



深圳市拓普微科技开发有限公司

SHENZHEN TOPWAY TECHNOLOGY CO., LTD.

LM6059CCA-1

LCD Module User Manual

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Rev.	Descriptions	Release Date
0.1	Preliminary release	2010-09-07

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1. Basic Specifications

1.1 Display Specifications

- 1) LCD Display Mode : FSTN, Positive, High-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

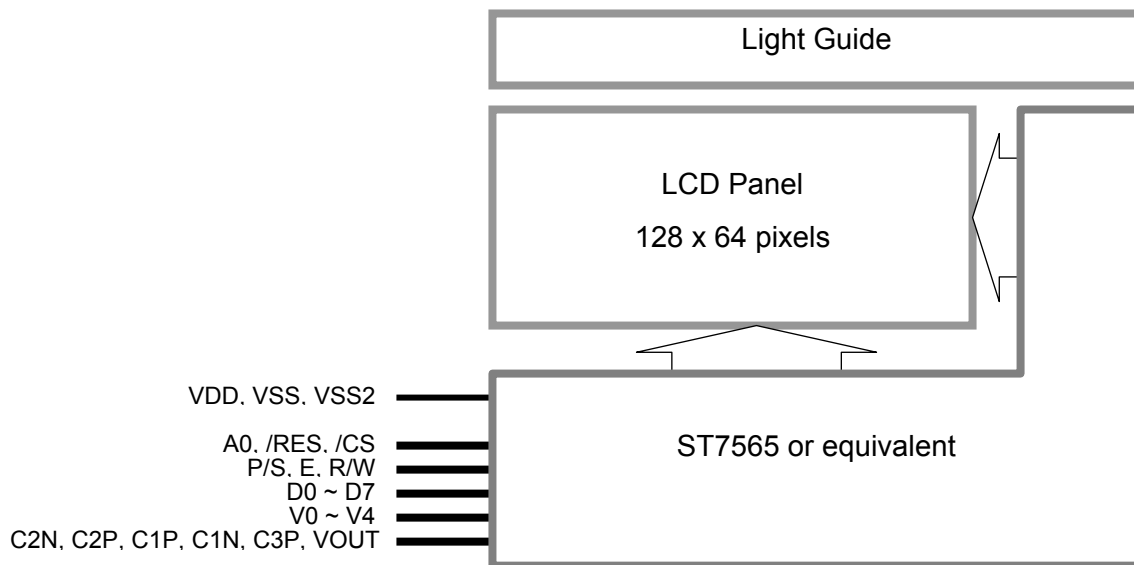
Note:

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

1.2 Mechanical Specifications

- 1) Outline Dimension : 44.9 x 38.9 x 4.5 (mm)
(See attached Outline Drawing for details)

1.3 Block Diagram



2. Terminal Functions

PIN NO	PIN Name	I/O	Descriptions	
			6800 mode(Default)	Serial mode
1	VDD	Power	Positive power supply	
2	P/S	Input	P/S=High	P/S=Low
3	VSS	Power	Negative power supply,0V	
4	V0	Power	LCD driver supply voltages where $V0 \geq V1 \geq V2 \geq V3 \geq V4 \geq VSS$	
5	V1	Power		
6	V2	Power		
7	V3	Power		
8	V4	Power		
9	C2N	Power	DC-DC voltage converter capacitors terminals	
10	C2P	Power		
11	C1P	Power		
12	C1N	Power		
13	C3P	Power		
14	VOUT	Power	Voltage converter Output	
15	VSS2	Power	Negative power supply,0V	
16	D7(SI)	I/O	8-bit Data bus;	Serial data input
17	D6(SCL)	I/O	Three state I/O terminal for display data or instruction data	Serial clock input
:	:	I/O	when /CS=H,D0~D7=High Impedance	Not used, Leave open
23	D0	I/O		
24	E	Input	R/W=H,E=H; Data or Status read from the LCD module	Not used, Leave open or pull Hi
25	R/W	Input	R/W=L,E=H→L; Data or Status latch into the LCD module	
26	A0	Input	Register Select A0 = H, Transferring the Display Data A0 = L, Transferring the Control Data	
27	/RES	Input	Reset signal /RES = L, Initialization is executed /RES = H, Normal running.	
28	/CS	Input	Chip Select /CS=L, enable access to the LCD module /CS=H, disable access to the LCD module	

