



FORMIKE ELECTRONIC CO.,LTD

PRODUCT SPECIFICATION

TFT LCD MODULE

MODEL : KWH018TG02-F01 Ver 1.0

Preliminary Specification

Finally Specification

CUSTOMER'S APPROVAL	
SIGNATURE:	DATE:

APPROVED BY	PM REVIEWD	PD REVIEWD	PREPARED BY
Kam	/	Stephen	Roy

Prepared By :

FORMIKE ELECTRONIC CO.,LTD

Address :Room A818 New Energy Building, NanHai Road, NanShan District, ShenZhen, China. 518054

TEL:(86) 755 88306921,88306931 FAX:(86) 755 88304615

Http:// www.wandisplay.com

- This specification is subject to change without notice.Please contact FORMIKE or it's representative before designing your product based on this specification.



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1 General Specification

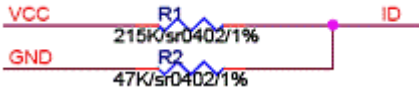
Feature		Description
Size		1.77 inch
Display Mode		Normally White, Transmissive
Technology Type		a-Si, Clear Type(3H)
Resolution		128(RGB) x 160
Interface		CPU 8bits/SPI
Color Depth		65/262K
Pixel Pitch (mm)		0.219x0.219
Pixel Configuration		R.G.B. Vertical Stripe
Viewing Direction		6 o'clock
Gray Scale Inversion Direction		12 o'clock
LCM (W x H x D) (mm)		34.0x47.0x2.4
Active Area(mm)		28.032x35.04
With/Without TSP		Without TSP
Weight (g)		TBD
LED Numbers		1 LED
Driver IC		HX8353D
Temperature	Operation	-20~+70°C
	Storage	-30~+80°C

Note : Viewing direction for best image quality is different from TFT definition.
There is a 180 degree shift.



2 Input/Output Terminals

2.1 TFT LCD Panel

No	Symbol	I/O	Description	Comment
1	LED1+	P	LED anode	
2	LED2+	P	NC	
3	LED-	P	LED cathode	
4	IM2	I	MCU Parallel interface bus and Serial interface select IM2='1', Parallel interface IM2='0', Serial interface	
5	NRES	I	Reset Pin	
6	DB7	I	Data input, In serial interface, they are not used and should be fixed at VCI or DGND level.	
7	DB6	I		
8	DB5	I		
9	DB4	I		
10	DB3	I		
11	DB2	I		
12	DB1	I		
13	DB0/SDI	I	Data input, when SPI interface, as SDI	
14	NC	-	No connection	
15	NC	-	No connection	
16	NC	-	No connection	
17	NC	-	No connection	
18	NC	-	No connection	
19	NC	-	No connection	
20	NC	-	No connection	
21	NC	-	No connection	
22	NRD	I	Read strobe in 8080 MCU parallel interface. -If not used, please fix this pin at VCI or DGND level.	
23	NWR	I	-Write enable in MCU parallel interface. -In 4-line SPI, this pin is used as D/CX (data/ command selection). -If not used, please fix this pin at VCI or DGND level.	
24	RS	I	-Display data/command selection pin in MCU interface. - RS ='1': display data or parameter. - RS ='0': command data. -In serial interface, this is used as SCL.	
25	NCS	I	Chip select	
26	ID	O	 <p>ID Pin R1=215K,R2=47K,VID=0.502V(VCC=2.8V)</p>	
27	VCI	P	Power supply	



28	SPI4W	I	- SPI4W='0', 3-line SPI enable. - SPI4W='1', 4-line SPI enable. -If not used, please fix this pin at DGND level.	
29	XR	I/O	NC	
30	YD	I/O	NC	
31	XL	I/O	NC	
32	YU	I/O	NC	
33	GND	P	GND	

Note1: I/O definition: I----Input O---Output P----Power/Ground



3 Absolute Maximum Ratings

3.1 Driving TFT LCD Panel

GND=0V, Ta = 25°C

Item	Symbol	MIN	MAX	Unit	Remark
Logic Supply Voltage	VCI	-0.3	3.6	V	
Analog Supply Voltage	VCI	-0.3	3.6	V	
Input voltage	D8~D15,NCS,RS,NWR,NRD NRES,IM2, SPI4W	-0.3	VCI+0.3	V	
Back Light Forward Current	I _{LED}		20	mA	For each LED
Operating Temperature	T _{OPR}	-20	70	°C	
Storage Temperature	T _{STG}	-30	80	°C	



4 Electrical Characteristics

4.1 Driving TFT LCD Panel

GND=0V, Ta=25°C

Item		Symbol	MIN	TYP	MAX	Unit	Remark
Logic Supply Voltage		V _{CI}	2.3	2.8	3.3	V	
Analog Supply Voltage		V _{CI}	2.3	2.8	3.3	V	
Input Signal Voltage	Low Level	V _{IL}	-0.3	--	0.2xV _{CI}	V	D8~D15,NCS,RS,NWR, NRD,NRES,IM2, SPI4W
	High Level	V _{IH}	0.8xV _{CI}	--	V _{CI}	V	
Output Signal Voltage	Low Level	V _{OL}	--	--	0.2xV _{CI}	V	
	High Level	V _{OH}	0.8xV _{CI}	--	--	V	
(Panel+ LSI) Power Consumption		Black Mode (60Hz)	--	TBD	--	-	
		Standby Mode	--	TBD	--	--	
		Sleeping Mode	--	TBD	--	--	

**4.2 Driving Backlight**

Ta=25°C

Item	Symbol	Min	Typ	Max	Unit	Remark
Forward Current	I_F	--	20	--	mA	1 LEDs
Forward Voltage	V_F	--	3.2	--	V	
Backlight Power Consumption	W_{BL}	--	64	--	mW	
Operating Life Time	-	10000	(20000)	-	Hrs	For each LED

Note 1: The figure below shows the connection of backlight LED.



