MODEL NO. : TM022HDH20

ISSUED DATE: 2010-05-07

VERSION : Ver 1.1

■**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	2010-04-23	Preliminary release.	Qiuping Yang
1.1	2010-05-07	Update mechanical drawing on page 26.	Qiuping Yang

1 General Specifications

Feature		Spec
Display Spec	Size	2.2 inch
	Resolution	240(RGB) x 320
	Interface	CPU 8/16 bit
	Color Depth	262K
	Technology Type	a-Si
	Pixel Pitch (mm)	0.141 x 0.141
	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)	40.10×55.20×2.35
	Active Area(mm)	33.84×45.12
	With /Without TSP	Without TSP
	Weight (g)	TBD
	LED Numbers	4 LEDs
Electronic	Driver IC	ILI9340

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	DB0	I	Data bus	
2	DB1	I	Data bus	
3	DB2	I	Data bus	
4	DB3	I	Data bus	
5	GND	P	Power Ground	
6	VCC	P	Power Supply	
7	/CS	I	Chip select	
8	RS	I	Register select	
9	/WR	I	Write strobe	
10	/RD	I	Read strobe	
11	IM0	I	Mode select	
12	NC(XR)	-	No connection	
13	NC(YU)	-	No connection	
14	NC(XL)	-	No connection	
15	NC(YD)	-	No connection	
16	LED-A	P	LED anode	
17	LED-K1	P	LED cathode	
18	LED-K2	P	LED cathode	
19	LED-K3	P	LED cathode	
20	LED-K4	P	LED cathode	
21	NC	-	No connection	
22	DB4	I	Data bus	
23	DB8	I	Data bus	
24	DB9	I	Data bus	
25	DB10	I	Data bus	
26	DB11	I	Data bus	
27	DB12	I	Data bus	
28	DB13	I	Data bus	
29	DB14	I	Data bus	
30	DB15	I	Data bus	
31	/RESET	I	Reset	
32	VCI	P	Power Supply	
33	VCC	P	Power Supply	
34	GND	P	Power Ground	
35	DB5	I	Data bus	
36	DB6	I	Data bus	
37	DB7	I	Data bus	

Note1: I/O definition: I-----Input; O---Output; P----Power/Ground.

IM0	Interface	DB pin	Remark
0	i80-parallel 16bit interface	DB[15~0]	
1	i80-parallel 8bit interface	DB[15~8]	D0~D7 If not use, fix to GND

3 Absolute Maximum Ratings

3.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

Item	Symbol	Min	Max	Unit	Remark
Analog Supply Voltage	VCI	-0.3	4.6	V	
Logic Supply Voltage	VCC	-0.3	4.6	V	
Input Signal Voltage	/CS,/WR,/RD,RS,/RESET IM0,DB[0:15]	-0.3	VCC+0.3	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℃

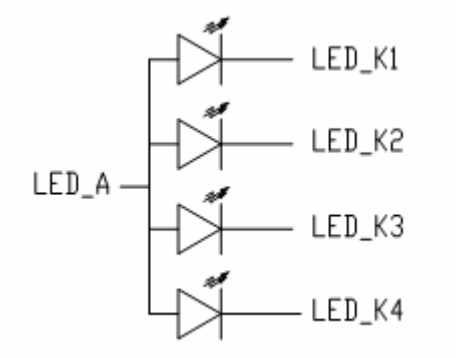
Item		Symbol	Min	Typ	Max	Unit	Remark
Analog Supply Voltage		VCI	2.5	2.8	3.3	V	
Logic Supply Voltage		VCC	1.65	1.8/2.8	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0	--	0.2xVCC	V	/CS,/WR,/RD,RS,/RESET IM0,DB[0:15]
	High Level	V_{IH}	0.8xVCC	--	VCC	V	
Output Signal Voltage	Low Level	V_{OL}	0	--	0.2xVCC	V	
	High Level	V_{OH}	0.8xVCC	--	VCC	V	
(Panel+ LSI) Power Consumption		Black Mode	--	TBD	--	mW	Frame Rate:60Hz
		8 color Mode	--	TBD	--	μW	
		Sleeping Mode	--	TBD	--	μW	

4.2 Driving Backlight

Ta=25℃

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	--	18	--	mA	For each LED
Forward Voltage	V_F	--	3.2	--	V	
Power Consumption	W_{BL}	--	230.4	--	mW	
Operating Life Time	--	10000	(20000)	--	Hrs	

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



Note 2: One LED: I_F =18mA, V_F =3.2V.

Note 3:

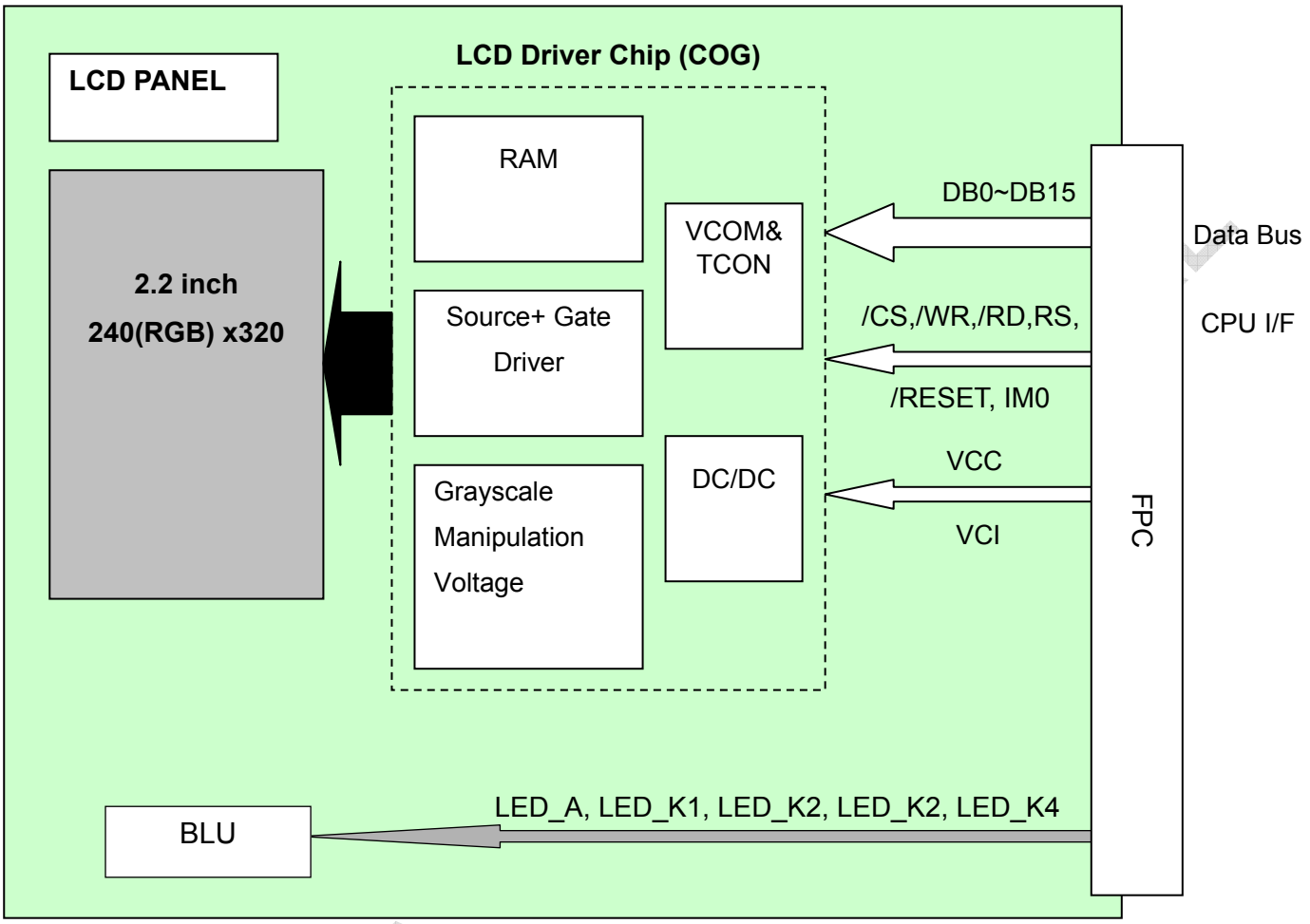
I_F is defined for one channel LED.

