



深圳显昶光电科技有限公司

Shenzhen Xianyang Optoelectronic Technology Co., Ltd

LCD MODULE SPECIFICATION

Customer: _____

Module No.: XY015WVC01-H1650A

Date: 2022-08-01

Version: 1.0

For Customer's Acceptance:

Approved by	Comment

Approved by	Checked by	Prepared by



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Record of Revision

Rev.	Date	Description	Editor
1.0	2022-08-01	First release	Zaiping.Yang

1 General Specifications

No.	Item	Specification	Remark
1	LCD Size	1.45 inch (Diagonal)	
2	Driver Element	a-SiTFT active matrix	
3	Resolution	412 (RGB) ×412	
4	Display Mode	Normally Black, Transmissive	
5	Pixel Pitch	0.0299 (H) × 0.0897(V)	
6	Display Colors	262k	
7	Surface Treatment	--	
8	Color Arrangement	RGB-Stripe	
9	Interface	4-line SPI/MI PI/QSPI	
10	Viewing Direction	ALL	
11	GrayScale Inversion Direction	--	Note 1
12	Outline Dimension (mm)	39.36(W) ×41.53 (H) ×1.66(T)	
13	Active Area (mm)	36.96 (W) ×36.96 (H)	
14	TouchScreen	Without Cover LENS	
15	Display Driver IC	SPD2010	
16	Touch Driver IC	Incell driver IC SPD2010	

Note 1: Viewing direction for best image quality is different from TFT definition. There is a 180。 shift.

Note 2 : RoHS compliant.

2 Pin Assignment

2.1 LCD Pin assignment

Match connector: FH26-31S-0.3SHW (Hirose) or equivalent.

PIN	Symbol	I/O	Description	Remark
1	GND	P	Ground	
2	D0P	I/O	MI PI DSI-D0+ data signals	
3	D0N	I/O	MI PI DSI-D0- data signals	
4	GND	P	Ground	
5	DCKP	I	MI PI DSI-CLK+ clock signals	
6	DCKN	I	MI PI DSI-CLK- clock signals	
7	GND	P	Ground	
8	QSPI D2	I	QSPI data signal	
9	QSPI D1	I	QSPI data signal	
10	D/QSPI D0	I	D/QSPI data signal	
11	GND	P	Power Ground	
12	SCL	I	SPI clock signal.	
13	SDA	I/O	SPI data signal	
14	RESET	I	System reset pin,Signal is active low.	
15	GND	P	Power Ground	
16	TP-RESET	I	Reset signal for touch circuit.	
17	TP-INT	I	Interrupt signal for touch circuit.	
18	IM1	I	Interface selection.	Note1
19	IM0	I	Interface selection.	Note1
20	GND	P	Power Ground	
21	PNSWAP	I	PNSWAP polarity swap of MI PI signal	
22	TEST-I(2)	I	This pin is used as D/CX (data/ command selection) in SPI Interface .	
23	TP-SCL	I	TP_I2C_SCL(3.3V), 4.7K~10K pull up resistor needed	
24	TP-SDA	I/O	TP_I2C_SDA (3.3V),4.7K~10K pull up resistor needed	
25	GND	P	Power Ground	
26	IOVCC	P	Power Supply for logic I/O 3.3V	
27	VCI	P	Power Supply for analog circuit 3.3V	
28	GND	P	Power Ground	
29	LEDA	P	LED anode	
30	LEDK	P	LED Cathode	
31	LEDK	P	LED Cathode	

I---Input, O---Output, P--- Power/Ground

Note1:

SPI/DSPI/QSPI are supported.

SPI interface or MIPI interface is selected by hardwire pins IM[0:1].

Table : Interface Selection

IM[1]	IM[0]	Interface	Used pins
0	0	Reserved	-
0	1	4-wire SPI (0xE4=0)	PNSWAP(CSX), TEST_I[2](DCX), SCL, SDA
0	1	4-wire DSPI (0xE4=1)	PNSWAP(CSX), TEST_I[2](DCX), SCL, SDA, D[0]
1	0	MIPI	PNSWAP, CP, CN, DP, DN
1	1	3-wire SPI	PNSWAP(CSX), TEST_I[2](DCX)=GND, SCL, SDA
1	1	QSPI	PNSWAP(CSX), TEST_I[2](DCX)=VDDIO, SCL, SDA, D[0:2]

3 Absolute Maximum Ratings

Ta = 25°C

Item	Symbol	Min.	Max.	Unit	Remark
Power Voltage	IOVCC	-0.30	+3.6	V	
	VCI	-0.30	+3.6	V	
Operating Temperature	Top	-20.0	70.0	°C	
Storage Temperature	Tst	-30.0	80.0	°C	
Operating and Storage Humidity	Hstg	10%	90%	%(RH)	

4. Electrical Characteristics

4.1 Recommended Operating Condition

VCC=3.3V , GND=0V , Ta = 25°C

Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply		VCC	2.6	2.8	3.3	V	
		IOVCC	2.6	2.8	3.3	V	
Input Signal Voltage	Low Level	V _{IL}	0	-	0.3 x VCC	V	
	High Level	V _{IH}	0.7 x VCC	-	VCC	V	
Current of Power supply		I _{DD}	-	20	50	mA	VCC=3.3V, color bar pattern

4.2 Backlight Unit Driving Condition

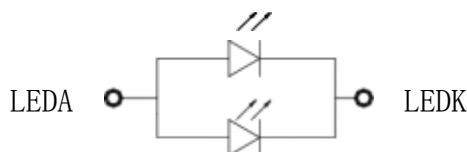
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I_F	-	40	50	mA	2 LEDs (1 LED Serial, 2 LED Parallel)
Forward Current Voltage	V_F	-	3.2	3.5	V	
Backlight Power Consumption	W_{BL}	-	128	175	mW	
Operating Life Time	--	30000	--	--	hrs	Note 2, Note 3

Note1: The LED driving condition is defined for each module (1 LED Serial, 2 LED Parallel).

Note2: When LCM is operated, the stable forward current should be inputted. And forward voltage is for reference only.

Note3: Optical performance should be evaluated at $T_a=25^{\circ}\text{C}$ When LED is driven at high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

Note4: The LED driving condition is defined for each LED module.



5 Timing Chart

5.1 4-SPI Interface Characteristics.

