Coversheet

MODEL NO. : TM013XDHT01-00

ISSUED DATE: 2018-07-20

VERSION : Ver 0.5

■**Preliminary Specification**
□**Final Product Specification**

Customer : huami

Approved by	Notes

SHANGHAI TIANMA Confirmed :

Prepared by	Checked by	Approved by
Wang gang		

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
0.1	2017-12-25	Preliminary Specification Release	Wang gang
0.2	2018-02-7	Design changes(pin assignment)	Wang gang
0.3	2018-02-11	Test condition change(All item)	Wang gang
0.4	2018-04-24	Test condition change(All item);2Ddrawing; Interface	Wang gang
0.5	2018-7-20	32HZ update 51HZ	Wang gang

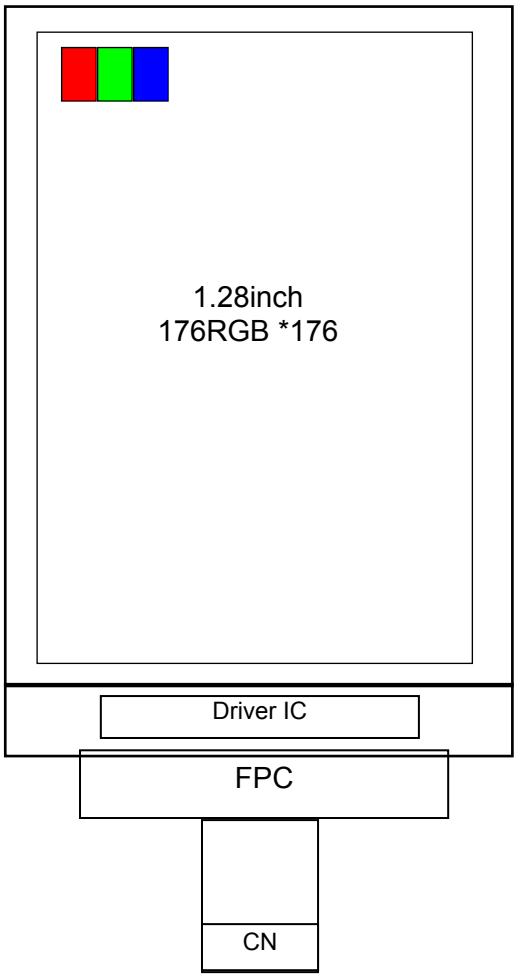
1. General Specifications

Feature		Spec
Display Spec.	Size	1.28 inch
	Resolution	176(RGB)×176
	Interface	4-wire SPI
	Color Depth	64 Color
	Technology Type	a-Si TFT
	Pixel Pitch (mm)	0.1308X0.1308
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	ECB/Transflective
	Surface Treatment(Up Polarizer)	HC
Mechanical Characteristics	LCM (W x H x D) (mm)	26.62 x 29.72 x 1.45
	Active Area(mm)	23.02x23.02
	With/Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	2LED
Electronic	Driver IC	ST7301-G6D-C

Note 1: Requirements on Environmental Protection: Q/S0002

Note 2: LCM weight tolerance : +/- 5%

2. BLOCK DIAGRAM



3. INPUT/OUTPUT TERMINALS PIN ASSIGNMENT

3.1 CN1 of FPC

No	Symbol	I/O	Description	Comment
1	VSS	P	Ground	
2	CSB	I	Chip select input pin.	
3	A0	I	It determines whether the access is related to data or command.	
4	RSTB	I	Reset input pin.	
5	SCLK	I	Serial input clock	
6	SDA	I/O	Serial input/output data	
7	TE	O	Tearing effect signal pin	
8	VDD	P	Power Supply	
9	VSS	P	Ground	
10	LEDK1	P	BL CATHODE	
11	LEDK2	P	BL CATHODE	
12	LEDA	P	BL ANODE	

Table 3.1 input terminal pin assignments

4. DC ELECTRICAL CHARACTERISTICS

4.1 Absolute maximum ratings

Item	Symbol	MIN	MAX	Unit	Remark
Logic Supply Voltage	VDDI	-0.3	4.0	V	Pin VDD supply both voltage
Analog Supply Voltage	VDDA	-0.3	4.0	V	
Back Light Forward Current	I_{LED}		2.5	mA	For each LED
Operating Temperature	T_{OPR}	-20	70	℃	
Storage Temperature	T_{STG}	-30	80	℃	

Table 4.1 absolute maximum rating

4.2 Recommended Operating Condition

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		VDDI	1.7	1.8	1.9	V	Pin VDD supply both voltage
Analog Supply Voltage		VDDA	1.7	1.8	1.9	V	
Input Signal Voltage	Low Level	V_{IL}	0	-	0.3* VDDI	V	
	High Level	V_{IH}	0.7* VDDI	-	VDDI	V	
Output Signal Voltage	Low Level	V_{OL}	0.0	-	0.2* VDDI	V	
	High Level	V_{OH}	0.8* VDDI	-	VDDI	V	
(Panel+LSI) Power Consumption		Normal Mode (51Hz)	1100	1200	4300	uW	
		Low Power Mode(1HZ)	50	70	100	uW	
		Sleeping Mode	5	10	-	uW	

Table 4.2 LCD module electrical characteristics

4.3 Recommended Driving Condition for Backlight

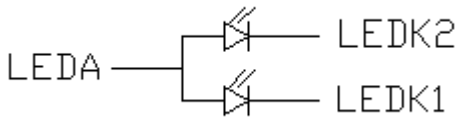


Figure4.3 Driving Backlight circuit diagram

Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	--	2.5	--	mA	For each LED
Forward Voltage	V_F	--	3	--	V	For each LED
Backlight Power Consumption	W_{BL}	--	15	--	mW	2 LEDs

Table 4.3 Driving Condition for Backlight characteristics

Note:

1）. The LED lifetime is defined as the module brightness decay 50% of original brightness at Ta=25 degree.

