MODEL NO : TM035HDHP13

MODEL VERSION: 00

SPEC VERSION : Ver 1.1

ISSUED DATE: 2018-02-02

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

Customer : MQ

Approved by	Notes

TIANMA Confirmed :

Prepared by	Checked by	Approved by
Xin Yin		

This technical specification is subjected to change without notice

Table of Contents

Record of Revision

Rev	Issued Date	Description	Editor
1.0	2017/6/21	Preliminary Specification Release	Tia Li
1.1	2018/2/2	Updated the LCD design.	Xin Yin

1 General Specifications

Feature		Spec
Display Spec.	Size	3.5
	Resolution	240(RGB)x320
	Technology Type	a-Si
	Pixel Configuration	R.G.B. Vertical Stripe
	Pixel pitch(mm)	0.222 x 0.222
	Display Mode	Normally Black
	Surface Treatment	AG
	Viewing Direction	All direction
Mechanical Characteristics	LCM (W x H x D) (mm)	64.00×85.00×2.90
	Active Area(mm)	53.28 x 71.04
	With /Without TSP	Without TSP
	Matching Connection Type	ZIF
	LED Numbers	8 LEDs
	Weight (g)	tbd
Electrical Characteristics	Interface	RGB 18 bit＋SPI
	Color Depth	262k
	Driver IC	S1D19K06D01B000

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

Note 2: Requirements on Environmental Protection: Q/S0002

Note 3: LCM weight tolerance: ± 5%

2 Input/Output Terminals

Pin No.	Symbol	I/O	Function	Remark
1	VL1	P	Power supply for LED(High voltage)	
2	GND	P	Ground	
3	VL2	P	Power supply for LED (Low voltage)	
4	GND	P	Ground	
5	VSHD	P	Power supply for digital	
6	GND	P	Ground	
7	GND	P	Ground	
8	GND	P	Ground	
9	VSYNC	I	Vertical sync. In RGB mode	
10	GND	P	Ground	
11	RESET	I	Reset	
12	GND	P	Ground	
13	GND	P	Ground	
14	GND	P	Ground	
15	CS	I	Chip select input	
16	GND	P	Ground	
17	SDO	O	Serial data output	
18	SDI	I	Serial data input	
19	GND	P	Ground	
20	SCL	I	Serial interface clock	
21	GND	P	Ground	

22	B5	I	Blue data input(MSB)	
23	B4	I	Blue data input	
24	B3	I	Blue data input	
25	B2	I	Blue data input	
26	B1	I	Blue data input	
27	B0	I	Blue data input(LSB)	
28	ENAB	I	Data enable in RGB mode	
29	GND	P	Ground	
30	HSYNC	I	Horizontal sync. In RGB mode	
31	GND	P	Ground	
32	DCLK	I	Pixel clock signal in RGB mode	
33	GND	P	Ground	
34	G5	I	Green data input(MSB)	
35	G4	I	Green data input	
36	G3	I	Green data input	
37	G2	I	Green data input	
38	G1	I	Green data input	
39	G0	I	Green data input(LSB)	
40	GND	P	Ground	
41	R5	I	Red data input(MSB)	
42	R4	I	Red data input	
43	R3	I	Red data input	
44	R2	I	Red data input	

45	R1	I	Red data input	
46	R0	I	Red data input(LSB)	
47	GND	P	Ground	
48	GND	P	Ground	
49	GND	P	Ground	
50	GND	P	Ground	

Note: I/O definition.
I---Input, O---Output, P--- Power/Ground, N--- No connection, T--Test

3 Absolute Maximum Ratings

GND=0V

Item	Symbol	MIN	MAX	Unit	Remark
Power Voltage	VDD	-0.3	5.0	V	Note1
Input voltage	V_{IN}	-0.3	5.0	V	
Operating Temperature	Top	-20	70	℃	
Storage Temperature	Tst	-30	80	℃	
Relative Humidity Note2	RH	--	≤95	%	Ta≤40℃
		--	≤85	%	40℃＜Ta≤50℃
		--	≤55	%	50℃＜Ta≤60℃
		--	≤36	%	60℃＜Ta≤70℃
		--	≤24	%	70℃＜Ta≤80℃
Absolute Humidity	AH	--	≤70	g/m³	Ta＞70℃

Table 3 Absolute Maximum Ratings

Note1: Input voltage include R0~R5, G0~G5, B0~B5, Dotclk, Hsync, Vsync, Enable, CS,SCL,SDI Reset

Note2: Ta means the ambient temperature.
It is necessary to limit the relative humidity to the specified temperature range.
Condensation on the module is not allowed.

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V，Ta=25℃

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Supply Voltage		VDD	3.1	3.3	3.4	V	
Input Signal Voltage	Low Level	V_{IL}	0	—	0.3xVDD	V	
	High Level	V_{IH}	0.7xVDD	—	VDD	V	
Output Signal Voltage	Low Level	V_{OL}	0	—	0.2xVDD	V	
	High Level	V_{OH}	0.8xVDD	—	VDD	V	

4.2 Driving Backlight

LEDGND=GND=0V, Ta = 25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Current of Each LED	I_{LED}	-	20	-	mA	
Forward Voltage	V_{LED}	22.4	24	26.4	V	
Power Consumption	W_{BL}	-	480	-	mW	
Operating Life Time	-	10000	20000	-	Hrs	

