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# SPECIFICATIONS FOR LCD MODULE

<b>CUSTOMER</b>	<div style="border: 1px solid black; padding: 2px; display: inline-block;"><b><u>Preliminary Reference Only</u></b></div>
<b>CUSTOMER PART NO.</b>	
<b>AMPIRE PART NO.</b>	<b>AM-320240NTMQW-CH</b> (Controller)
<b>APPROVED BY</b>	
<b>DATE</b>	

- Approved For Specifications**  
 **Approved For Specifications & Sample**

APPROVED BY	CHECKED BY	ORGANIZED BY

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**RECORD OF REVISION**

<b>Revision Date</b>	<b>Page</b>	<b>Contents</b>	<b>Editor</b>
2007/3/20	-	New Release	Kokai

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# 1 Features

5.7 inch Amorphous-TFT-LCD (Thin Film Transistor Liquid Crystal Display) module. This module is composed of a 5.7" TFT-LCD panel, LCD controller, power driver circuit and backlight unit.

## 1.1 TFT Panel Feature :

- (1) Construction: 5.7" a-Si color TFT-LCD, White LED Backlight and PCB.
- (2) Resolution (pixel): 320(R.G.B) X240
- (3) Number of the Colors : 262K colors ( R , G , B 6 bit digital each)
- (4) LCD type : Transmissive Color TFT LCD ( normally White)
- (5) Interface: 40 pin
- (6) Power Supply Voltage: 3.3V single power input. Built-in power supply circuit.
- (7) Viewing Direction: 6 O'clock ( The direction it's hard to be discolored ):

## 1.2 LCD Controller Feature:

- (1) MCU interface 8/9/16/18 bit 80&68 series MCU interface.
- (2) Display RAM size : 640x240x3x6 bits. Ex:320x240 two frame buffer with 262K colors.
- (3) Arbitrary display memory start position selection.
- (4) MCU interface : 8 bit / 9 bit / 16bit / 18 bits 80/68 MPU interface.
- (5) 8 bit / 16 bit interface support 65K ( R5G6B5) /262K(R6G6B6) colors data format.
- (6) 9 bit / 18 bit interface support 262K(R6G6B6) colors data format only.

# 2 Physical specifications

Item	Specifications	Unit	
Display resolution(dot)	960 (W) x 240(H)	mm	
Active area	115.2 (W) x 86.4 (H)	mm	
Screen size	5.7(Diagonal)	mm	
Pixel size	120 (W) x 360 (H)	um	
Color configuration	R.G.B stripe		
Overall dimension	131.0(W)x102.2(H)xT.B.D(D)	mm	
Weight	T.B.D	mg	
Backlight unit	LED		

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### 3 Electrical specification

#### 3.1 Absolute max. ratings

##### 3.1.1 Electrical Absolute max. ratings

Item	Symbol	Condition	Min.	Max.	Unit	Remark
Power voltage	VDD	VSS=0	-0.3	T.B.D	V	
Input voltage	V <sub>in</sub>		-0.3	VDD+0.3	V	Note 1

Note1: /CS,/WR,/RD,RS,DB0~DN17

##### 3.1.2 Environmental Absolute max. ratings

Item	OPERATING		STORAGE		Remark
	MIN	MAX	MIN	MAX	
Temperature	-20	70	-30	80	Note2,3,4,5,6,7
Humidity	Note1		Note1		
Corrosive Gas	Not Acceptable		Not Acceptable		

Note1 : Ta <= 40°C : 85% RH max

Ta > 40°C : Absolute humidity must be lower than the humidity of 85%RH at 40°C

Note2 : For storage condition Ta at -30°C < 48h , at 80°C < 100h

For operating condition Ta at -20°C < 100h

Note3 : Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

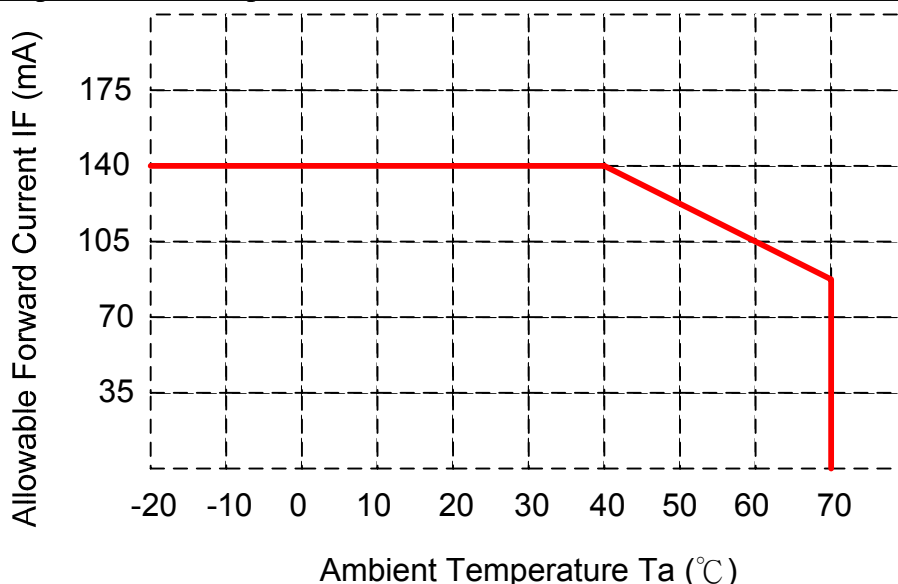
Note4 : The response time will be slower at low temperature.

Note5 : Only operation is guaranteed at operating temperature. Contrast , response time, another display quality are evaluated at +25°C

Note6 : When LCM is operated over 40°C ambient temperature, the I<sub>LED</sub> of the LED back-light should be follow :

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Note7 : This is panel surface temperature, not ambient temperature.

Note8 : When LCM be operated over than 40°C , the life time of the LED back-light will be reduced.

## 3.2 Electrical characteristics

### 3.2.1 DC Electrical characteristic of the LCD

Typical operating conditions (VSS=0V)

Item	Symbol	Min.	Typ.	Max.	Unit	Remark	
Power supply	VDD	3.0	3.3	3.6	V		
Input Voltage for logic	H Level	$V_{IH}$	2.0	-	5.5	V	Note 1
	L Level	$V_{IL}$	VSS	-	0.8	V	
Output Voltage for Logic	H Level	$V_{OH}$	2.4	-	VDD	V	Note 2
	L Level	$V_{OL}$	VSS	-	0.4	V	
Power Supply current	IDD	-	T.B.D	-	mA	Note 3	

Note1: With 5V Tolerance Input , /CS, /WR,/RD,RS,DB0~DB17

Note2: DB0~DB17

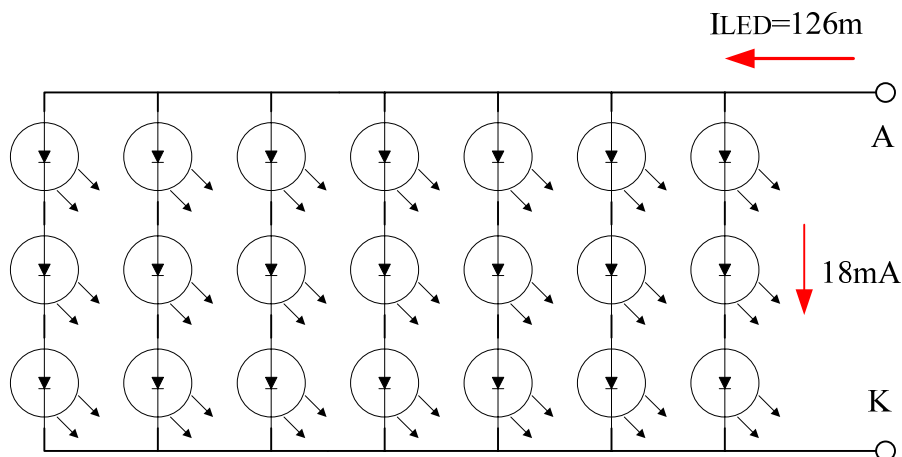
Note3:  $f_v = 60\text{Hz}$  ,  $T_a = 25^\circ\text{C}$  , Display pattern : All Black

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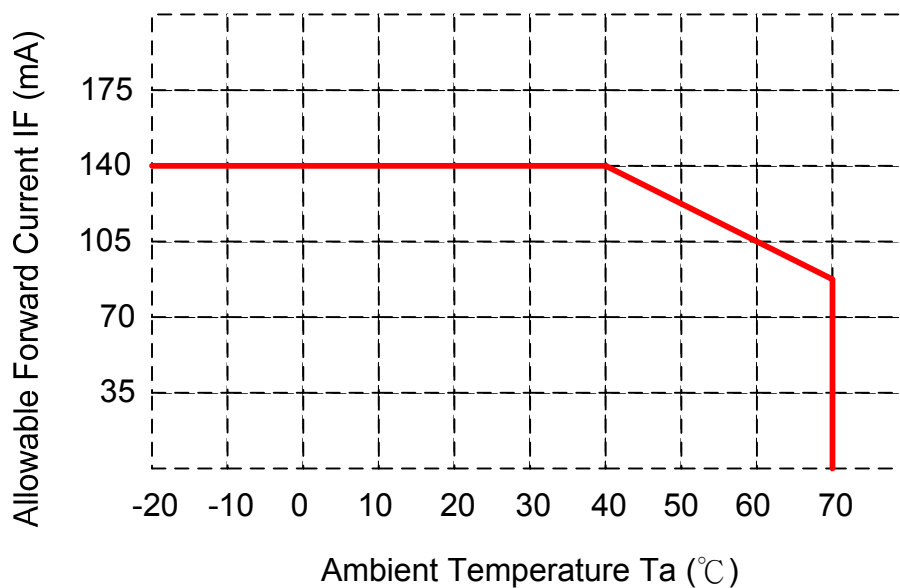
**3.2.2 Electrical characteristic of LED Back-light**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Condition
LED voltage	$V_{AK}$	--	10.5	12	V	$I_{LED} = 140mA, T_a = 25^\circ C$
LED forward current	$I_{LED}$	--	126	140	mA	$T_a = 25^\circ C$
	$I_{LED}$	--	84	105	mA	$T_a = 60^\circ C$
Lamp life time		10,000	-	-	Hr	$I_{LED} = 140mA, T_a = 25^\circ C$



- The constant current source is needed for white LED back-light driving.

