Pin connections

Pin	Symbol
1	CSA
2	CSB
3	VSS
4	VDD
5	V0
6	RST
7	RW
8	E
9~16	DB0~DB7
17	RST
18	VEE
19	A
20	K

DOTS DETAIL

0.40
0.56
0.04
0.04

Block diagram
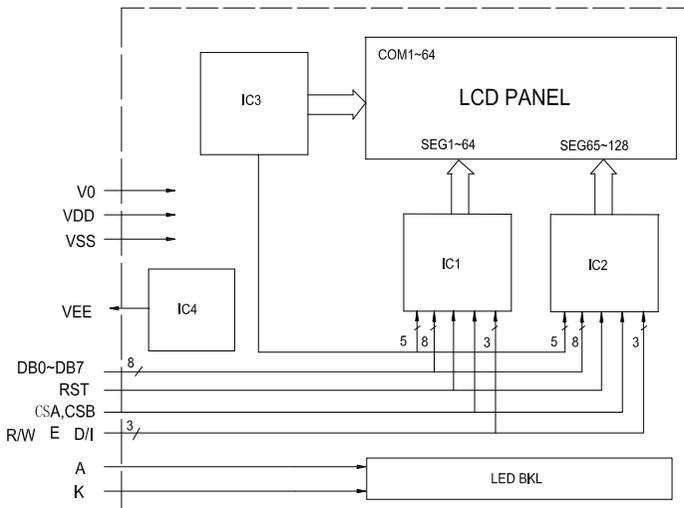
Feature

1. 128dots X 64dots matrix.
2. Built-in controller (S6B0108)
3. Interface with 8-bit ;5V power supoly
4. 5V;1/64Duty cycle, 1/9Bias.
5. Display Mode & Backlight Variations.
6. ROHS Compliant

Mechanical thickness

LCD module	T1	T2	Unit
Without or EL	5	10.0	mm
Edge backlight	---	---	mm
Bottom backlight	10.2	15.0	mm

Mechanical data

Item	Standard	Unit
Module size	78.0X70.0	mm
View area	62.0X44.0	mm
Dot size	0.40X0.56	mm
Area size	56.28X38.36	mm

Maximum Absolute Power Ratings

Item	Symbol	Standard			Unit
		Min	Typ	Max	
Input voltage	Vdd	-0.3	---	5.5	V
Power supply	Vin	-0.3	---	VDD	

Electronical characteristics

Item	Symbol	Condition	Standard			Unit
			Min	Typ	Max	
Operating voltage	V_{DD}	V_{DD} =5.0V	4.5	---	5.5	V
Operating current	I_{DD}	V_{DD} =5.0V	---	7.2	8	mA
Recommended LCD driving voltage for normal temp module	V_{LCD}	T_A =+25	---	8.5	---	V
		T_A =0	---	8.7	---	
		T_A =-20	---	9.1	---	
Backlight voltage	V_{LED}	Y-G	---	4.2	---	V
Backlight current	I_{LED}	V_{LED} =4.2V	---	240	---	mA
Operating temperature	T_o		---	-20	70	
Storage temperature	T_S		---	-30	80	