Table 4.2 LED backlight characteristics

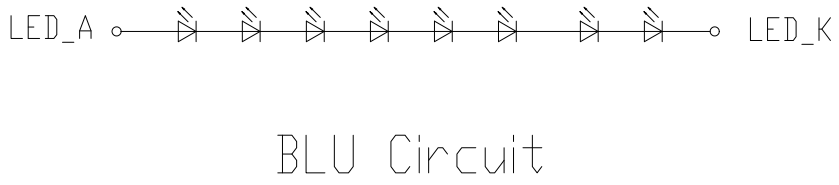


Figure4.2 LED connection of backlight

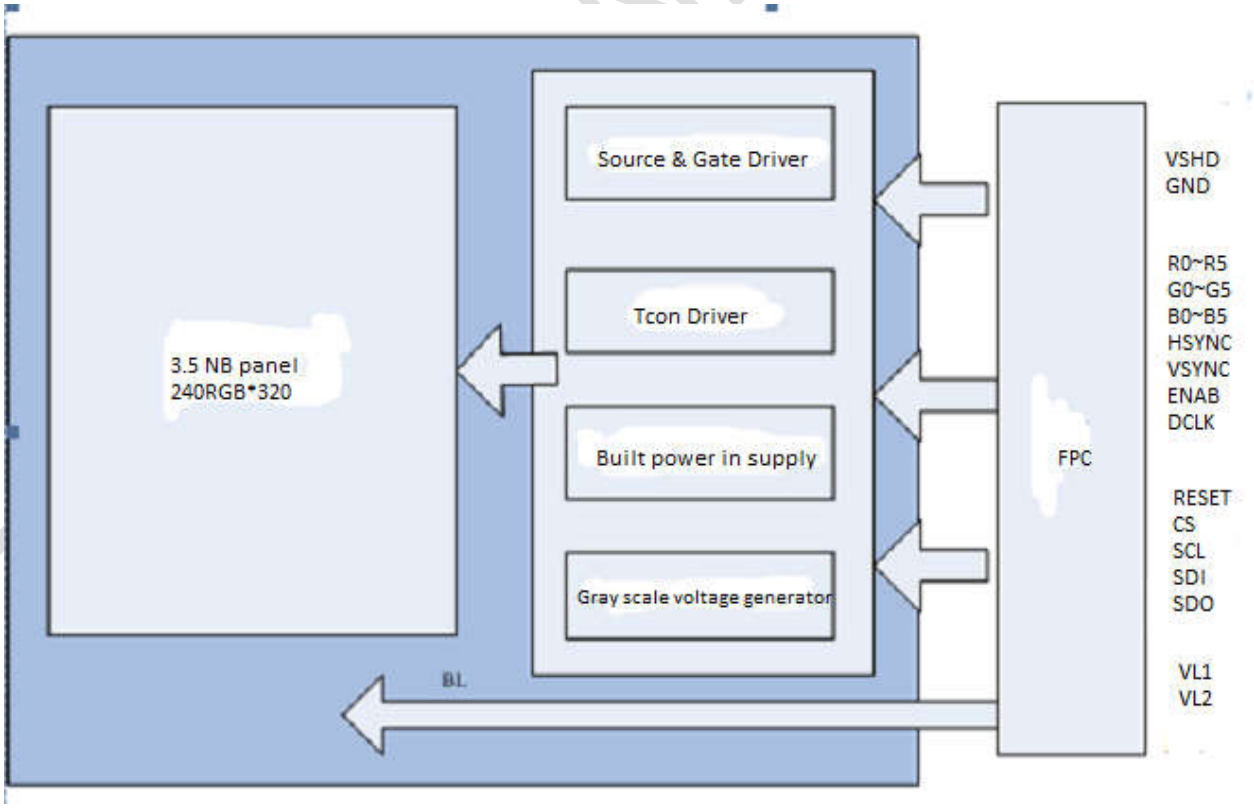
Note:

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.

