



上海冠显光电科技有限公司
Shanghai Top Display Optoelectronics Co., LTD

LCD MODULE SPECIFICATION

Customer: _____

Module No.: TS021WVC02NP-B1323B

Date: 2025-11-15

Version: 1.2

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	2024-12-19	First release	Hongwei.Li
1.1	2025-10-14	Change brightness information	Hongwei.Li
1.2	2025-11-15	Change interface information	Hongwei.Li

1 General Specifications

No.	Item	Specification	Remark
1	LCD Size	2.1 inch	
2	Driver Element	a-Si TFT active matrix	
3	Resolution	480 (RGB) × 480	
4	Display Mode	ADS_Normally Black, Transmissive	
5	Pixel Pitch	0.111 (H) × 0.111 (V)	
6	Display Colors	262K	
7	Surface Treatment	--	
8	Color Arrangement	RGB-Stripe	
9	Interface	QSPI/SPI	
10	Viewing Direction	ALL	
11	Gray Scale Inversion Direction	--	Note 1
12	Outline Dimension (mm)	56.18(W) × 59.71(H)	
13	Active Area (mm)	53.28 (W) × 53.28 (H)	
14	Touch Screen	Without CTP	
15	Display Driver IC	TR230S	
16	Touch Driver IC	--	

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 Pin assignment

Match connector 1: XF2M-2015-1A (OMRON) or equivalent.

N	Symbol	I/O	Description	Remark
1	GND	P	Ground	
2	VCC	P	POWER INPUT	
3	GND	P	Ground	
4	CS#	I	Chip selection:LOW active	
5	GND	P	Ground	
6	SDO1	I	SPI:SPI-MISO QSPI:QSPI-DATA1	
7	SDO0	I	SPI:SPI-MOSI QSPI:SPI-DATA0	
8	SCL	I	SPI/QSPI:SPI-Clock	
9	SDO3	I	QSPI:QSPI-DATA3	
10	SDO2	I	QSPI:QSPI-DATA2	
11	RESET#	I	TR230S Module_RESET and LCD-RESET: LOW active	
12	WAIT#	I	WAIT# STATUS flag, 0: Sending Command Not Allowed 1: Sending Command Allowed	
13	QSPI-INT	O	Touch interrupt	Note2
14	D/C#	I	DATA or COMMAND flag when choose , QSPI: NOT CONNECTION SPI-4WIRE interface: D/C#="H" is DATA or parameter D/C#="L" is COMMAND	
15	TP-INT	O	NC	
16	TP-SDA	I/O	NC	
17	TP-SCL	I	NC	
18	TP-RST	I	NC	
19	TP-VCC	P	NC	
20	TP-GND	P	NC	

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

Match connector 2: 2mm spacing 2X7 Pin Header

N	Symbol	I/O	Description	Remark
1	VCC	P	POWER INPUT	
2	GND	P	Ground	
3	GND	P	Ground	
4	CS#	I	Chip selection:LOW active	
5	GND	P	Ground	
6	SDO1	O	SPI:SPI-MISO QSPI:QSPI-DATA1	
7	SDO0	I	SPI:SPI-MOSI QSPI:SPI-DATA0	
8	SCL	I	SPI/QSPI:SPI-Clock	
9	SDO3	I	QSPI:QSPI-DATA3	
10	SDO2	I	QSPI:QSPI-DATA2	
11	RESET#	I	TR230S Module_RESET and LCD-RESET: LOW active	
12	WAIT#	I/O	WAIT# STATUS flag, 0: Sending Command Not Allowed 1: Sending Command Allowed	
13	QSPI-INT	I/O	Touch interrupt	Note2
14	D/C#	I/O	DATA or COMMAND flag when choose , QSPI: NOT CONNECTION SPI-4WIRE interface: D/C#="H" is DATA or parameter D/C#="L" is COMMAND	

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

Note1: IM[1:0] Configuration table

IMO	IM1	INTERFACE	Related Pins	Max. Clock
0	0	SPI-4WIRE	CS# 、 SCL 、 SD00 、 D/C# 、 WAIT#	100MHz
1	0	QSPI-4SDA	CS# 、 SCL 、 SD00 、 SD01 、 SD02 、 SD03 、 WAIT#	100MHz

Note2:

The PIN HOST does not need to be connected when the user drives the touch screen directly through the IIC.If the TR230 drives the touch screen, the user needs to detect the PIN to decide whether to read the touch event.

