

# LMS0192A-2

## LCD Module User Manual

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Rev.	Descriptions	Release Date
0.1	Prelimiay release	2007-04-03

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## 1. Basic Specifications

### 1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, Transflective
- 2) Display Color : Display Data = "1" : Dark Gray (\*1)  
: Display Data = "0" : Light Gray (\*2)
- 3) Viewing Angle : 6H
- 4) Driving Method : 1/65 duty, 1/9 bias
- 5) Back Light : White LED backlight

Note:

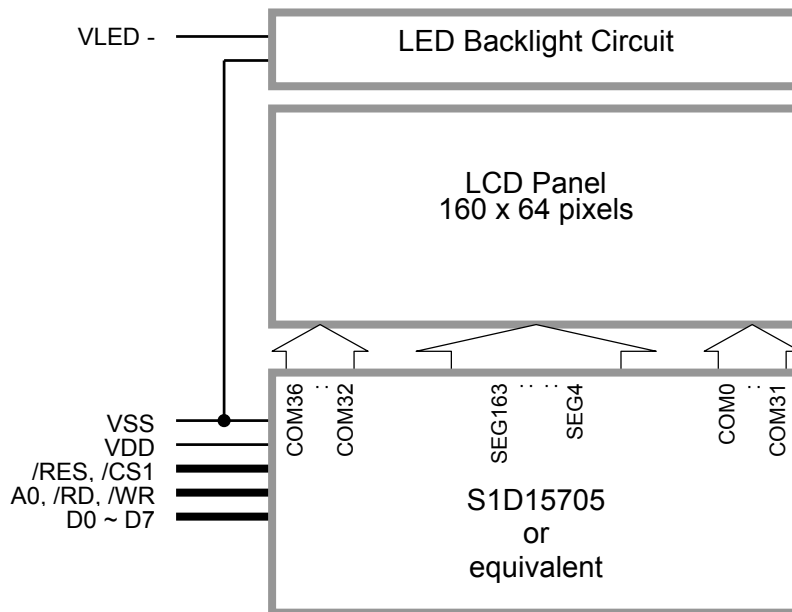
\*1. Color tone may slightly change by Temperature and Driving Condition.

\*2. The Color is defined as the inactive / background color

### 1.2 Mechanical Specifications

- 1) Outline Dimension : 79.0 x 42.3 x 6.3MAX (exclude FFC)  
See attached Outline Drawing for details

