

Revision Record

No.	Date	Model No.	Version	Remarks
1	Mar.14.2019	SC1602BS*B-XA-LB-G	REV.0	Spec RoHs-Compliant

**GENERAL SPECIFICATION**

TIEM	DESCRIPTION					
Product No	SC1602BS*B-XA-LB-G					
LCD Type	<input checked="" type="checkbox"/> STN Gray Positive	<input type="checkbox"/> 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 checked="" type="checkbox"/> Reflective		<input type="checkbox"/> Transflective		<input type="checkbox"/> Transmissive	
Backlight Type	<input checked="" type="checkbox"/> NO B/L	<input type="checkbox"/> LED		<input type="checkbox"/> CCFL		<input type="checkbox"/> EL
Backlight Color	<input type="checkbox"/> Yellow Green	<input type="checkbox"/> Green	<input type="checkbox"/> Amber		<input type="checkbox"/> White	<input type="checkbox"/> Blue Green
View Direction	<input checked="" type="checkbox"/> 6 O'clock			<input type="checkbox"/> 12 O'clock		
Temperature Range	<input type="checkbox"/> General Temp.,5V,Single Supply Voltage <input type="checkbox"/> Wide Temp., Single Supply Voltage <input checked="" type="checkbox"/> General Temp.,3.3V,Single Supply Voltage <input type="checkbox"/> Wide Temp., 3.3V,Single Supply Voltage <input type="checkbox"/> General Temp., Dual Supply Voltage <input type="checkbox"/> Wide Temp., Dual Supply Voltage <input type="checkbox"/> Super Wide Temp., Dual Supply Voltage					
Frame	<input checked="" 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.

✂This parts comply with RoHs



## 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	

### (2) Environmental Absolute Maximum Ratings

Item	Normal Temperature			
	Operating		Storage	
	Min,	Max.	Min,	Max.
Ambient Temperature	0°C	+50°C	-20°C	+70°C
Humidity(without condensation)	Note 2,4		Note 3,5	

Note 2  $T_a \leq 50^\circ\text{C}$  : 80% RH max

$T_a > 50^\circ\text{C}$  : Absolute humidity must be lower than the humidity of 85%RH at 50°C

Note 3  $T_a$  at -20°C will be <48hrs at 70°C 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  $T_a \leq 70^\circ\text{C}$  : 75RH max

$T_a > 70^\circ\text{C}$  : absolute humidity must be lower than the humidity of 75%RH at 70°C

Note 6  $T_a$  at -30°C will be <48hrs, at 80 °C will be <120hrs when humidity is higher than 70%.

**ELECTRICAL CHARACTERISTICS**

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Power Supply for Logic	$V_{DD}-V_{SS}$	-	2.7	3.3	4.5	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	$V_{DD}-V_O$	$T_a=0^{\circ}\text{C}$	-	-	-	Volt	
		$T_a=25^{\circ}\text{C}$	2.7	3.3	4.5		
		$T_a=50^{\circ}\text{C}$	-	-	-		
Power Supply Current for LCM	$I_{DD}$	$V_{DD}=3.3\text{V}$ $V_{DD}-V_O=3.3\text{V}$	-	2.0	3.0	mA	

**OPTICAL CHARACTERISTICS**

Item	Symbol	Condition	Min.	Typ	Max.	Unit	note
Viewing angle range	$\Phi f(12 \text{ o'clock})$	When $Cr \geq 1.4$	-	20	-	Degree	9,10
	$\Phi b(6 \text{ o'clock})$		-	40	-		
	$\Phi l(9 \text{ o'clock})$		-	30	-		
	$\Phi r(3 \text{ o'clock})$		-	30	-		
Rise Time	$T_r$	$V_{DD}-V_O=3.3\text{V}$ $T_a=25^{\circ}\text{C}$	-	200		mS	
Fall Time	$T_f$		-	250			
Frame frequency	Frm		-	64	-	Hz	8,10
Contrast	Cr		-	3.0	-		7

