B4 TV101WUM-NS1 Product Specification Rev.P0

BUYER	SEC
SUPPLIER	BEIJING BOE DISPLAY Technology CO., LTD
FG-Code	TV101WUM-NS1-4850

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

BEIJING BOE DISPLAY TECHNOLOGY

REVISION HISTORY

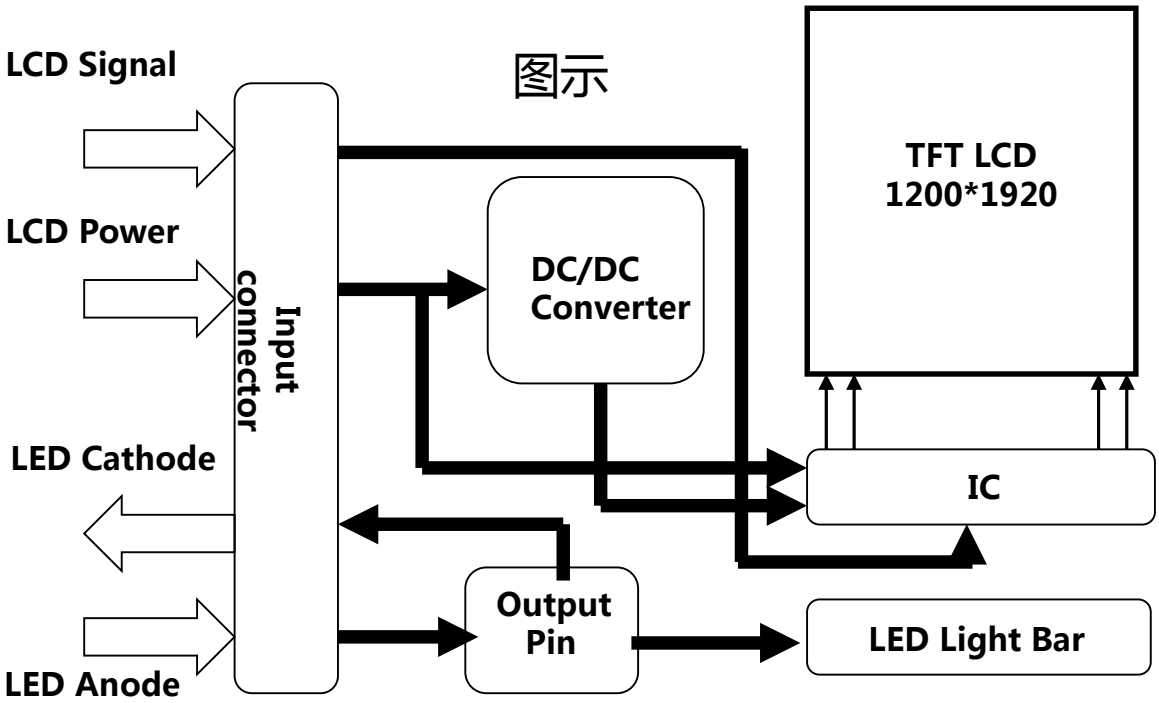
REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2017-2-10	张夺

Contents

1.0 GENERAL DESCRIPTION

1.1 Introduction

TV101WUM-NS0 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 10.1 inch diagonally measured active area with WUXGA resolutions (1200 horizontal by 1920 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.



1.2 Features

- 4 Lane MIPI Interface;
- 8-bit color depth, display 16.7M colors
- Thin and light weight
- High luminance and contrast ratio, low reflection and wide viewing angle
- RoHS compliant

1.3 Application

- Tablet PC

1.4 General Specification

The followings are general specifications at the model TV101WUM-NS0

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	135.36(H)*216.576(V)	mm	
Number Of Pixels	1200(H)×1920(V)	pixels	
Pixel Pitch	0.0376(H)×RGB×0.1128(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally Black		
Display Colors	16.7M(8bits)	colors	
Surface Treatment	Upper POL : AGLR Bottom POL : APF 3H		
Contrast Ratio	900:1(typ.)		
Viewing Angle(CR>10)	85/85/85/85(Typ.)	deg.	CR 10 : 1
Response Time	35(Max.)	ms	
Color Gamut	70.8%(Typ.)		(C.I.E 1931)
Brightness	360(M in)/450(Typ.)/540(Max.)	cd/m2	
Brightness Uniformity	9 point: min 80%		
Power Consumption	LCD: 0.35(Max.)(White Pattern) BLU: 2.377W(Max.)(w/o Driver)	watt	
Outline Dimension	142.32(H) x 227.376(V)	mm	
Weight	129(Typ.)136(Max)	gram	

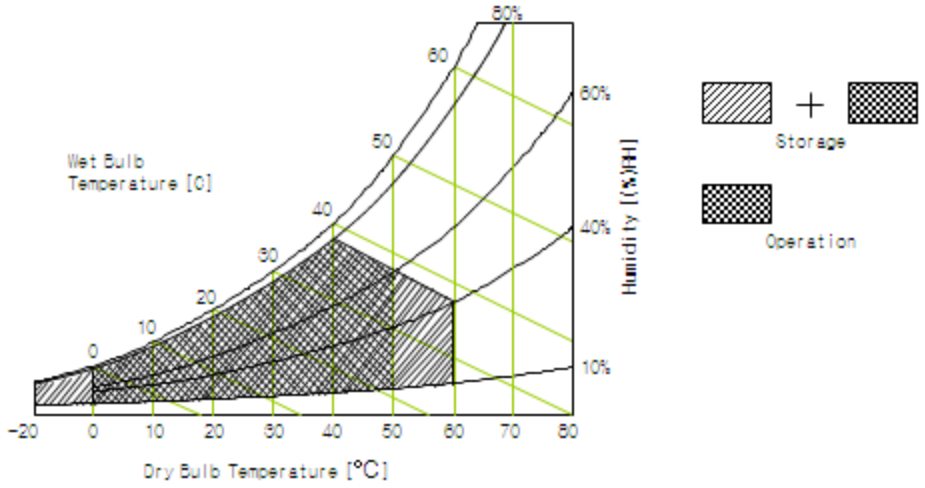
2.0 ABSOLUTE MAXIMUM RATINGS

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

< Table 3. Absolute Maximum Ratings>

Parameter		Symbol	Min.	Max.	Unit	Remarks
Power Supply	LCD Module	VSP	-0.3	6.6	V	Ta = 25 ℃
		VSN	-6.6	0.3	V	
		IOVCC	-0.3	2.1	V	
	BLU	VLED	26.1	27	V	
		ILED	86	86	mA	
	TP	-	-	-	-	
		-	-	-	-	
Operating Temperature		TOPR	-20	+85	℃	Note 1
Storage Temperature		TSTG	-55	+125	℃	
Operating Ambient Humidity		Hop	10	90	%RH	
Storage Humidity		Hst	10	90	%RH	

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

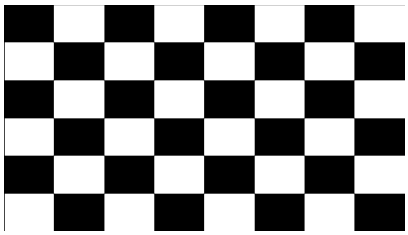
3.1 TFT LCD Module

< Table 4. LCD Module Electrical specifications > [Ta =25±2 ℃]

