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☐ Preliminary specification
■ Final specification

Product Specification

For

Approval

Project of Customer	IP450S LCD (LCD with Window)	
Approval by Customer	R&D	QA

Product Model	JM1701A

Supplier	JTO
Prepare	MARKE
Approval	DENNIS

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Revision History

REV.	Page NO.	DESCRIPTION OF CHANGES	DATE	PREPARED
O	-	Initial Release	2018.01. 10	MARKE

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1.0 GENERAL DESCRIPTIONS

1.1 Scope

This specification is applied to the L(Liquid)C(Crystal)D(Display) Module which JTO supplies to Customer.

1.2 Features

- External : LCD with Window(PMMA Material)
- Format : 131 * 64 Dots with ICONS
- LCD Mode : FSTN, Positive, Transflective Mode
- Viewing direction : 6 O'clock
- Driving scheme : 1/65 Duty, 1/9 Bias
- Low power operation : Power supply voltage (V_{DD}): 3.3V
- VLCD adjustable for best contrast : LCD driving voltage (V_{OP}): 9.0V
- Operating temperature : -20℃~70℃
- Storage temperature : -30℃~80℃
- Backlight : White Side LED, Vf=3.0±0.2V, If=20mA
- FPC(Flexible Printed Circuit)
- ROHS Compliant

LCD Module

131 * 64 Dots

With ICONS

1.3 General Specification

Parameter	Specification	Unit	Remarks
Viewing Area	72.0(H) ×26.55(V)	mm	
Number of Dots	131(H) × 64(V) with ICONS	Dots	
Dots Pitch	0.416(H) ×0.36 (V)	mm	
Dots Size	0.376(H) ×0.32 (V)		
Display mode	Transflective Mode		
Dimensional outline	79.2(H) × 42.0(V) × 8.5(T)	mm	
Viewing direction	6	O'clock	
D-IC	ST7565R		
Weight	About 32	g	

<Table 1. General Specifications>

1.4 Pin Descriptions

Pin no.	Symbol	Function
1	/CS	Chip Select , When CS0= “L”, chip is selected
2	/RET	When RST= “L”, the settings are initialized
3	A0	Selects register date “H” and instruction “L”
4	/WR	When connected to an 8080 MPU, this is active LOW. (R/W) This terminal connects to the 8080 MPU /WR signal. The signals on the data bus are latched at the rising edge of the /WR signal. • When connected to a 6800 Series MPU: This is the read/write control signal input terminal. When R/W = “H”: Read. When R/W = “L”: Write.
5	/RD	When connected to an 8080 MPU, this is active LOW. (E) This pin is connects to the /RD signal of the 8080MPU. And the ST7565R series datd bus is in an output status when this signal is “L” . • When connected to a 6800 Series MPU: This is active HIGH . This is the 6800 series MPU enable clock input terminal.
6~13	D0/D7	Bi-directional bus for both serial and parallel host interfaces. In serial modes , connect D6 to SCK, D7 to SDA, Connect any unused pins to VSS
14	VDD	Supply voltage for logic circuit +3.3V
15	VSS	Ground
16	VOUT	DC/DC voltage converter
17	C3+	DC/DC voltage converter
18	C1-	DC/DC voltage converter
19	C1+	DC/DC voltage converter
20	C2+	DC/DC voltage converter
21	C2-	DC/DC voltage converter
22	V4	This is a multi-level power supply for the liquid crystal drive.
23	V3	This is a multi-level power supply for the liquid crystal drive.

24	V2	This is a multi-level power supply for the liquid crystal drive.
25	V1	This is a multi-level power supply for the liquid crystal drive.
26	V0	This is a multi-level power supply for the liquid crystal drive.
27	C86	This is the MPU interface switch terminal C86="H":6800 series MPU interface C86="L":8080 MPU interface
28	P/S	This is the parallel data input/serial datd input switch terminal P/S="H":parallel data input P/S="L":serial data input
29	A	Supply voltage for backlight VDD (3.3V)
30	K	Supply voltage for backlight Ground (0V)

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2.0 ABSOLUTE MAXIMUM RATINGS

The followings are maximum values which, if exceed, may cause faulty operation or damage to the unit. The operational and non-operational maximum voltage and current values are listed in Table 2, 3.

2-1 LCD Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Remarks
Power Supply Voltage	V_{DD}	0.3	-	5.0	V	
LC operating Voltage	V_{OP}	8.7	9.0	9.3	V	Ta=25+/-2°C
Operating Temperature (Humidity)	T_{OP}	-20		+70	℃	
	RH			90	%	At 60°C
Storage Temperature (Humidity)	T_{ST}	-30		+80	℃	
	RH			90	%	At 60°C

< Table 2. Absolute LCD Maximum Ratings>

2-2 Backlight Driving Conditions

Parameter	Symbol	Values			Unit	Notes
		Min	Typ	Max		
Voltage for LED Backlight	V_L	-	3.0	3.2	V	Note 1
Current for LED Backlight	I_L	-	20	25	mA	
LED Life Time	-	20,000	-	-	Hr	

< Table 3. Backlight Driving Electrical Specifications >

Notes 1: The “LED Life Time” is defined as the module brightness decrease to 50% original brightness at Ta=25±2 ℃ and I_L=20mA(Max.).
The LED Life Time could be decrease if operating I_L is larger than 20mA.

