XIAMEN OCULAR

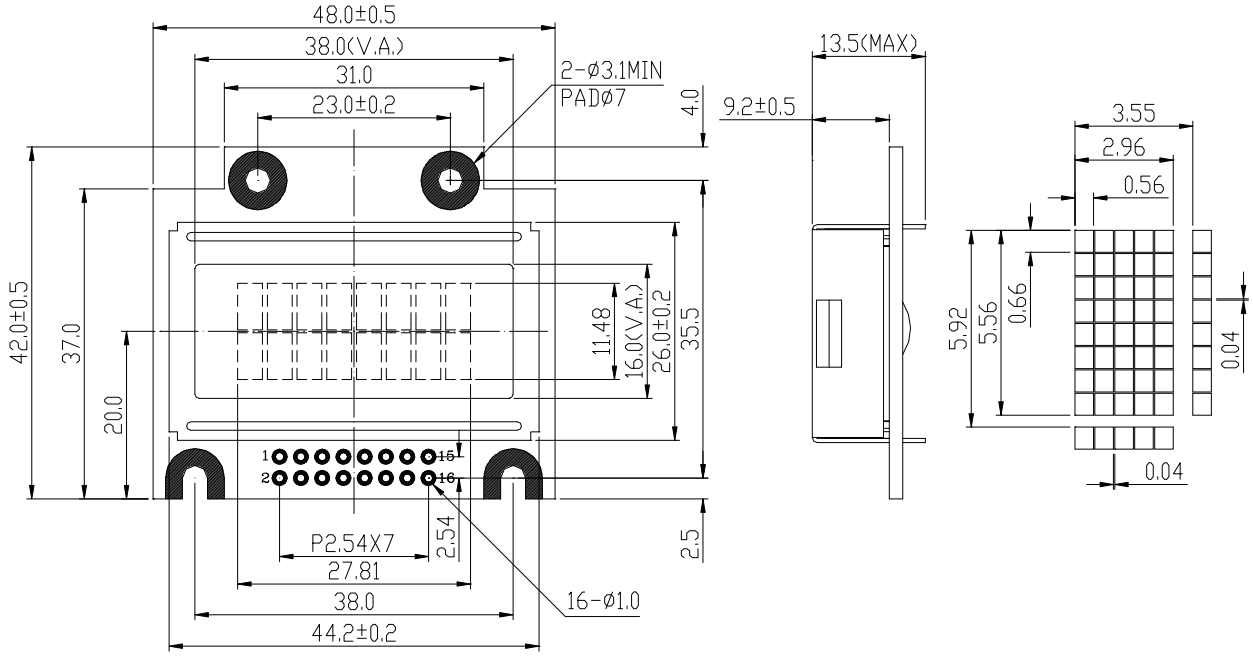
GDM0802J-NSW-BBW

SPECIFICATIONS OF LCD MODULE

Features

1. 5x8 dots, 8x2 characters
2. Built-in controller ST7066U or equivalence
3. +5.0V power supply
4. Easy interface with 4-bit or 8-bit MPU
5. STN blue LCD, transmissive mode, negative display
6. Driver method: 1/16 duty
7. 6 O'clock viewing direction
8. Side type LED backlight, white color
9. Operating temperature range -20°C to 70°C

