



深圳市茂昇电子有限公司

Shenzhen MaoSheng Electronics CO.,LTD

SPECIFICATION FOR LCD MODULE

CUSTOMER	
MODEL	MS1602J (I2C 5V)
REVISION	1.3

PREPARED	CHECKED	APPROVED

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REVISION RECORD

REV NO	REV DATE	CONTACTS	REMARKS
1.0	2017-7-6	First release	



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1. General Specifications

1.1. Description

This specification is applied to the liquid crystal display module MS1602J It's a STN, NEGATIVE, LCD module and display 16*2 Characters.

1.2 Features

Characters: 16×2 Lines

LCD Mode: STN, Yellow –Green/Blue/Grayish/Orange;

LCD Controller IC: AIP31068L or Equivalent

Driving Method: 1/16 Duty; 1/5Bias

Viewing Angle: 6 O'clock direction

I²C MPU Interface(default) OR 3-SPI MPU Interface

Backlight: LED

Operating Temperature Range: -20 to +70℃ ;

Storage Temperature Range : -30 to +80℃ ;

1.3 Mechanical information

ITEM	SPECIFICATIONS	UNIT
Module Size	80.0L×36.0W×13.0 (max) H	mm
View Area	64.5×16.0	mm
Number of Character	16×2 Lines	—
Character Size	2.96×5.56	mm
Character Pitch	3.55×5.96	mm



2. Absolute Maximum Ratings

Items	Symbol	Min	Max	Unit	Condition
Supply Voltage	Vdd	0	5.2	V	Vss=0V
Input Voltage	Vin	0	Vdd	V	Vss=0V
Operating Temperature	Top	-20	70	°C	No Condensation
Storage Temperature	Tst	-30	80	°C	No Condensation

Note: Voltage greater than above may damage the module
All voltages are specified relative to Vss=0V

3.DC Electrical Characteristics

DC characteristics

Items	Symbol	Test Condition	Min	TYP	Max	Unit
Operating Voltage	V _{DD}		4.5V	5.0	5.5	V
Supply Current	I _{DD}	Use internal Oscillator/external clock(VDD=5V, fosc=250KHz)	—	0.55	0.8	mA
Input High Voltage 1 (Except OSC1)	V _{IH1}	—	2.5	—	Vdd	V
	V _{IL1}	—	-0.3	—	0.6	V
Input High Voltage 2 (Except OSC1)	V _{IH2}	—	Vdd-1.0	—	Vdd	V
	V _{IL2}	—	-0.2	—	1	V
Output High Voltage 1 (DB0~DB7)	V _{OH1}	I _{OH} =-0.205mA	2.4	—	Vdd	V
	V _{OL1}	I _{OL} =1.2mA	—	—	0.4	V
Output High Voltage 2 (Except DB0~DB7)	V _{OH2}	I _O = -40uA	0.9Vdd	—	—	V
	V _{OL2}	I _O =40uA	—	—	0.1Vdd	V
Input Leakage Current	I _{IKG}	V _{IN} =0V~VDD	-1	—	1	uA
Input Low Current	I _{IL}	V _{IN} =0V V _{DD} =5V(pull up)	-50	-125	-250	uA
Internal clock(external Rf)	f _{OSC1}	Rf=91K Ω ±2%, VDD=5V	190	270	350	KHz
External clock	f _{OSC}	—	125	270	410	KHz
	duty		45	50	55	%
	t _R , t _F		—	—	0.2	uS
LCD Driving Voltage	V _{LCD}	V _{DD} -V5(1/5,1/4bias)	3.0	—	11.0	V