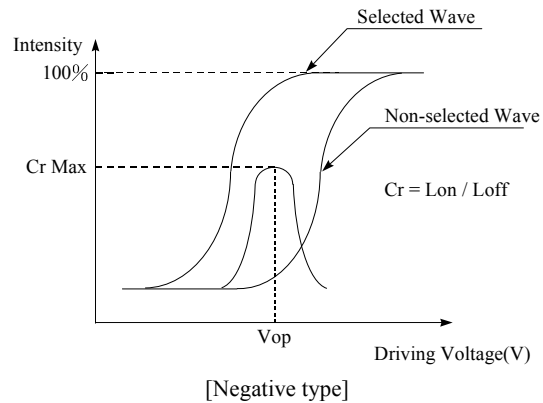
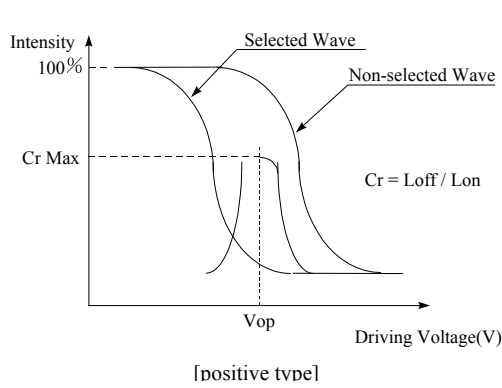
**MECHANICAL SPECIFICATION**

ITEM	DESCRIPTION
Product No.	SC1602B
Module Size	85.0(W)×30.0(H)×8.8(LED=12.7) max(D)
Viewing Area	65.0(W)mm×16.0(H)mm
Dot Size	0.56(W)mm×0.66(H)mm
Dot Pitch	0.60(W)mm×0.70(H)mm
Display Format	16 characters (W)×2 lines (H)
Duty Ratio	1/16 Duty
Controller	ST7066U or Equivalent

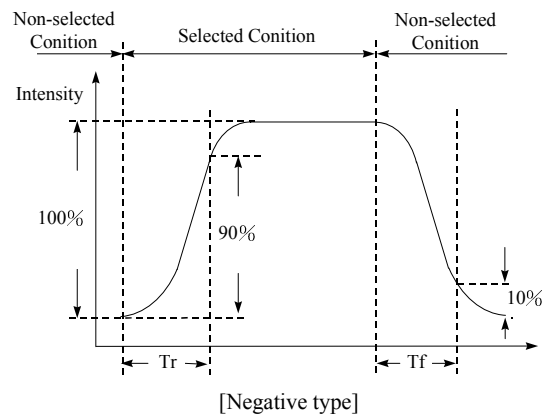
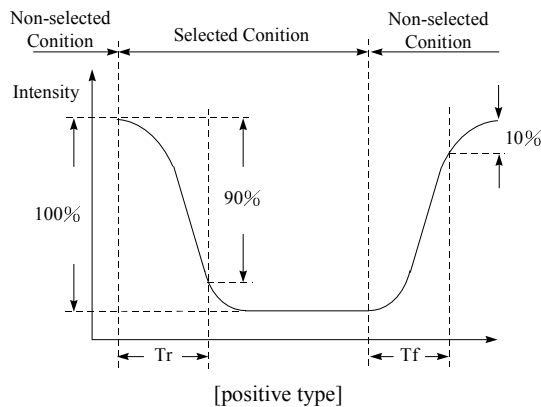
**INTERFACE PIN ASSIGNMENT**

Pin No.	Pin Out	Level	Description
1	VDD	3.3V	Power Supply Voltage
2	VSS	0V	Power Supply Ground
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)