4. Block Diagram



5 Timing Chart

5.1 RGB 18bits Interface Timing Characteristics

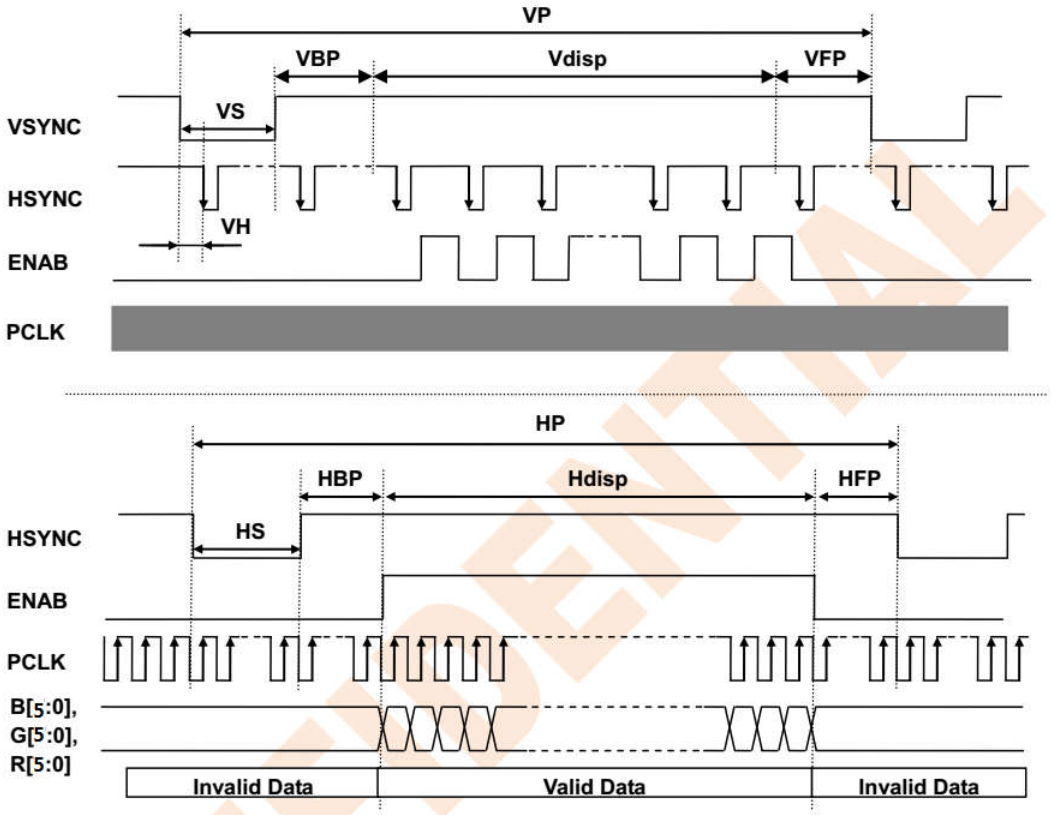


Figure 5.1.1 RGB 18bits interface timing

Table 5.1.1 RGB 18bits interface timing

Parameter	Symbol	Unit	Min.	Typ.	Max.	REMARKS
Clock Frequency	f_{pclk}	MHz	-	5.7	10	-
Vertical Sync period	VS	HSYNC	1	10	127	-
Vertical back porch period	VBP	HSYNC	1	20	127	-
Vertical front Porch period	VFP	HSYNC	1	10	127	-
Vertical display period	Vdisp	HSYNC	-	320	-	-
Horizontal Sync period	HS	CLK	1	4	127	-
Horizontal back porch period	HBP	CLK	1	10	127	--
Horizontal front porch period	HFP	CLK	1	10	127	-
H Active Time	Hdisp	CLK	-	240	-	-

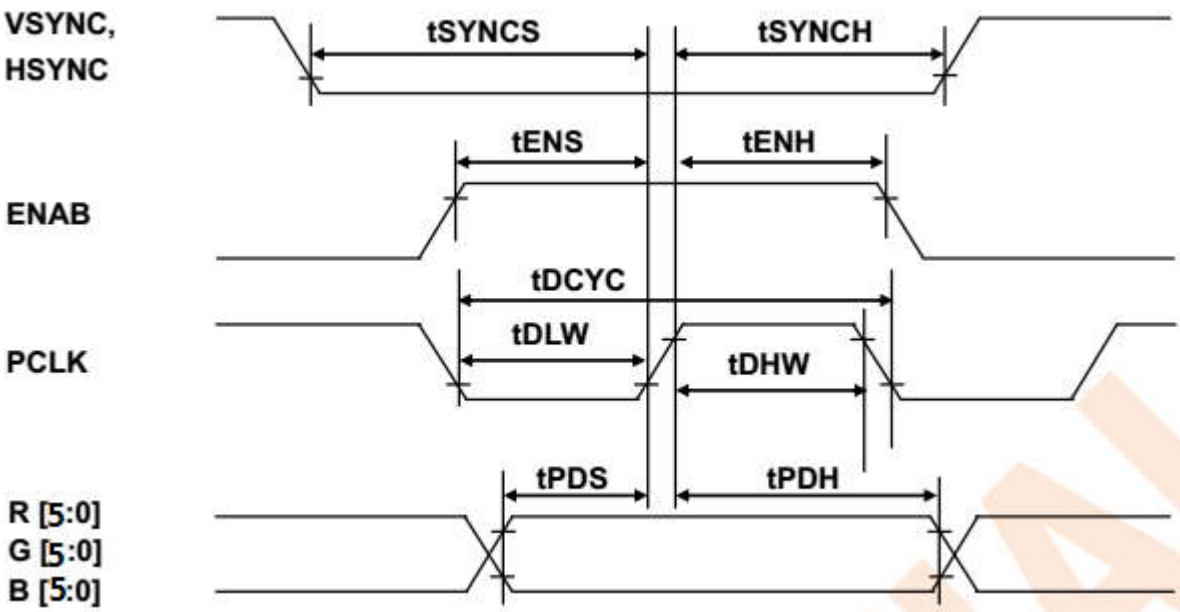


Figure 5.1.2 RGB Interface Timing

Table 5.1.2 RGB Interface Timing

GND=0V, VDDI=2.7 to 3.6V, VDD=2.7 to 3.6V, Ta＝-40 to 105℃

Parameter	Symbol	Condition	Rating			Unit
			Min.	Typ.	Max.	
SYNC signal set up time	tSYNCS	-	10	-	-	ns
SYNC signal hold time	tSYNCH	-	16	-	-	ns
Data enable signal set up time	tENS	-	10	-	-	ns
Data enable signal hold time	tENH	-	16	-	-	ns
Dot clock cycle time	tDCYC	-	66	-	-	ns
Dot clock high pulse width	tDHW	-	26	-	-	ns
Dot clock low pulse width	tDLW	-	26	-	-	ns
Data set up time	tPDS	-	10	-	-	ns
Data hold time	tPDH	-	16	-	-	ns

