MODEL NO. : TM024HDH30

ISSUED DATE: 2010-04-09

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.

Table of Contents

Record of Revision

Rev	Issue Date	Description	Editor
1.0	2010-04-09	Preliminary release.	Qiuping Yang

1 General Specifications

Feature		Spec
Display Spec	Size	2.4 inch
	Resolution	240(RGB) x 320
	Interface	CPU 8/9/16/18 bits
	Color Depth	262k
	Technology Type	a-Si
	Pixel Pitch (mm)	0.153x 0.153
	Pixel Configuration	R.G.B Vertical Stripe
	Display Mode	TM with Normally White
	Surface Treatment	Clear Type (3H)
	Viewing Direction	6 o'clock
	Gray Scale Inversion Direction	12 o'clock
Mechanical Characteristics	LCM (W x H x D) (mm)	42.72x60.26x2.25
	Active Area(mm)	36.72 x 48.96
	With /Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	3 LEDs
Electronic	Driver IC	HX8347G

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: RoHS.

Note 3: LCM weight tolerance: +/- 5%.

2 Input/Output Terminals

2.1 TFT LCD Panel

No	Symbol	I/O	Description	Remark
1	GND	P	Power Ground	
2	Y-	-	No connection	
3	X-	-	No connection	
4	Y+	-	No connection	
5	X+	-	No connection	
6	GND	P	Power Ground	
7	IM0	I	Mode select	Note 4-2
8	IM3	I	Mode select	Note 4-2
9	NC	-	No connection	
10	NC	-	No connection	
11	LCD_ID	O	LCD identify for reading a 0.0173Volt Voltage	
12	RESET	I	Reset signal	
13	D9	I	Data Input	
14	D0	I	Data Input	
15	D17	I	Data Input	
16	D16	I	Data Input	
17	D15	I	Data Input	
18	D14	I	Data Input	
19	D13	I	Data Input	
20	D12	I	Data Input	
21	D11	I	Data Input	
22	D10	I	Data Input	
23	D8	I	Data input	
24	D7	I	Data input	
25	D6	I	Data input	
26	D5	I	Data input	
27	D4	I	Data input	
28	D3	I	Data input	
29	D2	I	Data input	
30	D1	I	Data input	
31	RD	I	Read	
32	WR	I	Write	
33	RS	I	Register select	
34	CS	I	Chip select	
35	GND	P	Ground	

36	IOVCC	P	Power Supply of Logic Circuit	
37	VCC	P	Power Supply of Analog Circuit	
38	VCC	P	Power Supply of Analog Circuit	
39	NC	-	No connection	
40	LEDK3	P	LED cathode	
41	LEDK2	P	LED cathode	
42	LEDK1	P	LED cathode	
43	LEDA	P	LED anode	
44	GND	P	Ground	

Note 4-1: I/O definition: I-----Input; O---Output; P----Power/Ground.

Note 4-2:

IM3	IM0	Interface	Data Bus Use	
			Register/Content	GRAM
0	0	8080 MCU 16bit parallel	D8~D1	D17~D10,D8~D1
0	1	8080 MCU 8bit parallel	D17~D10	D17~D10
1	0	8080 MCU 18bit parallel	D8~D1	D17~D0
1	1	8080 MCU 9bit parallel	D17~D10	D17~D9

3 Absolute Maximum Ratings

3.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

Item	Symbol	Min	Max	Unit	Remark
Logic Supply Voltage	IOVCC	-0.3	4.6	V	
Analog Supply Voltage	VCC	-0.3	4.6	V	
Input Signal Voltage	RESET,CS,RS,WR,RD D0~D17,IM0,IM3	-0.3	IOVCC +0.5	V	
Back Light Forward Current	Vtp	-	7.0	V	
Operating Temperature	I_{LED}	-	25	mA	For each LED
Storage Temperature	T_{OPR}	-20	70	℃	

4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25℃

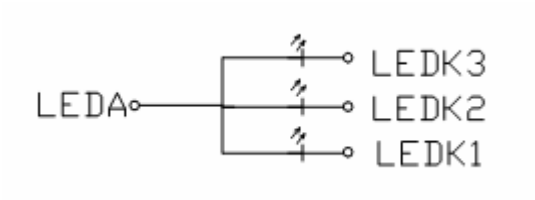
Item		Symbol	Min	Typ	Max	Unit	Remark
Logic Supply Voltage		IOVCC	1.65	1.8/2.8	3.3	V	
Analog Supply Voltage		VCC	2.3	2.8	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0	--	0.2xIOVCC	V	RESET,CS,RS,WR,RD D0~D17,IM0,IM3
	High Level	V_{IH}	0.8xIOVCC	--	IOVCC	V	
Output Signal Voltage	Low Level	V_{OL}	0	--	0.2xIOVCC	V	LCD_ID
	High Level	V_{OH}	0.8xIOVCC	--	IOVCC	V	
(Panel+ LSI) Power Consumption		Black Mode	--	TBD	--	mW	Frame Rate:60Hz
		Standby Mode	--	TBD	--	μW	
		Sleeping Mode	--	TBD	--	μW	

4.2 Driving Backlight

Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	--	20	--	mA	For each LED
Forward Voltage	V_F	--	3.2	--	V	
Power Consumption	W_{BL}	--	192	--	mW	
Operating Life Time	--	10000	(20000)	--	Hrs	

Note 1: The figure below shows the connection of backlight LED.



Note 2: One LED: I_F =20mA, V_F =3.2V.