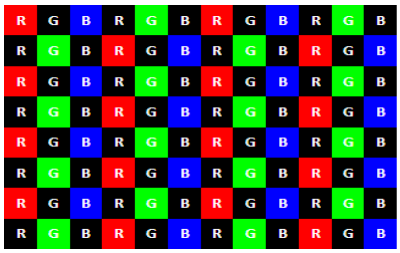
Parameter		Symbol	Values			Unit	Notes
			Min.	Typ.	Max.		
Power Supply Voltage		VDD	1.7	1.8	2.0	V	
		VSP	4.5	5.8	6.0	V	
		VSN	-4.5	-5.8	-6.0	V	
Power Supply Current		VDD	-	43	51	mA	Note 1
		VSP		24	86	mA	
		VSN	-	20	83	mA	
Power Consumption		PLCD	-	332	1072	mW	
Rush current		IRUSH	-	-	3.0	A	Note 2
CMOS Interface	Input Voltage	VIH	2.7		3.3	V	
		VIL	0		0.5	V	
	Output Voltage	VOH	2.7		3.3	V	
		VOL	0		0.5	V	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VDDIO=1.8V, Frame rate f_V=60Hz and Clock frequency = 159.61MHz. Test Pattern of power supply current

a) Typ : Mosaic 8 x 6 Pattern(L0/L255)



b) Max : skip 1H1V dot(L0/L255)



2. The duration of rush current is about 2ms and rising time of Power Input is 1ms(min)

3.2 Back-Light Unit

Table 5. LED Driver Electrical Specifications > [Ta =25±2 ℃]

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED Supply Voltage	VLED	23.4	27	27.9	V	Note 1
	VRP			300	mV	Ripple
LED Forward Current	ILED	-	85.2		mA	
Power Consumption	PLED	1.99	2.3	2.38	W	
LED Quantity	QLED	-	36	-	EA	
LED Life Time	TLED	15000	-	-	Hrs	Note 2

Notes: 1. PLED = VLED ×ILED (Without LED converter transfer efficiency)

2. The life time of LED, 10,000Hrs, is determined as the time at which luminance of the LED is 50% compared to that of initial value at the typical LED current on condition of continuous operating at 25 ± 2°C.

3.4 INPUT TERMINAL PIN ASSIGNMENT

This LCD employs two interface connections, a 34 pin ZIF connector is used for the LCD module electronics interface and a 9 pin ZIF connector is used for the internal backlight system.

3.4.1 Pin assignment for LCD module

Connector : FH34SRJ-34S-0.5SH_34P (Hirose) or equivalent

< Table7. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description	I/O
1	VSP	Power Supply 5.8V	I
2	VSP	Power Supply 5.8V	I
3	NC	NC	-
4	VSN	Power Supply -5.8V	I
5	VSN	Power Supply -5.8V	I
6	NC		-
7	VDD1V8	Power Supply 1.8V	I
8	VDD1V8	Power Supply 1.8V	I
9	PWM	PWMOUT	O
10	RESET	LCM RESET	I
11	GND	GROUND	P
12	D2P	MIPI Differential Data Input	P
13	D2N	MIPI Differential Data Input	P
14	GND	GROUND	P
15	D1P	MIPI Differential Data Input	P
16	D1N	MIPI Differential Data Input	P
17	GND	Ground	P
18	CLKP	MIPI Differential Clock Input	P
19	CLKN	MIPI Differential Clock Input	P
20	GND	Ground	P
21	D0P	MIPI Differential Data Input	P
22	D0N	MIPI Differential Data Input	P
23	GND	Ground	P
24	D3P	MIPI Differential Data Input	P
25	D3N	MIPI Differential Data Input	P

Pin No.	Symbol	Description	I/O
26	GND	Ground	P
27	LB1	LED Cathode(-)	I
28	LB2	LED Cathode(-)	I
29	LB3	LED Cathode(-)	I
30	LB4	LED Cathode(-)	I
31	NC	NC	-
32	VLED	LED Anode(+)	I
33	VLED	LED Anode(+)	I
34	NC	NC	-

3.4.2 Pin assignment for LED Bar

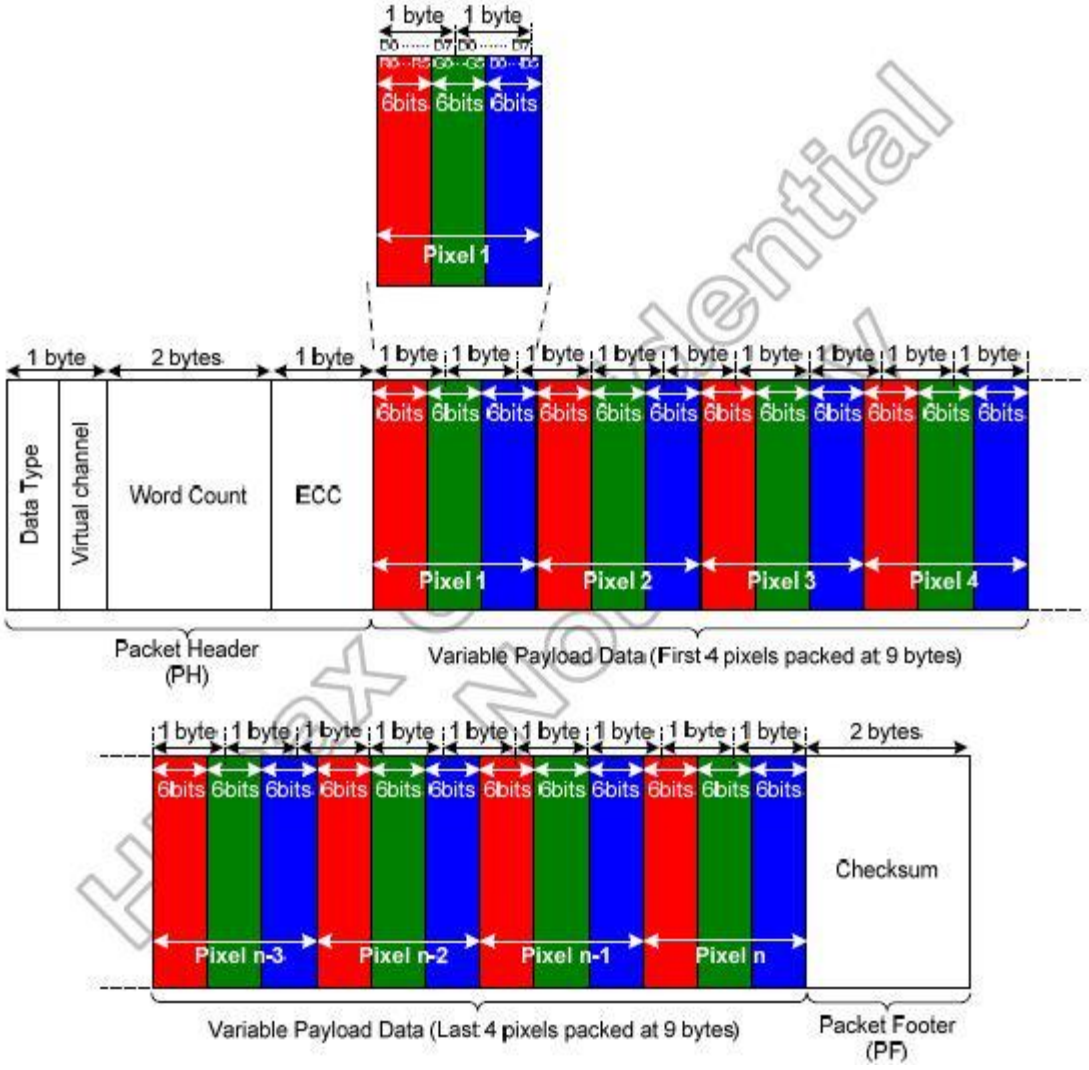
Connector : PF040-B09B-C09 (UJU) or equivalent

