



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

LCD MODULE SPECIFICATION

Customer: _____

Module No.: TL060HDV09CT-H1286C

Date: 2022-11-10

Version: 1.0

For Customer's Acceptance:

Approved by	Comment

Approved by	Checked by	Prepared by
Kanglin.Zhong	xianren.Zhou	Zaiping.Yang

Table of Contents

Record of Revision	3
1 General Specifications	4
2 Pin Assignment	5
3 Absolute Maximum Ratings	5
4. Electrical Characteristics	6
5 Timing Chart	7
6 Optical Characteristics	11
7 Environmental / Reliability Test	14
8 Mechanical Drawing	15
9 Precautions for Use of LCD Modules	16

Record of Revision

Rev.	Date	Description	Editor
1.0	2022-11-10	First release	Zaiping.Yang

1 General Specifications

No.	Item	Specification	Remark
1	LCD Size	6.0 inch (Diagonal)	
2	Driver Element	a-Si TFT active matrix	
3	Resolution	720 (RGB) ×1440	
4	Display Mode	Normally Black	
5	Pixel Pitch(mm)	0.0315 (H) × 0.0945 (V)	
6	Display Colors	262K	
7	Surface Treatment	AF	
8	Color Arrangement	RGB-Stripe	
9	Interface	3 line SPI+18B RGB	
10	Viewing Direction	ALL	
11	Gray Scale Inversion Direction	--	Note 1
12	Outline Dimension (mm)	85.80(W) × 151.80 (H) × 2.82 (T)	
13	Active Area (mm)	68.04 (W) × 136.08 (H)	
14	Touch Screen	With CTP	
15	Display Driver IC	NV3052C	
16	Touch Driver IC	FT5446-P03	

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 : 0.5mm pitch FPC/FFC,T=0.3mm.

Type of connector on FPC: XF2M-4015-1A (OMRON) or equivalent.

N	Symbol	I/O	Description	Remark
1	LEDA	p	LED Anode	
2	LEDK1	p	LED Cathode1	
3	LEDK2	p	LED Cathode2	
4	GND	P	Power Ground	
5	VCI	P	Power Supply 2.8V	
6	RESET	I	Reset pin	
7	NC	-	Not connection	
8	NC	-	Not connection	
9	SDA	I	Serial interface DATA Input/Output.	
10	SCK	I	SPI interface clock input.	
11	CS	I	Chip selection signal	
12	PCLK	I	Pixel clock signal in RGB I/F mode.	
13	DE	I	Data enable signal in RGB I/F mode.	
14	VSYNC	I	Vertical synchronizing signal.	
15	HSYNC	I	Horizontal synchronizing signal .	
16~33	DB0~DB17	I	RGB data signal (DB0~DB5: B0~B5; DB6~DB11:G0~G5; DB12~DB17:R0~R5)	
34	GND	P	Power Ground	
35	TP_INT	O	Touch Interrupt,(3.3V)	
36	TP_SDA	I/O	Touch IIC Data signal,(3.3V)	
37	TP_SCL	I	Touch IIC Clock signal,(3.3V)	
38	TP_RESET	I	Touch Reset Signal,(3.3V)	
39	TP_VCI	P	Touch Power supply,(3.3V)	
40	GND	P	Power Ground	

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

3 Absolute Maximum Ratings

Ta = 25℃

Item	Symbol	Min.	Max.	Unit	Remark
Power Voltage	VCI	-0.50	4.2	V	
	TP_VCI	-0.3	3.6	V	
Operating Temperature	Top	-20.0	70.0	℃	
Storage Temperature	T _{st}	-30.0	80.0	℃	
Operating and Storage Humidity	H _{stg}	10%	90%	%(RH)	

4. Electrical Characteristics

4.1 Recommended Operating Condition

VCI=3.3V, GND=0V, Ta = 25°C

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
TP supply Voltage	TP_VCI	2.8	3.0	3.3	V	
Analog/Digital supply Voltage	VCI	2.6	3.0	3.3	V	
Input logic high voltage	VIH	0.7VCI	-	VCI	V	R0~R5, G0~G5, 0~B5, DE, DCLK, HSYNC, VSYNC, MODE, RESET,
Input logic low voltage	VIL	0		0.3VCI	V	
Current of TP supply voltage	ITP_VCI	-	15	-	mA	
Analog/Digital supply Voltage	IVCI	-	40	65	mA	VCI=3.3V, color bar pattern

