

**SPECIFICATIONS FOR
LIQUID CRYSTAL DISPLAY MODULE**

MODEL NO : SD1602HULB-XA-G-G

CUSTOMER :

APPROVED SIGNATURE

DSGD :

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DATE : Jun.18.2010

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GENERAL SPECIFICATION

ITEM	DESCRIPTION					
Product No	SD1602HULB-XA-G-G					
LCD Type	<input type="checkbox"/> STN Gray Positive	STN Yellow Green Positive			<input type="checkbox"/> STN Blue Negative	
	<input type="checkbox"/> TN Negative			<input type="checkbox"/> TN Positive		
	<input type="checkbox"/> FSTN Negative White & Black			<input type="checkbox"/> FSTN Positive Black & White		
Rear Polarizer	<input type="checkbox"/> Reflective		Transflective		<input type="checkbox"/> Transmissive	
Backlight Type	<input type="checkbox"/> NO B/L		LED		<input type="checkbox"/> CCFL	<input type="checkbox"/> EL
Backlight Color	Yellow Green	<input type="checkbox"/> Green	<input type="checkbox"/> Amber		<input type="checkbox"/> White	<input type="checkbox"/> Blue Green
View Direction	6 O'clock			<input type="checkbox"/> 12 O'clock		
Temperature Range	Normal			<input type="checkbox"/> Wide		
Frame	<input type="checkbox"/> Black			<input type="checkbox"/> 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.

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}	-	276	mW	
LED Forward current	I_{AF}	-	60	mA	
LED Reverse Voltage	V_R	-	5	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 $T_a = 50$: 80% RH max

$T_a > 50$: Absolute humidity must be lower than the humidity of 85%RH at 50

Note 3 T_a 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 $T_a = 70$: 75RH max

$T_a > 70$: absolute humidity must be lower than the humidity of 75%RH at 70

Note 6 T_a 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	-	0.6	Volt	
	V_{IH}	H level	2.2	-	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 = 40 mA	-	4.1	4.6	Volt	
LED Forward Current	I_F	-	-	40	-	mA	
LED Reverse Current	I_R	VR=5V	-	-	0.2	mA	

OPTICAL CHARACTERISTICS

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	f(12 o'clock)	When Cr 1.4	-	20	-	Degree	9,10
	b(6 o'clock)		-	40	-		
	l(9 o'clock)		-	30	-		
	r(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
Contrast	Cr		-	3.0	-		7
The Brightness Of Backlight	L	IF=40 mA	80	100	-	cd/m ²	
Peak Emission Wavelength	P		567	570	577	nm	

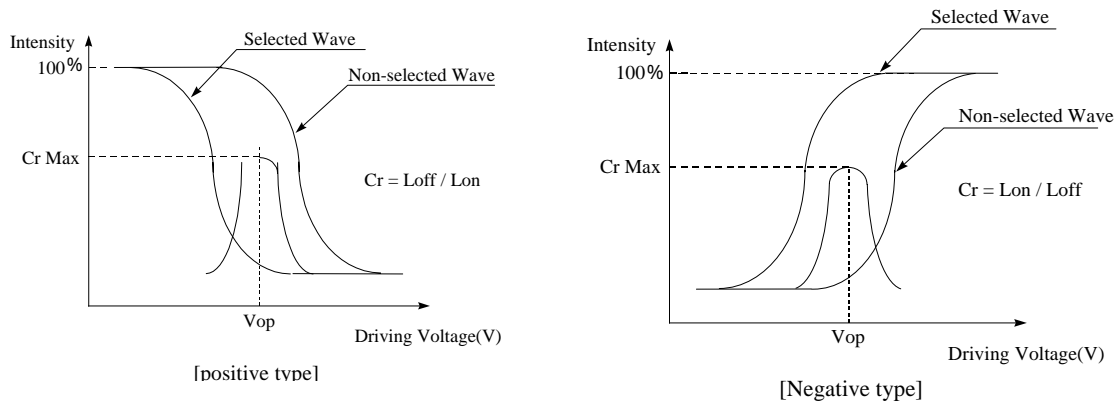
MECHANICAL SPECIFICATION

ITEM	DESCRIPTION
Product No.	SD1602H
Module Size	66.0(W)×26.0(H)×8.5 max(D)
View Area	52.0(W)×16.0(H)
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