When LCM is operated over 60°C ambient temperature, the  $I_{LED}$  of the LED back-light should be adjusted to 105mA max



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**3.3 AC Timing characteristic of the LCD**

**T.B.D**

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# 4 Optical specification

## 4.1 Optical characteristic of the LCD

Item		Symbol	Conditon	Min.	Typ.	Max.	Unit	Remark
Response Time	Rise	$T_r$	$\Theta = 0^\circ$	-	15	30	ms	Note 1,2,3,5
	Fall	$T_f$		-	35	50	ms	
Contrast ratio		CR	At optimized viewing angle	200	350	-		Note 1,2,4,5
Viewing Angle	Top		$CR \geq 10$	-	35	-	deg.	Note1,2, 5,6
	Bottom			-	15	-		
	Left			-	45	-		
	Right			-	45	-		
Brightness		$Y_L$	$I_{LED}=126mA, 25^\circ C$	427.5	450	-	$cd/m^2$	Note 7
			$I_{LED}=140mA, 25^\circ C$	475	500	-	$cd/m^2$	
Red chromaticity		XR	$\Theta = 0^\circ$ $\Theta = 0^\circ$	0.610	0.640	0.670		Note 7 For reference only. These data should be update according the prototype.
		YR		0.314	0.344	0.374		
Green chromaticity		XG		0.268	0.298	0.328		
		YG		0.553	0.583	0.613		
Blue chromaticity		XB		0.102	0.132	0.162		
		YB		0.107	0.137	0.167		
White chromaticity		XW		0.282	0.312	0.342		
		YW		0.299	0.329	0.359		

( )For reference only. These data should be update according the prototype.

Note 1: Ambient temperature= $25^\circ C$ , and lamp current  $I_{LED}=140mA$ . To be measured in the dark room.

Note 2: To be measured on the center area of panel with a viewing cone of  $1^\circ$  by Topcon luminance meter BM-7, after 10 minutes operation.

Note 3. Definition of response time:

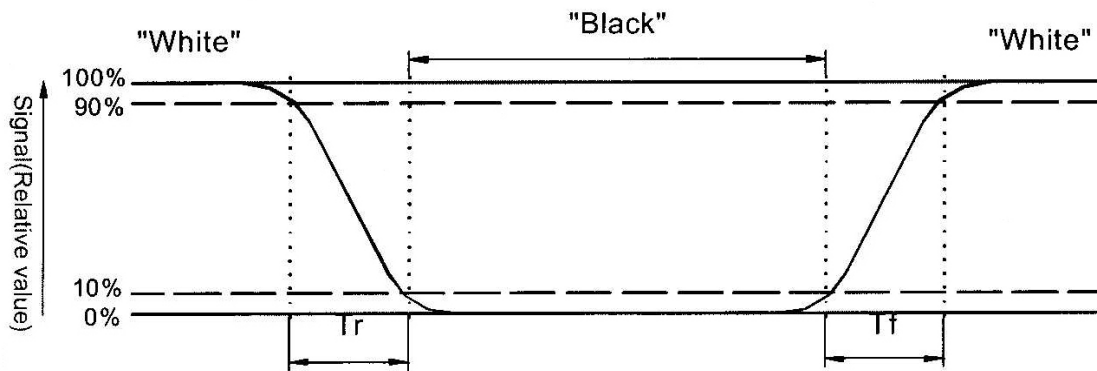
The output signals of photo detector are measured when the input signals are changed from "black" to "white" (falling time) and from "white" to "black" (rising time), respectively. The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.



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Note 4. Definition of contrast ratio:

Contrast ratio is calculated with the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Photo detector output when LCD is at "White" state}}{\text{Photo detector Output when LCD is at "Black" state}}$$

Note 5: White  $V_i = V_{i50} + 1.5V$

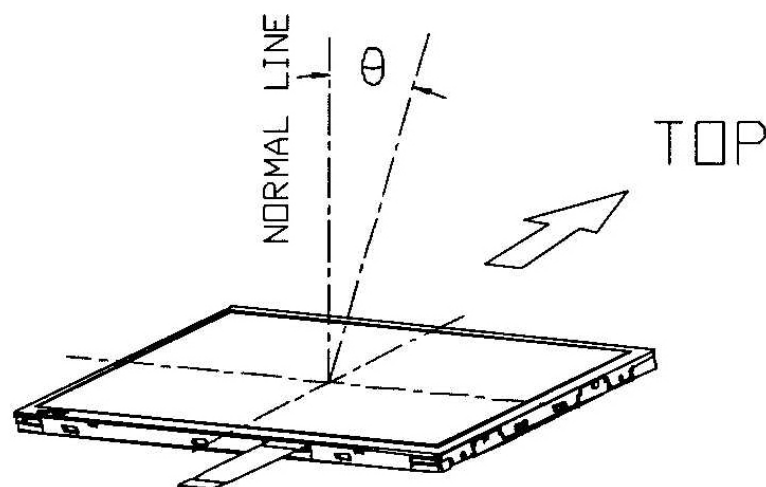
Black  $V_i = V_{i50} + 2.0V$

“±” means that the analog input signal swings in phase with  $V_{COM}$  signal.

“ $\frac{-}{+}$ ” means that the analog input signal swings out of phase with  $V_{COM}$  signal.

$V_{i50}$  : The analog input voltage when transmission is 50%. The 100% Transmission is defined as the transmission of LCD panel when all the Input terminals of module are electrically opened.

Note 6. Definition of viewing angle, Refer to figure as below.

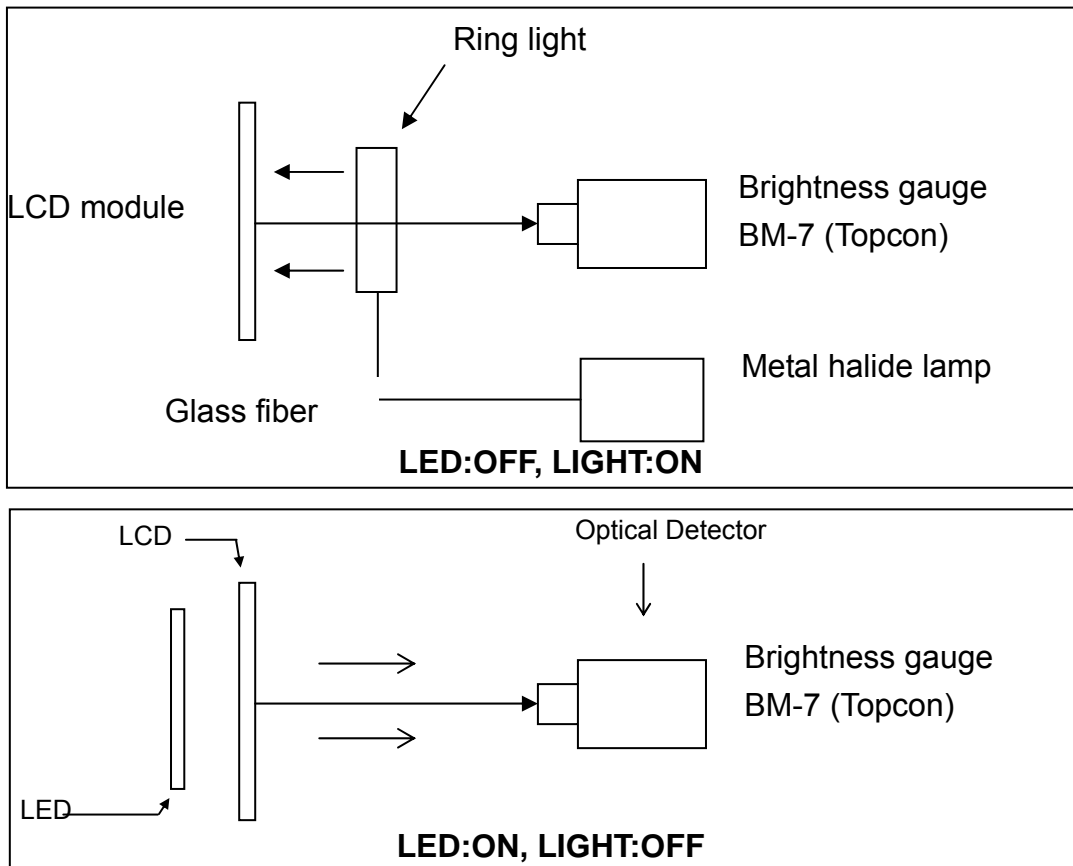


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Note 7. Measured at the center area of the panel when all the input terminals of LCD panel are electrically opened.