VDD=+5.0V, VSS=0V, Ta=-0~+50° C

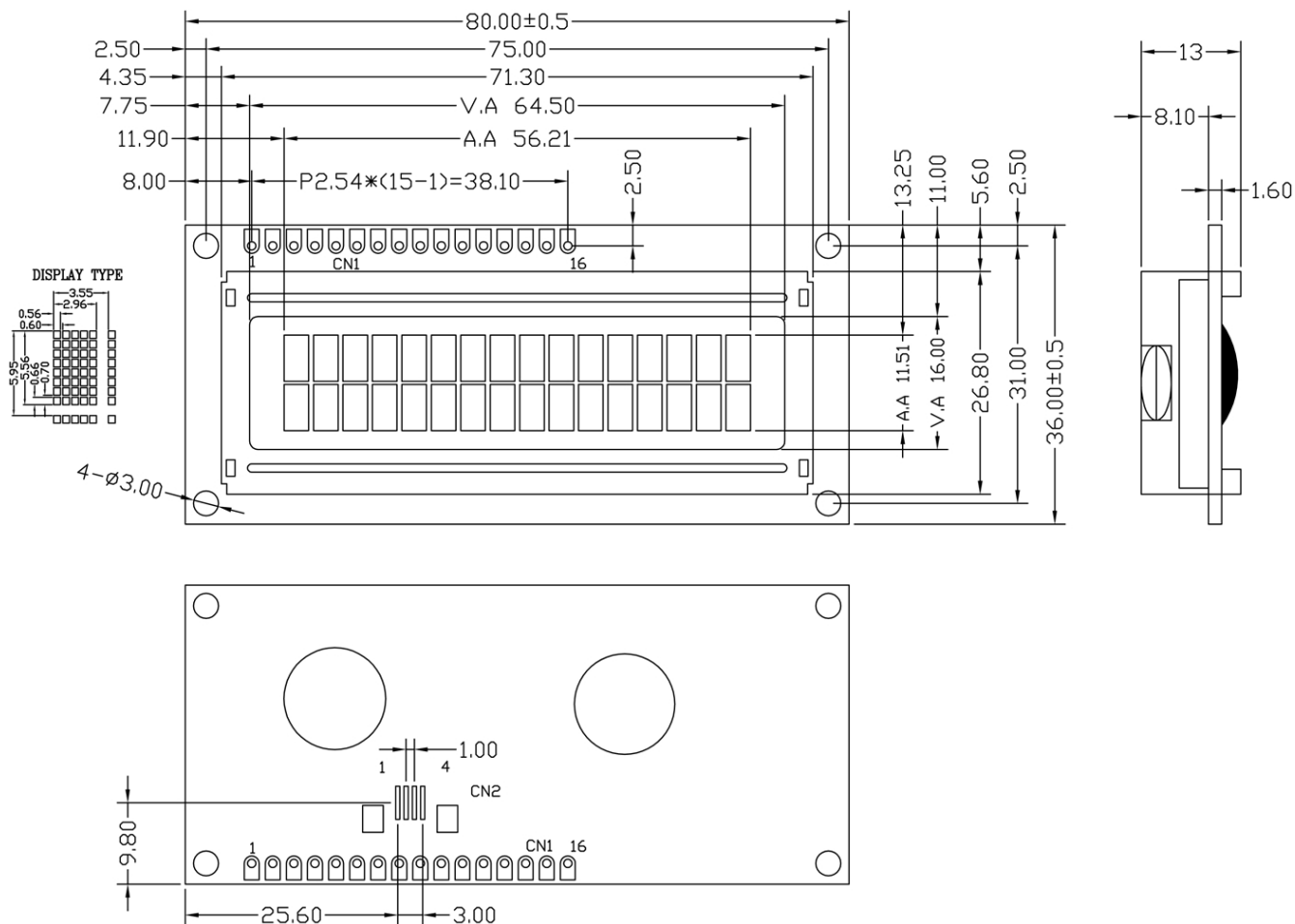


4.AC Characteristics

AC characteristics (VDD=+5.0V, VSS=0V, Ta=-20~70°)

Characteristic	Symbol	Test Condition	Min	TYP	Max	Unit
SCL Cycle Time	f_{SCLK}	I ² C	—	—	400	KHz
SCL Pulse Width	t_{LOW}		1.3	—	—	uS
SCL Rise/Fall Time	t_{HIGH}		0.6	—	—	uS
Address Setup Time	$t_{SU:DAT}$		100	—	—	nS
Address Hold Time	$t_{HD:DAT}$		0	—	0.9	uS
SCL/SDA Rise/Pulse Time	t_r, t_f		20	—	300	nS
START Steup Time	$t_{SU:STA}$		0.6	—	—	uS
START Hold Time	$t_{HD:STA}$		0.6	—	—	uS
STOP Steup Time	$t_{SU:STO}$		0.6	—	—	uS
STOP、START Spacing Interval	t_{BUF}		1.3	—	—	uS

5. Dimensional Drawing





6.Interface Pin Connections

CN1:

Pin No.	SYMBOL	LEVEL	FUNCTION
1	VSS	0V	Power Ground
2	VDD	+5.0V	Power Supply For Logic
3	V0	—	Contrast Adjust
4	SCL	H/L	Serial Clock
5	SDA	H/L	Serial Data
6	CSB	L	Chip selection signal. Active “L”.(IIC:No connection)
7~14	NC	—	No connection
15	LEDA	+5.0V	Power Supply For LED Backlight
16	LEDK	0V	

NOTE: IIC(default) :IIC short, SPI open;

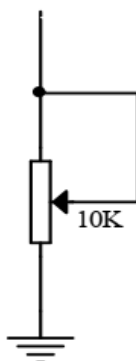
3-SPI: IIC open, SPI short.

CN2:

ITEM	SYMBOL	LEVEL	FUNCTION
1	VSS	0V	Power Ground
2	VDD	+5.0V	Power Supply For Logic
3	SCL	H/L	Serial Clock
4	SDA	H/L	Serial Data

Adjusting The LCD Display Contrast

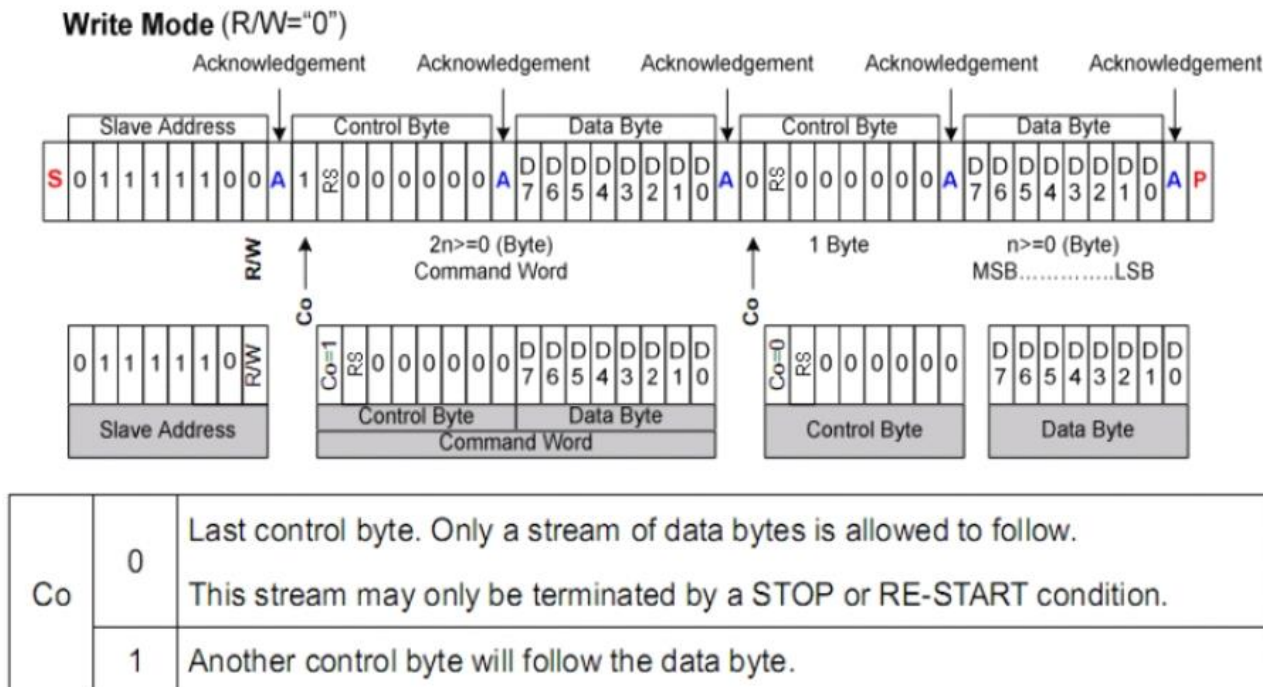
A Variable-Resistor must be connected to the LCD module for providing a reference to V0.The recommended value of the Variable-Resistor is 10K to 20K.