3. Absolute Maximum Ratings

Items	Symbol	Min.	Max.	Unit	Condition
Supply Voltage	V_{DD}	-0.3	+3.3	V	$V_{SS} = 0V$
Input Voltage	V_{IN}	-0.3	$V_{DD}+0.3$	V	$V_{SS} = 0V$
Operating Temperature	T_{OP}	-30	+60	°C	No Condensation
Storage Temperature	T_{ST}	-40	+70	°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.

4. Electrical Characteristics

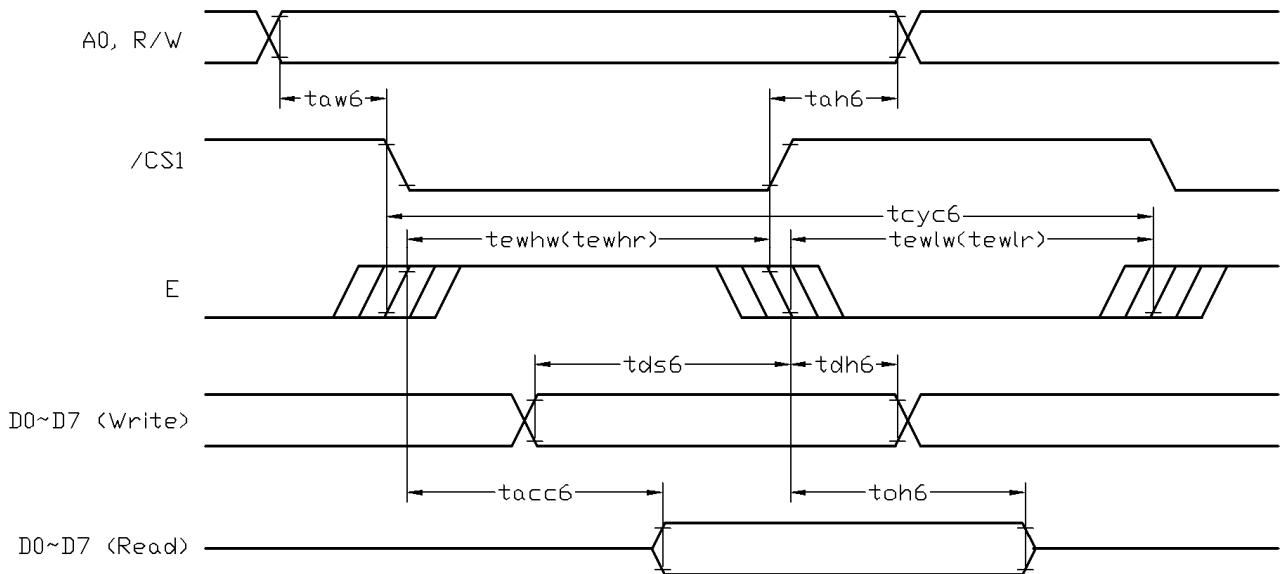
4.1 DC Characteristics

$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Items	Symbol	MIN.	TYP.	MAX.	Unit	Condition / Application Pin
Operating Voltage	V_{DD}	2.8	-	3.3	V	VDD,VSS
Input High Voltage	V_{IH}	$0.8 \times V_{DD}$	-	V_{DD}	V	/RES, /CS, A0,
Input Low Voltage	V_{IL}	V_{SS}	-	$0.2 \times V_{DD}$	V	E, R/W, D0~D7
Output High Voltage	V_{OH}	$0.75 \times V_{DD}$	-	V_{DD}	V	D0~D7
Output Low Voltage	V_{OL}	V_{SS}	-	$0.25 \times V_{DD}$	V	D0~D7
Operating Current	I_{DD}	-	0.4	1.5	mA	VDD