3.0 ELECTRICAL CHARACTERISTICS

3.1 DC Characteristics

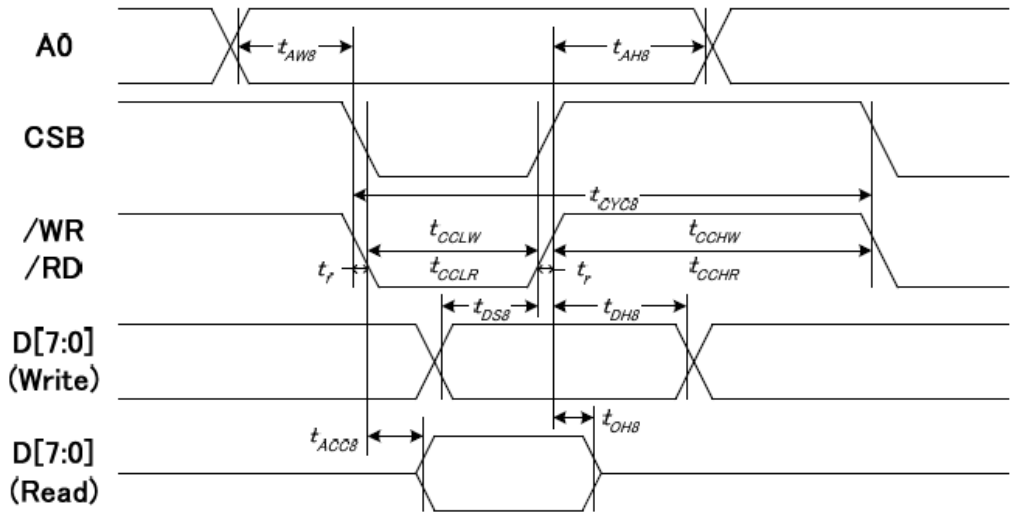
Ta = 25°C

Parameter	Symbol	Value	Unit	Remarks
Operating Voltage	V_{DD}	2.4~3.3	V	
LCD Module Operating Voltage	V_{OP}	Typ. 9.0	V	
LCD Module Current Consumption	I_{DD}	Max. 35	mA	
High Level Input Voltage	V_{IHC}	$0.8V_{DD}$~V_{DD}	V	
Low Level Input Voltage	V_{ILC}	V_{SS}~$0.2V_{SS}$	V	
High Level Output Voltage	V_{OHC}	$0.8V_{DD}$~V_{DD}	V	
Low Level Output Voltage	V_{OLC}	V_{SS}~$0.2V_{SS}$	V	

< Table 4. DC Characteristics >

3.2 AC Characteristics

3.2.1 System Bus Read/Write Characteristics 1 (For the 8080 Series MPU)



(VDD1 = 3.3V , Ta =25°C)

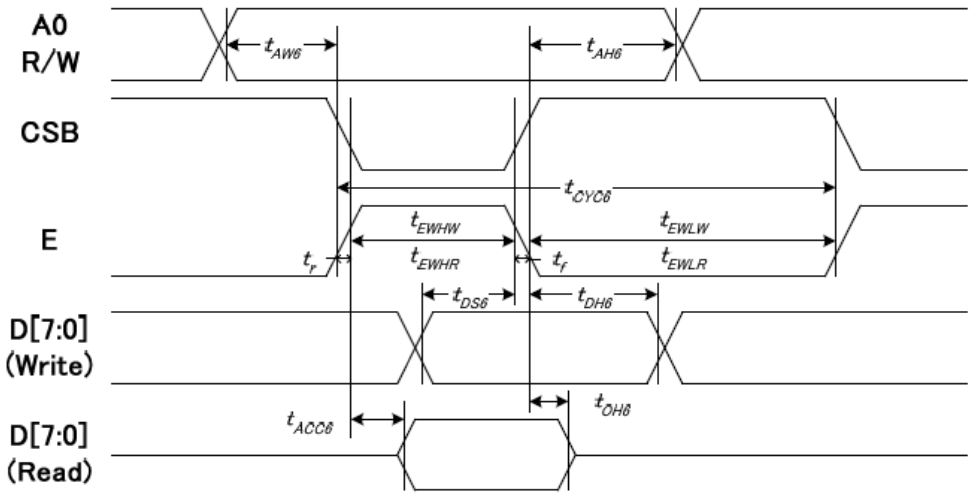
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW8		0	—	ns
Address hold time		tAH8		10	—	
System cycle time	/WR	tCYC8		240	—	
/WR L pulse width (WRITE)		tCCLW		80	—	
/WR H pulse width (WRITE)		tCCHW		80	—	
/RD L pulse width (READ)	RD	tCCLR		140	—	
/RD H pulse width (READ)		tCCHR		80		
WRITE Data setup time	D[7:0]	tDS8		40	—	
WRITE Data hold time		tDH8		20	—	
READ access time		tACC8	CL = 16 pF	—	70	
READ Output disable time		tOH8	CL = 16 pF	5	50	

*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 VDD1 as the reference.

*3 tCCLW and tCCLR are specified as the overlap between CSB being "L" and WR and RD being at the "L" level.

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



(VDD1 = 3.3V , Ta =25°C)

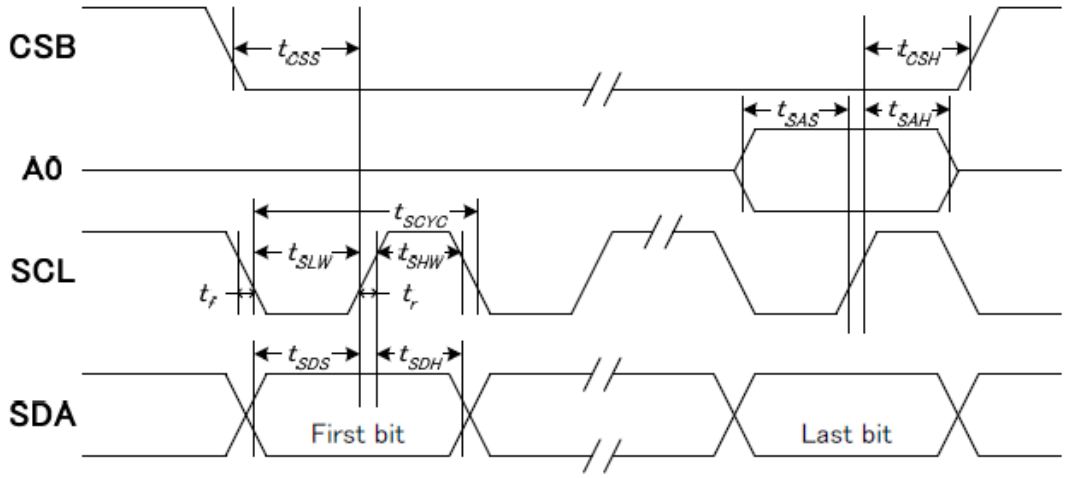
Item	Signal	Symbol	Condition	Min.	Max.	Unit
Address setup time	A0	tAW6		0	—	ns
Address hold time		tAH6		10	—	
System cycle time	E	tCYC6		240	—	
Enable L pulse width (WRITE)		tEWLW		80	—	
Enable H pulse width (WRITE)		tEWHW		80	—	
Enable L pulse width (READ)		tEWLR		80	—	
Enable H pulse width (READ)		tEWHR		140		
Write data setup time	D[7:0]	tDS6		40	—	
Write data hold time		tDH6		10	—	
Read data access time		tACC6	CL = 16 pF	—	70	
Read data output disable time		tOH6	CL = 16 pF	5	50	

*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 VDD1 as the reference.

