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FOR MESSRS. : _____

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ACCEPTED BY : _____

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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. The resolution of a 2.4" 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	2.4inch (diagonal)	--
5	Resolution	240(RGB) x320	--
6	Color Number	262K	--
7	Active Area	36.72 (W) x 48.96(H) (mm)	--
8	Dot Pitch	51 x 153 (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	43.6(W) x 61.5(H) x 2.8(D)	--
15	Power Supply	2.4~3.3 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

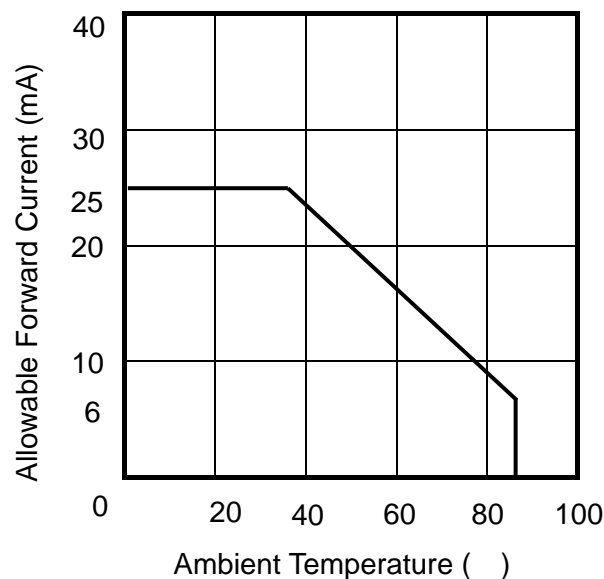
Ta=25

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	--	(20)	--	mA	--
Power Consumption	P _{BL}	--	(240)	--	mW	--