4.2 AC Characteristics

4.2.1 6800 Mode System Bus Timing



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
System cycle time	tcyc6	500	-	-	ns
Address setup time (A0)	taw6	10	-	-	ns
Address hold time (A0)	tah6	10	-	-	ns
Control LOW pulse width (/RD)	tewlr	275	-	-	ns
Control LOW pulse width (/WR)	tewlw	275	-	-	ns
Control HIGH pulse width (/RD)	tewhr	225	-	-	Ns
Control HIGH pulse width (/WR)	tewhw	225	-	-	Ns
Data setup time	tds6	50	-	-	Ns
Data hold time	tdh6	10	-	-	Ns
/RD access time (*2)	tacc6	-	-	175	Ns
Output disable time (*2)	tch6	13	-	125	Ns

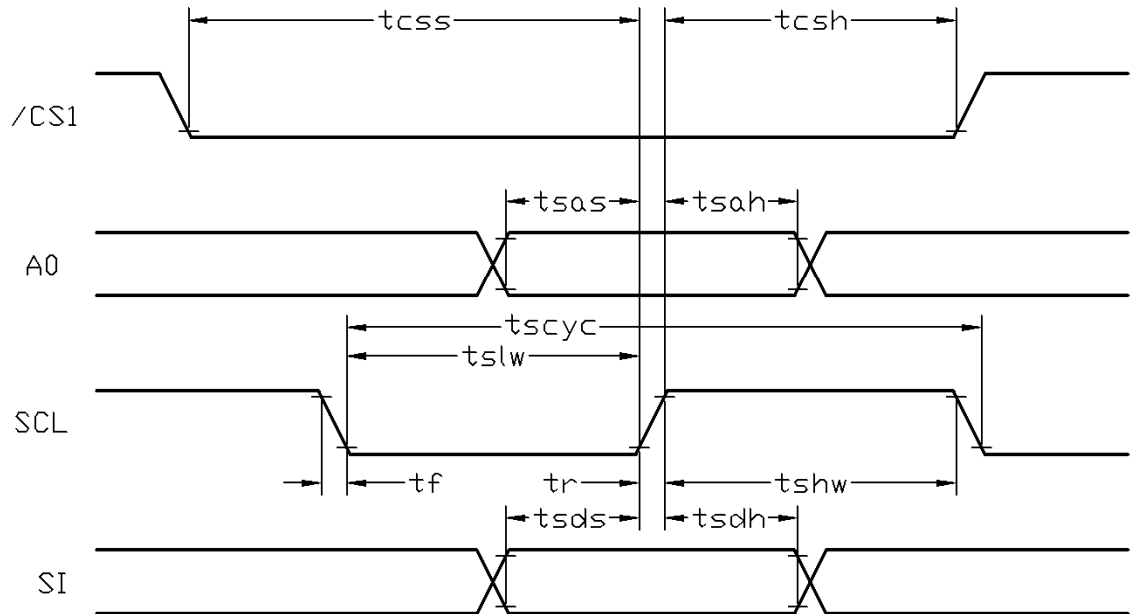
Note:

*1. Input signal rise/fall time should be less than 15ns .

*2. CL=100pF

*3.All timing is using 20% and 80% of VDD as the reference.

4.2.2 Serial Mode Interface



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Serial Clock Period	tscyc	125	-	-	Ns
Address setup time (A0)	tsas	38	-	-	Ns
Address hold time (A0)	tsah	25	-	-	Ns
SCL "H" pulse width	tshw	63	-	-	Ns
SCL "L" pulse width	tslw	63	-	-	ns
Data setup time	tsds	38	-	-	ns
Data hold time	tsdh	25	-	-	ns
CS-SCL time	tcss	38	-	-	ns
CS-SCL time	tcsh	75	-	-	ns

