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EVERBOUQUET INTERNATIONAL CO., LTD.
Address: 13F-3, No. 8, Lane 280, Sec. 6, Minchuan E. Rd., Nei-Hu 114, Taipei, Taiwan, R.O.C.
TEL: 886-2-2633-1253 FAX: 886-2-2631-2881

PART NO. : MF320240AT35-BF

FOR MESSRS. :

CONTENTS

陳 2011.02.14 佑銘

ACCEPTED BY : ---------- PROPOSED BY : ----------

RECORD OF REVISION

DATEAAA	REV.	PAGE	SUMMARY
2006/09/18	2	P1~P20	Change the P/N from MF320240A35-BF to MF320240AT35-BF.
2011/02/11	3	P1~P21	The new edition replaces the old edition.

3. General specifications

3.1 General specifications

It is a color active matrix TFT (Thin Film Transistor) liquid crystal display (LCD) that uses the amorphous silicon TFT as a switching devices. This model is composed of a Transmissive type TFT-LCD Panel, a driver circuit and a back-light unit.

3.2 Features

- High image quality a-Si TFT LCD module.
- 16.7M color number.
- Support 24-bits(RGB) input mode
- High contrast, high brightness
- Low power consumption.

3.3 Applications

- PDA
- Hand-held Device

4. Mechanical data

No	Item	Specification	Remark
1	Type	Transmissive	--
2	Display Mode	Normally White	--
3	Pixel Element	a-Si TFT	--
4	Screen Size	3.5inch	--
5	Resolution	320(RGB) x240	--
6	Color Number	16.7M	--
7	Active Area	70.08 (W) x 52.56(H) (mm)	--
8	Dot Pitch	73 x 219 (μm)	--
9	Color Arrangement	RGB-stripe	--
10	Assembly Type	COG	--
11	Back Light	LED	--
12	Viewing Direction	6 o'clock	--
13	Weight	TBD	--
14	Module Dimension	76.9(W) x 63.9(H) x 4.75(D)	

5. Absolute maximum ratings

5.1 Electrical absolute maximum ratings

(1) TFT-LCD Panel Absolute Maximum Ratings

Ta=25℃ GND=0V

Item	Symbol	Condition	Standard Value		Unit	Remark
			Min.	Max.		
Power supply	VDDIO	VSS=0V	-0.3	4.0	V	--
Input Voltage	Vi	--	-0.3	5.0	V	--

* If the LSI is used above these absolute maximum ratings, it may become permanently damaged. Using the LSI within the following electrical characteristics limit is strongly recommended for normal operation. If these electrical characteristic conditions are also exceeded, the LSI will malfunction and cause poor reliability.

(2) Back-Light Unit

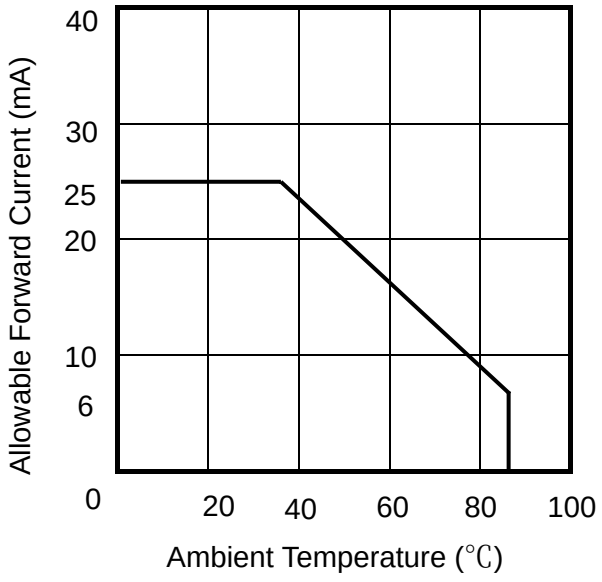
Ta=25℃

Item	Symbol	Min.	Max.	Unit	Remark
Current	I_B	--	(30)	mA	--

5.2 Environmental absolute maximum ratings

Item	Symbol	Min.	Max.	Unit	Remark
Operation temperature range	Top	-20	70	℃	Ambient
Storage temperature range	Tst	-30	80	℃	Ambient

(1) Corrosive gas environment is not acceptable.
(2) TFT-LCD color will change slightly depending on environment temperature. This phenomenon is reversible.
(3) Current reduction rate of LED backlight is according to the graph indicated below:



6. Electrical characteristics

(1)TFT-LCD Module

Ta =25℃

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Power supply voltage	VDDIO	(3.0)	(3.3)	(3.6)	V	--
Operating Current	IDD	--	(5.5)	(8.5)	mA	--
Vcom High Voltage	VCOMH	(2.5)	(3.6)	(4.5)	V	--
Vcom Low Voltage	VCOML	(-3.0)	(-2.4)	(0)	V	--

(2) Back-Light Unit

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Current	I_B	--	(20)	--	mA	--
Power Consumption	P_{BL}	--	(420)	--	mW	--