SPECIFICATIONS OF
LCD MODULE

MODULE NO : LGM12864B-NSW-BBW

DOC.REVISION: 00

	SIGNATURE	DATE
PREPARED BY (RD ENGINEER)	*Liu*	2006-12-01
CHECKED BY	*Chen*	2006-12-01
APPROVED BY	*Ye*	2006-12-02

DOCUMENT REVISION HISTORY

Version	DATE	DESCRIPTION	CHANGED BY
00	Dec-01-2006	First issue	

CONTENTS

1. Features

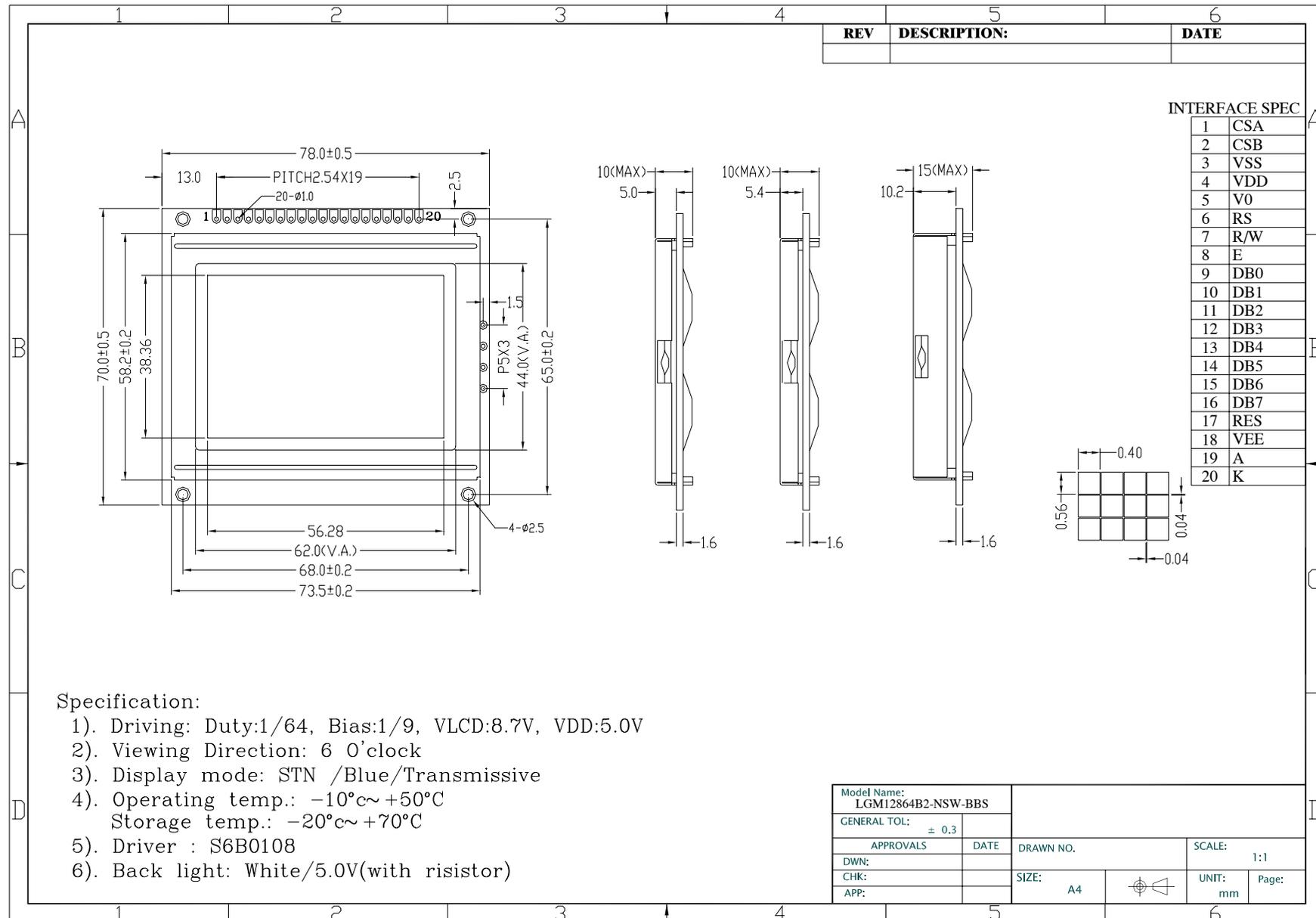1. 128X64 dots
2. Built-in controller (S6B0108)
3. +5.0V power supply
4. 1/64 duty cycle;1/9bias
5. BKL to be driven by pin19, pin20.

LCD type	☐FSTN positive		☐FSTN Negative	
	☐STN Yellow Green	☐STN Gray		☑STN-Blue
View direction	☑6 O'clock	☐12 O'clock		
Rear Polarizer	☐Reflective	☐Transflective		☑Transmissive
Backlight Type	VLED	☐EL	☐Internal Power	☐4.2V input
		☐CCFL	☑External Power	☐3.3 input
Backlight Color	☑White	☐Amber	☐Blue-Green	☐Yellow-Green
Temperature Range	☐Normal	☑Wide		☐Super Wide
DC to DC circuit	☑Build-in		☐Not Build-in	
El Driver IC	☐Build-in		☑Not Build-in	
Touch screen	☐With		☑Without	
Font type	☐English-Japanese	☐English-European	☐English-Russian	☐other

