PALM TECHNOLOGY CO., LTD.

The LCD(M) Specialist

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FOR MESSRS. : _____

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ACCEPTED BY : _____ PROPOSED BY : _____

RECORD OF REVISION

DATE	REV.	PAGE	SUMMARY
2008/10/07	2 (⚠1)	P8	8.Modify outline dimension (1)Modify the dimension (a)18.75→17.25 (b)(29.85)→(29.65) (2)Add the FPC bend radius (a)1.5 Max

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. The resolution of a 2.8”Main LCD contains 240 x 320 pixels, and can display up to 262K colors and is suitable for cell phone application.

3.2 Features

- High image quality a-Si TFT LCD module.
- 262K color number.
- 80-system 8/9/16/18-bit bus CPU/RGB I/F selection.
- High-speed RAM write function is available.
- Partial-screen display function is available.
- Sleep and Stand-by modes are available for power saving.
- High contrast, high brightness, Gamma adjustment.
- Low power consumption.

3.3 Applications

- Mobile phone.
- Portable 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	2.8inch (diagonal)	--
5	Resolution	240(RGB) x320	--
6	Color Number	262K	--
7	Active Area	43.2(W) x 57.6(H) (mm)	--
8	Dot Pitch	60 x 180 (μm)	--
9	Color Arrangement	RGB-stripe	--
10	Assembly Type	COG	--
11	Back Light	LED	--
12	Viewing Direction	12 o’clock	--
13	Weight	TBD	--
14	Module Dimension	50.0 (W) x 69.2 (H) x 3.45 (D)	(Excluding Guide Boss & FPC)
15	Power Supply	2.5~3.3 V	--
16	Interface	CPU/RGB I/F	--

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.		
Input power supply voltage	VCC	GND=0V	-0.3	4.6	V	--
	VCI	GND=0V	-0.3	4.6	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

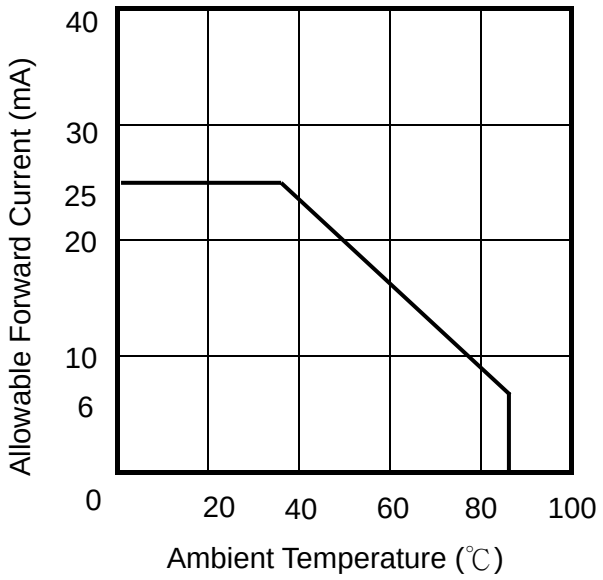
Ta=25℃

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	VCC	(2.5)	(2.8)	(3.3)	V	--
	VCI	(2.5)	(2.8)	(3.3)	V	--

(2) Back-Light Unit

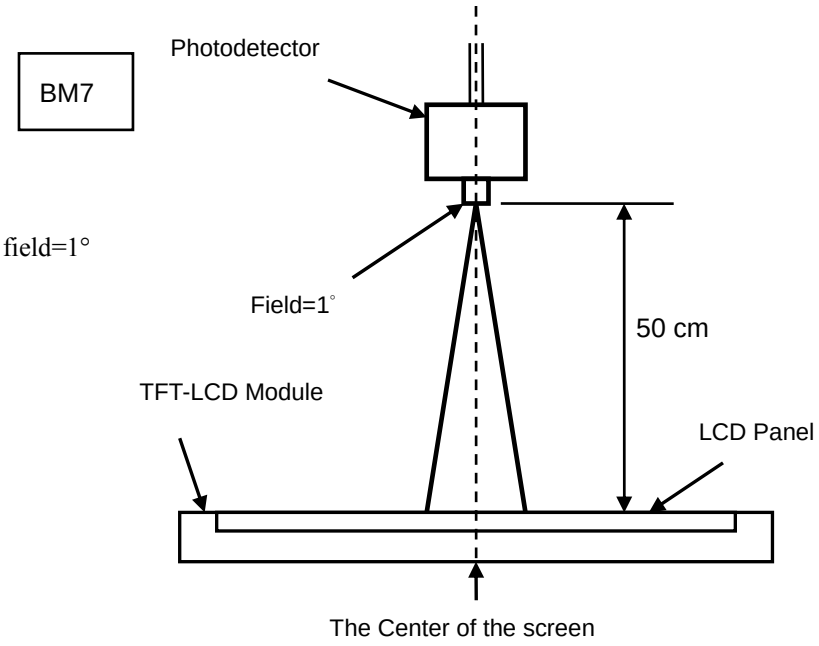
Item	Symbol	Min.	Typ.	Max.	Unit	Remark
Current	I_B	--	(15)	--	mA	LED:4EA (Series type)
Power Consumption	P_{BL}	--	(200)	--	mW	--

