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SPEC. NUMBER	PRODUCT GROUP	REV.	ISSUE DATE	PAGE
S8-	TFT- LCD	P0	2020-08-14	1 OF 29

TV103WUM-LL0 Product Specification Rev.P0

BUYER	Lenovo
SUPPLIER	BOE
FG-Code	TV103WUM-LL0

ITEM	BUYER SIGNATURE	DATE

ITEM	SUPPLIER SIGNATURE	DATE
Prepared		
Reviewed		
Approved		

BOE Technology Group Co., Ltd.

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TFT- LCD PRODUCT	P0	2020-08-14	

SPEC. NUMBER	SPEC . TITLE	PAGE
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REVISION HISTORY

REV.	ECN No.	DESCRIPTION OF CHANGES	DATE	PREPARED
P0		Initial Release	2020-08-14	Jiang Han

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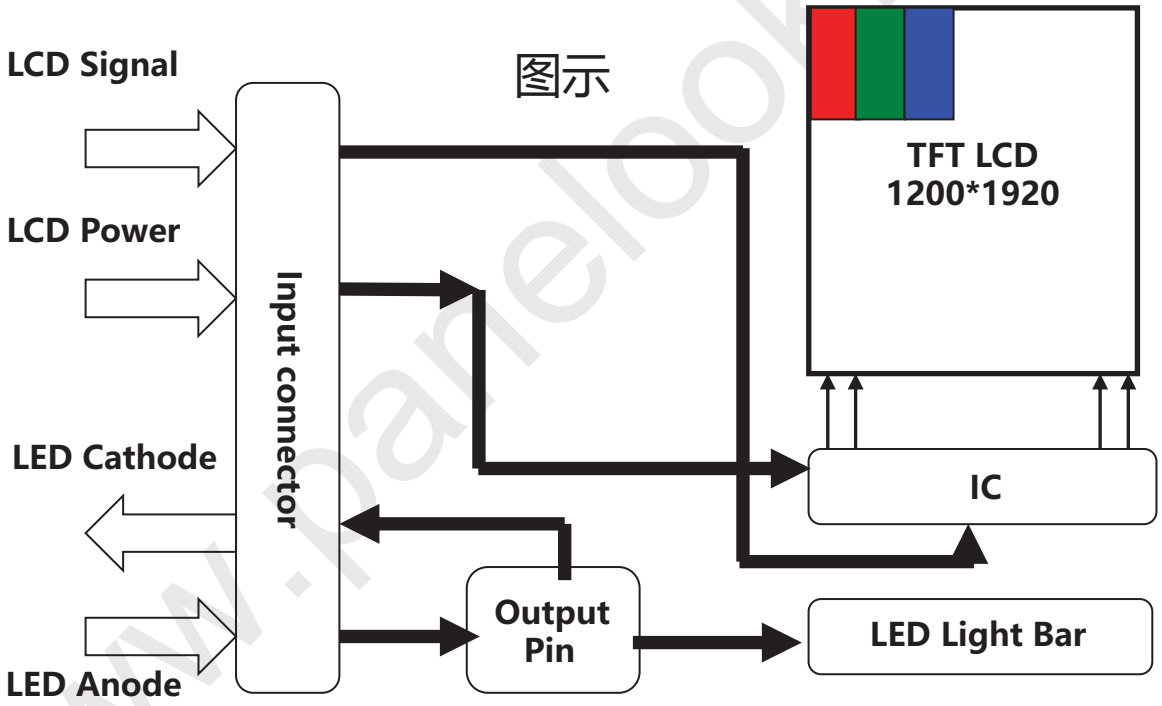
1.0 GENERAL DESCRIPTION

1.1 Introduction

TV103WUM-LL0 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 10.3 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.

图示



1.2 Features

- 4 Lane MIPI Interface
- FIC & Active Pen
- 8-bit color depth, display 16.7M colors
- Thin and light weight
- RoHS compliant

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1.3 Application

- Tablet PC

1.4 General Specification

The followings are general specifications at the TV103WUM-LL0

<Table 1. LCD Module Specifications>

Parameter	Specification	Unit	Remarks
Active Area	138.78(H)*222.048(V)	mm	
Number Of Pixels	1200(H)×1920(V)	pixels	
Pixel Pitch	0.03855(H)×RGB×0.11565(V)	mm	
Pixel Arrangement	Pixels RGB stripe arrangement		
Display Mode	Normally Black		
Display Colors	16.7M(8bits)	colors	
Display Mode	Normally Black		
Surface Treatment	HC		
Contrast Ratio	1000:1(typ.)		
Viewing Angle(CR>10)	80/80/80/80(typ.)	deg.	
Response Time	25ms(typ.)	ms	
Color Gamut	70.8% （typ.)		NTSC
Brightness	280(min)/330(typ)(w/CG)	cd/m2	Center
Brightness Uniformity	13 point: 75%(min)/80%(typ)		
Power Consumption	TLCM: 0.48(max.)(@white Pattern) BLU: 2.5(max.)(w/o Driver)	watt	
Outline Dimension	LCM:144.28(H)*231.398(V)*2.0(typ) TLCM:148.98(H)*239.85(V)*2.872(typ)	mm	
Weight	200(max.)	gram	

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<Table 2. Touch Panel Specifications>

Parameter		Specification				Remarks
TP Structure		FIC				
Sensing Method		Self Capacitance				
Sensor pitch		4.279*4.626mm&4.395*4.626mm				
Number Of Touch		10				
Performance	Sensitivity(mm)	Φ5				
	Report Rate	120Hz				
	Finger Separation	≦12mm				
	Response Time	Less than 30 (1st touch)				
	Accuracy(mm)	Center	≦1.0	Edge	≦1.5	@Φ7mm
	Precision(mm)	Center	≦1.0	Edge	≦1.5	@Φ7mm
	Linearity(mm)	Center	≦1.0	Edge	≦1.5	@Φ7mm
	Jitter(mm)	Center	≦0.5	Edge	≦0.5	@Φ7mm
SNR(dB)		30:1				
Latency		15 Average / 25 Max				
Hover		Yes，此项与Glove touch相冲突，需以实际需求效果调试				
Palm Rejection		Yes				
Temperature Shock Self-adaption		Yes				
Anti Water		Yes				
Function Reset		Yes				
Gesture Support		Yes				

<Table 3. Active Pen Specifications>

Parameter	Specification	Remarks
Pen Number	1	
Accuracy	±0.5mm/±1.0mm	
Linearity	±0.5mm/±1.0mm	
Stationary Jitter	±0.3mm/±0.5mm	
Hover Range	≥5mm	
Move latency	≤30ms	
Down latency	≤35ms	
Pen Report Rate	240Hz	
Simultaneous Pen & Touch	Pen 240Hz Touch 30Hz	
Pressure	≥4096(Amplitude)	

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2.0 ABSOLUTE MAXIMUM RATINGS

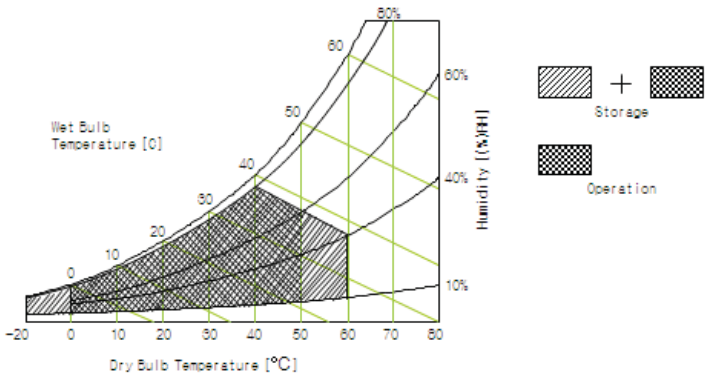
The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit.

< Table 3. Absolute Maximum Ratings>

Parameter	Symbol	Min.	Max.	Unit	Remarks
Logic Power Supply Voltage	VDDI	-0.3	2.15	V	Note1
Analog Power Supply Voltage	AVDD	-0.3	6.2	V	Note1
Analog Power Supply Voltage	AVEE	-0.3	-6.2	V	Note1
LED Forward Current of every LED string	I_{LED}	-	30	mA	Note2
LED string Reverse Voltage	V_R	-	45	V	
Operating Temperature	T_{OP}	-20	+60	℃	Note3
Storage Temperature	T_{ST}	-30	+70	℃	

Note:

1. These range above is maximum value not the actual operating temperature . Actual Operating temperature is no more than 70℃ and temperature refers to the LCM surface temperature ; Length of operation: No more than 8 hours per day, and no more than 4 hours of continuous use one time.
2. BOE is not responsible for product problems beyond the use conditions.
3. Temperature and relative humidity range are shown in the figure below. Wet bulb temperature should be 39 ℃ max. and no condensation of water.