1. MECHANICAL SPECIFICATIONS

Module size	78.0mm(L)*70.0mm(W)* Max14(H)mm
Viewing area	62.0mm(L)*44.0mm(W)
Dots size	0.40mm(L)*0.56mm(W)
Dots pitch	0.44mm(L)*0.60mm(W)
Weight	Approx. 80g

2. Outline dimension

REV	DESCRIPTION:	DATE

Specification:
1). Driving: Duty:1/64, Bias:1/9, VLCD:8.7V, VDD:5.0V
2). Viewing Direction: 6 O'clock
3). Display mode: STN /Blue/Transmissive
4). Operating temp.: −10°c~+50°C
   Storage temp.: −20°c~+70°C
5). Driver : S6B0108
6). Back light: White/5.0V(with risistor)

Model Name:
LGM12864B2-NSW-BBS

GENERAL TOL: ± 0.3

APPROVALS	DATE	DRAWN NO.		SCALE: 1:1
DWN:				
CHK:		SIZE: A4		UNIT: mm	Page:
APP:				

3. Absolute maximum ratings

Item	Symbol	Standard			Unit
Power voltage	$V_{DD}-V_{SS}$	0	-	5.5	V
Input voltage	V_{IN}	VSS	-	VDD	
Operating temperature range	V_{OP}	-20	-	+70	
Storage temperature range	V_{ST}	-25	-	+75	

4. Interface pin description

Pin No.	Symbol	I/O Type	Description
1 2	/CSA /CSB	I	Chip selection When CS1=L,CS2=H, select IC1 When CS1=H,CS2=L, select IC2
3	VSS	Supply	Ground
4	VDD	Supply	Power supply
5	V0	Supply	LCD driver supply voltage
6	RS		Command or data register selection
7	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.
8	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.
9--16	DB0-DB7	I/O	Data bus [0~7] Bi-directional data bus
17	/RST	I	Reset signal.When RSTB=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.
18	VEE	Power	VEE is the negative voltage. output
19	(A)	Power	power supply for LED backlight-
20	(k)	Power	

5. Optical characteristics

STN type display module (Ta=25 , VDD=5.0V)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Viewing angle		C_r 2	-60	-	35	deg
			-40	-	40	
Contrast ratio	C_r		-	6	-	-
Response time (rise)	T_r	-	-	150	250	ms
Response time (fall)	T_r	-	-	150	250	

6. Electrical characteristics

DC characteristics

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply voltage for LCD	$V_{DD}-V_0$	Ta =25	-	9.5	-	V
Input voltage	V_{DD}		4.7	-	5.5	
Supply current	I_{DD}	Ta=25 , V_{DD}=5.0V	-	3.5	5.5	mA
Input leakage current	I_{LKG}		-	-	1.0	uA
"H" level input voltage	V_{IH}		2.2	-	V_{DD}	
"L" level input voltage	V_{IL}	Twice initial value or less	0	-	0.6	
"H" level output voltage	V_{OH}	LOH=-0.25mA	2.4	-	-	V
"L" level output voltage	V_{OL}	LOH=1.6mA	-	-	0.4	
Backlight supply voltage	V_F		-	3.0		
Backlight supply current	I_F	V=5.0V R=51Ω	-	30	50	mA