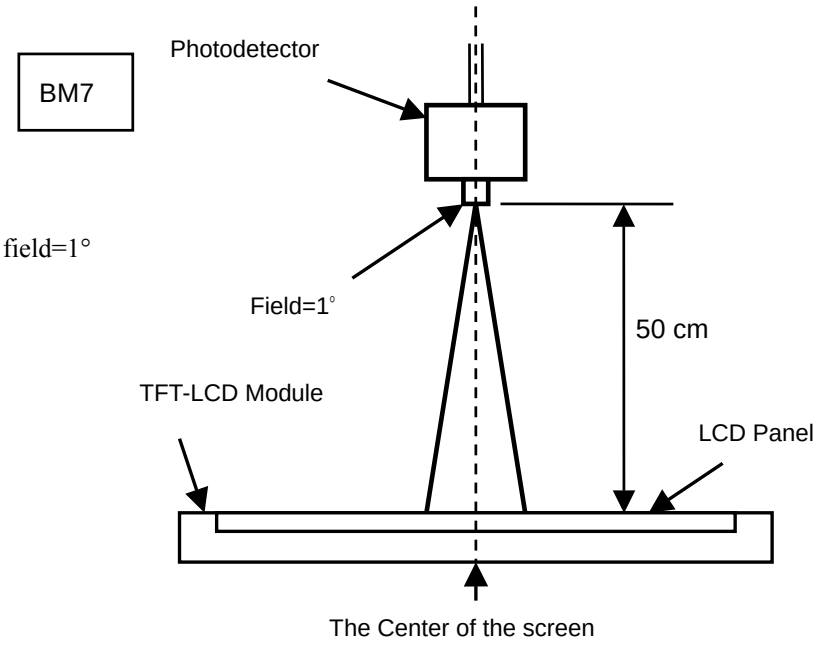
* Six LEDs is serial type

7. Optical characteristics

Ta = 25℃ , IB=20mA

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness		B	θ=0° Normal viewing angle At the center of panel	(180)	(200)	--	cd/m^2	(1)
Contrast Ratio		C/R		(200)	(250)	--	--	(2)
Response Time		Tr+Tf		--	(50)	(70)	ms	(3)
Color chromaticity (CIE 1931)	White	Wx		(0.244)	(0.294)	(0.344)	--	--
		Wy		(0.259)	(0.309)	(0.359)		
	Red	Rx		(0.577)	(0.627)	(0.677)		
		Ry		(0.310)	(0.360)	(0.410)		
	Green	Gx		(0.282)	(0.332)	(0.382)		
		Gy		(0.506)	(0.556)	(0.606)		
	Blue	Bx		(0.091)	(0.141)	(0.191)		
		By		(0.040)	(0.090)	(0.140)		
Viewing Angle	Top	θ_U	CR≧10 Backlight On	--	(45)	--	Degrees	(4)
	Bottom	θ_D		--	(50)	--		
	Left	θ_L		--	(50)	--		
	Right	θ_R		--	(50)	--		
Uniformity		Un	θ=0° Normal viewing angle	(70)	--	--	%	(5)

Note 1: The brightness test equipment setup

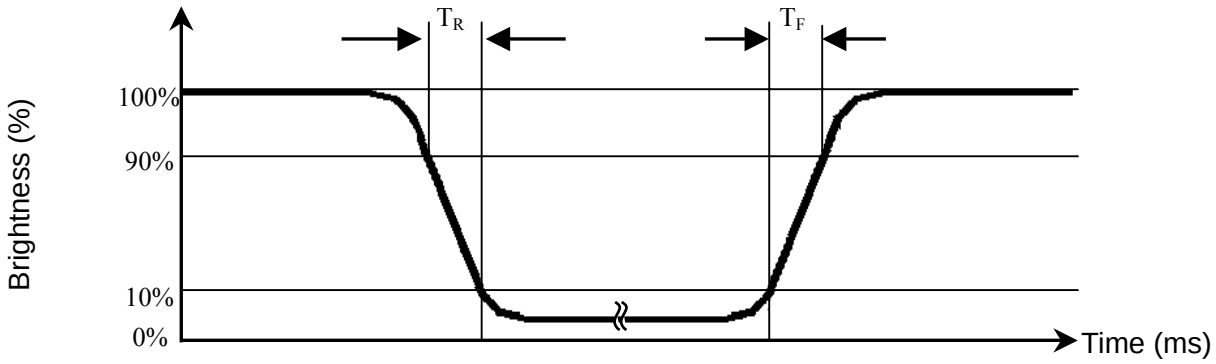


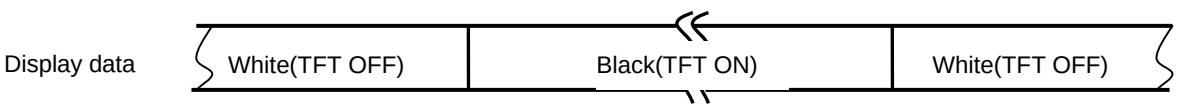
I_B=20mA, Field=1°
(As measuring "black" image, field=1°
Is the best testing condition.)

Note 2: Definition of contrast Ratio (C.R)

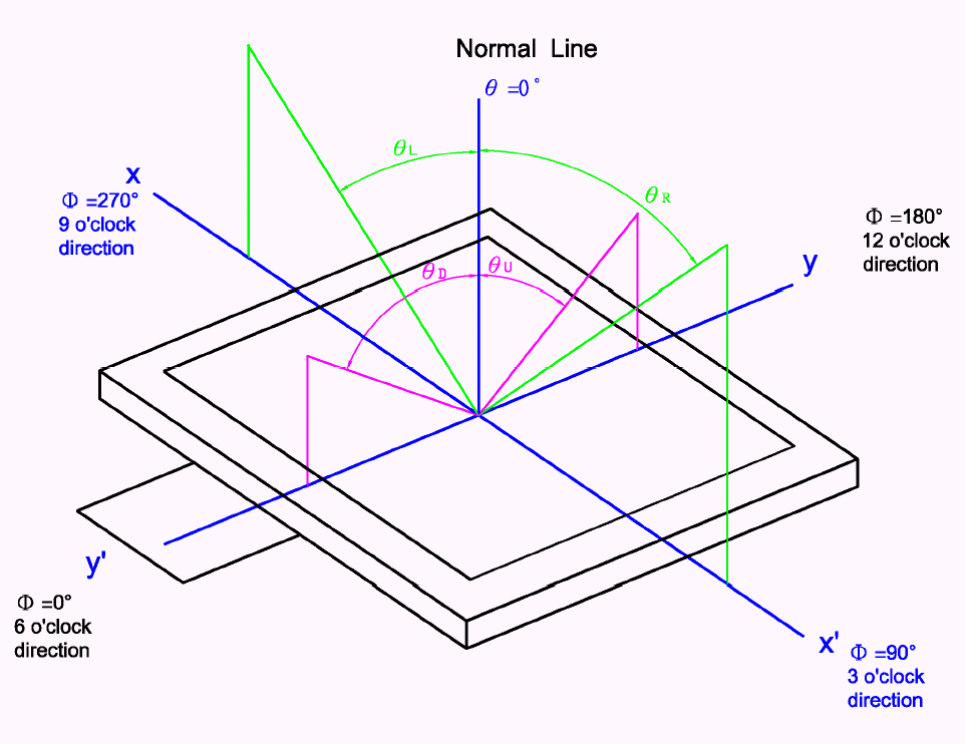
$$C.R = \frac{\textbf{Brightness When LCD is at "White" State}}{\textbf{Brightness When LCD is at "Black" State}}$$