Note 3:

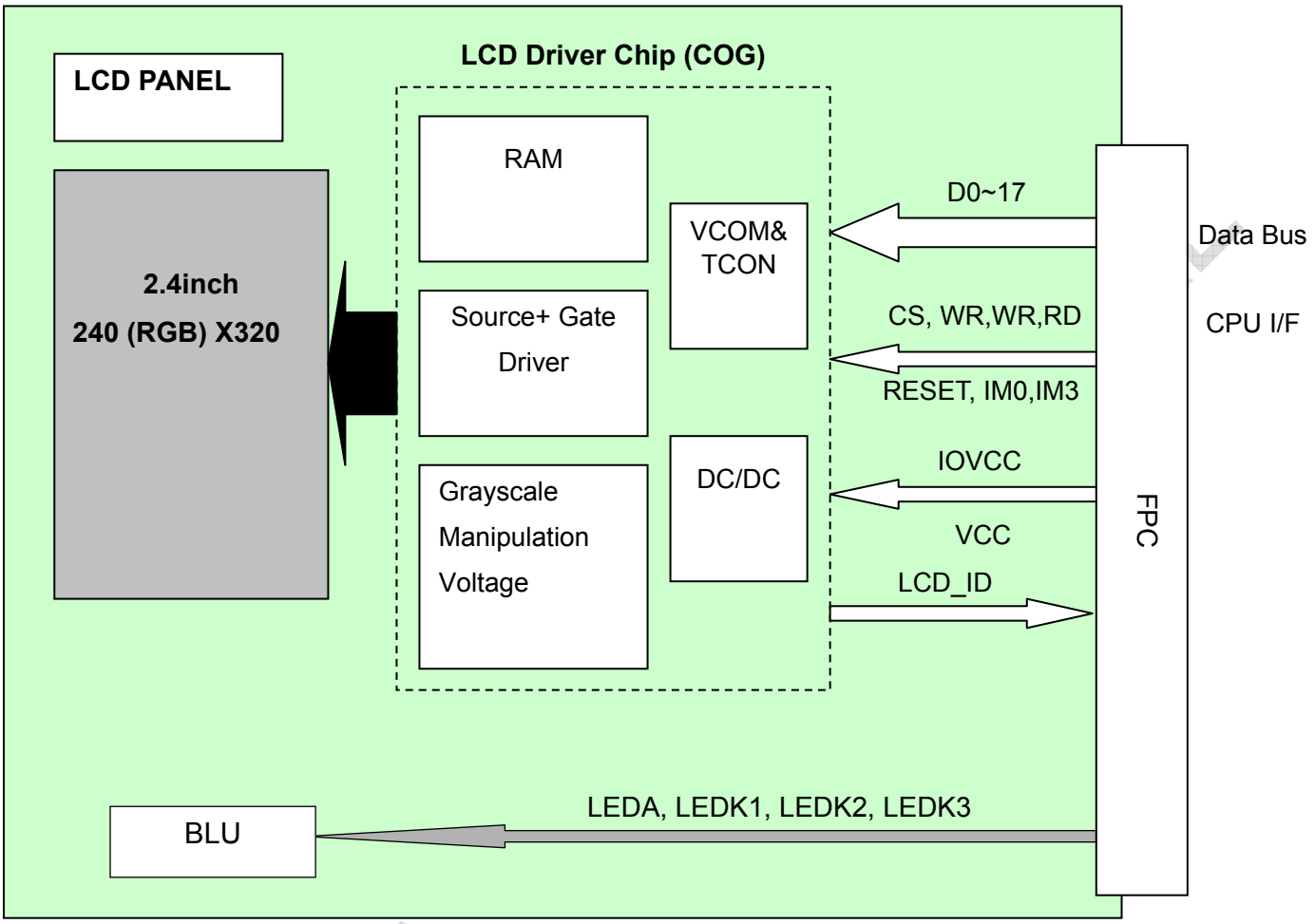
I_F is defined for one channel LED.

Optical performance should be evaluated at Ta=25℃ only.

If LED is driven by 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.

4.3 Block Diagram



5 Timing Chart

5.1 Timing Parameter

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

Signal	Symbol	Parameter	Spec.			Unit	Description
			Min.	Typ	Max.		
RS	tAST	Address setup time	10	-	-	ns	-
	tAHT	Address hold time (Write/Read)	10	-	-		
CS	tCHW	Chip select "H" pulse width	0	-	-	ns	-
	tCS	Chip select setup time (Write)	15	-	-		
	tRCS	Chip select setup time (Read ID)	45	-	-		
	tRCSFM	Chip select setup time (Read FM)	355	-	-		
	tCSF	Chip select wait time (Write/Read)	10	-	-		
	tCSH	Chip select hold time	10	-	-		
WR	tWC	Write cycle	66	-	-	ns	-
	tWRH	Control pulse "H" duration	15	-	-		
	tWRL	Control pulse "L" duration	15	-	-		
RD	tRC	Read cycle (ID)	160	-	-	ns	When read ID data
	tRDH	Control pulse "H" duration (ID)	90	-	-		
	tRDL	Control pulse "L" duration (ID)	45	-	-		
RD(FM)	tRCFM	Read cycle (FM)	450	-	-	ns	When read from frame memory
	tRDHFM	Control pulse "H" duration (FM)	90	-	-		
	tRDLFM	Control pulse "L" duration (FM)	355	-	-		
D[17:0]	tDST	Data setup time	10	-	-	ns	For maximum CL=30pF For minimum CL=8pF
	tDHT	Data hold time	10	-	-		
	tRAT	Read access time (ID)	-	-	100		
	tRATFM	Read access time (FM)	-	-	340		
	tODH	Output disable time	20		80		

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.

Table 5.1 Timing Parameter

Refer to the HX-8347G datasheet(HX8347-G_DS_T_preliminary_v01) for more details.

