AGTechnologies
LCD Displays

SPECIFICATION

AGM 12864S-801

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RECORDS OF REVISION

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CONTENTS

1. GENERAL SPECIFICATIONS 4
2. BLOCK DIAGRAM 5
3. OUTLINE DRAWING 6
4. INTERFACE ASSIGNMENT 9
5. APPLICATION CIRCUIT 9
6. TIMING CHARACTERISTICS 10
7. POWER ON/OFF SEQUENCE 14
8. RECOMMENDED INITIAL CODES 16
9. INSTRUCTION TABLE. 17
10. ABSOLUTE MAXIMUM RATING 17
11. ELECTRICAL CHARACTERISTICS 18
12. LED BACKLIGHT 18
13. POTICAL CHARACTERISTICS. 19
14. ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS 22
15. RELIABILITY TEST 22
16. STANDARD OF INSPECTION 24
17. USING LCD MODULES 28

1. GENERAL SPECIFICATIONS

1-1.DESCRIPTION:

The AGM 12864S-801 is a dot matrix mono Liquid Crystal Display Module(LCM).
This specification covers the delivery requirements for the liquid crystal display delivered by AGTECHNOLOGIES to Customer.

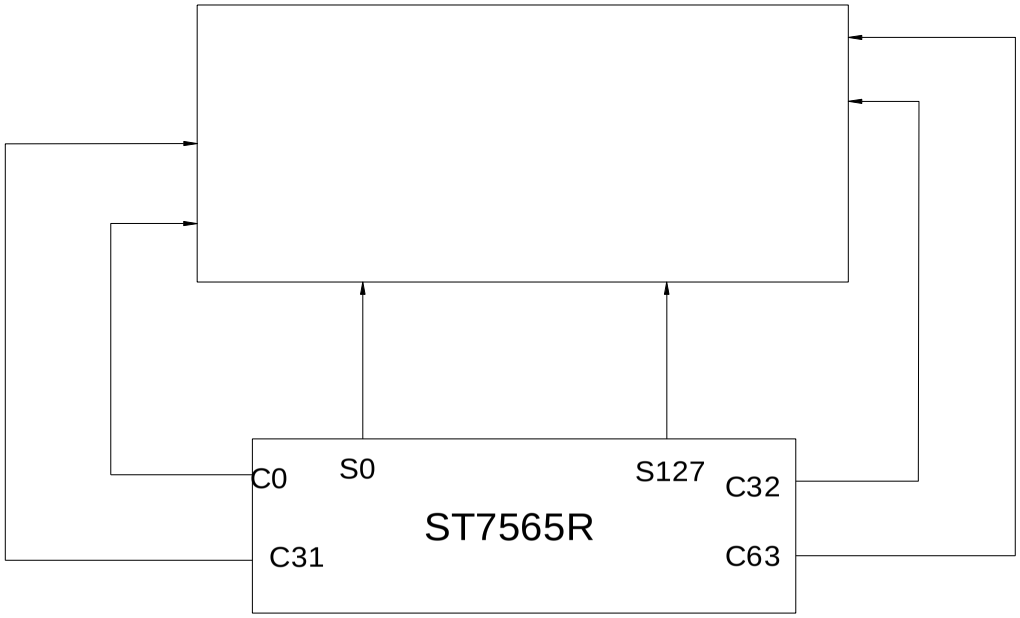
1-2. FEATURES

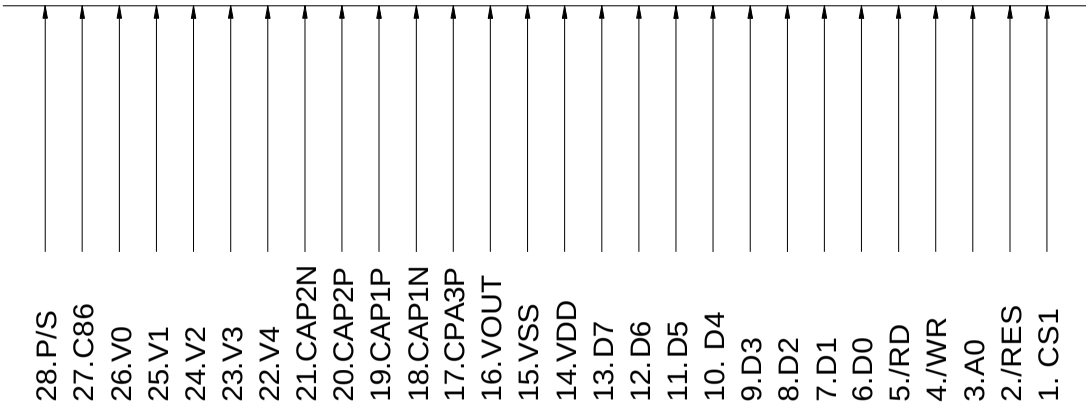
(1) Display Type: STN, Negative Blue, Transmissive, 6 O'clock
(2) Driving Method: 1/65 duty, 1/9 bias
(3) Built-in controller: ST7565R
(4) With White Backlight

1-3.GENERAL SPECIFICATION

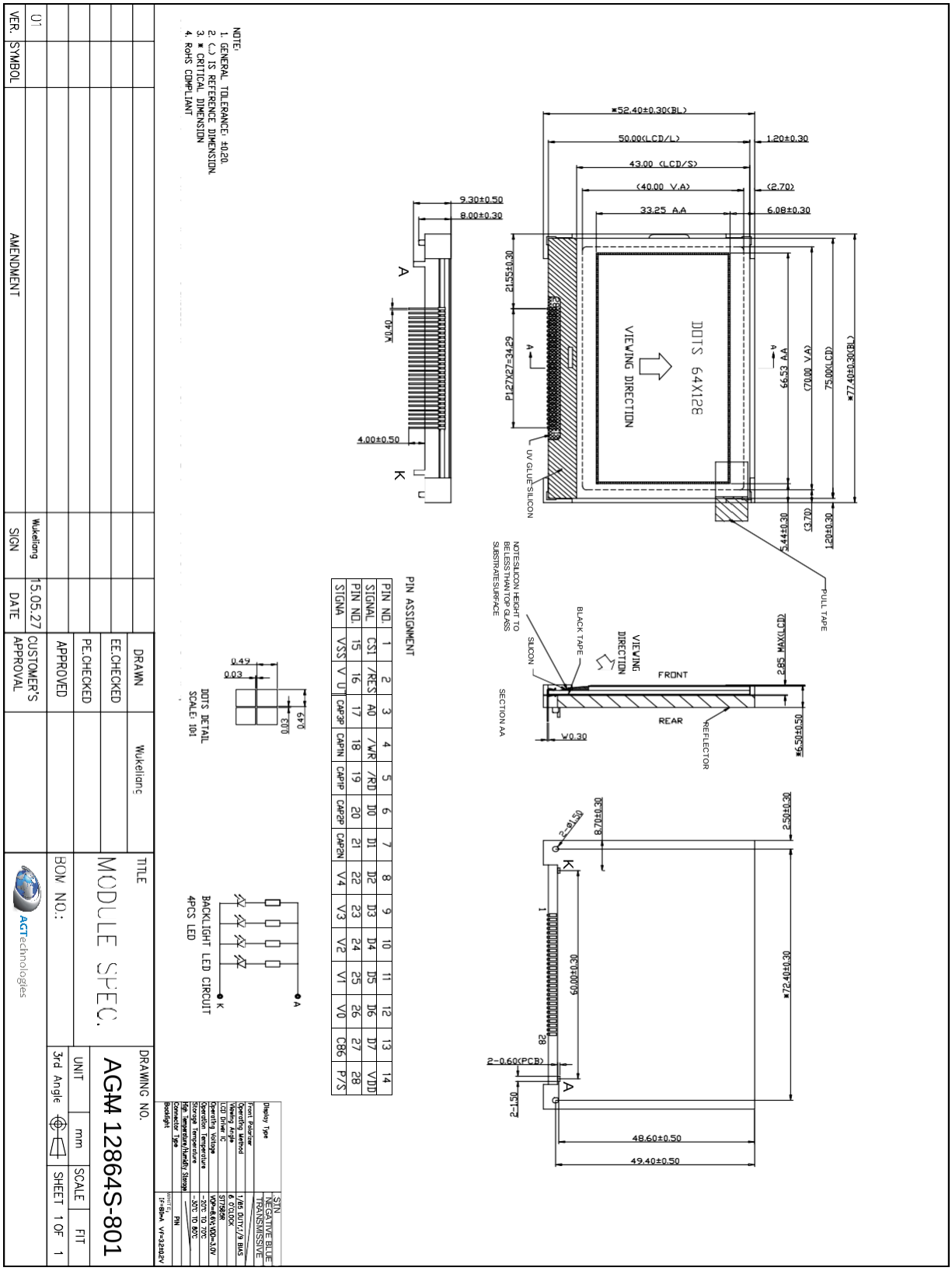
ITEM	SPECIFICATIONS	UNIT
DISP.CONSTRUCTION	128*64 Dots	--
OUTLINE DIMEMSIONS	77.4(W)*52.4(H)*6.5(T)	mm
VIEWING AREA	70.0(W) *40.0(H)	mm
ACTIVE AREA	66.53(W) * 33.25(H)	mm
DOT SIZE	0.49(W) * 0.49(H)	mm
DOT PITCH	0.52(W) x 0.52(H)	mm
ASSY.TYPE	COG+FPC+BL	--
INTERFACE	6800 ,8080,SPI	--