*3 tEWLW and tEWLR are specified as the overlap between CSB being "L" and E.

3.2.3 System Bus Read/Write Characteristics 3 (For the SPI)

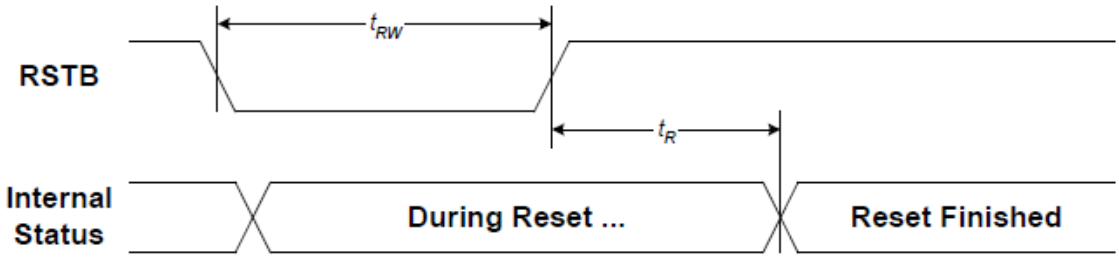


(VDD1 = 3.3V , Ta =25°C)

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	—	
CSB-SCLK time	CSB	tCSS		20	—	
CSB-SCLK time		tCSH		40	—	

*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 VDD1 as the standard.

3.2.4 Hardware Reset Timing



(VDD1 = 3.3V , Ta =25°C)

Item	Symbol	Condition	Min.	Max.	Unit
Reset time	tR		—	1.0	us
Reset "L" pulse width	tRW		1.0	—	

4.0 CONTROL OF DISPLAY COMMANDS

Table 16: Table of ST7565P Commands (Note) *: disabled data

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 1	LCD display ON/OFF 0: OFF, 1: ON
(2) Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
(3) Page address set	0	1	0	1	0	1	1	Page address				Sets the display RAM page address
(4) Column address set upper bit Column address set lower bit	0 0	1 1	0 0	0 0	0 0	0 0	1 0	Most significant column address Least significant column address				Sets the most significant 4 bits of the display RAM column address. Sets the least significant 4 bits of the display RAM column address.
(5) Status read	0	0	1	Status				0	0	0	0	Reads the status data
(6) Display data write	1	1	0	Write data								Writes to the display RAM
(7) Display data read	1	0	1	Read data								Reads from the display RAM
(8) ADC select	0	1	0	1	0	1	0	0	0	0	0 1	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 1	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 1	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 1	Sets the LCD drive voltage bias ratio 0: 1/9 bias, 1: 1/7 bias (ST7565P)
(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 1	*	*	*	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) V0 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 Electronic volume register set	0	1	0	1 0	0 0	0 Electronic volume value	0	0	0	0	1	Set the V0 output voltage electronic volume register
(19) Static indicator ON/OFF Static indicator register set	0	1	0	1 0	0 0	1 0	0 0	1 0	1 0	0 0	0 1 Mode	0: OFF, 1: ON Set the flashing mode
(20) Booster ratio set	0	1	0	1 0	1 0	1 0	1 0	1 0	0 0	0 step-up value	0	select booster ratio 00: 2x,3x,4x 01: 5x 11: 6x
(21) Power saver												Display OFF and display all points ON compound command
(22) NOP	0	1	0	1	1	1	0	0	0	1	1	Command for non-operation
(23) Test	0	1	0	1	1	1	1	*	*	*	*	Command for IC test. Do not use this command

5.0 RECOMMANDED INITIAL CODE

instruction	RS	RD	WR	Hex display(instruction)
reset	0	1	0	0X01
set VLCD range	0	1	0	0X05
set HV-gen, x5 stage	0	1	0	0X13
function set(extened instruction set)	0	1	0	0X35
set vop	0	1	0	0XC4
temp.control	0	1	0	0X04
bias system	0	1	0	0X14
function set(normal instruction set)	0	1	0	0X20
display control	0	1	0	0X0C
set Y add. Of RAM	0	1	0	0X40
set X add. Of RAM	0	1	0	0X80
* set vop =65±10(D)				

Note ; JTO requires the customer to follow the above instructions strictly.
If customer would like to change the above instructions,
the customer should inform JTO and get re-check from JTO,
or the customer will be responsible for any unexpected result
because of the change.

6.0 OPTICAL SPECIFICATIONS

6.1 Overview

The test of Optical specifications shall be measured in a dark room (ambient luminance ≤ 1lux and temperature = 25±2℃) with the equipment of Luminance meter system (Goniometer system and TOPCON BM-7) and test unit shall be located at an approximate distance 50cm from the LCD surface at a viewing angle of θ and Φ equal to 0°. We refer to θØ=0(=θ3) as the 3 o'clock direction (the "right"), θØ=90 (= θ12) as the 12 o'clock direction ("upward"), θØ=180 (= θ9) as the 9 o'clock direction ("left") and θØ=270(= θ6) as the 6 o'clock direction ("bottom"). While scanning θand/or Ø, the center of the measuring spot on the Display surface shall stay fixed.