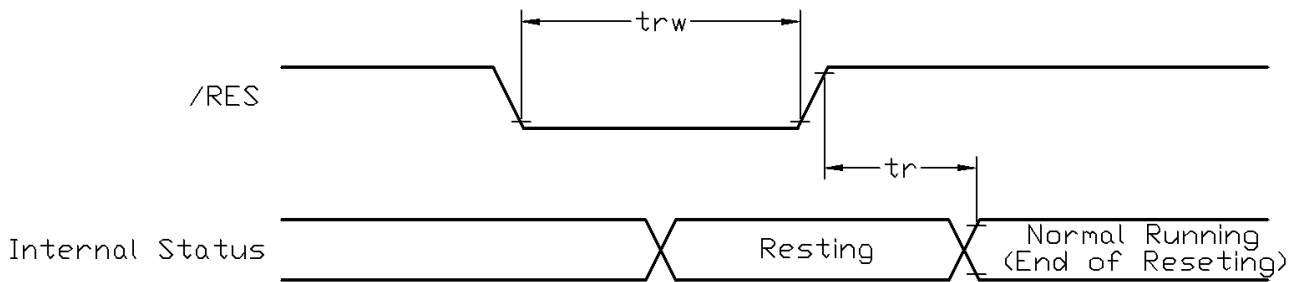
Note:

*1. Input signal rise/fall time should be less than 15ns .

*2. CL=100pF

*3.All timing is using 20% and 80% of VDD as the reference.

4.2.3 Reset Timing



$V_{SS}=0V, V_{DD}=3.0V, T_{OP}=25^{\circ}C$

Item	Symbol	MIN.	TYP.	MAX.	Unit
Reset time	tr	-	-	2.5	μs
Reset LOW pulse width	trw	2.5	-	-	μs

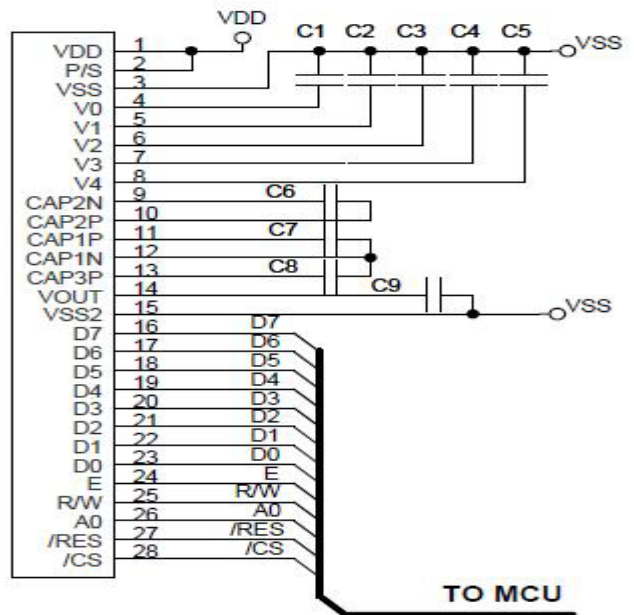
Note:

*1.All timing is using 20% and 80% of VDD as the reference.

5. Function specifications

5.1 Application circuit (Example)

- 4x boosting
- 68 mode
- Using internal ref resistor
- C1~C5 = 1.0uF (25V)
- C6~C9 = 1.0uF (25V)



Note:

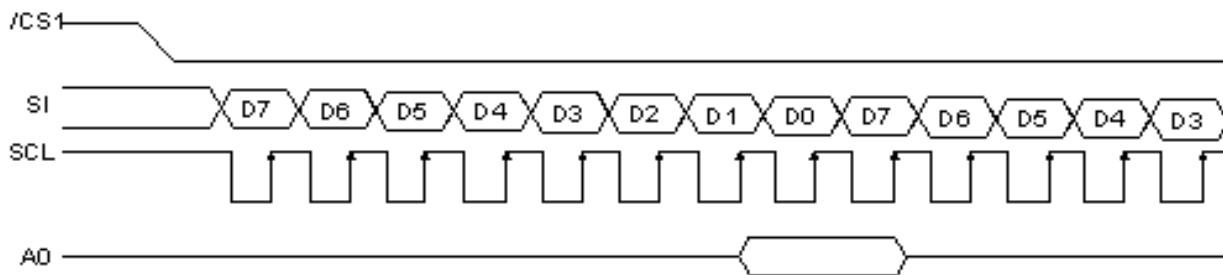
Please refer to the ST7565 data sheet for details

5.2 The Parallel Interface

Shared	6800 Mode		Function
	A0	R/W E	
H	H	H	Reads the display data
H	L	H→L	Writes the display data
L	H	H	Status read
L	L	H→L	Write control data(command)

5.3 The Serial Interface

When the serial interface has been selected then when the chip is in active state the serial data input(SI) and the serial clock(SCL) can be received. The serial data is read from the serial data input pin in the rising edge of the serial clock . When "A0"="H", the data is display data, and when "A0"="L", the data is command.



