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

SPECIFICATION
FOR
LCM MODULE

MODULE NO.: ABG122032A02-YHY
DOC.REVISION：00

Customer Approval:

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)		May-25-2006
PREPARED BY (QA ENGINEER)		
CHECKED BY		
APPROVED BY		

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Apr-6-2006	First issue	
01	Apr-12-2006	Change pin definiens	
02	May-25-2006	Replace the IC	

CONTENTS

1. FUNCTIONS & FEATURES

1.1. Format	: 122x32dots
1.2. LCD mode	: STN / Positive transflective mode / Yellow-green
1.3. Viewing direction	: 6 o'clock
1.4. Driving scheme	: 1/32 Duty cycle, 1/6 Bias
1.5. Power supply voltage(V_{DD})	: 5.0V
1.6. LCD driving voltage	: 4.5V
1.7. Operation temp	: -20~70℃
1.8. Storage temp	: -30~80℃
1.9. Backlight color	: Yellow-green

2. MECHANICAL SPECIFICATIONS

2.1. Module size	: 80.0mm(L)*36.0mm(W)* 13.5MAX mm(H)
2.2. Viewing area	: 60.5mm(L)*18.5mm(W)
2.3. Dot pitch	: 0.44mm(L)*0.49mm(W)
2.4. Dot size	: 0.40mm(L)*0.45mm(W)
2.5. Weight	: Approx.