5.2 Register Write/Read timing (for CPU 8 Bit)

a. Write to register

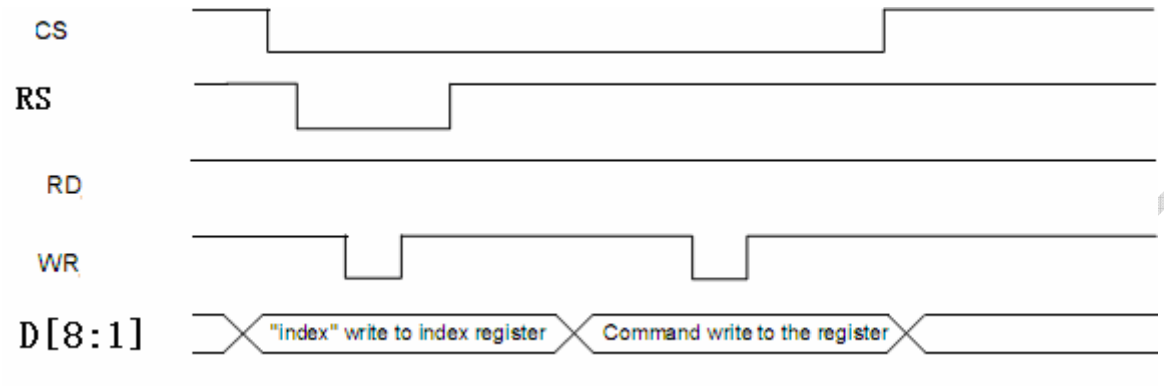


Figure 5.1 Register write timing in parallel bus system interface (for I80 series MPU)

b. Read from register

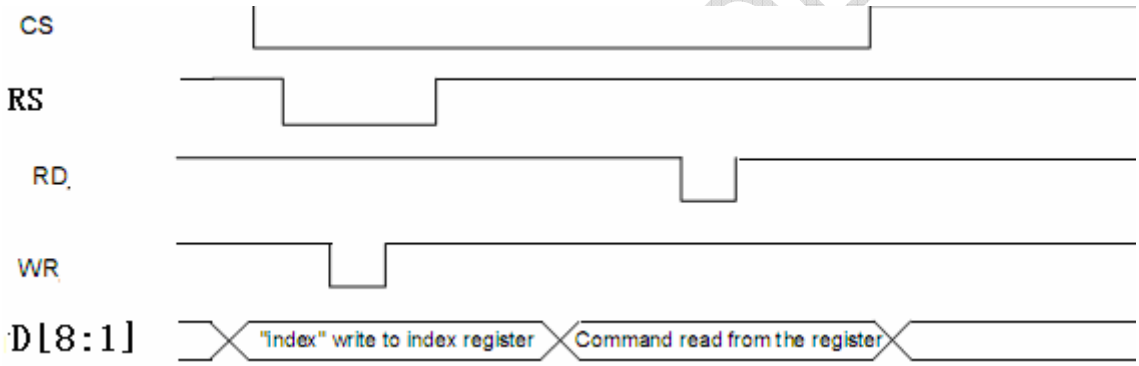


Figure 5.2 Register read timing in parallel bus system interface (for I80 series MPU)

5.3 GRAM write timing in i80 8/16bit system

Register Command	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
	x	x	x	x	x	x	x	x	x	x	0	0	1	0	0	0	1	0	22H
17H	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Color
03h	x	x	x	x	x	x	x	x	x	x	R3	R2	R1	R0	G3	G2	G1	G0	4K-Color (2-pixels/ 3-bytes)
	x	x	x	x	x	x	x	x	x	x	B3	B2	B1	B0	R3	R2	R1	R0	
	x	x	x	x	x	x	x	x	x	x	G3	G2	G1	G0	B3	B2	B1	B0	
05h	x	x	x	x	x	x	x	x	x	x	R4	R3	R2	R1	R0	G5	G4	G3	65K-Color (1-pixel/ 2-bytes)
	x	x	x	x	x	x	x	x	x	x	G2	G1	G0	B4	B3	B2	B1	B0	
06h	x	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	x	x	262K-Color (1-pixel/ 3bytes)
	x	x	x	x	x	x	x	x	x	x	G5	G4	G3	G2	G1	G0	x	x	
	x	x	x	x	x	x	x	x	x	x	B5	B4	B3	B2	B1	B0	x	x	

Table 5.2 8 bit parallel interface GRAM write table

Register Command	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Command
	x	x	x	x	x	x	x	x	x	x	0	0	1	0	0	0	1	0	22H
17H	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Color
03h							R3	R2	R1	R0	G3	G2	G1	G0	B3	B2	B1	B0	4K-Color
05h	x	x	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	65K-Color
06h	x	x	R5	R4	R3	R2	R1	R0	x	x	G5	G4	G3	G2	G1	G0	x	x	262K-Color (2-pixels/ 3bytes)
	x	x	B5	B4	B3	B2	B1	B0	x	x	R5	R4	R3	R2	R1	R0	x	x	
	x	x	G5	G4	G3	G2	G1	G0	x	x	B5	B4	B3	B2	B1	B0	x	x	
07h	x	x	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	262K-Color (16+2)
	x	x	x	x	x	x	x	x	x	x	x	x	x	x	X	x	B1	B0	

Table 5.3 16 bit parallel interface GRAM write table

Register Command	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Register
	x	x	x	x	x	x	x	x	x	x	0	0	1	0	0	0	1	0	22H
17H	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Color
06h	x	x	x	x	x	x	x	x	x	R5	R4	R3	R2	R1	R0	G5	G4	G3	262K-Color (1-pixels/ 2bytes)
	x	x	x	x	x	x	x	x	x	G2	G1	G0	B5	B4	B3	B2	B1	B0	