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

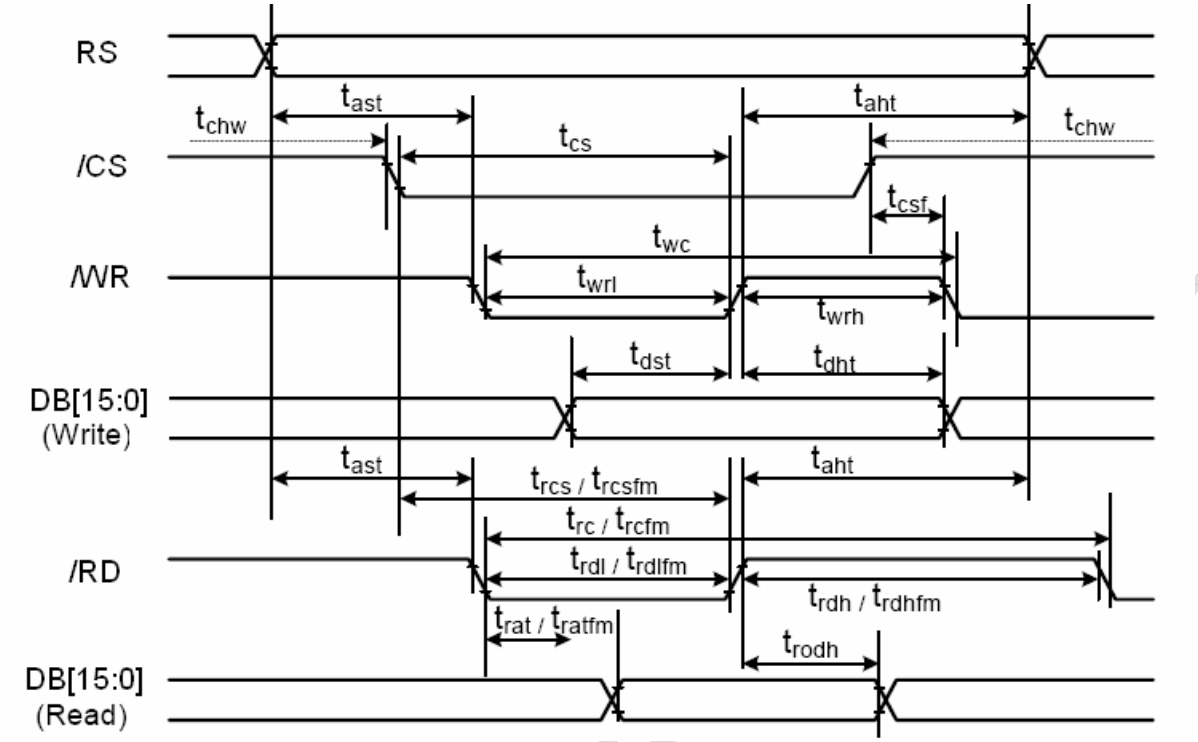
5.1 Timing Parameter

Normal Write Mode

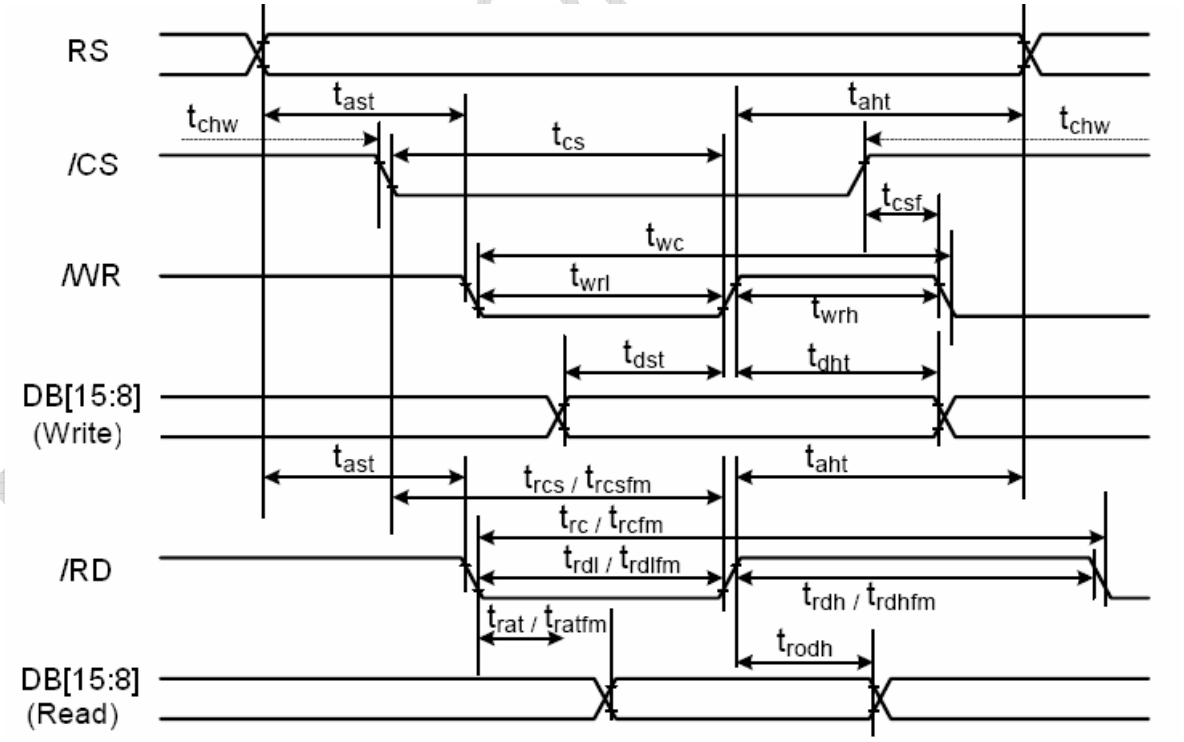
Signal	Symbol	Parameter	min	max	Unit	Description
RS	tast	Address setup time	0	-	ns	
	taht	Address hold time (Write/Read)	10	-	ns	
/CS	tchw	CSX "H" pulse width	0	-	ns	
	tcs	Chip Select setup time (Write)	15	-	ns	
	trcs	Chip Select setup time (Read ID)	45	-	ns	
	trcsfm	Chip Select setup time (Read FM)	355	-	ns	
	tcsf	Chip Select Wait time (Write/Read)	10	-	ns	
/WR	twc	Write cycle	66	-	ns	
	twrh	Write Control pulse H duration	15	-	ns	
	twrl	Write Control pulse L duration	15	-	ns	
/RD(FM)	trcfm	Read Cycle (FM)	450	-	ns	
	trdhfm	Read Control H duration (FM)	90	-	ns	
	trdlfm	Read Control L duration (FM)	355	-	ns	
/RD(ID)	trc	Read cycle (ID)	160	-	ns	
	trdh	Read Control pulse H duration	90	-	ns	
	trdl	Read Control pulse L duration	45	-	ns	
DB[17:0] DB[15:0] DB[8:0] DB[7:0]	tdst	Write data setup time	10	-	ns	For maximum CL=30pF For minimum CL=8pF
	tdht	Write data hold time	10	-	ns	
	trat	Read access time	-	40	ns	
	tratfm	Read access time	-	340	ns	
	trod	Read output disable time	20	80	ns	