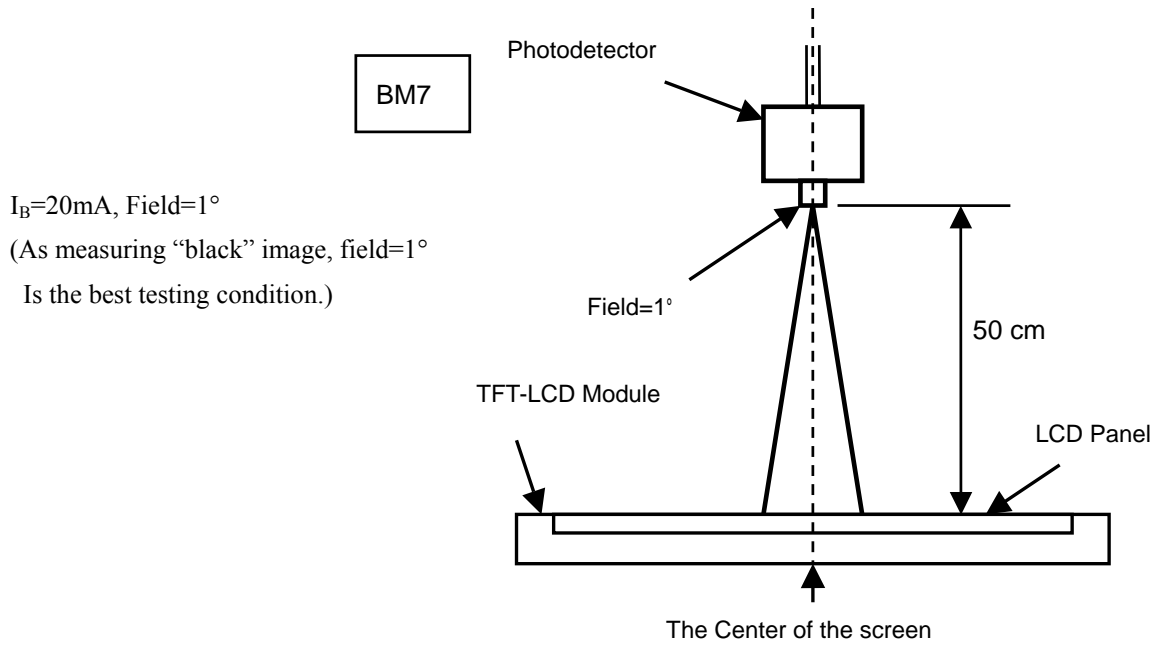
* Four LEDs is series type

7. Optical characteristics

Ta = 25 , VCC =2.8V, IB=20mA

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note	
Brightness	B	$\theta=0^\circ$ Normal viewing angle At the center of panel	(150)	(200)	--	cd/m ²	(1)	
Contrast Ratio	C/R		(150)	(200)	--	--	(2)	
Response Time	Rising: Tr		Tr + Tf	--	(35)	(50)	ms	(3)
	Falling: Tf							
Color chromaticity (CIE 1931)	White		Wx	(0.258)	(0.308)	(0.358)	--	--
			Wy	(0.296)	(0.346)	(0.396)		
	Red		Rx	(0.583)	(0.633)	(0.683)		
			Ry	(0.279)	(0.329)	(0.379)		