Ta = 25°C

Parameter		Symbol	Condition	Min.	Typ.	Max.	Unit	Remark
Viewing Angle range	Horizontal	Θ_3	CR > 2	20	30	35	Deg.	Note 1
		Θ_9		20	30	35		
	Vertical	Θ_{12}		10	15	20		
		Θ_6		30	35	40		
Contrast Ratio		CR	Θ = 0°	10	15	-		Note 2
LCM Brightness		Br	Θ = 0°	30	60	-	cd/m2	BLU ON, White Display
LCM Uniformity		-	Θ = 0°	70	85	-	%	BLU ON, White Display Note 3
Response Time (Rising + Falling)		T_{RT}	Θ = 0°	-	200	-	ms	Note 4

<Table 5. Optical Specifications>

Notes :

1. Viewing angle is the angle at which the contrast ratio is greater than 10. The viewing angles are determined for the horizontal or 3, 9 o'clock direction and the vertical or 6, 12 o'clock direction with respect to the optical axis which is normal to the LCD surface (see Figure 3 shown in Appendix).

2. Contrast measurements shall be made at viewing angle of Θ= 0 and at the center of the LCD surface.
   Luminance shall be measured with all pixels in the view field set first to white, then to the dark (black) state.

   (see Figure 3) Luminance Contrast Ratio (CR) is defined mathematically.

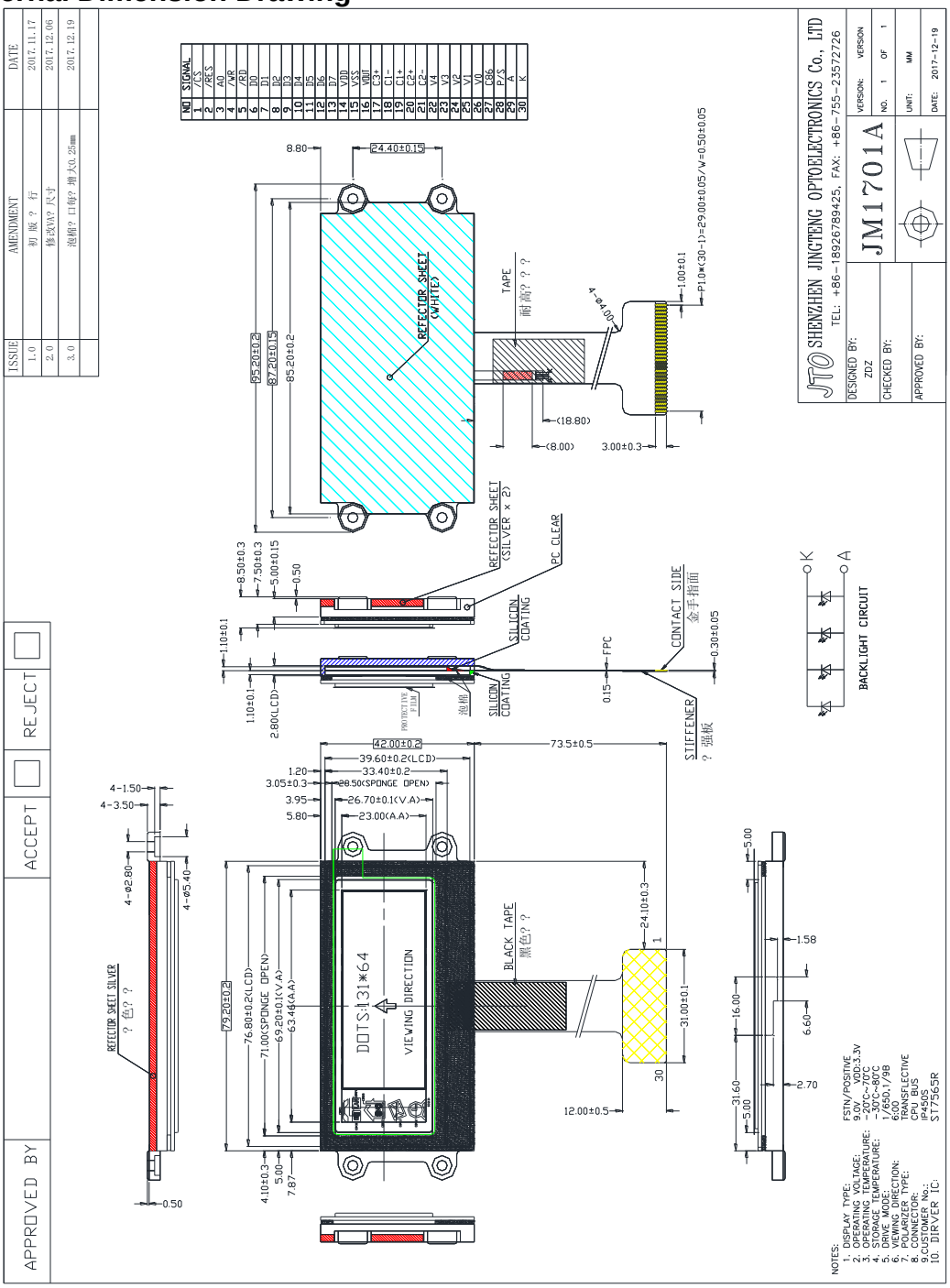
$$CR = \frac{\text{Luminance when displaying a white raster}}{\text{Luminance when displaying a black raster}}$$

3. The White luminance uniformity on LCD surface is then expressed as : ΔY = Minimum Luminance of 5 points / Maximum Luminance of 5 points.