2. BLOCK DIAGRAM





3. OUTLINE DRAWING

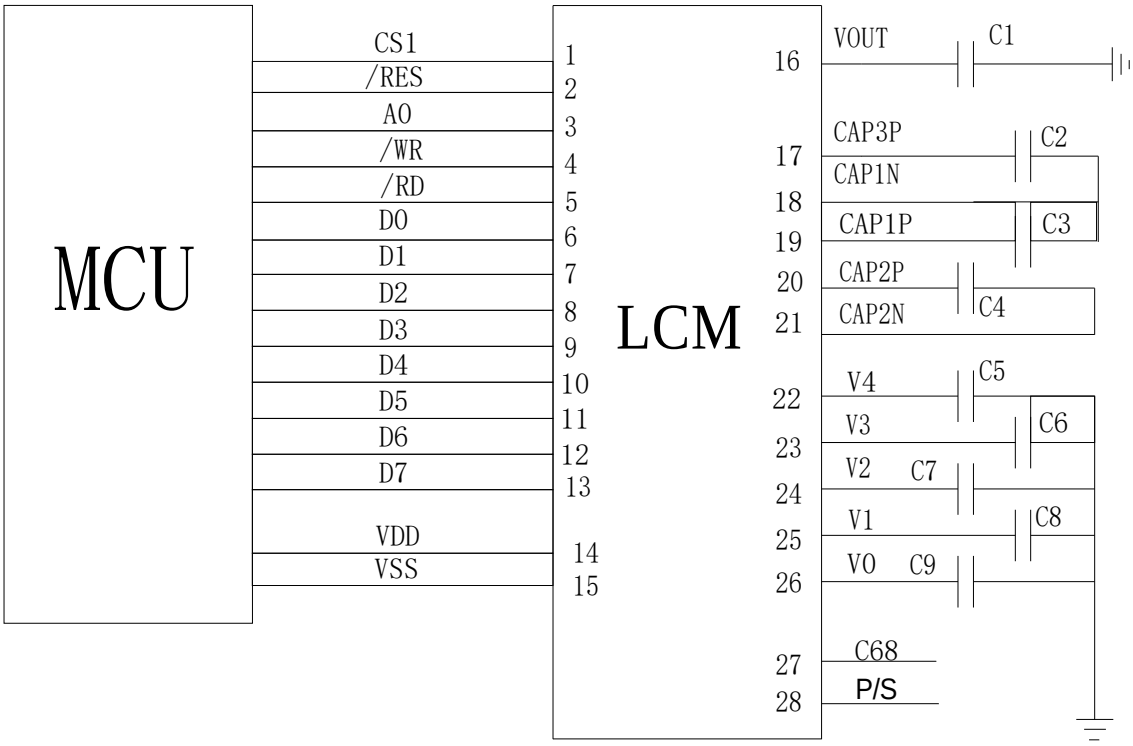


4. INTERFACE ASSIGNMENT

<table>
<tr><th>PIN NO.</th><th>FUNCTION DESCRIPTIONS</th><th>SYMBOL</th></tr>
<tr><td>1</td><td>Chip Select. Chip is selected when CS0 = “L”. When the chip is not selected, D[7:0] will be of high impedance.</td><td>CS1</td></tr>
<tr><td>2</td><td>Initialized by setting RES to LOW.
Reset operation is performed at the RES signal level.</td><td>/RES</td></tr>
<tr><td>3</td><td>Normally the lowest order bit of the MPU address bus is connected to discriminate data / commands.
A0=HIGH: Indicates that D0 to D7 are display data.
A0=LOW: Indicates that D0 to D7 are control data.</td><td>A0</td></tr>
<tr><td>4</td><td>Read/Write execution control pin. When PSB is “H”,
<table>
<tr><th>C86</th><th>MPU Type</th><th>RWR</th><th>Description</th></tr>
<tr><td>H</td><td>6800 series</td><td>R/W</td><td>Read/Write control input pin.
R/W=“H”: read.
R/W=“L”: write.</td></tr>
<tr><td>L</td><td>8080 series</td><td>/WR</td><td>Write enable input pin.
Signals on D[7:0] will be latched at the rising edge of /WR signal.</td></tr>
</table>
RWR is not used in serial interface and should be fixed to “H” by VDD.</td><td>/WR</td></tr>
<tr><td>5</td><td>Read/Write execution control pin. When PSB is “H”,
<table>
<tr><th>C86</th><th>MPU Type</th><th>ERD</th><th>Description</th></tr>
<tr><td>H</td><td>68þ0 series</td><td>E</td><td>Read/Write control input pin.
R/W="H“: When E is “H”, D[7:0] are in output mode.
R/W="L“: Signals on D[7:0] are latched at the falling edge of E signal.</td></tr>
<tr><td>L</td><td>8080 series</td><td>/RD</td><td>Read enable input pin.
When /RD is “L”, D[7:0] are in output mode.</td></tr>
</table>
ERD is not used in serial interface and should be fixed to “H” by VDD.</td><td>RD</td></tr>
<tr><td>6</td><td rowspan="8">Data bus</td><td>D0</td></tr>
<tr><td>7</td><td>D1</td></tr>
<tr><td>8</td><td>D2</td></tr>
<tr><td>9</td><td>D3</td></tr>
<tr><td>10</td><td>D4</td></tr>
<tr><td>11</td><td>D5</td></tr>
<tr><td>12</td><td>D6</td></tr>
<tr><td>13</td><td>D7</td></tr>
<tr><td>14</td><td>Commonly used with the MPU power supply pin Vcc.</td><td>VDD</td></tr>
<tr><td>15</td><td>GND</td><td>VSS</td></tr>
<tr><td>16</td><td>NC</td><td>VOUT</td></tr>
</table>

<table>
<tr><td>17</td><td rowspan="5">DC-DC voltage converter for LCD driver circuit. If using built-in voltage booster circuit, the application circuit please refers to section of Liquid Crystal Driver Power Circuit.</td><td>CAP3P</td></tr>
<tr><td>18</td><td>CAP1N</td></tr>
<tr><td>19</td><td>CAP1P</td></tr>
<tr><td>20</td><td>CAP2P</td></tr>
<tr><td>21</td><td>CAP2N</td></tr>
<tr><td>22</td><td rowspan="5">The power supply pins for LCD.
Insure the voltage levels of VOUT, V0, V1, V2, V3 and V4 always match below relation: VOUT > V0 > V1 > V2 > V3 > V4 > VSS</td><td>V4</td></tr>
<tr><td>23</td><td>V3</td></tr>
<tr><td>24</td><td>V2</td></tr>
<tr><td>25</td><td>V1</td></tr>
<tr><td>26</td><td>V0</td></tr>
<tr><td>27</td><td>C86 selects the microprocessor type in parallel interface mode.
<table>
<tr><th>PSB</th><th>C86</th><th>Selected Interface</th></tr>
<tr><td>“H”</td><td>“H”</td><td>Parallel 6800 Series MPU Interface</td></tr>
<tr><td>“H”</td><td>“L”</td><td>Parallel 8080 Series MPU Interface</td></tr>
<tr><td>“L”</td><td>“X”</td><td>Serial 4-Line SPI Interface</td></tr>
</table>
Please refer to “APPLICATION NOTES” and “Microprocessor Interface” (Section 6) for detailed connection of the selected interface.</td><td>C86</td></tr>
<tr><td>28</td><td>PSB selects the interface type: Serial or Parallel.</td><td>P/S</td></tr>
</table>

