

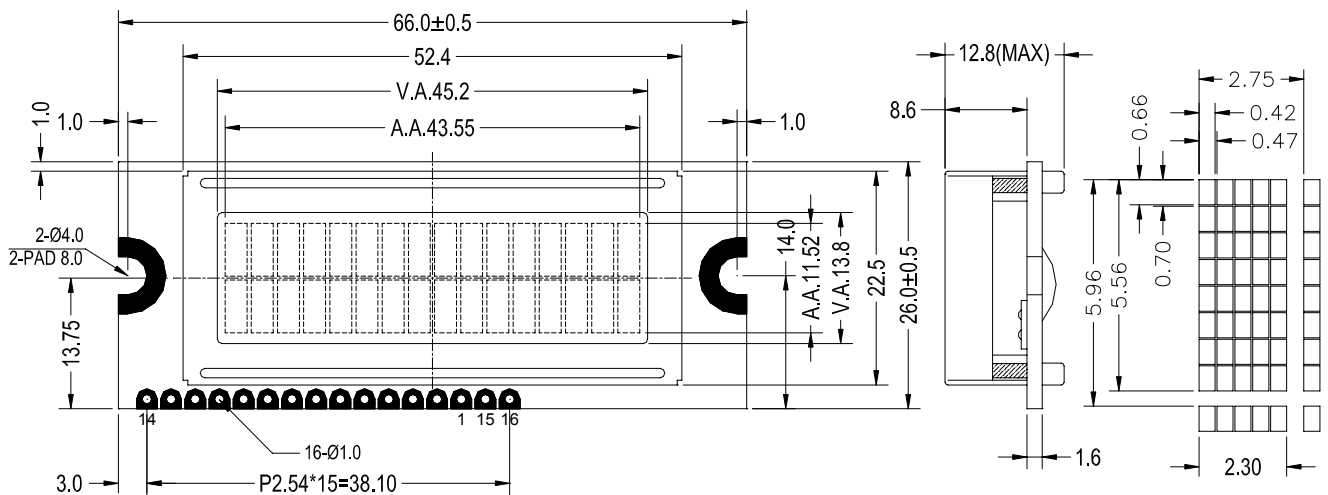
GDM1602AN-FL-YBW-1

SPECIFICATIONS OF LCD MODULE

Features

1. 5x8 dots
2. Built-in controller (ST7070-0B)
3. +5V power supply
4. Interface with 4-bit , 8-bit
5. Display Mode: STN(Yellow-Green), positive, transfective
6. 1/16 duty cycle
7. Viewing angle: 6:00 O'clock
8. Backlight(yellow-green) to be driven by pin 15, pin 16
9. 16*2 characters

Outline dimension

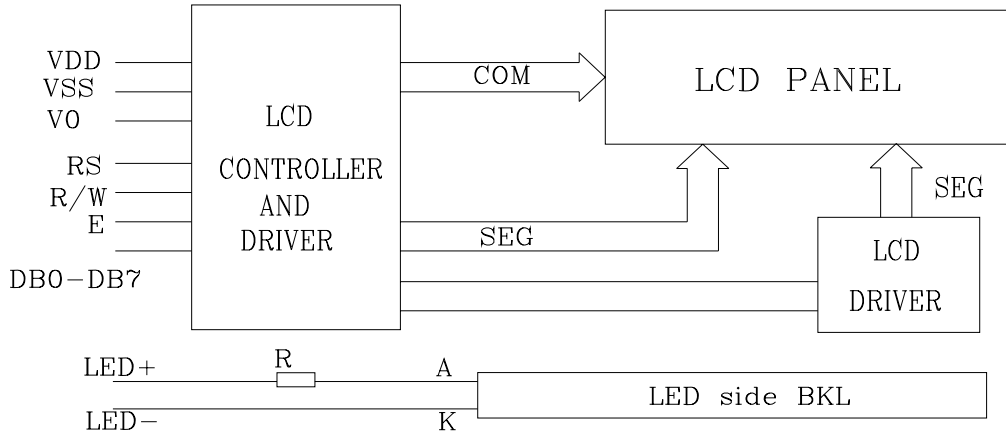


Unit:mm

Absolute maximum ratings

Item	Symbol	Standard	Standard	Standard	Unit
Power voltage	$V_{DD}-V_{SS}$	0	-	5.5	V
Input voltage	V_{IN}	V_{SS}	-	V_{DD}	
Operating temperature range	T_{op}	-20	-	+70	°C
Storage temperature range	T_{st}	-30	-	+80	

