TITLE : TV097QXM-NU0 Product Specification

Rev.P1

BEIJING BOE OPTOELECTRONICS TECHNOLOGY

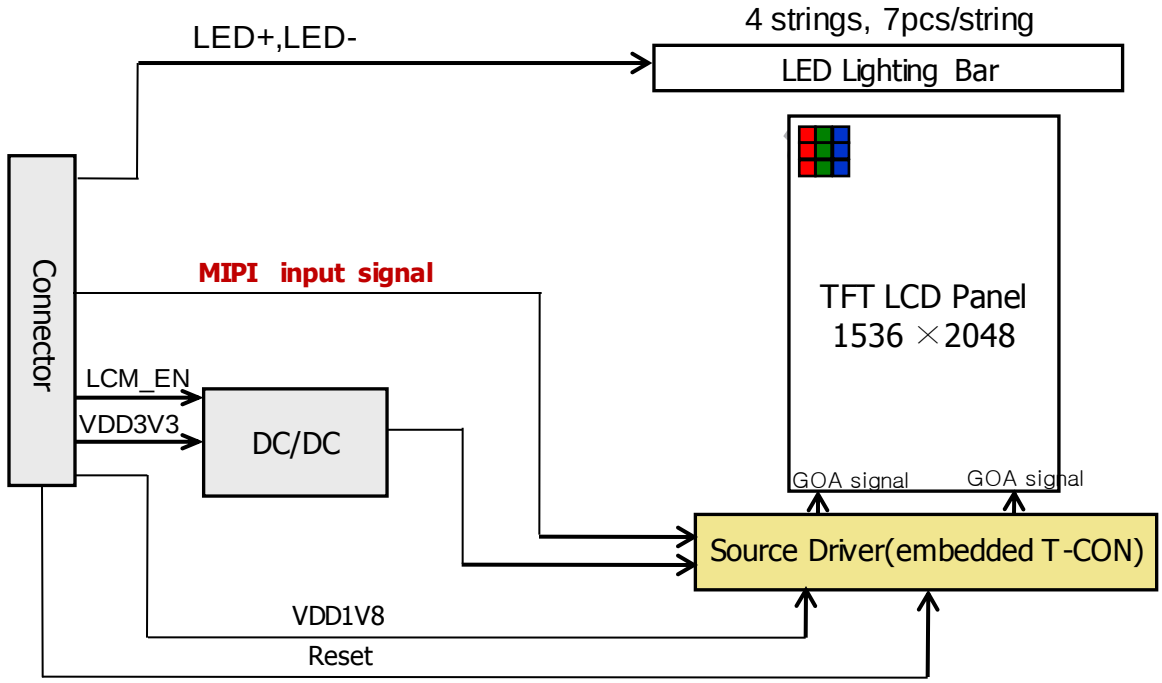
REV.	ECN NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0	-	Initial Release	2016.5.30	
P1	-	Pin map, Optical update	2016.7.30	

Contents

1.0 General Description

1.1 Introduction

TV097QXM-NU0 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 9.7inch diagonally measured active area with WQXGA resolutions (1536 horizontal by 2048 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

- 8lanes MIPI Interface
- Thin and light weight
- Data enable signal mode
- 8-bit color depth, display 16.7M colors
- Low driving voltage and low power consumption
- RoHS Compliant

1.3 General Specification

The followings are general specifications at the model TV097QXM-NU0. (listed in Table 1.)

Parameter·	Specification	Unit	Remarks
LCD Size	9.7	inch	-
Active area	147.456 x196.608	mm	-
Number of pixels	1536*2048	pixels	-
Pixel pitch	32*96	um	-
Pixel arrangement	RGB	-	-
Display colors	16.7M	colors	-
Display mode	Normal black	-	-
LCM Outline Dimension	152.536 x 206.548x1.95Typ.)	mm	Warpage≤0.4mm
NTSC	72%	-	-
Inversion Type	Column-Inv	-	
Response Time	Max. 30ms	ms	
Power Consumption (Max) @White pattern	Panel Power800mW BLU Power:3530mW	mW	W/O LED Driver
CR	Typ. 1000 Min:800		
Brightness	Typ:460 Min:415	nits	@center
Brightness Uniformity（13Point）	Min.70%@13points, Min.80%@9points	-	
Viewing angle (CR≧10)	Min:85/85/85/85		
LCM Weight	110(Max.)	gram	-

2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The recommended operating conditions are listed in Table 2.1.

