SPECIFICATIONS FOR
LIQUID CRYSTAL DISPLAY MODULE

MODEL NO : SD1602GULB-XB-GB-G

CUSTOMER :

APPROVED SIGNATURE

DSGD :

CHKD : Gili Wang

APPD : Chuan-Lin Hsu

DATE : Oct.15.2014

SUNLIKE DISPLAY TECHNOLOGY CO .

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Revision Record

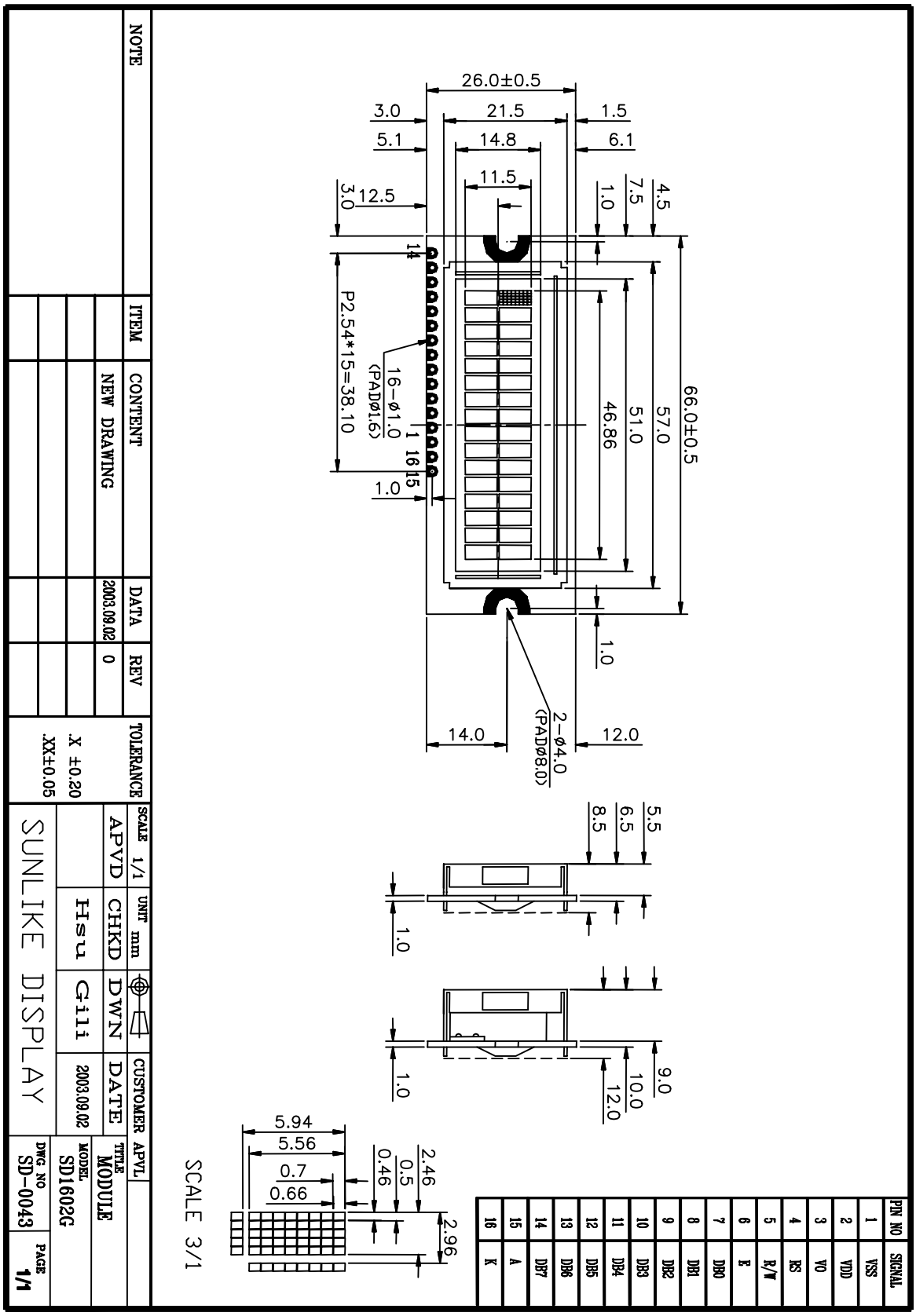
No.	Date	Model No.	Version	Remarks
1	Oct.15.2014	SD1602GULB-XB-GB-G	REV.0	Spec RoHS-Compliant

TIEM	DESCRIPTION				
Product No	SD1602GULB-XB-GB-G				
LCD Type	☐ STN Gray Positive	■ STN Yellow Green Positive	☐ STN Blue Negative		
	☐ TN Negative	☐ TN Positive			
Rear Polarizer	☐ Reflective	■ Transflective	☐ Transmissive		
Backlight Type	■ LED	☐ NO B/L	☐ EL	☐ CCFL	
Backlight Color	☐ White	☐ Amber	☐ Blue Green	■ Yellow Green	☐ Other
View Direction	■ 6 O'clock	☐ 12 O'clock			
Temperature Range	■ Normal	☐ Wide			
Frame	■ Black	☐ Silver			

TO BE VERY CAREFUL !

The LCD driver ICs are made by CMOS process, which are very easy to be damaged by static charge, make sure the user is grounded when handling the LCM.