Table 5.1 Timing Parameter

I80-parallel 16bit register write/read timing



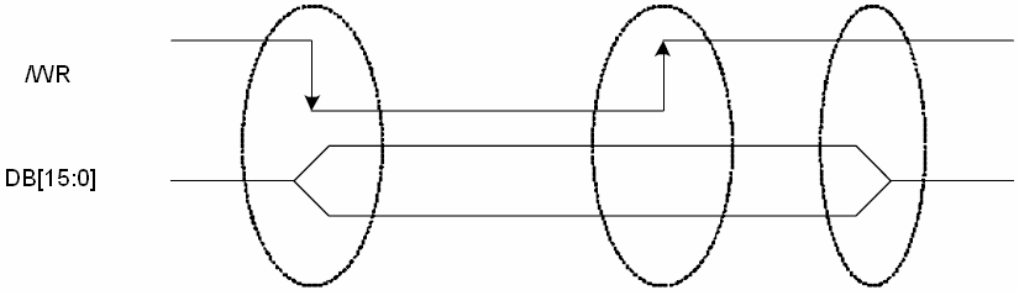
I80-parallel 8bit register write/read timing



5.2 Register write/read timing

5.2.1 Register Write Timing

5.2.1.1 16-bit System Bus Interface Register Write Timing



Note: /WR is an unsynchronized signal (It can be stopped)

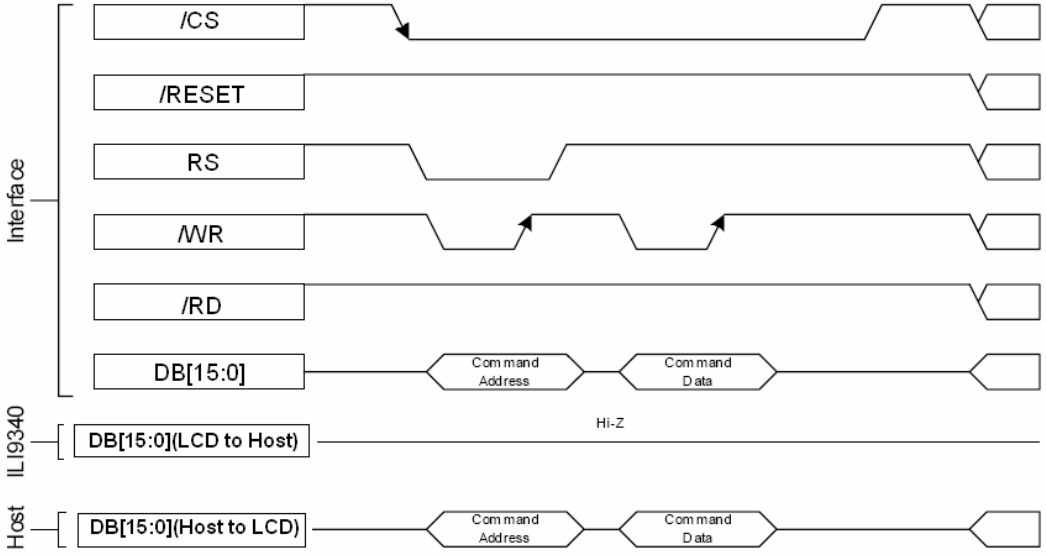
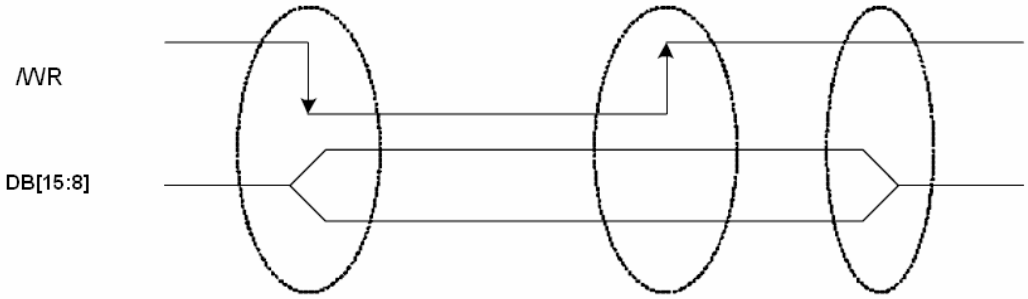


Figure 5.2.1.1 16-bit System Bus Interface Timing(Register Write Timing)

5.2.1.2 8-bit System Bus Interface Register Write Timing



Note: /WR is an unsynchronized signal (It can be stopped)