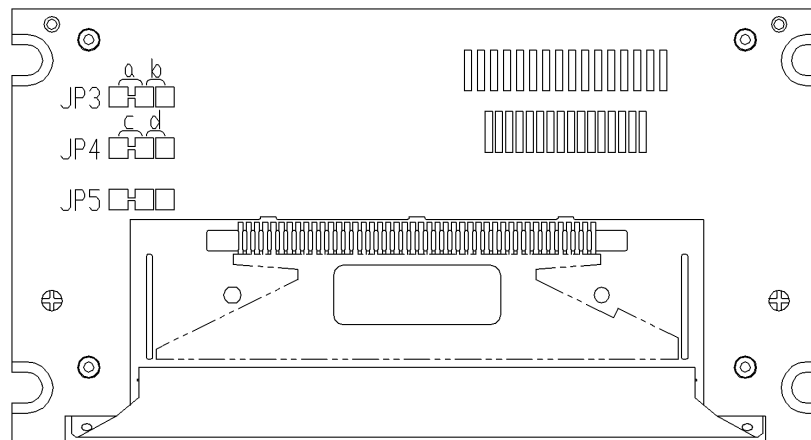
### 1.3 Block Diagram



**1.4 Terminal Functions**

Pin No.	Pin Name	I/O	Descriptions
1	VLED-	Power	Backlight Negative Power Supply
2	/CS1	Input	Chip Select: /CS1=LOW : Data IO is enabled
3	/RES	Input	Reset: /RES=LOW: Initialization is executed /RES=HIGH: Normal
4	A0	Input	Control / Display data flag: A0=HIGH: data on D0 to D7 is display data A0=LOW: data on D0 to D7 is control data
5	/WR(R/W)	Input	In 8080 interface mode: Write enable input, active LOW In 6800 interface mode: R/W=HIGH: Read mode selected R/W=LOW: Write mode selected
6	/RD(E)	Input	In 8080 interface mode: Read enable input, active LOW In 6800 interface mode: Enable Clock Signal, active HIGH
7 : 12	D0 : D5	I/O	Bi-directional data bus: In parallel interface mode: 8-bit data I/O In serial interface mode: D7=SI(Serial data input), D6=SCL(Serial clock input)
13	D6(SCL)		
14	D7(SI)		
15	VDD	Power	Positive Power Supply
16	VSS	Power	0V Supply, Ground (0V)

**1.5 Jumpers Functions**



Back side of LCD module

Jumper	Function	Descriptions																		
JP3	8080/6800 Mode	Microprocessor interface mode select <b>a=short, b=open:</b> 8080 series microprocessor interface (default) <b>a=open, b=short:</b> 6800 series microprocessor interface																		
JP4	P/S Mode	Serial / Parallel interface mode select <b>c=close, d=open:</b> Parallel interface selected <b>c=open, d=close:</b> Serial interface selected (default) <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>P/S mode</th> <th>Chip Select</th> <th>Data / Command</th> <th>Data</th> <th>Read / Write</th> <th>Serial Clock</th> </tr> </thead> <tbody> <tr> <td>Parallel I/F</td> <td>/CS1</td> <td>A0</td> <td>D0-D7</td> <td>/RD, /WR</td> <td>-</td> </tr> <tr> <td>Serial I/F</td> <td>/CS1</td> <td>A0</td> <td>SI (D7)</td> <td>Write only</td> <td>SCL (D6)</td> </tr> </tbody> </table> <p>In serial interface mode: No data can be read from RAM D0 to D5 are HZ, /RD and /WR must be fixed HIGH or LOW</p>	P/S mode	Chip Select	Data / Command	Data	Read / Write	Serial Clock	Parallel I/F	/CS1	A0	D0-D7	/RD, /WR	-	Serial I/F	/CS1	A0	SI (D7)	Write only	SCL (D6)
P/S mode	Chip Select	Data / Command	Data	Read / Write	Serial Clock															
Parallel I/F	/CS1	A0	D0-D7	/RD, /WR	-															
Serial I/F	/CS1	A0	SI (D7)	Write only	SCL (D6)															
JP5	Reserved	-																		

**Cautions:**

When setting the Jumper, take extreme care at any unexpected short circuit or damage on the LCD module.

## 2. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	$V_{DD}$	-0.3	+4.5	V	$V_{SS} = 0V$
Input Voltage	$V_{IN}$	-0.3	$V_{DD}+0.3$	V	$V_{SS} = 0V$
Operating Temperature	$T_{OP}$	-20	+70	°C	No Condensation
Storage Temperature	$T_{ST}$	-20	+80	°C	No Condensation

Cautions:

Any Stresses exceeding the Absolute Maximum Ratings may cause substantial damage to the device. Functional operation of this device at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect device reliability.

## 3. Electrical Characteristics

### 3.1 DC Characteristics

$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	$V_{DD}$	2.9	3.3	3.6	V	VDD
Input High Voltage	$V_{IH}$	$0.8 \times V_{DD}$	-	$V_{DD}$	V	/RES, /CS1, A0, /WR, /RD, D0~D7
Input Low Voltage	$V_{IL}$	0	-	$0.2 \times V_{DD}$	V	
Output High Voltage	$V_{OH}$	$0.7 \times V_{DD}$	-	$V_{DD}$	V	$I_{OH}=-0.3mA, D0~D7$
Output Low Voltage	$V_{OL}$	0	-	$0.3 \times V_{DD}$	V	$I_{OL}=0.3mA, D0~D7$
Operating Current	$I_{DD}$	-	0.4	1.8	mA	VDD
Sleep Mode Current	$I_{DDs}$	-	-	1.0	$\mu A$	VDD