Table 5.4 9 bit parallel interface GRAM write table

Register Command	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Register
	x	x	x	x	x	x	x	x	x	x	0	0	1	0	0	0	1	0	22H
17H	DB17	DB16	DB15	DB14	DB13	DB12	DB11	DB10	DB9	DB8	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Color
06h	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0	262K-Color

Table 5.5 18 bit parallel interface GRAM write table

a. Write to GRAM

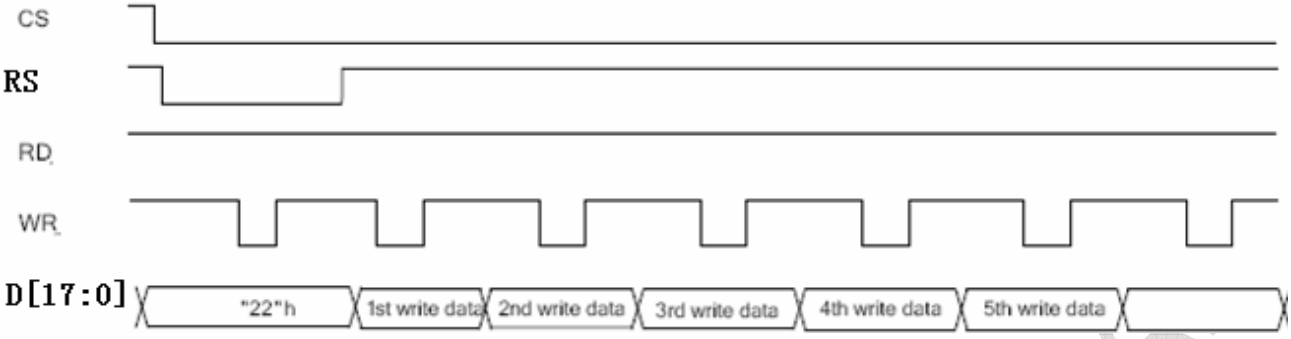


Figure 5.3 GRAM write timing in parallel bus system interface

b. Read from GRAM

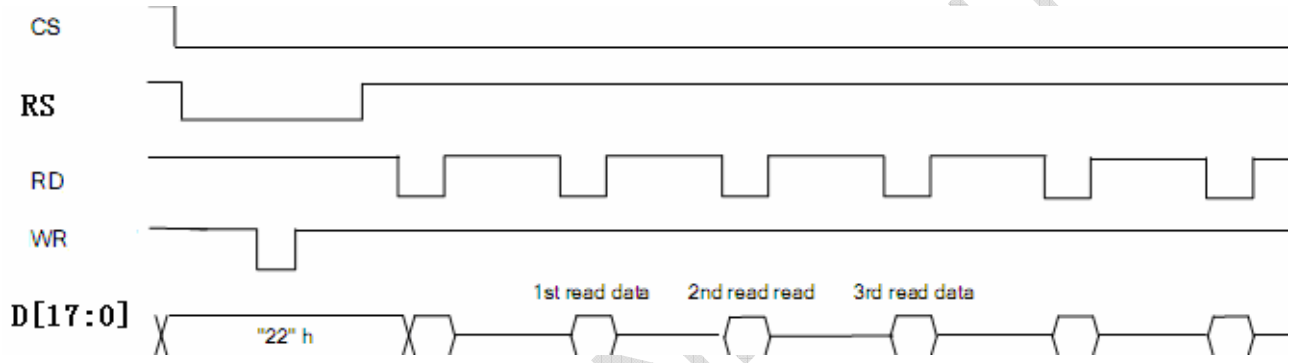


Figure 5.4 GRAM read timing in parallel bus system interface

5.4 Reset Timing Characteristics

Item	Symbol	Unit	Min	Typ	Max
RESET low pulse width	t_{RESW}	μs	10		
Reset complete time(STB out mode)	t_{rREST}	ms	5		
Reset complete time(STB mode)	t_{RES}	ms	120		
Reset goes high lever after power on time	t_{RES}	ms	1		

