Talk		CT	Θ = 0°	-	-	-	%	
Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark

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 1).

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) 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 9 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 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 9 points / Maximum Luminance of 9 points.
(see FIGURE 2).

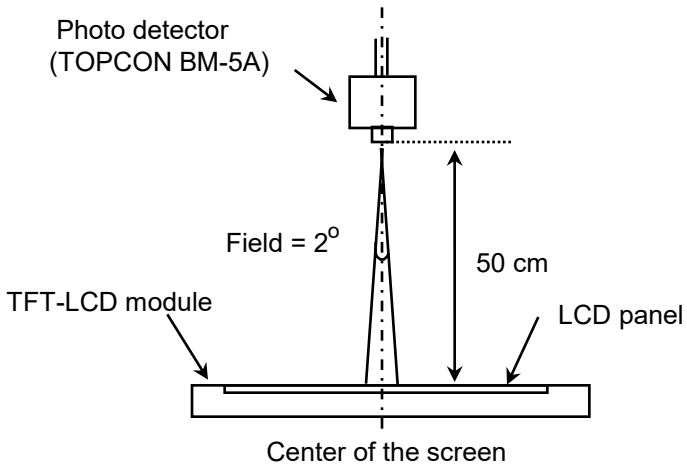
5. The color chromaticity coordinates specified in Table 5 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

6. The electro-optical response time measurements shall be made as FIGURE 3 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 Td.

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 4).

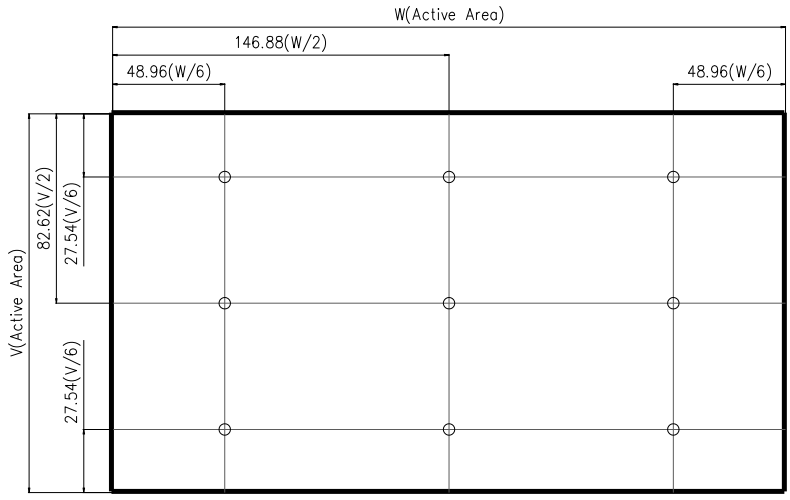
4.3 Optical measurements

Figure 1. Measurement Set Up



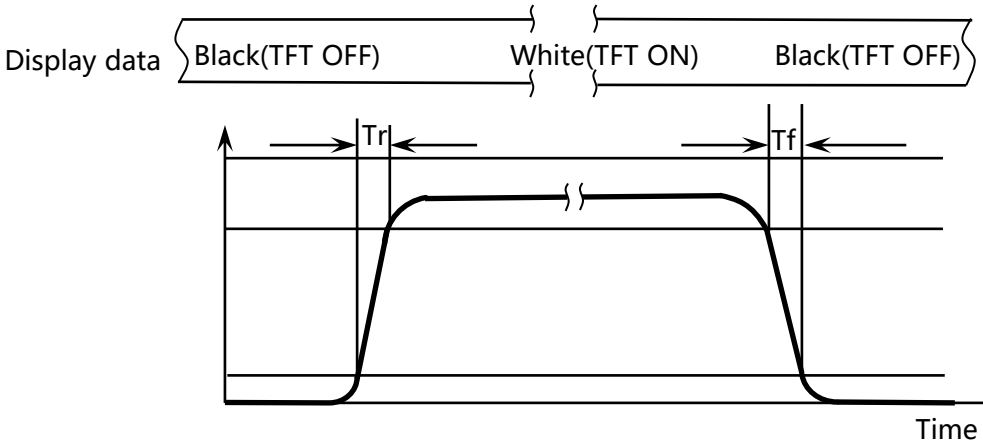
Optical characteristics measurement setup

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



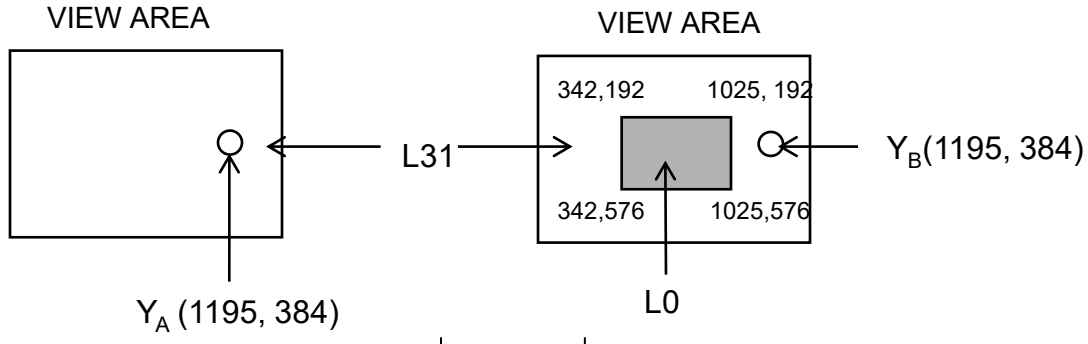
Center Luminance of white is defined as luminance values of center 9 points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.

Figure 3. Response Time Testing



The electro-optical response time measurements shall be made as shown in FIGURE 3 by switching the "data" input signal ON and OFF. The times needed for the luminance to change from 10% to 90% is Td and 90% to 10% is Tr.

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

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 4).