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



### Conditions:

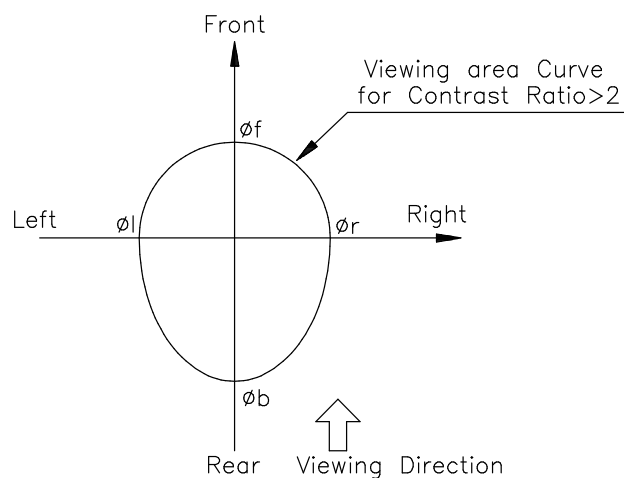
Operating Voltage : Vop

Frame Frequency : 64 Hz

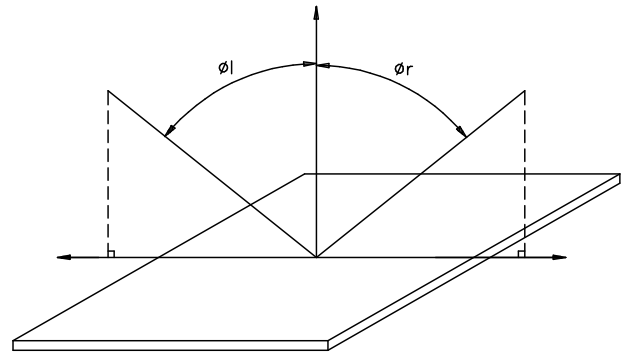
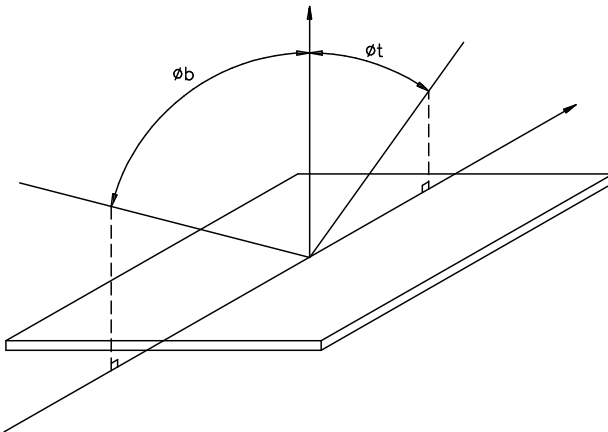
Viewing Angle( $\theta$ ,  $\varphi$ ):  $0^\circ$ ,  $0^\circ$

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

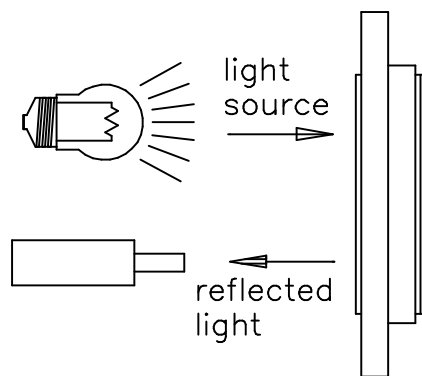
## [Note 9] Definition of Viewing Direction



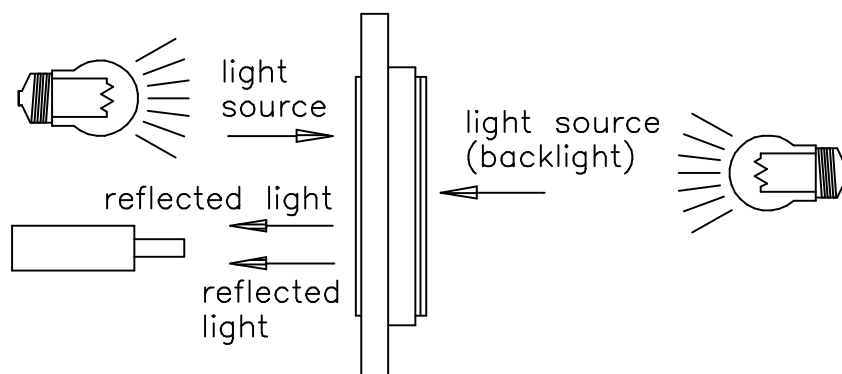
**[Note 10] Definition of viewing angle**



