MODEL NO. : TM032LDH03

ISSUED DATE: 2010-01-15

VERSION : Ver 2.1

□Preliminary Specification
■Final Product Specification

Customer :

Approved by	Notes

SHANGHAI TIANMA Confirmed :

Prepared by	Checked by	Approved by
2010.1.15	2010-01-15	劉慶全

This technical specification is subjected to change without notice

Table of Contents

Record of Revision

Rev	Issued Date	Description	Editor
1.0	2009-1-16	Preliminary Specification Release	Xinhua Kang
1.1	2009-9-10	Modify Up-Polarizer Size &Update Mechanical Drawing	Xinhua Kang
1.2	2009-10-21	Update Mechanical Drawing, Add the Mark of Driver IC	Xinhua Kang
2.0	2009-10-23	Final Specification Release	Xinhua Kang
2.1	2010-1-15	Update Optical Specification, Add the Water Mark from Tianma and Add the Life of LED.	Xinhua Kang

1 General Specifications

Feature		Spec
Display Spec.	Size	3.2 inch
	Resolution	240(RGB) x 400
	Interface	CPU/SPI+RGB 18 bits/16 bits/8 bits
	Color Depth	262K/65K
	Technology Type	a-Si
	Pixel Pitch (mm)	0.174X0.174
	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)	48.40x81.50x2.15(Exclude Pol.&Tape)
	Active Area(mm)	41.76x69.60
	With /Without TSP	Without TSP
	Weight (g)	16.6
	LED Numbers	6 LEDs
Electronic	Driver IC	HX8352-A

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

2.1 TFT LCD Panel

Connector Type:FH26-45S-0.3SHW

No	SYMBOL	I/O	Description	Remark
1	FLM	O	Tearing effect output	
2	GND	P	Ground	
3	ENABLE	I	A data ENABLE signal in RGB I/F mode; Has to be fixed to GND level if is not used	
4	DOTCLK	I	Dot clock signal in RGB I/F mode; Has to be fixed to GND level if is not used	
5	VSYNC	I	Frame synchronizing signal in RGB I/F mode; Has to be fixed to IOVCC level if is not used	
6	GND	P	Ground	
7	HSYNC	I	Line synchronizing signal in RGB I/F mode; Has to be fixed to IOVCC level if is not used	
8	BS0	I	Interface selection	Note 2
9	BS1	I	Interface selection	Note 2
10	BS2	I	Interface selection	Note 2
11	IOVCC	P	Digital I/O power supply	
12	VCC	P	Digital power supply	
13	SDI	I	Serial data input; If not used, please let it connected to IOVCC or GND level	
14	SDO	O	Serial data output	
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	D9	I	Data input	
24	D8	I	Data input	
25	D7	I	Data input	
26	D6	I	Data input	
27	D5	I	Data input	
28	D4	I	Data input	
29	D3	I	Data input	
30	D2	I	Data input	
31	D1	I	Data input	
32	D0	I	Data input	
33	RESET	I	Reset signal; Must be reset after power is supplied	
34	RD	I	Read signal; Fix it to IOVCC or GND level when using serial bus interface	

35	WR	I	Write signal; Fix it to IOVCC or GND level when using serial bus interface	
36	RS/SCL	I	Command or parameter select signal under parallel mode; Low: command, High: parameter. When under serial interface, it servers as clock signal.	
37	CS	I	Chip select signal, low: chip can be accessed; Must be connected to GND if is not used	
38	LED6	P	Back light cathode LED6	
39	LED5	P	Back light cathode LED5	
40	LED4	P	Back light cathode LED4	
41	LED3	P	Back light cathode LED3	
42	LED2	P	Back light cathode LED2	
43	LED1	P	Back light cathode LED1	
44	LEDA	P	Back light anode	
45	LCM_ID	O	ID pin	

Note 1: I/O definition：

I-----Input O---Output P----Power(Ground)

Note 2: Interface selection：

BS2	BS1	BS0	Interface Mode	DB Pins
0	0	0	16-bit bus interface,80-system, 65K-color	D15-D0: Data ; D17-D16: Unused
0	0	1	16-bit bus interface,80-system, 262K-color	D15-D0: Data ; D17-D16: Unused
0	1	0	18-bit bus interface,80-system, 262K-color	D17-D0: Data
0	1	1	8-bit bus interface,80-system, 262K-color	D7-D0: Data ; D17-D8: Unused
1	0	0	8-bit bus interface, 80-system, 65K-color	D7-D0: Data; D17-D8: Unused
1	1	ID	Serial bus IF + RGB interface	D17-D0: Data

3 Absolute Maximum Ratings

3.1 Driving TFT LCD Panel

Ta = 25°C

Item	Symbol	Min.	Max.	Unit	Remark
Supply Voltage	VCC	-0.3	4.6	V	
Supply Voltage	IOVCC	-0.3	4.6	V	
Input Signal Voltage	D[17: 0], CS,RD, WR,RS/SCL, SDI,VSYNC,HSYNC,DOTCLK, ENABLE, RESET, BS[2:0]	-0.3	VCC +0.3	V	
Back Light Forward Current	I_{LED}	--	25	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℃

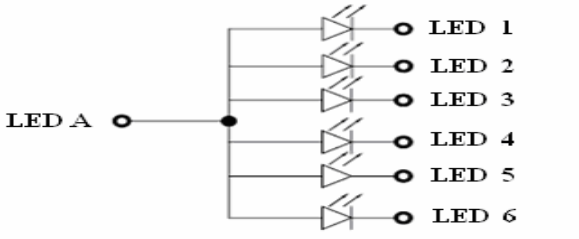
Item		Symbol	Min.	Typ.	Max.	Unit	Remark
Logic & Analog Power Supply		VCC	2.5	2.8	3.3	V	
IO Pad Power Supply		IOVCC	1.65	2.8	3.3	V	
Input Signal Voltage	Low Level	V_{IL}	0	--	0.2xIOVCC	V	D[17: 0], CS,RD, WR,RS/SCL, SDI,VSYNC,HSYNC, DOTCLK, ENABLE, RESET, BS[2:0]
	High Level	V_{IH}	0.8xIOVCC	--	IOVCC	V	
Output Signal Voltage	Low Level	V_{OL}	0	--	0.3xIOVCC	V	SDO, FLM
	High Level	V_{OH}	0.7xIOVCC	--	IOVCC	V	
(Panel+ LSI) Power Consumption		Black Mode (60Hz)	--	--	25	mA	
		8 color Mode	--	--	15	mA	
		Standby Mode	--	--	100	uA	

4.2 Driving Backlight

Ta=25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Forward Current	I_F	--	15	25	mA	6LEDs (in parallel)
Forward Voltage	V_F	--	3.2	--	V	
Power Consumption	W_{BL}	--	288	--	mW	
Operating Life Time	--	10000	(20000)	--	Hrs	

Note1: Figure below shows the connection of backlight LED.



Note 2: One LED : I_F =15mA, V_F =3.2V

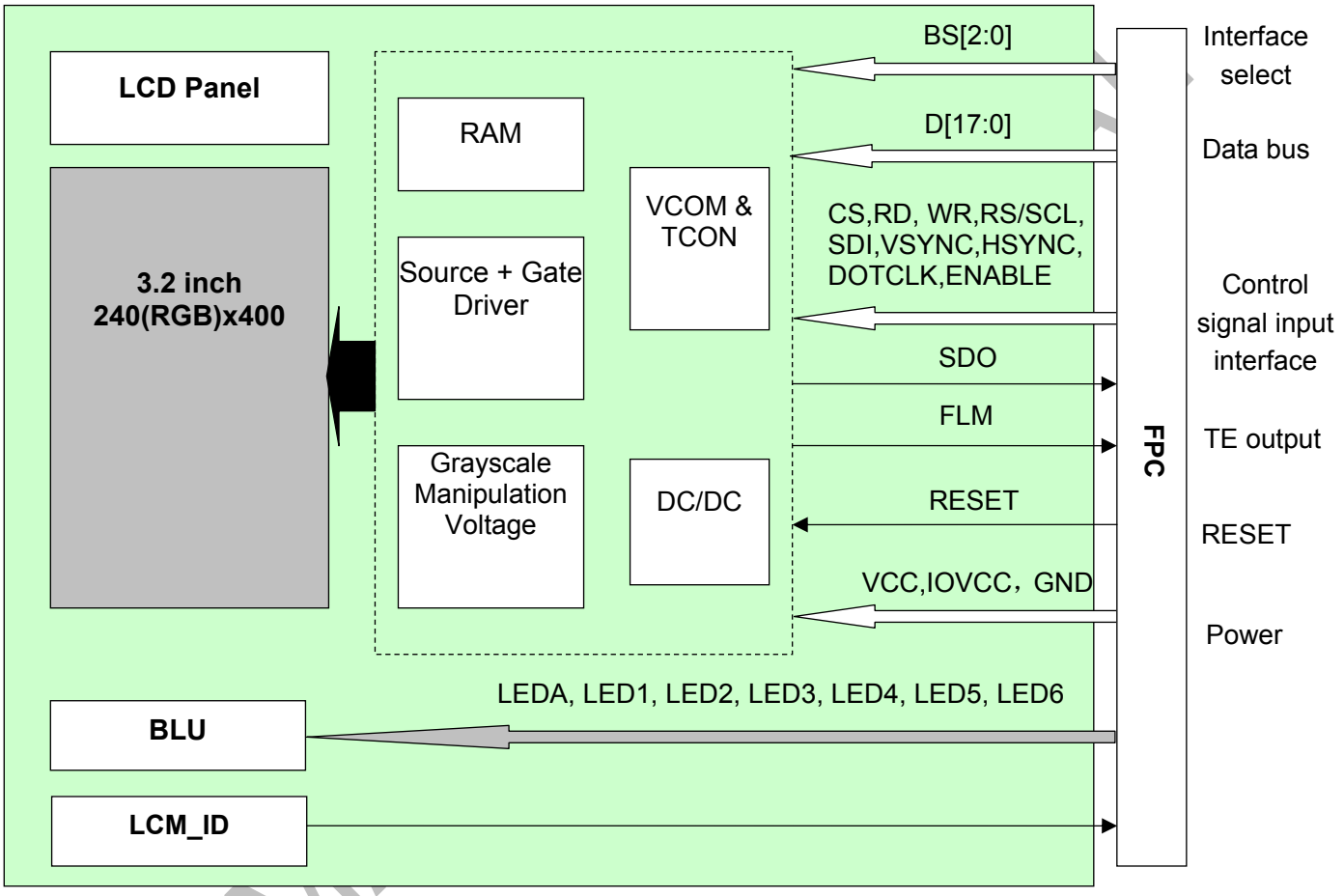
Note 3: I_F is defined for one channel LED.

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.