	Green		Gx	(0.244)	(0.294)	(0.344)		
			Gy	(0.526)	(0.576)	(0.626)		
	Blue	Bx	(0.083)	(0.133)	(0.183)			
		By	(0.072)	(0.122)	(0.172)			
Viewing Angle	Top	θ_U	--	(15)	--	Degrees	(4)	
	Bottom	θ_D	--	(35)	--			
	Left	θ_L	--	(45)	--			
	Right	θ_R	--	(45)	--			
Uniformity	Un	$\theta=0^\circ$ Normal viewing angle	--	(60)	--	%	(5)	

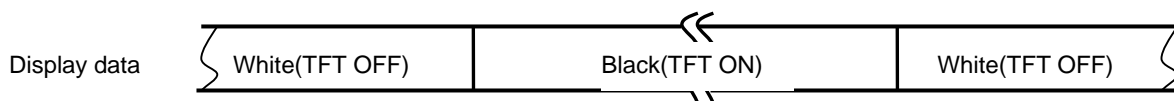
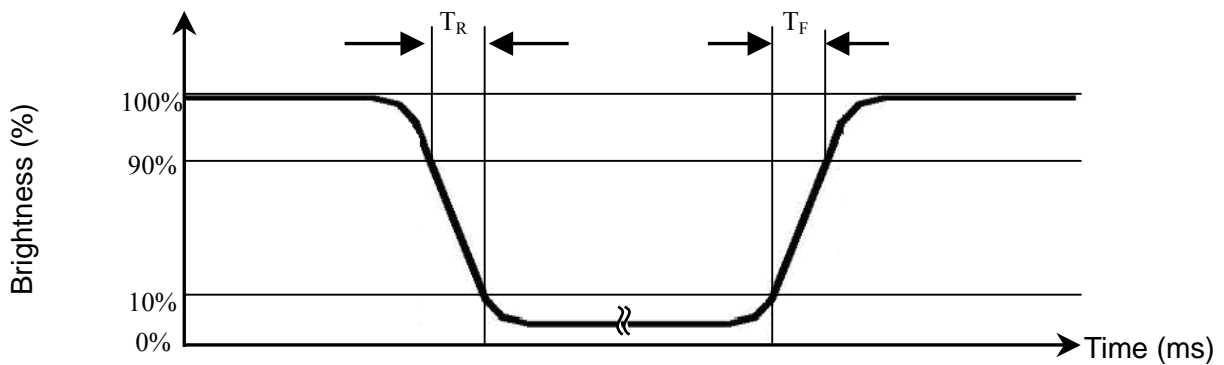
Note 1: The brightness test equipment setup



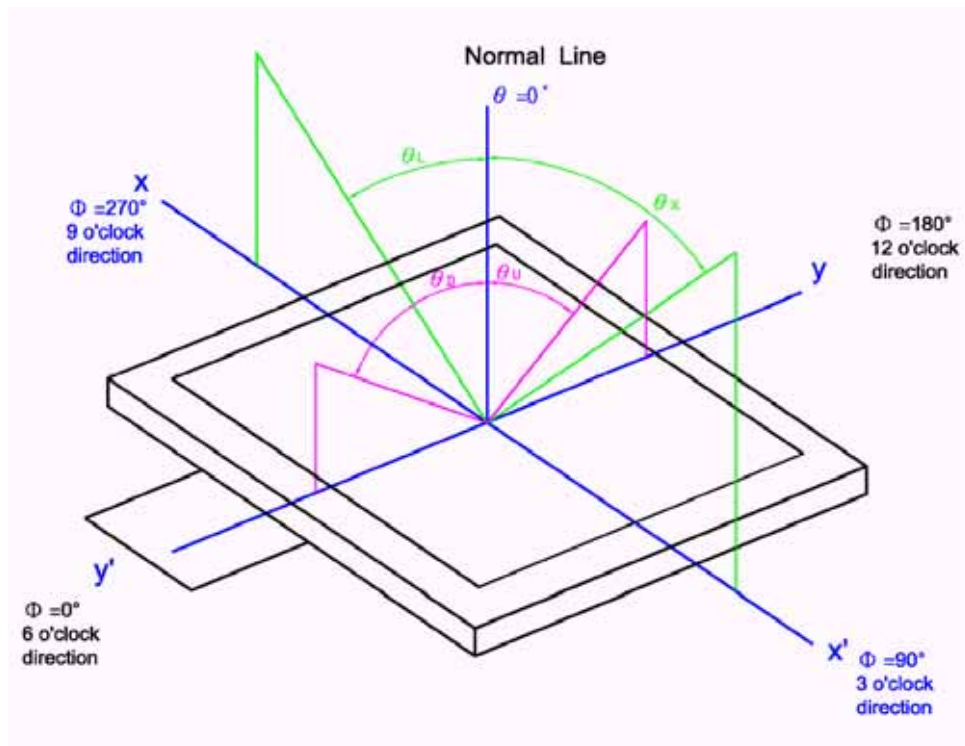
Note 2: Definition of contrast Ratio (C.R)