Note 2: One LED : $I_F = 20$ mA, $V_F = 3.2$ V

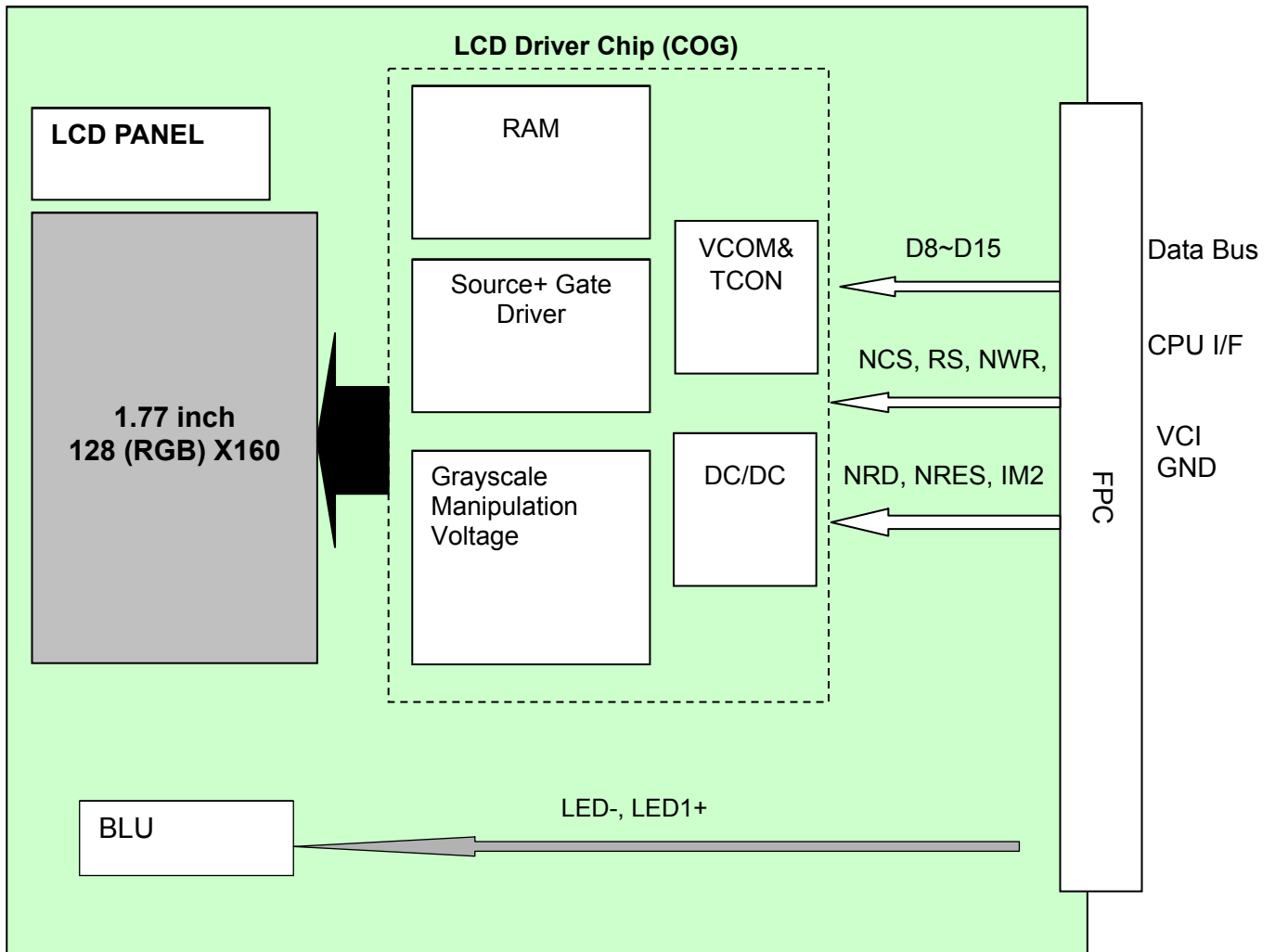
Note 3: : I_F is defined for one channel LED.

Optical performance should be evaluated at Ta=25°C 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





5.1 Timing Chart(Parallel interface)
5 Timing Chart(Parallel interface)

5.1.1Timing Parameter

(VSSA=0V, IOVCC=1.65V to 3.3V, VCI=2.5V to 3.3 V, T_A = -30 to 70℃)

Signal	Symbol	Parameter	Min.	Max.	Unit	Description
DNC_SCL	t _{AST}	Address setup time	0	-	ns	
	t _{AHT}	Address hold time (Write/Read)	10	-		
NCS	t _{CHW}	Chip select "H" pulse width	0	-	ns	
	t _{CS}	Chip select setup time (Write)	15	-		
	t _{RCS}	Chip select setup time (Read ID)	45	-		
	t _{RCSFM}	Chip select setup time (Read FM)	355	-		
	t _{CSF}	Chip select wait time (Write/Read)	10	-		
	t _{CSH}	Chip select hold time	10	-		
NWR_SCL	t _{WC}	Write cycle	66	-	ns	
	t _{WRH}	Control pulse "H" duration	15	-		
	t _{WRL}	Control pulse "L" duration	15	-		
NRD_E (ID)	t _{RC}	Read cycle (ID)	160	-	ns	When read ID data
	t _{RDH}	Control pulse "H" duration (ID)	90	-		
	t _{RDL}	Control pulse "L" duration (ID)	45	-		
NRD_E (FM)	t _{RCFM}	Read cycle (FM)	450	-	ns	When read from frame memory
	t _{RDHF}	Control pulse "H" duration (FM)	90	-		
	t _{RDLFM}	Control pulse "L" duration (FM)	355	-		
D17 to D0	t _{DST}	Data setup time	10	-	ns	For maximum C _L =30pF For minimum C _L =8pF
	t _{DHT}	Data hold time	10	-		
	t _{RAT}	Read access time (ID)	-	40		
	t _{RATFM}	Read access time (FM)	-	340		
	t _{ODH}	Output disable time	20	80		

Note: The input signal rise time and fall time (tr, tf) is specified at 15 ns or less.
 Logic high and low levels are specified as follows: **Table 5.1 timing parameter** Input signals.

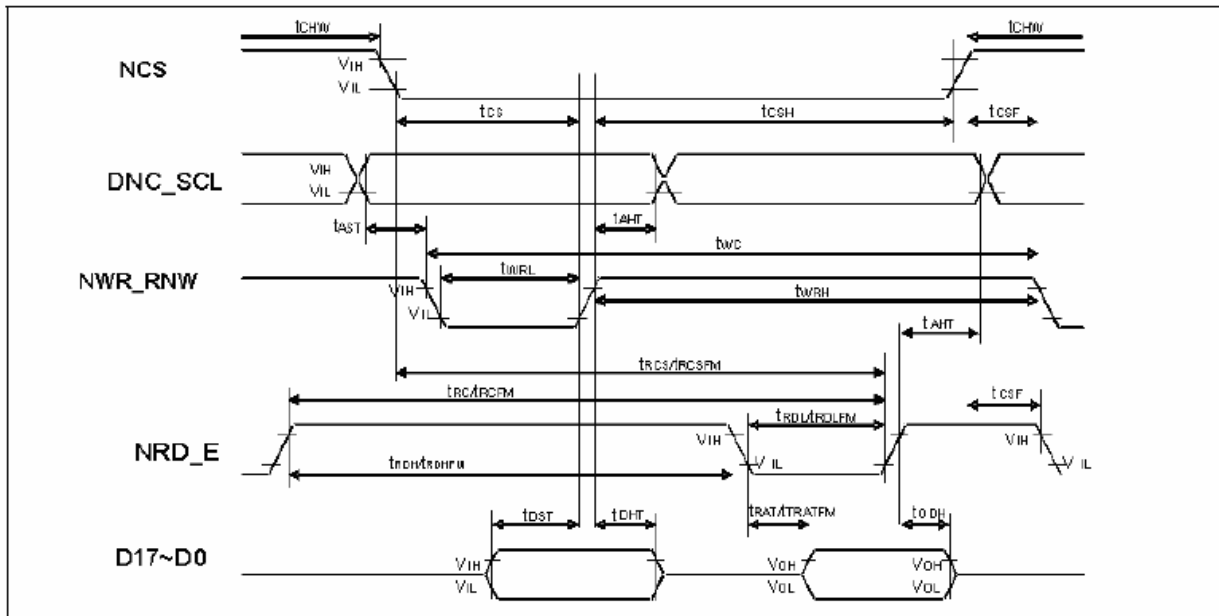
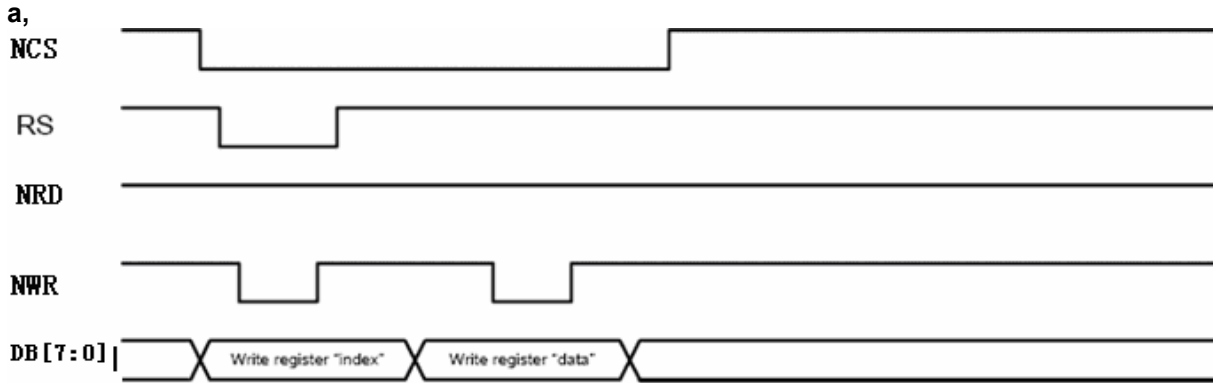