3 Absolute Maximum Ratings

Ta = 25°C

Item	Symbol	Min.	Max.	Unit	Remark
Power Voltage	VCC	-0.30	+5.8	V	
Operating Temperature	Top	-20.0	70.0	°C	
Storage Temperature	T _{st}	-30.0	80.0	°C	
Operating and Storage Humidity	H _{stg}	10%	90%	%(RH)	

4 Electrical Characteristics

4.1 Recommended Operating Condition

VCC=5V, GND=0V, Ta = 25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply Voltage	VCC	3.3	5	5.5	V	
Input Signal Voltage	Low Level	V _{IL}	-0.3	-	0.3*3.3	V
	High Level	V _{IH}	0.7*3.3	-	3.3+0.3	V
Power supply Voltage	I _{VCC}	-	116		mA	VCC=5V, color bar pattern

4.2 Backlight Unit Driving Condition

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I _F	-	20	25	mA	4LEDs
Forward Current Voltage	V _F	-	12.8	14	V	(4 LED Serial, 1LED
Backlight Power Consumption	W _{BL}	-	256	350	mW	Parallel)Note5
Operating Life Time	--	30000	--	--	hrs	Note 2, Note 3

Note1: The LED driving condition is defined for each module (4 LED Serial, 1 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 Ta=25℃ 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.

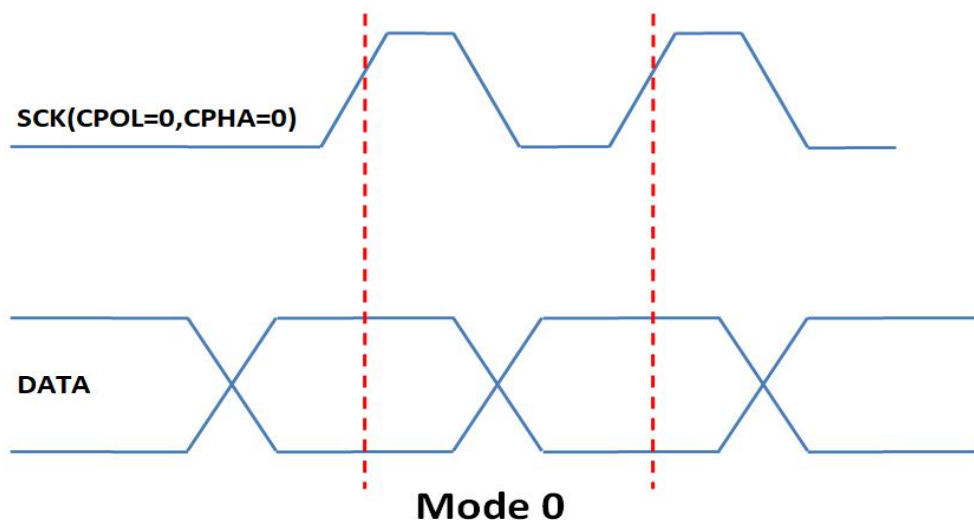
Note4: The LED driving condition is defined for each LED module.

Note5:The product has already integrated the backlight driving circuit.



5 Interface Description

If there is no special indication, TR230S works on Mode 0, That means data transmission occurs during rising edge of the clock.