5.2 3-Wire SPI Interface Timing Characteristics

5.2.1 AC Characteristics

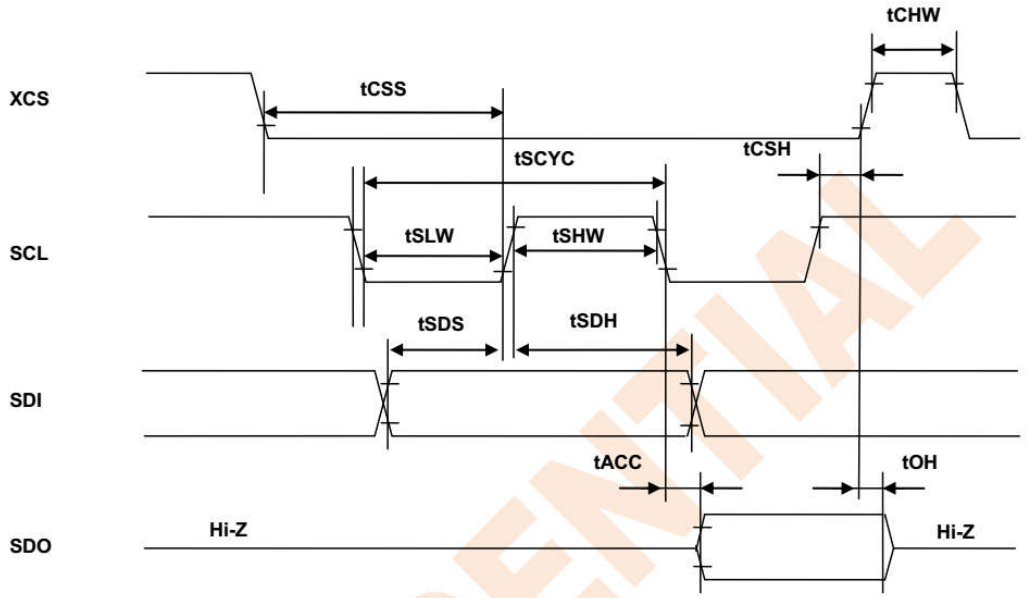


Figure 5.2.1 Serial Interface Timing

Table 5.2.1 Serial Interface Timing

GND=0V, VDDI=2.7 to 3.6V, VDD=2.7 to 3.6V, Ta=-40 to 105℃

Parameter		Symbol	Condition	Rating			Unit
				Min.	Typ.	Max.	
Chip select signal set up time		tCSS	-	5	-	-	ns
Chip select signal hold time		tCSH	-	5	-	-	ns
Chip select signal high pulse width		tCHW	-	10	-	-	ns
Serial clock cycle time	Write	tSCYCW	-	50	-	-	ns
	Read	tSCYCR	-	200	-		ns
Serial clock high pulse width	Write	tSHW	-	20	-	-	ns
	Read	tSHR	-	80	-	-	ns
Serial clock low pulse width	Write	tSLW	-	20	-	-	ns
	Read	tSLR	-	80	-	-	ns
Data set up time		tSDS	-	5	-	-	ns
Data hold time		tSDH	-	5	-	-	ns
Read data access time		tACC	CL=30pF	-	-	50	ns
Read data disable time		tOH	-	-	-	50	ns

5.2.2 **Write Operation**

The SDI signal is identified as a data at rising edge of the SCL while XCS=”L”. Data input sequence is that the A0 signal which is a command/parameter identification bit (0: command/1: parameter) is input at first, and then from upper bits of command/parameter are followed. Parameter bytes are input in the order of 1st Byte (P1), 2nd Byte (P2), 3rd Byte (P3) … sequentially.

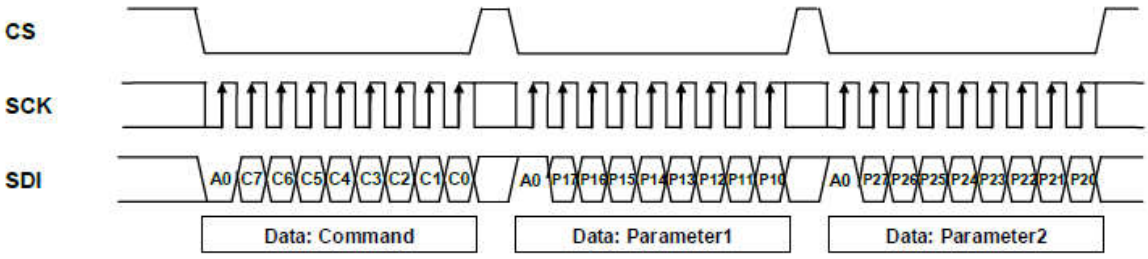


Figure 5.2.2 9-Wire SPI Write cycle

5.2.3 **Read Operation**

An example of 1-byte data read operation is as shown in the figure below. After inputting read command, the read data is output from the SDO pin while SCL=”L”. Output data sequence of the read data is same as the write operation except there is no A0 bit. After reading last data bit, this IC exits the read operation mode by setting XCS=”H” and a new command is allowed to receive.