Figure 11.1 Parallel interface characteristics (8080-series MPU)
i80 System Bus Timing

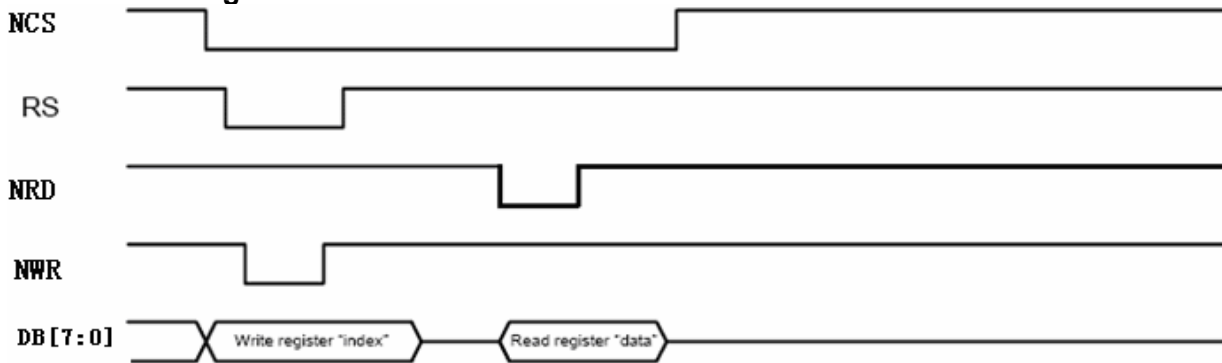


5.1.2 Register write/read timing in I80 series system

Write to register

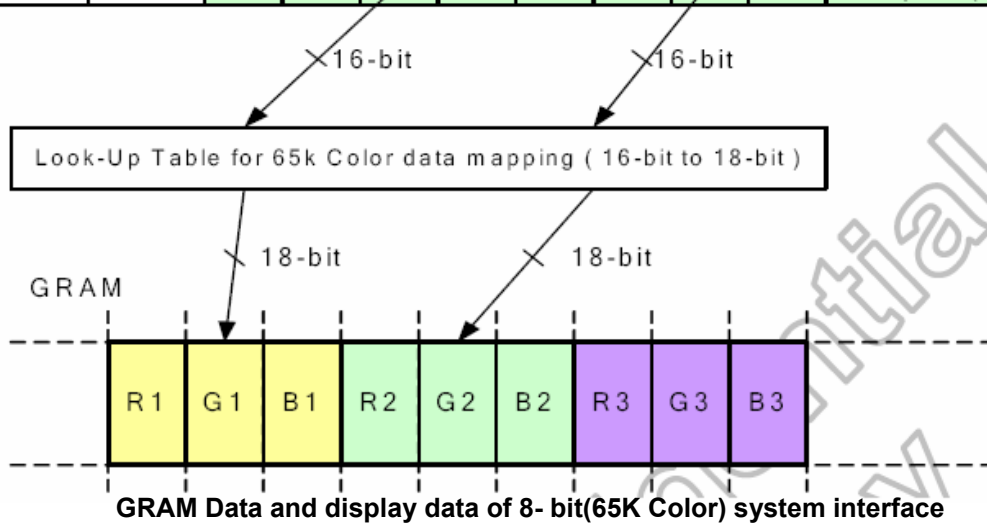


b. Read from register



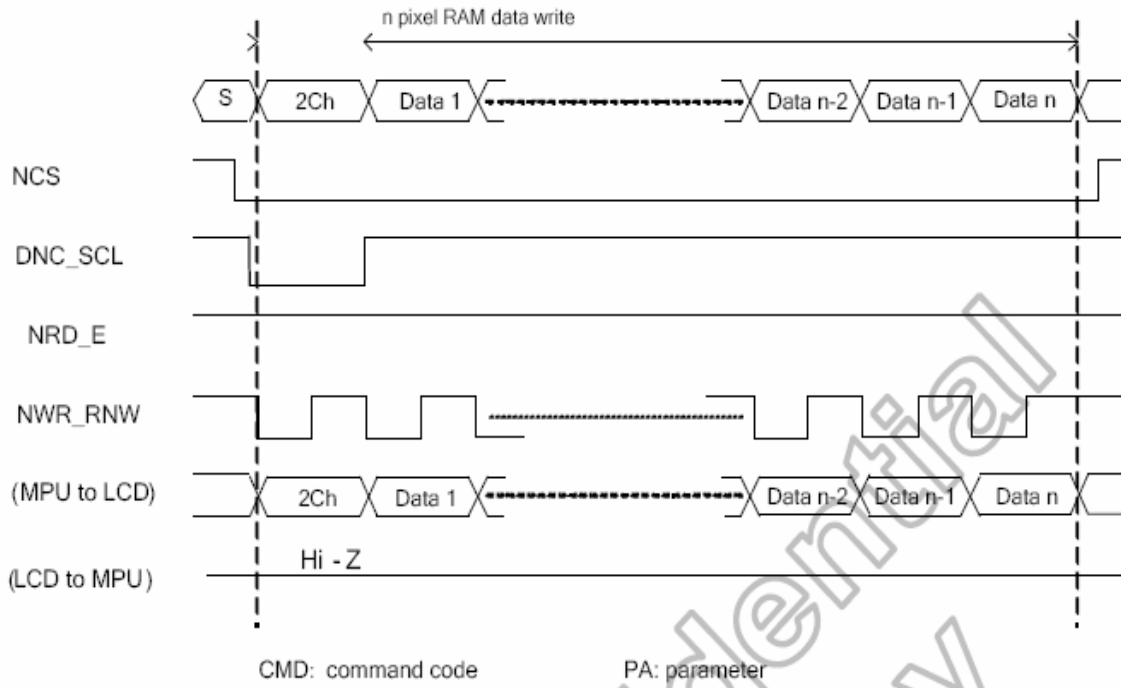
5.1.3.GRAM write/read timing in i80 series system