7. Optical characteristics

Ta = 25℃, VCC =2.8V, IB=15mA

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Brightness		B	θ=0° Normal viewing angle At the center of panel	(150)	(200)	--	cd/m^2	(1)
Contrast Ratio		C/R		(150)	(250)	--	--	(2)
Response Time	Rising: Tr	Tr + Tf		--	(50)	(80)	ms	(3)
	Falling: Tf							
Color chromaticity (CIE 1931)	White	Wx		(0.264)	(0.294)	(0.324)	--	--
		Wy		(0.304)	(0.334)	(0.364)		
	Red	Rx		(0.603)	(0.633)	(0.663)		
		Ry		(0.296)	(0.326)	(0.356)		
	Green	Gx		(0.267)	(0.297)	(0.327)		
		Gy		(0.547)	(0.577)	(0.607)		
	Blue	Bx		(0.103)	(0.133)	(0.163)		
		By		(0.099)	(0.129)	(0.159)		
Viewing Angle	Top	θ_U	CR≧10 Backlight On	--	(50)	--	Degrees	(4)
	Bottom	θ_D		--	(25)	--		
	Left	θ_L		--	(60)	--		
	Right	θ_R		--	(60)	--		
Uniformity		Un	θ=0° Normal viewing angle	(70)	--	--	%	(5)

Note 1: The brightness test equipment setup

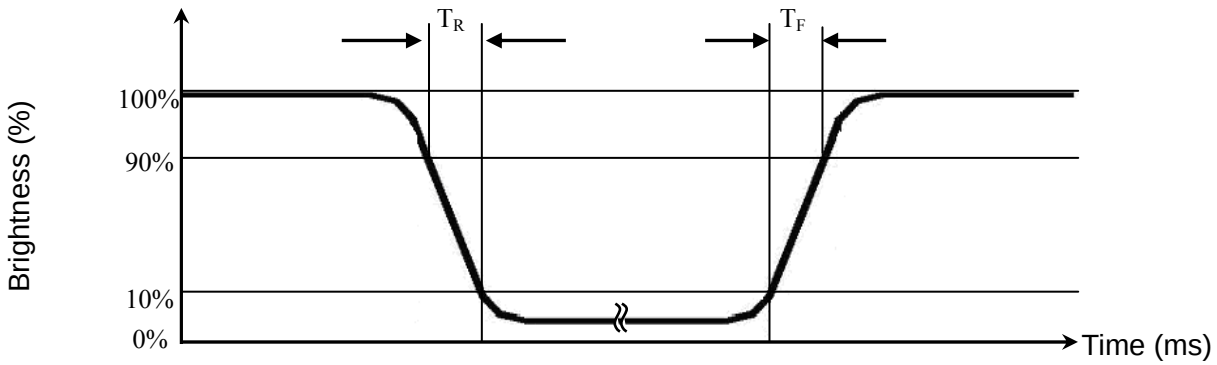


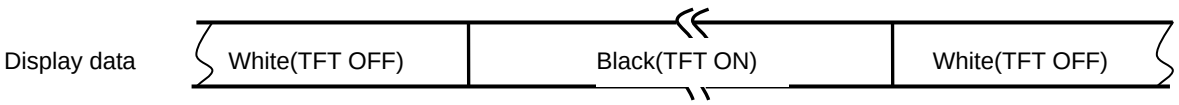
I_B=15mA, Field=1°
(As measuring "black" image, field=1°
Is the best testing condition.)

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

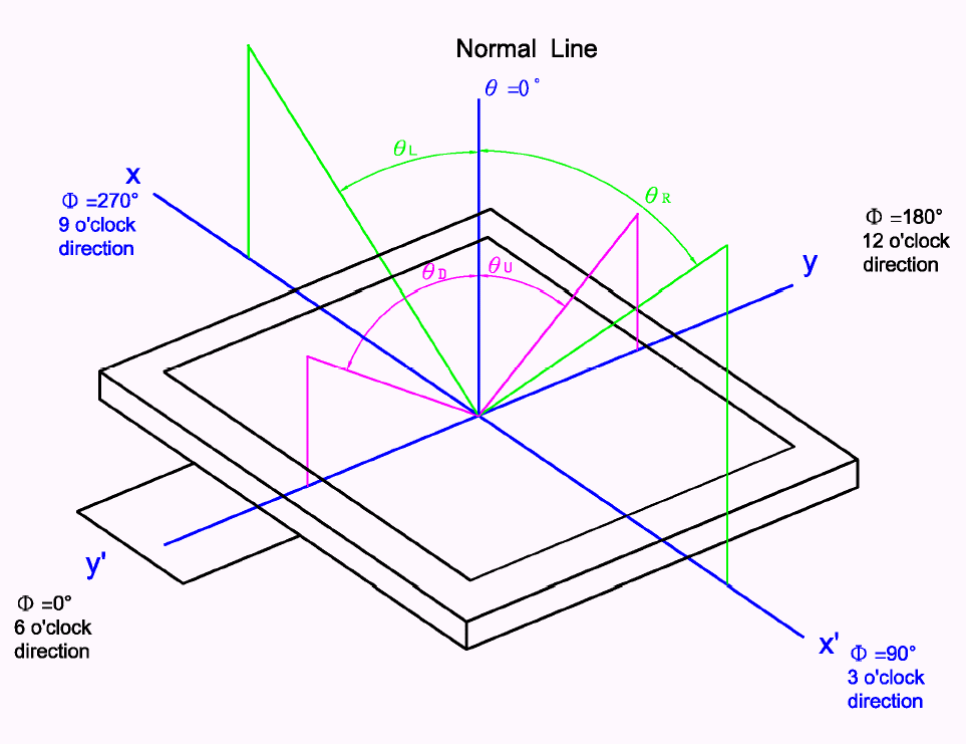
$$C.R = \frac{\textbf{Brightness When LCD is at "White" State}}{\textbf{Brightness When LCD is at "Black" State}}$$

