TITLE : TV133QHM-NL0

Product Specification

Rev. 2

HEFEI BOE OPTOELECTRONICS TECHNOLOGY

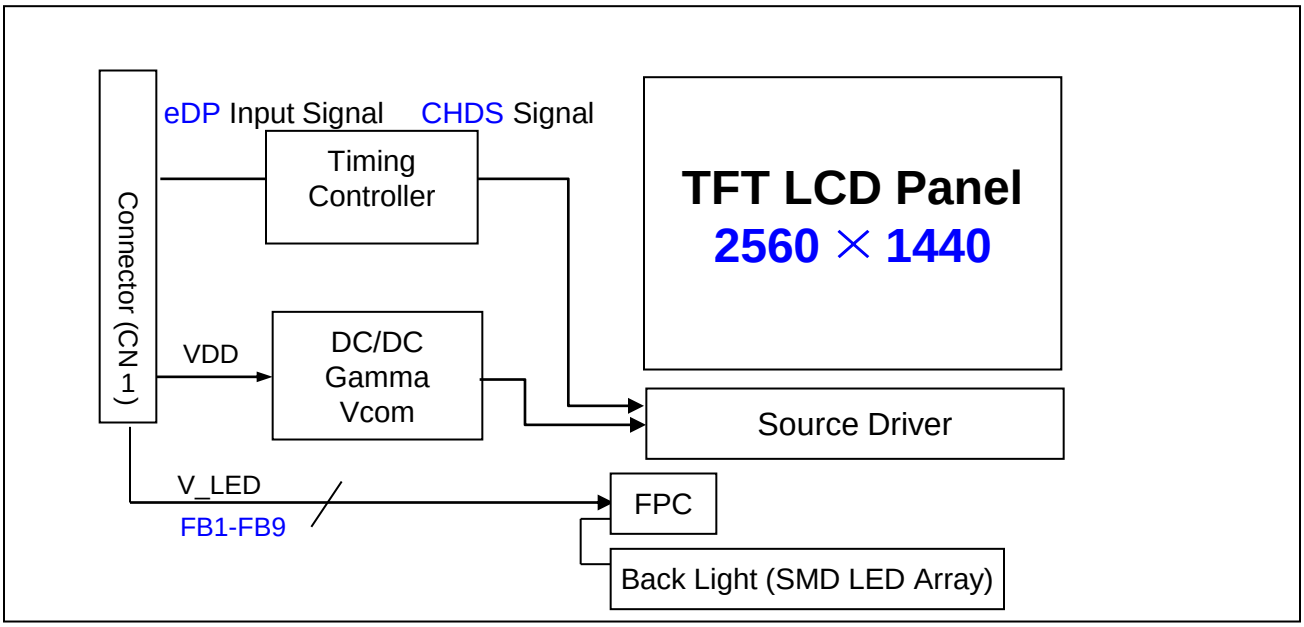
REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
0	-	Initial Release	2014.3.18	Q.Y.Shen
1	-	Change the drawing	2014.7.04	Q.Y.Shen
2	-	Change the drawing	2014.08.11	Q.Y.Shen

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

TV133QHM-NL0 is a 8 color active matrix TFT LCD module using amorphous silicon TFT's (Thin Film Transistors) as an active switching devices. This module has a 13.3 inch diagonally measured active area with QHD resolutions (2560 horizontal by 1440 vertical pixel array). Each pixel is divided into RED, GREEN, BLUE dots which are arranged in vertical stripe and this module can display 16.7M colors. The TFT-LCD panel used for this module is adapted for a low reflection and higher color type.



1.2 Features

- EDP 1.3 Interface
- Thin and light weight
- Display 16.7M colors(8bit)
- High luminance and contrast ratio, low reflection and wide viewing angle
- 3.3V for Logic Power
- RoHS Compliant

1.3 Application

- Tablet & Application Mini-PC (Wide Type)

1.4 General Specification

< Table 1. General Specifications >

Parameter	Specification	Unit	Remarks
Active area	293.76(H)x165.24(V)	mm	
Number of pixels	2560(H) ×RGB×1440 (V)	pixels	
Pixel pitch	114.75(H)×114.75(V)	㎛	
Pixel arrangement	Pixels RGB stripe arrangement		
Display colors	16.7M(8bits)	colors	
Display mode	Transmission mode. Normally Black		
Outline Dimension	306.3(H)x178.5(V)	mm	
Weight	250(max)	gram	
Surface Treatment	HC, 3H, (Front Polarizer)		
Back-light	54EA		

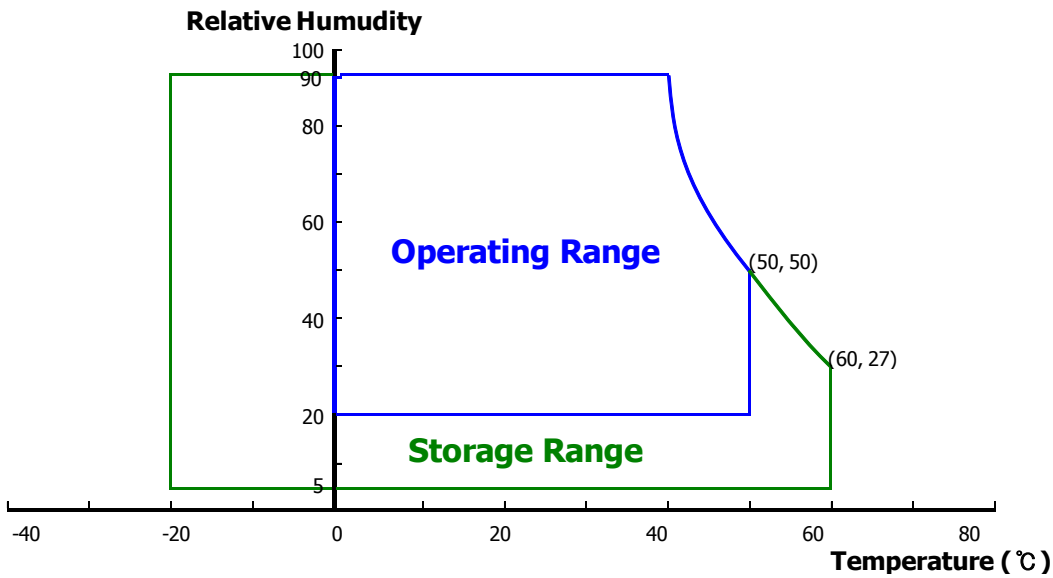
2.0 ABSOLUTE MAXIMUM RATINGS

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. LCD Module Electrical Specifications > [Ta =25±2 ℃]

Parameter	Symbol	Min.	Max.	Unit	Remarks
Power Supply Voltage (LCD Module)	V_{DD}	-0.3	5.0	V	
LED Forward Voltage of every LED string	V_{LED}	16.2	18	V	
LED Forward Current of every LED string	I_{LED}	-	21	mA	
LED string Reverse Voltage	V_R	-	3.0	V	
Operating Temperature	T_{OP}	-20	+70	℃	1)
Storage Temperature	T_{ST}	-30	+80	℃	

Note : 1) Temperature and relative humidity range are shown in the figure below.
Wet bulb temperature should be 39 ℃ max. and no condensation of water.