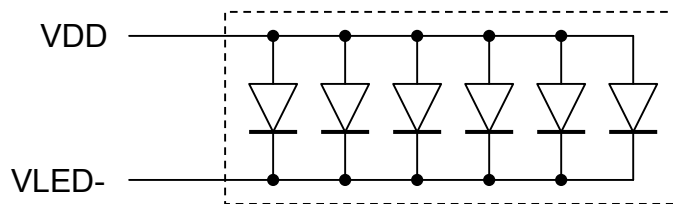
### 3.2 LED Backlight Circuit Characteristics

$V_{DD}=3.3V, I_{f_{VLED-}}=120mA, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Applicable Pin
Forward Voltage	$V_{f_{VLED-}}$	-	0	-	V	VLED-
Forward Current	$I_{f_{VLED-}}$	-	-	150	mA	VLED-

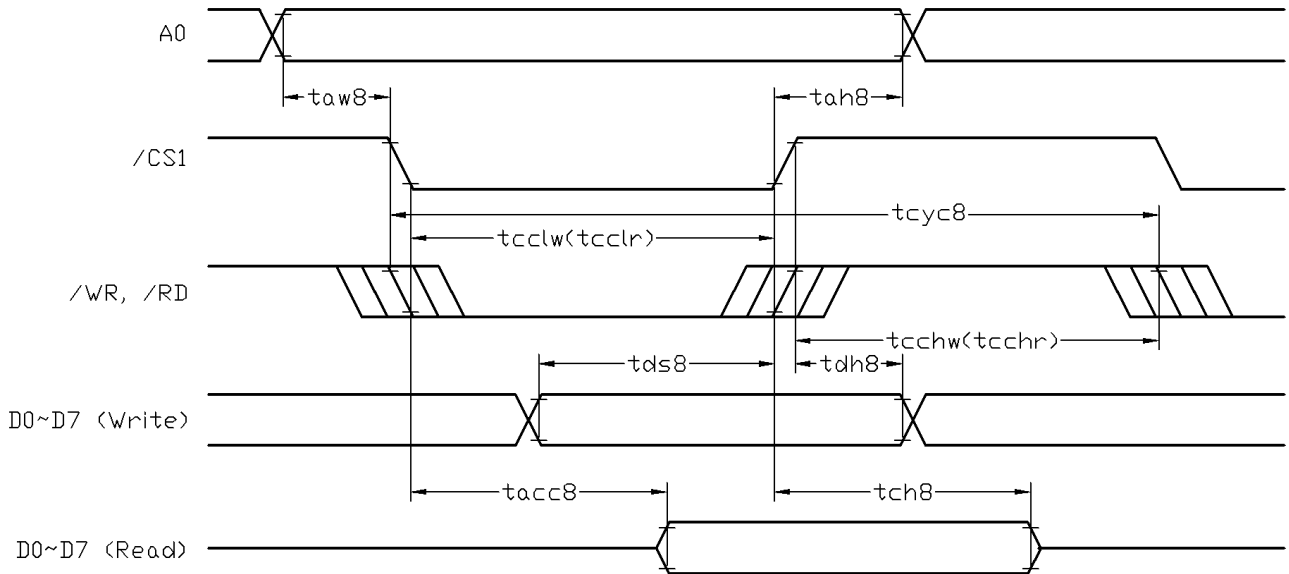
Cautions:

Exceeding the recommended driving current could cause substantial damage to the backlight and shorten its lifetime.