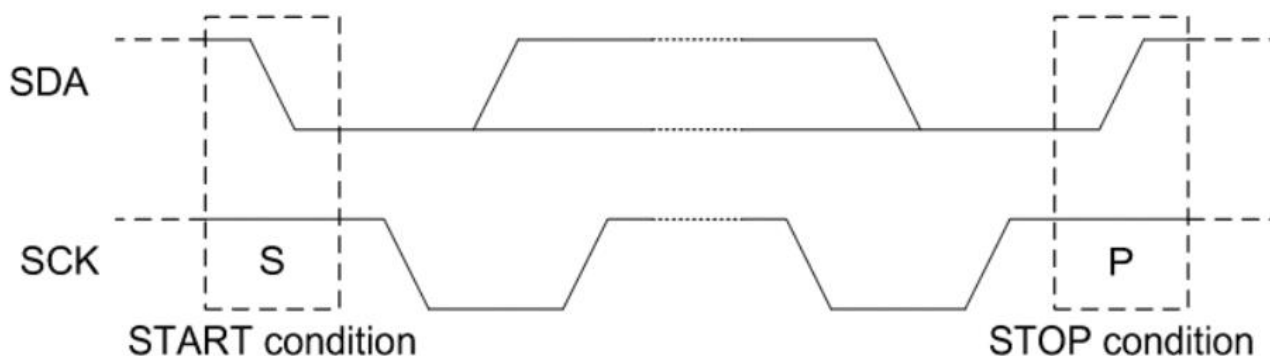


IIC

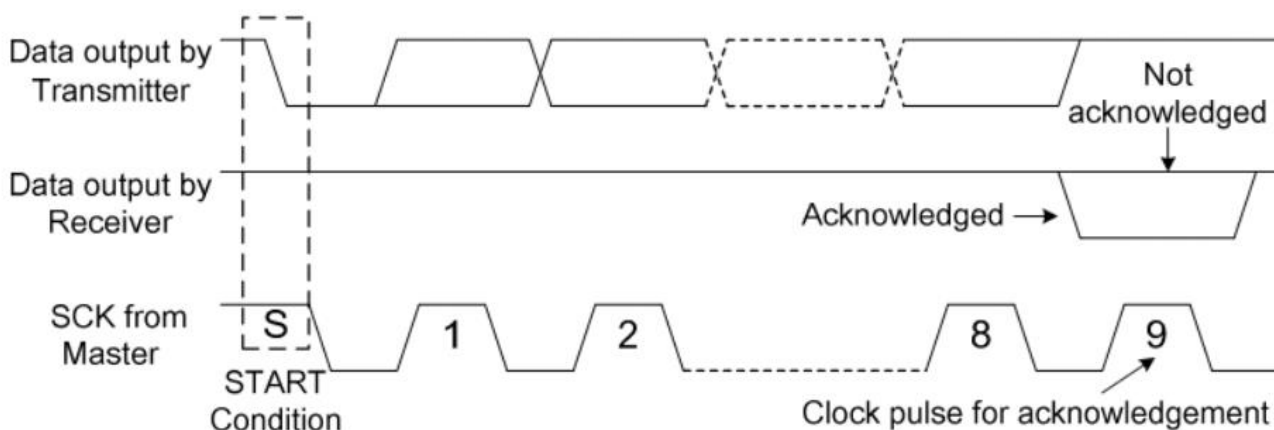
MPU Write Timing



START STOP:



ASK :