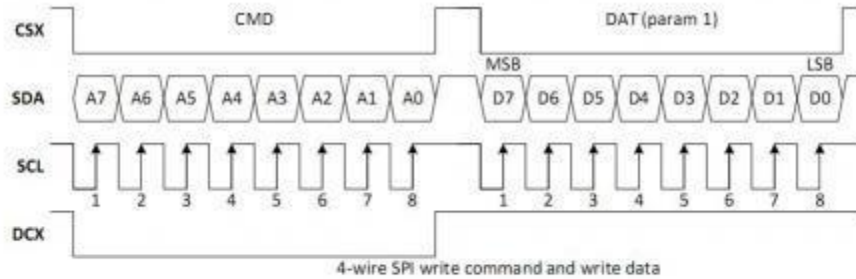


Figure : 4-wire SPI write command and write data

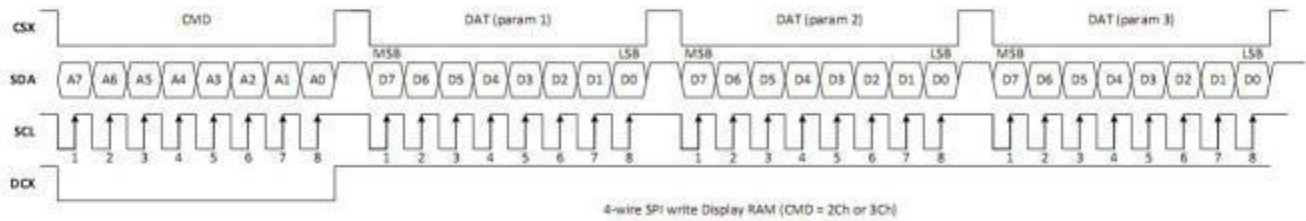


Figure : 4-wire SPI write RAM data

(Note: for each time using 0x2C or 0x3C cmd to write RAM data, please write 4 pixels data or more.)

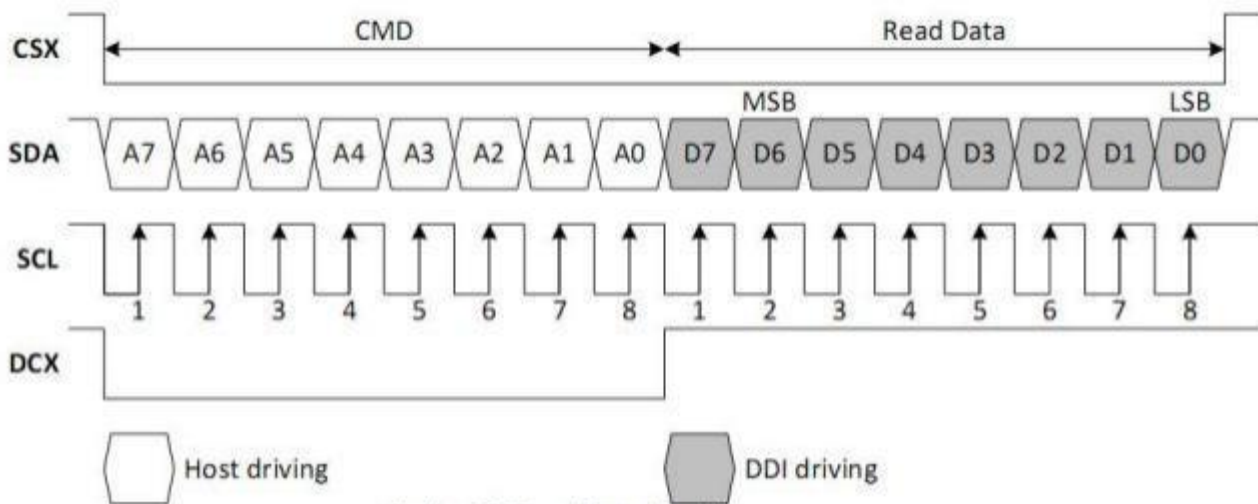


Figure : 4-wire SPI Read

5.2 4-DSPI Interface Characteristics.

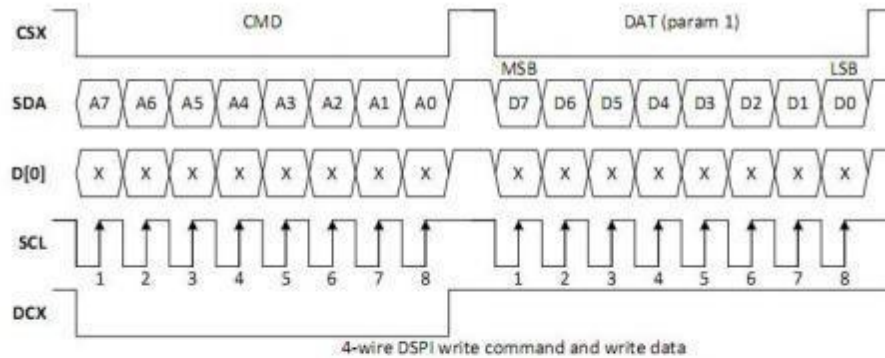


Figure : 4-wire DSPI write command and write data

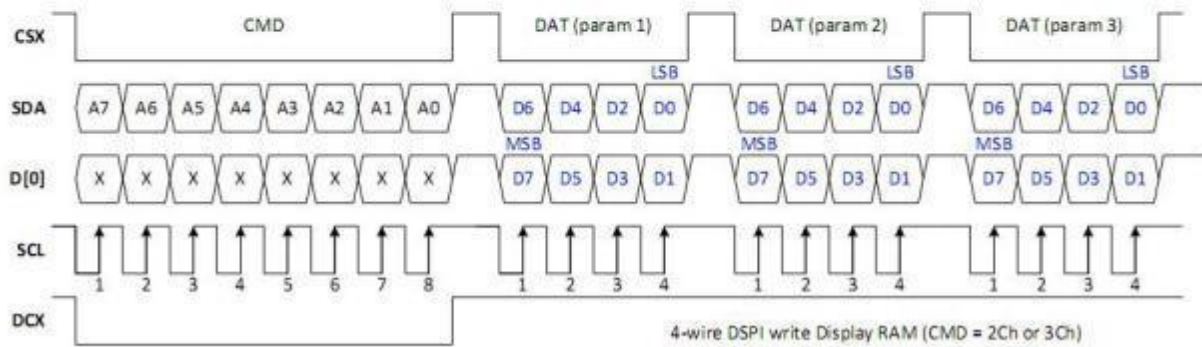


Figure : 4-wire DSPI write RAM data

(Note: for each time using 0x2C or 0x3C cmd to write RAM data, please write 4 pixels data or more.)

