

# **PRODUCT SPECIFICATION/ APPROVAL SHEET**

**CUSTOMER:**

**DONGXINDA MODEL NO: DXDCG1602D11-6925**

**CUSTOMER MODEL NO:-**

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**Please confirm your acceptance of this approval sheet by return fax.**

**CONFIRMATION SIGNATURE:**

<b>complete</b>	<b>confirmation</b>	<b>approval</b>

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# 1. GENERAL DESCRIPTION

The ST7032 dot-matrix liquid crystal display controller and driver LSI displays alphanumeric, Japanese kana characters, and symbols. It can be configured to drive a dot-matrix liquid crystal display under the control of a 4-/ 8-bit or serial interface microprocessor. Since all the functions such as display RAM, character generator, and liquid crystal driver, required for driving a dot-matrix liquid crystal display are internally provided on one chip, a minimal system can be interfaced with this controller/driver.

The ST7032 character generator ROM is extended to generate 256 5x8dot character fonts for a total of

256 different character fonts. The low power supply (2.7V to 5.5V) of the ST7032 is suitable for any portable battery-driven product requiring low power dissipation.

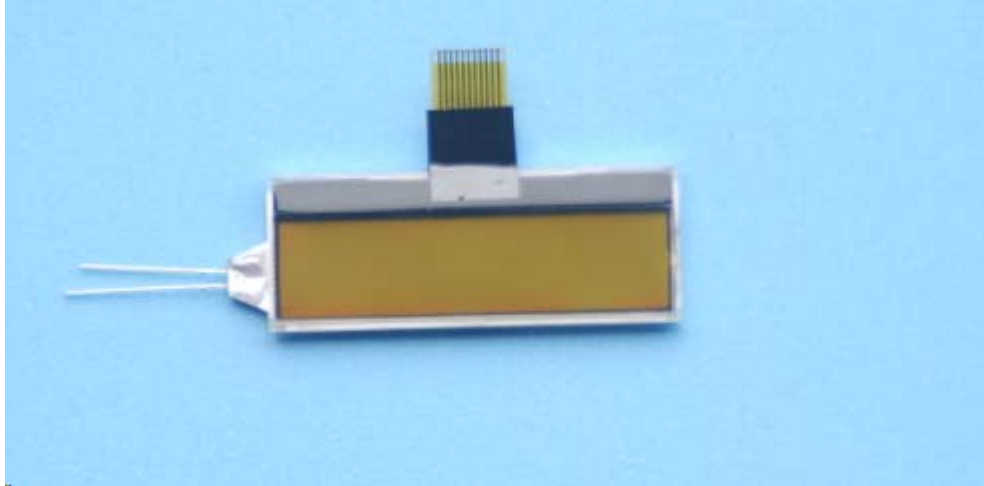
The ST7032 LCD driver consists of 17 common signal drivers and 80 segment signal drivers. The maximum display RAM size can be either 80 characters in 1-line display or 40 characters in 2-line display. A single ST7032 can display up to one 16-character line or two 16-character lines. No extra drivers can be cascaded.

# 2. FEATURES

- **5 x 8 dot matrix possible**
- **Low power operation support:**
  - 2.7 to 5.5V
- **Range of LCD driver power**
  - 2.7 to 7.0V
- **4-bit or 8-bit or serial MPU interface enabled**
- **80 x 8-bit display RAM (80 characters max.)**
- **10,240-bit character generator ROM for a total of 256 character fonts(max)**
- **64 x 8-bit character generator RAM(max)**
- **16-common x 80-segment and 1-common x 80-segment ICON liquid crystal display driver**
- **16 x 5 –bit ICON RAM(max)**
- **Programmable duty cycles**
  - 1/8 or 1/9 for one line of 5 x 8 dots with cursor
  - 1/16 or 1/17 for two lines of 5 x 8 dots & cursor
- **Wide range of instruction functions:**
  - Display clear, cursor home, display on/off, cursor on/off, display character blink, cursor shift, display shift, double height font
- **Automatic reset circuit that initializes the controller/driver after power on and external reset pin**
- **Internal oscillator(Frequency=540KHz) and external clock**
- **Built-in voltage booster and follower circuit (low power consumption )**
- **Com/Seg direction selectable**
- **Multi-selectable for CGRAM/CGROM size**
- **Instruction compatible to ST7066U and KS0066U and HD44780**
- **Available in COG type**



## 5. MATERIAL OBJECT PICTURE



# 6. LED BACKLIGHT

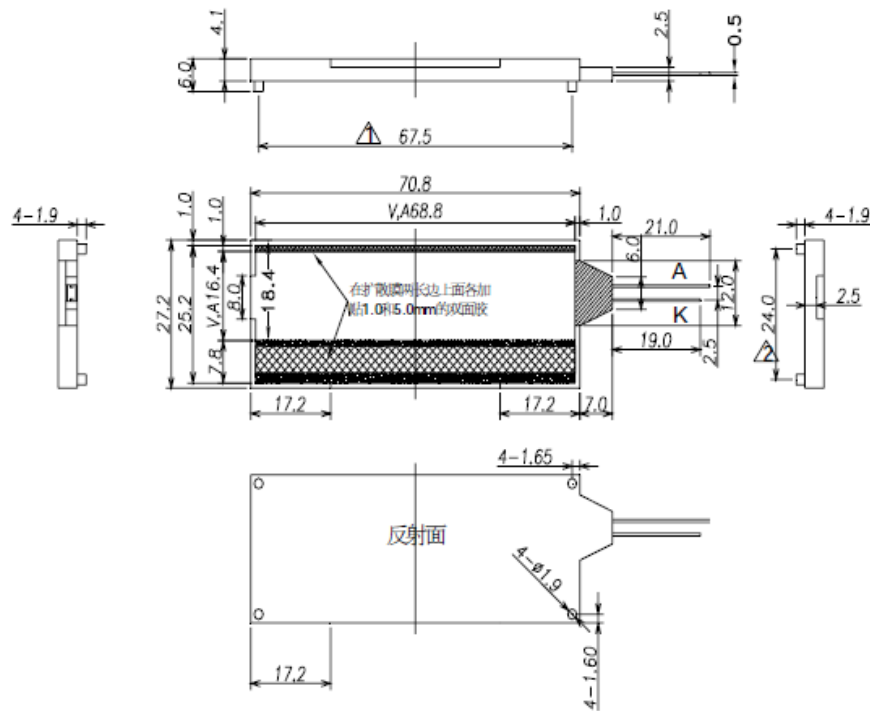
## 1. Diagram

### 1. 结构尺寸 MECHANICAL OUTLINE

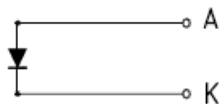
(未注尺寸公差 Unspecified Tolerances is:  $\pm 0.3$  mm)