5.0 INTERFACE CONNECTION.

5.1 Electrical Interface Connection

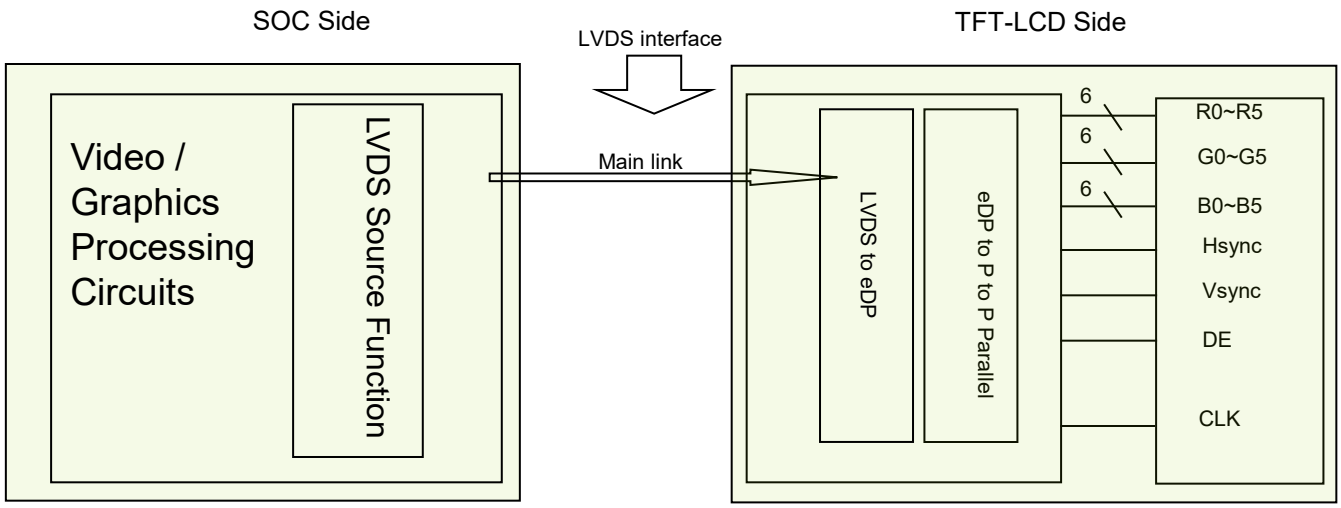
The electronics interface connector is Yeonho 05002HR-H51G5(G) or Compatible.
The connector interface pin assignments are listed in Table 6.

<Table 6. Pin Assignments for the Interface Connector>

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	NC	No Connection
2	NC	No Connection
3	GND	Ground
4	GND	Ground
5	LCD_VCC	+3.3V
6	LCD_VCC	+3.3V
7	BIST	Panel self test enable
8	GND	Ground
9	ODD A-	Odd pixel Negative LVDS differential data input.
10	ODD A+	Odd pixel Positive LVDS differential data input.
11	ODD B-	Odd pixel Negative LVDS differential data input.
12	ODD B+	Odd pixel Positive LVDS differential data input.
13	ODD C-	Odd pixel Negative LVDS differential data input.
14	ODD C+	Odd pixel Positive LVDS differential data input.
15	GND	Ground
16	ODD CLK-	Odd pixel Negative LVDS differential clock input.
17	ODD CLK+	Odd pixel Positive LVDS differential clock input.
18	GND	Ground
19	ODD D-	Odd pixel Negative LVDS differential data input.
20	ODD D+	Odd pixel Positive LVDS differential data input.
21	GND	Ground
22	EVEN A-	Even pixel Negative LVDS differential data input.
23	EVEN A+	Even pixel Positive LVDS differential data input.
24	EVEN B-	Even pixel Negative LVDS differential data input.

Terminal	Symbol	Functions
Pin No.	Symbol	Description
25	EVEN B+	Even pixel Positive LVDS differential data input.
26	EVEN C-	Even pixel Negative LVDS differential data input.
27	EVEN C+	Even pixel Positive LVDS differential data input.
28	GND	Ground
29	EVEN CLK-	Even pixel Negative LVDS differential clock input.
30	EVEN CLK+	Even pixel Positive LVDS differential clock input.
31	GND	Ground
32	EVEN D-	Even pixel Negative LVDS differential data input.
33	EVEN D+	Even pixel Positive LVDS differential data input.
34	GND	Ground
35	MSDA_P	I2C-SDA
36	MSCL_P	I2C-SCL
37	NC	No Connection
38	BL_GND	Ground
39	BL_GND	Ground
40	BL_GND	Ground
41	BL_GND	Ground
42	BL_EN	Backlight on/off Control pin
43	BL_PWM	Backlight PWM Dimming
44	NC	No Connection
45	NC	No Connection
46	BL_PWR	+12V
47	BL_PWR	+12V
48	BL_PWR	+12V
49	BL_PWR	+12V
50	NC	No Connection
51	NC	No Connection

5-2. LVDS Interface



5.3.LVDS Input signal

PORT 1	PORT 2
ODD A-	EVEN A-
ODD A+	EVEN A+
ODD B-	EVEN B-
ODD B+	EVEN B+
ODD C-	EVEN C-
ODD C+	EVEN C+
ODD CLK-	EVEN CLK-
ODD CLK+	EVEN CLK+
ODD D-	EVEN D-
ODD D+	EVEN D+

5.4 Back-light & LCM Interface Connection

<Table 7. Pin Assignments for the BLU & LCM Connector>

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	LED-	Current Return	6	LED-	Current Return
2	LED-	Current Return	7	NC	No Connector
3	LED-	Current Return	8	LED+	Power Supply
4	LED-	Current Return	9	LED+	Power Supply
5	LED-	Current Return			

6.0 SIGNAL TIMING SPECIFICATION

6.1 The DV133FHM-NN0 is operated by the DE only.

Item		Symbols	Min	Typ	Max	Unit
Clock	Frequency	1/Tc	60	74.25	78	MHz
Frame Period		Tv	1120	1140	1170	lines
			-	60	-	Hz
			-	16.67	-	ms
Vertical Display Period		Tvd	-	1080	-	lines
One line Scanning Period		Th	2020	2030	2400	clocks
Horizontal Display Period		Thd	-	1920	-	clocks

6.2 LVDS Rx Interface Timing Parameter

The specification of the LVDS Rx interface timing parameter is shown in Table 6.

