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CONTENTS

NO.	ITEM	PAGE
1.	COVER	1
2.	RECORD OF REVISION	2
3.	GENERAL SPECIFICATION	3
4.	MECHANICAL DATA	3
5.	ABSOLUTE MAXIMUM RATINGS	4
6.	ELECTRICAL CHARACTERISTICS	5
7.	OPTICAL CHARACTERISTICS	6~8
8.	OUTLINE DIMENSION	9
9.	BLOCK DIAGRAM	10
10.	INPUT TEMINAL PIN ASSIGNMENT	11~12
11.	BASIC DISPLAY COLOR AND GRAY SCALE	13
12.	INTERFACE SPECIFICATIONS	14~15
13.	DRIVER IC CONTROL ALGONRITHMS	16
14.	RELIABILTY TEST ITEMS	16
15.	GENERAL PRECAUTIONS	17~18

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RECORD OF REVISION

DATE	PAGE	SUMMARY

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-bit parallel (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 3.4(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 voltage	VDD	AVSS=0V	-0.3	7.0	V	Analog
	VCC	GND=0V	-0.3	7.0	V	Digital
	V _{GH}	GND=0V	-0.3	32.0	V	--
	V _{GL}	GND=0V	-22.0	0.3	V	--
	V _{GH} -V _{GL}	GND=0V	-0.3	45	V	--
Input Voltage	V _i	--	-0.3	VDD+0.3	V	--
	V _i	--	-0.3	VCC+0.3	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

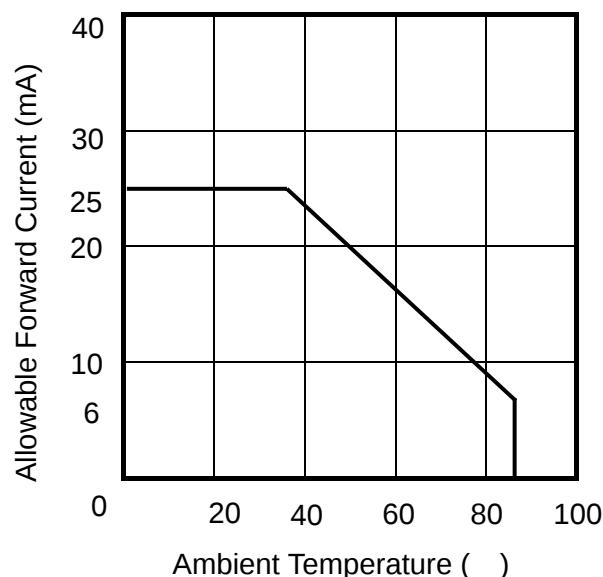
Ta=25

Item	Svmbol	Min.	Max.	Unit	Remark
Current	I _B	--	(30)	mA	--

5.2 Environmental absolute maximum ratings

Item	Svmbol	Min.	Max.	Unit	Remark
Operation temperature range	Top	-20	70		Ambient
Storage temperature range	Tst	-30	70		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
Digital Power supply	VCC	3	3.3	3.6	V	--
Analog Power supply	VDD	3.8	5	5.5	V	--
Digital Operating Current	ICC	--	1.8	2.7	mA	--
Analog Operating Current	IDD	--	5.8	8.7	mA	--
Gate On Power	VGH	--	15	--	V	--
Gate Off Power	VGL	--	-10	--	V	--
Gate On Current	IGH	--	0.04	--	mA	--
Gate Off Current	IGL	--	0.03	--	mA	--
Vcom Current	ICOM(RMS)	--	8	--	V	--
Vcom High Current	VCOMH	2.5	--	4	V	NOTE(1)
Vcom Low Current	VCOML	-1.5	--	0	V	NOTE(1)
Frame frequency	fFrame	--	60	90	Hz	--
Dot Data Clock	DCLK	--	--	6.4	MHz	--

NOTE:(1) VCOMH&VCOML: Adjust the color with gamma data

(2) Back-Light Unit

Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Current	I _B	--	(20)	--	mA	--
Power Consumption	P _{BL}	--	(420)	--	mW	--

