

# SPECIFICATION

## FOR LCD MODULE

<b>MODEL NO:</b>	<b>TM12864A8CCWGWA</b>
<b>CUSTOMER:</b>	<b>SMET</b>
<b>CUSTOMER P/N.</b>	
<b>VERSION</b>	<b>V1.0</b>
<b>CUSTOMER APPROVED</b>	

- Preliminary specification
- Final specification

PREPARED BY	CHECKED BY	VERIFIED BY QA DEPT.	APPROVED BY

-----  
**TIANMA MICRO-ELECTRONICS CO., LTD**

**Address: 8F, 64th Building, Jinlong, Majialong Industrial Area, Nanshan District, Shenzhen, China**

**Tel: +86-755-26094288**

**Fax: +86-755-86225774**

**Web: [www.tianma.cn](http://www.tianma.cn) [www.tianma.com](http://www.tianma.com)**

-----

---

**TIANMA MICROELECTRONICS CO., LTD**

Company confidential. Duplication or disclosure prohibited. All rights reserved

RoHS

**REVISION RECORD**

Version	Page	Revision Items	Name	Date
1.0	1	First release	YL	2011.2.15

**TABLE OF CONTENTS**

	<b>Page</b>
<b>1. Description -----</b>	<b>3</b>
<b>2. Features -----</b>	<b>3</b>
<b>3. Absolute Maximum Ratings -----</b>	<b>4</b>
<b>4. Mechanical Characteristics-----</b>	<b>5</b>
<b>5. Circuit -----</b>	<b>6</b>
<b>6. Interface Description -----</b>	<b>8</b>
<b>7. Instruction Code &amp; Timing Characteristics -----</b>	<b>9</b>
<b>8. Electrical Specifications-----</b>	<b>16</b>
<b>9. LED Backlight Characteristics-----</b>	<b>16</b>
<b>10. Optical Characteristics -----</b>	<b>17</b>
<b>11. Reliability-----</b>	<b>21</b>
<b>12. Package -----</b>	<b>23</b>
<b>13. Quality Level -----</b>	<b>24</b>
<b>14. Precautions for Use of LCD Modules-----</b>	<b>30</b>
<b>15. LCD Module Part Numbering System -----</b>	<b>31</b>

## 1 Description

The TM12864A8CCWGWA, Graphics LCM unit consists of 128×64 dot-matrix LCD panel, LCD driver, controller LSI on a single IC. Incorporating display data RAM in the controller LSI, the unit can efficiently display under microprocessor control.

- ◆ Wide Operating temperature.
- ◆ Requirements on environmental protection: RoHS.

## 2 Features

Item	Contents
LCD type	FSTN
	Positive
LCD Duty	1/65
LCD Bias	1/9
Polarizer	Transflective
LCD background color	White
Segment color	Black
Backlighting	LED
Backlighting type	Edge
Backlighting color	White
Backlighting drive	Vf=3.2V,If=60 mA(Typ)
View direction	6:00
Operating temperature	-20℃~70℃
Storage temperature	-30℃~80℃
Controller	ST7565R
Frame	--
Technology	COG
Power supply	VDD=3.0V
Data Transfer	8 Bit Parallel / SPI 4

### Notes:

- Color tone can slightly change with temperature and driving voltage.
- Color tone will be changed by backlight.

### 3 Absolute Maximum Ratings

(Without LED backlighting ,Ta=25°C)

Parameter	Symbol	Min	Max	Unit	Remark
Logic circuit supply voltage	V <sub>DD</sub>	-0.3	+3.6	V	
LCD driving voltage	V <sub>LCD</sub>	-0.3	+13.5	V	
Operating temperature range	Top	-20	+70	°C	No Condensation
Storage temperature range	Tst	-30	+80	°C	

Note :

- LCD operating voltage LCD operating voltage  $V_{LCD}=V_0 - V_{SS}$ .
- If the module is above these absolute maximum ratings. It may become permanently damaged.
- $V_{DD} > V_{SS}$  must be maintained.

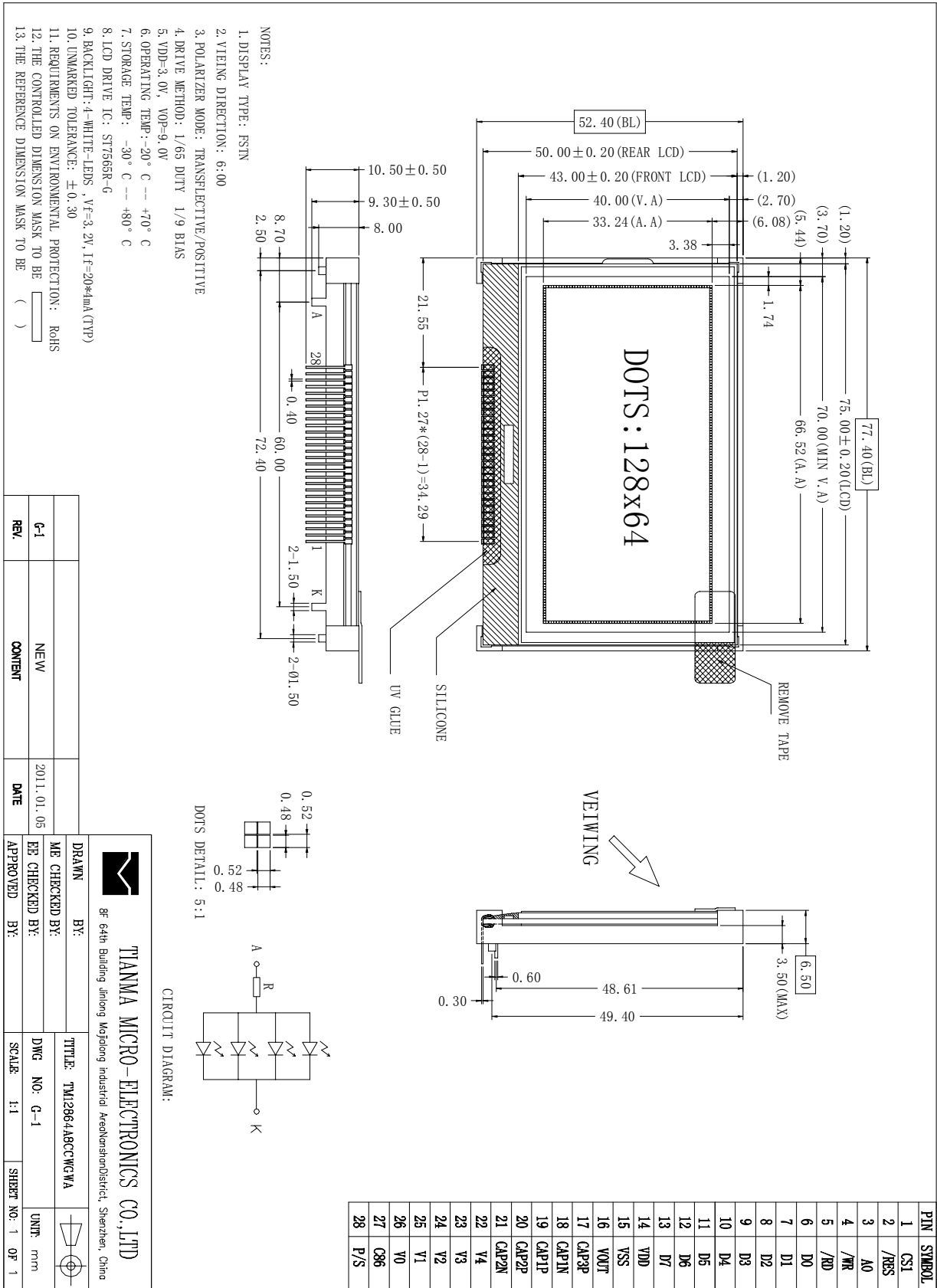
## 4 Mechanical Characteristics

### 4.1 Mechanical Features

Parameter	Standard Value	Unit
Display type	Dots Matrix module	--
Character size(W×H)	--	mm
Number of dots/characters (W×H)	128 x 64	--
View area (W×H)	70.0(Min) x 40.0	mm
Active Area (W×H)	66.52 x 33.24	mm
Dot Size (W×H)	0.48 x 0.48	mm
Dot Pitch (W×H)	0.52 x 0.52	mm
Module size(W×H×D)	77.40 x 52.40 x 6.50(MAX) *	mm
Module total weight (approx)	--	g
Module outline dimensions	Refer to page 5-“Mechanical drawing”	--

NOTE: The thickness does not include the length of pin and the length of LED A/K pin.

## 4.2 Mechanical Drawing.



- NOTES:**
1. DISPLAY TYPE: FSTN
  2. VIEWING DIRECTION: 6:00
  3. POLARIZER MODE: TRANSPARENT/POSITIVE
  4. DRIVE METHOD: 1/65 DUTY 1/9 BIAS
  5. VDD-3.0V, VOP-9.0V
  6. OPERATING TEMP: -20° C --- +70° C
  7. STORAGE TEMP: -30° C --- +80° C
  8. LCD DRIVE IC: ST7565R-G
  9. BACKLIGHT: 4-WHITE-LEDS , VF=3.2V, IF=20\*1mA (TYP)
  10. UNMARKED TOLERANCE: ± 0.30
  11. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: RoHS
  12. THE CONTROLLED DIMENSION MASK TO BE ( )
  13. THE REFERENCE DIMENSION MASK TO BE ( )