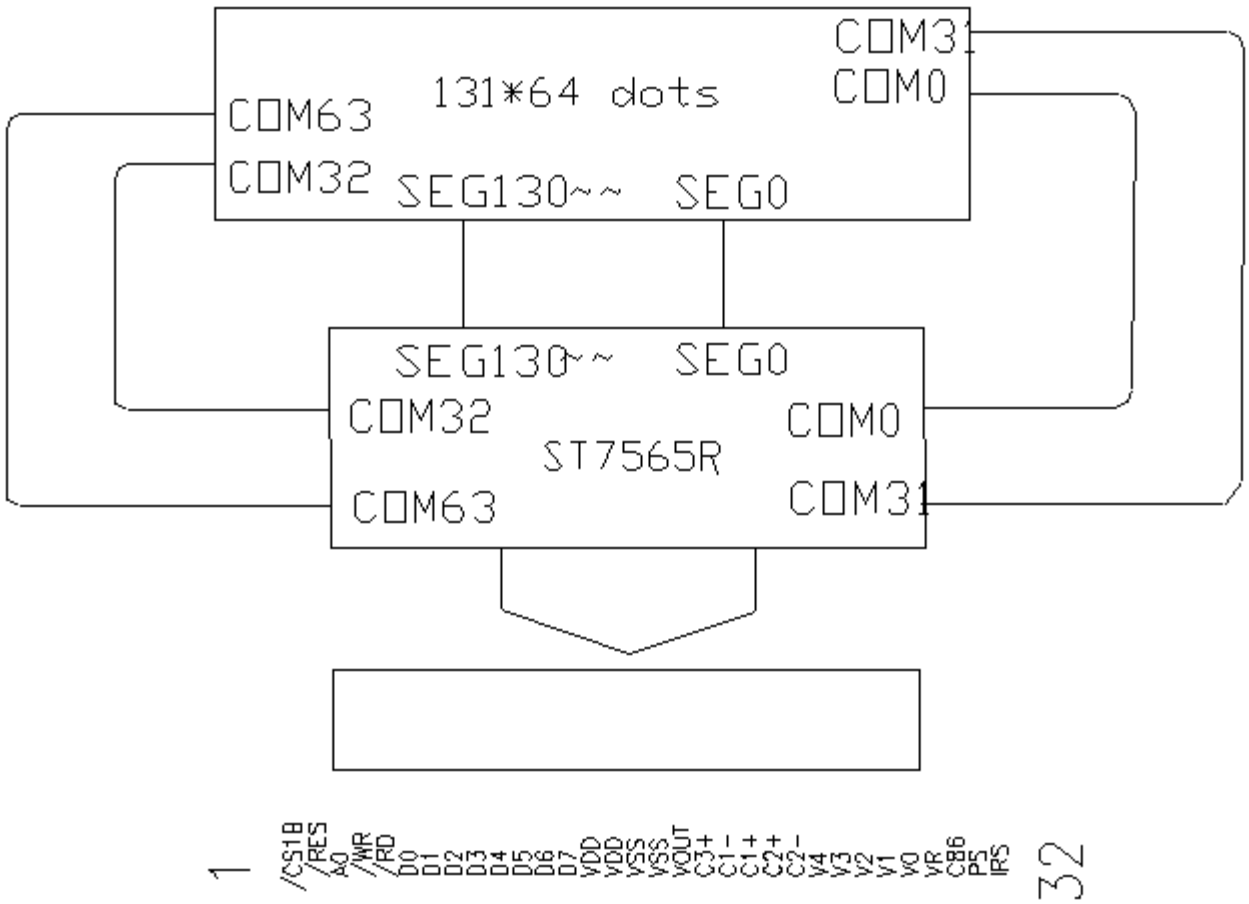
4. The electro-optical response time measurements shall be made as Figure 4 by switching the "data" input signal ON and OFF. The times needed for the transmittance to change from 10% to 90% is Tr, and 90% to 10% is Td.

7.0 MECHANICAL CHARACTERISTICS

7.1 External Dimension Drawing



7.2 Block Diagram



8.0 RELIABILITY TEST

No	Test Items	Conditions
1	High temperature storage test	Ta = 80 ℃, 96 hrs
2	Low temperature storage test	Ta = -30 ℃, 96 hrs
3	High temperature operation test	Ta = 70 ℃, 96 hrs
4	Low temperature operation test	Ta = -20 ℃, 96 hrs
5	High temperature & high humidity operation test	Ta = 60 ℃, 90%RH, 96 hrs
6	Thermal shock	Ta = -20 ℃ ↔ 25℃↔70 ℃ (30min ↔ 5min↔30min), 10 cycle
7	Electro-static discharge test (non-operating)	Air 150pF 330Ω ± 6KV ,5dots*10times Contact 150pF 330Ω ± 3KV, 5dots*10times

<Table 6. Reliability test>

Note. Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20+8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

9.0 APPENDIX

Figure 1. The Definition of Vth & Vsat

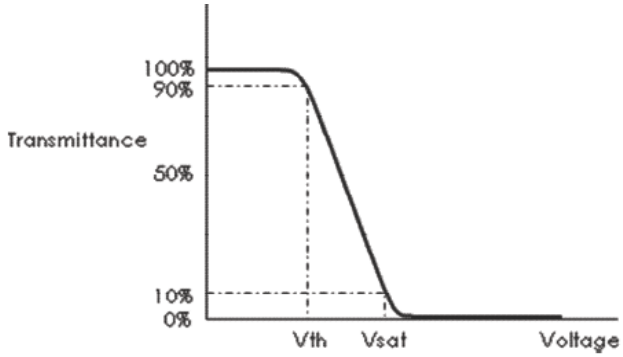


Figure 2. Measurement Set Up

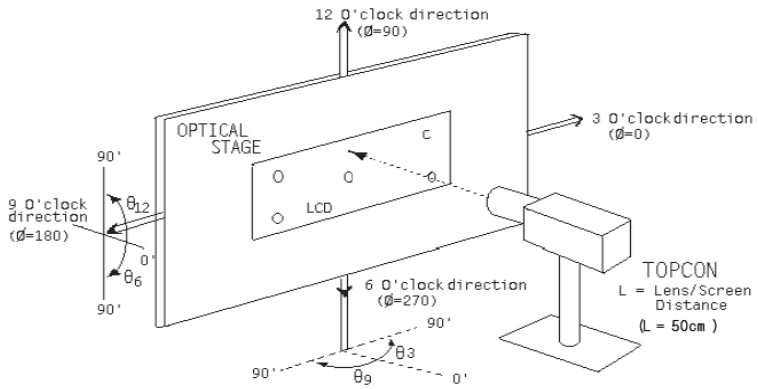
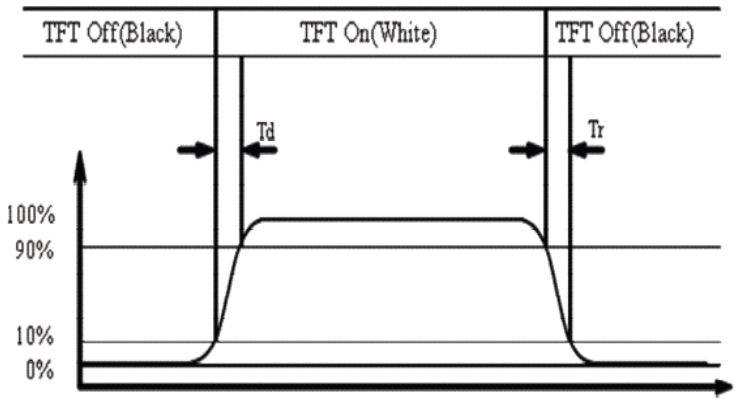