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

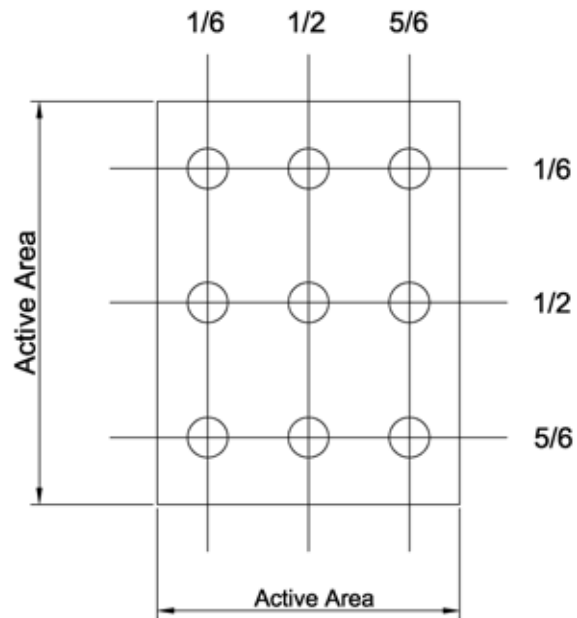
Note 3: Definition of response time



Note 4: Definition of viewing angle

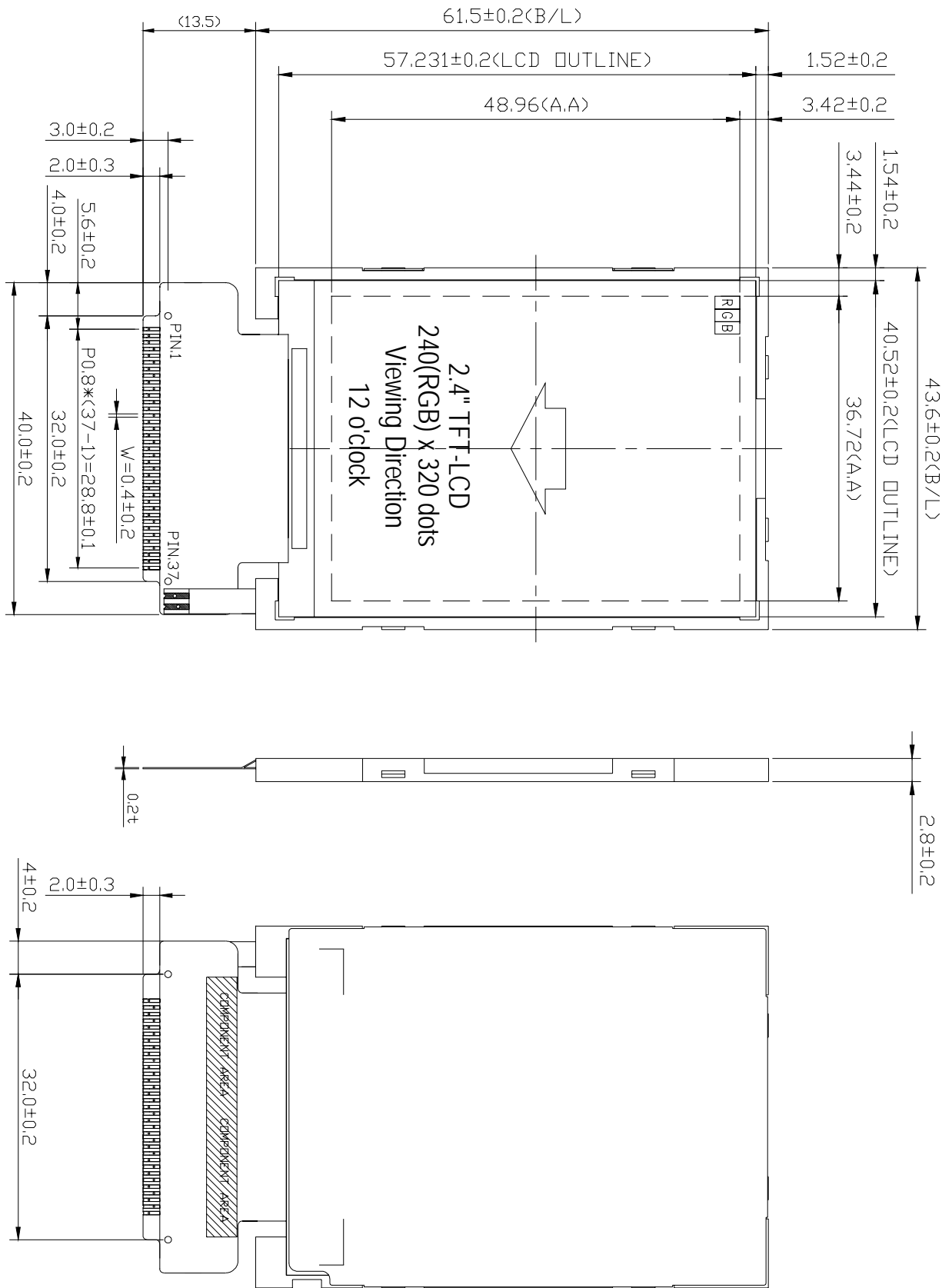


Note 5: Definition of uniformity (Un)



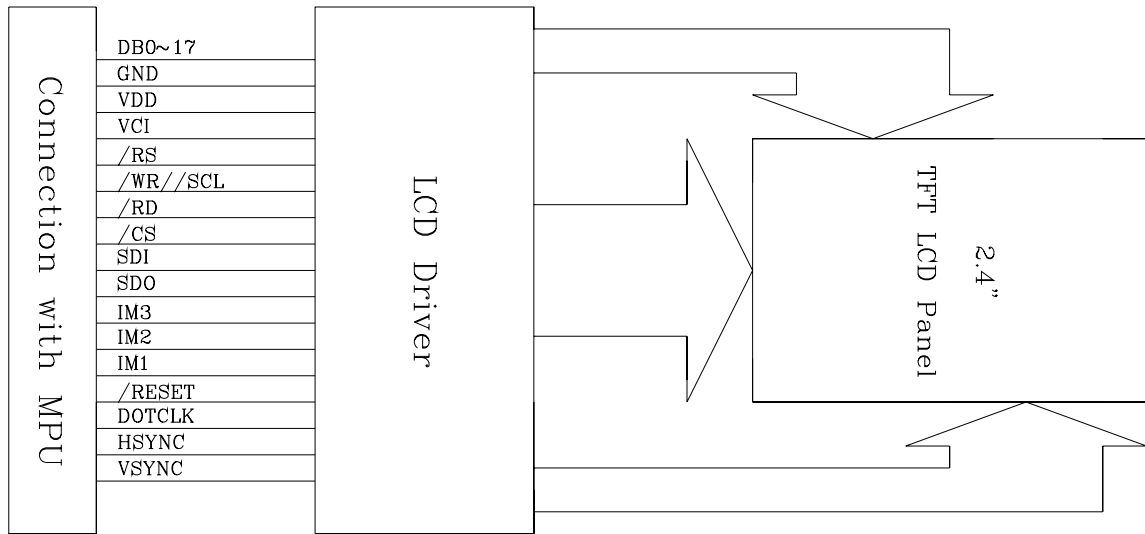
$$U_n = \frac{B_{min}}{B_{max}} \times 100\%$$