REV.	G-1	NEW	2011.01.05
CONTENT			

**TIANMA MICRO-ELECTRONICS CO., LTD**

8F 64th Building Jintong Wajiang Industrial AreaJintongDistrict, Shenzhen, China

**DRAWN BY:**

**ME CHECKED BY:**

**EEB CHECKED BY:**

**APPROVED BY:**

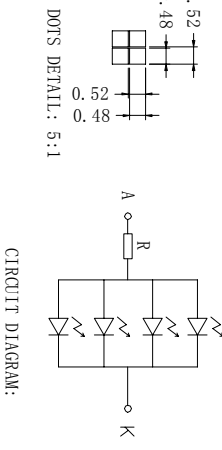
**TITLE: TM12864A8CCWGWA**

**DWG NO: G-1**

**SCALE: 1:1**

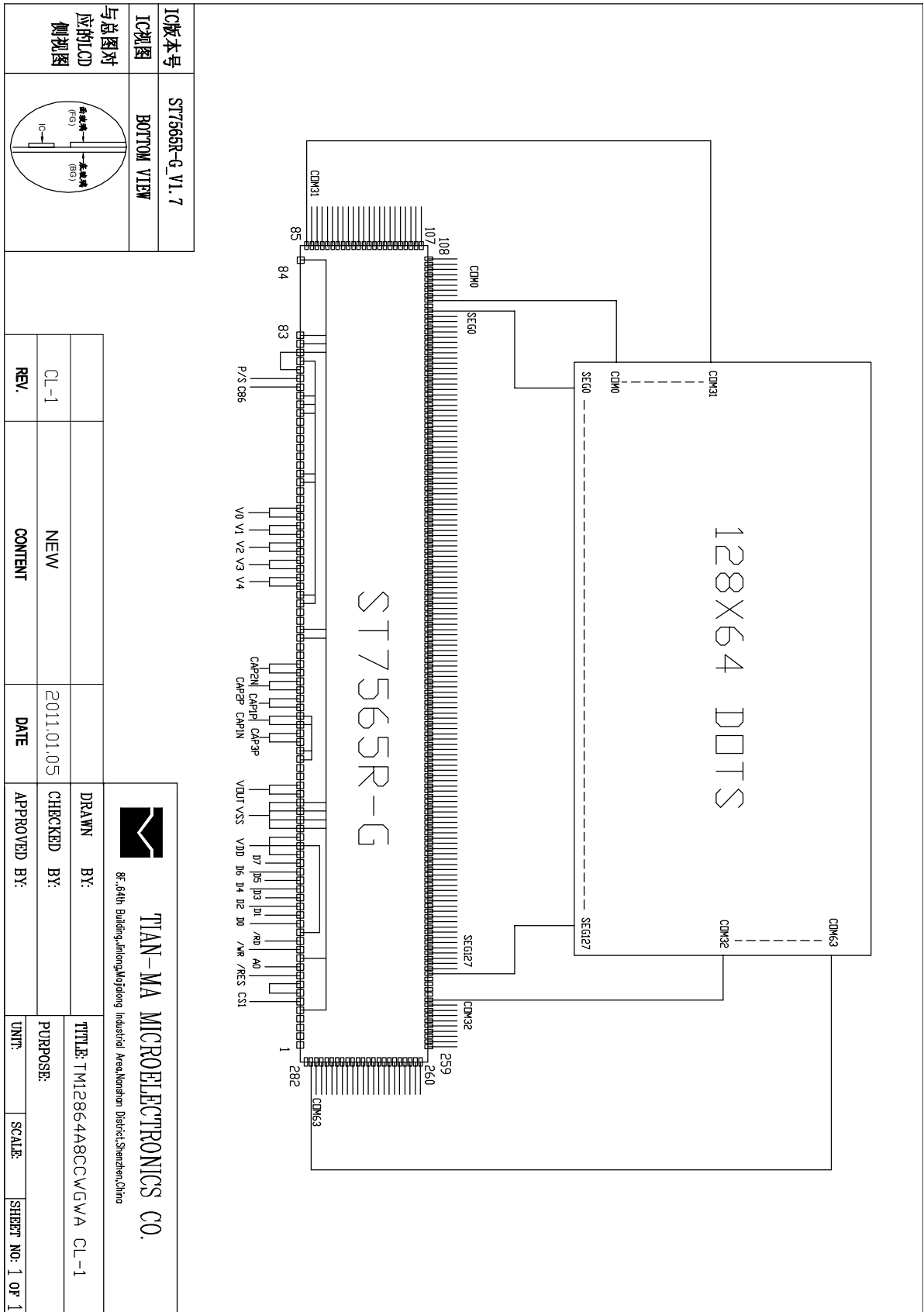
**SHEET NO: 1 OF 1**

**UNIT: mm**



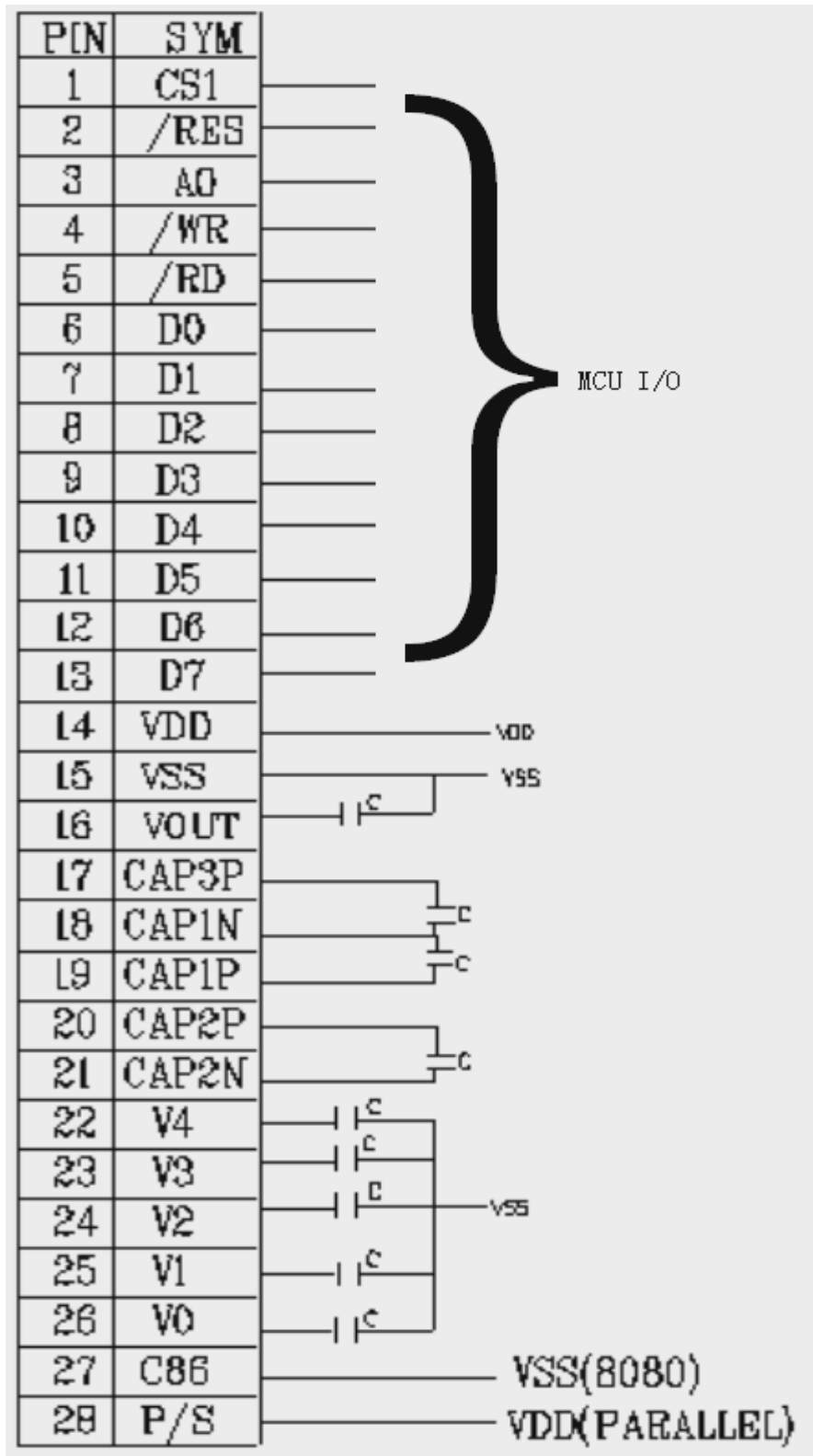
## 5 Circuit

### 5.1 Block Diagram



## 5.2 Recommend power supply Circuit

One example:8080 Parallel 8 bit interface:



Notes:

C:1.0uf ,16V ; More interface application please see the ST7565R datasheet.

The value of capacitors just for reference, please find the detail in ST7565R datasheet .



## 6 Interface Description

Pin No.	Symbol	I/O	Description
1	CS1	I	Chip select input
2	/RES	I	Reset input pin When RESETB is "L", initialization is executed.
3	A0	I	It determines whether the data bits are data or command
4	/WR	I	Write signal and is low-active.
5	/RD	I	Read signal and is low-active
6	D0	I/O	Data bit 0
7	D1	I/O	Data bit 1
8	D2	I/O	Data bit 2
9	D3	I/O	Data bit 3
10	D4	I/O	Data bit 4
11	D5	I/O	Data bit 5
12	D6	I/O	Data bit 6
13	D7	I/O	Data bit 7
14	VDD	3.0V	Power supply voltage for logic .
15	VSS	0V	Ground
16	VOUT	--	Voltage converter input/output pin
17	CAP3P	--	Capacitor 3 positive connection pin for voltage converter
18	CAP1N	--	Capacitor 1 negative connection pin for voltage converter
19	CAP1P	--	Capacitor 1 positive connection pin for voltage converter
20	CAP2P	--	Capacitor 2 positive connection pin for voltage converter
21	CAP2N	--	Capacitor 2 negative connection pin for voltage converter
22	V4	--	LCD driver supply voltage
23	V3	--	LCD driver supply voltage
24	V2	--	LCD driver supply voltage
25	V1	--	LCD driver supply voltage
26	V0	--	LCD driver supply voltage
27	C86	I	The MPU interface selection pin.H/L:6800/8080 Series
28	P/S	I	Mode interface. H : Parallel data input/output ; L: Serial data input