2）. Environmental conditions such as sustained high operating temperatures, high humidity, operating conditions and other factors have an adverse effect on LED Lifetime. It is difficult to characterize LED lifetime for all the various operational, environmental and design permutations possible. Numerous environmental conditions such as ambient temperature, humidity and ventilation have impact on LED brightness decay. Brightness decay is also affected by control, thermal management, current levels, and other electrical design considerations.

3）. The SHTM Minima value of LED Lifetime is estimated to be "20,000hrs" which is based on non-full life testing and our supplier’s data. Full life testing for LEDs is impractical due to the long expected lifetime. Even with 24/7 operation, testing an LED for 20,000 hours would take 2.3 years, and such an endeavor is impractical because technology continues to develop and evolve so quickly, products would be obsolete by the time life testing is completed. Results based on actual usage environment may vary. This means that SHTM shall not be held liable for any problems related to LED life time that do not meet SHTM typical value from the use of SHTM's module.

5. AC ELECTRICAL CHARACTERISTICS

5.1 SPI Interface Characteristics

System Bus Timing for 4SPI MCU Interface

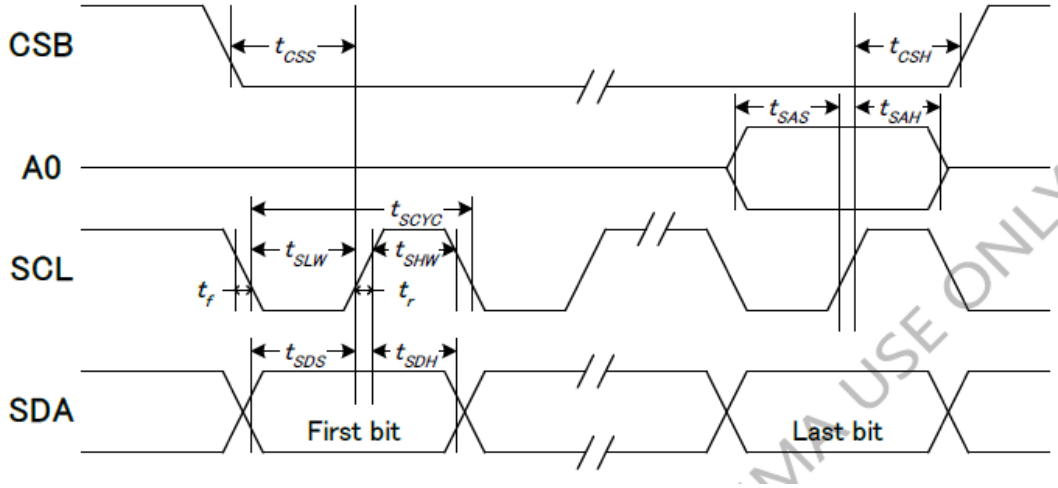


Figure5.1 System Bus Timing for 4SPI MCU Interface

VDDI = 1.8~3.3V, Ta = 25˚C

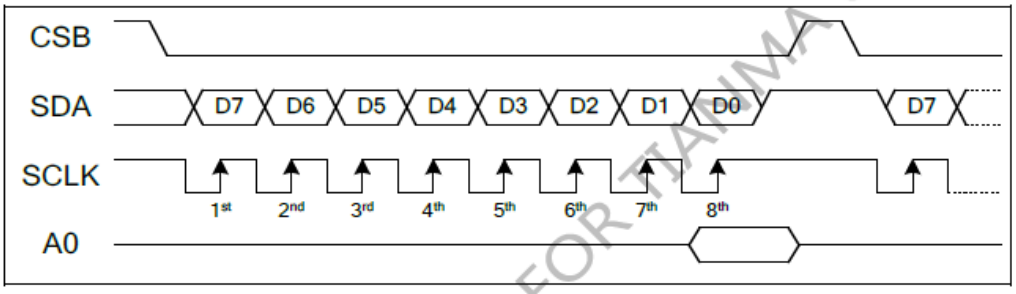
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCL	tSCYC		30	—	ns
SCLK "H" pulse width		tSHW		15	—	
SCLK "L" pulse width		tSLW		15	—	
Address setup time	A0	tSAS		10	—	
Address hold time		tSAH		10	—	
Data setup time	SDA	tSDS		10	—	
Data hold time		tSDH		10	—	
CSB-SCLK time	CSB	tCSS		10	—	
CSB-SCLK time		tCSH		10	—	

Note:

1. The input signal rise and fall time (tr, tf) are specified at 15 ns or less.
2. All timing is specified using 20% and 80% of VDDI as the standard.