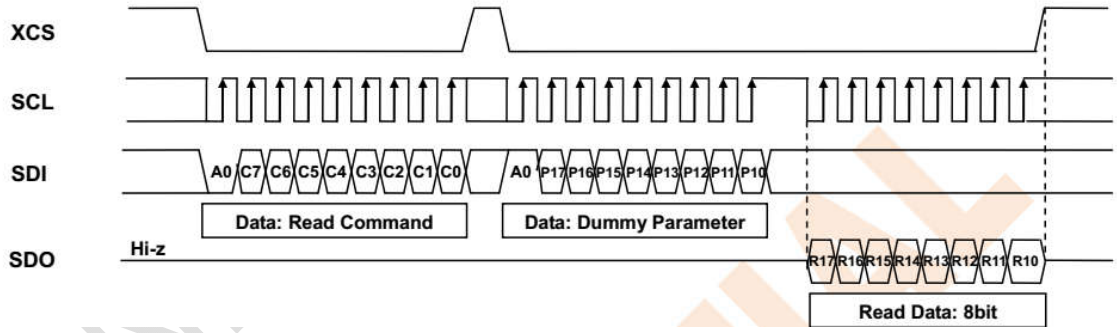
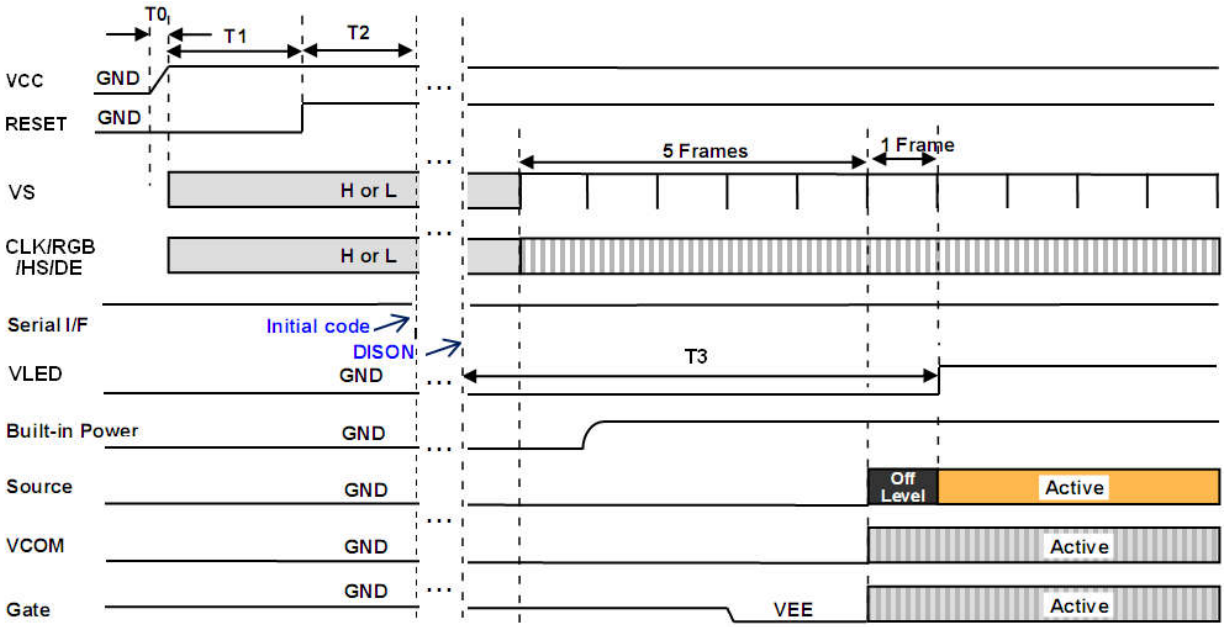