65k Color Data	DNC_SCL	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	GRAM Write
MEMWR	0	GRAM Write command code								-
1st write	1	R14	R13	R12	R11	R10	G15	G14	G13	-
2nd write	1	G12	G11	G10	B14	B13	B12	B11	B10	1st pixel (R1/G1/B1)
3rd write	1	R24	R23	R22	R21	R20	G25	G24	G23	-
4th write	1	G22	G21	G20	B24	B23	B22	B21	B20	2nd pixel (R2/G2/B2)

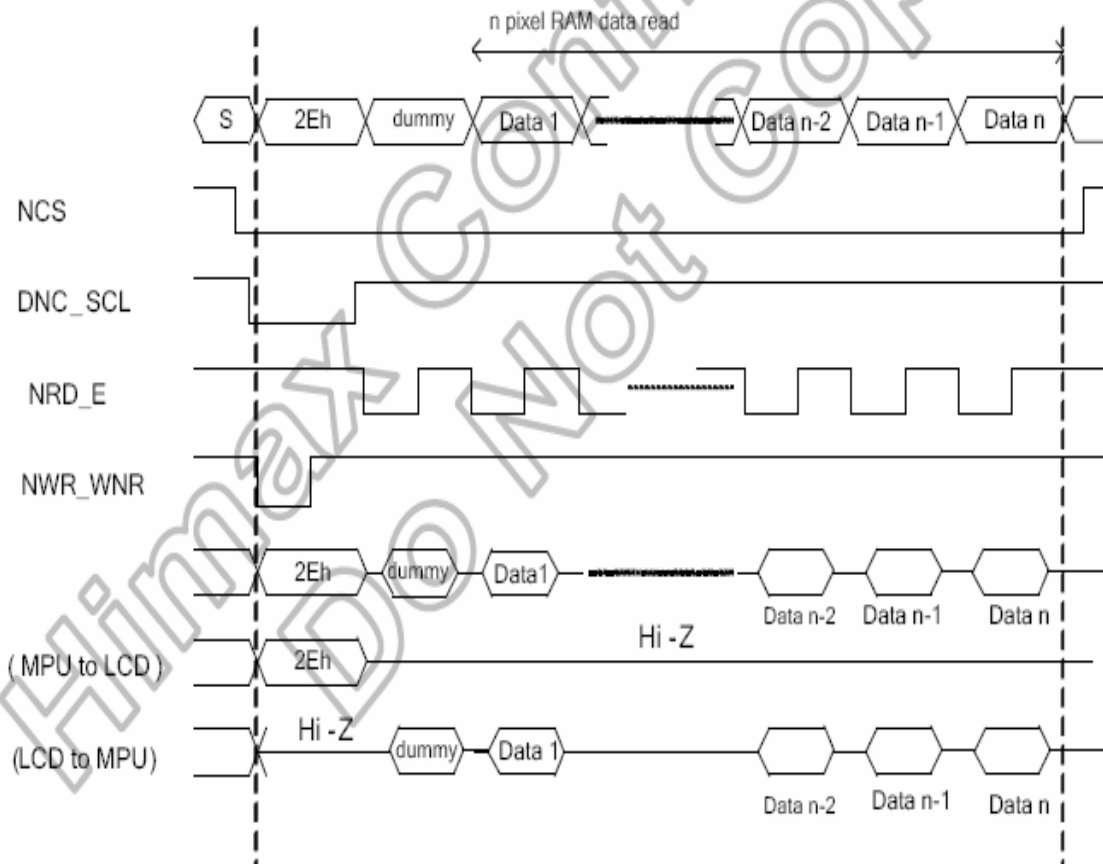




Write to GRAM

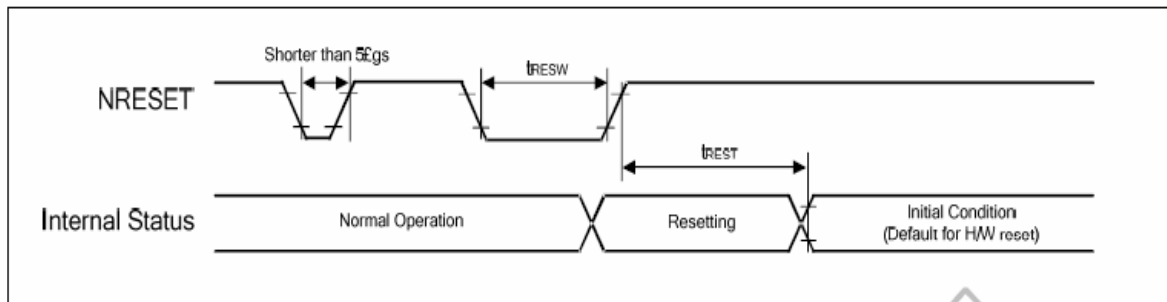


Read from GRAM



5.1.4 Reset Timing Characteristics

Ta=25°C


Figure 11.5 Reset input timing

Symbol	Parameter	Related Pins	Spec.			Note	Unit
			Min.	Typ.	Max.		
tRESW	Reset low pulse width ⁽¹⁾	NRESET	10	-	-	-	μs
tREST	Reset complete time ⁽²⁾	-	-	-	5	When reset applied during Sleep In mode	ms
		-	-	-	120	When reset applied during Sleep Out mode	ms