Note 3: Definition of response time

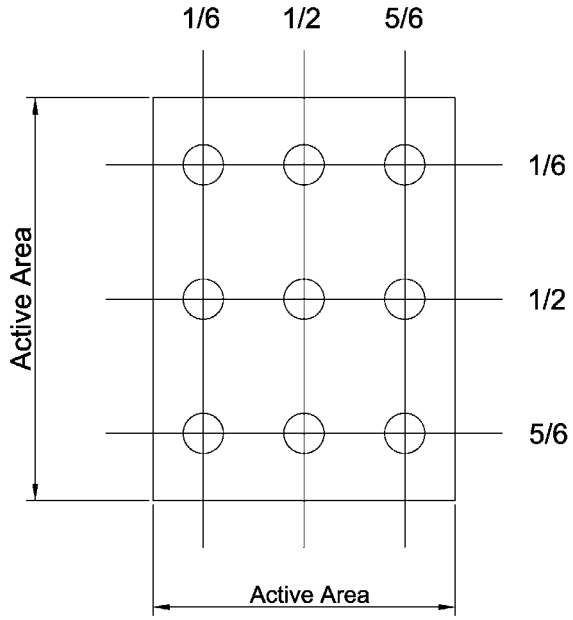




Note 4: Definition of viewing angle

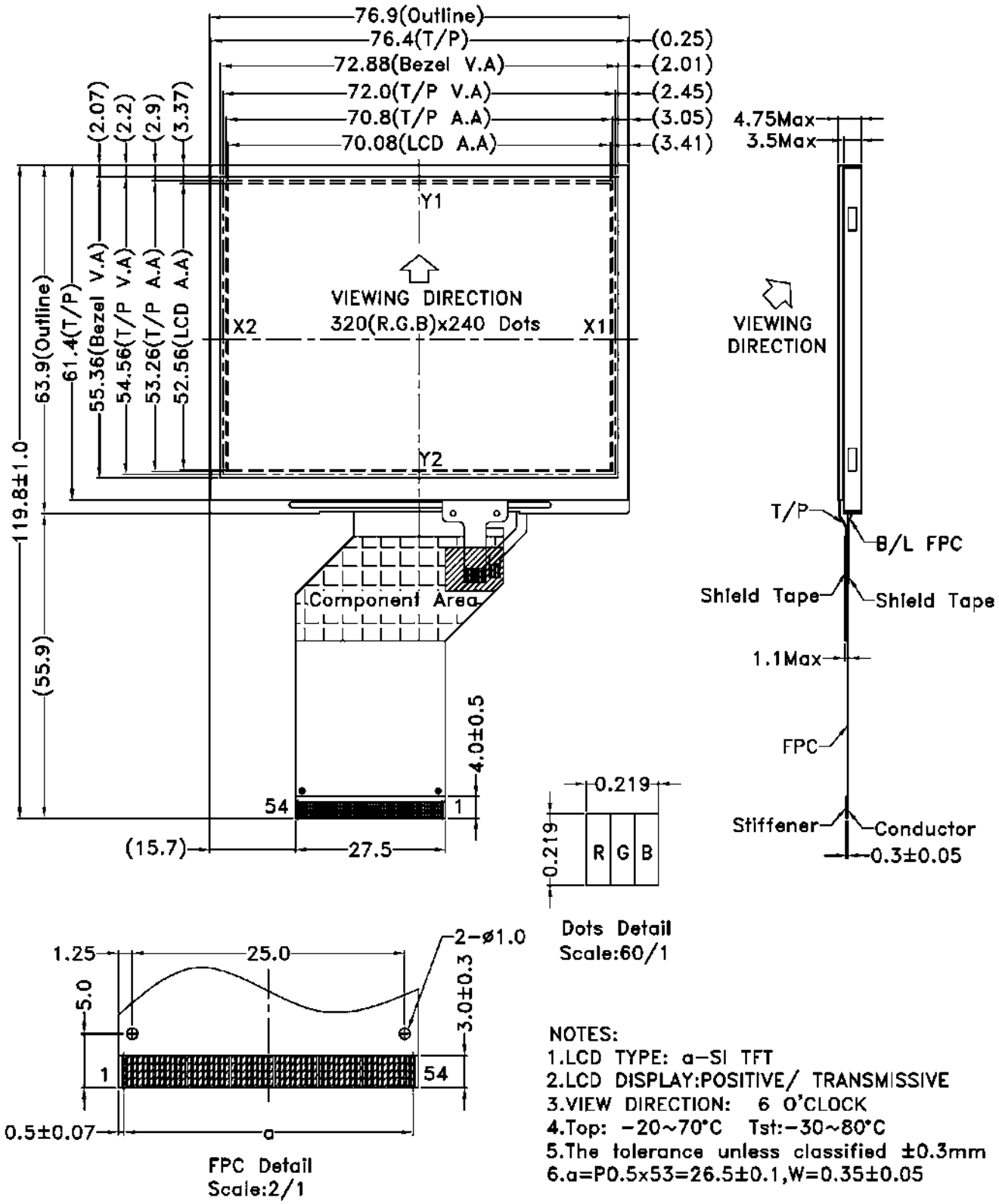


Note 5: Definition of uniformity (Un)