**3.3 AC Characteristics**

**3.3.1 8080 Mode System Bus Timing**



$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

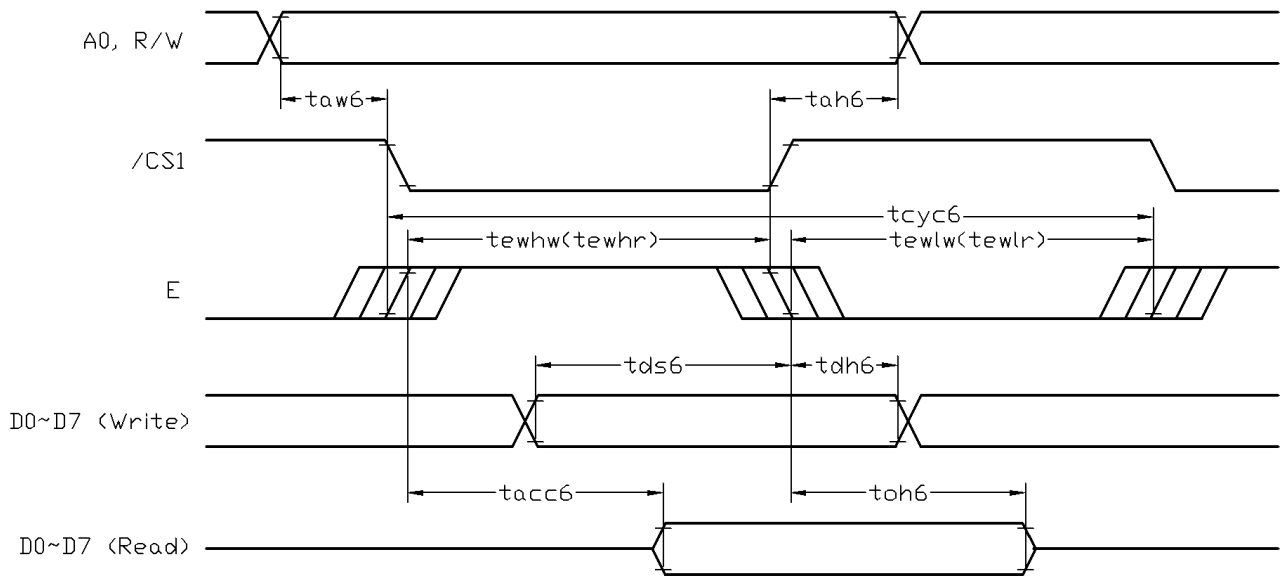
Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc8	1000	-	-	ns
Address setup time (A0)	taw8	10	-	-	ns
Address hold time (A0)	tah8	10	-	-	ns
Control LOW pulse width (/WR)	tcclw	150	-	-	ns
Control LOW pulse width (/RD)	tcclr	300	-	-	ns
Control HIGH pulse width (/WR)	tcchw	150	-	-	ns
Control HIGH pulse width (/RD)	tcchr	150	-	-	ns
Data setup time	tds8	100	-	-	ns
Data hold time	tdh8	38	-	-	ns
/RD access time (*2)	tacc8	-	-	350	ns
Output disable time (*2)	tch8	-	-	250	ns

Note:

\*1. Input signal rise/fall time should be less than 12ns

\*2. CL=100pF

**3.3.2 6800 Mode System Bus Timing**



$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

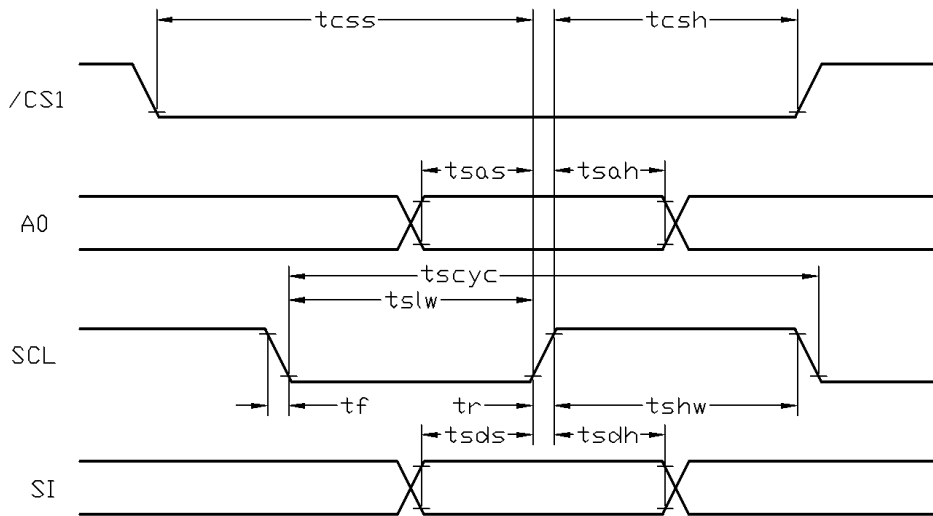
Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc6	1000	-	-	ns
Address setup time	taw6	10	-	-	ns
Address hold time	tah6	10	-	-	ns
Enable High pulse width (Read)	tewhr	300	-	-	ns
Enable High pulse width (Write)	tewhw	150	-	-	ns
Enable Low pulse width (Read)	tewlr	150	-	-	ns
Enable Low pulse width (Write)	tewlw	150	-	-	ns
Data setup time	tds6	100	-	-	ns
Data hold time	tdh6	38	-	-	ns
Output disable time (*2)	toh6	-	-	250	ns
Access time (*2)	tacc6	-	-	350	ns