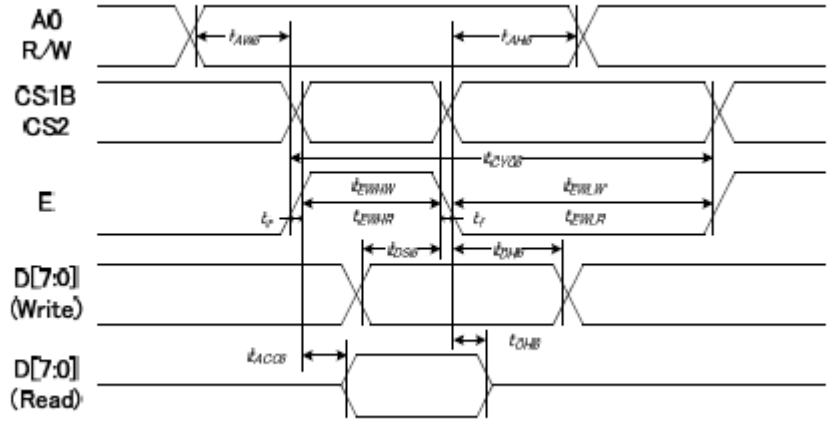
5. APPLICATION CIRCUIT



C1~C9: 1.0uF/25V

6. TIMING CHARACTERISTICS

System Bus Timing for 6800 Series MPU



(VDD = 3.3V , Ta =25˚C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		0	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)		tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		10	—	
Read data access time		tACC6	CL = 100 pF	—	70	
Read data output disable time		tOH6	CL = 100 pF	5	50	

(VDD = 2.7V , Ta =25˚C)

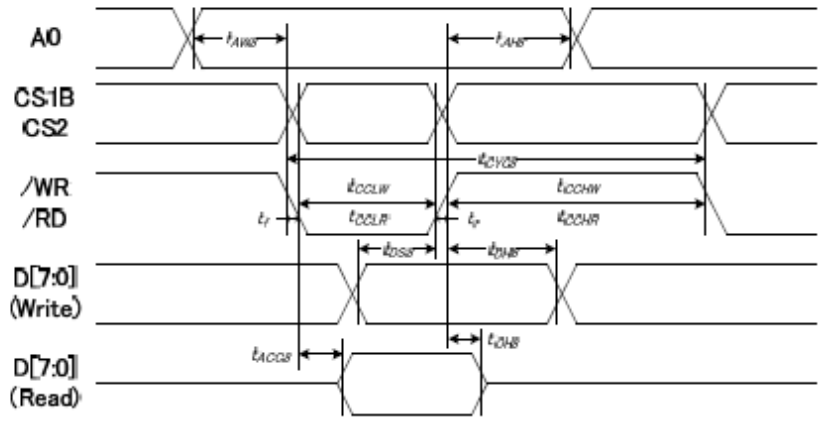
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		0	—	
System cycle time	E	tCYC6		400	—	
Enable L pulse width (WRITE)		tEWLW		220	—	
Enable H pulse width (WRITE)		tEWHW		180	—	
Enable L pulse width (READ)		tEWLR		220	—	
Enable H pulse width (READ)		tEWHR		180	—	
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		0	—	
Read data access time		tACC6	CL = 100 pF	—	140	
Read data output disable time		tOH6	CL = 100 pF	10	100	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≦ (tCYC6 – tEWLW – tEWHW) for (tr + tf) ≦ (tCYC6 – tEWLR – tEWHR) are specified.

*2 All timing is specified using 20% and 80% of VDD as the reference.

*3 tEWLW and tEWLR are specified as the overlap between CS1B being "L" (CS2="H") and E.

System Bus Timing for 8080 Series MPU



(VDD = 3.3V , Ta =25˚C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		0	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)	RD	tCCLR		140	—	
/RD H pulse width (READ)		tCCHR		80		
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 100 pF	—	70	
READ Output disable time		tOH8	CL = 100 pF	5	50	

(VDD = 2.7V , Ta =25˚C)

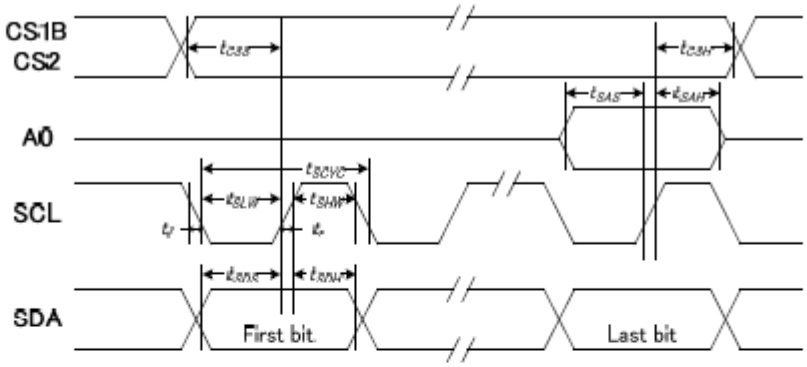
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		0	—	
System cycle time	/WR	tCYC8		400	—	
/WR L pulse width (WRITE)		tCCLW		220	—	
/WR H pulse width (WRITE)		tCCHW		180	—	
/RD L pulse width (READ)	RD	tCCLR		220	—	
/RD H pulse width (READ)		tCCHR		180	—	
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		0	—	
READ access time		tACC8	CL = 100 pF	—	140	
READ Output disable time		tOH8	CL = 100 pF	10	100	

*1 The input signal rise time and fall time (tr, tf) is specified at 15 ns or less. When the system cycle time is extremely fast, (tr + tf) ≦ (tCYC8 – tCCLW – tCCHW) for (tr + tf) ≦ (tCYC8 – tCCLR – tCCHR) are specified.

*2 All timing is specified using 20% and 80% of VDD as the reference.

*3 tCCLW and tCCLR are specified as the overlap between CS1B being “L” (CS2=“H”) and WR and RD being at the “L” level.

System Bus Timing for 4-Line Serial Interface



(VDD = 3.3V , Ta =25˚C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		50	—	ns
SCLK "H" pulse width		tSHW		25	—	
SCLK "L" pulse width		tSLW		25	—	
Address setup time	A0	tSAS		20	—	
Address hold time		tSAH		10	—	
Data setup time	SDA	tSDS		20	—	
Data hold time		tSDH		10	—	
CS-SCLK time	CS1B	tCSS		20	—	
CS-SCLK time	CS2	tCSH		40	—	

(VDD = 2.7V , Ta =25˚C)

Item	Signal	Symbol	Condition	Min.	Max.	Unit
Serial clock period	SCLK	tSCYC		100	—	ns
SCLK "H" pulse width		tSHW		50	—	
SCLK "L" pulse width		tSLW		50	—	
Address setup time	A0	tSAS		30	—	
Address hold time		tSAH		20	—	
Data setup time	SDA	tSDS		30	—	
Data hold time		tSDH		20	—	
CS-SCLK time	CS1B	tCSS		30	—	
CS-SCLK time	CS2	tCSH		60	—	