<Table 6. LVDS Rx Interface Timing Specification>

Symbol	Description	Min	Typ.	Max	Units
$Rate_{LVDS}$	LVDS data rate per pair	420	519.75	546	Mbps
$f_{CLK-LVDS}$	LVDS input clock frequency	60	74.25	78	MHz
$V_{TH-LVDS}$	Differential input high threshold			0.1	V
$V_{TL-LVDS}$	Differential input low threshold	-0.1			V
$V_{CM-LVDS}$	LVDS common mode voltage	0.9		1.4	V

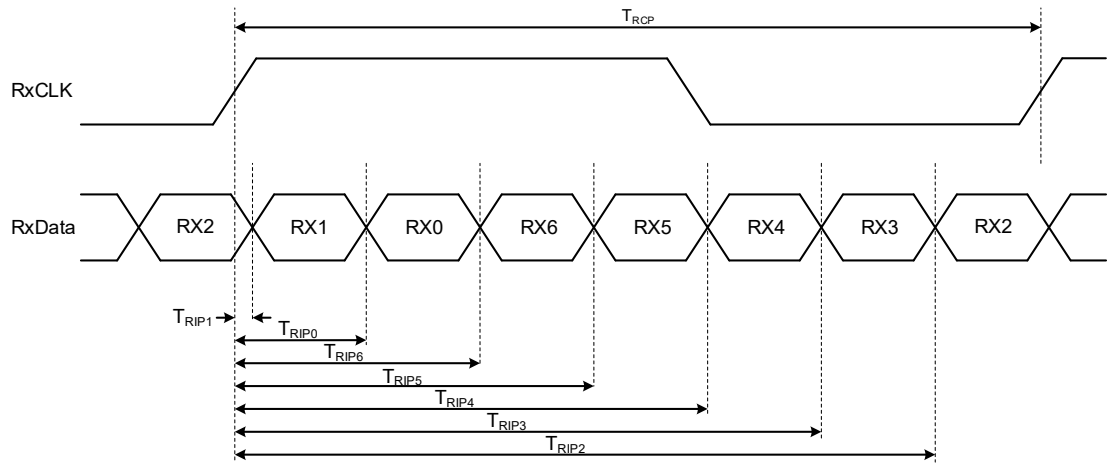
* Vdiff = (RXz+)-(RXz-),…. ,(RXCLK+)-(RXCLK-)

6.3 LVDS Input Timing Diagrams

The specification of the LVDS input timing diagrams is shown in Table 7.

<Table 7. LVDS Input Timing Diagrams >

Symbol	Description	Min	Typ.	Max	Units
T_{RCP}	Clock period	12.82	13.47	16.67	ns
UI	1 data bit time		1/7		T_{RCP}
T_{RIP1}	Input Data 0	-0.2	0	0.2	UI
T_{RIP0}	Input Data 1	0.8	1	1.2	UI
T_{RIP6}	Input Data 2	1.8	2	2.2	UI
T_{RIP5}	Input Data 3	2.8	3	3.2	UI
T_{RIP4}	Input Data 4	3.8	4	4.2	UI
T_{RIP3}	Input Data 5	4.8	5	5.2	UI
T_{RIP2}	Input Data 6	5.8	6	6.2	UI



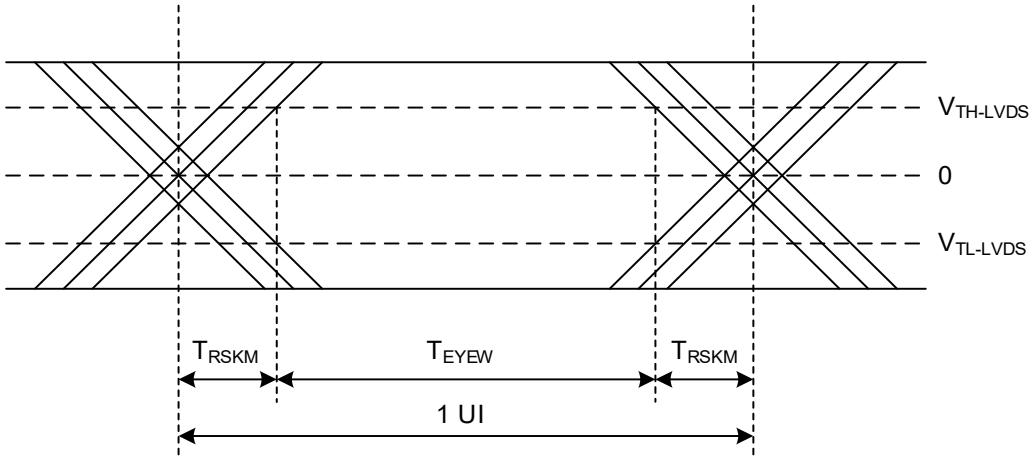
* Vdiff = (RXz+)-(RXz-),…. ,(RXCLK+)-(RXCLK-)

6.4 LVDS Input Eye Diagram

The specification of the LVDS Input Eye Diagram is shown in Table 8.