Note:

\*1. Input signal rise/fall time should be less than 12ns

\*2. CL=100pF

**3.3.3 Serial Interface Timing**



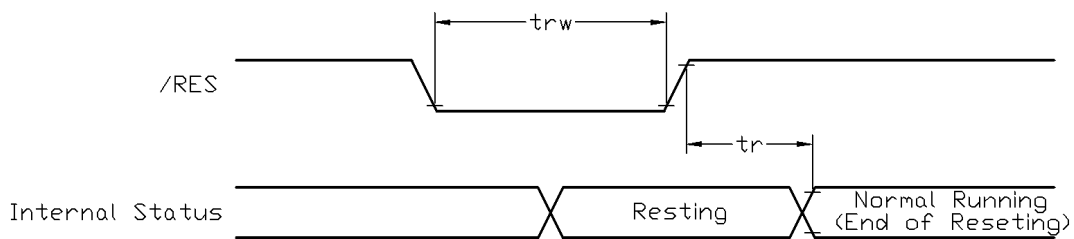
$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial clock cycle	tscyc	500	-	-	ns
Serial clock High pulse width	tshw	190	-	-	ns
Serial clock Low pulse width	tslw	190	-	-	ns
Address setup time	tsas	320	-	-	ns
Address hold time	tsah	320	-	-	ns
Data setup time	tsds	190	-	-	ns
Data hold time	tsdh	190	-	-	ns
CS serial clock time	tcss	320	-	-	ns
CS serial clock time	tcsh	320	-	-	ns

Note:

\*1. Input signal rise/fall time should be less than 12ns

**3.3.4 Reset Timing**



$V_{SS}=0V, V_{DD}=3.3V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset time	tr	-	-	2	$\mu s$
Reset LOW pulse width	trw	2	-	-	$\mu s$

Note:

\*1. Input signal rise/fall time should be less than 12ns



## 4. Function Specifications

### 4.1 Basic Setting

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

- Built-in Oscillator Circuit=ON
- LCD Bias Set = 1/9
- ADC = 1 (reverse)
- COM Output State Selection = reverse
- Display Start Line = 0
- Display All Lighting ON/OFF = OFF (normal)
- Display Normal/Reverse = Normal
- Set Power Control Set:  
voltage follower = ON, voltage booster = ON, voltage adjusting circuit = ON
- Display ON/OFF = ON

Note:

\*1. These setting/commands should issue the LCD module while start up.

\*2. See the Display Commands section for details.

### 4.2 Resetting the LCD module

The LCD module should be initialized by using /RES terminal.

While turning on the VDD and VSS power supply, maintain /RES terminal at LOW level. After the power supply stabilized, release the reset terminal (/RES=HIGH)

### 4.3 Display Memory Map

Page address	data	LCD Display (front view)	
0	D0 : D7		
1	D0 : D7		
2	D0 : D7		
3	D0 : D7		
4	D0 : D7		
5	D0 : D7		
6	D0 : D7		
7	D0 : D7		
Column Address		24h	→ C3h

Note:

\*1. ADC = 1 (reverse)

