XIAMEN OCULAR

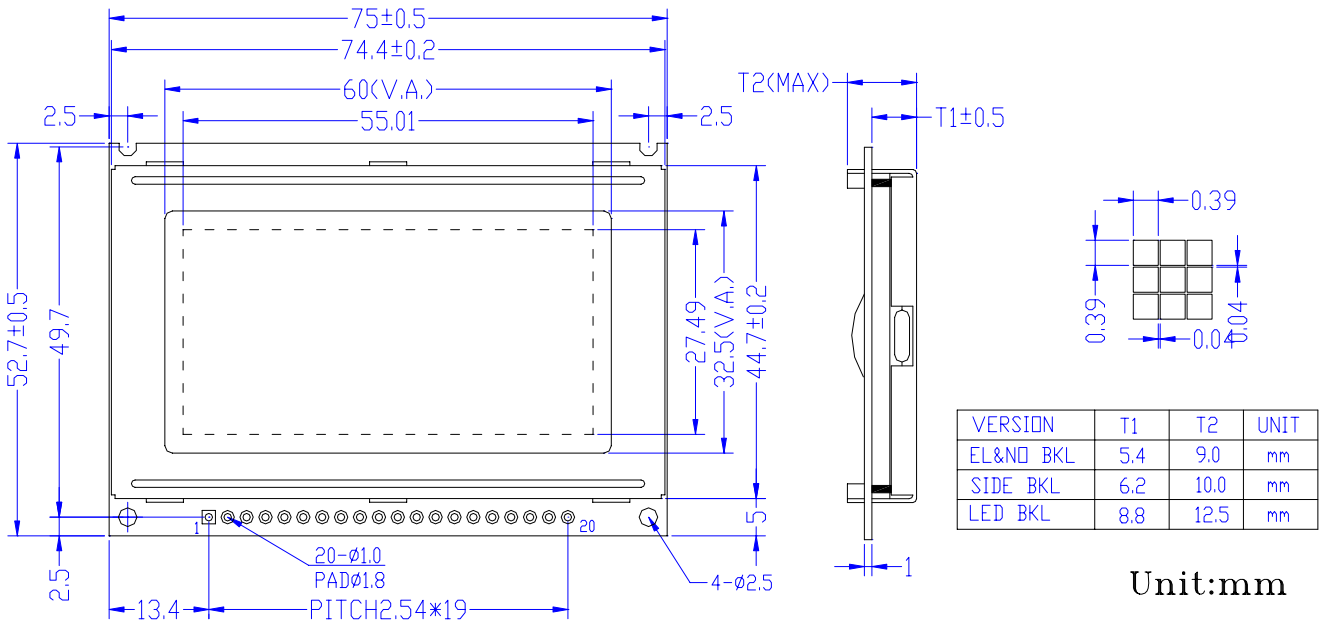
GDM12864H

SPECIFICATIONS OF LCD MODULE

Features

a) 128x64 dots graphic LCD module
b) Low power consumption
c) Built-in controller (S6B0108)
d) +5V power supply
e) 1/64 duty cycle
f) Easy interface with 8-bit MPU
g) LED backlight optional
h) Negative voltage optional