<Table 8. LVDS Input Eye Diagram >

Symbol	Description	Min	Typ.	Max	Units
T_{EYEW}	Input eye width	0.6			UI
T_{RSKM}	Input eye border			0.2	UI



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

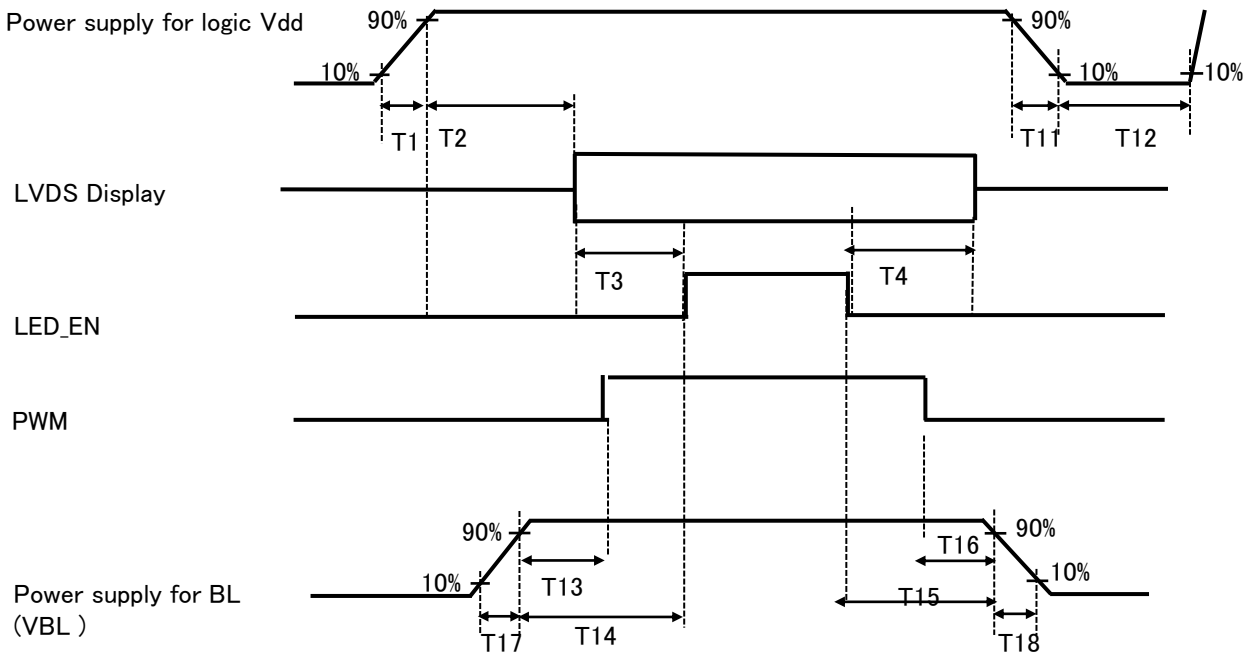
7.0 INPUT SIGNALS, BASIC DISPLAY COLORS & GRAY SCALE OF COLORS

< Table 9. Input Signal and Display Color Table >

	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 seq uence shall be as shown in below



- 0.5ms ≤ T1 ≤ 10 ms
- 200ms ≤ T3
- 200ms ≤ T4
- 0ms ≤ T2 ≤ 200 ms
- 10ms ≤ T13
- 20ms ≤ T14
- 0.5ms ≤ T17 ≤ 20ms
- 3ms ≤ T11 ≤ 10 ms
- 500ms ≤ T12
- 20ms ≤ T15
- 10ms ≤ T16
- 0.5ms ≤ T18 ≤ 20ms

Notes:

1. When the power supply VDD is 0V, keep the level of input signals on the low or k eep 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.

9.0 RELIABILITY TEST

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

<Table 10. Reliability test>

No	Test Items	Conditions
1	High temperature storage test	Ta = 60°C , 60%RH, 240 hrs
2	Low temperature storage test	Ta = -20°C , 240 hrs
3	High temperature & high humidity operation test	Ta = 50°C , 80%RH, 240 hrs
4	High temperature operation test	Ta = 50°C , 60%RH, 240 hrs
5	Low temperature operation test	Ta = 0°C , 240 hrs
6	Thermal shock	Ta = -20 °C ↔ 60 °C (0.5 hr), 60%±3%RH, 100 cycle
7	Vibration test (non-operating)	Ta = 25°C , 60%RH, 1.5G, 10~500Hz, Sine X,Y,Z / Sweep rate : 1 hour
8	Shock test (non-operating)	Ta = 25°C , 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°C , 60%RH,

10.0 PRECAUTIONS

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

10.1 Mounting Precautions

- Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- You must mount a module using specified mounting holes (Details refer to the drawings)
- You should consider the mounting structure so that uneven force (ex. Twisted stress, Concentrated stress)is not applied to the module. And the case on which a module is mounted should have sufficient strength so that external force is not transmitted directly to the module.
- Do not apply mechanical stress or static pressure on LCD, and avoid impact, vibration and falling.
- Acetic acid type and chlorine type materials for the cover case are not desirable because the former generates corrosive gas of attacking the polarizer at high temperature and the latter causes circuit break by electro-chemical reaction.
- Be careful to prevent water & chemicals contact the module surface.
- You should adopt radiation structure to satisfy the temperature specification.
- Connectors are precision devices to transmit electrical signals, and operators should plug in parallel
- Do not touch, push or rub the exposed polarizers with glass, tweezers or anything harder than HB pencil lead. And please do not rub with dust clothes with chemical treatment.
  Do not touch the surface of polarizer for bare hand or greasy cloth.(Some cosmetics are detrimental to the polarizer.)
- When the surface becomes dusty, please wipe gently with absorbent cotton or other soft materials like chamois soaks with petroleum benzine. Normal-hexane is recommended for cleaning the adhesives used to attach front / rear polarizers. Do not use acetone, toluene and alcohol because they cause chemical damage to the polarizer.
- Wipe off saliva or water drops as soon as possible. Their long time contact with polarizer causes deformations and color fading..
- Do not disassemble the module.
- This module has its circuitry PCB’s on the rear side and Driver IC and should be handled carefully in order not to be stressed.