COLOR : YELLOW GREEN

颜色 : 黄绿色



### 2. 电路图 CIRCUIT DIAGRAM (LED 1X1=1 dies)



### 3. 保存和焊接条件 STORAGE & SOLDERING CONDITIONS:

- Store with care. Storing the units in bad condition will cause the reflector sheet and decrease its adhesive power. Storage The products under the condition: temperature ( $25^{\circ}\text{C} \pm 10^{\circ}\text{C}$ ) and humidity ( $65^{\circ}\text{CRH} \pm 20^{\circ}\text{CRH}$ ) our recommendation.
- The Soldering Temperature is  $260 \pm 5^{\circ}\text{C}$  and Soldering Time should be less than 3 sec, and soldering iron power should be less than 30W.
- The soldering point should be farther than 1.6mm ( $1/10''$ ) from body .

## 7. ELECTRICAL CHARACTERISTICS

### ■ Absolute Maximum Ratings

Characteristics	Symbol	Value
Power Supply Voltage	VDD	-0.3 to +7.0
LCD Driver Voltage	V <sub>LCD</sub>	7.0- V <sub>SS</sub> to -0.3+V <sub>SS</sub>
Input Voltage	V <sub>IN</sub>	-0.3 to VDD+0.3
Operating Temperature	T <sub>A</sub>	-40°C to + 90°C
Storage Temperature	T <sub>STO</sub>	-55°C to + 125°C

### ■ DC Characteristics

(T<sub>A</sub> = 25°C , VDD = 2.7 V – 4.5 V )

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
VDD	Operating Voltage	-	2.7	-	4.5	V
V <sub>LCD</sub>	LCD Voltage	V0-V <sub>SS</sub>	2.7	-	7.0	V
I <sub>CC</sub>	Power Supply Current	VDD=3.0V (Use internal booster/follower circuit)	-	160	230	uA
V <sub>IH1</sub>	Input High Voltage (Except OSC1)	-	1.9	-	VDD	V
V <sub>IL1</sub>	Input Low Voltage (Except OSC1)	-	- 0.3	-	0.8	V
V <sub>IH2</sub>	Input High Voltage (OSC1)	-	0.7 VDD	-	VDD	V
V <sub>IL2</sub>	Input Low Voltage (OSC1)	-	-	-	0.2 VDD	V
V <sub>OH1</sub>	Output High Voltage (DB0 - DB7)	I <sub>OH</sub> = -1.0mA	0.75 VDD	-	-	V
V <sub>OL1</sub>	Output Low Voltage (DB0 - DB7)	I <sub>OL</sub> = 1.0mA	-	-	0.8	V
V <sub>OH2</sub>	Output High Voltage (Except DB0 - DB7)	I <sub>OH</sub> = -0.04mA	0.8 VDD	-	VDD	V
V <sub>OL2</sub>	Output Low Voltage (Except DB0 - DB7)	I <sub>OL</sub> = 0.04mA	-	-	0.2 VDD	V
R <sub>COM</sub>	Common Resistance	V <sub>LCD</sub> = 4V, I <sub>d</sub> = 0.05mA	-	2	20	KΩ
R <sub>SEG</sub>	Segment Resistance	V <sub>LCD</sub> = 4V, I <sub>d</sub> = 0.05mA	-	2	30	KΩ
I <sub>LEAK</sub>	Input Leakage Current	V <sub>IN</sub> = 0V to VDD	-1	-	1	μA
I <sub>PUP</sub>	Pull Up MOS Current	VDD = 3V	20	30	40	μA
fOSC	Oscillation frequency	VDD = 3V, 1/17duty	350	540	1100	KHz

## 8. MODULE DESCRIPTION

### 8.1. PIN DESCRIPTION

PIN NO.	Symbol	Description
1	/RES	"L"RESET SIGNAL
2	D6	In I <sup>2</sup> C interface DB7 (SDA) is input data and DB6 (SCL) is clock input.
3	D7	
4	VSS	GROUND
5	DIRC	Common signals direction select: 0:Com1~16←Row address 15~0(Invert) 1:Com1~16←Row address 0~15(Normal)
6	SHL	Segment signals direction select: 0:Seg1~80←Column address 79~0(Invert) 1:Seg1~80←Column address 0~79(Normal)
7	VDD	POWER SUPPLY
8	VIN	POWER SUPPLY
9	VOUT	POWER SUPPLY
10	CP1P	For voltage booster circuit(VDD-VSS) External capacitor about 0.1u~4.7uf
11	CP1N	