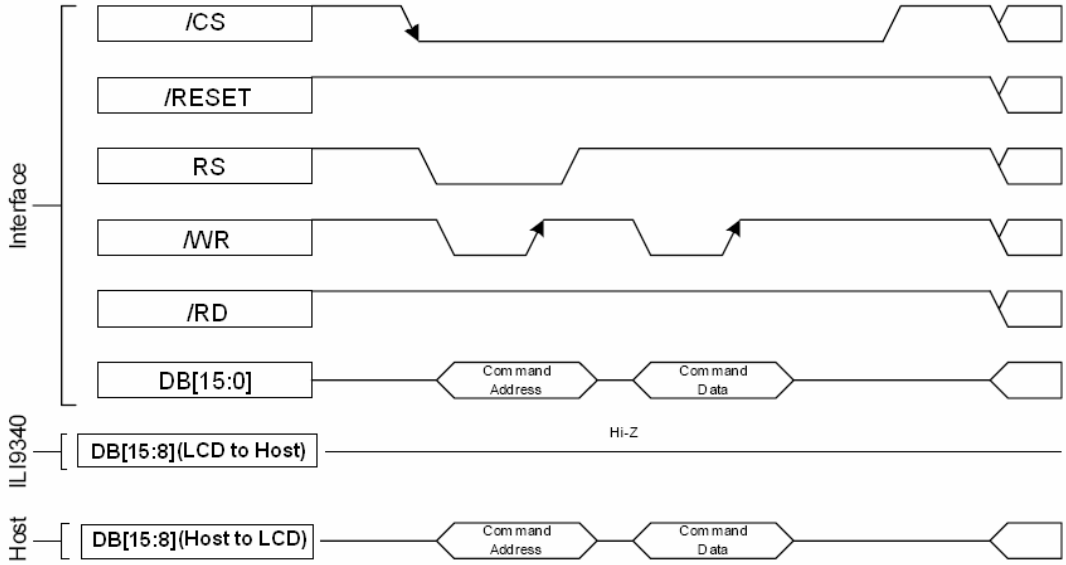
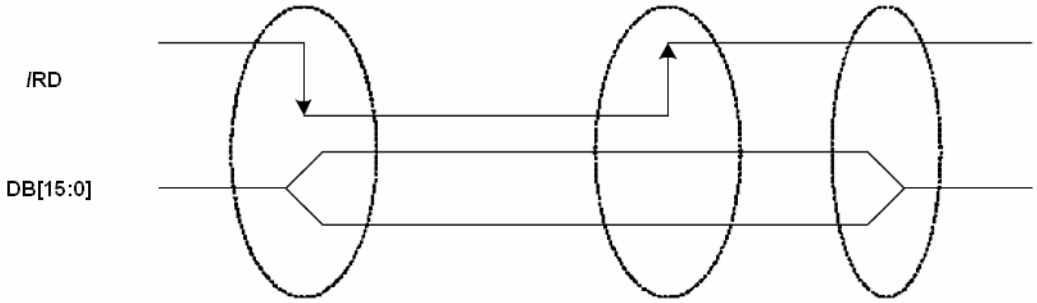


Figure 5.2.1.2 8-bit System Bus Interface Timing(Register Write Timing)

5.2.2 Register read Timing

5.2.2.1 16-bit System Bus Interface Register read Timing



Note: /WR is an unsynchronized signal (It can be stopped).

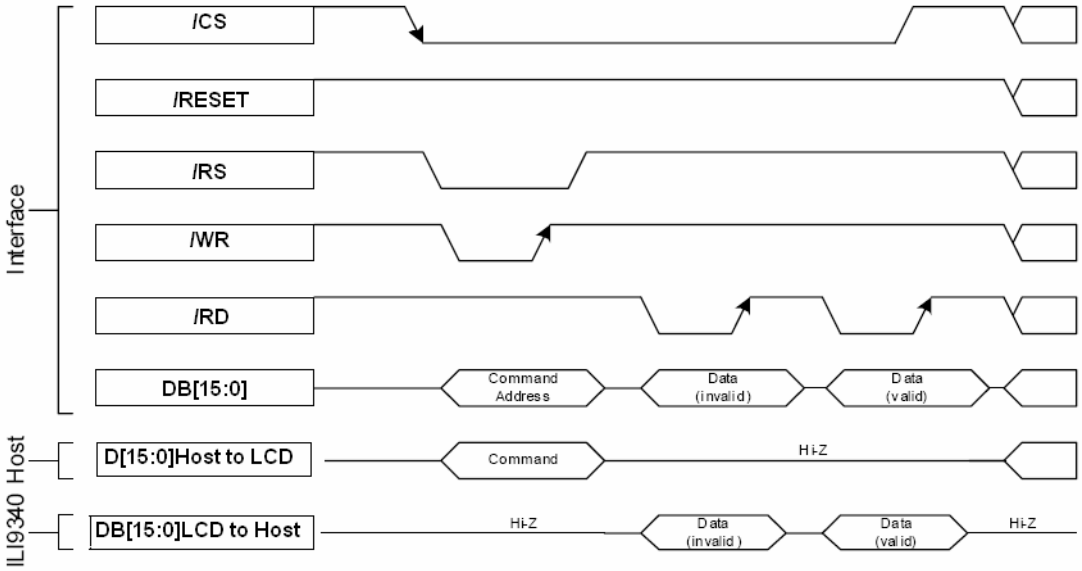
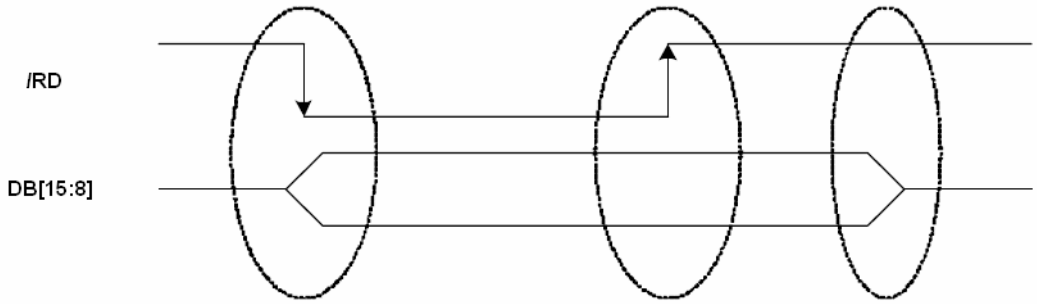


Figure 5.2.2.1 16-bit System Bus Interface Timing(Register Read Timing)

5.2.2.2 8-bit System Bus Interface Register read Timing



Note: /WR is an unsynchronized signal (It can be stopped).

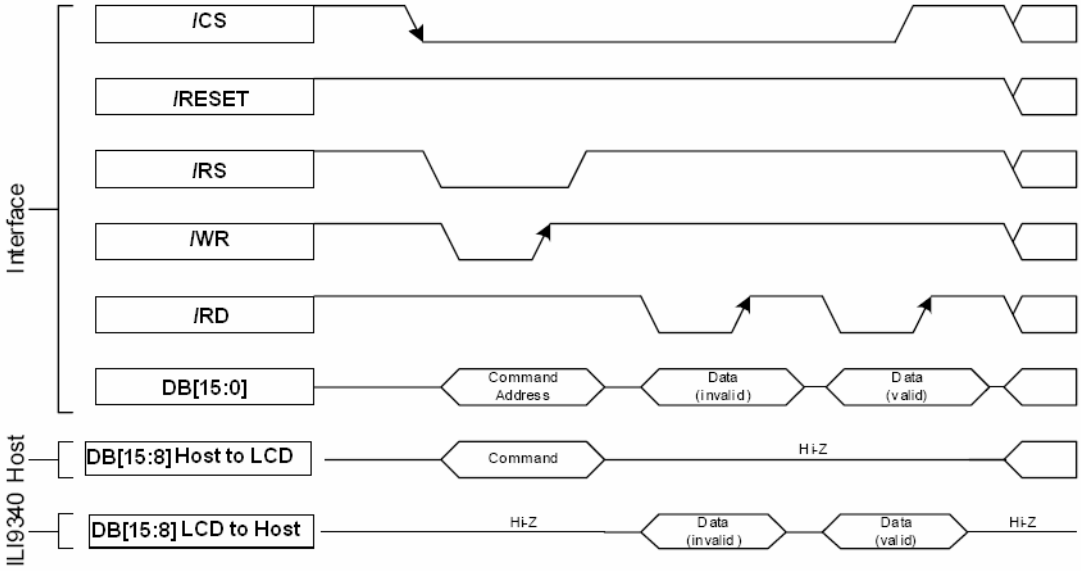


Figure 5.2.2.2 8-bit System Bus Interface Timing(Register Read Timing)

