MODEL NO. : TM028HBH31

ISSUED DATE: 2011-08-02

VERSION : Ver 1.0

■Preliminary Specification
□Final Product Specification

Customer :_____

Approved by	Notes

SHANGHAI TIANMA Confirmed :

Prepared by	Checked by	Approved by

This technical specification is subjected to change without notice

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Record of Revision

Rev	Issued Date	Description	Editor
1.0	2011-08-02	Preliminary Specification Release	Longping.Deng

1 General Specifications

Feature		Spec
Display Spec.	Size	2.83 inch
	Resolution	240(RGB) x 320
	Interface	RGB 18 bits + 3 SPI
	Color Depth	262K
	Technology Type	a-Si
	Pixel Pitch (mm)	0.180 x 0.180
	Pixel Configuration	R.G.B. Vertical Stripe
	Display Mode	TM with Normally White
	Surface Treatment(Up Polarizer)	Clear type (3H)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	52.90 x 71.70 x 4.20
	Active Area(mm)	43.20x 57.60
	With /Without TSP	With TSP
	Weight (g)	39.0
	LED Numbers	4 LEDs
Electronic	Driver IC	HX8347-G

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

TFT LCD Panel

Recommended connector: HIROSE FH23-61S-0.3SHW

No	Symbol	I/O	Description	Remarks
1	DEN	I	Data enable	Note1
2	DCLK	I	Data sampling clock signal	
3	/RST	I	RESET(low active)	
4	Y1	I	Touch panel Y(6 clock side)	
5	GND	P	Ground	Note1
6	NC	N	No connection	
7	NC	N	No connection	
8	GND	P	Ground	
9	NC	N	No connection	
10	NC	N	No connection	
11	NC	N	No connection	
12	NC	N	No connection	
13	GND	P	Ground	
14	X1	I	Touch panel X(left side)	
15	NC	N	No connection	
16	NC	N	No connection	
17	NC	N	No connection	
18	NC	N	No connection	
19	GND	P	Ground	
20	VDD	P	Power supply of digital	
21	VDD	P	Power supply of digital	
22	NC	N	No connection	
23	NC	N	No connection	
24	Y2	I	Touch panel Y(12 clock side)	
25	GND	P	Ground	
26	NC	N	No connection	
27	X2	I	Touch panel X(right side)	
28	VDD	P	Power supply of digital	
29	PD17	I	Red data bit R5	
30	PD16	I	Red data bit R4	
31	PD15	I	Red data bit R3	

32	PD14	I	Red data bit R2	
33	PD13	I	Red data bit R1	
34	PD12	I	Red data bit R0	
35	PD11	I	Green data bit G5	
36	PD10	I	Green data bit G4	
37	PD9	I	Green data bit G3	
38	PD8	I	Green data bit G2	
39	PD7	I	Green data bit G1	
40	PD6	I	Green data bit G0	
41	PD5	I	Blue data bit B5	
42	PD4	I	Blue data bit B4	
43	PD3	I	Blue data bit B3	
44	PD2	I	Blue data bit B2	
45	PD1	I	Blue data bit B1	
46	PD0	I	Blue data bit B0	
47	NC	N	No connection	
48	/CS	I	SPI chip select	
49	SCL	I	SPI clock	
50	SDI	I	SPI serial data input	
51	SDO	O	SPI serial data output	Note1
52	HSYNC	I	Horizontal sync signal	
53	GND	P	Ground	
54	NC	N	No connection	
55	NC	N	No connection	
56	VSYNC	I	Vertical sync signal	
57	LED+	P	LED anode	
58	LED+	P	LED anode	
59	LED-	P	LED cathode	
60	LED-	P	LED cathode	
61	NC	N	No connection	

Note1: I/O definition.

I---Input, O---Output, P--- Power/Ground, N--- No connection

Note 3-1:

18 Bit RGB	Mode	R(5:0)	G(5:0)	B(5:0)	HSYNC	VSYNC	DEN	DCLK
	SYNC mode	R(5:0)	G(5:0)	B(5:0)	HSYNC	VSYNC	Floating	DCLK
	DE mode	R(5:0)	G(5:0)	B(5:0)	Pull high	Pull high	DEN	DCLK

3 Absolute Maximum Ratings

GND=0V, Ta = 25°C

Item	Symbol	Min	Max	Unit	Remark
Logic Supply Voltage	VDD	-0.3	4.6	V	
Input Signal Voltage	DEN,DCLK, /RST,PD0~PD17, /CS,SCL,SDI, HSYNC, VSYNC,	-0.3	VDD +0.3	V	
Touch Panel Pin Voltage	X1,X2,Y1,Y2	--	7.0	V	
Back Light Forward Current	I_{LED}	--	25.0	mA	For each LED
Operating Temperature	T_{OPR}	-20	70	℃	
Storage Temperature	T_{STG}	-30	80	℃	

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25℃

Item		Symbol	Min	Typ	Max	Unit	Remark
Logic Supply Voltage		VDD	2.3	2.8	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0	-	0.3xVDD	V	DEN,DCLK, /RST, PD0~PD17,/CS,SCL, SDI, HSYNC, VSYNC,
	High Level	V_{IH}	0.7xVDD	-	VDD	V	
Output Signal Voltage	Low Level	V_{OL}	0	-	0.3xVDD	V	SDO
	High Level	V_{OH}	0.7xVDD	-	-	V	
Power Consumption (Panel+ LSI)		Black Mode (60Hz)	-	15.4	-	mW	
		Standby Mode	-	70.0	-	μW	
		Sleeping Mode	-	196.0	-	μW	

4.2 Driving Backlight

Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	-	15.0	25	mA	Note 1,2,3,4
Forward Voltage	V_F	11.6	12.8	13.6	V	
Power Consumption	W_{BL}	-	192	-	mW	

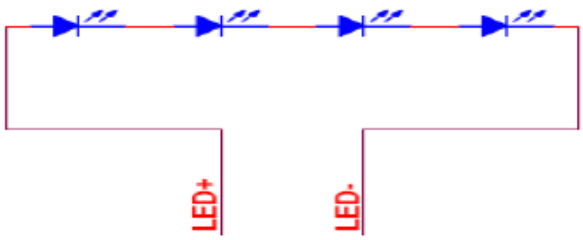
Note 1: The LED driving condition is defined for each LED module （4 LED Serial）.