Item		Symbol	Values			Unit	Remark
			Min	Typ	Max		
Power Supply Voltage		AVDD	-0.3	5.5	6.6	V	
		AVEE	-0.3	-5.5	-6.6	V	
		VCC	-0.3	1.8	5.5	V	
Ripple Voltage		V_{RP}	-	50	-	mV	
LEDPWM OUT	High Level	VOH	0.8VDD1V8	-	VDD1V8	V	VDD1V8= 1.65~3.6V
	Low Level	VOL	0		0.2VDD1V8	V	
Frame frequency		Frame		60		HZ	
Rising Input High Threshold Voltage Level		LCM_EN_H	1.65	1.8	3.6	V	
Falling Input High Threshold Voltage Level		LCM_EN_L	0	-	0.4	V	

2.1 Power Consumption of TFT Panel

Power Supply: Frame Frequency: Fframe =60HZ @ 25degC,

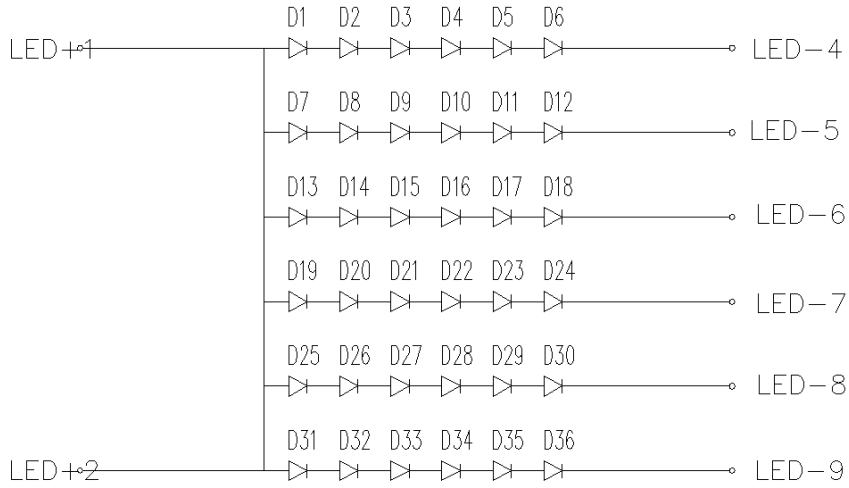
Display Mode	Item	Symbol	Value			Unit	Remark
			Min	Typ	Max		
Display White	Power Supply	VCC	1.65	1.8	3.3	V	
	Current of IOVCC	I_{VDD1V8}	40	45	50	mA	
	Power Supply	AVDD	4.6	5.5	6.6	V	
	Current of VDD	I_{AVDD}	15	20	25	mA	
	Power Supply	AVEE	-4.6	-5.5	-6.6		
	Current of VDD	I_{AVEE}	15	20	25		

2.2 Power Consumption of Backlight

Test Condition : ILED=21mA LED 36PCS
Warning: LCM Brightness must match Optical Spec requirement when ILED=21mA
Backlight Unit Schematic:

Item	Symbol	Value			Unit	Remark
		Min	Typ	Max		
Forward Voltage Per LED	VF	19.6	20.3	21	V	IF=21mA
Forward Current Per LED	IF	-	84	-	mA	
Power Consumption	PLED	-	-	1.764	W	Note 5
LED Quantity		36			Pcs	

Note 5 : When ILED=21mA, the VBL must be in the range of above table specified.
The FPC wire resistance between LED+ and LED- must be less than 0.15ohm
PBL= ILEDX VBL



36(6S6P) WHITE LED DIAGRAM

3.0 INTERFACE CONNECTION

3.1 Module Input Signal & Power

- FPC Signal interface：61 Pin.(Hirose FH36W-61S-0.3SHW(50))

<Table 4. 1Display Interfacer>

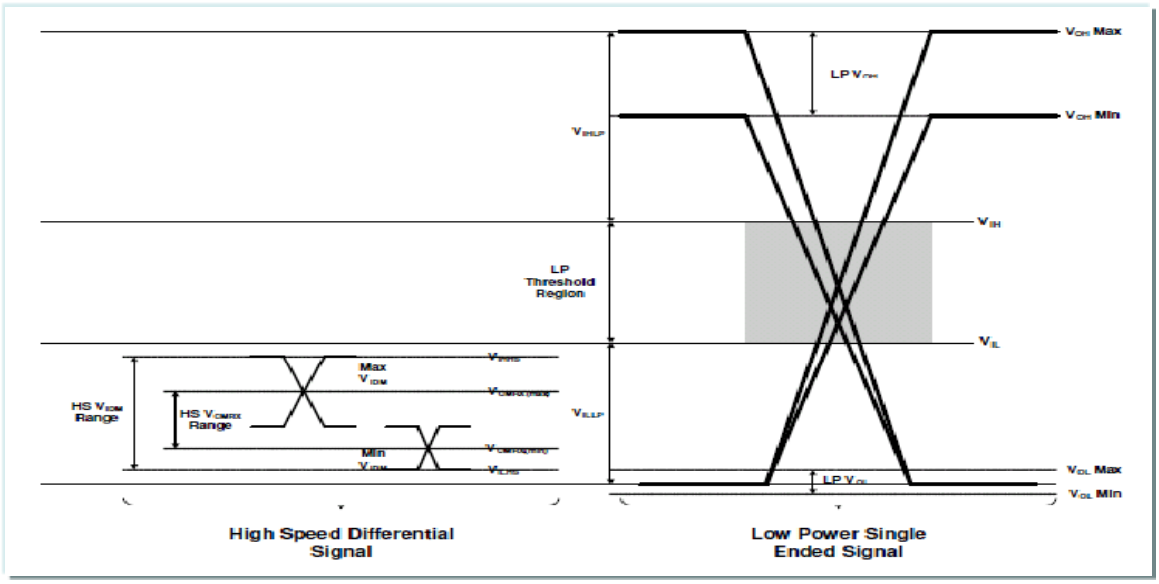
Pin No.	Symbol	Description	Remark
1	TP_VSYS	3.7~4.2V input for TP	
2	TP_V18	1.8V input for TP.(Z500W: Report Switch)	
3	SCL	I2C clock (SCL) or SPI clock (SCLK)	
4	SDA	I2C data(SDA) or SPI data input(MOSI)	
5	INT	Spare GPIO (may be used for ATTN)	
6	RST	Dedicated active low extemal reset pin	
7	GND	Ground	
8	ID2(Tx:NC,Bx:GND)	No connection,please keep it floating(For LCM ID)	
9	AVEE	AVEE(-5.5V)	
10	AVEE	AVEE(-5.5V)	
11	NC	No connection,please keep it floating	
12	AVDD	AVDD(+5.5V)	
13	AVDD	AVDD(+5.5V)	
14	NC	No connection,please keep it floating	
15	LCM_V18	VDDIO/VREG_L14A(1.8V) for LCM	
16	LCM_V18	VDDIO/VREG_L14A(1.8V) for LCM	
17	DISP_RESET	Device reset signal for LCM(H:1.8V / L:0V)	
18	LEDPWM	PWM Control Signal For LED Driver (CABC)(H=1.8V L=0 V)	
19	ID0	0 ohm to GND(For LCM/TP ID)	
20	ID1	No connection,please keep it floating(For LCM ID)	
21	TE	TE to touch and CPU for H/V sync	
22	GND	Ground of LCM	
23	P_D0P	Pri-MIPI differential data0 input (Positive)	
24	P_D0N	Pri-MIPI differential data0 input (Negative)	
25	GND	Ground of LCM	