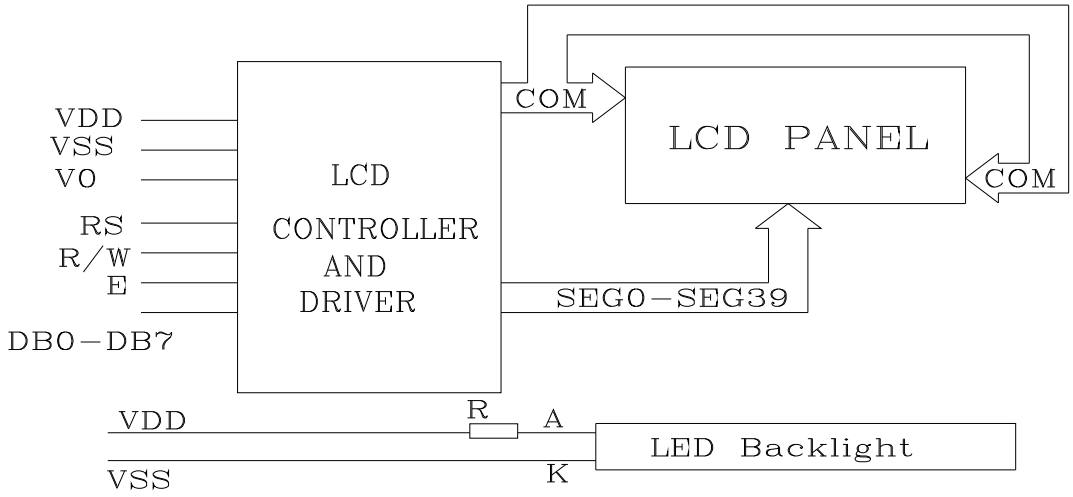
Outline dimension



Absolute maximum ratings

Item	Symbol	Standard			Unit
		Min.	Typical	Max.	
Power voltage	V_{DD}-V_{SS}	0	-	7.0	V
Input voltage	V_{IN}	V_{SS}	-	V_{DD}	
Operating temperature range	V_{OP}	-20	-	70	°C
Storage temperature range	V_{ST}	-30	-	80	

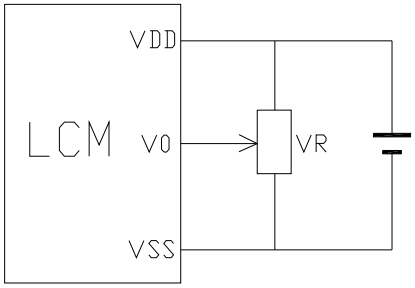
Block diagram



Interface pin description

Pin no.	Symbol	External connection	Function
1	V_{SS}	Power supply	Signal ground for LCM (GND)
2	DB0	MPU	Data Bit 0
3	K	BKL power	GND
4	DB1	MPU	Data Bit 1
5	V_{DD}	Power supply	Power supply for logic (+4.6V) for LCM
6	DB2	MPU	Data Bit 2
7	V0	Power supply	Contrast adjust
8	DB3	MPU	Data Bit 3
9	A	BKL power	+5V
10	DB4	MPU	Data Bit 4
11	E	MPU	Operation (data read/write) enable signal
12	DB5	MPU	Data Bit 5
13	R/W	MPU	Read/write select signal
14	DB6	MPU	Data Bit 6
15	RS	MPU	Register select signal
16	DB7	MPU	Data Bit 7

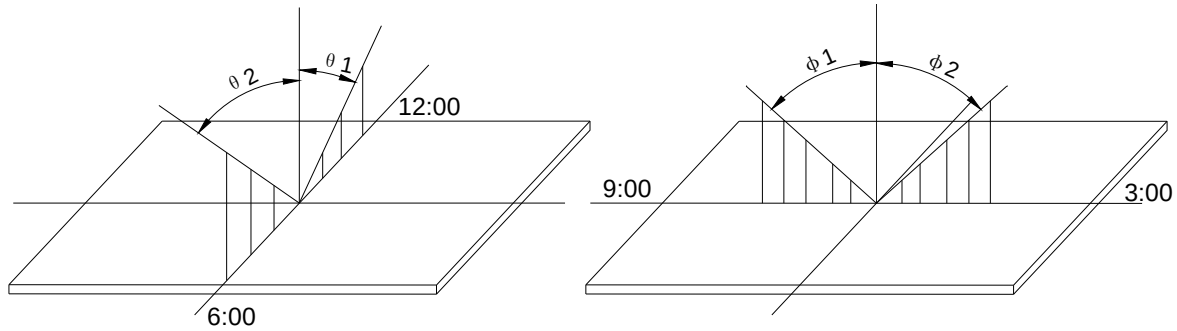
Contrast adjust



V_{DD}~V_0: LCD Driving voltage

VR: 10k~20k

Optical characteristics



STN type display module (Ta=25℃, V_{DD}=5.0V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	θ1	Cr≥2		35		deg
	θ2			40		
	Φ1			35		
	Φ2			35		
Contrast ratio	Cr		-	10	-	-
Response time (rise)	Tr	-	-	190	270	ms
Response time (fall)	Tr	-	-	200	280	