4.2 Backlight Unit Driving Condition

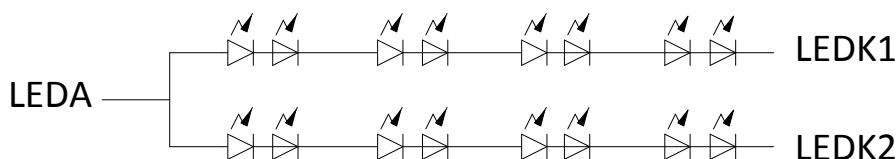
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	IF	-	40	50	mA	16 LEDs (8 LED Serial, 2LED Parallel)
Forward Current Voltage	VF	-	25.6	28	V	
Backlight Power Consumption	WBL	-	1024	1400	mW	
Operating Life Time	--	30000	--	--	hrs	Note 2, Note 3

Note1: The LED driving condition is defined for each module (8 LED Serial, 2 LED Parallel).

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

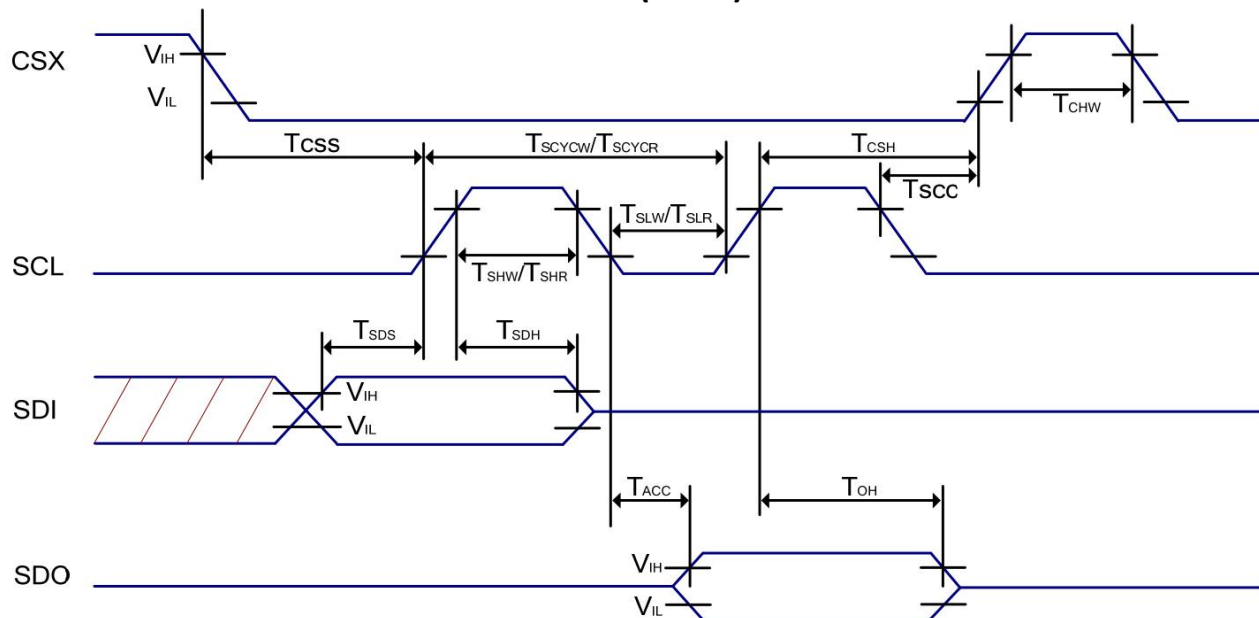
Note3: Optical performance should be evaluated at Ta=25°C When LED is driven at high current, high ambient temperature & humidity condition. The life time of LED will be reduced. Operating life means brightness goes down to 50% initial brightness. Typical operating life time is estimated data.