3.0 ELECTRICAL SPECIFICATIONS

3.1 TFT LCD Module

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

Parameter	Symbol	Values			Unit	Notes
		Min	Typ.	Max		
Power Supply Input Voltage	V_{DD}	3.0	3.3	3.6	V	Note 1
Power Supply Current	I_{DD}	-	-	394	mA	
LED Forward Voltage of every LED string	V_{LED}	16.2	-	18	V	Note 2
LED Forward Current of every LED string	I_{LED}	-	21	-	mA	
Power Consumption	P_D	-	1.3	1.5	W	white pattern
	P_{BL}	-	-	3.52	W	w/o Driver
	P_{Total}	-	-	5.02	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 ℃
Max value at White Pattern

2. Calculated value for reference (VLED X ILED)

3.2 Back-light Unit

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

Parameter			Min.	Typ.	Max.	Unit	Remarks
LED Forward Voltage		V_F	2.7	-	3.0	V	-
LED Forward Current		I_F	-	21	-	mA	-
LED Power Consumption		P_{LED}	-	-	3.52	W	Note 1
LED Life-Time		N/A	15,000	-	-	Hour	IF = 20mA Note 2
LED Forward Voltage of every LED string		V_{LED}	16.2	-	18	V	
LED Forward Current of every LED string		I_{LED}	20	21	22	mA	
PWM Control Level	PWM High Level	V_{PML}	1.2	-	3.6	V	
	PWM Low Level	V_{PML}	-	-	0.4	V	
PWM Control Frequency		F_{PWM}	5	-	20	KHz	
PWM duty Ratio		Duty	10%	-	100%	%	

Notes : 1. Calculator Value for reference $V_{LED} \times I_{LED} \times 9 = P_{LED}$

2. The LED Life-time define as the estimated time to 50% degradation of initial luminous.

4.0 OPTICAL SPECIFICATION

4.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1lux 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°. 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.	
Color Gamut				55	60	-	%	
Luminance Contrast ratio		CR	Θ = 0°	600	800	-		Note 2
Luminance of White	center Points	Y_w	Θ = 0°	330	350	-	cd/m^2	Note 3
White Luminance uniformity	5 Points	ΔY5		-	80	-		Note 4
White Luminance uniformity	13Points	ΔY13		-	60	-		Note 4
White Chromaticity		W_x	Θ = 0°	Typ. -0.03	0.300	Typ. +0.03		Note 5
		W_y			0.320			
Reproduction of color	Red	R_x	Θ = 0°	Typ. -0.03	0.636	Typ. +0.03		
		R_y			0.345			
	Green	G_x			0.327			
		G_y			0.585			
	Blue	B_x			0.146			
		B_y			0.096			
Response Time (Rising + Falling)		T_{RT}	Ta= 25° C Θ = 0°	-	25	-	ms	Note 6
Gamma Scale				2.0	2.2	2.4		
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 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 5point 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, the LED current is set at 20mA.

4. The White luminance uniformity on LCD surface is then expressed as : ΔY = Minimum Luminance of 5 (13)points / Maximum Luminance of 5(13) (points (see FIGURE 2).

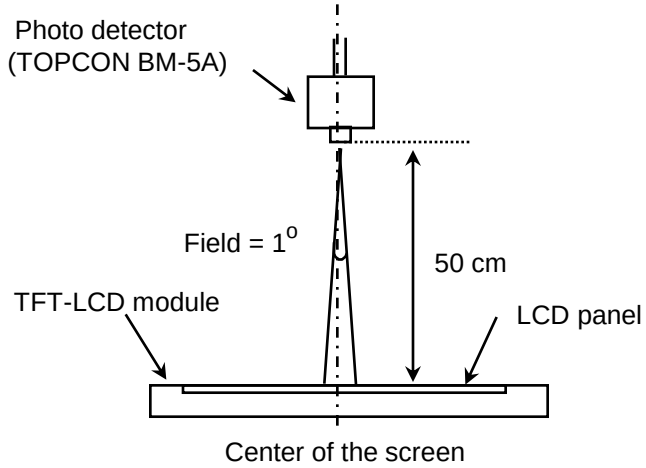
5. The color chromaticity coordinates specified in Table 5 shall be calculated from the spectral data measured with all pixels first in red, green, blue and white. Measurements shall be made at the center of the panel.

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).

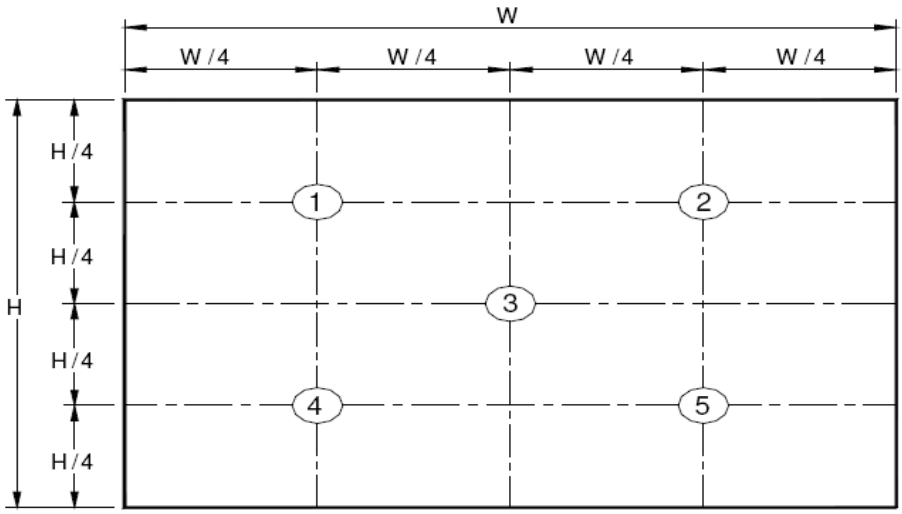
4.3 Optical measurements

Figure 1. Measurement Set Up



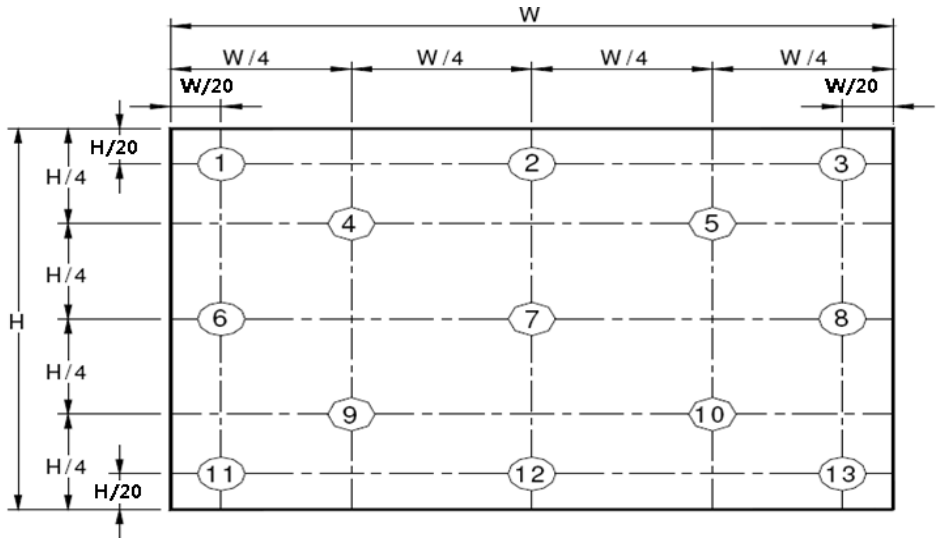
View angel range measurement setup

Figure 2. White Luminance and Uniformity Measurement Locations (5 points)