## 7 Instruction Code & Timing Characteristics

### 7.1 COMMAND

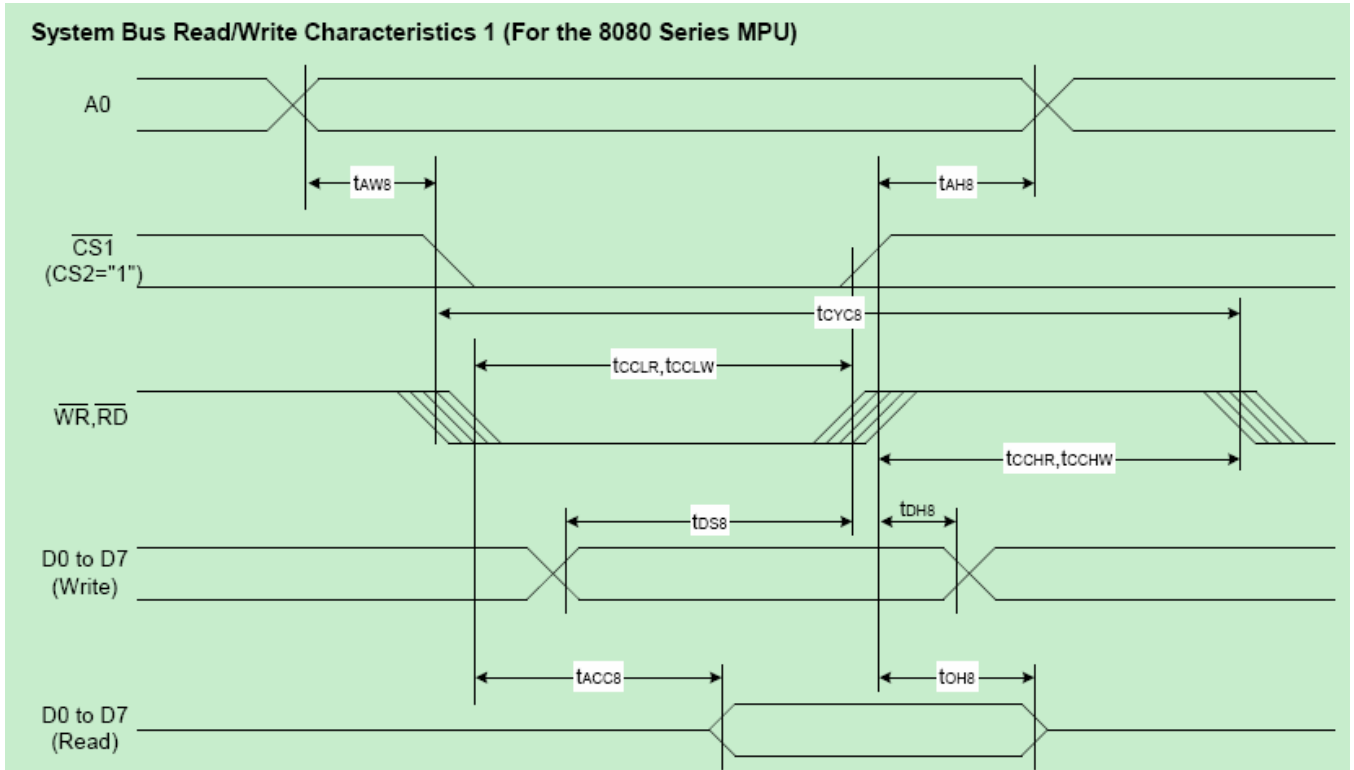
The table below lists the types of commands, including the code of each command. More details refer to ST7565R data sheet please.

Command	Command Code										Function			
	A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0		
(1) Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0	LCD display ON/OFF 0: OFF, 1: ON		
(2) Display start line set	0	1	0	0	1	Display start address					0	Sets the display RAM display start line address		
(3) Page address set	0	1	0	1	0	1	Page address					0	Sets the display RAM page address	
(4) Column address set upper bit	0	1	0	0	0	0	1	Most significant column address					0	Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
Column address set lower bit				0	0	0	0	Least significant column address						
(5) Status read	0	0	1	Status				0	0	0	0	0	Reads the status data	
(6) Display data write	1	1	0	Write data							0	Writes to the display RAM		
(7) Display data read	1	0	1	Read data							0	Reads from the display RAM		
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0	Sets the display RAM address SEG output correspondence 0: normal, 1: reverse		
(9) Display normal/reverse	0	1	0	1	0	1	0	0	1	1	0	Sets the LCD display normal/ reverse 0: normal, 1: reverse		
(10) Display all points ON/OFF	0	1	0	1	0	1	0	0	1	0	0	Display all points 0: normal display 1: all points ON		
(11) LCD bias set	0	1	0	1	0	1	0	0	0	1	0	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565R)		
(12) Read-modify-write	0	1	0	1	1	1	0	0	0	0	0	Column address increment At write: +1 At read: 0		
(13) End	0	1	0	1	1	1	0	1	1	1	0	Clear read/modify/write		
(14) Reset	0	1	0	1	1	1	0	0	0	1	0	Internal reset		
(15) Common output mode select	0	1	0	1	1	0	0	0	*	*	*	Select COM output scan direction 0: normal direction 1: reverse direction		
(16) Power control set	0	1	0	0	0	1	0	1	Operating mode			Select internal power supply operating mode		
(17) V <sub>0</sub> voltage regulator internal resistor ratio set	0	1	0	0	0	1	0	0	Resistor ratio			Select internal resistor ratio(Rb/Ra) mode		
(18) Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set the V <sub>0</sub> output voltage electronic volume register		
Electronic volume register set				0	0	Electronic volume value								
(19) Sleep mode set	0	1	0	1	0	1	1	0	0	0	1	0: Sleep mode, 1: Normal mode		
(20) Booster ratio set	0	1	0	1	1	1	1	1	0	0	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x		
(21) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation		
(22) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command		

## 7.2 Interface Timing Characteristics

Note: Please refer to IC: ST7565R data sheet for more details.

### 7.2.1 CPU Interface Timing



(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH8</sub>		0	—	Ns
Address setup time		t <sub>AW8</sub>		0	—	
System cycle time		t <sub>CYC8</sub>		240	—	
Enable L pulse width (WRITE)	WR	t <sub>CCLW</sub>		80	—	
Enable H pulse width (WRITE)		t <sub>CCHW</sub>		80	—	
Enable L pulse width (READ)	RD	t <sub>CCLR</sub>		140	—	
Enable H pulse width (READ)		t <sub>CCHR</sub>		80	—	
WRITE Data setup time	D0 to D7	t <sub>DS8</sub>		40	—	
WRITE Address hold time		t <sub>DH8</sub>		0	—	
READ access time		t <sub>ACC8</sub>	CL = 100 pF	—	70	
READ Output disable time		t <sub>OH8</sub>	CL = 100 pF	5	50	

(V<sub>DD</sub> = 2.7V, T<sub>a</sub> = -30 to 85°C)

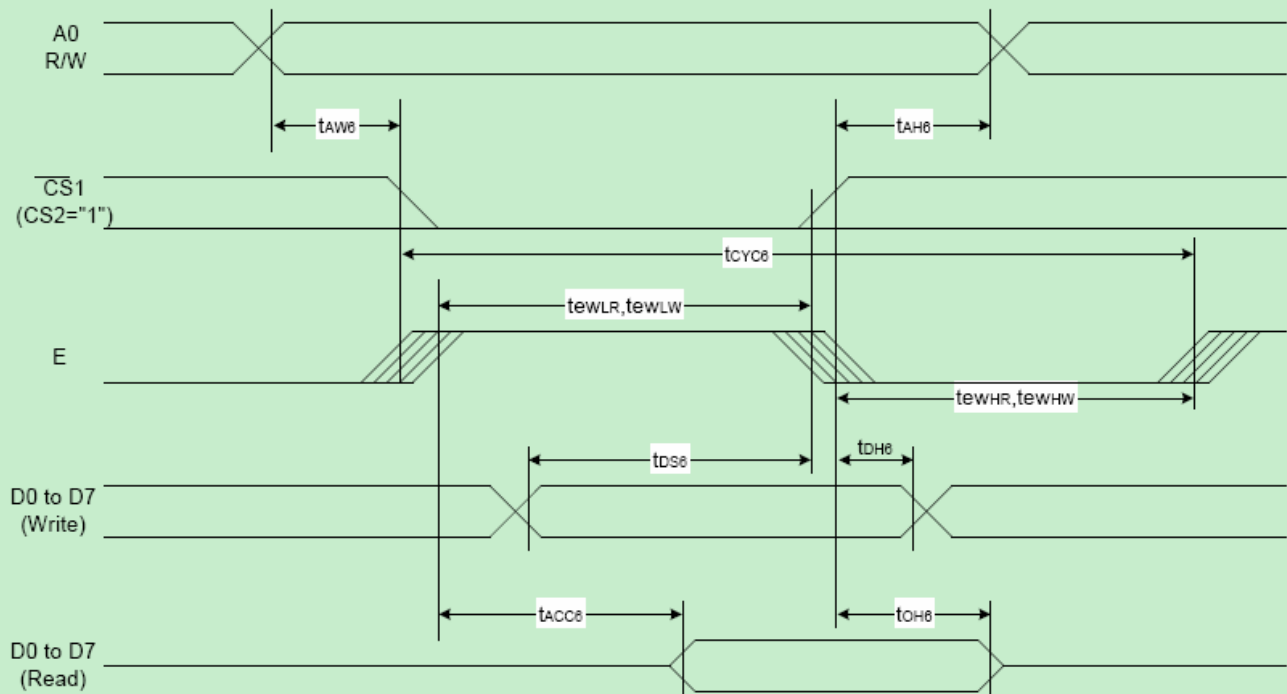
Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH8</sub>		0	—	ns
Address setup time		t <sub>AW8</sub>		0	—	
System cycle time		t <sub>CYC8</sub>		400	—	
Enable L pulse width (WRITE)	WR	t <sub>CCLW</sub>		220	—	
Enable H pulse width (WRITE)		t <sub>CCHW</sub>		180	—	
Enable L pulse width (READ)	RD	t <sub>CCLR</sub>		220	—	
Enable H pulse width (READ)		t <sub>CCHR</sub>		180	—	
WRITE Data setup time	D0 to D7	t <sub>DS8</sub>		40	—	
WRITE Address hold time		t <sub>DH8</sub>		0	—	
READ access time		t <sub>ACC8</sub>	CL = 100 pF	—	140	
READ Output disable time		t <sub>OH8</sub>	CL = 100 pF	10	100	

\*1 The input signal rise time and fall time (t<sub>r</sub>, t<sub>f</sub>) is specified at 15 ns or less. When the system cycle time is extremely fast, (t<sub>r</sub> + t<sub>f</sub>) ≤ (t<sub>CYC8</sub> - t<sub>CCLW</sub> - t<sub>CCHW</sub>) for (t<sub>r</sub> + t<sub>f</sub>) ≤ (t<sub>CYC8</sub> - t<sub>CCLR</sub> - t<sub>CCHR</sub>) are specified.