Electrical characteristics

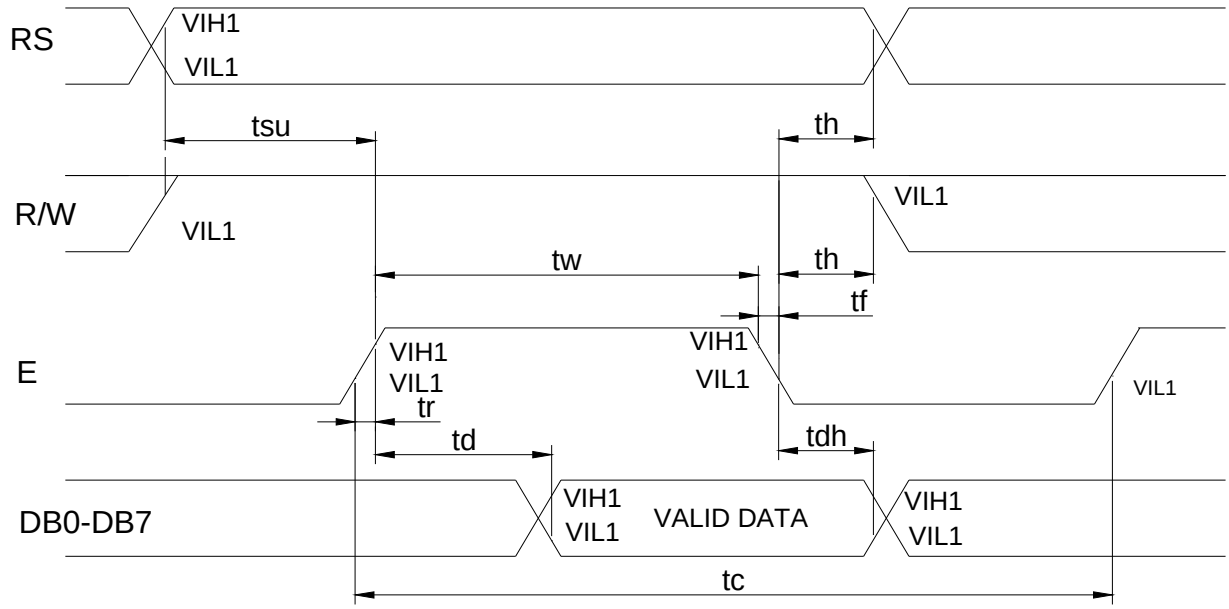
DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_{DD}-V_0	Ta =25°C	-	4.6	5.0	V
Input voltage	V_{DD}		4.8	5.0	5.3	
Supply current	I_{DD}	Ta=25°C, V_{DD}=5.0V	-	1.0	1.5	mA
Input leakage current	I_{LKG}		-	-	1.0	uA
“H” level input voltage	V_{IH}		2.2	-	V_{DD}	V
“L” level input voltage	V_{IL}	Twice initial value or less	0	-	0.6	
“H” level output voltage	V_{OH}	L_{OH}=-0.25mA	2.4	-	-	
“L” level output voltage	V_{OL}	L_{OH}=1.6mA	-	-	0.4	
Backlight supply voltage	V_F	R=100Ω	-	4.6	-	
Backlight supply current	I_F	V_F=4.6V R=100Ω	-	20	25	mA

Read cycle (Ta=25°C, V_{DD}=5.0V)