3. BLOCK DIAGRAM

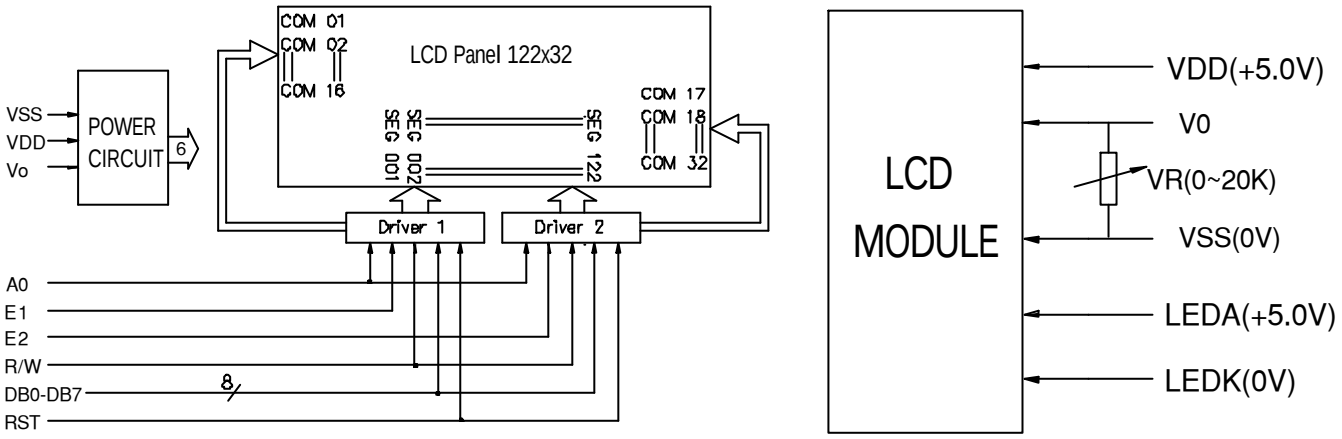


Figure 1. Block diagram

4. DIMENSIONAL OUTLINE

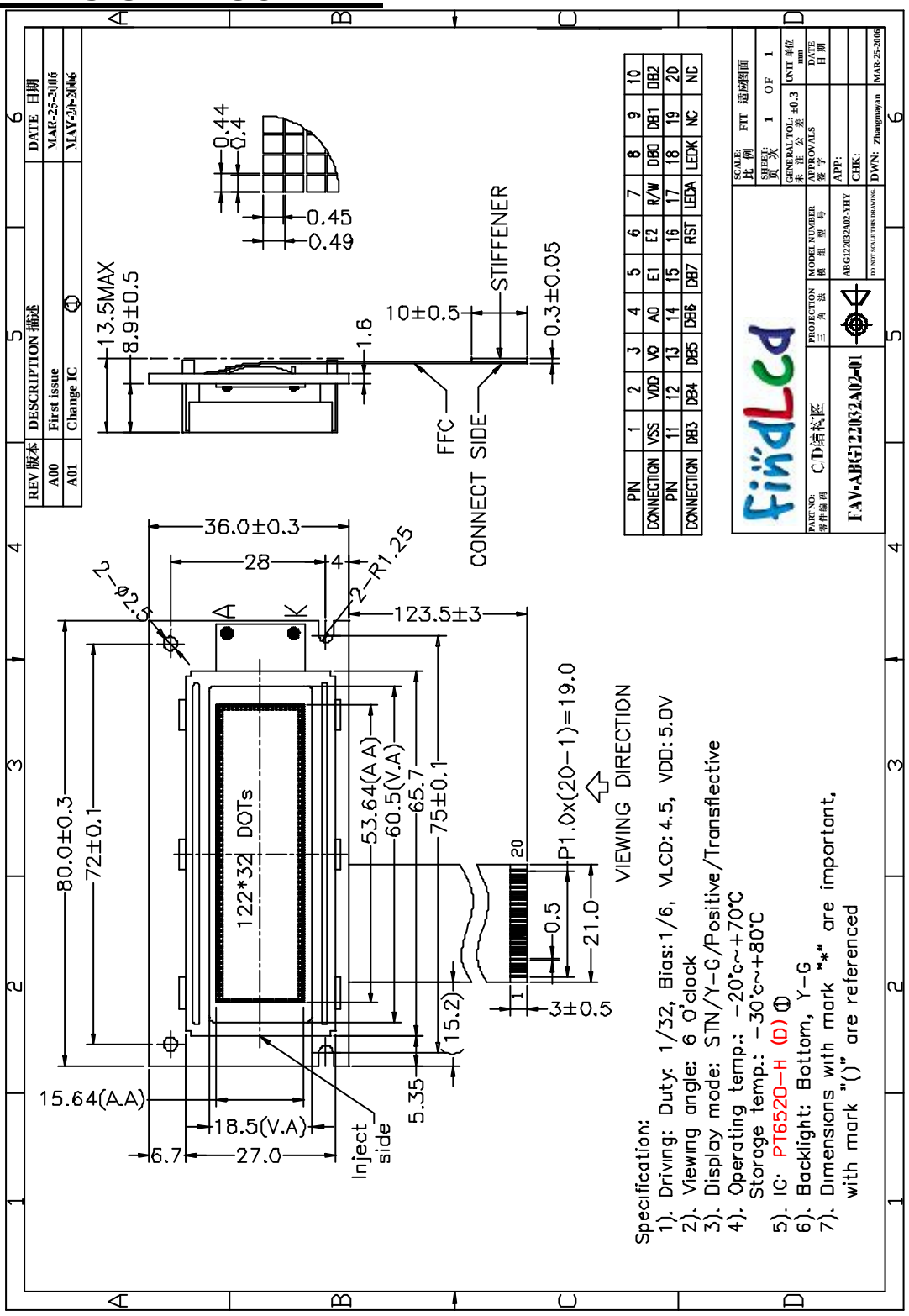


Figure 2. Dimensional outline

5. PIN DESCRIPTION

No.	Symbol	Function
1	VSS	GND(0V)
2	VDD	Power supply(+5.0V)
3	VO	Supply voltage for LCD drive
4	A0	Register selection. (H: Data register L: Instruction register)
5	E1	Enable signal for IC1(left half of the panel)
6	E2	Enable signal for IC2(right half of the panel)
7	R/W	Read /write selection. (H: Read L: write)
8~15	DB0~DB7	Data bus lines
16	RST	Reset signal(The rise of the signal is for active and keep RET='h')
17	LEDA	Power supply for backlight(+5.0V)
18	LEDK	Power supply for backlight(0V)
19/20	NC	No connection