## 8.2. PIN FUNCTION

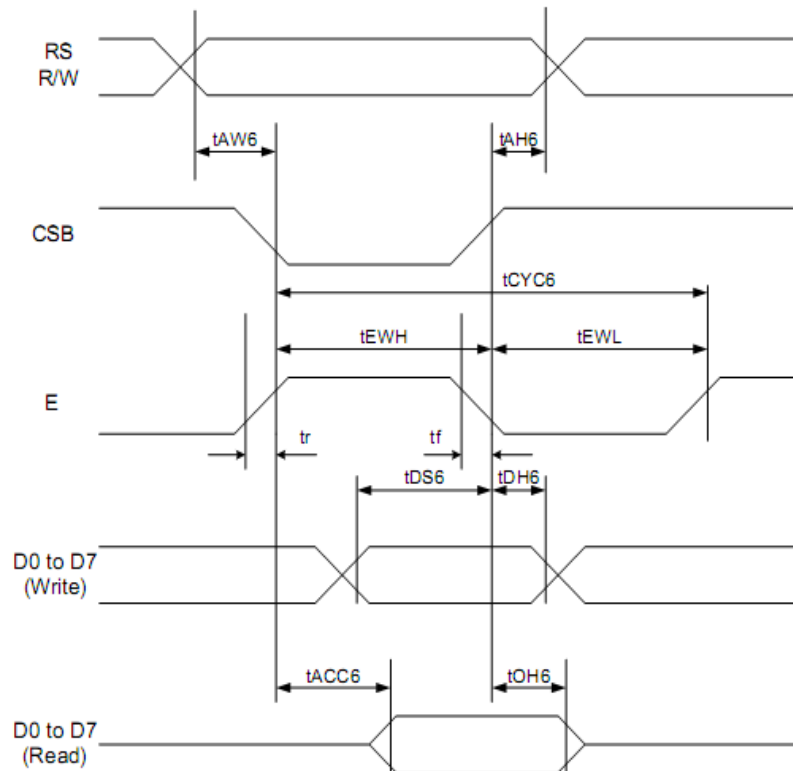
Name	Number	I/O	Interfaced with	Function		
SHLC	1	I	ITO option	Common signals direction select: 0:Com1~16←Row address 15~0(Invert) 1:Com1~16←Row address 0~15(Normal)		
SHLS	1	I	ITO option	Segment signals direction select: 0:Seg1~80←Column address 79~0(Invert) 1:Seg1~80←Column address 0~79(Normal)		
COM1 to COM16	16	O	LCD	Common signals that are not used are changed to non-selection waveform. COM9 to COM16 are non-selection waveforms at 1/8 or 1/9 duty factor		
COMI	2	O	LCD	ICON common signals		
SEG1 to SEG80	80	O	LCD	Segment signals		
OPF1 OPF2	2	I	ITO option	The built-in voltage follower circuit selection		
				OPF1	OPF2	Bias select
				0	0	Built-in voltage follower(only use at EXT=0)
				0	1	Built-in bias resistor(2.2K $\Omega$ )
				1	0	Built-in bias resistor(6.8K $\Omega$ )
1	1	External bias resistor select				
CAP1P	1	-	Power supply	For voltage booster circuit(VDD-VSS) External capacitor about 0.1 $\mu$ ~4.7 $\mu$ F		
CAP1N	1	-	Power supply			
VIN	1	-	Power supply	Input the voltage to booster		
VOUT	1	-	Power supply	DC/DC voltage converter. connect a capacitor between this terminal and VDD.		
V0 to V4	5	-	Power supply	Power supply for LCD drive V0-Vss = 7V (Max) Built-in/external Voltage follower circuit		
VDD VSS	2	-	Power supply	VDD: 2.7V to 5.5V, VSS: 0V		
CLS	1	I	ITO option	Internal/External oscillation select 0:external clock 1:internal oscillation		
OSC1 OSC2	2	I/O	Oscillation resistor clock	the pin input is an external clock, it must be input to OSC1.		
TEST1~5	5	I/O	Test pin	TEST1,2,4 must connect to VDD. TEST3,5 no connection.		

## 8.3. DC CHARACTERISTICS

( TA = 25°C, VDD = 4.5 V - 5.5 V )

Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
VDD	Operating Voltage	-	4.5	-	5.5	V
V <sub>LCD</sub>	LCD Voltage	V0-Vss	2.7	-	7.0	V
I <sub>CC</sub>	Power Supply Current	VDD=5.0V (Use internal booster/follower circuit)	-	240	340	uA
V <sub>IH1</sub>	Input High Voltage (Except OSC1)	-	2.7	-	VDD	V
V <sub>IL1</sub>	Input Low Voltage (Except OSC1)	-	-0.3	-	0.8	V
V <sub>IH2</sub>	Input High Voltage (OSC1)	-	0.7 VDD	-	VDD	V
V <sub>IL2</sub>	Input Low Voltage (OSC1)	-	-	-	1.0	V
V <sub>OH1</sub>	Output High Voltage (DB0 - DB7)	I <sub>OH</sub> = -1.0mA	3.8	-	VDD	V
V <sub>OL1</sub>	Output Low Voltage (DB0 - DB7)	I <sub>OL</sub> = 1.0mA	-	-	0.8	V
V <sub>OH2</sub>	Output High Voltage (Except DB0 - DB7)	I <sub>OH</sub> = -0.04mA	0.8 VDD	-	VDD	V
V <sub>OL2</sub>	Output Low Voltage (Except DB0 - DB7)	I <sub>OL</sub> = 0.04mA	-	-	0.2 VDD	V
R <sub>COM</sub>	Common Resistance	V <sub>LCD</sub> = 4V, I <sub>d</sub> = 0.05mA	-	2	20	KΩ
R <sub>SEG</sub>	Segment Resistance	V <sub>LCD</sub> = 4V, I <sub>d</sub> = 0.05mA	-	2	30	KΩ
I <sub>LEAK</sub>	Input Leakage Current	V <sub>IN</sub> = 0V to VDD	-1	-	1	μA
I <sub>PUP</sub>	Pull Up MOS Current	VDD = 5V	65	95	125	μA
fOSC	Oscillation frequency	VDD = 5V, 1/17duty	350	540	1100	KHz