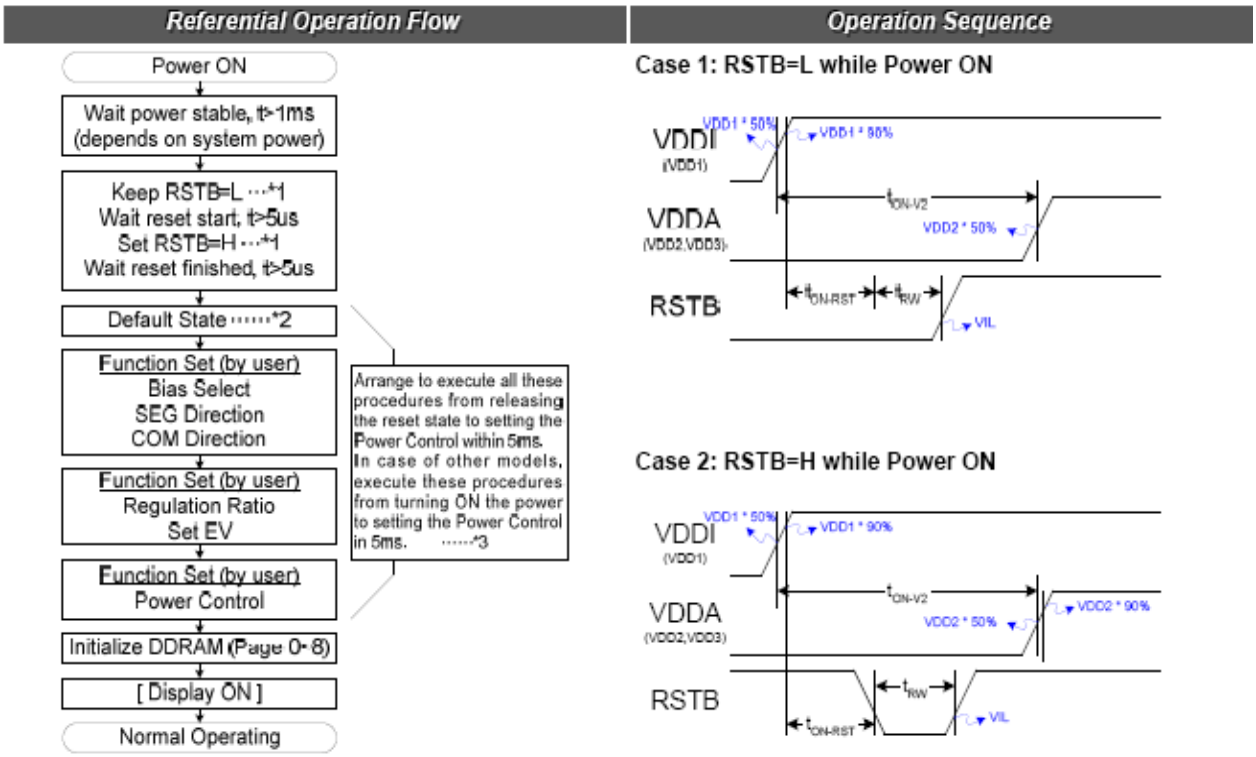
*1 The input signal rise and fall time (tr, tf) are specified at 15 ns or less.

*2 All timing is specified using 20% and 80% of VDD as the standard.

7. POWER ON/OFF SEQUENCE

7-1. POWER ON SEQUENCE

Power ON



Note: The detailed description can be found in the respective sections listed below.

1. Please refer to the timing specification of t_{RW} and t_R.
2. Refer to Section RESET CIRCUIT.
3. The 5ms requirement depends on the characteristics of LCD panel and the external component of the power circuit. It is recommended to check with the real products with external component.
4. The detailed instruction functionality is described in Section INSTRUCTION DESCRIPTION;
5. Power stable is defined as the time that the later power (VDDI or VDDA) reaches 90% of its rated voltage.

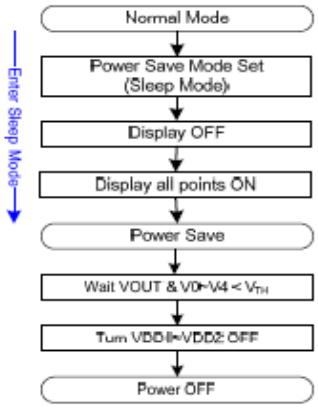
7-2. POWER OFF SEQUENCE

Power OFF Flow and Sequence

In power save mode, LCD outputs are fixed to VSS and all analog outputs are discharged. The power can be turned OFF after ST7565R is in the power save mode. The power save mode can be triggered by the following two methods.

Referential Power OFF Flow	*Operation Sequence*

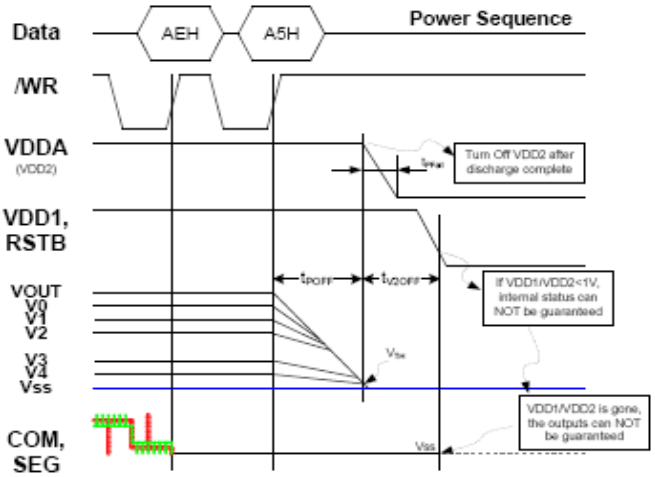
CASE 1: Use Power Save Instruction



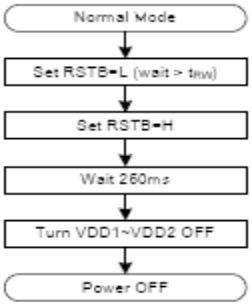
Power OFF Flow

Instruction Flow

After the built-in power circuits are OFF and completely discharged (the power level of built-in analog circuit is smaller than V_{TH} of LCD panel), the power (VDDI, VDDA) can be removed. V_{TH} is around 0.2V to 1.0V.



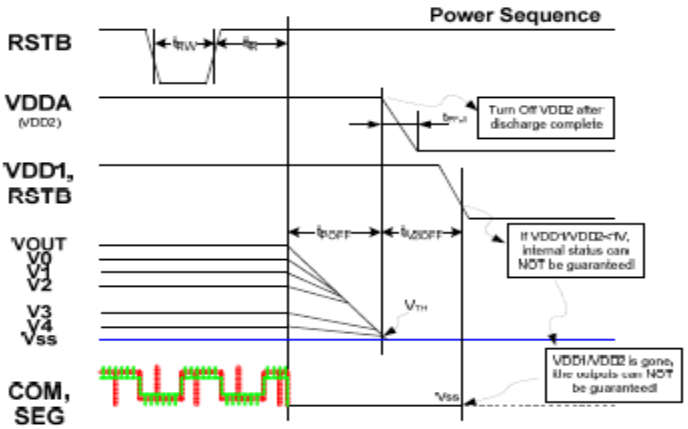
CASE 2: Use Hardware Reset Function



Power OFF Flow

Instruction Flow

After the built-in power circuits are OFF and completely discharged (the power level of built-in analog circuit is smaller than V_{TH} of LCD panel), the power (VDDI, VDDA) can be removed. V_{TH} is around 0.2V to 1.0V.



Note:

1. t_{POFF}: Internal Power discharge time. Discharge time for built-in circuit is dependent on user's system design.
2. t_{V2OFF}: Period between VDDI and VDDA OFF time. => 0 ms (min).
3. It is NOT recommended to turn VDDI OFF before VDDA. Without VDDI, the internal status cannot be guaranteed and internal discharge-process maybe stopped. The un-discharged power maybe flows into COM/SEG output(s) and the liquid crystal in panel maybe polarized.
4. IC will NOT be damaged if either VDDI or VDDA is OFF while another is ON.
5. The timing is dependent on panel loading and the external capacitor(s).

8. RECOMMENDED INITIAL CODES

```
      void Initial(void)
{
   writec(0xa2);                    /* 1/9 bias */
   writec(0xe2);
   writec(0xa0);                    /* ADC select , Normal */
   writec(0xc8);                    /* Common output reverse */
   writec(0xa6);                    /* normal display 1=on */
   writec(0x2c);
   writec(0x2e);
   writec(0x2f);                    /* V/C off, V/R off, V/F on */

   writec(0xf8);                    /***5 booster***/
   writec(0x00);
   writec(0x25);                    /* internal resistor ratio */
   writec(0x81);                    /* electronic volume mode set */
   writec(0x16);                    /* electronic volume */
   writec(0x40);                    /* display start first line */
   writec(0xa7);                    /* display rerevse */
   writec(0xaf);                    /* display on */
}
```