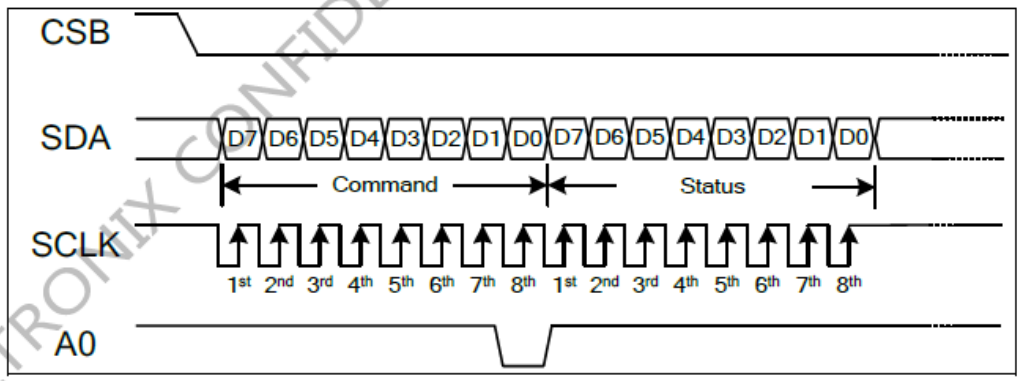
Table 5.1 4SPI Interface characteristics

4-Line Serial Interface



Write Operation of Single 4-Line SPI

After entering the "Read Status" instruction to read IC status, the information is shifted out as shown below. CSB signal must be kept at "L" during this period. All read out data will be 8 bits.



Read Status Operation of Single 4-Line SPI

5.2 Data Input Mode

TYPE1: There are 4 write operations for 24-bit data. (Set by "BPS=0" of command 0x3Ah)

Command	A0	D7	D6	D5	D4	D3	D2	D1	D0
DDRAM write	0	0	0	1	0	1	1	0	0
1st write	1	P1	P2	P3	P4	P5	P6	-	-
2nd write	1	P7	P8	P9	P10	P11	P12	-	-
3rd write	1	P13	P14	P15	P16	P17	P18	-	-
4th write	1	P19	P20	P21	P22	P23	P24	-	-

Note: - don't care

TYPE2: There are 3 write operations for 24-bit data. (Set by "BPS=1" of command 0x3Ah)

Command	A0	D7	D6	D5	D4	D3	D2	D1	D0
DDRAM write	0	0	0	1	0	1	1	0	0
1st write	1	P1	P2	P3	P4	P5	P6	P7	P8
2nd write	1	P9	P10	P11	P12	P13	P14	P15	P16
3rd write	1	P17	P18	P19	P20	P21	P22	P23	P24

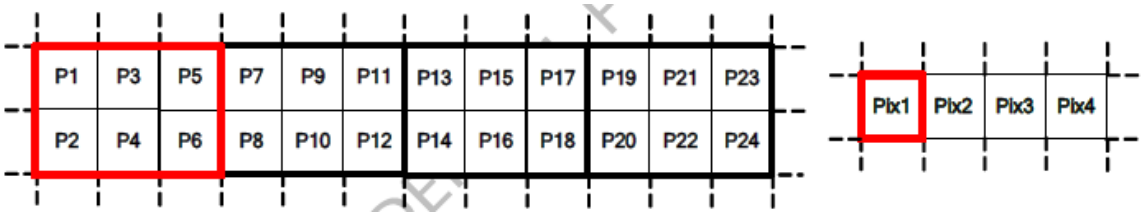
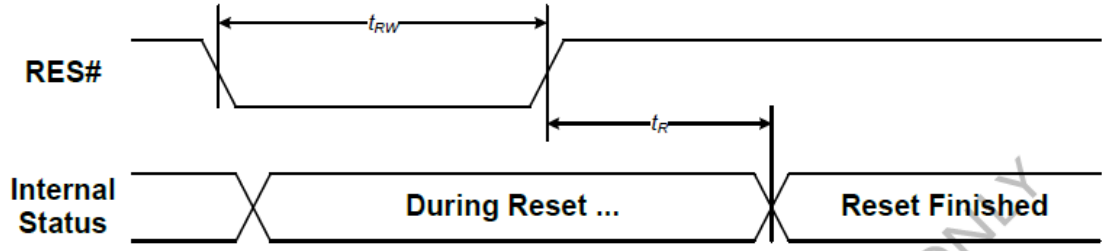


Figure5.2 Data to Display Mapping

5.3 Reset timing



VDDI = 1.8~3.3V, Ta = 25˚C

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1	ms
Reset "L" pulse width	tRW		1	—	ms

6. POWER ON/OFF SEQUENCE

VDDI and VDDA can be applied in any order.

VDDA and VDDI can be power down in any order.

During power off, if LCD is in the Sleep Out mode, VDDA and VDDI must be powered down minimum 500msec after RSTB has been released.

During power off, if LCD is in the Sleep In mode, VDDI or VDDA can be powered down minimum 0msec after RSTB has been released.

CSB can be applied at any timing or can be permanently grounded. RSTB has priority over CSB.

Note 1: There will be no damage to the display module if the power sequences are not met.

Note 2: There will be no abnormal visible effects on the display panel during the Power On/Off Sequences.