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



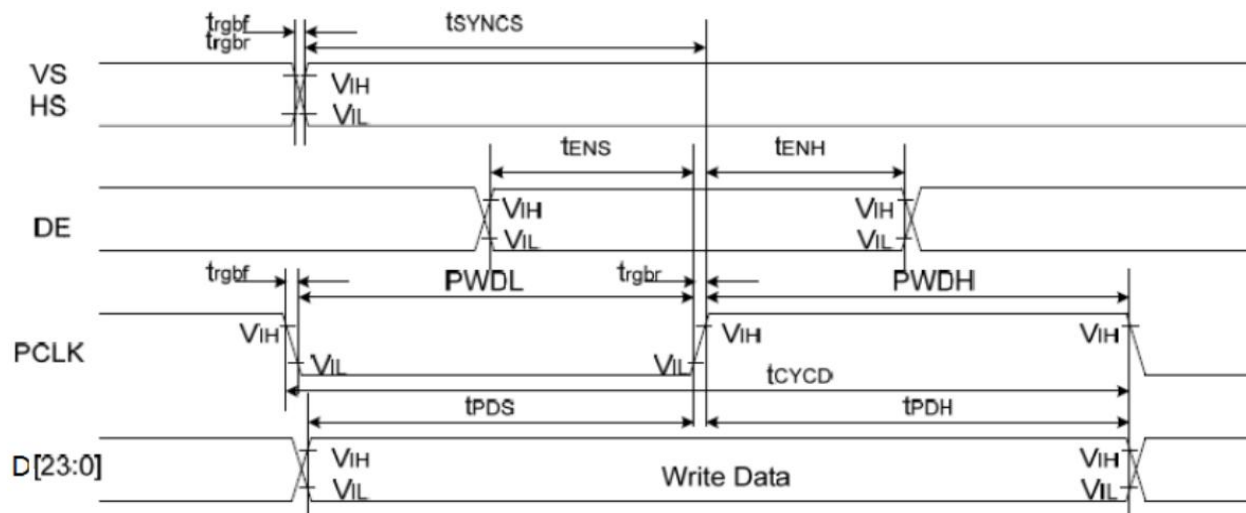
5 Timing Chart

5.1 Serial Interface Characteristics(3Line)



Signal	Symbol	Parameter	MIN	MAX	Unit	Description
CSX	T_{CSS}	Chip select setup time	15	-	ns	-
	T_{CSH}	Chip select hold time	15	-	ns	
	T_{SCC}	Chip select setup time	20	-	ns	
	T_{CHW}	Chip "H" pulse width	40	-	ns	
SCL	T_{SCYCW}	Serial clock cycle (Write)	66	-	ns	-
	T_{SHW}	SCL "H" pulse width (Write)	10	-	ns	
	T_{SLW}	SCL "L" pulse width (Write)	10	-	ns	
	T_{SCYCR}	Serial clock cycle (Read)	150	-	ns	-
	T_{SHR}	SCL "H" pulse width (Read)	60	-	ns	
	T_{SLR}	SCL "L" pulse width (Read)	60	-	ns	
SDI	T_{SDS}	Data setup time	10	-	ns	-
	T_{SDH}	Data hold time	10	-	ns	
	T_{ACC}	Access time	10	50	ns	For maximum $C_L=30pF$ For minimum $C_L=8pF$
	T_{OH}	Output disable time	15	50	ns	

5.2 TFT-LCD RGB Input Timing



Signal	Symbol	Parameter	min	max	Unit	Description
VS/HS	tSYNCS	VS/HS setup time	5	-	ns	24/18/16-bit bus RGB interface mode
	tSYNCH	VS/HS hold time	5	-	ns	
DE	tENS	DE setup time	5	-	ns	
	tENH	DE hold time	5	-	ns	
D[23:0]	tPOS	Data setup time	5	-	ns	
	tPDH	Data hold time	5	-	ns	
PCLK	PWDH	PCLK high-level period	13	-	ns	
	PWDL	PCLK low-level period	13	-	ns	
	tCYCD	PCLK cycle time	28	-	ns	
	trgbr, trgbf	PCLK, HS, VS rise/fall time	-	15	ns	