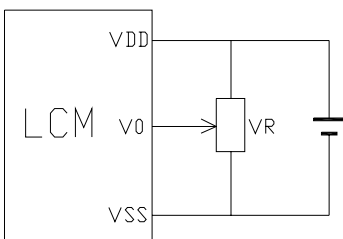
Block diagram



Interface pin description

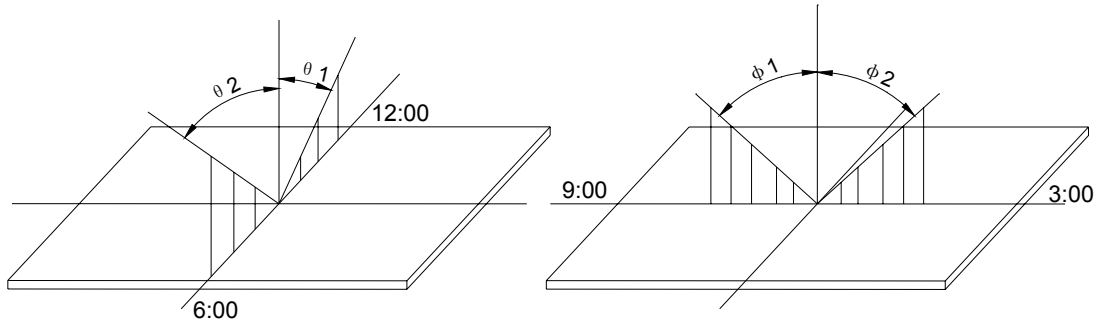
Pin no.	Symbol	External connection	Function
1	V _{SS}	Power supply	Signal ground for LCM (GND)
2	V _{DD}		Power supply for logic (+5V) for LCM
3	V ₀		Contrast adjust
4	RS	MPU	Register select signal
5	R/W	MPU	Read/write select signal
6	E1	MPU	Operation (data read/write) enable signal
7~10	DB0~DB3	MPU	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 tristate data bus pins. Used for data transfer and receive between the MPU and the ST7070. DB7 can be used as a busy flag.
15	LED-	LED BKL power supply	Power supply for BKL (GND)
16	LED+		Power supply for BKL (+5.0V)

Contrast adjust



V_{DD}-V₀: LCD Driving voltage
 VR: 10k~20k

Optical characteristics



STN type display module (Ta=25°C, VDD=5.0V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle	$\theta 1$	$C_r \geq 2$	-	20	-	deg
	$\theta 2$		-	40	-	
	$\Phi 1$			35		
	$\Phi 2$			35		
Contrast ratio	C_r		-	10	-	-
Response time (rise)	T_r	-	-	200	250	ms
Response time (fall)	T_r	-	-	300	350	

Electrical characteristics

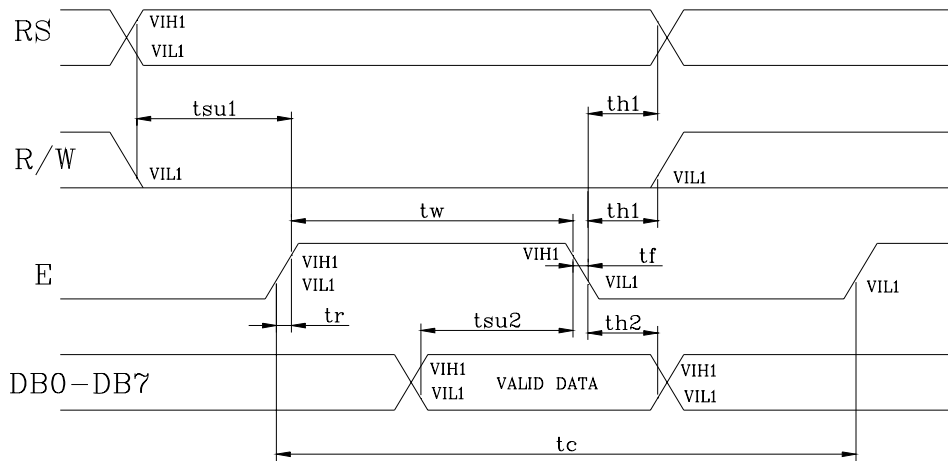
DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	V_0-v_{SS}	Ta =25°C	-	4.6	-	V
Input voltage	V_{DD}		4.7	5.0	5.3	
Supply current	I_{DD}	Ta=25°C, VDD=5.0V	-	1.5	2.0	mA
Input leakage current	I_{LKG}		-	-	1.0	uA
“H” level input voltage	V_{IH}		2.5	-	V_{DD}	V
“L” level input voltage	V_{IL}		-0.3	-	0.6	
“H” level output voltage	V_{OH}	LOH=-0.1mA	3.9	-	V_{DD}	
“L” level output voltage	V_{OL}	LOH=0.1mA	-	-	0.4	
Backlight supply voltage	V_F		3.8	4.0	4.3	
Backlight supply current	I_F	VLED=5.0V, R=6.8Ω		100		