Mechanical Specifications



VERSION	T1	T2	UNIT
EL&NO BKL	5.4	9.0	mm
SIDE BKL	6.2	10.0	mm
LED BKL	8.8	12.5	mm

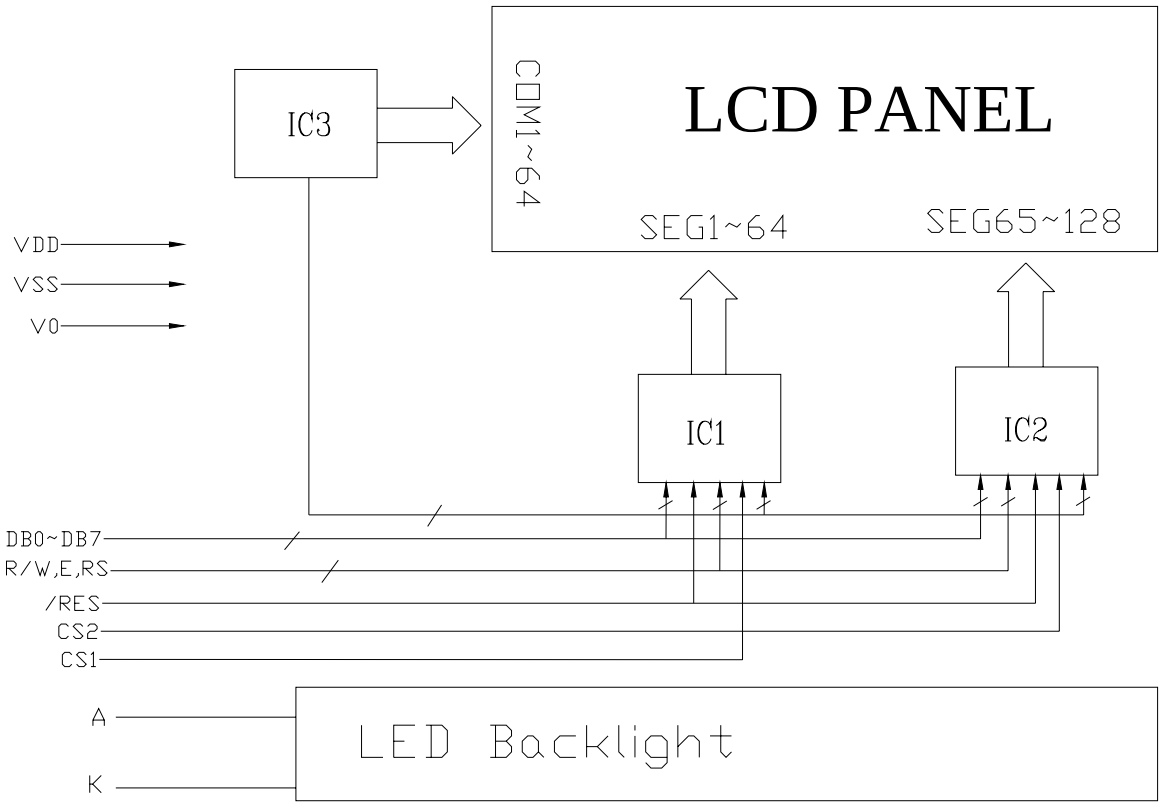
Unit:mm

Temperature Characteristics

Parameter	Symbol	Rating	Unit
Operating temperature	Top	0 ~ +50	℃
Storage temperature	Tst	-10 ~ +60	℃

*****Wide temperature range is available
(operating/storage temperature as –20~+70/-30~+80℃)

BLOCK DIAGRAM



Electro-Optical characteristics

STN TYPE (SUPER TWISTED NEMATIC) (T_A=25℃, V_{DD}=5.0V±0.25V)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Viewing Angle	$\frac{\theta 2 - \theta 1}{\phi}$	Cr = 2.0	70 -90	-	+90	deg.
Contrast Ratio	Cr	θ =20° ϕ = 0°	-	5	-	-
Response Time (rise)	t_R	θ =20° ϕ = 0°	-	200	250	ms
Response Time (fall)	t_F	θ =20° ϕ = 0°	-	300	350	ms

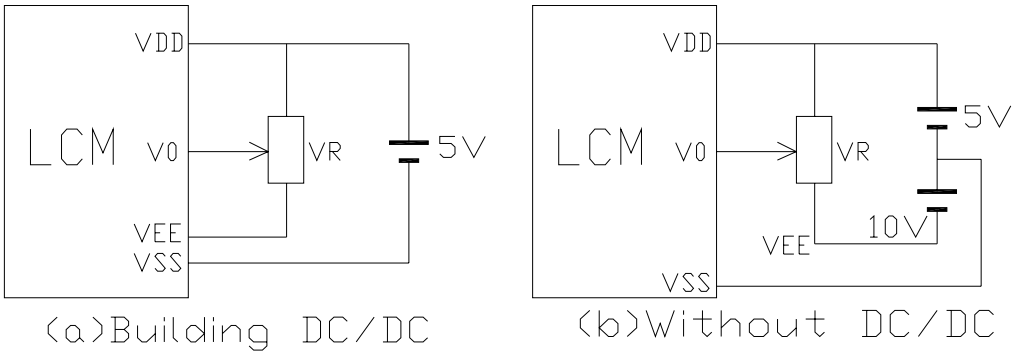
FSTN TYPE DISPLAY MODULE (T_A=25℃, V_{DD}=5.0V±0.25V)

ITEM	SYMBOL	CONDITION	MIN.	TYP.	MAX.	UNIT
Viewing angle	θ	Cr≥2	-60		45	deg
	Φ		-40		40	
Contrast ratio	Cr		—	10	—	—
Response time(rise)	Tr	—	—	300		ms
Response time(fall)	Tr	—	—	280		ms