5.3 Recommended Timing Setting of TCON

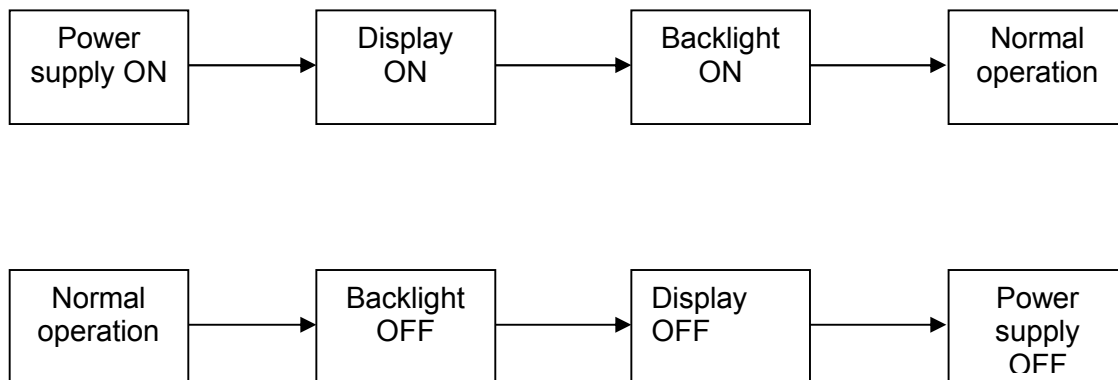
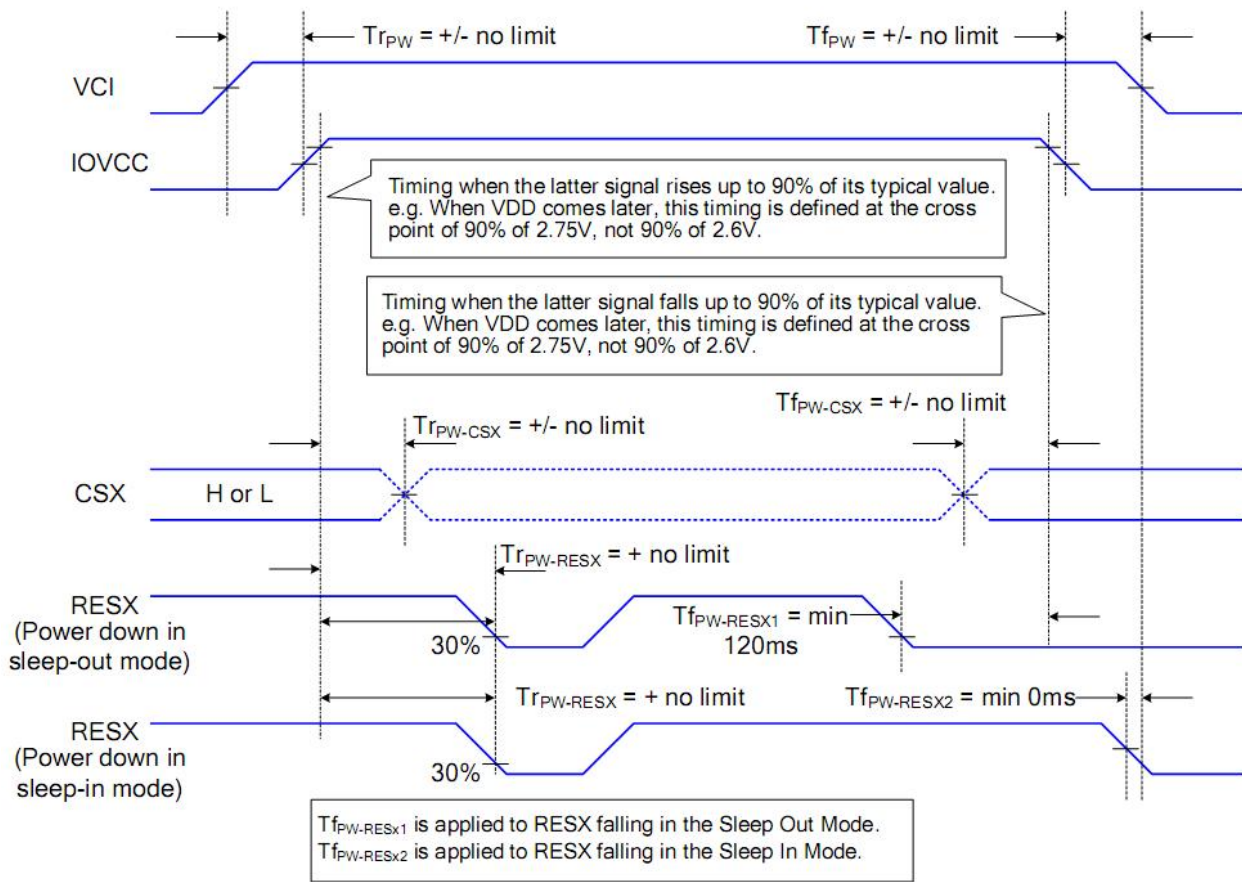
TCON (Embedded in Source IC) Input Timing (DCLK, HS, VS, DE)

VCI=3.3V, GND=0V, Ta=25°C

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remark
DCLK	Fclk	-	72	-	MHz	
	tclk	-	13.8	-	ns	
HSD	thd	-	720	-	tclk	
	thpw	-	2	-	tclk	
	thb	-	44	-	tclk	
	thfp	-	50	-	tclk	
	thfp	-	50	-	tclk	
VSD	tvb	-	8	-	th	
	tvfp	-	16	-	th	
	tvb	-	8	-	th	
	tvfp	-	16	-	th	

Note: For reference only, it needs to be adjusted according to the actual display effect.