Write cycle (Ta=25°C, VDD=5.0V)

Parameter	Symbol	Test pin	Min.	Typ.	Max.	Unit
Enable cycle time	t_c	E	40	-	-	ns
Enable pulse width	t_w		40	-	-	
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 setup time	t_{su2}	DB0~DB7	20	-	-	
data hold time	t_{h2}		10	-	-	

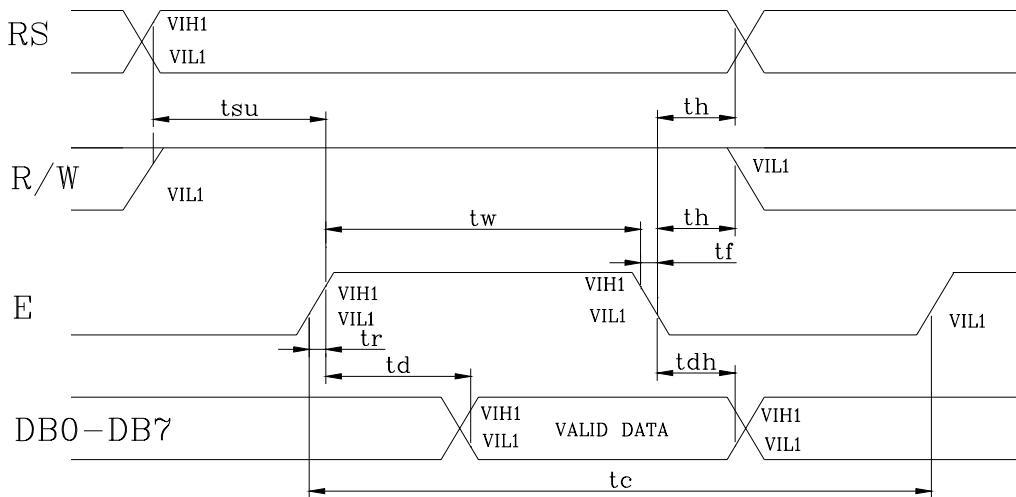
Write mode timing diagram



Read cycle (Ta=25°C, VDD=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 setup time	t_d	DB0~DB7	-	-	100	
data hold time	t_{dh}		10	-	-	

Read mode timing diagram



Instruction description

Outline

To overcome the speed difference between the internal clock of ST7070 and the MPU clock, ST7070 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) ST7070 function set instructions (set display methods, set data length, etc.)
- 2) Address set instructions to internal RAM

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- 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.

Instruction Table

Instruction	Instruction code										Description	fosc=270 KHZ	
	RS	R/W	DB7	DB6	DB 5	DB4	DB3	DB2	DB 1	DB0			
EXT=0 OR 1													
Clear Display	0	0	0	0	0	0	0	0	0	0	1	Write "20H" to DDRAM and set DDRAM address to "00H"	1.52ms
Return Home	0	0	0	0	0	0	0	0	0	1	-	Set DDRAM address to "00H" and return cursor to its original position if shifted. The contents of DDRAM are not changed.	
Display ON/OFF	0	0	0	0	0	0	1	D	C	P		D=1:entire display on C=1:cursor on P: font table page selection	37us
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.	37us
Function set	0	0	0	0	1	DL	N	EXT	-	-		DL: interface data is 8/4 bits N: number of line is 2/1	37us
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).	37us
Read data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM).	37us
EXT=0													
Entry mode Set	0	0	0	0	0	0	0	1	I/D	S		Assign cursor moving direction And blinking of entire display	37us
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address Counter.	37us
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address Counter.	37us
EXT=1													
Bias resistor Select	0	0	0	0	0	0	0	1	Rb 1	Rb 0		Used internal resistor only provide 1/5 bias mode . Rb[1:0] 00: External Resister 01~11:Internal Resistor	37 us
COM,SEG direction select	0	0	0	1	0	0	C1	C2	S1	S2		C1: com1~8→com8~1 C2: com9~16→com16~9 S1: seg1~40→seg40~1 S2: seg41~80→seg80~41	37us
Set display data length	0	0	1	L6	L5	L4	L3	L2	L1	L0		To specify the number of data bytes(3SPI mode)	37us

Note:

Be sure the ST7070 is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7070. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to Instruction Table for the list of each instruction execution time.

Contents

Instruction Description

EXT=0 or 1

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, bring the cursor to the left edge on the first 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.

Contents of DDRAM does not change.

3) Display ON/OFF control

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

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.

P : Font table selection bit

When P = "Low", it select page 1 of font table.(set DDRAM data bit-8=0)

When P = "High", it select page 2 of font table(set DDRAM data bit-8=1)

4) 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.

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

Note that display shift is performed simultaneously in all the lines.