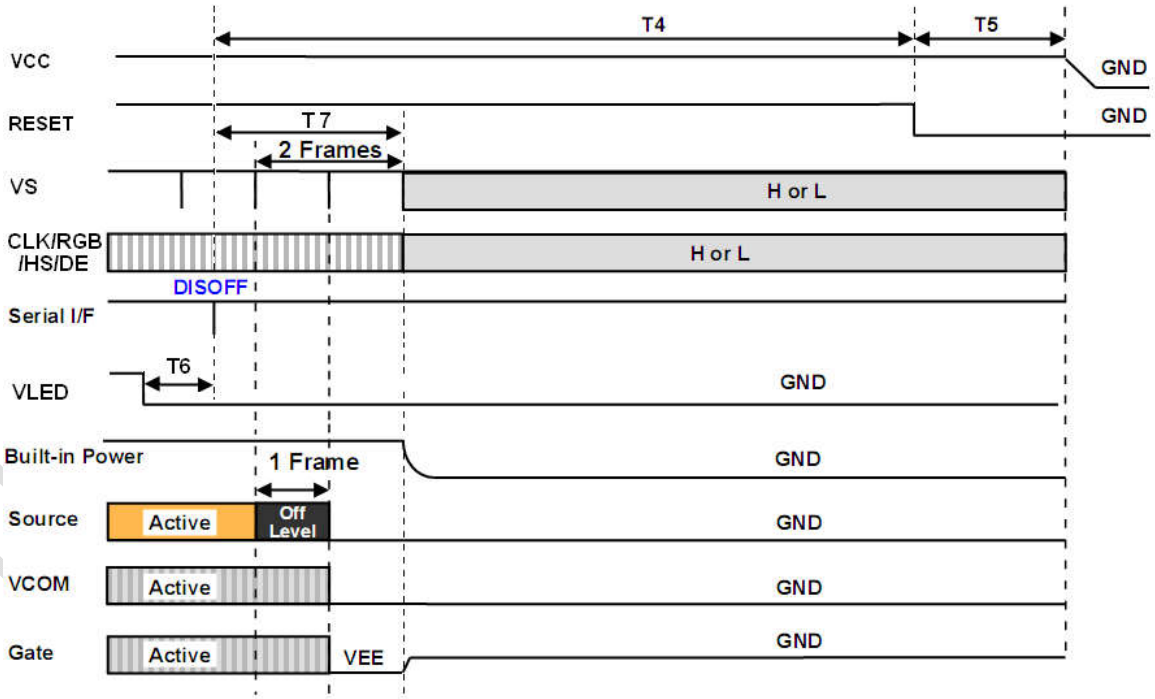
Figure 5.2.3 9-Wire SPI Read cycle

5.3 Power ON Sequence



Note1: T0>10us, T1>1ms, T2>1ms,T3>120ms,

5.4 Power Off Sequence



Note1: T4>250ms, T5>9us, T6>20ms, T7>50ms

6 Optical Characteristics

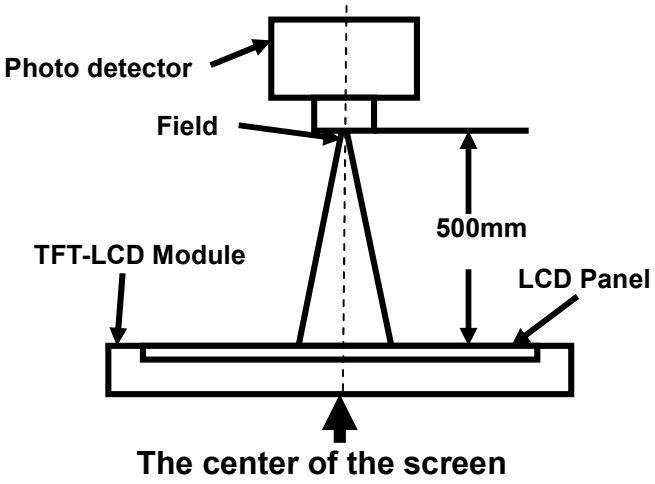
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angles		θT	CR≧10	80	88		Degree	Note2,3
		θB		80	88			
		θL		80	88			
		θR		80	88			
Contrast Ratio		CR	θ=0°	600	800			Note 3
Response Time		T_{ON}	25℃		25	40	ms	Note 4
		T_{OFF}						
Chromaticity	**White**	x	Backlight is on		0.295±0.05			Note 1,5
		y			0.321±0.05			
	Red	x			0.617±0.05			Note 1,5
		y			0.328±0.05			
	Green	x			0.332±0.05			Note 1,5
		y			0.595±0.05			
	Blue	x			0.158±0.05			Note 1,5
		y			0.066±0.05			
Uniformity		U		75	80		%	Note 6
NTSC				55	60		%	Note 5
Luminance		L		800	1000		cd/m^2	Note 7

Test Conditions:

1. I_F= 20 mA, and the ambient temperature is 25℃.
2. The test systems refer to Note 1 and Note 2.

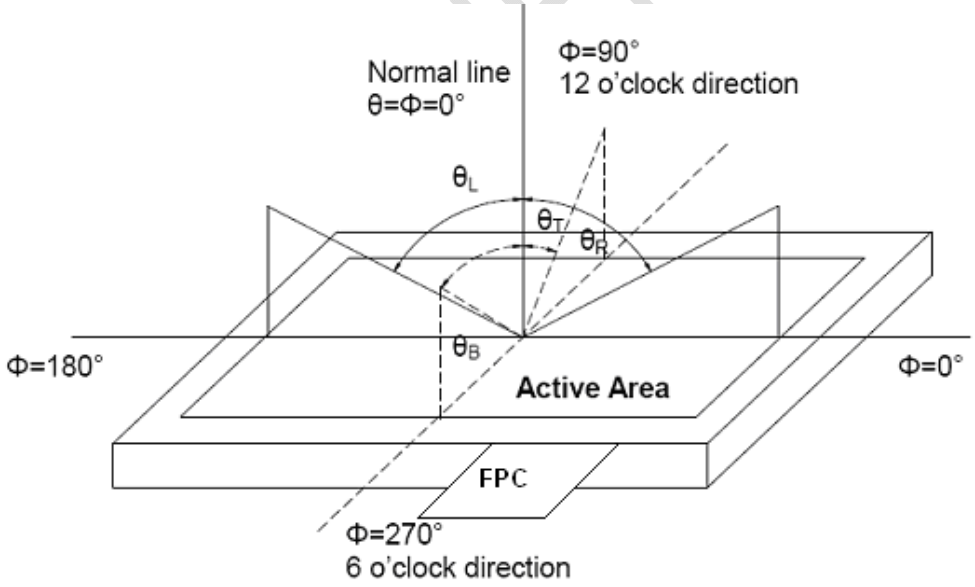
Note 1: Definition of optical measurement system.

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.



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

viewing angle is measured at the center point of the LCD.



Note 3: Definition of contrast ratio

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

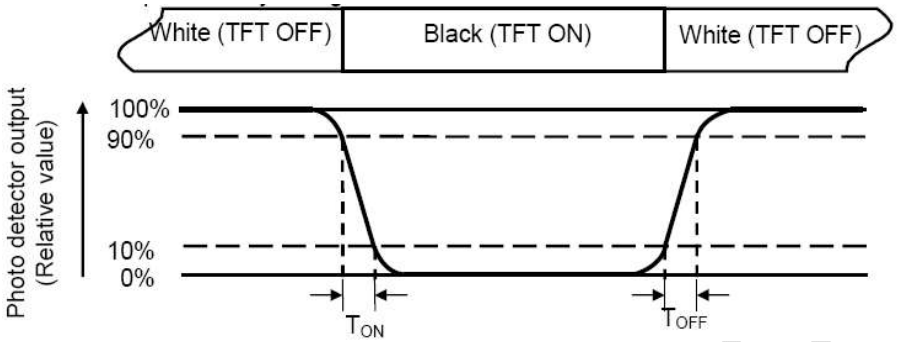
"White state ": The state is that the LCD should drive by Vwhite.