5.4 POWER ON/OFF SEQUENCE :



5.5 Reset timing

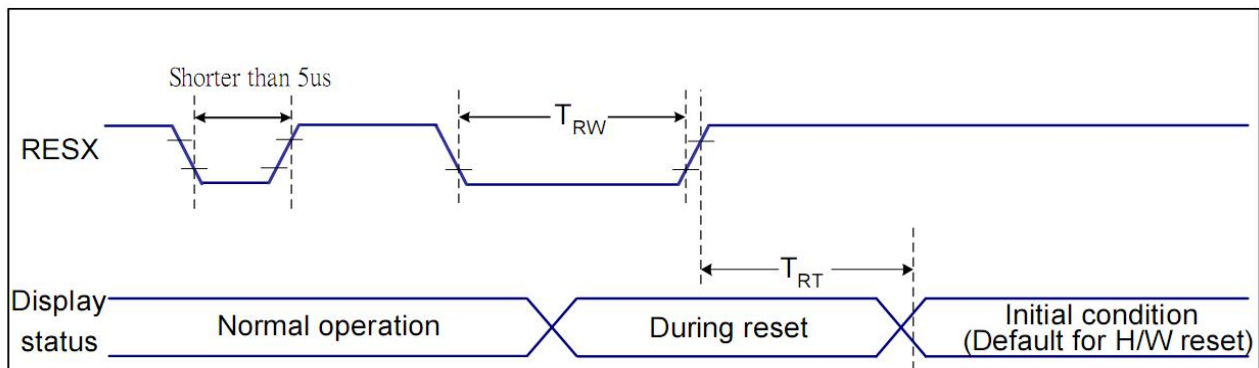


Figure Reset Timing

$IOVCC=1.65$ to $3.3V$, $VCI=2.6$ to $3.3V$, $AGND=DGND=0V$, $T_a=25^{\circ}C$

Related Pins	Symbol	Parameter	MIN	MAX	Unit
RESX	TRW	Reset pulse duration	10	-	us
	TRT	Reset cancel		5	ms
				120	ms

Table Reset Timing

6 Optical Characteristics

Ta=25℃

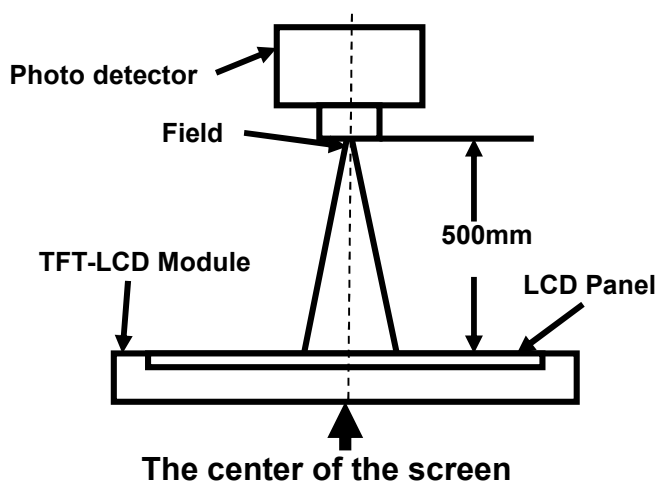
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
View Angles		θT	CR ≧ 10	-	80	-	Degree	Note 2
		θB		-	80	-		
		θL		-	80	-		
		θR		-	80	-		
Contrast Ratio		CR	θ=0°	800	1000	-		Note1 Note3
Response Time		T _{ON}	25℃	-	25	35	ms	Note1 Note4
		T _{OFF}						
Chromaticity	White	x	Backlight is on	0.272	0.292	0.312		Note1 Note5
		y		0.301	0.321	0.341		
	Red	x		0.642	0.662	0.682		
		y		0.308	0.328	0.348		
	Green	x		0.240	0.260	0.280		
		y		0.556	0.576	0.596		
	Blue	x		0.114	0.134	0.154		
		y		0.097	0.117	0.137		
Uniformity		U		70	80	-	%	Note1 Note6
NTSC				65	70	-	%	Note 5
Luminance		L		280	300	-	cd/m ²	Note1 Note7

Test Conditions:

1. $I_F = 40 \text{ mA}$, $V_F = 25.6 \text{ V}$ 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.