Interface Pin Connections

Pin No.	Symbol	I/O Type	Description
1	VDD	Supply	Power supply
2	VSS	Supply	Ground
3	V0	Supply	LCD driver supply voltage
4~11	DB0~ DB7	I/O	Data bus [0~7] Bi-directional data bus
12	CS2	I	Chip selection When CS1=L,CS2=H, select IC1 When CS1=H,CS2=L, select IC2
13	CS1		
14	RES	I	Reset signal. When RES=L 【1】ON/OFF register becomes set by 0.(display off) 【2】display start line register becomes set by 0 (Z-address 0 set, display from line 0) 【3】After releasing reset , this condition can be changed only by instruction.
15	R/W		Read or Write **RW** **Description** H Data appears at DB[7:0] and can be read by the CPU while E= H CS1B=L,CS2B=L and CS3=H. L Display data DB[7:0] can be written at falling edge of E when CS1B=L, CS2B=L and CS3=H.
16	D/I		Data input/output pin of internal shift register **MS SHL DIO1 DIO2** H H Output Output H L Output Output L H Input Output L L Output Input
17	E		Enable signal **E** **Description** H Read data in DB[7:0] appears while E= "High". L Display data DB[7:0] is latched at falling edge of E.
18	VEE	Power	VEE is connected by the same voltage.
19	A(LED+)		Power for backlight (Anode)
20	K(LED-)		Power for backlight (Cathode)

CONTRAST ADJUST



V_{DD}~V_0: LCD Driving voltage

VR: 10k~20k

Electrical Absolute Maximum Ratings (S6B0107)

Parameter	Symbol	Rating	Unit	Note
Operating voltage	V_{DD}	-0.3 ~ +7.0	V	*1
Supply voltage	V_{EE}	V_{DD}-19.0 ~ V_{DD}+0.3	V	*4
Driver supply voltage	V_B	-0.3 ~ V_{DD}+0.3	V	*1,2
	V_{LCD}	V_{EE}-0.3 ~ V_{DD}+0.3	V	*3,4

***Notes:**

*1. Based on V_{SS} = 0V

*2. Applies to input terminals and I/O terminals at high impedance. (Except V0L, V1L, V4L, and V5L)

*3. Applies to V0L, V1L, V4L, and V5L.

*4. Voltage level: $V_{DD} \geqslant V0 \geqslant V1 \geqslant V2 \geqslant V3 \geqslant V4 \geqslant V5 \geqslant V_{EE}$

DC Electrical Characteristics(S6B0107)

(VDD= 4.5 to 5.5V, VSS=0V,VDD-VEE=8~17V,Ta= -30 to +85℃)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Operating voltage	V_{DD}	-	4.5	-	5.5	V	
Input voltage	V_{IH}	-	0.7_{VDD}	-	V_{DD}		*1
	V_{IL}	-	V_{SS}	-	$0.3V_{DD}$		
output voltage	V_{OH}	I_{OH}= -0.4mA	V_{DD}-0.4	-	-		*2
	V_{OL}	I_{OL}= 0.4mA	-	-	0.4		
Input leakage current	I_{LKG}	V_{IN}= V_{DD} ~ V_{SS}	-1.0	-	+1.0	μA	*1
OSC Frequency	fosc	Rf=47kΩ±2% Cf=20pF±5%	315	450	585	kHz	
On Resistance (Vdiv-Ci)	R_{ONS}	V_{DD}-V_{EE}=17V Load current±150μA	-	-	1.5	kΩ	
Operating current	I_{DD1}	Master mode 1/128 Duty	-	-	1.0	mA	*3
	I_{DD2}	Master mode 1/128 Duty	-	-	0.2		*4
Supply Current	I_{EE}	Master mode 1/128 Duty	-	-	0.1		*5
Operating	f_{op1}	Master mode External Duty	50	-	600	kHz	
Frequency	f_{op2}	Slave mode	0.5	-	1500		

Notes

*1. Applies to input terminals FS, DS1, DS2, CR, SHL, MS and PCLK2 and I/O terminals DIO1, DIO2, M , and CL2 in the input state.

*2. Applies to output terminals CLK1, CLK2 and FRM and I/O terminals DIO1, DIO2, M , and CL2 in the output state.

*3. This value is specified about current flowing through V_{SS}.

Internal oscillation circuit: Rf=47kΩ, cf=20pF

Each terminals of DS1, DS2, FS, SHL, and MS is connected to V_{DD} and out is no load.

*4. This value is specified about current flowing through V_{SS}.

Each terminals is DS1, DS2, FS, SHL, PCLK2 and CR is connected to V_{DD},MS is connected to V_{SS} and CL2, M, DIO1 is external clock.

*5. This value is specified about current flowing through V_{EE}, Don't connect to V_{LCD} (V1~V5).

Electrical Absolute Maximum Ratings(S6B0108)

Parameter	Symbol	Rating	Unit	Note
Operating voltage	V_{DD}	-0.3 ~ +7.0	V	*1
Supply voltage	V_{EE}	V_{DD}-19.0 ~ V_{DD}+0.3	V	*4
Driver supply voltage	V_B	-0.3 ~ V_{DD}+0.3	V	*1,3
	V_{LCD}	V_{EE}-0.3 ~ V_{DD}+0.3	V	*2

***Notes:**

*1. Based on V_{SS} = 0V
*2. Applies the same supply voltage to V_{EE}. $V_{LCD}=V_{DD}-V_{EE}$.
*3. Applies to M, FRM, CLK1,CLK2, CL, RESETB, ADC, CS1B, CS2B,CS3, E, R/W, RS and DB0~DB7.
*4. Applies V0L,V2L,V3L and V5L.