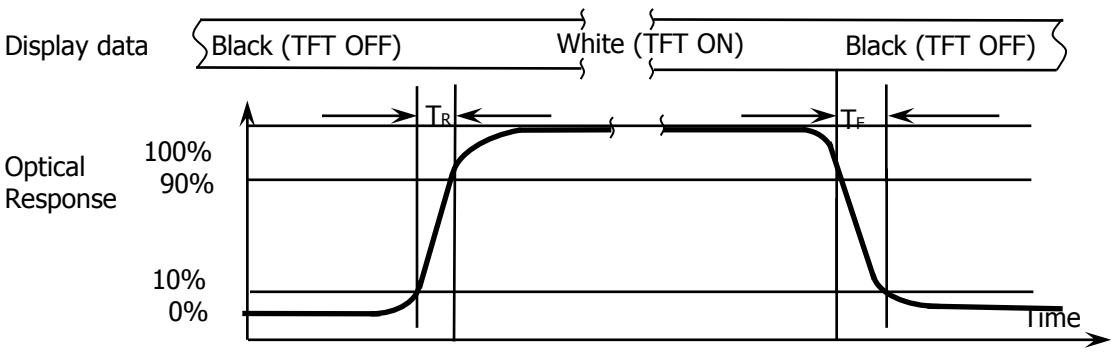
Center Luminance of white is defined as luminance values of center 5 points across the LCD surface. Luminance shall be measured with all pixels in the view field set first to white. This measurement shall be taken at the locations shown in FIGURE 2 for a total of the measurements per display.
The White luminance uniformity on LCD surface is then expressed as : ΔY5 = Minimum Luminance of 5 points / Maximum Luminance of 5points (see FIGURE 2).

Figure 3. Uniformity Measurement Locations (13 points)



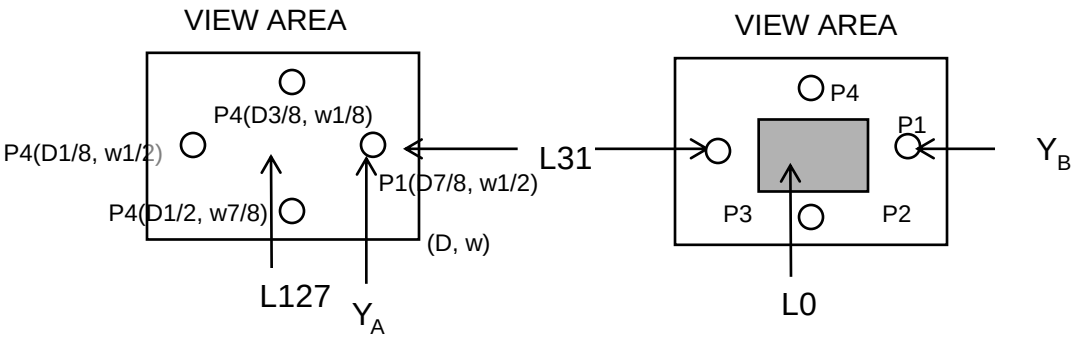
The White luminance uniformity on LCD surface is then expressed as : ΔY13 = Minimum Luminance of 13 points /Maximum Luminance of 13 points (see FIGURE 3).
The White luminance uniformity of 5 point is the same test method as 13 point using FIGURE 2.

Figure 4. Response Time Testing



The electro-optical response time measurements shall be made as shown in FIGURE 4 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.

Figure 5. Cross Modulation Test Description



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

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 5).

5.0 INTERFACE CONNECTION.

5.1 Electrical Interface Connection

The electronics interface connector is FH26W-45S-0.3SHW

The connector interface pin assignments are listed in Table 6.

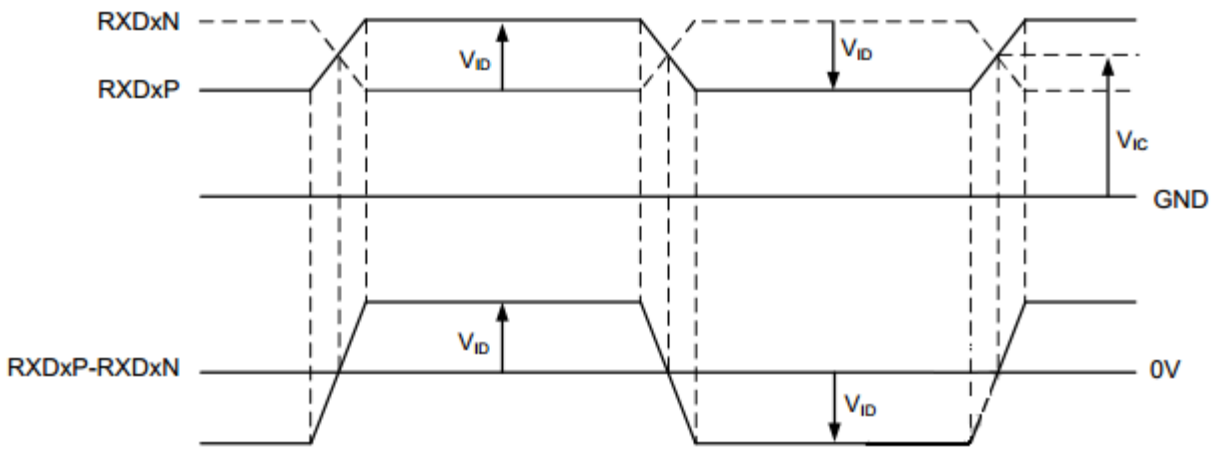
<Table 5. 1. Pin Assignments for the Interface Connector>

Terminal	Symbol	Functions
Pin No.	Symbol	Description
1	VDD	Power Supply, 3.3V
2	VDD	Power Supply, 3.3V
3	VDD	Power Supply, 3.3V
4	VDD	Power Supply, 3.3V
5	NC	NC
6	ID	LCD ID（Ground)
7	NC	NC
8	GND	Ground
9	AUX-N	eDP AUX CH negative
10	AUX-P	eDP AUX CH positive
11	GND	Ground
12	EDP-RX0N	eDP RX channel 0 negative
13	EDP-RX0P	eDP RX channel 0 positive
14	GND	Ground
15	EDP-RX1N	eDP RX channel 1 negative
16	EDP-RX1P	eDP RX channel 1 positive
17	GND	Ground
18	EDP-RX2N	eDP RX channel 2 negative
19	EDP-RX2P	eDP RX channel 2 positive
20	GND	Ground