$$Un = \frac{\mathbf{Bmin}}{\mathbf{Bmax}} x100\%$$

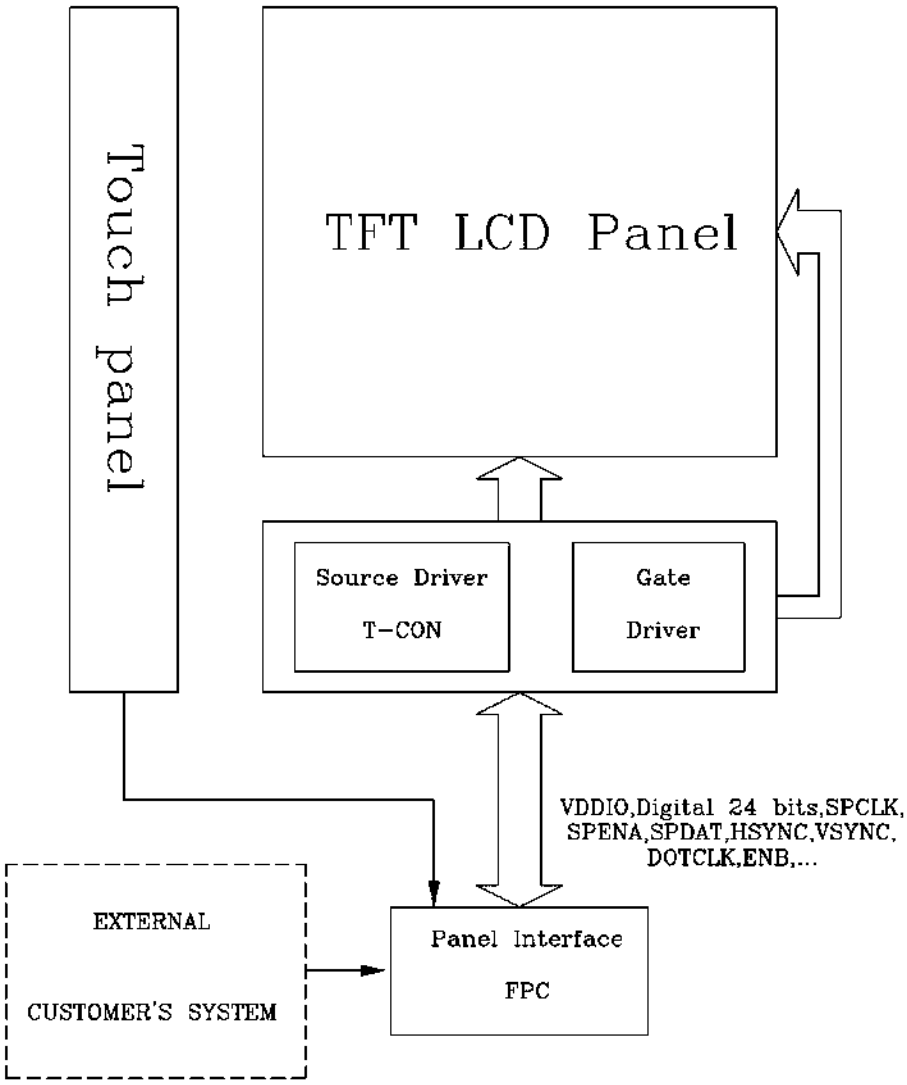
8. Outline dimension



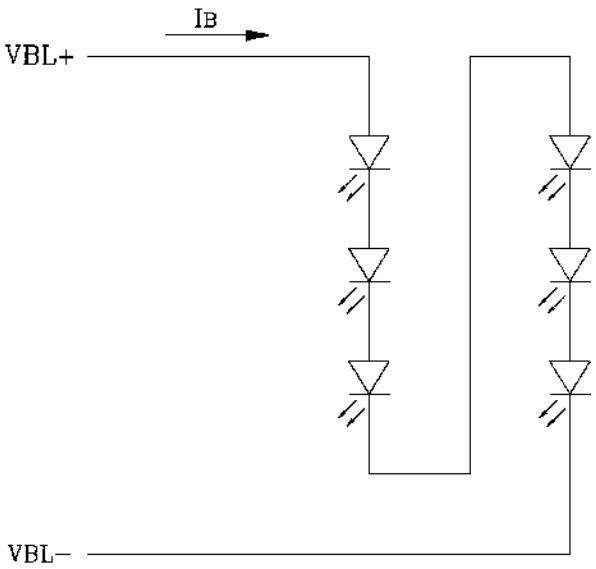
NOTES:
1.LCD TYPE: a-SI TFT
2.LCD DISPLAY:POSITIVE/ TRANSMISSIVE
3.VIEW DIRECTION: 6 O'CLOCK
4.Top: -20~70°C Tst:-30~80°C
5.The tolerance unless classified ±0.3mm
6.a=P0.5x53=26.5±0.1,W=0.35±0.05

9.Block diagram

9.1 TFT-LCD Module (Interface System Structure)



9.2 Back-light Unit



10. Input Terminal Pin Assignment

10.1 Input Signal & Power

Pin no	Symbol	Description	Remark
1	VBL-	Backlight LED ground	-
2	VBL-	Backlight LED ground	-
3	VBL+	Backlight LED power	-
4	VBL+	Backlight LED power	-
5	NC	NO CONNECTION	-
6	/RESET	Hardware reset	-
7	NC	NO CONNECTION	-
8	Y1	Touch panel TOP	-
9	X1	Touch panel RIGHT	-
10	Y2	Touch panel BOTTOM	-
11	X2	Touch panel LEFT	-
12	B0	Blue data bit 0	-
13	B1	Blue data bit 1	-
14	B2	Blue data bit 2	-
15	B3	Blue data bit 3	-
16	B4	Blue data bit 4	-
17	B5	Blue data bit 5	-
18	B6	Blue data bit 6	-
19	B7	Blue data bit 7	-
20	G0	Green data bit 0	-
21	G1	Green data bit 1	-
22	G2	Green data bit 2	-
23	G3	Green data bit 3	-
24	G4	Green data bit 4	-
25	G5	Green data bit 5	-
26	G6	Green data bit 6	-
27	G7	Green data bit 7	-
28	R0	Red data bit 0	-
29	R1	Red data bit 1	-
30	R2	Red data bit 2	-
31	R3	Red data bit 3	-
32	R4	Red data bit 4	-
33	R5	Red data bit 5	-