< Table8. Pin assignment for LED Bar >

Pin No	Symbol	Description	Remarks
1	NC	NC	
2	VLED	LED Anode Power Supply	
3	VLED	LED Anode Power Supply	
4	NC	NC	
5	FB4	LED Cathode Power Supply	21.3mA
6	FB3	LED Cathode Power Supply	21.3mA
7	FB2	LED Cathode Power Supply	21.3mA
8	FB1	LED Cathode Power Supply	21.3mA
9	NC	NC	

3.5 MIPI Interface Characteristic

3.5.1 Data Format

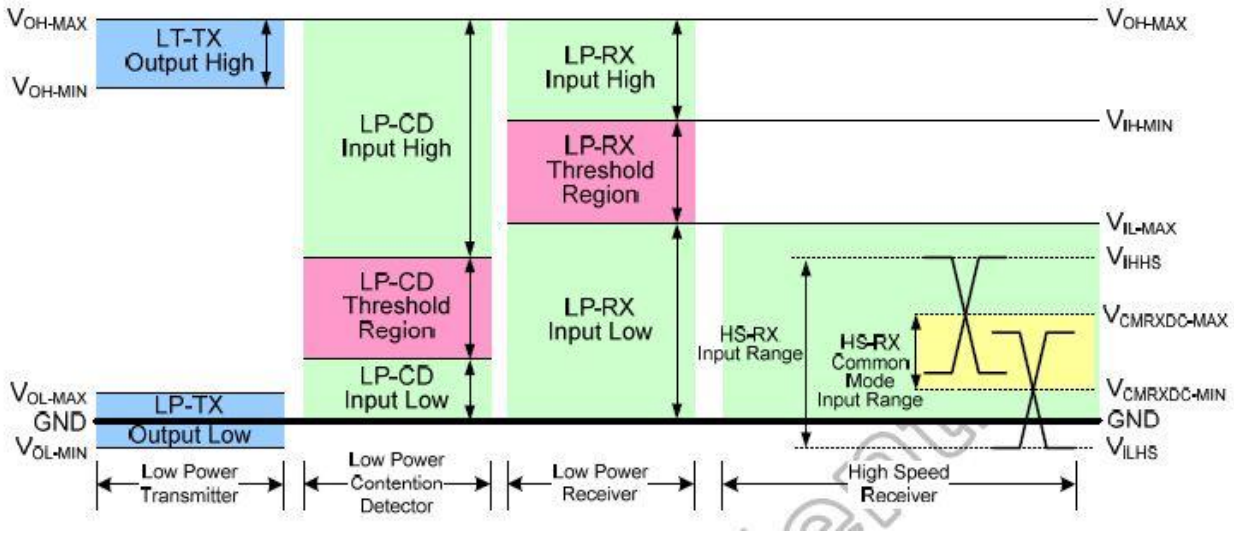


< MIPI Tx Data Configuration >

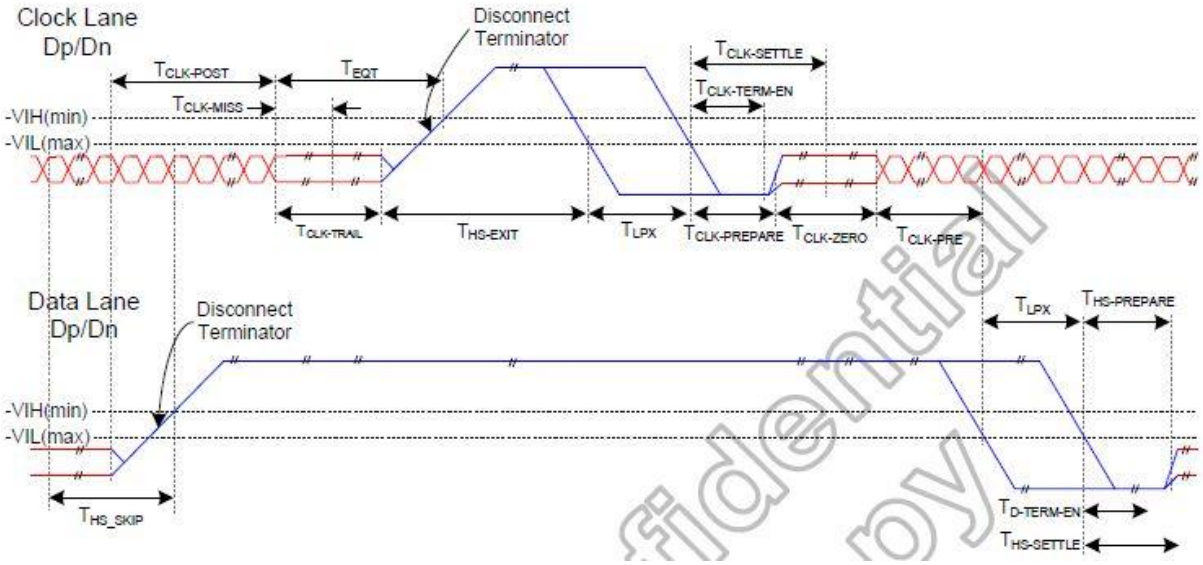
3.5.2 DC Specification

< Table11. DC Specification >

Parameter	Symbol	Min	Typ	Max	Unit	Condition
MIPI digital operation current	I_{VCCIF}	-	-	-	mA	
MIPI digital stand-by current	$I_{VCCIFST}$	-	-	-	uA	
MIPI Characteristics for High Speed Receiver						
Single-ended input low voltage	V_{ILHS}	-40	-	-	mV	
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($V_{OD}=V_{DP}-V_{DN}$)	$\|V_{OD}\|$	140	200	270	mV	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	-	-	-	mV	
Ground shift	V_{GNDSH}	-	-	-	mV	
Output low level	V_{OL}	-50	-	50	mV	
Output high level	V_{OH}	1.1	1.2	1.3	V	