Pin No.	Symbol	Description	Remark
26	P_D1P	Pri-MIPI differential data1 input (Positive)	
27	P_D1N	Pri-MIPI differential data1 input (Negative)	
28	GND	Ground of LCM	
29	P_CLKP	Pri-MIPI differential clock input (Positive)	
30	P_CLKN	Pri-MIPI differential clock input (Negative)	
31	GND	Ground of LCM	
32	P_D2P	Pri-MIPI differential data2 input (Positive)	
33	P_D2N	Pri-MIPI differential data2 input (Negative)	
34	GND	Ground of LCM	
35	P_D3P	Pri-MIPI differential data3 input (Positive)	
36	P_D3N	Pri-MIPI differential data3 input (Negative)	
37	GND	Ground of LCM	
38	S_D0P	Sec-MIPI differential data0 input (Positive)	
39	S_D0N	Sec-MIPI differential data0 input (Negative)	
40	GND	Ground of LCM	
41	S_D1P	Sec-MIPI differential data1 input (Positive)	
42	S_D1N	Sec-MIPI differential data1 input (Negative)	
43	GND	Ground of LCM	
44	S_CLKP	Sec-MIPI differential clock input (Positive)	
45	S_CLKN	Sec-MIPI differential clock input (Negative)	
46	GND	Ground of LCM	
47	S_D2P	Sec-MIPI differential data2 input (Positive)	
48	S_D2N	Sec-MIPI differential data2 input (Negative)	
49	GND	Ground of LCM	
50	S_D3P	Sec-MIPI differential data3 input (Positive)	
51	S_D3N	Sec-MIPIdifferential data3 input (Negative)	
52	GND	Ground of LCM	
53	FB3	FB3	
54	FB6	FB6	
55	FB2	FB2	
56	FB5	FB5	
57	FB1	FB1	
58	FB4	FB4	
59	NC	No connection,please keep it floating	
60	LED+	Anode for light bar	
61	LED+	Anode for light bar	