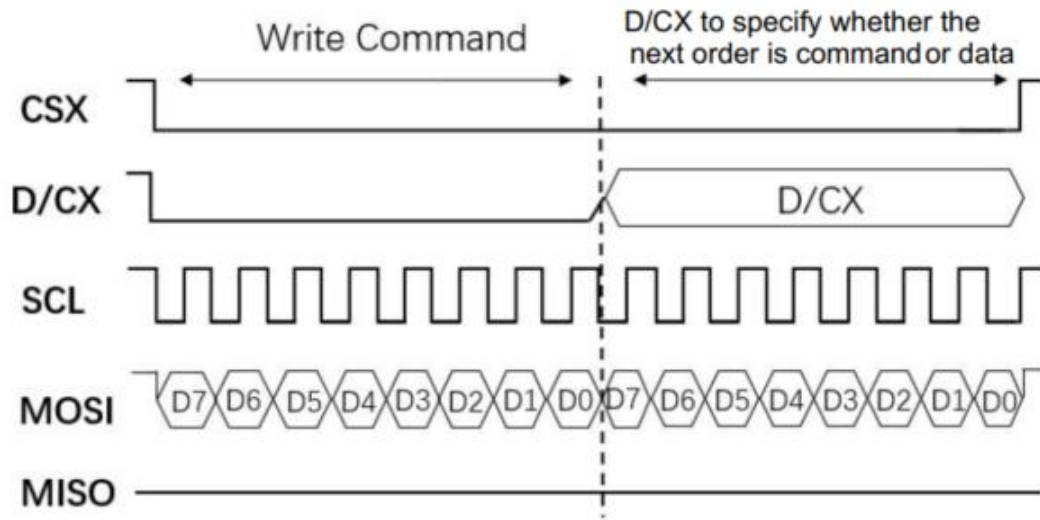
5.1 PIN DESCRIPTION

PIN NAME	Description
CS#	Chip selection: LOW active
SCL	Serial Interface Clock
SDO0	SPI: MOSI QSPI: QSPI-DATA0
SDO1	SPI: MISO QSPI: QSPI-DATA1
SDO2	QSPI: QSPI-DATA2
SDO3	QSPI: QSPI-DATA3
D/C#	DATA or COMMAND flag, 0:COMMAND 1:DATA
WAIT#	WAIT# STATUS flag, 0: Sending Command Not Allowed 1: Sending Command Allowed

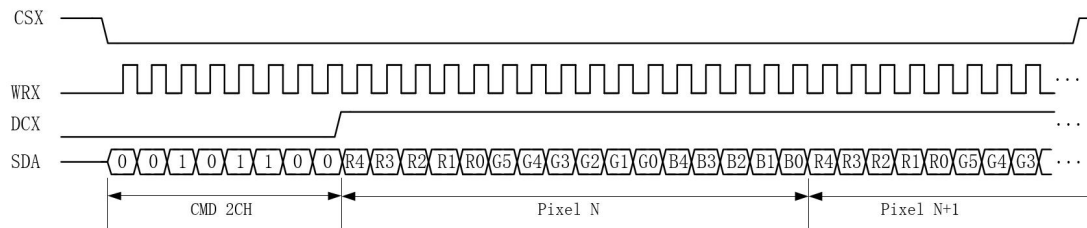
5.2 INTERFACE TIMING

• SPI-4WIRE

Timing for sending command and data:



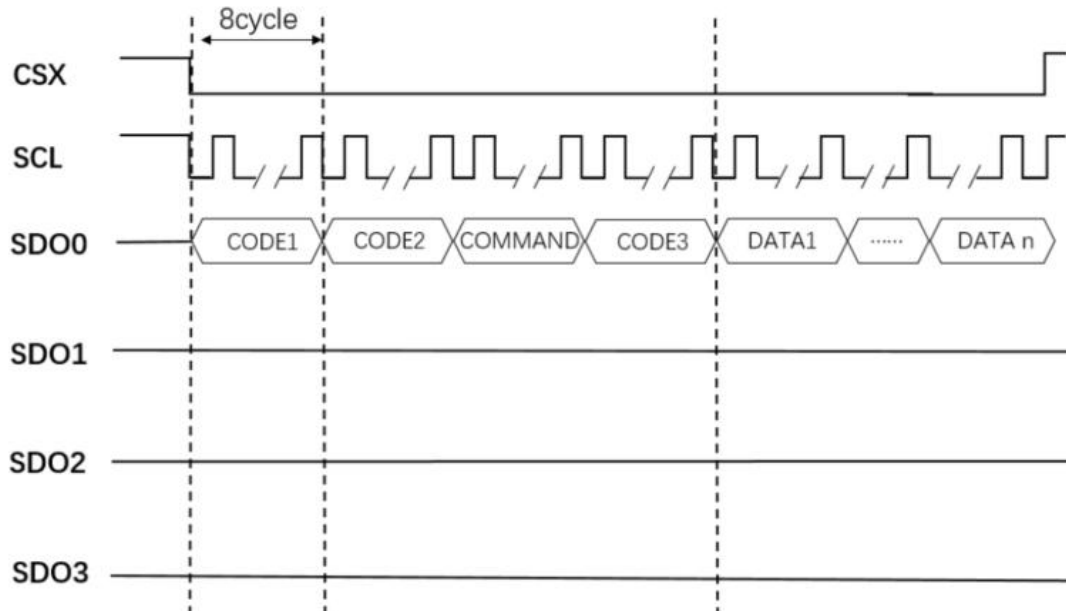
Display data writing format:



• QSPI-4SDA

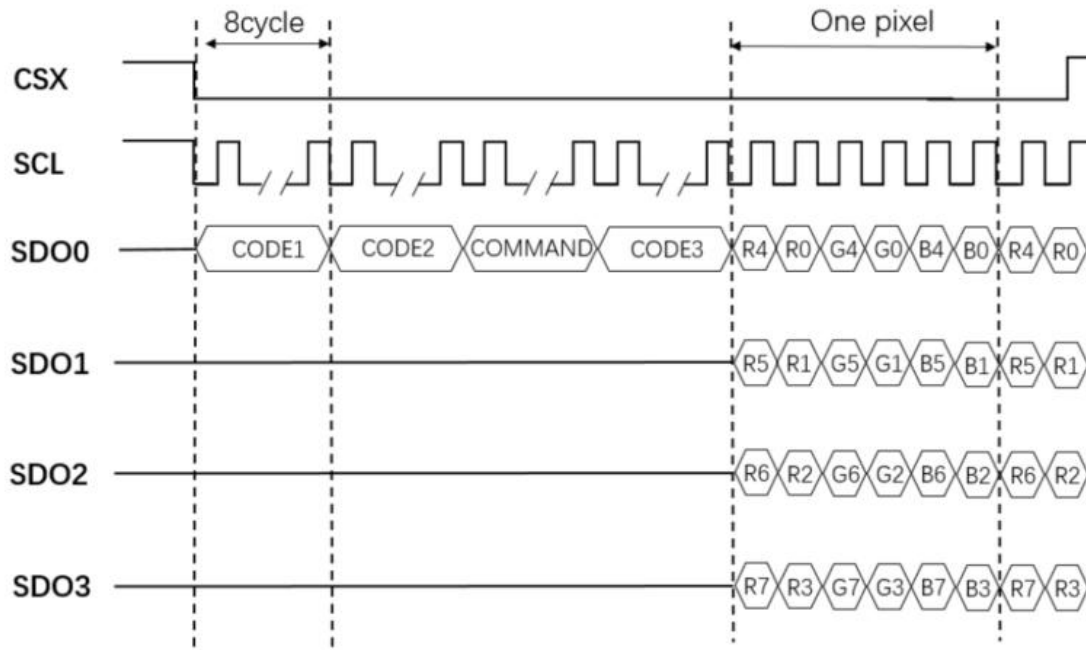
Timing for sending command:

(CODE1=0x02, CODE2=CODE3=0x00)



Display data writing format:

(CODE1=0x12, CODE2=CODE3=0x00 COMMAND = 0x2C)



6 Optical Characteristics

Ta=25°C

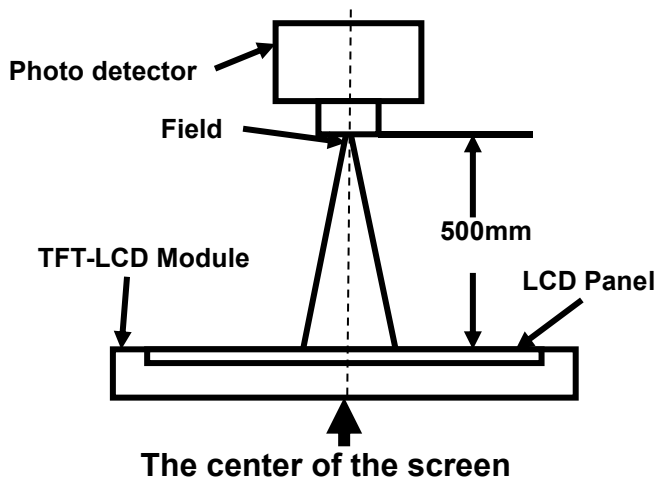
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
View Angles		θT	CR ≧ 10	80	85	-	Degree	Note 2
		θB		80	85	-		
		θL		80	85	-		
		θR		80	85	-		
Contrast Ratio		CR	θ=0°	800	1000	-		Note1 Note3
Response Time		T _{ON}	25℃	-	30	35	ms	Note1
		T _{OFF}						Note4
Chromaticity	White	x	Backlight is on	0.284	0.314	0.344		Note1 Note5
		y		0.269	0.299	0.329		
	Red	x		0.627	0.657	0.687		
		y		0.289	0.319	0.349		
	Green	x		0.330	0.360	0.390		
		y		0.554	0.584	0.614		
	Blue	x		0.088	0.118	0.148		
		y		0.022	0.052	0.082		
Uniformity		U		80	90	-	%	Note1 Note6
NTSC				64	69	-	%	Note 5
Luminance		L		--	450	-	cd/m ²	Note1 Note7

Test Conditions:

1. $I_F = 20 \text{ mA}$, $V_F = 12.8 \text{ V}$ 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.