Note 3: Definition of response time

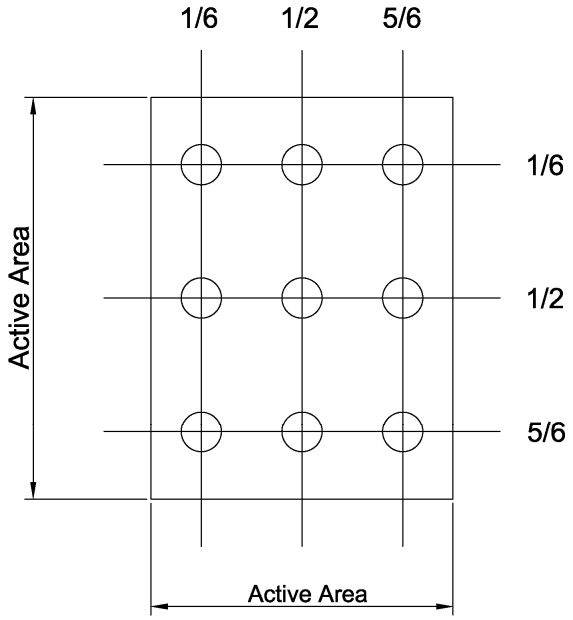




Note 4: Definition of viewing angle

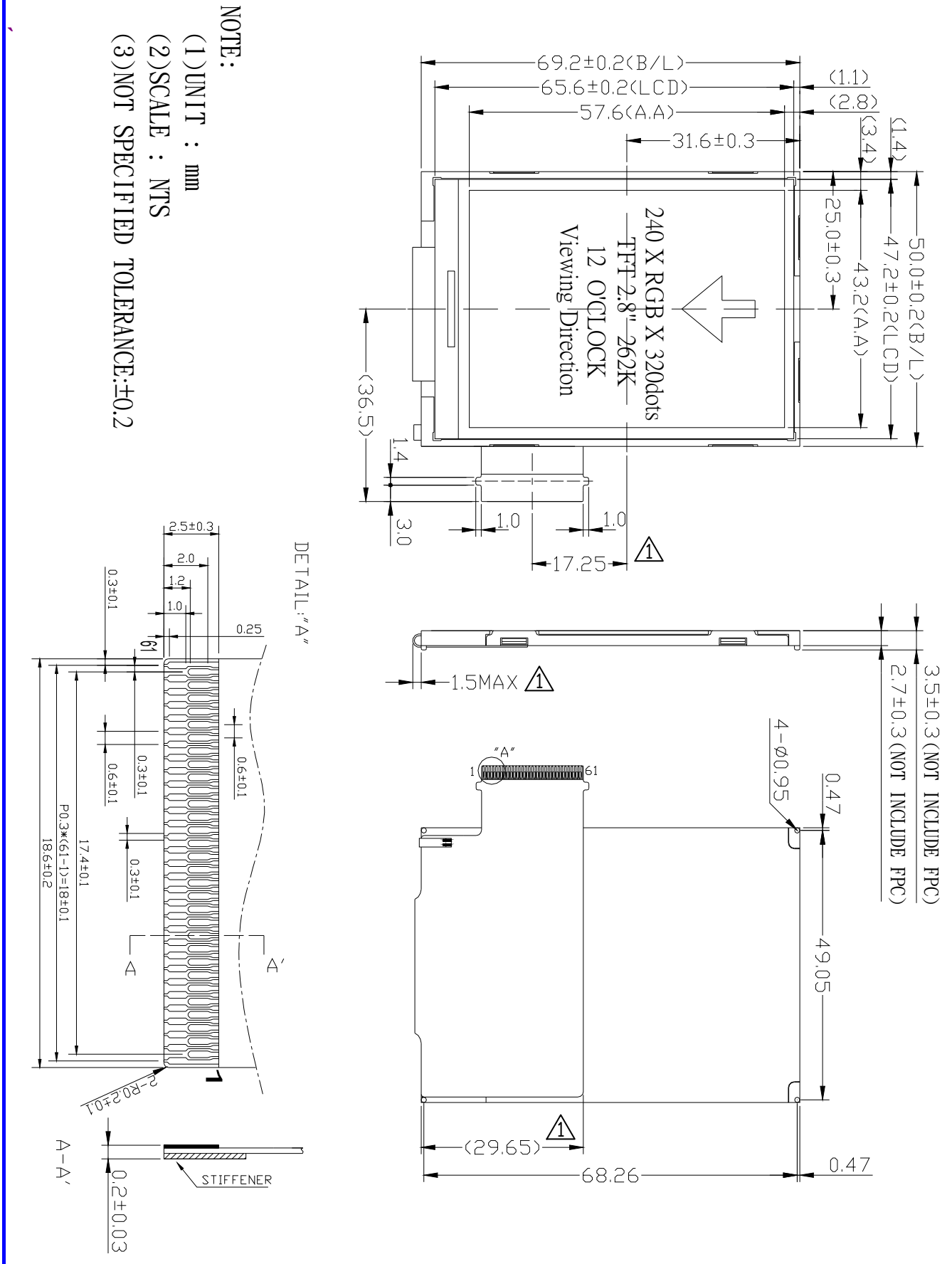