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	AC Value
0	0	Shift cursor to the left, AC is decreased by 1	AC=AC-1
0	1	Shift cursor to the right, AC is increased by 1	AC=AC+1
1	0	Shift all the display to the left, cursor moves according to the display	AC=AC
1	1	Shift all the display to the right, cursor moves according to the display	AC=AC

5) Function set

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

DL: Interface data length control bit

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

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

When 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.

EXT : Select basic or extended instruction set

When EXT="Low" the commands 'Entry Mode Set', 'Set CGRAM address' and 'Set DDRAM address' can be performed,

when EXT="High" the commands 'Bias resistor select', 'COM,SEG direction select' and 'Set display data length' can be performed. Other command can be executed in both cases.

When EXT="Low" : disable extension instruction

When EXT="High" : enable extension instruction

6) 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

When BF = "High", indicates that the internal operation is being processed. So during this time the next instruction cannot be accepted. The address Counter (AC) stores DDRAM/CGRAM addresses, transferred from IR. After writing into (reading from) DDRAM/CGRAM, AC is automatically increased (decreased) by 1.

7) 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.

8) 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.

EXT=0

9) Entry mode set

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

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.

S: shift of entire display

When DDRAM read (CGRAM read/write) operation or SH="Low", shifting of entire display is not performed. If SH="High" and DDRAM write operation, shift of entire display is performed according to I/D value. (I/D="high". shift left, I/D="Low". Shift right).

10) 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.

11) 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".

EXT=1

12) Bias resistor select

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	Rb1	Rb0

Set internal bias resistor value.

Rb1	Rb0	Description
L	L	External bias resistor select.
L	H	Build-in resistor select (R=2.2K).
H	L	Build-in resistor select (R=6.8K).
H	H	Build-in resistor select (R=9.0K).

13) COM、SEG direction select

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	0	0	C1	C2	S1	S2

The SEG and COM output in ST7070 all have bi-direction control by the register.

COM OUTPUT :

C1	COM1	COM8
0	COM1 ----->	COM8
1	COM8 ----->	COM1

C2	COM9	COM16
0	COM9 ----->	COM16
1	COM16 ----->	COM9

SEG OUTPUT :

S1	SEG1	SEG40
0	SEG1 ----->	SEG40
1	SEG40 ----->	SEG1

S2	SEG41	SEG80
0	SEG41 ----->	SEG80
1	SEG80 ----->	SEG41

14) Set display data length

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	L6	L5	L4	L3	L2	L1	L0

L6	L5	L4	L3	L2	L1	L0	Data length
0	0	0	0	0	0	0	1
0	0	0	0	0	0	1	2
...
1	0	0	1	1	1	0	79
1	0	0	1	1	1	1	80

Only in 3line-SPI interface will use the register to set the number of display data(Max=4F). To write data to DDRAM , send Data Direction Command in 3-pin SPI . Data is latched at the rising edge of SCLK . And the DDRAM column address pointer will be increased by one automatically.

Reset Function

Initializing by Internal Reset Circuit

An internal reset circuit automatically initializes the ST7070 when the power is turned on or hardware reset pin has low. The following instructions are executed during the initialization. The busy flag (BF) is kept in the busy state until the initialization ends (BF = 1). The busy state lasts for 40 ms after VDD rises to 4.5 V.

1. Display clear
2. Function set:
 - DL = 1; 8-bit interface data
 - N = 1; 2-line display
 - EXT=0;disable extension instruction.
3. Display on/off control:
 - D = 0; Display off
 - C = 0; Cursor off
 - P = 0; Page 1 of font table(DDRAM data b8=0)
4. Entry mode set:
 - I/D = 1; Increment by 1
 - S = 0; No shift
5. Bias resistor select:
 - Rb1=0;Rb2=0 select external bias resistor.
6. COM、SEG direction select:
 - C1=0;C2=0;S1=0;S2=0 not reverse.

Note:

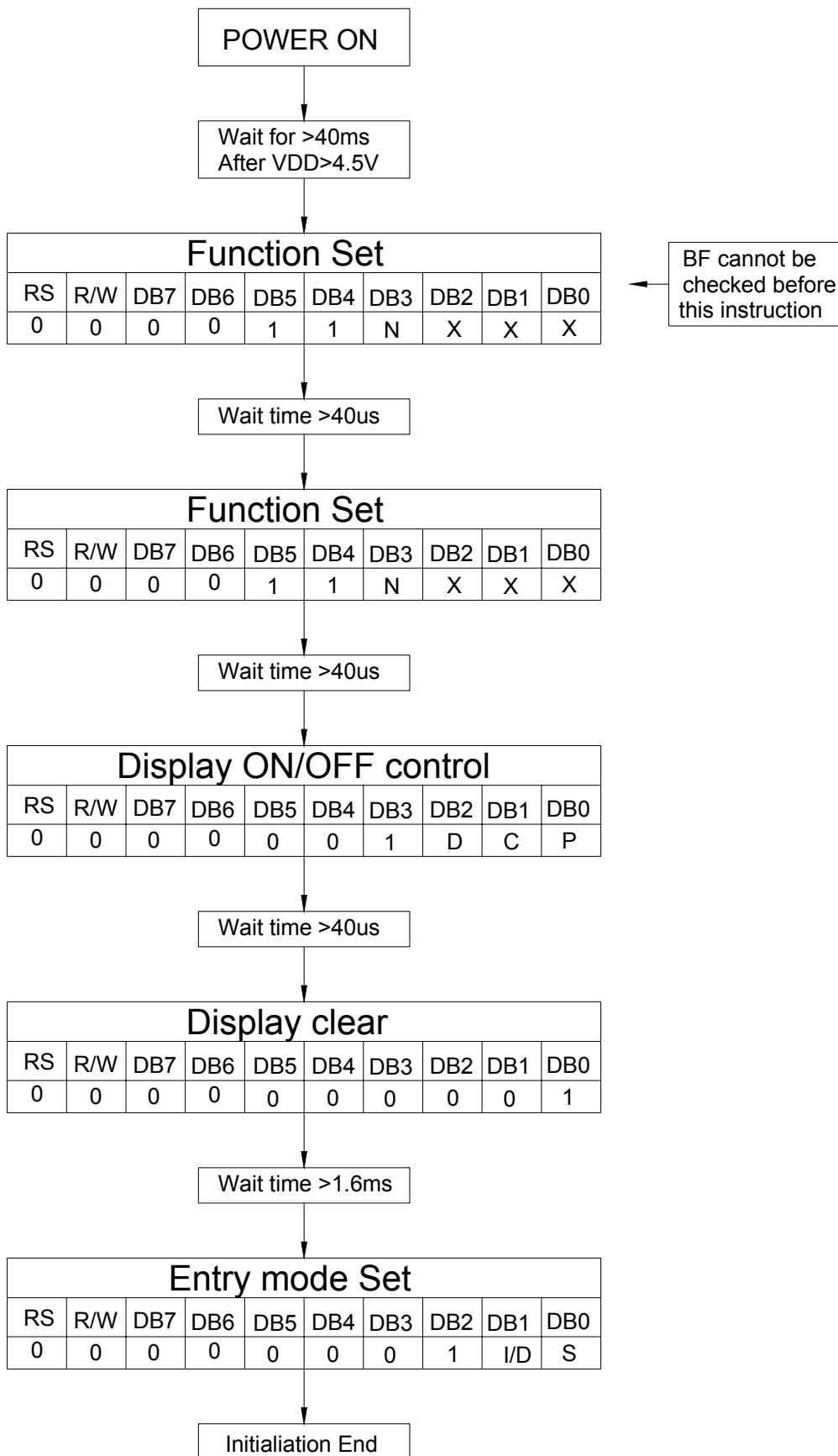
If the electrical characteristics conditions listed under the table Power Supply Conditions Using Internal Reset Circuit are not met, the internal reset circuit will not operate normally and will fail to initialize the ST7070. For such a case, initialization must be performed by the MPU as explain by the following figure.

Display character address code:

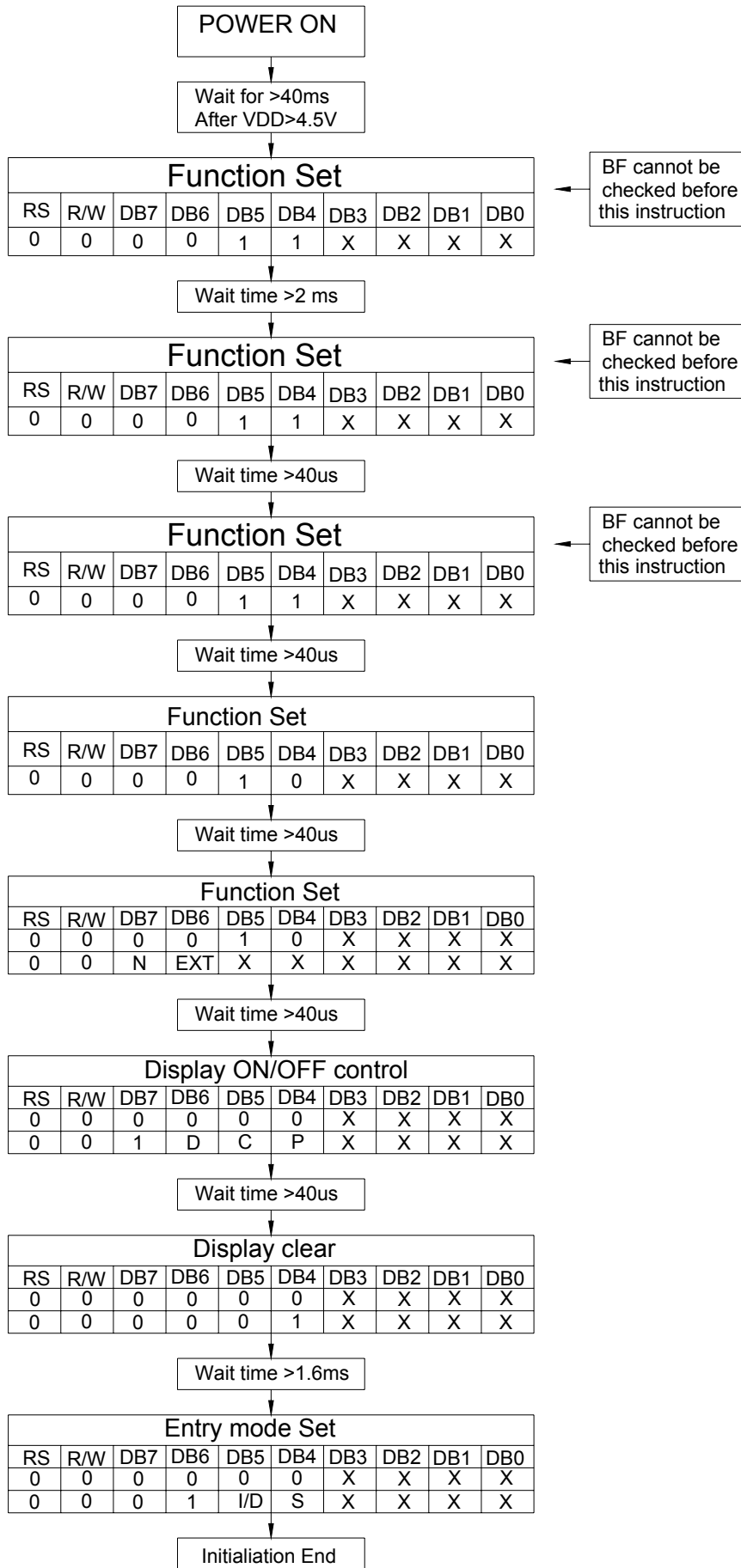
Display position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
DDRAM address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DDRAM address	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F

Initializing by Instruction

- 8-bit Interface (fosc=270KHz)



● 4-bit Interface (fosc=270KHz)



Standard character pattern(ST7070-0B-01) (Command: Display ON/OFF P=0)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)	0	1	2	3	4	5	6	7	8	9	0	A	B	C	D
0001	(2)	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
0010	(3)	T	U	V	W	X	Y	Z	[\]	^	_	0	1	2
0011	(4)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
0100	(5)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
0101	(6)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
0110	(7)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
0111	(8)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
1000	(1)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
1001	(2)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
1010	(3)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
1011	(4)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
1100	(5)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
1101	(6)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7
1110	(7)	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2
1111	(8)	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7

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Standard character pattern(ST7070-0B-02) (Command: Display ON/OFF P=1)

b7-b4 b3-b0	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	1	0		U	.	Р	В	А	В	&	У	Б	В	Э	Т	І
0001	І	У	І	В	І	В	А	В	А	В	В	В	В	В	В	В
0010	І	В	І	В	І	В	І	В	І	В	І	В	І	В	І	В
0011	І	В	І	В	І	В	І	В	І	В	І	В	І	В	І	В
0100	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
0101	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
0110	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
0111	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1000	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1001	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1010	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1011	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1100	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1101	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1110	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В
1111	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В	В

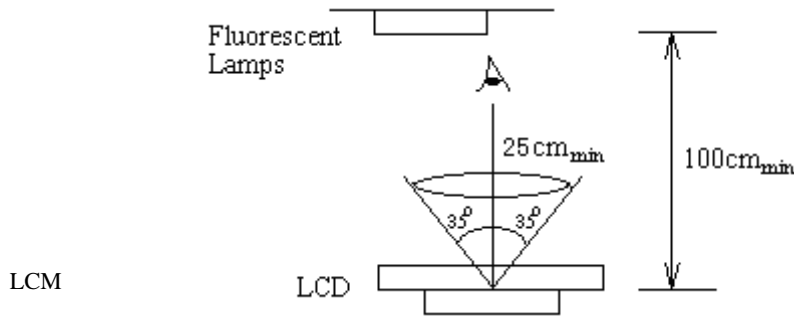
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Quality Specifications

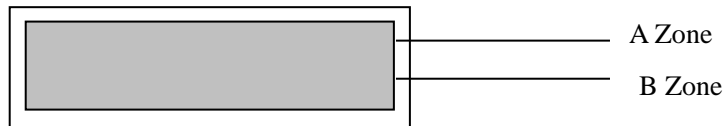
1 STANDARD OF THE PRODUCT APPEARANCE TEST

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 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).