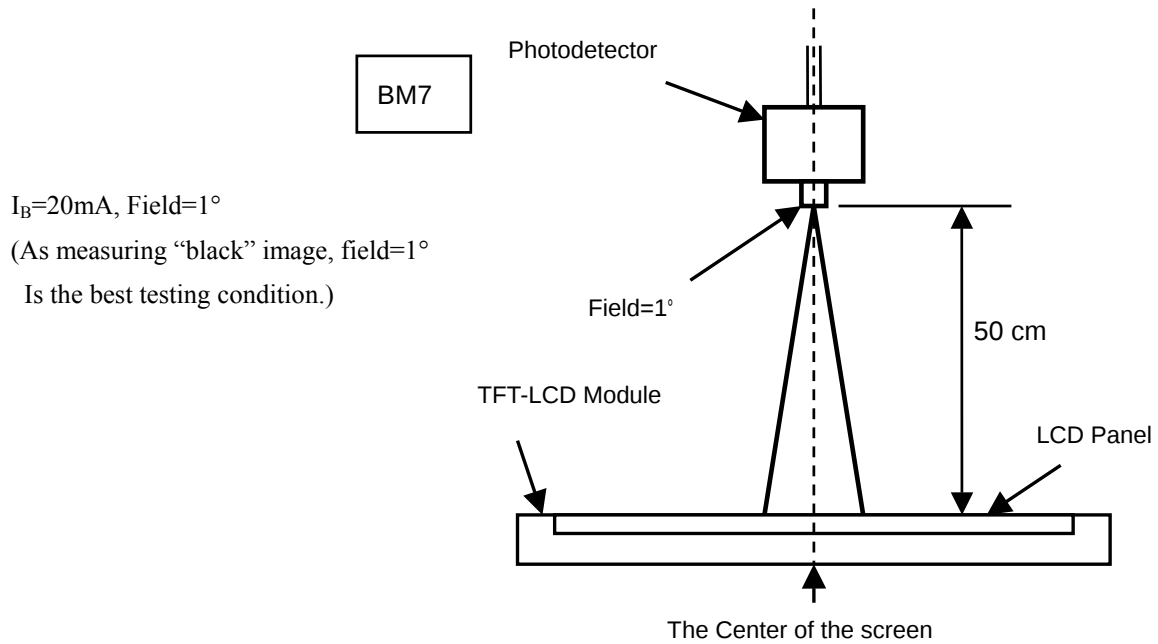
* Three LEDs is serial type

7. Optical characteristics

$T_a = 25^\circ\text{C}$, $I_B = 20\text{mA}$

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness		B	$\theta = 0^\circ$ Normal viewing angle At the center of panel	(200)	(290)	--	cd/m^2	(1)
Contrast Ratio		C/R		(180)	(220)	--	--	(2)
Response Time		Rising: Tr		--	(15)	(30)	ms	(3)
		Falling: Tf		--	(35)	(50)		
Color chromatic ity	White	W_x		(0.21)	(0.31)	(0.41)	--	--
		W_y		(0.23)	(0.33)	(0.45)		
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	$\theta = 0^\circ$ Normal viewing angle	--	(60)	--	%	(5)

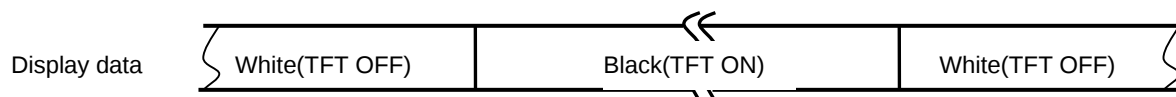
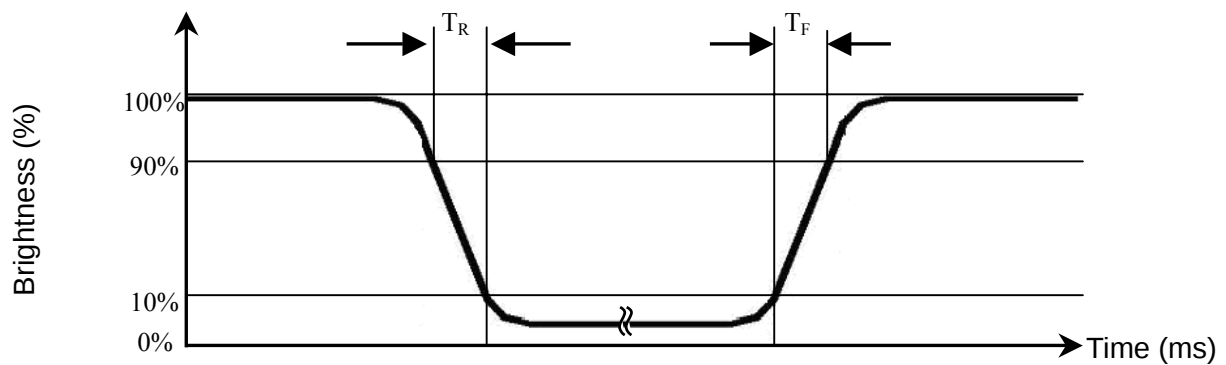
Note 1: The brightness test equipment setup