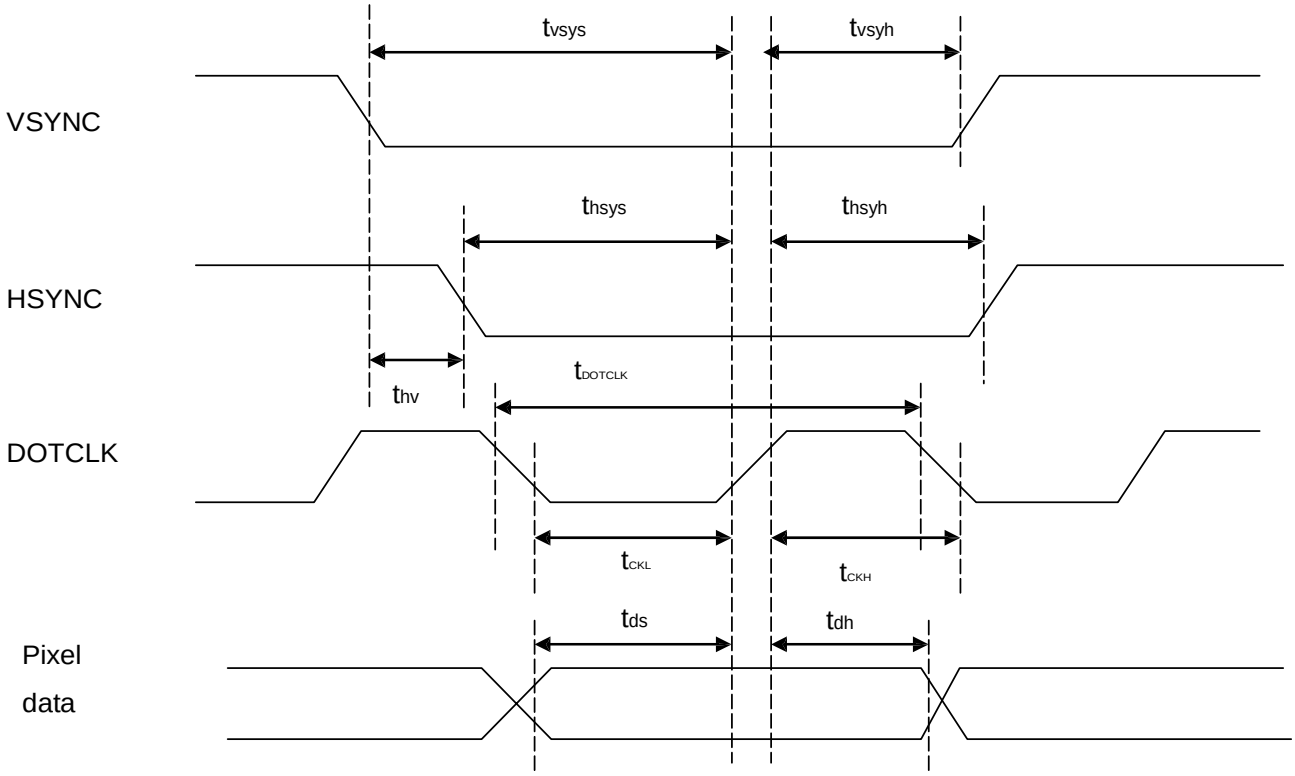
Pin no	Symbol	Description	Remark
34	R6	Red data bit 6	-
35	R7	Red data bit 7	-
36	HSYNC	Horizontal sync input	-
37	VSYNC	Vertical sync input	-
38	DOTCLK	Dot data clock	-
39	VDDIO	Digital power	-
40	VDDIO	Digital power	-
41	VDDIO	Digital power	-
42	VDDIO	Digital power	-
43	SPENA	SPI Interface Data Enable Signal	-
44	NC	NO CONNECTION	-
45	NC	NO CONNECTION	-
46	NC	NO CONNECTION	-
47	NC	NO CONNECTION	-
48	SHUT	Display shut down pin to put the driver into sleep mode. A sharp falling edge must be provided to such pin when IC power on. Internal pull low. - Connect to VDDIO for sleep mode - Connect to VSS for normal operating mode (Refer to Power Up Sequence)	-
49	SPCLK	SPI Interface Data Clock	-
50	SPDAT	SPI Interface Data	-
51	NC	NO CONNECTION	-
52	ENB	Data enable control	-
53	VSS	Ground	-
54	VSS	Ground	-

11. Basic Display Color and Gray Scale

Color			Input Color Data																							
			Red								Green								Blue							
			MSB							LSB	MSB							LSB	MSB							LSB
			R7	R6	R5	R4	R3	R2	R1	R0	G7	G6	G5	G4	G3	G2	G1	G0	B7	B6	B5	B4	B3	B2	B1	B0
Basic Colors	Black		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)		1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(255)		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	Blue(255)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Cyan		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta		1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	Yellow		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
	White		1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Red	Red(0)	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)		0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	:		:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(253)		1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(254)		1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(255)	Bright	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Green(0)	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green (1)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	Green (2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	:		0	0	0	0	0	0	0	0	:	:	:	:	:	:	:	:	0	0	0	0	0	0	0	0
	Green (253)		0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1	0	0	0	0	0	0	0	0
	Green (254)		0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0
	Green (255)	Bright	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
Blue	Blue (0)	Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue (1)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue (2)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
	:		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	:	:	:	:	:	:	:	:
	Blue (253)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	0	1
	Blue (254)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0
	Blue (255)	Bright	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