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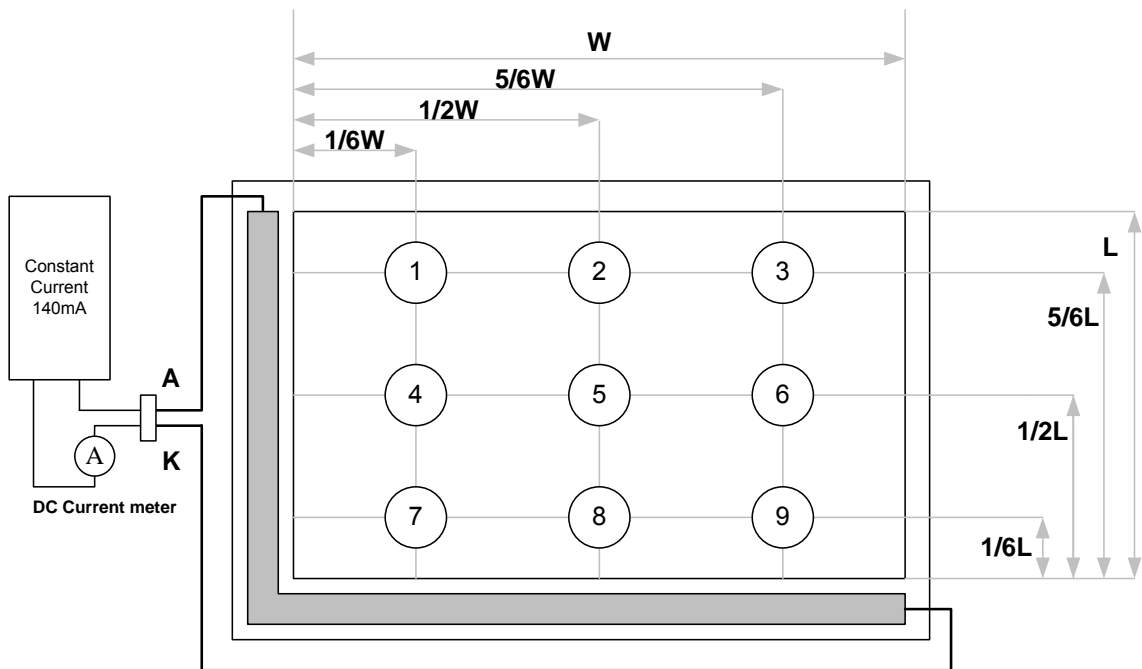
**4.2 Optical characteristic of the Back-light**

ITEM	MIN	TYP	MAX	UNIT	Condition
Bare Brightness	3650	3850	--	Cd/m2	$I_{LED} = 140mA, Ta = 25^{\circ}C$
AVG. X of 1931 C.I.E.	0.28	0.31	0.34	--	$I_{LED} = 140mA, Ta = 25^{\circ}C$
AVG. X of 1931 C.I.E.	0.28	0.31	0.34	--	$I_{LED} = 140mA, Ta = 25^{\circ}C$
Brightness Uniformity	80	--	--	%	$I_{LED} = 140mA, Ta = 25^{\circ}C$

( ) For reference only. These data should be update according the prototype.

Note1 : Measurement after 10 minutes from LED BL operating.

Note2 : Measurement of the following 9 places on the display.



Note3: The Uniformity definition

$(\text{Min Brightness} / \text{Max Brightness}) \times 100\%$

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# 5 Interface specifications

## 5.1 Driving signals for the TFT panel

(Suitable FPC :t=0.3+/-0.03mm , 0.5+/-0.03mm pitch)

Pin no	Symbol	I/O	Description	Remark
1~3	VDD	-	Power supply for the logic (3.3V)	
4~6	VSS	-	GND	
7	/RESET	I	Reset signal for TFT LCD controller	
8	/RD(R/W)	I	80mode : /RD low active signal for TFT LCD controller 68mode : R/W signal Hi: read Lo:Write	
9	/WR(E)	I	80mode : /WR low active signal for TFT LCD controller 68mode : E signal latch on rising edge	
10	/CS	I	Chip select low active signal for TFT LCD controller	
11	RS	I	Register and Data select for TFT LCD controller	
12	65K/262K	I	When use 8 or 16 bit MPU interface. The 65K/262K data format can be select. Lo : 65K Hi:262K colors When use 9 or 18 bit MPU interface. The 262K data can be used only. The 65K/262K pin must set to Hi	
13	DB0	I/O	Data Bus	
14	DB1	I/O	Data Bus	
15	DB2	I/O	Data Bus	
16	DB3	I/O	Data Bus	
17	DB4	I/O	Data Bus	
18	DB5	I/O	Data Bus	
19	DB6	I/O	Data Bus	
20	DB7	I/O	Data Bus	
21	DB8	I/O	Data Bus	
22	DB9	I/O	Data Bus	
23	DB10	I/O	Data Bus	
24	DB11	I/O	Data Bus	
25	DB12	I/O	Data Bus	
26	DB13	I/O	Data Bus	
27	DB14	I/O	Data Bus	
28	DB15	I/O	Data Bus	
29	DB16	I/O	Data Bus	
30	DB17	I/O	Data Bus	
31	TPCS	I	Chip select low active signal for Touch panel controller	When Built in the TP Controller
32	SK	I	Serial clock for Touch panel controller	
33	DI	I	Serial Data input for Touch panel controller	
34	DO	O	Serial Data output for Touch panel controller	
35	IRQ	O	Active low when user touch the Touch panel	
36	VSS	-	GND	
37	XT		Touch Panel Top side signal	When Built in Touch Panel
38	YL		Touch Panel Left side signal	
39	XB		Touch Panel Bottom side signal	
40	YR		Touch Panel Right side signal	

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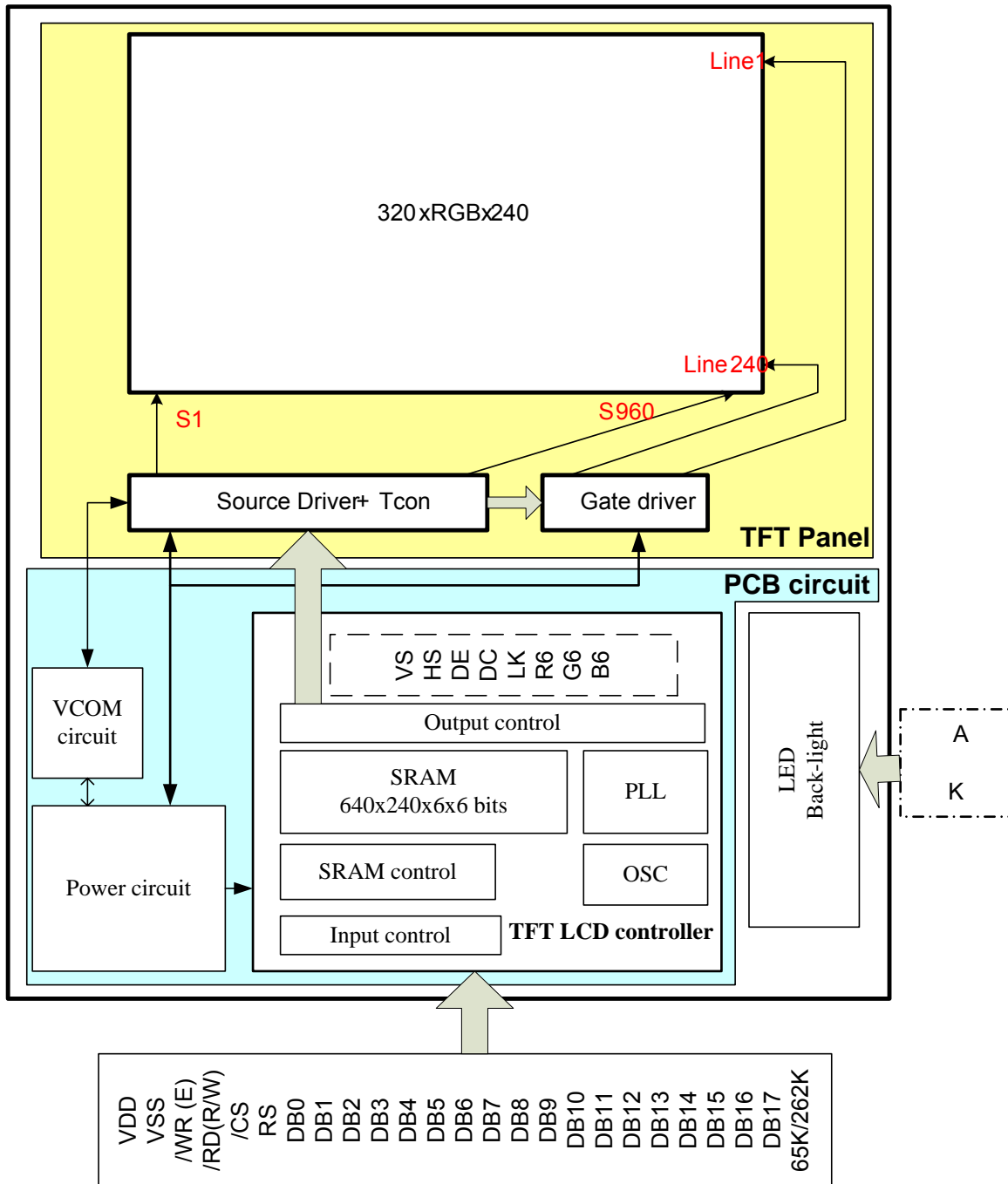
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**5.2 Driving signals for the LED back-light**