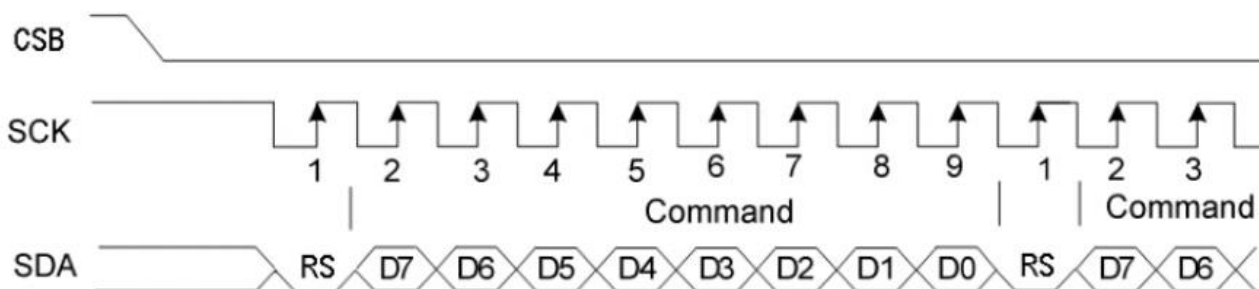




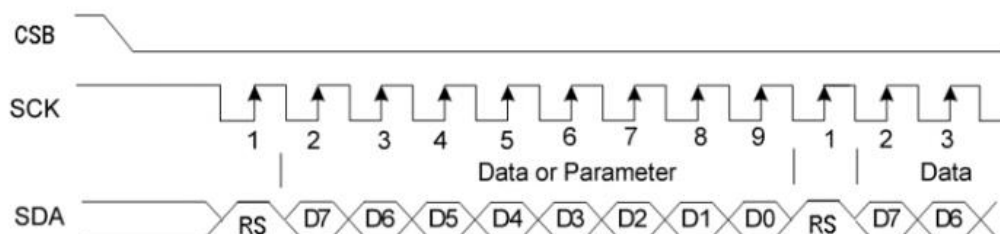
AiP31068L (LCD) Slave Address : 0X7C.

3-SPI:

MPU write timing



MPU read timing



Basic Setting

To drive the LCD module correctly and provide normally display, please use the following setting:

- N=1, 2-line display
- F=0, 5×8 dots font
- D=1, display on

Note:

- These setting/commands should issue to the LCD module while start up.
- See the Display Commands section for details

Resetting the LCD module

When turning on the VDD and VSS power supply, LCD module will execute the reset routine automatically. It takes about 50ms. After the reset routine, the LCD module status will be as follow:

- N=1, 2-line display
- Display clear
- DL=1, 8-bit interface



- F=0, 5×8 dot character font
- D=0, Display off
- C=0, Cursor off
- B=0, Blinking off
- I/D=1, Increment by 1
- S=0, No shift

NOTE:

- Reset routine could not generate the Basic Setting

Display Memory Map

There are two main memory-areas in the LCD module for display.

- Character Generator RAM(CGRAM)
- Display Data RAM(DDRAM)

Character Generator RAM(CGRAM)

Character Generator RAM is for storing the User-defined Characters(5×8 dots font). Totally 8 User-defined Characters(character code = 00h-07h) could be created.

The User-defined Character Codes are 00h and 07h. They could be called into DDRAM as normal character.

User-defined Character Code	CGRAM Address	CGRAM Data (Font Pattern)	
		D7 ~ D5	D4 ~ D0
00h (08h)	00h 01h : 06h 07h	Not Use	5 x 8 dots font pattern
01h (09h)	08h 09h : 0Eh 0Fh	Not Use	5 x 8 dots font pattern
02h (0Ah)	10h 11h : 16h 17h	Not Use	5 x 8 dots font pattern
03h (0Bh)	18h 19h : 1Eh 1Fh	Not Use	5 x 8 dots font pattern
04h (0Ch)	20h 21h : 26h 27h	Not Use	5 x 8 dots font pattern
05h (0Dh)	28h 29h : 2Eh 2Fh	Not Use	5 x 8 dots font pattern
06h (0Eh)	30h 31h : 36h 37h	Not Use	5 x 8 dots font pattern
07h (0Fh)	38h 39h : 3Eh 3Fh	Not Use	5 x 8 dots font pattern

CGRAM Address Map



Display commands

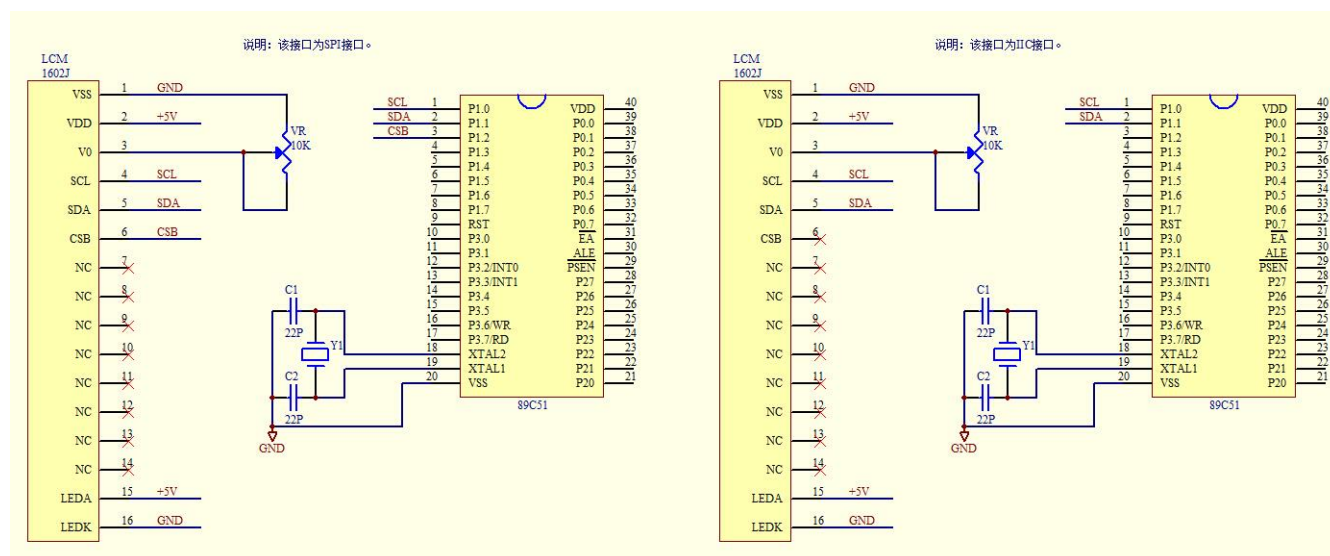
Instruction	RS	D7	D6	D5	D4	D3	D2	D1	D0	Execution time fosc=270KHz	Description
Clear Display	0	0	0	0	0	0	0	0	1	1.53ms	Write "20H" to DDRAM and set DDRAM address to "00H" from AC
Return Home	0	0	0	0	0	0	0	1	-	1.53ms	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Entry Mode Set	0	0	0	0	0	0	1	I/D	SH	39us	Assign cursor moving direction and enable the shift of entire display
Display ON/ OFF Control	0	0	0	0	0	1	D	C	B	39us	Set display (D), cursor(C), and blinking of cursor(B) on/off control bit.
Cursor or Display Shift	0	0	0	0	1	S/C	R/L	-	-	39us	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.
Function Set	0	0	0	1	-	N	F	-	-	39us	Set numbers of display line (N: 2-line/1-line) and, display font type (F:5x10 dots/5x8 dots)
Set CGRAM Address	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	39us	Set CGRAM address in address counter.
Set DDRAM Address	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	39us	Set DDRAM address in address counter
Write Data to RAM	1	D7	D6	D5	D4	D3	D2	D1	D0	43s	Write data into internal RAM (DDRAM/CGRAM).