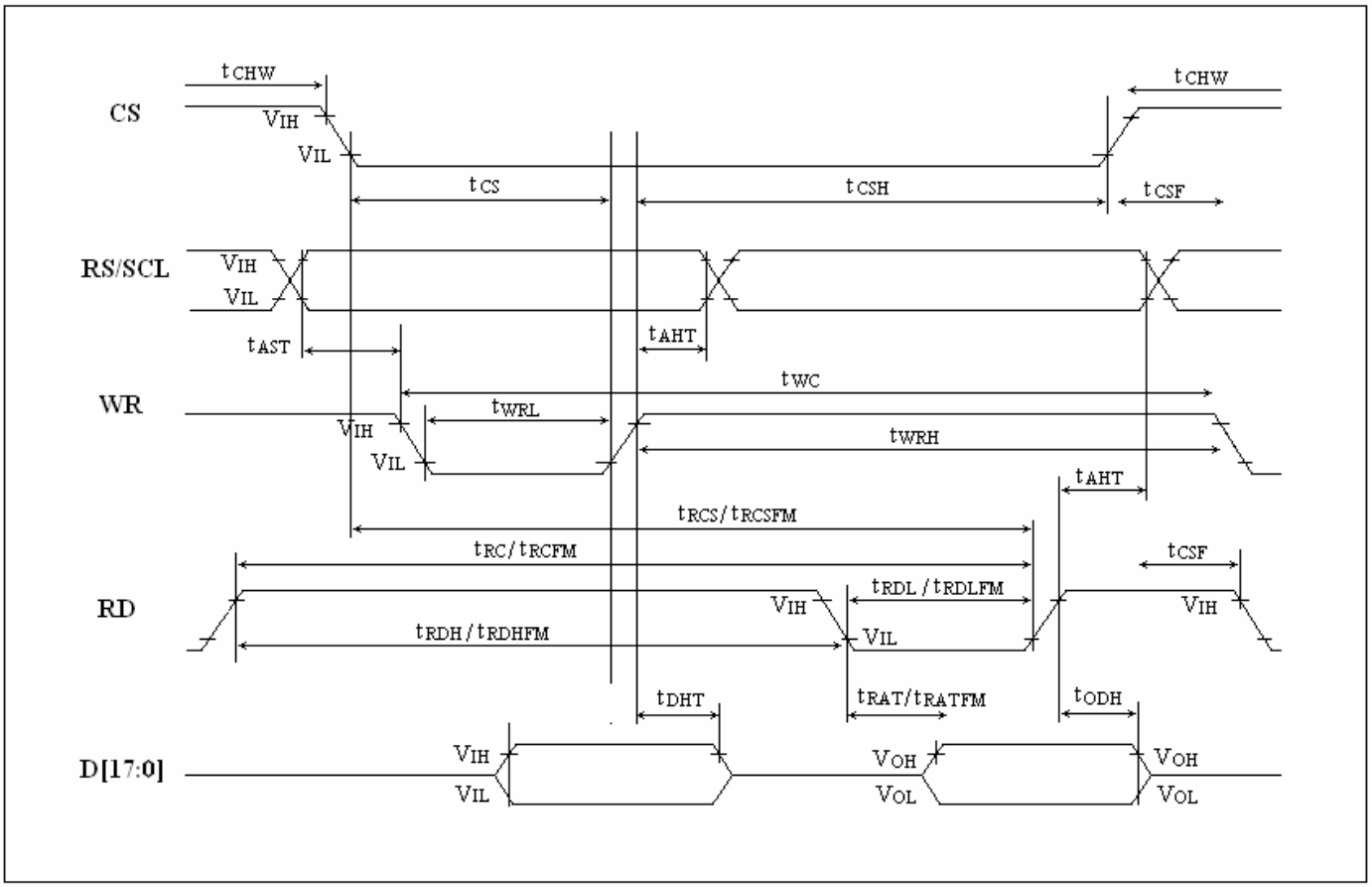
4.3 Block Diagram



5 Timing Chart

5.1 CPU interface

5.1.1 CPU Interface Characteristics



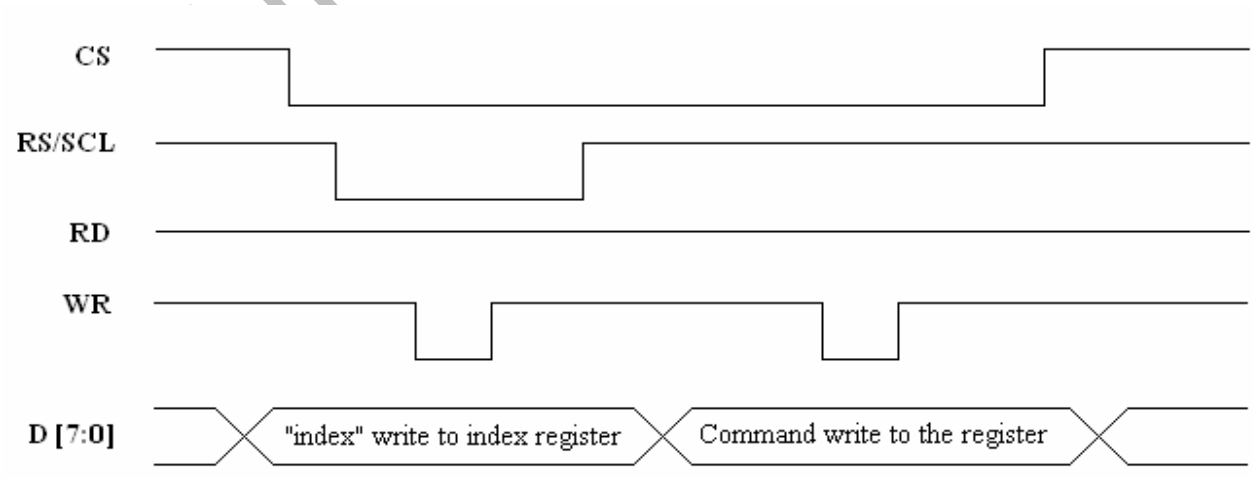
5.1.2 **CPU Interface Timing Parameters**

Normal Write Mode (IOVCC=1.65~3.3V, VCC=2.3~3.3V)

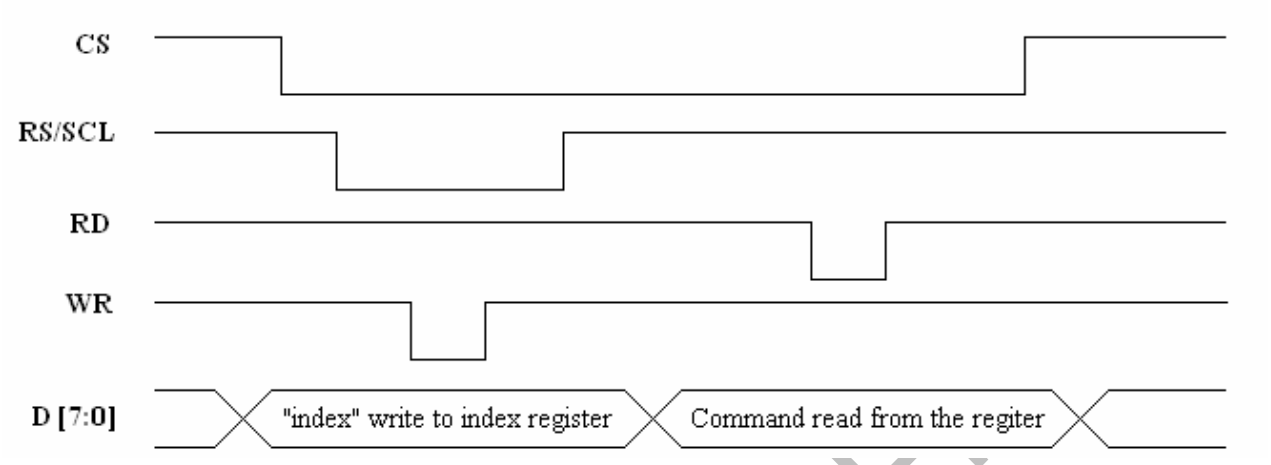
Signal	Symbol	Parameter	Spec.			Description
			Min.	Max.	Unit	
RS/SCL	t_{AST} t_{AHT}	Address setup time Address hold time(Write/Read)	10 10	-	ns	-
CS	t_{CHW} t_{CS} t_{RCS} t_{RCSFM} t_{CSF} t_{CSH}	Chip select “H” pulse width Chip select setup time (Write) Chip select setup time (Read ID) Chip select setup time (Read FM) Chip select wait time(Write/Read) Chip select hold time	0 35 100 100 10 10	-	ns	-
WR	t_{WC} t_{WRH} t_{WRL}	Write cycle Control pulse “H” duration Control pulse “L” duration	100 20 20	-	ns	-
RD	t_{RC} t_{RDH} t_{RDL}	Read cycle (ID) Control pulse “H” duration (ID) Control pulse “L” duration (ID)	150 40 50	-	ns	When read ID data
RD	t_{RCFM} t_{RDHFM} t_{RDLFM}	Read cycle (FM) Control pulse “H” duration (FM) Control pulse “L” duration (FM)	250 50 150	-	ns	When read from frame memory
D[17:0]	t_{DST} t_{DHT} t_{RAT} t_{RATFM} t_{ODH}	Data setup time Data hold time Read access time (ID) Read access time (FM) Output disable time	20 20 - - 20	- - 70 100 80	ns	For maximum C_L=30pF For minimum C_L=8pF

5.1.3 **CPU Interface Register Write/Read Timing**

5.1.3.1 **System Bus Interface Register Write Timing**



5.1.3.2 **System Bus Interface Register Read Timing**



5.1.4 **GRAM Write/Read Data Format**

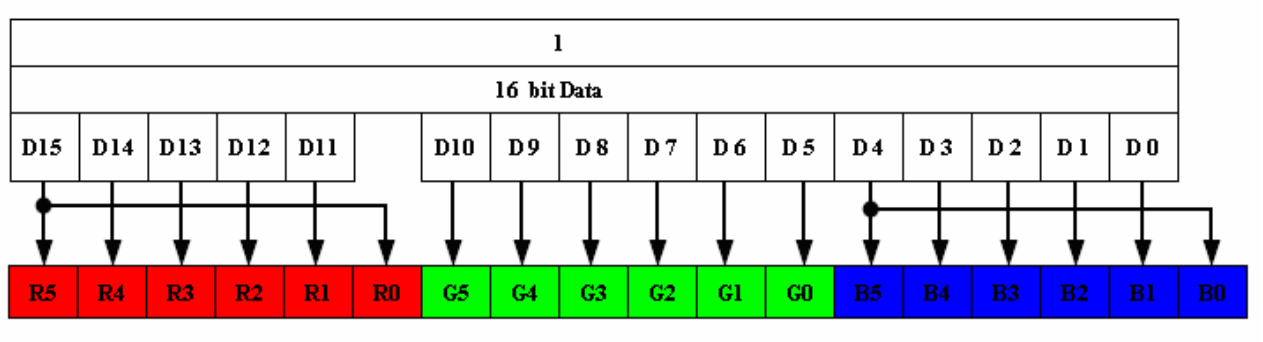
5.1.4.1 **18-bit Read/Write GRAM Data Format(262K)**

1																	
18 bit Data																	
D17	D16	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0

5.1.4.2 **16-bit Read/Write GRAM Data Format(262K/65K)**

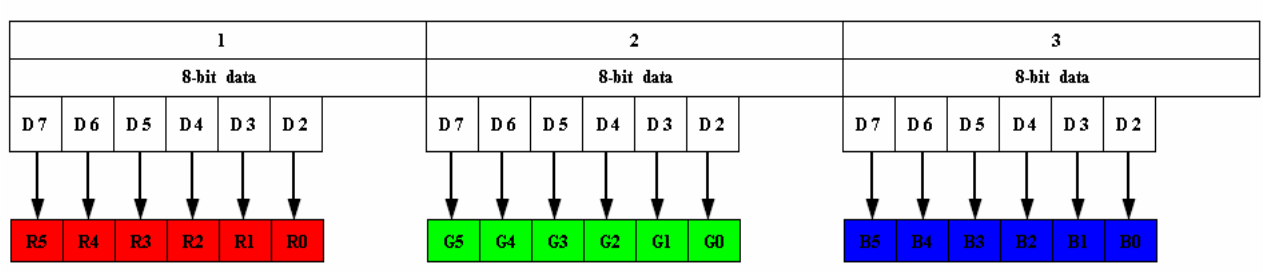
1																2	
16 bit data																2 bit data	
D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0	D1	D0
R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0