4. Signal Timing Specifications

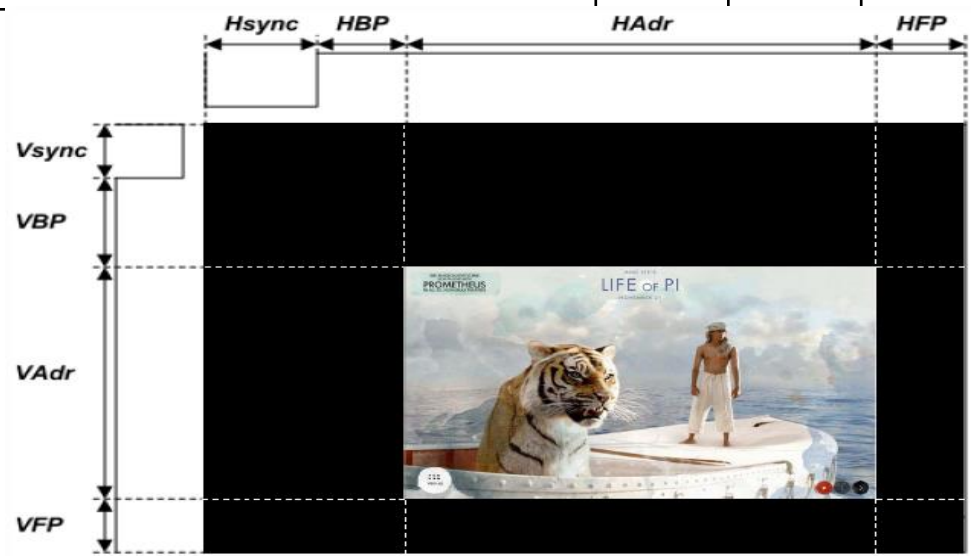
4.1 MIPI Input Signal SPEC

Parameter	Symbol	Min	Typ	Max	Unit	Condition
MIPI digital operation current	I_{VCCIF}	-	16	24	mA	-
MIPI digital stand-by current	$I_{VCCIFST}$	-	-	200	uA	-
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	V_{ILHS}	-40	-	-		
Single-ended input high voltage	V_{IHHS}	-	-	460	mV	
Common-mode voltage	V_{CMRXDC}	70	-	330	mV	
Differential input impedance	Z_{ID}	80	100	125	Ω	
HS transmit differential voltage(V_{OD}=V_{DP}-V_{DN})	$\|V_{OD}\|$	85	200	250	mV	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	880	-	1350	mV	
Ground shift	V_{GNDSH}	-50	-	50	mV	
Output low level	V_{OL}	-50	-	50	mV	
Output high level	V_{OH}	1.1	1.2	1.3	V	

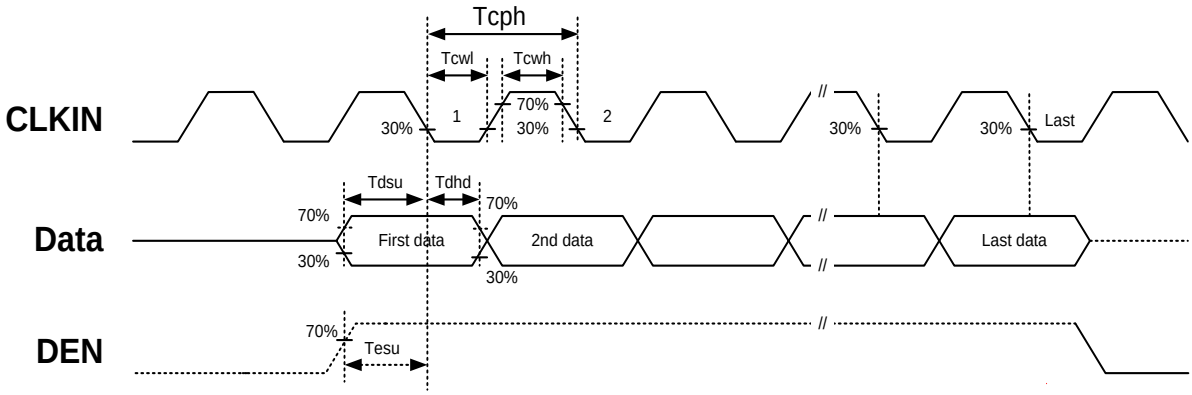


4.2 Signal Timing Spec

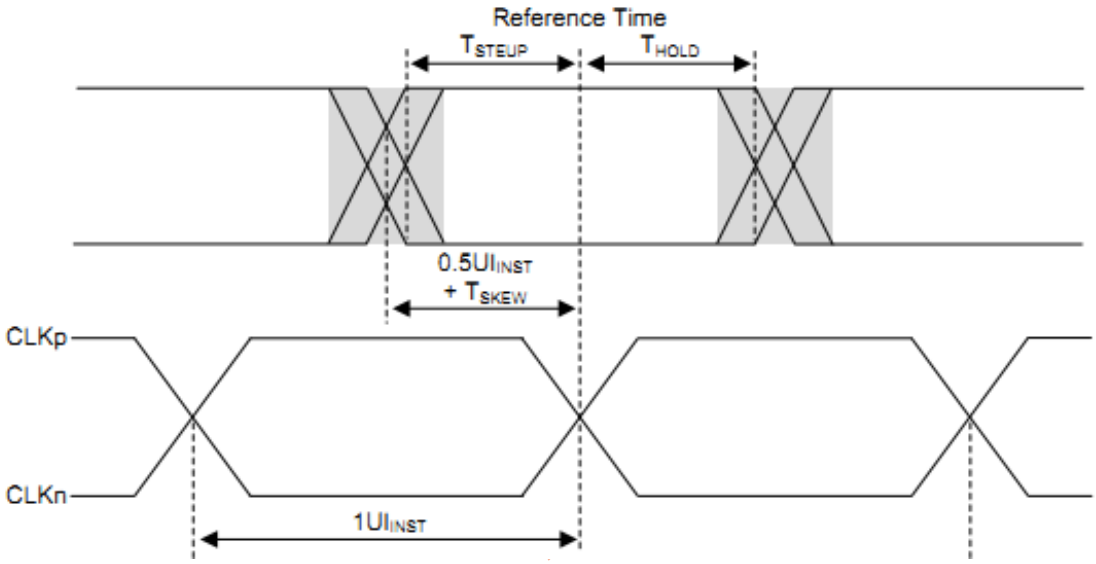
Item			SYNBOL	min	Typ.	Max.	UNIT
LCD	Frame Rate		-	-	60	-	Hz
	Pixels Rate		-		241.6464		MHz
Timing	DCLK	Frequency	fCLK		241.6464		MHz
		Period	Tclk		4.1382		ns
	Horizontal	Horizontal total time	tHP		1940		t_{CLK}
		Horizontal Active time	tHadr		1536		t_{CLK}
		Horizontal Pulse Width	tHsync		4		t_{CLK}
		Horizontal Back Porch	tHBP		200		t_{CLK}
		Horizontal Front Porch	tHFP		200		t_{CLK}
	Vertical	Vertical total time	tvp		2076		t_H
		Vertical Active time	tVadr		2048		t_H
		Vertical Pulse Width	tVsync		2		t_H
		Vertical Back Porch	tVBP		12		t_H
		Vertical Front Porch	tVFP		14		t_H
Bit Rate			TX SPD (MBPS)		725		Mbps
Lane					8		Lane