5.4 Basic Setting

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

- ADC = 0 (normal)
- SHL select = 1 (reverse)
- LCD Bias Select = 1/9
- Initial Display Line = 0
- Entire Display ON/OFF = OFF (normal)
- Reverse Display ON/OFF = OFF (normal)
- Set Power Control Set:
 - voltage follower = ON, voltage converter = ON, voltage regulator = 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.

5.5 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)

5.6 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		00h	→ 7Fh

- Note:
- *1. ADC = 0 (normal)
 - *2. SHL Selection = 1 (reverse)
 - *3. Initial Display Line = 0

5.7 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	DON	DON=0, display off DON=1, display on
2	Display start line set	0	1	0	0	1	Display start address						Sets the display RAM display start line address
3	Set Page Address	0	1	0	1	0	1	1	Page Address				Set the display RAM page address
4	Set Column Address (Upper-4-bits)	0	1	0	0	0	0	1	Col. Add. Upper				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				Set the lower-4-bit of column address counter
5	Read Status	0	0	1	Status				0	0	0	0	Read the status data
6	Write Display Data	1	1	0	Write Data								Write data into the display RAM
7	Read Display Data	1	0	1	Read Data								Read data from the display RAM
8	ADC Select	0	1	0	1	0	1	0	0	0	0	ADC	Sets the display RAM address SEG output correspondence ADC= 0,normal . ADC=1, reverse
9	Normal/Reverse Display	0	1	0	1	0	1	0	0	1	1	REV	REV=0, Normal display REV=1, Reverse display
10	Entire Display ON/OFF	0	1	0	1	0	1	0	0	1	0	EON	EON=0, Normal display EON=1, Entire display ON
11	Set LCD Bias	0	1	0	1	0	1	0	0	0	1	BIAS	Set the LCD driving voltage bias BIAS=0, 1/9 BIAS BIAS=1, 1/7 BIAS
12	Set Read-Modify-Write	0	1	0	1	1	1	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	Reset Read-Modify-Write	0	1	0	1	1	1	0	1	1	1	0	Clear the "Read-Modify-Write" mode
14	Reset	0	1	0	1	1	1	0	0	0	1	0	Resets the LCD module
15	SHL Select	0	1	0	1	1	0	0	SHL	*	*	*	Set the COM scanning direction SHL=0, Normal display SHL=1, Flipped in y direction * = don't care terms
16	Power Control Set	0	1	0	0	0	1	0	1	VC	VR	VF	Set the power circuit operation mode VF: LCD Supply Voltage Follower VR: LCD Supply Voltage Regulator VC: LCD Supply Voltage Converter (1=ON, 0=OFF)
17	Regulator Resistor Select	0	1	0	0	0	1	0	0	Radio setting			Set the built-in resistor ratio (Rb/Ra)

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 ST7565P data sheet.

5.8 Display Commands (continue)

No.	Instructions	Code										Function	
		A0	/RD	/WR	D7	D6	D5	D4	D3	D2	D1		D0
18	Electronic volume mode set	0	1	0	1	0	0	0	0	0	0	1	Set reference voltage mode
	Electronic volume register set	0	1	0	*	*	Electronic Control value					Set reference voltage register (Display contrast value)	
19	Power Save	-	-	-	-	-	-	-	-	-	-	-	Compound Instruction: Display OFF + Entire Display ON
20	NOP	0	1	0	1	1	1	0	0	0	1	1	Non-operation command

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 ST7565P data sheet.