16-bit Read/Write GRAM Data Format 262K

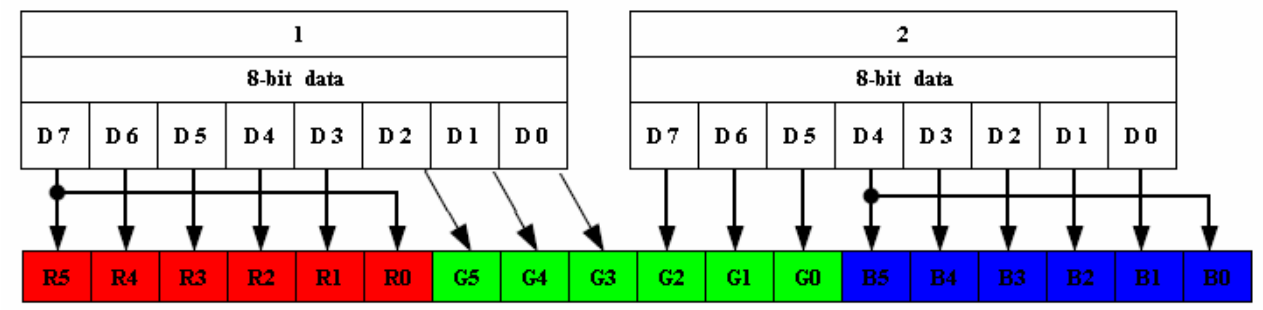


16-bit Read/Write GRAM Data Format 65K

5.1.4.3 8-bit Read/Write GRAM Data Format(262K/65K)



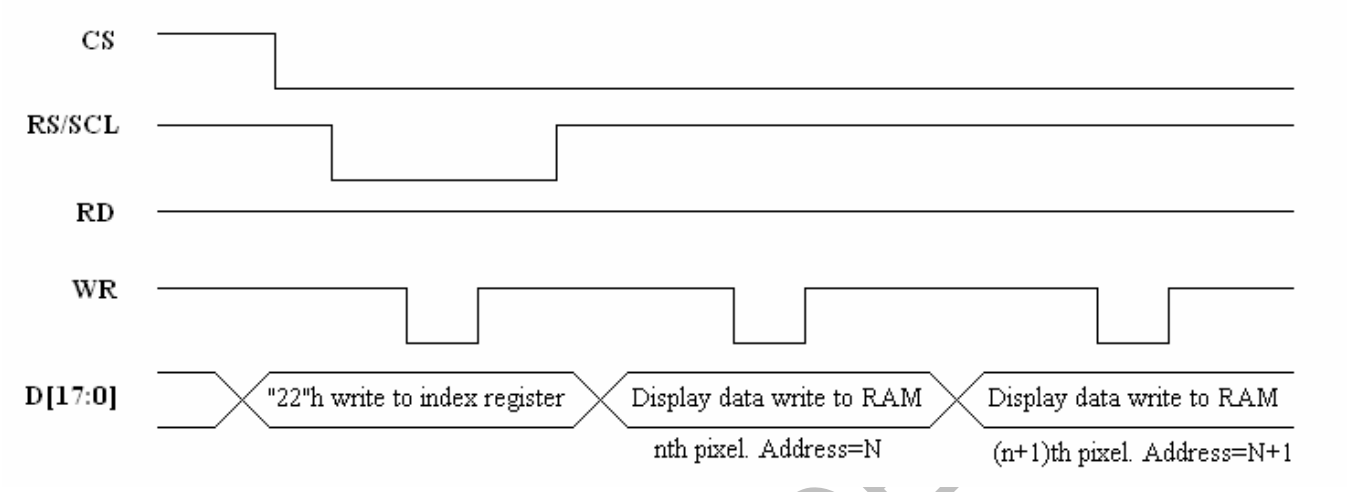
8-bit Read/Write GRAM Data Format 262K



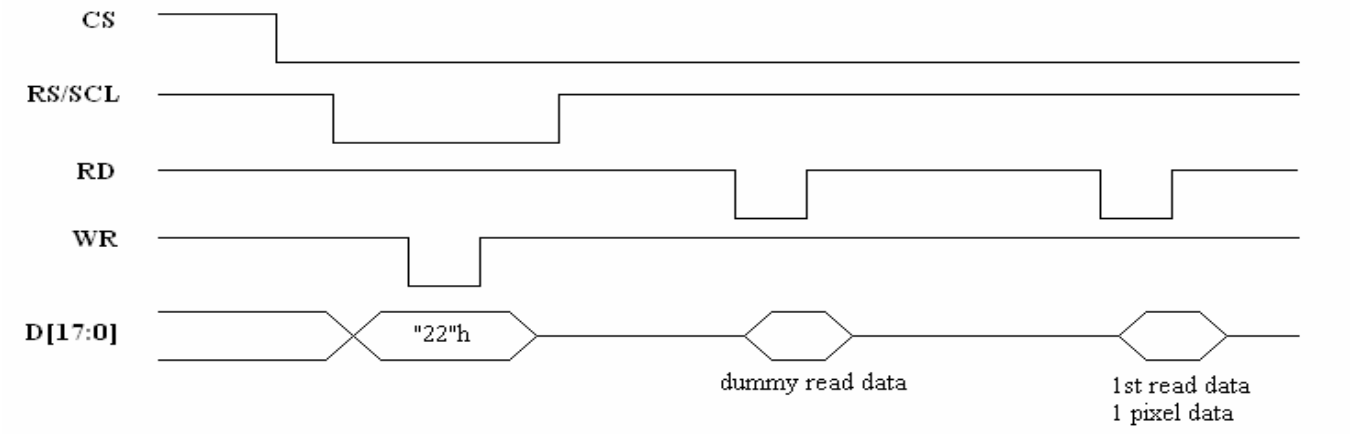
8-bit Read/Write GRAM Data Format 65K

5.1.5 **Data Bus GRAM Write/Read Timing**

5.1.5.1 **18-bit Data Bus GRAM Write/Read Timing(262K)**

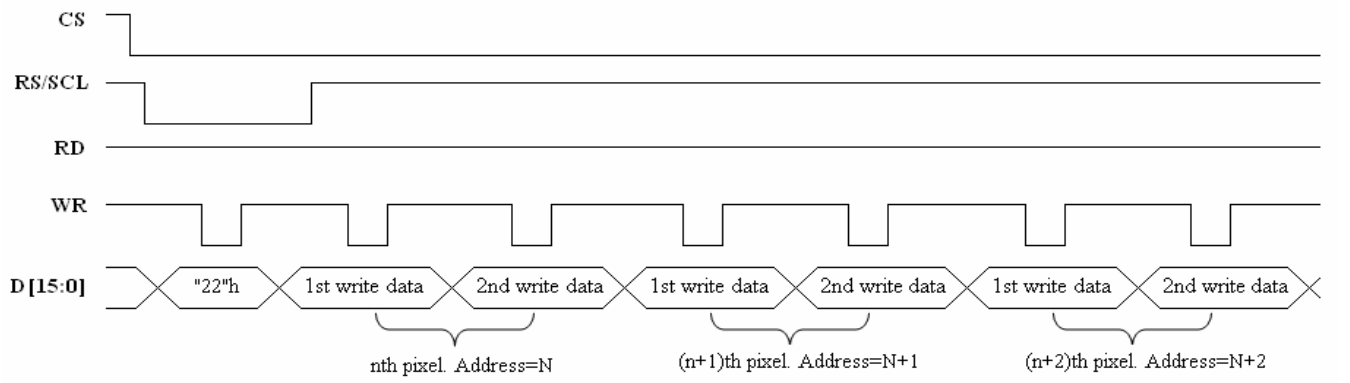


Data Bus GRAM Write Timing

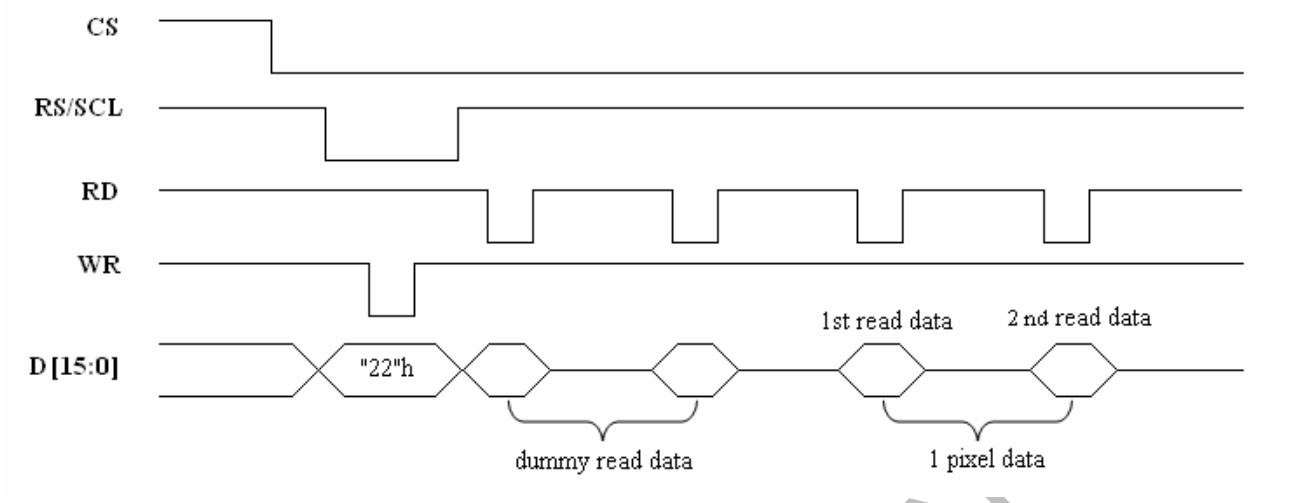


Data Bus GRAM Read Timing

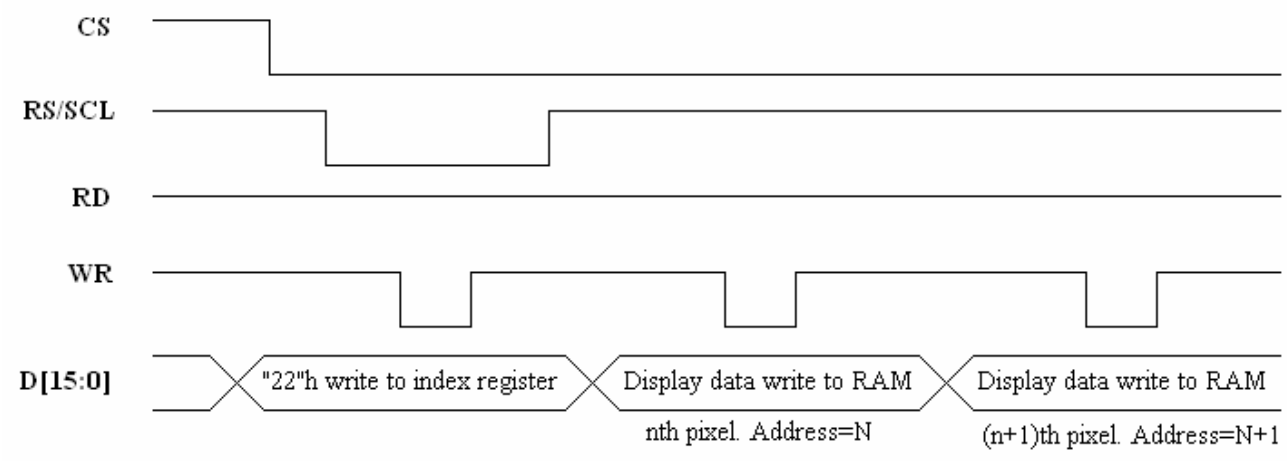
5.1.5.2 **16-bit Data Bus GRAM Write/Read Timing(262K/65K)**