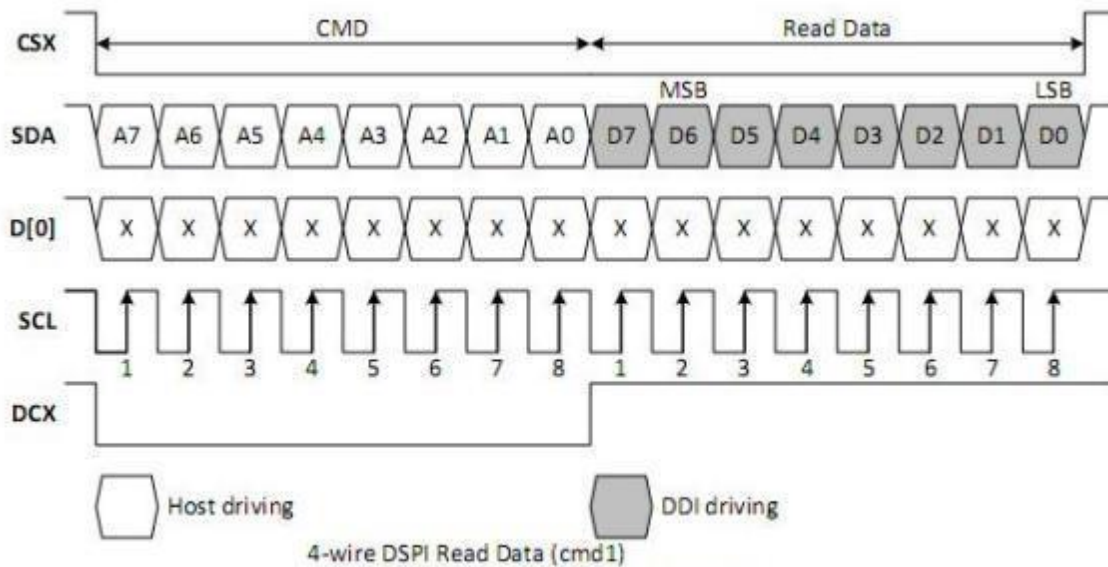


Figure: 4-wire DSPI Read

5.3 3-wire SPI Interface Characteristics.

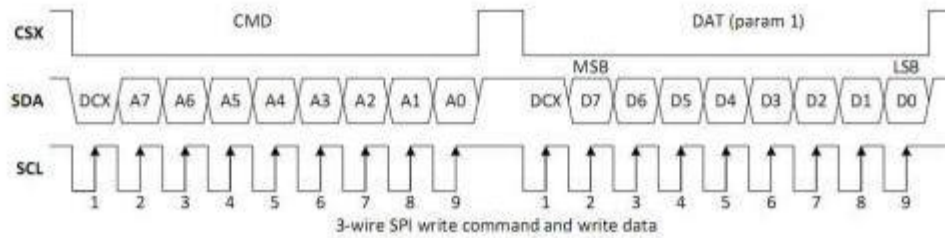


Figure : 3-wire SPI write command and write data

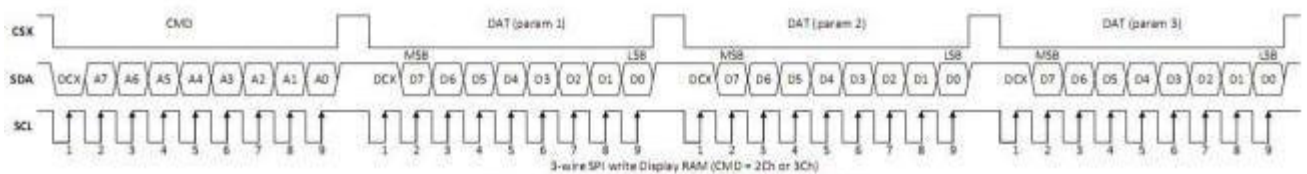
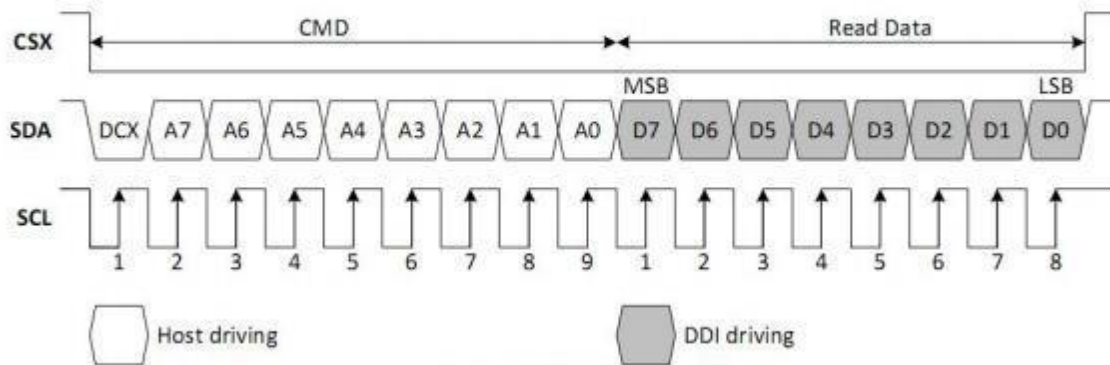


Figure: 3-wire SPI write RAM data

(Note: for each time using 0x2C or 0x3C cmd to write RAM data, please write 4 pixels data or more.)