Table 5.4 RESET Timing Parameter

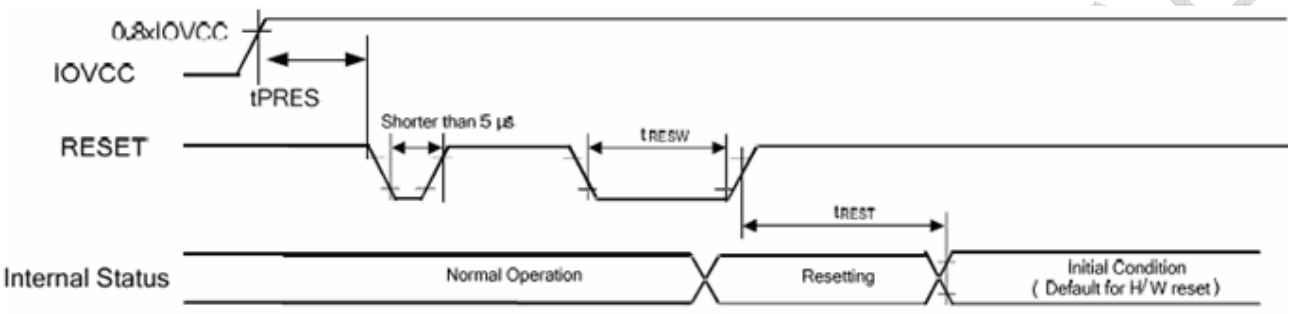
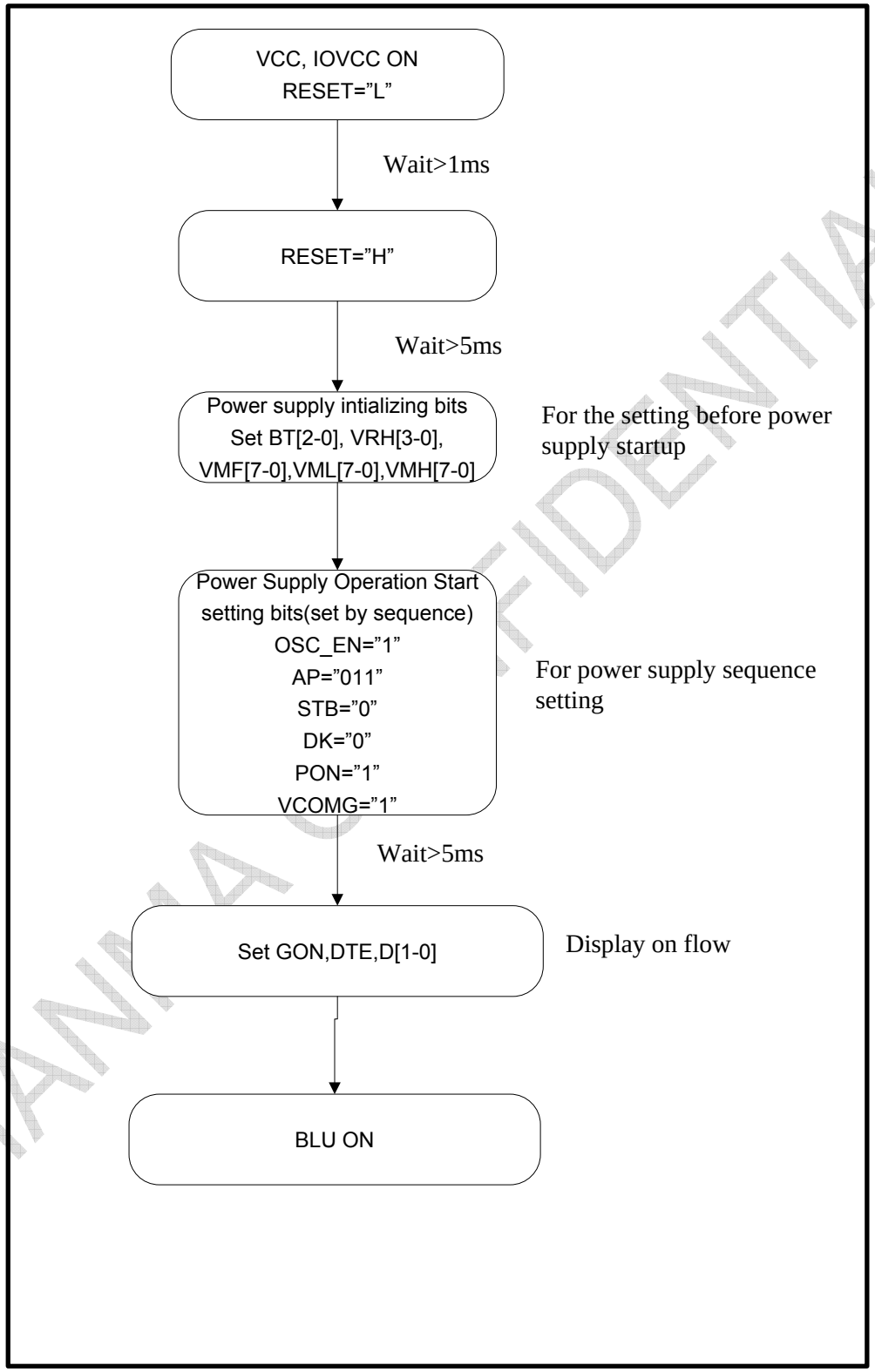