NRES Timing

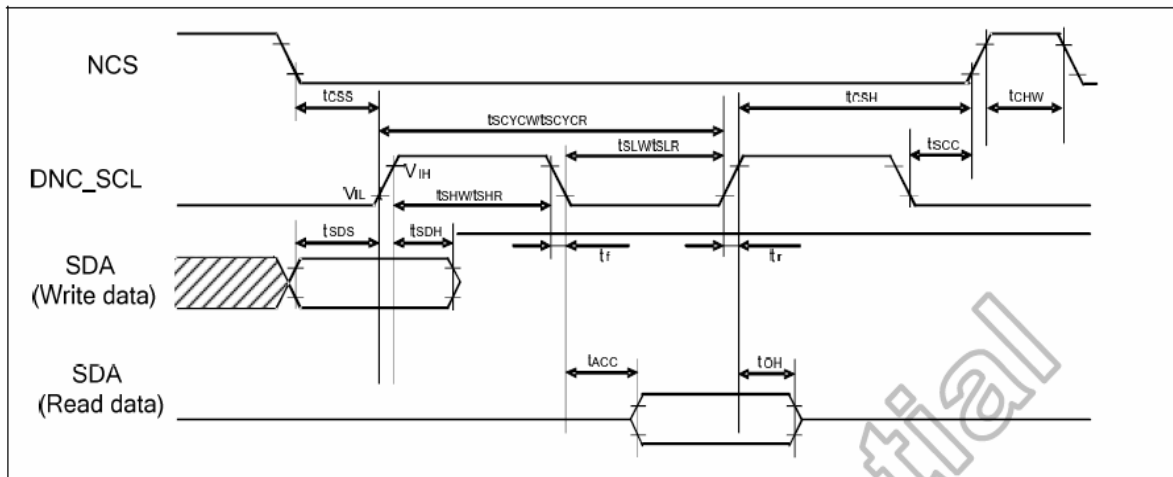


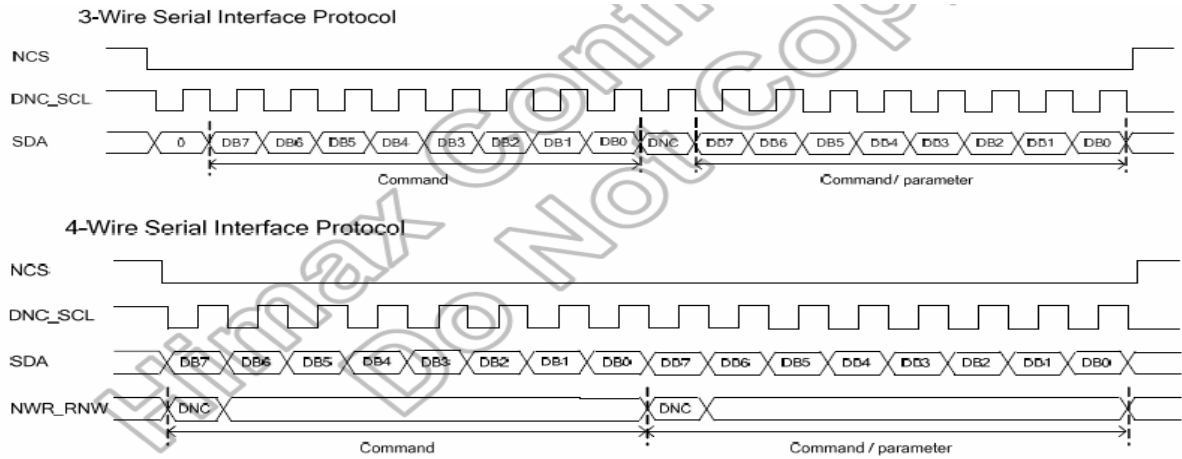
5.2 Timing Chart(4-wire SPI interface)

5.2.1 Timing Parameter

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Serial clock cycle (Write)	tSCYCW		66	-	-	
DNC_SCL "H" pulse width (Write)	tSHW	DNC_SCL	15	-	-	ns
DNC_SCL "L" pulse width (Write)	tSLW		15	-	-	
Data setup time (Write)	tSDS	SDA	10	-	-	ns
Data hold time (Write)	tSDH		10	-	-	
Serial clock cycle (Read)	tSCYCR		150	-	-	
DNC_SCL "H" pulse width (Read)	tSHR	DNC_SCL	60	-	-	ns
DNC_SCL "L" pulse width (Read)	tSLR		60	-	-	
Access Time	tACC	SDI for maximum CL=30pF For minimum CL=8pF	10	-	50	ns
Output disable time	tOH	SDO For maximum CL=30pF For minimum CL=8pF	15	-	50	ns
DNC_SCL to Chip select	tSCC	DNC_SCL, NCS	15	-	-	ns
NCS "H" pulse width	tCHW	NCS	40	-	-	ns
Chip select setup time	tCSS		60	-	-	ns
Chip select hold time	tCSH		65	-	-	ns

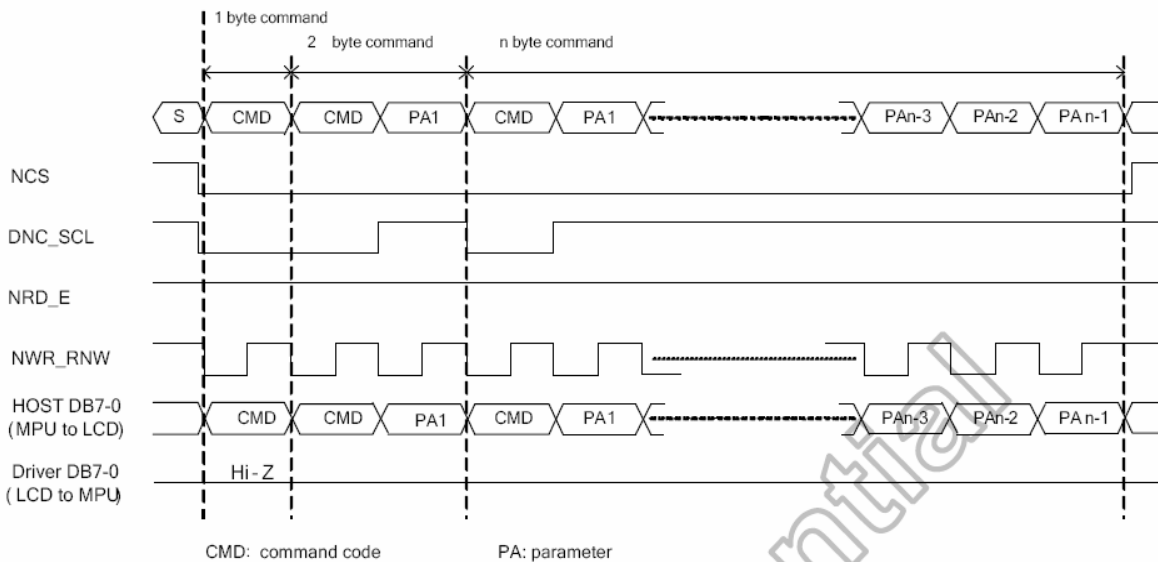
Note1 : NCS—CSX; RS—SCL; NWR—D/CX; DB0—SDA;





5.2.2 write command mode

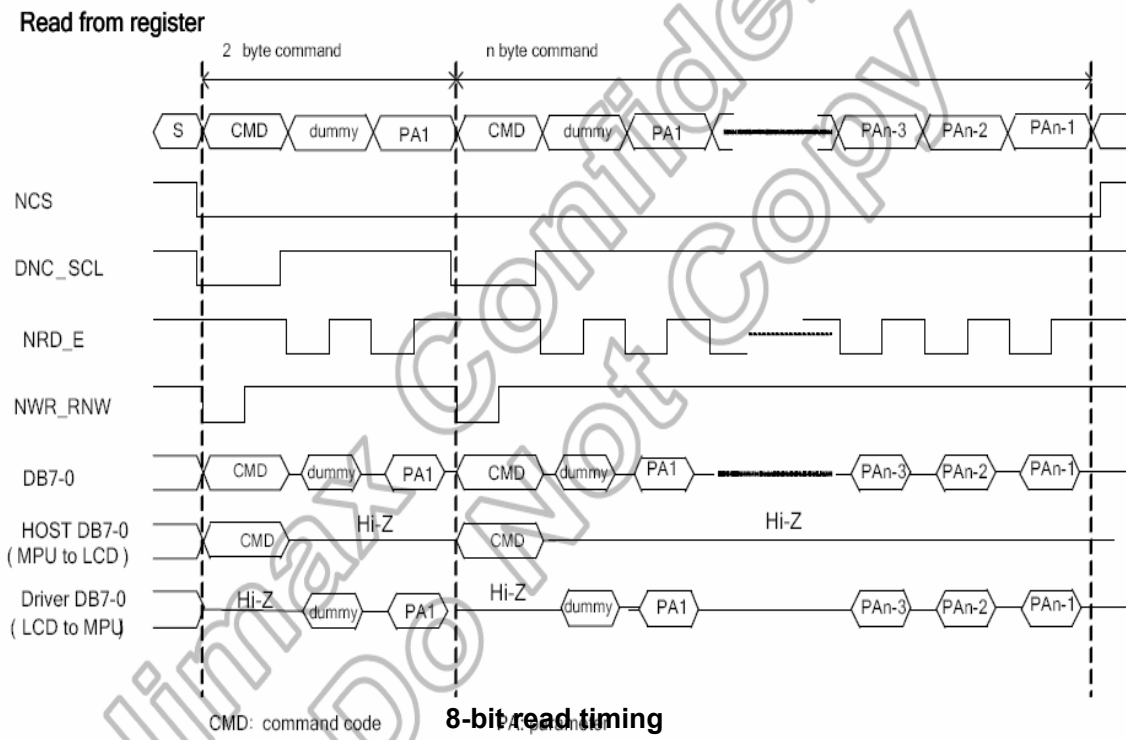
Write to register



Note2 : D/CX is sampled when 8th rising edge of SCL. D/CX indicates whether the byte is command (D/CX=0) or parameter/RAM data (D/CX=1)



