# XIAMEN OCULAR

GDM0802A-NSW-BBS

SPECIFICATIONS OF LCD MODULE

Features

1. 5x8 dots, 8x2 characters
2. Built-in controller ST7066U or Equivalence
3. +3.3V power supply
4. 1/16 duty cycle
5. Easy interface with 4-bit or 8-bit MPU
6. STN blue LCD, transmissive mode, negative display,
7. 6 O'clock viewing direction
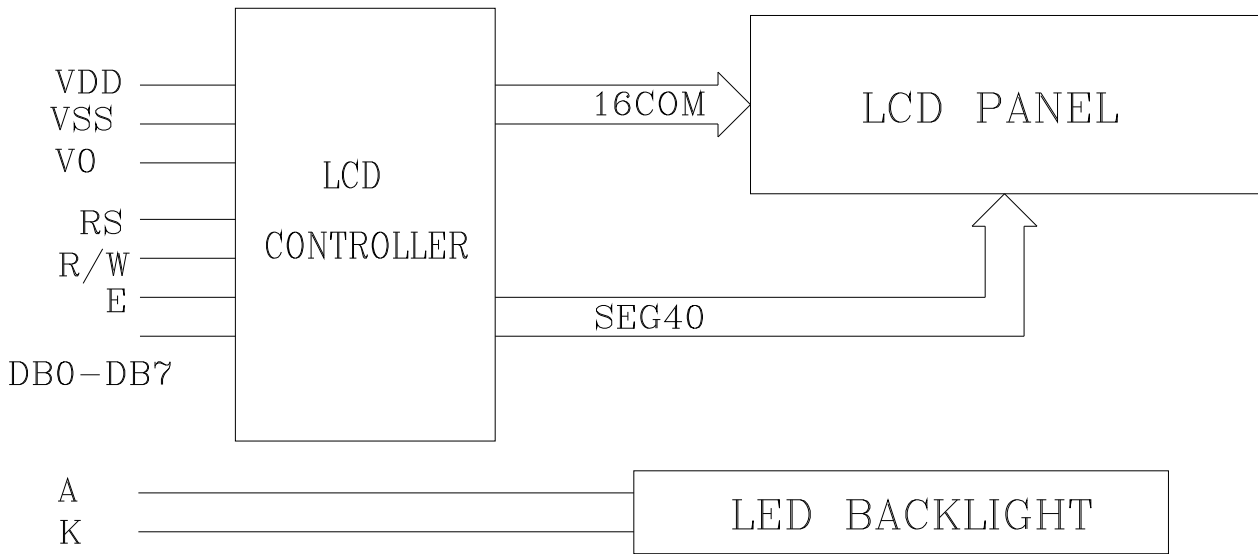8. Side type LED backlight, white color
9. Working temperature range -0℃ to 50℃