JST Housing: BHR-03VS-1

Pin no	Symbol	Level	Description	Remark
1	A	-	LED Anode	
2	NC	-	No connection	
3	K	-	LED Cathode	

**6 BLOCK DIAGRAM**

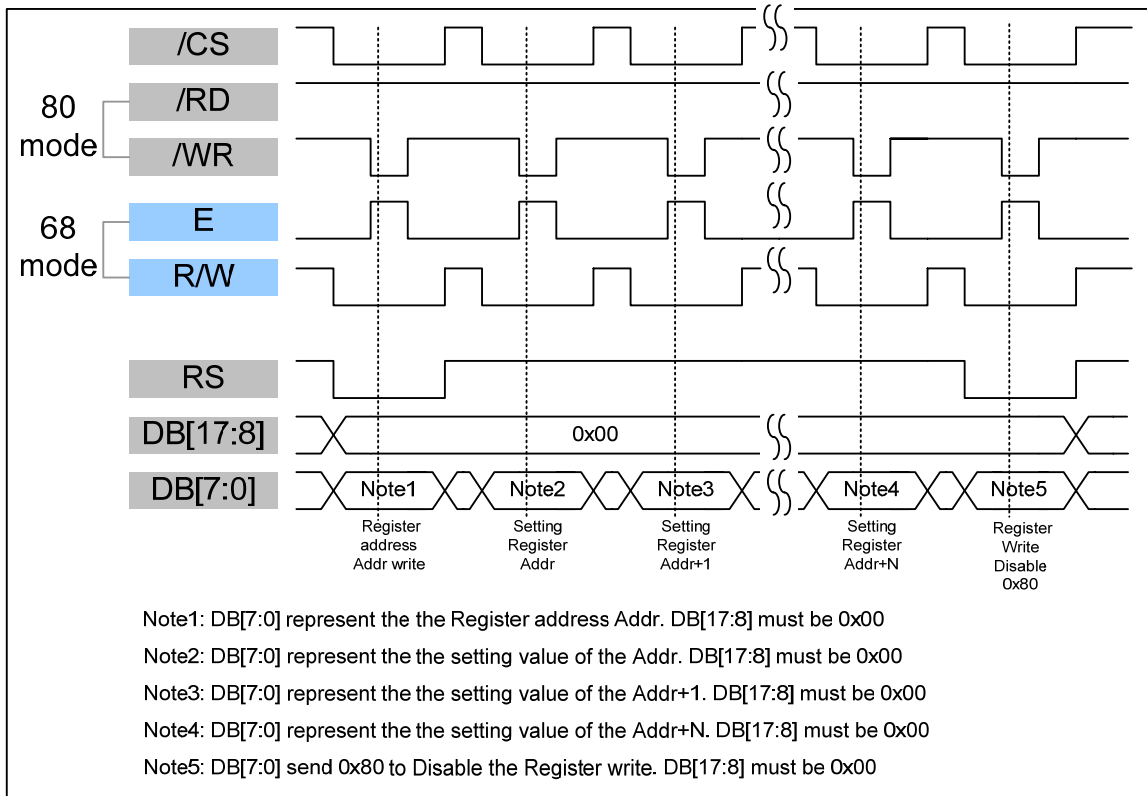


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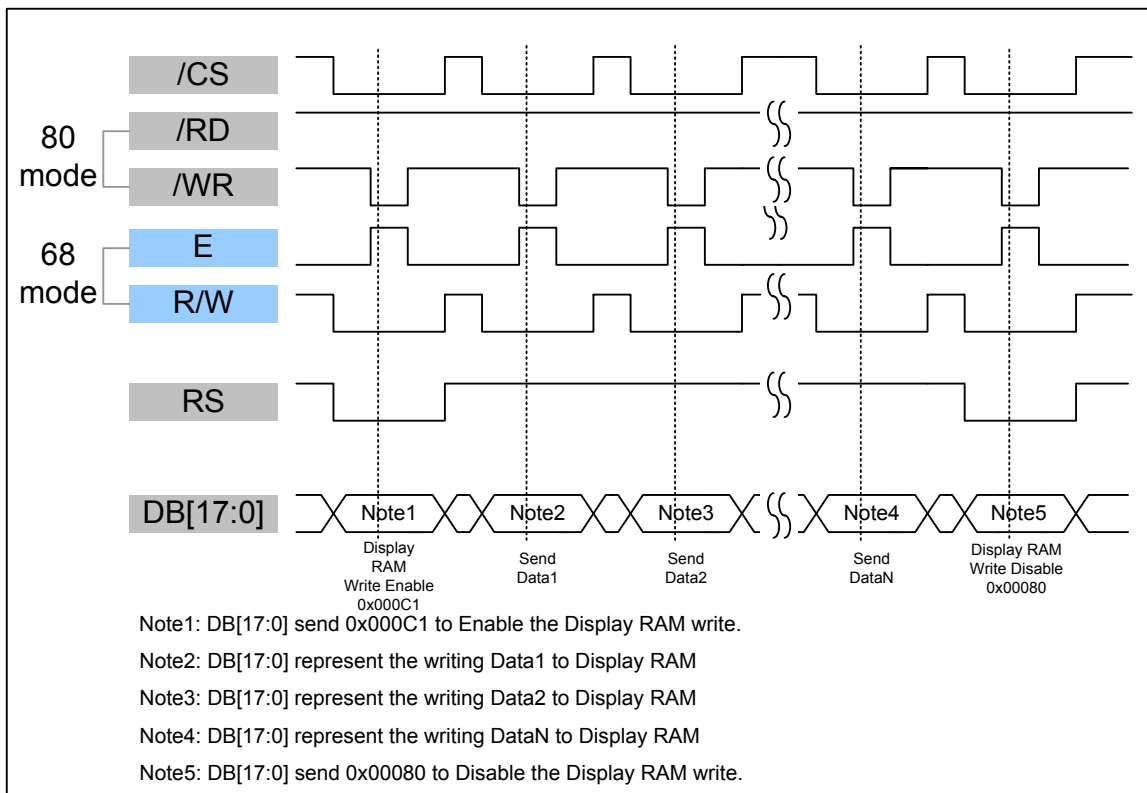
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# 7 Interface Protocol