"Black state": The state is that the LCD should drive 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)

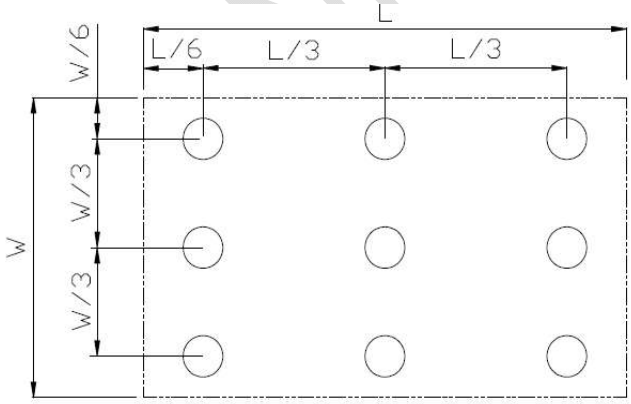
Color coordinates measured at center point of LCD.

Note 6: Definition of Luminance Uniformity

Active area is divided into 9 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



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.

7 Environmental / Reliability Test

No	Test Item	Condition	Remarks
1	High Temperature Operation	60℃/240H	IEC60068-2-1:2007 GB2423.2-2008
2	Low Temperature Operation	-20℃/240H	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	70℃/240H	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	-30℃/240H	IEC60068-2-1:2007 GB2423.1-2008
5	Storage at High Temperature and Humidity	40℃,90％RH,240H	IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (non-operation)	-30℃-+70℃，30min，Change Time: 5min， total 20cycle	Start with cold temperature, End with high temperature, IEC60068-2-14:1984, GB2423.22-2002
7	ESD	C=150pF、R=330Ω Air: ±8KV Contact: ±4KV 5point/panel, 5times	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration Test	Frequency range:10~55Hz Stroke: 1.5mm Sweep: 10Hz~55Hz~10Hz 30min s for each direction of X.Y.Z.(1.5 hours for total)	IEC60068-2-6:1982 GB/T2423.10—1995
9	Mechanical Shock (Non OP)	Half Sine Wave 60G ,6ms,±X,±Y,±Z 3times for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
10	Package Drop Test	Height:60cm; 1corner,3edges,6surfaces	IEC60068-2-32:1990 GB/T2423.8—1995

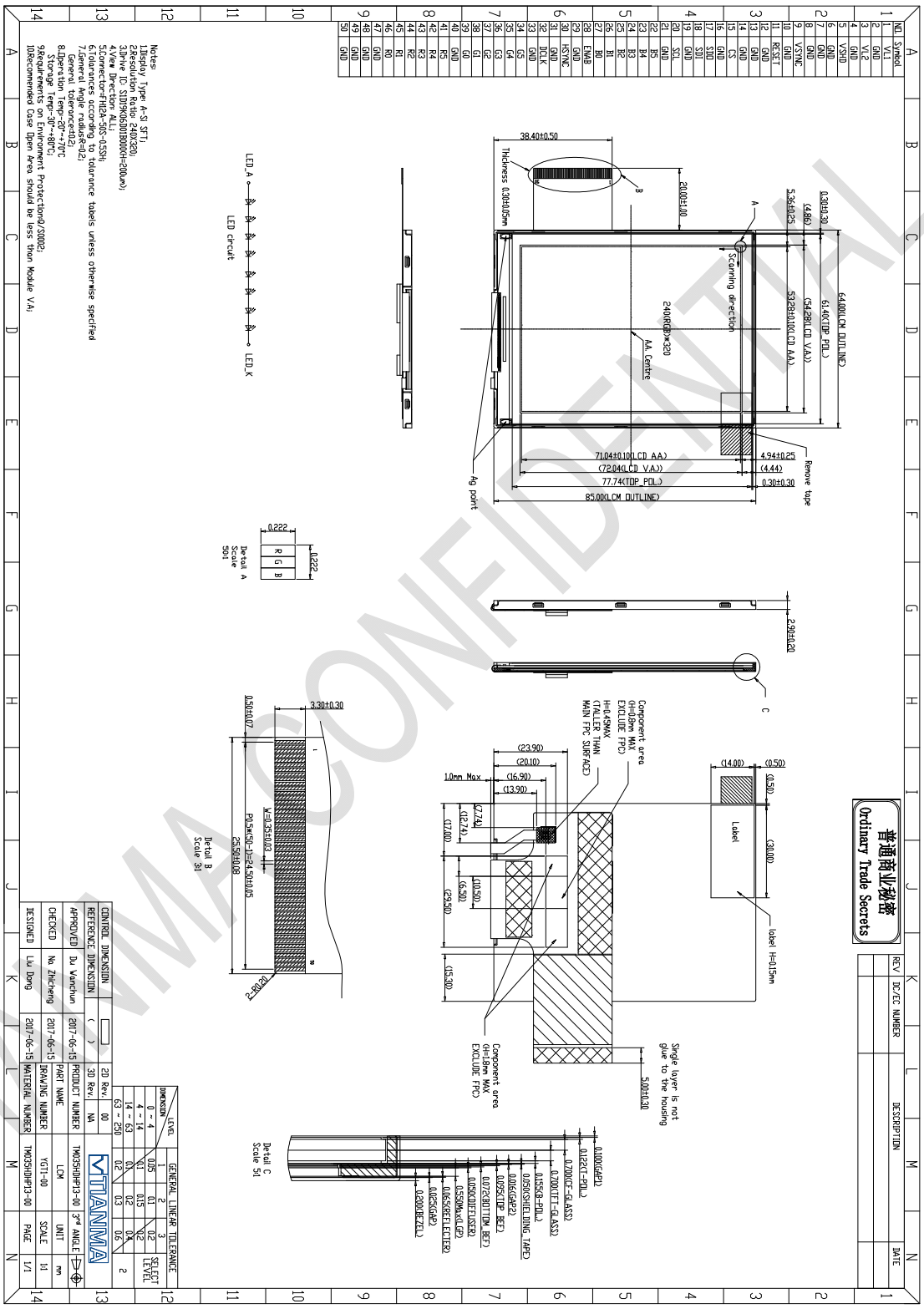
Note1: Ts is the temperature of panel's surface.

