GEMINI Technology Co., Ltd.
www.FindLCD.com

SPECIFICATION
FOR
LCM MODULE

MODULE NO.: ABC016004A01-YHY-R
DOC.REVISION：00

Customer Approval:

www.FindLCD.com

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		Nov-21-2005
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
A00	Nov-21-2005	First issue	

CONTENTS

1. FUNCTIONS & FEATURES

1.1. Format	: 16x4 characters
1.2. LCD mode	: STN / Positive transflective mode / Y-G
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/16 Duty , 1/5 Bias
1.5. Power supply voltage (V_{DD})	: 5.0V
1.6. LCD driving voltage(Vop)	: 4.2V
1.7. Operation temp	: -20~70℃
1.8. Storage temp	: -30~80℃
1.9. Backlight color	: Yellow-Green
2.0 Driver IC	: SPLC780A

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 87.0mm(L)*60.0mm(W)* 14.5max mm(H)
2.2. Viewing area	: 61.8mm(L)*25.2mm(W)
2.3 Character pitch	: 3.55mm(L)*5.35mm(W)
2.4 Character size	: 2.96mm(L)*4.76mm(W)
2.5. Dot pitch	: 0.6mm(L)*0.6mm(W)
2.6. Dot size	: 0.56mm(L)*0.56mm(W)
2.7. Weight	: Approx.