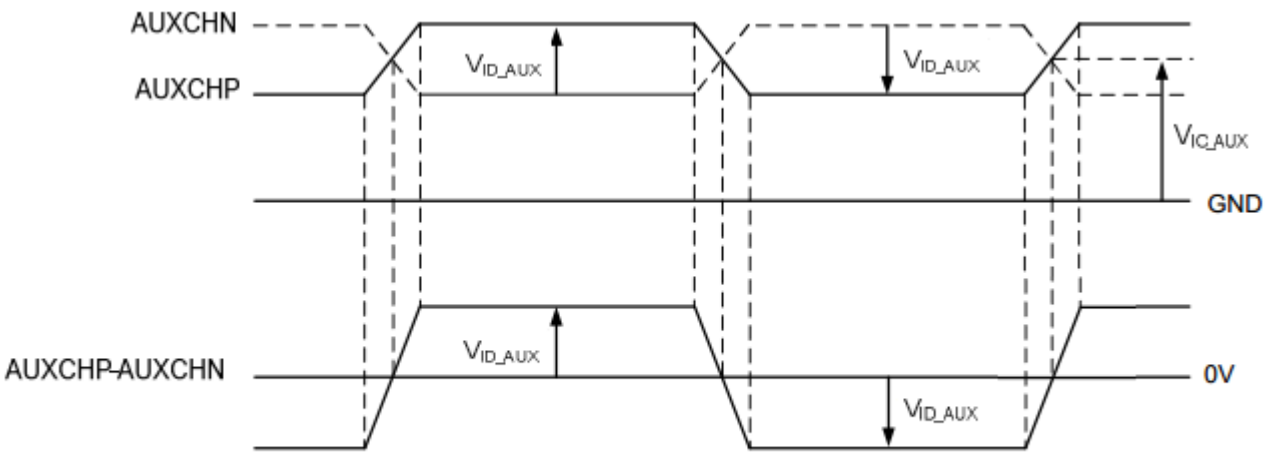
<Table 5.2. Pin Assignments for the Interface Connector>

Terminal	Symbol	Functions
Pin No.	Symbol	Description
21	EDP-RX3N	eDP RX channel 3 negative
22	EDP-RX3P	eDP RX channel 3 positive
23	GND	Ground
24	HPD	HPD
25	GND	Ground
26	NC	NC
27	NC-SCL	NC(BOE internal use)
28	NC-SDA	NC(BOE internal use)
29	GND	Ground
30	LED-PWMIN	LED PWMIN
31	LED-PWMOUT	LED PWMOUT
32	LEDB1	LEDB-
33	LEDB2	LEDB-
34	LEDB3	LEDB-
35	LEDB4	LEDB-
36	LEDA1	LEDA-
37	LEDA2	LEDA-
38	LEDA3	LEDA-
39	LEDA4	LEDA-
40	LEDA5	LEDA-
41	NC	NC
42	VLEDB2	LEDB+
43	VLEDB1	LEDB+
44	VLEDA2	LEDA+
45	VLEDA1	LEDA+