10.2 Operating Precautions

- Do not connector or disconnect the cable to/from the Module at the “Power On” Condition.
- 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.
- 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 minimized the interference.
- Be careful for condensation at sudden temperature change. Condensation makes damage to polarizer or electrical contacted parts. And after fading condensation, smear or spot will occur.
- As the low temperature, the response time is greatly delayed. As the high temperatures (higher than the operating temperature) the LCD may turn black screen. The above phenomenon cannot explain the failure of the display. When the temperature returns to the normal operating temperature, the LCD will return to normal display.
- Do not exceed the absolute maximum rating value.(supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on). Otherwise the Module may be damaged.
- Please do not give any mechanical and/or acoustical impact to LCM. Otherwise, LCM can’t be operated its full characteristics perfectly.
- Design the length of cable to connect between the connector for back-light and the converter as shorter as possible and the shorter cable shall be connected directly , The long cable between back-light and Converter may cause the Luminance of LED to lower and need a higher startup voltage
- The cables should be as short as possible between System Board and PCB interface.
- The conductive material and signal cables are kept away from LED driver inductor to prevent abnormal display, sound noise and temperature rising.

11.3 Electrostatic Discharge Precautions

- Avoid to wear synthetic clothing, cotton clothing or other antistatic fibers are suggested. Wear anti-static gloves, anti-static wrist strap and conductive shoes grounding when contact with LCM
- Since a module is composed of electronic circuits, it is not strong to electrostatic discharge. Make certain that treatment persons are connected to ground through wrist band etc.
- Do not close to static electricity to avoid product damage.
- Do not touch interface pin directly.

10.4 Precautions for Strong Light Exposure

- Do not leave the module operation or storage in Strong light . Strong light exposure causes degradation of polarizer and color filter.

10.5 Precautions for Storage

A. Atmosphere Requirement

ITEM	UNIT	MIN	MAX
Storage Temperature	(℃)	5	40
Storage Humidity	(%rH)	35	75
Storage Life	6 months		
Storage Condition	• The storage room should be equipped with a dark and good ventilation facility. • Prevent products from being exposed to the direct sunlight, moisture and water. • The product need to keep away from organic solvent and corrosive gas. • Be careful for condensation at sudden temperature change. • Storage condition is guaranteed under packing conditions.		

B. Package Requirement

- The product should be placed in a sealed polythene bag to avoid air.
- Product Should be placed on the pallet, Which is away from the floor, Be cautions not to pile the product up.
- The polarizer surface should not come in contact with any other object. It is recommended that they be stored in the container in which they were shipped.
- As the original protective film, do not use the adhesive protective film to avoid change of Pol color and characteristic.
- The phase transition of Liquid Crystal in the condition of the low or high storage temperature will be recovered when the LCD module returns to the normal condition.

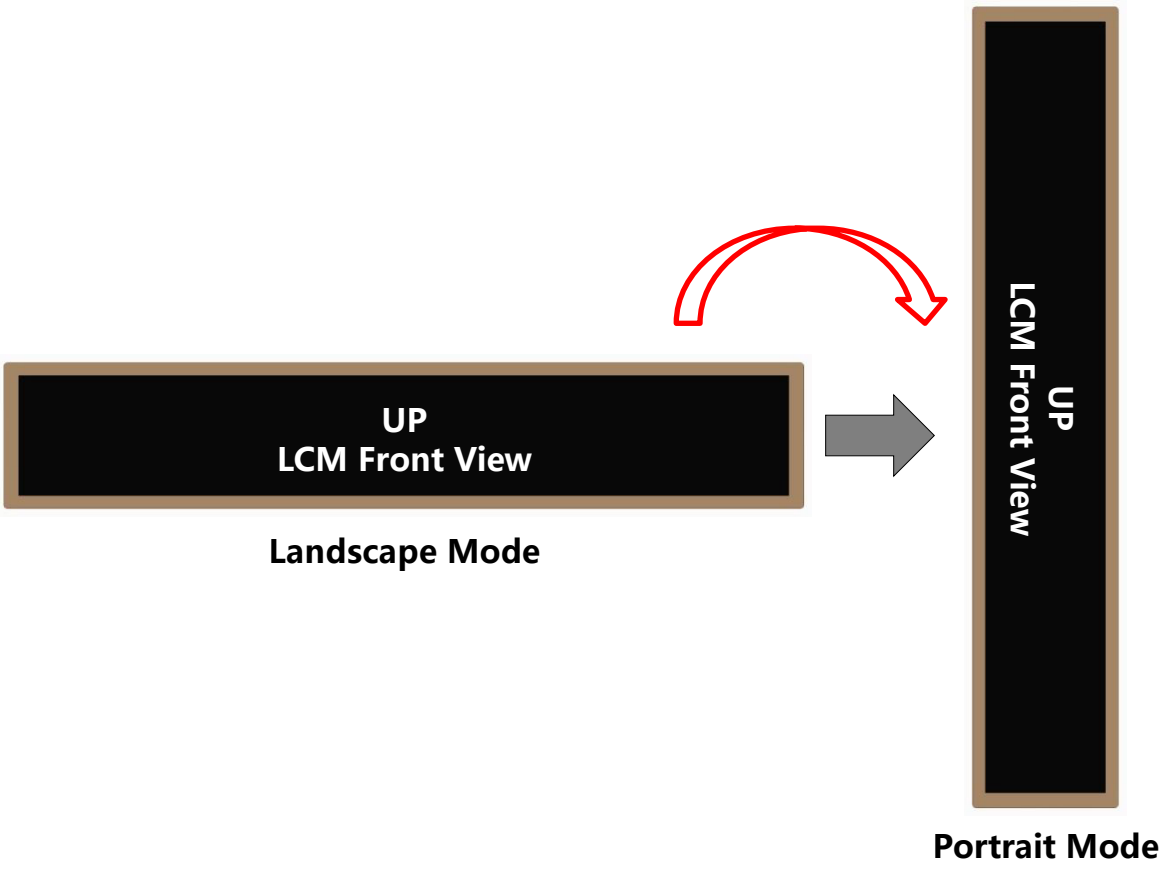
10.6 Precautions for protection film

- The ambient is maintained at more than 50%RH with anti-static equipment such as the iron fan when peeled off the protection film .
- People who peeled off the protection film should wear anti-static strap.