3. BLOCK DIAGRAM

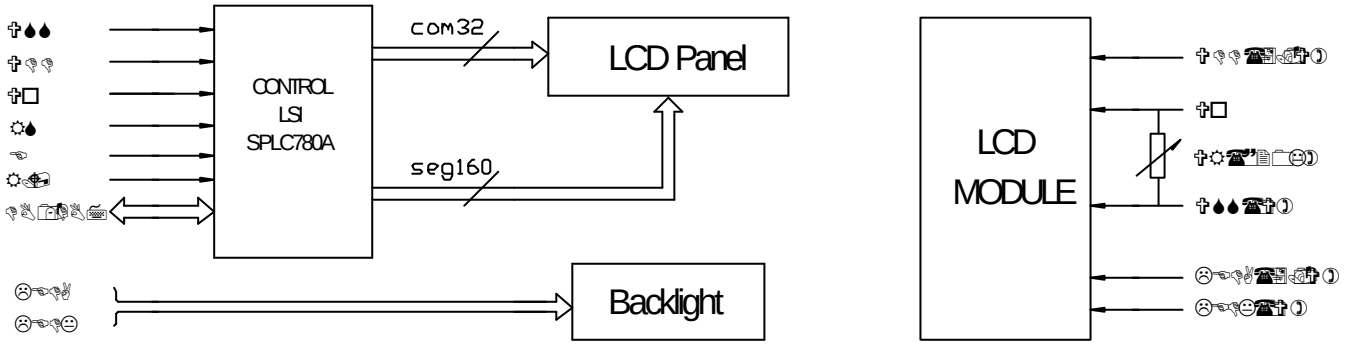


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE

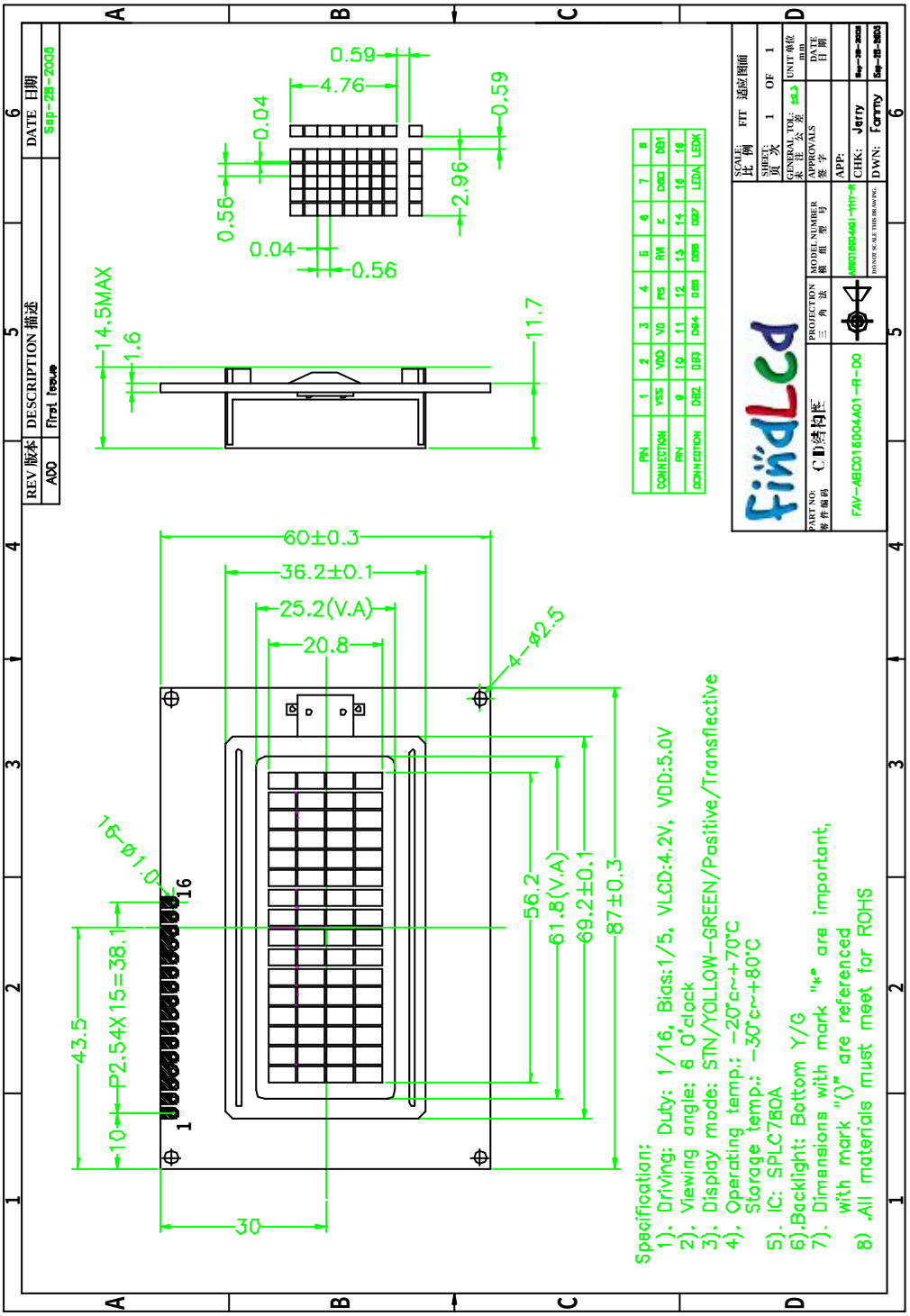


Figure 2. Dimensional outline

5. PIN DESCRIPTION

No.	Symbol	Function
1	VSS	GND (0V)
2	VDD	Power supply for Logic (+5V)
3	V0	Power supply for LCD drive
4	RS	Register selection (H: Data register, L: Instruction register)
5	R/W	Read/write selection (H: Read, L: Write)
6	E	Enable signal for LCM
7-14	DB0~DB7	Data Bus line
15	LEDA	Power supply for Backlight(+5V)
16	LEDK	Power supply for Backlight(0V)

6. MAXIMUM ABSOLUTE LIMIT

Maximum Absolute Power Ratings

ABSOLUTE MAXIMUM RATINGS

Characteristics	Symbol	Ratings
Operating Voltage	V_{DD}	-0.3V to +7.0V
Driver Supply Voltage	V_{LCD}	V_{DD}-12V to V_{DD}+0.3V
Input Voltage Range	V_{IN}	-0.3V to V_{DD} + 0.3V
Operating Temperature	T_A	0 ℃ to +60 ℃
Storage Temperature	T_{STO}	-55 ℃ to +125 ℃