Input Voltage = 3.2 V x 4 = 12.8 V

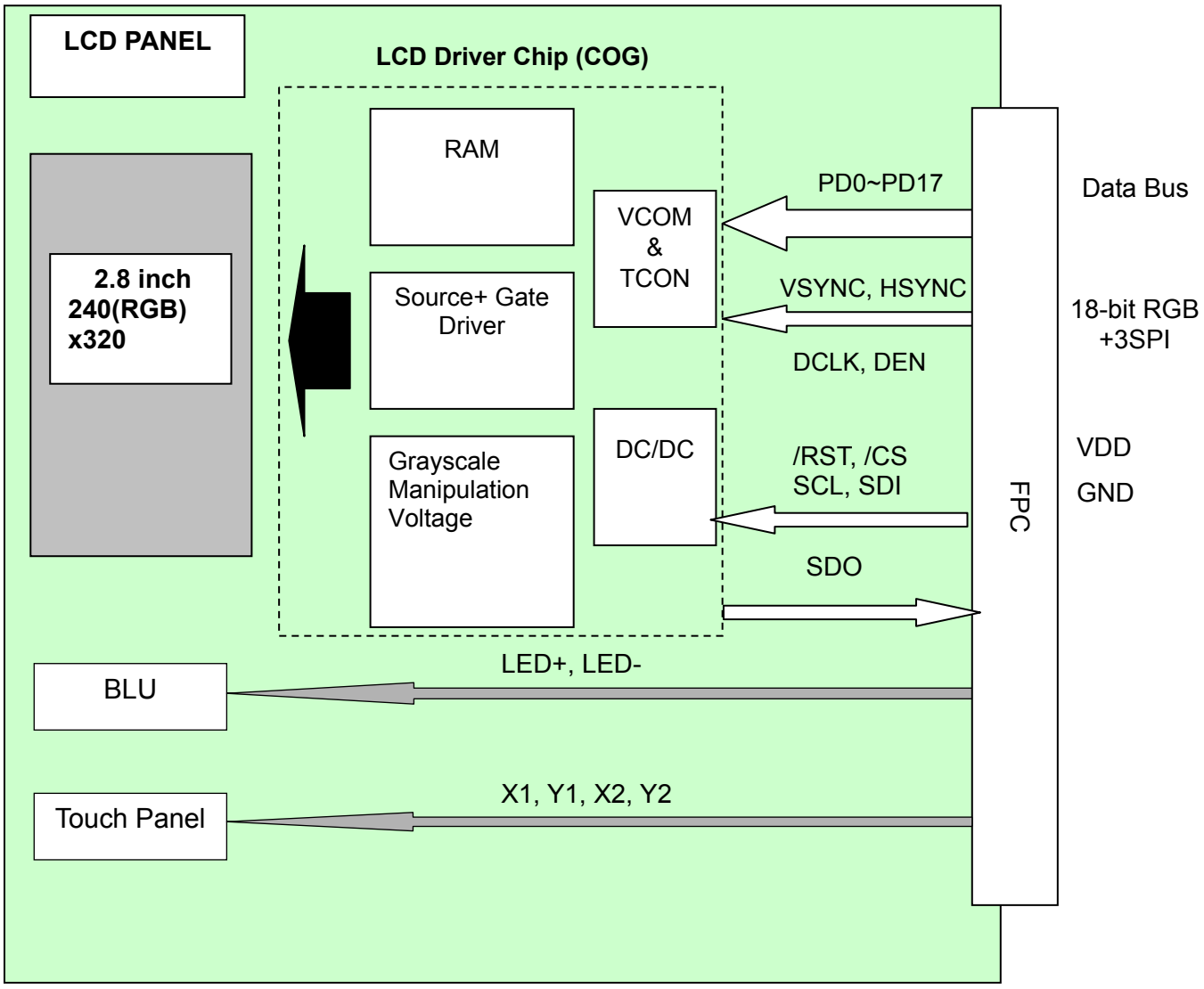
Note 2: $W_{BL} = I_{LED1} \times V_{LED1} + I_{LED2} \times V_{LED2} + I_{LED3} \times V_{LED3} + I_{LED4} \times V_{LED4}$

Note 3: The minimum life of LED is 20,000 hours, which is defined that the brightness becomes 50% of the original value under standard condition.

Note 4: The LED driving condition is defined for each LED module.