6. MAXIMUM ABSOUTE LIMIT

(For IC)

Parameter	Symbol	Condition	Unit
Supply voltage (1)	V_{SS}	–8.0 ~ +0.3	V
Supply voltage (2)	V5	–16.5 ~ +0.3	V
Supply voltage (3)	V1, V4, V2, V3	V5 ~ +0.3	V
Input voltage	V_{IN}	V_{SS} – 0.3 ~ +0.3	V
Output voltage	V0	V_{SS} – 0.3 ~ +0.3	V
Allowable loss	P_D	250	mW
Operating temperature	T_{opr}	–30 ~ +85	°C
Storage temperature	T_{stg}	–65 ~ +150	°C
Soldering temperature/time	T_{solder}	260 / 10 (at lead)	°C / Sec

Notes:

1. All voltages are based on VDD = 0V.
2. The following condition must always hold true with voltages V1, V2, V3, V4 and V5:
VDD = V1= V2= V3= V4= V5
3. **The LSI may be permanently damaged if used with any value in excess of the absolute maximum ratings. During normal operation, the LSI should preferably be used within the specified electrical characteristics. Failure to meet them can cause the** LSI to malfunction or lose its reliability.
4. Generally, flat package LSIs may have moisture resistance lowered when solder dipped. In mounting LSIs on a board, it is recommended to use a method which is least unlikely to give thermal stress on the package resin.

7. ELECTRICAL CHARACTERISTICS

(VDD=0V, VSS=-5V)

Parameter		Symbol	Condition		Min	Typ	Max	Unit	Applicable Pin
Operating voltage (1)*1	Recommended	VSS			-5.5	-5.0	-4.5	V	VSS
	Potential				-7.0	-	-2.4	V	
Operating voltage (2)	Recommended	V5			-13	-	-3.5	V	V5
	Potential				-13	-	-	V	
	Potential	V1, V2			0.6xV5	-	VDD	V	V1, V2
	Potential	V3, V4			V5	-	0.4xV5	V	V3, V4
High input voltage		VIHT			VSS+2.0	-	VDD	V	*2, *3
		VIHC			0.2xVSS	-	VDD		
		VIHT	VSS=-3v		0.2xVSS	-	VDD		*2, *3
		VIHC	VSS=-3v		0.2xVSS	-	VDD		
Low input voltage		VILT			VSS	-	VSS+0.8		*2, *3
		VILC			VSS	-	0.8xVSS		
		VILT	VSS=-3v		VSS	-	0.85xVSS		*2, *3
		VILC	VSS=-3v		VSS	-	0.8xVSS		
High output voltage		VOHT	IOH=-3.0mA		VSS+2.4	-	-	V	OSC2 *4, *5
		VOHC1	IOH=-2.0mA		VSS+2.4	-	-		
		VOHC2	IOH=-120Ma		0.2xVSS	-	-		
		VOHT	VSS=-3v	IOH=-2mA	0.2xVSS			V	*4, *5 OSC2
		VOHC1	VSS=-3v	IOH=-2mA	0.2xVSS				
		VOHC2	VSS=-3v	IOH=-50µA	0.2xVSS				
Low output voltage		VOLT	IOL=3.0mA		-	-	VSS+0.4	V	OSC2 *4, *5
		VOLT1	IOL=2.0mA		-	-	VSS+0.4		
		VOLT2	IOL=120µA		-	-	0.8xVSS		
		VOLT	VSS=-3v	IOL=2mA			0.8xVSS	V	*4, *5 OSC2
		VOLC1	VSS=-3v	IOL=2mA			0.8xVSS		
		VOLC2	VSS=-3v	IOL=50µA			0.8xVSS		
Input leak current		ILI			-1	-	1	µA	*6
Output leak current		ILO			-3	-	3	µA	*7
LCD driver ON resistance		RON	Ta=25°C	V5=-5.0V	-	5	7.5	KΩ	SEG0~60 COM0~15
				V5=-3.5V	-	10	50		
Static current consumption		IDDQ	CS=CL=VDD		-	0.05	1	µA	VDD
Dynamic current dissipation	External CLK	During IDD (1)	During display Vs=-5.0V	Rf=1MΩ	-	9.5	15	µA	VDD
	Oscillator		During display V5=-5V VSS =-3V	Rf=1 MΩ	-	6.0	12	µA	
		IDD (2)	During access Tcyc = 200kHz		-	300	500	µA	VDD
			VSS=-3V, During access Tcyc = 200 kHz			150	300		
Input terminal capacity		CIN	Ta=25°C, f=1MHz		-	5.0	8	pF	All input terminals
Oscillation frequency		Fosc	Rf=1MΩ+2%	VSS=-5.0V	15	18	21	kHz	*4, *5 OSC2
			Rf=1MΩ +2%	VSS=-3.0V	11	16	21		
Reset time		tR			1.0	-		µs	RES
Hysteresis		VH			0.05VSS	0.1VSS	-	V	