7. ELECTRICAL CHARACTERISTICS

7.1 DC CHARACTERISTICS

DC CHARACTERISTICS (T_A = 25 ℃, VDD = 5V)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min	Typ	Max		
Operating Voltage	V_{DD}	4.5	-	5.5	V	
Operating Current	I_{DD}	-	0.55	0.8	mA	External clock (Note)
Input High Voltage	V_{IH1}	2.2	-	V_{DD}	V	Pins:(E, RS, R/W,
Input Low Voltage	V_{IL1}	-0.3	-	0.6	V	DB0 - DB7)
Input High Voltage	V_{IH2}	V_{DD}-1	-	V_{DD}	V	Pin OSC1
Input Low Voltage	V_{IL2}	-0.2	-	1.0	V	Pin OSC1
Input High Current	I_{IH}	-	-	2	μA	Pins: (RS, R/W,
Input Low Current	I_{IL}	-50	-125	-250	μA	DB0 - DB7)
Output High Voltage (TTL)	V_{OH1}	2.4	-	V_{DD}	V	I_{OH} = - 0.1 mA Pins: DB0 - DB7
Output Low Voltage (TTL)	V_{OL1}	-	-	0.4	V	I_{OL} = 0.1 mA Pins: DB0 - DB7
Output High Voltage (CMOS)	V_{OH2}	0.9V_{DD}	-	V_{DD}	V	I_{OH} = - 40 μA,Pins: CLK1,CLK2,M,D
Output Low Voltage (CMOS)	V_{OL2}	-	-	0.1V_{DD}	V	I_{OL} = 40 μA, Pins: CLK1,CLK2,M,D
LCD Driver Voltage	V_{LCD}	V_{DD}-0.3		12	V	V_{DD} - V5
Voltage Drop	Vdcom	-	-	1	V	I_O = 0.1 mA Pins: COM1-COM16
	Vdseg	-	-	1	V	I_O = 0.1 mA Pins: SEG1-SEG40

Note: F_{OSC}=250KHz, pin E="L", RS,R/W,DB0-DB7 are open, all outputs are no loads.

7.2 AC Characteristics

(VDD = 4.5V ~ 5.5V, Ta = 25℃)

AC CHARACTERISTICS (T_A = 25 ℃, VDD = 5 V)

Internal Clock Operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min	Typ	Max		
OSC Frequency	F_{OSC1}	190	270	350	KHz	Rf = 91 KΩ ± 2%

External clock operation

Characteristics	Symbol	Limit			Unit	Test Condition
		Min	Typ	Max		
External Frequency	F_{OSC3}	125	250	350	KHz	
Duty Cycle		45	50	55	%	
Rise/Fall Time	t_r, t_f			0.2	μs	

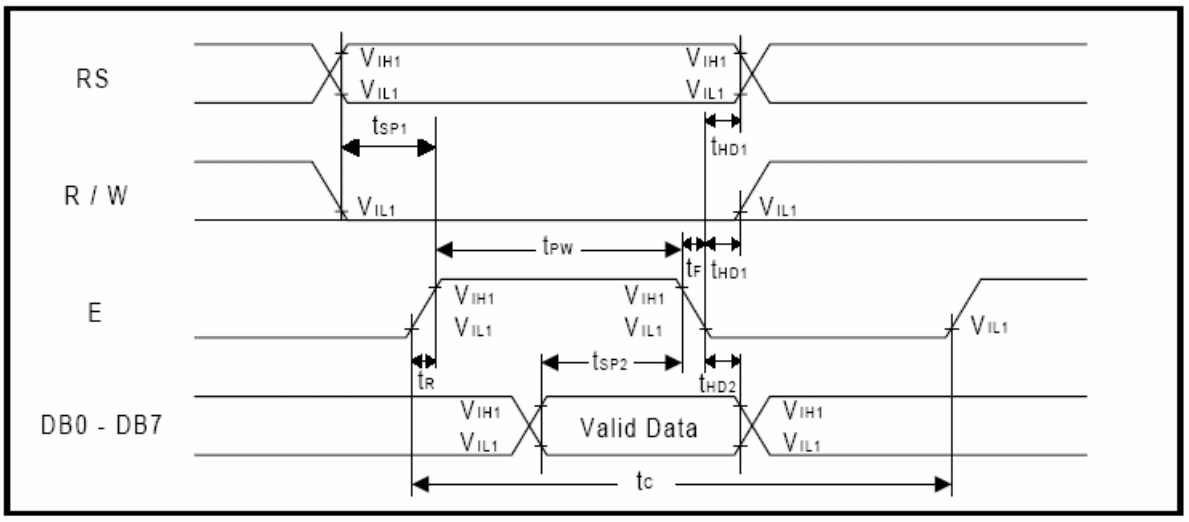
■ Write Mode (Writing data from MPU to SPLC780A)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min	Typ	Max		
E Cycle Time	t_C	400	-	-	ns	Pin E
E Pulse Width	t_{PW}	150	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	30	-	-	ns	Pins: RS, R/W,E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W,E
Data Setup Time	t_{SP2}	40	-	-	ns	Pins: DB0 ~ DB7
Data Hold Time	t_{HD2}	10	-	-	ns	Pins: DB0 ~ DB7