4.3 Signal Timing wave forms

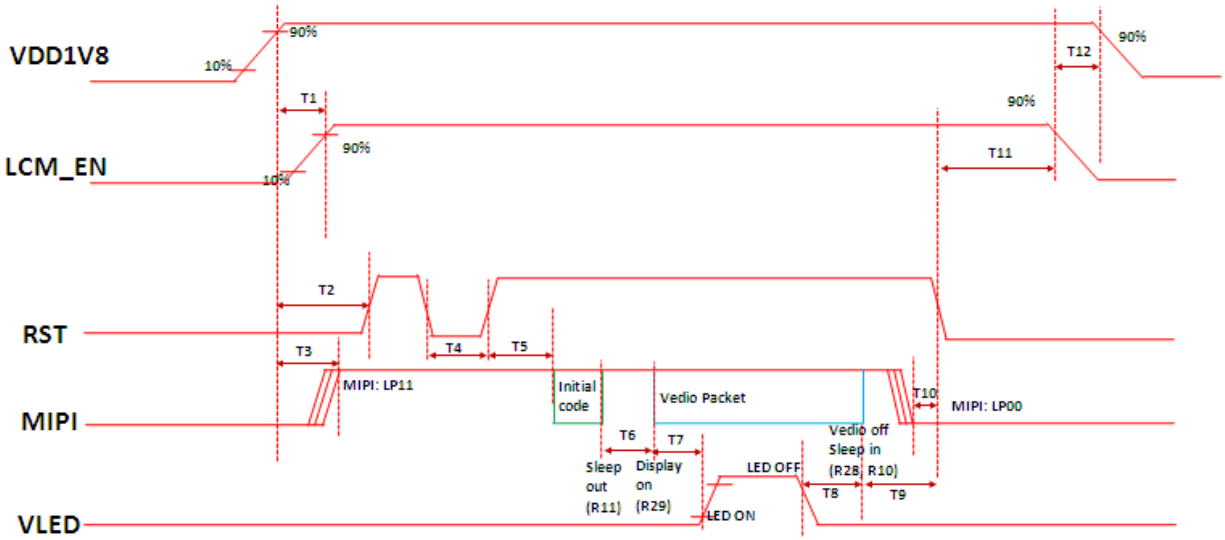


4.4 MIPI Data-Clock Timing Specifications



Clock Parameter	Symbol	Min	Typ	Max	Unit
UI instantaneous	UI_{INST}	2	-	5	ns
Data to Clock Setup Time[receiver]	$T_{SETUP[RX]}$	0.15			UIINST
Clock to Data Hold Time[receiver]	$T_{HOLD[RX]}$	0.15			UIINST
Data to Clock Skew	$T_{SKEW[TX]}$	-0.15	-	0.15	-

4.5 Power sequence (NT35523)



ITEM	Min	Typ	Max	Unit	Remark
T1	0	-	-	ms	
T2	15	-	-	ms	
T3	0	-	T2	ms	
T4	10	-	-	us	
T5	20	-	-	ms	
T6	120	-	300	ms	
T7	6	-	-	Frame	
T8	0	-	-	ms	
T9	100	-	-	ms	
T10	0	-	-	ms	
T11	0	-	-	ms	
T12	0	-	-		

5.0 Optical Specifications

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 (CA-310、BM-5A) 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 $\theta_{Ø=0}$ (=θ_3) as the 3 o'clock direction (the "right"), $\theta_{Ø=90}$ (= θ_{12}) as the 12 o'clock direction ("upward"), $\theta_{Ø=180}$ (= θ_9) as the 9 o'clock direction ("left") and $\theta_{Ø=270}$(= θ_6) as the 6 o'clock direction ("bottom"). While scanning θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed. The measurement shall be executed after 30 minutes warm-up period. VDD shall be 3.3V +/-10% at 25°C. Optimum viewing angle direction is 6 'clock.