Notes: 1. A wide range of operating voltages is guaranteed, except in case of abrupt voltage fluctuations during MPU access.
2. A0, D0~D7, E, R/W and CS pins
3. CL, FR, M/S and RES pins
4. A0, E, R/W, CS, CL, RES, M/S pins

8. TIMING CHARACTERISTICS

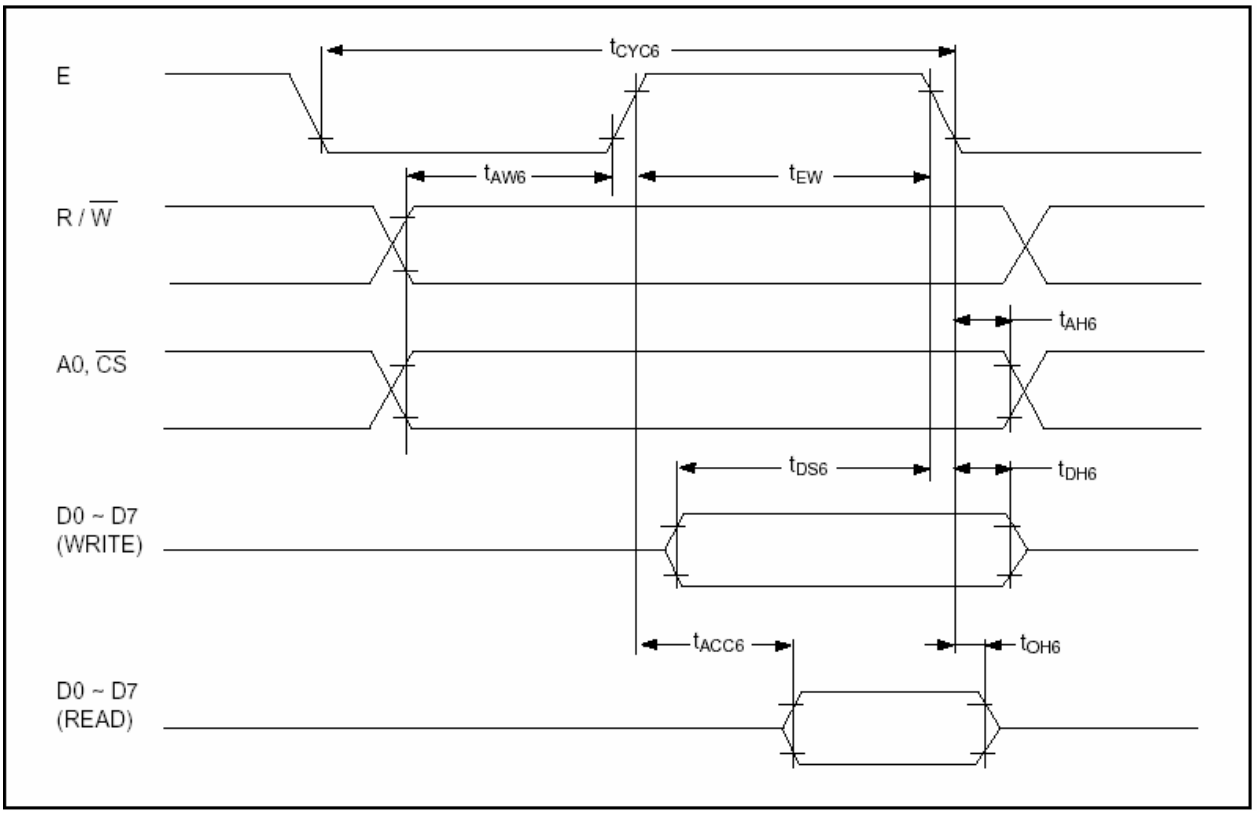
Ta = –210 to 75°C, VSS = –5.0V ± 10%

Parameter	Symbol	Signal	Condition	Min	Typ	Max	Unit
System cycle time	t_{CYC6} *1	A0, $\overline{CS}$		1000	—	—	ns
Address setup time	t_{AW6}	R/$\overline{W}$		20	—	—	ns
Address hold time	t_{AH6}			10	—	—	ns
Data setup time	t_{DS6}	D0 – D7		80	—	—	ns
Data hold time	t_{DH6}			10	—	—	ns
Output disable time	t_{OH6}		CL = 100 pF	10	—	60	ns
Access time	t_{ACC6}			—	—	90	ns
Enable pulse width: Read	t_{EW}	E		100	—	—	ns
Enable pulse width: Write				80	—	—	ns

*1 t_{CYC6} indicates the cycle time during which $\overline{CS}$•E = "H". It does not mean the cycle time of signal E.

*2 Each of the values where Vss = –3.0V is about 200% of that where Vss = –5.0V (i.e., the listed value).

*3 The rise or fall time of input signals should be less than 15 ns.



System bus read/write II (68-family MPU)

9. CONTROL AND DISPLAY INSTRUCTION

	Command	Code											Function
		A0	$\overline{RD}$	$\overline{WR}$	D7	D6	D5	D4	D3	D2	D1	D0	
(1)	Display ON/OFF	0	1	0	1	0	1	0	1	1	1	0/1	Turns all display on or off, independently of display RAM data or internal status. 1: ON 0: OFF (Power-saving mode with static drive on)*
(2)	Display Start Line	0	1	0	1	1	0	Display Start Address (0 – 31)					Specifies RAM line corresponding to uppermost line (COM0) of display.