Note 3: There will be no abnormal visible effects on the display between end of Power On Sequence and before receiving Sleep Out command. Also between receiving Sleep In command and Power Off Sequence.

Note 4: If RSTB line is not held stable by host during Power On Sequence as defined in the sequence below, then it will be necessary to apply a Hardware Reset (RSTB) after Host Power On Sequence is complete to ensure correct operation. Otherwise function is not guaranteed.

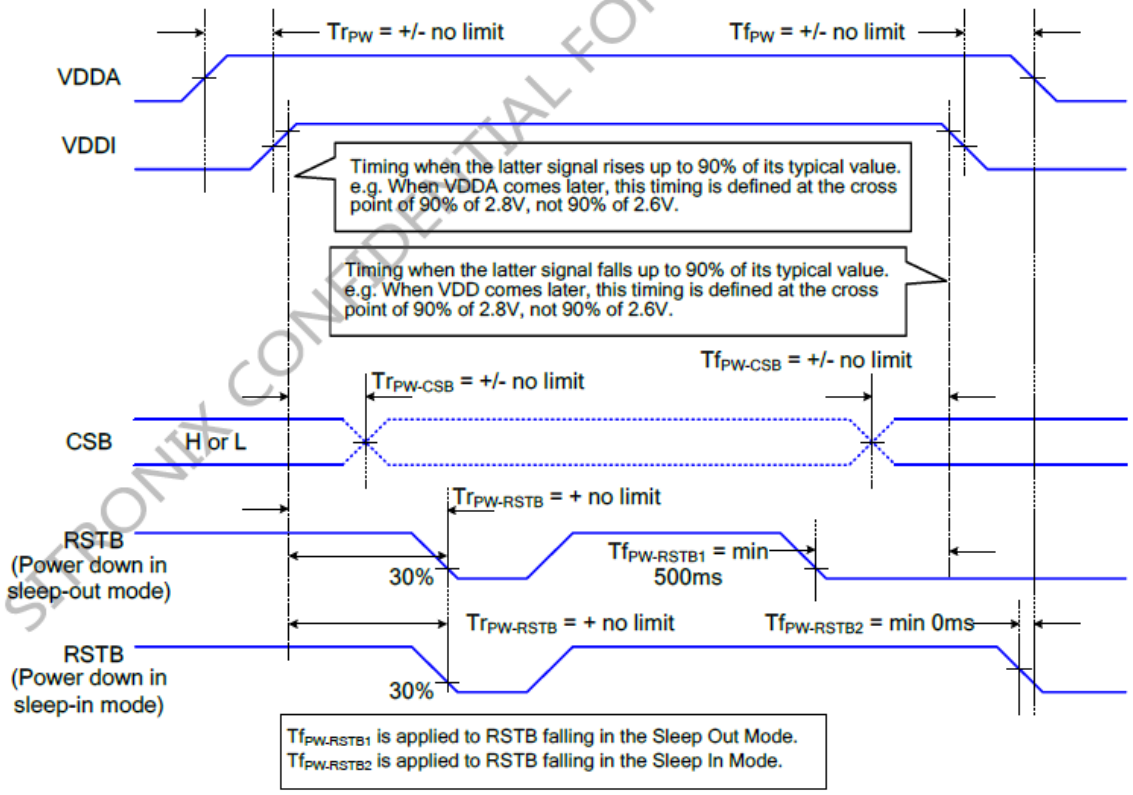


Figure 6.1 power on/off sequence

7. Optical Characteristics

7.1 Optical Specification

Ta=25℃

Reflection mode								
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧2	45	60	-	Degree	Note 2
		θB		45	60	-		
		θL		45	60	-		
		θR		45	60	-		
Contrast Ratio		CR	θ=0°	10	14	-	-	Note1 Note3
Response Time		T_{ON}	25℃	-	20	30	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is off	0.2858	0.3358	0.3858	-	Chromaticity
		y		0.3174	0.3674	0.4174		
	Red	x		0.436	0.4860	0.536		
		y		0.2997	0.3497	0.3997		
	Green	x		0.2594	0.3094	0.3594		
		y		0.416	0.466	0.516		
	Blue	x		0.1498	0.1998	0.2498		
		y		0.1982	0.2482	0.2982		
Uniformity		U	-	75	80		%	Note1 Note6
NTSC		-	-	12	16	-	%	Note 5
Luminance		L		9	10	-	cd/m^2	Note1 Note7
Transmission mode								
Item		**Symbol**	**Condition**	**Min**	**Typ**	**Max**	**Unit**	**Remark**
Transmittance		TR	-	0.36	0.40		%	
Contrast ratio		CR	θ=0°	20	25		-	
Chromaticity	White	x	Backlight is on		0.306		-	±0.05
		y			0.322			
	Red	x			0.459			
		y			0.332			