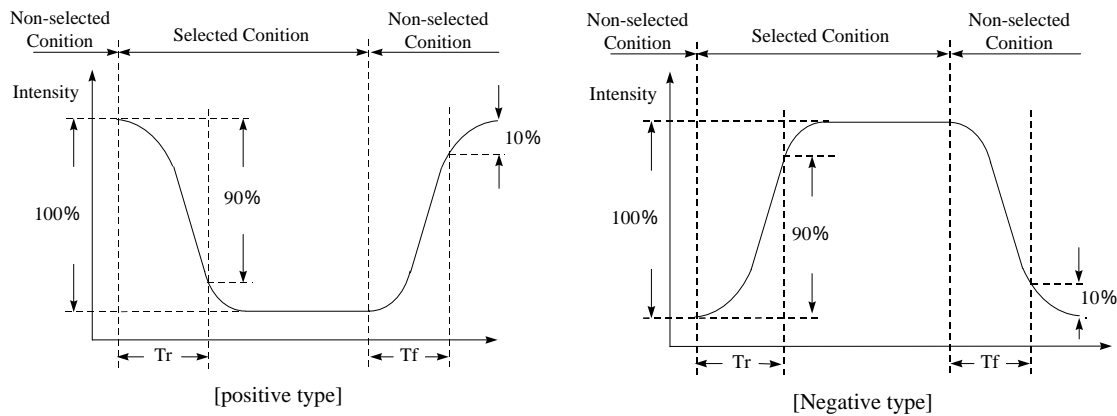
INTERFACE PIN ASSIGNMENT

Pin No.	Pin Out	Level	Description
1	VSS	0V	Power Supply Ground
2	VDD	5V	Power Supply Voltage
3	VO	---	Power Supply Voltage For LCD
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
15	A	4.2V	LED Power Supply (+)
16	K	0V	LED Power Supply (-)

[Note 7] Definition of Operation Voltage (Vop)



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



Conditions:

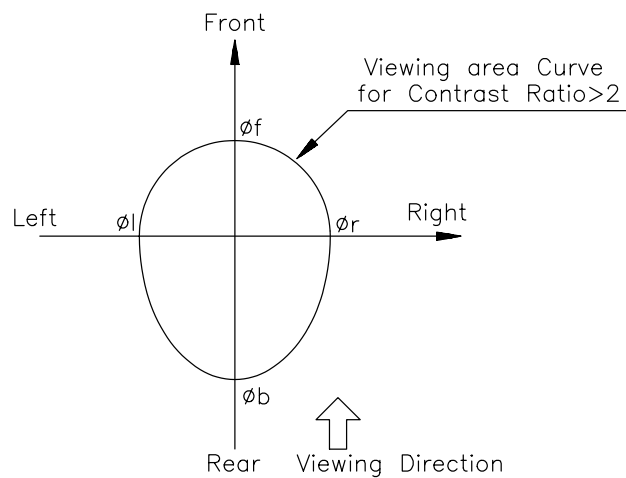
Operating Voltage : Vop

Frame Frequency : 64 Hz

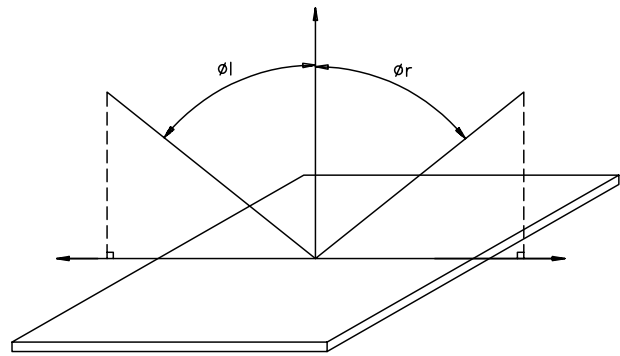
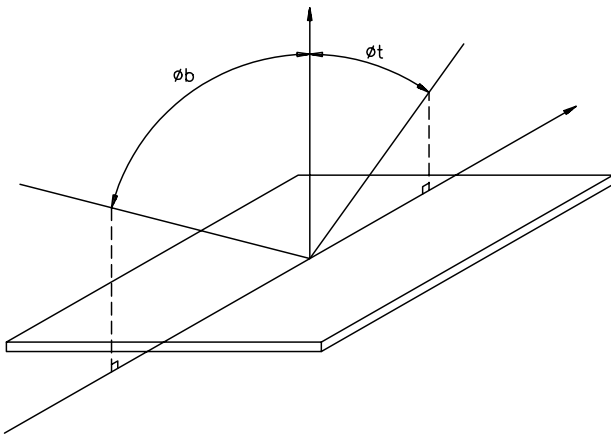
Viewing Angle (,): 0°, 0°