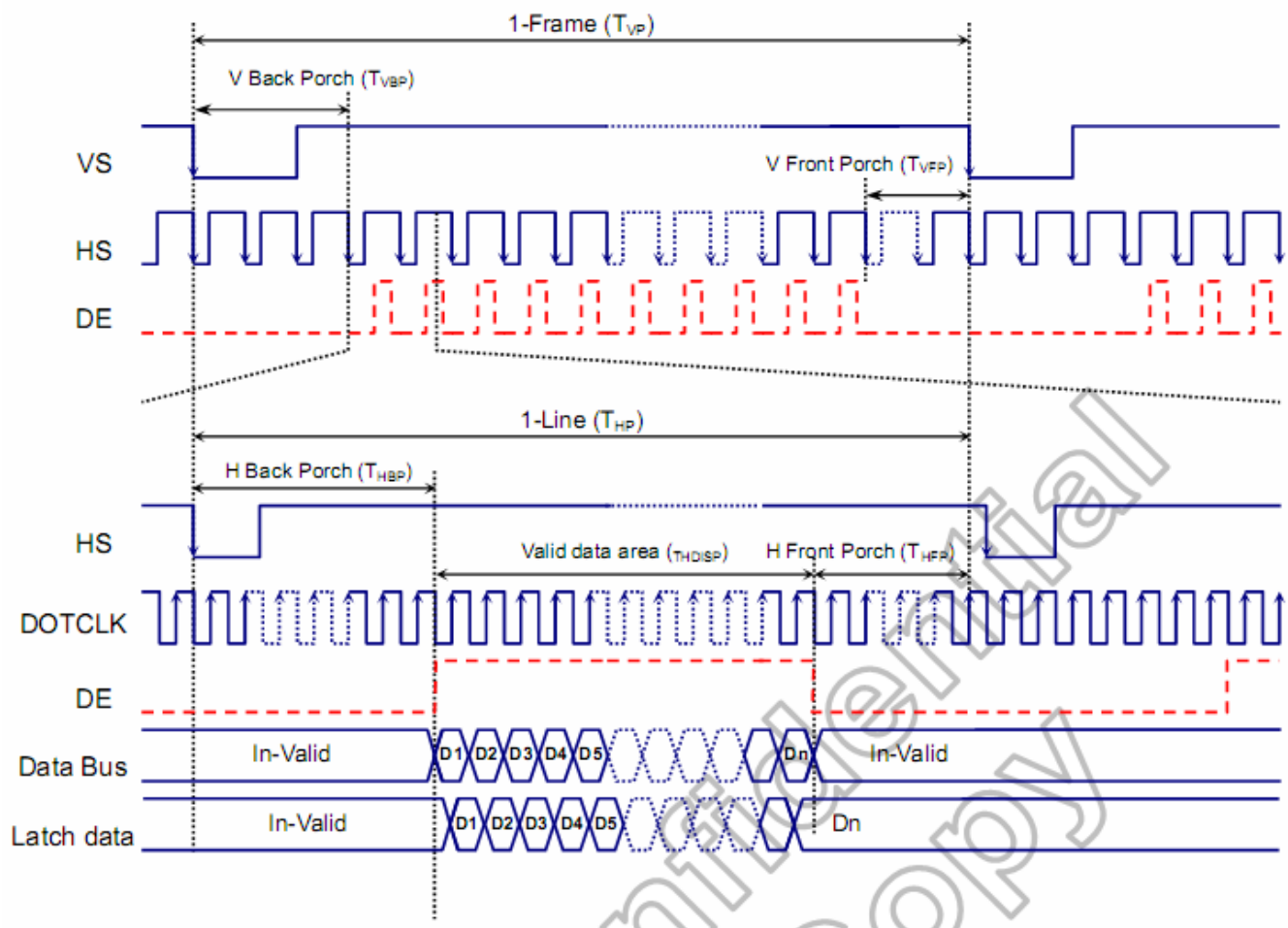
4.3 Block Diagram



5 Timing Chart

5.1 RGB 18bit interface

5.1.1 RGB 18bit Data Input Format



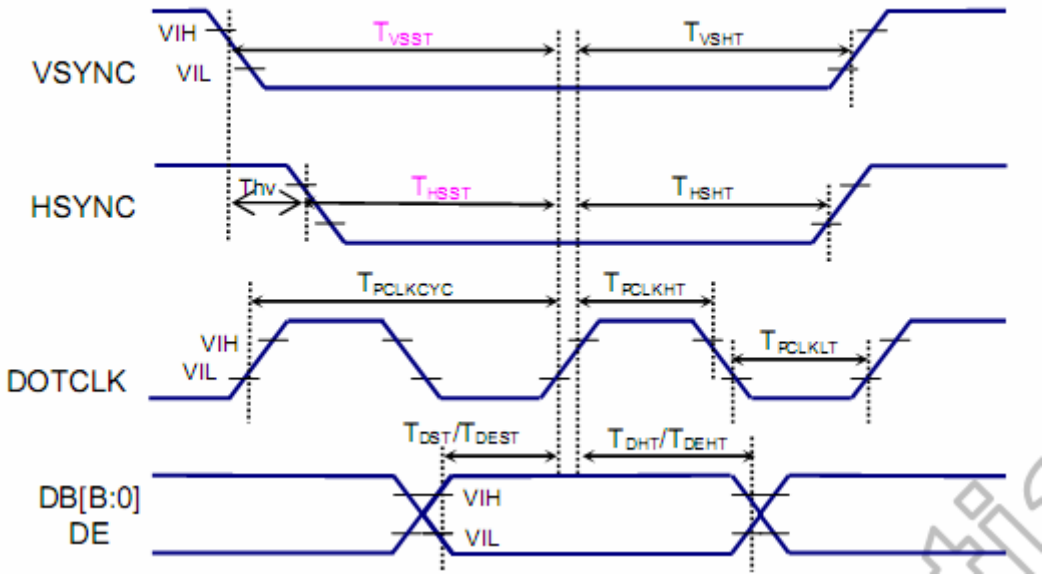
Note: (1) RGB mode 2 doesn't need DE signal
(2) EPL='0', VSPL='0', HSPL='0' and DPL='0' of SETRGBIF (32H) command.

(GND=0V, Ta=25℃)

Item	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
Vertical Timing						
Vertical cycle period	T_{VP}	-	324	326	452	HS
Vertical low pulse width	T_{VS}	-	2	2	-	HS
Vertical front porch	T_{VFP}	-	2	2	6	HS
Vertical back porch	T_{VBP}	-	2	4	126	HS
Vertical blanking period	T_{VBL}	$T_{VBP}+T_{VFP}$	4	6	132	HS
Vertical active area	T_{VDISP}	-	-	320	-	HS
			-		-	HS
			-		-	HS
Vertical refresh rate	TVRR	Frame rate	50	60	80	Hz
Horizontal Timing						
Horizontal cycle period	T_{HP}	-	244	252	1008	DOTCLK
Horizontal low pulse width	T_{HS}	-	2	2	256	DOTCLK
Horizontal front porch	T_{HFP}	-	2	4	256	DOTCLK
Horizontal back porch	T_{HBP}	-	2	8	256	DOTCLK
Horizontal blanking period	T_{HBL}	$T_{HBP}+T_{HFP}$	4	12	256	DOTCLK
Horizontal active area	T_{HDISP}	-	-	240	-	DOTCLK
Pixel clock cycle TVRR=60Hz	f_{CLKCYC}	-	3.9	-	16.6	MHz