5.2 EDP Input signal SPEC.

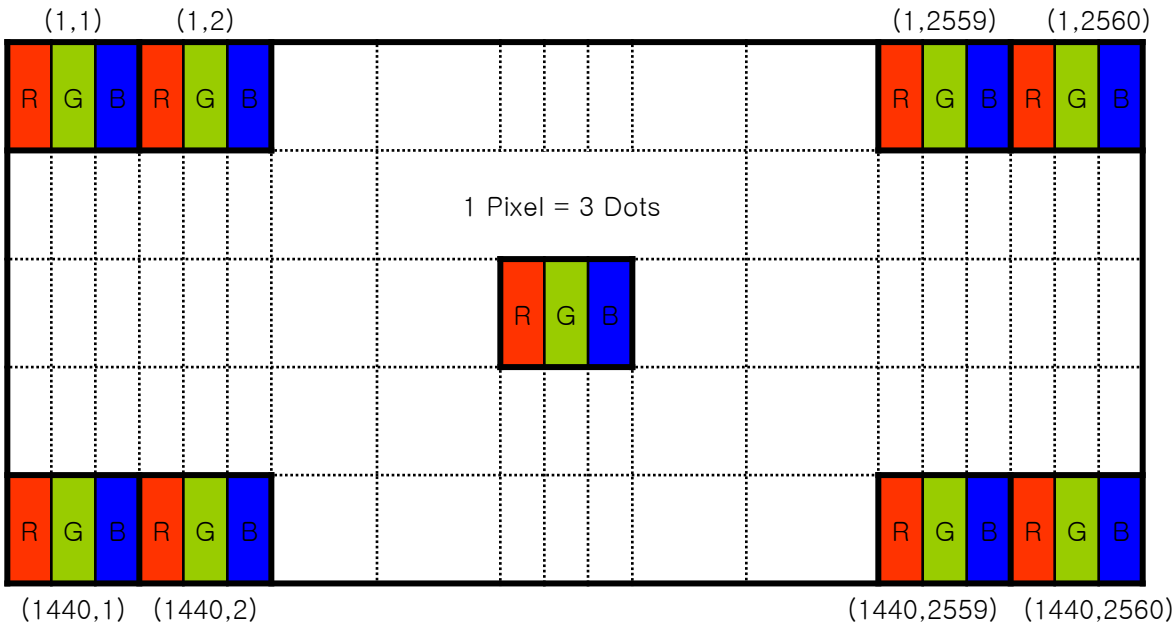


Main Link V_{ID} and V_{IC} definition



AUX CH V_{ID_AUX} and V_{IC_AUX} definition

5.3 Data Input Format

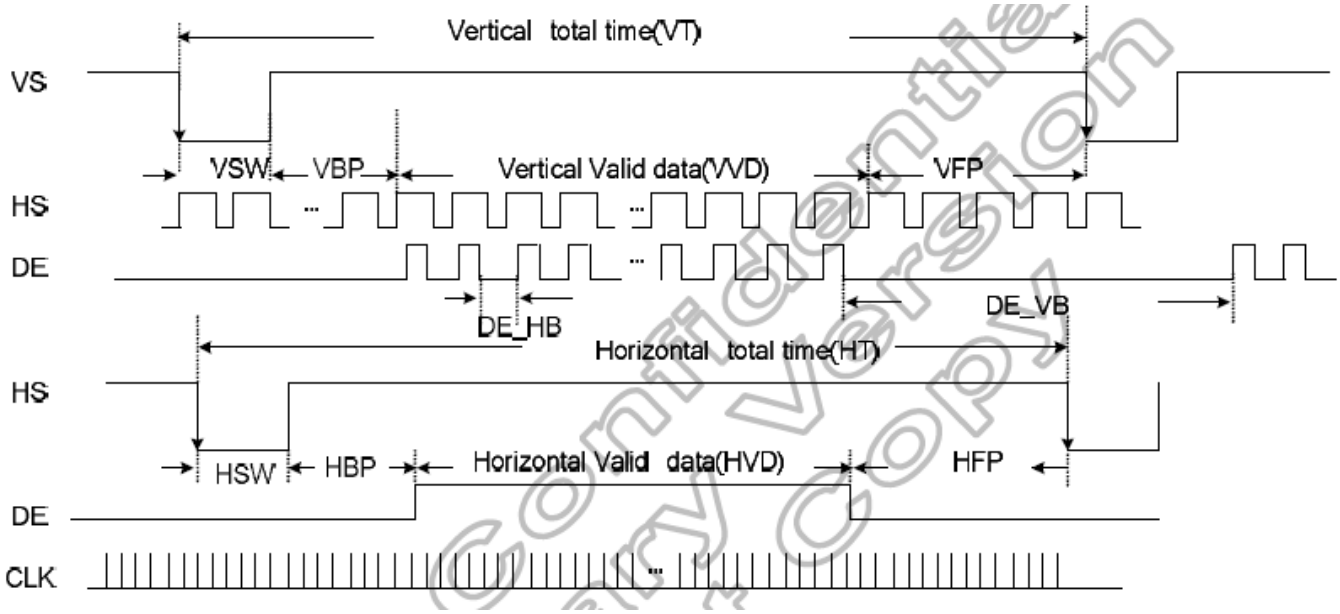


Display Position of Input Data (H-V)

6.0 SIGNAL TIMING SPECIFICATION

6.1 Signal timing

ITEM	Symbol		Min	Typ	Max	Unit	Note
CLK	Period	t_{CLK}	-	4.19	-	ns	
	Frequency	-	-	238.3	-	Mbps	
Hsync	Period	t_{HP}	-	2720	-	t_{CLK}	
	Frequency	f_H	-	163.2	-	KHz	
Vsync	Period	t_{VP}	-	1460	-	t_{HP}	
	Frequency	f_V	-	87.6	-	Hz	
Horizontal Active Display Term	Valid	t_{HV}	-	2560	-	t_{CLK}	
	Total	t_{HP}	-	2720	-	t_{CLK}	
Vertical Active Display Term	Valid	t_{VV}	-	1440	-	t_{HP}	
	Total	t_{VP}	-	1460	-	t_{HP}	



6.2 EDP Interface Timing Parameter

The specification of the EDP interface timing parameter is shown in Table 8.

<Table 8. EDP Interface Timing Specification>

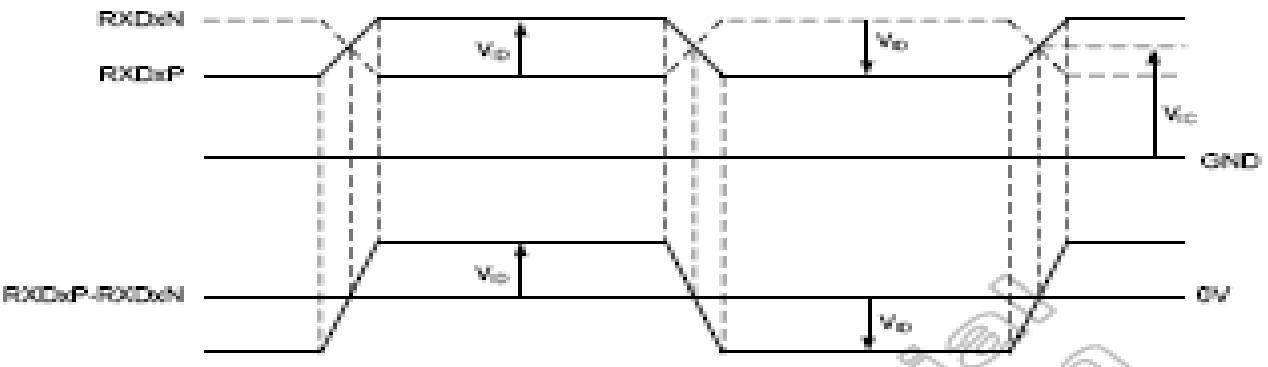


Figure 7.1: Main Link V_{ID} and V_{IC} definition

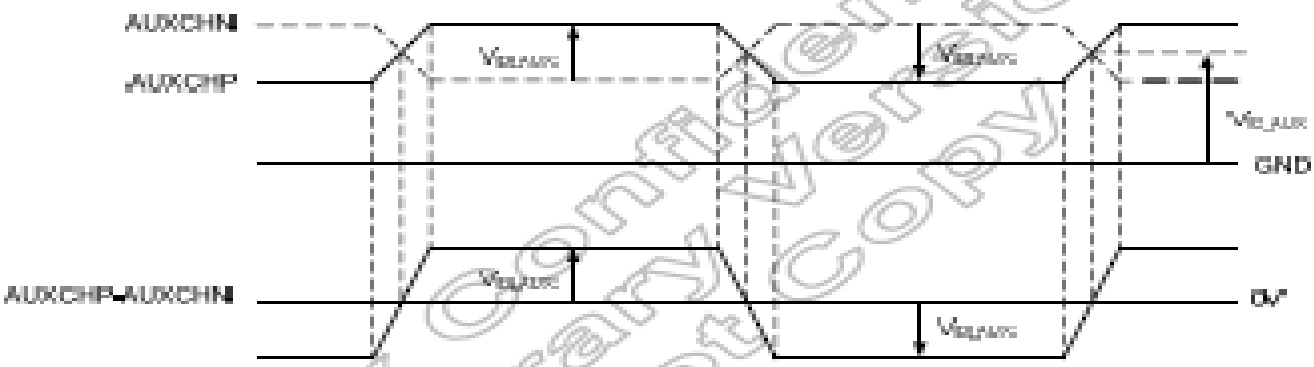
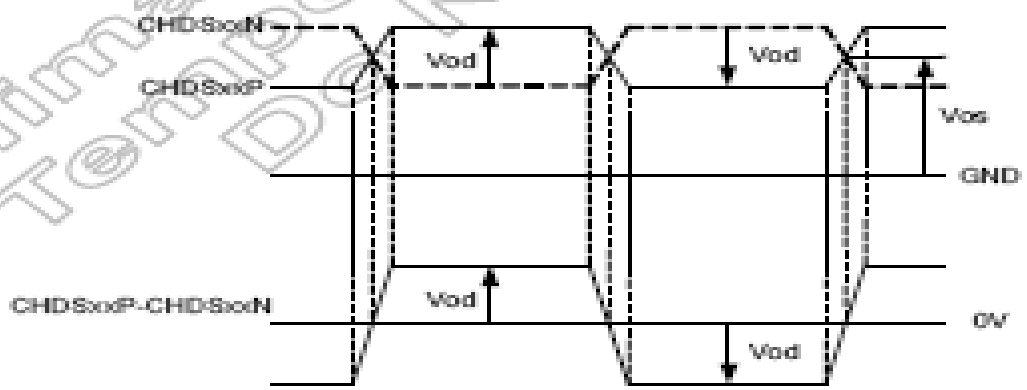