**[Note 11] Description of Measuring Equipment**



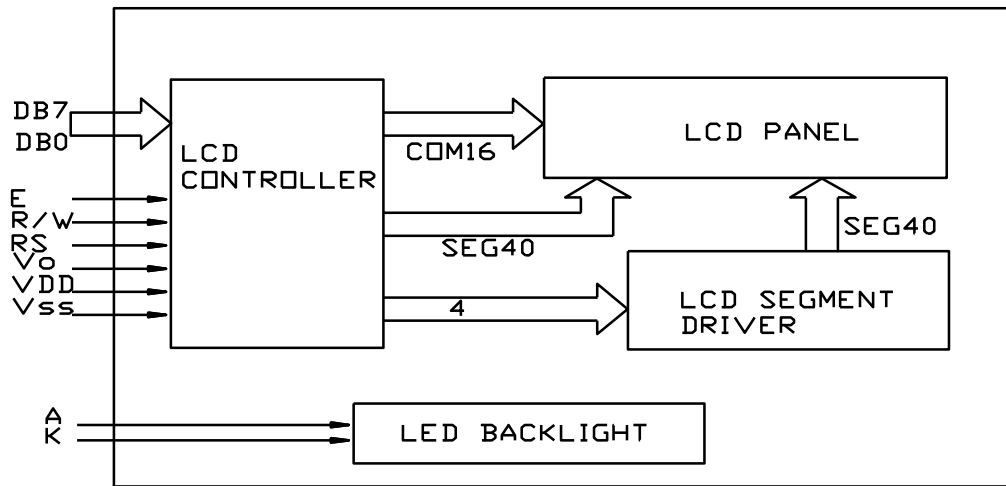
Reflective type



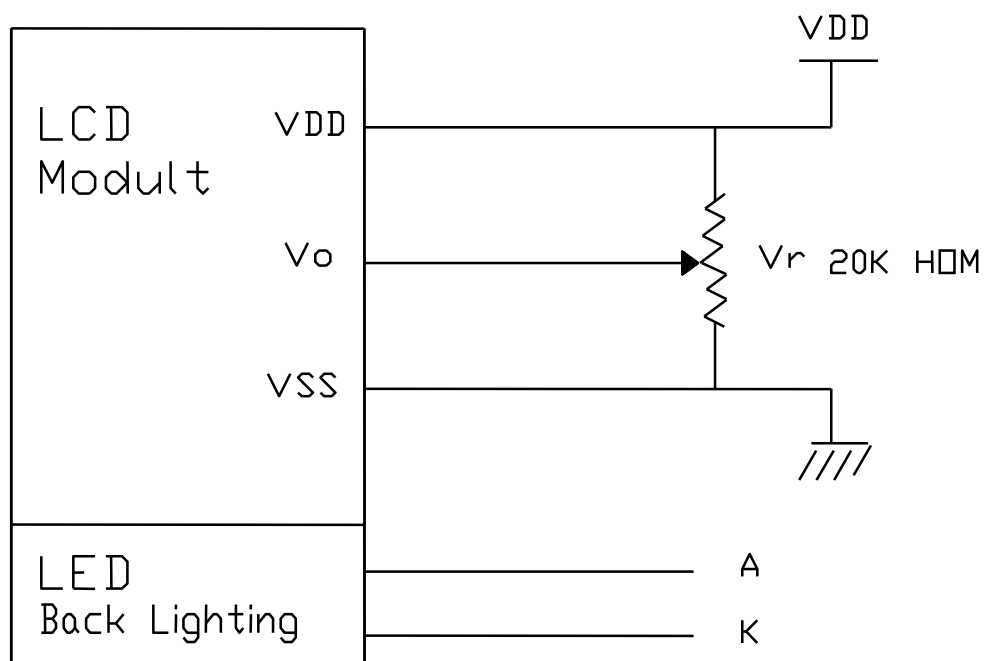
Transflective type



## BLOCK DIAGRAM



## POWER SUPPLY



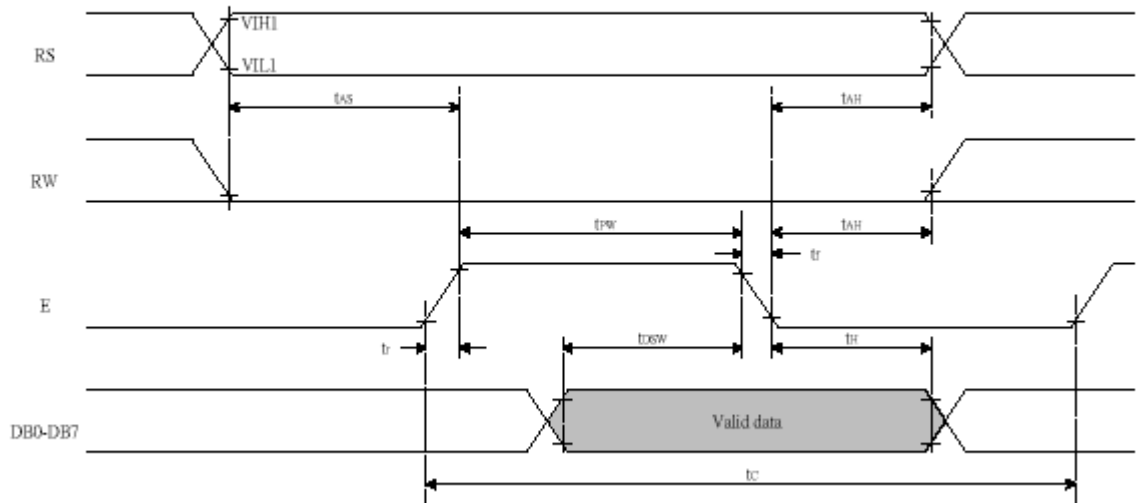
**TIMING CHARACTERISTICS**

TA=25°C ,VCC=2.7V

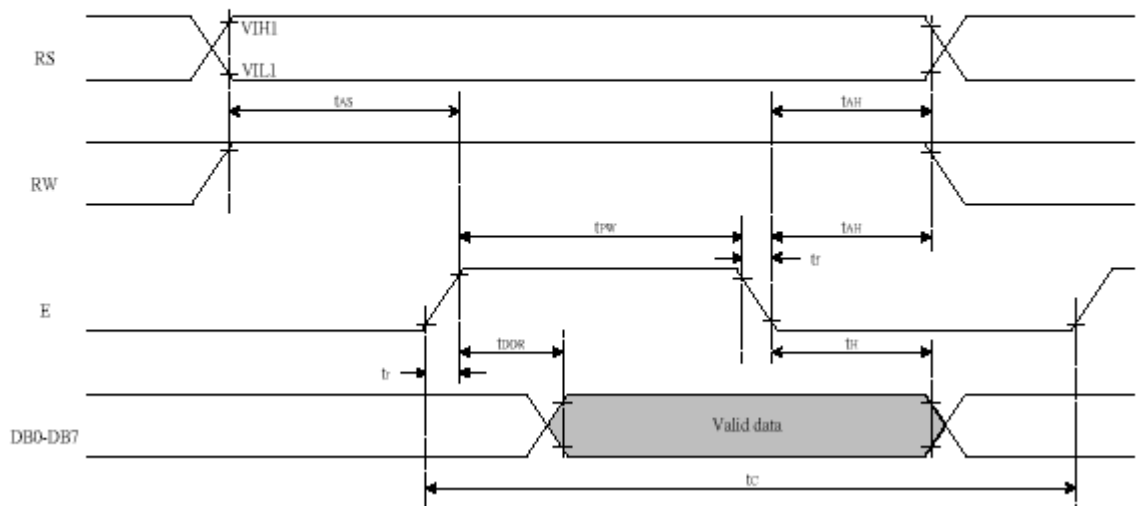
Symbol	Characteristics	Test Condition	Min.	Typ.	Max.	Unit
<i>Internal Clock Operation</i>						
f <sub>OSC</sub>	OSC Frequency	R = 75KΩ	190	270	350	KHz
<i>External Clock Operation</i>						
f <sub>EX</sub>	External Frequency	-	125	270	410	KHz
	Duty Cycle	-	45	50	55	%
T <sub>R</sub> ,T <sub>F</sub>	Rise/Fall Time	-	-	-	0.2	μs
<i>Write Mode (Writing data from MPU to ST7066U)</i>						
T <sub>C</sub>	Enable Cycle Time	Pin E	1200	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	460	-	-	ns