Outline dimension
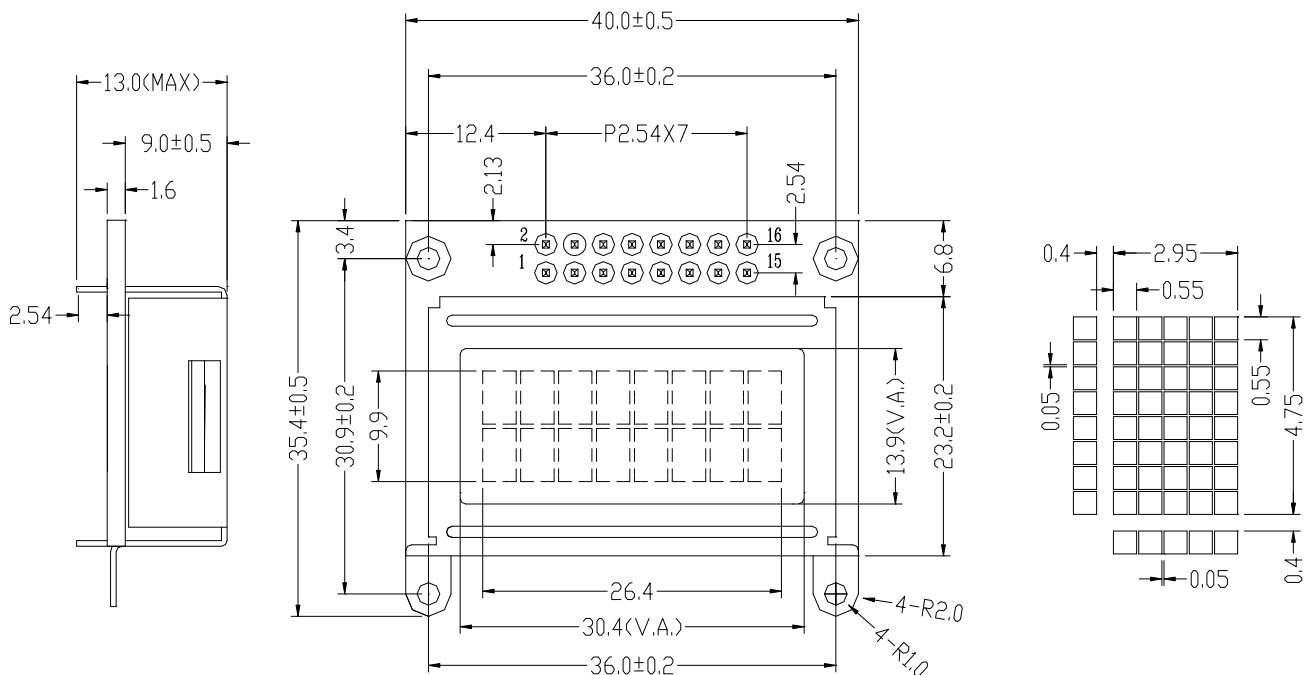
Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	V_{DD}-V_{SS}	-0.3	-	7.0	V
Input voltage	V_{IN}	-0.3	-	V_{DD}+0.3	
Operating temperature range	T_{OP}	0	-	+50	℃
Storage temperature range	T_{ST}	-10	-	+60	

GDM0802A-NSW-BBS

Block diagram

```
VDD ───┐
VSS ───┤     ┌──────────┐                    ┌────────────────────┐
V0  ───┤     │          │──16COM──▷          │                    │
       │     │   LCD    │                    │     LCD PANEL      │
RS  ───┤     │CONTROLLER│                    │                    │
R/W ───┤     │          │                    └────────────────────┘
E   ───┤     │          │──SEG40──────────────────△
       │     │          │
DB0-DB7┤     └──────────┘

A  ─────────────────────────────┌────────────────────┐
K  ─────────────────────────────│   LED BACKLIGHT    │
                                 └────────────────────┘
```

Interface pin description

| Pin no.	Symbol	External connection	Function
1	V_{SS}	Power supply	Signal ground for LCM (GND)
2	V_{DD}		Power supply for logic for LCM (+5.0V DC)
3	V_0		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	Four low order bi-directional three-state data bus lines. Used for data transfer between the MPU and the LCM. These four are not used during 4-bit operation.
11~14	DB4~DB7	MPU	Four high order bi-directional three-state data bus lines. Used for data transfer between the MPU
15	A	Backlight power supply	LED+ (+5V)
16	K		LED- GND

Contrast adjust

```
┌──────────────┐
│              │  VDD ──────┬──────────┐
│  LCM   V0 ──▷│──VR│       │        ─┬─ 5V
│              │            │         ─┴─
│          VSS │────────────┴──────────┘
└──────────────┘
```
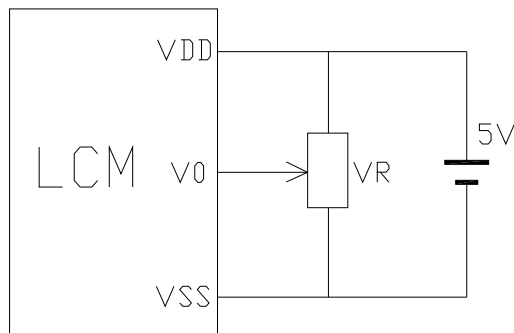
V_{DD}-V_0: LCD Driving voltage