3.5.3 AC Specification

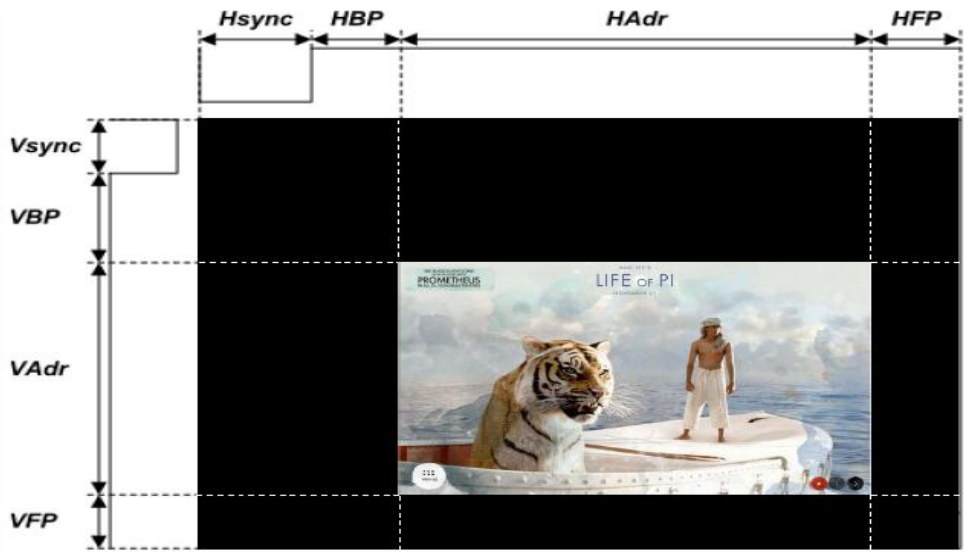


< Switching the clock lane between clock transmission and low-power mode >

3.6 Interface timing Parameter

< Table13. Timing Parameter >

Item			Symbol	min	typ	max	UNIT
LCD	Frame Rate		-	-	60	-	Hz
	Pixels Rate		-	-	156	-	MHz
Timing	DCLK	Frequency	fCLK	-	468	-	MHz
		Period	Tclk	-	2.14	-	ns
	Horizontal	Horizontal total time	tHP	-	1340	2047	t_{CLK}
		Horizontal Active time	tHadr		1200		t_{CLK}
		Horizontal Pulse Width	tHsync	-	24	-	t_{CLK}
		Horizontal Back Porch	tHBP	-	80	-	t_{CLK}
		Horizontal Front Porch	tHFP	-	60	-	t_{CLK}
	Vertical	Vertical total time	tvp	-	1944	2047	t_H
		Vertical Active time	tVadr		1920		t_H
		Vertical Pulse Width	tVsync	-	2	-	t_H
		Vertical Back Porch	tVBP	-	10	-	t_H
		Vertical Front Porch	tVFP	-	14	-	t_H
Bit Rate			TX SPD (Mbps)	980	980	995	Mbps
Lane				-	4	-	Lane

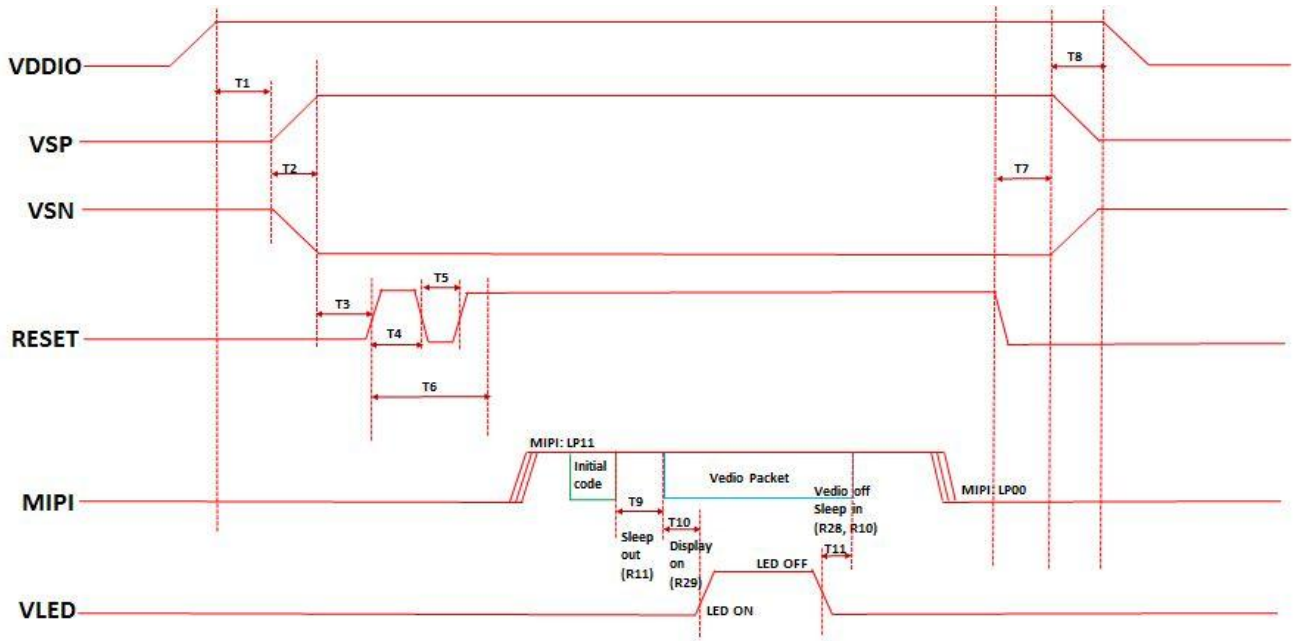


3.7 Input Color Data Mapping

< Table14. Input Signal and Display Color Table >

Color & Gray Scale		Input Data Signal																							
		Red Data								Green Data								Blue Data							
		R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	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
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Cyan	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Red	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Magenta	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	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	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	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
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	▽	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	1	1	0	0	0	0	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
	△	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	▽	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	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	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	▽	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
Gray Scale of White	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	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
	Darker	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0
	△	↑								↑								↑							
	▽	↓								↓								↓							
	Brighter	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1
	▽	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1

3.8 Power Sequence



< Table15. Sequence Table >

Item	Time	Unit	Remark
T1	>0	ms	
T2	1	ms	
T3	>5	ms	
T4	>=0	ms	
T5	>=0	ms	
T6	>6	ms	
T7	>0	ms	
T8	>0	ms	
T9			
T10			
T11			
T12			
T13			
T14			

4.0 OPTICAL SPECIFICATIONS

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 (Gonio meter 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 θ and/or Ø, the center of the measuring spot on the Display surface shall stay fixed.

4.2 Optical Specifications

< Table16. Optical Table >

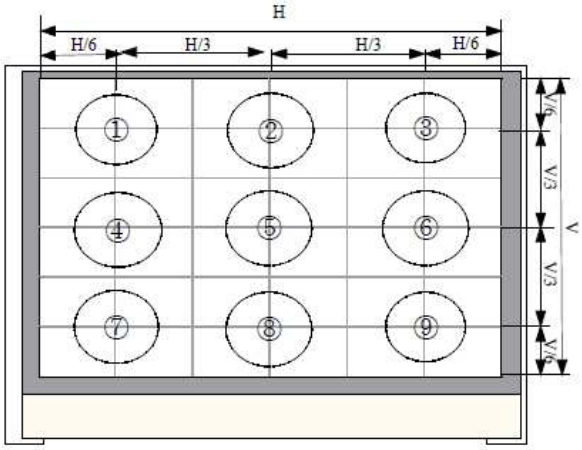
Item	Symbol		Condition	Min	Typ.	Max	Unit	Note
luminance	Bp		θ=0°	360	450	540	cd/m2	Note 1
Brightness Uniformity	△Bp			80	--	--	%	Note 2
Viewing Angle	Horizontal	Θ_3	CR > 10	85	--	--	deg	Note 3
		Θ_9		85	--	--		
	Vertical	Θ_{12}		85	--	--		
		Θ_6		85	--	--		
Contrast Ratio	Cr		θ=0°	700	900		-	Note 4
Response Time	T_{RT}		Ta= 25° C Θ = 0°	--	--	35	ms	Note 5
Color Coordinate of CIE1931	**Rx**		θ=0°	0.610	0.640	0.670	-	Note 6
	Ry			0.300	0.330	0.360		
	Gx			0.270	0.300	0.330		
	Gy			0.570	0.600	0.630		
	Bx			0.120	0.150	0.180		
	By			0.030	0.060	0.090		
NTSC Ratio	NTSC		CIE1931	65	70.8	--	%	Note 7
Color Temperature	CT			6450	6950	7650		
Flicker	amount		-	-	-	10%	dB	Note 8
Gamma	-			2.15	2.4	2.65		Note 9

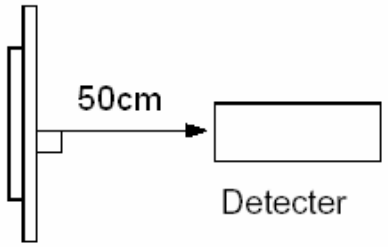
Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Crosstalk	△CT	-	-	-	1.0		Note 10
Reflectance	Rf	@550nm				%	Note 11
Polarization Direction of Front Polarizer	PdF			0°		deg	Note 12
Polarization Direction of Rear Polarizer	PdR			90°		Deg	
Contrast decrease ratio		θL=30°			70	%	Note 13
		θR=30°			70	%	
		ψT=30°			70	%	
		ψB=30°			70	%	
Color shift		θL=30°			3	JNCD	Note 14
		θR=30°			3	JNCD	
		ψT=30°			3	JNCD	
		ψB=30°			3	JNCD	
CABC Test							Note 15

Note1:Luminance measurement

The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.