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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	VDDI	1.7	1.8	1.9	V	Note 1
	AVDD	5.6	5.7	5.8	V	
	AVEE	-5.8	-5.7	-5.6	V	
Power Supply Current	IVDD	-	65	70	mA	
	AVDD	-	17	20	mA	
	AVEE	-	35	42	mA	
Power Consumption	PLCD	-	-	0.48	W	
Rush current	IRUSH	-	-	1.3	A	

Notes : 1. The supply voltage is measured and specified at the interface connector of LCM.
The current draw and power consumption specified is for VDDI=1.8V, AVDD/AVEE=±5.7V, Frame rate f_V=60Hz and MIPI bit rate= 1.026Gbps, white Pattern.

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3.2 Back-Light Unit

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

Parameter	Symbol	Values			Unit	Notes
		Min.	Typ.	Max.		
LED Supply Voltage	VLED	-	25.65	27	V	Note 1
	VRP			300	mV	Ripple
LED Forward Current	ILED	-	92	-	mA	
Power Consumption	PLED	-	2.36	2.5	W	
Rush current	IRUSH	-	-	1.3	A	
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, 15,000Hrs, 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.

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3.4 INPUT TERMINAL PIN ASSIGNMENT

This LCD employs three interface connections, a 45 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 :20655-045E-01 (I-PEX)& F03002FA045D8WL(昶通)

< Table7. Pin Assignment for LCD Module Connector >

Pin No.	Symbol	Description	I/O
1	GND	Ground	P
2	GND	Ground	P
3	AVDD	5.7V input power	P
4	AVDD	5.7V input power	P
5	NC	NC	P
6	AVEE	-5.7V input power	P
7	AVEE	-5.7V input power	P
8	GND	Ground	P
9	GND	Ground	P
10	D3-	MIPI differential data3 input (Negative)	I
11	D3+	MIPI differential data3 input (Positive)	I
12	GND	Ground	P
13	D0-	MIPI differential data0 input (Negative)	I
14	D0+	MIPI differential data0 input (Positive)	I
15	GND	Ground	P
16	CLK-	MIPI differential clock input (Negative)	I
17	CLK+	MIPI differential clock input (Positive)	I
18	GND	Ground	P
19	D1-	MIPI differential data1 input (Negative)	I
20	D1+	MIPI differential data1 input (Positive)	I
21	GND	Ground	P
22	D2-	MIPI differential data2 input (Negative)	I
23	D2+	MIPI differential data2 input (Positive)	I
24	GND	Ground	P
25	GND	Ground	P

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Pin No.	Symbol	Description	I/O
26	ID0	Himax，ID0=0	P
27	NC		I
28	LEDPWM_OUT	Output pin for PWM signal of LED driving.	I
29	TE	TE	I
30	REST	This signal will reset the device and must be applied properly to initialize the chip.	I
31	VDD18	Power Supply 1.8V	P
32	VDD18	Power Supply 1.8V	P
33	GND	Ground	P
34	TP_SCL	I2C CLK,TYP. 1.8V	I
35	TP_SDA	I2C SDA,TYP. 1.8V	I
36	TP_INT	Interrupt signal for TP	I
37	TP_RST	The external reset input for TP	I
38	GND	Ground	P
39	FB1	Power for LED1 Cathode	P
40	FB2	Power for LED2 Cathode	P
41	FB3	Power for LED3 Cathode	P
42	FB4	Power for LED4 Cathode	P
43	NC	NC	-
44	VLED	Power for LED Anode	P
45	VLED	Power for LED Anode	P

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3.4.2 Pin assignment for LED Bar

Connector : PF040-B09B-C09(UJU)

< Table8. Pin assignment for LED Bar >

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

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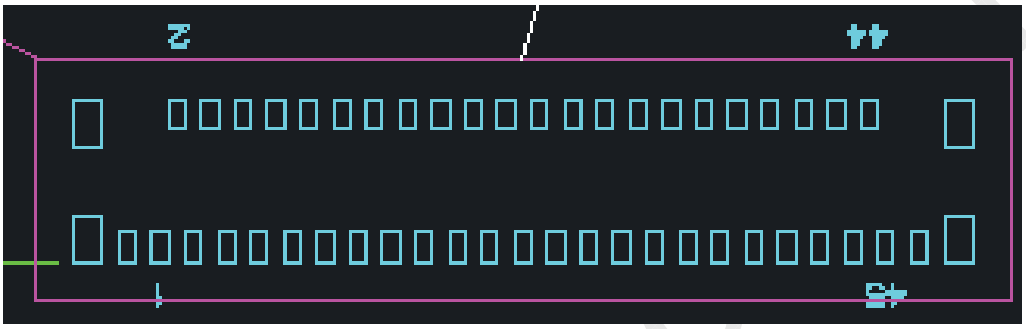
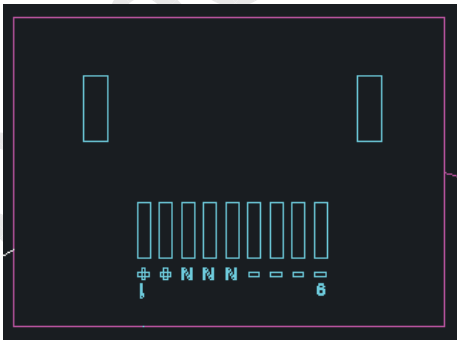
3.4.5 First Pin Location

Main Connector: 20655-045E-01 (I-PEX)& F03002FA045D8WL(昶通)



Pin1

LED Connector: PF040-B09B-C09



Pin1

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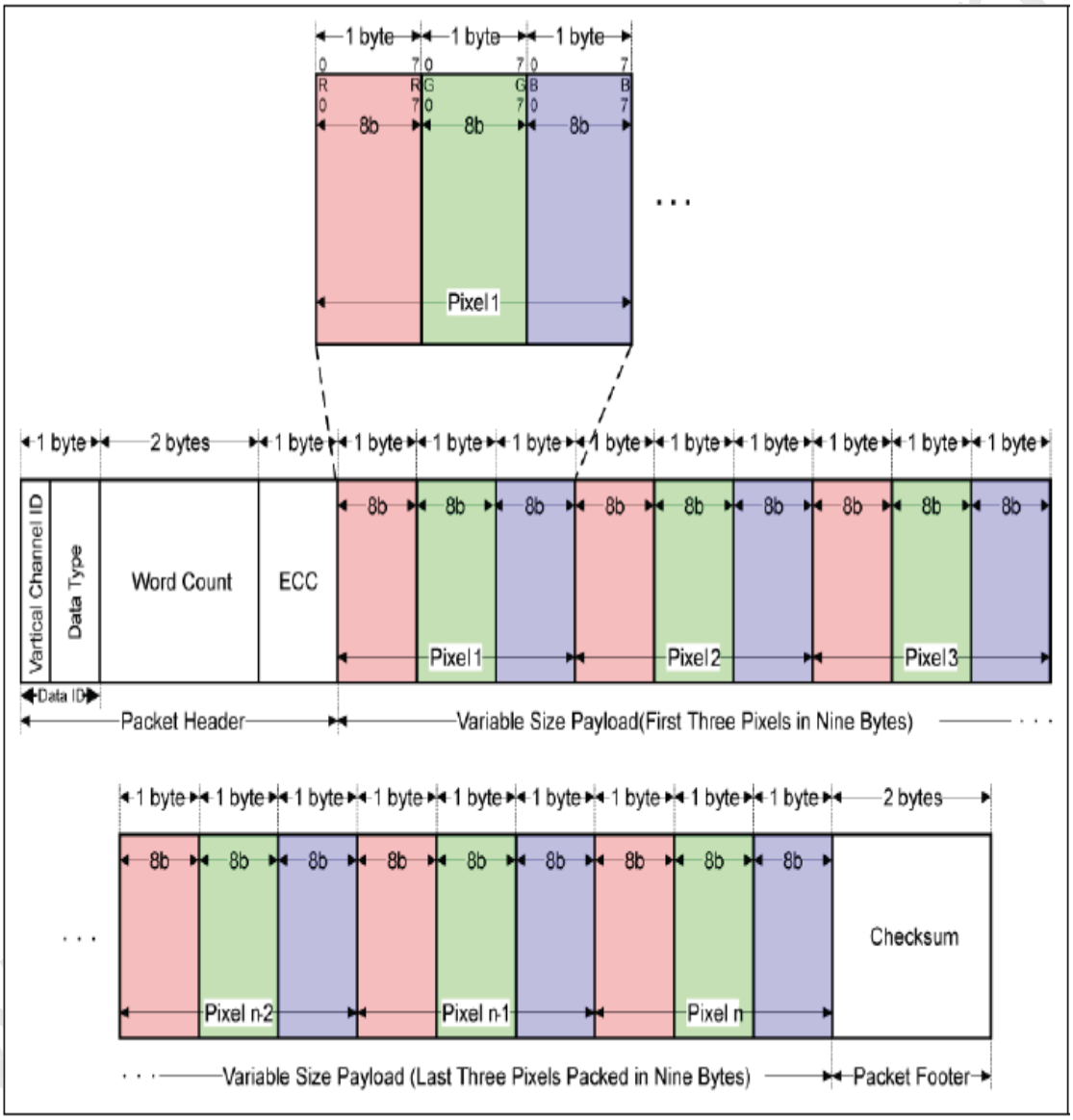
3.5 MIPI Interface Characteristic