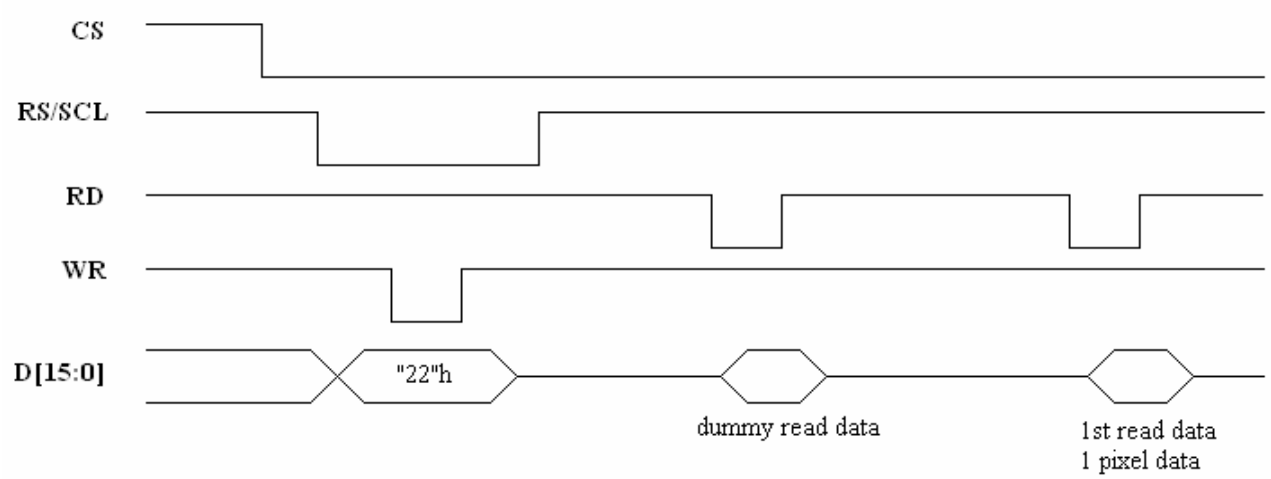
16-bit Data Bus GRAM Write Timing 262K



16-bit Data Bus GRAM Read Timing 262K

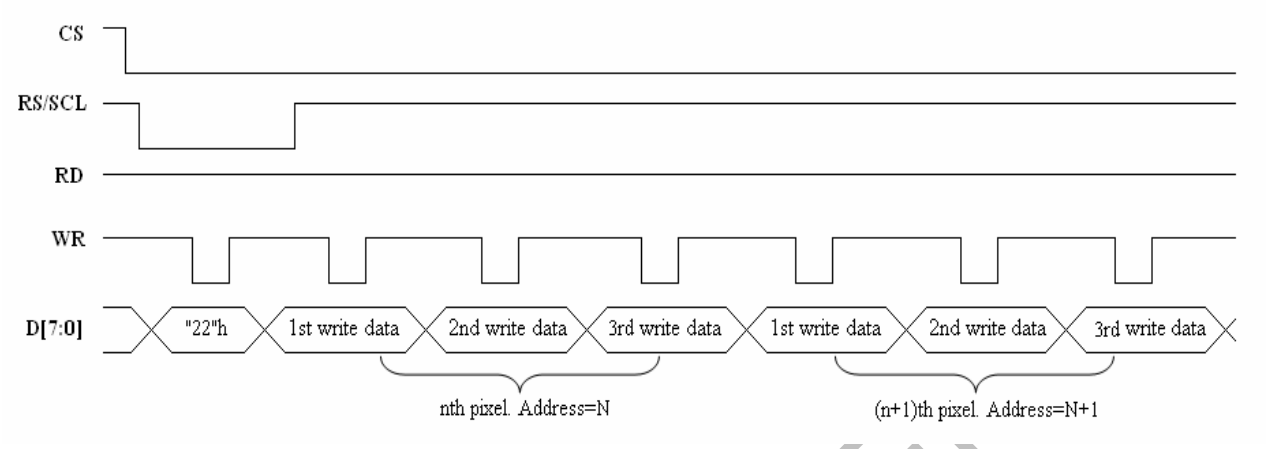


16-bit Data Bus GRAM Write Timing 65K

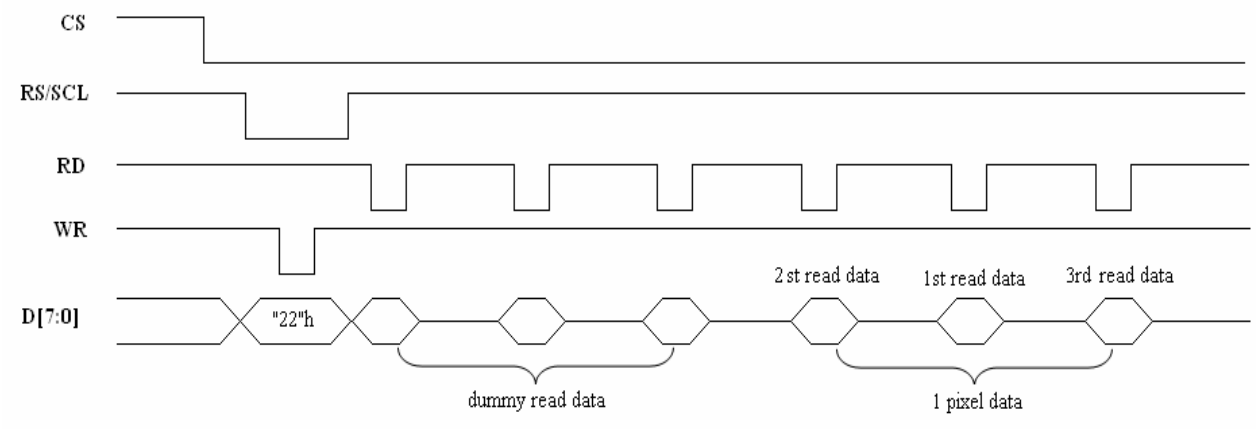


16-bit Data Bus GRAM Read Timing 65K

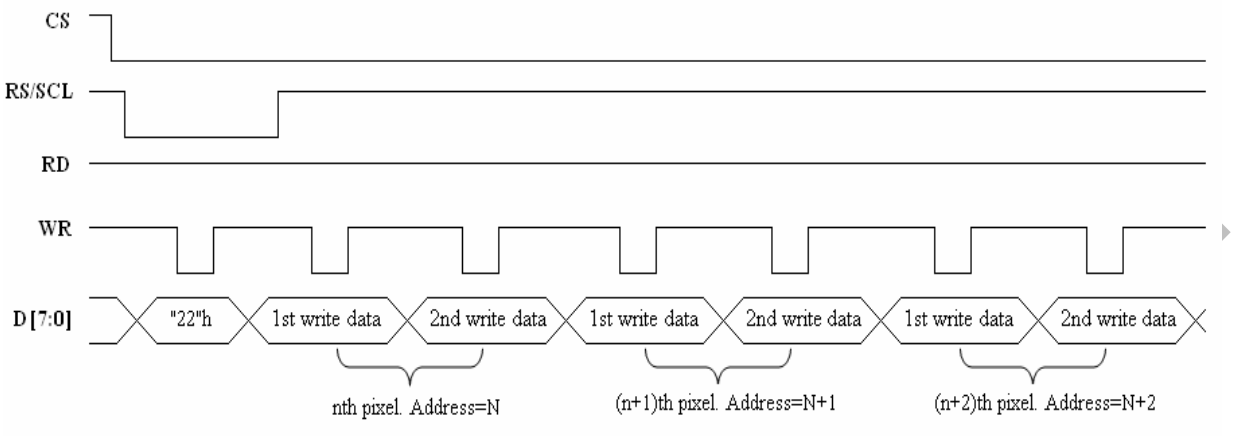
5.1.5.3 **8-bit Data Bus GRAM Write/Read Timing(262K/65K)**