## 8.4. TIMING CHARACTERISTICS

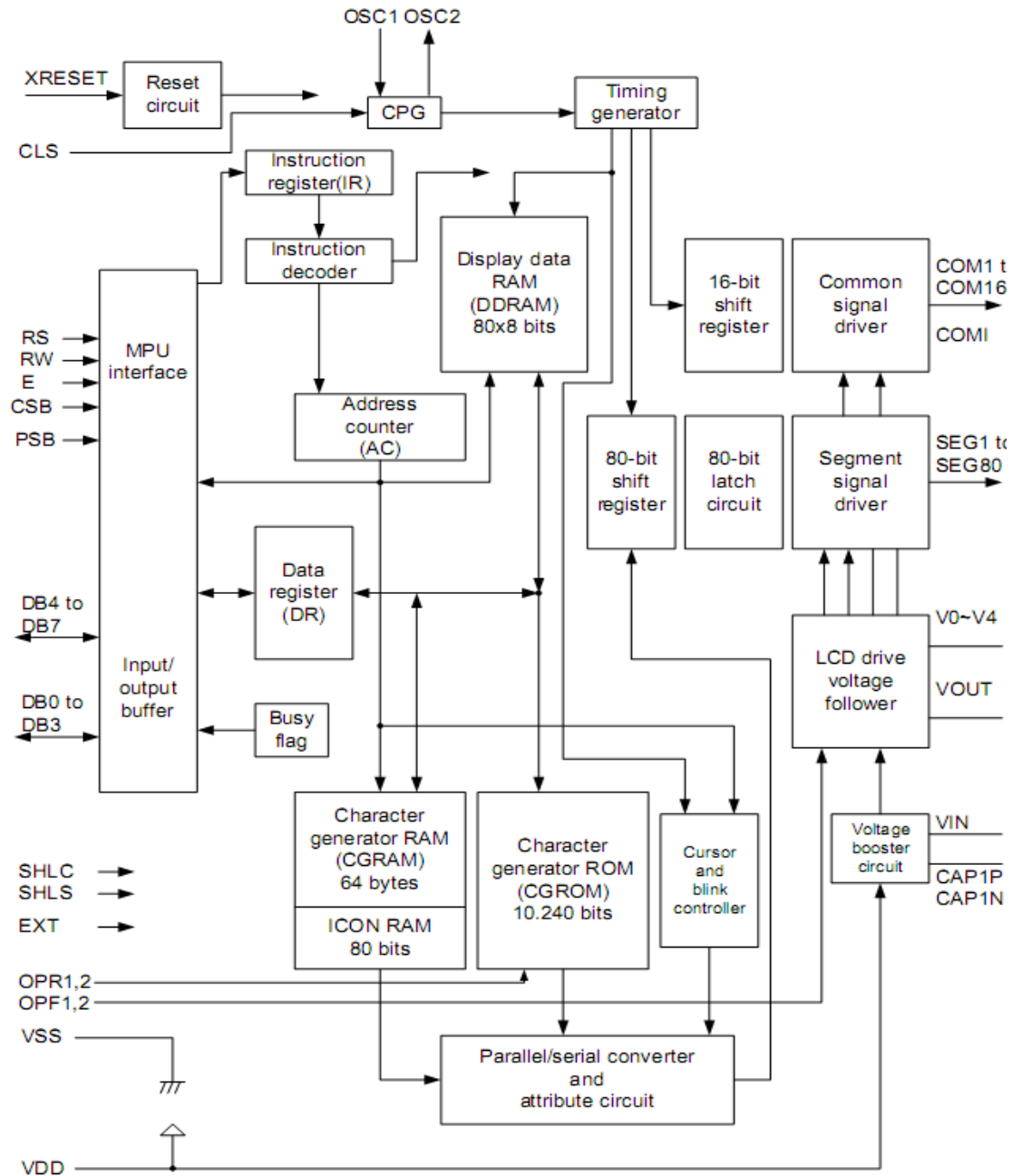


( $T_a = -40$  to  $85^\circ\text{C}$ )

Item	Signal	Symbol	Condition	VDD=2.7 to 4.5V Rating		VDD=4.5 to 5.5V Rating		Units
				Min.	Max.	Min.	Max.	
Address hold time	RS	$t_{AH6}$	—	20	-	20	-	ns
Address setup time	RS	$t_{AW6}$	—	20	-	20	-	
System cycle time	RS	$t_{CYC6}$	—	250	-	150	-	ns
Data setup time	D0 to D7	$t_{DS6}$	—	100	-	80	-	ns
Data hold time	D0 to D7	$t_{DH6}$		40	-	20	-	
Access time	D0 to D7	$t_{ACC6}$	CL = 100 pF	-	500	-	400	ns
Output disable time	D0 to D7	$t_{OH6}$		300	-	150	-	
Enable Rise/Fall time	E	$t_r, t_f$	—	-	20	-	20	ns
Enable H pulse time	E	$t_{EWH}$	—	200	-	120	-	ns
Enable L pulse time	E	$t_{EWL}$	—	50	-	30	-	ns

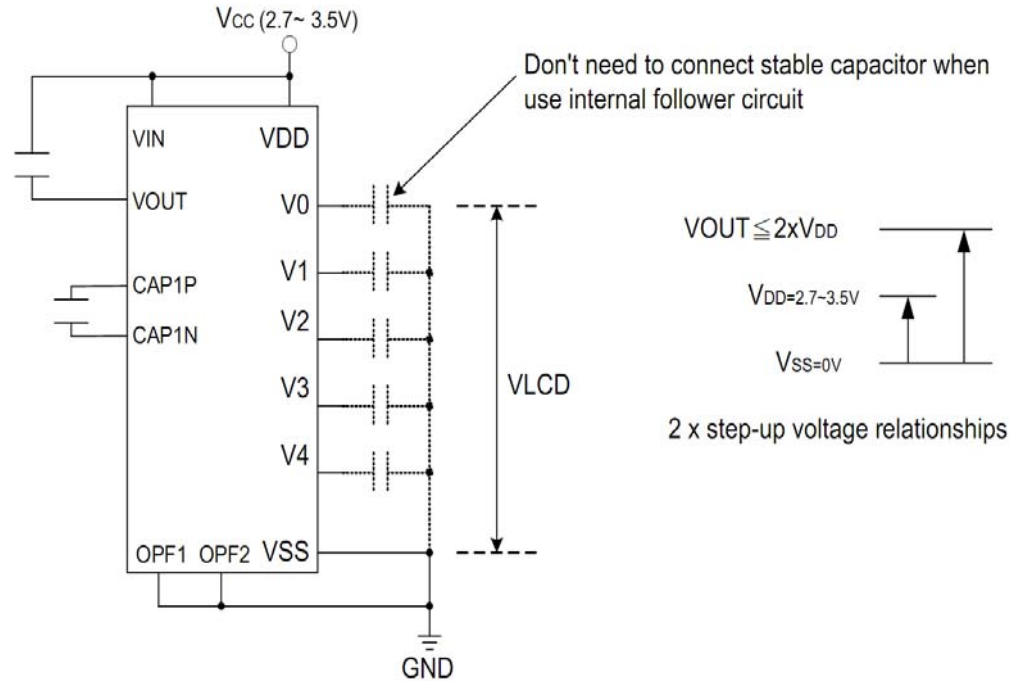
Note: All timing is specified using 20% and 80% of VDD as the reference.