5.2.3 read function

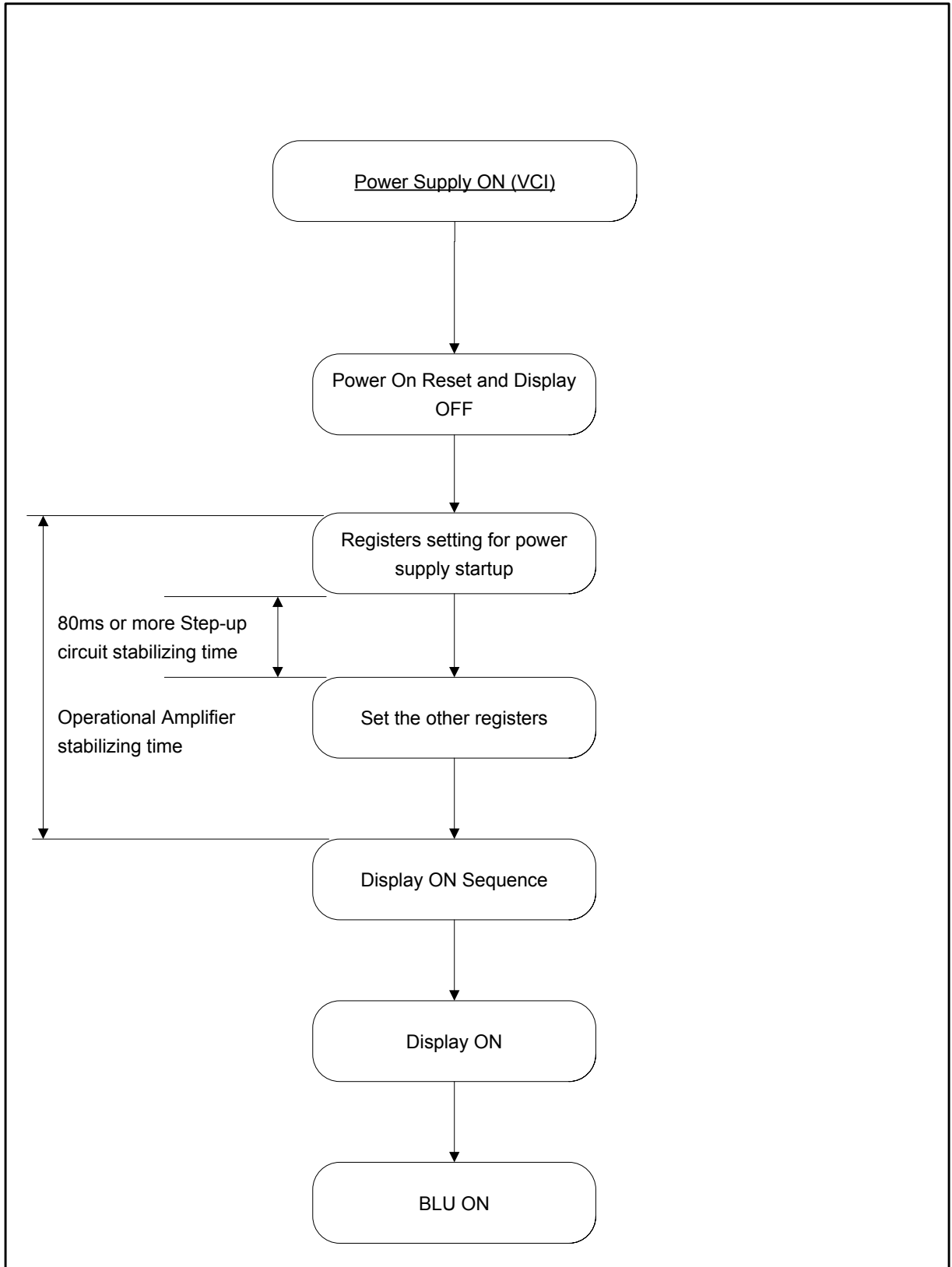




5.3

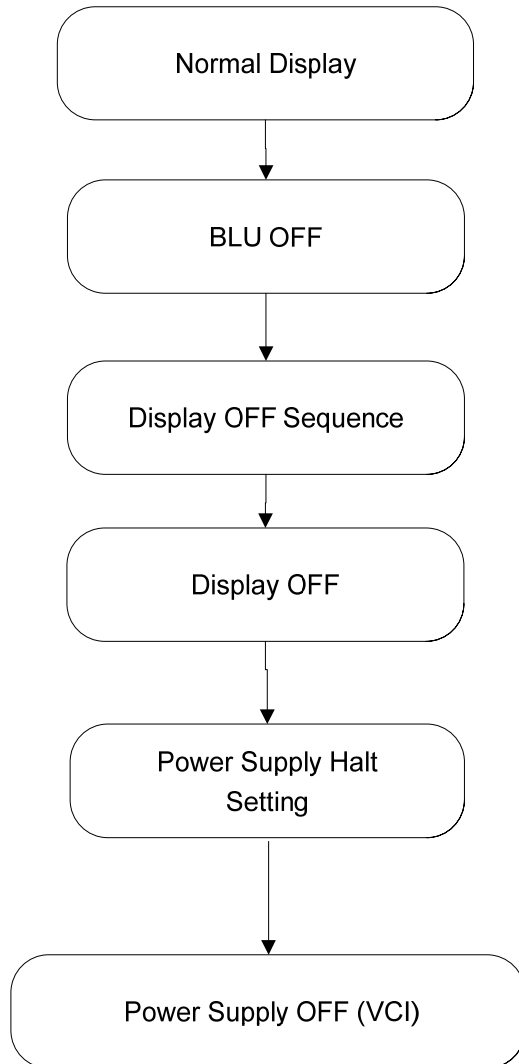
Power On/Off sequence

5.3.1 Power on Sequence





5.3.2 Power off Sequence



**6 Optical Characteristics**

Ta=25°C

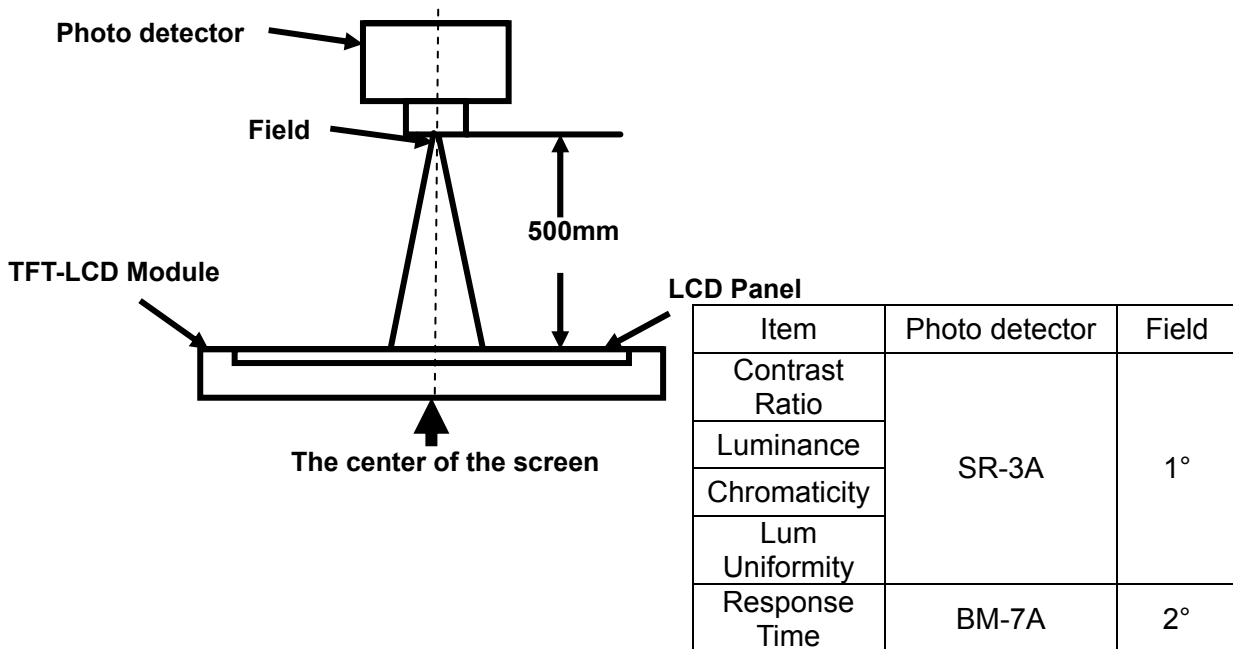
Item	Symbol	Condition	Min	Typ	Max	Unit	Remark	
View Angles	θT	$CR \geq 10$	45	50	-	Degree	Note 2	
	θB		15	20	-			
	θL		40	45	-			
	θR		40	45	-			
Contrast Ratio	CR	$\theta=0^\circ$	200	350	-	-	Note1 Note3	
Response Time	T_{ON}	25°C	-	30	40	ms	Note1	
	T_{OFF}						Note4	
Chromaticity	White	Backlight is on	x	0.222	0.272	0.322	-	Note5 Note1
			y	0.255	0.305	0.355		
	Red		x	0.540	0.590	0.640		
			y	0.290	0.340	0.390		