Parameter	Symbol	Test pin	Min.	Typ.	Max.	Unit
Enable cycle time	t_c	E	1200	-	-	ns
Enable pulse width	t_w		140	-	-	
Enable rise/fall time	t_r, t_f		-	-	25	
RS; R/W setup time	t_{su}	RS; R/W	0	-	-	
RS; R/W address hold time	t_h	RS; R/W	10	-	-	
Data output delay	t_d	DB0~DB7	-	-	100	
Data hold time	t_{dh}		10	-	-	

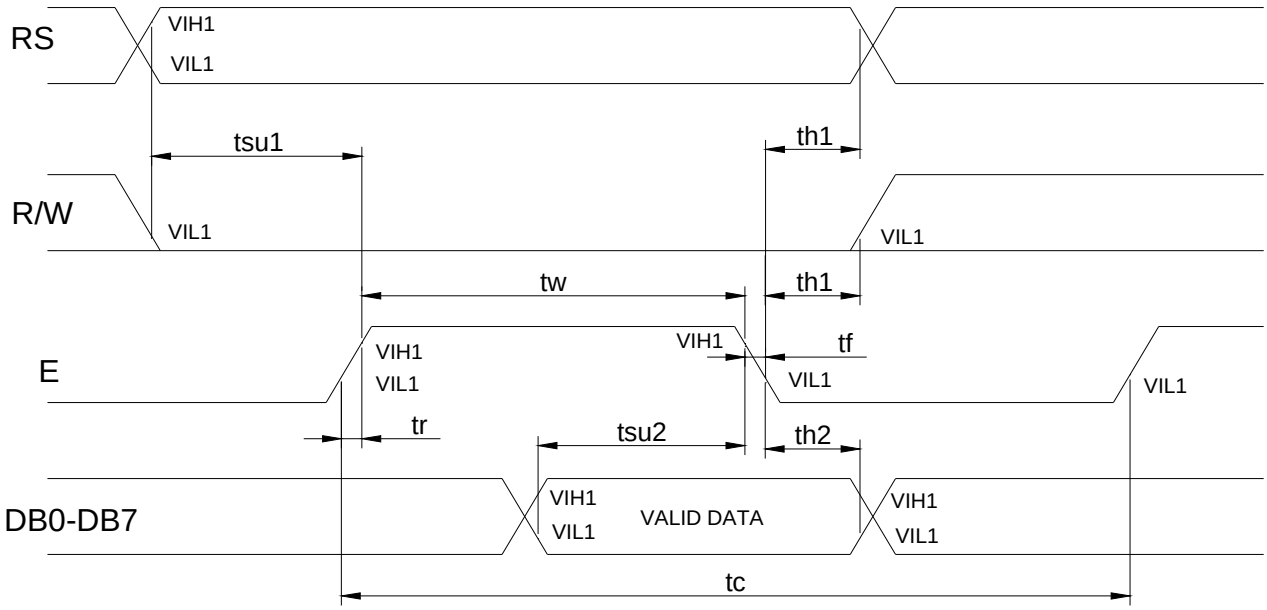
Read mode timing diagram



Write cycle (Ta=25°C, V_{DD}=5.0V)

Parameter	Symbol	Test pin	Min.	Typ.	Max.	Unit
Enable cycle time	t_c	E	1200	-	-	ns
Enable pulse width	t_w		140	-	-	
Enable rise/fall time	t_r, t_f		-	-	25	
RS; R/W setup time	t_{su1}	RS; R/W	0	-	-	
RS; R/W address hold time	t_{h1}	RS; R/W	10	-	-	
Data output delay	t_{su2}	DB0~DB7	40	-	-	
Data hold time	t_{h2}		10	-	-	

Write mode timing diagram



Instruction description

Outline

To overcome the speed difference between the internal clock of ST7066U and the MPU clock, ST7066U performs

internal operations by storing control in formations to IR or DR. The internal operation is determined according to the signal from MPU, composed of read/write and data bus.

Instructions can be divided largely into four groups:

1) ST7066U function set instructions (set display methods, set data length, etc.)
2) Address set instructions to internal RAM
3) Data transfer instructions with internal RAM
4) Others

The address of the internal RAM is automatically increased or decreased by 1.