## 8.5 BLOCK DIAGRAM OF LCM



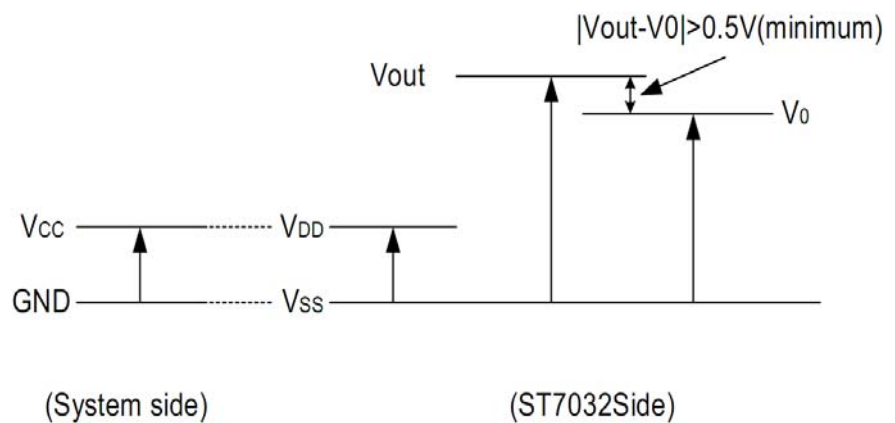
## 8.6. APPLICATION OF LCM

- When built-in booster and voltage followers are used(OPF1=0,OPF2=0)



Note:

Ensure V<sub>0</sub> level stable, that must let |V<sub>out</sub>-V<sub>0</sub>| over 0.5V(if panel size over 4.5",the |V<sub>out</sub>-V<sub>0</sub>| propose over 0.8V).



## 8.7. LCD AND CONNECTION

SHLC/SHLS ITO option pin can select at different direction for LCD panel

- Com normal direction/Seg normal direction



A rectangular LCD display showing two lines of text. The first line contains the uppercase letters A through P, and the second line contains the uppercase letters Q through Z followed by A through F. The characters are in a standard, upright font.

2Line x 16 Characters,SHLC=1,SHLS=1

- Com normal direction/Seg reverse direction



A rectangular LCD display showing two lines of text. The first line contains the uppercase letters P through O in reverse order, and the second line contains the uppercase letters Q through Z followed by A through F in reverse order. The characters are in a standard, upright font.

2Line x 16 Characters,SHLC=1,SHLS=0

- Com reverse direction/Seg normal direction



A rectangular LCD display showing two lines of text. The first line contains the uppercase letters Q through P in reverse order, and the second line contains the uppercase letters A through Z followed by A through F in reverse order. The characters are in a standard, upright font.

2Line x 16Characters,SHLC=0,SHLS=1

- Com reverse direction/Seg reverse direction



A rectangular LCD display showing two lines of text. The first line contains the uppercase letters Q through P in reverse order, and the second line contains the uppercase letters A through Z followed by A through F in reverse order. The characters are in a standard, upright font.

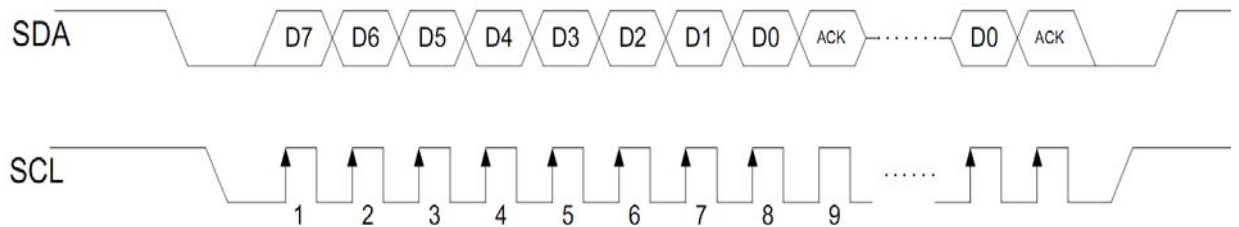
2Line x 16Characters,SHLC=0,SHLS=0

# 9. ELECTRO-OPTICAL CHARACTERISTICS

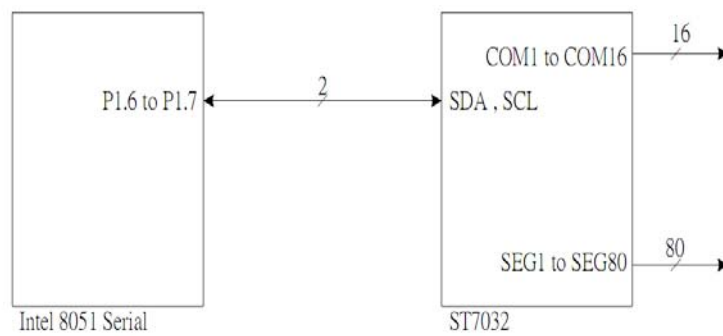
## 9.1. INTERFACE DATA

- For I<sup>2</sup>C interface data, only two bus lines (DB6 to DB7) are used.