※This parts comply with RoHs



NOTE	ITEM	CONTENT	DATA	REV
		NEW DRAWING	2003.09.02	0

TOLERANCE: .X ±0.20, .XX±0.05

SCALE	1/1	UNIT	mm	CUSTOMER APVL
APVD	CHKD	DWN	DATE	
	Hsu	Gili	2003.09.02	

SUNLIKE DISPLAY

TITLE: MODULE
MODEL: SD1602G
DWG NO: SD-0043
PAGE: 1/1

PIN NO	SIGNAL
1	VSS
2	VDD
3	VO
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

ABSOLUTE MAXIMUM RATING

(1) Electrical Absolute Ratings

Item	Symbol	Min.	Max.	Unit	Note
Power Supply for Logic	V_{DD}-V_{SS}	-0.3	7.0	Volt	
Power Supply for LCD	V_{DD}-V_O	-0.3	10.0	Volt	
Input Voltage	V_I	-0.3	V_{DD}	Volt	
LED Power Dissipation	P_{AD}	-	621	mW	
LED Forward current	I_{AF}	-	135	mA	
LED Reverse Voltage	V_R	-	8	V	

(2) Environmental Absolute Maximum Ratings

Item	Normal Temperature				Wide Temperature			
	Operating		Storage		Operating		Storage	
	Min,	Max.	Min,	Max.	Min,	Max.	Min,	Max.
Ambient Temperature	0℃	+50℃	-20℃	+70℃	-20℃	+70℃	-30℃	+80℃
Humidity(without condensation)	Note 2,4		Note 3,5		Note 4,5		Note 4,6	

Note 2 Ta≦50℃: 80% RH max
Ta>50℃: Absolute humidity must be lower than the humidity of 85%RH at 50℃

Note 3 Ta at -20℃ will be<48hrs at 70℃will be <120hrs when humidity is higher than 70%.

Note 4 Background color changes slightly depending on ambient temperature. This phenomenon is reversible.

Note 5 Ta≦70℃: 75RH max
Ta>70℃: absolute humidity must be lower than the humidity of 75%RH at 70℃

Note 6 Ta at -30℃ will be <48hrs, at 80 ℃ will be <120hrs when humidity is higher than 70%.

ELECTRICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	V_{DD}-V_{SS}	-	4.5	5.0	5.5	Volt	
Input Voltage	V_{IL}	L level	-0.3	-	0.6	Volt	
	V_{IH}	H level	0.7 V_{DD}	-	V_{DD}	Volt	
LCM Recommend LCD Module Driving Voltage	V_{DD} –V_O	Ta＝0℃	-	-	-	Volt	
		Ta＝25℃	4.2	4.5	4.8		
		Ta＝50℃	-	-	-		
Power Supply Current for LCM	I_{DD}	V_{DD} =5.0V V_{DD}-V_O =4.5V	-	2.0	3.0	mA	
LED Forward Voltage	V_F	If＝90 mA	-	4.1	4.6	Volt	
LED Forward Current	I_F	-	-	90	-	mA	
LED Reverse Current	I_R	VR=8V	-	-	0.2	mA	

OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	Φf(12 o'clock)	When Cr≧ 1.4	-	20	-	Degree	9,10
	Φb(6 o'clock)		-	40	-		
	Φl(9 o'clock)		-	30	-		
	Φr(3 o'clock)		-	30	-		
Rise Time	Tr	V_{DD}-V_O =4.5V Ta=25℃	-	200		mS	
Fall Time	Tf		-	250			
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	3.0	-		7
The Brightness Of Backlight	L	IF=90 mA	120	180	-	cd/㎡	
Peak Emission Wavelength	λP		567	570	577	nm	

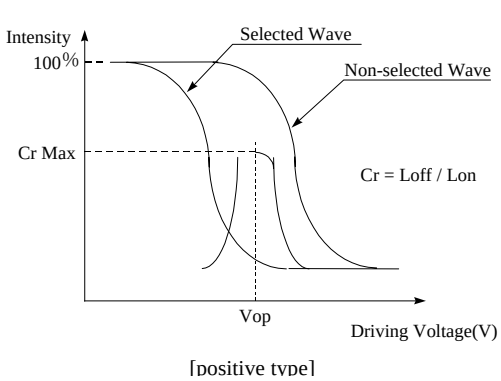
MECHANICAL SPECIFICATION

ITEM	DESCRIPTION
Product No.	SD1602G
Module Size	66.0(W)×26.0(H)×8.5 max(D)
Viewing Area	51.0(W)mm×14.8(H)mm
Dot Size	0.46(W)mm×0.66(H)mm
Dot Pitch	0.50(W)mm×0.70(H)mm
Display Format	16 characters (W)×2 lines (H)
Duty Ratio	1/16 Duty
Controller	ST7066U or Equivalent