NOTE:

- Do not use any other commands not listed, or the system malfunction may result.
- For the details of rte display commands, please refer to AIP31068L datasheet.

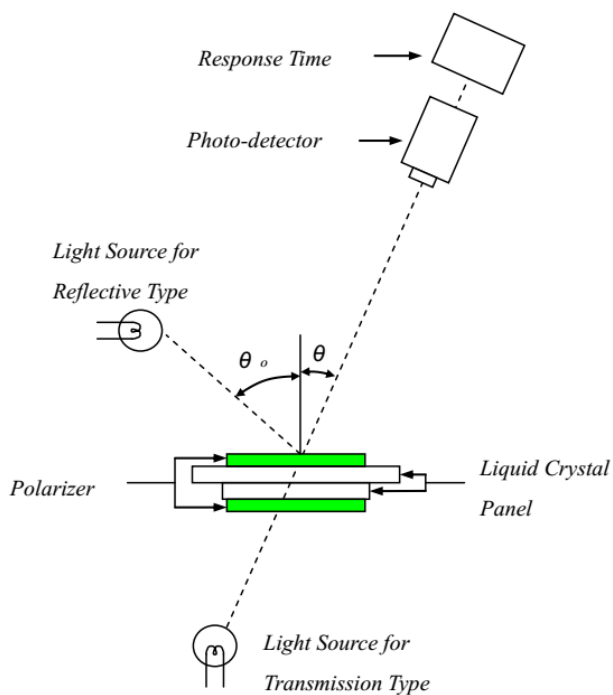


Application Circuits



7. Electro-optical Characteristics

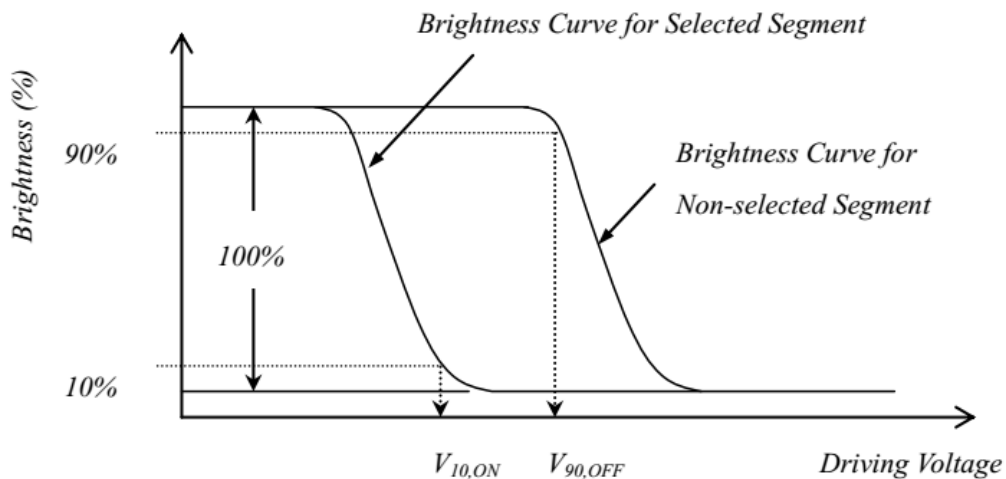
7.1. Electro-Optical Characteristics Test Method