## 7.1 18Bit-80/68-Write to Command Register



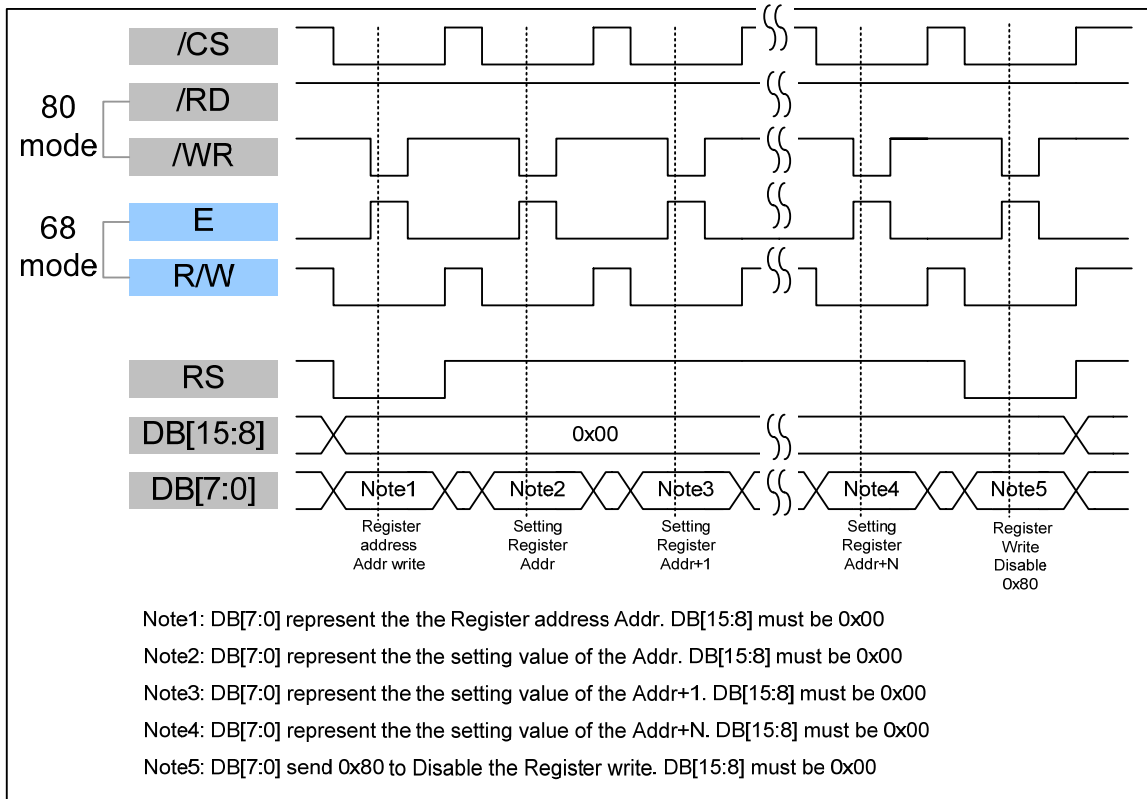
## 7.2 18Bit-80/68-Write to Display RAM



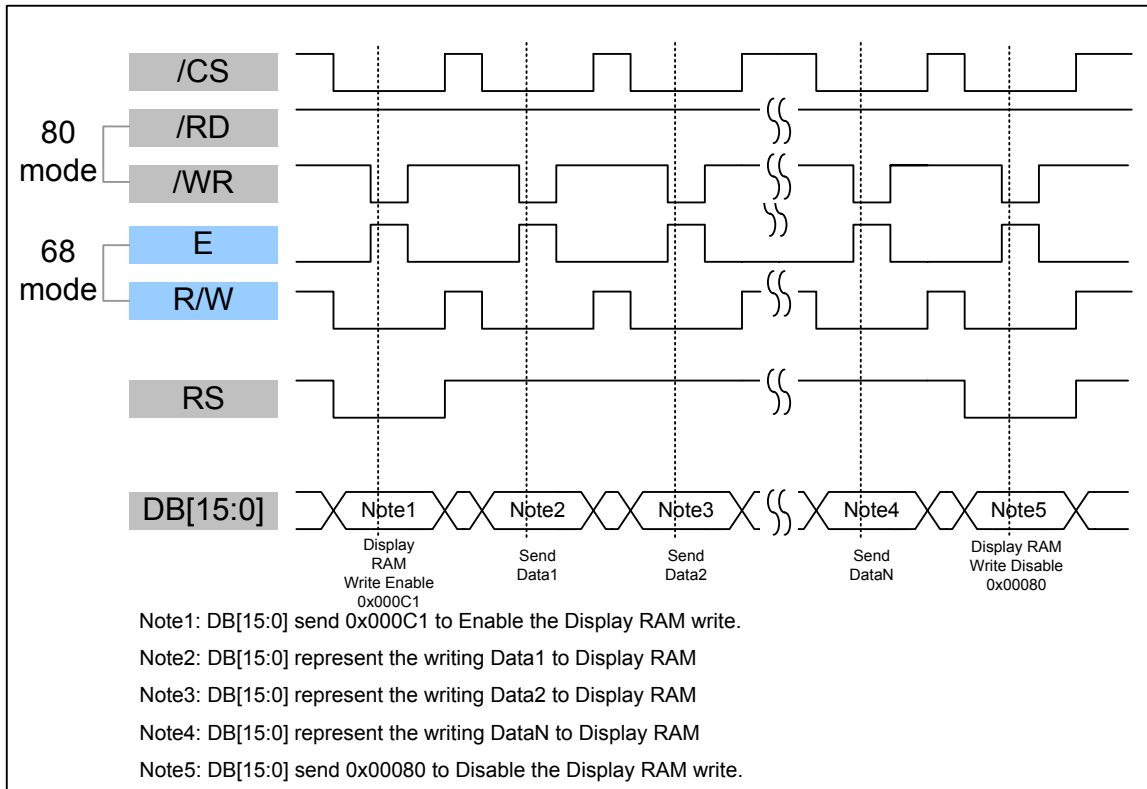
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### 7.3 16Bit-80/68- Write to Command Register



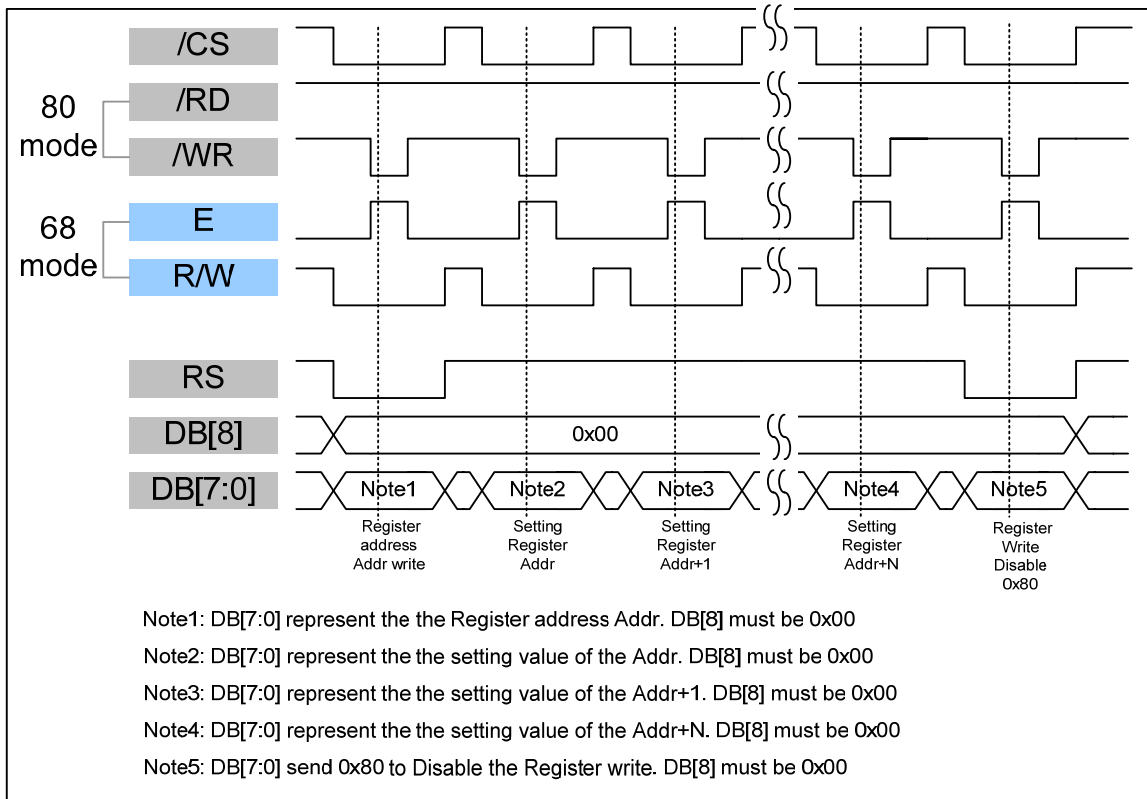
### 7.4 16Bit-80/68-Write to Display RAM



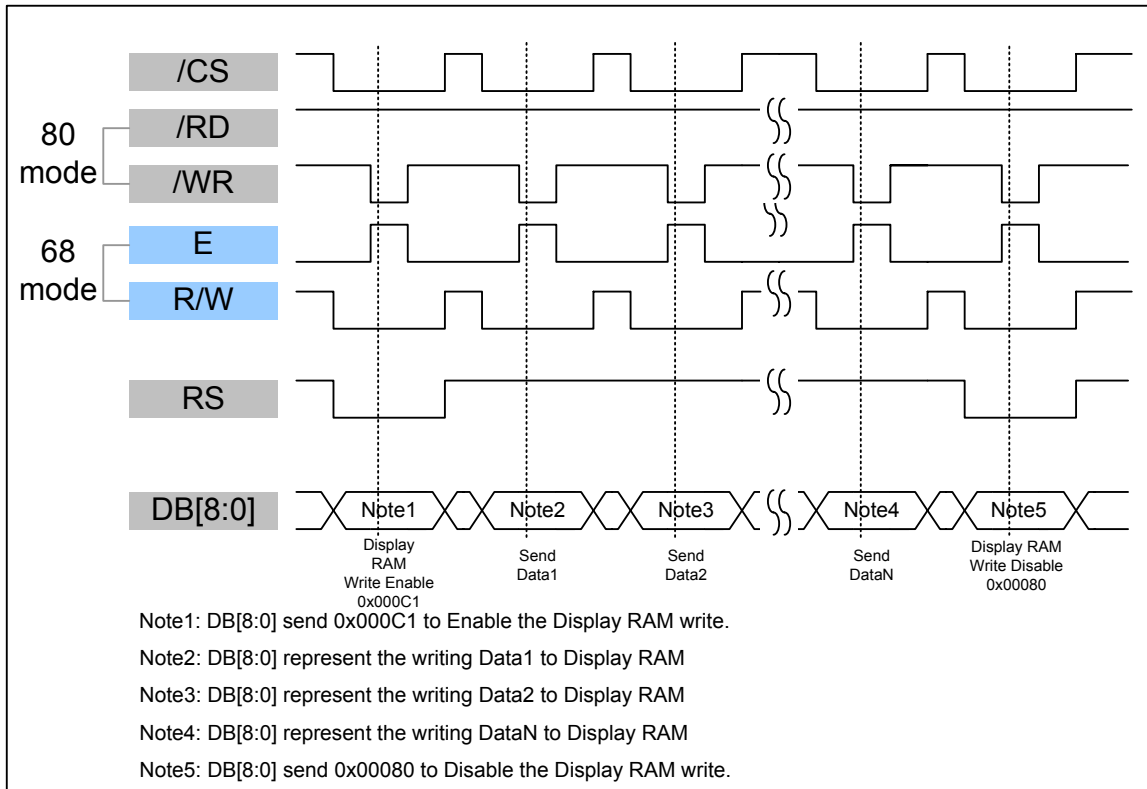
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### 7.5 9Bit-80/68- Write to Command Register