9. INSTRUCTION TABLE

INSTRUCTION	A0	R/W (RWR)	COMMAND BYTE								DESCRIPTION
			D7	D6	D5	D4	D3	D2	D1	D0	
Display ON/OFF	0	0	1	0	1	0	1	1	1	D	D=1, display ON D=0, display OFF
Set Start Line	0	0	0	1	S5	S4	S3	S2	S1	S0	Set display start line
Set Page Address	0	0	1	0	1	1	Y3	Y2	Y1	Y0	Set page address
Set Column Address	0	0	0	0	0	1	X7	X6	X5	X4	Set column address (MSB)
	0	0	0	0	0	0	X3	X2	X1	X0	Set column address (LSB)
Read Status	0	1	BUSY	MX	D	RST	0	0	0	0	Read IC Status
Write Data	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write display data to RAM
Read Data	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read display data from RAM
SEG Direction	0	0	1	0	1	0	0	0	0	MX	Set scan direction of SEG MX=1, reverse direction MX=0, normal direction
Inverse Display	0	0	1	0	1	0	0	1	1	INV	INV =1, inverse display INV =0, normal display
All Pixel ON	0	0	1	0	1	0	0	1	0	AP	AP=1, set all pixel ON AP=0, normal display
Bias Select	0	0	1	0	1	0	0	0	1	BS	Select bias setting 0=1/9; 1=1/7 (at 1/65 duty)
Read-modify-Write	0	0	1	1	1	0	0	0	0	0	Column address increment: Read:+0 , Write:+1
END	0	0	1	1	1	0	1	1	1	0	Exit Read-modify-Write mode
RESET	0	0	1	1	1	0	0	0	1	0	Software reset
COM Direction	0	0	1	1	0	0	MY	-	-	-	Set output direction of COM MY=1, reverse direction MY=0, normal direction
Power Control	0	0	0	0	1	0	1	VB	VR	VF	Control built-in power circuit ON/OFF
Regulation Ratio	0	0	0	0	1	0	0	RR2	RR1	RR0	Select regulation resistor ratio
Set EV	0	0	1	0	0	0	0	0	0	1	Double command!! Set electronic volume (EV) level
	0	0	0	0	EV5	EV4	EV3	EV2	EV1	EV0	
Power Save Mode Set	0	0	1	0	1	0	1	1	0	MD	MD=0, sleep mode MD=1, normal
	0	0	0	0	0	0	0	0	0	0	
Power Save	0	0	Compound Command								Display OFF + All Pixel ON
Set Booster	0	0	1	1	1	1	1	0	0	0	Double command!! Set booster level: BL[1:0]=(0,0), x2, x3, x4 BL[1:0]=(0,1), x5 BL[1:0]=(1,1), x6
	0	0	0	0	0	0	0	0	BL1	BL0	
NOP	0	0	1	1	1	0	0	0	1	1	No operation
Test	0	0	1	1	1	1	-	-	-	-	Do NOT use. Reserved for testing.

Note: Symbol "-" means this bit can be "H" or "L".

10. ABSOLUTE MAXIMUM RATING

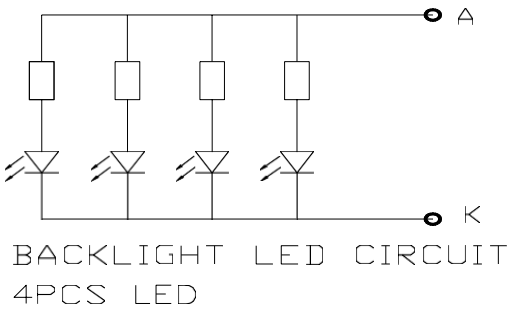
ITEM	SYMBOL	STANDARD VALUE			UNIT
		MIN	TYP	MAX	
SUPPLY VOLTAGE FOR LOGIC	VDD－VSS	-0.3	-	3.6	V
LCD POWER SUPPLY VOLTAGE	VIN	-0.3	-	13.5	V
OPERATING TEMPERATURE	T_{OP}	-20	-	70	℃
STORAGE TEMPERATURE	T_{STG}	-30	-	80	℃

11. ELECTRICAL CHARACTERISTICS

ITEM	SYMBOL	CONDITIONS	STANDARD VALUE			UNIT
			MIN	TYP	MAX	
SUPPLY VOLTAGE FOR LOGIC	VDD－VSS	Ta= +25℃	2.7	3.0	3.3	V
SUPPLY VOLTAGE FOR LCD	V0－VSS		8.4	8.6	8.8	V
INPUT VOLTAGE “H” LEVEL	VIH		0.8VDD	-	VDD	V
INPUT VOLTAGE “L” LEVEL	VIL		VSS	-	0.2VDD	V
OUTPUT VOLTAGE “H” LEVEL	VOH		0.8VDD	-	VDD	V
OUTPUT VOLTAGE “L” LEVEL	VOL		VSS	-	0.2VDD	V

12. LED BACKLIGHT

12-1 LED CIRCUIT:



12-2.ABSOLUTE MAXIMUN RATING

PARAMETER	SYMBOL	SPECIFICATIONS	UNIT
POWER DISSIPATION	PD	272	mW
FORWARD CURRENT	Ifm	80	mA
FORWARD VOLTAGE	Vf	3.2	V
REVERSE VOLTAGE	Vr	5	V
OPERATION TEMPERATURE	TOPR	-20 ～+70	℃
STORAGE TEMPERATURE	TSTG	-30 ～+80	℃

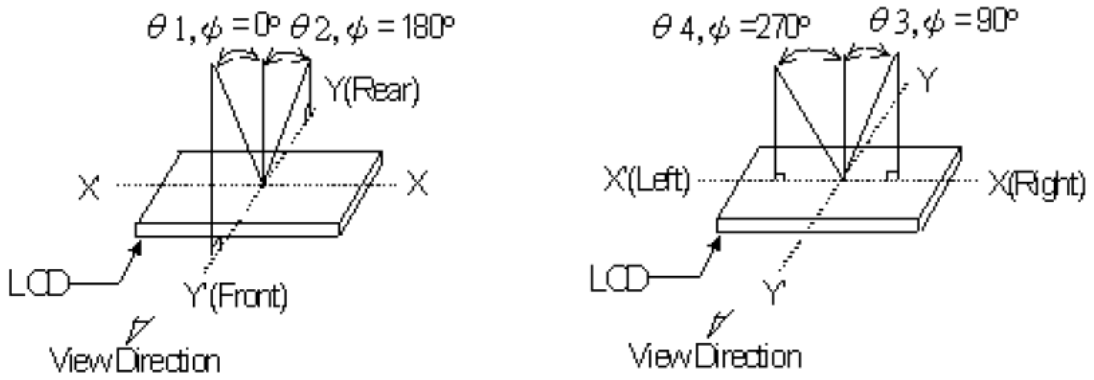
12-3. ELECTRICAL CHARACTERISTICS (Ta=25℃)

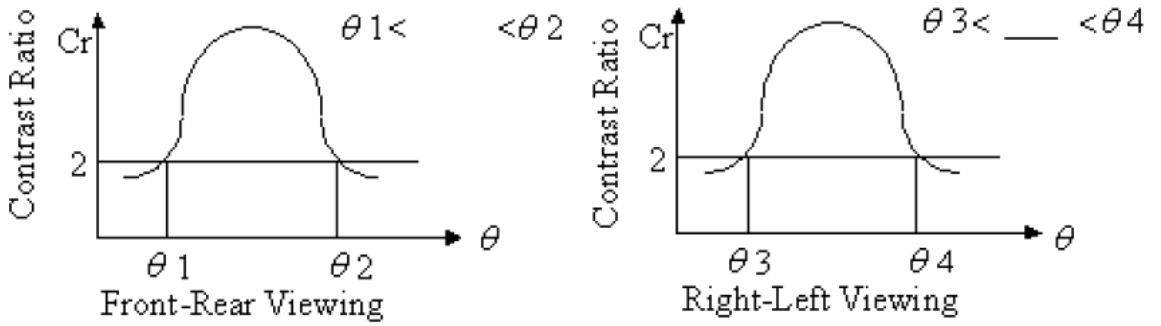
PARAMETER	SYMBOL	LIGHT SOURCE	CONDITIONS	STANDARD VALUE			UNIT
				MIN	TYP	MAX	
FORWARD VOLTAGE	Vf	WHITE	If=80mA	3.0	3.2	3.4	V
REVERSE CURRENT	IR		Vr=5V	--	--	10	uA
SURFACE BRIGHTNESS	Lv		If=80mA	--	1100	--	cd/m^2
LUMINOUS UNIFORMITY	Δ		If=80mA	70%	--	--	--
Color chromaticiy (White)	W_x		If=80mA	0.26	0.28	0.30	--
	W_y		If=80mA	0.27	0.29	0.31	--

13. OPTICAL CHARACTERISTICS

Item		Symbol	Temp.	Condition	Min.	Typ.	Max.	Unit.	Note
Response Time	Rise time	tr	-20℃	θ=0° φ=0°	--	2100	2500	mS	-
			25℃		--	120	150		
			70		--	38	45		
	fall time	tf	-20℃		--	4400	5300		
			25℃		--	200	250		
			70		--	65	80		
Viewing Angle		θ	25℃ Cr≥2	Φ=0°	--	25	30	deg.	-
				Φ=90°	--	30	40		
				Φ=180°	--	25	30		
				Φ=270°	--	25	30		
Contrast Ratio		K	25℃	θ=φ=0°	--	3	4	-	-