Note: (1) IOVCC=1.65 to 3.3V, VCI=2.3 to 3.3V, VSSA=VSSD=0V, T_A=-30 to 70℃ (to +85℃ no damage)
(2) Data lines can be set to "High" or "Low" during blanking time – Don't care.
(3) HP is multiples of DOTCLK.
(4)16.6MHz is using at below condition: 324(Hs)x1008(DOTCLK)x50(Hz)

5.1.2 RGB 18bit Input Timing Wave

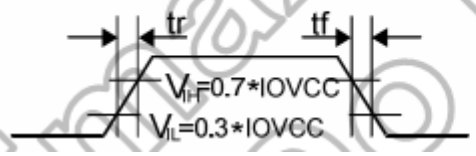


(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.3V to 3.3V,Ta = -30 to 70° C)

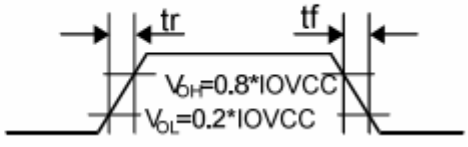
Item	Symbol	Condition	Spec.			Unit
			Min.	Typ.	Max.	
Pixel low pulse width	T_{CLKLT}	-	15	-	-	ns
Pixel high pulse width	T_{CLKHT}	-	15	-	-	ns
Vertical Sync. set-up time	T_{VSST}	-	15	-	-	ns
Vertical Sync. hold time	T_{VSSHT}	-	15	-	-	ns
Horizontal Sync. set-up time	T_{HSST}	-	15	-	-	ns
Horizontal Sync. hold time	T_{VSSHT}	-	15	-	-	ns
Data Enable set-up time	T_{DEST}	-	15	-	-	ns
Data Enable hold time	T_{DEHT}	-	15	-	-	ns
Data set-up time	T_{DST}	-	15	-	-	ns
Data hold time	T_{DHT}	-	15	-	-	ns
Phase difference of sync signal falling edge	Thv	-	0	-	240	Dotclk

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.