3-wire SPI Read Data (cmd1)

Figure : 3-wire SPI Read

5.4 QSPI Interface Characteristics.

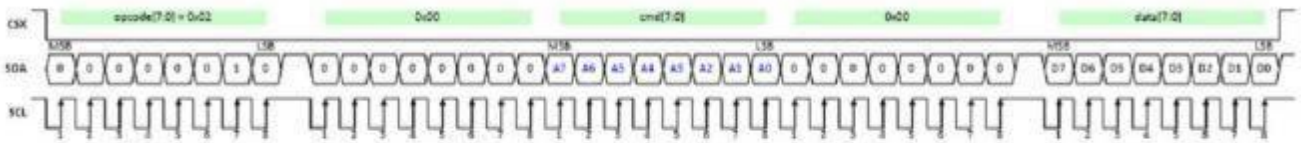


Figure : QSPI write command and write data (1 data lane)

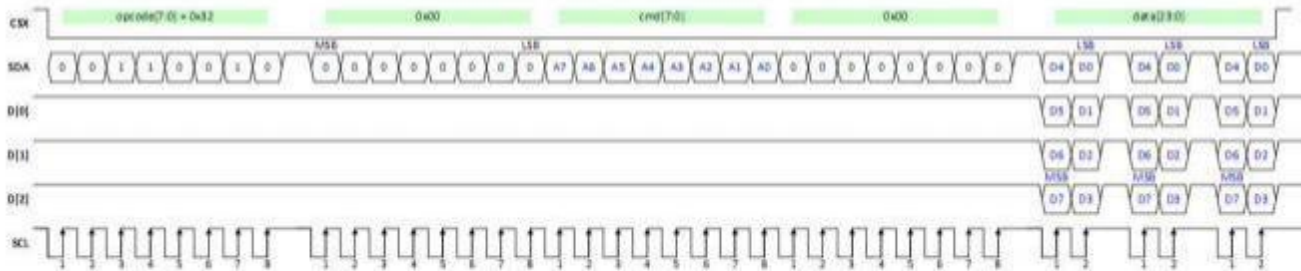


Figure : QSPI write command and write data (4 data lanes)

(Note: for each time using 0x2C or 0x3C cmd to write RAM data, please write 4 pixels data or more.)