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.

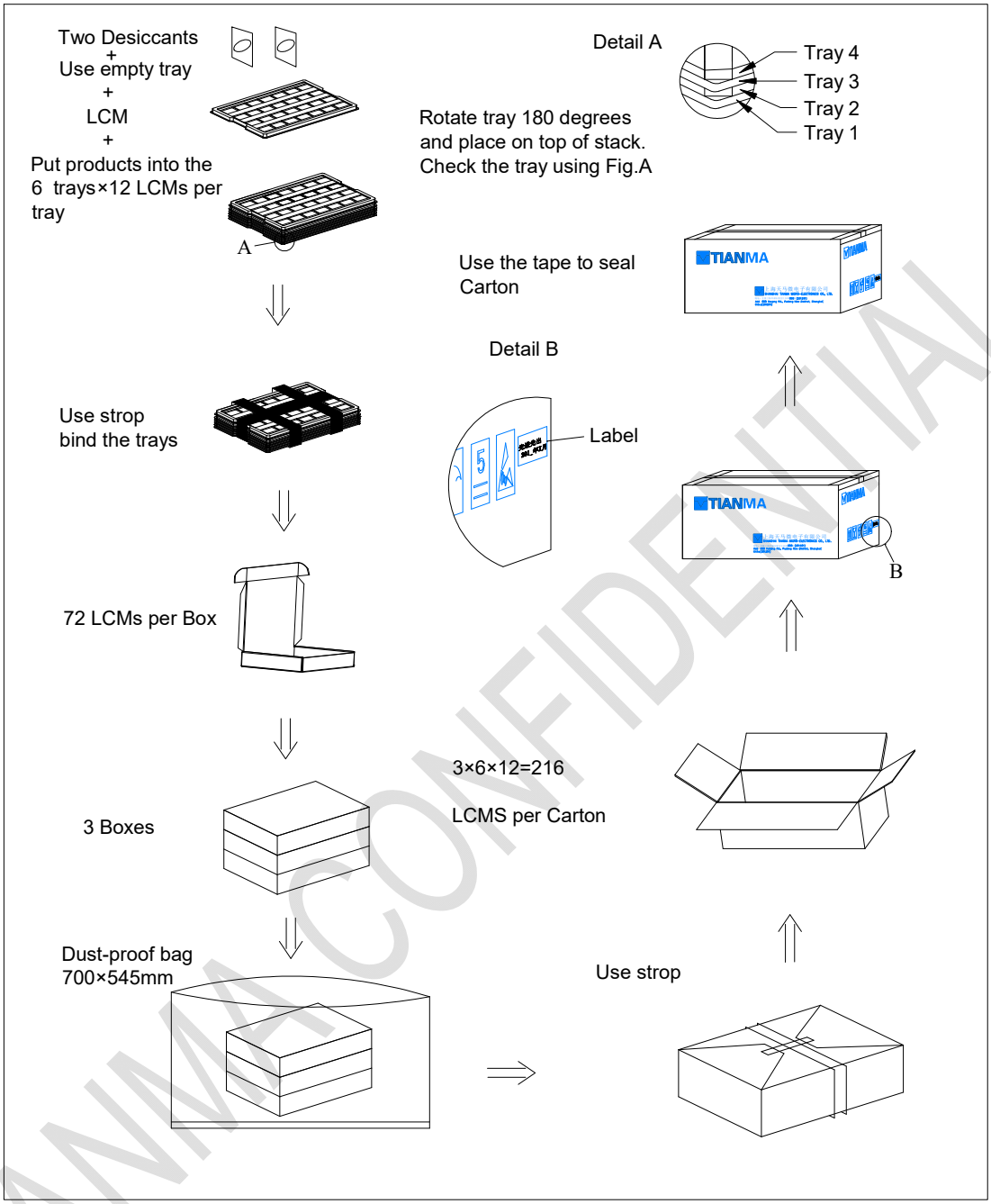
Note 4: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but don't guarantee all of the cosmetic specification.

8 Mechanical Drawing



9 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM	TM035HDHP13-00	64.00×85.00×2.90	TBD	216	
2	Tray	PET	485×330×16.5	TBD	21	Anti-static
3	Box	CORRUGATED PAPER	520×345×74	TBD	3	
4	Carton	CORRUGATED PAPER	544×365×250	TBD	1	
5	Dust-Proof Bag	PE	700.00×545.00×0.05	TBD	1	
6	Desiccant		45×35(2g)	TBD	6	
7	Label	Paper	100×52	TBD	1	
8	Total weight	TBD				



10 Precautions for Use of LCD Modules

10.1 Handling Precautions

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

10.1.2 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.

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

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

10.1.5 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

10.1.6 Do not attempt to disassemble the LCD Module.

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

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

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

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

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

10.1.8.4 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.

10.2 Storage precautions

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

10.2.2 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%

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

10.3 Transportation Precautions

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