Driving Wave form : 1/N duty, 1/a bias

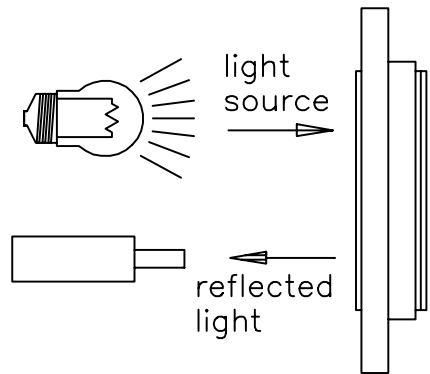
[Note 9] Definition of Viewing Direction



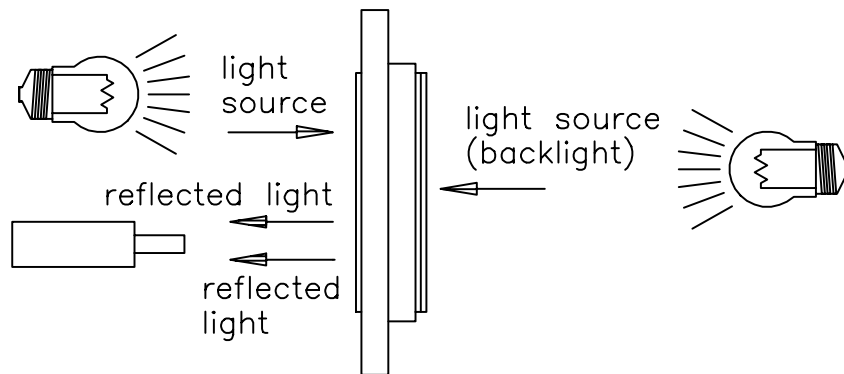
[Note 10] Definition of viewing angle



[Note 11] Description of Measuring Equipment

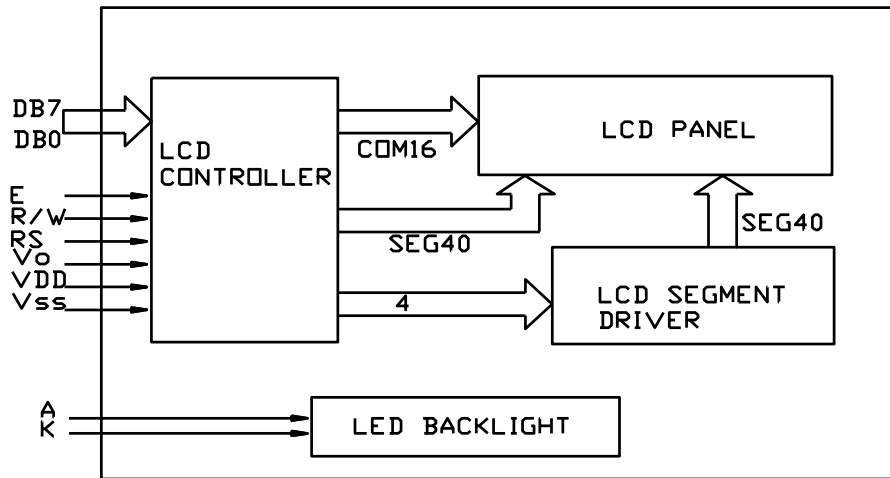


Reflective type

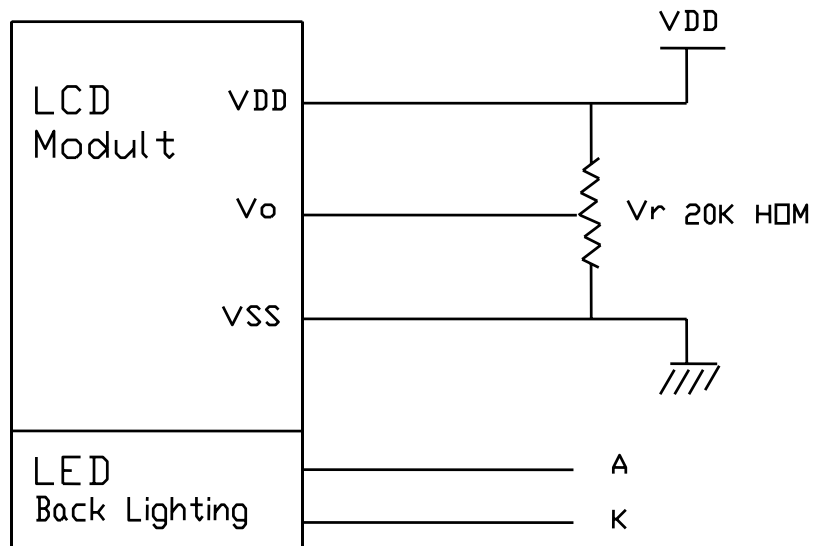


Transflective type

BLOCK DIAGRAM



POWER SUPPLY



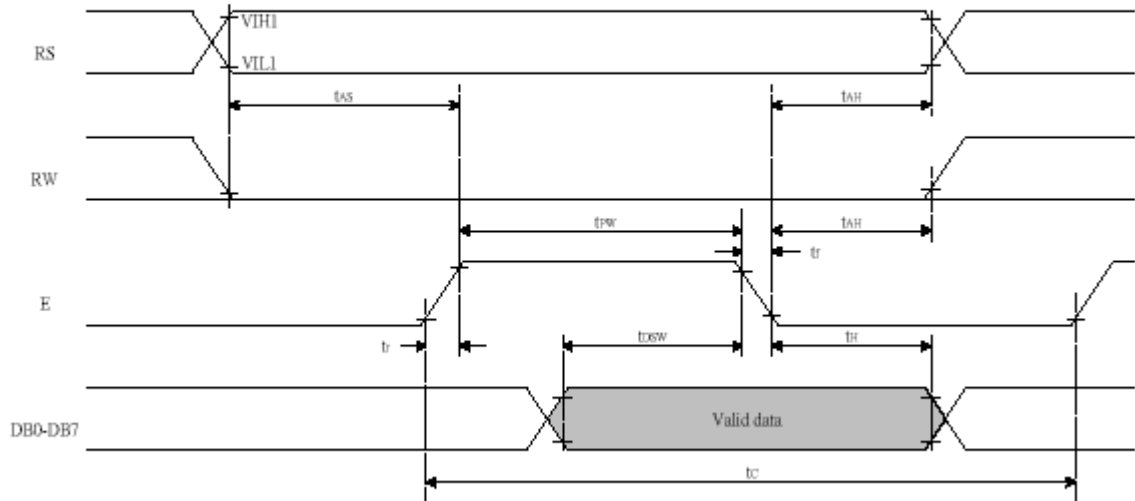
TIMING CHARACTERISTICS

TA=25 , VCC=5V

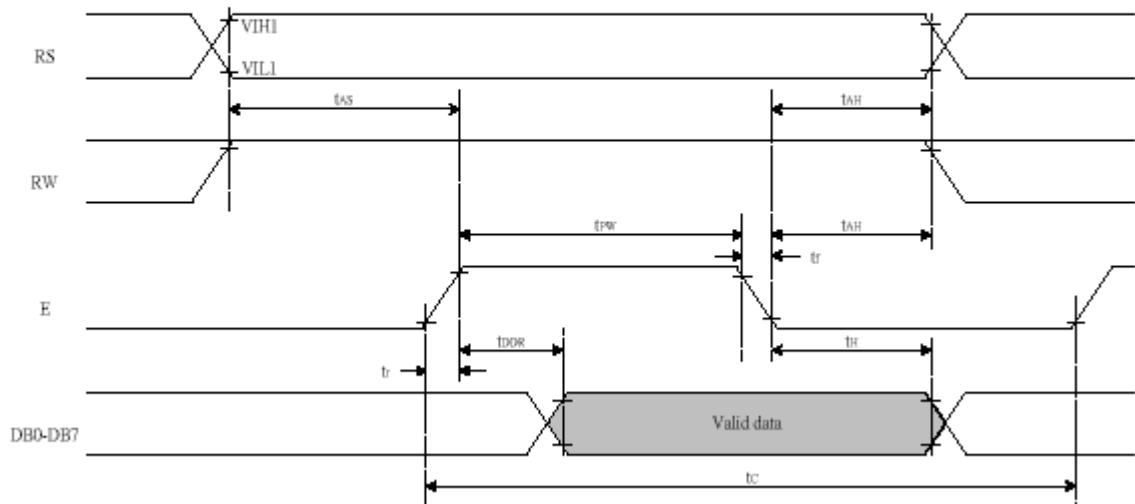
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
f _{osc}	OSC Frequency	R = 91KΩ	190	270	350	KHz
<i>External Clock Operation</i>						
f _{EX}	External Frequency	-	125	270	410	KHz
	Duty Cycle	-	45	50	55	%
T _R , T _F	Rise/Fall Time	-	-	-	0.2	μs
<i>Write Mode (Writing data from MPU to ST7066U)</i>						
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
<i>Read Mode (Reading Data from ST7066U to MPU)</i>						
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	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC	1.53mS
Return Home	0	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	0	1	I/D	S	Assign cursor moving direction and make shift of entire display enable.	39 μ S
Display ON/OFF	0	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 μ S
Cursor or Display Shift	0	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 μ S
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 μ S
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Set CGRAM address in address counter.	39 μ S
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Set CGRAM address in address Counter.	39 μ S
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	AC0	Whether during internal Operation or not can be known By reading BF. The contents of Address counter can also be read.	0 μ S
Write Data to ram	1	0	D7	D6	D5	D4	D3	D2	D1	D0	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μ S
Read Data From RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μ S
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 \times 11 dots							ADD:DDRAM Address Corresponds to cursor address.		EX	
S/C=0 : Cursor movement			F=0 : 5 \times 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.		40 μ s \times 250/270=37 μ s	
R/L=0 : Shift to the left			BF=0 : Instruction acceptable										
DL=1 : 8-bit													