5.3 GRAM write/read timing

5.3.1 16-bit Read/Write GRAM Data format

Count	0	1	2	3	…	238	239	240
RS	0	1	1	1	…	1	1	1
D15		0R4	1R4	2R4	…	237R4	238R4	239R4
D14		0R3	1R3	2R3	…	237R3	238R3	239R3
D13		0R2	1R2	2R2	…	237R2	238R2	239R2
D12		0R1	1R1	2R1	…	237R1	238R1	239R1
D11		0R0	1R0	2R0	…	237R0	238R0	239R0
D10		0G5	1G5	2G5	…	237G5	238G5	239G5
D9		0G4	1G4	2G4	…	237G4	238G4	239G4
D8		0G3	1G3	2G3	…	237G3	238G3	239G3
D7	C7	0G2	1G2	2G2	…	237G2	238G2	239G2
D6	C6	0G1	1G1	2G1	…	237G1	238G1	239G1
D5	C5	0G0	1G0	2G0	…	237G0	238G0	239G0
D4	C4	0B4	1B4	2B4	…	237B4	238B4	239B4
D3	C3	0B3	1B3	2B3	…	237B3	238B3	239B3
D2	C2	0B2	1B2	2B2	…	237B2	238B2	239B2
D1	C1	0B1	1B1	2B1	…	237B1	238B1	239B1
D0	C0	0B0	1B0	2B0	…	237B0	238B0	239B0

Figure 5.3.1.1 16-bit Read/Write GRAM Data format(65K)

Count	0	1	2	3	…	358	359	360
RS	0	1	1	1	…	1	1	1
D15		0R5	0B5	1G5	…	238R5	238B5	239G5
D14		0R4	0B4	1G4	…	238R4	238B4	239G4
D13		0R3	0B3	1G3	…	238R3	238B3	239G3
D12		0R2	0B2	1G2	…	238R2	238B2	239G2
D11		0R1	0B1	1G1	…	238R1	238B1	239G1
D10		0R0	0B0	1G0	…	238R0	238B0	239G0
D9					…			
D8					…			
D7	C7	0G5	1R5	1B5	…	238G5	239R5	239B5
D6	C6	0G4	1R4	1B4	…	238G4	239R4	239B4
D5	C5	0G3	1R3	1B3	…	238G3	239R3	239B3
D4	C4	0G2	1R2	1B2	…	238G2	239R2	239B2
D3	C3	0G1	1R1	1B1	…	238G1	239R1	239B1
D2	C2	0G0	1R0	1B0	…	238G0	239R0	239B0
D1	C1				…			
D0	C0				…			

Figure 5.3.1.2 16-bit Read/Write GRAM Data format(262K)

5.3.2 8-bit Read/Write GRAM Data format

COUNT	0	1	2	3	4	…	477	478	479	480
RS	0	1	1	1	1	…	1	1	1	1
DB15	C7	0R4	0G2	1R4	1G2	…	238R4	238G2	239R4	239G2
DB14	C6	0R3	0G1	1R3	1G1	…	238R3	238G1	239R3	239G1
DB13	C5	0R2	0G0	1R2	1G0	…	238R2	238G0	239R2	239G0
DB12	C4	0R1	0B4	1R1	1B4	…	238R1	238B4	239R1	239B4
DB11	C3	0R0	0B3	1R0	1B3	…	238R0	238B3	239R0	239B3
DB10	C2	0G5	0B2	1G5	1B2	…	238G5	238B2	239G5	239B2
DB9	C1	0G4	0B1	1G4	1B1	…	238G4	238B1	239G4	239B1
DB8	C0	0G3	0B0	1G3	1B0	…	238G3	238B0	239G3	239B0

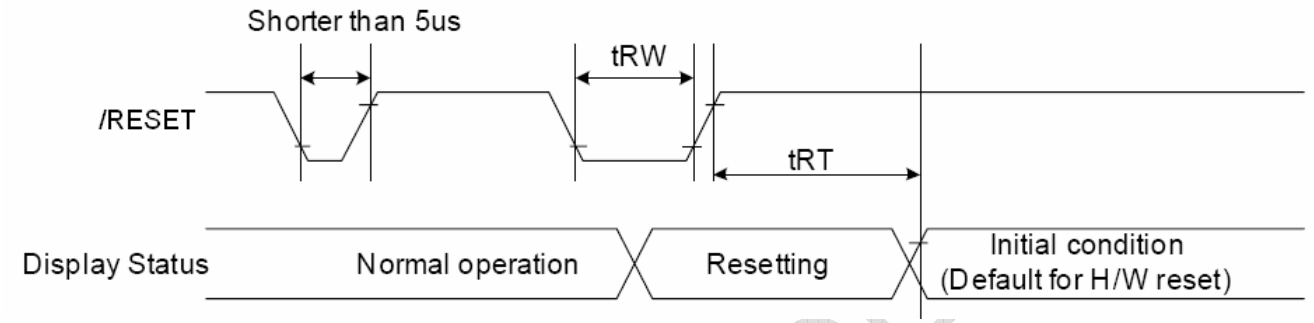
Figure 5.3.1.2 8-bit Read/Write GRAM Data format(65K)

Count	0	1	2	3	…	718	719	720
D/CX	0	1	1	1	…	1	1	1
DB15	C7	0R5	0G5	0B5	…	239R5	239G5	239B5
DB14	C6	0R4	0G4	0B4	…	239R4	239G4	239B4
DB13	C5	0R3	0G3	0B3	…	239R3	239G3	239B3
DB12	C4	0R2	0G2	0B2	…	239R2	239G2	239B2
DB11	C3	0R1	0G1	0B1	…	239R1	239G1	239B1
DB10	C2	0R0	0G0	0B0	…	239R0	239G0	239B0
DB9	C1				…			
DB8	C0				…			

Figure 5.3.1.2 8-bit Read/Write GRAM Data format(262K)