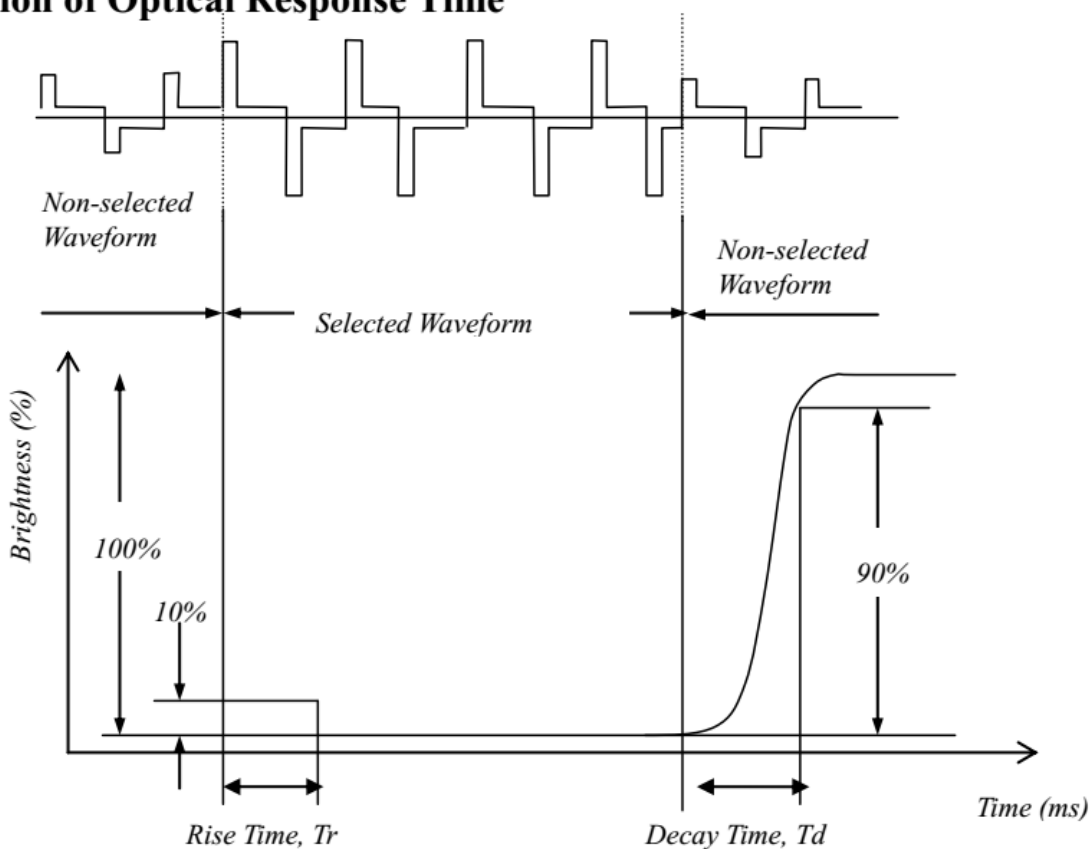


7.2. Definition of Operating Voltage V_{op}

$$V_{op} = (V_{10,ON} + V_{90,OFF})/2$$

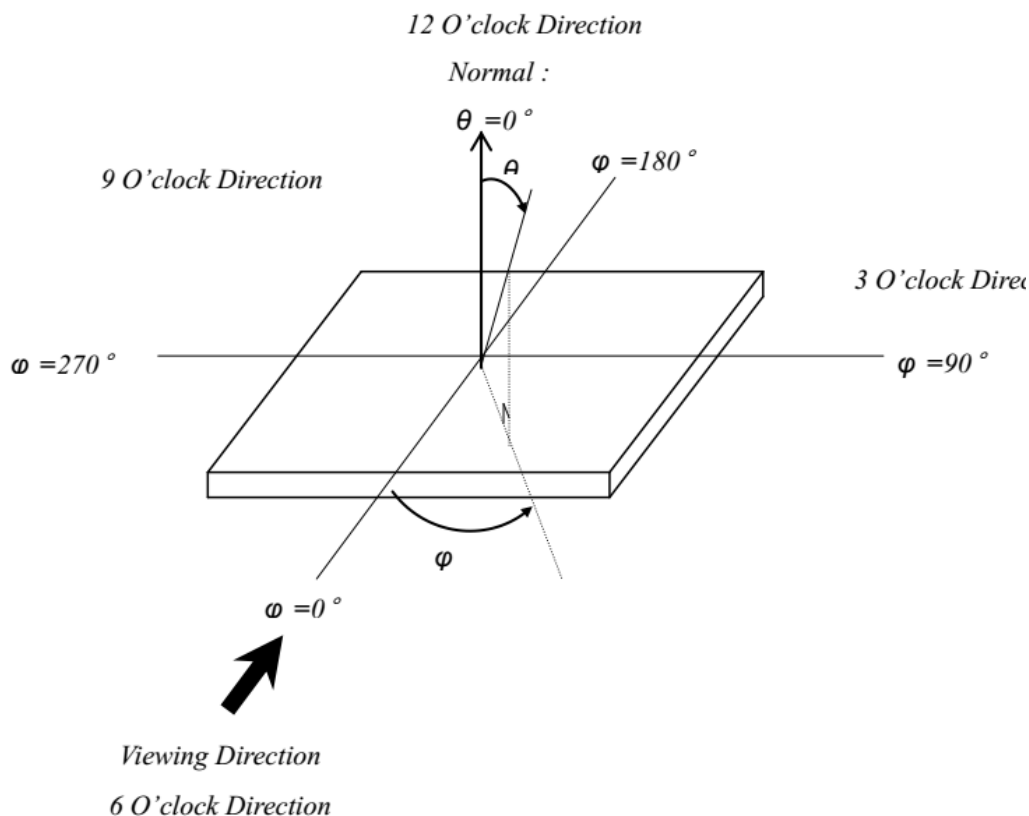


7.3. Definition of Optical Response Time



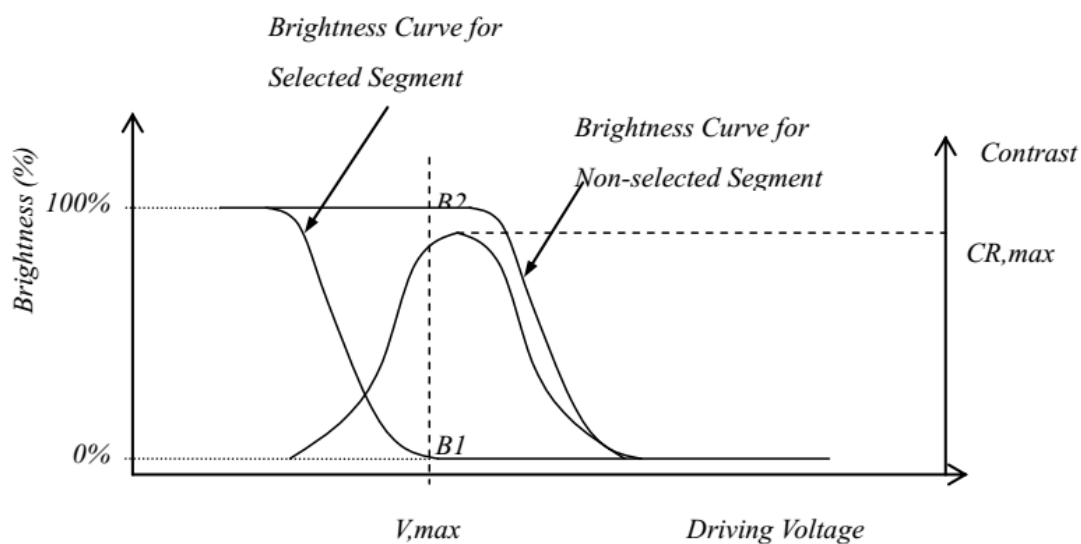


7.4. Definition of Viewing Angle



7.5. Definition of Contrast ratio, CR