12. Timing Characteristics

12.1 Pixel timing

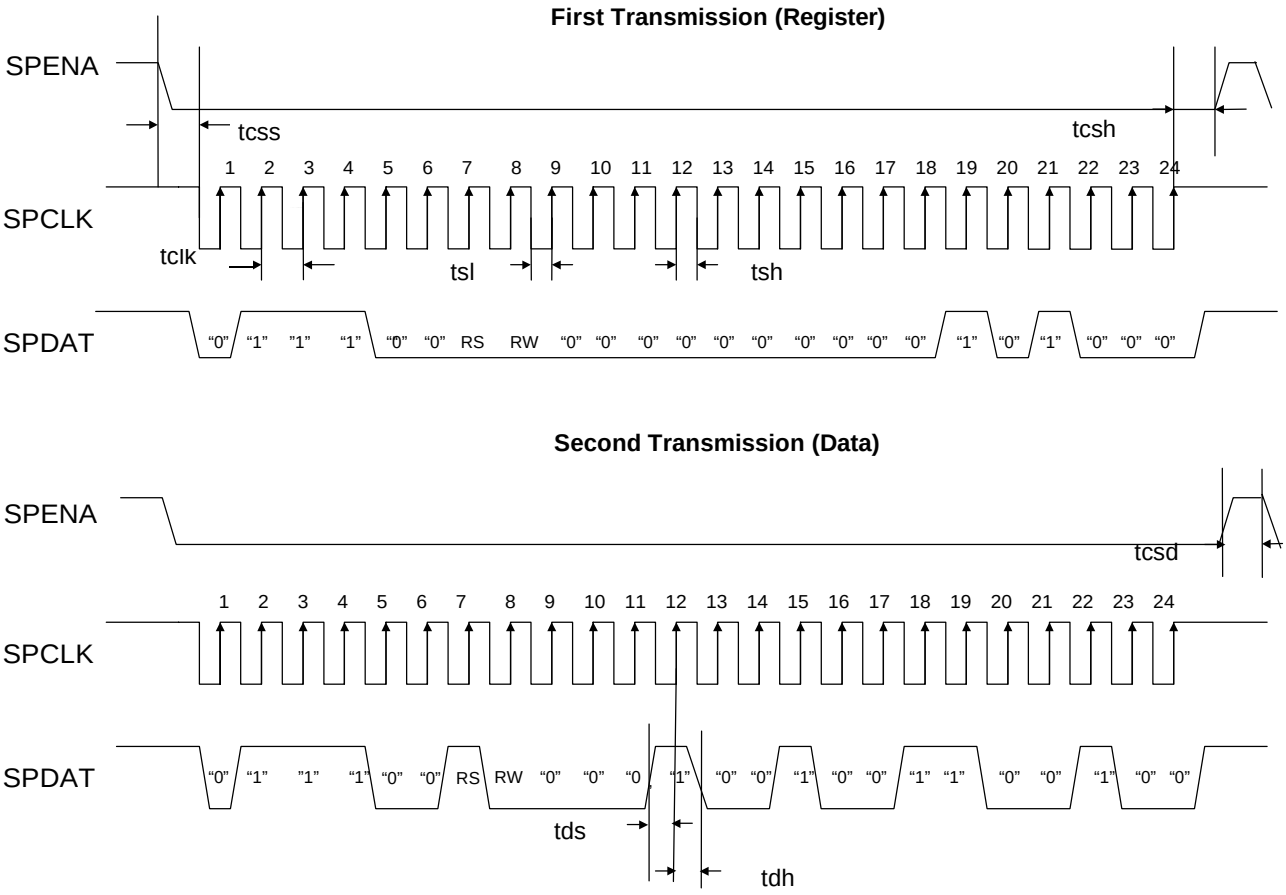


Characteristics	Symbol	Min		Typ		Max		Unit
		24 bit	8 bit	24 bit	8 bit	24 bit	8 bit	
DOTCLK Frequency	fDOTCLK	--	--	(6.5)	(19.5)	(10)	(30)	MHz
DOTCLK Period	tDOTCLK	(100)	(33.3)	(154)	(51.3)	--	--	ns
Vertical Sync Setup Time	tvsys	(20)	(10)	--	--	--	--	ns
Vertical Sync Hold Time	tvsyh	(20)	(10)	--	--	--	--	ns
Horizontal Sync Setup Time	thsys	(20)	(10)	--	--	--	--	ns
Horizontal Sync Hold Time	thsyh	(20)	(10)	--	--	--	--	ns
Phase difference of Sync Signal Falling Edge	thv	(1)		--		(240)		tDOTCLK
DOTCLK Low Period	tCKL	(50)	(15)	--	--	--	--	ns
DOTCLK High Period	tCKH	(50)	(15)	--	--	--	--	ns
Data Setup Time	tds	(12)	(10)	--	--	--	--	ns
Data hold Time	tdh	(12)	(10)	--	--	--	--	ns
Reset pulse width	tRES	(10)		--		--		µs

Note(1): External clock source must be provided to DOTCLK pin of HX8238-A.
The driver will not operate if absent of the clocking signal.