	Green		x	0.271	0.321	0.371		
			y	0.461	0.511	0.561		
	Blue		x	0.096	0.146	0.196		
			y	0.062	0.112	0.162		
Uniformity	U	-	70	80	-	%	Note1 Note6	
NTSC	-	-	-	40	-	%	Note 5	
Luminance	L		140	170	-	cd/m ²	Note1 Note7	

Test Conditions:

1. $V_F=3.2V$, $I_F=15mA$ (One LED current), the ambient temperature is 25°C.
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.



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).

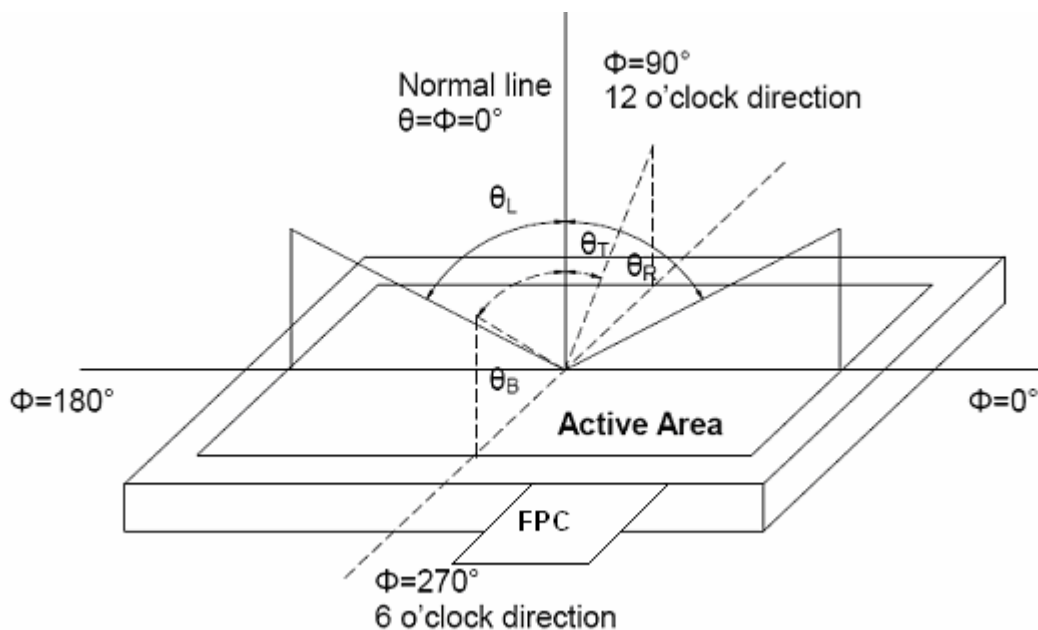


Fig. 1 Definition of viewing angle

Note 3: Definition of contrast ratio

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

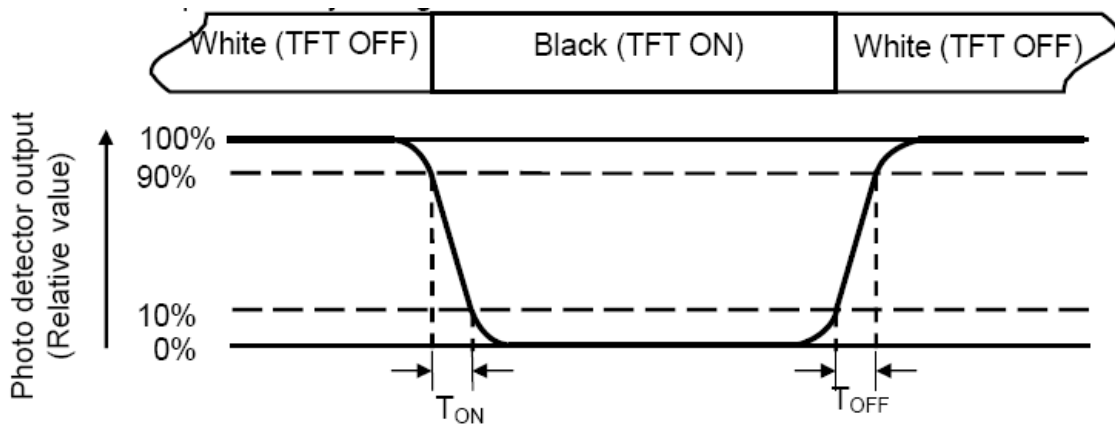
“White state “:The state is that the LCD should driven by Vwhite.