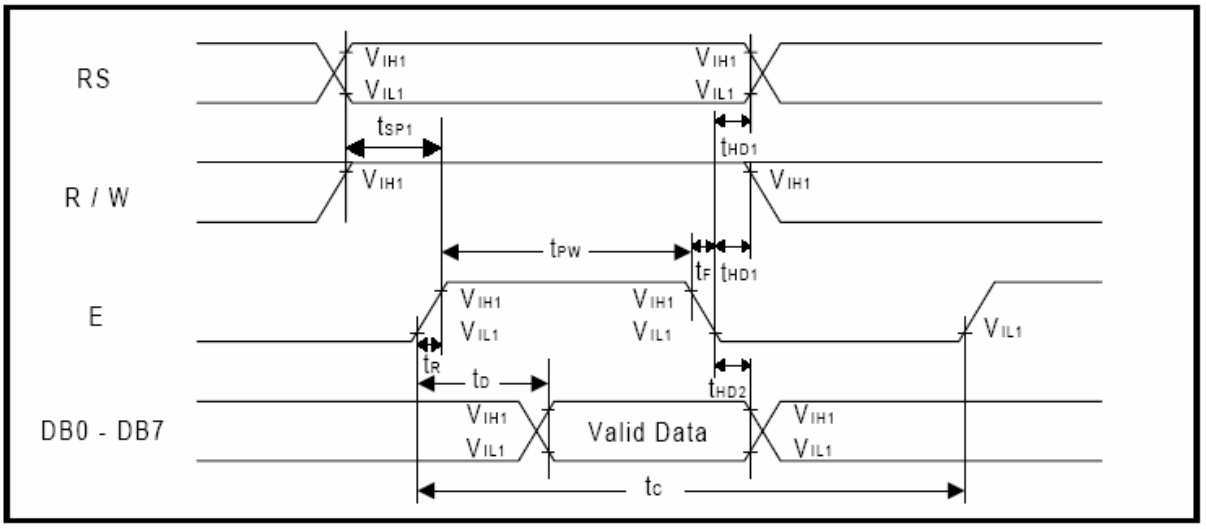
■ Read Mode (Reading data from SPLC780A to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min	Typ	Max		
E Cycle Time	t_C	400	-	-	ns	Pin E
E Pulse Width	t_W	150	-	-	ns	Pin E
E Rise/Fall Time	t_R, t_F	-	-	25	ns	Pin E
Address Setup Time	t_{SP1}	30	-	-	ns	Pins: RS, R/W,E
Address Hold Time	t_{HD1}	10	-	-	ns	Pins: RS, R/W,E
Data Output Delay Time	t_D	-	-	100	ns	Pins: DB0 ~ DB7
Data hold time	t_{HD2}	20	-	-	ns	Pin DB0 ~ DB7

Write Mode Timing Diagram (Writing data from MPU to SPLC780A)



Read Mode Timing Diagram (Reading data from SPLC780A to MPU)