Note(2): The interface of this module can drive by digital 24-bit data

12.2 SPI interface timing diagram & transaction example

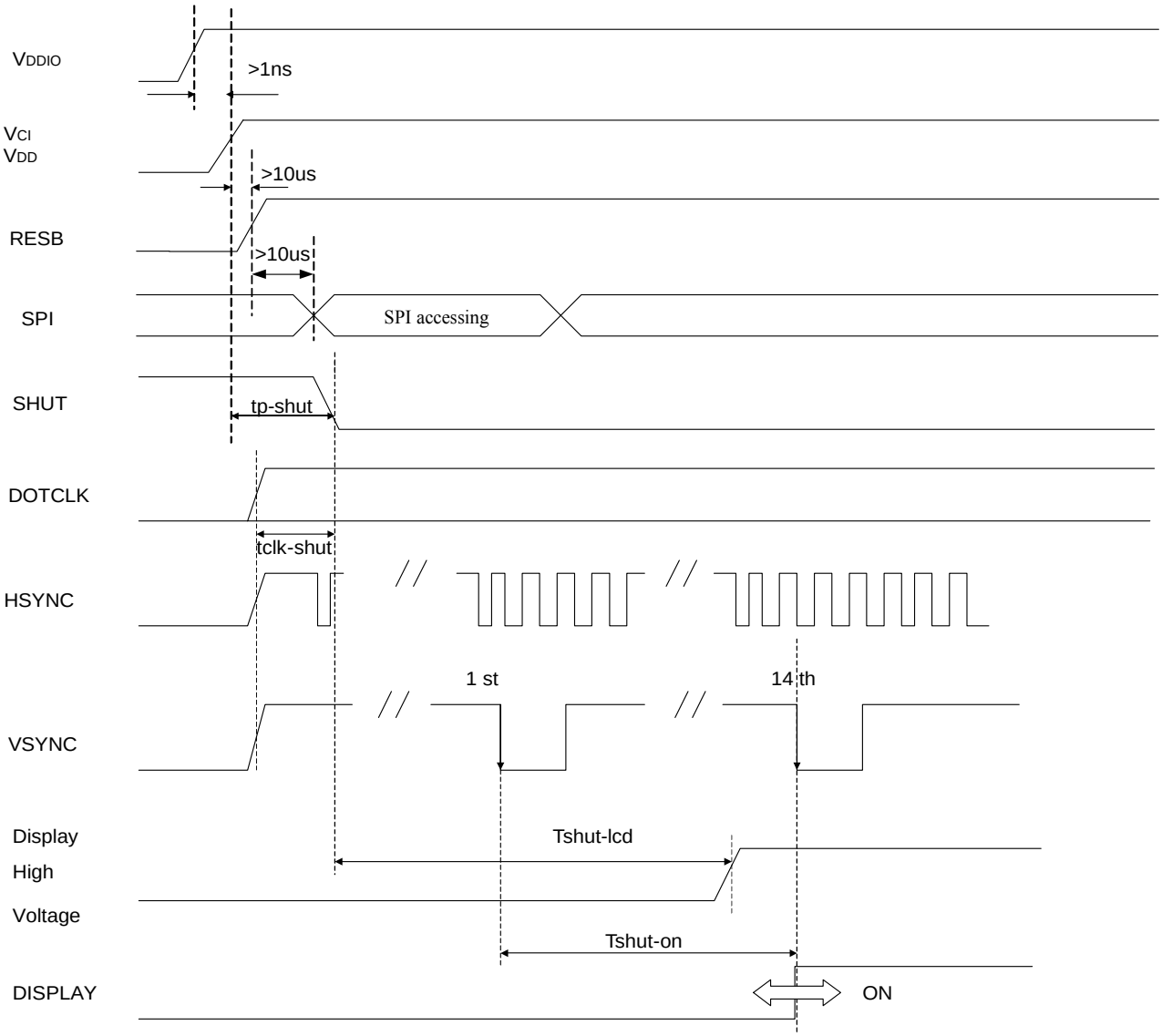


Note: The example transmit "0x1264h" to register R28h.

SPID connected to VSS.

Characteristics	Symbol	Min	Typ	Max	Unit
Serial Clock Frequency	fclk	--	--	(20)	MHz
Serial Clock Cycle Time	tclk	(50)	--	--	ns
Clock Low Width	tsl	(25)	--	--	ns
Clock High Width	tsh	(25)	--	--	ns
Chip Select Setup Time	tcss	(0)	--	--	ns
Chip Select Hold Time	tcsh	(10)	--	--	ns
Chip Select High Delay Time	tcsd	(20)	--	--	ns
Data Setup Time	tds	(5)	--	--	ns
Data Hold Time	tdh	(10)	--	--	ns

12.3 Power up sequence



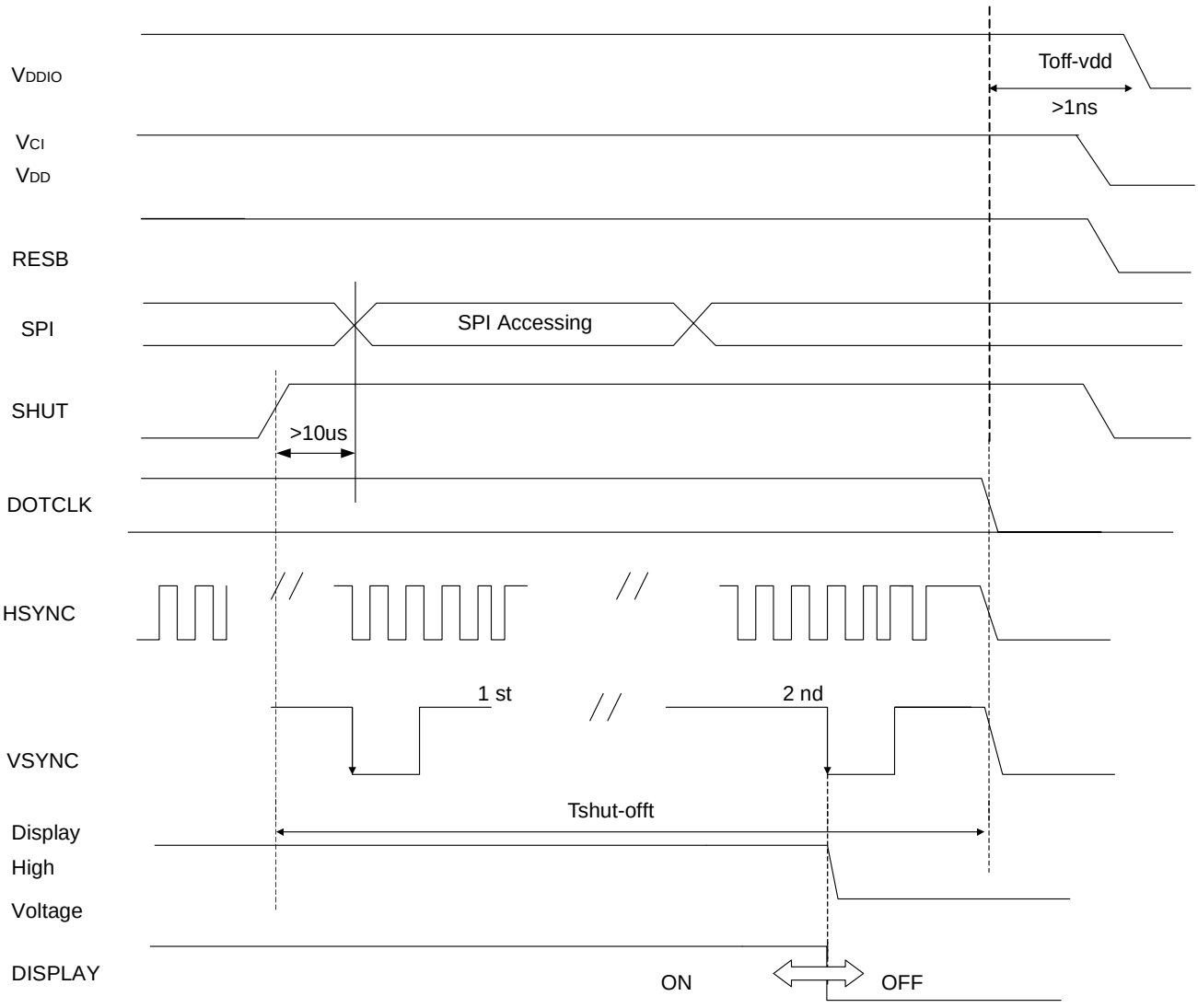
Characteristics	Symbol	Min	Typ	Max	Unit
VDDD / VDDIO on to falling edge of SHUT	tp-shut	(1)	--	--	µs
DOTCLK	tclk-shut	(1)	--	--	clk
Falling edge of SHUT to LCD power on	tshut-lcd	--	--	(128)	ms
Falling edge of SHUT to display start - 1 line: 408 clk - 1 frame: 262 line -DOTCLK = 6.5MHz	tshut-on	--	--	14	frame
		--	(166)	(232.4)	ms

Note(1): It is necessary to input DOTCLK before the falling edge of SHUT.