10.7 Appropriate Condition for Commercial Display

-Generally large-sized LCD modules are designed for consumer applications . Accordingly, a long-term display like in Commercial Display application, can cause uneven display including image sticking. To optimize module's lifetime and function, several operating usages are required.

1. Normal operating condition
   - Temperature: 20±15℃
   - Operating Ambient Humidity : 55±20%
   - Display pattern: dynamic pattern (Real display)
   - Well-ventilated place is recommended to set up Commercial Display system
2. Special operating condition
   a. Ambient condition
   - Well-ventilated place is recommended to set up Commercial Display system.
   b. Power and screen save
   - Periodical power-off or screen save is needed after long-term display.
   c. Product reliability and functions are only guaranteed when the product is used under right operation usages. If product will be used in extreme conditions such as high temperature, high humidity, high altitude, special display images, running time, long time operation, outdoor operation, etc. It is strongly recommended to contact BOE for filed application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at airports, transit stations, banks, stock market and controlling systems.
3. Operating usages to protect against image sticking due to long-term static display.
   a. Suitable operating time: under 20 hours a day.
   b. Static information display recommended to use with moving image.
   - Cycling display between 5 minutes' information(static) display and 10 seconds' moving image.
   c. Background and character (image) color change
   - Use different colors for background and character, respectively.
   - Change colors themselves periodically.
   d. Avoid combination of background and character with large different luminance.
   1) Abnormal condition just means conditions except normal condition.
   2) Black image or moving image is strongly recommended as a screen save
4. Lifetime in this spec. is guaranteed only when Commercial Display is used according to operating usages.
5. Module should be turned clockwise based on front view when used in portrait mode.



10.8 Other Precautions

A. LC Leak

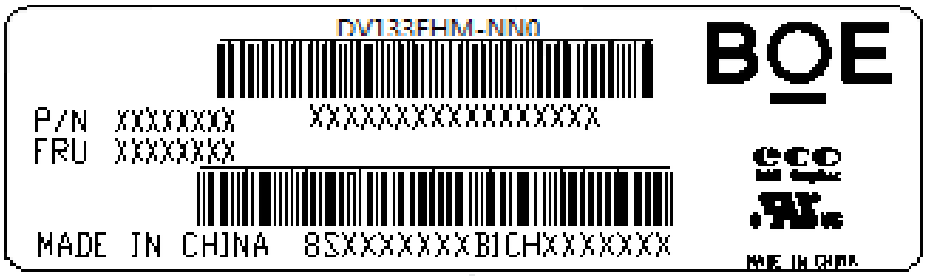
- If the liquid crystal material leaks from the panel, it is recommended to wash the LC with acetone or ethanol and then burn it.
- If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, skin or clothes, it has to be washed away thoroughly with soap.
- If LC in mouth, mouth need to be washed, drink plenty of water to induce vomiting and follow medical advice.
- If LC touch eyes, eyes need to be washed with running water at least 15 minutes.

B. Rework

- When returning the module for repair or etc., Please pack the module not to be broken. We recommend to use the original shipping packages.

11.0 LABEL

(1) LCM label



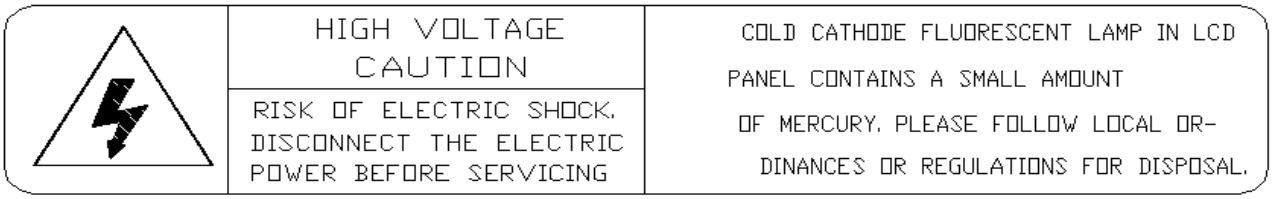
LCM ID 编码规则:

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	S	L	S	T	1	2	3	5	9	4	2	0	0	0	1	D	B
描述	GBN		等级	line	年		月	FG-Code后4位				Serial Number					

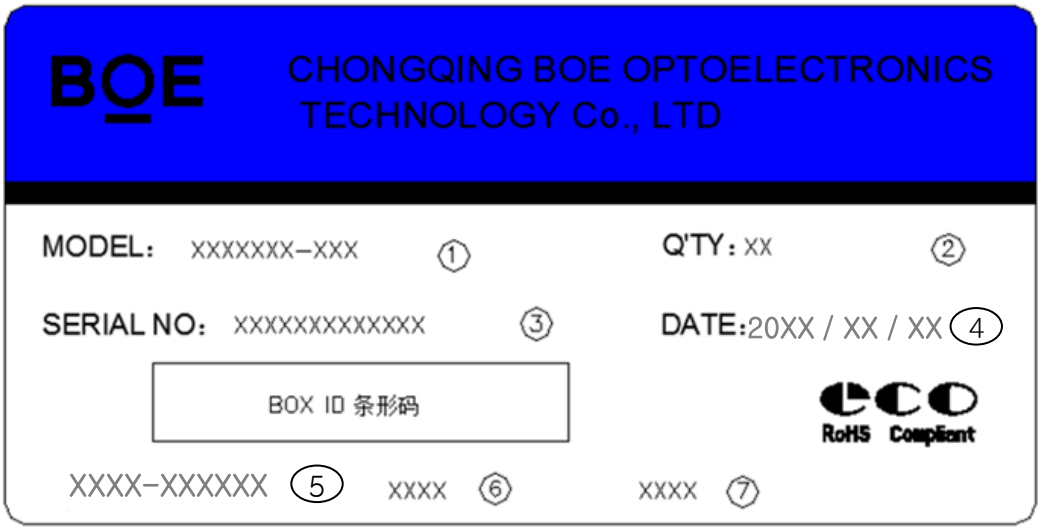
客户Serial Number码规则：

	YMD	####
Part Number	MFG Date	S/N
13 digit: num-alphabet	3 digit: Num-alphabet	4 digit: Num-alphabet
Follow Timi PN Rule MD10000004337	Skip "I,O,Q"	SN:4bit, use 0~9 and A~Z numeral-alphabet, skip letter "I,O,Q,U"；SN must NOT be duplicated.
	Year=last digit of year	
	Month=1-9 for Jan-Sept, A=Oct, B=Nov, C=Dec	
	Day=1-9 for 1st thru 9th, A=10, B=11, etc. skip "I,O,Q,U"	