Figure 3. Response Time Testing



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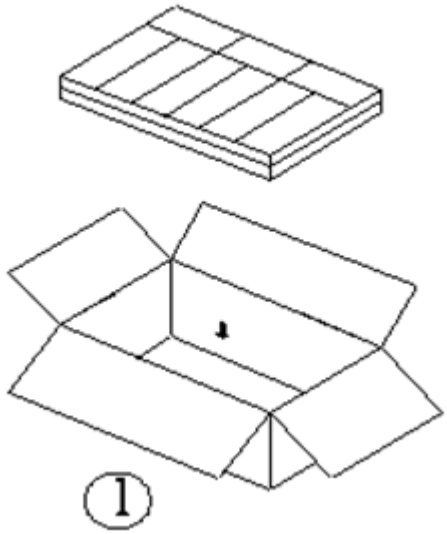
10.0 PACKING



① Carton Size : 45.5(L) * 40.0(W) * 19.0(H) CM

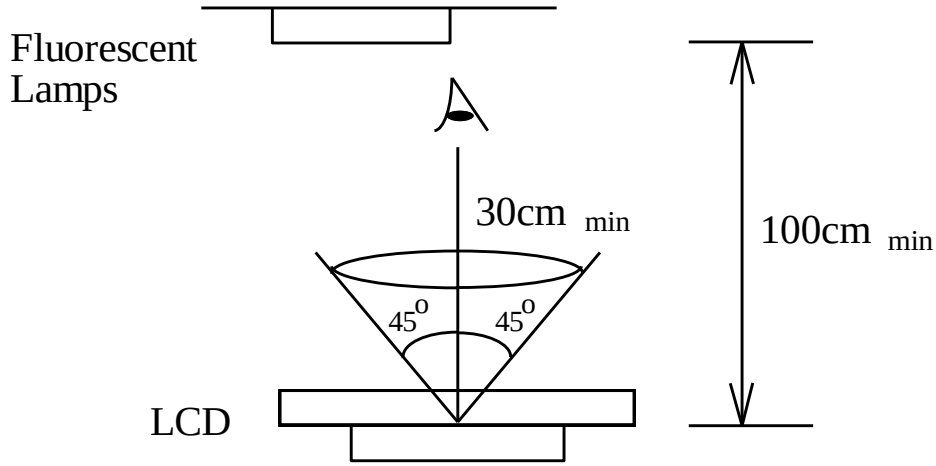
① Quantity : 180 EA /1Carton)

① Weight : 8.01 (32g x 180EA + 2.25kg) kg/1Carton

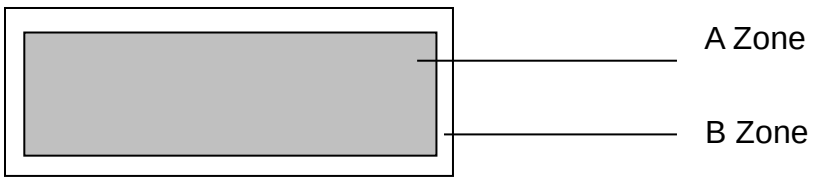
11. QUALITY SPECIFICATIONS

11.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more. Viewing direction for inspection is 45 from vertical against LCM.



Definition of zone:



A Zone : Active display area (Minimum viewing area).
B Zone : Non-active display area
(Outside viewing area, The visual inspection standard is not applied in this area.).

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11.2 Specification of quality Assurance

AQL inspection standard
Sampling method: MIL-STD-105E, Level II, single sampling.

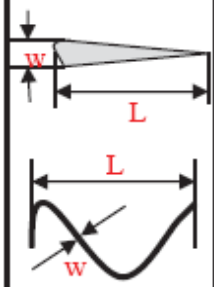
Defect classification **(Note: * is not including)**

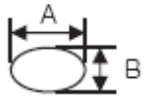
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,7	
	Non-display	Flat cable or pin reverse	9	
		Wrong or missing component	10	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Bubble and foreign material	3	
	Soldering	Poor connection	8	
	Wire	Poor connection	9	

Note on defect classification

<table>
<tr><th>Item</th><th>Criterion for Defects</th><th>Defect Type</th><th>Remark</th></tr>
<tr><td>Non Display</td><td>Non Display is not allowed</td><td>Major</td><td></td></tr>
<tr><td>Line Defect</td><td>All Kinds of Line defects Such as Vertical, Horizontal, Cross are not allowed</td><td>Major</td><td></td></tr>
<tr><td>Unnormally display</td><td>display unnormally is not allowed (data crack)</td><td>Major</td><td></td></tr>
<tr><td>Panel</td><td>Leakage of liquid crystal is not acceptable</td><td>Major</td><td></td></tr>
<tr><td>[Spot]
Black Spot
White Spot
Bright Spot
Foreign Particle
Pinhole
Dimple</td><td>Size:
Φ=(A+B)/2

<table><tr><th>Size(mm)</th><th>Acceptable Number</th></tr><tr><td>Φ ≤ 0.15</td><td>2</td></tr><tr><td>0.15 < Φ ≤ 0.25</td><td>1</td></tr></table>* Distance ≥ 5mm</td><td>Minor</td><td></td></tr>
</table>