Display starts at 10th falling edge of VSTNC after the falling edge of SHUT.

Note(2):The voltage of VDD be boost from VDDIO.

12.4 Power down sequence



Characteristics	Symbol	Min	Typ	Max	Unit
Rising edge of SHUT to display off - 1 line: 408 clk - 1 frame: 262 line - DOTCLK = 6.5MHz	tshut-off	(2)	--	--	frame
		(33.4)	--	--	ms
Input-signal-off to VDDD / VDDIO off	toff-vdd	(1)	--	--	µs

Note(1): DOTCLK must be maintained at lease 2 frames after the rising edge of SHUT.

Display become off at the 2nd falling edge of VSTNC after the falling edge of SHUT.

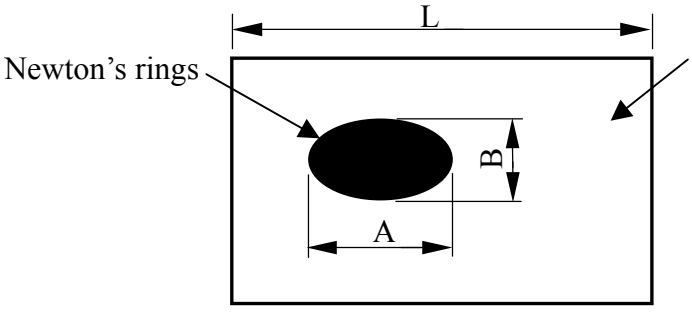
If RESET signal is necessary for power down, provide it after the 2-frames-cycle of the SHUT period.

Note(2): The voltage of VDD be boost from VDDIO.

13. Touch Screen Panel Specifications

1	Input Method and Activation Force	Stylus < 80grams and Finger < 80grams
2	Typical Optical Characteristics	Visible Light Transmission : >80% Haze : 10%(typ)
3	Electrical Specifications	1. Operating Voltage 7V or less 2. Circuit close resistance X : 300~900 ohm Y : 200~800 ohm 3. Circuit open resistance > 10 Mohm at 25V DC 4. Contact bounce < 20ms 5. Operative resistance ≤ 2.0 kohm
4	Linearity Tolerance	X≤1.5% (maximum), Y≤1.5% (maximum)
5	Environment Specification	Operating Temperature -20°C ~ +70°C (Operating Humidity: 20%~90% RH) Storage Temperature -30°C ~ +80°C (Storage Humidity: 10%~90% RH)

13.1 Newton ring inspect Specification



L：Long side of Touch Panel
A：Length of Newton's rings
B：Width of Newton's rings

(A+B) / 2 < L/4：Acceptable

14. Driver IC Control Algorithms

Refer to the data Sheet of LCD DRIVER IC1 HX8238 or equivalent

15. Reliability Test Items

No.	Test items	Conditions		Remark
1	High temperature storage	80℃ 240H		--
2	Low temperature storage	-30℃ 240H		--
3	High temperature & high humidity storage	60℃. 90% RH, 240H		--
4	Low temperature operation	-20℃ 240H		--
5	Vibration test	Freq.:10 ~ 55~10 Hz, Amp.:1.5 mm 1H for each direction of X, Y, Z		Non-operation
6	Electrostatic discharge	Terminals	150pF, 0Ω, ±300 V, Contact	Non-operation
		Panel	150pF, 330Ω, ±8 KV, Air	
7	Thermal Shock	-30℃ ,30 min /80℃ ,30 min , 20 cycles		Static
8	High temperature operation	70℃ 240H		--
9	Low temperature operation	-20℃ 240H		--
10	High temperature & high humidity operation	50℃. 90% RH, 240H		Operating

Criterion: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.

16. General Precautions

Please pay attentions to the followings as using the LCD module.

16.1 Handling

(a) Do not apply strong mechanical stress like drop, shock or any force to LCD module. It may cause improper operation, even damage.

(b) Because the polarizer is very fragile and easy to be damaged, do not hit, press or rub the display surface with hard materials.

(c) Do not put heavy or hard material on the display surface, and do not stack LCD modules.

(d) If the display surface is dirty, please wipe the surface softly with cotton swab or clean cloth.

(e) Avoid using Ketone type materials (e.g. Acetone), Toluene, Ethyl acid or Methyl chloride to clean the display surface. It might damage the polarizer permanently. The recommended solvents are water and Isopropyl alcohol.

(f) Wipe off water droplets or oil immediately.

(g) Protect the LCD module from ESD. It will damage the LSI and the electronic circuit.

(h) Do not touch the output pins directly with bare hands.

(I) Do not disassemble the LCD module.

16.2 Storage

(a) Do not leave the LCD modules in high temperature, especially in high humidity for a long time.

(b) Do not expose the LCD modules to sunlight directly.

(c) The liquid crystal is deteriorated by ultraviolet. Do not leave it in strong ultraviolet ray for a long time.

(d) Avoid condensation of water. It may cause improper operation.

(e) Please stack only up to the number stated on carton box for storage and transportation. Excessive weight will cause deformation and damage of carton box.

16.3 Operation

(a) When mounting or dismounting the LCD modules, turn the power off.

(b) Protect the LCD modules from electric shock.

(c) The Driver IC control algorithms should always obeyed to avoid damaging the LSI and electronic circuit.

(d) Be careful to avoid mixing up the polarity of power supply for backlight.

(e) Absolute maximum rating specified above has to be always kept in any case. Exceeding it may cause non-recoverable damage of electronic components or, nevertheless, burning.

(f) When a static image is displayed for a long time, remnant image is likely to occur.

(g) Be sure to avoid bending the FPC to an acute shape, it might break FPC.

16.4 Others

(a) If the liquid crystal leaks from the panel, it should be kept away from the eyes or mouth.

(b) For the fragility of polarizer, it is recommended to attach a transparent protective plate over the display surface.

(c) It is recommended to peel off the protection film on the polarizer slowly so that the electrostatic charge can be minimized