8. Outline dimension

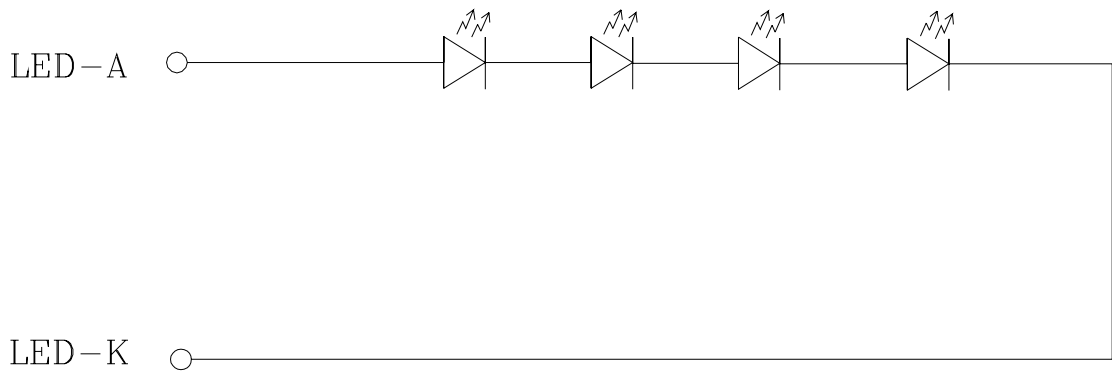


9. Block diagram

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

11. Interface Specifications

11.1 DC Characteristics (VCC=2.4 to 3.3V, IOVCC=1.65~3.3V, Ta= -40~+85)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
Input high voltage	V _{IH}	V	VCC= 1.65 ~ 3.3V	(0.8*IOVCC)	-	(IOVCC)
Input low voltage	V _{IL}	V	VCC= 1.65 ~ 3.3V	(-0.3V)	-	(0.2*IOVCC)
Output high voltage(1) (DB0-17 Pins)	V _{OHI}	V	I _{OH} = -0.1 mA	(0.8IOVCC)	-	-
Output low voltage (DB0-17 Pins)	V _{OLI}	V	VCC=1.65~2.4V, I _{OL} = 0.1mA	-	-	(0.2IOVCC)
I/O leakage current	I _{Li}	μA	V _{in} = 0 ~ VCC	(-1)	-	(1)
Current consumption during normal operation (VCC – VSSD)+ (IOVCC – VSSD)	I _{OP(VCC)}	μA	VCC=VCI=2.8V, Ta=25°C f _{osc} = 930KHz (320 line) Black image Frame rate =60Hz SAP=111,AP=011,HCK=30h DCCLK=18h,DC=0101 NLINE=000001 VR1SEL=000,VR2SEL=000 VSEL=100,BT=0101 VRH=0011,VCM=10000 VDV=10001,XVCOMG=0 DDVDHXON=1,COLOR=0	-	(450)	(700)
Current consumption during normal operation (VCI – VSSD)	I _{OP(VCI)}	μA		-	(2.2)	(2.7)
Current consumption during standby mode (VCC – VSSD)+ (IOVCC – VSSD)	I _{ST(VCC)}	μA	VCC=VCI=2.8V , Ta=25°C	-	(5)	(10)
Current consumption during standby mode (VCI – VSSD)	I _{ST(VCI)}	μA		(0.5)	(1)	
Output voltage deviation	-	mV	-	-	(5)	-
Dispersion of the Average Output Voltage	V	mV	-	-	-	(35)

11.2 AC Characteristics

11.2.1 Clock Characteristics (VCC = 2.4 ~ 3.3V)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
External clock frequency	fcp	KHz	VCC=2.4~3.3V	450	550	650
External clock duty ratio	Duty	%	VCC=2.4~3.3V	(45)	(50)	(55)
External clock rise time	trcp	μs	VCC=2.4~3.3V	-	-	(0.2)
External clock fall time	tfcf	μs	VCC=2.4~3.3V	-	-	(0.2)
R-C oscillation clock	fosc	KHz	Rf=100K ohm, VCC=2.8V	450	550	650