2 SPECIFICATION OF QUALITY ASSURANCE

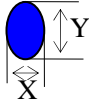
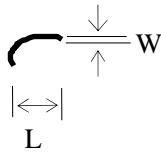
AQL inspection standard

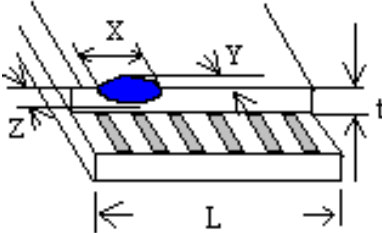
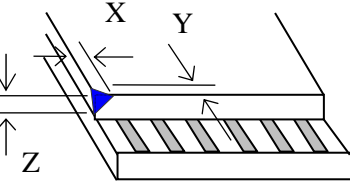
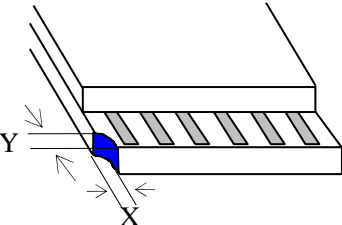
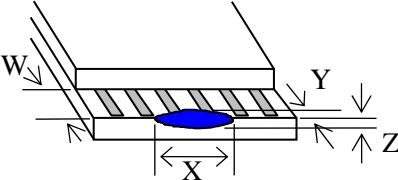
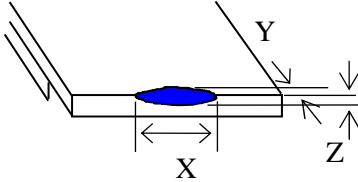
Sampling method: GB2828-87, Level II, single sampling

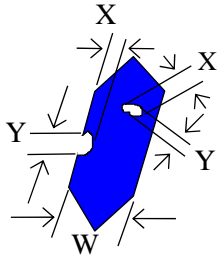
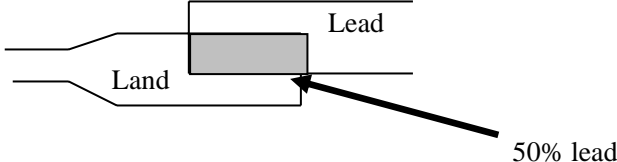
Defect classification (**Note: * is not including**)

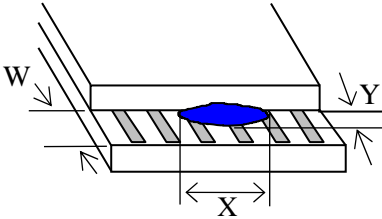
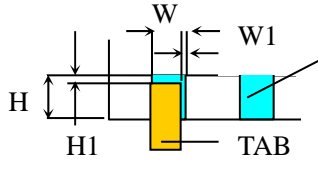
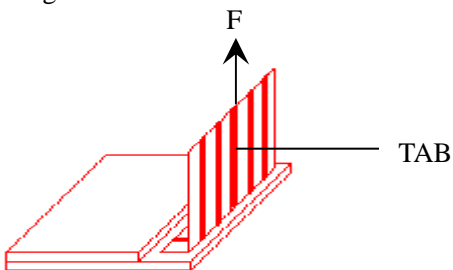
Classify		Item	Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction	2	
		Contrast defect (dim, ghost)		
		Backlight	1,8	
Non-display	Flat cable or pin reverse	10		
	Wrong or missing component	11		
Minor	Display state	Background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

Note on defect classification

No.	Item	Criterion												
1	Short or open circuit	Not allow												
	LC leakage													
	Flickering													
	No display													
	Wrong viewing direction													
	Wrong Back-light													
2	Contrast defect	Refer to approval sample												
	Background color deviation													
3	Point defect, Black spot, dust (including Polarizer)	 <table border="1" data-bbox="861 873 1300 1120"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty.</th> </tr> </thead> <tbody> <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> </tbody> </table> <p style="text-align: center;">Unit: Inch²</p>	Point Size	Acceptable Qty.	$\phi \leq 0.10$	Disregard	$0.10 < \phi \leq 0.15$	2	$0.15 < \phi \leq 0.25$	1	$\phi > 0.25$	0		
	Point Size		Acceptable Qty.											
$\phi \leq 0.10$	Disregard													
$0.10 < \phi \leq 0.15$	2													
$0.15 < \phi \leq 0.25$	1													
$\phi > 0.25$	0													
$\phi = (X+Y)/2$														
4	Line defect, Scratch	 <table border="1" data-bbox="790 1355 1340 1534"> <thead> <tr> <th colspan="2">Line</th> <th rowspan="2">Acceptable Qty.</th> </tr> <tr> <th>L</th> <th>W</th> </tr> </thead> <tbody> <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>$0.15 \geq W > 0.1$</td> </tr> </tbody> </table> <p style="text-align: center;">Unit: mm</p>	Line		Acceptable Qty.	L	W	---	$0.05 > W$	Disregard	$3.0 > L$	$0.1 > W > 0.05$	$2.0 > L$	$0.15 \geq W > 0.1$
			Line			Acceptable Qty.								
			L	W										
			---	$0.05 > W$	Disregard									
$3.0 > L$	$0.1 > W > 0.05$													
$2.0 > L$	$0.15 \geq W > 0.1$													
5	Rainbow	Not more than two color changes across the viewing area.												