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

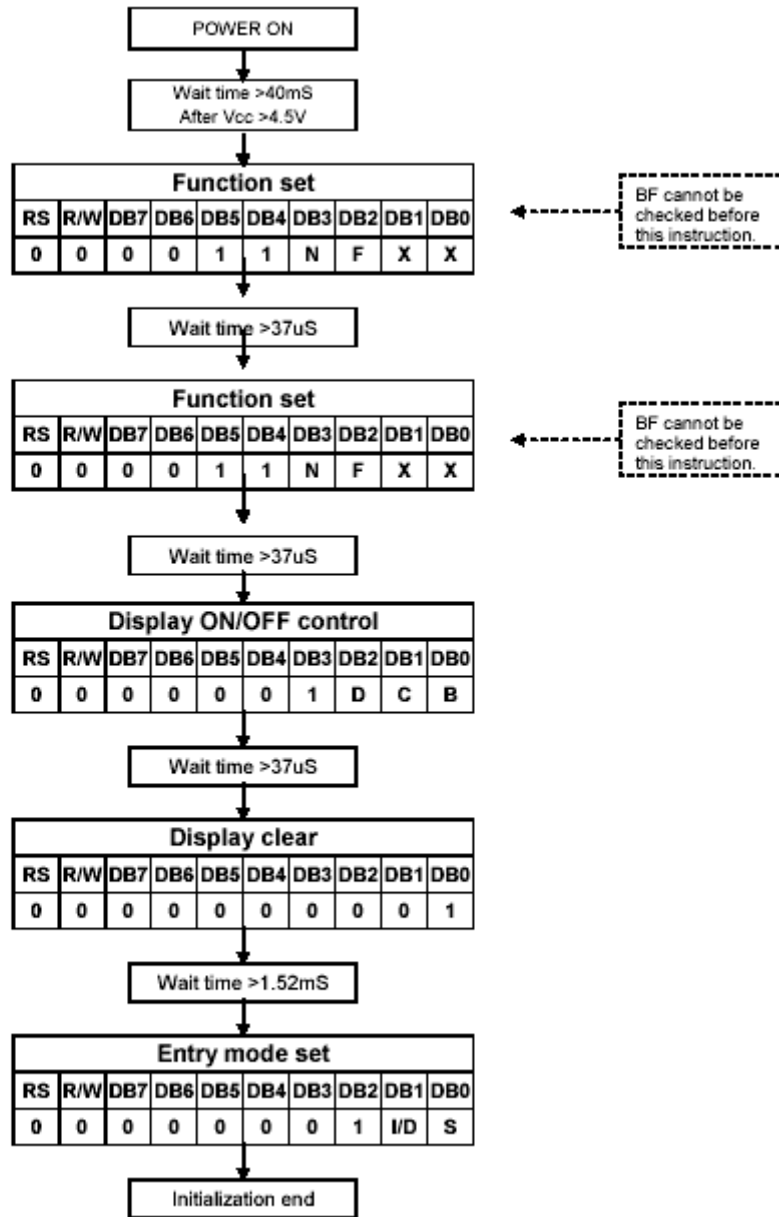
S = 0; No shift

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

For 16*1 Display

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

For 16*2 or 8*2 Display

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Character	00	01	02	03	04	05	06	07	8	9	0A	0B	0C	0D	0E	0F
DD RAM																
Address	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	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
DD RAM	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F
Address	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	00	01	02	03	04	05	06	07	08	09	---	---	10	11	12	13
DD RAM																
Address	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)								CG RAM Address						Character Patterns (CG RAM data)																																																
7	6	5	4	3	2	1	0	5	4	3	2	1	0	7	6	5	4	3	2	1	0																																									
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1	1	1	1	1																																																										
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CHARACTER FONT TABLE

Upper 4 bit Lower 4 bit	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL				0	1	2	3	4					一	二	三	四
LLLH			!	5	6	7	8	9			.	ア	イ	ウ	エ	オ
LLHL			"	10	11	12	13	14			「	イ	ウ	エ	オ	カ
LLHH			#	15	16	17	18	19			」	ウ	エ	オ	カ	キ
LHLL			\$	20	21	22	23	24			、	エ	オ	カ	キ	ク
LHLH			%	25	26	27	28	29			・	オ	カ	キ	ク	ケ
LHHL			&	30	31	32	33	34			ヲ	カ	キ	ク	ケ	コ
LHHH			'	35	36	37	38	39			ヲ	カ	キ	ク	ケ	コ
HLLL			(40	41	42	43	44			々	カ	キ	ク	ケ	コ
HLLH)	45	46	47	48	49			々	カ	キ	ク	ケ	コ
HLHL			*	50	51	52	53	54			キ	コ	ク	ケ	コ	ク
HLHH			+	55	56	57	58	59			キ	コ	ク	ケ	コ	ク
HHLL			,	60	61	62	63	64			カ	キ	ク	ケ	コ	ク
HHLH			-	65	66	67	68	69			キ	コ	ク	ケ	コ	ク
HHHL			.	70	71	72	73	74			キ	コ	ク	ケ	コ	ク
HHHH			/	75	76	77	78	79			キ	コ	ク	ケ	コ	ク

HANDLING PRECAUTION

1. Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers 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

-Trichlorotrifluoroethane

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

Do not use the following solvent :

-Water

-Kettle

-Aromatics

3. Caution against static charge

The LCD Module uses C-MOSLSI drivers, so we recommend 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 intense 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.