Item		Symbol	Condition	Value			Unit	Note
				Min	Typ	Max		
luminance		Bp	θ=0 Φ=0	415	460	--	cd/m2	Note 3
Uniformity		△Bp13		70	--	--	%	Note 4
		△Bp5		80	--	--	%	
Viewing Angle	Left	θ_L	Cr≥10	85	--	--	deg	Note1
	Right	θ_R		85	--	--		
	Top	ψ_T		85	--	--		
	Bottom	ψ_B		85	--	--		
Contrast Ratio		Cr	θ=0 Φ=0	800	1000	--	-	Note 2
Response Time		Tr+Tf		--	--	30	ms	Note 7
		Tgray		-	--	--	--	
Color Coordinate of CIE1931	Red	x	θ=0 Φ=0	0.621	0.646	0.671	-	Note 5.6
		y		0.311	0.336	0.361		
	Green	x		0.298	0.323	0.348		
		y		0.586	0.611	0.636		
	Blue	x		0.117	0.142	0.167		
		y		0.033	0.058	0.083		
	White	x		0.269	0.294	0.319		
		y		0.29	0.315	0.34		

5.0 Optical Specifications

NTSC Ratio	NTSC	CIE1931	68	72	-	%	Note 5,6
Flicker	amount	-	-	-	-30	dB	
Gamma	-		2.0	2.2	2.4		
Crosstalk	△CT	-	-	-	2	%	

Note :

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 1point 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 luminance is measured by CA310 when the LED current is set at 21mA.

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4. The White luminance uniformity on LCD surface is then expressed as : △Bp13 = Minimum Luminance of 13points / Maximum Luminance of 13points ; △Bp9 = Minimum Luminance of 9points / Maximum Luminance of 9points (see FIGURE 2).

5. The color chromaticity coordinates specified 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 color chromaticity coordinates specified 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.

7. 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.

6.0 Reliability Test

No	Test Item	Test Condition	Remark
1	High temperature storage	70C/240h	-
2	Low temperature storage	-30C/240h	
3	High temperature/High humidity Storage	60C/90%RH/240h	
4	High temperature operating	60C/240h	
5	Low temperature operating	-10℃/240h	
6	High temperature/High humidity operating	60C/90%RH/240h	
7	Thermal Shock Storage	-30℃ (30 min)~ +70 ℃(30 min) , 27 cycles	

No	Other Test Item	Test Condition
1	Shock test	980m/s2,Action time: 6ms, Time: 3 times for each direction, Diretion:+/-X, +/-Y, +/-Z
2	Package Vibration test	Frequency range: 10-55Hz, stroke:1.5mm, swep time: 1 minute, test period: 2 hours for each direction of X, Y, Z
3	Package Drop test	Height: 60cm, 1 corner, 3 edges, 6 surfaces: 1 time for each direction
4	ESD test (Component-LCD MDL)	【HM Air】150pF, 330Ω,±15KV 【HM Contact】150pF,330Ω,±8KV SPEC.: No abnormal display

7.0 LABEL

(1) Product label

贴附位置：背板

标签尺寸：12mm × 12mm, 厚度：0.0

打印信息如下：

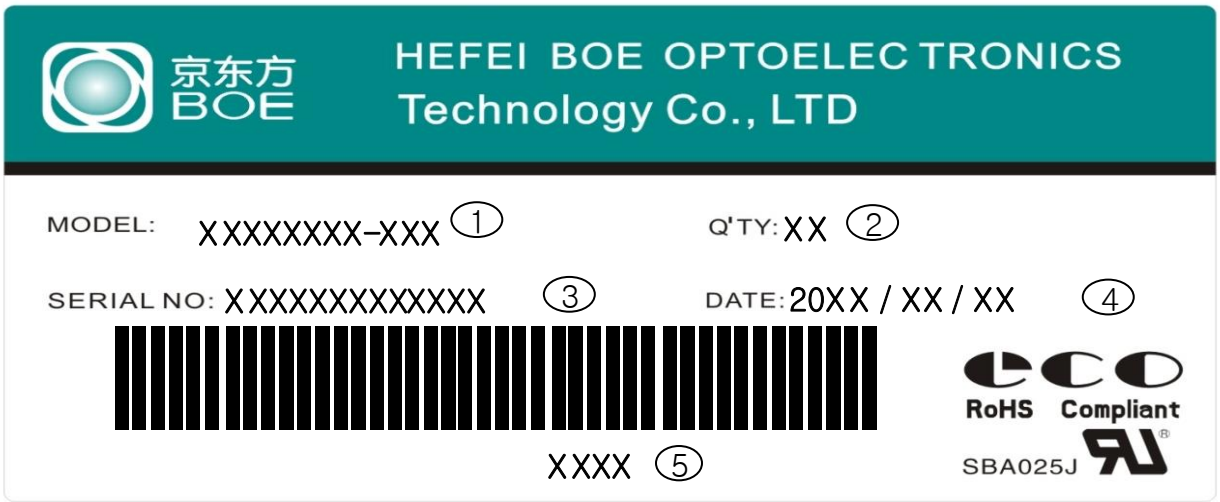
1. FG-CODE：TV097QXM-NU0
2. MDL ID（编码规则如下）
3. 日期

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
代码	X	X	P	3	5	A	7	3	9	P	0	0	0	1	E	E	J
描述	GBN 代码		等级	B3 工厂	年	月	日	FG Code后四位				流水码 36进制(无I 和 O)					