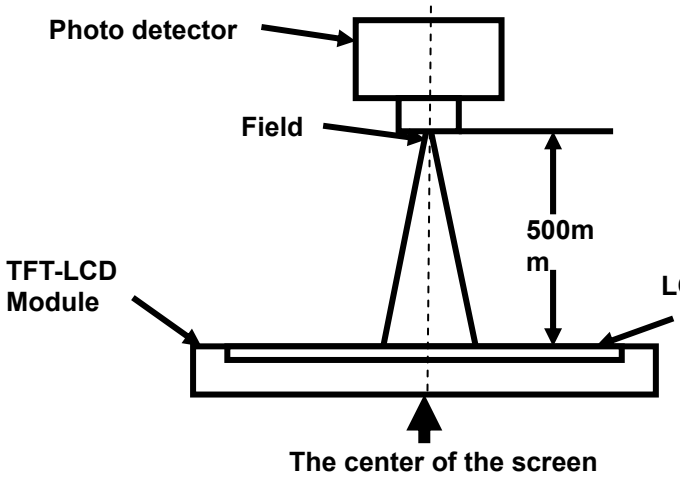
	Green	x			0.310			
		y			0.451			
	Blue	x			0.175			
		y			0.157			
NTSC		-	-	12	17	-		±5%
Flicker		-	-		-40		db	

Test Conditions:

1. V_F =3.0V, 1/3*I_F = 2.5mA(Backlight current for each LED), the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

The optical characteristics should be measured in dark room. After 5 minutes operation, the optical 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	CS2000	1°
Luminance		
Chromaticity		
Lum Uniformity		
Response Time	BM-7A	

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

viewing angle is measured at the center point of the LCD by EZcontrastXL88。

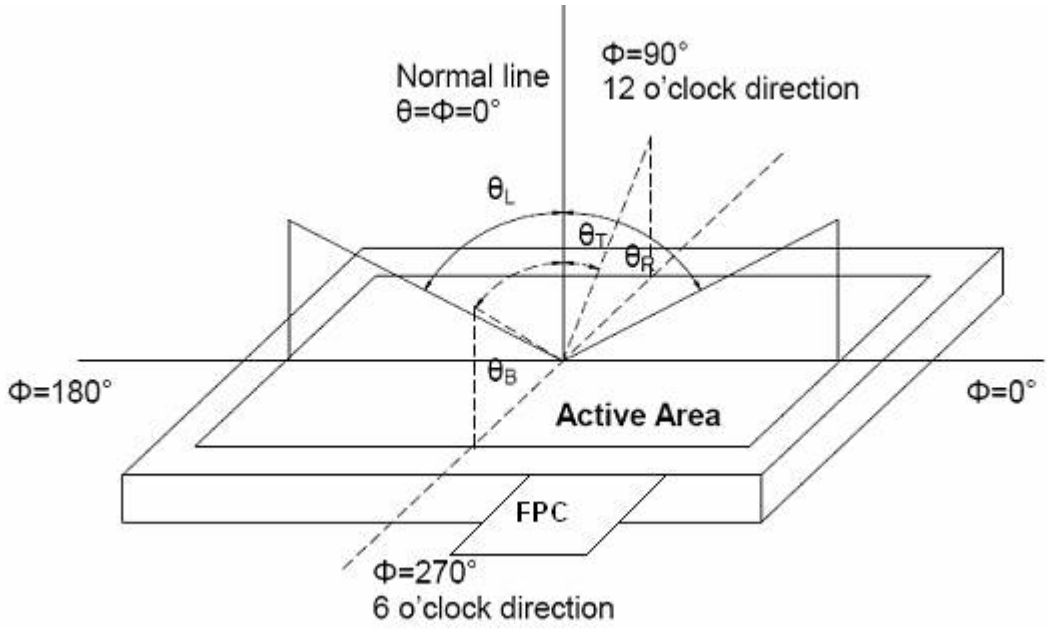


Fig. 7.1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

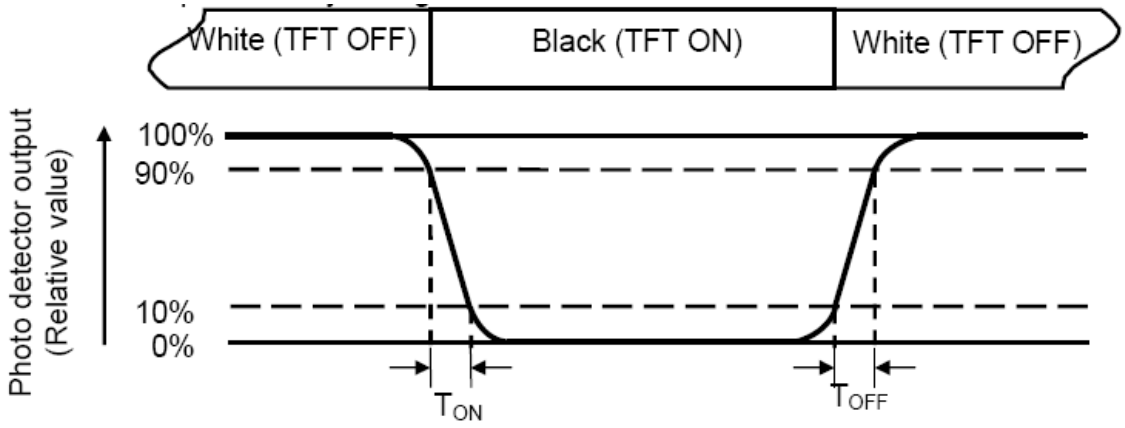
“White state “:The state is that the LCD should be driven by Vwhite.