➤ Example of timing sequence



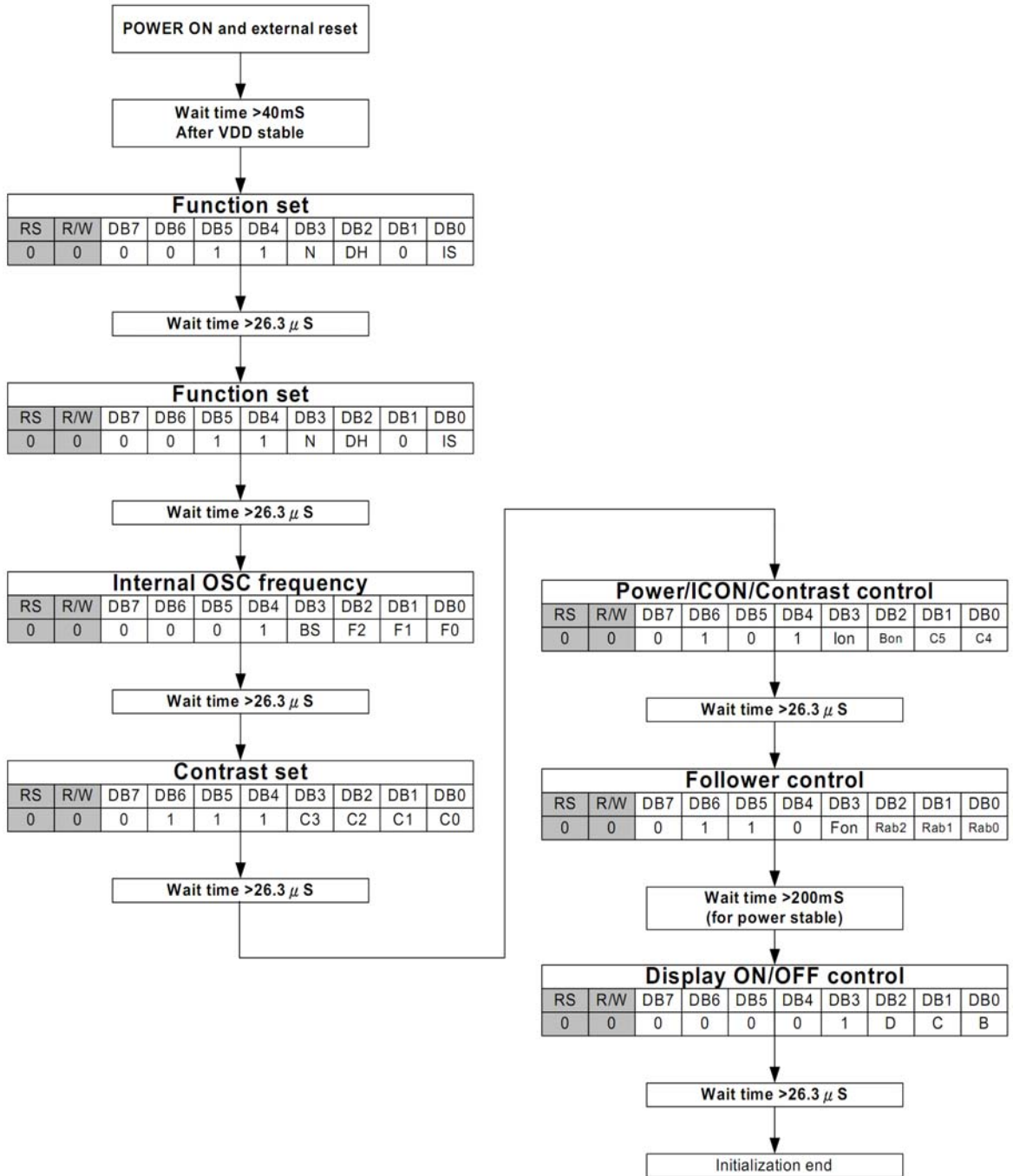
➤ Intel 8051 interface( I<sup>2</sup>C )