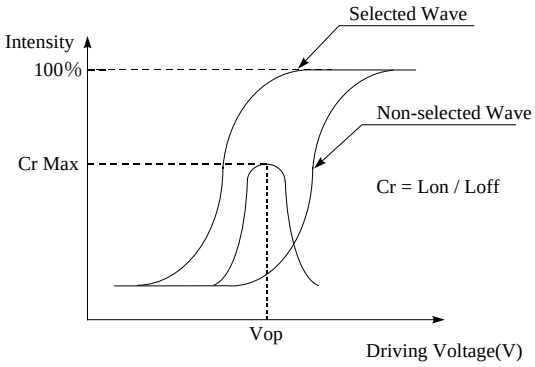
INTERFACE PIN ASSIGNMENT

Pin No.	Pin Out	Level	Description
1	VSS	0V	Power Supply Ground
2	VDD	5V	Power Supply Voltage
3	Vo	---	Contrast Adj
4	RS	H/L	Register Select
5	R/W	H/L	Read / Write
6	E	H,H→L	Enable Signal
7	DB0	H/L	Data Bit 0
8	DB1	H/L	Data Bit 1
9	DB2	H/L	Data Bit 2
10	DB3	H/L	Data Bit 3
11	DB4	H/L	Data Bit 4
12	DB5	H/L	Data Bit 5
13	DB6	H/L	Data Bit 6
14	DB7	H/L	Data Bit 7

[Note 7] Definition of Operation Voltage (Vop)

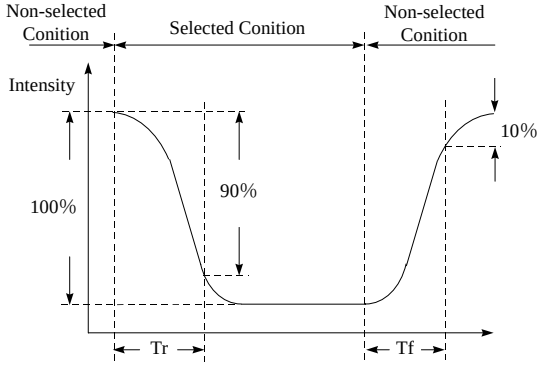


[positive type]

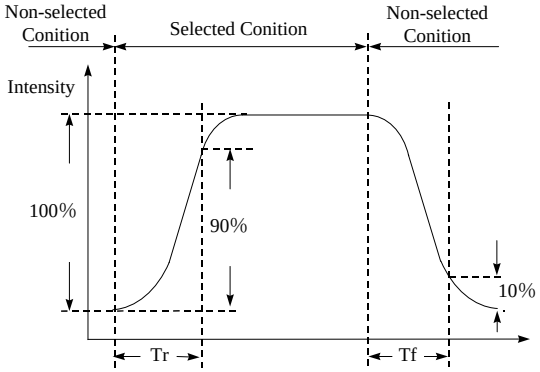


[Negative type]

[Note 8] Definition of Response Time (Tr, Tf)



[positive type]



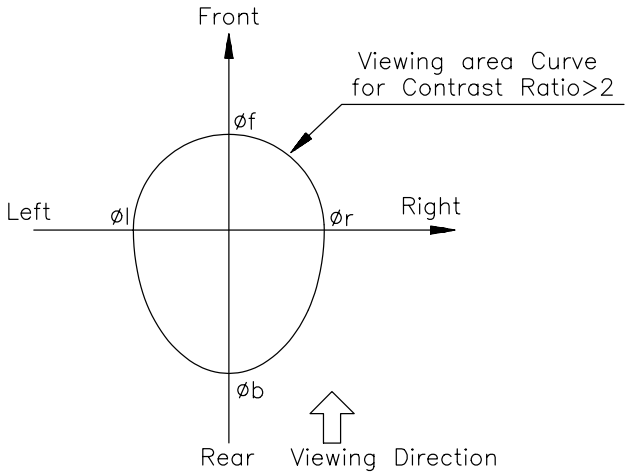
[Negative type]

Conditions:

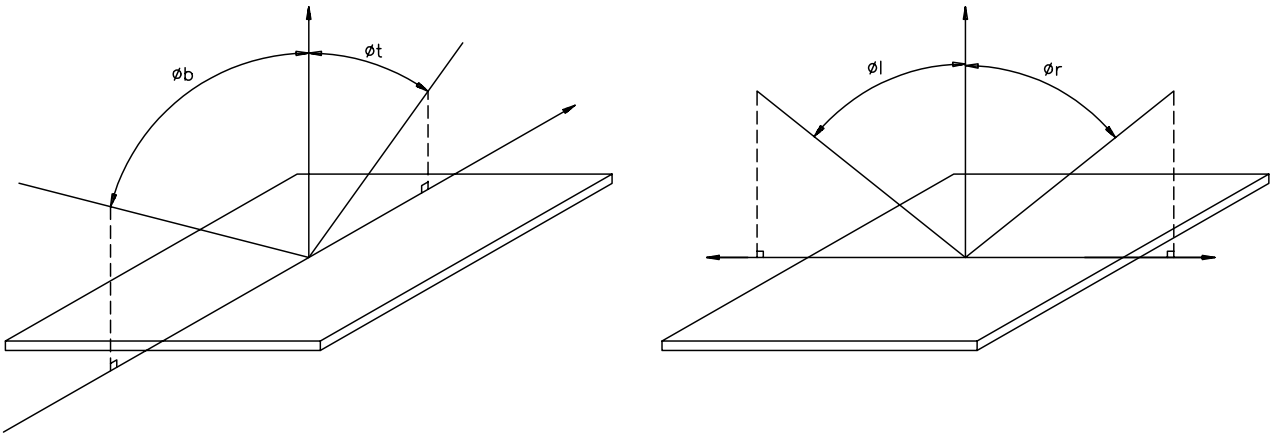
Operating Voltage : Vop **Viewing Angle(θ , ϕ): 0° , 0°**