No	Item	Criterion																																	
6	<p>Chip</p> <p>Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal width L: Glass length</p>	 <p>Acceptable criterion</p> <table border="1" data-bbox="938 353 1326 432"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>$< L/8$</td> <td>0.5mm</td> <td>$\leq t/2$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="927 667 1326 745"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 2</td> <td>0.5mm</td> <td>$\leq t$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="943 958 1326 1070"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 3</td> <td>≤ 2</td> <td>$\leq t$</td> </tr> <tr> <td colspan="2">shall not reach to ITO</td> <td></td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="927 1339 1326 1417"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>Disregard</td> <td>≤ 0.2</td> <td>$\leq t$</td> </tr> </tbody> </table>  <p>Acceptable criterion</p> <table border="1" data-bbox="927 1619 1294 1697"> <thead> <tr> <th>X</th> <th>Y</th> <th>Z</th> </tr> </thead> <tbody> <tr> <td>≤ 5</td> <td>≤ 2</td> <td>$\leq t/3$</td> </tr> </tbody> </table>	X	Y	Z	$< L/8$	0.5mm	$\leq t/2$	X	Y	Z	≤ 2	0.5mm	$\leq t$	X	Y	Z	≤ 3	≤ 2	$\leq t$	shall not reach to ITO			X	Y	Z	Disregard	≤ 0.2	$\leq t$	X	Y	Z	≤ 5	≤ 2	$\leq t/3$
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X	Y	Z																																	
Disregard	≤ 0.2	$\leq t$																																	
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≤ 5	≤ 2	$\leq t/3$																																	

No.	Item	Criterion								
7	Segment pattern $W = \text{Segment width}$ $\phi = (X+Y)/2$	(1) Pin hole $\phi < 0.10\text{mm}$ is acceptable.  <table border="1" data-bbox="853 492 1316 667"> <thead> <tr> <th>Point Size</th> <th>Acceptable Qty</th> </tr> </thead> <tbody> <tr> <td>$\phi \leq 1/4W$</td> <td>Disregard</td> </tr> <tr> <td>$1/4W < \phi \leq 1/2W$</td> <td>1</td> </tr> <tr> <td>$\phi > 1/2W$</td> <td>0</td> </tr> </tbody> </table> <p style="text-align: right;">Unit: mm</p>	Point Size	Acceptable Qty	$\phi \leq 1/4W$	Disregard	$1/4W < \phi \leq 1/2W$	1	$\phi > 1/2W$	0
Point Size	Acceptable Qty									
$\phi \leq 1/4W$	Disregard									
$1/4W < \phi \leq 1/2W$	1									
$\phi > 1/2W$	0									
8	Back-light	(1) The color of backlight should be in match with the specification. (2) Not allow flickering								
9	Soldering	(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. 								
10	Wire	(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.								
11*	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.								

No	Item	Criterion
12	Protruded W: Terminal Width	 <p>Acceptable criteria: $Y \leq 0.4$</p>
13	TAB	<p>1. Position</p>  <div style="border: 1px solid black; padding: 5px; width: fit-content; margin-left: auto;"> $W1 \leq 1/3W$ $H1 \leq 1/3H$ </div> <p>2. TAB bonding strength test</p>  <p> $P (=F/TAB \text{ bonding width}) \geq 650\text{gf/cm}$,(speed rate: 1mm/min) 5pcs per SOA (shipment) </p>
14	Total no. of acceptable Defect	<p>A. Zone</p> <p>Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm</p> <p>B. Zone</p> <p>It is acceptable when it is no trouble for quality and assembly in customer's end product.</p>

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.

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 isopropyl alcohol, ethyl alcohol or trichlorotrifluoroethane, 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 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 spreads 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.

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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: $280^{\circ}\text{C}\pm 10^{\circ}\text{C}$
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 V_o .
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.