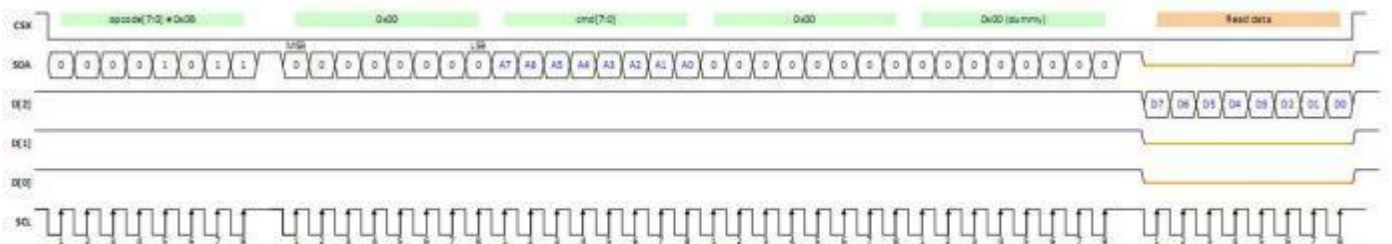


Figure : QSPI Read

5.5 MIPI Interface Characteristics.

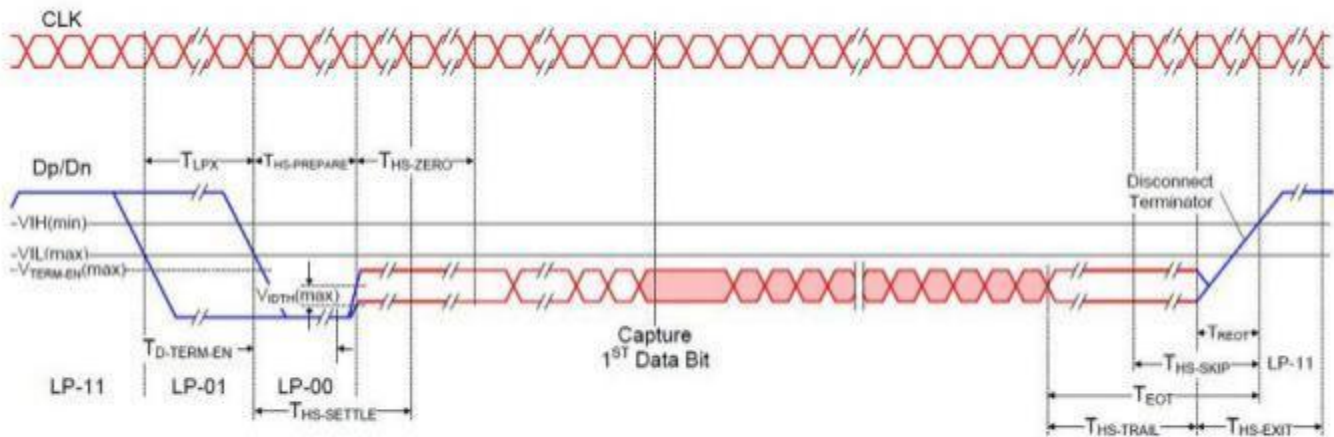


Figure : High-Speed Data Transmission in Bursts

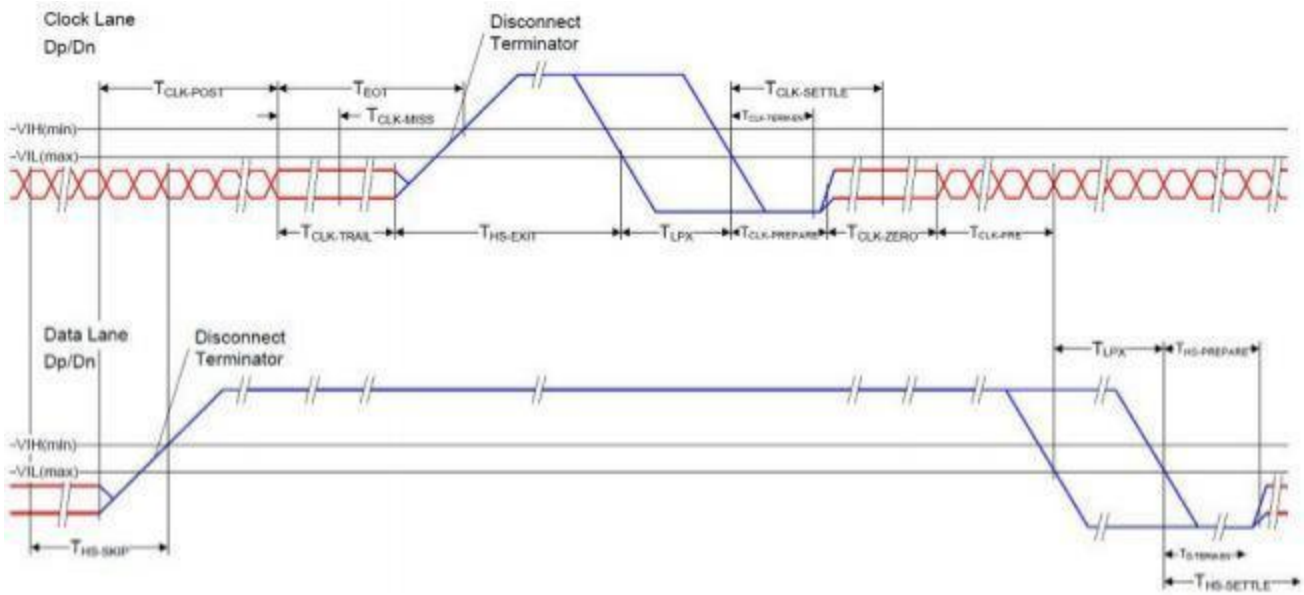


Figure : Switching the Clock Lane between Clock Transmission and Low Power Mode

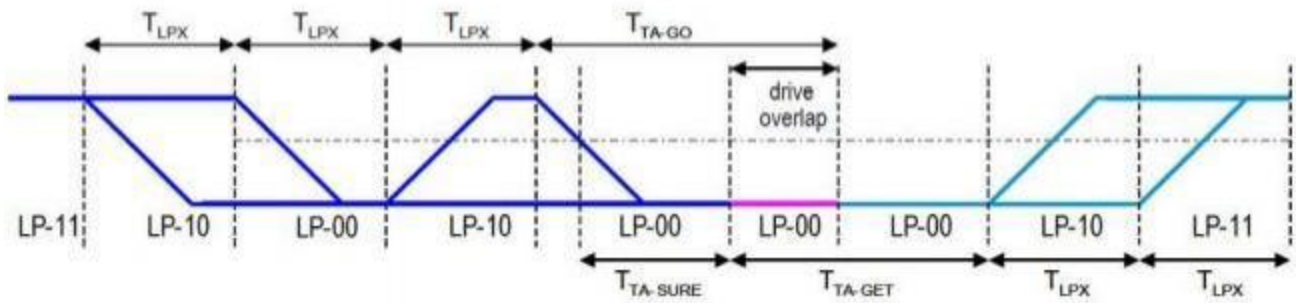
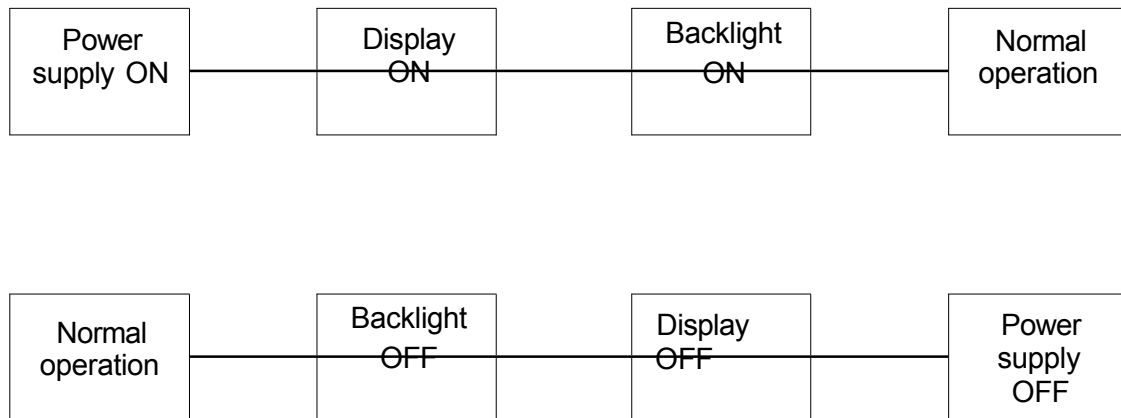
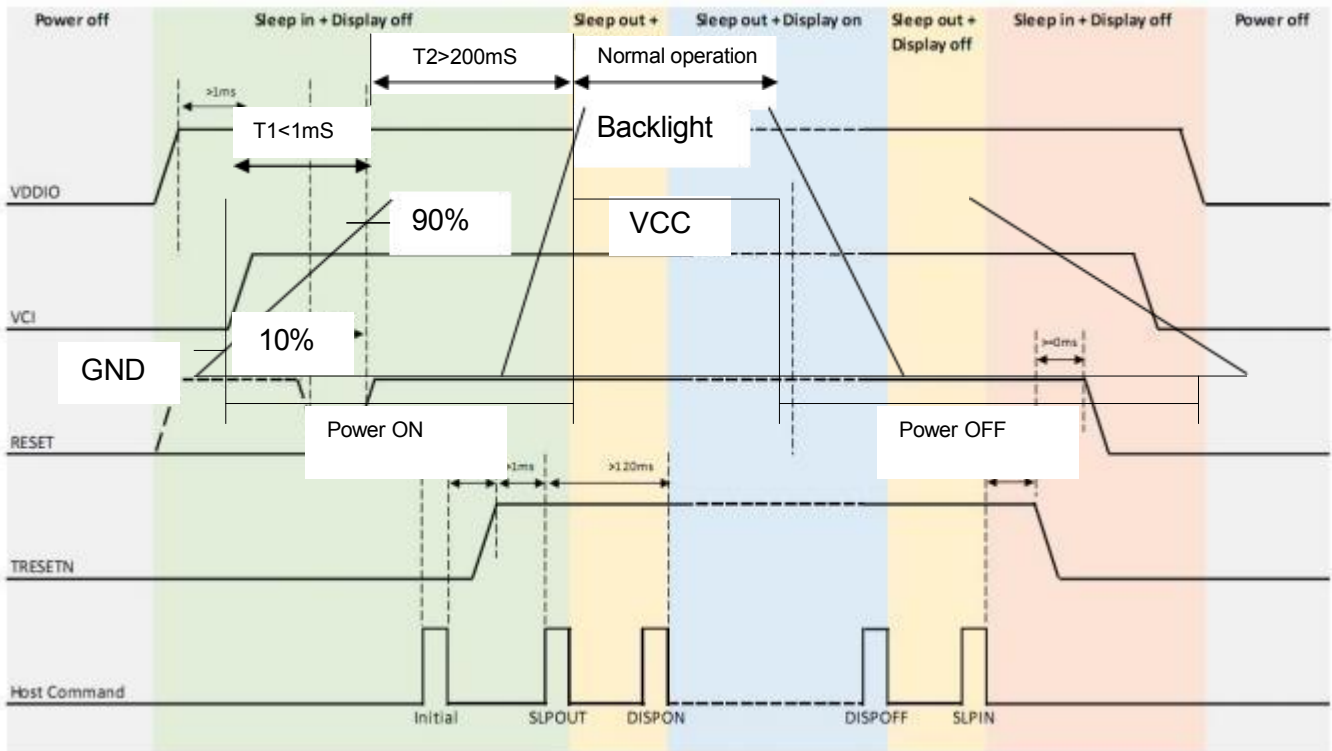