3.5.1 Data Format



< MIPI Tx Data Configuration >

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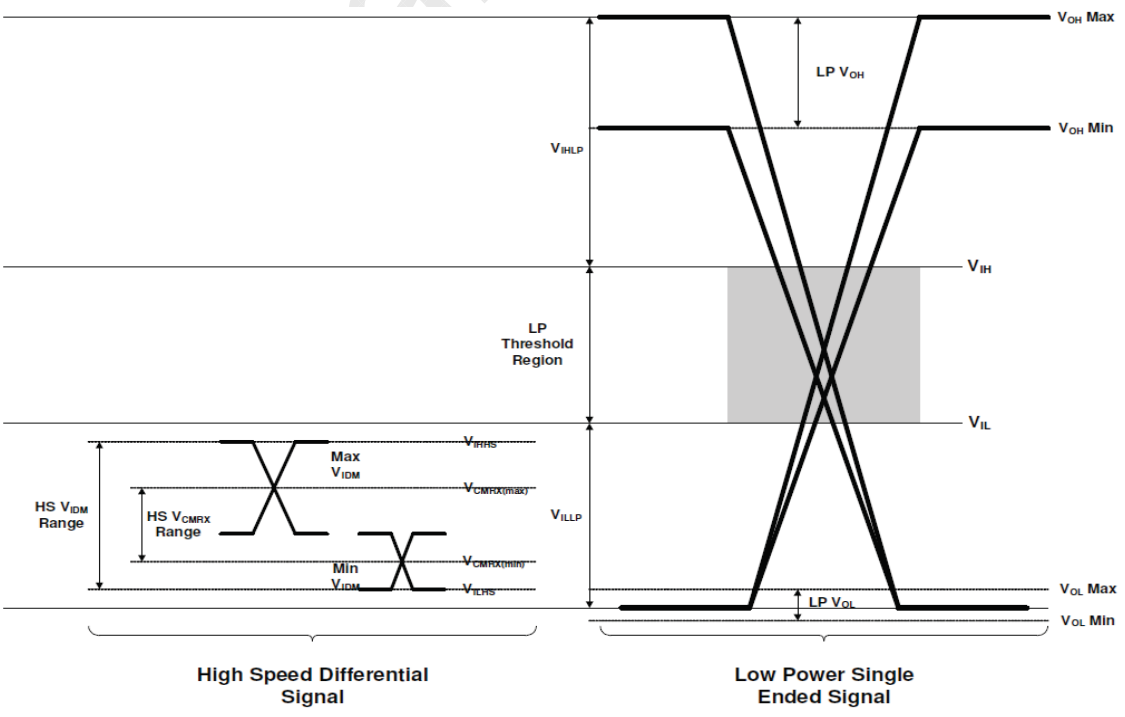
3.5.2 DC Specification

< Table11. DC Specification >

Parameter	Symbol	Min	Typ	Max	Unit	Condition
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	
MIPI Characteristics for Low Power Receiver						
Pad signal voltage range	V_I	-50	-	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	



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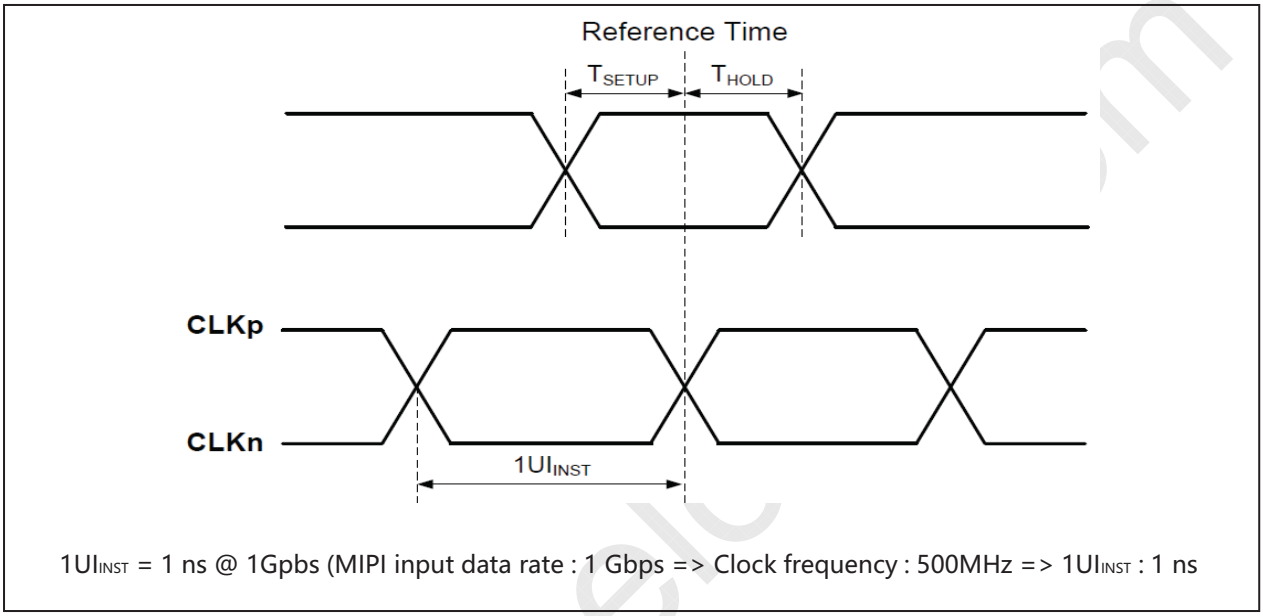
3.5.3 AC Specification



$1UI_{INST}$ = 1 ns @ 1Gpbs (MIPI input data rate : 1 Gbps => Clock frequency : 500MHz => $1UI_{INST}$: 1 ns

< Timing Diagram of MIPI Transmitter>

< Table12. AC Specification >

Description	Symbol	Condition	Min	Typ	Max	Unit
Data to Clock Setup Time	T_{SETUP}	-	0.15	-	-	UI_{INST}
Clock to Data Hold Time	T_{HOLD}	-	0.15	-	-	UI_{INST}

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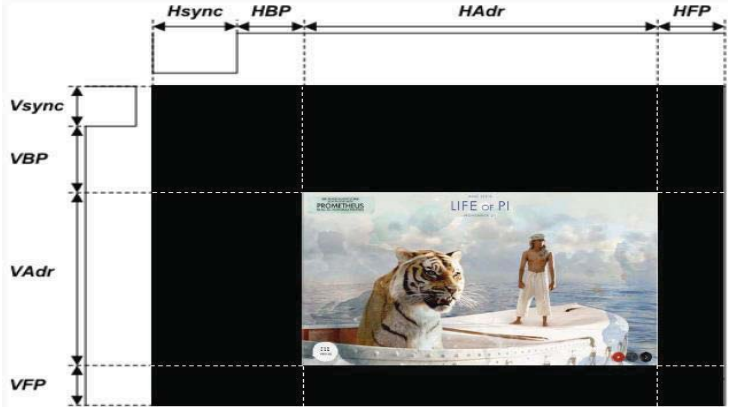
3.6 Interface timing Parameter

< Table13. Timing Parameter >

ITEM			SYNBOL	min	typ	max	UNIT
LCD	Frame Rate		-	-	60	-	Hz
	Pixels Rate		-	-	156.76	-	MHz
Timing	Mipi CLK	Frequency	fCLK	-	513	-	MHz
		Period	Tclk	-	1.95	-	ns
	Horizontal	Horizontal total time	tHP	-	1272	-	t_{CLK}
		Horizontal Active time	tHadr	1200			t_{CLK}
		Horizontal Pulse Width	tHsync	-	14	-	t_{CLK}
		Horizontal Back Porch	tHBP	-	26	-	t_{CLK}
		Horizontal Front Porch	tHFP	-	32	-	t_{CLK}
	Vertical	Vertical total time	tvp	-	2054	-	t_H
		Vertical Active time	tVadr	1920			t_H
		Vertical Pulse Width	tVsync	-	8	-	t_H
		Vertical Back Porch	tVBP	-	28	-	t_H
		Vertical Front Porch	tVFP	-	98	-	t_H
Bit Rate			TX SPD (MBPS)	-	1026	-	Mbps
Lane				-	4	-	Lane