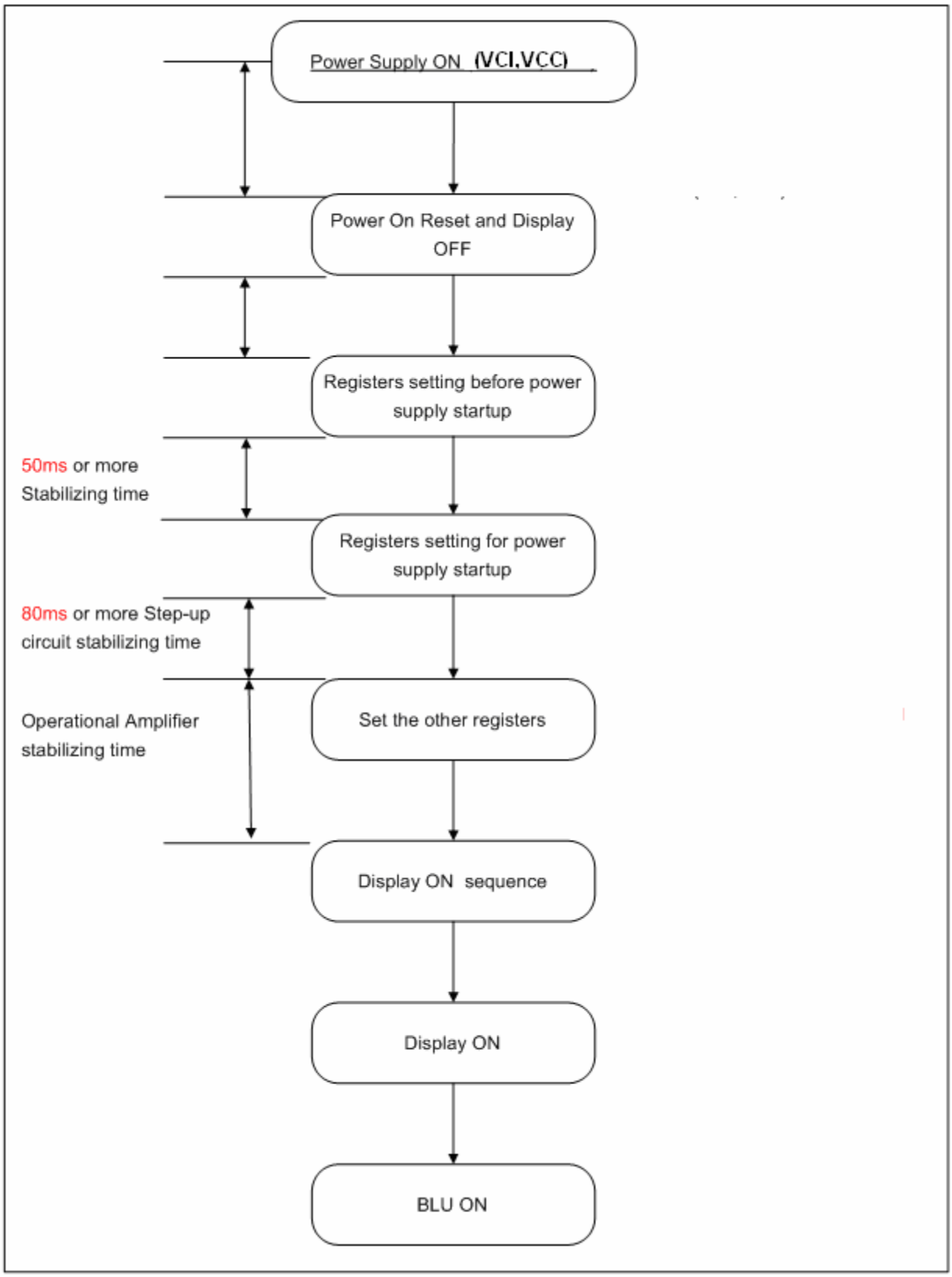
5.4 Reset Timing Characteristics

Signal	Symbol	Parameter	Min	Max	Unit
/RESET	tRW	Reset pulse duration	10		uS
	tRT	Reset cancel		5 (note 1,5)	mS
				120 (note 1,6,7)	mS