8. CONTROL AND DISPLAY INSTRUCTION

Instruction	Instruction Code										Description	Execution time (fosc=270KHz)
	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.52ms
Return Home	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the shift of entire display	38μs
Display ON/ OFF Control	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C), and blinking of cursor(B) on/off control bit.	38μs
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	-	-	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	38μs
Function Set	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL: 8-bit/4-bit), numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots)	38μs
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	38μs
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in counter	38μs
Read Busy Flag and Address Counter	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read.	
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	38μs
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	38μs

9. CHARACTER GENERATOR ROM

10.BACK LIGHT CHARACTERISTICS

LCD Module with bottom LED Backlight
ELECTRICAL RATINGS

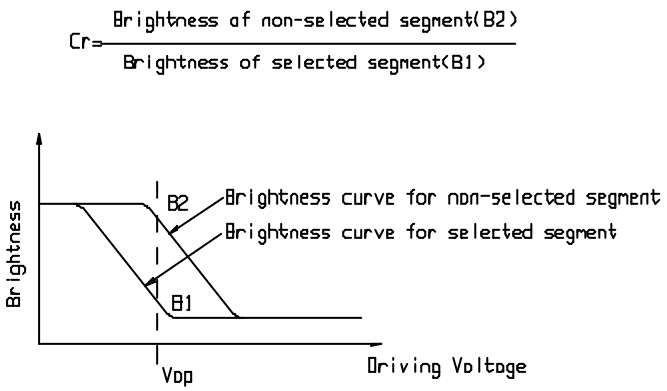
Ta = 25℃

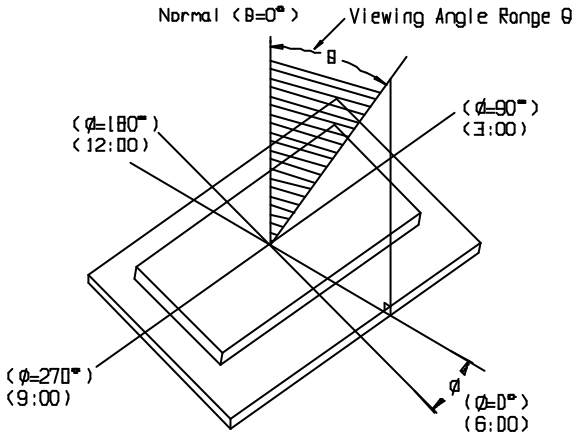
Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=100mA	3.8	4.0	4.2	V
Reverse Current	IR	VR=8 V	---	1000	---	uA
Luminous Intensity (With LCD dots off)	IV	IF=100mA	---	101	---	Cd/m^2
Wave length	??	IF=100mA	---	568	---	nm
Color	Yellow-Green					

11. ELECTRO-OPTICAL CHARACTERISTICS

(V_{OP} = 4.8V, Ta = 25℃)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -20°C	4.5	4.7	4.9	V
		Ta = 25°C	4.0	4.2	4.4	
		Ta = 70°C	3.5	3.7	3.9	
Response time	Tr	Ta = 25°C	---	185	---	ms
	Tf		---	200	---	ms
Contrast	Cr	Ta = 25°C	---	4.2	---	---
Viewing angle range	θ	Cr≧2	-40	---	+40	deg
	Φ		-40	---	+40	deg



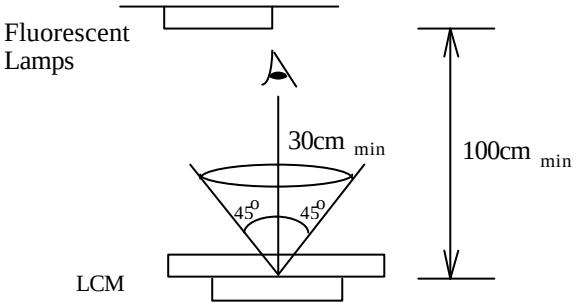


12.QUALITY SPECIFICATIONS

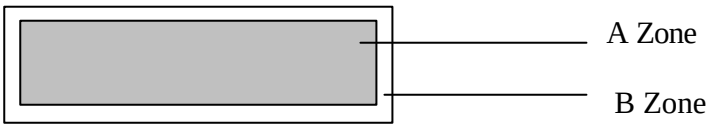
12.1 Standard of the product appearance test

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).