\*2 All timing is specified using 20% and 80% of V<sub>DD</sub> as the reference.

\*3 t<sub>CCLW</sub> and t<sub>CCLR</sub> are specified as the overlap between /CS1 being "L" (CS2 = "H") and /WR and /RD being at the "L" level.

### System Bus Read/Write Characteristics 2 (For the 6800 Series MPU)



(V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH6</sub>		0	—	ns
Address setup time		t <sub>AW6</sub>		0	—	
System cycle time		t <sub>CYC6</sub>		240	—	
Enable L pulse width (WRITE)	WR	t <sub>EWLW</sub>		80	—	
Enable H pulse width (WRITE)		t <sub>EWHW</sub>		80	—	
Enable L pulse width (READ)	RD	t <sub>EWLR</sub>		80	—	
Enable H pulse width (READ)		t <sub>EWHR</sub>		140	—	
WRITE Data setup time	D0 to D7	t <sub>DS6</sub>		40	—	
WRITE Address hold time		t <sub>DH6</sub>		0	—	
READ access time		t <sub>ACC6</sub>	CL = 100 pF	—	70	
READ Output disable time		t <sub>OH6</sub>	CL = 100 pF	5	50	

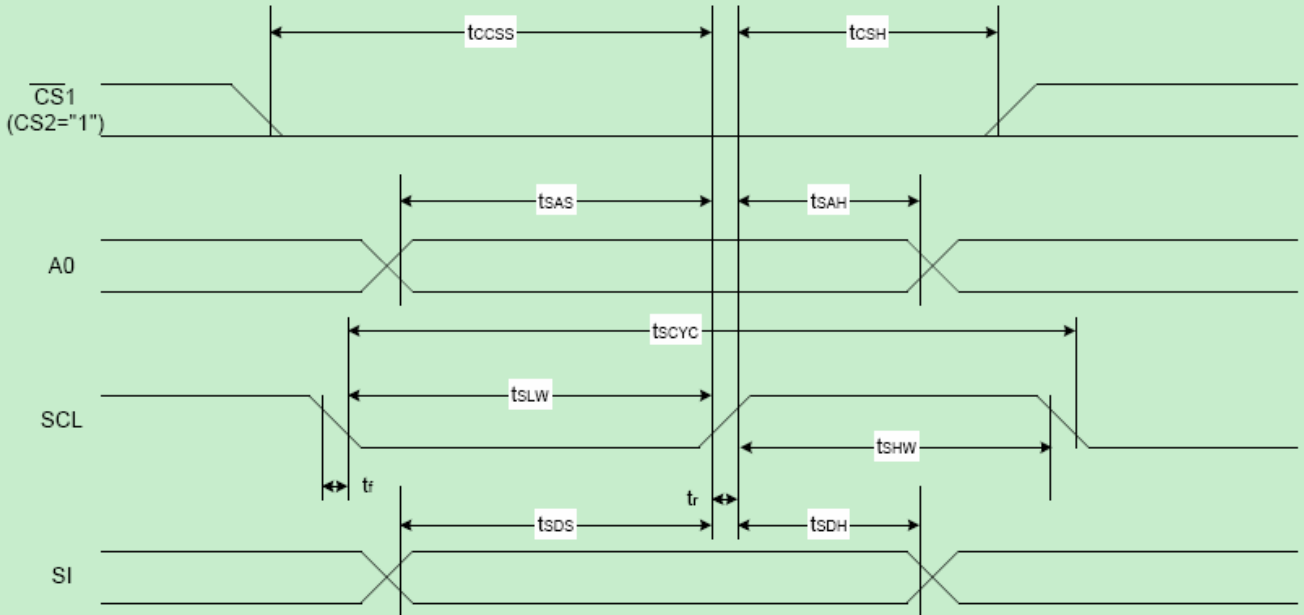
 (V<sub>DD</sub> = 2.7V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
Address hold time	A0	t <sub>AH6</sub>		0	—	ns
Address setup time		t <sub>AW6</sub>		0	—	
System cycle time		t <sub>CYC6</sub>		400	—	
Enable L pulse width (WRITE)	WR	t <sub>EWLW</sub>		220	—	
Enable H pulse width (WRITE)		t <sub>EWHW</sub>		180	—	
Enable L pulse width (READ)	RD	t <sub>EWLR</sub>		220	—	
Enable H pulse width (READ)		t <sub>EWHR</sub>		180	—	
WRITE Data setup time	D0 to D7	t <sub>DS6</sub>		40	—	
WRITE Address hold time		t <sub>DH6</sub>		0	—	
READ access time		t <sub>ACC6</sub>	CL = 100 pF	—	140	
READ Output disable time		t <sub>OH6</sub>	CL = 100 pF	10	100	

\*1 The input signal rise time and fall time (t<sub>r</sub>, t<sub>f</sub>) is specified at 15 ns or less. When the system cycle time is extremely fast, (t<sub>r</sub> + t<sub>f</sub>) ≤ (t<sub>CYC6</sub> - t<sub>EWLW</sub> - t<sub>EWHW</sub>) for (t<sub>r</sub> + t<sub>f</sub>) ≤ (t<sub>CYC6</sub> - t<sub>EWLR</sub> - t<sub>EWHR</sub>) are specified.

\*2 All timing is specified using 20% and 80% of V<sub>DD</sub> as the reference.

\*3 t<sub>EWLW</sub> and t<sub>EWLR</sub> are specified as the overlap between  $\overline{CS1}$  being "L" (CS2 = "H") and E.

**The 4-line SPI Interface**

 (V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	T <sub>scyc</sub>		50	—	ns
SCL "H" pulse width		T <sub>shw</sub>		25	—	
SCL "L" pulse width		T <sub>slw</sub>		25	—	
Address setup time	A0	T <sub>sas</sub>		20	—	
Address hold time		T <sub>sah</sub>		10	—	
Data setup time	SI	T <sub>sds</sub>		20	—	
Data hold time		T <sub>sdh</sub>		10	—	
CS-SCL time	CS	T <sub>css</sub>		20	—	
CS-SCL time		T <sub>csH</sub>		40	—	

 (V<sub>DD</sub> = 2.7V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating		Units
				Min.	Max.	
4-line SPI Clock Period	SCL	T <sub>scyc</sub>		100	—	ns
SCL "H" pulse width		T <sub>shw</sub>		50	—	
SCL "L" pulse width		T <sub>slw</sub>		50	—	
Address setup time	A0	T <sub>sas</sub>		30	—	
Address hold time		T <sub>sah</sub>		20	—	
Data setup time	SI	T <sub>sds</sub>		30	—	
Data hold time		T <sub>sdh</sub>		20	—	
CS-SCL time	CS	T <sub>css</sub>		30	—	
CS-SCL time		T <sub>csH</sub>		60	—	

 \*1 The input signal rise and fall time ( $t_r, t_f$ ) are specified at 15ns or less.

 \*2 All timing is specified using 20% and 80% of V<sub>DD</sub> as the standard.

## 7.2.2 Reset Timing

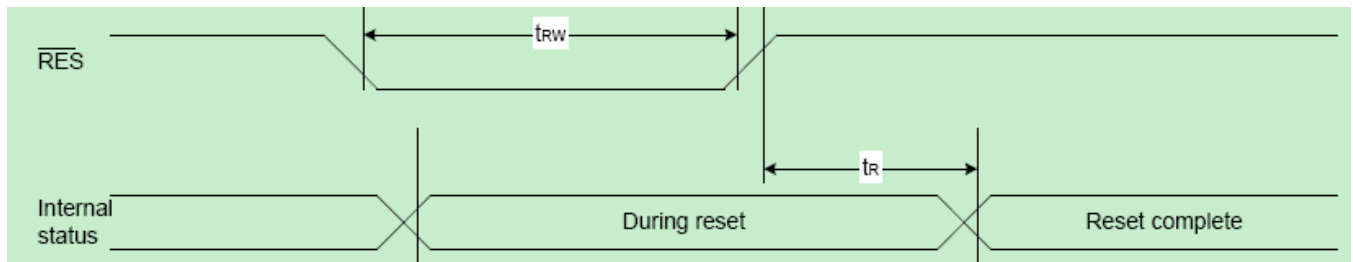


Figure 41

Table 30

 (V<sub>DD</sub> = 3.3V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t <sub>R</sub>		—	—	1.0	us
Reset "L" pulse width	/RES	t <sub>RW</sub>		1.0	—	—	us