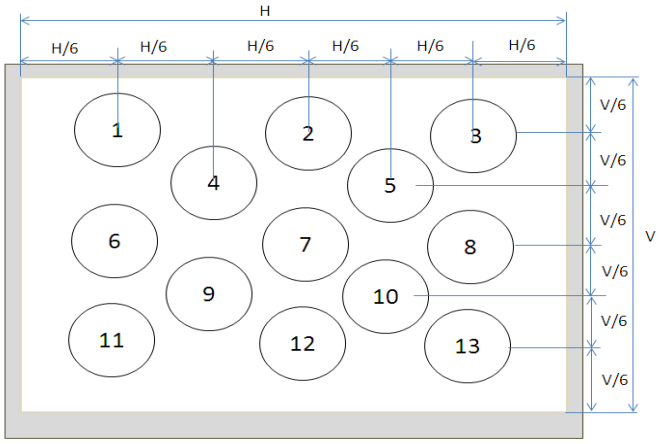
- The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the average value of 9 measured spots. Measurement equipment CS2000 or si milar equipments(Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25℃.
- Adjust operating voltage to get optimum contrast at the center of the display.
- Measured value at the center point of LCD panel must be after more than 5 minutes while backlight



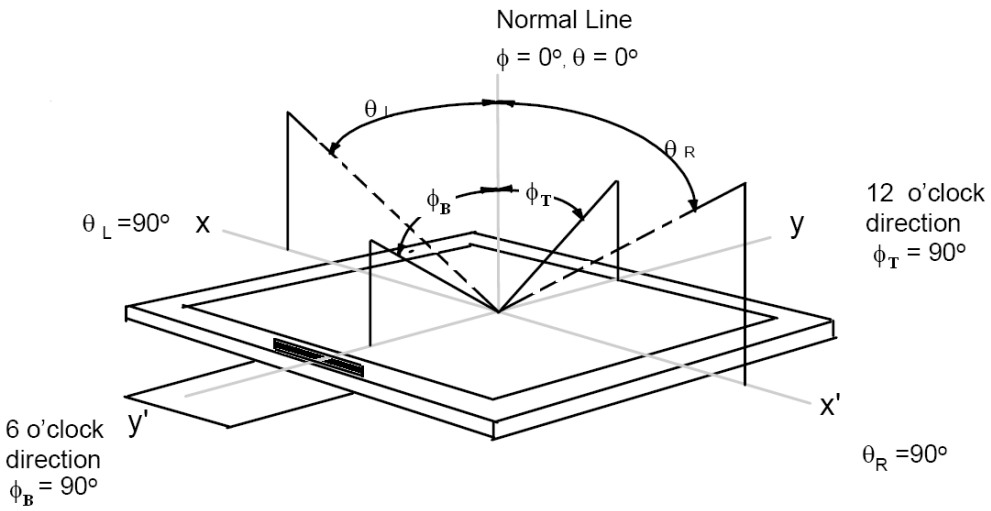


Note2:Uniformity

- The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.
- Measurement equipment:CS2000 or similar equipments
- The luminance uniformity is calculated by using following formula:
- △Bp = Bp (Min.) / Bp (Max.)×100 (%)
- Bp (Max.) = Maximum brightness in 13 measured spots
- Bp (Min.) = Minimum brightness in 13 measured spots.



Note 3:**The definition of Viewing Angle**
Refer to the graph below marked by θ and Φ.

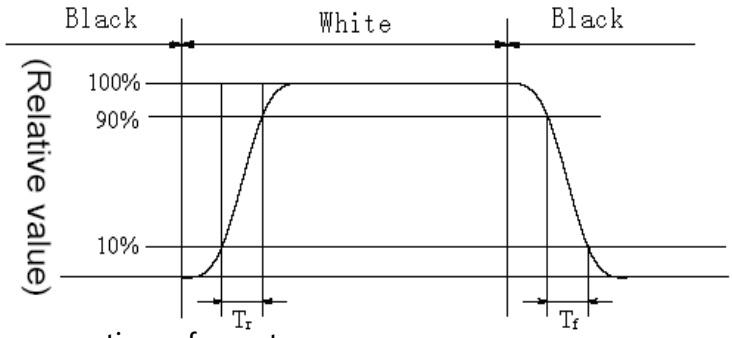


Note4:**ThedefinitionofContrastRatio** (Test LCM using CS2000 or similar equipments):

$$\text{Contrast Ratio(CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

(Contrast Ratio is measured in optimum common electrode voltage)

Note5:**DefinitionofResponse time.**(Test LCD using DMS501 or similar equipments):
The output sign also photo detector are measured when the input sign also are changed from "black " to "white" (Voltage falling time)and from "white" to "black" (Voltage rising time), respectively . The response time is defined as the time interval between the 10% and 90% of amplitudes . Refer to fi gures below.



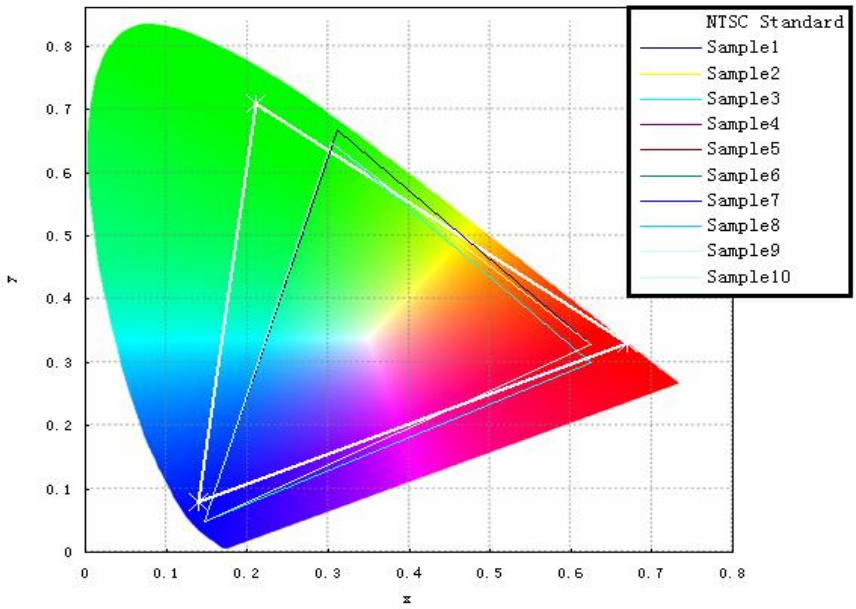
	L0	L1	L2	L3	L4	L5	L6	L7
L0	■							
L1		■						
L2			■					
L3				■				
L4					■			
L5						■		
L6							■	
L7								■