Figure 7.2: AUX CH V_{ID_AUX} and V_{IC_AUX} definition



DC electrical character

Symbol	Parameter	Condition	Spec. Min.	Spec. Typ.	Spec. Max.	Unit
CMOS/TTL DC specifications						
V_{IH}	High level input voltage	-	0.7VDDIO	-	VDDIO	V
V_{IL}	Low level input voltage	-	VSSIO	-	0.3VDDIO	V
V_{OH}	High level output voltage	-	0.8VDDIO	-	VDDIO	V
V_{OL}	Low level output voltage	-	VSSIO	-	0.2VDDIO	V
I_{IN}	Input current	-	-10	-	10	μA
R_{PD}	Pull low resistance	AGMODE (C1) PWMI (C2) TEST (E2) CABC_EN (E6) COLOR_EN (D6)	75	150	225	KΩ
DP DC specifications						
V_{IC}	Main link common mode voltage	-	0	-	2.0	V
V_{ID}	Main link swing voltage	2.7 Gbps	±60	-	±600	mV
		1.62 Gbps	±20	-	±600	mV
V_{IC_AUX}	AUX common mode voltage	-	0	-	2.0	V
V_{ID_AUX}	AUX swing voltage	Transmitting	±0.195	-	±0.69	V
		Receiving	±0.16	-	±0.68	V
CHDS DC specifications						
Vod	Output differential voltage	RL=100Ω (T_A=25℃)	±160	±200	±240	mV
Vos	Output offset voltage		0.7	0.9	1.1	V
$\|I_{od}\|$	Output current		1.6	2	2.4	mA
V_{EYE}	Eye diagram differential voltage		-	TBD	-	mV

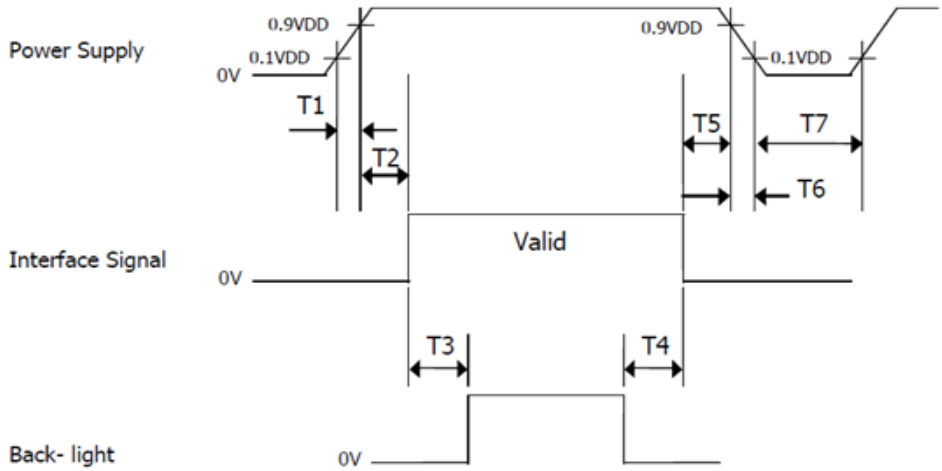
AC electrical character

Parameter	Symbol	Condition	Spec. Min.	Spec. Typ.	Spec. Max.	Unit
UI period	t_{UI}	-	0.83	-	4	ns
Effective V_{eye} rising/falling time	C1, C2	-	-	TBD	-	t_{UI}
Interpair skew	t_{SKEW}	-	-20	-	20	t_{UI}

7.0 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

Power-On/Off Timing Sequence:



Parameter	Values			Units
	Min	Typ	Max	
T1	0	-	10	ms
T2	0	-	50	ms
T3	200	-	-	ms
T4	200	-	-	ms
T5	0.5	-	50	ms
T6	0	-	10	ms
T7	500	-	-	ms

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.

8.0 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.

10.1 TFT LCD Module

Connector Name /Description	For Signal Connector
Manufacturer	Hirose or Compatible
Type/ Part Number	FH26W-45S-0.3SHW or Compatible

10.2 LED Connector

Pin No.	Symbol	For Signal Connector
1	VLEDA	LED Anode Power Supply
2	VLEDB	LED Anode Power Supply
3	NC	No Connection
4	LEDA1	LED Cathode Power Supply
5	LEDA2	LED Cathode Power Supply
6	LEDA3	LED Cathode Power Supply
7	LEDA4	LED Cathode Power Supply
8	LEDA5	LED Cathode Power Supply
9	LEDB1	LED Cathode Power Supply
10	LEDB1	LED Cathode Power Supply
11	LEDB1	LED Cathode Power Supply
12	LEDB1	LED Cathode Power Supply

9.0 MECHANICAL CHARACTERISTICS

9.1 Dimensional Requirements

FIGURE 5 shows mechanical outlines for the model TV133QHM-NL0.
Other parameters are shown in Table 9.

<Table 9. Dimensional Parameters>

Parameter	Specification	Unit
Active Area	293.76(H)x165.24(V)	mm
Number of pixels	2560(H) ×RGB×1440 (V)	
Pixel pitch	114.75(H)×114.75(V)	um
Pixel arrangement	RGB Vertical stripe	
Display colors	16.7M	
Display mode	Normally Black	
Dimensional outline	306.3(H)x178.5(V)	mm
Weight	250 (Max)	gram
Back-light	LED, Horizontal-LED Array type	

9.2 Mounting

See FIGURE 6.

9.3 Glare and Polarizer Hardness.

The surface of the LCD has an low reflection coating and hard coating to reduce scratching.

9.4 Light Leakage

There shall not be obvious 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 150lux.

10.0 RELIABILITY TEST

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

<Table 10. Reliability test>

No		Conditions
1	High temperature storage test	Ta = 60 ℃, 240 hrs
2	Low temperature storage test	Ta = -20 ℃, 240 hrs
3	High temperature & high humidity operation test	Ta = 60 ℃, 90%RH, 240 hrs
4	High temperature operation test	Ta = 60 ℃, 240 hrs
5	Low temperature operation test	Ta = -20 ℃, 240 hrs
6	Thermal shock	Ta = -40 ℃ ↔ 60 ℃ (2 hr), 50cycle
7	Power on/off	Per 1min,3000times
8	Packing Vibration	5~200Hz,1.47G,Random±Z, ±X, ±Y/60min
9	Drop Test	1Angle,3Edge,6Face垂直跌落 Height: JIS-Z-0200 Level 1
10	Electro-static discharge test	Operating: Air : 150 pF, 330Ω, ±12 KV Contact : 150 pF, 330Ω, ±8 KV Non - Operating: Air : 150 pF, 330Ω, ±4 KV Contact : 150 pF, 330Ω, ±2 KV

11.0 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.

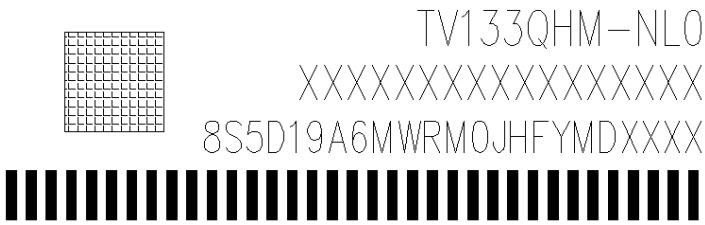
(4) Cautions for the atmosphere
- Dew drop atmosphere should be avoided.
- Do not store and/or operate the LCD module in a high temperature and/or humidity atmosphere. Storage in an electro-conductive polymer packing pouch and under relatively low temperature atmosphere is recommended.