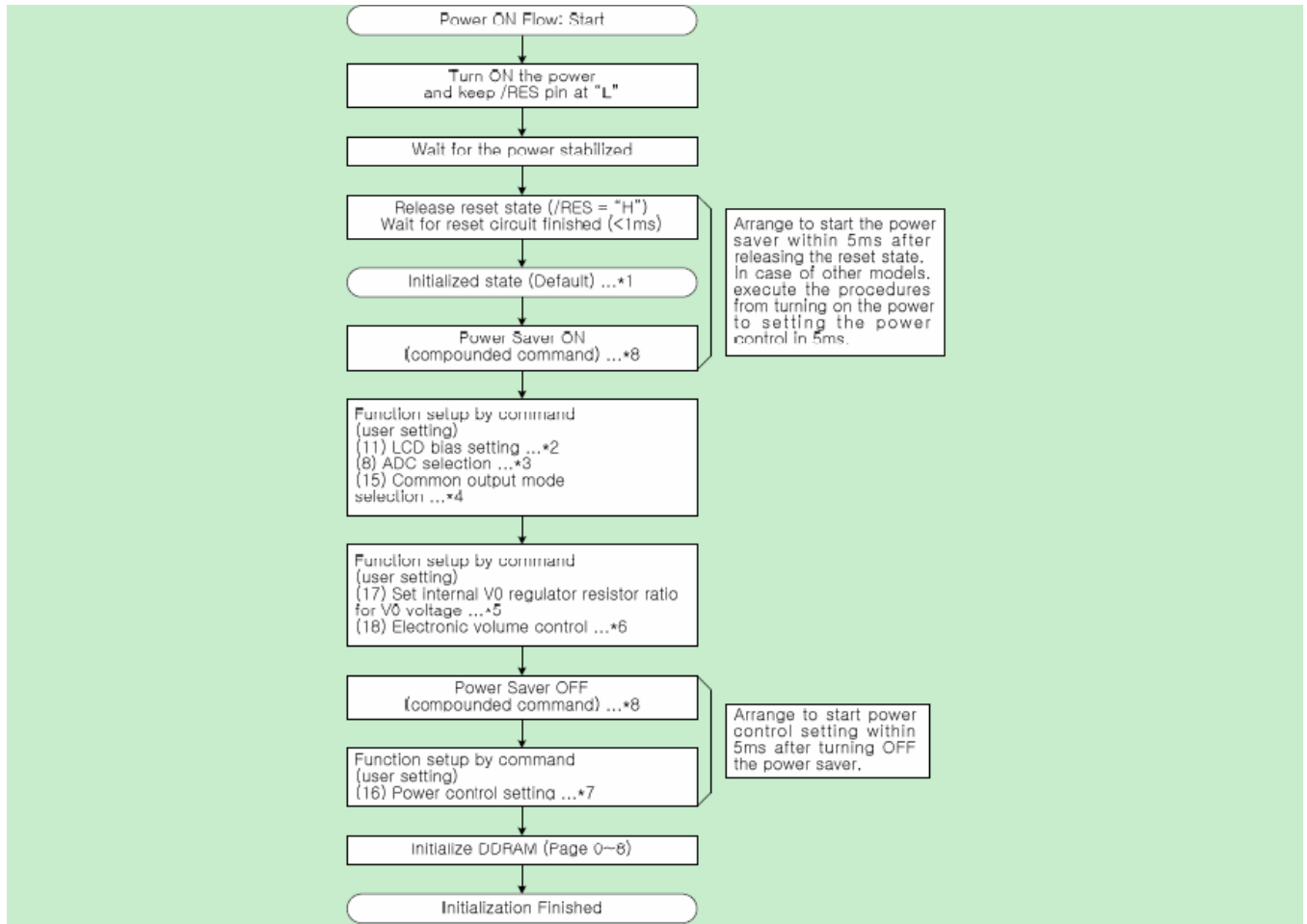
Table 31

 (V<sub>DD</sub> = 2.7V, T<sub>a</sub> = -30 to 85°C)

Item	Signal	Symbol	Condition	Rating			Units
				Min.	Typ.	Max.	
Reset time		t <sub>R</sub>		—	—	2.0	us
Reset "L" pulse width	/RES	t <sub>RW</sub>		2.0	—	—	us

\*1 All timing is specified with 20% and 80% of V<sub>DD</sub> as the standard.

### 7.3 Initialization Flow Map



\* The target time of 5ms will result to vary depending on the panel characteristics and the capacitance of the smoothing capacitor. Therefore, we suggest you to conduct an operation check using the actual equipment.

Notes: Refer to respective sections or paragraphs listed below.

\*1: Description of functions; Resetting circuit

\*2: Command description; LCD bias setting

\*3: Command description; ADC selection

\*4: Command description; Common output state selection

\*5: Description of functions; Power circuit & Command description; Setting the built-in resistance ratio for regulation of the  $V_0$  voltage

\*6: Description of functions; Power circuit & Command description; Electronic volume control

\*7: Description of functions; Power circuit & Command description; Power control setting

\*8: Command description; Sleep mode (multiple commands)

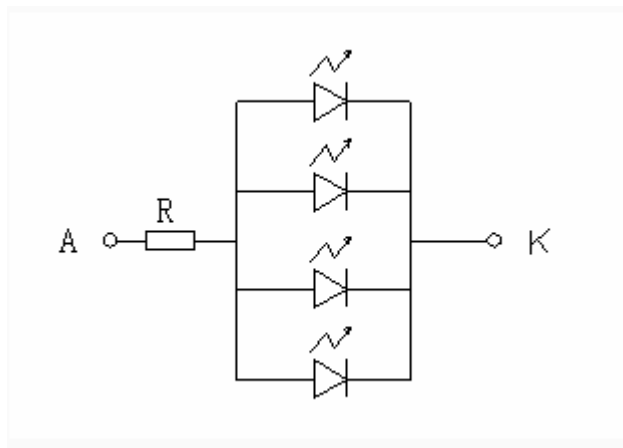


## 8 Electrical Characteristics

 $V_{SS}=0V, \quad Ta=25^{\circ}C$ 

Item	Symbol	Condition	MIN	TYP	MAX	UNIT	
Logic circuit supply voltage	$V_{DD}$	--	2.7	3.0	3.3	V	
LCD driving voltage	$V_0$		8.7	9.0	9.3		
Input voltage for logic circuit	"H"level	$V_{DD}=3.0V$	$0.8 V_{DD}$	--	$V_{DD}$		
	"L"level		0	--	$0.2 V_{DD}$		
Output voltage for logic circuit	"H"level		$0.8 V_{DD}$	--	$V_{DD}$		
	"L"level		0	--	$0.2 V_{DD}$		
Used driver IC	ST7565R OF SITRONIX						

## 9 LED Backlight Characteristics

 $Ta=25^{\circ}C$ 


Item	Symbol	Condition	MIN.	TYP.	MAX.	Unit
Forward current	$I_f$	$V_f = 3.2V$	--	60	80	mA
Luminous intensity	Bp		200	250	--	cd/m <sup>2</sup>
Luminous Uniformity	$\Delta Bp$		70	--	--	%
Color coordinate	X		0.270	0.2993	0.320	--
	Y		0.270	0.3126	0.320	--

### Note:

- Measured at the bare LED backlight unit.
- If the backlight is above these maximum ratings for long time, the service life of the LED backlight will reduce or it will cause poor reliability.

## 10 Optical Characteristics

### 10.1 Optical Characteristics

Ta=25°C

Parameter	Symbol	Ratings			Unit	Measuring Temp.	Reference	
		Min	Type	Max.				
Operating voltage	$V_o$	8.7	9.0	9.3	V	25°C	(Note10-1)	
Frame frequency	f	--	77	--	Hz		(Note10-2)	
Contrast ratio	$Cr(\theta=20^\circ, \phi=90^\circ \text{ or } 270^\circ)$	--	3.4	--		25°C	(Note10-3)	
Response time	Turn on	$t_{on}$	--	--	191	ms	25°C	(Note10-4)
			--	--			0°C	
	Turn off	$t_{off}$	--	--	230	ms	25°C	
			--	--			0°C	
Viewing angle (Cr≥2)	Up-down	$\theta_1$ ( $\phi=90^\circ \text{ or } 270^\circ$ )	-35	--	30	deg	25°C	(Note10-5)
	Left-right	$\theta_2$ ( $\phi=0^\circ \text{ or } 180^\circ$ )	-34	--	28	deg	25°C	

(Note10-1) The maximum and minimum ratings don't mean the LCD works well in the whole range of  $V_o$ .  $V_o$  must be adjusted to optimize the viewing angle and contrast. Refer to definition of drive voltage, refer to 10.2.

(Note10-2) The frequency shouldn't be too low to avoid flicker. Refer to definition of drive voltage, refer to 10.2.

(Note10-3) Refer to 10.2/10.3/10.4/10.5.

(Note10-4) The selected state is dark and non-selected state is white( or bright) with positive type, reversely the selected state is white (or bright) and non-selected state is dark with negative type. Refer to 10.6 definition of response time.

(Note10-5) Generally the viewing direction is 6:00 or 12:00, sometimes 3:00 or 9:00. The range of left to right and up to down based on Cr=2 show the viewing angle. Viewing angle range isn't the range of defects inspection. Refer to 10.4/10.7.

**10.2 Definition of Drive Voltage**

(1) Definition of Drive Voltage and Waveform

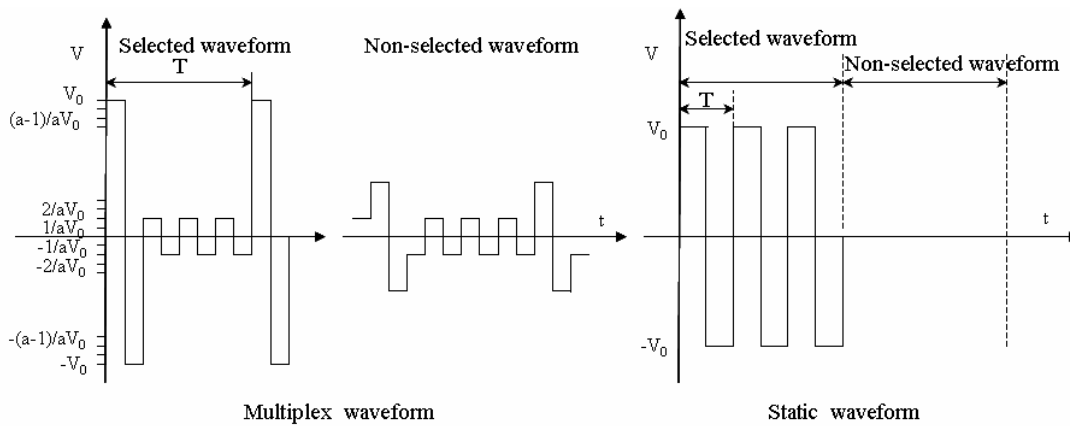


Fig.1 Definition of drive voltage and waveform

Operating voltage:  $V_0$

Frame frequency:  $f=1/T$

Duty:  $1/N$

Bias:  $1/a$

(2) Operating Voltage:  $V_0$

TIANMA can evaluate whether the LCD can be redesigned to obtain customer preferable performance if customer's LCD drive voltage isn't adjustable.