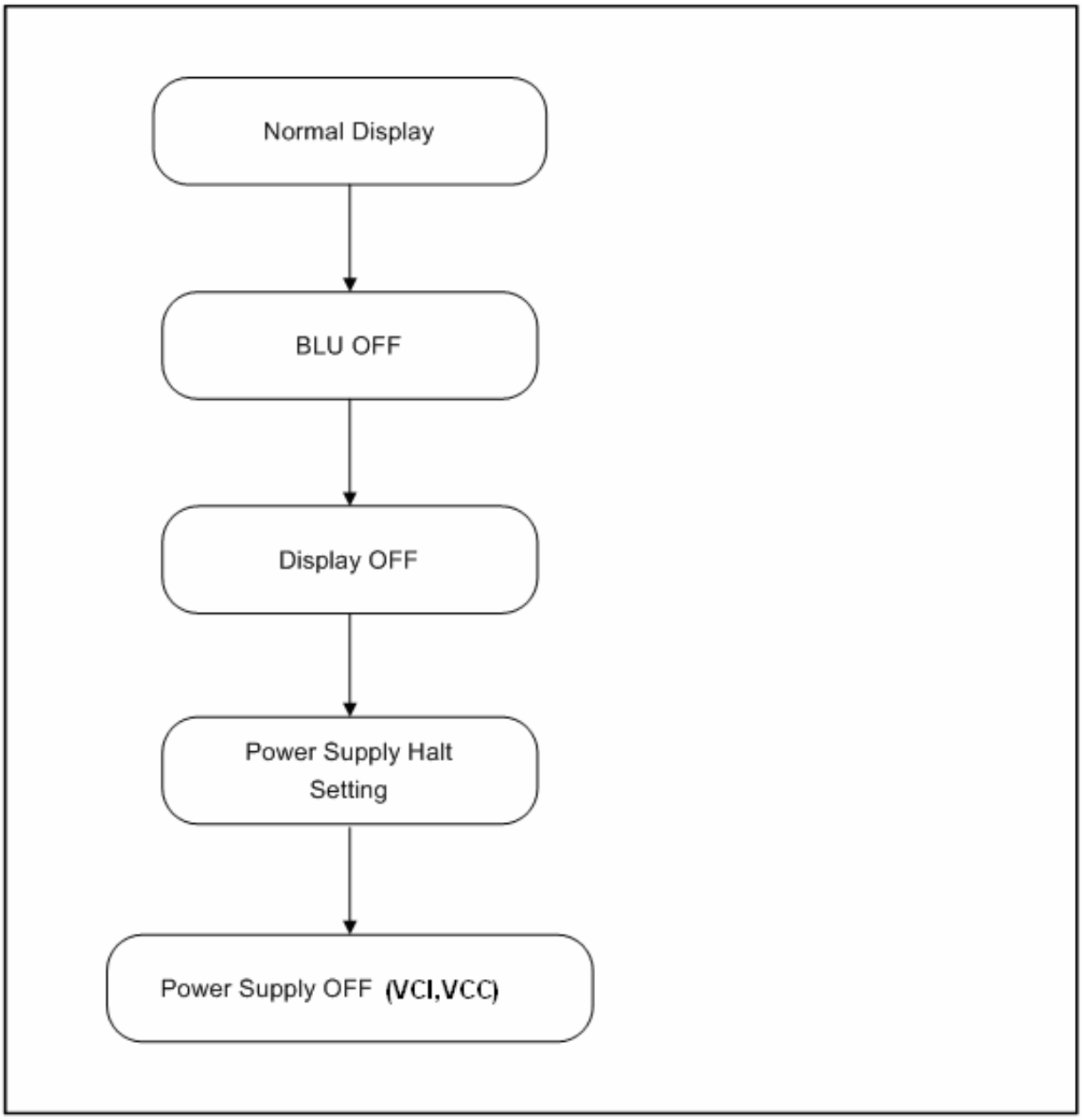


5.5 Power ON/OFF Sequence

5.5.1 Power ON Sequence



5.5.2 Power OFF Sequence



6 Optical Characteristics Optical Specification

Ta=25℃

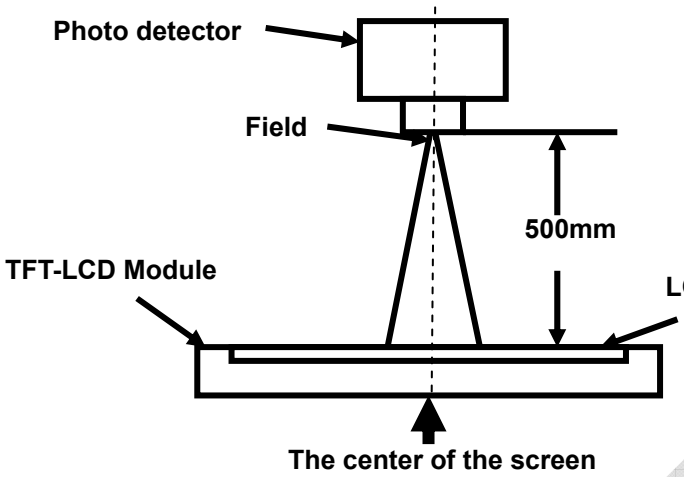
Item		Symbol	Condition	Min	Typ	Max	Unit	Remark
View Angle		θT	CR≥10	60	70	--	Degree	Note 2
		θB		50	60	--		
		θL		60	70	--		
		θR		60	70	--		
Contrast Ratio		CR	θ=0°	400	500	--		Note1 Note3
Response Time		T_{ON}	25℃		20	30	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.245	0.295	0.345		Note1 Note5
		y		0.274	0.324	0.374		
	Red	x		0.556	0.606	0.656		
		y		0.277	0.327	0.377		
	Green	x		0.294	0.344	0.394		
		y		0.484	0.534	0.584		
	Blue	x		0.096	0.146	0.196		
		y		0.056	0.106	0.156		
Uniformity (%)		U		--	80	--		Note1 Note6
NTSC (%)				--	50	--		Note5
Luminance		L		170	220	--		Note1 Note7

Test Conditions:

1. V_F =3.2V ,I_F =18mA(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)。

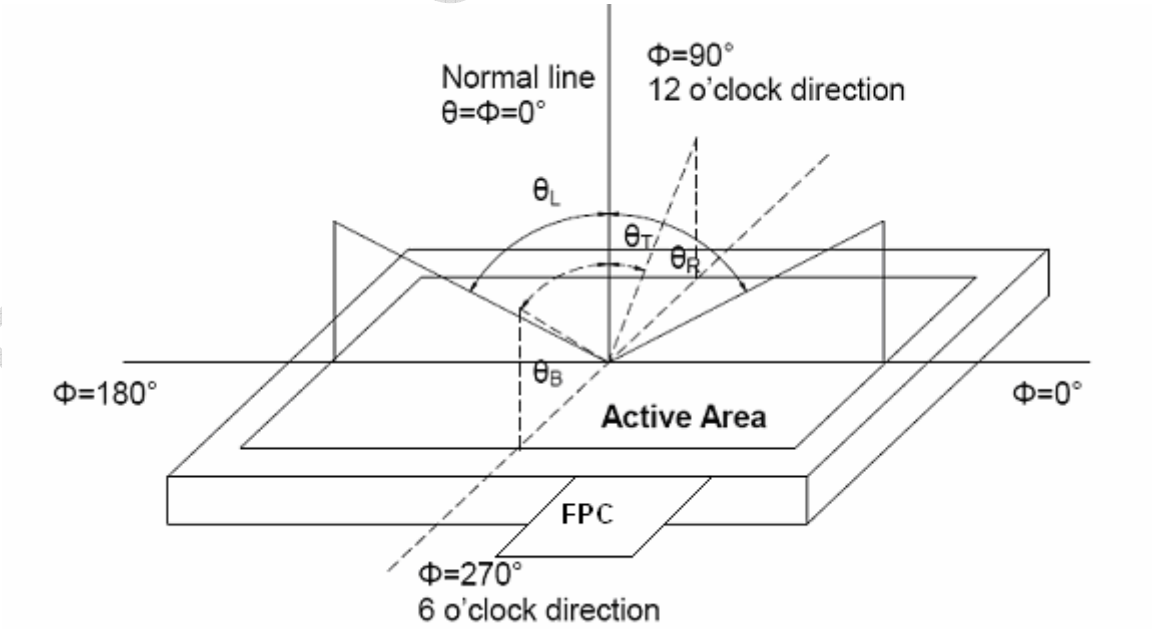


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

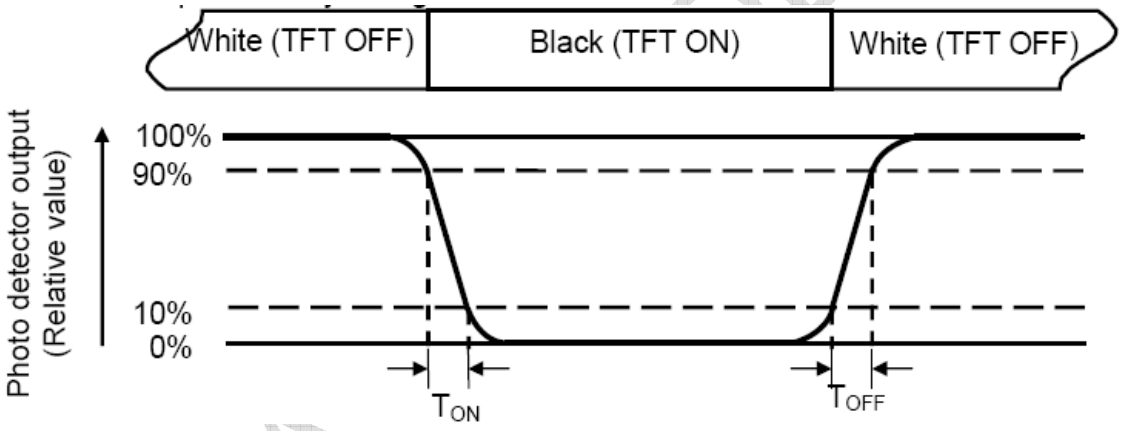
“White state “:The state is that the LCD should driven by Vwhite.