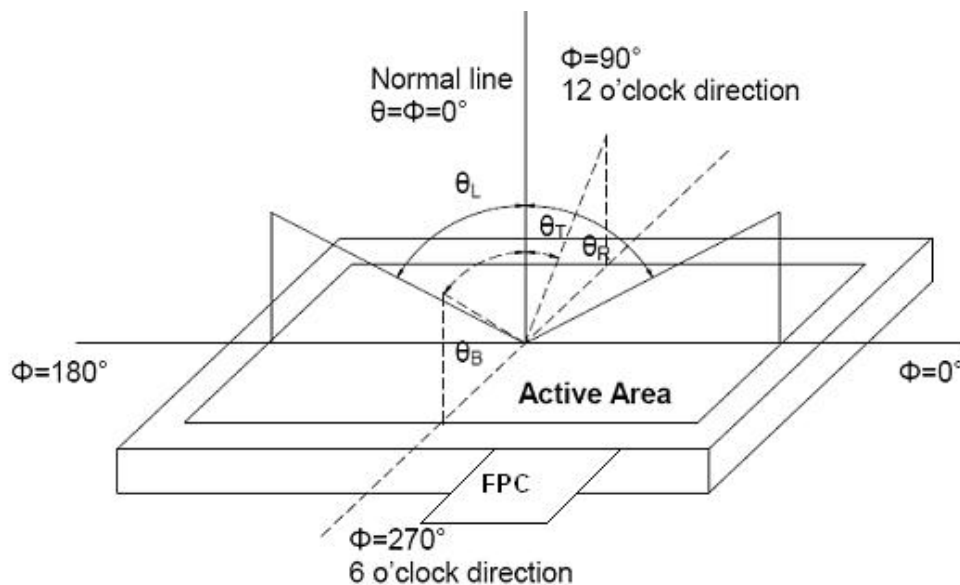
Properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



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

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

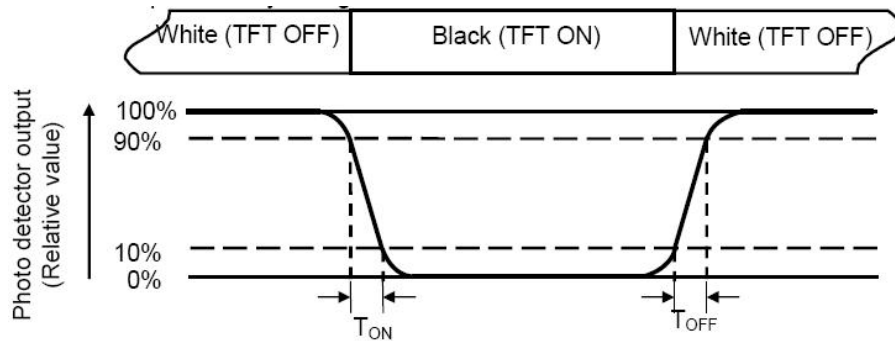
“White state “: The state is that the LCD should drive by V_{white}.

“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)

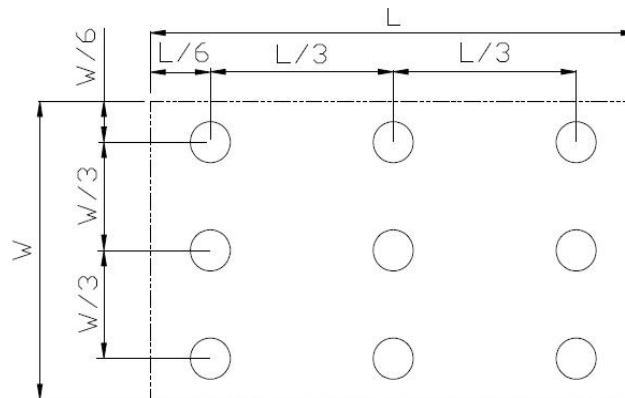
Color coordinates measured at center point of LCD.