**10.3 Optical Characteristics Measurement Equipment and Method**

The setup and test method are showed in Fig.2. Test methods are different according to different illumination mode.

Transmissive mode: light resource is placed at the back of LCD.

Reflective mode and transfective mode: light resource is placed at the front side of LCD.

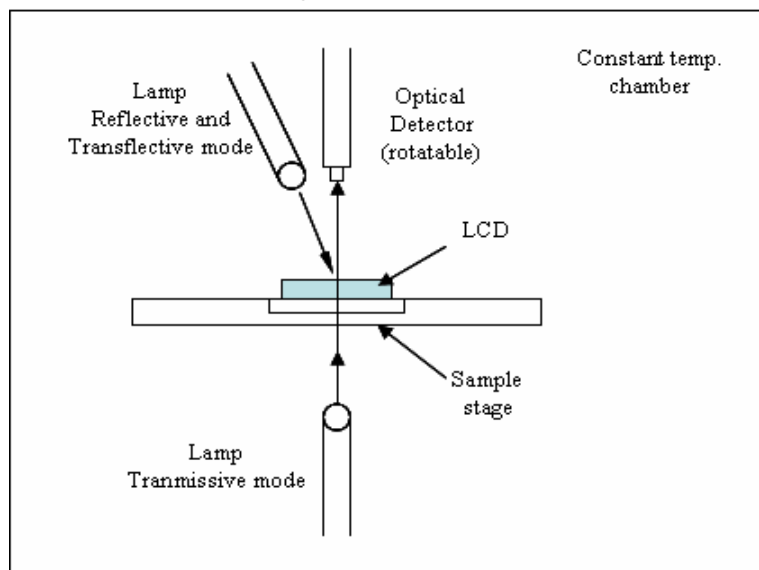


Fig.2 Optical characteristics measurement equipment

The chamber temperature, light resource and driving signal should be stable before testing. If test the

characteristics under high or low temperature, the test system should be stable for more than 10 minutes before testing.

**10.4 Definition of Viewing Direction**

Refer to the graph below marked by  $\theta$  and  $\phi$

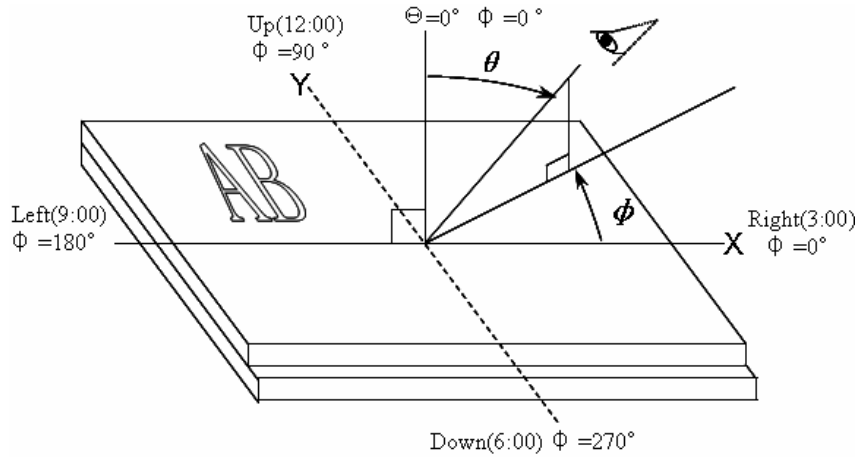


Fig.3 Definition of viewing direction

**10.5 Definition of Contrast Ratio**

Contrast ratio can be calculated by the formula (10-1) below for positive type. If the LCD is negative type,  $Cr(\theta, \phi)$  is equal to luminance ( $\theta, \phi$ , non-selected state) divided by luminance ( $\theta, \phi$ , selected state). Fig.4 shows the relationship between selected state, non-selected state and bright state, dark state.

$$Cr(\theta, \phi) = \frac{L_2}{L_1} = \frac{\text{Luminance}(\theta, \phi) \text{ (Bright state)}}{\text{Luminance}(\theta, \phi) \text{ (Dark state)}} \quad (10-1)$$

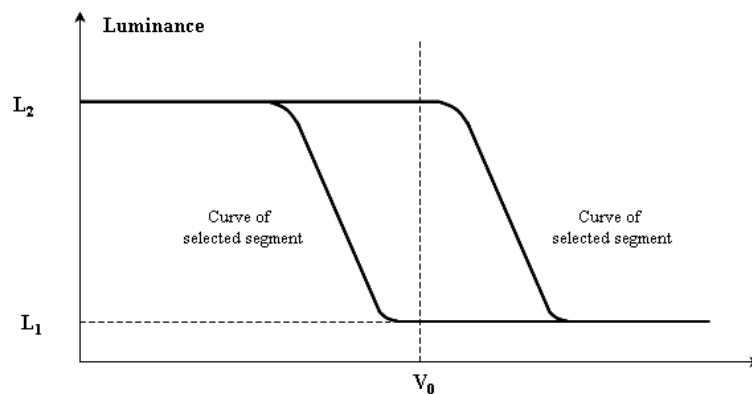


Fig.4 Electro-optical characteristic (EOC) graph (positive type)

## 10.6 Definition of Response Time

Turn on time (rise time):  $t_{on} = t_d + t_r$  (from non-selected state to selected state)

Turn off time (fall time):  $t_{off} = t_D + t_R$  (from selected state to non-selected state)

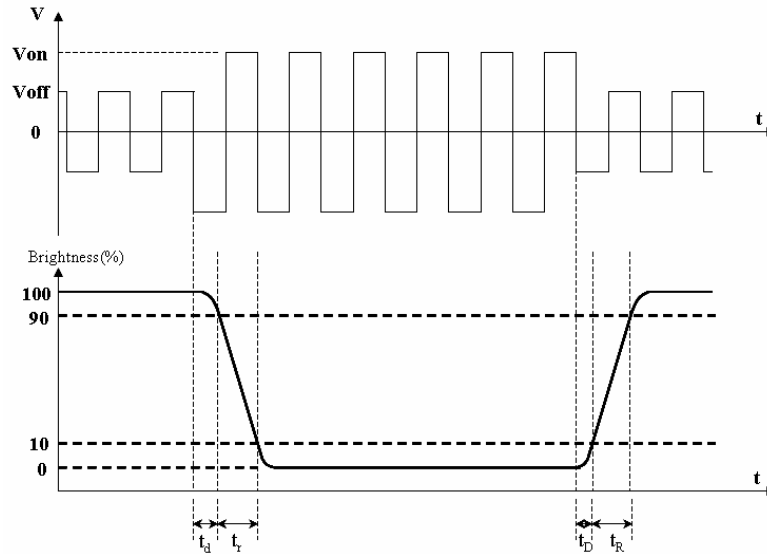


Fig.5 Definition of response time (positive type)

## 10.7 Definition of Viewing Angle

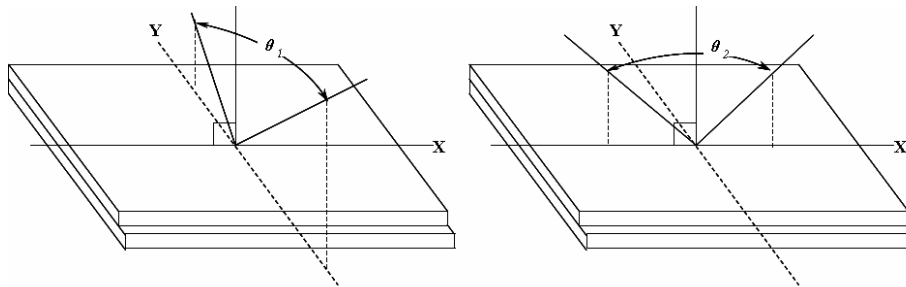


Fig.6 Definition of viewing angle

$\theta_1$  ——range of viewing angle from up to down.

$\theta_2$  ——range of viewing angle from left to right.

## 11 Reliability

### 11.1 Content of Reliability Test

Ta=25°C

No	Test Item	Test condition	Criterion
1	High Temperature Storage	80°C±2°C 120H Restore 2H at 25°C Power off	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-30°C±2°C 120H Restore 2H at 25°C Power off	
3	High Temperature Operation	70°C±2°C 120H Restore 2H at 25°C Power on	
4	Low Temperature Operation	-20°C±2°C 120H Restore 4H at 25°C Power on	
5	High Temperature & Humidity Operation	40°C±2°C 90%RH 120H Power on	
6	Temperature Cycle	-30°C→25°C→80°C 30min 5min 30min after 10cycle, Restore 2H at 25°C Power off	
7	Vibration Test	10Hz~150Hz, 100m/s <sup>2</sup> , 120min	
8	Shock Test	Half-sine wave, 300m/s <sup>2</sup> , 11ms	
9	Drop Test(package state)	800mm, concrete floor, 1corner, 3edges, 6 sides each time	

Notes:

- Each test item applies for a test sample only once, The test sample can not be used again in any other test item.
- The test sample is inspected after 2 hours or more storing at room temperature and room humidity after each test item is finished.
- For Damp Proof Test, Pure water(Resistance>10MΩ) should be used.