Note 5: Definition of uniformity (Un)



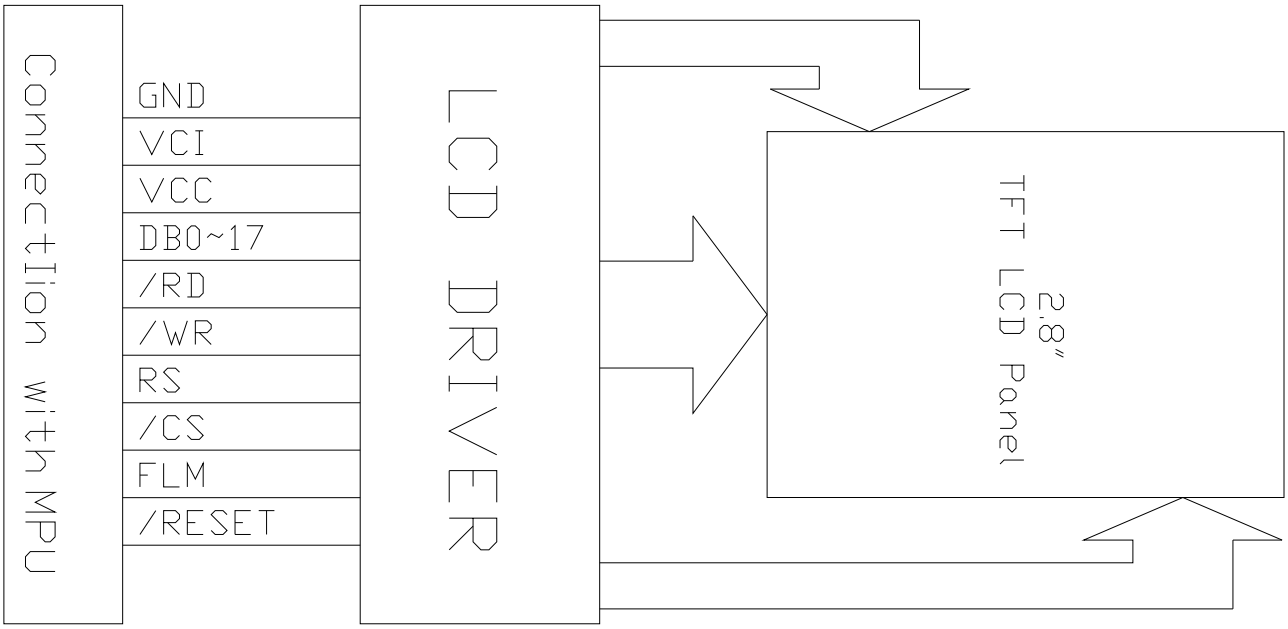
$$Un = \frac{\mathbf{Bmin}}{\mathbf{Bmax}} x100\%$$