Response time of gray to gray:
Measurement equipment: DMS501 or similar equipments.
Test method: we define 8 grays L0-L7,the grays of L0-L7 were defined as:0,36,73, 109, 146, 182, 219, 25 5. Theoutputsignalsofphotodetectoraremeasuredwhentheinputsignalsarechanged from "Lx" to "Ly" , x, y= [0, 7]. The response time is defined as the time interval between the 10% and 90% of amplitudes. The result of the test can be noted as below:

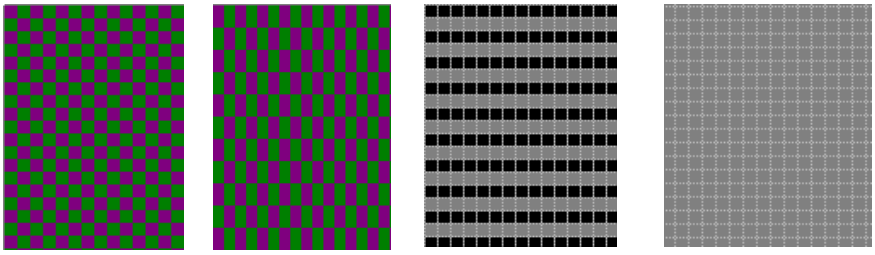
Note 6: Color Coordinates of CIE 1931
The test condition is at ILED=20mA and measured on the surface of LCD module at 25℃.
Measurement equipment:CS2000 or similar equipments
The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

Note 7: Definition of Color of CIE Coordinate and NTSC Ratio.

$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$



Note 8: **Flicker**
- Measurement equipment :CA-210 or similar equipments
- Measuring temperature: Ta=25℃.
- Test method: JEITA method
- Test pattern : Refer to below(Test Pattern should be full-fill of display screen)



1 Dot Inversion, 2 Dot Inversion , Line Inversion , Frame Inversion
The point should be marked is, for line and frame inversion, the background of Flicker Test Pattern
- "gray " are defined as middle gray scale .For example, RGB 24bit "gray" defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

For Dot inversion, the RGB data for first pixel is (127, 0, 127), the RGB data for the second pixel is (0, 127 , 0).

●Frame Frequency Requirement before test： The LCD must be tuned to more than 65HZ before measu rement.

●Measurement Point: the center of display active area

●Conversion of Flicker ratio:

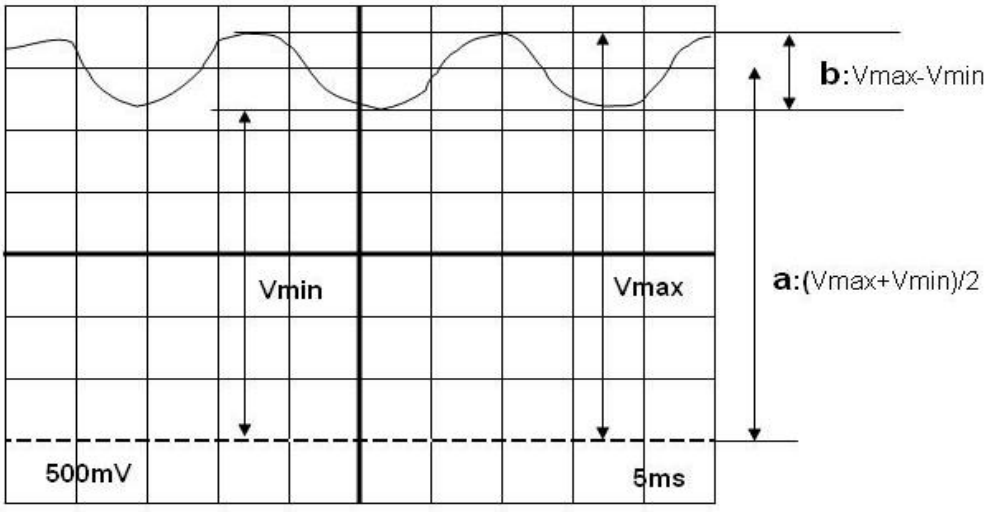
Flicker [dB] = 10 x log[Px/P0]

Where

Px: Maximum power spectrum of AC component after passing through integrator

P0: Power spectrum of DC component after passing through integrator

AC component=b (Refer to below diagram)



Note 9: gamma curve control

●For gamma curve control, HUAWEI’ s request as below:

●1,the whole curve’ s tolerance must control within +/-0.3, HUAWEI will test the gray scale below: 0, 8, 16, 25, 33, 41, 49, 58, 66, 74, 82, 90, 99, 107, 115, 123, 132, 140, 148, 156, 165, 173, 181, 189, 19 7,206, 214, 222, 230, 239, 247, 255

Note 10:Crosstalk

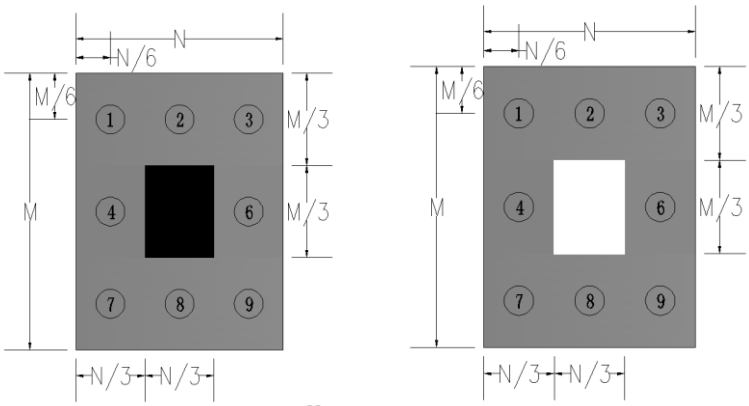
●There should be no visible cross-talk in normal direction of the display when the two ” Cross-talk Test Patterns ” below are loaded.

●Measurement equipment:CS2000 or similar equipments

●The point should be marked is, the background of Cross-talk Test Pattern- “gray ” are defined as middle gray scale . For example, RGB 24bit “gray” defined as below:

R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0

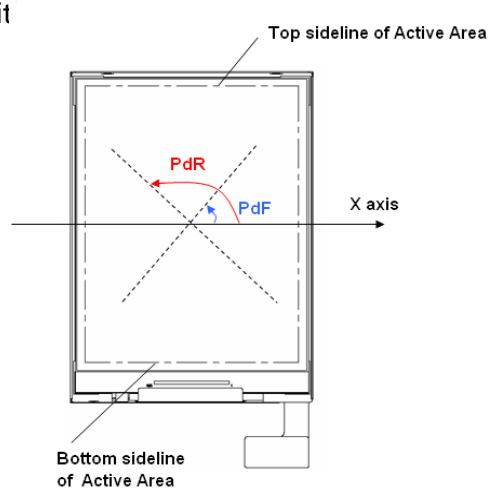
●△Bpn = Bpn (gray) / Bpn (white)
Which n means the dot No. In the Cross-talk Test Pattern ;
Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;
Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;
●△Bp (Max.) = Maximum value in △Bp1~△Bp9, except the No. 5 spot.
●△Bp (Min.) = Minimum value in △Bp1~△Bp9, except the No.5 spot.
●△CT=△Bp (Max.)/△Bp(Min.).
●△CT must be less than 1.10