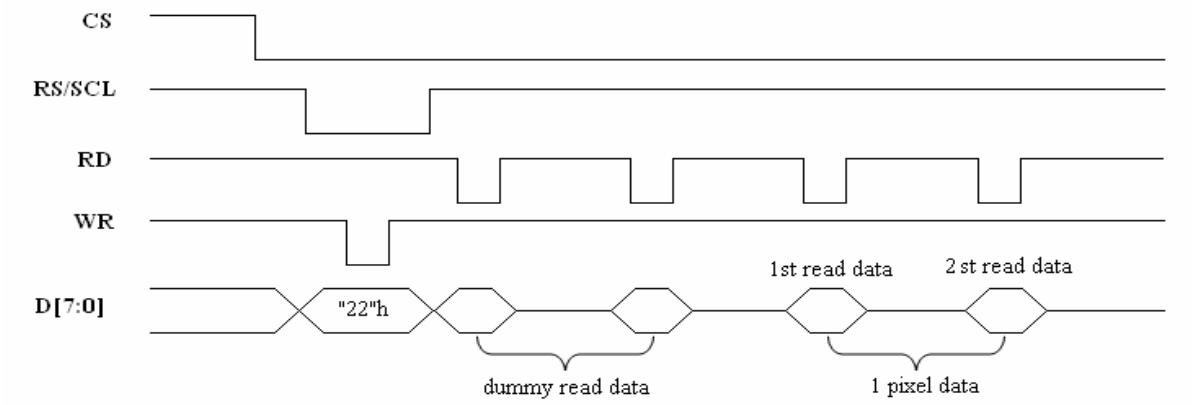
8-bit Data Bus GRAM Write Timing 262K



8-bit Data Bus GRAM Read Timing 262K



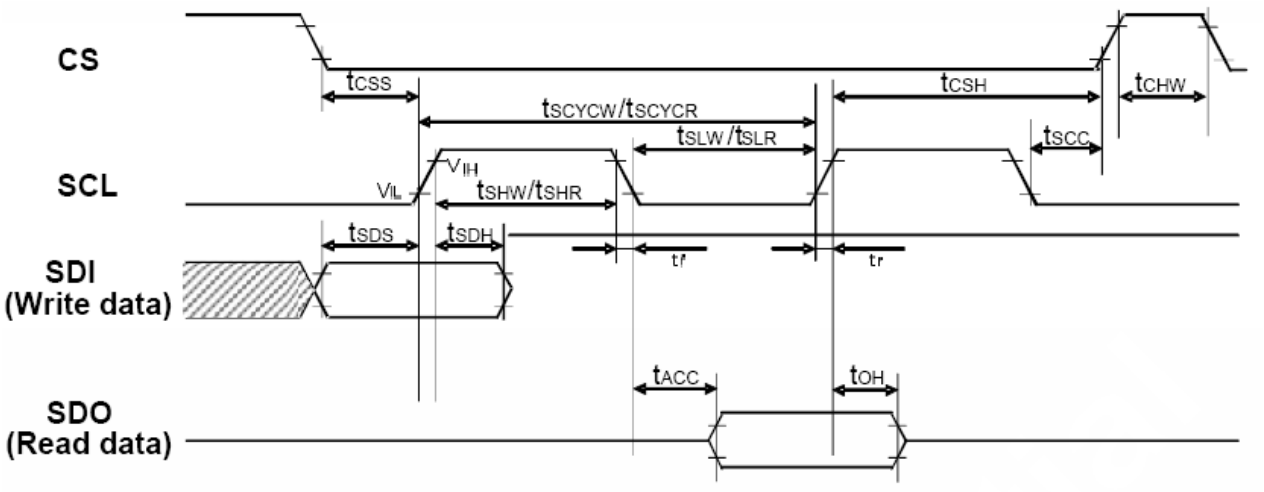
8-bit Data Bus GRAM Write Timing 65K



8-bit Data Bus GRAM Read Timing 65K

5.2 SPI interface

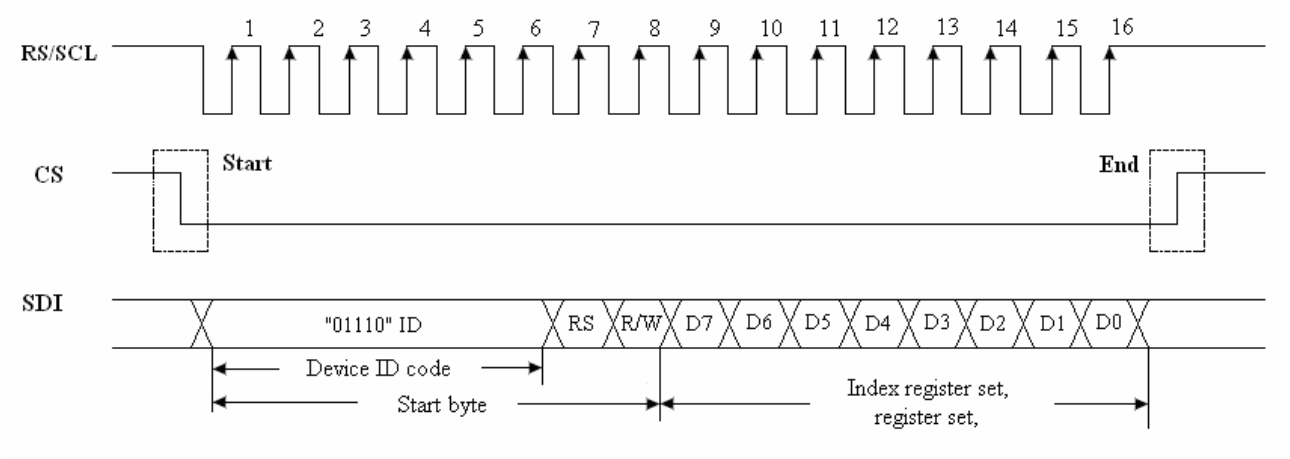
5.2.1 SPI Interface Characteristics



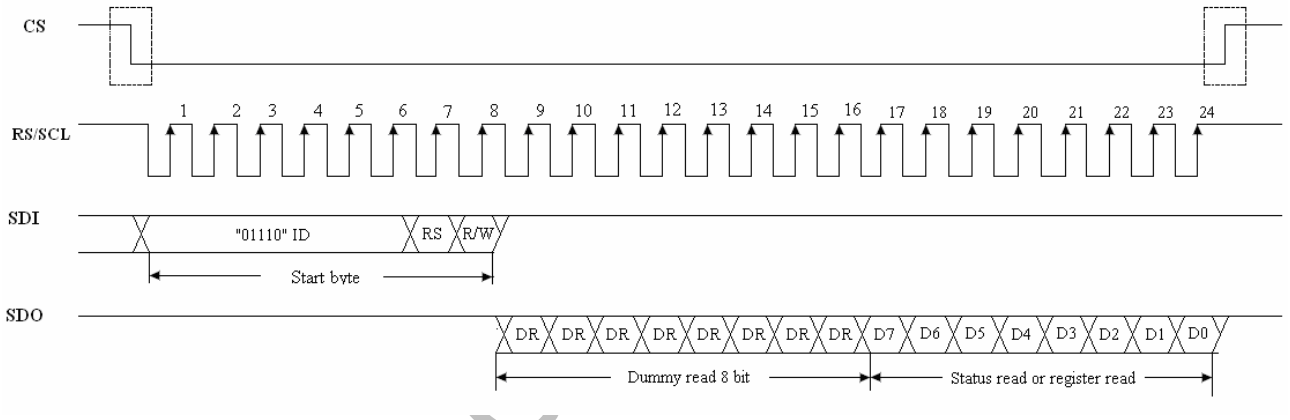
5.2.2 SPI Interface Timing Parameters

Item		Symbol	Unit	Min.	Typ.	Max.
Serial clock cycle time	Write	t_{SCYCW}	ns	100	-	-
	Read	t_{SCYC}	ns	150	-	-
Serial clock high level pulse width	Write	t_{SHW}	ns	35	-	-
	Read	t_{SHR}	ns	60	-	-
Serial clock low level pulse width	Write	t_{SLW}	ns	35	-	-
	Read	t_{SLR}	ns	100	-	-
Access Time		t_{ACC}	ns	10	-	100
Chip select set up time		t_{CSS}	ns	60	-	-
Chip select hold time		t_{CSH}	ns	60	-	-
Data set up time		t_{SDS}	ns	30	-	-
Data hold time		t_{SDH}	ns	30	-	-
Output disable time		t_{OH}	ns	15	-	100
CS “H” pulse width		t_{CHW}	ns	45	-	-
SCL to Chip select		t_{SCC}	ns	50	-	-

5.2.3 SPI Interface Register Write/Read Timing



Register Write Timing



Register Read Timing

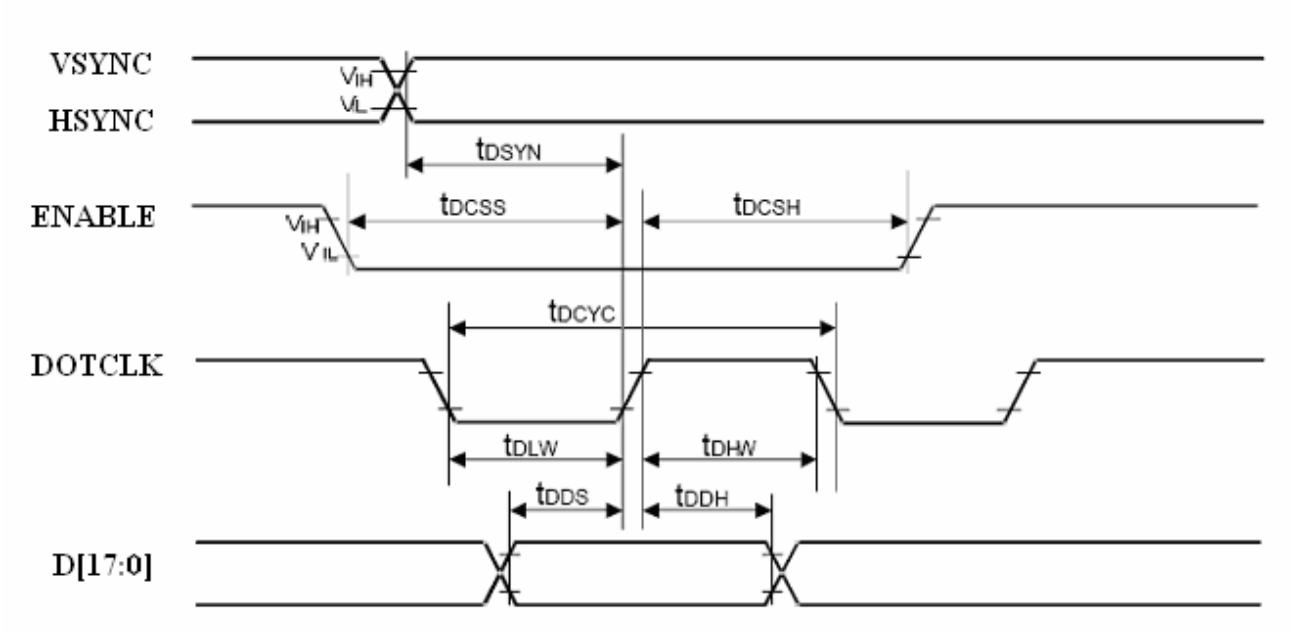
5.2.4 SPI Interface Start Byte Format

Transferred Bits	S	1	2	3	4	5	6	7	8
Start Byte Format	Transfer Start	Device ID Code						RS	R/W
		0	1	1	1	0	ID(BS0)	1/0	1/0

RS	R/W	Function
0	0	Set an index register
1	0	Write a register or GRAM data
1	1	Read a register or GRAM data

5.3 RGB Interface

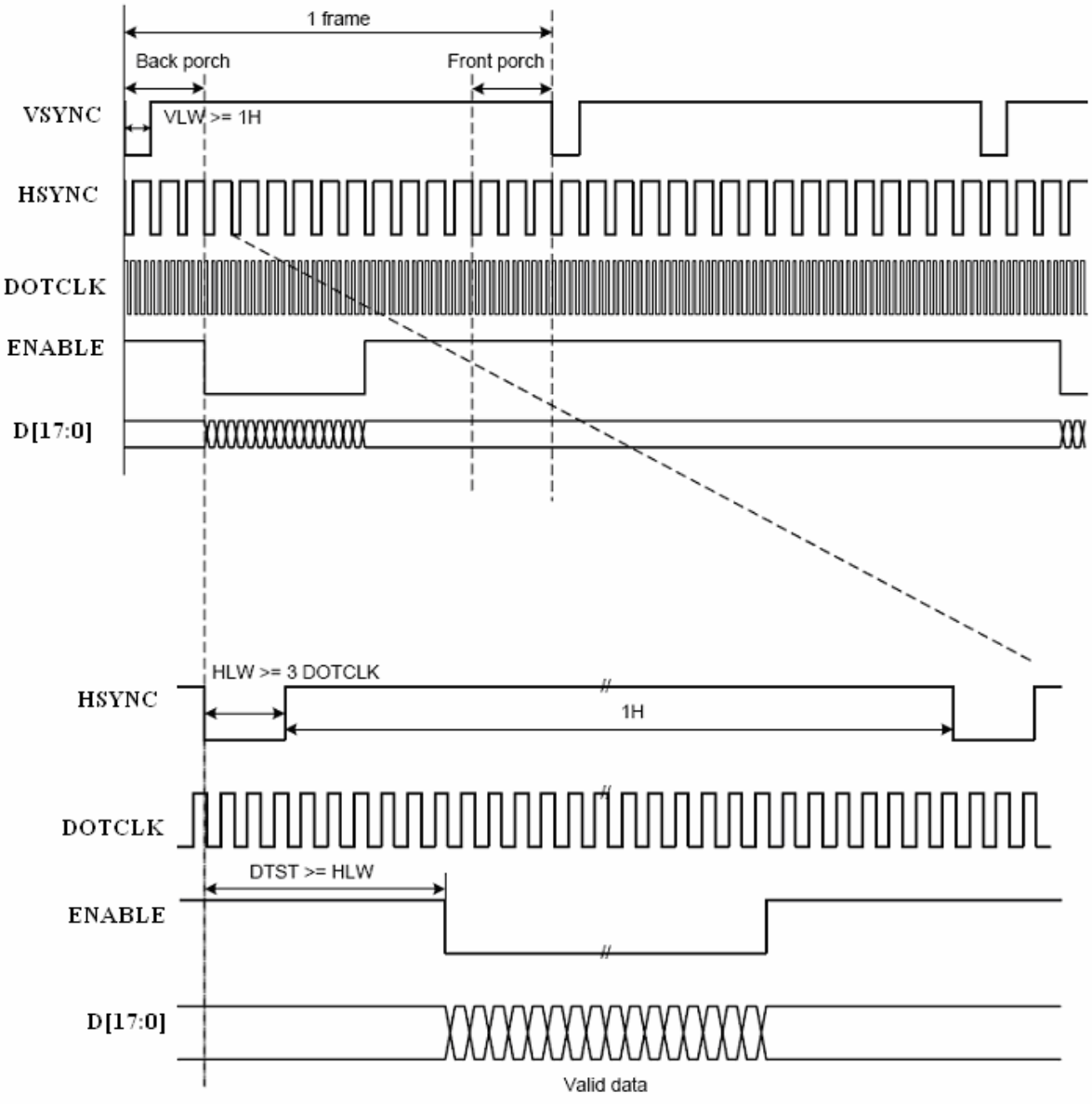
5.3.1 RGB Interface Characteristics



5.3.2 RGB Interface Timing Parameters

Symbol	Parameter	Related Pins	Spec.			Unit
			Min.	Typ.	Max.	
t_{DSYN}	VSYNC/HSYNC setup time		15	-	-	ns
t_{DCSS}	ENABLE setup time	ENABLE	15	-	-	ns
t_{DCSH}	ENABLE hold time		15	-	-	ns
t_{DDS}	RGB Data setup time	DOTCLK D[17:0]	15	-	-	ns
t_{DDH}	RGB Data hold time		15	-	-	ns
t_{DHW}	DOTCLK high-level pulse width	DOTCLK	20	-	-	ns
t_{DLW}	DOTCLK low-level pulse width		20	-	-	ns
t_{DCYC}	DOTCLK cycle time		100	-	-	ns