<table>
<tr><th>Item</th><th>Criterion for Defects</th><th>Defect Type</th><th>Remark</th></tr>
<tr><td>[Line]
Black Line
White Line
Foreign Particle
Scratch</td><td>  </td><td>* If we cannot see any line in the appropriate operating condition of LCM, It is Acceptable
<table><tr><th>Width(mm)</th><th>Length(mm)</th><th>Qty</th></tr><tr><td>W ≤ 0.03</td><td>L ≤ 2</td><td>2</td></tr><tr><td>0.03 < W ≤ 0.05</td><td>2 < L ≤ 4</td><td>1</td></tr></table></td><td>Minor</td><td></td></tr>
<tr><td>Polarizer Defect

. Dent
. Bubble</td><td>Size:
Φ=(A+B)/2
  </td><td><table><tr><th>Size(mm)</th><th>Acceptable Number</th></tr><tr><td>Φ ≤ 0.15</td><td>Ignore</td></tr><tr><td>0.15 < Φ ≤ 0.25</td><td>2</td></tr><tr><td>0.25 < Φ ≤ 0.30</td><td>1</td></tr><tr><td>0.3 < Φ</td><td>0</td></tr></table></td><td>Minor</td><td></td></tr>
</table>

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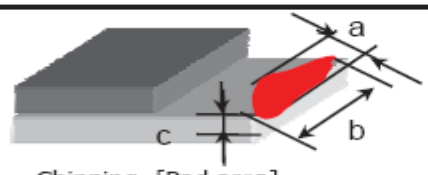
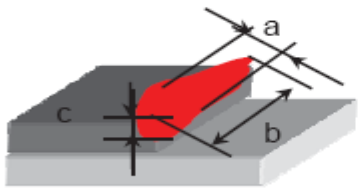
<table>
<tr><th>Item</th><th>Criterion for Defects</th><th>Defect Type</th><th>Remark</th></tr>
<tr><td rowspan="2">Glass Defect</td><td>
Progressive crack is not allowed</td><td>Major</td><td></td></tr>
<tr><td> 
a
b
c
Chipping [Pad area]

Size (mm)
a ≤ 0.5
b: Ignore
c ≤ t

a
b
c
Chipping [Real of Pad area]

Size (mm)
a ≤ 1.0
b: Ignore
c ≤ t

 
a
b
c
Side Chipping [Except of Pad area]

Size (mm)
a ≤ 1.0
b: Ignore
c ≤ t</td><td>Minor</td><td></td></tr>
</table>

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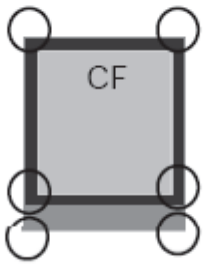
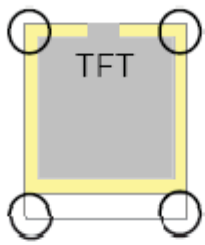
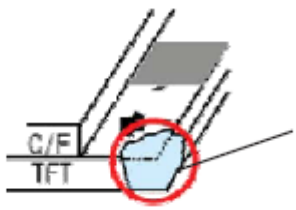
<tr><td rowspan="2">Glass Defect</td><td>

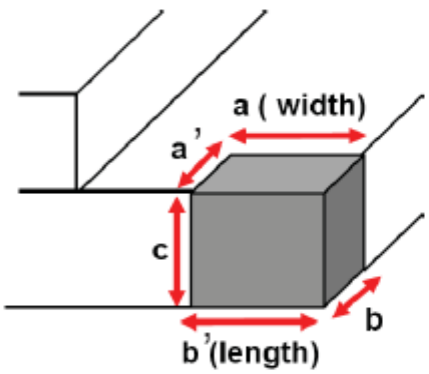
Chipping [Corner]



Size (mm)	Size (mm)
a ≤ 3.0	a' ≤ 3.0
b ≤ 3.0	b' ≤ 3.0
c ≤ t	c ≤ t

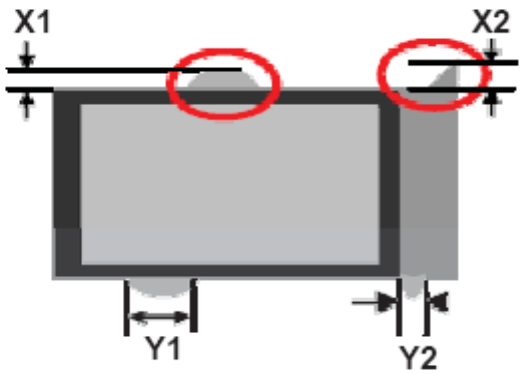






</td><td>Minor</td><td></td></tr>
<tr><td>

Glass burr



Width (mm)	Length (mm)	Acc. Number
X1, X2 ≤ 0.2	Y1, Y2: Ignore	Ignore
0.2 < X1, X2	-	0

</td><td>Minor</td><td></td></tr>
</table>

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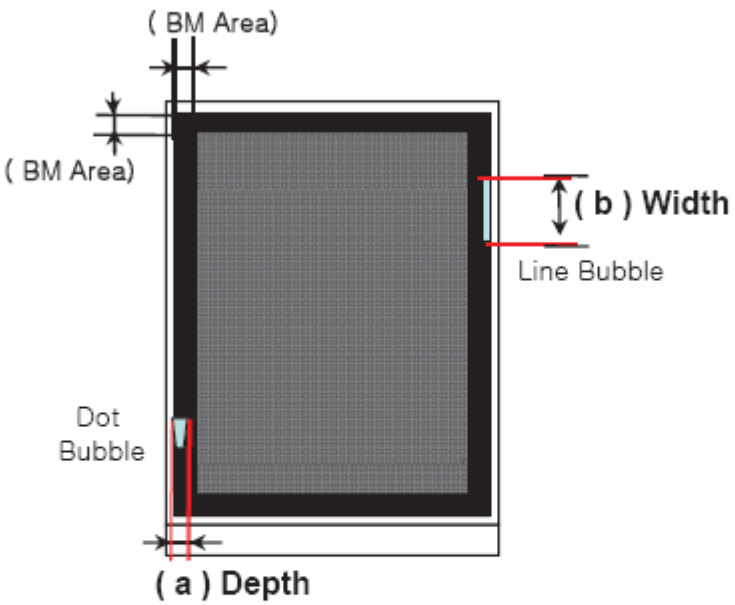
<tr>
<td>Polarizer Defect