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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

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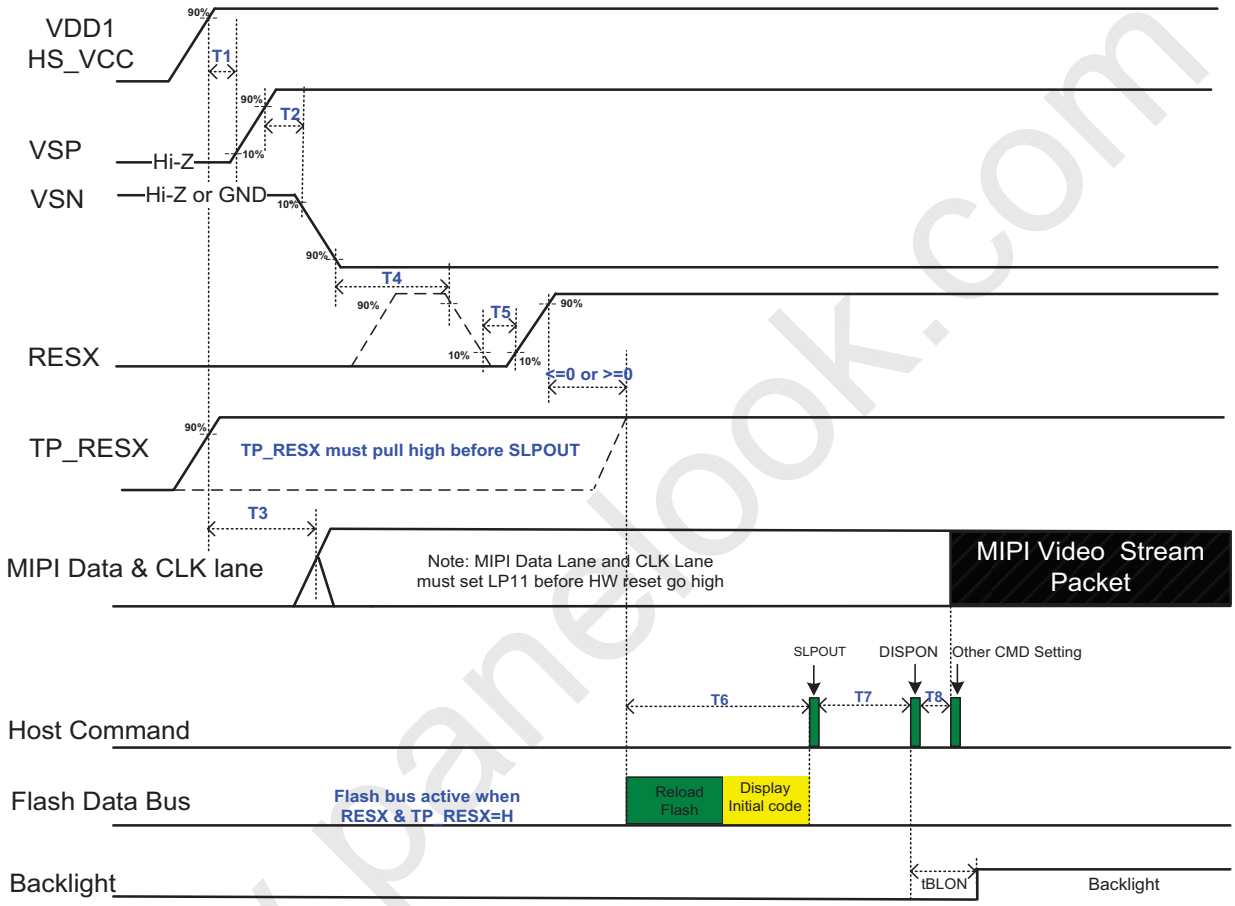
3.8 Power Sequence



Power on sequence for display initial code by FW

Symbol	Description	Min	Max	Unit	Note
T1	VDD1 to VSP	1	–	ms	
T2	VSP to VSN	1	–	ms	
T3	VDD1 to MIPI Lane	1	–	ms	
T4	Power Ready to Global Reset	1	–	ms	
T5	RESX Keep Low	15	–	ms	TP Reset is the same
T6	(RESX &TP_RESX)=H to Sleep Out (Flash reload speed:12.5MHz)	156	–	ms	For cascade chip application
T7	Sleep Out to Display On	10	–	ms	
T8	Display On to IC Ready	20	–	ms	
tBLON	Display On Command to BL On time	40	–	ms	

< Table15-1. Sequence Table >

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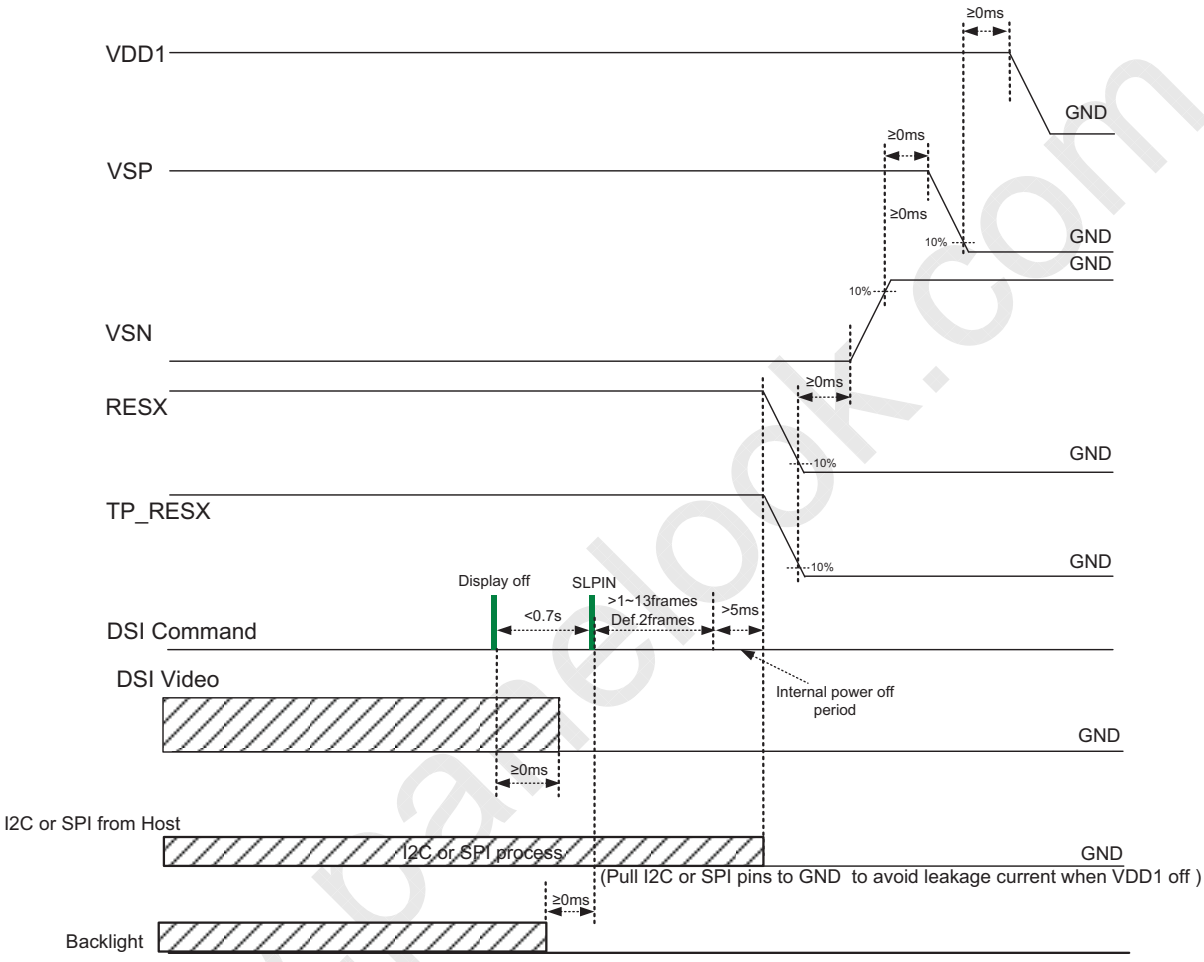