5.3.3 **RGB Interface Timing Chart**



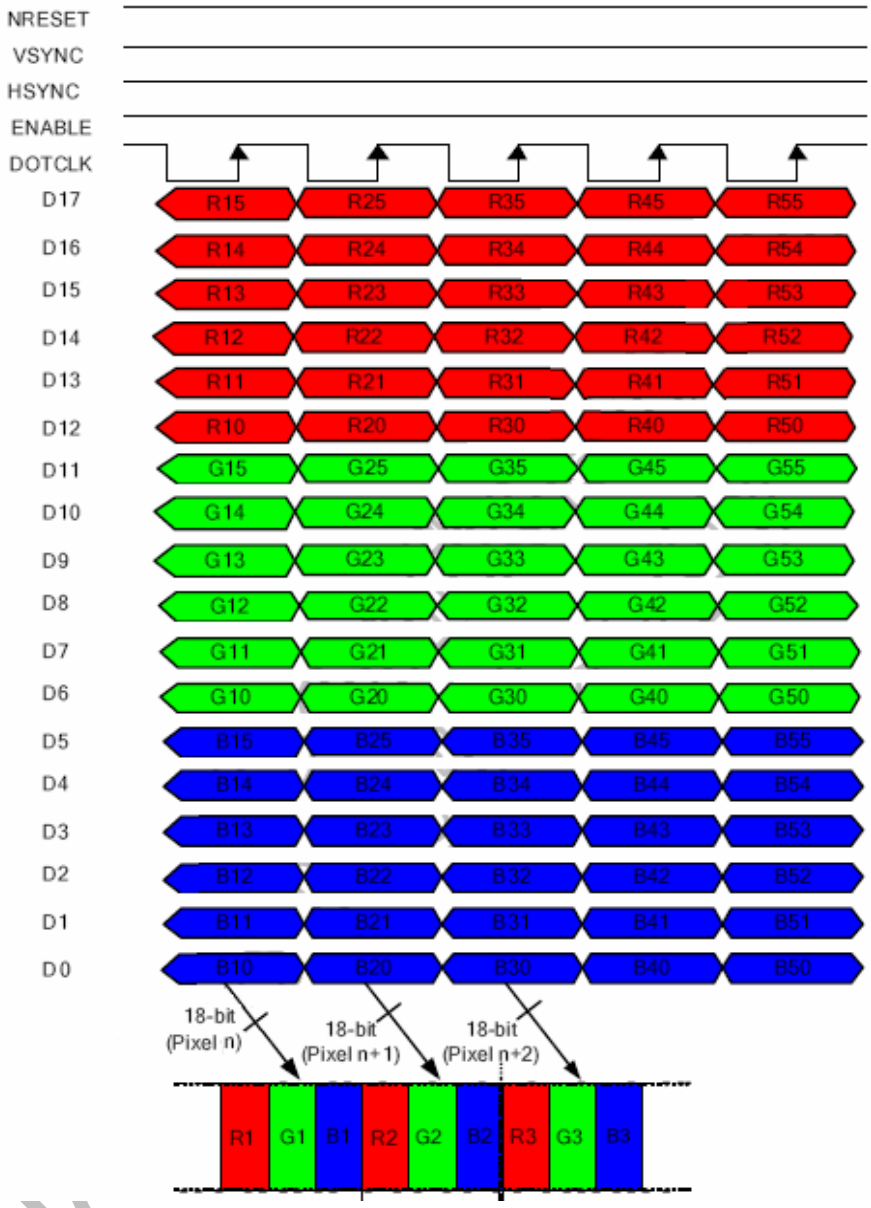
VLW: VSYNC low period

HLW: HSYNC low period

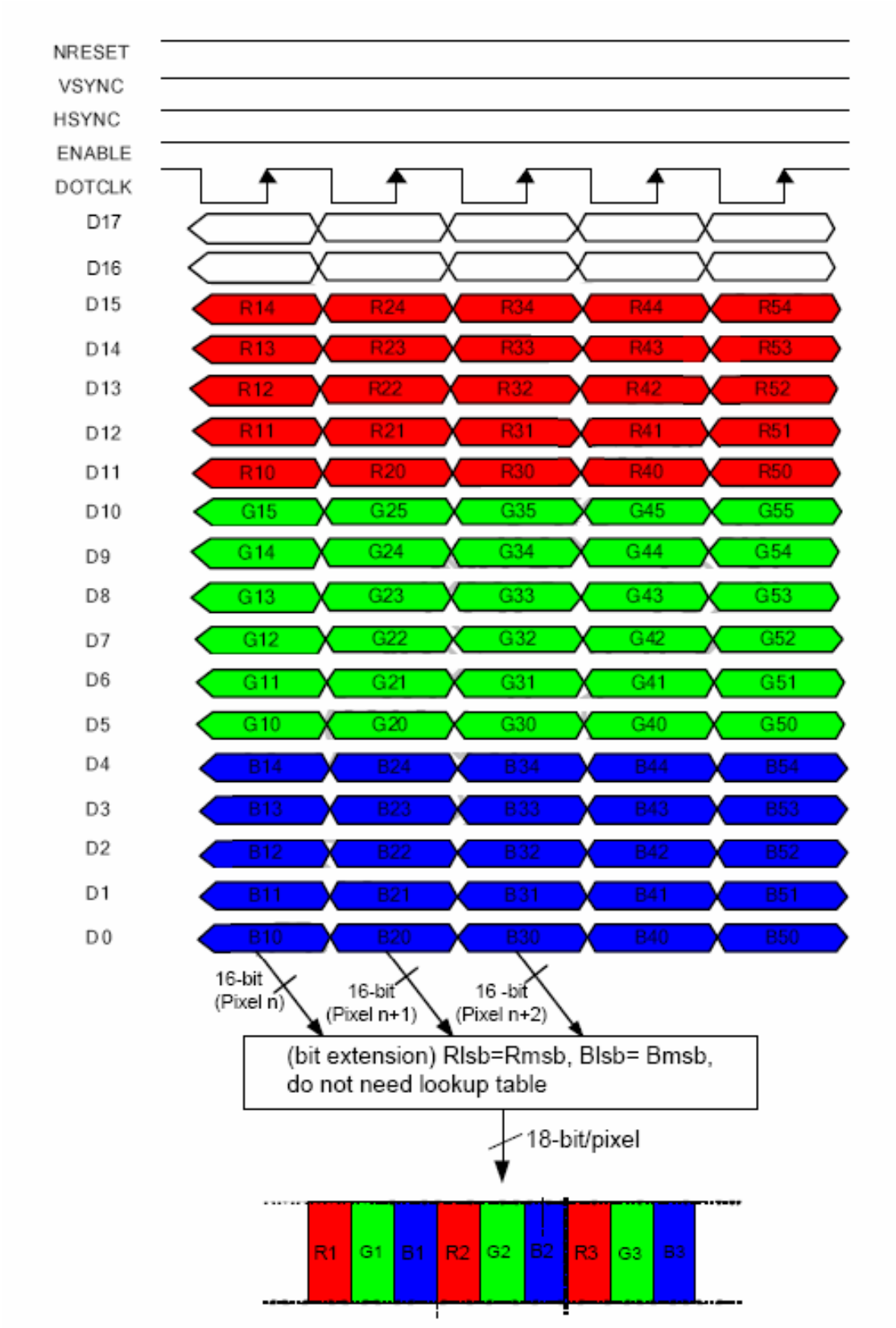
DTST: data transfer startup time

Note 1: Use the high speed write mode (HWM=1) to write data through the RGB interface.

5.3.4 **RGB Interface Data Format**



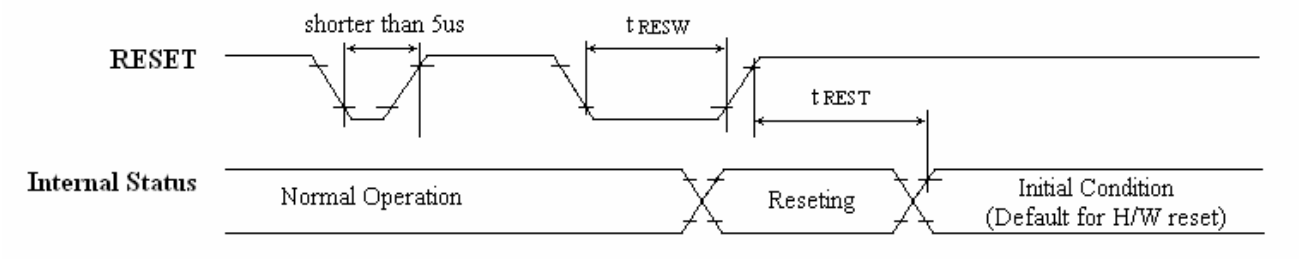
18-bit/Pixel Color Order (262k) (CSEL[2:0] = 110)



16-bit/Pixel Color Order (65k) (CSEL[2:0] = 101)