Edge Bubble</td>
<td>


<table>
<tr><th>구분</th><th>Size</th></tr>
<tr><td>Dot Type</td><td>a ≤ BM Area 50%, b : Ignore</td></tr>
<tr><td>Line Type</td><td>a ≤ BM Area 50%, b : Ignore</td></tr>
</table>
※ The size measurement is adhesive POL of the criterion
</td>
<td>Minor</td>
<td></td>
</tr>
</table>

12. Handling & Cautions

12.1 Mounting Method

- The panel of the LCD consists of two thin glasses with polarizers which easily get damaged. So extreme care should be taken when handling the LCD.
- Excessive stress or pressure on the glass of the LCD should be avoided. Care must be taken to insure that no torsional or compressive forces are applied to the LCD unit when it is mounted.
- If the customer's set presses the main parts of the LCD, the LCD may show the abnormal display. But this phenomenon does not mean the malfunction of the LCD and should be pressed by the way of mutual agreement.
- To determine the optimum mounting angle, refer to the viewing angle range in the specification for each model.
- Mount a LCD module with the specified mounting parts.

11.2 caution of LCD Handling and Cleaning

- Since the LCD is made of glass, do not apply strong mechanical impact or static load onto it. Handling with care since shock, vibration,and careless handling may seriously affect the product. If it falls from a high place or receives a strong shock, the glass may be broken.
- The polarizers on the surface of panel are made from organic substances. Be very careful for chemicals not to touch the polarizers or it leads the polarizers to be deteriorated.
- If the use of a chemical is unavoidable, use soft cloth with solvent（recommended below）to clean the LCD‘s surface with wipe lightly.
  -IPA(Isopropyl Alcohol), Ethyl Alcohol, Trichlorotriflorothane
- Do not wipe the LCD's surface with dry or hard materials that will damage the polarizers and others. Do not use the following solvent.
  -Water, Ketone, Aromatics

- It is recommended that the LCD be handled with soft gloves during assembly, etc. The polarizers on the LCD's surface are vulnerable to scratch and thus to be damaged by sharp particles.

- Do not drop water or any chemicals onto the LCD's surface.

- A protective film is supplied on the LCD and should be left in place until the LCD is required for operation.

- The ITO pad area needs special careful caution because it could be easily corroded. Do not contact the ITO pad area with HCFC,Soldering flux,Chlorine,Sulfur,saliva or fingerprint. To prevent the ITO corrosion, customers are recommended that the ITO area would be covered by UV or silicon.

11.3 Caution Against Static Charge

- The LCD modules use C-MOS LSI drivers, so customers are recommended that any unused input terminal would be connected to Vdd or Vss, do not input any signals before power is turn on, and ground you body, work/assembly area, assembly equipments to protect against static electricity.

- Remove the protective film slowly, keeping the removing direction approximate 30-degree not vertical from panel surface, If possible, under ESD control device like ion blower, and the humidity of working room should be kept over 50%RH to reduce the risk of static charge.

- Avoid the use work clothing made of synthetic fibers. We recommend cotton clothing or other conductivity-treated fibers.

- In handling the LCD, wear non-charged material gloves. And the conducting wrist to the earth and the conducting shoes to the earth are necessary.

12.4 Caution For operation

- It is indispensable to drive the LCD within the specified voltage limit since the higher Voltage than the limit causes the shorter LCD's life. An electro-chemical reaction due to DC causes undesirable deterioration of the LCD so that the use of DC drive should avoid.
- Do not connect or disconnect the LCD to or from the system when power is on.
- Never use the LCD under abnormal conditions of high temperature and high humidity.
- When expose to drastic fluctuation of temperature (hot to cold or cold to hot）,the LCD may be affected; Specifically, drastic temperature fluctuation from cold to hot , produces dew on the LCD's surface which may affect the operation of the polarizer and the LCD.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD may turn black at temperature above its operational range. However those phenomena do not mean malfunction or out of order with the LCD. The LCD will revert to normal operation once the temperature returns to the recommended temperature range for normal operation.
- Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.
- Do not disassemble and/or re-assemble LCM Module.

12.5 Packaging

- Modules use LCD element, and must be treated as such.
  -Avoid intense shock and falls from a height.
  -To prevent modules from degradation, do not operate or store them exposed directly to sunshine or high temperature/humidity for long periods.

12.6 Storage

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Relative humidity of the environment should therefore be kept below 60%RH. The period of quality assurance shall be **within 6 months** after the data of delivery, when kept in the above-mentioned conditions.

- Original protective film should be used on LCD's surface (polarizer). Adhesive type protective film should be avoided, because it may change color and/or properties of the polarizers.

- Do not store the LCD near organic solvents or corrosive gasses.

- Keep the LCD safe from vibration, shock and pressure.

- Black or white air-bubbles may be produced if the LCD is stored for long time in the lower temperature or mechanical shocks are applied onto the LCD.

- In the case of storing for a long period of time for the purpose or replacement use, the following ways are recommended.
  -Store in a polyethylene bag with sealed so as not to enter fresh air outside in it.
  -Store in a dark place where neither exposure to direct sunlight nor light is.
  -Keep temperature in the specified storage temperature range.
  -Store with no touch on polarizer surface by the anything else. If possible, store the LCD in the packaging situation LCD when it was delivered.

12.7 Safety

- For the crash damaged or unnecessary LCD, it is recommended to wash off liquid crystal by either of solvents such as acetone and ethanol an should be burned up later.

- In the case the LCD is broken, watch out whether liquid crystal leaks out or not. If your hands touch the liquid crystal, wash your hands cleanly with water an soap as soon as possible.

- If you should swallow the liquid crystal, first, wash your mouth thoroughly with water, then drink a lot of water and induce vomiting, and then, consult a physician.

- If the liquid crystal should get in your eyes, flush your eyes with running water for at least fifteen minutes.

- If the liquid crystal touches your skin or clothes, remove it and wash the affected part of your skin or clothes with soap and running water.