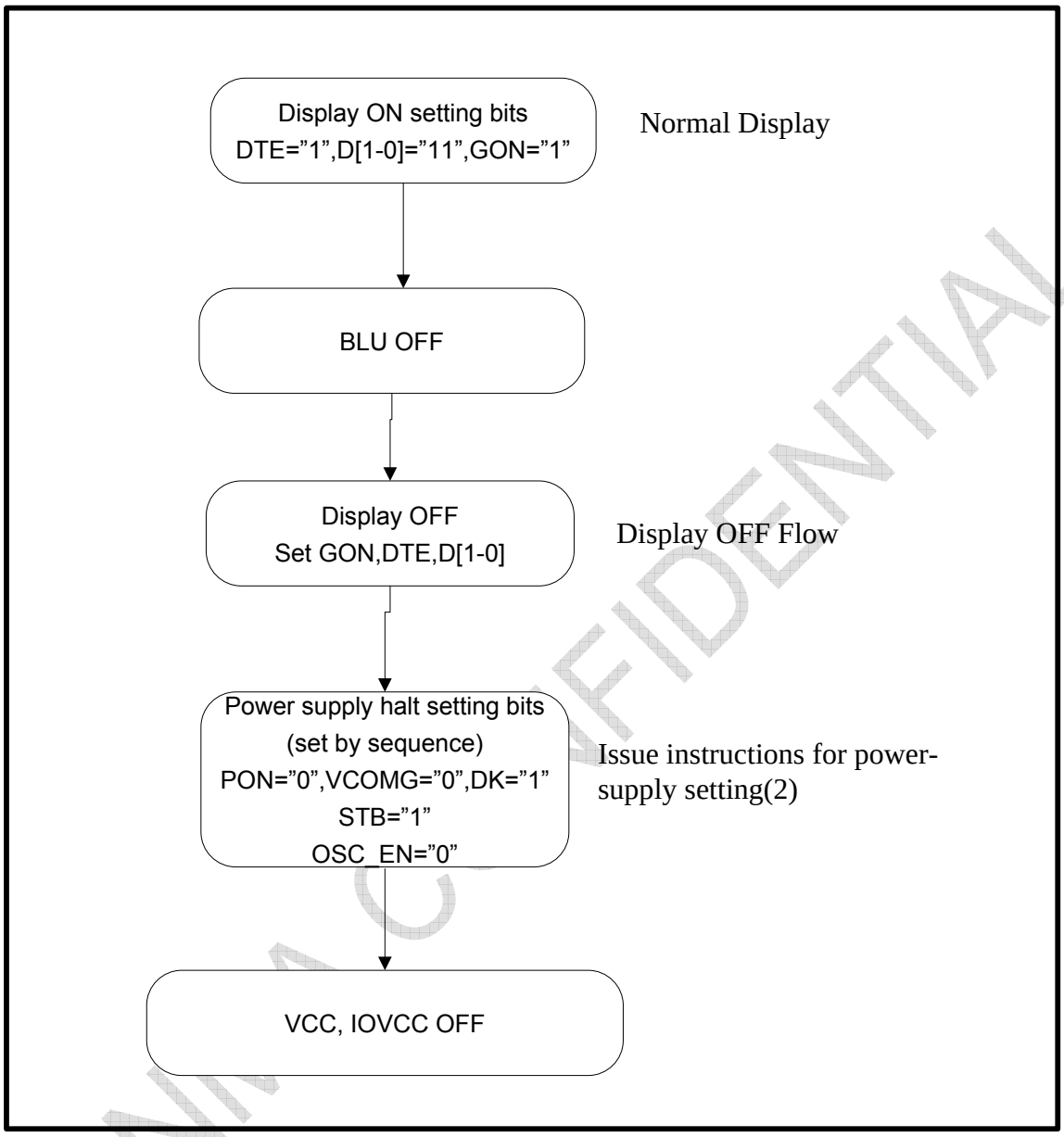
Figure 5.4 RESET Timing

5.5 Power ON/OFF Sequence

5.5.1 Power ON Sequence



5.5.2 Power OFF Sequence



6 Optical Characteristics Optical Specification

Ta=25℃

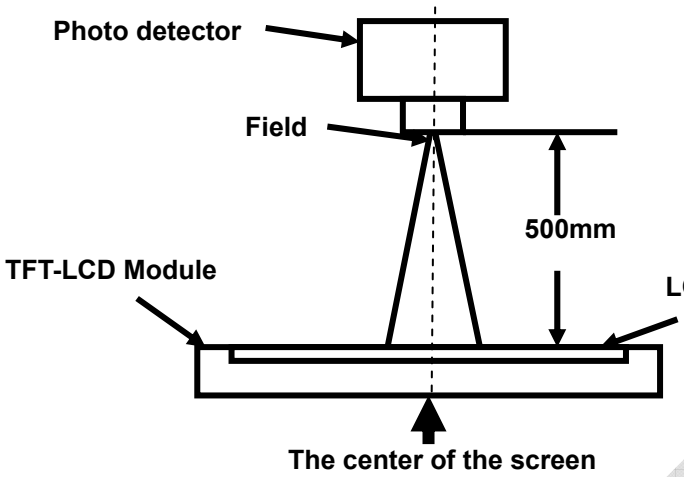
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angle		θT	CR≥10	40	50	-	Degree	Note 2
		θB		40	20	-		
		θL		15	45	-		
		θR		35	45	-		
Contrast Ratio		CR	θ=0°	300	350	-		Note1 Note3
Response Time		T_{ON}	25℃	-	20	30	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.235	0.285	0.335		Note1 Note5
		y		0.255	0.305	0.355		
	Red	x		0.540	0.590	0.640		
		y		0.280	0.330	0.380		
	Green	x		0.280	0.330	0.380		
		y		0.530	0.580	0.630		
	Blue	x		0.110	0.150	0.200		
		y		0.050	0.100	0.150		
Uniformity (%)		U		--	80	--		Note1 Note6
NTSC (%)				--	50	--		Note5
Luminance		L		200	225	--		Note1 Note7

Test Conditions:

1. V_F =3.2V ,I_F =20mA(LED current), the ambient temperature is 25℃.
2. The test systems refer to Note1 and Note2.

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)。

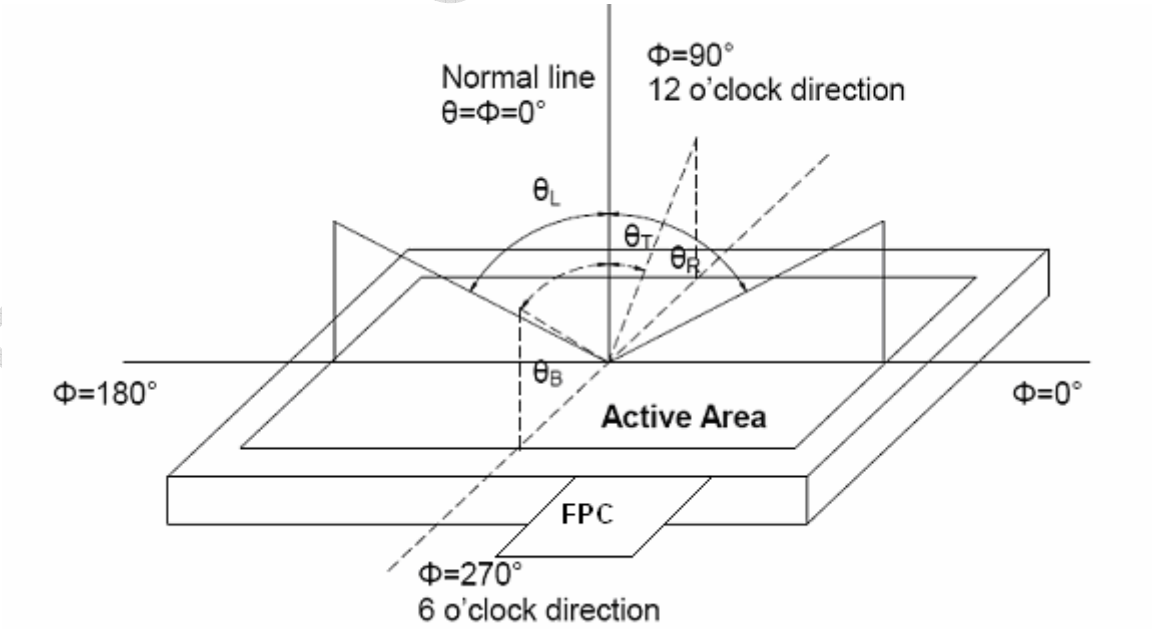


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

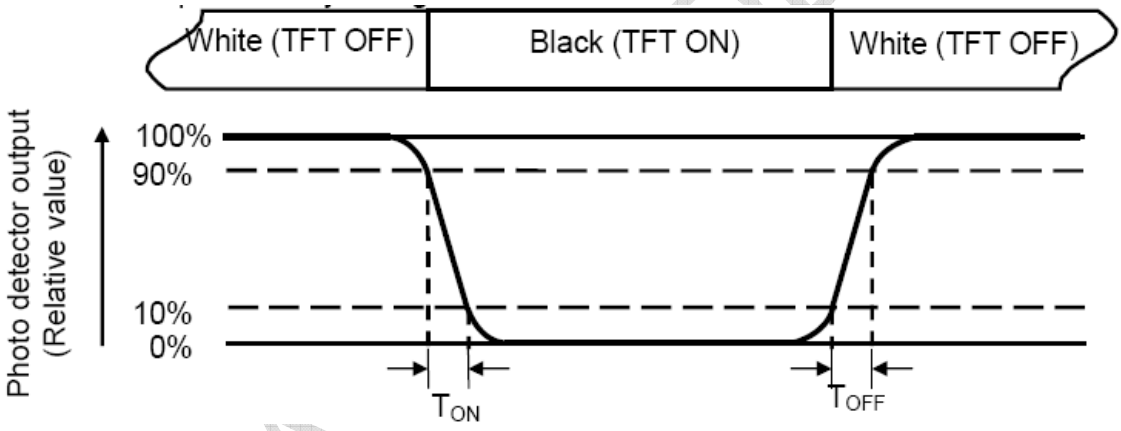
“White state “:The state is that the LCD should driven by Vwhite.

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

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.

Luminance Uniformity(U) = Lmin/ Lmax

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

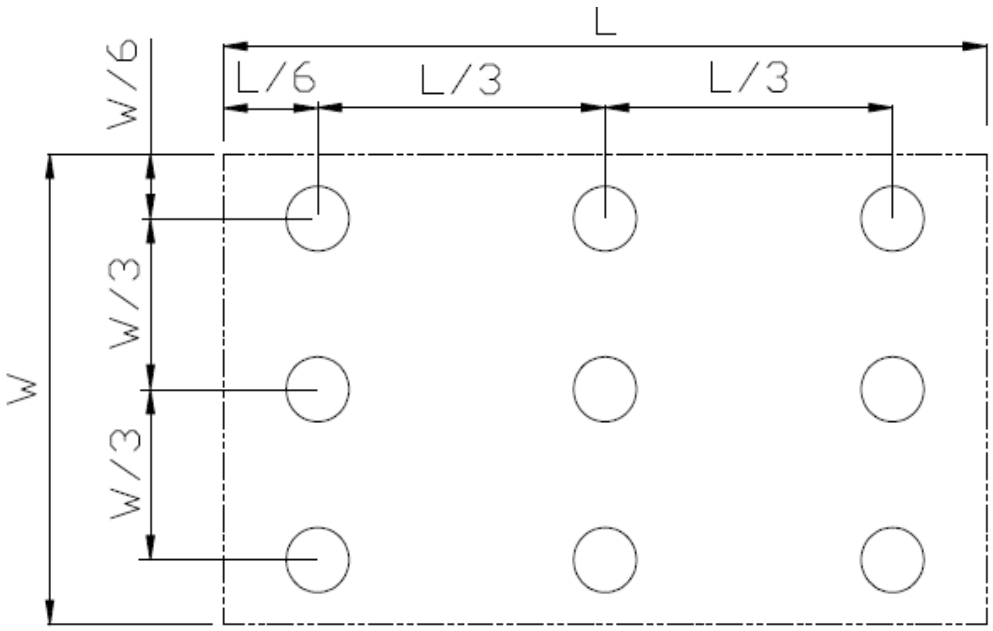


Fig. 2 Definition of uniformity

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.