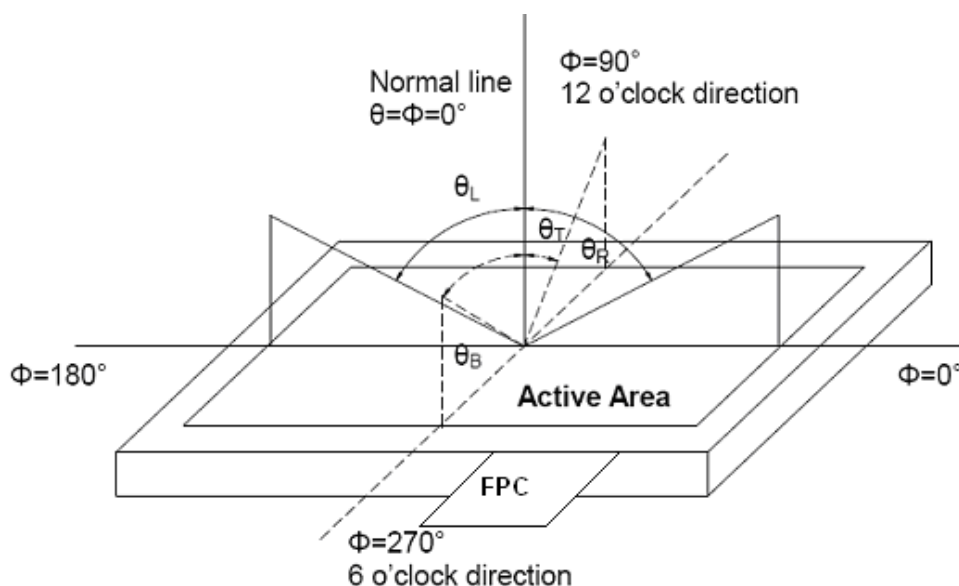
Properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



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

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

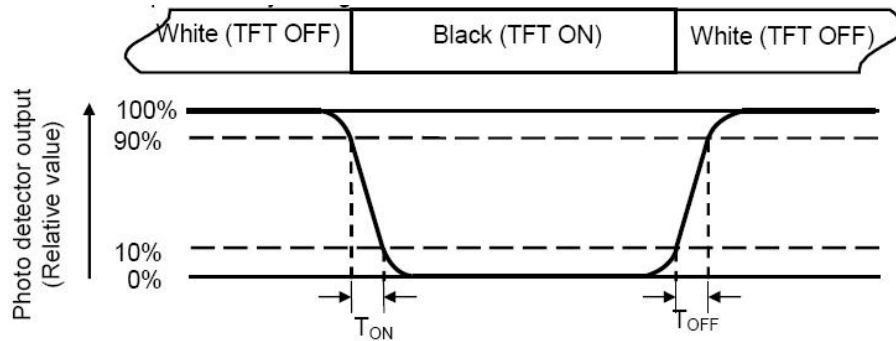
“White state “: The state is that the LCD should drive by V_{white}.

“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)

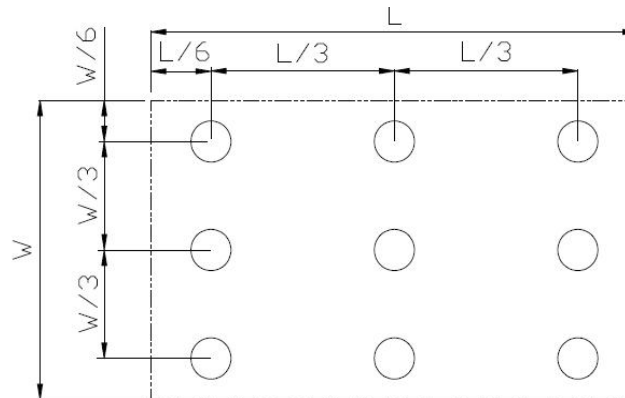
Color coordinates measured at center point of LCD.

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.