Note: during internal operation, busy flag (DB7) is read "High".

Busy flag check must be preceded by the next instruction.

Contents

1) Clear display

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Clear all the display data by writing "20H" (space code) to all DDRAM address, and set DDRAM address to "00H" into AC (address counter).

Return cursor to the original status, namely, brings the cursor to the left edge on the fist line of the display.

Make the entry mode increment (I/D="High").

2) Return home

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	1	-

Return home is cursor return home instruction.

Set DDRAM address to "00H" into the address counter.

Return cursor to its original site and return display to its original status, if shifted.

Content of DDRAM does not change.

3) Entry mode set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Set the moving direction of cursor and display.

I/D: increment / decrement of DDRAM address (cursor or blink)

When I/D="high", cursor/blink moves to right and DDRAM address is increased by 1.

When I/D="Low", cursor/blink moves to left and DDRAM address is increased by 1.

*CGRAM operates the same way as DDRAM, when reading from or writing to CGRAM.

(I/D="high". shift left, I/D="Low". Shift right).

4) Display ON/OFF control

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

Control display/cursor/blink ON/OFF 1 bit register.

D: Display ON/OFF control bit

When D="High", entire display is turned on.

When D="Low", display is turned off, but display data remains in DDRAM.

C: cursor ON/OFF control bit

When D="High", cursor is turned on.

When D="Low", cursor is disappeared in current display, but I/D register preserves its data.

B: Cursor blink ON/OFF control bit

When B="High", cursor blink is on, which performs alternately between all the "High" data and display characters at the cursor position.

When B="Low", blink is off.

5) Cursor or display shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	-	-

Shifting of right/left cursor position or display without writing or reading of display data.

This instruction is used to correct or search display data. (Refer to Table 6)

During 2-line mode display, cursor moves to the 2nd line after the 40th digit of the 1st line.

When display data is shifted repeatedly, each line is shifted individually.

When display shift is performed, the contents of the address counter are not changed.

Shift patterns according to S/C and R/L bits

S/C	R/L	Operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC is increased by 1
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6) Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	-	-

DL: Interface data length control bit

When DL="High", it mans 8-bit bus mode with MPU.

When DL="Low", it mans 4-bit bus mode with MPU. Hence, DL is a signal to select 8-bit or 4-bit bus mode.

In 4-bit bus mode, it needs to transfer 4-bit data twice.

N: Display line number control bit

When N="Low", 1-line display mode is set.

When N="High", 2-line display mode is set.

F: Display line number control bit

When F="Low", 5x8 dots format display mode is set.

When F="High", 5x11 dots format display mode.

7) Set CGRAM address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

Set CGRAM address to AC.

The instruction makes CGRAM data available from MPU.

8) Set DDRAM address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC.

This instruction makes DDRAM data available form MPU.

When 1-line display mode (N=LOW), DDRAM address is form “00H” to “4FH”.

In 2-line display mode (N=High), DDRAM address in the 1st line form “00H” to “27H”, and DDRAM address

In the 2nd line is from “40H” to “67H”.

9) Read busy flag & address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether ST7066U is in internal operation or not.

If the resultant BF is “High”, internal operation is in progress and should wait BF is to be LOW, which by then if the nest instruction can be performed. In this instruction you can also read the value of the address counter.

10) Write data to RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

Write binary 8-bit data to DDRAM/CGRAM.

The selection of RAM from DDRAM, and CGRAM, is set by the previous address set instruction (DDRAM address set, CGRAM address set).

RAM set instruction can also determine the AC direction to RAM.

After write operation. The address is automatically increased/decreased by 1, according to the entry mode.

11) Read data from RAM

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

Read binary 8-bit data from DDRAM/CGRAM.

The selection of RAM is set by the previous address set instruction. If the address set instruction of RAM is not performed before this instruction, the data that has been read first is invalid, as the direction of AC is not yet determined. If RAM data is read several times without RAM address instructions set before, read operation, the correct RAM data can be obtained from the second. But the first data would be incorrect, as there is no time margin to transfer RAM data.