Power off sequence

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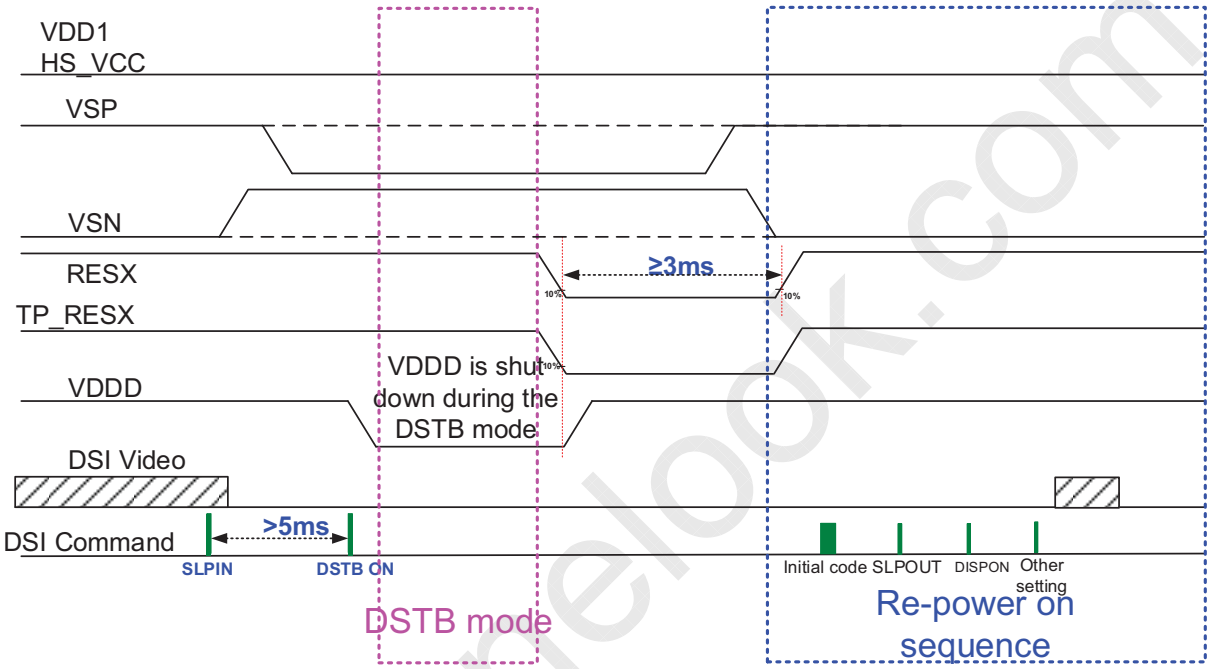

DSTB Mode Power sequence

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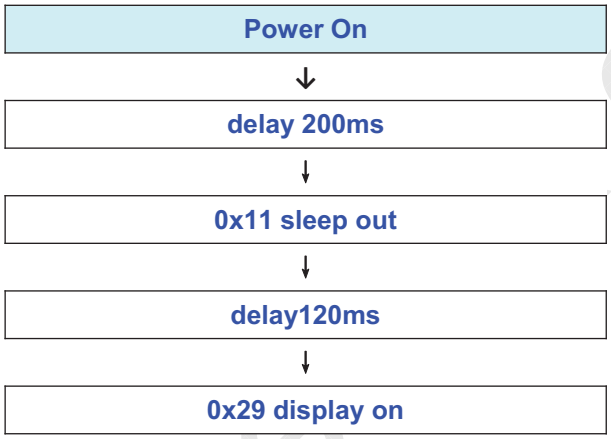
3.9 initial code

< Power On Sequence >



Note：Initial code包含在FW中，TP_RSTN引脚拉高后自动从flash加载FW，只需下发sleep out(0x11)及display on(0x29)指令

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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°	280	330	--	cd/m2	Note 1
Maximum Brightness of Black Pattern	Bblk	=0°	---	---	0.65	cd/m2	
Brightness Uniformity	▵Bp		75	80	--	%	Note 2
Viewing Angle	θL	Cr≥10	75	80	--	deg	Note 3
	θ_R		75	80	--		
	ψ_T		75	80	--		
	ψ_B		75	80	--		
Contrast Ratio	Cr	θ=0° FF=0°	800	1000		-	Note 4
Response Time	Tr+Tf			25	30	ms	Note 5
	Tgray				35	ms	
Color Coordinate of CIE1931	**Rx**	θ=0°		0.643		-	Note 6
	Ry			0.336			
	Gx			0.317			
	Gy			0.612			
	Bx			0.150			
	By			0.052			
	Wx		0.271	0.301	0.331		
	Wy		0.293	0.323	0.353		
NTSC Ratio	NTSC	CIE1931	65	70.8	--	%	Note 7
Color Temperature	CT			7200			
Flicker	amount	-	-	-	-30	dB	Note 8
Gamma	-		1.9	2.2	2.5		Note 9

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Item	Symbol	Condition	Min	Typ	Max	Unit	Note
Crosstalk	▵CT	-	-	1.1	1.2		Note 10
Polarization Direction of Front Polarizer	PdF		89.5	90	90.5	deg	Note 11
Polarization Direction of Rear Polarizer	PdR		-0.5	0	0.5	Deg	
Luminance decrease ratio		θL=30°			70	%	Note 12
		θR=30°			70	%	
		ψT=30°			70	%	
		ψB=30°			70	%	
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	
Gray inversion angle		ψ=0°				deg	Note 15
Afterimage					3	Minute	Note 16

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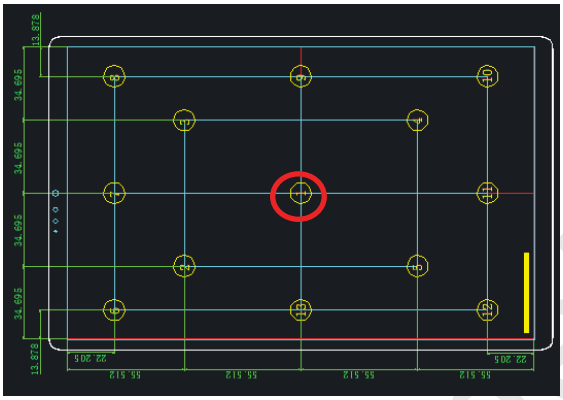
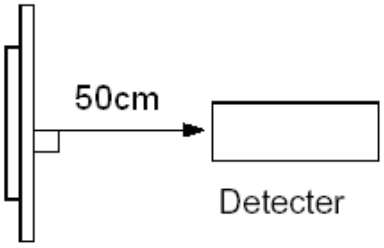
Note1:Luminance measurement

The test condition is at ILED=23mA and measured on the surface of LCD module at 25℃.

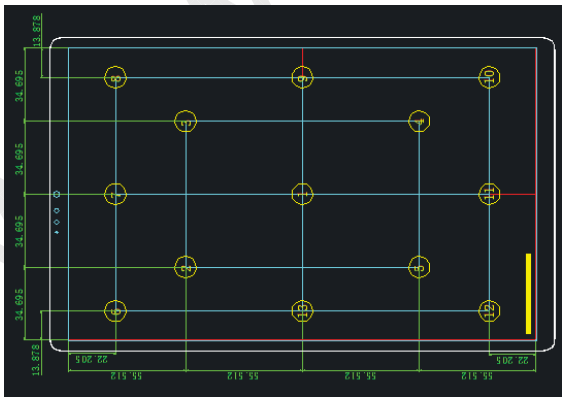
- The data are measured after LEDs are lighted on for more than 5 minutes and LCM displays are fully white. The brightness is the average value of 13 measured spots. Measurement equipment CS2000 or similar equipments(Field of view:1deg,Distance:50cm)
- Measuring surroundings: Dark room.
- Measuring temperature: 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 turning on.





Note2:Uniformity

- The test condition is at ILED=23mA 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.



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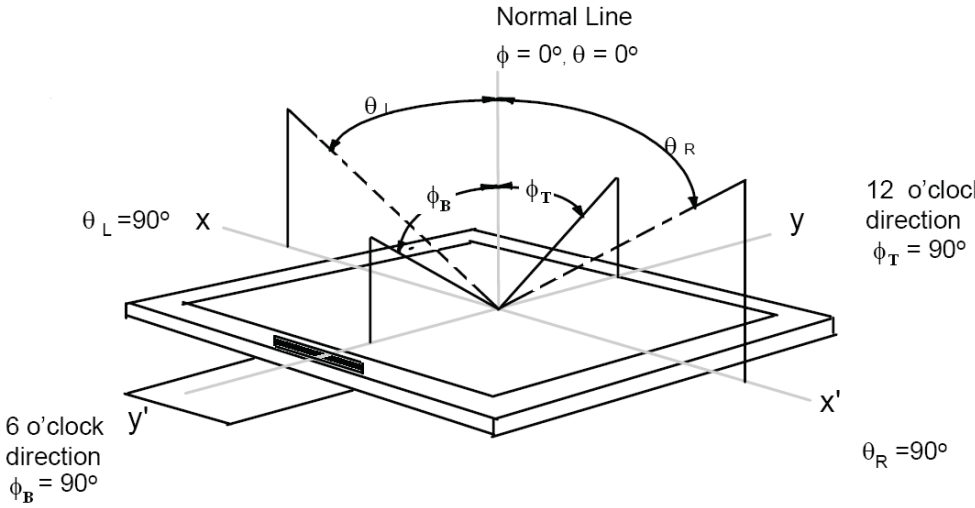
Note 3:The definition of Viewing Angle
Refer to the graph below marked by θ and Φ.