Frame Frequency : 64 Hz **Driving Wave form : 1/N duty, 1/a bias**

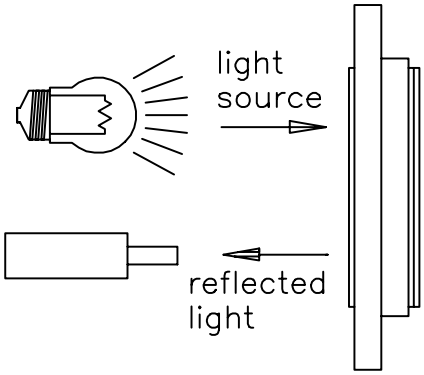
[Note 9] Definition of Viewing Direction



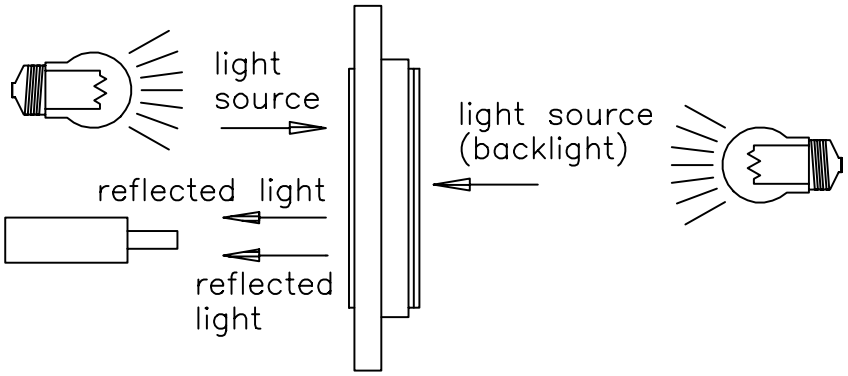
[Note 10] Definition of viewing angle



[Note 11] Description of Measuring Equipment

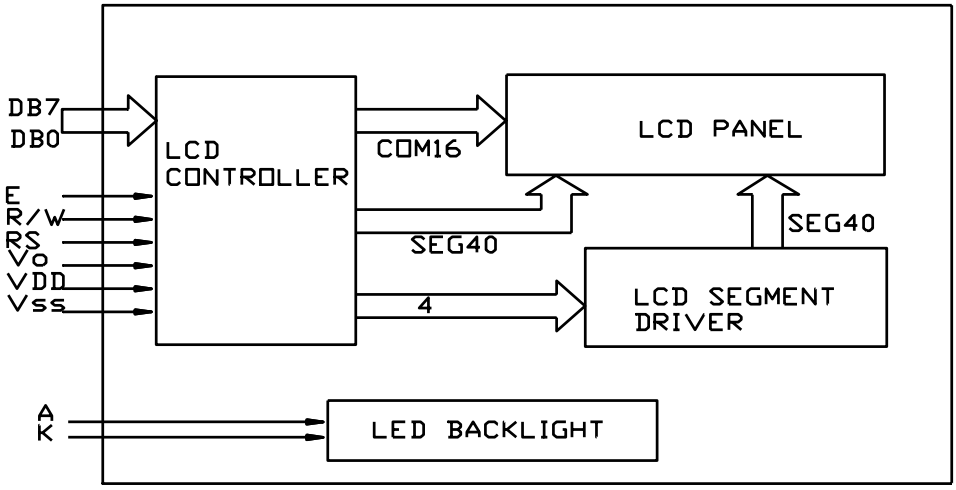


Reflective type

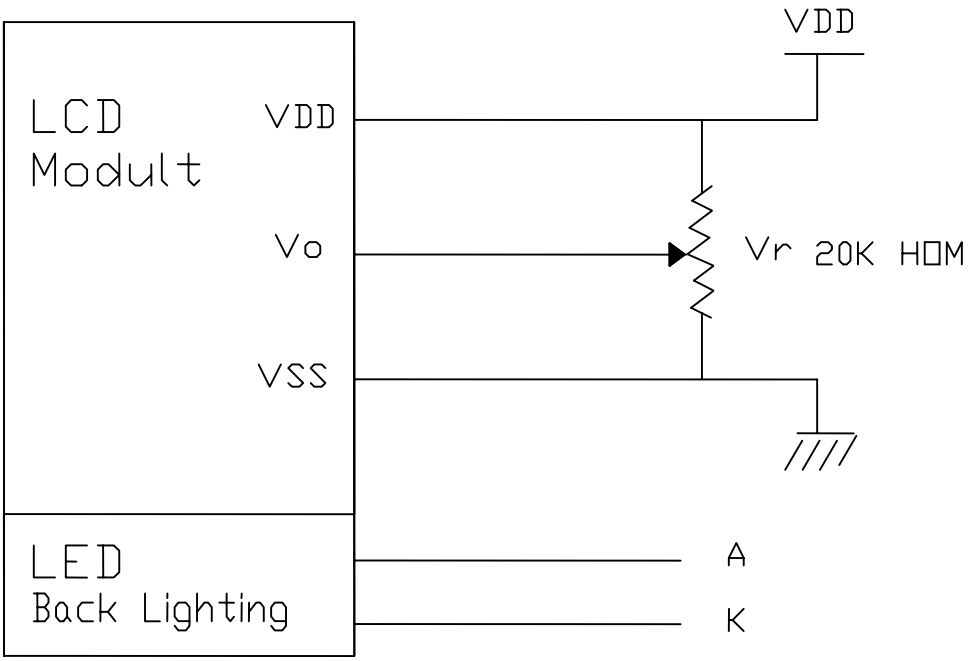


Transflective type

BLOCK DIAGRAM



POWER SUPPLY



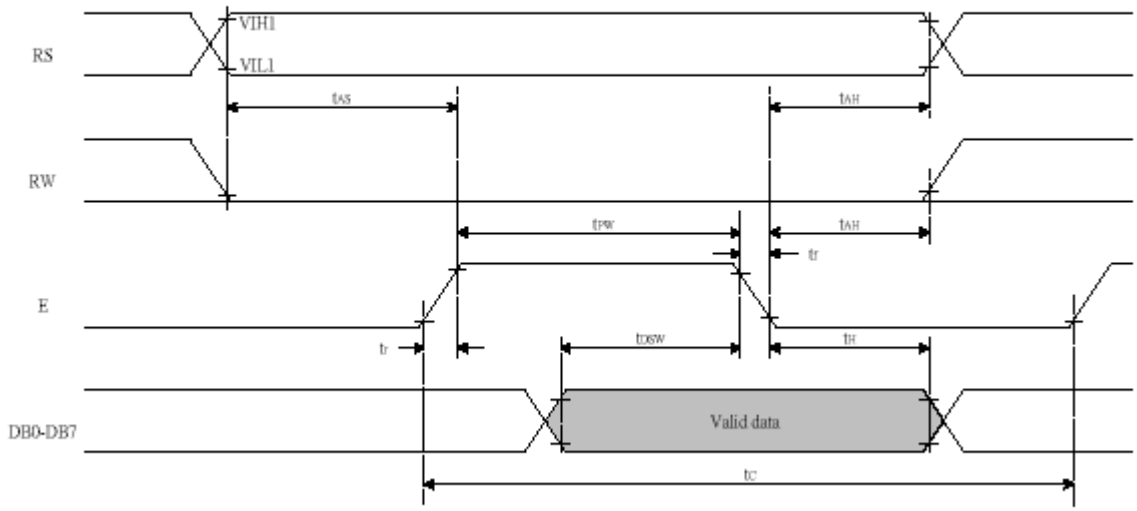
TIMING CHARACTERISTICS

TA=25℃ ,VCC=5V

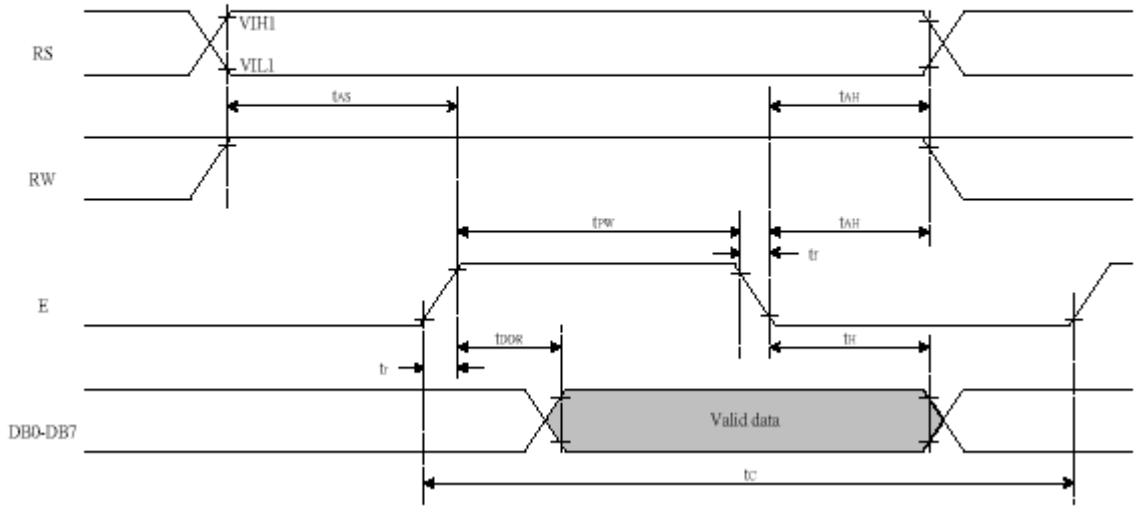
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
Internal Clock Operation						
f_{OSC}	OSC Frequency	R = 91KΩ	190	270	350	KHz
External Clock Operation						
f_{EX}	External Frequency	-	125	270	410	KHz
	Duty Cycle	-	45	50	55	%
T_R, T_F	Rise/Fall Time	-	-	-	0.2	μs
Write Mode (Writing data from MPU to ST7066U)						
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DSW}	Data Setup Time	Pins: DB0 - DB7	40	-	-	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
Read Mode (Reading Data from ST7066U to MPU)						
T_C	Enable Cycle Time	Pin E	1200	-	-	ns
T_{PW}	Enable Pulse Width	Pin E	140	-	-	ns
T_R, T_F	Enable Rise/Fall Time	Pin E	-	-	25	ns
T_{AS}	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T_{AH}	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T_{DDR}	Data Setup Time	Pins: DB0 - DB7	-	-	100	ns
T_H	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns

Read/Write Timing Chart

- **Writing data from MPU to ST7066U**



- **Reading data from ST7066U to MPU**



Commands

Instruction	Instruction code										Description	Execution Time(f_{osc} is 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"toDDRAM.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	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and make shift of entire display enable .	39 µS
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	Set display(D), cursor(C),and blinking of cursor(B) on/off Control bit .	39 µS
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 DDRAM data .	39 µS
Function Set	0	0	0	0	1	DL	N	F	*	*	Set interface data length (DL:4-bit/8-bit),numbers of display line(N:1-line/2-line),display font type(F:5*8 dots/5*11 dots)	39 µS
Set CG RAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter .	39 µS
Set DD RAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address Counter .	39 µS
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Whether during internal Operation or not cat be known By reading BF . The contents of Address counter can also be read .	0 µS
Write Data to ram	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM) .	43 µS
Read Data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM) .	43 µS

Code		Description	Executed Time (max)
I/D=1 : Increment	DL=0:4-bit	DDRAM: Display Data RAM	fcp or fose=250kHz
I/D=0 : Decrement	N=1 : 2 lines	CGRAM: Character Generator RAM	However, when Frequency changes,
S=1 : With display shift	N=0 : 1 lines	ACG:CGRAM Address	execution time also changes
S/C=1 : Display shift	F=1 : 5 × 11 dots	ADD:DDRAM Address Corresponds to cursor address.	EX
S/C=0 : Cursor movement	F=0 : 5 × 8 dots	AC: Address Counter, used for both DDRAM and CGRAM	if fcp or fose is 270kHz
R/L=1 : Shift to the right	BF=1:Internal operation is being performed	* : Invalid.	40µs × 250/270=37µs
R/L=0 : Shift to the left			
DL=1 : 8-bit	BF=0 : Instruction acceptable		

Reset Function

Initializing by Internal Reset Circuit

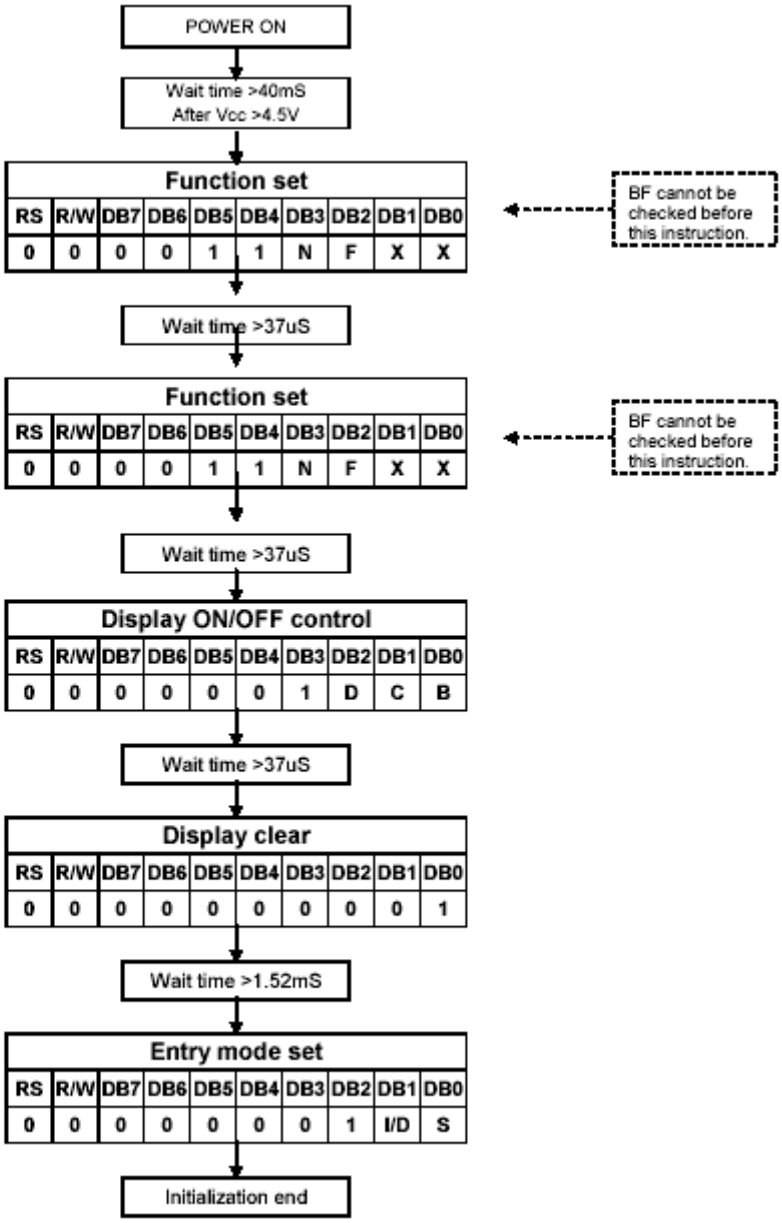
An internal reset circuit automatically initializes the IC when the power is turned on. The following instructions are executed during the initialization. The busy flag (BF) is kept in the busy state until the initialization ends (BF = 1). The busy state lasts for 40 ms after VCC rises to 4.5 V.

1. Display clear
2. Function set:
   DL = 1; 8-bit interface data
   N = 0; 1-line display
   F = 0; 5x8 dot character font
3. Display on/off control:
   D = 0; Display off
   C = 0; Cursor off
   B = 0; Blinking off
4. Entry mode set:
   I/D = 1; Increment by 1
   S = 0; No shift

Note:
If the electrical characteristics conditions listed in the table Power Supply Conditions are not met, the internal reset circuit will not operate normally and will fail to initialize the IC. For such a case, initialization must be performed by the MPU as explain by the following figures.