In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction,

It also transfers RAM data to output data register.

After read operation, address counter is automatically increased/decreased by 1 according to the entry mode.

After CGRAM read operation, display shift may not be executed correctly.

NOTE: In case of RAM write operation, AC is increased/decreased by 1 as in read operation.

At this time, AC indicates next address position, but only the previous data can be read by the read instruction.

Instruction table

Instruction	Instruction code										Description	Execution Time (fosc= 270 KHZ
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	Write “20H” to DDRA and set DDRAM address to “00H” from AC	1.53ms
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.	1.53ms
Entry mode Set	0	0	0	0	0	0	0	1	I/D	SH	Assign cursor moving direction and blinking of entire display	39us
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.	
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.	39us
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: 5x11/5x8)	39us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39us
Read busy Flag and Address	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.	0us
Write data to Address	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43us
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43us

NOTE:

When an MPU program with checking the busy flag (DB7) is made, it must be necessary 1/2fosc is necessary for executing the next instruction by the falling edge of the “E” signal after the busy flag (DB7) goes to “Low”.

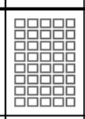
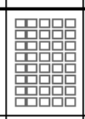
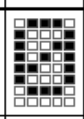
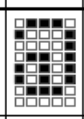
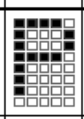
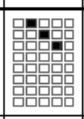
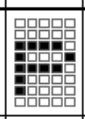
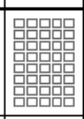
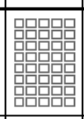
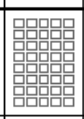
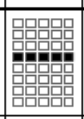
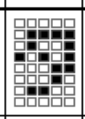
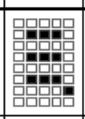
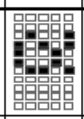
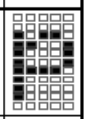
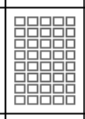
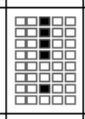
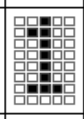
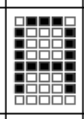
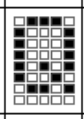
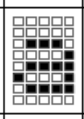
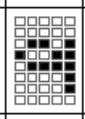
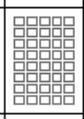
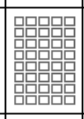
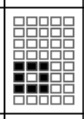
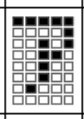
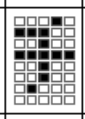
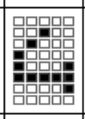
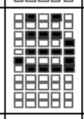
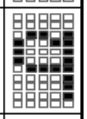
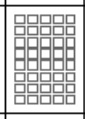
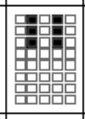
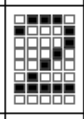
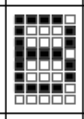
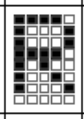
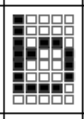
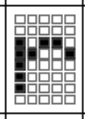
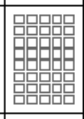
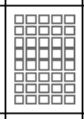
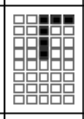
DDRAM address:

Display position

1	2	3	4	5	6	7	8
00	01	02	03	04	05	06	07
40	41	42	43	44	45	46	47

DDRAM address

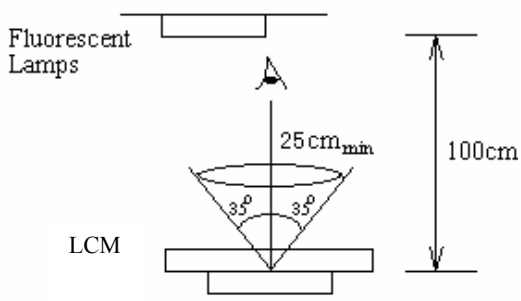
Standard character pattern

Upper 4bit / Lower 4bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL	CG RAM (1)															
LLLH	(2)															
LLHL	(3)															
LLHH	(4)															
LHLL	(5)															
LHLH	(6)															
LHHL	(7)															
LHHH	(8)															
HLLL	(1)															
HLLH	(2)															
HLHL	(3)															
HLHH	(4)															
HHLL	(5)															
HHLH	(6)															
HHHL	(7)															
HHHH	(8)															