(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.

12.0 LABEL

(1) Product label



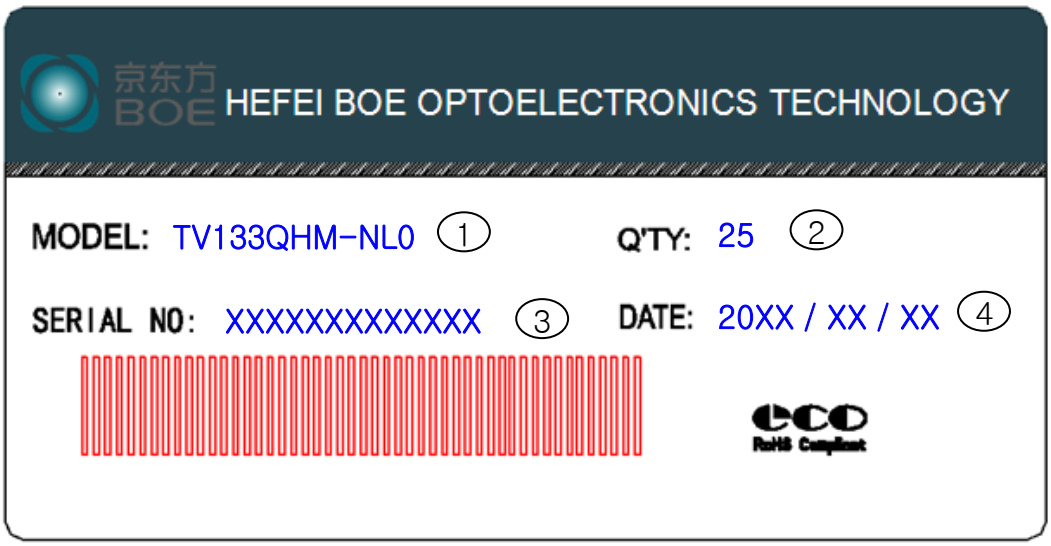
序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	4	F	P	3	1	2	7	3	8	5	0	0	0	1	E	E	J
描述	GBN代码		等级	B3	年份		月	FG Code后四位				序列号					

Code	Description
L	LCM
H	HYDIS
A	BOEOT
B	BOEOT
C	BOEOT
3	BOEHF

Code	Description
1	1月
2	2月
…	…
X	10月
Y	11月
Z	12月

(2) Box label

Label Size: 110 mm (L) × 56 mm (W)
Contents
Model: TV133QHM-NL0
Q`ty: 25pcs Module in one box
Serial No.: Box Serial No. See next figure for detail description.
Date: Packing Date
Internal use of Product



1. **FG-CODE**
2. **Box 产品数量**
3. **Box ID, 编码规则如下**
4. **Box Packing 日期**

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13
代码	4	J	P	3	1	2	7	0	0	0	1	H	D
描述	GBN代码		等级	B3	年份		月	Rev	序列号				

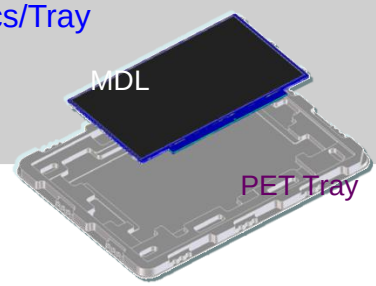
13.0 PACKING INFORMATION

13.1 Packing order

-. 将 1pcs MDL 平放入Tray

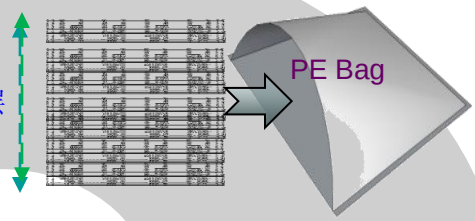
MDL 上放置EPE Spacer

-. 容量: 1pcs/Tray



-. 将26pcs PET Tray 平放入PE Bag;

-. Tray 旋转180°放置, 顶部1pcs 空Tray;

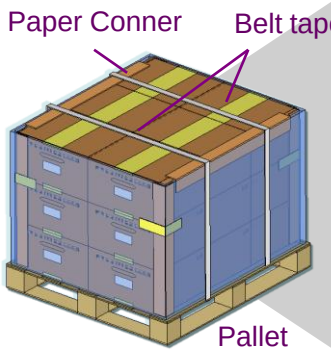


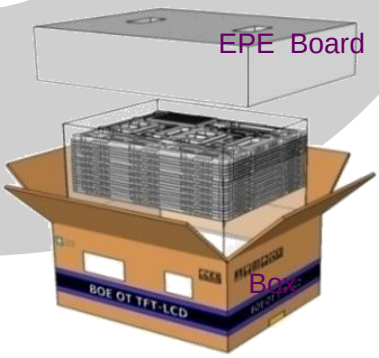
-. 每个Pallet上放3层Box

1层6箱,共计18ea Box

-. Pallet外进行缠膜包装

-. 容量: 450pcs/Pallet





13.2 Notes

- Box Dimension: 496mm×396mm×290mm
- Package Quantity in one Box: 25pcs
- Total Weight: 11.4kg

14.0 MECHANICAL OUTLINE DIMENSION

Figure 6. TFT-LCD Module Outline Dimension (Front View)