Initializing by Instruction

8 bit Interface(fosc =270KHZ)



DD RAM ADDRESSING

For 10*4 Display

	1	2	3	4	5	6	7	8	9	10
Character DD RAM Address	00	01	02	03	04	05	06	07	08	09
	40	41	42	43	44	45	46	47	48	49
	0A	0B	0C	0D	0E	0F	10	11	12	13
	5A	5B	5C	5D	5E	5F	50	51	52	53

For 16*1 Display

Character DD RAM Address	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

For 16*2 or 8*2 Display

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

For 16*4 Display

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Character DD RAM Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
	50	51	52	53	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F

For 20*2 Display

	1	2	3	4	5	6	7	8	9	10	---	---	17	18	19	20
Character DD RAM Address	00	01	02	03	04	05	06	07	08	09	---	---	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	---	---	50	51	52	53

For 20*4 Display

	1	2	3	4	5	6	7	8	9	10	---	---	17	18	19	20
Character DD RAM Address	00	01	02	03	04	05	06	07	08	09	---	---	10	11	12	13
	40	41	42	43	44	45	46	47	48	49	---	---	50	51	52	53
	14	15	16	17	18	19	1A	1B	1C	1D	---	---	24	25	26	27
	54	55	56	57	58	59	5A	5B	5C	5D	---	---	64	65	66	67

For 40*2 Display

	1	2	3	4	5	6	7	8	9	10	---	---	37	38	39	40
Character DD RAM Address	00	01	02	03	04	05	06	07	08	09	---	---	24	25	26	27
	40	41	42	43	44	45	46	47	48	49	---	---	64	65	66	67

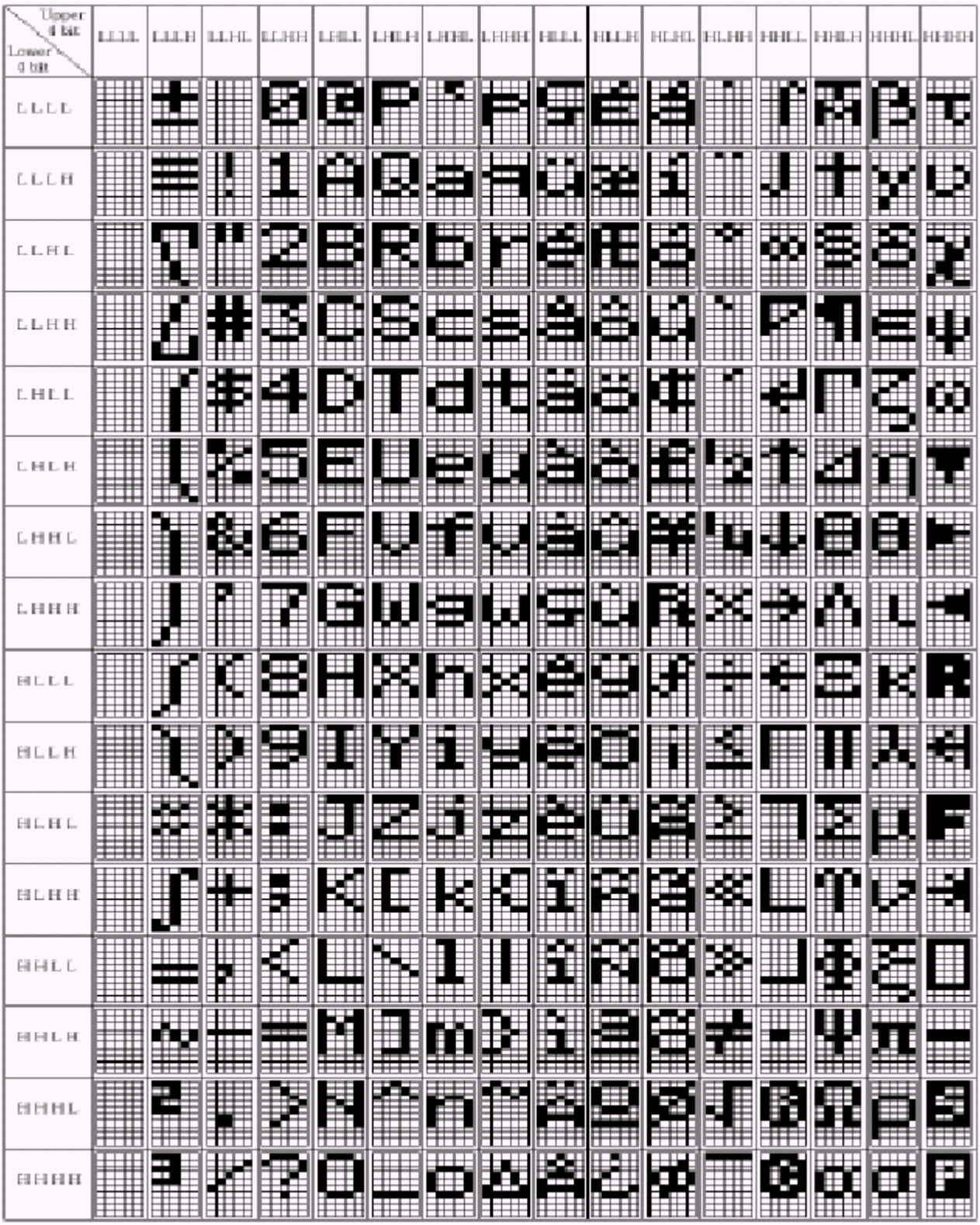
For 40*4 Display

	E	1	2	3	4	5	6	7	8	9	10	---	---	37	38	39	40
Character DD RAM Address	E1	00	01	02	03	04	05	06	07	08	09	---	---	24	25	26	27
		40	41	42	43	44	45	46	47	48	49	---	---	64	65	66	67
	E2	00	01	02	03	04	05	06	07	08	09	---	---	24	25	26	27
		40	41	42	43	44	45	46	47	48	49	---	---	64	65	66	67