年：2015—5，2016—6 …… 2020---0，2021---1…..
月：1~12月→ 1~9，A，B，C
日：1~31 → 1~9，A~V

(2) Box label

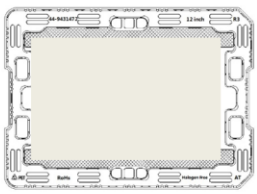
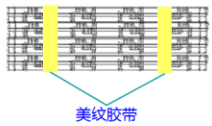
Label Size: 110 mm (L) × 56 mm (W)
Contents
Model: TV097QXM-NU0
Q`ty: Module Q`ty in one box
Serial No.: Box Serial No. See next figure for detail description.
Date: Packing Date
Internal use of Product

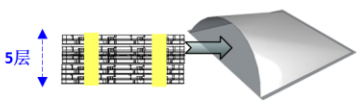
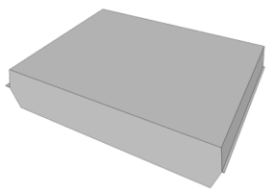
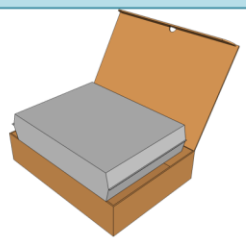


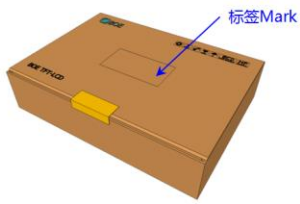
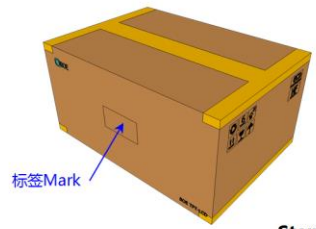
1. **FG-CODE**
2. **Box 产品数量**
3. **Box ID, 编码规则如下**
4. **Box Packing 日期**
5. **FG-CODE 后四位**

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13
代码	X	X	P	3	1	5	C	0	0	0	1	H	D
描述	GBN 代码		等级	B3 工厂	年		月	版本号	流水码 36进制(无I 和 O)				

8.0 Packing information

将MDL放入到Tray中，每个Tray上放一张Spacer。 1 MDL/ Tray	将盛装MDL的Tray叠码6层，然后加放1个Tray作盖。 6 MDL/7 Tray	用美纹胶带延平行于Tray的宽边方向捆绑两道，每道至少缠绕胶带3圈。（捆绑前确认Tray是否互旋180°）
 Step 1	 Step 2	 Step 3

将7层 Tray放入一个Shielding Bag。 6 MDL/Shielding Bag	使用抽真空封口机进行抽真空封口。	将封好口的一包产品放入一个Inner Box。 6 MDL/Inner Box
 Step 4	 Step 5	 Step 6

用封箱胶带对Inner Box进行封箱，并在Box的Mark处粘贴相应标签。	将封好的Inner Box装入Outer Box。 6 Inner Box/Outer Box	采用“H”形封箱方式，对Box进行封箱，并在Box的Mark处粘贴相应标签。 36 MDL/Outer Box
 Step 7	 Step 8	 Step 9

在Pallet上放一个Dual Cover，按“田”字型对Outer Box进行码拍。 12 Outer Box/Pallet	四角插上Paper Corner，套上Dual Cover，用打包带打包，并粘贴相应标签。 432 MDL/Pallet
 Step 10	 Step 11

9.0 Handing & 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.

10. MECHANICAL OUTLINE DIMENSION

Figure 12. LCM Module Outline Dimension (Front View)