“Black state”: The state is that the LCD should be driven by Vblack.

Vwhite: To be determined Vblack: 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 5 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

Luminance Uniformity(U) = Lmin/ Lmax

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

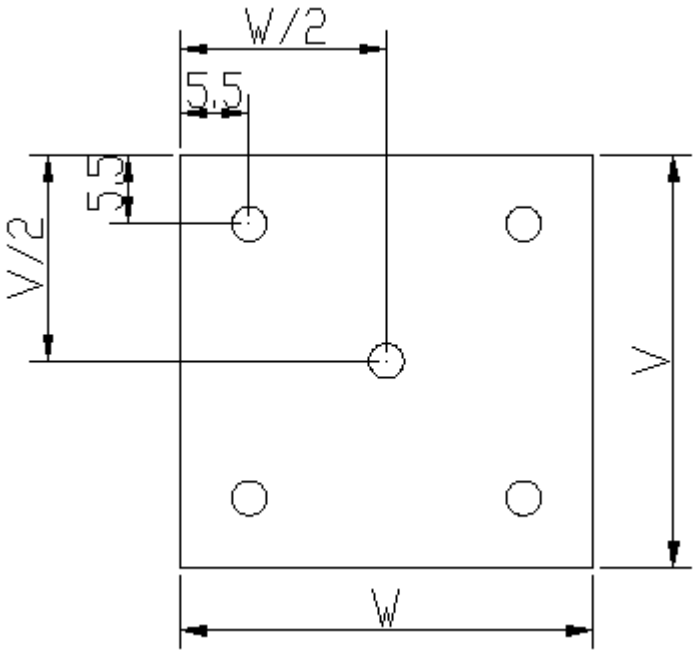


Fig. 7.2 Definition of uniformity

Lmax: The measured maximum luminance of all measurement position.

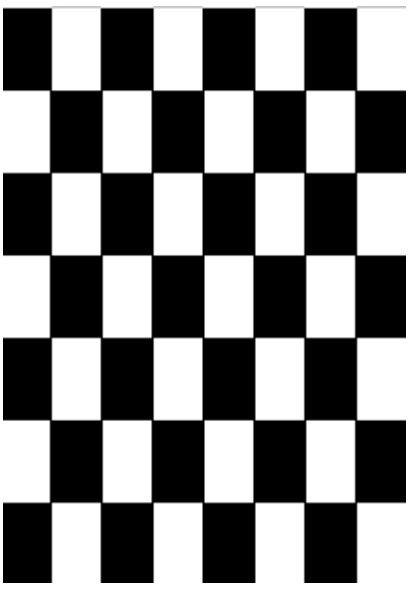
Lmin: The measured minimum luminance of all measurement position.

Note 7: Definition of Luminance:

Measure the luminance of white state at center point.

Note 8: Image sticking:

With typical maximum luminance and 8x8 chessboard pattern below, Weak temporary burn-in allowed after 1 hours of static image but it must disappear within 3 minutes.



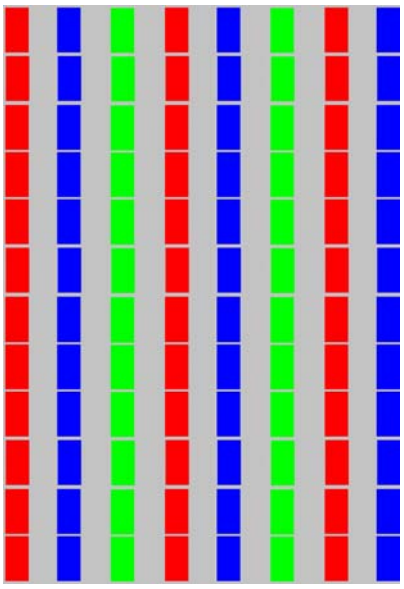


Fig. 7.3 8x8 chessboard pattern Fig. 7.4 Flicker pattern

Note 9: Flicker pattern: sub-pixel column inversion flicker pattern

8 . Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ta=+60℃ 240 hours	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	Ta=-20℃ 240 hours	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature and Humidity Operation	Ta=+40℃／90%RH 240 hours	IEC60068-2-1:2007 GB2423.1-2008
4	High Temperature Storage	Ta=+80℃ 240 hours	IEC60068-2-1:2007 GB2423.2-2008
5	Low Temperature Storage	Ta = -40℃, 240hours	IEC60068-2-1:2007 GB2423.1-2008
6	High Temperature and Humidity Storage	Ta=+60℃，90%RH，240H hours	IEC60068-2-78 :2001 GB/T2423.3—2006
7	Thermal Shock (non-operation)	'-40℃，1hrs~80℃，1hrs，change time：3min，50cycle	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
8	Life time (Operation)	Ta=+60℃ 90%RH，288 hours	IEC60068-2-1:2007 GB2423.2-2008
9	ESD	串行实验，先静态，再动态；先接触，再空气；单点放电 10 次。放电间隔 1S 静态 C=1500Ω R=100pf,接触±4-±6kv,空气±6-±8kv 动态 C=330Ω R=150pf,接触±1-±4kv,空气±4-±6kv 程序画面：使用一键循环的画质检查画面 受试点： 5 点（四角+中心），推荐非台阶侧起测试 受试位置：BM 靠近 AA 区（可使放电位置更近玻璃缝隙；尽量枪头尖端放电，而非侧面） 放电角度：静电枪垂直受试样品 残余电荷释放：单次放电后，使用带泄放电阻的放电电缆扫除过受试点、整面和 FPC 露铜区 ※注意记录：环境温湿度，失效点位 等级在 D 级及以上 (等级说明： A-画面无异常，显示功能正常	IEC61000-4-2:2001 GB/T17626.2-2006