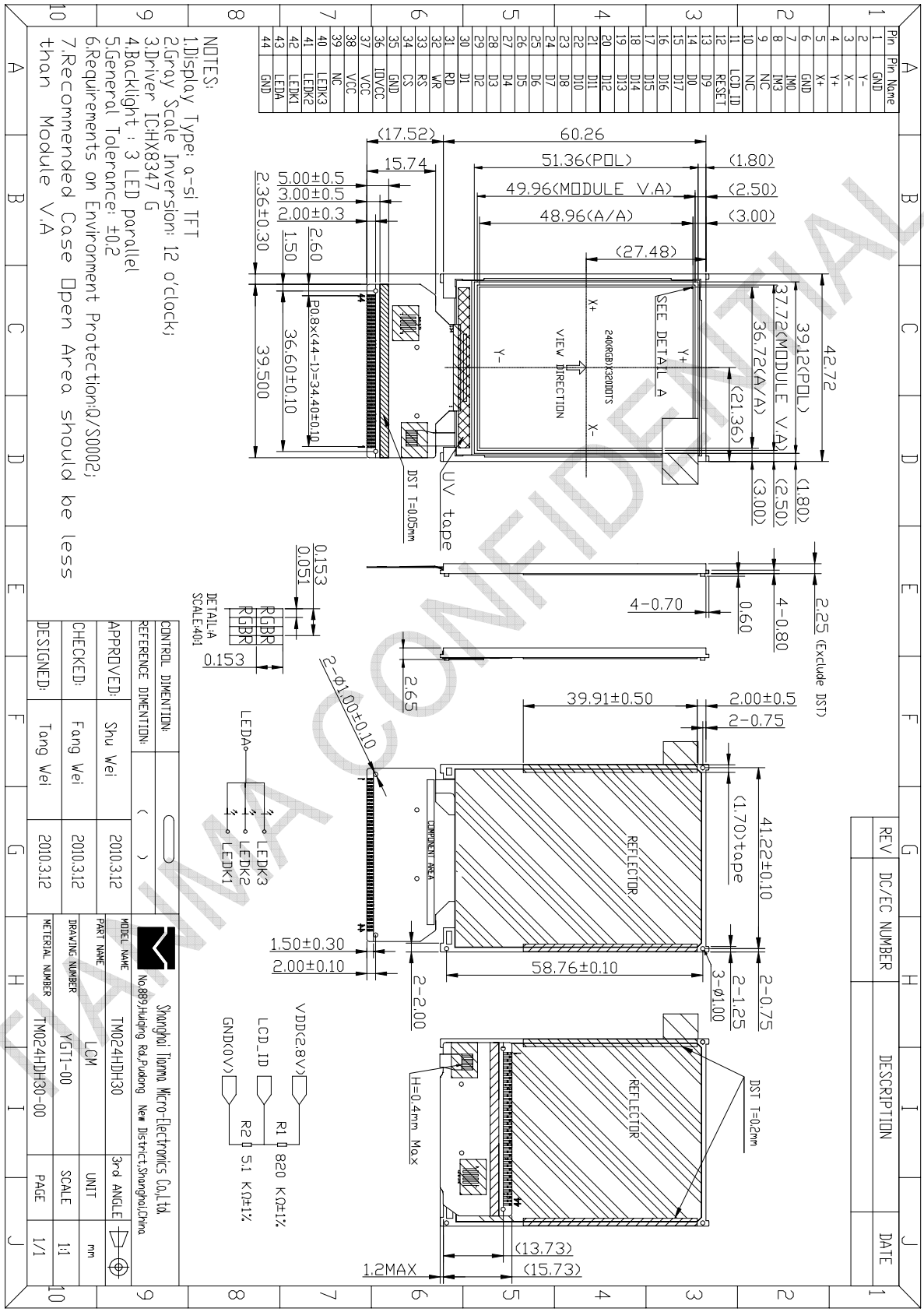
7 Environmental / Reliability Test

No	Test Item	Condition	Remark
1	High Temperature Operation	Ts=+70℃, 240hrs	Note1 IEC60068-2-1,GB2423.2
2	Low Temperature Operation	Ta=-20℃, 240hrs	IEC60068-2-1 GB2423.1
3	High Temperature Storage	Ta=+80℃, 240hrs	IEC60068-2-1 GB2423.2
4	Low Temperature Storage	Ta=-30℃, 240hrs	IEC60068-2-1 GB2423.1
5	High Temperature & High Humidity Storage	Ta=+60℃, 90% RH 240 hours	Note2 IEC60068-2-78 GB/T2423.3
6	Thermal Shock (Non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14,GB2423.22
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 GB/T17626.2
8	Vibration (Non-operation)	Frequency range:10~55Hz, Stroke:1.5mm Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z. (6 hours for total)(Package condition)	IEC60068-2-6 GB/T2423.10
9	Shock (Non-operation)	60G 6ms, ±X,±Y,±Z 3times, for each direction	IEC60068-2-27 GB/T2423.5
10	Package Drop Test	Height:80 cm,1 corner, 3 edges, 6 surfaces	IEC60068-2-32 GB/T2423.8
11	Package Vibration Test	Random Vibration: 0.015GxG/Hz for 5-200Hz, -6dB/Octave from 200-500Hz 2 hours for each direction of X,Y,Z (6 hours for total)	IEC60068-2-34 GB/T2423.11

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

Note2: Ta is the ambient temperature of sample.

8 Mechanical Drawing



9 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM024HDH30	42.72x60.26x2.25	TBD	TBD	
2	Tray	PET(Transmit)	TBD	TBD	TBD	
3	EPE	EPE	TBD	TBD	TBD	
4	Desiccant	Desiccant	TBD	TBD	TBD	
5	Anti-static bag	PE	TBD	TBD	TBD	
6	BOX	Corrugated paper	TBD	TBD	TBD	
7	Carton	Corrugated paper	TBD	TBD	TBD	
8	Total Weight(Kg)	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:

10.2.3 Temperature: 0℃~40℃ Relatively humidity: ≤80%

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

10.3 Transportation Precautions:

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