8. Outline dimension

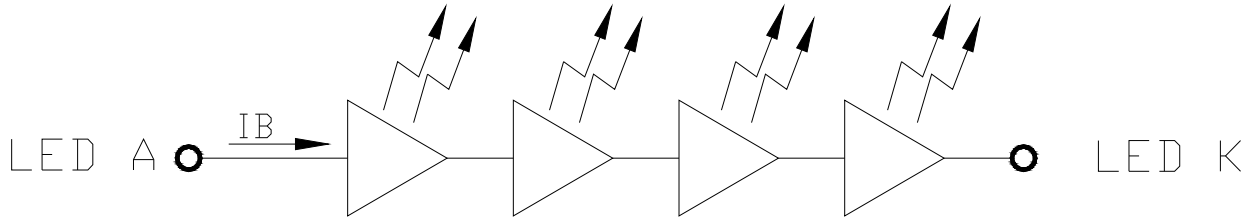


9.Block diagram

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	GND	Power Ground	-
2	VCI	Analog Power Supply	Input
3	VCC	Logic Power Supply	-
4	SDO	Serial bus interface data output pin	Output
5	SDI	Serial bus interface data input pin	Input
6	IM0	MPU Interface mode select	Input
7	IM1	MPU Interface mode select	Input
8	IM2	MPU Interface mode select	Input
9	IM3	MPU Interface mode select	Input
10	VSYNC	Vertical synchronization signal input pin	Input
11	HSYNC	Horizontal synchronization signal input pin	Input
12	DOTCLK	Dot clock signal input used in the RGB interface circuit	Input
13	ENABLE	Enable signal pin used in the RGB interface circuit	Input
14	DB17	Data 17	Input/Output
15	DB16	Data 16	Input/Output
16	DB15	Data 15	Input/Output
17	DB14	Data 14	Input/Output
18	DB13	Data 13	Input/Output
19	DB12	Data 12	Input/Output
20	DB11	Data 11	Input/Output
21	DB10	Data 10	Input/Output
22	DB9	Data 9	Input/Output
23	DB8	Data 8	Input/Output
24	DB7	Data 7	Input/Output
25	DB6	Data 6	Input/Output
26	DB5	Data 5	Input/Output
27	DB4	Data 4	Input/Output
28	DB3	Data 3	Input/Output
29	DB2	Data 2	Input/Output
30	DB1	Data 1	Input/Output
31	DB0	Data 0	Input/Output
32	/RD	Read	Input
33	/WR	Write	Input
34	RS	Register Select	Input
35	/CS	Chip Select	Input
36	FLM	FLM Pin	Input
37	/RESET	System Reset	Input

38	GND	Power Ground	-
39	LED A	LED Anode(+)	-
40	LED K	LED Cathode(-)	-
41	N.C	NO CONNECTION	-
42	N.C	NO CONNECTION	-
43	N.C	NO CONNECTION	-
44	N.C	NO CONNECTION	-
45	N.C	NO CONNECTION	-
46	N.C	NO CONNECTION	-
47	N.C	NO CONNECTION	-
48	N.C	NO CONNECTION	-
49	N.C	NO CONNECTION	-
50	N.C	NO CONNECTION	-
51	N.C	NO CONNECTION	-
52	N.C	NO CONNECTION	-
53	N.C	NO CONNECTION	-
54	N.C	NO CONNECTION	-
55	N.C	NO CONNECTION	-
56	N.C	NO CONNECTION	-
57	N.C	NO CONNECTION	-
58	N.C	NO CONNECTION	-
59	N.C	NO CONNECTION	-
60	N.C	NO CONNECTION	-
61	N.C	NO CONNECTION	-

10.2 Select the MPU interface mode

IM3	IM2	IM1	IM0	MPU interface mode	DB pins
0	0	1	0	16-bit interface, 80-system	DB[17-10], DB[8-1]
0	0	1	1	8-bit interface, 80-system	DB[17-10]
1	0	1	0	18-bit interface, 80-system	DB[17-0]
1	0	1	1	9-bit interface, 80-system	DB[17-9]
0	1	0	ID	Serial peripheral interface	SDI,SDO(DB[1:0])

11. Interface Specifications

11.1 DC Characteristics

(VCC=VCI=2.40～3.0V, IOVCC=1.65～3.30,Ta= -40～85℃)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.	Note
Input high voltage	V_{IH}	V	IOVCC= 1.8 ~ 3.3V	0.8*IOVCC	-	IOVCC	-
Input low voltage	V_{IL}	V	IOVCC= 1.8 ~ 3.3V	-0.3	-	0.2*IOVCC	-
Output high voltage(1) (DB0-17 Pins)	V_{OH1}	V	IOH = -0.1 mA	0.8*IOVCC	-	-	-
Output low voltage (DB0-17 Pins)	V_{OL1}	V	IOVCC=1.65~3.3V	-	-	0.2*IOVCC	-
I/O leakage current	I_{LI}	μA	Vin = 0 ~ VCC	-0.1	-	0.1	-
Current consumption during normal operation (V_{CC} – GND)	I_{OP}	μA	VCC=2.8V , Ta=25°C , fOSC = 512KHz (Line) GRAM data = 0000h	-	100 (VCC)	-	-
Current consumption during standby mode (V_{CC} – GND)	I_{ST}	μA	VCI=2.8V , Ta=25 °C	-	30	50	-
LCD Drive Power Supply Current (DDVDH-GND)	ILCD	mA	VCI=2.8V , VREG1OUT =4.8V DDVDH=5.2V , Frame Rate: 70Hz, line-inversion, Ta=25 °C, GRAM data = 0000h,	-	5.5	-	-
LCD Driving Voltage (DDVDH-GND)	DDVDH	V	-	4.5	-	6	-
Output deviation voltage	V_{DEV}	mV	-	-	-	20	-
Output offset voltage	V_{OFFSET}	mV	Note1	-	-	35	-

Note (1):The Max value is between with measure point and setting value

11.2 AC Characteristics

Clock Characteristics (VCI = 2.5 ~ 3.3V, VCC=1.65~3.3V)