CG RAM MAPPING

Character Code (DD RAM data) 7 6 5 4 3 2 1 0 (High … Low)	CG RAM Address 5 4 3 2 1 0 (High … Low)	Character Patterns (CG RAM data) 7 6 5 4 3 2 1 0 (High … Low)	
0 0 0 0 * 0 0 0	0 0 0	* * *	0 1 1 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 0 0 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	←Character Pattern ←Cursor
0 0 0 0 * 0 0 1	0 0 1	* * *	1 1 1 1 1 1 0 0 0 1 1 0 1 0 1 1 0 1 1 1 1 0 1 0 1 1 0 0 0 1 1 1 1 1 1 0 0 0 0 0	←Character Pattern ←Cursor
⋮ ⋮ ⋮ ⋮ ⋮ ⋮ ⋮ ⋮	⋮ ⋮ ⋮	⋮ ⋮ ⋮	⋮	
0 0 0 0 * 1 1 1	1 1 1	* * *	1 1 1 1 1 1 0 0 0 1 1 1 1 0 1 1 0 0 0 1 1 0 1 1 1 1 0 0 0 1 1 1 1 1 1 0 0 0 0 0	←Character Pattern ←Cursor

CHARACTER FONT TABLE



RELIABILITY

The LCD module shall have no failure in the following reliability test. However the following Test of a different item doesn't do by means of the same LCD module.

Test Item	Test Conditions		Note
	Normal Temp. type	Extended Temp. type	
High temperature operation	50±3°C, t =120hrs	70±3°C, t =120hrs	2
Low temperature operation	0±3°C, t =120hrs	-20±3°C, t =120hrs	2
High Temperature storage	70±3°C, t =120hrs	80±3°C, t =120hrs	1 , 2
Low Temperature storage	-20±3°C, t =120hrs	-30±3°C, t =120hrs	1 , 2
Temperature Cycle	-20°C 25°C 70°C 30min. 5min. 30min. (1 cycle) Total 5 cycle	-30°C 25°C 80°C 30min. 5min. 30min. (1 cycle) Total 5 cycle	1 , 2
Humidity Test	40°C, Humidity 90％, 96 hrs		1 , 2
Shock Test (Packing)	Half – sine wave 100m/s^2 Duration ：11ms		
Vibration Test (Packing)	Sweep frequency ： 10 ~ 55 ~ 10 Hz/1min Amplitude ： 0.75mm Test direction ： X.Y.Z/3 axis Duration ： 30min/each axis		2

Note l. The module should not have condensation of water on it.
Note 2. The module should be inspected after 1-hour storage under normal Conditions (15°C to 35°C , 45% to 65% RH)

Definitions of life end point
(1) Current consumption is more than specified value.
(2) Function of the module is not maintained.
(3) There is visible degradation of appearance and display quality.
(4) Contrast ratio is less than 50% of specified minimum value.
(5) Brightness is less than 50% of specified minimum value.

Life Time: LCD Module 50,000hr (type)
LED Backlight 20,000hr (type)
Conditions : Ta=25°C , Humidity=65±20% RH

QUALITY

TEST CONDITIONS

Ambient temperature :25 ±5℃

Humidity :65±20% RH

Illumination

Visual inspection shall be performed under the single fluoredcent lamp(20W)with about 50 cm sistance from LCD module by naked eyes with 30 cm distance from LCD module.

Viewing angle for inspection should be within viewing angle specified im this specification.

Defects which is visible only in the surface glare shall be disregarded.

Operating conditions :

Unless otherwise specified LCD module shall be operated by the ration value (typical value)

DIMENSIONS

Item	Description	Class
Important Dimensions	Dimensional outline. Dimension between the mounting holes.	Major
Others	Dimensional specified in this specification	Minor

HANDLING PRECAUTION

1. Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizes which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

2. Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and Wipe lightly.

-Isopropyl alcohol

-Ethyl alcohol

-Trichlorotriflorothane

Do not wipe the display surface with dry or hard materials that will damage the polarize surface.

Do not use the following solvent：

-Water

-Kettle

-Aromatics

3. Caution against static charge

The LCD Module use C-MOSLSI drivers, so we recommend end that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

4. Packaging

-Modules use LCD elements, and must be treated as such. Avoid in tense shock and falls from a height.

-To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

5. Caution for operation

-It is indispensable to drive LCD’s with in the specified voltage limit since the higher voltage than the limit shorten LCD life.

An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.

-Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.

- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.

- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit. Usage under the relative condition of 40 ℃, 50%RH or less is required.

6. Storage

In the case of storing for a long period of time (for instance. For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.

- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.

-Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

7. Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol. Which should be burned up later.

- When any liquid crystal leaked out of a damaged glass cell comes in contact with your hands, please wash it off well with soap and water.