11.3 80-system Bus Interface Timing Characteristics

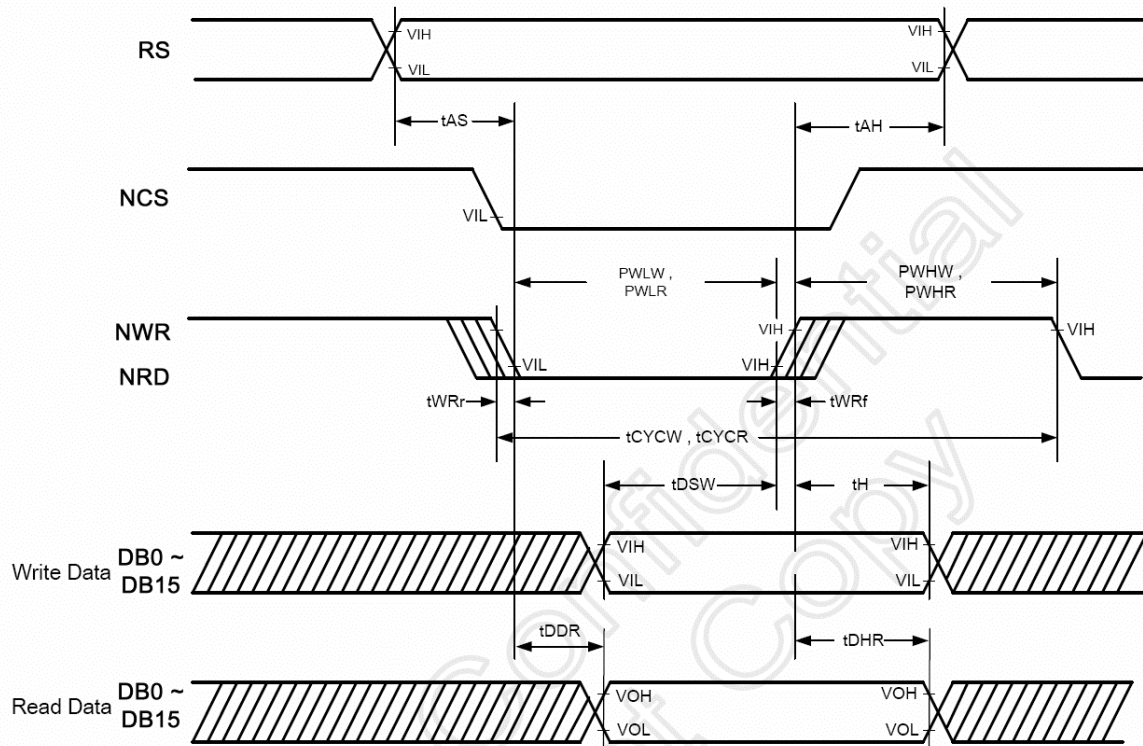
(1) 80-System Normal Write Mode

(a) (IOVCC=1.65~2.4V, VCC=2.4~3.3V)

Item		Symbol	Unit	Test Condition	Min.	Typ.	Max.
Bus cycle time	Write	t _{CYCW}	ns	Note 1	(100)	-	-
	Read	t _{CYCR}	ns		(3000)	-	-
Write low-level pulse width		PW _{LOW}	ns		(50)	-	-
Read low-level pulse width		PW _{LR}	ns		(150)	-	-
Write high-level pulse width		PW _{HW}	ns		(50)	-	-
Read high-level pulse width		PW _{HR}	ns		(150)	-	-
Write / Read rise / fall time		t _{WRf} , t _{WRf}	ns		-	-	(25)
RS Setup time	RS to NCS, NWR	t _{AS}	ns		(10)	-	-
RS Hold time	NCS, NWR to RS	t _{AH}	ns		(5)	-	-
Write data set up time		t _{DSW}	ns		(10)	-	-
Write data hold time		t _H	ns		(15)	-	-
Read data delay time		t _{DDR}	ns		-	-	(100)
Read data hold time		t _{DHR}	ns		(5)	-	-