MPU Interface

Characteristic	Symbol	Min	Typ	Max	Unit
E Cycle	t_C	1000	-	-	
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	-	-	ns
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
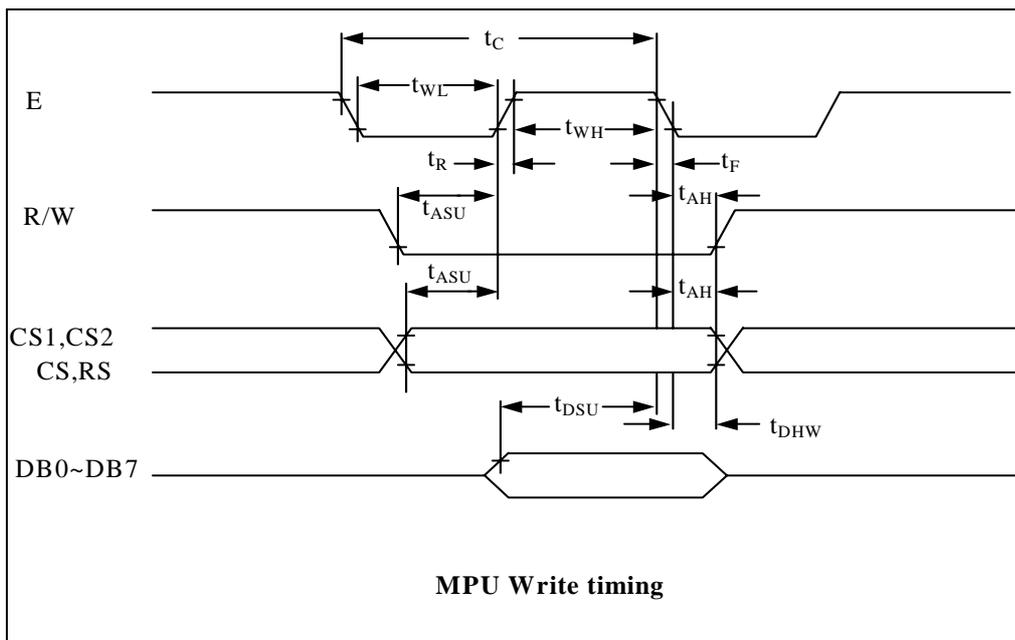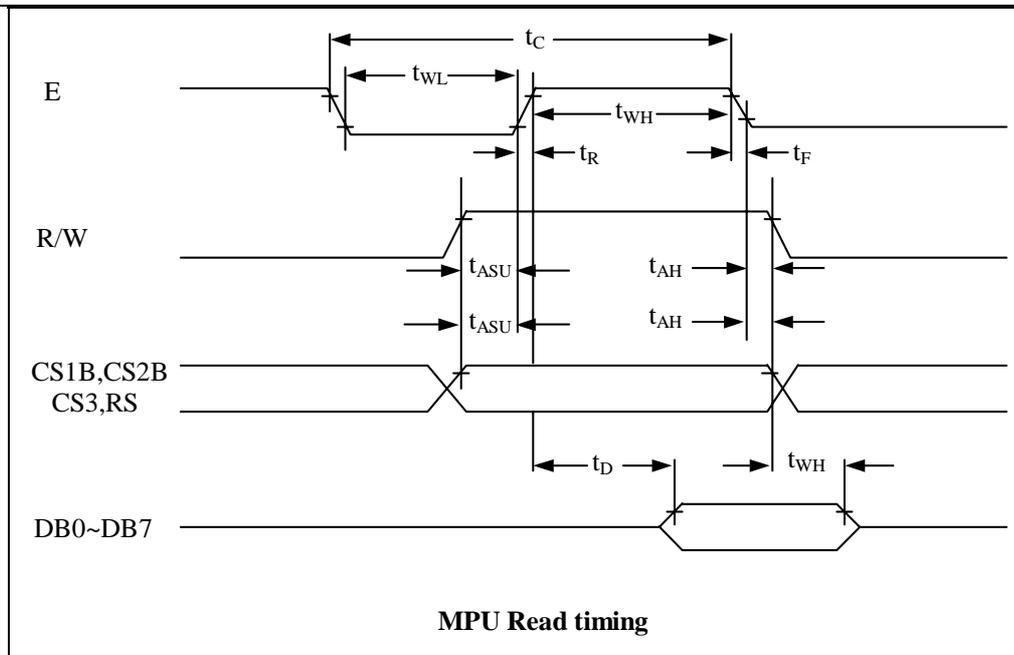
7. OPERATING PRINCIPLES & METHODS

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
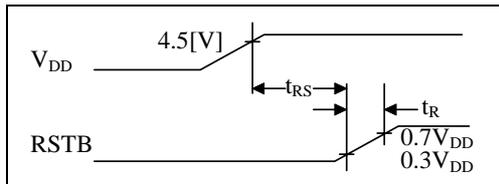
5. Busy flag

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.