VR: 10k~20k

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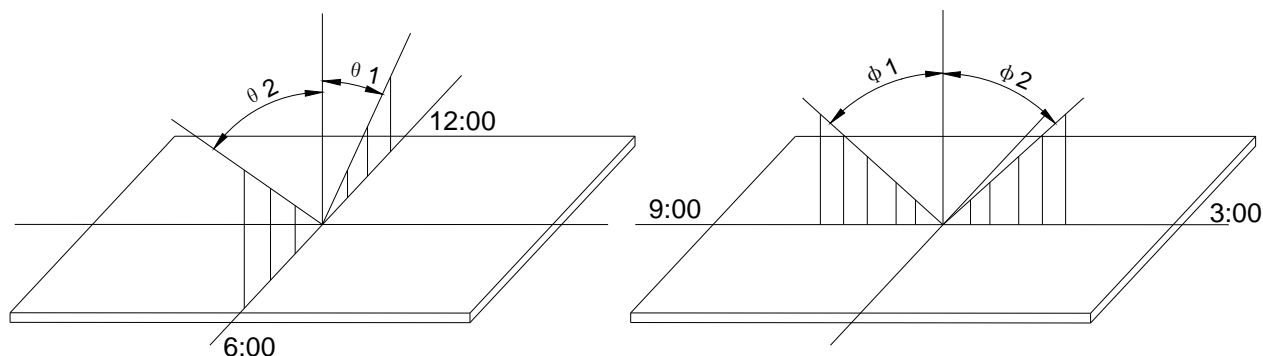
STN type display module (Ta=25℃, V_{DD}=5.0V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	θ	Cr≥2	-60	-	35	deg
	Φ		-40	-	40	
Contrast ratio	Cr		-	6	-	-
Response time (rise)	Tr	-	-	190	290	ms
Response time (fall)	Tr	-	-	200	300	

Electrical characteristics

DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_{DD}-V_0	Ta =25℃	-	4.5	-	V
Input voltage	V_{DD}		2.7	5.0	5.5	
Supply current	I_{DD}	Ta=25℃, V_{DD}=5.0	-	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 current	I_F	R=150 Ohm,V_{DD}=5.0	-	12	15	mA

Read cycle (Ta=25℃, 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		10	-	-	
Data output delay	t_d	DB0~DB7	-	-	100	
Data hold time	t_{dh}		10	-	-	

Read mode timing diagram

Write cycle (Ta=25℃, V_DD=5.0V)

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

Write mode timing diagram
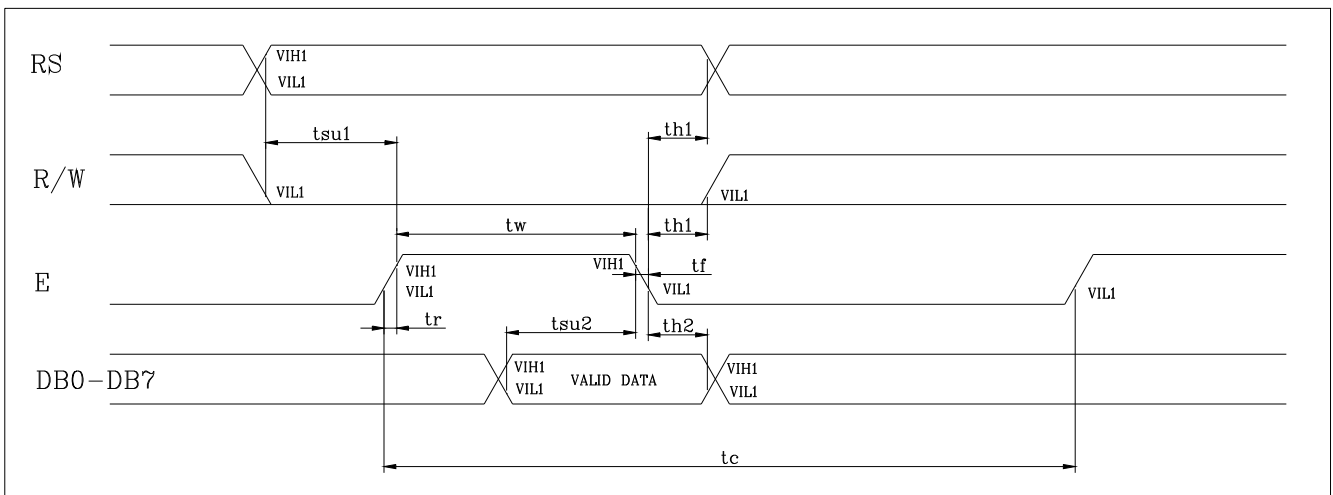
Instruction description

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.