Figure : MIPI BUS Turnaround Procedure

5.6 Power ON/OFF Timing

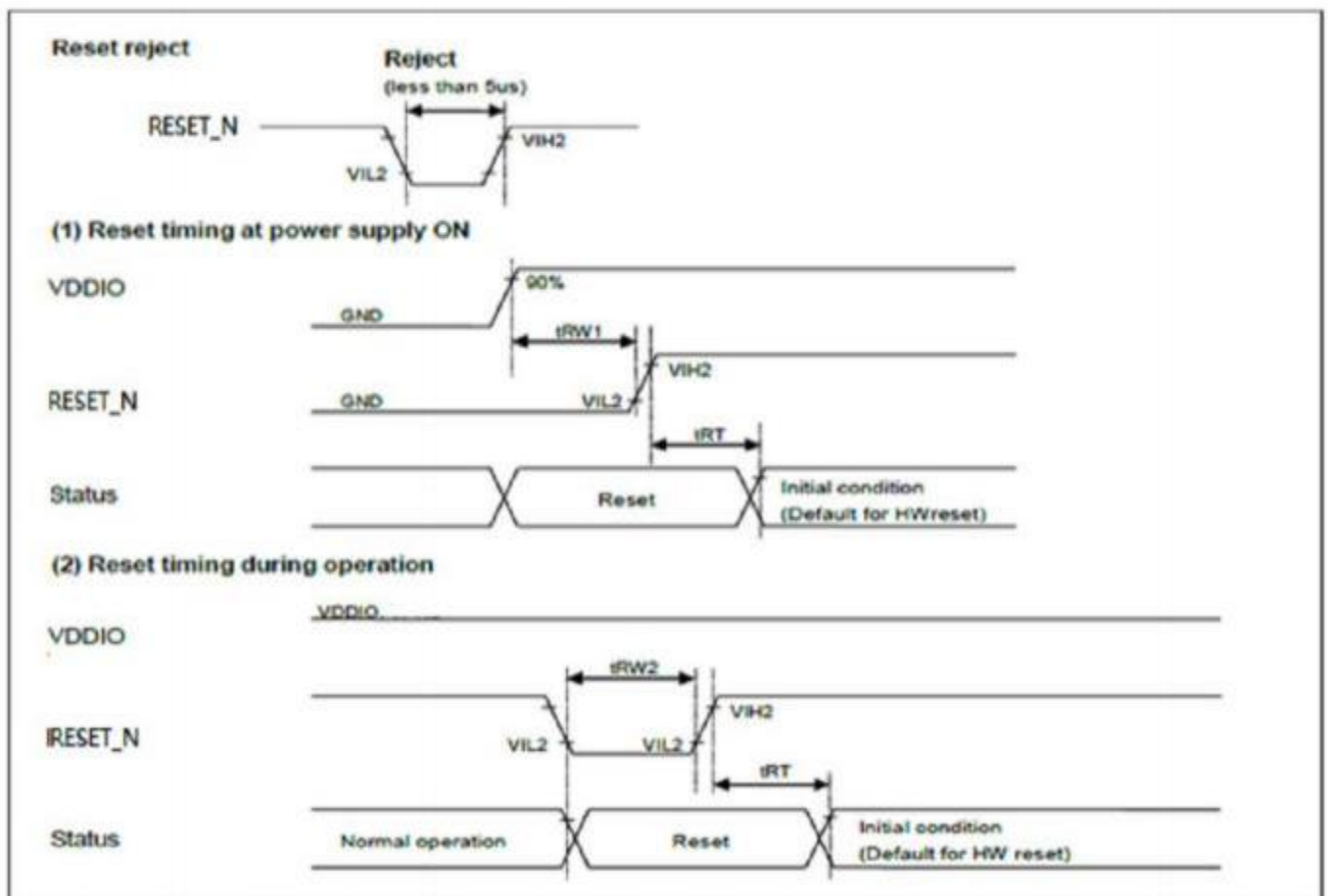


5.7 reset timing

Table : Reset Characteristics

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
Reset "Low" level width 1	tRW1	ms	Power On	1	-	-
Reset "Low" level width 2	tRW2	ms	Operation	1	-	-
Reset time	tRT	ms	-	20	-	-