\*2. COM Output State Selection = reverse

\*3. Display Start Line = 0

**4.4 Display Commands**

No.	Instructions	Code										Function		
		A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0	
1	Display ON/OFF	0	1	0	1	0	1	0	1	1	1	1	0 / 1	0 = Turns off LCD 1 = Turns on LCD
2	Set Display Start Line	0	1	0	0	1	Display Start Address					0	Specifies display RAM location for first line of display	
3	Set Page Address	0	1	0	1	0	1	1	Page Address			0	Set the display RAM page address	
4	Set Column Address (Upper-4-bits)	0	1	0	0	0	0	1	Col. Add. Upper			0	Set the upper-4-bit of column address counter	
	Set Column Address (Lower-4-bits)	0	1	0	0	0	0	0	Col. Add. Lower			0	Set the lower-4-bit of column address counter	
5	Read Status	0	0	1	Status				0	0	0	0	0	Read the internal status D4=RESET, 1=resetting, 0=normal D5=Display ON/OFF, 1=off, 0=on D6=ADC Flag, D7=BUSY Flag, 1=busy, 0=ready
6	Write Display Data	1	1	0	Display Data							0	Write data into the display RAM	
7	Read Display Data	1	0	1	Display Data							0	Read data form the display RAM	
8	ADC Select	0	1	0	1	0	1	0	0	0	0	0	0 / 1	Sets the Column Address direction 0 = Normal display 1 = flipped in x direction
9	Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	1	0 / 1	0 = Normal display 1 = Reverse display
10	Display All ON	0	1	0	1	0	1	0	0	1	0	0	0 / 1	0 = Normal display 1 = All-on
11	Set LCD Bias	0	1	0	1	0	1	0	0	0	1	1	0 / 1	Set the LCD driving voltage bias 0 = 1/9 BIAS 1 = 1/7 BIAS
12	Read-Modify-Write	0	1	0	1	1	1	0	0	0	0	0	0	Enter the "Read-Modify-Write" mode column address counter will increase in each "Write Display Data", and will not increase in each "Read Display Data command"
13	End	0	1	0	1	1	1	0	1	1	1	0	0	Clear the "Read-Modify-Write" mode
14	Reset	0	1	0	1	1	1	0	0	0	1	0	0	Resets the LCD module
15	COMMON Output Status Selection	0	1	0	1	1	0	0	0	1	*	*	*	Set the COM scanning direction 0 = Normal display 1 = flipped in y direction * = don't care terms
16	Power Control Set	0	1	0	0	0	1	0	1	Power Status			0	Set the power circuit operation mode D0 = LCD Supply Voltage Follower D1 = LCD Supply Voltage Adjusting Circuit D2 = LCD Supply Voltage Booster (1=ON, 0=OFF)

**4.5 Display Commands (continue)**

No.	Instructions	Code											Function
		A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1	D0	
17	Set Internal Resistance Ratio for V5 adjustment	0	1	0	0	0	1	0	0	Ratio Setting		Set the built-in resistor ratio (Rb/Ra)	
18	Electronic Vol. mode	0	1	0	1	0	0	0	0	0	1	Turn on the Electronic Vol Mode	
	Set Electronic Vol. Register	0	1	0	x	x	Electronic Control value		Set Electronic Vol. Value (Display contrast value)				
20	Power Save	0	1	0	1	0	1	0	1	0	0	Moves to the power save state: 0 = stand-by 1 = sleep	
21	Power Save Reset	0	1	0	1	1	1	0	0	0	1	Reset power save	
22	Set n-Line Reversal Drive Register	0	1	0	0	0	1	1	No. of Rev Line		Sets the number of line reversal drive lines		
23	n-line Reversal Drive Reset	0	1	0	1	1	1	0	0	1	0	Resets the line reversal drive	
24	Turn ON Built-in Oscillator Circuit	0	1	0	1	0	1	0	1	0	1	Start the operation of the built-in CR oscillator circuit	
25	NOP	0	1	0	1	1	1	0	0	0	1	Non-operation command	
26	Test	0	1	0	1	1	1	1	x	x	x	Test Command. Do not use.	

Note: \*1. Do not use any other command not listed, or the system malfunction may result.  
\*2. For the details of the Display Commands, please refer to S1D15705 Series data sheet.

**4.5.1 Power off the LCD Module**

It recommends that enter sleep mode before power off the LCD module.

**4.5.2 Refreshing The LCD Module**

It recommends that the operating modes and display contents be refreshed periodically to prevent the effect of unexpected noise.