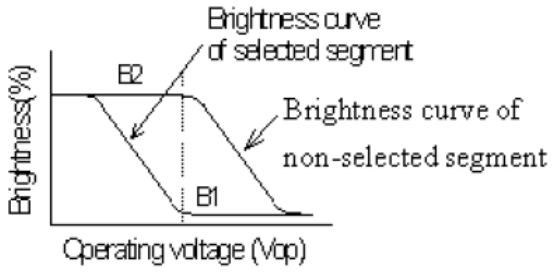
(1) DEFINITION OF VIEWING ANGLE



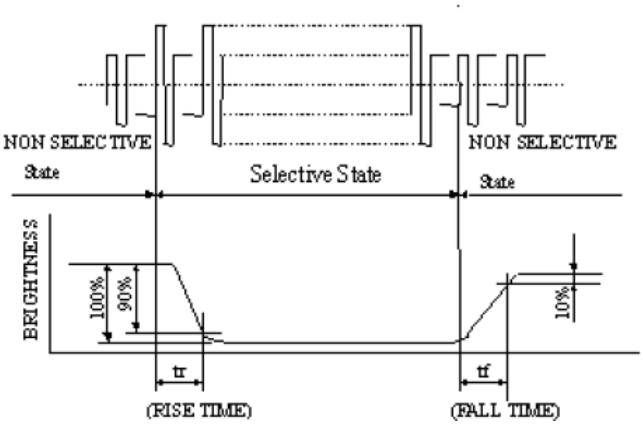


(2) DEFINITION OF CONTRAST

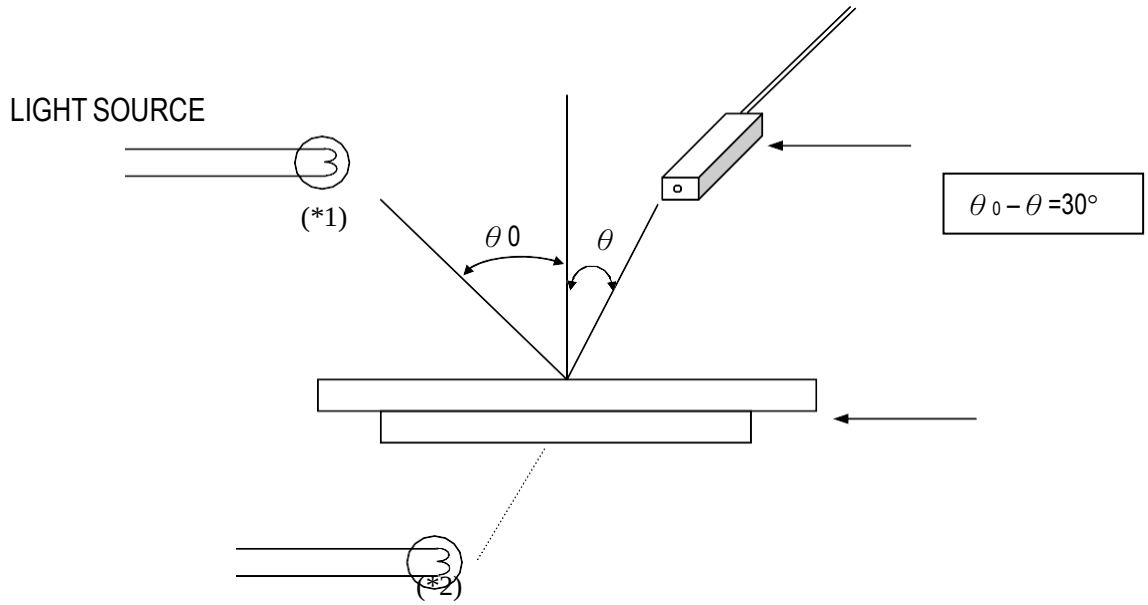
$$CR = \frac{\text{Brightness of non-selected segment (B2)}}{\text{Brightness of selected segment (B1)}}$$



(3) DEFINITION OF RESPONSE



(4) MEASURING INSTRUMENTS FOR ELECTRO-OPTICAL CHARACTERISTICS



*1.Light source position for measuring the reflective type of LCD panel

*2.Light source position for measuring the transflective / transmissive types of LCD panel

(5) DEFINITION OF LUMINANCE UNIFORMITY

To test for uniformity, the tested area is divided into 3 rows and 3 columns. The measurement spot is placed at the center of each circle as below.

$$\text{Luminance Uniformity } (U_L) = \frac{L_{min}}{L_{max}}$$

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

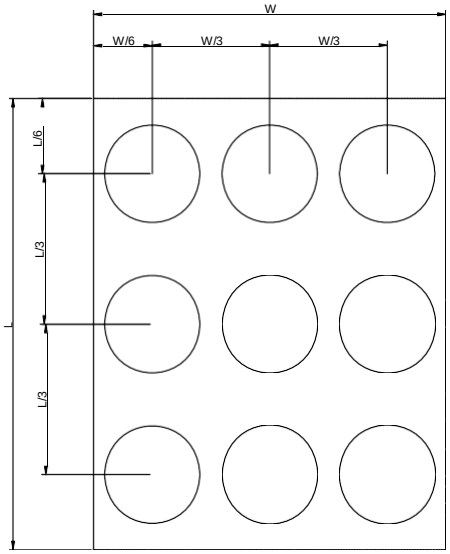


Fig .Definition of luminance uniformity

L_{min} : The measured minimum luminance of all measurement position.

L_{max} : The measured maximum luminance of all measurement position

14. ENVIRONMENTAL ABSOLUTE MAXIMUM RATINGS

ITEM	SYMBOL	CONDITIONS	CRITERION
OPERATING TEMPERATURE	TOPR	-20℃～+70℃	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
STORAGE TEMPERATURE	TSTG	-30℃～+80℃	NO DEFECT IN DISPLAYING AND OPERATIONAL FUNCTION
HUMIDITY	—	See Note	WITHOUT CONDENSATION

Note: Test condition:

1) Temperature and humidity: if no specification, temperature set at 25+/-2℃, and humidity set at 60+/-5% RH.

2) Operating state:all the tests to which the samples subject should be in operating condition.

15. RELIABILITY TEST

ITEM	CONDITIONS	CRITERION
Operating Temperature	HIGH TEMPERTURE +70℃ 120HRS	No defect in displaying and operational function
	LOW TEMPERTURE -20℃ 120HRS	
Storage Tempereature	HIGH TEMPERTURE +80℃ 120HRS	No defect in displaying and operational function
	LOW TEMPERTURE -30℃ 120HRS	
High Humidity & high Temp	50℃ 90%RH 120HRS	No defect in displaying and operational function
Vibration	• Operating Time: 30 minutes exposure for each direction (X,Y,Z) • Sweep Frequency: 10～55Hz (1 min) • Amplitude: 1.5mm	No defect in displaying and operational function
Thermal Shock	-25℃(30mins) ◎◎+75℃(30mins) 50 cycles	No defect in displaying and operational function
Package laminative load test	Atmospheric pressure:86kPa~106kPa, Temperature:15℃~35℃, Humidity:20%~75% Test machine speed:10mm/min The package laminative load on Sample carton: The weight of a box of production(Kg) multiply 8*2*24H	No defects in display and operational functions

Packing Drop Test	Droping from a height of 1m onto concrete surface (1 corner, 3 edges, 6 faces)	No defect in appearance
Life Time	50,000H	

NOTE: The samples must be free from defect before test, must be restore at room condition at least for 2 hours after reliability test before any inspection.

Each item need 8pcs at least for testing before qualification.

16. THE STANDARD OF INSPECTION

16-1 SAMPLING PLAN

Unless there is other agreement , sampling plan for incoming inspection should follow GB2828-2003.

Lot size: Quantity per shipment as one lot (different model as different lot.) 16-1-2

Sampling type: Normal inspection, single sampling.

16-1-3 Sampling level: Level II.

16-1-4 Acceptable Quality Level

Major defect: AQL=0.40

Minor defect: AQL=0.65

Total defect : AQL=0.65

16-2 PANEL INSPECTION CONDITION

16-2-1 Environment:Room Temperature: 25±5℃.Humidity: 55±5% RH.Illumination:800~1200Lux.