(3)	Set Page Address	0	1	0	1	0	1	1	1	0	Page (0–3)		Sets display RAM page in page address register.
(4)	Set Column (Segment) Address	0	1	0	0	Column Address (0–79)							Sets display RAM column address in column address register.
(5)	Read Status	0	0	1	Busy	ADC	ON/OFF	RESET	0	0	0	0	Reads the following status: BUSY 1: Internal operation 0: Ready ADC 1: CW output (forward) 0: CCW output (reverse) ON/OFF 1: Display off 0: Display on RESET 1: Being reset 0: Normal
(6)	Write Display Data	1	1	0	Write Data								Writes data from data bus into display RAM. Display RAM location whose address has been preset is accessed. After access, the column address is incremented by 1.
(7)	Read Display Data	1	0	1	Read Data								Reads data from display RAM onto data bus.
(8)	Select ADC	0	1	0	1	0	1	0	0	0	0	0/1	Used to invert relationship of assignment between display RAM column addresses and segment driver outputs. 0: CW output (forward) 1: CCW output (reverse)
(9)	Static Drive ON/OFF	0	1	0	1	0	1	0	0	1	0	0/1	Selects normal display or static driving operation. 1: Static drive (power-saving mode) 0: Normal driving
(10)	Select Duty	0	1	0	1	0	1	0	1	0	0	0/1	Selects LCD cell driving duty 1: 1/32 0: 1/16
(11)	Read Modify Write	0	1	0	1	1	1	0	0	0	0	0	Increments column address counter by 1 when display data is written. (This is not done when data is read.)
(12)	End	0	1	0	1	1	1	0	1	1	1	0	Clears read modify write mode.
(13)	Reset	0	1	0	1	1	1	0	0	0	1	0	Sets display start line register on the first line. Also sets column address counter and page address counter to 0.