**4.6 Basic Operating Sequence (example)**

**4.6.1 Initialization Sequence**

	Code Function										Note	
	A0	D7	D6	D5	D4	D3	D2	D1	D0	hex		
Turn on Power Supply VDD & VSS While maintaining /RES at LOW	-	-	-	-	-	-	-	-	-	-	-	-
Wait until power supply is stabilized	-	-	-	-	-	-	-	-	-	-	-	-
Release the /RES Reset Signal (/RES = HIGH)	-	-	-	-	-	-	-	-	-	-	-	See AC Characteristics section for timing details
Turn ON Built-in Oscillator Circuit	0	1	0	1	0	1	0	1	1	ABh	Turn on the Oscillator	
LCD bias = 1/9	0	1	0	1	0	0	0	1	0	A2h	LCD panel Characteristic	
ADC = reverse	0	1	0	1	0	0	0	0	1	A1h	Flip on x-direction (SEG)	
COM Output Status = reverse	0	1	1	0	0	1	0	0	0	C8h	Flip on y-direction (COM)	
Display Start Line=0	0	0	1	0	0	0	0	0	0	40h	i.e. Display RAM "page 0 - D0" Matched to top line of the LCD	
Power Control LCD Supply Voltage Follower = ON LCD Supply Voltage Adjusting Circuit = ON LCD Supply Voltage Booster = ON	0	0	0	1	0	1	1	1	1	2Fh	Turn on all the internal power circuit for driving the LCD normally	
Set Internal Resistance Ratio for V5 adjustment	0	0	0	1	0	0	1	0	1	25h	Set the built-in resistor ratio to middle	
Set Electronic Vol. mode Set Electronic Vol. Register	0	1	0	0	0	0	0	0	1	81h	Set to the middle of the range It may be adjusted for achieving the best display contrast	
	0	0	0	0	1	0	0	1	1	13h		
Display ON	0	1	0	1	0	1	1	1	1	AFh	Turn on the LCD display	
Set Page Address = 0	0	1	0	1	1	0	0	0	0	B0h	Specify the Display Data RAM page address to 00h	
Set Column Address (Upper-4bit=0) Set Column High (Lower-4bit=0)	0	0	0	0	1	0	0	0	0	10h	Specify the Display Data RAM column address to 00h	
	0	0	0	0	0	0	0	0	0	00h		
Write Display Data	1	Display Data									Write data to Display Data RAM. After write, the internal Column Address Counter will be increased by 1 automatically	
Write Other Display Data ...												

## 5. Design and Handling Precaution

1. The LCD panel is made by glass. Any mechanical shock (eg. dropping from high place) will damage the LCD module.
2. Do not add excessive force on the surface of the display, which may cause the Display color change abnormally.
3. The polarizer on the LCD is easily get scratched. If possible, do not remove the LCD protective film until the last step of installation.
4. Never attempt to disassemble or rework the LCD module.
5. Only Clean the LCD with Isopropyl Alcohol or Ethyl Alcohol. Other solvents (eg. water) may damage the LCD.
6. When mounting the LCD module, make sure that it is free from twisting, warping and distortion.
7. Ensure to provide enough space (with cushion) between case and LCD panel to prevent external force adding on it, or it may cause damage to the LCD or degrade the display result.
8. Only hold the LCD module by its side. Never hold LCD module by add force on the heat seal or TAB.
9. Never add force to component of the LCD module. It may cause invisible damage or degrade of the reliability.
10. LCD module could be easily damaged by static electricity. Be careful to maintain an optimum anti-static work environment to protect the LCD module.
11. When peeling off the protective film from LCD, static charge may cause abnormal display pattern. It is normal and will resume to normal in a short while.
12. Take care and prevent get hurt by the LCD panel sharp edge.
13. Never operate the LCD module exceed the absolute maximum ratings.
14. Keep the signal line as short as possible to prevent noisy signal applying to LCD module.
15. Never apply signal to the LCD module without power supply.
16. IC chip (eg. TAB or COG) is sensitive to the light. Strong lighting environment could possibly cause malfunction. Light sealing structure casing is recommend.
17. LCD module reliability may be reduced by temperature shock.
18. When storing the LCD module, avoid exposure to the direct sunlight, high humidity, high temperature or low temperature. They may damage or degrade the LCD module