Input Signal Slope

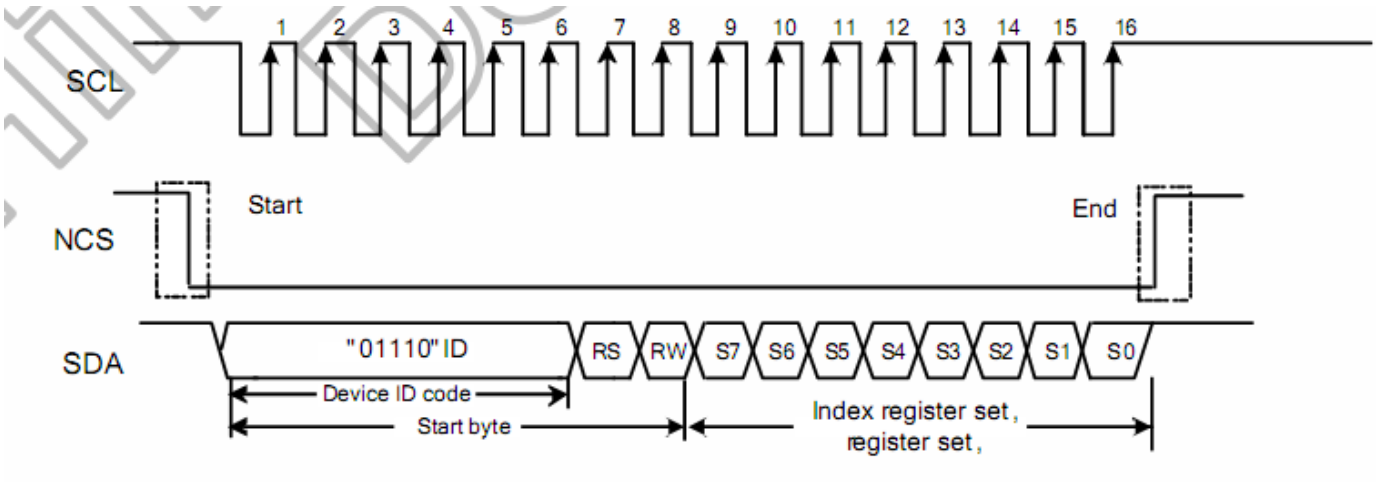


Output Signal Slope

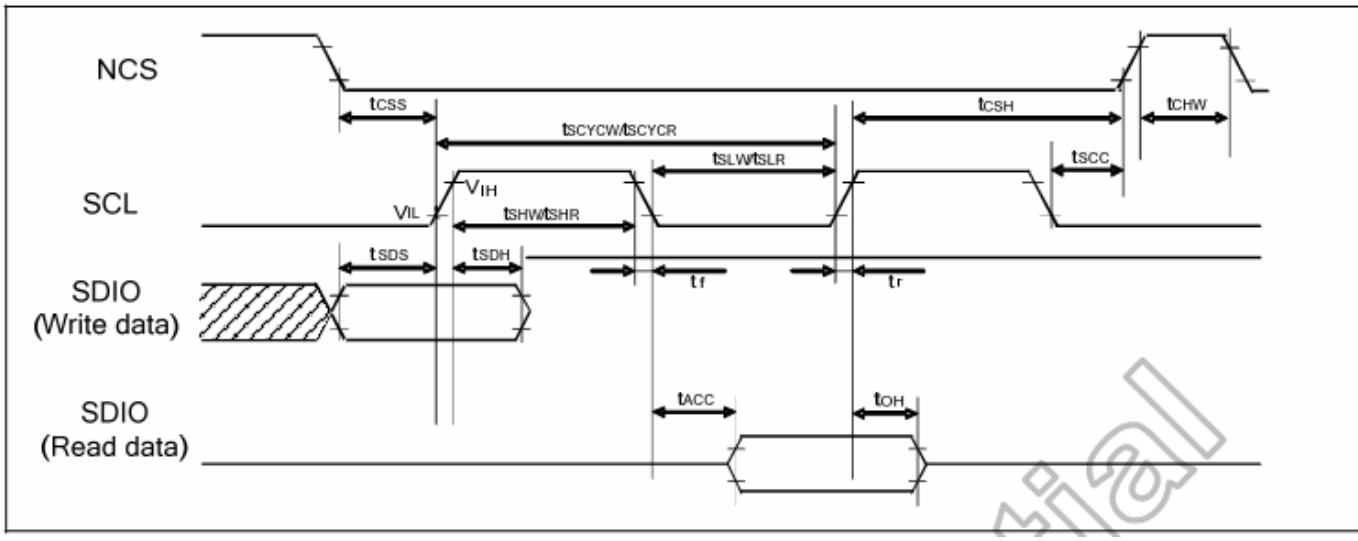


5.2 SPI interface

5.2.1 3-Wire Serial Communication Data Format(ID=1)



5.2.2 3-Wire Serial Communication AC Timing

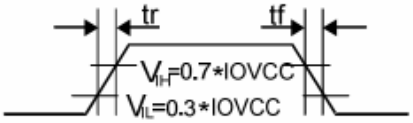


(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.3V to 3.3V, T_A=-30 to 70° C)

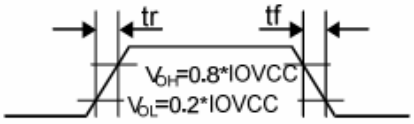
Parameter	Symbol	Conditions	Spec.			Unit
			Min.	Typ.	Max.	
Serial clock cycle (Write) SCL "H" pulse width (Write) SCL "L" pulse width (Write)	tSCYCW tSHW tSLW	SCL	33 10 10	- - -	- - -	ns
Data setup time (Write) Data hold time (Write)	tSDS tSDH	SDIO	10 10	- -	- -	ns
Serial clock cycle (Read) SCL "H" pulse width (Read) SCL "L" pulse width (Read)	tSCYCR tSHR tSLR	SCL	150 60 60	- - -	- - -	ns
Access Time	tACC	SDI for maximum CL=30pF For minimum CL=8pF	10	-	50	ns
Output disable time	tOH	SDO For maximum CL=30pF For minimum CL=8pF	15	-	50	ns
SCL to Chip select	tSCC	SCL, NCS	20	-	-	ns
NCS "H" pulse width	tCHW	NCS	40	-	-	ns
Chip select setup time Chip select hold time	tCSS tCSH	NCS	15 15	- -	- -	ns

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
Logic high and low levels are specified as 30% and 70% of IOVCC for Input signals.