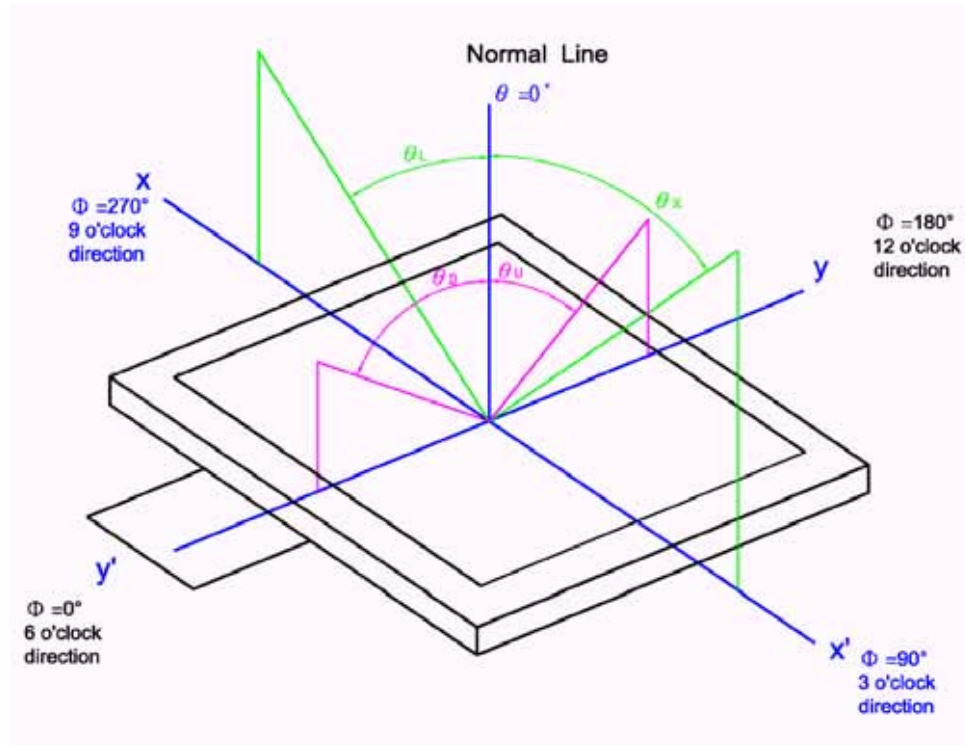
Note 2: Definition of contrast Ratio (C.R)