“Black state”: The state is that the LCD should 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 (TON) is the time between photo detector output intensity changed from 90% to 10%. And fall time (TOFF) 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.

$$\text{Luminance Uniformity}(U) = L_{\min} / L_{\max}$$

L-----Active area length W----- Active area width

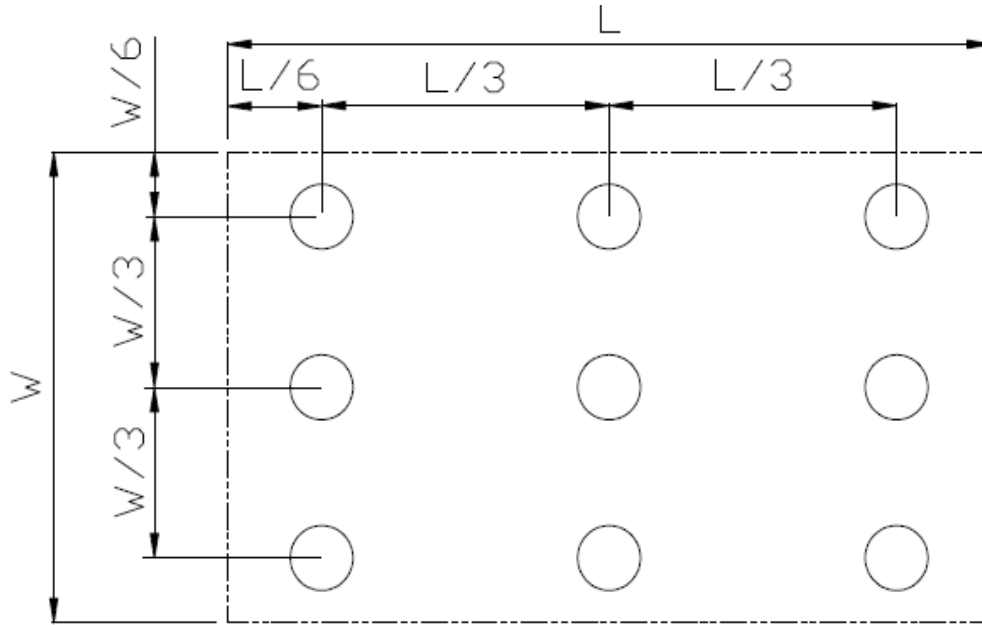


Fig. 2 Definition of uniformity

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 Test

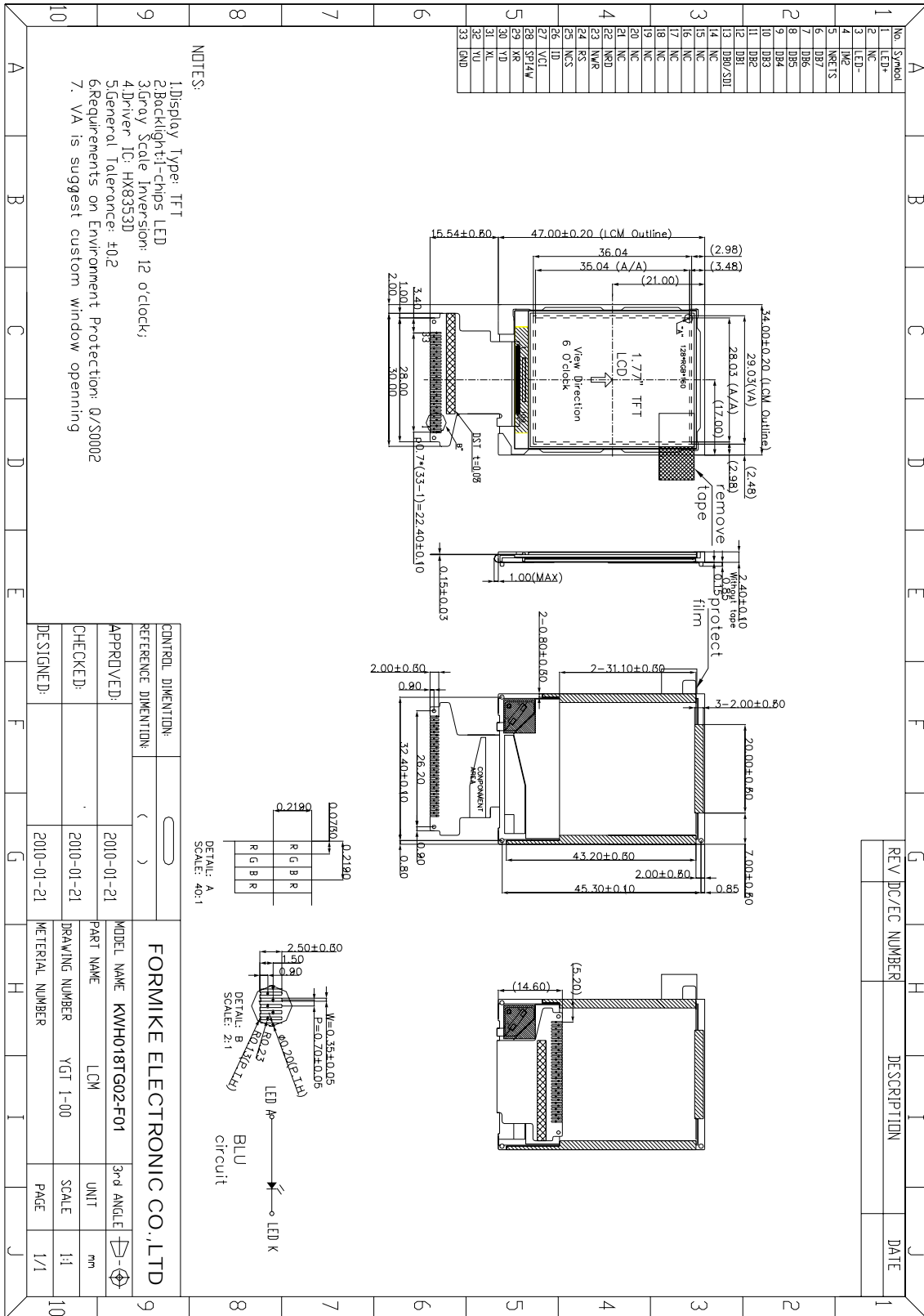
No	Test Item	Condition	Remark
1	High Temperature Operation	Ts=+70°C, 240hrs	Note1 IEC60068-2-1:2007,GB2423.2-2008
2	Low Temperature Operation	Ta=-20°C, 240hrs	IEC60068-2-1:2007 GB2423.1-2008
3	High Temperature Storage	Ta=+80°C, 240hrs	IEC60068-2-1:2007 GB2423.2-2008
4	Low Temperature Storage	Ta=-30°C, 240hrs	IEC60068-2-1:2007 GB2423.1-2008
5	High Temperature & High Humidity Storage	Ta=+60°C, 90% RH 240 hours	Note2 IEC60068-2-78 :2001 GB/T2423.3—2006
6	Thermal Shock (Non-operation)	-30°C 30 min~+70°C 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°C ~35°C, 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 hours for each direction of X.Y.Z. (6 hours for total)(Package condition)	2 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 Information

No	Item	Model (Material)	Dimensions(mm)	Unit Weight(Kg)	Quantity	Remark
1	Module	KWH018TG02-F01	34x47x2.4	TBD	672	
2	Tray	PET(Transmit)	315×247×10.3	TBD	48	Anti-static
3	EPE	EPE	315×247×5	0.0035	12	
4	Anti-static bag	PE	327×440	0.021	6	
5	BOX	Corrugated Paper	345×260×70	TBD	6	
6	Desiccant	Desiccant	45x50	0.0035	12	
7	Carton	Corrugated Paper	544×365×250	1.01	1	
8	Total weight(Kg)	TBD				

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°C ~ 40°C 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.