* With display off (command (1)), static drive going on (9) invokes power-saving mode.

10.? BACK LIGHT CHARACTERISTICS

LCD Module with bottom backlight
ELECTRICAL RATINGS

Ta = 25℃

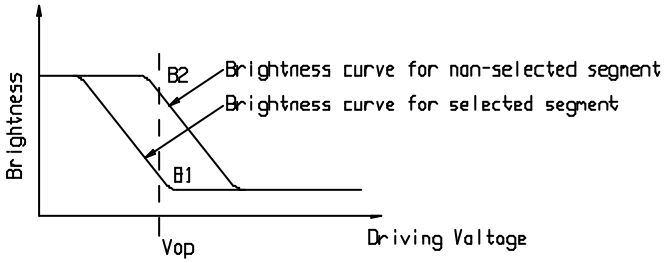
Item	Symbol	Condition	Min	Typ	Max	Unit
Forward Voltage	VF	IF=100mA	4.0	4.2	4.4	V
Reverse Current	IR	VR=10V	---	0.1	---	mA
Luminous Intensity (With LCD dots off)	IV	IF=100mA	--	---	---	Cd/m^2
Wave length	??	IF=100mA	568	570	575	nm
Color	Yellow-green					

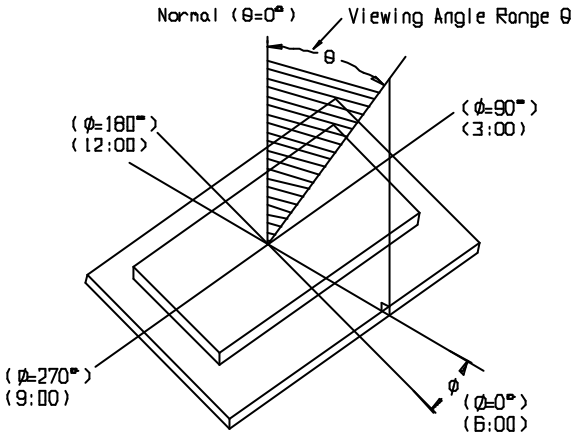
11. ELECTRO-OPTICAL CHARACTERISTICS?

(V_{OP} =4.5V, Ta = 25°C)

Item	Symbol	Condition	Min	Typ	Max	Unit
Operating Voltage	Vop	Ta = -20°C	4.9	5.0	5.2	V
		Ta = 25°C	4.3	4.5	4.7	
		Ta = 70°C	3.9	4.0	4.1	
Response time	Tr	Ta = 25°C	---	185	---	ms
	Tf		---	200	---	ms
Contrast	Cr	Ta = 25°C	---	4	---	---
Viewing angle range	θ	Cr≥2	-40	---	+40	deg
	Φ		-40	---	+40	deg

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



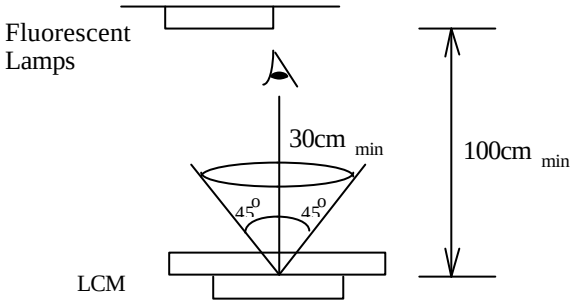


12.QUALITY SPECIFICATIONS

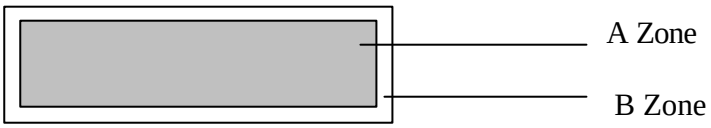
12.1 Standard of the product appearance test