16-2-2 Inspection Distance： 25±5 cm from the inspector to the module.

16-2-3 Inspection Angle:The inspector shall rotate the display 45°from the centerline of the viewing direction to assure that clear cosmetic flaws do not exist on the surface within the view area.

16-2-4 Viewing time for inspector is 6-10 Seconds.

16-3 MODULE INSPECTION STANDARDS

16-3-1 Defect definition

MAJOR:display or functional defects, serious deviation from the specifications, customers can not work properly; Severe skin defects, serious deviation from the specifications, the client does not work properly.

MINOR: slightly deviate from the specifications, does not affect the product function, but the appearance of an impact on product

Note: The following standard if no entities are specified, with mm meter.

16-3-2 Product area and size code definition

A area: said display active area(characters display)

B area: says visual area (except A area)

C area: the unvisual areas.

T: it saysthe thickness of the single glass

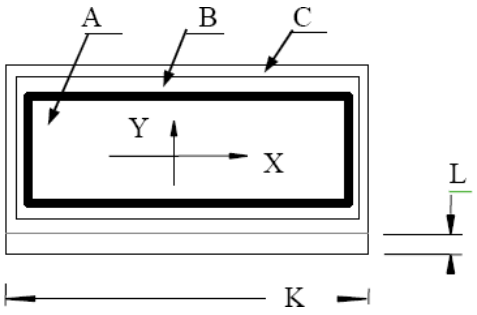
L: said glass pin lengths

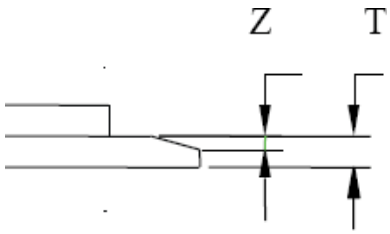
K: said product length

X :said glass long side direction or glass edge direction along the length of the gap

Y :said glass short side direction or gap with glass edge along the vertical length

Z: the thickness of crack or gap



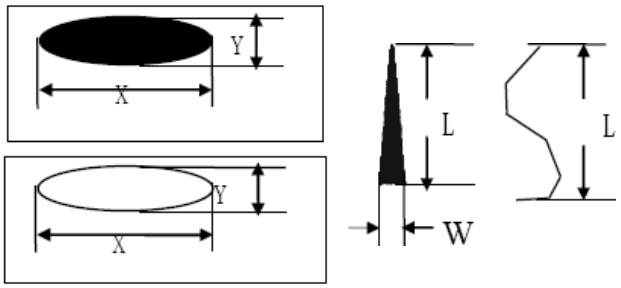


16-3-2 Point, line definition

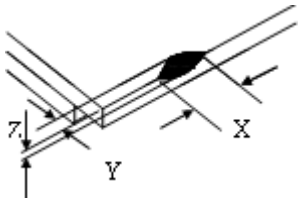
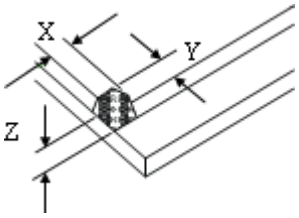
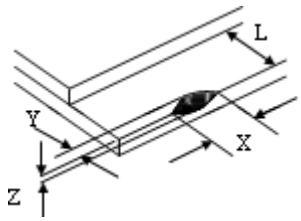
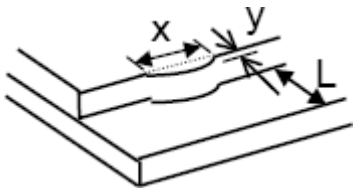
point: Φ = (X + Y) / 2

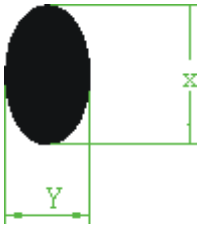
The length of the X says point length; Y says point width

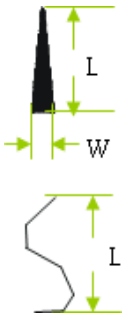
Line:L says the length of the line; W says line width

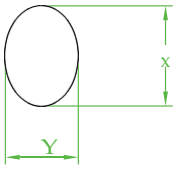


16-3-3 Inspection items and specification for appearance(power off)

No.	Item	Criterion	AQL
1	Dimension	Dimension out of the specification	1.0
2	Glass crack	1、General crack  X: ≤ K/8; Y: ≤75% seal width; Z: <T 2、corner  X: ≤ K/8; Y: ≤75% seal width; Z: <T 3、contact pad crack  X: ≤ K/8; Y: ≤ L/3; Z: Z≤L/4 4、Substrate protuberance and internal crack  X: ≤ K/8; Y: ≤L/3 Transfer position crack: ≤L/5	2.50

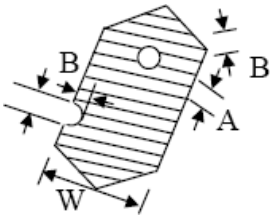
<table>
<tr><td>3</td><td>Black dot \ White dot</td><td> 

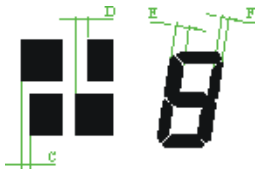
<table>
<tr><td rowspan="2">D</td><td colspan="2">Acceptable of defect</td></tr>
<tr><td>A/B Area</td><td>C Area</td></tr>
<tr><td>D<0.2</td><td>No check</td><td rowspan="3">No check</td></tr>
<tr><td>0.2≤D≤0.3</td><td>2</td></tr>
<tr><td>0.3<D</td><td>0</td></tr>
</table>
X: long diameter Y: shot diameter
D: average of diameter D=(X+Y)/2</td><td>2.50</td></tr>
<tr><td>4</td><td>Line defect</td><td> 

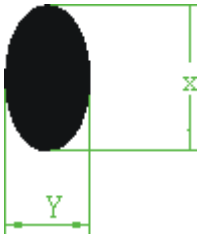
<table>
<tr><td rowspan="2">Length</td><td rowspan="2">Whidth</td><td colspan="2">Acceptable of defect</td></tr>
<tr><td>A/B Area</td><td>C Area</td></tr>
<tr><td>accept</td><td>W≤0.02</td><td>No check</td><td rowspan="3">No check</td></tr>
<tr><td>L≤3</td><td>W≤0.05</td><td>2</td></tr>
<tr><td rowspan="2">L≤2.5</td><td>W≤0.05</td><td>2</td></tr>
<tr><td>W＞0.05</td><td colspan="2">As round type</td></tr>
</table>
L: Length W: Width
Defect of polarizer（Scratches、Spot）: According to the limit specimen</td><td>2.50</td></tr>
<tr><td>5</td><td>Polarizer Bubble</td><td> 

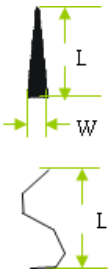
<table>
<tr><td rowspan="2">D</td><td colspan="2">Acceptable of defect</td></tr>
<tr><td>A/B Area</td><td>C Area</td></tr>
<tr><td>D<0.2</td><td>No check</td><td rowspan="3">No check</td></tr>
<tr><td>0.2≤D≤0.3</td><td>2</td></tr>
<tr><td>0.3<D</td><td>0</td></tr>
</table></td><td>2.50</td></tr>
<tr><td>6</td><td>External print of panel</td><td>1、 Transfigure、pin hole：same as segment transfinguer
2、 Print width: print width ≥1/2 standard width is acceptable</td><td>2.50</td></tr>
<tr><td>7</td><td>Silicon glue</td><td>The area of painting silicon glue must cover the ITO circuit.</td><td>2.50</td></tr>
<tr><td>8</td><td>Defect of PCB</td><td>1、 The char 、wrong edition、bresking off circuit、crack and air-logged orifice are unreceivable for PCB.
2、 gold finger of PCB can not be oxidative、smudgy and broken..</td><td>2.50</td></tr>
<tr><td>9</td><td>SMT organ</td><td>1、 deflexion of component≤1/3width of component
2、 Trying to keep dot of soldering tin orbicular
3、 Damage、break、wrong assembly and unseal are unreceivable for component.
4、 comply with IPC-610E</td><td>2.50</td></tr>
<tr><td>10</td><td>Steel Frame</td><td>1、 Break and distortion are unreceivable for frame.
2 、 If there is one nick which can not lead to cast or hole of painting, we allow that following:
Length≤5mm;Width≤0.3mm</td><td>2.50</td></tr>
</table>