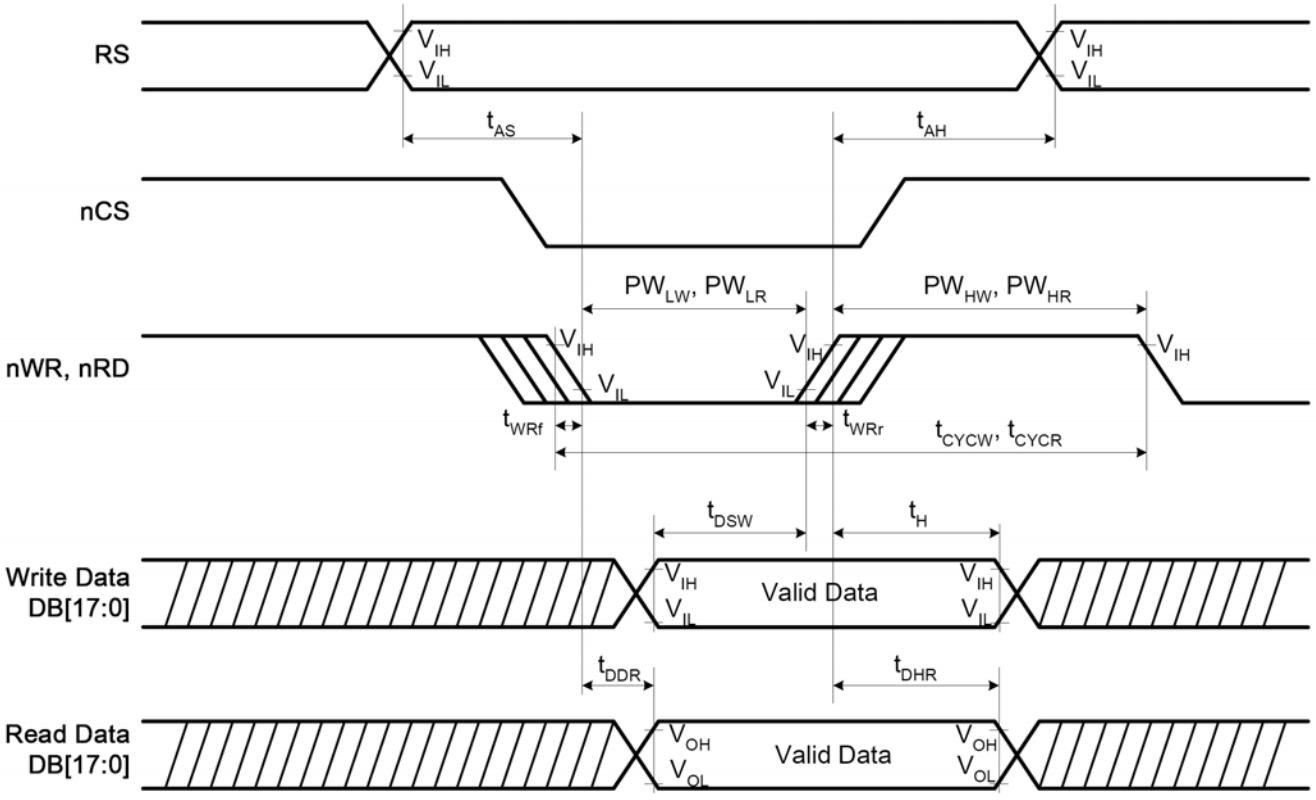
Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
External clock frequency	fcp	KHz	VCC=2.5~3.3V	(450)	(550)	(650)
External clock duty ratio	Duty	%	VCC=2.5~3.3V	(45)	(50)	(55)
External clock rise time	trcp	μs	VCC=2.5~3.3V	-	-	(0.2)
External clock fall time	tfcp	μs	VCC=2.5~3.3V	-	-	(0.2)
R-C oscillation clock	f_{OSC}	KHz	Rf=100K ohm, VCC=2.8V	(450)	(550)	(650)

11.3 i80-system Bus Interface Timing Characteristics

Normal Write Mode (IOVCC=1.65~3.3V)

Item		Symbol	Unit	Test Condition	Min	Typ	Max
Bus cycle time	Write	t_{CYCW}	ns	Note (2)	100	--	--
	Read	t_{CYCR}	ns		300	--	--
Write low-level pulse width		PW_{LW}	ns		50	--	500
Write hight-level pulse width		PW_{HW}	ns		50	--	--
Read low-level pulse width		PW_{LR}	ns		150	--	--
Read high-level pulse width		PW_{HR}	ns		150	--	--
Write / Read rise / fall time		t_{WRr}/ t_{WRf}	ns		--	--	25
Setup time	Write(Rs to nCS,E/nWR)	t_{AS}	ns	Note (2)	10	--	--
	Read(RS to nCS,RW/nRD)				5	--	--
Address hold time		t_{AH}	ns		5	--	--
Write data set up time		t_{DSW}	ns		10	--	--
Write data hold time		t_H	ns		10	--	--
Read data delay time		t_{DDR}	ns		--	--	100
Read data hold time		t_{DHR}	ns		5	--	--