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

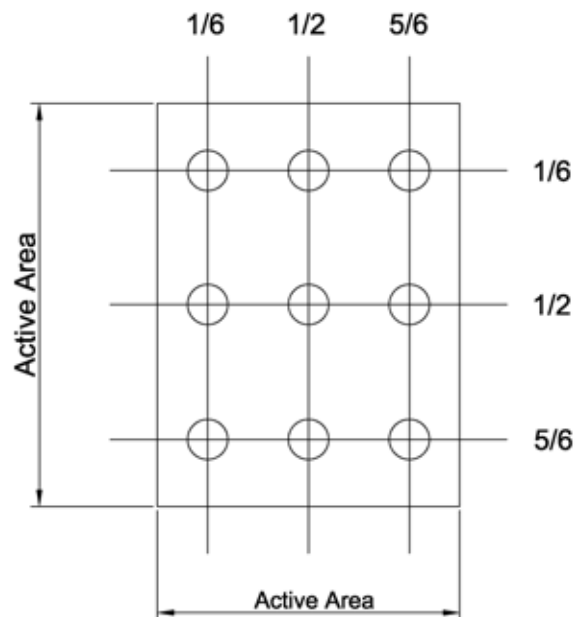
Note 3: Definition of response time



Note 4: Definition of viewing angle

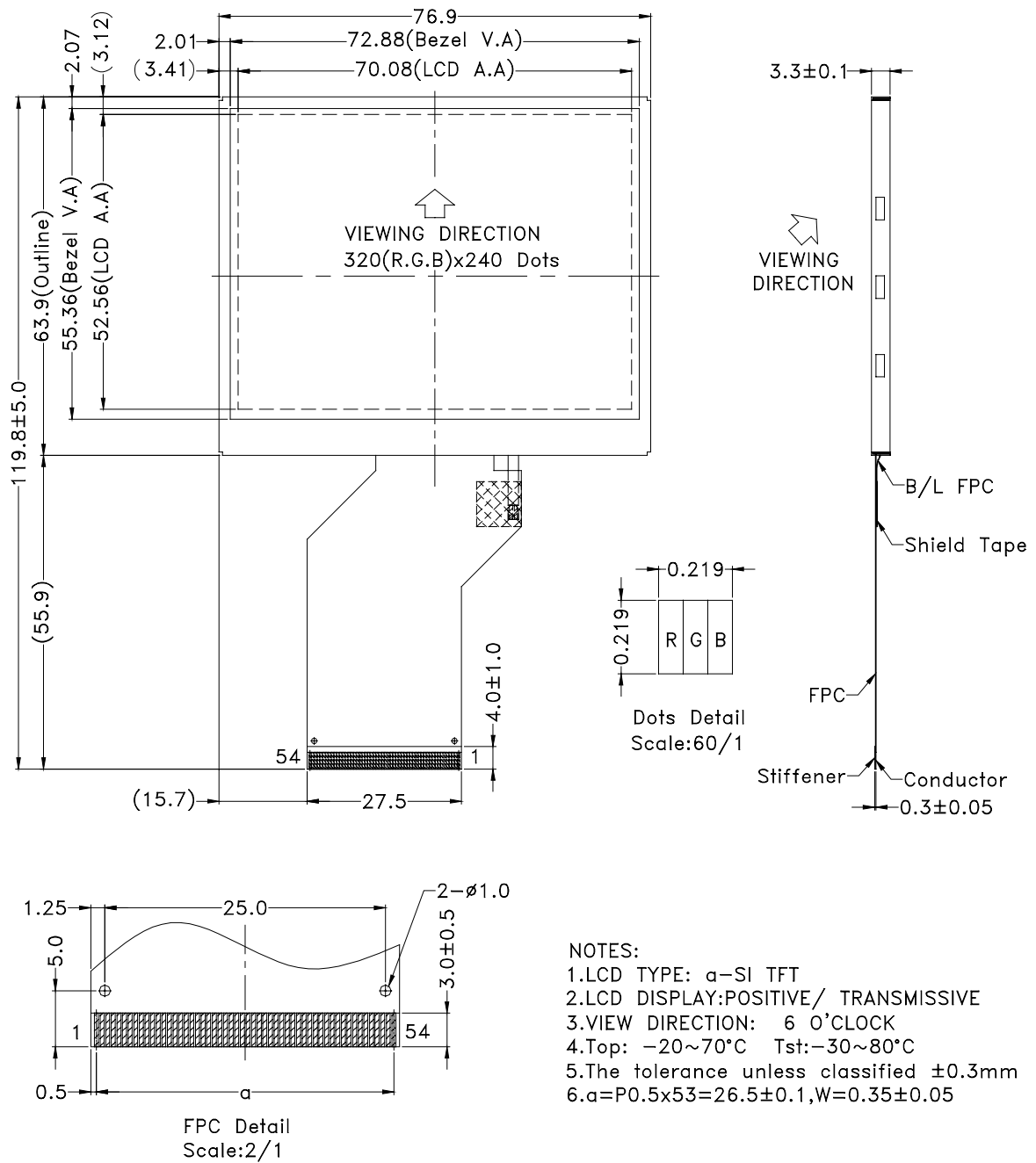


Note 5: Definition of uniformity (U_n)