(2) High voltage caution label



(3) Box label



Remark：

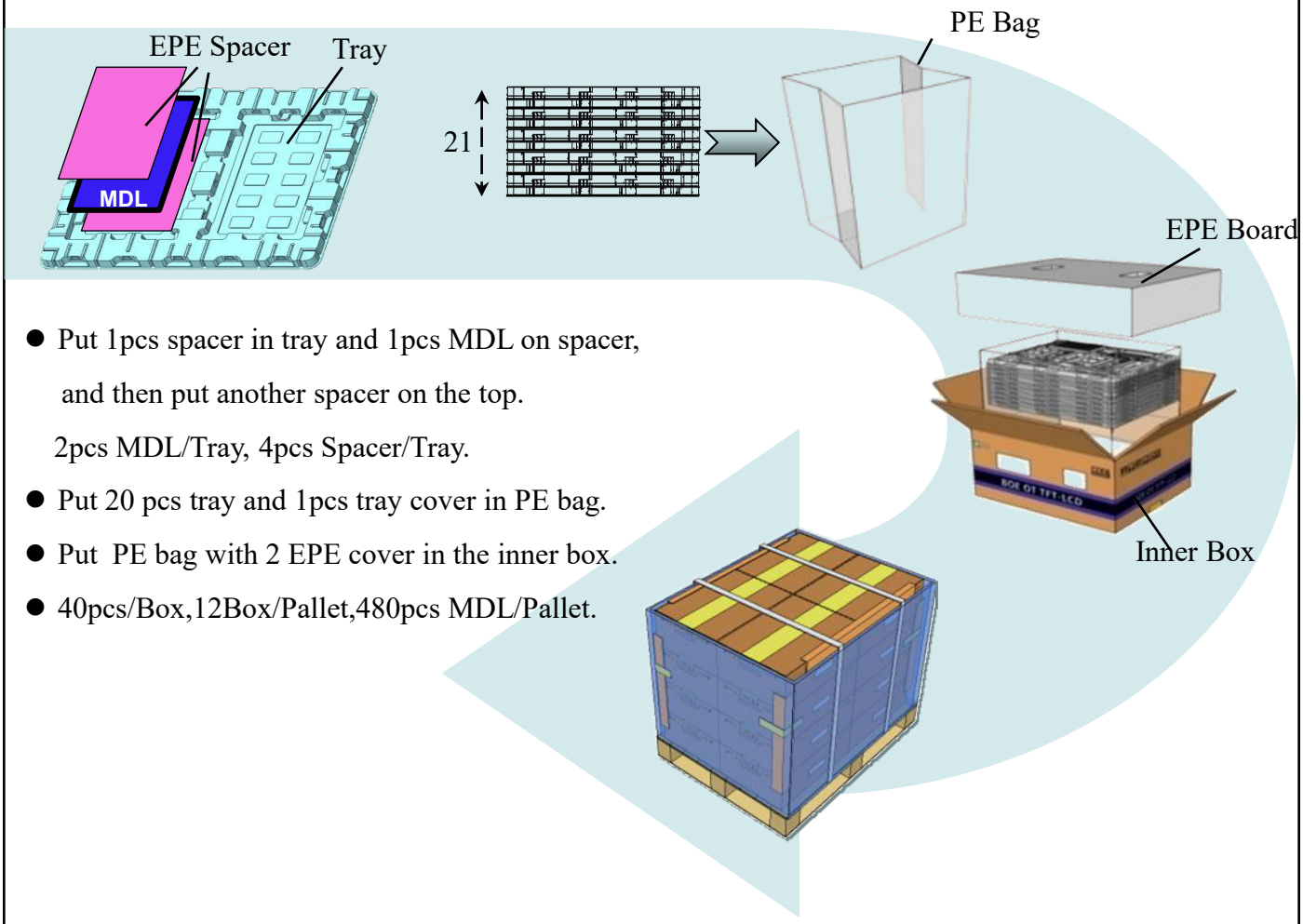
1. **Model name**
2. **Product quantity per 1 box**
3. **Box ID, Encoding rules as follow table**
4. **Box Packing date**
5. **Product material number(**customer side)

Box ID 编码规则

No.	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
Describe	GBN code		Grade	B3	Year		Month	Rev	Serial number				

13.0 PACKING INFORMATION

13.1 Packing order



- Put 1pcs spacer in tray and 1pcs MDL on spacer, and then put another spacer on the top. 2pcs MDL/Tray, 4pcs Spacer/Tray.
- Put 20 pcs tray and 1pcs tray cover in PE bag.
- Put PE bag with 2 EPE cover in the inner box.
- 40pcs/Box,12Box/Pallet,480pcs MDL/Pallet.