Note(2): 80-system bus Timing

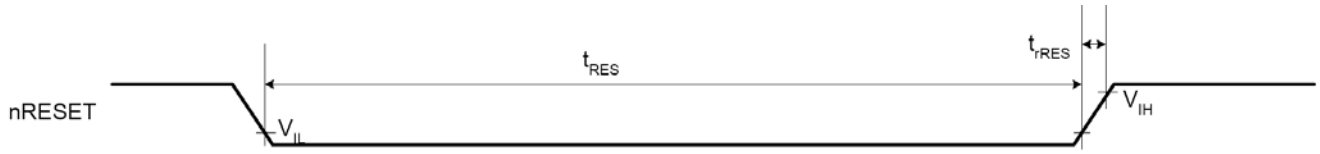


11.4 Reset Timing Characteristics

(VCC=1.65~3.3V, VCI=2.5~3.3V)

Item	Symbol	Unit	Test Condition	Min	Typ.	Max
Reset low-level width	t_{RES}	ms	Note (3)	(1)	--	--
Reset rise time	tr_{RES}	µs		--	--	(10)

Note(3): RESET Timing

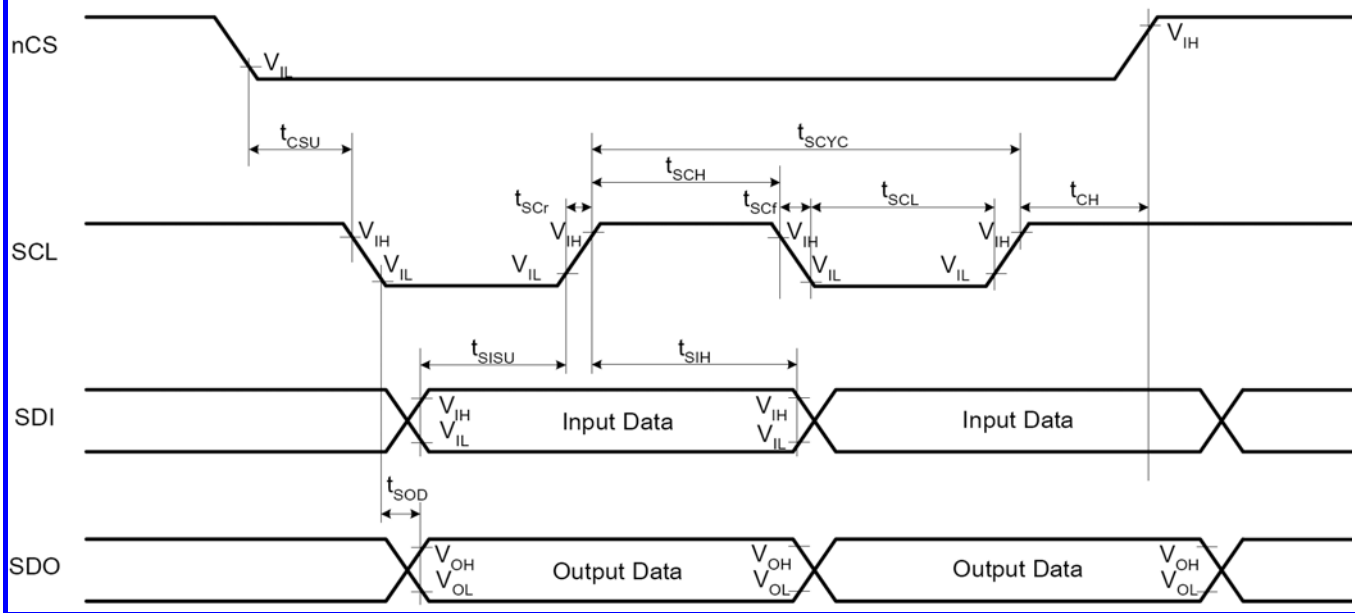


11.5 Serial Data Transfer Interface Timing Characteristics

(IOVCC=1.65~3.3V)

Item		Symbol	Unit	Test Condition	Min	Typ	Max
Serial clock cycle	Write(receiced)	t_{SCYC}	µs	Note (4)	100	--	--
	Read(transmitted)	t_{SCYC}	µs		200	--	--
Serial clock hight-level pulse width	Write(receiced)	t_{SCH}	ns		40	--	--
	Read(transmitted)	t_{SCH}	ns		100	--	--
Serial clock low-level pulse width	Write(receiced)	t_{SCL}	ns		40	--	--
	Read(transmitted)	t_{SCL}	ns		100	--	--
Serial clock rise / fall time		t_{SCr}, t_{SCf}	ns		--	--	5
Chip select set up time		t_{CSU}	ns		10	--	--
Chip select hold time		t_{CH}	ns		50	--	--
Serial input data set up time		T_{SISU}	ns		20	--	--
Serial input data hold time		t_{SIH}	ns		20	--	--
Serial output data set up time		t_{SOD}	ns		--	--	100
Serial output data hold time		t_{SOH}	ns		5	--	--