### 9.3. SERIAL INTERFACE



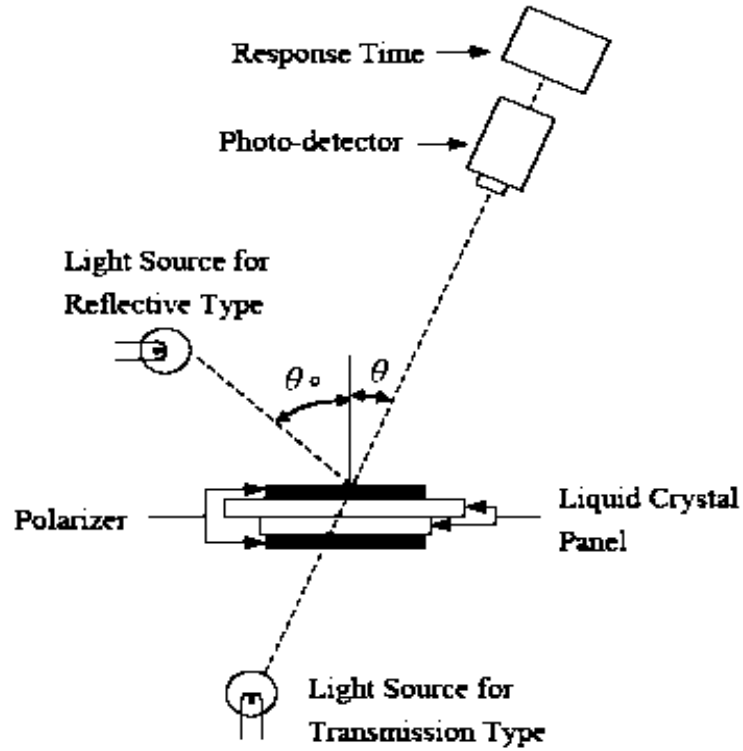
## 9.4. INITIAL PROGRAM CODE

### ➤ Initial Program Code Example For 8051 MPU(Serial Interface):

```
-----  
INITIAL_START:  
    CALL    HARDWARE_RESET  
    CALL    DELAY40mS  
    MOV     A,#38H           ;FUNCTION SET  
    CALL    WRINS_NOCHK     ;8 bit,N=1,5*7dot  
    CALL    DELAY30uS  
    MOV     A,#39H           ;FUNCTION SET  
    CALL    WRINS_NOCHK     ;8 bit,N=1,5*7dot,IS=1  
    CALL    DELAY30uS  
    MOV     A,#14H           ;Internal OSC frequency adjustment  
    CALL    WRINS_NOCHK  
    CALL    DELAY30uS  
    MOV     A,#78H           ;Contrast set  
    CALL    WRINS_NOCHK  
    CALL    DELAY30uS  
    MOV     A,#5EH           ;Power/ICON/Contrast control  
    CALL    WRINS_NOCHK  
    CALL    DELAY30uS  
    MOV     A,#6AH           ;Follower control  
    CALL    WRINS_NOCHK  
    CALL    DELAY200mS      ;for power stable  
    MOV     A,#0CH           ;DISPLAY ON  
    CALL    WRINS_NOCHK  
    CALL    DELAY30uS  
    MOV     A,#01H           ;CLEAR DISPLAY  
    CALL    WRINS_NOCHK  
    CALL    DELAY2mS  
    MOV     A,#06H           ;ENTRY MODE SET  
    CALL    WRINS_NOCHK     ;CURSOR MOVES TO RIGHT  
    CALL    DELAY30uS  
-----  
MAIN_START:  
    XXXX  
    XXXX  
    XXXX  
    XXXX  
    .  
    .  
    .  
-----  
WRINS_NOCHK:  
    PUSH    1  
    MOV     R1,#8  
    CLR     RS  
$1  
    RLC     A  
    MOV     SI,C  
    SET     SCL  
    NOP  
    CLR     SCL  
    DJNZ   R1,$1  
    POP     1  
  
    CALL    DLY1.5mS  
    RET
```