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

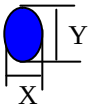
Sampling method: MIL-STD-105E, Level II, single sampling

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

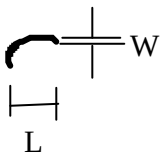
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background 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 Wire	Poor connection Poor connection	9 10	
	TAB	Position, Bonding strength	13	

Note on defect classification

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

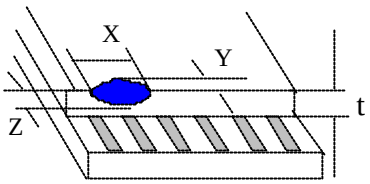
ϕ = (X+Y)/2</td><td> 

<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>
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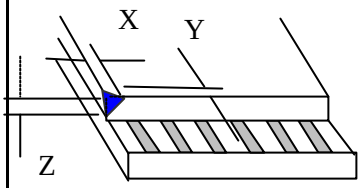
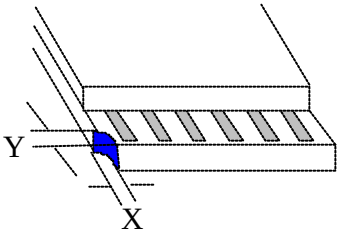
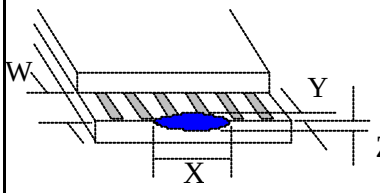


Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤2</td><td>0.5mm</td><td>≤t</td></tr>
</table>


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>
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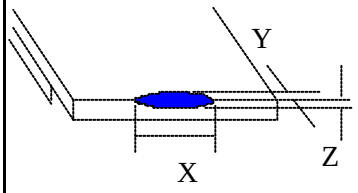
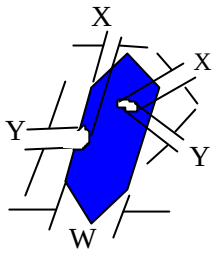
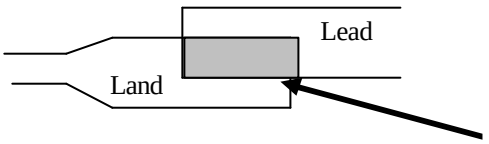
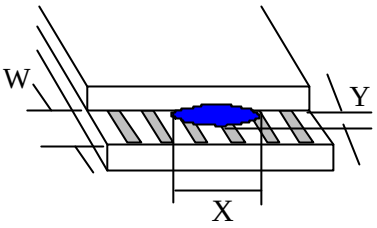
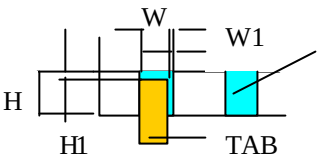
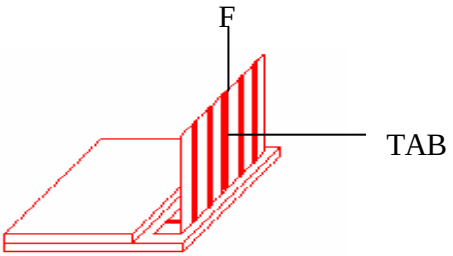


Acceptable criterion
<table>
<tr><th>X</th><th>Y</th><th>Z</th></tr>
<tr><td>≤5</td><td>≤2</td><td>≤t/3</td></tr>
</table>
</td></tr>
</table>

<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.

12.3 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 make 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 when ever 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 enches.
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 ailures or defect.