Note1: 80-system bus Timing

80-System Normal Write Mode

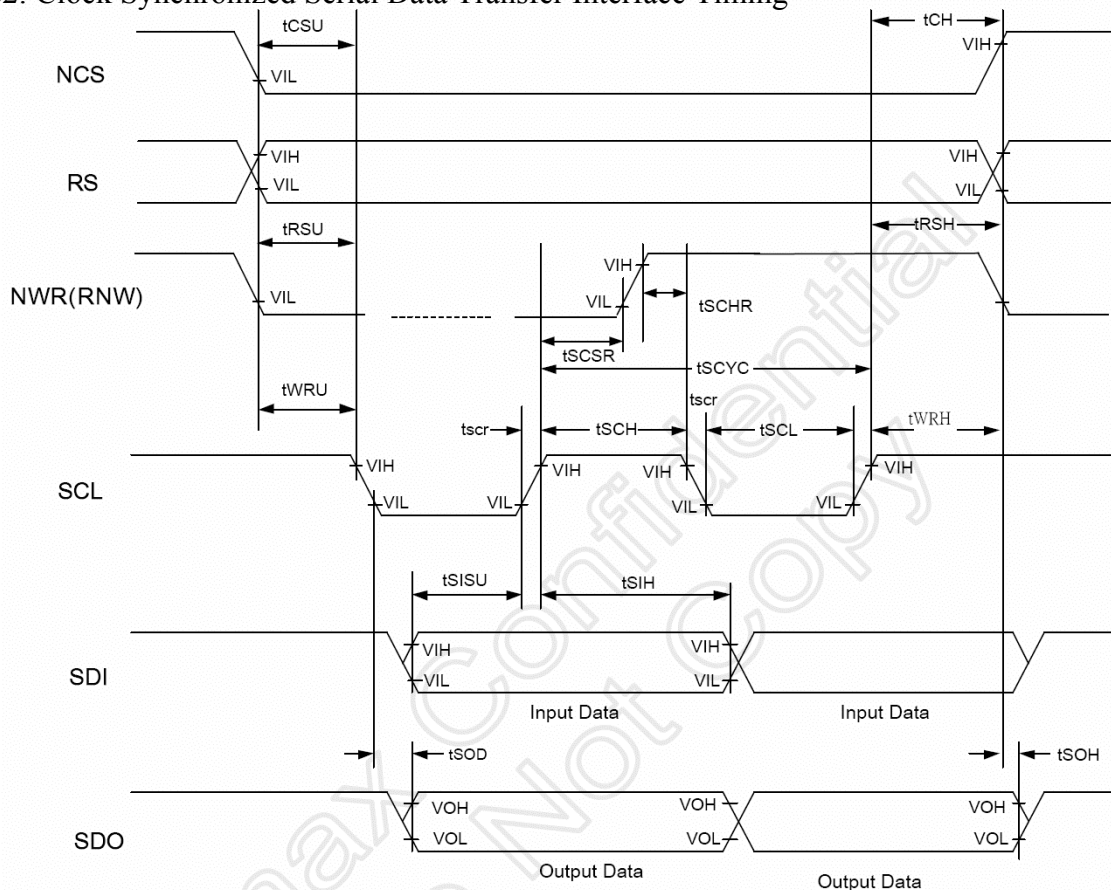


11.4 Serial Data Transfer Interface Timing Characteristics

IOVCC=1.65~3.3V, VCC=2.4~3.3V

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
Serial clock cycle time	Write (received)	t_{SCYC}	Note 2	(100)	-	-
	Read (transmitted)	t_{SCYC}		(200)	-	-
Serial clock high – level pulse width	Write (received)	t_{SCH}		(40)	-	-
	Read (transmitted)	t_{SCH}		(100)	-	-
Serial clock low – level pulse width	Write (received)	t_{SCL}		(40)	-	-
	Read (transmitted)	t_{SCL}		(100)	-	-
Serial clock rise / fall time	t_{scr}, t_{scf}	ns		-	-	(5)
Chip select (NCS) set up time	t_{CSU}	ns		(10)	-	-
Chip select (NCS) hold time	t_{CH}	ns		(50)	-	-
RS set up time	t_{RSU}	ns		(10)	-	-
RS hold time	t_{RSH}	ns		(10)	-	-
Read/write select (RNW) set up time	t_{WRU}	ns		(10)	-	-
Read/write select (RNW) hold time	t_{WRH}	ns		(10)	-	-
Read clock set up time	t_{SCSR}	ns		(10)	-	-
Read clock hold time	t_{SCHR}	ns		(10)	-	-
Serial input data set up time	t_{SISU}	ns		(20)	-	-
Serial input data hold time	t_{SIH}	ns		(20)	-	-
Serial output data delay time	t_{SOD}	ns		-	-	(100)
Serial output data hold time	t_{SOH}	ns		(5)	-	-