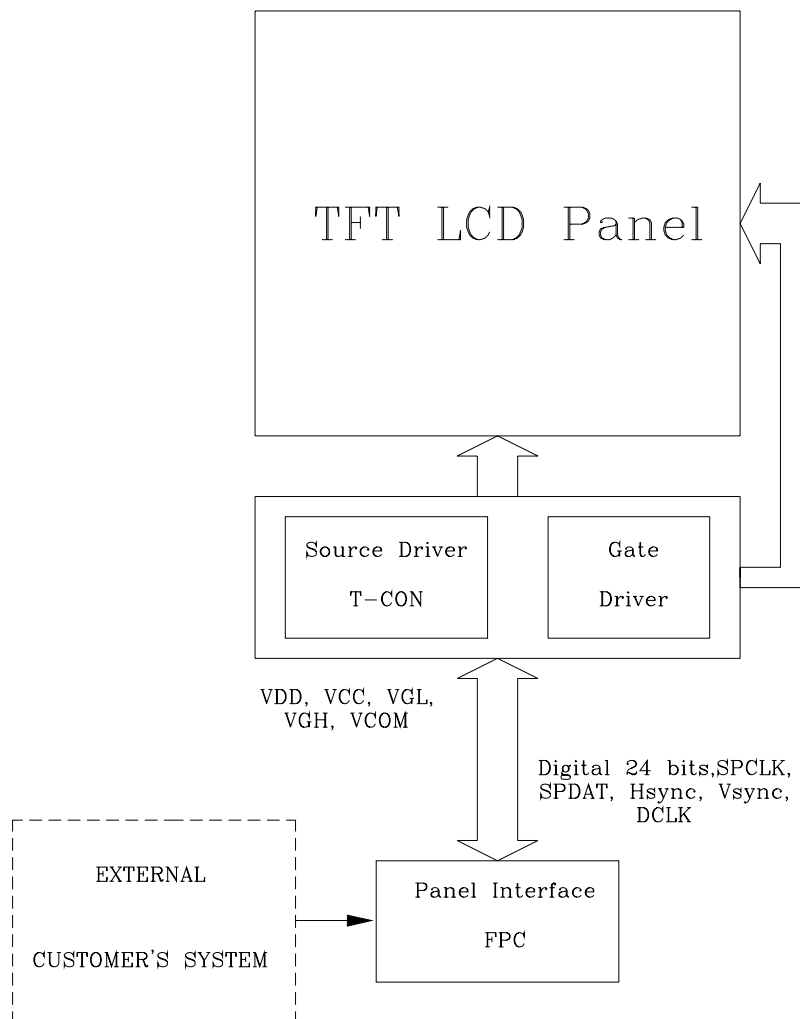
$$U_n = \frac{B_{\min}}{B_{\max}} \times 100\%$$

8. Outline dimension

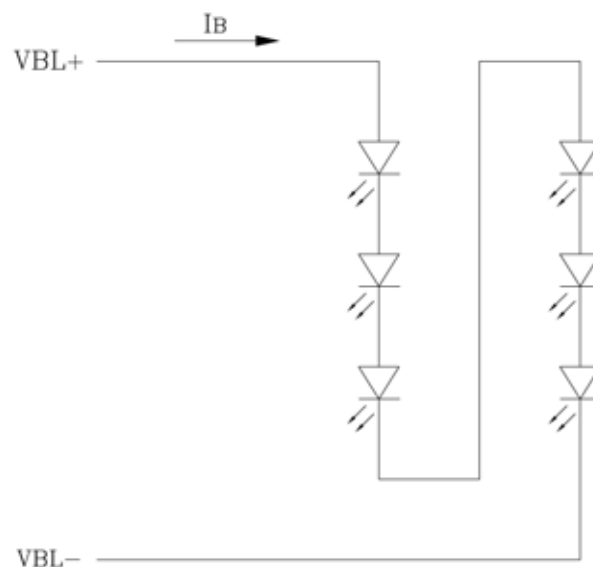


9. Block diagram

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	NC	NO CONNECTION	-
7	POL	Polarity Signal Connect Vcom driving circuit	NOTE(1)
8	/RESET	Hardware reset	-
9	SPENA	SPI Interface Data Enable Signal	-
10	SPCLK	SPI Interface Data Clock	-
11	SPDAT	SPI Interface Data	-
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	DCLK	Dot data clock	-
39	VDD	Analog power	-
40	VDD	Analog power	-
41	VCC	Digital power	-
42	VCC	Digital power	-
43	NC	NO CONNECTION	-
44	NC	NO CONNECTION	-
45	VGL	Gate OFF power	-
46	NC	NO CONNECTION	-
47	VGH	Gate ON power	-
48	NC	NO CONNECTION	-
49	NC	NO CONNECTION	-
50	NC	NO CONNECTION	-
51	VCOM	Driving Input	NOTE(1)
52	ENB	Data enable control	NOTE(2)
53	AVSS	Ground	-
54	GND	Ground	-