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

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

Character pattern table (ROM) — image of character glyphs indexed by Upper 4bit (columns: LLLL, LLLH, LLHL, LLHH, LHLL, LHLH, LHHL, LHHH, HLLL, HLLH, HLHL, HLHH, HHLL, HHLH, HHHL, HHHH) and Lower 4bit (rows: LLLL, LLLH, LLHL, LLHH, LHLL, LHLH, LHHL, LHHH, HLLL, HLLH, HLHL, HLHH, HHLL, HHLH, HHHL, HHHH).

Specification of Quality Assurance

1 Purpose

This specification provides the product technical conditions, quality inspection, reliability test and the method of packing, transport and storage for GDM0802A LCD module.

2 Scope of application

This specification applies to GDM0802A character dot matrix LCD module.

3 Requirements

3.1 All specs of GDM0802A character dot matrix module should be compliant to this specification.

3.2 The module structure, outline dimension, viewing area, display mode, viewing angle and pin-out interface for GDM0802A should conform to the design drawing approved by client.

3.3 The cosmetic quality criteria of GDM0802A are specified in table 1.

Table 1. LCM Cosmetic Quality Criteria

ITEM	INSPECTION CRITERIA
Outline Dimension	Conforms to design drawing spec or sample approved by client
Interface	Conforms to design drawing spec or sample approved by client
Display Mode	Conforms to design drawing spec or sample approved by client
Component Soldering	(1)Rejected when component is not attached on soldering surface and sticking up (2)Rejected when solder covers less than 2/3 of soldering area or component is not connected to soldering area
Metal Frame	(1)Surface of metal frame should be clean and smooth. The scratch of coating or roasted lacquer layer is according to following standard: Width and Length of scratch Numbers allowed W≤0.10; L≤5.0 3 W≤0.20; L≤3.0 2 W≤0.30; L≤3.0 1 Rejected when scratch exceeds the above spec. (2) Shape of frame should conform to design drawing spec, out of shape is not allowed.
Adhesive Sealing	(1) Too small adhesive area to cause exposure of IC pin (Free of soldering-proof area) on PCB is rejected. (2) Exposure of chip bonding wire on COB board is rejected. (3) Bubble size on surface of adhesive sealing exceeding 0.5mm is rejected.
PCB Board	(1)Size of drill hole on PCB board should conform to design drawing spec or sample approved by client. (2)Printing the non-concerned text or symbol on PCB is rejected.

3.4 Function test criteria of GDM0802A are specified in table 2.

Table 2. LCM Function Test Criteria

ITEM		INSPECTION CRITERIA
Display Pattern		Rejected when display the following patterns: a. Missing horizontal or vertical line; b. Uneven contrast of display pattern; c. Glimmering or jumping pattern; d. Disorder of display function; e. No display or light display.
Pattern Defect	Rainbow	Viewing at specified viewing angle range, more than two color rainbow on display panel inspected by naked eye is not allowed.
	Extra or Missing pattern	Not allowed
	Pattern Intrusion or Protrusion	(1) a x b>0.2x0.2mm^2 Not allowed (2) a or b>1/5D Not allowed (3) When size of a or b is less than or equal to the above range, the total number of pattern intrusion or protrusion should not exceed 4.

LED Backlight Defect	Transmissive type LCD	Spot of LED backlight:
		  Diameter of spot Number allowed
		  Dia.≤0.10mm Ignored
		0.10mm<Dia.≤0.20mm 6
		0.20mm<Dia.≤0.25mm 5
		0.25mm<Dia.≤0.40mm 3
		0.40mm<Dia. 0

Function Defect		The followings are not allowed: a. No function switch; b. Slow response time.