5.8.1 Power off the LCD Module

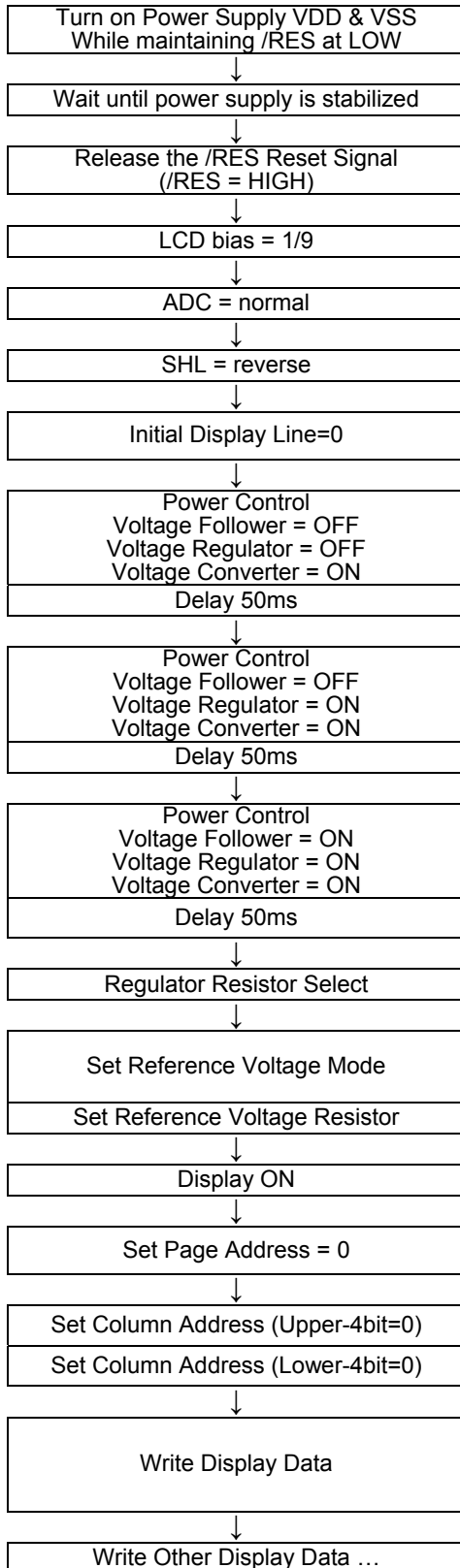
It recommends that enter Power Save mode before power off the LCD module.

5.8.2 Refreshing The LCD Module

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

5.9 Basic Operating Sequence (example)

5.9.1 Initialization Sequence



Code Function											Note	
A0	D7	D6	D5	D4	D3	D2	D1	D0	hex			
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	See AC Characteristics section for timing details
0	1	0	1	0	0	0	1	0	A2h		LCD panel Characteristic	
0	1	0	1	0	0	0	0	0	A0h		No flip on x-direction (SEG)	
0	1	1	0	0	1	0	0	0	C8h		Flip on y-direction (COM)	
0	0	1	0	0	0	0	0	0	40h		i.e. Display RAM "page 0 - D0" Matched to top line of the LCD	
0	0	0	1	0	1	1	0	0	2Ch		Turn on the internal Voltage Converter and wait until VOUT stable.	
-	-	-	-	-	-	-	-	-	-			
0	0	0	1	0	1	1	1	0	2Eh		Turn on the Internal Voltage Regulator and wait until VOUT stable.	
-	-	-	-	-	-	-	-	-	-			
0	0	0	1	0	1	1	1	1	2Fh		Turn on the internal Voltage Follower and wait until VOUT stable	
-	-	-	-	-	-	-	-	-	-			
0	0	0	1	0	0	1	1	0	26h		Set the built-in resistor ratio	
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	1	0	1	0	1Ah			
0	1	0	1	0	1	1	1	1	AFh		Turn on the LCD display	
0	1	0	1	1	0	0	0	0	B0h		Specify the Display Data RAM page address to 00h	
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			
1	Display Data										Write data to Display Data RAM. After write, the internal Column Address Counter will be increased by 1 automatically	

6. 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