4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judge as a good part. Using ionizer (an antistatic blower) is recommended at working area in order to reduce electro-static voltage. When removing protection film from LCM panel, peel off the tag slowly( recommended more than one second) while blowing with ionizer toward the peeling face to minimize ESD which may damage electrical circuit.
5. EL evaluation should be excepted from reliability test with humidity and temperature: Some defects such as black spot/blemish can happen by natural chemical reaction with humidity and Fluorescence that EL has.
6. Polarizer test criteria
  - a. when testing avoid samples take out then return, It can cause water coagulation in Polarizer. Increase the distance of samples , And put samples before the wind.
  - b. When the samples are put into the test, put them upright so that the glasses keep spaces between them each other. (Fig.7)

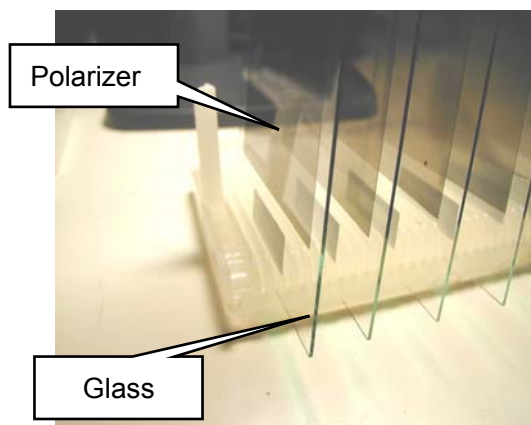


Fig.7

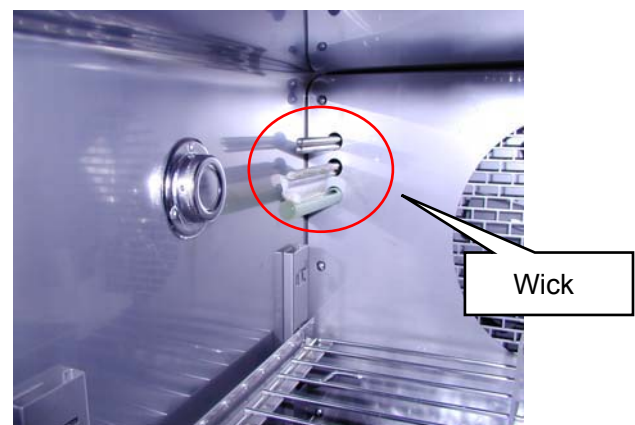


Fig.8

- c. Put samples into testing machine as small as possible so that it is drafty.
  - d. Do not put samples under wick because water will fall.( Fig.8)
  - e. Do not open testing machine except for taking them out in order to prevent moisture condensation.
7. The criteria refer to 11.2.

## 11.2 Inspection of Criteria

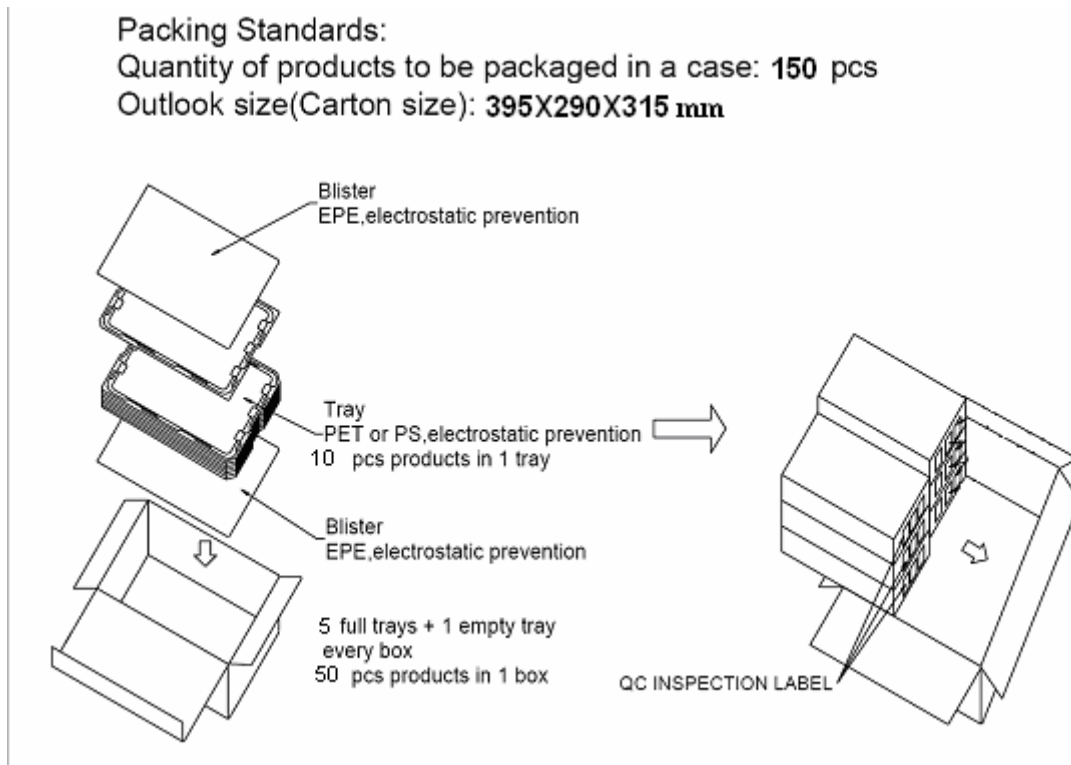
Remark NO.	Content
1	Functional test is OK. Missing Segment, shorts, unclear segment, nondisplay, display abnormally, liquid crystal leak are unallowable.
2	After testing, cosmetic defects should not happen, no low temperature bubbles, seal loose and fall, frame rainbow, ACF bubble growing are unallowable in the appearance test.
3	Total current consumption should not be over 200% of initial value.
4	After tests being executed, Contrast must be larger than 50% of its initial value prior to the tests.
5	No glass crack, chipped glass, end seal loose frame crack and so on.
6	No structure loose and fall.

## 12 Package

### Packing Standards:

Quantity of products to be packaged in a case: **150 pcs**

Outlook size(Carton size): **395X290X315 mm**





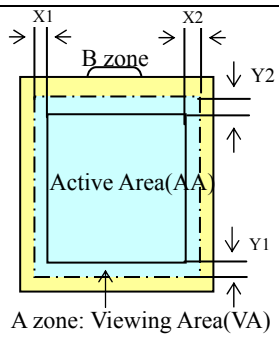
## 13 Quality Level

### 13.1 Classification of Defects

Major defects (MA): A major defect refers to a defect that may substantially degrade usability for product applications, including all functional defects (such as no display, abnormal display, open or missing segment, short circuit, missing component), outline dimension beyond the drawing, progressive defects and those affecting reliability.

Minor defects (MI): A minor defect refers to a defect which is not considered to be able to substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation, such as black spot, white spot, bright spot, pinhole, black line, white line, contrast variation, glass defect, polarizer defect, etc.

### 13.2 Definition of Inspection Range

<p>For LCD defects, dividing two areas to make a judgment (according figure 1).</p> <p>A zone : Inside Viewing area                  B zone : Outside Viewing area                  X1(A.A~V.A): 1.74mm    X2(A.A~V.A): 1.74mm                  Y1(A.A~V.A): 3.38mm    Y2(A.A~V.A): 3.38mm</p>	 <p>Figure 1</p>
--	---

### 13.3 Inspection Items and General Notes

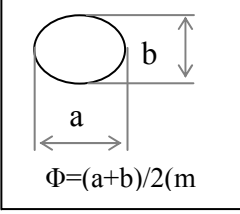
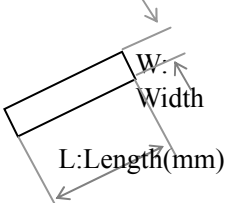
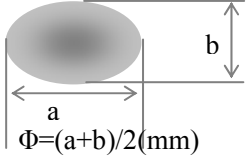
General notes	①Should any defects which are not specified in this standard happen, additional standard shall be determined by mutual agreement between customer and TIANMA. ②Viewing area should be the area which TIANMA guarantees. ③Limit sample should be prior to this Inspection standard. ④Viewing judgment should be under static pattern. ⑤Inspection conditions Inspection distance: 250 mm (from the sample)      Temperature : 25±5 °C Inspection angle : 45 degrees in 6 o'clock direction (all defects in viewing area should be inspected from this direction)	
Inspection items	Pinhole, Bright spot, Black spot, White spot, Black line, White Line, Foreign particle, Bubble	The color of a small area is different from the remainder. The phenomenon doesn't change with voltage
	Contrast variation	The color of a small area is different from the remainder. The phenomenon changes with voltage
	Polarizer defect	Scratch, Dirt, Particle, Bubble on polarizer or between polarizer and glass
	Functional defect	no display, display abnormally, open or missing segment, short circuit, False viewing direction
	Glass defect	Glass crack, Shaved corner of glass, Surplus glass
	Segment defect	Pin holes or cracks in segment, Transformation of segment
	PCB defect	Components assembly defect

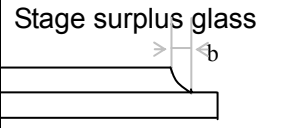
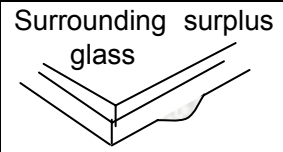
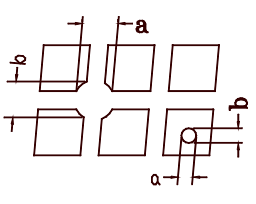
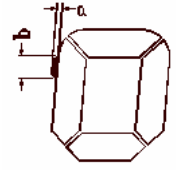
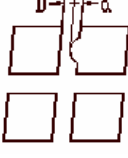
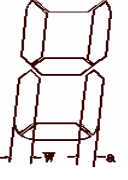
### 13.4 Outgoing Inspection Level

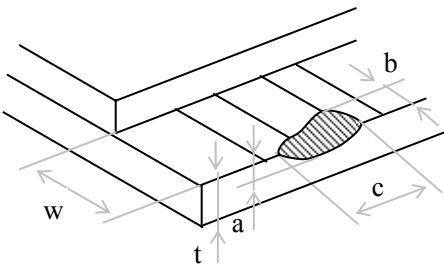
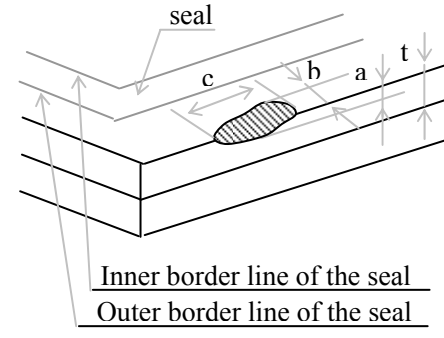
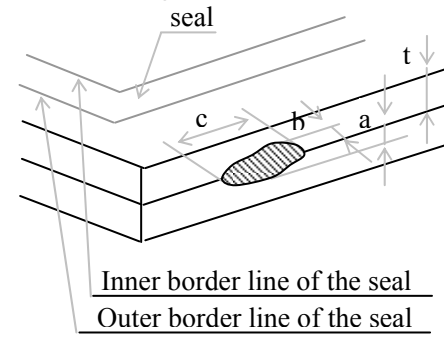
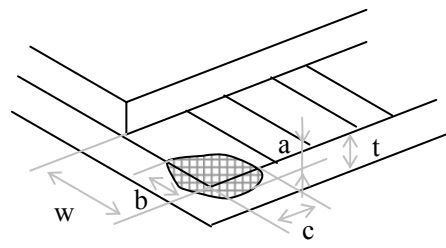
Outgoing Inspection standard	Inspection conditions	Inspection				
		Min.	Max.	Unit	IL	AQL
Major Defects	See 13.3 general notes	See	13.5		II	0.65
Minor Defects	See 13.3 general notes	See	13.5		II	1.5