12.2 Specification of quality assurance

AQL inspection standard

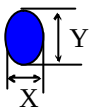
Sampling method: MIL-STD-105E, Level II, single sampling

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

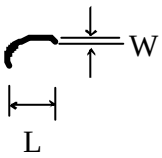
Classify		Item	Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</td></tr>
<tr><td rowspan="2">2</td><td>Contrast defect</td><td rowspan="2">Refer to approval sample</td></tr>
<tr><td>Background color deviation</td></tr>
<tr><td>3</td><td>Point defect,
Black spot, dust
(including Polarizer)

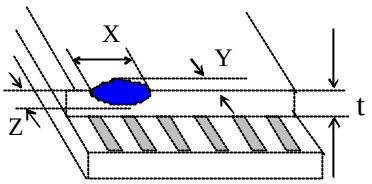
ϕ = (X+Y)/2</td><td> 

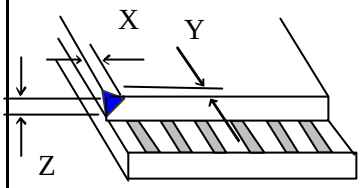
<table>
<tr><th>Point
Size</th><th>Acceptable Qty.</th></tr>
<tr><td>ϕ≦0.10</td><td>Disregard</td></tr>
<tr><td>0.10<ϕ≦0.20</td><td>3</td></tr>
<tr><td>0.20<ϕ≦0.25</td><td>2</td></tr>
<tr><td>0.25<ϕ≦0.30</td><td>1</td></tr>
<tr><td>ϕ>0.30</td><td>0</td></tr>
</table>
Unit：mm</td></tr>
<tr><td>4</td><td>Line defect,

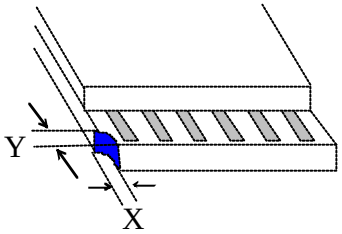
Scratch</td><td> 

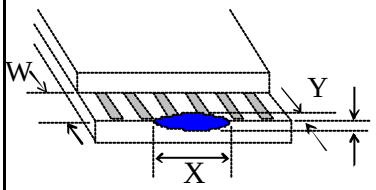
<table>
<tr><th colspan="2">Line</th><th>Acceptable Qty.</th></tr>
<tr><td>L</td><td>W</td><td></td></tr>
<tr><td>---</td><td>0.015≧W</td><td>Disregard</td></tr>
<tr><td>3.0≧L</td><td>0.03≧W</td><td rowspan="2">2</td></tr>
<tr><td>2.0≧L</td><td>0.05≧W</td></tr>
<tr><td>1.0≧L</td><td>0.1＞W</td><td>1</td></tr>
<tr><td>---</td><td>0.05<W</td><td>Applied as point defect</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>5</td><td>Rainbow</td><td>Not more than two color changes across the viewing area.</td></tr>
</table>

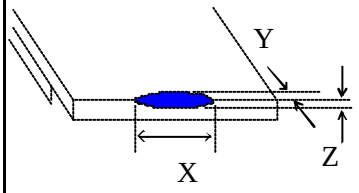
<table>
<tr><th>No</th><th>Item</th><th>Criterion</th></tr>
<tr><td>6</td><td>Chip

Remark:
X: Length direction
Y: Short direction
Z: Thickness direction
t: Glass thickness
W: Terminal Width</td><td>


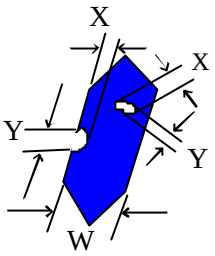
Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤2</td><td>0.5mm</td><td>≤t/2</td></tr>
</table>