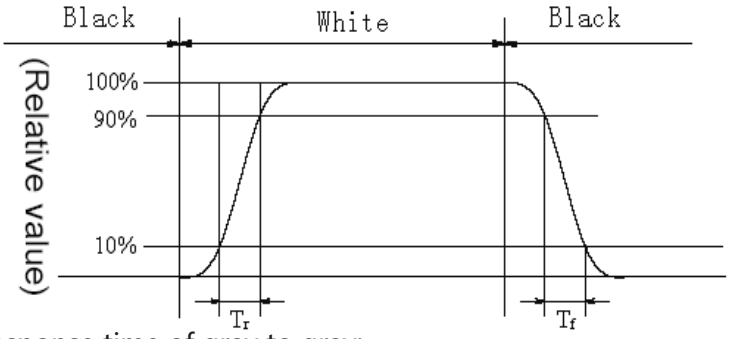


Note4:ThedefinitionofContrastRatio (Test LCM using CS2000 or similar equipments):

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

(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 figures 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, 255. 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:

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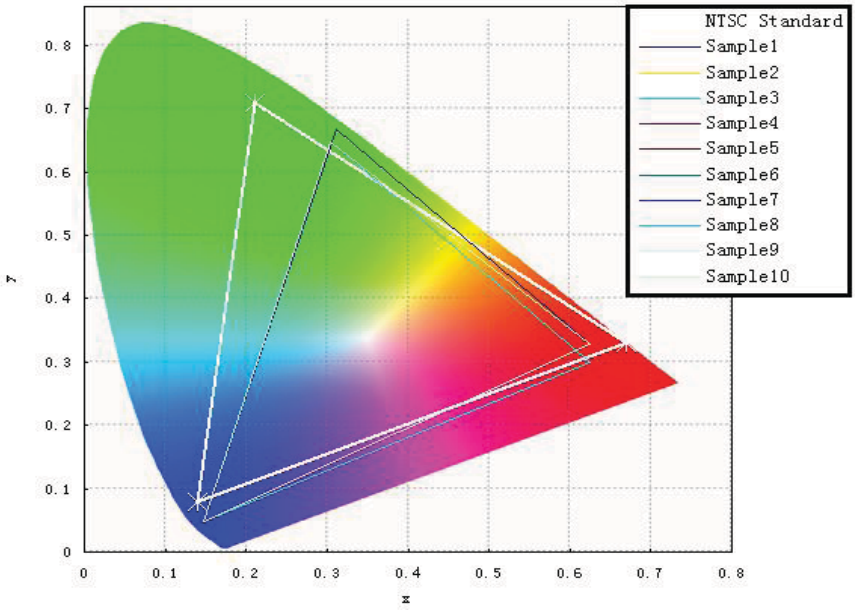
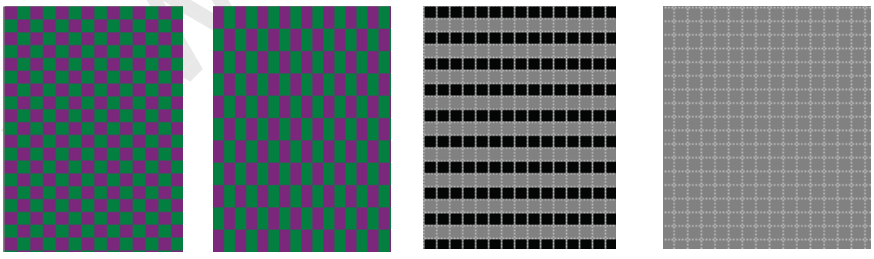
Note 6: Color Coordinates of CIE 1931
The test condition is at ILED=23mA and measured on the surface of LCD module at 25℃.
Measurement equipment:CS2000 or similar equipments
The Color Coordinate (CIE 1931) is the measurement of the center of the display shown in below figure.

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

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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:

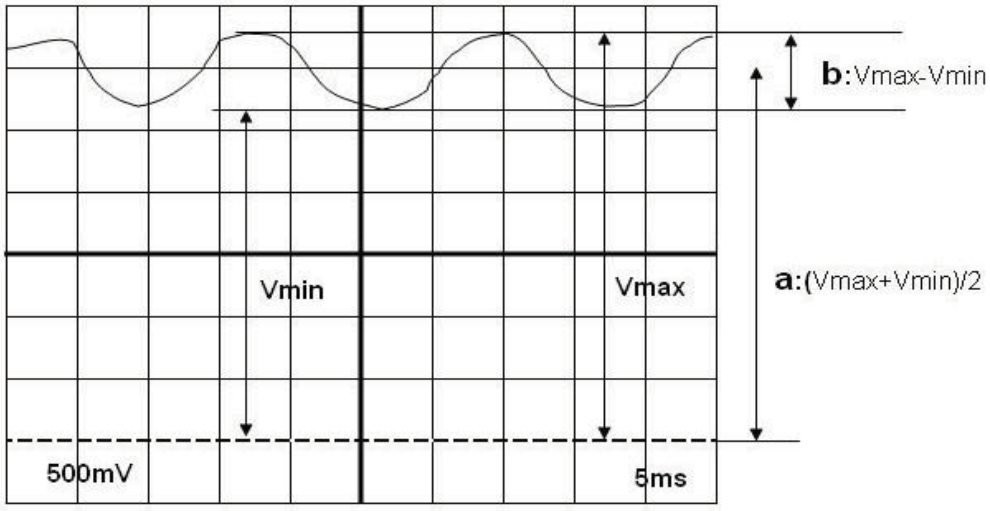
Flicker [dB] = 10 x log[Px/P0]

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

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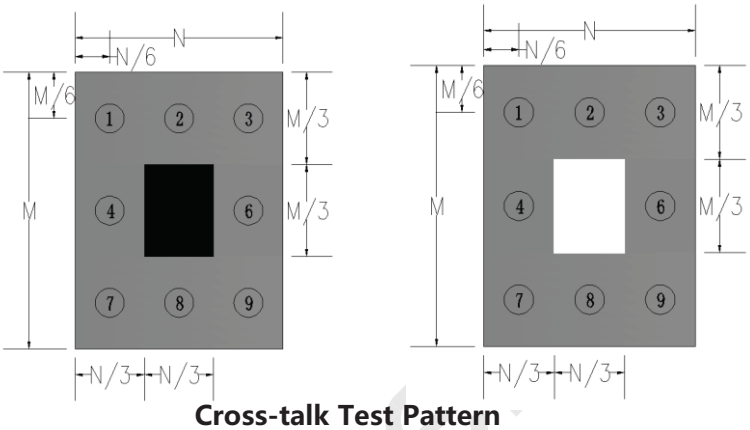
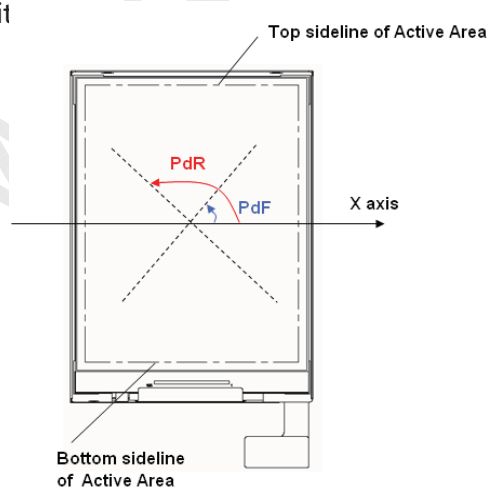
●△Bpn = Bpn (gray) / Bpn (white)
Which n means the dot No. In the Cross-talk Test Pattern ;
Bpn (gray) means the brightness of the No.n spots in Cross-talk Test Pattern;
Bpn (white) means the brightness of the No.n spots in Full white Test Pattern;
●△Bp (Max.) = Maximum value in △Bp1~△Bp9, except the 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: 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 above definit



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Note 12: **Definition of Luminance decrease ratio**

- Refer to the graph of note 9.
- Test pattern : Full White
- The luminance decrease ratio is calculated by using following formula:

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

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:

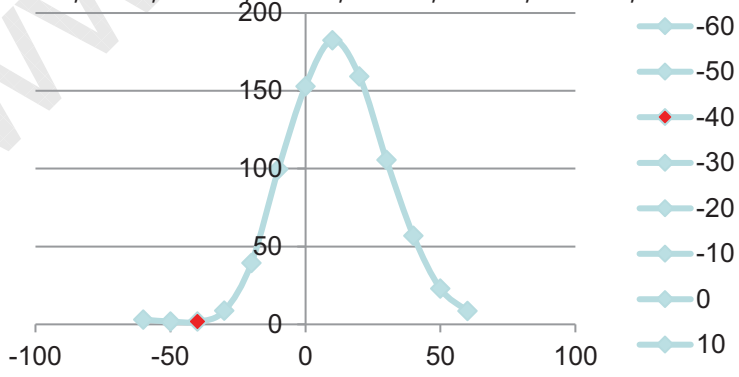
$$\text{Contrast decrease Ratio} = 1 - \frac{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=30^\circ}{\text{Contrast test at } \theta_L/\theta_R/\psi_T/\psi_B=0^\circ}$$

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: **Definition of gray inversion angle**

- Refer to the graph of note 9.
- Using luminance test method.
- Test pattern : 128 gray
- If the viewing direction is 12 o' clock ,then test the luminance while θ=-60°,θ=-50°, θ=-40°, θ=-30°, θ=-20°, θ=-10°, θ=0°, θ=10°, θ=20°, θ=30°, θ=40°, θ=-50°, θ=60°. The luminance test as figure below:



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Note 16: **After image judgment**
Power on the LCD 1 hour at tessellated picture(8*8), then switch to 128 gray picture or Flicker picture, if the afterimage can' t be seen within 3 minutes, the LCD is OK.

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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	高温驱动（HTO）	60°C，240hr
2	低温驱动（LTO）	-20°C，240hr
3	高温高湿驱动（HTBO）	60°C，90%，240hr
4	高温存储（HTS）	80°C，240hr
5	低温存储（LTS）	-40°C，240hr
6	高温高湿存储（HTBS）	60°C，90%，240hr
7	寿命测试（ALT）	-10~60°C，0~90%，240hr
8	Thermal shock test	-40~60°C，60hr
9	8585	85°C，85%，480hr
10	Cold bubble	-20°C，48hr；-30°C，1hr
11	Altitude test	24hr
12	高温启动	'70°C，24hr，Storage，每8hr启动一次
13	低温启动	'-30°C，24hr，Storage，每8hr启动一次
14	盐雾测试	35°C， 5%浓度NaCl，24hr
…		
…		

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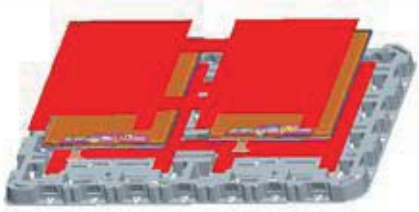
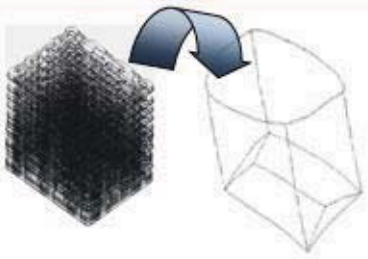
6.0 PACKING INFORMATION(产品形态：TLCM)

Packing procedure:

-. 将 1pcs EPE Pad 放于Tray底部，再将2pcs TLCM 平放入EPE Pad 上面（Panel 面朝下放置），然后上部再放一张EPE Pad -. 容量: 2pcs TLCM/Tray	-. 将18pcs PET Tray 堆码后(18层直叠堆码，顶端为空tray)两端缠3圈胶带后，平放入PE Bag并用胶带十字封口 -. 容量: 34pcs TLCM/Shielding Bag
 Step 1	 Step 2
-.将PET Tray堆码后,上下放置EPE Board,平放入Inner Box -. 容量：34pcs TLCM/Inner Box	-. 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8ea后，以缠绕膜包裹,并“井”字打包 -. 容量: 612pcs TLCM/Pallet
 Step 3	 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: 34pcs

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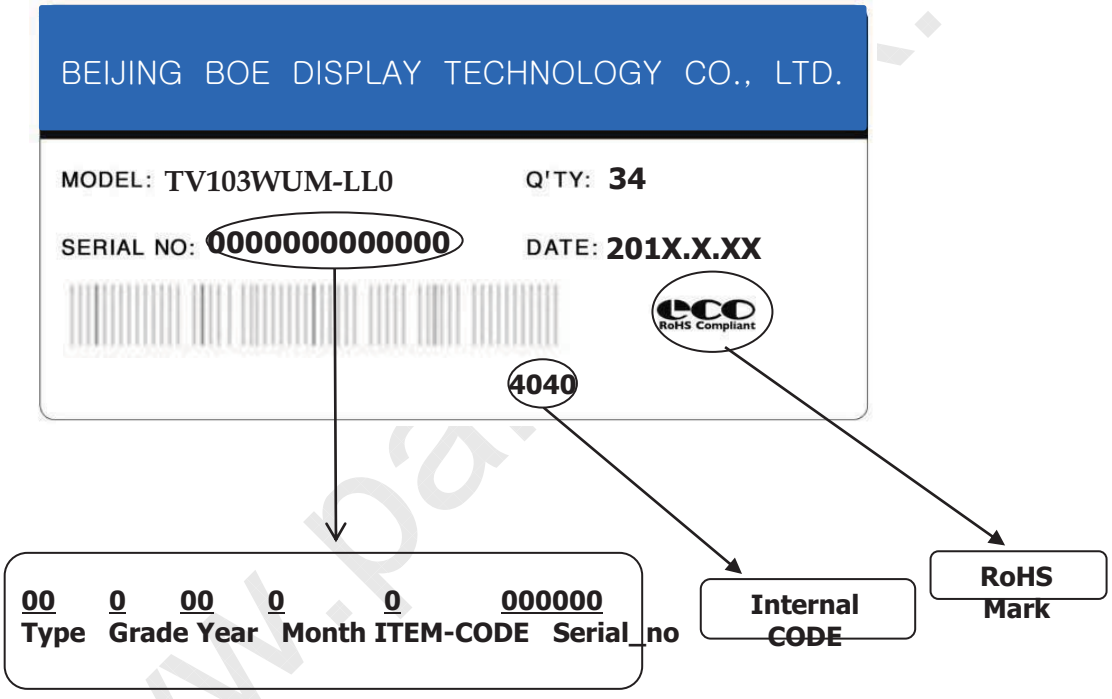
6.2 Box label (产品形态: TLCM)

- Label Size :110mm*55mm
- Contents
  Model : LCM
  Q`ty : 34pcs/Box
  Serial No. : Box Serial No. as shown below.
  Date : Packing Date
  FG Code : FG Code of Product



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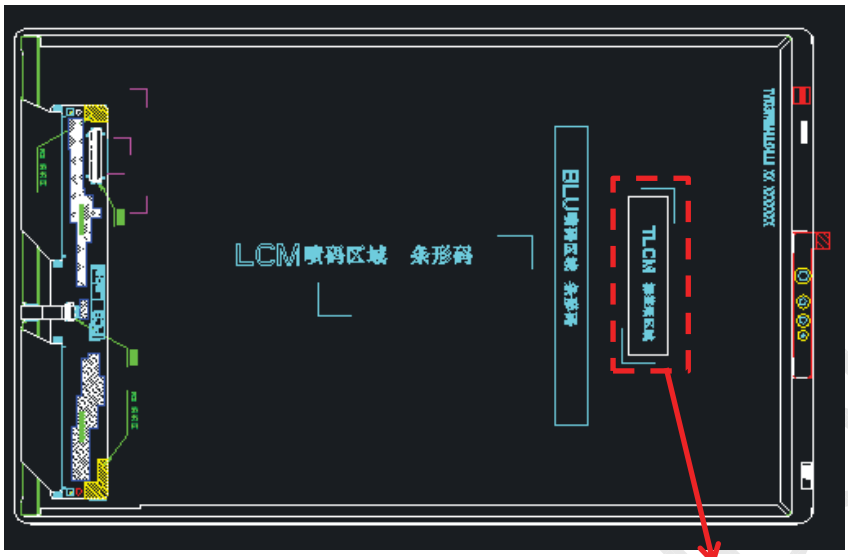
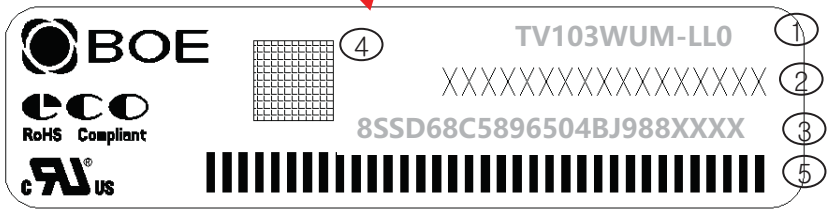
7.0 Product Label



标签贴附于背板Mark内,
标签尺寸: 48mm × 12mm
1、FG-CODE: TV103WUM-LL0
2、MDL ID
3、8S码, 客户料号: SD68C58965
4、8S 码对应二维码
5、MDL ID 对应条纹码



客户要求喷码信息

序列号	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
代码	3	H	E	L	B	C	H	E	T	1	5	0	4	1	5	A	0	0	0	0	1
描述	客户料号后四位				供应商代码	产地		产品阶段 ET/DT PT/MP		年		月		日		白班 A 夜班 B	流水码: 00001~ZZZZZ				

BOE MDL 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	E	N	P	4	1	2	7	4	0	4	0	0	0	1	E	E	J
描述	GBN代码		等级	B4	年份		月	FG Code后四位				序列号					

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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.