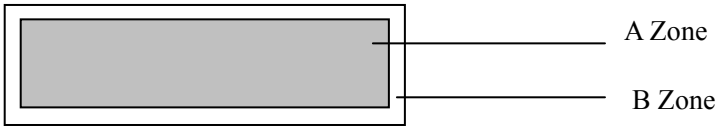
Quality Specifications

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 25 cm or more. Viewing direction for inspection is 35° from vertical against LCM.



Definition of zone:



A Zone: Active display area (minimum viewing area).

B Zone: Non-active display area (outside viewing area).

Specification of quality assurance

AQL inspection standard

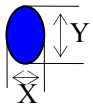
Sampling method: MIL-STD-105E, Level II, normal one time sampling

Defect classification

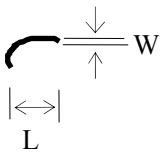
Classify	Item		Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background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

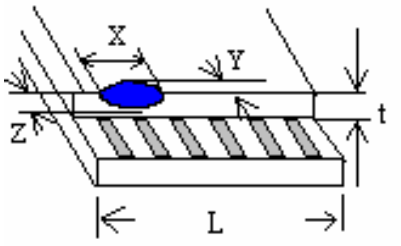
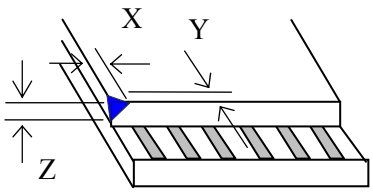
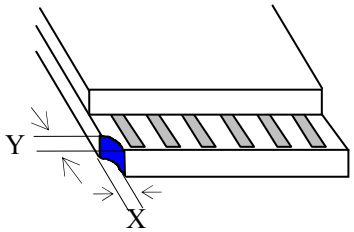
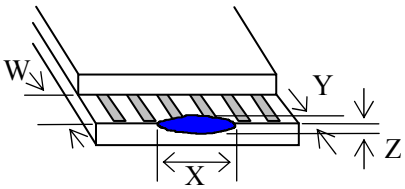
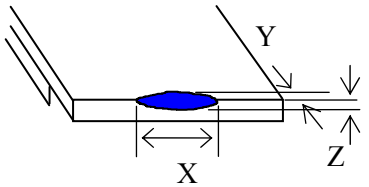
<table>
<tr><th>No.</th><th>Item</th><th>Criterion</th></tr>
<tr><td rowspan="6">1</td><td>Short or open circuit</td><td rowspan="6">Not allow</td></tr>
<tr><td>LC leakage</td></tr>
<tr><td>Flickering</td></tr>
<tr><td>No display</td></tr>
<tr><td>Wrong viewing direction</td></tr>
<tr><td>Wrong Back-light</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, white spot
(including Polarizer)

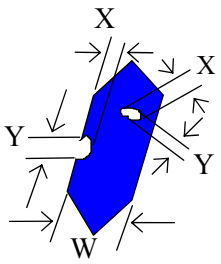
$\phi = (X+Y)/2$</td><td> 

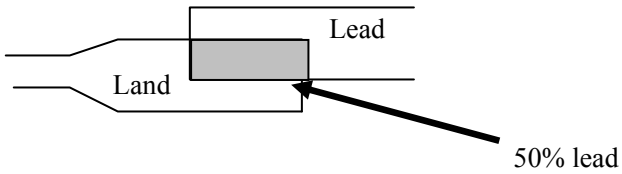
<table>
<tr><th>Point Size</th><th>Acceptable Qty.</th></tr>
<tr><td>$\phi \leq 0.10$</td><td>Disregard</td></tr>
<tr><td>$0.10 < \phi \leq 0.15$</td><td>2</td></tr>
<tr><td>$0.15 < \phi \leq 0.25$</td><td>1</td></tr>
<tr><td>$\phi > 0.25$</td><td>0</td></tr>
</table>
Unit：Inch^2</td></tr>
<tr><td>4</td><td>Line defect.