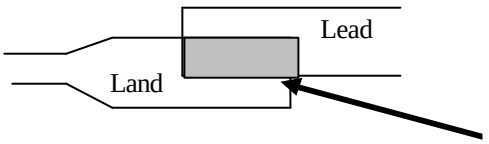
Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤2</td><td>0.5mm</td><td>≤t</td></tr>
</table>


Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤3</td><td>≤2</td><td rowspan="2">≤t</td></tr>
<tr><td colspan="2">shall not reach to ITO</td></tr>
</table>


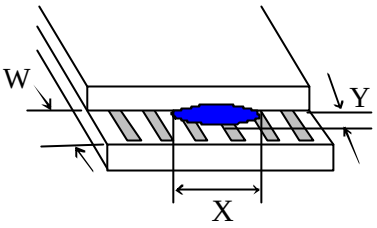
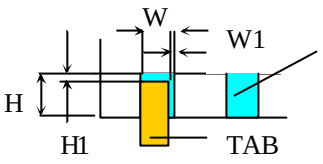
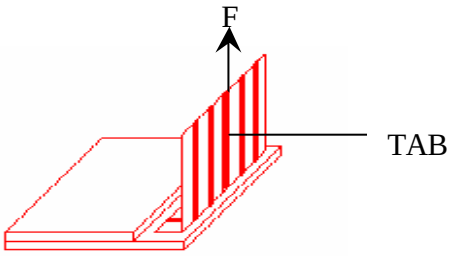
Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>Disregard</td><td>≤0.2</td><td>≤t</td></tr>
</table>


Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤5</td><td>≤2</td><td>≤t/3</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td>7</td><td>Segment
pattern
W = Segment width
ϕ = (X+Y)/2</td><td>(1) Pin hole
ϕ < 0.10mm is acceptable.
 

<table>
<tr><th>Point Size</th><th>Acceptable Qty</th></tr>
<tr><td>ϕ≤1/4W</td><td>Disregard</td></tr>
<tr><td>1/4W< ϕ≤1/2W</td><td>1</td></tr>
<tr><td>ϕ>1/2W</td><td>0</td></tr>
</table>
Unit: mm</td></tr>
<tr><td>8</td><td>Back-light</td><td>(1) The color of backlight should correspond its specification.
(2) Not allow flickering</td></tr>
<tr><td>9</td><td>Soldering</td><td>(1) Not allow heavy dirty and solder ball on PCB.
(The size of dirty refer to point and dust defect)
(2) Over 50% of lead should be soldered on Land.
 

50% lead</td></tr>
<tr><td>10</td><td>Wire</td><td>(1) Copper wire should not be rusted
(2) Not allow crack on copper wire connection.
(3) Not allow reversing the position of the flat cable.
(4) Not allow exposed copper wire inside the flat cable.</td></tr>
<tr><td>11*</td><td>PCB</td><td>(1) Not allow screw rust or damage.
(2) Not allow missing or wrong putting of component.</td></tr>
</table>

No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: Y ≤ 0.4
13	TAB	1. Position  W1≦1/3W H1≦1/3H 2 TAB bonding strength test  P (=F/TAB bonding width) ≧650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment)
14	Total no. of acceptable Defect	A. Zone Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm B. Zone It is acceptable when it is no trouble for quality and assembly in customer's end product.

11.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	No abnormalities in functions and appearance
High temp. Operating	70°C	48	
Low temp. Storage	-30°C	48	
Low temp. Operating	-20°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	0°C ← 25°C →50°C (30 min ← 5 min → 30min)	10cycles	

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.

12.4 Precaution for using LCD/lCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not made any modification on the PCB without consulting Gemini.
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: 280°C±10°C
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over 40°C is required, the relative humidity should be kept below 60%, and avoid direct sunlight.

Limited Warranty

Gemini LCDs and modules are not consumer products, but may be incorporated by Gemini's customers into consumer products or components thereof, Gemini does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of Gemini is limited to repair or replacement on the terms set forth below. Gemini will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between Gemini and the customer, Gemini will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with Gemini general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.