Voltage level: $V_{DD} \geqslant V0 \geqslant V1 \geqslant V2 \geqslant V3 \geqslant V4 \geqslant V5 \geqslant V_{EE}$

DC Electrical Characteristics(S6B0108)

(VDD= 4.5 to 5.5V, VSS=0V,VDD-VEE=8~17V,Ta= -30 to +85℃)

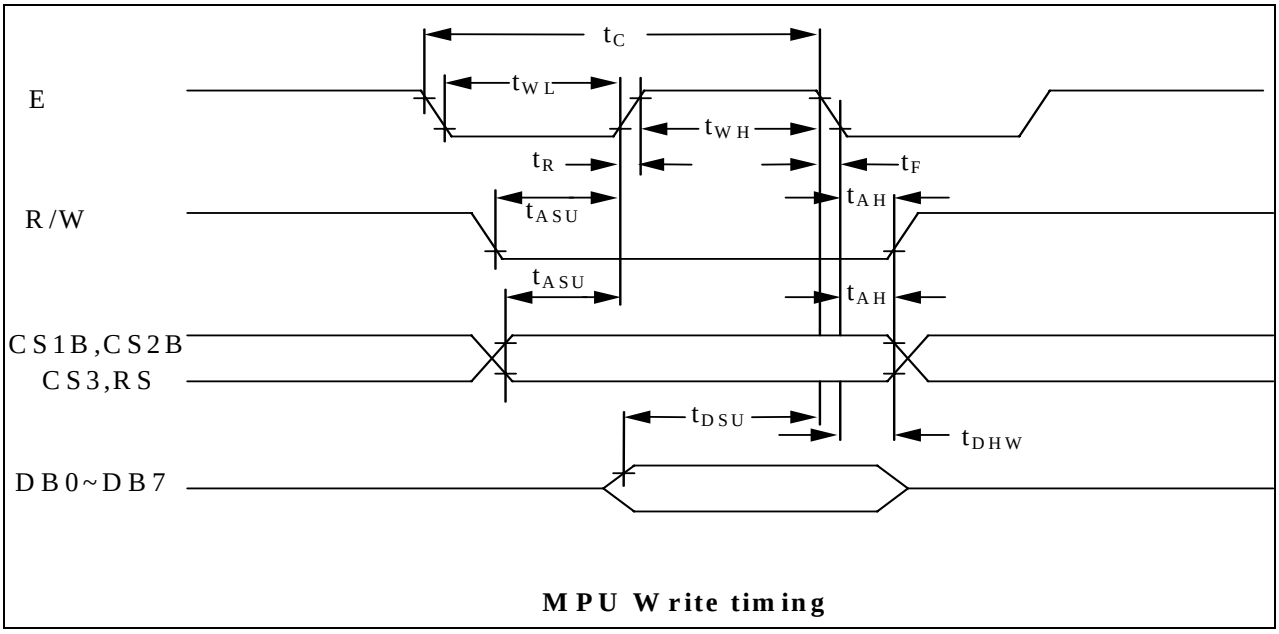
Item	Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Operating voltage	V_{DD}	-	4.5	-	5.5	V	
Input High voltage	V_{IH1}	-	0.7_{VDD}	-	V_{DD}		*1
	V_{IH2}	-	2.0	-	V_{DD}		*2
Input Low voltage	V_{IL1}	-	0	-	$0.3V_{DD}$		*1
	V_{IL2}	-	0	-	0.8		*2
Output High Voltage	V_{OH}	I_{OH}= -0.2mA	2.4	-	-		*3
Output Low Voltage	V_{OL}	I_{OL}= 1.6mA	-	-	0.4		*3
Input leakage current	I_{LKG}	$V_{IN}= V_{SS} \sim V_{DD}$	-1.0	-	+1.0	μA	*4
Three-state (OFF) Input Current	I_{TSL}	$V_{IN}= V_{SS} \sim V_{DD}$	-5.0	-	5.0		*5
Driver Input leakage current	I_{DIL}	$V_{IN}= V_{EE} \sim V_{DD}$	-2.0		2.0		*6
On Resistance (Vdiv-Ci)	R_{ONS}	V_{DD}-V_{EE}=15V Load current±100μA	-	-	7.5	kΩ	*8
Operating current	I_{DD1}	During Display	-	-	0.1	mA	*7
	I_{DD2}	During Access Access Cycle=1MHz	-	-	0.5		*7