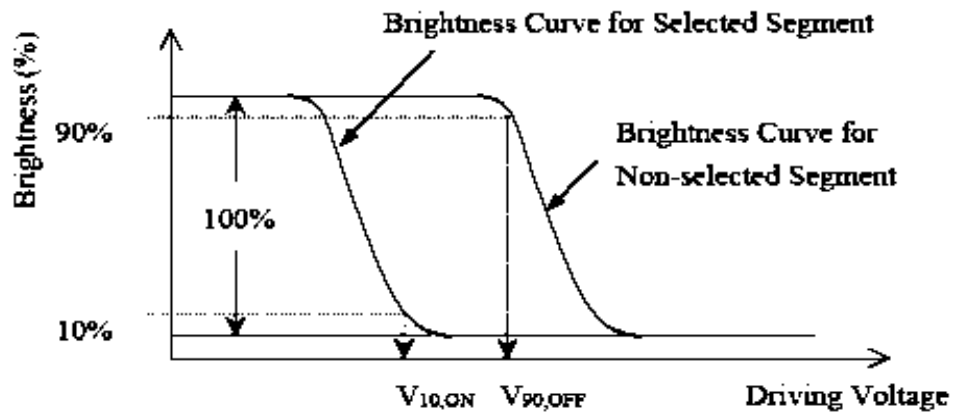
# 10. VISUAL ANGLE

## 10.1. ELECTRO-OPTICAL CHARACTERISTICS TEST METHOD

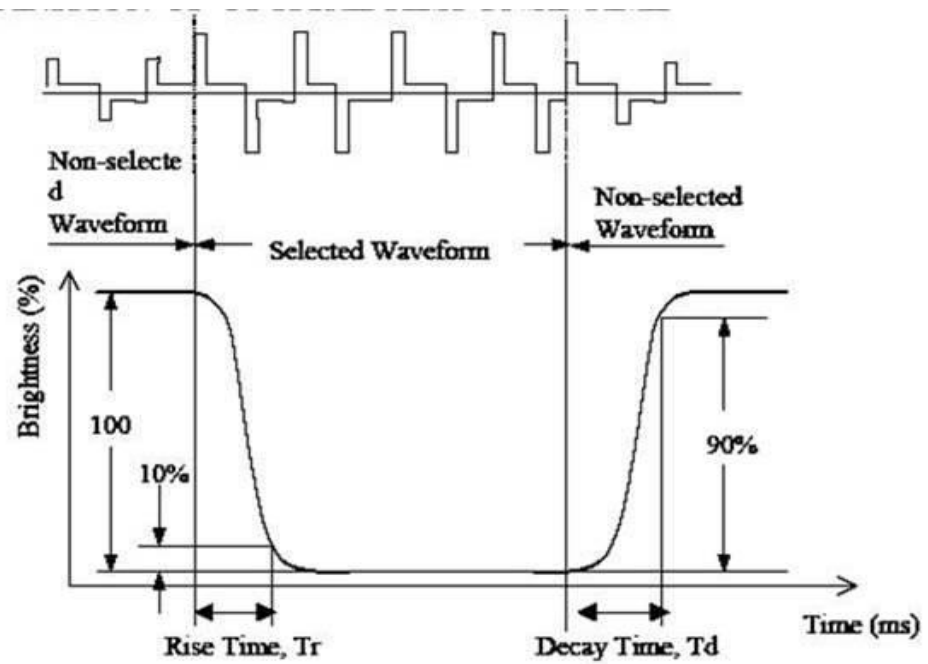


### 8.2. DEFINITION OF OPERATING VOLTAGE, VOP

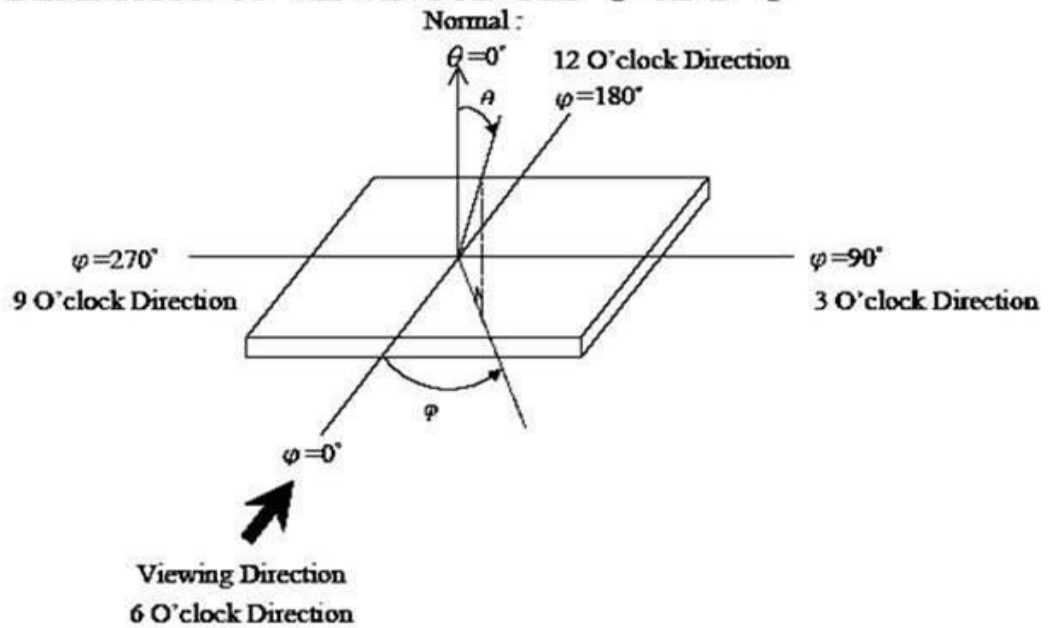
$$V_{op} = (V_{10,ON} + V_{90,OFF})/2$$



### 10.3. DEFINITION OF OPTICAL RESPONSE TIME

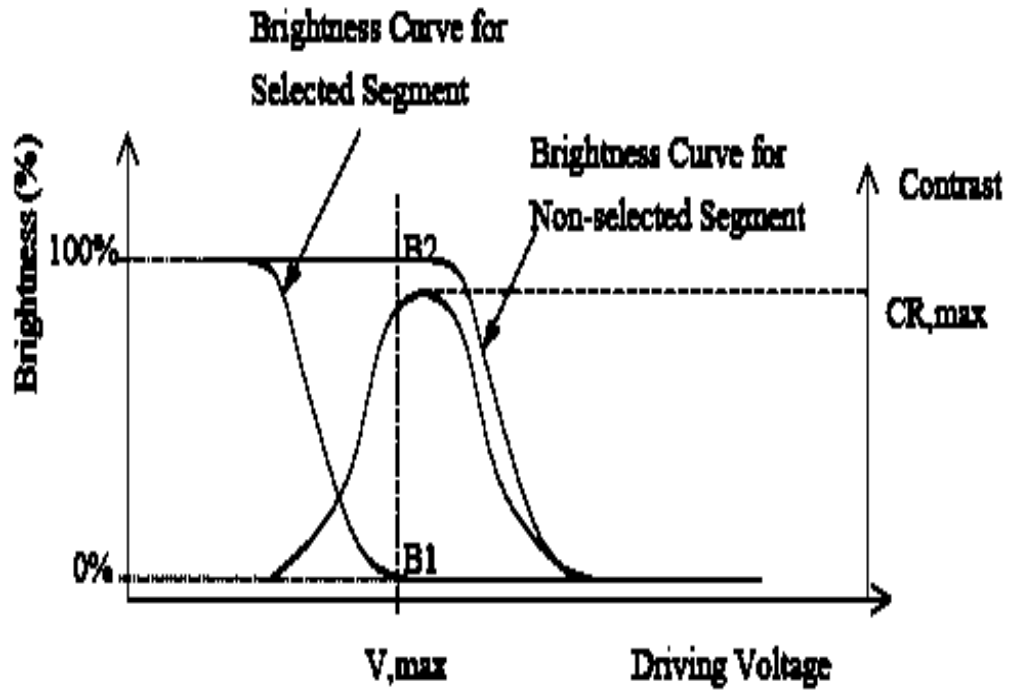


### 10.4. DEFINITION OF VIEWING ANGLE $\Theta$ AND $\Phi$



### 10.5.DEFINITION OF CONTRAST RATIO , CR

$$CR = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$



# 11. INSPECTION CRITERIA

## 11 . (1). INSPECTION CONDITON

### 1.1 Environmental conditions

The environmental conditions for inspection shall be as follows

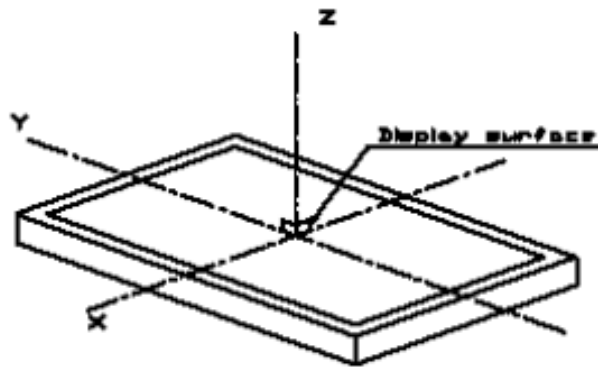
Room temperature:  $20\pm 3^{\circ}\text{C}$

Humidity:  $65\pm 20\%RH$

### 1.2. The external visual inspection

With a single 20-watt fluorescent lamp as the light source, the inspection was in the distance of 30cm or more from the LCD to the inspector's eyes .

## LIGHT METHOD



Fluorescent lamp perpendicular to the display surface.