5.4 Reset Timing Characteristics

IOVCC=1.65~3.3V, VCC=2.3~3.3V



Reset Timing Parameters

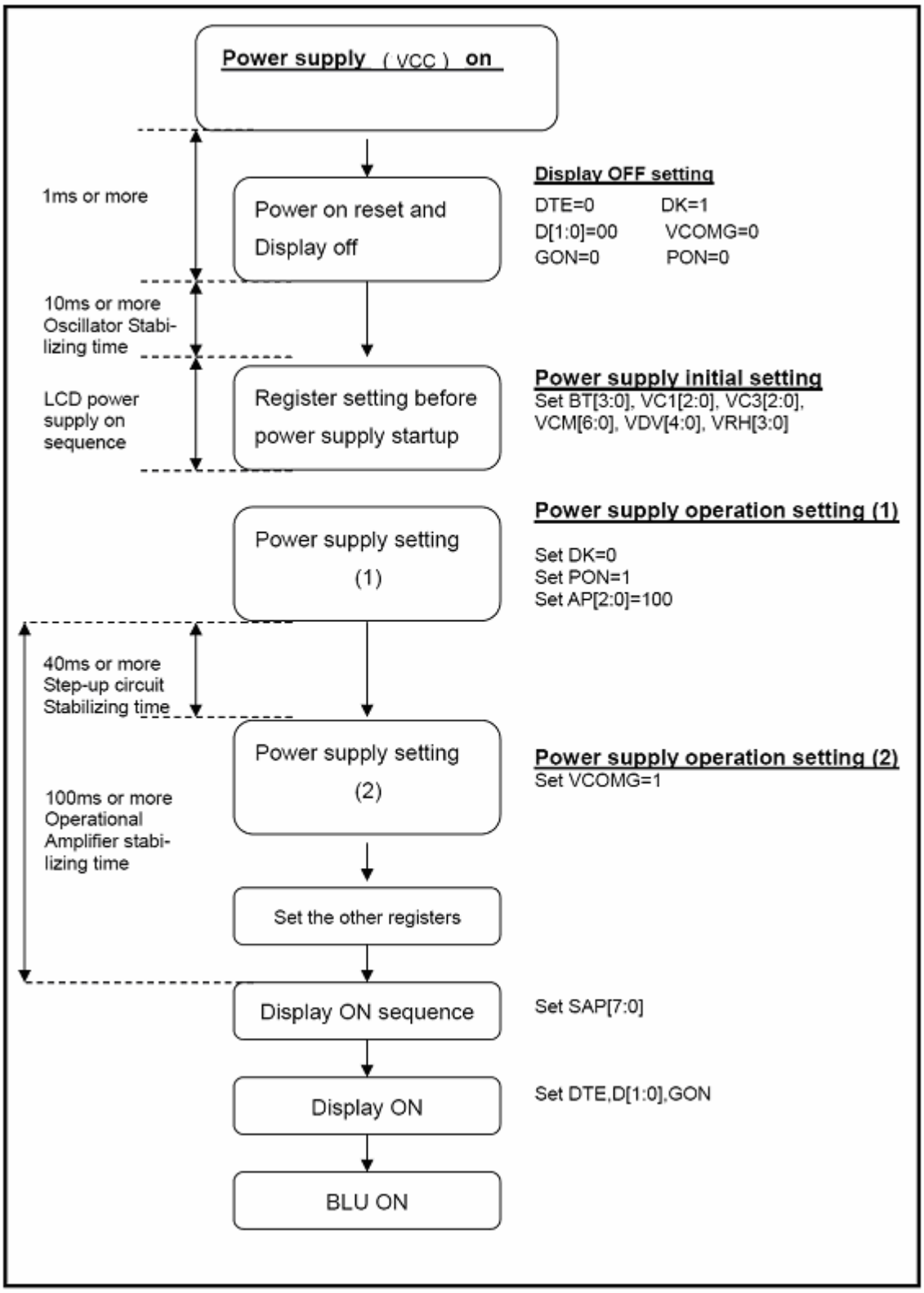
Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
t_{RESW}	Reset low pulse width	RESET	10	-	-	-	us
t_{REST}	Reset complete time	-	-	-	5	When reset applied during “Sleep In mode”	ms
		-		-	120	When reset applied during “Sleep Out mode”	ms

Note 1:

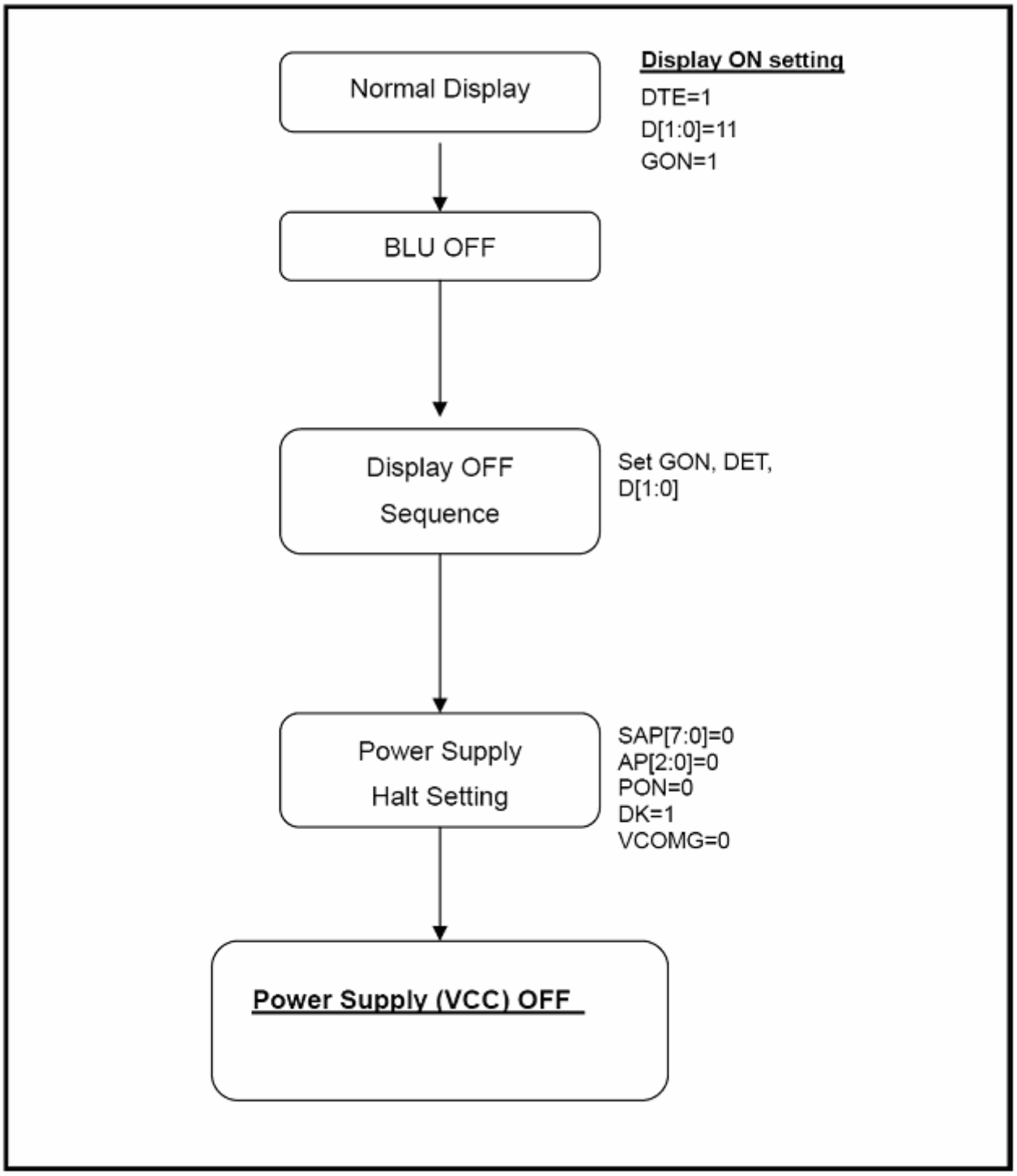
RESET Pulse	Action
Shorter than 5μs	Shorter than 5μs
Longer than 10μs	Reset
Between 5μs and 10μs	Reset Start

5.5 Power On/Off Sequence

5.5.1 Power on Sequence



5.5.2 Power off Sequence



6 Optical Characteristics

6.1 Optical Specification

Ta=25℃

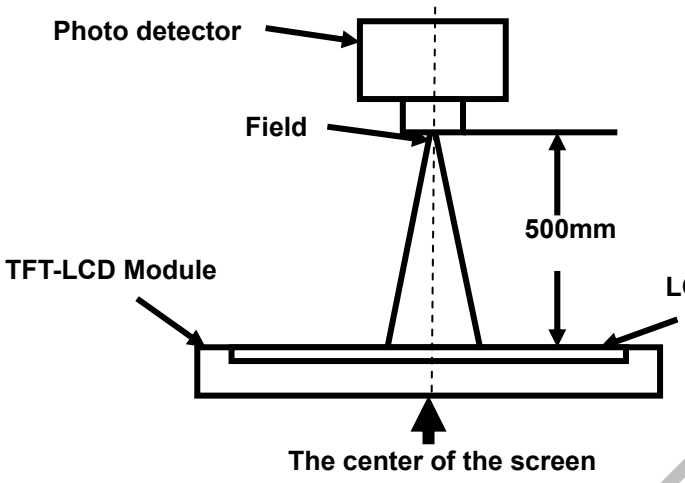
Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
View Angles		θT	CR≧10	60	70	-	Degree	Note 2
		θB		50	60	-		
		θL		60	70	-		
		θR		60	70	-		
Contrast Ratio		CR	θ=0°	400	500	-		Note1 Note3
Response Time		T_{ON}	25℃	-	20	30	ms	Note1 Note4
		T_{OFF}						
Chromaticity	White	x	Backlight is on	0.230	0.280	0.330		Note5, Note1
		y		0.240	0.290	0.340		
	Red	x		0.561	0.611	0.661		
		y		0.288	0.338	0.388		
	Green	x		0.274	0.324	0.374		
		y		0.562	0.612	0.662		
	Blue	x		0.095	0.145	0.195		
		y		0.041	0.091	0.141		
Uniformity		U		-	80	-	%	Note1 Note6
NTSC				-	60	-	%	Note 5
Luminance		L		300	350	-	cd/m^2	Note1 Note7

Test Conditions:

1. V_F =3.2V, I_F=15mA(Backlight current), 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	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)。

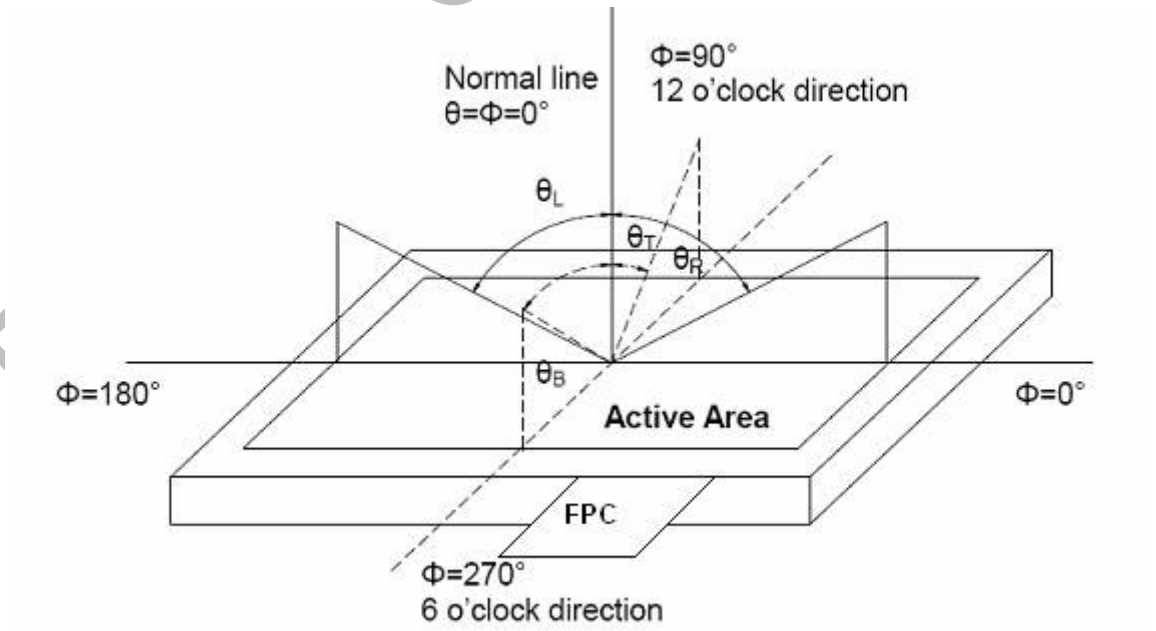


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

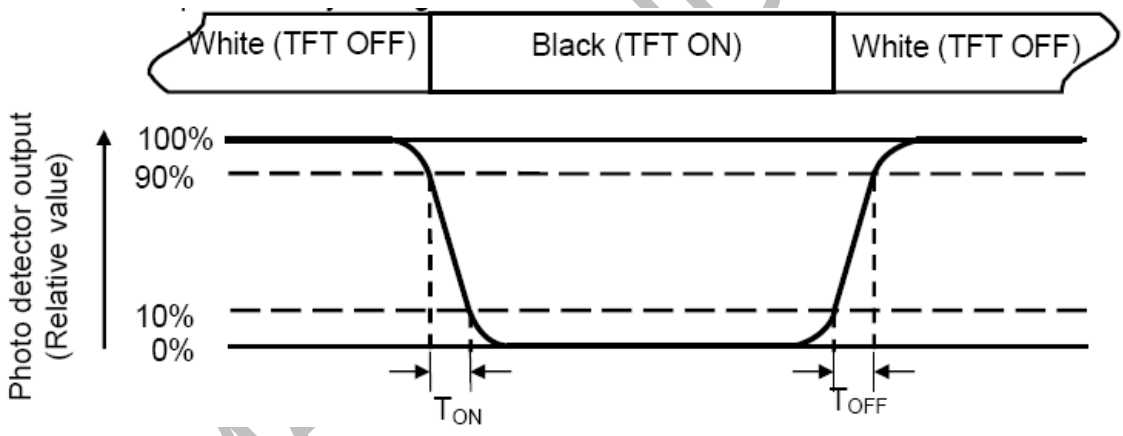
“White state “:The state is that the LCD should be driven by Vwhite.