### 7.6 9Bit-80/68-Write to Display RAM

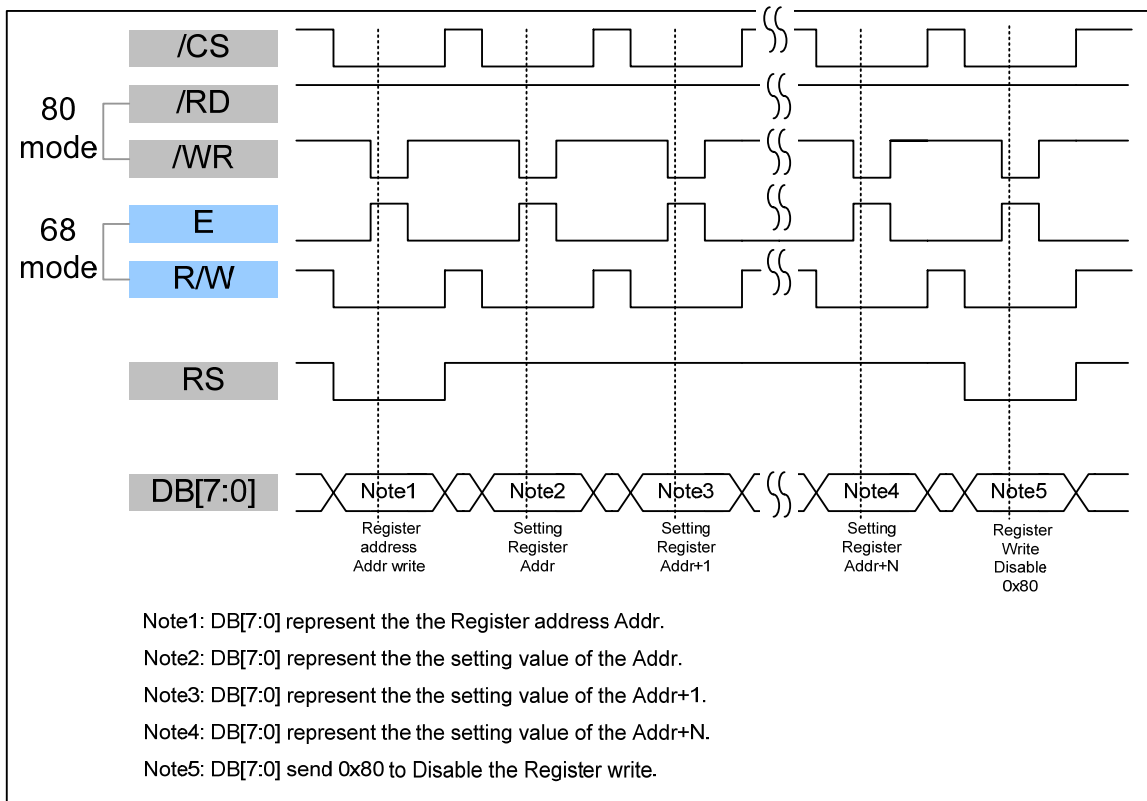




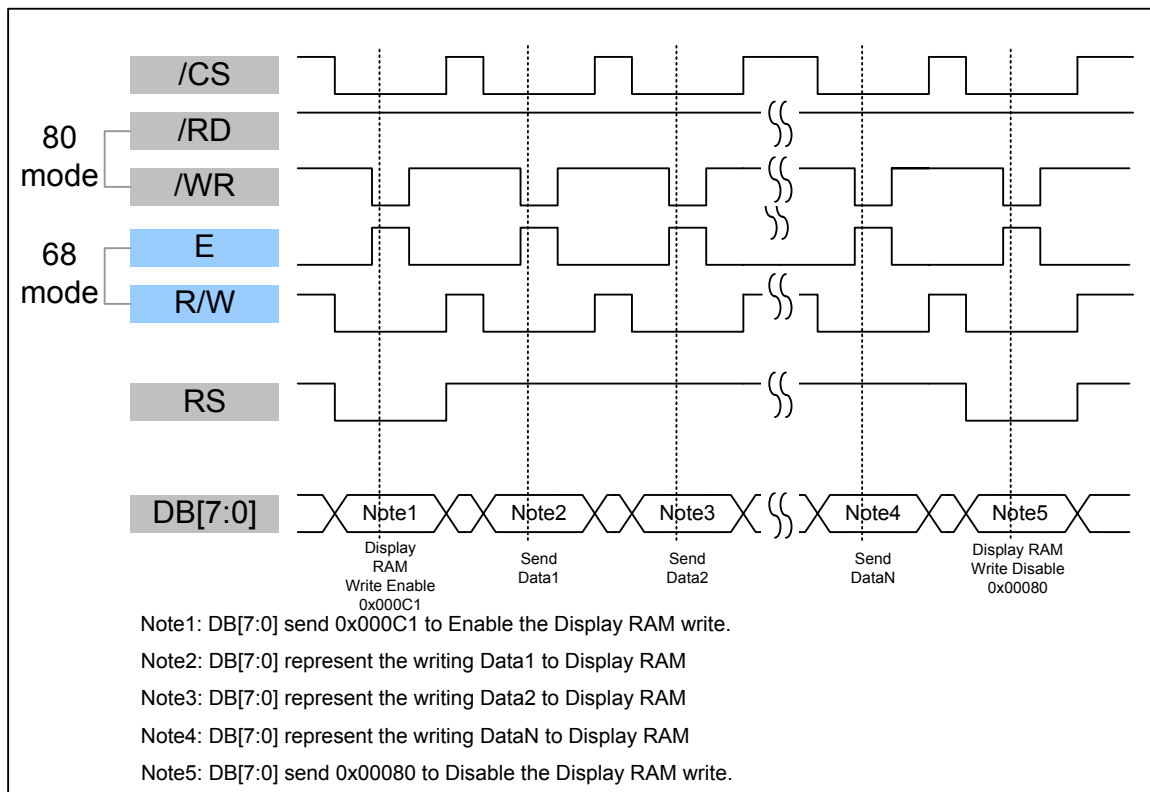
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### 7.7 8Bit-80/68- Write to Command Register



### 7.8 8Bit-80/68-Write to Display RAM



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### 7.9 Data transfer order Setting

#### 7.9.1 18 bit interface 262K color only (Pin12 65K/262K =High)

DB	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0

#### 7.9.2 16 bit interface 65K color (Pin12 65K/262K =Low)

DB	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B4	B3	B2	B1	B0

#### 7.9.3 16 bit interface 262K color (Pin12 65K/262K =High)

DB	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0	
1 <sup>st</sup> data	X	X	X	X	X	X	X	X	X	X	X	X	X	X	R5	R4	
2 <sup>nd</sup> data		R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0

#### 7.9.4 9 bit interface 262K color only (Pin12 65K/262K =High)

DB	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 <sup>st</sup> data	X	X	X	X	X	X	X	R5	R4	R3	R2	R1	R0	G5	G4	G3
2 <sup>nd</sup> data	X	X	X	X	X	X	X	G2	G1	G0	B5	B4	B3	B2	B1	B0

#### 7.9.5 8 bit interface 65K color (Pin12 65K/262K =Low)

DB	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 <sup>st</sup> data	X	X	X	X	X	X	X	X	R4	R3	R2	R1	R0	G5	G4	G3
2 <sup>nd</sup> data	X	X	X	X	X	X	X	X	G2	G1	G0	B4	B3	B2	B1	B0

#### 7.9.6 8 bit interface 262K color (Pin12 65K/262K =High)

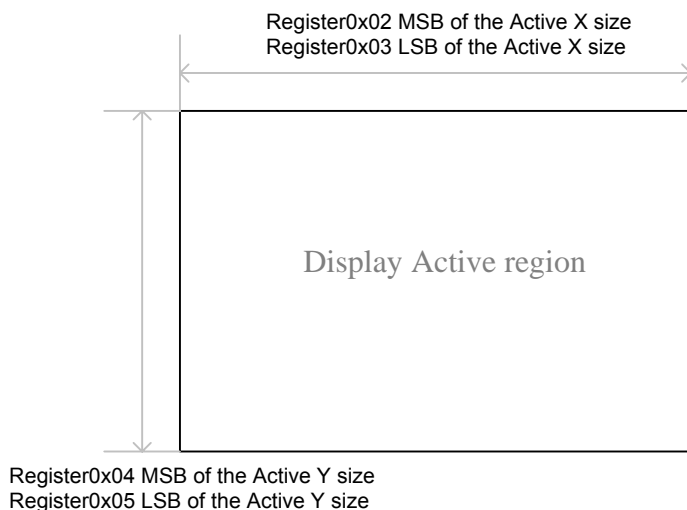
DB	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1 <sup>st</sup> data	X	X	X	X	X	X	X	X							R5	R4
2 <sup>nd</sup> data	X	X	X	X	X	X	X	X	R3	R2	R1	R0	G5	G4	G3	G2
3 <sup>rd</sup> data	X	X	X	X	X	X	X	X	G1	G0	B5	B4	B3	B2	B1	B0