T <sub>R</sub> ,T <sub>F</sub>	Enable Rise/Fall Time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T <sub>AH</sub>	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T <sub>DSW</sub>	Data Setup Time	Pins: DB0 - DB7	80	-	-	ns
T <sub>H</sub>	Data Hold Time	Pins: DB0 - DB7	10	-	-	ns
<i>Read Mode (Reading Data from ST7066U to MPU)</i>						
T <sub>C</sub>	Enable Cycle Time	Pin E	1200	-	-	ns
T <sub>PW</sub>	Enable Pulse Width	Pin E	480	-	-	ns
T <sub>R</sub> ,T <sub>F</sub>	Enable Rise/Fall Time	Pin E	-	-	25	ns
T <sub>AS</sub>	Address Setup Time	Pins: RS,RW,E	0	-	-	ns
T <sub>AH</sub>	Address Hold Time	Pins: RS,RW,E	10	-	-	ns
T <sub>DDR</sub>	Data Setup Time	Pins: DB0 - DB7	-	-	320	ns
T <sub>H</sub>	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	Description Time (270KHz)
	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 DDRAM. and set DDRAM address to "00H" from AC	1.52 ms
Return Home	0	0	0	0	0	0	0	0	1	x	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	1.52 ms
Entry Mode Set	0	0	0	0	0	0	0	1	I/D	S	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.	37 us
Display ON/OFF	0	0	0	0	0	0	1	D	C	B	D=1:entire display on C=1:cursor on B=1:cursor position on	37 us
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.	37 us
Function Set	0	0	0	0	1	DL	N	F	x	x	DL:interface data is 8/4 bits N:number of line is 2/1 F:font size is 5x11/5x8	37 us
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter	37 us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter	37 us
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.	0 us
Write data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM)	37 us
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM)	37 us

## Note:

Be sure the ST7066U is not in the busy state (BF = 0) before sending an instruction from the MPU to the ST7066U. 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.