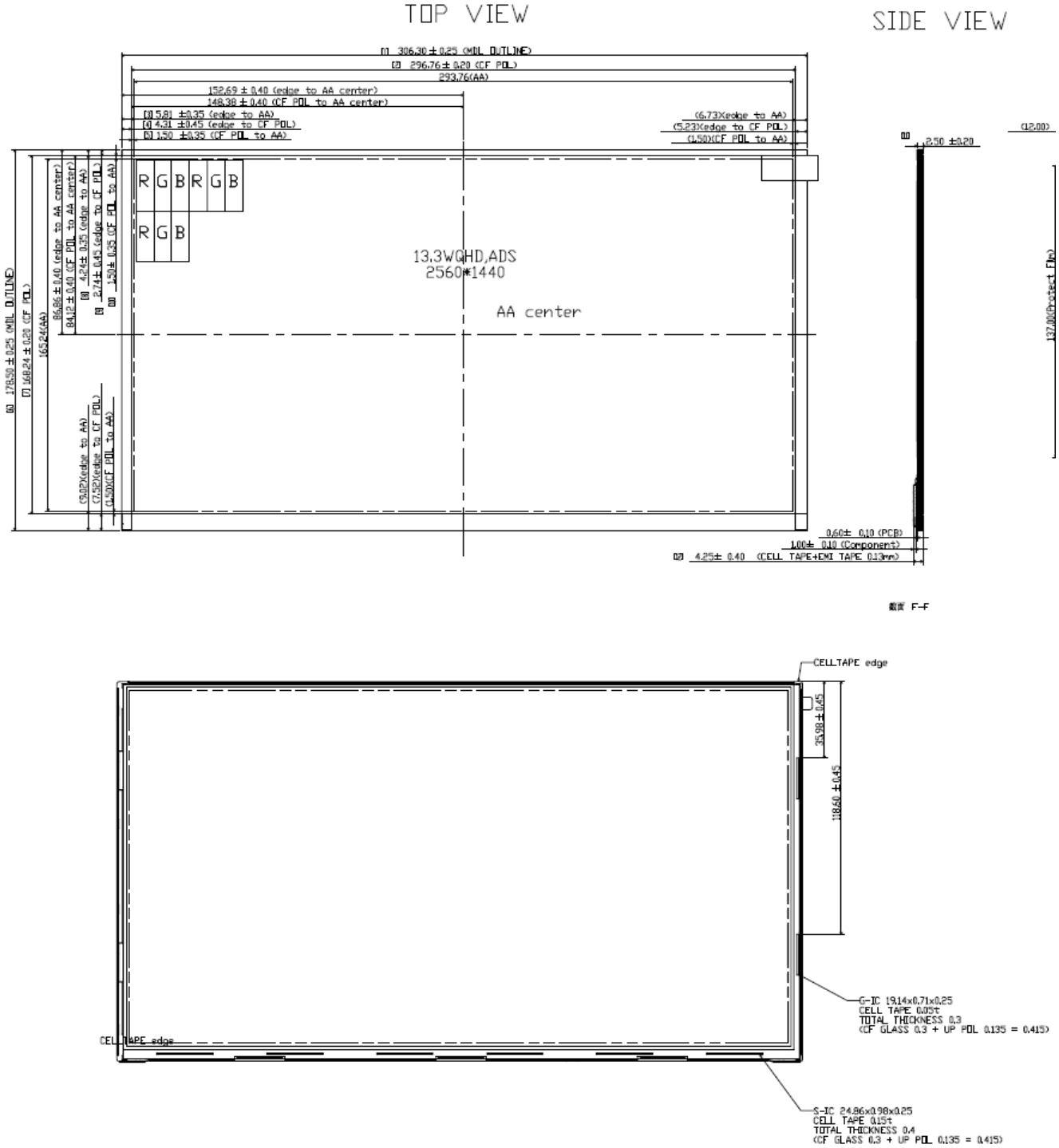
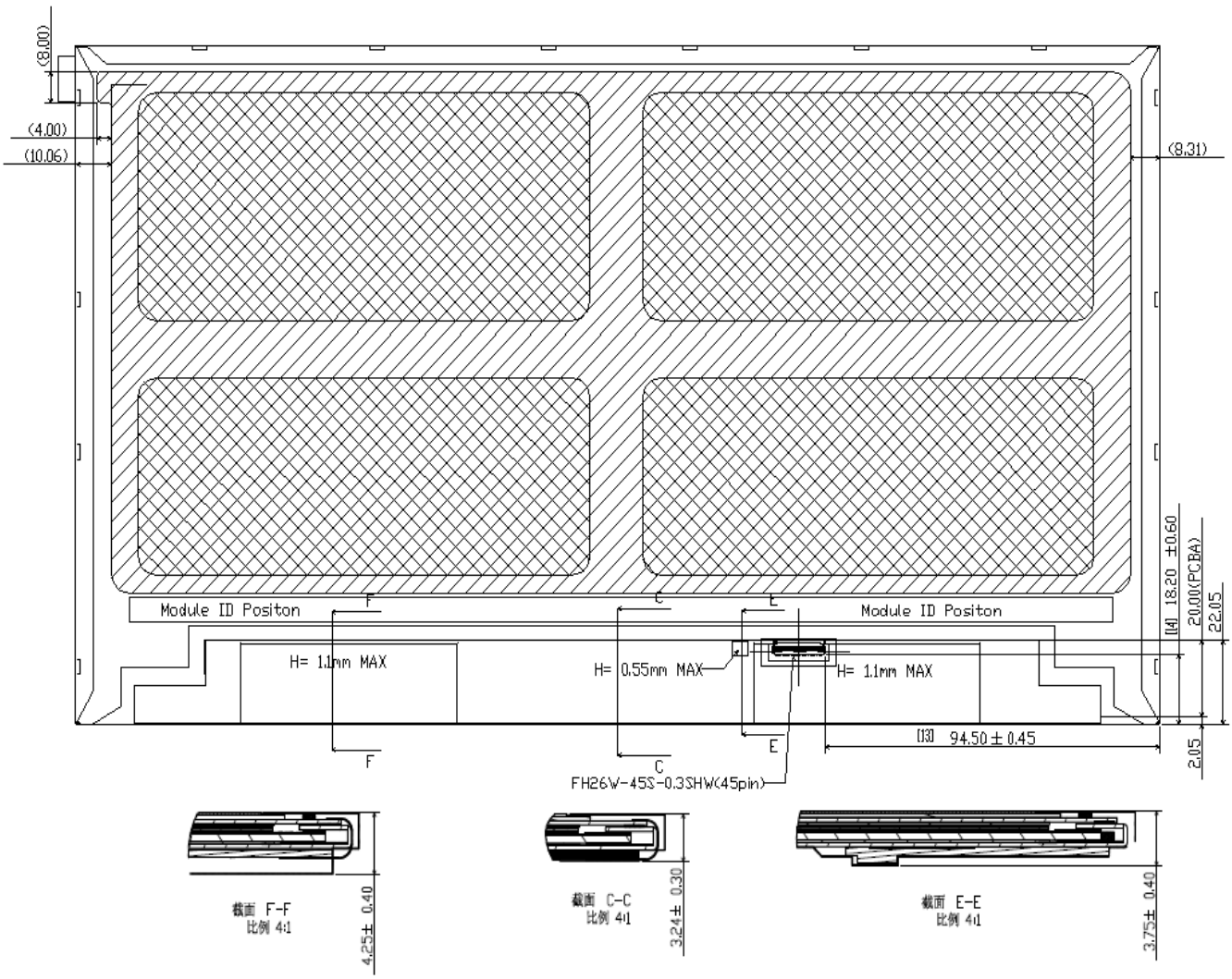


Figure 7. TFT-LCD Module Outline Dimensions (Rear view)



Pin Number		Pin Number		Pin Number		Pin Number	
1	VDD	13	eDP_RX0P	25	GND	37	LEDA2
2	VDD	14	GND	26	NC	38	LEDA3
3	VDD	15	eDP_RX1N	27	NC_SCL	39	LEDA4
4	VDD	16	eDP_RX1P	28	NC_SDA	40	LEDA5
5	NC	17	GND	29	GND	41	NC
6	ID	18	eDP_RX2N	30	LED_PWMIN	42	VLEDB
7	NC_AGING	19	eDP_RX2P	31	LED_PWMOU	43	VLEDB1
8	GND	20	GND	32	LEDB1	44	VLEDA2
9	AUX_N	21	eDP_RX3N	33	LEDB2	45	VLEDA1
10	AUX_P	22	eDP_RX3P	34	LEDB3		
11	GND	23	GND	35	LEDB4		
12	eDP_RX0N	24	DP_HPD	36	LEDA1