Note(4):SPI System Bus Timing



11.6 RGB Interface Timung Characteristics

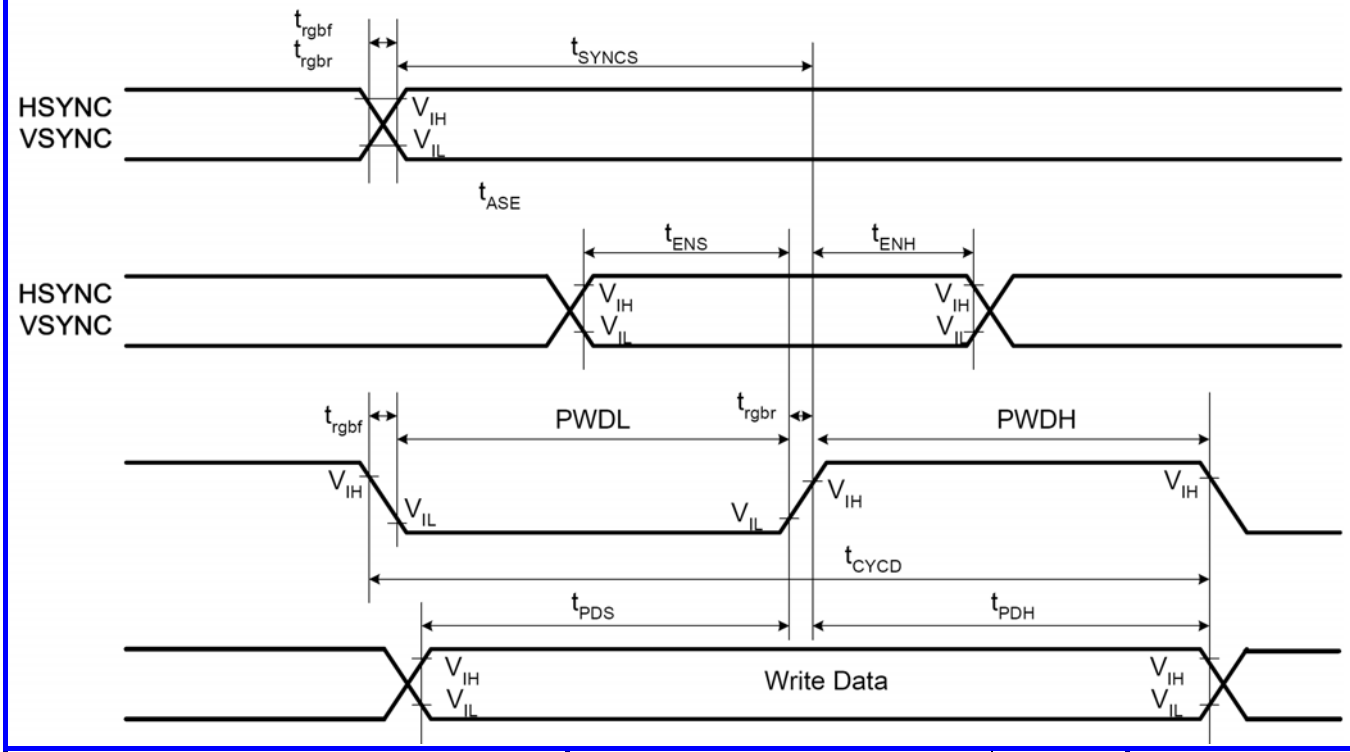
18/16-bit Bus RGB Interface Mode (IOVCC=1.65~3.3V)

Item	Symbol	Unit	Test Condition	Min	Typ	Max
VSYNC/HSYNC setup time	t_{SYNCS}	ns	Note (5)	0	--	--
ENABLE setup time	t_{ENS}	ns		10	--	--
ENABLE hold time	t_{ENH}	ns		10	--	--
PD Data setup time	t_{PDS}	ns		10	--	--
PD Data hold time	t_{PDH}	ns		40	--	--
DOTCLK high-level pulse width	PWDH	ns		40	--	--
DOTCLK low-level pulse width	PWDL	ns		40	--	--
DOTCLK cycle time	t_{CSU}	ns		100	--	--
DOTCLK,VSYNC,HSYNC,rise/fall time	t_{rght} ,t_{rghf}	ns		--	--	25

6-bit Bus RGB Interface Mode (IOVCC=1.65~3.3V)

Item	Symbol	Unit	Test Condition	Min	Typ	Max
VSYNC/HSYNC setup time	t_{SYNCS}	ns	Note (5)	0	--	--
ENABLE setup time	t_{ENS}	ns		10	--	--
ENABLE hold time	t_{ENH}	ns		10	--	--
PD Data setup time	t_{PDS}	ns		10	--	--
PD Data hold time	t_{PDH}	ns		30	--	--
DOTCLK high-level pulse width	PWDH	ns		30	--	--
DOTCLK low-level pulse width	PWDL	ns		30	--	--
DOTCLK cycle time	t_{CSU}	ns		80	--	--
DOTCLK,VSYNC,HSYNC,rise/fall time	t_{rght} ,t_{rghf}	ns		--	--	25

Note (5):RGB Interface Timing



12. Driver IC Control Algorithms

Refer to the data Sheet of LCD Control IC ILI9325 or equivalent

13. 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.				

14. General Precautions

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

14.1 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.

14.2 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.

14.3 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.

14.4 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