“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 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

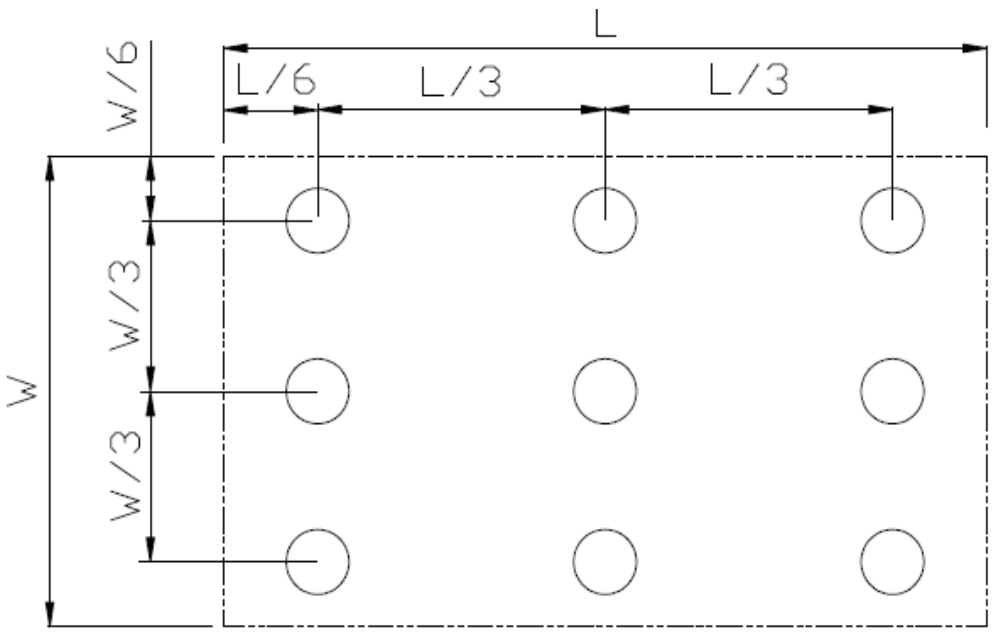


Fig. 2 Definition of uniformity

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.

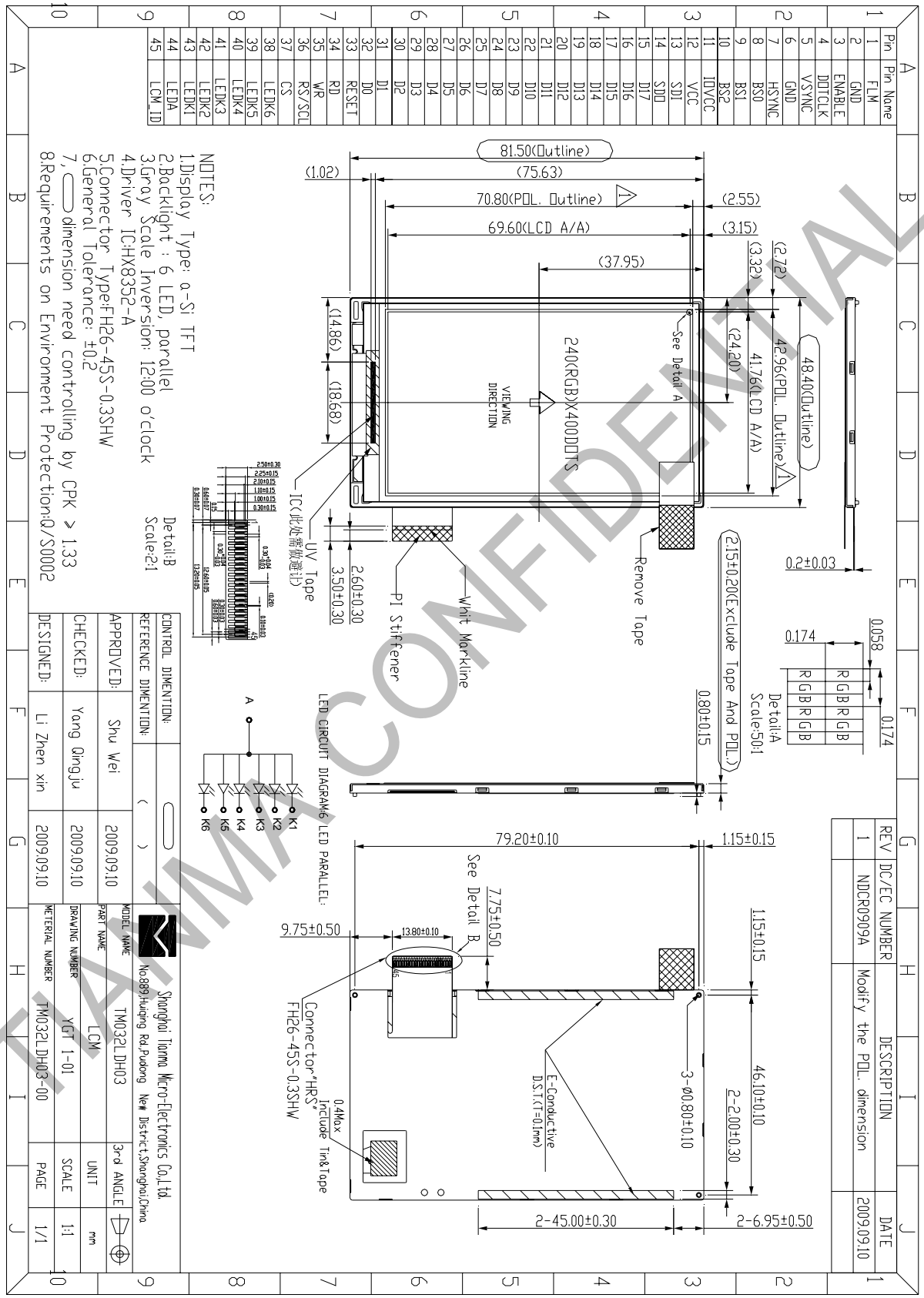
7 Environmental / Reliability Tests

No	Test Item	Condition	Remarks
1	High Temperature Operation	Ts=+70℃, 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=+80℃, 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	Ta=+60℃, 90% RH 240 hours	Note2 IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30℃ 30 min~+80℃ 30 min, Change time:5min, 20 Cycles	Start with cold temperature, End with high temperature, IEC60068-2-14:1984,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 2 hours for each direction of X.Y.Z. (6 hours for total)(Package condition)	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.

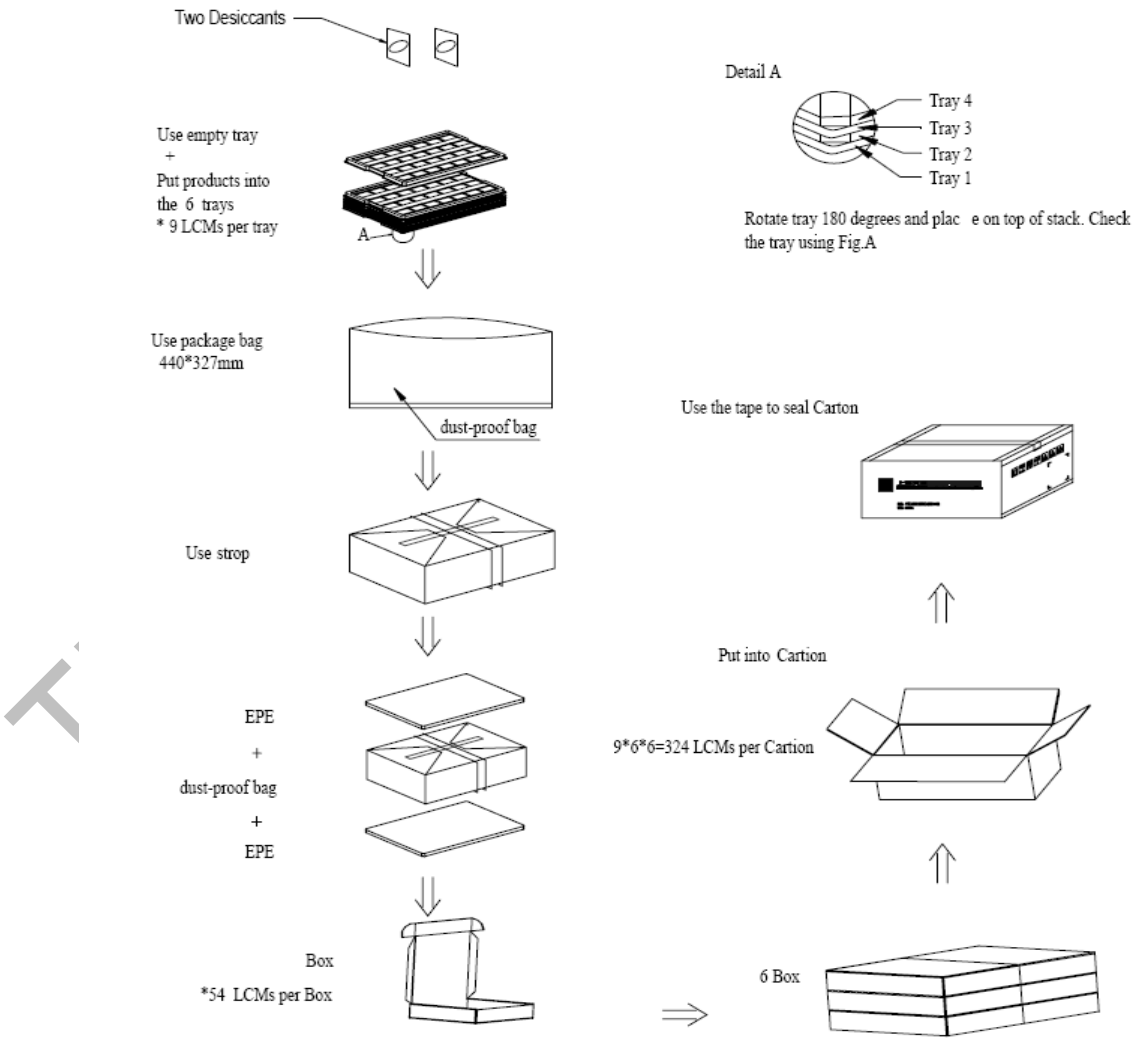
Note2: Ta is the ambient temperature of sample.

8 Mechanical Drawing



9 Packing Drawing

No	Item	Model(Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	LCM module	TM032LDH03	48.4x81.5x2.15	0.0166	324	
2	Tray	PET（Transmit）	315×247×10.8	0.083	42	Anti-static
3	EPE	EPE	315×247×5	0.009	12	
4	Anti-static bag	PE	327×440	0.021	6	
5	BOX	CORRUGATED PAPER	345×260×70	0.227	6	
6	Desiccant	Desiccant	45×50	0.0035	12	
7	Carton	CORRUGATED PAPER	544×365×250	1.01	1	
8	Total Weight(Kg)	10.8+/- 5%				



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:

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