Note2: Clock Synchronized Serial Data Transfer Interface Timing



11.5 RGB Interface Timing Characteristics

(1) RGB-interface mode, Normal Write Mode

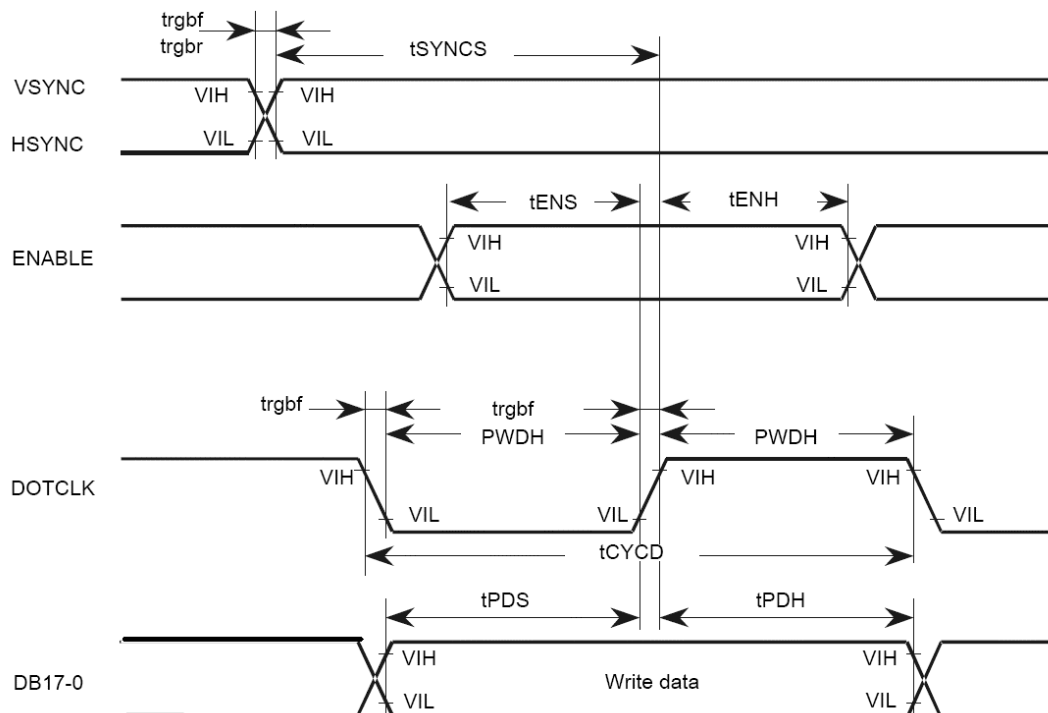
(a) (IOVCC=1.65~2.4V, VCC=2.4~3.3V)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
VSYNC / HSYNC set up time	t_{SYNCS}	ns	NOTE3	(0)	-	-
ENABLE set up time	t_{ENS}	ns		(10)	-	-
ENABLE hold time	t_{ENH}	ns		(10)	-	-
DOTCLK low-level pulse width	PW_{DL}	ns		(40)	-	-
DOTCLK high-level pulse width	PW_{DH}	ns		(40)	-	-
DOTCLK cycle time	t_{CYCD}	ns		(100)	-	-
DATA set up time	t_{PDS}	ns		(10)	-	-
DATA hold time	t_{PDH}	ns		(40)	-	-
DOTCLK,VSYNC,HSYNC rising and falling time	$t_{\text{rgbr}}, t_{\text{rgbf}}$	ns		-	-	(25)

(b) (IOVCC=2.4~3.3V, VCC=2.4~3.3V)

Item	Symbol	Unit	Test Condition	Min.	Typ.	Max.
VSYNC / HSYNC set up time	t_{SYNCS}	ns	NOTE3	(0)	-	-
ENABLE set up time	t_{ENS}	ns		(10)	-	-
ENABLE hold time	t_{ENH}	ns		(10)	-	-
DOTCLK low-level pulse width	PW_{DL}	ns		(30)	-	-
DOTCLK high-level pulse width	PW_{DH}	ns		(30)	-	-
DOTCLK cycle time	t_{CYCD}	ns		(80)	-	-
DATA set up time	t_{PDS}	ns		(10)	-	-
DATA hold time	t_{PDH}	ns		(30)	-	-
DOTCLK,VSYNC,HSYNC rising and falling time	$t_{\text{rgbr}}, t_{\text{rgbf}}$	ns		-	-	(25)

Note3: RGB Interface Operation



11.6 Reset Timing Characteristics

(IOVCC=1.65~3.3V, VCC=2.4~3.3V)

Item	Symbol	Unit	Test Condition	Min	Typ.	Max
Reset low-level width	t_{RES}	ms	Note 4	(1)	--	--
Reset rise time	t_{rRES}	μ s		--	--	(10)

Note4: RESET Timing



12. Driver IC Control Algorithms

Refer to the data Sheet of LCD Control IC ILI9320 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
<p>Criterion: There should be no change which might affect the practical display function when the display quality test is conducted under normal operating condition.</p>				

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