$1/f_{CLK} \leq T\ Busy \leq 3/f_{CLK}$

f_{CLK} is CLK1, CLK2 Frequency
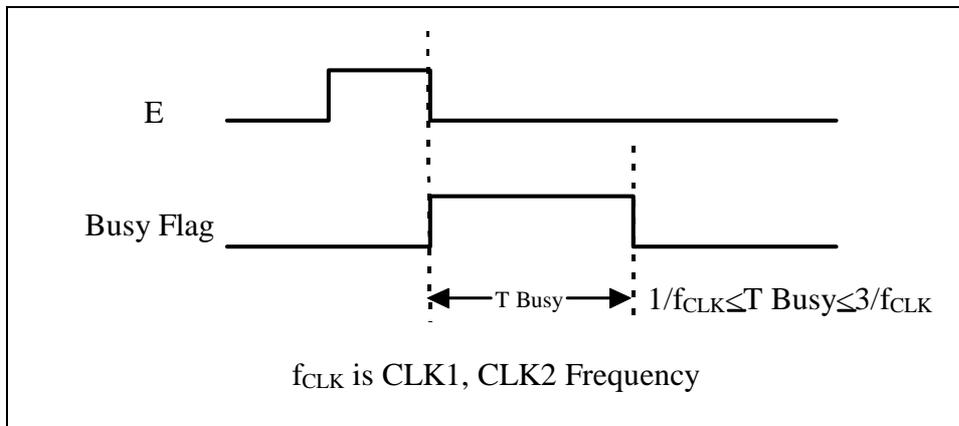
6. Display On/Off Flip-Flop

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.

11. Command definitions

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

11.1 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

11.2 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

11.3 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

11.4 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

11.5 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.

11.6 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

11.7 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

12. QUALITY SPECIFICATIONS
12.1 Standard of the product appearance test

Manner of appearance test: The inspection should be performed in using 20W x 2 fluorescent lamps. Distance between LCM and fluorescent lamps should be 100 cm or more. Distance between LCM and inspector eyes should be 30 cm or more.

Viewing direction for inspection is 45° from vertical against LCM.
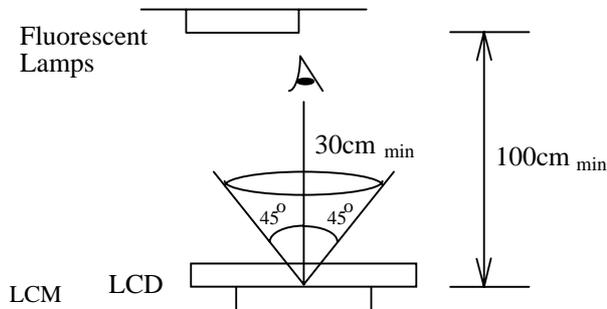
Definition of zone:
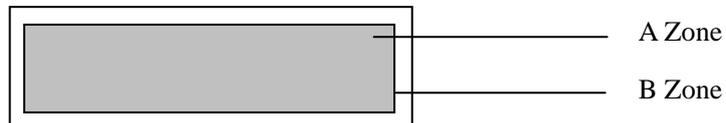
A Zone: Active display area (minimum viewing area).
B Zone: Non-active display area (outside viewing area).

12.2 Specification of quality assurance
AQL inspection standard

Sampling method: MIL-STD-105E, Level II, single sampling

Defect classification   **(Note: * is not including)**

Classify		Item	Note	AQL
Major	Display state	Short or open circuit	1	0.65
		LC leakage		
		Flickering		
		No display		
		Wrong viewing direction		
		Contrast defect (dim, ghost)	2	
		Back-light	1,8	
	Non-display	Flat cable or pin reverse	10	
		Wrong or missing component	11	
Minor	Display state	Background color deviation	2	1.0
		Black spot and dust	3	
		Line defect, Scratch	4	
		Rainbow	5	
		Chip	6	
		Pin hole	7	
	Polarizer	Protruded	12	
		Bubble and foreign material	3	
	Soldering	Poor connection	9	
	Wire	Poor connection	10	
	TAB	Position, Bonding strength	13	

Note on defect classification

No.	Item	Criterion
1	Short or open circuit	Not allow
	LC leakage	
	Flickering	
	No display	
	Wrong viewing direction	
	Wrong Back-light	
2	Contrast defect	Refer to approval sample
	Background color deviation	
3	Point defect, Black spot, dust (including Polarizer) $\phi = (X+Y)/2$	
4	Line defect, Scratch	
5	Rainbow	Not more than two color changes across the viewing area.