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.

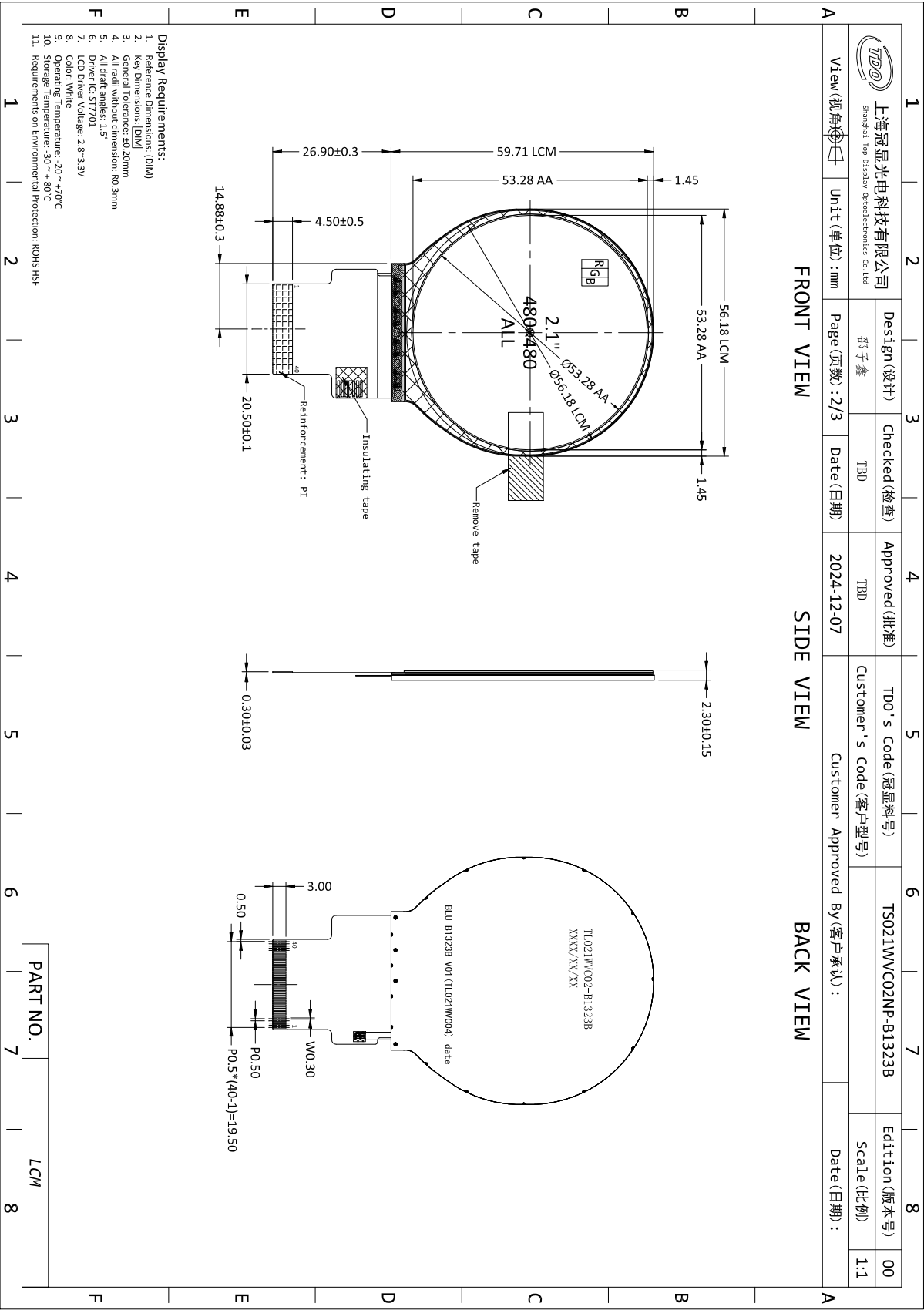
7 Environmental / Reliability Test

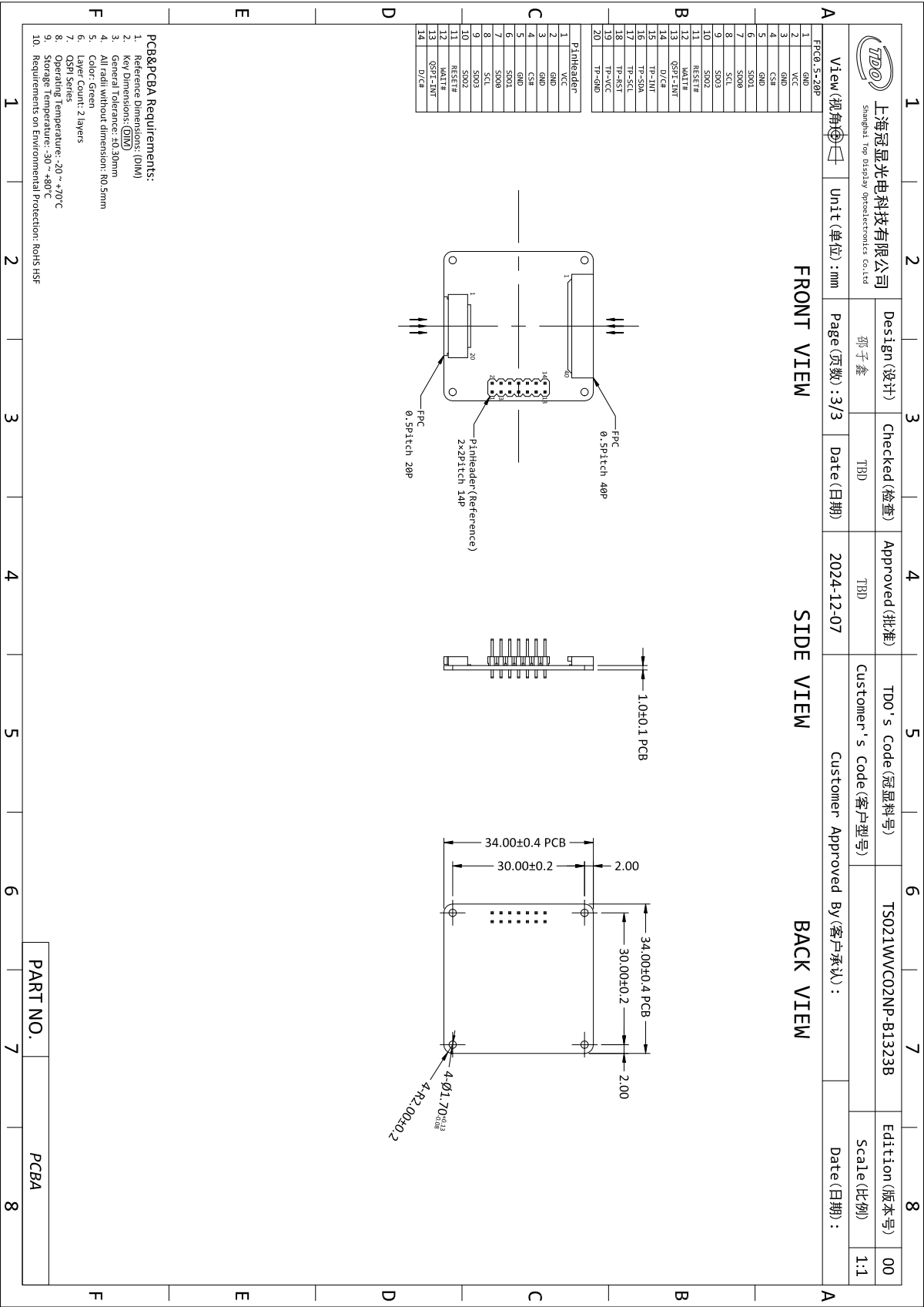
No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts = +70°C, 240 hours	No abnormalities in functions
2	Low Temperature Operation	Ta = -20°C, 240 hours	No abnormalities in functions
3	High Temperature Storage	Ta = +80°C, 240 hours	No abnormalities in functions
4	Low Temperature Storage	Ta = -30°C, 240 hours	No abnormalities in functions
5	Storage at High Temperature and Humidity	Ta = +60°C, 90% RH max, 240 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, 5 point/panel Air: ±8Kv, 5 times; Contact: ±4Kv, 5 times (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.

8 Mechanical Drawing





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.