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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.

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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.

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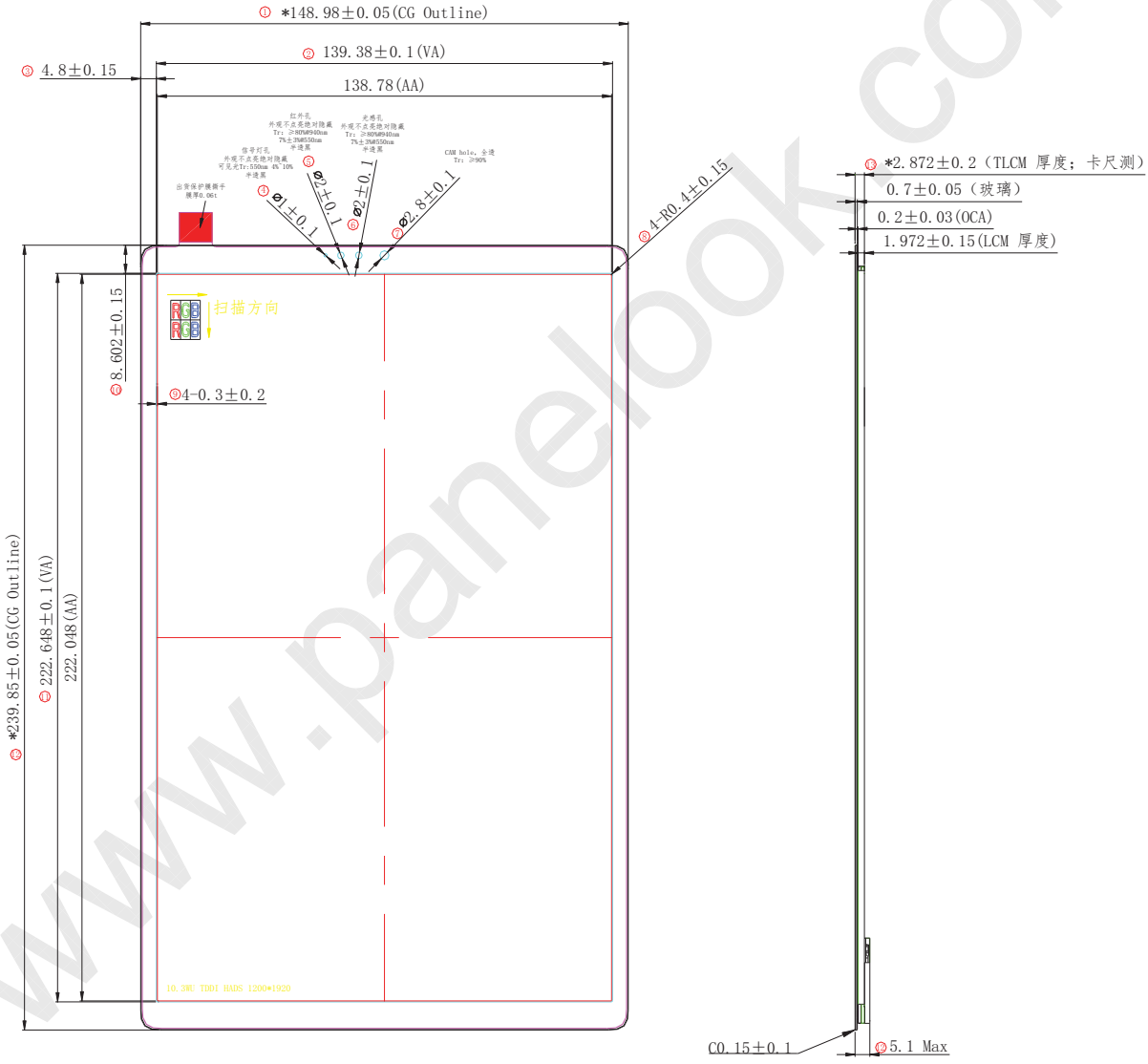
9.0 APPENDIX

Mechanical Drawing

Drawing Attachment: Front



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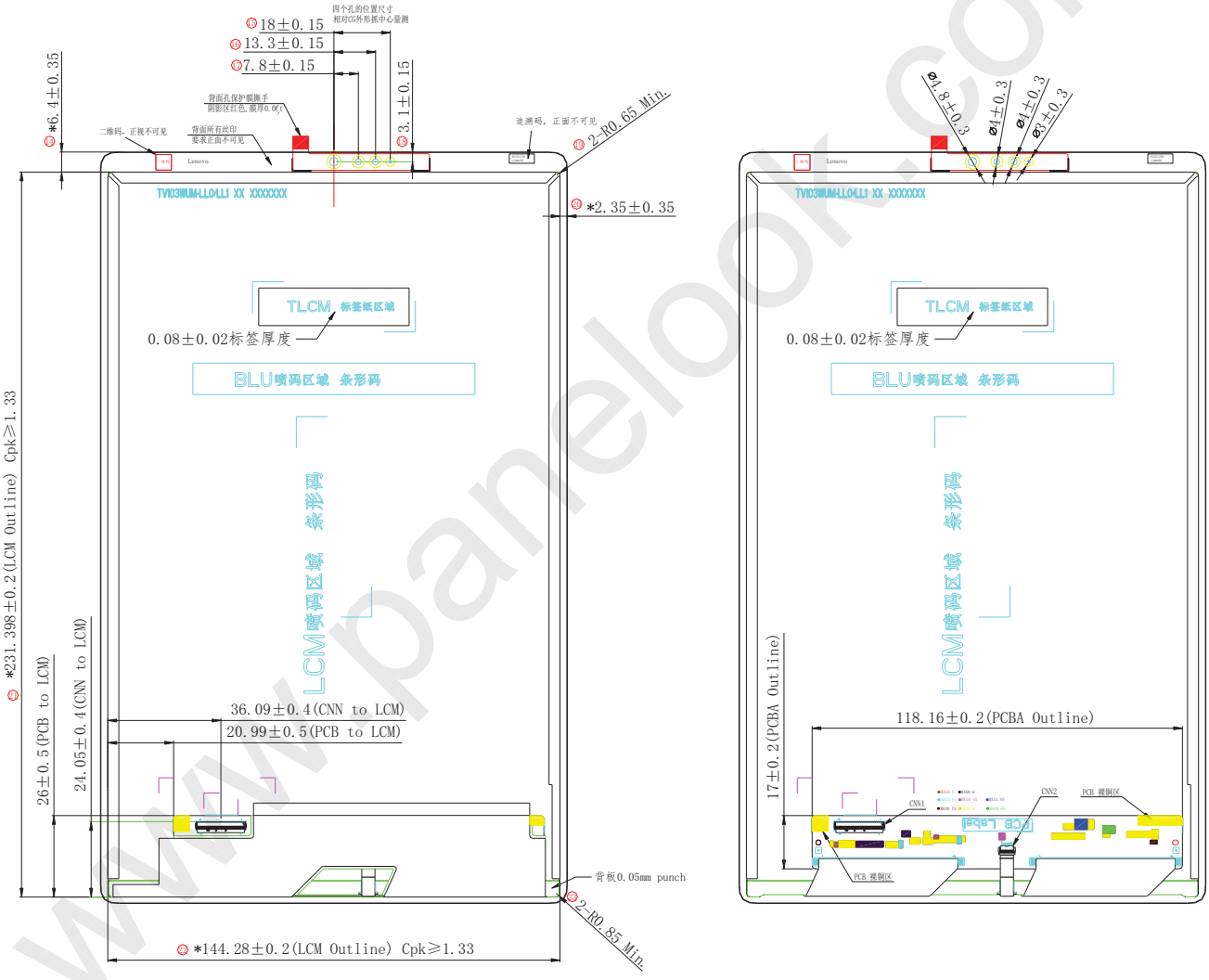
Mechanical Drawing

Drawing Attachment: Back



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