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**8 Register Depiction**

Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
00	00									
Description	set the start position of Memory / Register									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
02	01	MSB of the X-size								
Description	set the horizontal of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
03	40	LSB of the X-size								
Description	set the horizontal of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
04	00	MSB of the Y-size								
Description	set the vertical of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
05	F0	LSB of the Y-size								
Description	set the vertical of display active region									



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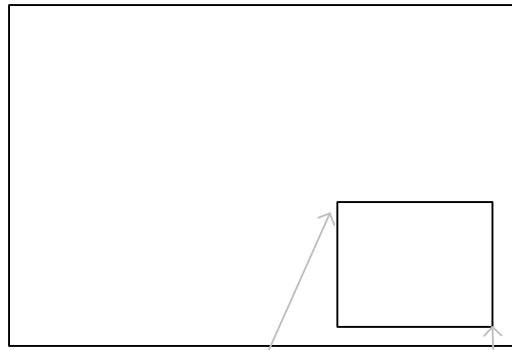
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Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
06	00	MSB of X-axis start position								
Description	set the horizontals start position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
07	00	LSB of X-axis start position								
Description	set the horizontals start position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
08	00	MSB of X-axis end position								
Description	set the horizontals end position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
09	00	LSB of X-axis end position								
Description	set the horizontals end position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
0A	00	MSB of Y-axis start position								
Description	set the vertical start position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
0B	00	LSB of Y-axis start position								
Description	set the vertical start position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
0C	00	MSB of Y-axis end position								
Description	set the vertical end position of display active region									
Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
0D	00	LSB of Y-axis end position								
Description	set the vertical end position of display active region									

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Register0x06 MSB of X-axis Start position  
Register0x07 LSB of X-axis Start position  
Register0x0A MSB of Y-axis Start position  
Register0x0B LSB of Y-axis Start position

Register0x08 MSB of X-axis End position  
Register0x09 LSB of X-axis End position  
Register0x0C MSB of Y-axis End position  
Register0x0D LSB of Y-axis End position

Register Address (Hex)	Default (Hex)	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Remark
T.B.D	T.B.D									
Description	set the Display RAM address									

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**9 DISPLAYED COLOR AND INPUT DATA**

	Color & Gray Scale	DATA SIGNAL																	
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Color	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(0)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green(0)	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0
	Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Red	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(61)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(31)	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Red(1)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Green	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(61)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(31)	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Green(1)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Blue	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(31)	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
Blue(0)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

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# 10 QUALITY AND RELIABILITY

## 10.1 TEST CONDITIONS

Tests should be conducted under the following conditions :

Ambient temperature :  $25 \pm 5^{\circ}\text{C}$

Humidity :  $60 \pm 25\% \text{ RH}$ .

## 10.2 SAMPLING PLAN

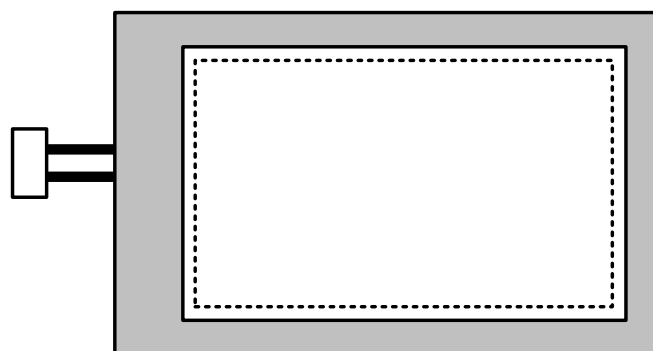
Sampling method shall be in accordance with MIL-STD-105E , level II, normal single sampling plan .


## 10.3 ACCEPTABLE QUALITY LEVEL

A major defect is defined as one that could cause failure to or materially reduce the usability of the unit for its intended purpose. A minor defect is one that does not materially reduce the usability of the unit for its intended purpose or is an infringement from established standards and has no significant bearing on its effective use or operation.

## 10.4 APPEARANCE

An appearance test should be conducted by human sight at approximately 30 cm distance from the LCD module under fluorescent light. The inspection area of LCD panel shall be within the range of following limits.



 Zone A ( Active Area)

 Zone B ( Viewing Area)

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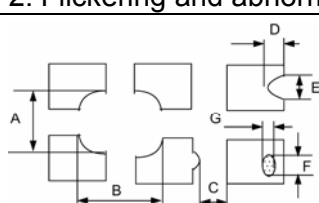
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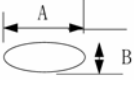
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**10.5 INSPECTION QUALITY CRITERIA**

No.	Item	Criterion for defects	Defect type															
1	Non display	No non display is allowed	Major															
2	Irregular operation	No irregular operation is allowed	Major															
3	Short	No short are allowed	Major															
4	Open	Any segments or common patterns that don't activate are rejectable.	Major															
5	Black/White spot (I)	<table border="1"> <thead> <tr> <th>Size D (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.15</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.15 &lt; D \leq 0.20</math></td> <td>3</td> </tr> <tr> <td><math>0.20 &lt; D \leq 0.30</math></td> <td>2</td> </tr> <tr> <td><math>0.30 &lt; D</math></td> <td>0</td> </tr> </tbody> </table>	Size D (mm)	Acceptable number	$D \leq 0.15$	Ignore	$0.15 < D \leq 0.20$	3	$0.20 < D \leq 0.30$	2	$0.30 < D$	0	Minor					
Size D (mm)	Acceptable number																	
$D \leq 0.15$	Ignore																	
$0.15 < D \leq 0.20$	3																	
$0.20 < D \leq 0.30$	2																	
$0.30 < D$	0																	
6	Black/White line (I)	<table border="1"> <thead> <tr> <th>Length(mm)</th> <th>Width (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td><math>10 &lt; L</math></td> <td><math>0.03 &lt; W \leq 0.04</math></td> <td>5</td> </tr> <tr> <td><math>5.0 &lt; L \leq 10</math></td> <td><math>0.04 &lt; W \leq 0.06</math></td> <td>3</td> </tr> <tr> <td><math>1.0 &lt; L \leq 5.0</math></td> <td><math>0.06 &lt; W \leq 0.07</math></td> <td>2</td> </tr> <tr> <td><math>L \leq 1.0</math></td> <td><math>0.07 &lt; W \leq 0.09</math></td> <td>1</td> </tr> </tbody> </table>	Length(mm)	Width (mm)	Acceptable number	$10 < L$	$0.03 < W \leq 0.04$	5	$5.0 < L \leq 10$	$0.04 < W \leq 0.06$	3	$1.0 < L \leq 5.0$	$0.06 < W \leq 0.07$	2	$L \leq 1.0$	$0.07 < W \leq 0.09$	1	Minor
Length(mm)	Width (mm)	Acceptable number																
$10 < L$	$0.03 < W \leq 0.04$	5																
$5.0 < L \leq 10$	$0.04 < W \leq 0.06$	3																
$1.0 < L \leq 5.0$	$0.06 < W \leq 0.07$	2																
$L \leq 1.0$	$0.07 < W \leq 0.09$	1																
7	Black/White sport (II)	<table border="1"> <thead> <tr> <th>Size D (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td><math>D \leq 0.30</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.30 &lt; D \leq 0.50</math></td> <td>5</td> </tr> <tr> <td><math>0.50 &lt; D \leq 1.20</math></td> <td>3</td> </tr> <tr> <td><math>1.20 &lt; D</math></td> <td>0</td> </tr> </tbody> </table>	Size D (mm)	Acceptable number	$D \leq 0.30$	Ignore	$0.30 < D \leq 0.50$	5	$0.50 < D \leq 1.20$	3	$1.20 < D$	0	Minor					
Size D (mm)	Acceptable number																	
$D \leq 0.30$	Ignore																	
$0.30 < D \leq 0.50$	5																	
$0.50 < D \leq 1.20$	3																	
$1.20 < D$	0																	
8	Black/White line (II)	<table border="1"> <thead> <tr> <th>Length (mm)</th> <th>Width (mm)</th> <th>Acceptable number</th> </tr> </thead> <tbody> <tr> <td><math>20 &lt; L</math></td> <td><math>0.05 &lt; W \leq 0.07</math></td> <td>5</td> </tr> <tr> <td><math>10 &lt; L \leq 20</math></td> <td><math>0.07 &lt; W \leq 0.09</math></td> <td>3</td> </tr> <tr> <td><math>5.0 &lt; L \leq 10</math></td> <td><math>0.09 &lt; W \leq 0.10</math></td> <td>2</td> </tr> <tr> <td><math>L \leq 5.0</math></td> <td><math>0.10 &lt; W \leq 0.15</math></td> <td>1</td> </tr> </tbody> </table>	Length (mm)	Width (mm)	Acceptable number	$20 < L$	$0.05 < W \leq 0.07$	5	$10 < L \leq 20$	$0.07 < W \leq 0.09$	3	$5.0 < L \leq 10$	$0.09 < W \leq 0.10$	2	$L \leq 5.0$	$0.10 < W \leq 0.15$	1	Minor
Length (mm)	Width (mm)	Acceptable number																
$20 < L$	$0.05 < W \leq 0.07$	5																
$10 < L \leq 20$	$0.07 < W \leq 0.09$	3																
$5.0 < L \leq 10$	$0.09 < W \leq 0.10$	2																
$L \leq 5.0$	$0.10 < W \leq 0.15$	1																
9	Back Light	1. No Lighting is rejectable 2. Flickering and abnormal lighting are rejectable	Major															
10	Display pattern	 <table border="1"> <tbody> <tr> <td><math>\frac{A+B}{2} \leq 0.30</math></td> <td><math>0 &lt; C</math></td> <td><math>\frac{D+E}{2} \leq 0.25</math></td> <td><math>\frac{F+G}{2} \leq 0.25</math></td> </tr> </tbody> </table> <p>Note: 1. Acceptable up to 3 damages 2. NG if there're to two or more pinholes per dot</p>	$\frac{A+B}{2} \leq 0.30$	$0 < C$	$\frac{D+E}{2} \leq 0.25$	$\frac{F+G}{2} \leq 0.25$	Minor											
$\frac{A+B}{2} \leq 0.30$	$0 < C$	$\frac{D+E}{2} \leq 0.25$	$\frac{F+G}{2} \leq 0.25$															