NOTE:

- (1) The polarity of Vcom(Pin51) should be generated from POL(Pin 7).
- (2) For digital RGB input data format, both SYNC mode and DE+SYNC mode are supported.
If ENB signal is fixed low, SYNC mode is used. Otherwise, DE+SYNC mode is used.

11. Basic Display Color and Gray Scale

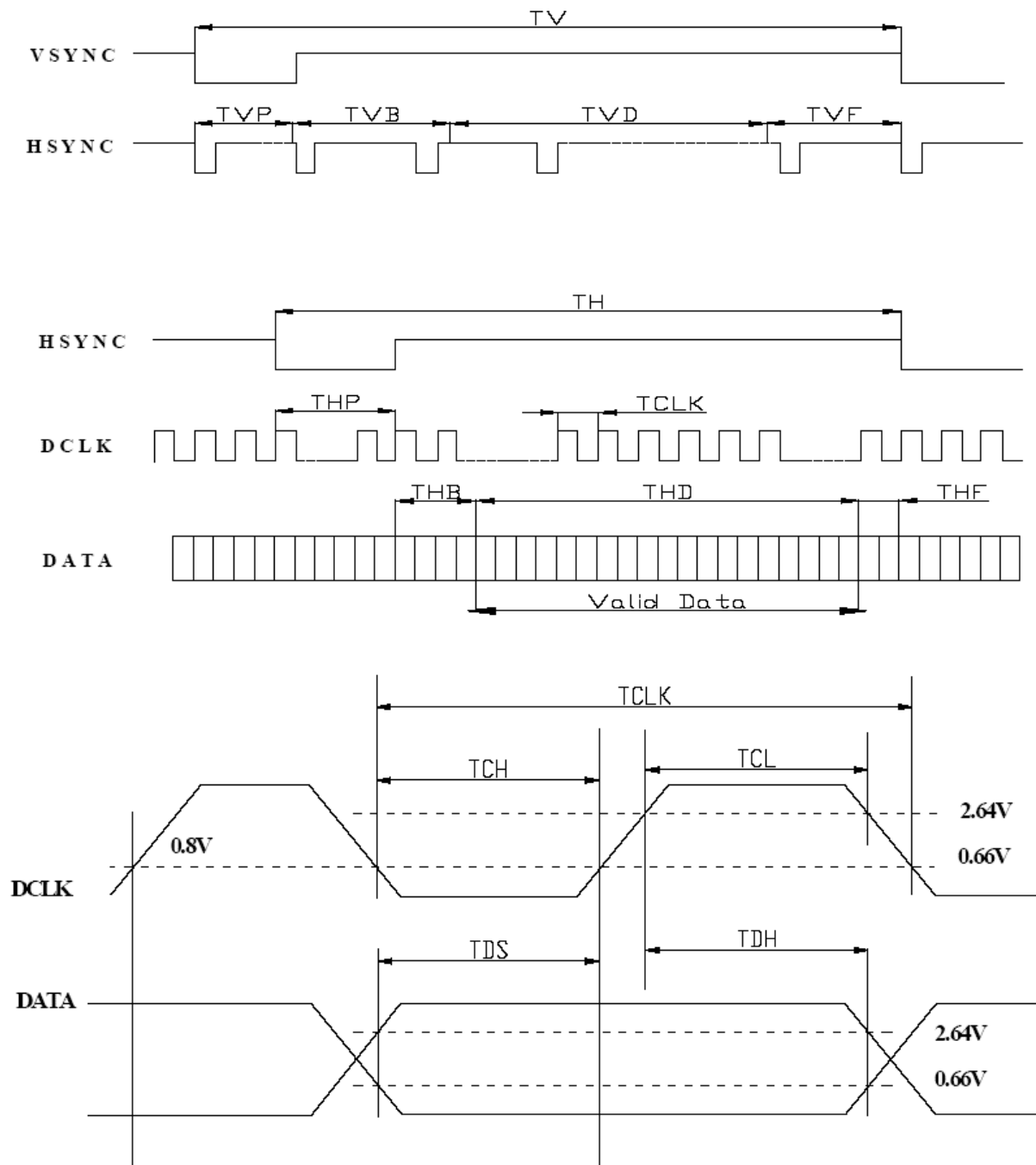
Color			Input Color Data																							
			Red								Green								Blue							
			MSB				LSB				MSB				LSB				MSB				LSB			
			R	R	R	R	R	R	R	R	G	G	G	G	G	G	G	G	B	B	B	B	B	B	B	B
7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0	7	6	5	4	3	2	1	0			
Basic Colors	Black		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	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	
	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	
	Blue(255)		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	
	Magenta		1	1	1	1	1	1	1	1	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	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	
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	
	Red(1)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Red(2)		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	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	
	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	
	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	
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	
	Green (1)		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	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	
	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	
	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	
	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	
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	
	Blue (1)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	
	Blue (2)		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	:	:	:	:	:	:	:	:	
	Blue (253)		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	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	1	1	1	1	1	1	1	1	