Figure : Reset Operation



6 Optical Characteristics

Ta=25°C

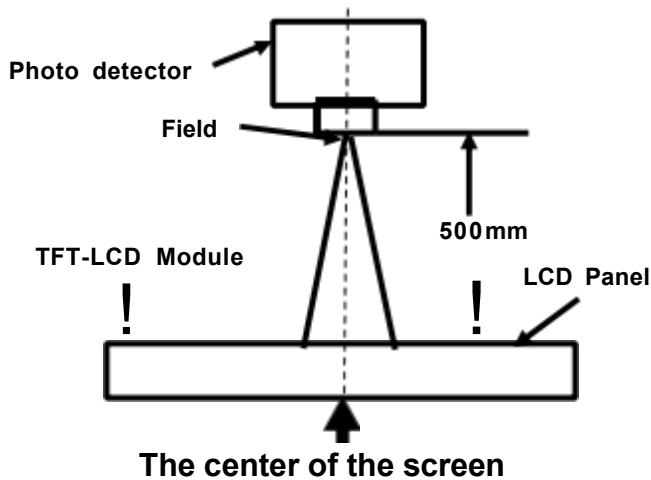
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
View Angles		θT	CR≥10	-	85	-	Degree	Note 2
		θB		-	85	-		
		θL		-	85	-		
		θR		-	85	-		
Contrast Ratio		CR	θ=0°	1200	1500	-		Note1 Note3
Response Time		T _{ON}	25℃	--	35	40	ms	Note1 Note4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.240	0.270	0.300		Note1 Note5
		y		0.280	0.310	0.340		
	Red	x		0.629	0.659	0.689		
		y		0.296	0.326	0.356		
	Green	x		0.247	0.277	0.307		
		y		0.559	0.589	0.619		
	Blue	x		0.106	0.136	0.166		
		y		0.098	0.128	0.158		
Uniformity		U		80	85	-	%	Note1 Note6
NTSC				65	70	-	%	Note 5
Luminance		L		180	210	-	cd/m²	Note1 Note7

Test Conditions:

1. $I_F = 40 \text{ mA}$, $V_F = 3.3 \text{ V}$ and the ambient temperature is $25 \pm 2^\circ\text{C}$. humidity is $65 \pm 7\%$
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

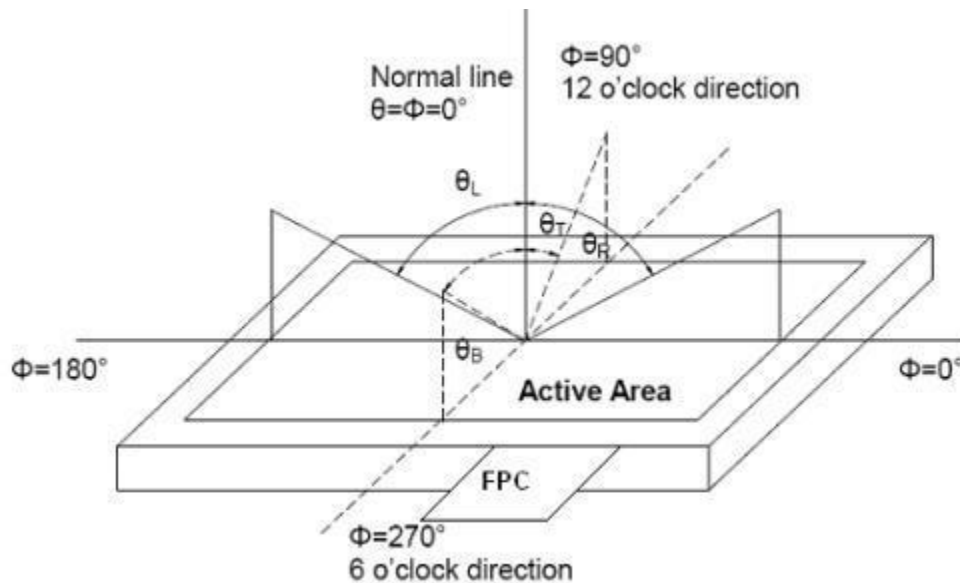
Properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	SR-3A	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	2°

Note 2: Definition of viewing angle range and measurement system.

Viewing angle is measured at the center point of the LCD by CONOSCOPE(ergo-80).



Note 3: Definition of contrast ratio

$$\text{Contrast ratio (CR)} = \frac{\text{Luminance measured when LCD is on the "White" state}}{\text{Luminance measured when LCD is on the "Black" state}}$$

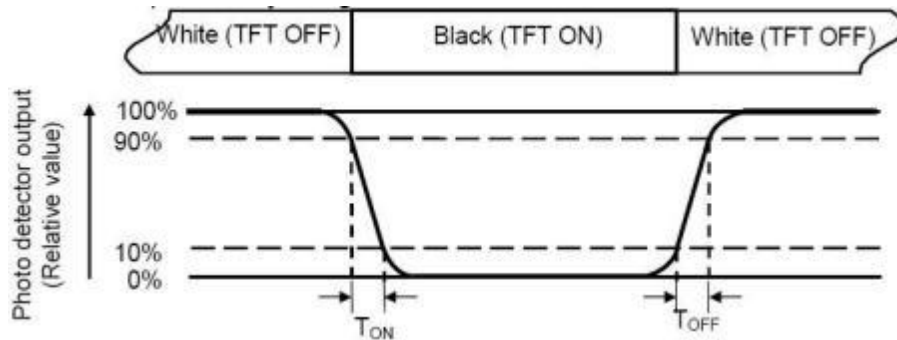
“White state” : The state is that the LCD should drive by V_{white} .

“Black state” : The state is that the LCD should drive by V_{black} .

V_{white} : To be determined V_{black} : To be determined.

Note 4: Definition of response time

The response time is defined as the LCD optical switching time interval between “White” state and “Black” state. Rise time (T_{ON}) is the time between photo detector output intensity changed from 90% to 10%. And fall time (T_{OFF}) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

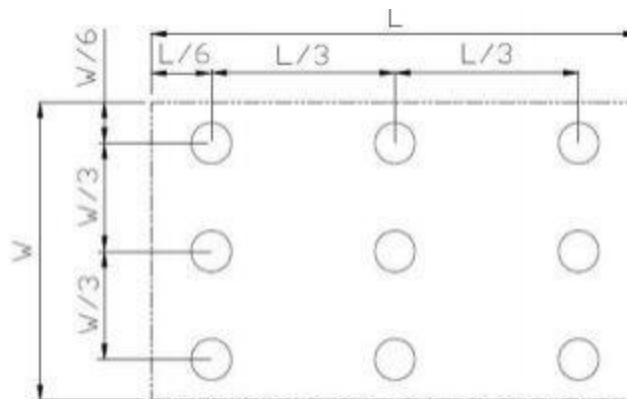
Color coordinates measured at center point of LCD.

Note 6: Definition of luminance uniformity

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Luminance Uniformity (U)} = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width



$L_{\max}$: The measured Maximum luminance of all measurement position.

$L_{\min}$: The measured Minimum luminance of all measurement position.