“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

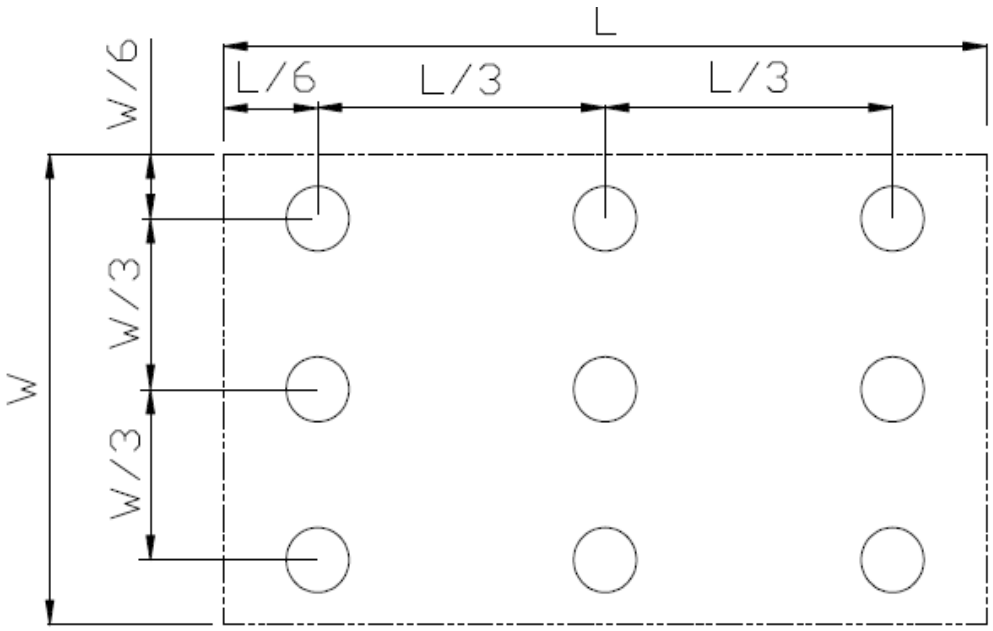


Fig. 2 Definition of uniformity

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.

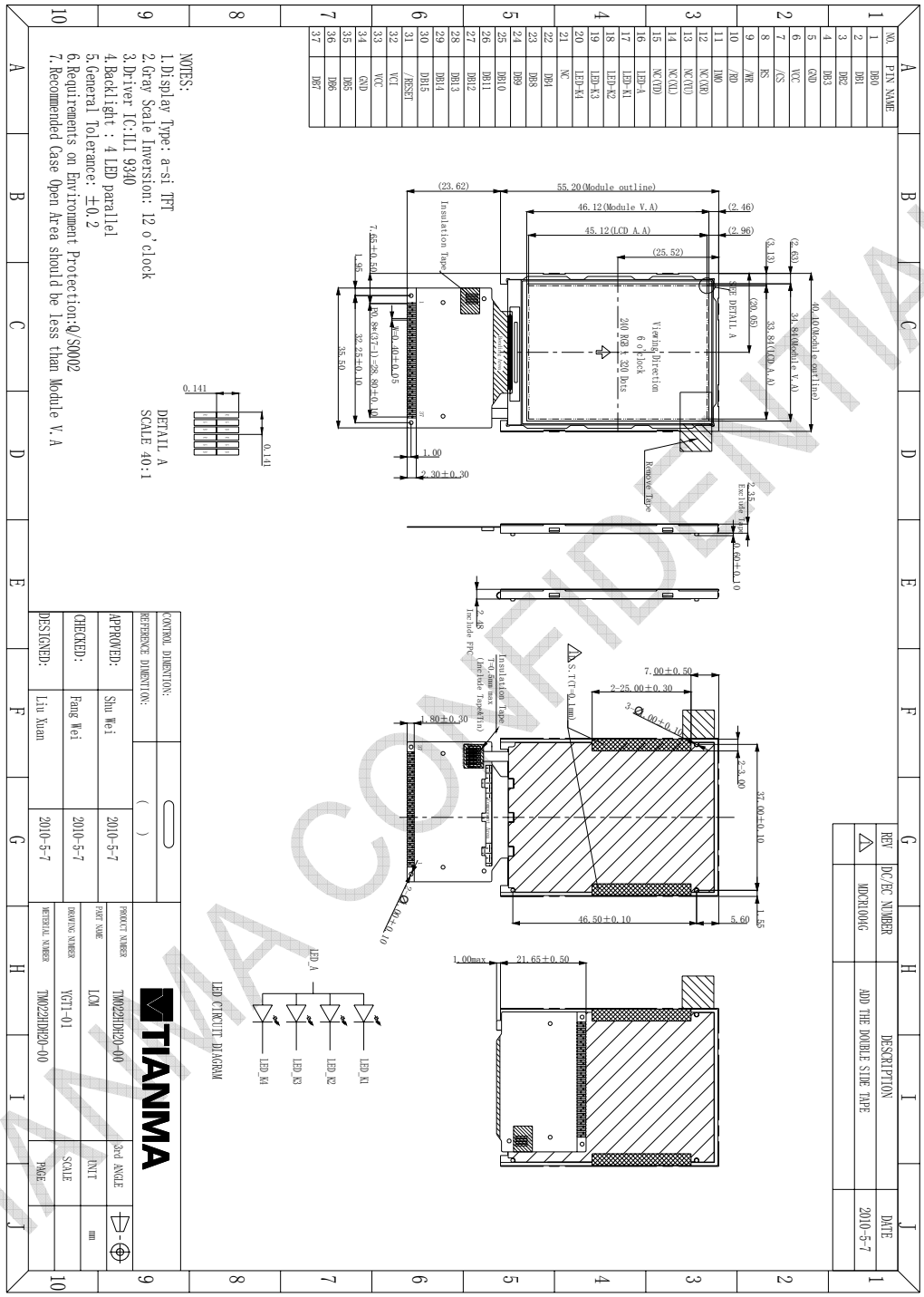
7 Environmental / Reliability Test

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.

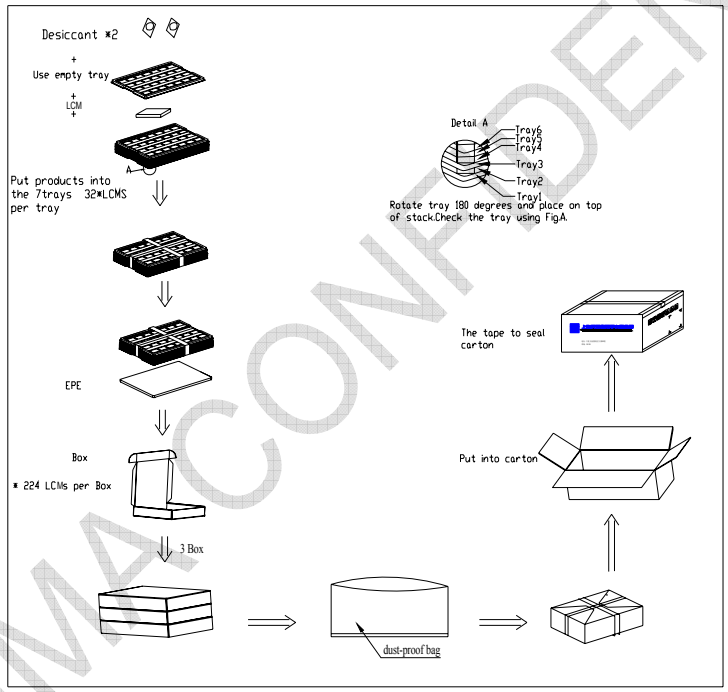
Note2: Ta is the ambient temperature of sample.

8 Mechanical Drawing



9 Packing Drawing

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM022HDH20	40.10×55.20×2.35	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.