		B-画面有横线、闪烁、画异、无显等异常，但在不实施静电放电时恢复正常显示 C-画面有横线、闪烁、画异、无显等异常，且在不实施静电放电时不能恢复，但信号 Reset 后能恢复正常显示 D-画面有横线、闪烁、画异、无显等异常，在不实施静电放电时不能恢复，且信号 Reset 后不能恢复正常显示，但在重启系统电源后能恢复正常显示 E-画面有横线、闪烁、画异、无显等异常，且不能恢复正常显示)	
10	Vibration Test	振动方式：随机振动（模拟路跑） 10-55HZ 额定功率，振动加速度 1.5G，X，Y，Z 三轴各 90 分钟，振幅 1.5mm	IEC60068-2-6:1982 GB/T2423.10—1995
11	Package Drop Test	Height:120cm, 1corner,3edges,6surfaces	IEC60068-2-32:1990 GB/T2423.8—1995
12	FPC 弯折测试	弯折角度为 0º~180º~0º，弯折直径=1mm，弯折频率：40-45 次/分钟，手动弯折 20 个循环	FPC 无断裂、破损，功能正常
13	FPC 拉力测试	测试角度 90°，拉伸速度 50mm/min，拉力 500g/cm	FPC 与 LCD 无脱离，功能正常

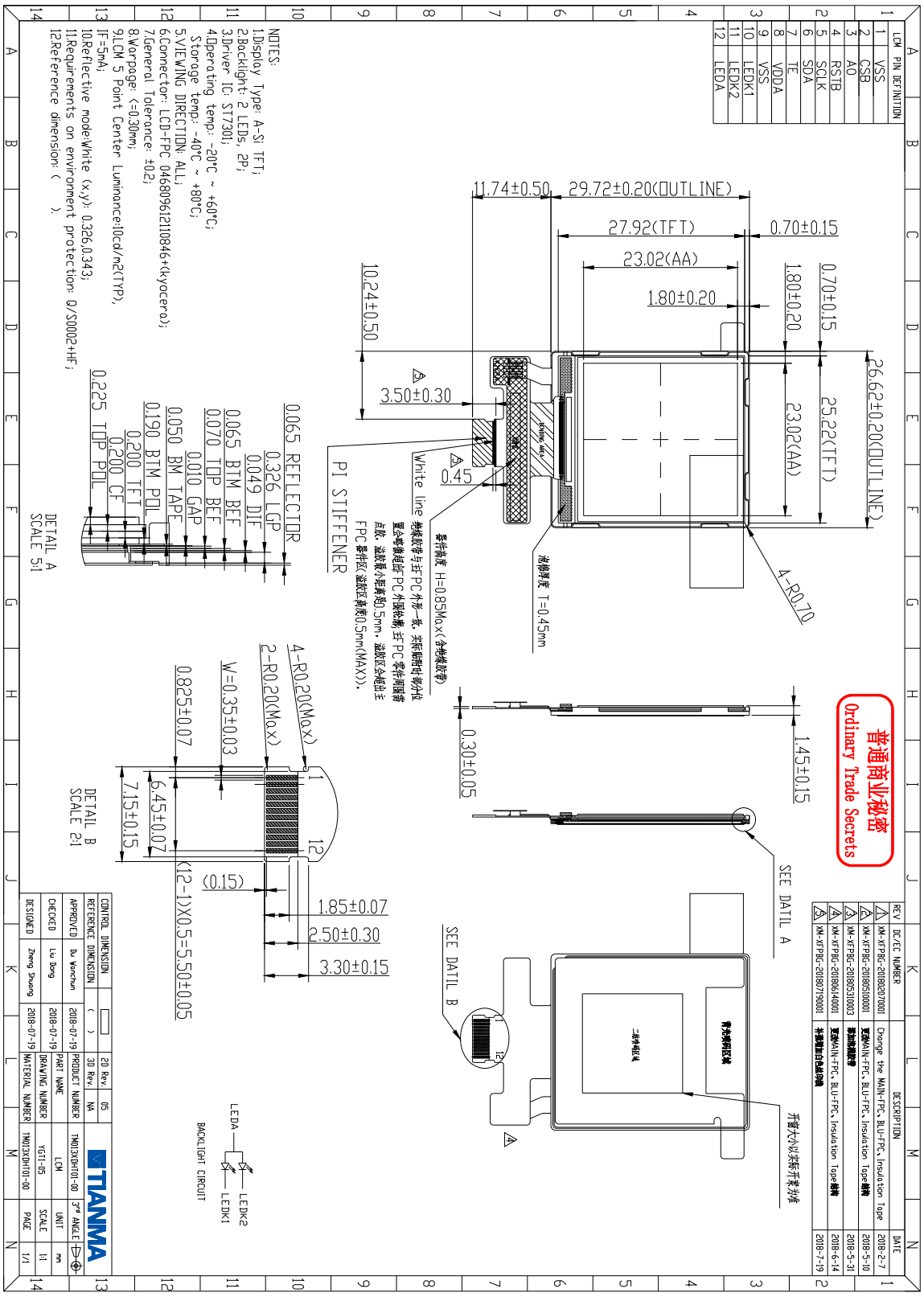
Note1: Ts is the temperature of panel's surface.