Figure 22. Packing Order

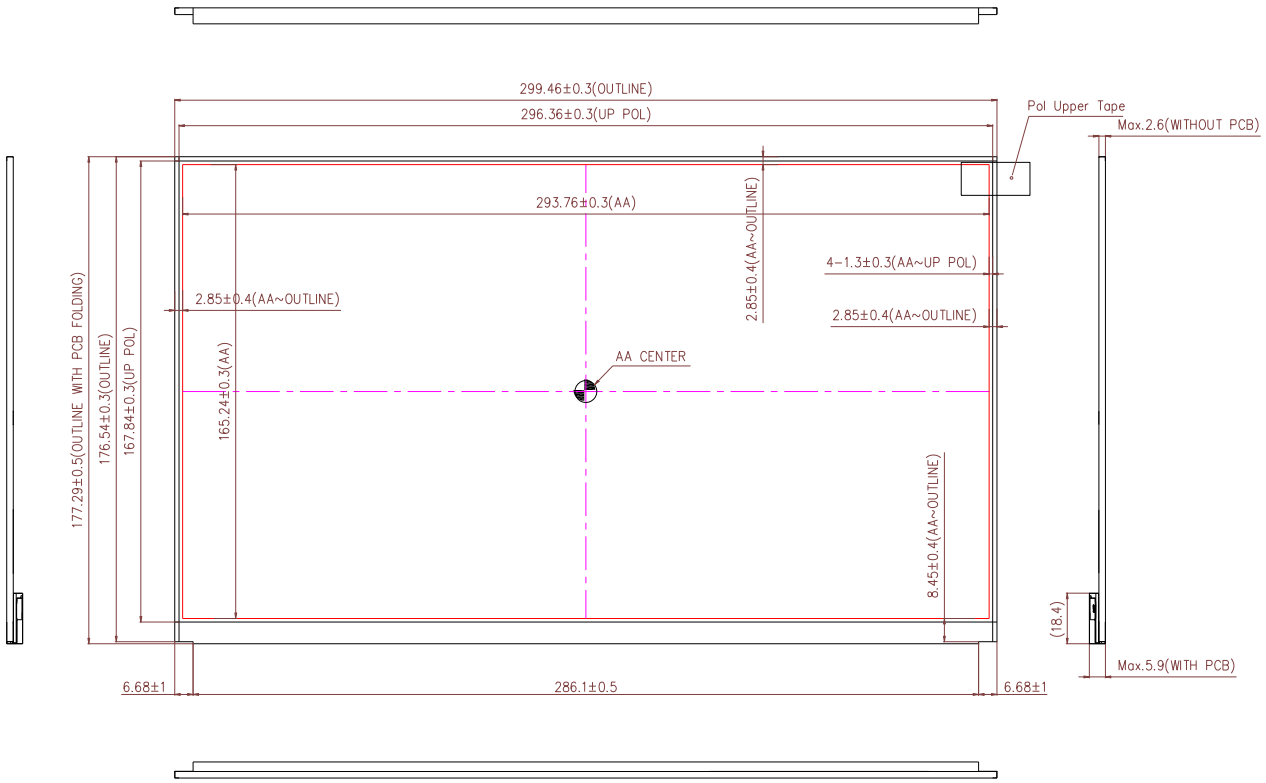
13.2 Notes

- Box Dimension: 545mm×465mm×290mm
- Package Quantity in one Box: 40pcs
- Total Weight: 15kg

12. MECHANICAL OUTLINE DIMENSION

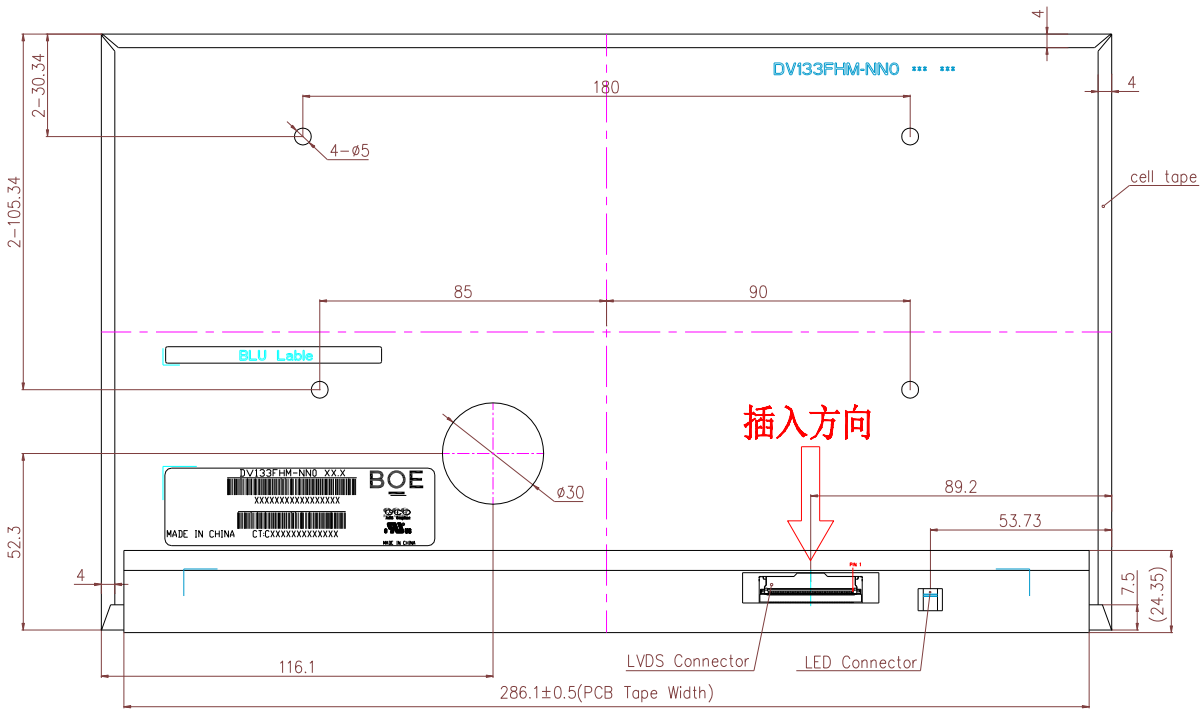
12.1 Outline Dimension

Figure 6. TFT-LCD Modules Outline Dimensions (Front view)



12.2 Total Solution Outline Dimension

Figure 7. TFT-LCD Modules Outline Dimensions (Rear view)



Note:
1. Top Polarizer is the highest part.
2. No light leakage from all 4 coners of LCM.
3. Size unit: mm.
4. General tolerance: ±0.3mm.

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