$$CR = \frac{\text{Brightness of Non-selected Segment (B2)}}{\text{Brightness of Selected Segment (B1)}}$$





8. Inspection Criteria

8.1. Inspection Conditions

8.1.1 Environmental conditions

The environmental conditions for inspection shall be as follows

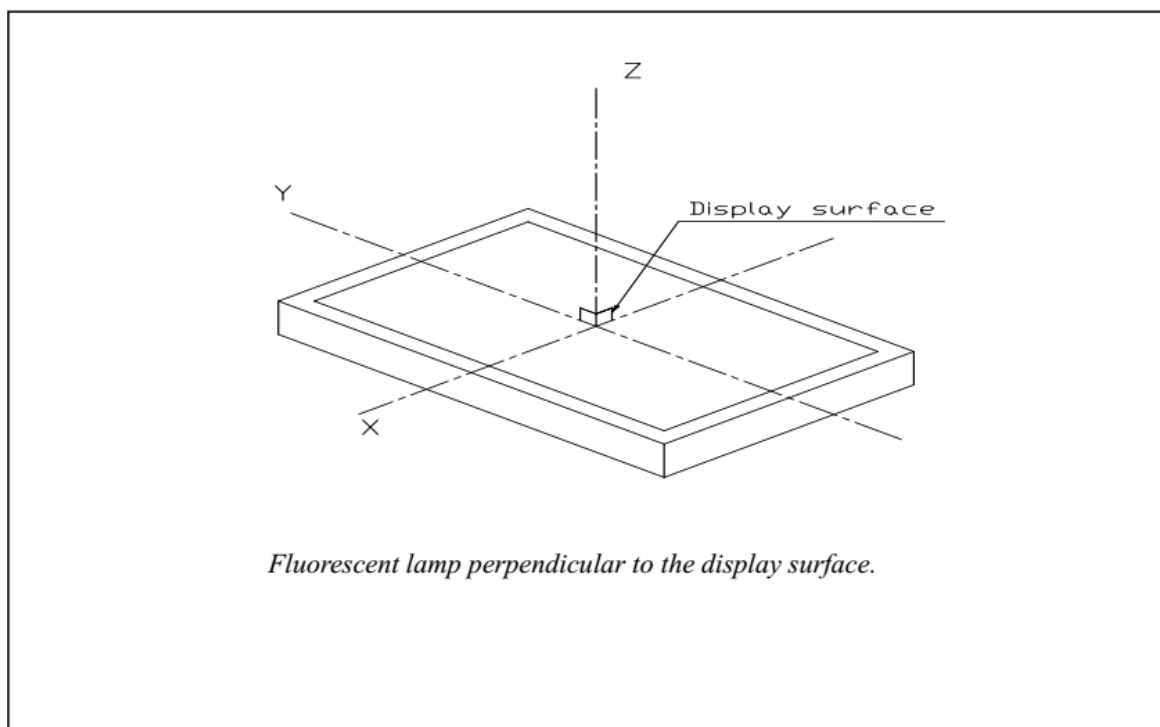
Room temperature: $20\pm 3^{\circ}\text{C}$