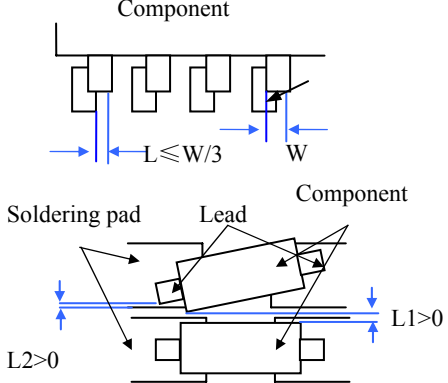
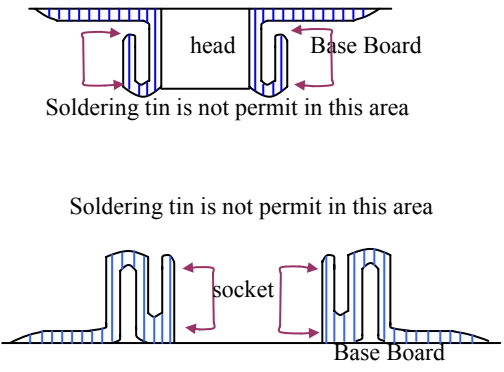
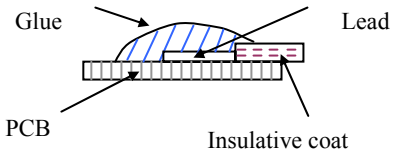
Note: Sampling standard conforms to GB2828

### 13.5 Inspection Items and Criteria

Inspection items			Judgment standard			
			Category		Acceptable number	
					A zone	B zone
1	Black spot, White spot, Bright Spot, Pinhole, Foreign Particle, Particle in or on glass, Scratch on glass		A	$\Phi \leq 0.10$	Neglected	Neglected
			B	$0.10 < \Phi \leq 0.20$	3	
			C	$0.20 < \Phi$	0	
2	Black line, White line, Particle Between Polarizer and glass, Scratch on glass		A	$W \leq 0.02$	Neglected	Neglected
			B	$0.02 < W \leq 0.05$ $L \leq 3.0$	3	
			C	$W > 0.05$ or $L > 3.0$	0	
3	Contrast variation		A	$\Phi \leq 0.2$	Neglected	Neglected
			B	$0.2 < \Phi \leq 0.3$	2	
			C	$0.3 < \Phi \leq 0.4$	1	
			D	$0.4 < \Phi$	0	
			Total defective point(B,C)		3	
4	Bubble inside cell		any size	none	none	
5	Polarizer defect (if Polarizer is used)	Scratch, damage on polarizer, Particle on polarizer or between polarizer and glass.	Refer to item 1 and item 2.			
			Bubble, dent and convex	A	$\Phi \leq 0.3$	Neglected
		B		$0.3 < \Phi \leq 0.7$	2	
		C		$0.7 < \Phi$	0	

6	Surplus glass	Stage surplus glass 	$b \leq 0.3\text{mm}$			
		Surrounding surplus glass 	Should not influence outline dimension and assembling.			
7	Open segment or open common		Not permitted			
8	Short circuit		Not permitted			
9	False viewing direction		Not permitted			
10	Contrast ratio uneven		According to the limit specimen			
11	Crosstalk		According to the limit specimen			
12	Black /White spot(display)		Refer to item 1			
13	Black /White line(display)		Refer to item 2			
14	Pin holes and cracks in segment		not counted	Max.3 dots allowed	Max.3 dots allowed	
			$x < 0.1\text{mm}$	0.1mm x 0.2mm		
		$x = (a+b)/2$		not counted		Max.2 dots allowed each segment
		$A < 0.1\text{mm}$	0.1mm A 0.2mm D < 0.25mm			
15	Transformation of segment		not counted	Max.1 defect allowed each segment	Max.3 defects allowed	
			$x < 0.1\text{mm}$	0.1mm x 0.2mm		
			$x = (a+b)/2$			
			not counted	Max.1 defect allowed each segment		
			$a < 0.1\text{mm}$	0.1mm a 0.2mm D > 0		
			$0.8W \leq a \leq 1.2W$ a=measured value of width W=nominal value of width		Max.2 defects allowed	

Inspection items		Judgment standard			
		Category(application: B zone)	Acceptable number		
16	Glass defect crack	①The front of lead terminals	A	$a \leq t, b \leq 1/5W, c \leq 3\text{mm}$	Max.3 defects allowed
			B	Crack at two sides of lead terminals should not cover patterns and alignment mark	
			②Surrounding crack—non-contact side	 <p><math>b &lt; \text{Inner border line of the seal}</math></p>	
		③ Surrounding crack— contact side	 <p><math>b &lt; \text{Outer border line of the seal}</math></p>		
		④Corner	A	$a \leq t, b \leq 3.0, c \leq 3.0$	
			B	Glass crack should not cover patterns u and alignment mark and patterns.	

Inspection items		Judgment standard	
		Category(application: B zone)	
17	PCB defect	<p>Component soldering: No cold soldering、short、open circuit、burr、tin ball The flat encapsulation component position deviation must be less than 1/3 width of the pin (Pic.1); the sheet component deviation: Pin deviates from the pad and contact with the near components is not permitted (Pic.2)</p>	<p>Component</p> 
		<p>lead defect: The lead lack must be less than 1/3 of its width; The lead burr must be less than 1/3 of the seam; Impurities connect with the near leads is not permitted</p>	
		<p>Connector soldering: Soldering tin is at contact position of the plug and socket is not permitted No foundation is scald Serious cave distortion on plug and socket contact pin is not permitted</p>	
		<p>Glue on root of the speaker receiver and motor lead: The insulative coat of the lead must join into the PCB; the protected glue must envelop to the insulative coat.</p>	

## 14 Precautions for Use of LCD Modules

### 14.1 Handling Precautions

- 14.1.1 The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- 14.1.2 Liquid in LCD is hazardous substance, 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, thoroughly and promptly wash it off using soap and water.
- 14.1.3 Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- 14.1.4 Don't touch, push or rub the exposed polarizer covering the display surface of the LCD module with anything harder than an HB pencil lead, the polarizer is soft and easily scratched, handle it carefully.
- 14.1.5 Don't put or attach anything on the display area to avoid leaving any marks on.
- 14.1.6 If the display surface is contaminated or becomes dusty, breathe on the surface and gently wipe it with a soft dry cloth. do not scrub hard to avoid damage the surface. 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
- 14.1.7 Do not attempt to disassemble the LCD Module.
- 14.1.8 If the logic circuit power is off, do not apply the input signals.
- 14.1.9 Avoid using the same display pattern long time ( continuous ON segment).Software must be prepared so that the pattern will be changed
- 14.1.10 To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
- a. Be sure to ground the body and electric appliances when handling the LCD Modules. It is preferable to use conductive mat on table and wear cotton clothes or conductive processed fibre. Synthetic fibre is not recommended.
  - b. Tools required for assembly, such as soldering irons, must be properly ground.
  - c. To reduce the amount of static electricity generated, do not conduct assembly and other work under dry conditions.
  - d. The LCD Module is coated with a film to protect the display surface. Be careful and slow when peeling off this protective film since static electricity may be generated. It is recommended to use ionic fan or machine when operating. It is recommended to remove the protection foil slowly (> 3 sec.).
  - e. It is preferable to wear gloves etc, to avoid damaging the LCD. Please do not touch electrodes with bare hands or avoid any other contamination.

## 14.2 Storage Precautions

- 14.2.1 When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps.
- 14.2.2 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 : 5°C ~ 40°C
  - Relatively humidity: ≤80%
- 14.2.3 The LCD modules should be stored in a clean environment or room, free from acid, alkali and harmful gas.
- 14.2.4 Store the module in anti-static electricity container and without any physical load.

## 14.3 Transportation Precautions

The LCD modules should be no falling and violent shocking during transportation, and also should avoid excessive press, water, damp and sunshine.

## 14.4 Soldering

- 14.4.1 Use the high quality solders, only solder the I/O terminals.
- 14.4.2 No higher than 280°C and time less than 3-4 second during soldering.
- 14.4.3 Rewiring: no more than 3 times.
- 14.4.4 when you remove connector or cable soldered to I/O terminals, please confirm that solder is fully melted. If you remove by force, electrodes at I/O terminals may be damaged (or stripped off). It is recommended to use solder suction machine.

## 15. LCD Module Part Numbering System

<b>TM</b>	<b>12864</b>	<b>A8</b>	<b>C</b>	<b>C</b>	<b>W</b>	<b>G</b>	<b>W</b>	<b>A</b>
-----------	--------------	-----------	----------	----------	----------	----------	----------	----------

①	②	③	④	⑤	⑥	⑦	⑧	⑨
---	---	---	---	---	---	---	---	---

NO.	Explanation	
①	<b>TIANMA module indicating</b>	
②	<b>Module type: 128 Columns X 64 Rows</b>	
③	<b>TIANMA module series</b>	
④	<b>LCD type</b>	
	C	Positive, FSTN
⑤	<b>Backlight type</b>	
	C	Transflective, LED
⑥	<b>Temperature range</b>	
	W	Wide temperature
⑦	<b>Technology</b>	
	G	COG
⑧	<b>The color of backlight</b>	
	W	White
⑨	<b>Function choice</b>	
	A	Basic funtion