12. Interface Specifications

12.1 AC Timing Characteristics

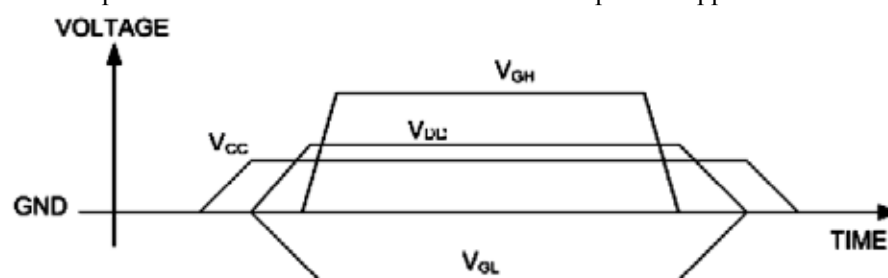
Item	Symbol	Min.	Typ.	Max.	Unit
DCLK Frequency	Dclk	-	(6.4)	-	MHz
DCLK High Time	Tch	-	(78)	-	ns
DCLK Low Time	Tcl	-	(78)	-	ns
Data Setup Time	Tds	(12)	-	-	ns
Data Hold Time	Tdh	(12)	-	-	ns
Hsync Period	TH	-	(408)	-	DCLK
Hsync Pulse Width	Thp	-	(30)	-	DCLK
Hsync Back-Porch	Thb		(38)		DCLK
Hsync Display Period	Thd	-	(320)	-	DCLK
Hsync Front-Porch	Thf	-	(20)	-	DCLK
Vsync period NTSC	Tv	-	(262.5)	-	TH
Vsync period PAL	Tv	-	(312.5)	-	TH
Vsync Pulse Width	Tvp	(1)	(3)	(5)	TH
Vsync Back-Porch NTSC	Tvb	-	(15)	-	TH
Vsync Back-Porch PAL	Tvb	-	(23)	-	TH
Vsync Display Period	Tvd	-	(240)	-	TH
Vsync Front-Porch NTSC	Tvf	-	(4.5)	-	TH
Vsync Front-porch PAL	Tvf	-	(46.5)	-	TH

12.2 AC Timing Diagrams



12.2 AC Timing Diagrams

The LCD panel adopts high voltage driver ICs, so it could be permanently damaged if a wrong power on/off sequence is used. When powering on the LCD, V_{CC} should go up firstly, and then turn on BGL and V_{DD} , and finally V_{GH} . Turn off the LCD panel with reversed order or shut off all the power supplies simultaneously.



13. Driver IC Control Algorithms

- 1.Refer to the data Sheet of LCD DRIVER IC1 HX8218 or equivalent
- 2.Refer to the data Sheet of LCD DRIVER IC2 HX8615 or equivalent

14. Reliability Test Items

No.	Test items	Conditions		Remark
1	High temperature storage	70	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.

15. General Precautions

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

15.1 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.

15.2 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.

15.3 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.

15.4 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