## 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

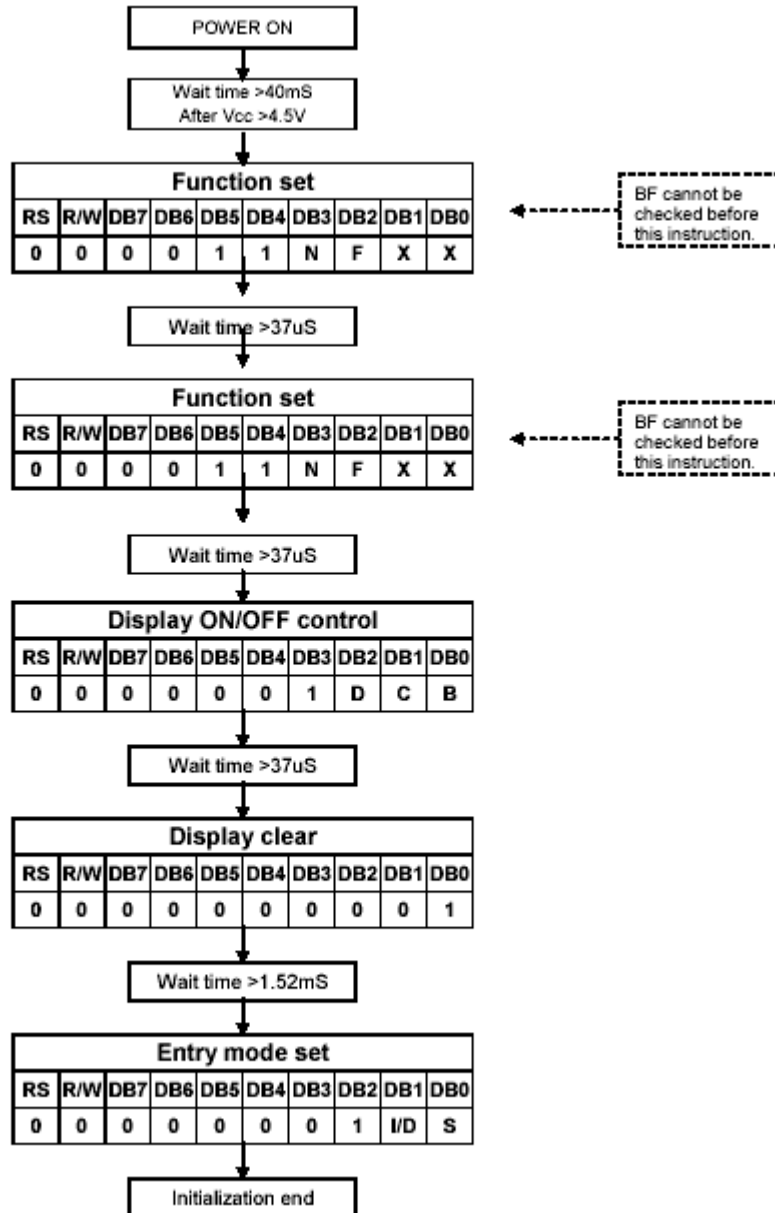
S = 0; No shift

#### 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 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

## CG RAM MAPPING

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



## CHARACTER FONT TABLE

Upper 4 bit Lower 4 bit	LLLL	LLHH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HHLH	HHLH	HHLH	HHLH	HHLH	HHLH
LLLL				0	1	2	3	4					一	二	三	四
LLHH			!	5	A	B	C	D					。	ア	チ	△
LLHL			"	6	E	F	G	H					「	イ	ウ	×
LLHH			#	7	I	J	K	L					」	ウ	テ	モ
LHLL			\$	8	O	P	Q	R					、	エ	ト	カ
LHLH			%	9	S	T	U	V					・	オ	ナ	ユ
LHHL			&	A	F	U	F	V					ヲ	カ	ニ	ヨ
LHHH			'	B	W	9	W						ヲ	キ	ヌ	ラ
HLLL			(	C	H	×	H	×					ィ	ウ	キ	リ
HLLH			)	D	I	Y	i	Y					ち	ケ	ル	リ
HLHL			*	E	J	Z	j	Z					エ	コ	レ	ジ
HLHH			+	F	K	L	k	L					オ	サ	ロ	×
HHLH			,	G	L	¥	I	I					カ	シ	フ	ワ
HHLH			-	H	M	J	m	J					ユ	ス	へ	シ
HHLH			.	I	N	^	n	^					ヨ	セ	ホ	°
HHLH			/	J	O	_	o	+					ッ	リ	マ	°

**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
	Extended Temp. type	
High temperature operation	50±3℃ , t=120hrs	2
Low temperature operation	0±3℃ , t=120hrs	2
High Temperature storage	70±3℃ , t=120hrs	1 , 2
Low Temperature storage	-20±3℃ , t=120hrs	1 , 2
Temperature Cycle	-30℃ ~ 25℃ ~ 80℃ 30min. 5min. 30min. (1 cycle) Total 5 cycle	1 , 2
Humidity Test	40℃ , Humidity 90% , 96 hrs	1 , 2
Shock Test (Packing)	Half – sine wave 100m/s <sup>2</sup> 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 1. 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℃ to 35℃ , 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)

Conditions : Ta=25℃ , Humidity=65±20% RH

### QUALITY

#### TEST CONDITIONS

Ambient temperature :25 65°C

Humidity :65620% RH

Illumination

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

Viewing angle for inspection should be within viewing angle specified in 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 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 °C, 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.