3.5 Defects like bad alignment layer and fluid leakage are not allowed on the display panel.

3.6 Electrical and optical parameters for GDM0802A LCM refer to Table 3.

Table 3. 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		150	250	ms
	t_d		150	250	
Viewing Angle (Cr=3)	θ	45	-	60	deg
	Φ	-40	-	40	
Operating Temp.	T_{OP}	-20~+70			℃
Storage Temp.	T_{ST}	-25~+80			
Minimum Life Time	τ	≥50000			h

3.7 Reliability Test

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

3.7.1 Low Temperature and Storage Test

Wide temperature type -30 ℃ 500 Hours   Restore 12 Hours

Standard temperature type -20℃ 500 Hours   Restore 12 Hours

3.7.2 High Temperature and Storage Test

Wide Temperature type 80 ℃ 500 Hours   Restore 12 Hours

Standard temperature type 70℃ 500 Hours   Restore 12 Hours

3.7.3 Humidity Test

40±2℃, RH=93±2%   500 Hours   Restore 12 Hours

3.7.4 Temperature Shock Test

-20℃ 30Min → 25℃ 30min → 70℃ 30Min → 25℃ 30Min → -20℃ 30Min 10 Cycles, Restore   12 Hours

3.7.5 Vibration Test

Sweep for 3 min at 10Hz, and amplitude 2mm at 10Hz for 2 hours each in X, Y and Z direction

3.7.6 Drop Test

Drop shock from height of 1m 10pcs in packing

3.8 The LCM Must Have Following Distinct Marks:

a)   Brand of manufacturer.

b)   Part Number: GDM0802A-XXX-XXX

a)   Product qualified label.

b)   Lot number or date of manufacture

4   General experiment or test condition (Tc)

Operating Voltage: V_{DD}=Driving Voltage of IC;

Environmental Temperature: To=25±3℃;

Environmental Humidity: RH≤70%

5　Inspection procedure

To guarantee the display in accordance with the technical spec, product inspection must be carried out in manufacturing and outgoing process.

5.1 Cosmetic and Display Function Inspection

This inspection includes all batch inspection of GDM0802A module. Unless otherwise specified, all cosmetic items inspected are be carried out with bare-eye inspection at the condition of normal illumination & eyesight and 25cm distance between inspector eye and module.

The items for cosmetic and display function inspection are shown in Table 4.

5.2 Outgoing Inspection

Before products are shipped out of factory, outgoing inspection is implemented according to the relevant regulation in this specification. All acceptance items must be passed prior to the delivery.

The items for outgoing AQL level are also shown in Table 4.

Table 4. Items for cosmetic and display function inspection

ITEM	REQUIREMENT	CONDITION	METHOD	COSMETIC AND FUNCTION INSPECTION	OUTGOING INSPECTION AQL
Structure and Size	Chapter 3.2	Power Off	Measuring Tool	Random Sampling 20~25 Pcs	2.0
Cosmetic	Chapter 3.3	Power Off	Measuring Tool or Visual Check	100% Inspection	2.0
Display Function	Chapter 3.4, 3.5	Power Off or Whole Screen Display	Eye Check or Inspection with Power On.		0.65
Marks	Chapter 3.8	Power Off	Visual Check		2.0

6　Packing, Transportation, storage

6.1　Packing Content

6.1.1　Package for GDM0802A LCM is anti-static bag (or shield bag) and carton box inside, and hard carton outside.

6.1.2　After LCM are packed into anti-static bag and put in box, separate alignment in good order with tight press and fixed position is required.

6.1.3　Unless otherwise specified, packing carton should be marked with description of P/N, quantity, date of manufacture, etc. and symbols of 'TAKE CARE' 'UP SIDE' 'NO WET'.

6.2　Transportation

Unless otherwise specified, carton with LCM can be carried by any means of transport. During transportation, being wet by rain, mechanical strike, close to corrosive materials such as acid and alkali etc. should be avoided.

6.3　Storage

6.3.1 Unless otherwise specified, LCM should be stored in circumstance of –20~+60℃ temperature range with relative humidity RH≤80%, good ventilation and free of corrosiveness.

6.3.2 After the LCM qualified is packed into warehouse, the storage time is generally less than half year. If the storage is longer than the time, the LCM should be re-inspected and qualified prior to shipping and use.