Cross-talk Test Pattern

Note 11: Reflectance Ratio
●Measurement equipment : X-rite SP64
●Measurement parameter : Reflectance Ratio @550nm

Note 12: Polarization Direction Definition
●Viewing direction is normal user viewing direction which is vertical to the display surface
●The polarizer which is closer to viewer is defined as Front Polarizer
●The polarizer which is on the rear side of viewer is defined as Rear Polarizer
●The X axis is defined as parallel line to top & bottom sidelines of the Active Area
●PdF which is marked in blue arrow is polarization degree of Front polarizer
●PdB which is marked in red arrow is polarization degree of Back polarizer
●The polarization degree parameter must be indicated in range of 0deg to 180deg according to abov
e definit



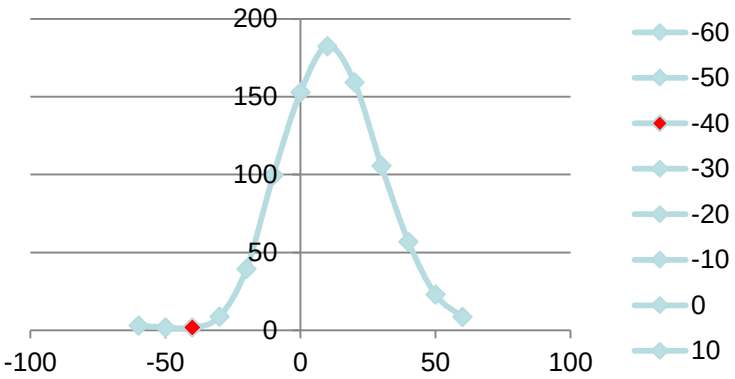
Note 13: **Definition of Contrast decrease ratio**

- Refer to the graph of note 9.
- Using contrast test method.
- The contrast decrease ratio is calculated by using following formula:

$$\text{Contrast decrease Ratio} = 1 - \frac{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=30°}{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=0°}$$

Note14: Color Shift JNCD

- For JNCD measure:
- Fix on one pattern like white pattern,
- On the condition θ=0 F=0°, we can get the color coordinate (u1', v1') and onθL=30° we can get anot her color coordinate (u2', v2')
- Delta = Square Root((u2' - u1')^2 + (v2' - v1')^2)
- JNCD stands for "Just Noticeable Color Difference"
- For the (u', v') color space JNCD=0.0040.
- 2JNCD means Delta u' v' <0.0080
- For color shift we need to measure white/red/green/blue pattern.
- This Requirement is from our customer and we have test some of our phone display and the result is OK.



Note 15: **CABC Test**

- Measurement equipment :CS-2000 or similar equipments
- Testing picture: CABC Brightness-Gray and APL FIX gamma test picture.
- Test method:
- Power on LCD, test Brightness-Gray picture, drawing the brightness-gray curve, confirm save the power ' s scale.

Test APL FIX gamma picture, drawing the APL FIX gamma curve, assurance the curve is smooth.

5.0 RELIABLITY TEST

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

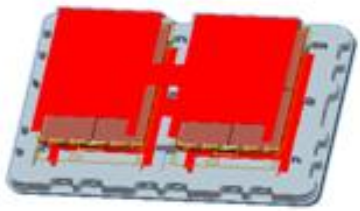
<Table 17. Reliability Test Parameters >

No	Test Items	Conditions
1	Temperature Humidity Bias	Ta = 60 ℃, 90%RH, 240h
2	High Temperature Operation	Ta = 60 ℃, 240 h
3	Low Temperature Operation	Ta = -20 ℃, 240 h
4	Thermal Shock Test	Ta = -40 ℃ ↔ 85℃ (2 h), 20cycles
5	Accelerate Life Test	Ta = -10 ℃ ↔ 65℃ ,93%RH (2 h), 10cycles
6	8585	Ta=85℃, 85%RH, 120h
7	ESD	非LDI 侧7points: Air, 150 pF, 330Ω, ±5 KV LDI Center point：Air, 150 pF, 330Ω, ±2 KV

6.0 PACKING INFORMATION(产品形态： MDL)

Packing procedure:

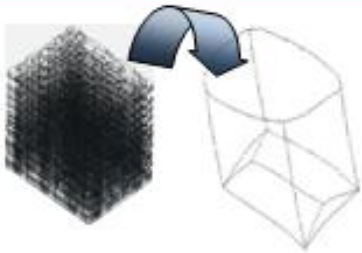
-.将 1pcs EPE Pad 放于Tray底部，再将2pcs MDL 平放入EPE Pad 上面（Panel 面朝上放置），然后上部再放一张EPE Pad 26层叠加(tray 不旋转叠放），顶部1pcs 空Tray.
-.容量: 2pcs MDL/Tray



Step 1

-.将26pcs PET Tray 平放入PE Bag

-.容量: 50pcs MDL/PE Bag



Step 2

-.将PET Tray堆码后平放入Inner Box,上下放置EPE Board

-.容量：50pcs MDL/Inner Box

Step 3

-.每个Pallet上放3层Box，1层6箱,共计18ea Box
Pallet 四边及打包带位置放置纸护角后，以缠绕膜包裹
-.容量: 900pcs MDL/Pallet