Notes

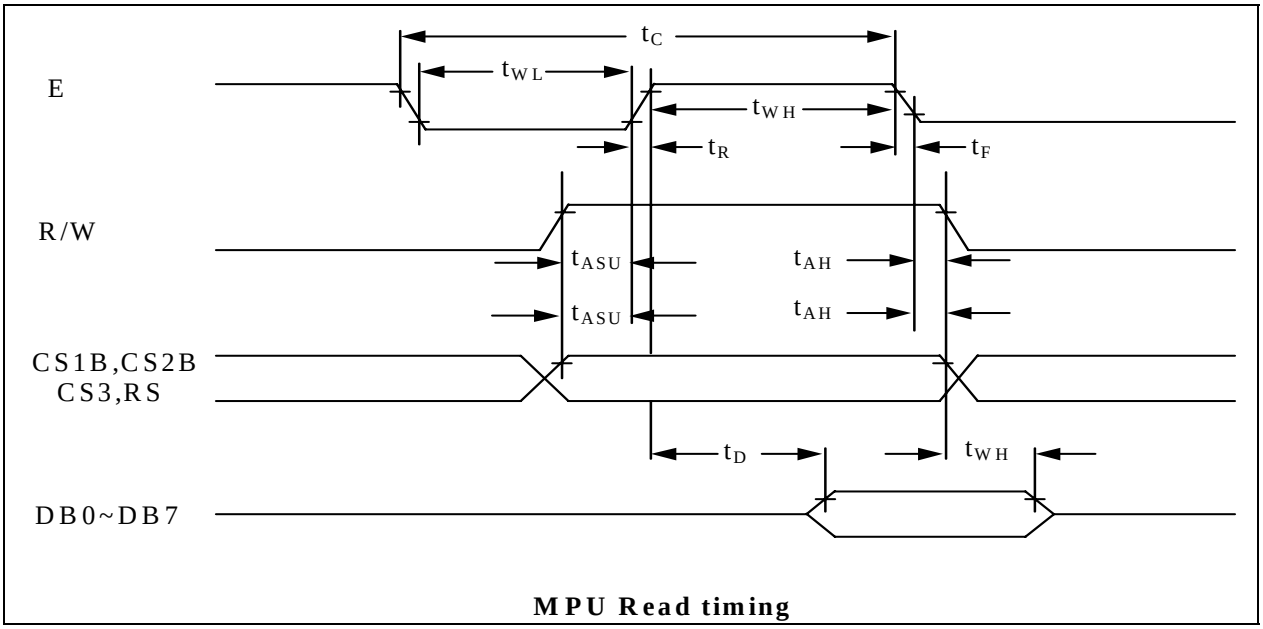
*1. CL, FRM, M, RSTB, CLK1, CLK2
*2. CS1B, CS2B, CS3, E, R/W, RS, DB0~DB7
*3. DB0~DB7
*4. Except DB0~DB7
*5. DB0~DB7 at high impedance
*6. V0, V1, V3, V3, V4, V5
*7. 1/64 duty , FCLK=250KHZ, Frame Frequency=70HKZ, Output: No Load
*8. V_{DD}-V_{EE}=15.5V
V0L>V2L>= V_{DD}-2/7(V_{DD}-V_{EE})>V3L= V_{EE}+2/7(V_{DD}-V_{EE})>V5L

MPU Interface

Characteristic	Symbol	Min	Typ	Max	Unit
E Cycle	t_C	1000	-	-	ns
E High Level Width	t_{WH}	450	-	-	
E Low Level Width	t_{WL}	450	-	-	
E Rise Time	t_R	-	-	25	
E Fall Time	t_F	-	-	25	
Address Set-Up Time	t_{ASU}	140	-	-	
Address Hold Time	t_{AH}	10	-	-	
Data Set-Up Time	t_{SU}	200	-	-	
Data Delay Time	t_D	-	-	320	
Data Hold Time (Write)	t_{DHW}	10	-	-	
Data Hold Time (Read)	t_{DHR}	20	-	-	



MPU Write timing



MPU Read timing

OPERATING PRINCIPLES & METHODS

1. I/O Buffer

Input buffer controls the status between the enable and disable of chip. Unless the CS1B to CS3 is in active mode, Input or output of data and instruction does not execute. Therefore internal state is not change. But RSTB and ADC can operate regardless CS!B-CS3.

2. Input register

Input register is provided to interface with MPU which is different operating frequency. Input register stores the data temporarily before writing it into display RAM.
When CS1B to CS3 are in the active mode, R/W and RS select the input register. The data from MPU is written into input register. Then writing it into display RAM. Data latched for falling of the E signal and write automatically into the display data RAM by internal operation.