Input Signal Slope

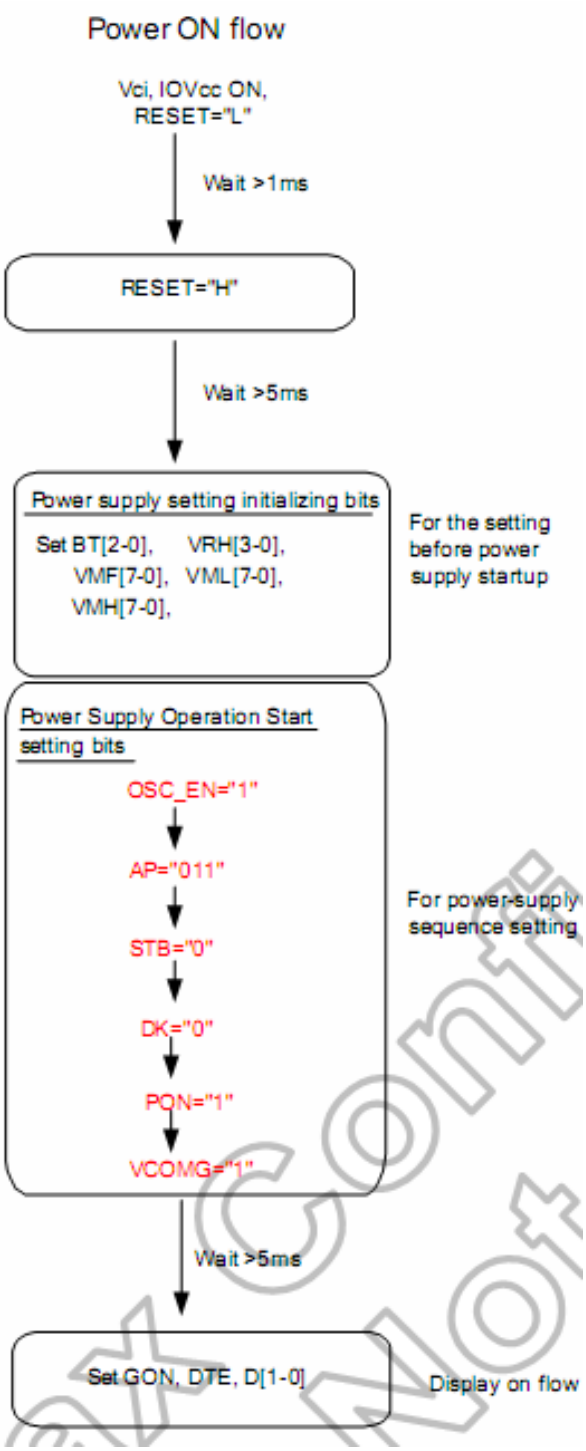


Output Signal Slope

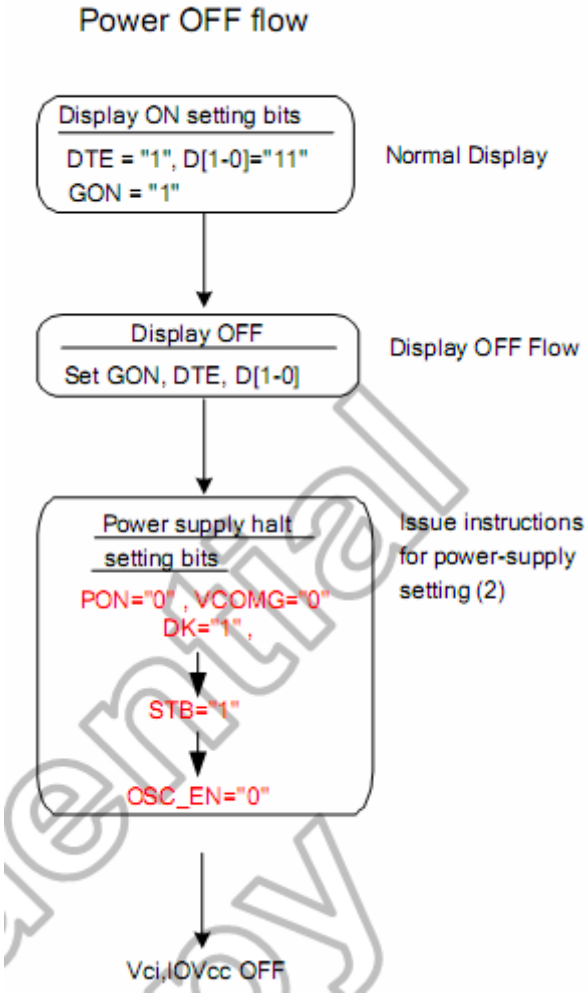


5.3 POWER ON/OFF SEQUENCE

5.3.1 Power on sequence



5.3.2 Power off sequence



6 Optical Characteristics

6.1 Optical Specification

Ta=25℃

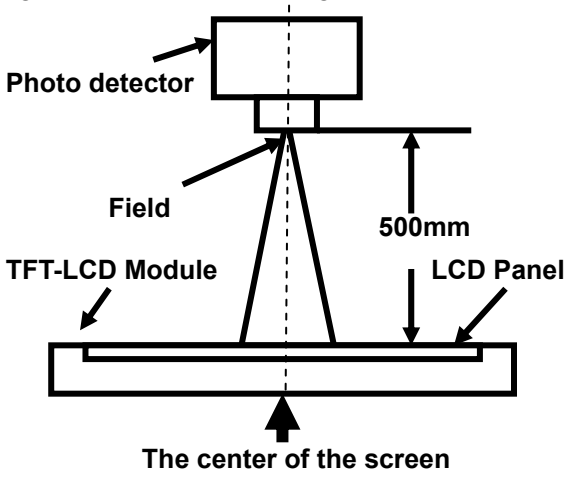
Item		Symbol	Condition	MIN	TYP	MAX	Unit	Remark
View Angles		θT	CR≧10	50	60	-	Degree	Note 2
		θB		30	40	-		
		θL		50	60	-		
		θR		50	60	-		
Contrast Ratio		CR	θ=0°	200	350	-		Note1,3
Response Time		T_{ON}	25℃	-	25	40	ms	Note1,4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.240	0.290	0.340		Note1,5
		y		0.260	0.310	0.360		
	Red	x		0.434	0.584	0.534		
		y		0.268	0.318	0.368		
	Green	x		0.285	0.335	0.385		
		y		0.532	0.582	0.632		
	Blue	x		0.093	0.143	0.193		
		y		0.047	0.097	0.147		
Uniformity		U		75	80	-	%	Note1,6
NTSC				-	55	-	%	Note 5
Luminance(TSP)		L		150	200	-	cd/m^2	Note1,7

Test Conditions:

1. The ambient temperature is 25℃. And one LED current is 15mA,
2. The test systems refer to Note 1 and Note 2.

Note 1: Definition of optical measurement system.

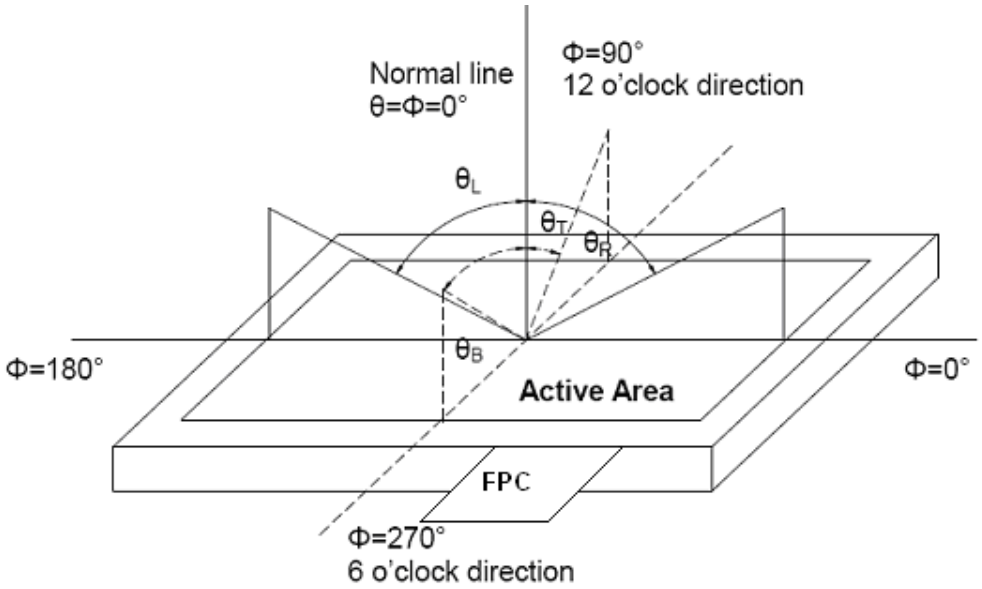
The optical characteristics should be measured in dark room. After 5 minutes operation, the optical properties are measured at the center point of the LCD screen. All input terminals LCD panel must be ground when measuring the center area of the panel.