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11	Blemish & Foreign matters  Size: $D = \frac{A+B}{2}$	Size D (mm)	Acceptable number	Minor	
		D ≤ 0.15 0.15 < D ≤ 0.20 0.20 < D ≤ 0.30 0.30 < D	Ignore 3 2 0		
12	Scratch on Polarizer  	Width (mm)	Length (mm)	Acceptable number	Minor
		W ≤ 0.03 0.03 < W ≤ 0.05 0.05 < W ≤ 0.08 0.08 < W	Ignore L ≤ 2.0 L > 2.0 L > 1.0 L ≤ 1.0 Note (1)	Ignore Ignore 1 1 Ignore Note(1)	
Note(1) Regard as a blemish					
13	Bubble in polarizer	Size D (mm)	Acceptable number	Minor	
		D ≤ 0.20 0.20 < D ≤ 0.50 0.50 < D ≤ 0.80 0.80 < D	Ignore 3 2 0		
14	Stains on LCD panel surface	Stains that cannot be removed even when wiped lightly with a soft cloth or similar cleaning too are rejectable.		Minor	
15	Rust in Bezel	Rust which is visible in the bezel is rejectable.		Minor	
16	Defect of land surface contact (poor soldering)	Evident crevices which is visible are rejectable.		Minor	
17	Parts mounting	1. Failure to mount parts 2. Parts not in the specifications are mounted 3. Polarity, for example, is reversed		Major Major Major	
18	Parts alignment	1. LSI, IC lead width is more than 50% beyond pad outline.		Minor	
		2. Chip component is off center and more than 50% of the leads is off the pad outline.		Minor	
19	Conductive foreign matter (Solder ball, Solder chips)	1. $0.45 < \varphi$ , $N \geq 1$		Major	
		2. $0.30 < \varphi \leq 0.45$ , $N \geq 1$ $\varphi$ : Average diameter of solder ball (unit: mm)		Minor	
		3. $0.50 < L$ , $N \geq 1$ L: Average length of solder chip (unit: mm)		Minor	
20	Faulty PCB correction	1. Due to PCB copper foil pattern burnout, the pattern is connected, using a jumper wire for repair; 2 or more places are corrected per PCB.		Minor	
		2. Short circuited part is cut, and no resist coating has been performed.		Minor	

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21	Defect Dot	The TFT panel may have bright dot or Dark dot. The acceptable number defection:				Minor
		Bright dot	Dark dot	Total dot	Distance between Dark-- dark	
		2	3	4	$L \geq 5$ mm	

## 11 Reliability test items (Note2):

No.	Test items	Conditions	Remark
1	High temperature storage	Ta=80°C 240Hrs	
2	Low temperature storage	Ta=-30°C 240Hrs	
3	High temperature operation	Ta=70°C 240Hrs	
4	Low temperature operation	Ta=-20°C 240Hrs	
5	High temperature and high humidity	Ta=40°C,85% RH 240Hrs	Operation
6	Heat shock	-30°C~80°C/200 cycles 1Hrs/cycle	Non-operation
7	Electrostatic discharge	±200V,200Pf(0Ω),once for each terminal	Non-operation
8	Vibration	Frequency range :8~33.3Hz Stoke :1.3mm Sweep :2.9G,33.3~400Hz Cycle :15 minutes 2 hours for each direction of X,Z 4 hours for Y direction	JIS C7021, A-10 Condition A
9	Mechanical shock	100G, 6ms,±X, ±Y,±Z 3 times for each direction	JIS C7021, A-7 Condition C
10	Vibration (With carton)	Random vibration: 0.015G <sup>2</sup> /Hz from 5~200Hz -6dB/octave from 200~500Hz	IEC 68~34
11	Drop (with carton)	Height:60cm 1 corner,3 edges,6 surfaces	JIS Z0202

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## **12 USE PRECAUTIONS**

### **12.1 Handling precautions**

- 1) The polarizing plate may break easily so be careful when handling it. Do not touch, press or rub it with a hard-material tool like tweezers.
- 2) Do not touch the polarizing plate surface with bare hands so as not to make it dirty. If the surface or other related part of the polarizing plate is dirty, soak a soft cotton cloth or chamois leather in benzine and wipe off with it. Do not use chemical liquids such as acetone, toluene and isopropyl alcohol. Failure to do so may bring chemical reaction phenomena and deteriorations.
- 3) Remove any spit or water immediately. If it is left for hours, the suffered part may deform or decolorize.
- 4) If the LCD element breaks and any LC stuff leaks, do not suck or lick it. Also if LC stuff is stuck on your skin or clothing, wash thoroughly with soap and water immediately.

### **12.2 Installing precautions**

- 1) The PCB has many ICs that may be damaged easily by static electricity. To prevent breaking by static electricity from the human body and clothing, earth the human body properly using the high resistance and discharge static electricity during the operation. In this case, however, the resistance value should be approx.  $1M\Omega$  and the resistance should be placed near the human body rather than the ground surface. When the indoor space is dry, static electricity may occur easily so be careful. We recommend the indoor space should be kept with humidity of 60% or more. When a soldering iron or other similar tool is used for assembly, be sure to earth it.
- 2) When installing the module and ICs, do not bend or twist them. Failure to do so may crack LC element and cause circuit failure.
- 3) To protect LC element, especially polarizing plate, use a transparent protective plate (e.g., acrylic plate, glass etc) for the product case.
- 4) Do not use an adhesive like a both-side adhesive tape to make LCD surface (polarizing plate) and product case stick together. Failure to do so may cause the polarizing plate to peel off.

### **12.3 Storage precautions**

- 1) Avoid a high temperature and humidity area. Keep the temperature between  $0^{\circ}\text{C}$  and  $35^{\circ}\text{C}$  and also the humidity under 60%.
- 2) Choose the dark spaces where the product is not exposed to direct sunlight or fluorescent light.

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- 3) Store the products as they are put in the boxes provided from us or in the same conditions as we recommend.

## 12.4 Operating precautions

- 1) Do not boost the applied drive voltage abnormally. Failure to do so may break ICs. When applying power voltage, check the electrical features beforehand and be careful. Always turn off the power to the LC module controller before removing or inserting the LC module input connector. If the input connector is removed or inserted while the power is turned on, the LC module internal circuit may break.
- 2) The display response may be late if the operating temperature is under the normal standard, and the display may be out of order if it is above the normal standard. But this is not a failure; this will be restored if it is within the normal standard.
- 3) The LCD contrast varies depending on the visual angle, ambient temperature, power voltage etc. Obtain the optimum contrast by adjusting the LC drive voltage.
- 4) When carrying out the test, do not take the module out of the low-temperature space suddenly. Failure to do so will cause the module condensing, leading to malfunctions.
- 5) Make certain that each signal noise level is within the standard (L level: 0.2V<sub>dd</sub> or less and H level: 0.8V<sub>dd</sub> or more) even if the module has functioned properly. If it is beyond the standard, the module may often malfunction. In addition, always connect the module when making noise level measurements.
- 6) The CMOS ICs are incorporated in the module and the pull-up and pull-down function is not adopted for the input so avoid putting the input signal open while the power is ON.
- 7) The characteristic of the semiconductor element changes when it is exposed to light emissions, therefore ICs on the LCD may malfunction if they receive light emissions. To prevent these malfunctions, design and assemble ICs so that they are shielded from light emissions.
- 8) Crosstalk occurs because of characteristics of the LCD. In general, crosstalk occurs when the regularized display is maintained. Also, crosstalk is affected by the LC drive voltage. Design the contents of the display, considering crosstalk.

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### **12.5 Other**

- 1) Do not disassemble or take the LC module into pieces. The LC modules once disassembled or taken into pieces are not the guarantee articles.
- 2) The residual image may exist if the same display pattern is shown for hours. This residual image, however, disappears when another display pattern is shown or the drive is interrupted and left for a while. But this is not a problem on reliability.

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**13 OUTLINE DIMENSION**

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