16-3-4 Inspection items and specification for display defect(power on)

<table>
<tr><td>1</td><td>Electrical Defect</td><td></td><td><table><tr><td>Segment missing</td><td>Not allow</td></tr><tr><td>Segment short</td><td>Not allow</td></tr><tr><td>Non-display</td><td>Not allow</td></tr></table></td><td></td><td>1.0</td></tr>
<tr><td>2</td><td>Pin hole</td><td>1、Pin hole
 

<table><tr><td>width</td><td>Acceptable of defect</td></tr><tr><td>W＜0.4</td><td>D≤0.2 & D≤1/2W</td></tr><tr><td>W≥0.4</td><td>D≤0.25 & D≤1/3W</td></tr></table>
* D=(A+B)/2　　D≤0.1 acceptable</td><td></td><td>2.50</td></tr>
<tr><td>3</td><td>Display pattern</td><td> 

<table><tr><td>Width</td><td>Acceptable of defect</td></tr><tr><td>W＜0.4</td><td>C、D、G≤1/2W</td></tr><tr><td>W≥0.4</td><td>C、D、G≤0.2</td></tr></table>
W: Design dimension　　C、D: discrepant dimension　G=|E-F|</td><td></td><td>1.0</td></tr>
<tr><td>4</td><td>Black/white dot</td><td> 

<table><tr><td rowspan="2">D</td><td colspan="2">Acceptable QTY</td></tr><tr><td>A/B Area</td><td>C Area</td></tr><tr><td>D<0.2</td><td>No check</td><td rowspan="3">No check</td></tr><tr><td>0.2≤D≤0.3</td><td>2</td></tr><tr><td>0.3<D</td><td>0</td></tr></table>
X: long diameter
Y: shot diameter
D: average diameter　　D=(X+Y)/2</td><td></td><td>2.50</td></tr>
<tr><td>5</td><td>Line defect</td><td> 

<table><tr><td rowspan="2">Length</td><td rowspan="2">Width</td><td colspan="2">Acceptable QTY</td></tr><tr><td>A/B Area</td><td>C Area</td></tr><tr><td>不计</td><td>W≤0.02</td><td>No check</td><td rowspan="3">No check</td></tr><tr><td>L≤3</td><td>W≤0.03</td><td>2</td></tr><tr><td rowspan="2">L≤2.5</td><td>0.03＜W≤0.05</td><td>2</td></tr><tr><td>W＞0.05</td><td colspan="2">Sa round type</td></tr></table>
L: length　W: width</td><td></td><td>2.50</td></tr>
</table>

17. USING LCD MODULES

17-1 LIQUID CRYSTAL DISPLAY MODULES

LCD is composed of glass and polarizer. Pay attention to the following items when handling.

(1) Please keep the temperature within specified range for use and storage. Polarization degradation, bubble generation or polarizer peel-off may occur with high temperature and high humidity.

(2) Do not touch, push or rub the exposed polarizer with anything harder than an HB pencil lead (glass, tweezers, etc.).

(3) N-hexane is recommended for cleaning the adhesives used to attach front/rear polarizers and reflectors made of organic substances which will be damaged by chemicals such as acetone, toluene, ethanol and isopropylalcohol.

(4) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, wipe gently with absorbent cotton or other soft material like chamois soaked in Isopropyl alcohol or Ethyl alcohol. Do not scrub hard to avoid damaging the display surface.

(5) Wipe off saliva or water drops immediately, contact with water over a long period of time may cause deformation or color fading.

(6) Avoid contacting oil and fats.

(7) Condensation on the surface and contact with terminals due to cold will damage, stain or dirty the polarizers. After products are tested at low temperature they must be warmed up in a container before coming is contacting with room temperature air.

(8) Do not put or attach anything on the display area to avoid leaving marks on.

(9) Do not touch the display with bare hands. This will stain the display area and degradate insulation between terminals (some cosmetics are determinated to the polarizers).

(10) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(11) As glass is fragile. It tends to become or chipped during handling especially on the edges. Please avoid dropping or jarring.

17-2 PRECAUTION FOR HANDING LCD MODULES

Since LCM has been assembled and adjusted with a high degree of precision, avoid applying excessive shocks to the module or making any alterations or modifications to it.

(1) Do not alter, modify or change the the shape of the tab on the metal frame.

(2) Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.

(3) Do not damage or modify the pattern writing on the printed circuit board.

(4) Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector.

(5) Except for soldering the interface, do not make any alterations or modifications with a soldering iron.

(6) Do not drop, bend or twist LCM. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.

(7) In order to avoid the cracking of the FPC,you should to pay attention to the area of FPC where the FPC was bent .the edge of coverlay;the area of surface of Ni-Au plating,the area of soldering land,the area of through hole.

17-3 ELECTRO-STATIC DISCHARGE CONTROL

Since this module uses a CMOS LSI, the same careful attention should be paid to electrostatic discharge as for an ordinary CMOS IC.

(1) Make certain that you are grounded when handing LCM. To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity etc., exercise care to avoid holding the following sections when handling the modules. - Exposed area of the printed circuit board. - Terminal electrode sections.

(2) Before remove LCM from its packing case or incorporating it into a set, be sure the module and your body have the same electric potential.

(3) When soldering the terminal of LCM, make certain the AC power source for the soldering iron does not leak.

(4)When using an electric screwdriver to attach LCM, the screwdriver should be of ground potentiality to minimize as much as possible any transmission of electromagnetic waves produced sparks coming from the commutator of the motor.

(5) As far as possible make the electric potential of your work clothes and that of the work bench the ground potential.

(6) To reduce the generation of static electricity be careful that the air in the work is not too dried. A relative humidity of 50%-60% is recommended.

17-4 PRECAUTIONS FOR OPERATION

(1) Viewing angle varies with the change of liquid crystal driving voltage (VO). Adjust VO to show the best contrast.

(2) Driving the LCD in the voltage above the limit shortens its life.

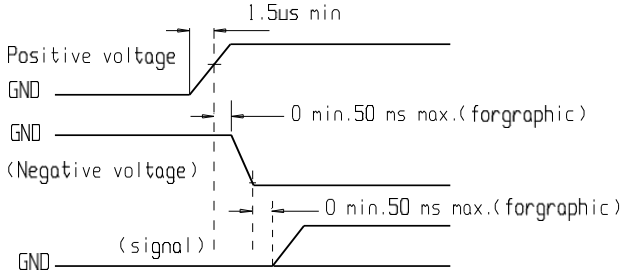
(3) If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

(4) Response time is greatly delayed at temperature below the operating temperature range. However, this does not mean the LCD will be out of the order. It will recover when it returns to the specified temperature range.

(5) If the display area is pushed hard during operation, the display will become abnormal. However, it will return to normal if it is turned off and then back on.

(6) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it must be used under the relative condition of 40°C , 50% RH.

(7) When turning the power on, input each signal after the positive/negative voltage becomes stable.



17-5 STORAGE

When storing LCDs as spares for some years, the following precaution are necessary.

(1) Store them in a sealed polyethylene bag. If properly sealed, there is no need for dessicant.

(2) Store them in a dark place. Do not expose to sunlight or fluorescent light, keep the temperature between 0°C and 35°C.

3) The polarizer surface should not come in contact with any other objects. (We advise you to store them in the container in which they were shipped.)

(4) Environmental conditions :

- Do not leave them for more than 160hrs. at 70°C.
- Should not be left for more than 48hrs. at -20°C.

17-6 SAFETY

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.

(2) If any liquid leakes out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

17-7 LIMITED WARRANTY

Unless agreed between AGT and customer, AGT will replace or repair any of its LCD modules which are found to be functionally defective when inspected in accordance with AGT LCD acceptance standards (copies available upon request) for a period of one year from date of shipments. Cosmetic/visual defects must be returned to AGT within 90 days of shipment. Confirmation of such date shall be based on freight documents. The warranty liability of AGT limited to repair and/or replacement on the terms set forth above. AGT will not be responsible for any subsequent or consequential events.

17-8 RETURN LCM UNDER WARRANTY

No warranty can be granted if the precautions stated above have been disregarded. The typical examples of violations are :

- Broken LCD glass.
- Circuit modified in any way, including addition of components.

Module repairs will be invoiced to the customer upon mutual agreement. Modules must be returned with sufficient description of the failures or defects. Any connectors or cable installed by the customer must be removed completely without damaging the PCB's eyelet, conductors and terminals.