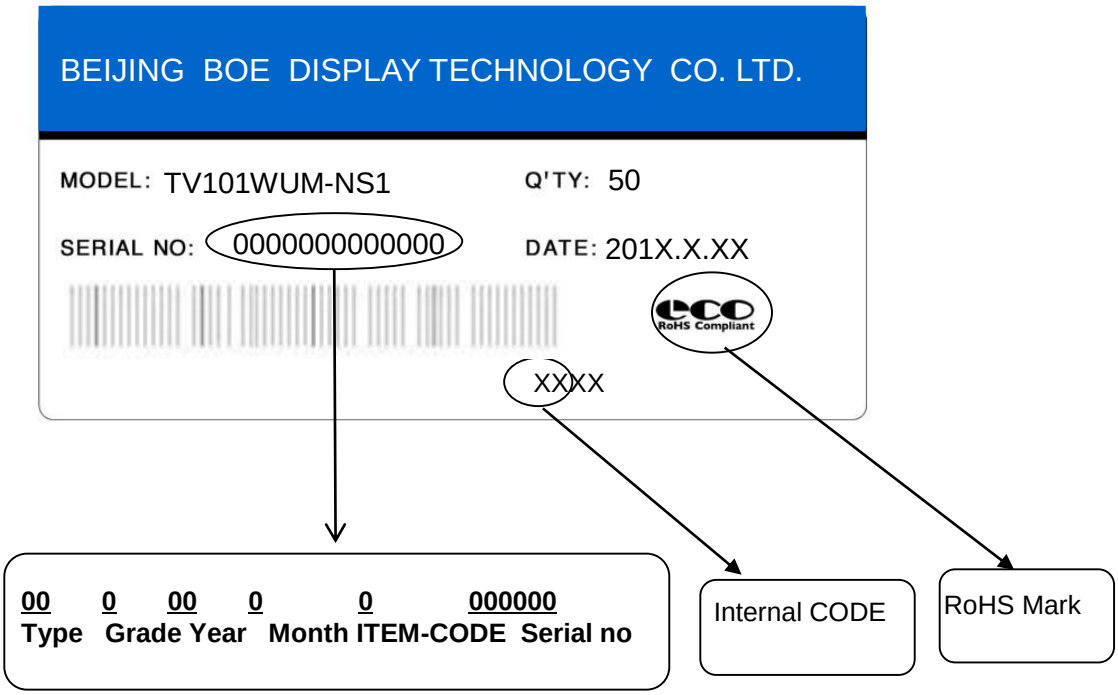
Step 4

6.1 Packing Note(产品形态：LCM)

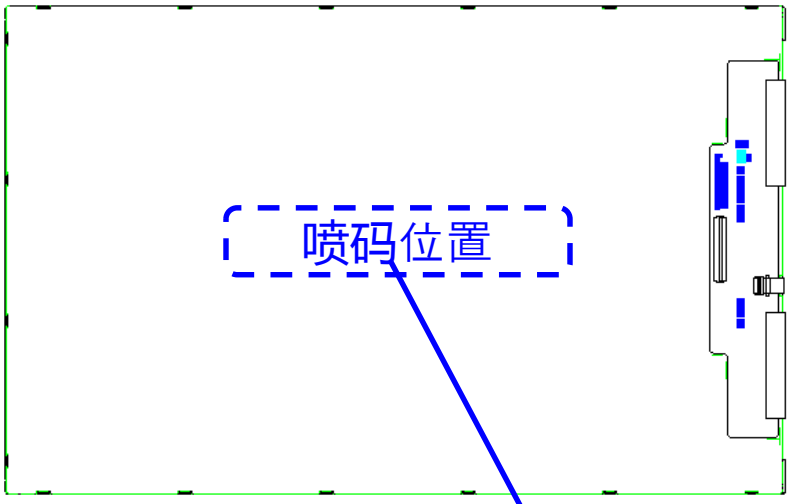
- Box Dimension: 496mm(W) x 396mm(D) x 290mm(H)
- Package Quantity in one Box: 50pcs

6.2 Box label (产品形态： MDL)

- Label Size :80mm*50mm
- Contents
  Model : LCM
  Q`ty : 50pcs/Box
  Serial No. : Box Serial No. as shown below.
  Date : Packing Date
  FG Code : FG Code of Product



7.0 Product Label



Remark:
喷码位置：背板中部
11. FG-CODE
2. MDL ID (编码规则如下)
3. MDL ID 条纹码

③

TV101WUM-NS1-4850 ①
XXXXXXXXXXXXXXXXX ②

MDL ID 编码规则

Digit / Code	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Code	S	L	S	8	1	0	8	5	9	4	2	0	0	0	1	D	B
Description	Product Code /GBN		Grade	Line	Year		Month	Model Extension Code (Last 4 Digits Of FGCODE)				Serial No Hex-Decimal 000000-FFFFFF					

月：1~12月→ 1~9, X, Y, Z

8.0 Handling & Cautions

8.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizers which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

8.2 Caution of LCD Handling and Cleaning

- Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration,and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
- The polarizers on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizers or it leads the polarizers to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent (recommended below) to clean the LCD ‘s surface with wipe lightly.
  -IPA(Isopropyl Alcohol), Ethyl Alcohol, Trichlorotriflorothane
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizers and others. Do not use the following solvent.
  -Water, Ketone, Aromatics
- It is recommended that the LCD be handled with soft gloves during assembly, etc. The polarizers on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.
- Do not drop water or any chemicals onto the LCD's surface.
- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.
- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC,Soldering flux,Chlorine,Sulfur,saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

8.3 Caution Against Static Charge

- The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.
- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.
- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.
- In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

8.4 Caution For operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature (hot to cold or cold to hot) ,the LCD may be affected; Specifically, drastic temperature fluctuation from cold to hot ,produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.

8.5 Packaging

- Modules use LCD element, and must be treated as such.
  -Avoid intense shock and falls from a height.
  -To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

8.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH.
- Original protective film should be used on LCD’ s surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizers.
- Do not store the LCD near organic solvents or corrosive gasses.
- Keep the LCD safe from vibration, shock and pressure.
- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.
- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
  -Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
  -Store in a dark place where neither exposure to direct sunlight nor light is.
  -Keep temperature in the specified storage temperature range.
  -Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

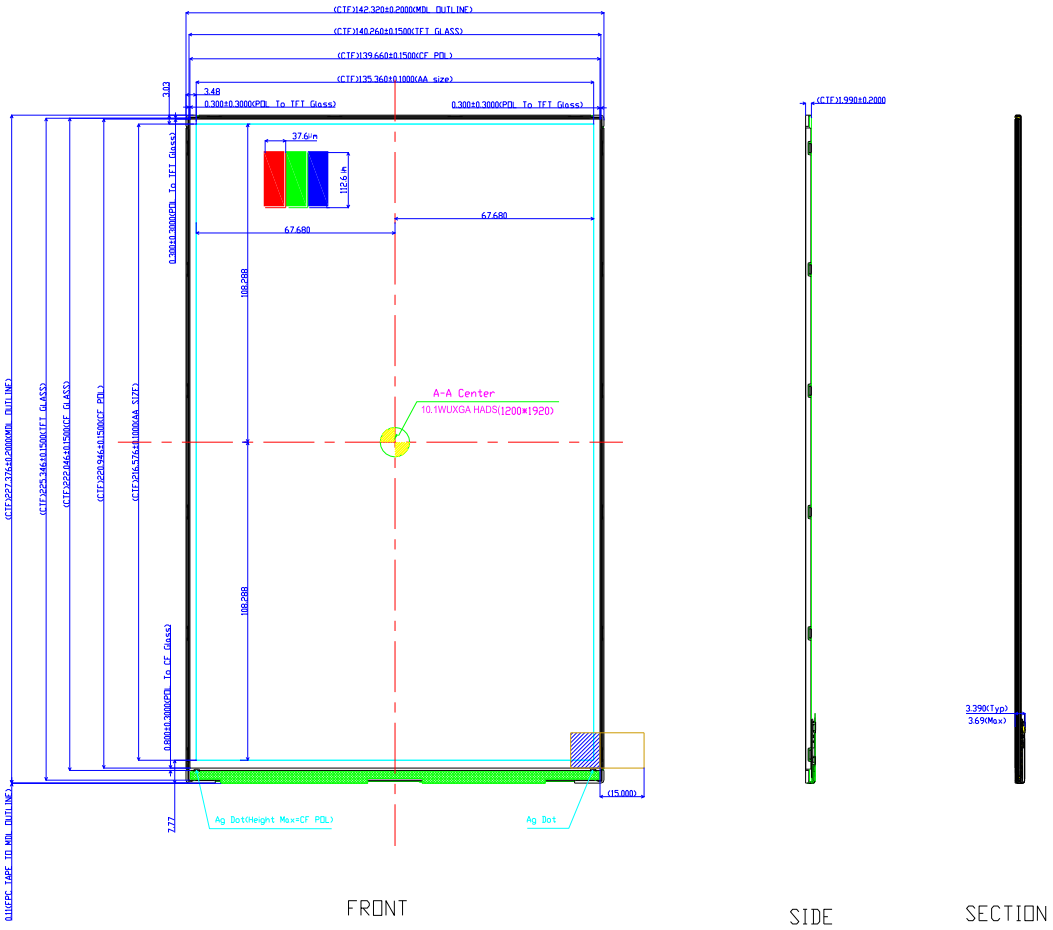
8.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.
- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.
- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.
- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.
- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.

9.0 APPENDIX

Mechanical Drawing

Drawing Attachment: Front



Mechanical Drawing

Drawing Attachment: Back