Item	Photo detector	Field
Contrast Ratio	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

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

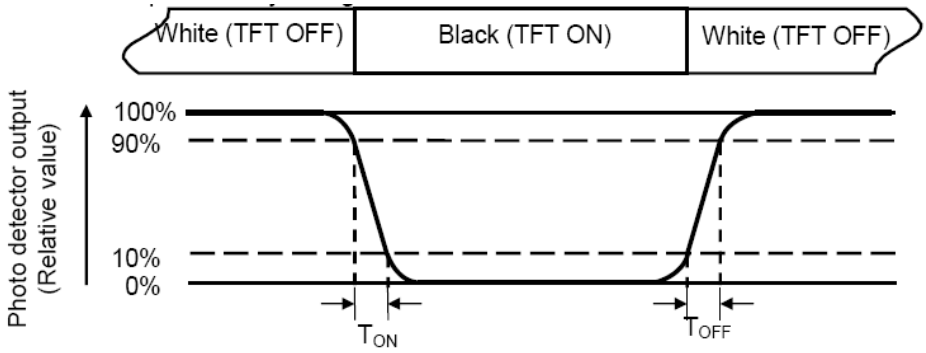
"White state ":The state is that the LCD should driven by Vwhite.

"Black state": The state is that the LCD should 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 (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) is the time between photo detector output intensity changed from 10% to 90%.



Note 5: Definition of color chromaticity (CIE1931)

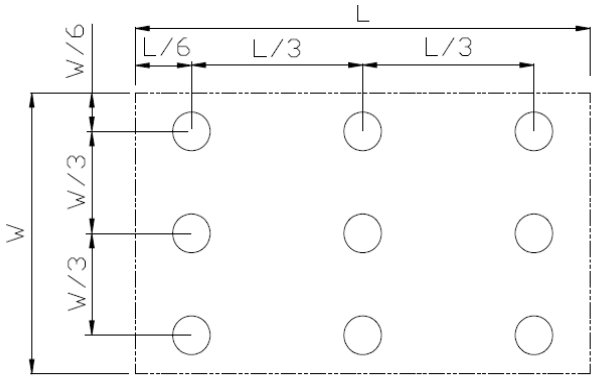
Color coordinates measured at center point of LCD.

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.

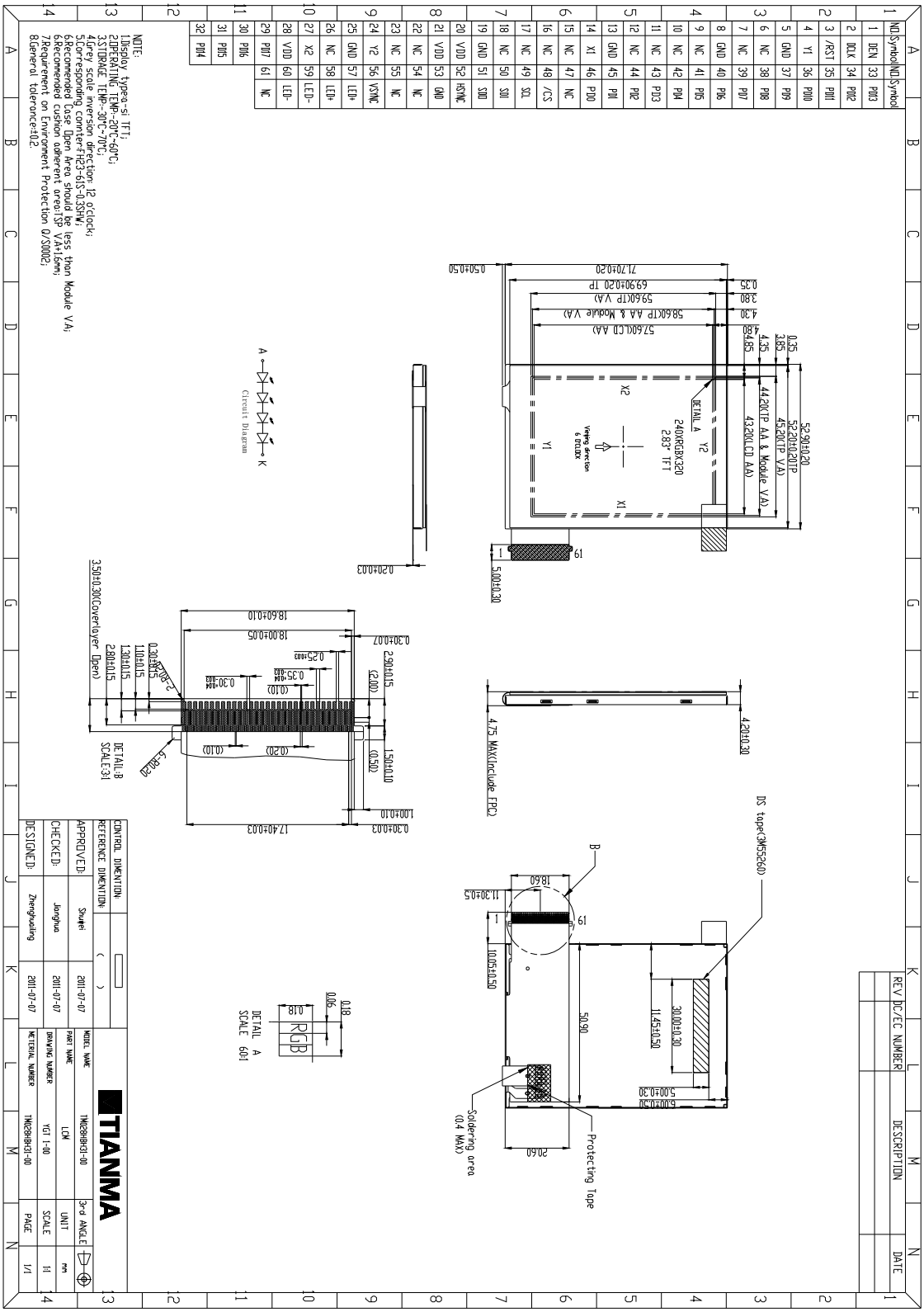
6 Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts=+60℃, 240hrs	Note1 IEC60068-2-1:2007,GB2423.2-2008
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	Ta=+70℃, 240hrs	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1:2007 GB2423.1-2008
5	High Temperature & High Humidity Storage	+60℃, 90% RH max,240 hours	Note2 IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30℃ 30 min~+70℃ 30 min, Change time:5min, 20 Cycle	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,GB2423.22-2002
7	Electro Static Discharge (Operation)	C=150pF, R=330Ω，5points/panel Air:± 8KV, 5times; Contact:± 4KV, 5 times; （Environment: 15℃～35℃, 30%～60%, 86Kpa～106Kpa）	IEC61000-4-2:2001 GB/T17626.2-2006
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 1 hours for each direction of X.Y.Z.(3 hours for total)	IEC60068-2-6:1982 GB/T2423.10—1995
9	Shock (Non-operation)	60G 6ms, ± X,± Y,± Z 3times for each direction	IEC60068-2-27:1987 GB/T2423.5—1995
10	Package Drop Test	Height:80 cm， 1 corner, 3 edges, 6 surfaces	IEC60068-2-32:1990 GB/T2423.8—1995