Note 7: Definition of luminance:

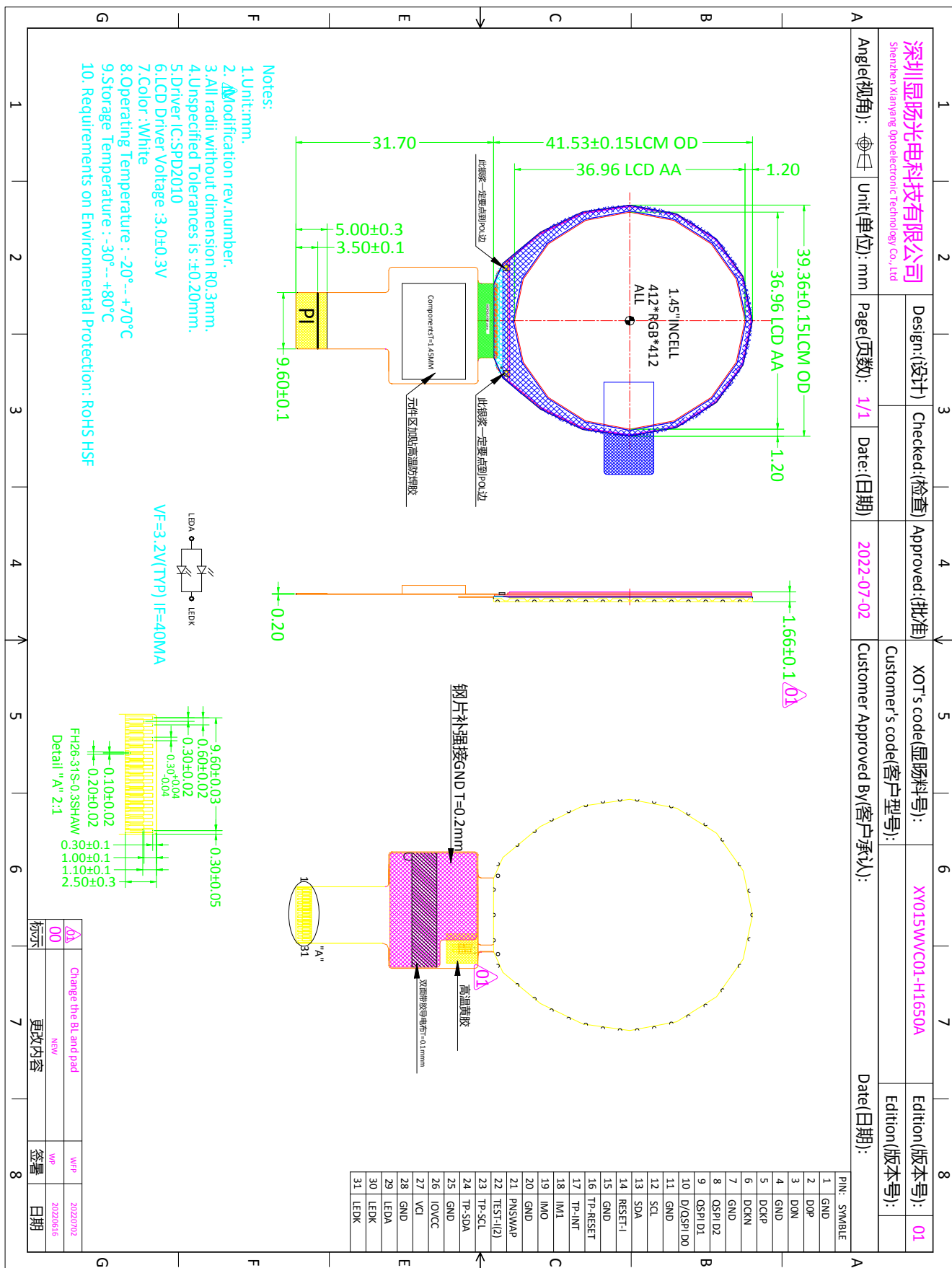
Measure the luminance of white state at center point.

7 Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts = +70°C, 120 hours	No abnormalities in functions
2	Low Temperature Operation	Ta = -20°C, 120 hours	No abnormalities in functions
3	High Temperature Storage	Ta = +80°C, 120 hours	No abnormalities in functions
4	Low Temperature Storage	Ta = -30°C, 120 hours	No abnormalities in functions
5	Storage at High Temperature and Humidity	Ta = +60°C, 90% RH max, 120 hours	No abnormalities in functions
6	Thermal Shock (non-operating)	-30°C 30 min ~ +70°C 30 min, Change time: 0.5 hour □ 5 min □ 0.5 hour. 10 Cycle	Start with cold temperature, End with high temperature,
7	ESD	C=150pF, R=330Ω, 5point/panel Air: ±8Kv, 5times; Contact: ±4Kv, 5times (Environment: 15°C ~ 35°C, 30% ~ 60% RH, 86Kpa ~ 106Kpa)	No abnormalities in functions

Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of samples.



9 Precautions for Use of LCD Modules

Handling Precautions

9.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.

9.1.2 If the display panel is damaged and the liquid crystal substance inside it leaks out, be sure not to get any in your mouth, if the substance comes into contact with your skin or clothes, promptly wash it off using soap and water.

9.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.

9.1.4 The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.

9.1.5 If the display surface is contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If still not completely clear, moisten cloth with one of the following solvents:

- Isopropyl alcohol
- Ethyl alcohol

Solvents other than those mentioned above may damage the polarizer. Especially, do not use the following:

- Water
- Ketone
- Aromatic solvents

9.1.6 Do not attempt to disassemble the LCD Module.

9.1.7 If the logic circuit power is off, do not apply the input signals.

9.1.8 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

9.1.8.1 Be sure to ground the body when handling the LCD Modules.

9.1.8.2 Tools required for assembly, such as soldering irons, must be properly ground.

9.1.8.3 To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.

9.1.8.4 The LCD Module is coated with a film to protect the display surface. Be care when peeling off this protective film since static electricity may be generated.

Storage Precautions

9.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.

9.2.2 The LCD modules should be stored under the storage temperature range. If the LCD modules will be stored for a long time, the recommend condition is: Temperature : 0°C ~ 40°C Relatively humidity: ≤80%

9.2.3 The LCD modules should be stored in the room without acid, alkali and harmful gas.

Transportation Precautions

9.3.1 The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.