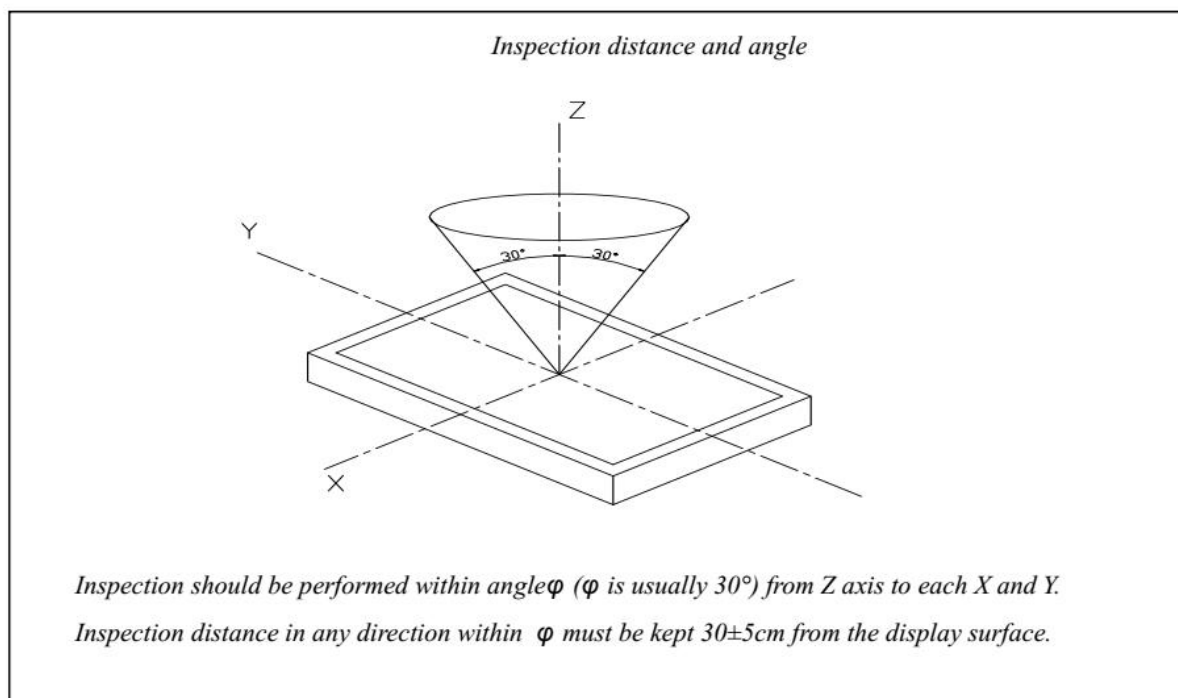
Humidity: $65\pm 20\%RH$

8.1.2 The external visual inspection

With a single 20-watt fluorescent lamp as the light source, the inspection was in the distance of 3 or more from the LCD to the inspector's eyes .

8.2. Light Method





8.3. Classification of defects

8.3.1 Major defect

A major defect refers to a defect that may substantially degrade usability for product applications.

8.3.2 Minor defect

A minor defect refers to a defect which is not considered to be able substantially degrade the product application or a defect that deviates from existing standards almost unrelated to the effective use of the product or its operation.



9. Reliability

9.1. MTBF

The LCD module shall be designed to meet a minimum MTBF value of 50000 hours with normal. (25°C in the room without sunlight)

9.2. TESTS

NO.	Test Item	Test condition	Criterion
1	High Temperature Storage	80°C±2°C 96H Restore 2H at 25°C Power off	After testing, cosmetic and electrical defects should not happen.
2	Low Temperature Storage	-30°C±2°C 96H Restore 2H at 25°C Power off	
3	High Temperature Operation	70°C±2°C 96H Restore 2H at 25°C Power on	
4	Low Temperature Operation	-20°C±2°C 96H Restore 2H at 25°C Power on	
5	High Temperature & Humidity Operation	60°C±2°C 90%RH 96H Power on	
6	Temperature Cycle	-30°C ↔ 25°C ↔ 80°C 30min 5min 30min after 10 cycle, Restore 2H at 25°C Power off	
7	Vibration Test	10Hz~150Hz, 100m/s ² , 120min	
8	Shock Test	Half-sine wave, 300m/s ² , 11ms	
9	Drop Test(package state)	800mm, concrete floor, 1 corner, 3 edges, 6 sides each time	1. After testing, cosmetic and electrical defects should not happen. 2. the product should remain at initial place 3. Product uncovered or package broken is not permitted.



10. Precautions for Using LCD Module

10.1 handing precautions

- (1) The display panel is made of glass. Do not subject it to a mechanical shock or impact by dropping it.
- (2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
- (3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- (4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarizer carefully.
- (5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is heavily contaminated, moisten a cloth with one of the following solvents:
 - Isopropyl alcohol
 - Ethyl alcohol
- (6) Solvents other than those above mentioned may damage the polarizer.
Especially, do not use the following:
 - Water
 - Ketone
 - Aromatic solvents
- (7) Extra care to minimize corrosion of the electrode. Water droplets, moisture condensation or a current flow in a high-humidity environment accelerates corrosion of the electrode.
- (8) Install the LCD Module by using the mounting holes. When mounting the LCD Module, make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
- (9) Do not attempt to disassemble or process the LCD Module.
- (10) NC terminal should be open. Do not connect anything.
- (11) If the logic circuit power is off, do not apply the input signals.
- (12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD Module.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions



-The LCD Module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

10.2 storage precautions

When storing The LCD Module, avoid exposure to direct sunlight of fluorescent lamps. Keep the modules in bags (avoid high temperature/ high humidity and low temperatures below 0°C). Whenever possible, the LCD Module should be stored in the same conditions in which they were shipped from our company.

10.3 others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature.

If the LCD Module have been operating for a long time showing the same display patterns the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be recovered by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability.

To minimize the performance degradation of the LCD Module resulting from destruction caused by static electricity etc. exercise care to avoid holding the following sections when handling the modules.

- Exposed area of the printed circuit board.
- Terminal electrode sections

-END-