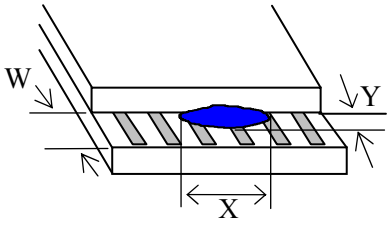
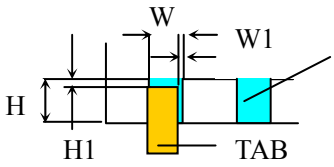
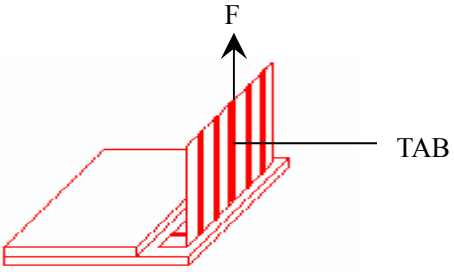
Scratch</td><td> 

<table>
<tr><th colspan="2">Line</th><th rowspan="2">Acceptable Qty.</th></tr>
<tr><th>L</th><th>W</th></tr>
<tr><td>---</td><td>0.05>W</td><td rowspan="3">Disregard</td></tr>
<tr><td>3.0>L</td><td>0.1>W>0.05</td></tr>
<tr><td>2.0>L</td><td>0.15≥W>0.1</td></tr>
<tr><td>L≥2.0</td><td>W>0.1</td><td>0</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>

No	Item	Criterion
6	Chip Remark: X: Length Y: Width Z: Thickness t: Glass thickness W: Terminal width L: Glass length	 Acceptable criterion X: < L /8; Y: 0.5mm; Z: ≤t/2  Acceptable criterion X: ≤2; Y: 0.5mm; Z: ≤t  Acceptable criterion X: ≤3; Y: ≤2; Z: ≤t shall not reach to ITO  Acceptable criterion X: Disregard; Y: ≤0.2; Z: ≤t  Acceptable criterion X: ≤5; Y: ≤2; Z: ≤t/3

<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 with 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.
 
</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.

Electrical and optical inspection

Electrical and Optical Parameters of LCM

ITEM	SYMBOL	STN Dot Matrix Character Type			UNIT
		MIN.	TYP.	MAX.	
LCD Operating Voltage	V_{lcd}	-	5.0	-	V
Contrast	Cr	10:1			-
Response Time (25℃)	t_r		190	290	ms
	t_d		200	300	
Viewing Angle (Cr=3)	θ	45	-	60	deg
	Φ	-40	-	40	
Operating Temp.	T_{OP}	-20~+70			°C
Storage Temp.	T_{ST}	-30~+80			
Minimum Life Time	τ	≥50000			h

Reliability of LCM

Reliability test

Items of reliability test are as the followings with no abnormalities and function failures found after the test: (Number of specimen: 16)

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	96	No abnormalities in functions and appearance
High temp. Operating	70°C	96	
Low temp. Storage	-30°C	96	
Low temp. Operating	-20°C	96	
Humidity	40°C/ 90%RH	96	
Temperature shock	-20°C ← 25°C →70°C (30 min ← 5 min → 30min)	12 cycles	

Recovery time should be 12 hours minimum.

Vibration test

10~55Hz and amplitude 1.5mm at X, Y and Z direction for 2 hours each

Drop test

Drop shock from height of 1m, 10pcs in packing

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 isopropyl alcohol or ethyl alcohol, do not use water, ketone or aromatics. Never scrub the polarizer 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 XIAMEM OCULAR
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 sprays on skin or clothes, please wash it off immediately with 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 on display such as the LSI pads and the copper leads on the PCB.
3. Do not touch the connection terminals of the display with bare hand; it may 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$\pm$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.