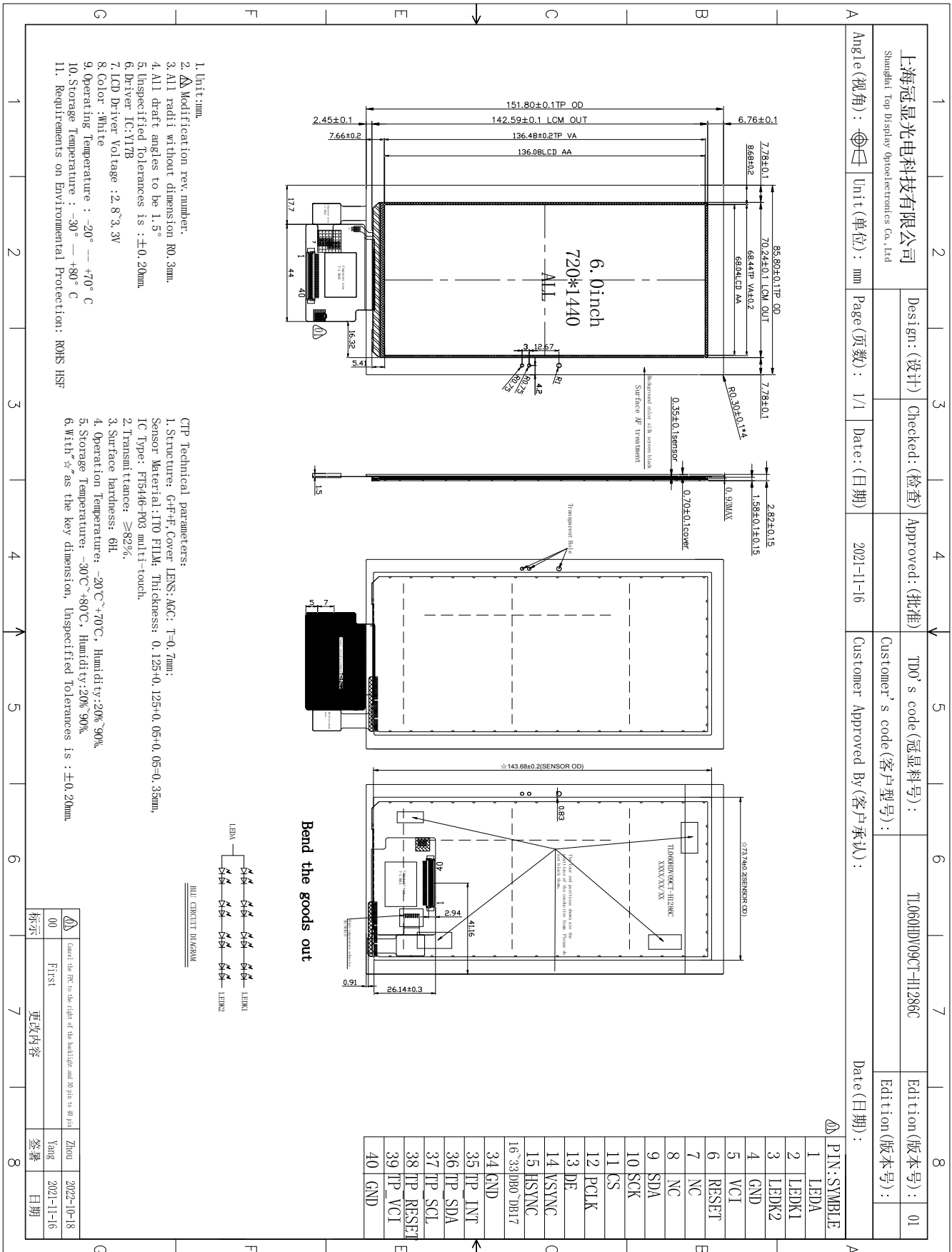
7 Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts = +70℃, 240 hours	No abnormalities in functions
2	Low Temperature Operation	Ta = -20℃, 240 hours	No abnormalities in functions
3	High Temperature Storage	Ta = +80℃, 240 hours	No abnormalities in functions
4	Low Temperature Storage	Ta = -30℃, 240 hours	No abnormalities in functions
5	Storage at High Temperature and Humidity	Ta = +60℃, 90% RH max, 240 hours	No abnormalities in functions
6	Thermal Shock (non-operating)	-30℃ 30 min ~ +70℃ 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℃~35℃, 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.