3. Output register

Output register stores the data temporarily from display data RAM when CS1B, CS2B and CS3 are in active mode and R/W and RS=H, stored data in display data RAM is latched in output register. When CS1B to CS3 is in active mode and R/W=H , RS=L, status data (busy check) can read out.
To read the contents of display data RAM, twice access of read instruction is needed. In first access, data in display data RAM is latched into output register. In second access, MPU can read data which is latched. That is to read the data in display data RAM, it needs dummy read. But status read is not needed dummy read.

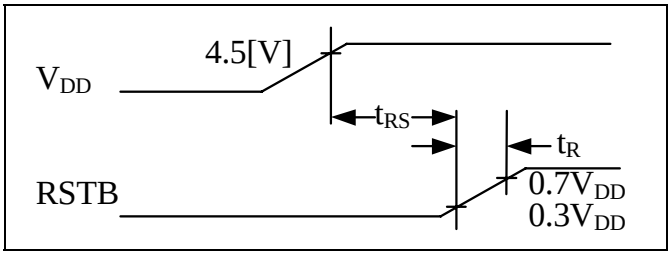
RS	R/W	Function
L	L	Instruction
	H	Status read (busy check)
H	L	Data write (from input register to display data RAM)
	H	Data read (from display data RAM to output register)

4. Reset

The system can be initialized by setting RSTB terminal at low level when turning power on, receiving instruction from MPU. When RSTB becomes low, following procedure is occurred.
1. Display off
2. Display start line register become set by 0.(Z-address 0)
While RSTB is low, No instruction except status read can by accepted. Therefore, execute other instructions after making sure that DB4= (clear RSTB) and DB7=0 (ready) by status read instruction.
The conditions of power supply at initial power up are shown in table 1.

Table 1. Power Supply Initial Conditions

Item	Symbol	Min	Typ	Max	Unit
Reset Time	t_{RS}	1.0	-	-	us
Rise Time	t_R	-	-	200	ns

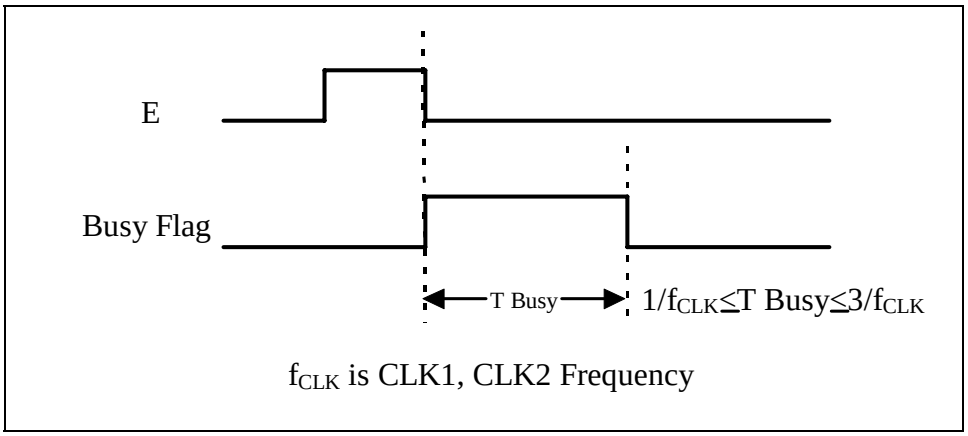


5. Busy flag

Busy flag indicates that S6B0108 is operating or no operating. When busy flag is high, S6B0108 is in internal operating .

When busy flag is low, S6B0108 can accept the data or instruction.

DB7indicates busy flag of the S6B0108.



6. Display On/Off Flip-Flop

The display on/off flip-flop makes on/off the liquid crystal display. When flip-flop is reset (logical low), selective voltage or non selective voltage appears on segment output terminals. When flip-flop is set (logic high), non selective voltage appears on segment output terminals regardless of display RAM data.
The display on/off flip-flop can changes status by instruction. The display data at all segment disappear while RSTB is low.
The status of the flip-flop is output to DB5 by status read instruction.
The display on/off flip-flop synchronized by CL signal.

7. X Page Register

X page register designates pages of the internal display data RAM.
Count function is not available. An address is set by instruction.

8. Y address counter

Y address counter designates address of the internal display data RAM. An address is set by instruction and is increased by 1 automatically by read or write operations of display data.

9. Display Data RAM

Display data RAM stores a display data for liquid crystal display. To indicate on state dot matrix of liquid crystal display , write datra1. The other way , off state, writes 0.
Display data RAM address and segment output can be controlled by ADC signal.
ADC=H => Y-address 0: S1~Y address 63: S64
ADC=L => Y-address 0: S64~Yaddress 63: S1
ADC terminal connect the V_{DD} or V_{SS}.