Note2: Ta is the ambient temperature of sample.

Note3: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

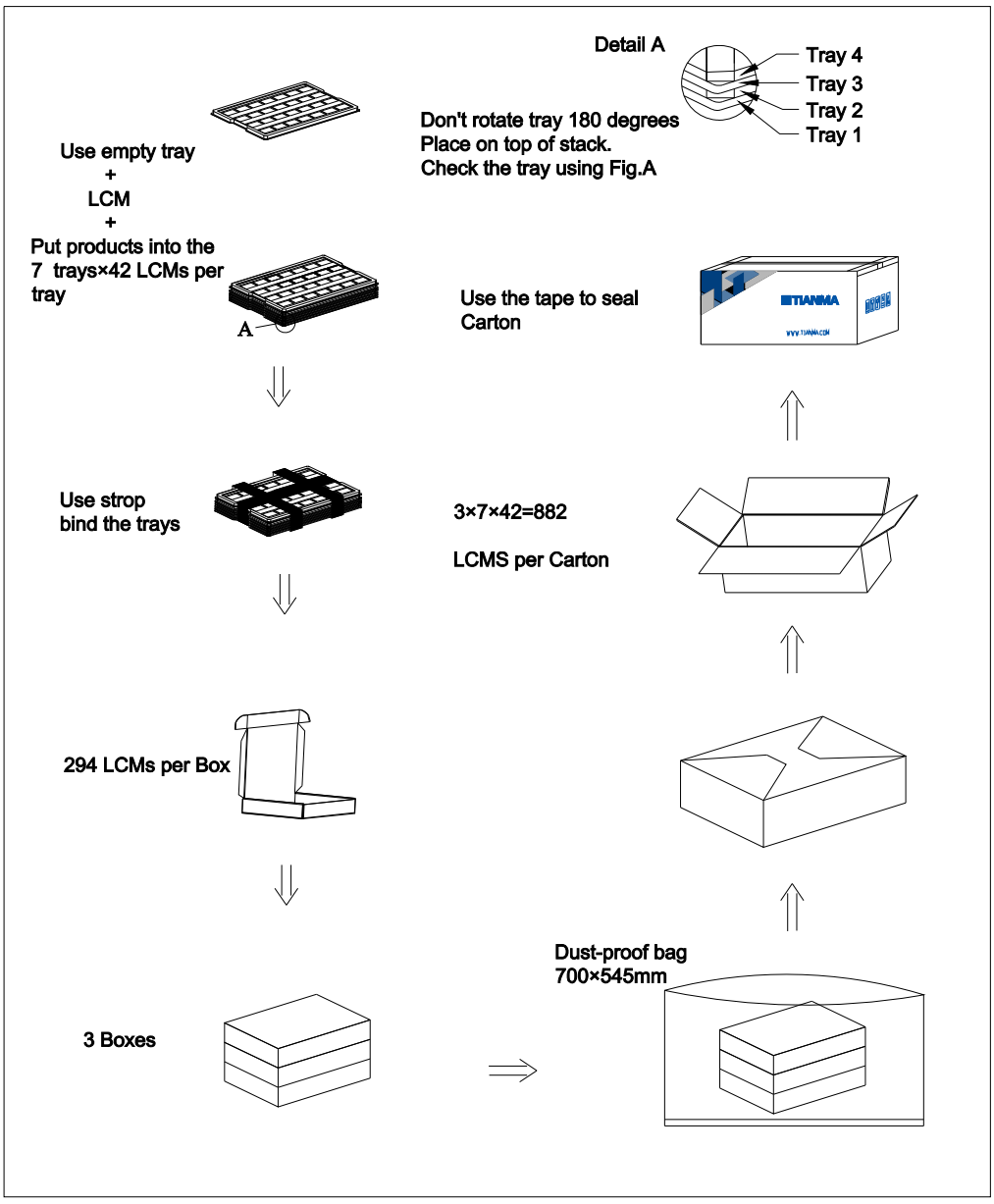
Note 4: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

9.Mechanical Drawing



10 . Packing Drawing

No	Item	Model (Materiel)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM Module	TM013XDHT01-00	26.62×29.72×1.45	TBD	882	
2	Tray	PET	485×330×14	TBD	24	Anti-static
3	Dust-Proof Bag	PE	700×545×0.05	TBD	1	
4	BOX	Corrugated Paper	520×345×74	TBD	3	
5	Carton	Corrugated Paper	544×365×250	TBD	1	
6	Total Weight	TBD				



Precautions for Use of LCD Modules

11.1 Handling Precautions

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

11.1.2 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.

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

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

11.1.5 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

11.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

11.1.8.4 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.

11.2 Storage precautions

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

11.2.2 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℃ ～ 40℃ Relatively humidity: ≤80%

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

11.3 Transportation Precautions:

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