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

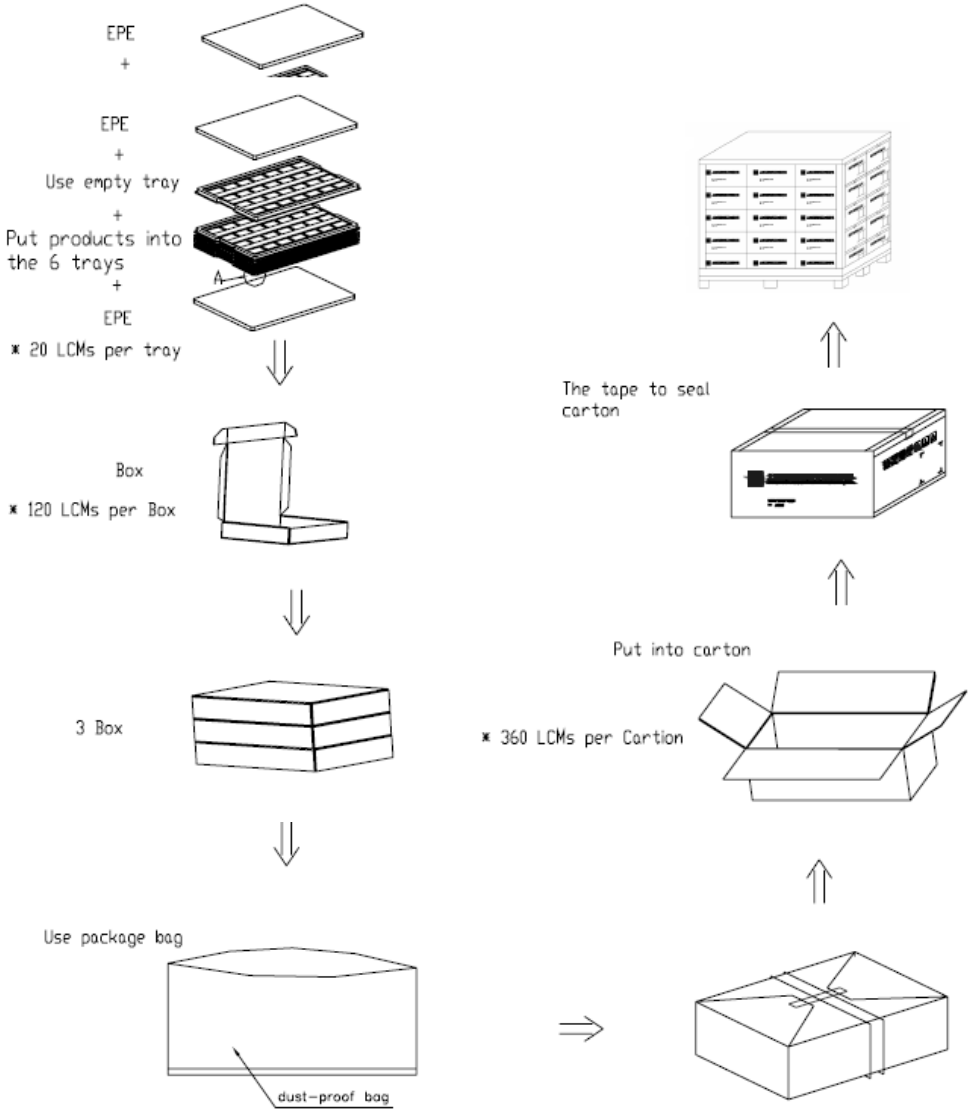
Note2: Ta is the ambient temperature of sample.

7 Mechanical Drawing



8 Packing Drawing

No	Item	Model(Material)	Dimensions (mm)	Unit Weigt (Kg)	Quantity	Remark
1	LCM	TM028HBH15	52.90x71.70x4.20	0.039	360	
2	Tray	PET(Transmit)	485.0x330.0x12.0	0.165	21/360	Anti-static
3	EPE	EPE	485.0X330.0X5.0	0.039	6/360	
4	Dust-Proof Bag	PE	700.0x545.0	0.051	1/360	
5	Box	Corrugated Paper	520.0x345.0x74.0	0.783	3/360	
6	Carton	Corrugated Paper	544.0x365.0x250.0	1.030	1/360	
7	Total Weight (Kg)	21.169Kg(+-5%)				



9 Precautions for Use of LCD Modules

9.1 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.

9.2 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℃ ～ 40℃ Relatively humidity: ≤80%

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

9.3 Transportation Precautions:

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