10. Display Start Line Register

The display start line register indicates of display data RAM to display top line of liquid crystal display.
Bit data (DB<0.5>) of the display start line set instruction is latched in display start line register. Latched data is transferred to the Z address counter while FRM is high, presetting the Z address counter.
It is used for scrolling of the liquid crystal display screen.

Display Control Instruction

The display control instructions control the internal state of the S6B0108. Instruction is received from MPU to S6B0108 for the display control. The following table shows various instructions.

Instruction	RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Function
Read Display Date	1	1	Read data								Reads data (DB[7:0]) from display data RAM to the data bus.
Write Display Date	1	0	Write data								Writes data (DB[7:0]) into the DDRAM. After writing instruction, Y address is incriminated by 1 automatically
Status Read	0	1	Busy	0	ON/ OFF	Re-set	0	0	0	0	Reads the internal status BUSY 0: Ready 1: In operation ON/OFF 0: Display ON 1: Display OFF RESET 0: Normal 1: Reset
Set Address (Y address)	0	0	0	1	Y address (0~63)						Sets the Y address at the column address counter
Set Display Start Line	0	0	1	1	Display start line (0~63)						Indicates the Display Data RAM displayed at the top of the screen.
Set Address (X address)	0	0	1	0	1	1	1	Page (0~7)			Sets the X address at the X address register.
Display On/off	0	0	0	0	1	1	1	1	1	0/1	Controls the display ON or OFF. The internal status and the DDRAM data is not affected. 0: OFF, 1: ON

1. Display On/Off

The display data appears when D is 1 and disappears when D is 0.
Though the data is not on the screen with D=0, it remains in the display data RAM.
Therefore, you can make it appear by changing D=0 into D=1.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	1	1	1	D

2. Set Address (Y Address)

Y address (AC0~AC5) of the display data RAM is set in the Y address counter.
An address is set by instruction and increased by 1 automatically by read or write operations of display data.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0

3. Set Page (X Address)

X address (AC0~AC2) of the display data RAM is set in the X address register.
Writing or reading to or from MPU is executed in this specified page until the next page is set.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	0	1	1	1	AC2	AC1	AC0

4. Display Start Line (Z Address)

Z address (AC0~AC5) of the display data RAM is set in the display start line register and displayed at the top of the screen.
When the display duty cycle is 1/64 or others (1/32~1/64), the data of total line number of LCD screen, from the line specified by display start line instruction, is displayed.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	1	AC5	AC4	AC3	AC2	AC1	AC0

5. Status Read

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	BUSY	0	ON/OFF	RESET	0	0	0	0

- BUSY
  When BUSY is 1, the Chip is executing internal operation and no instructions are accepted.
  When BUSY is 0, the Chip is ready to accept any instructions.
- ON/OFF
  When ON/OFF is 1, the display is on.
  When ON/OFF is 0, the display is off.
- RESET
  When RESET is 1, the system is being initialized.
  In this condition, no instructions except status read can be accepted.
  When RESET is 0, initializing has finished and the system is in the usual operation condition.

6. Write Display Data

Writes data (D0~D7) into the display data RAM.
After writing instruction, Y address is increased by 1 automatically.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	0	D7	D6	D5	D4	D3	D2	D1	D0

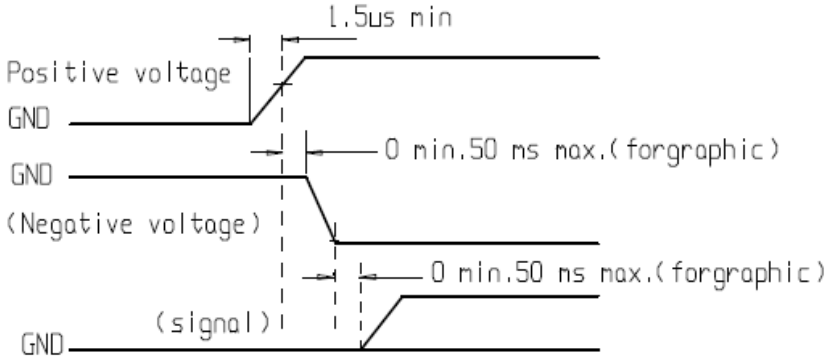
7. Read Display Data

Reads data (D0~D7) from the display data RAM.
After reading instruction, Y address is increased by 1 automatically.