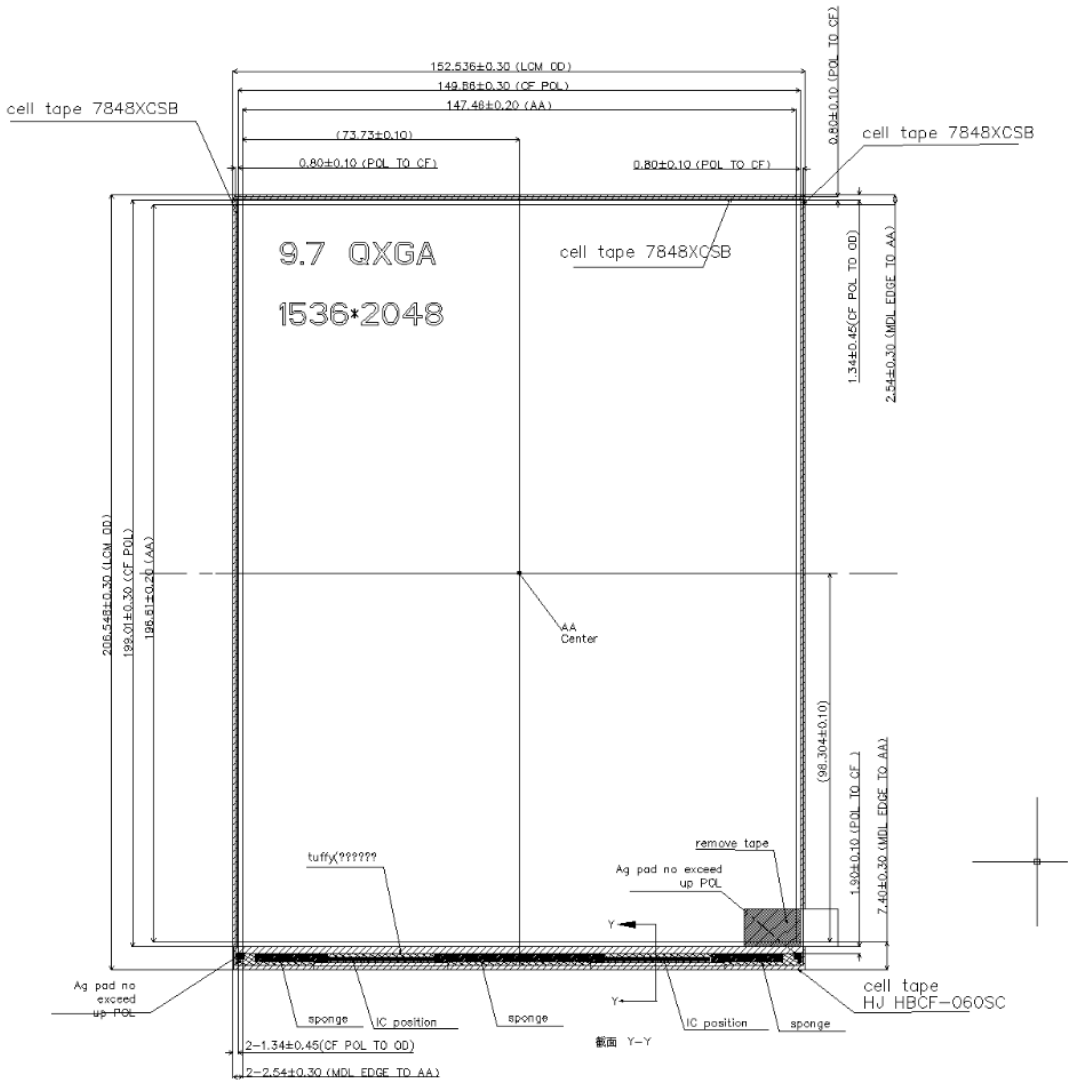


Figure 13. TFT-LCD Module Outline Dimensions (Rear view)

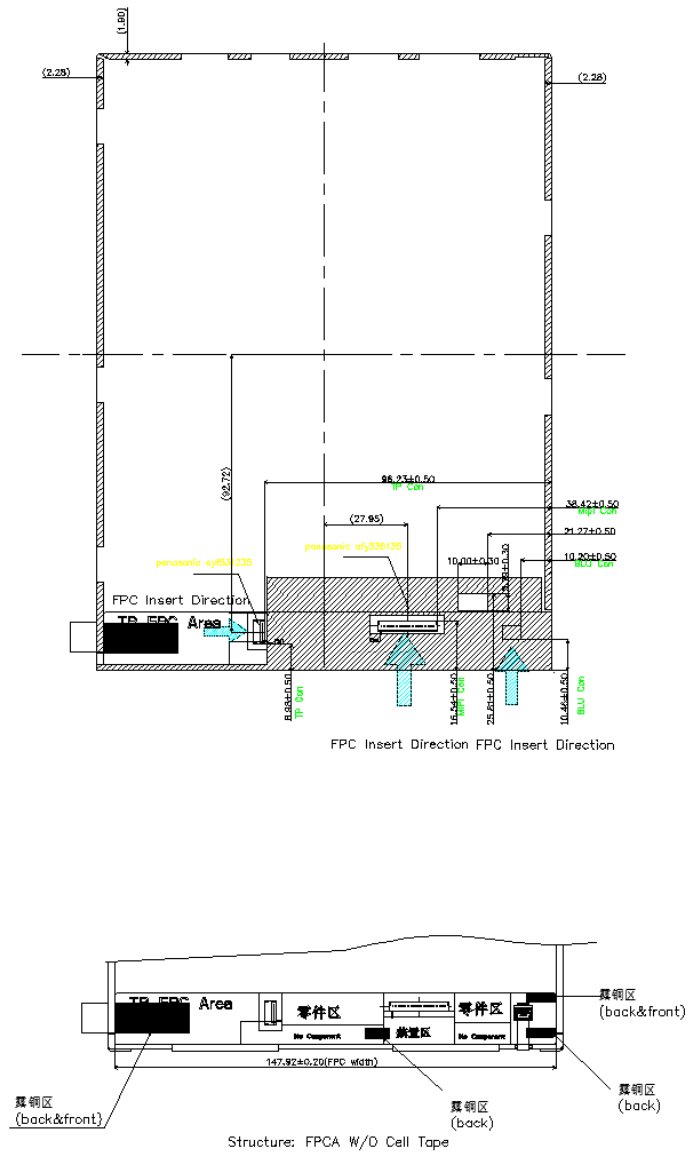


Figure 14. Back Light Unit Outline Dimensions (Front view)