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
1	1	D7	D6	D5	D4	D3	D2	D1	D0

LCM Operation Precautions

(1) It is an indispensable condition to drive LCD within the specified voltage limit since the higher voltage than the limit causes the shorter LCD life. An electrochemical reaction due to direct current causes LCD's undesirable deterioration, so that the use of direct current driver should be avoided.
(2) Response time will be extremely delayed at lower temperature than the specified operating temperature range and on the other hand LCD's show dark blue color in the higher temperature. However, those phenomena do not mean any malfunction or display out of order with LCD's, which will come back in the specified operation temperature range.
(3) If the display area is pushed hard during operation, some fonts will be abnormally displayed. But it resumes normal condition after turning off once.
(4) A slight dew depositing on terminals could be a cause for electrochemical reaction resulting in terminal open circuit.
(5) Display contrast varies with the change of liquid crystal driving voltage (V_O). Adjust V_O to show the best contrast.
(6) Condensation on terminals can cause an electrochemical reaction disrupting the terminal circuit. Therefore, it is suggested to use the LCD under the relative condition of 40°C, 85% RH.
(7) When turning the power on, input each signal after the positive/negative voltage becomes stable.



(8) The backlight must be operated within the condition of specification. The overload current or too high voltage will reduce the life time or destroy the backlight.

Handing Precautions

(1) The display panel is made of glass. Do not subject it to a mechanical shock by dropping it or impact.
(2) If the display panel is damaged and the liquid crystal substance leaks out, be sure not to get any in your mouth. If the substance contacts your skin or clothes, wash it off using soap and water.
(3) Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
(4) The polarizer covering the display surface of the LCD module is soft and easily scratched. Please handle the polarizer carefully.
(5) If the display surface becomes contaminated, breathe on the surface and gently wipe it with a soft dry cloth. If it is

heavily contaminated, moisten cloth with one of the following solvents :

- Isopropyl alcohol
- Ethyl alcohol

(6) Solvents other than those above-mentioned may damage the polarizer. Especially, do not use the following.

- Water
- Ketone
- Aromatic solvents

(7) Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.

(8) Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the IO cable or the backlight cable.

(9) Do not attempt to disassemble or process the LCD module.

(10) NC terminal should be open. Do not connect anything.

(11) If the logic circuit power is off, do not apply the input signals.

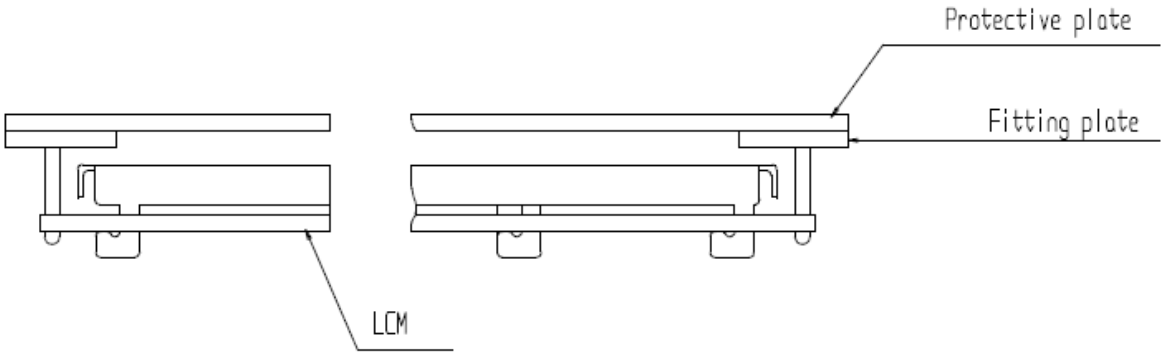
(12) To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.

- Be sure to ground the body when handling the LCD modules.
- Tools required for assembling, such as soldering irons, must be properly grounded.
- To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
- The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.

Installing Precautions

The hole in the printed circuit board is used to fix LCM as shown in the picture below. Attend to the following items when installing the LCM.

(1) Cover the surface with a transparent protective plate to protect the polarizer and LC cell.



(2) When assembling the LCM into other equipment, the spacer to the bit between the LCM and the fitting plate should have enough height to avoid causing stress to the module surface, refer to the individual specifications for measurements. The measurement tolerance should be 0.1mm.

Storage Precautions

In case of storing for a long period of time for the purpose of replacement use, the following ways are recommended.
(1) Storage in a polyethylene bag with the opening sealed so as not to enter fresh air outside in it, and with no desiccant.
(2) Placing in a dark place where neither exposure to direct sunlight nor light is, keeping temperature in the range from -30°C to 80°C
(3) Storing with no touch on polarizer surface by anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery from us.)

Safety

(1) It is recommended to crush damaged or unnecessary LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
(2) If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

Others

Liquid crystals solidify under low temperature (below the storage temperature range) leading to defective orientation or

the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subject to a low temperature. If the LCD modules have been operating for a long time showing the same display patterns, the display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. A normal operating status can be regained by suspending use for some time. It should be noted that this phenomenon does not adversely affect performance reliability. To minimize the performance degradation of the LCD modules resulting from destruction caused by static electricity
etc., exercise care to avoid holding the following sections when handling the modules.
- Exposed area of the printed circuit board.
- Terminal electrode sections.