For item 3:
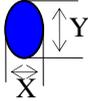
Point Size	Acceptable Qty.
$\phi \leq 0.10$	Disregard
$0.10 < \phi \leq 0.20$	3
$0.20 < \phi \leq 0.25$	2
$0.25 < \phi \leq 0.30$	1
$\phi > 0.30$	0

Unit: mm

For item 4:

Line		Acceptable Qty.
L	W	
---	$0.015 \leq W$	Disregard
$3.0 \leq L$	$0.03 \leq W$	2
$2.0 \leq L$	$0.05 \leq W$	
$1.0 \leq L$	$0.1 \leq W$	1
---	$0.05 < W$	Applied as point defect

Unit: mm

No	Item	Criterion

No	Item	Criterion
6	Chip Remark: X: Length direction Y: Short direction Z: Thickness direction t: Glass thickness W: Terminal Width	
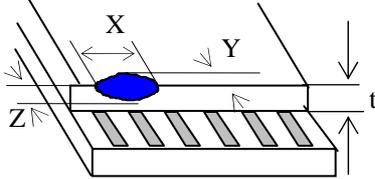
Acceptable criterion

X	Y	Z
2	0.5mm	t/2
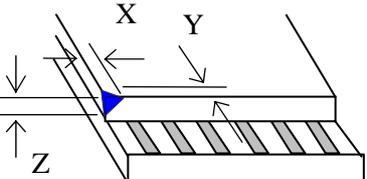
Acceptable criterion

X	Y	Z
2	0.5mm	t
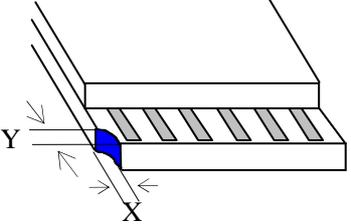
Acceptable criterion

X	Y	Z
3	2	t
shall not reach to ITO		
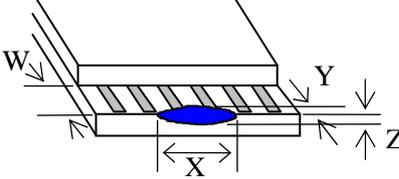
Acceptable criterion

X	Y	Z
Disregard	0.2	t

Acceptable criterion

X	Y	Z
5	2	t/3

No.	Item	Criterion
7	Segment pattern W = Segment width $\phi = (X+Y)/2$	(1) Pin hole 　$\phi < 0.10$mm is acceptable. | Point Size	Acceptable Qty | |---|---| | ϕ　1/4W | Disregard | | 1/4W$<\phi$　1/2W | 1 | | ϕ　1/2W | 0 | Unit: mm
8	Back-light	(1)　The color of backlight should correspond its specification. (2)　Not allow flickering
9	Soldering	(1)　Not allow heavy dirty and solder ball on PCB. (The size of dirty refer to point and dust defect) (2)　Over 50% of lead should be soldered on Land.
10	Wire	(1) Copper wire should not be rusted (2) Not allow crack on copper wire connection. (3) Not allow reversing the position of the flat cable. (4) Not allow exposed copper wire inside the flat cable.
11*	PCB	(1) Not allow screw rust or damage. (2) Not allow missing or wrong putting of component.
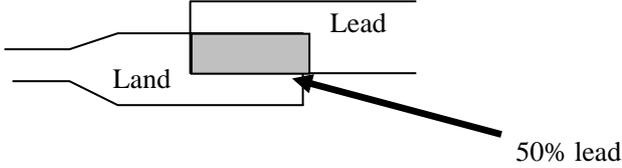
No	Item	Criterion
12	Protruded W: Terminal Width	 Acceptable criteria: $Y \leq 0.4$
13	TAB	1. Position $W1 \quad 1/3W$ $H1 \quad 1/3H$ 2 TAB bonding strength test P (=F/TAB bonding width) 650gf/cm ,(speed rate: 1mm/min) 5pcs per SOA (shipment)
14	Total no. of acceptable Defect	A. Zone Maximum 2 minor non-conformities per one unit. Defect distance: each point to be separated over 10mm B. Zone It is acceptable when it is no trouble for quality and assembly in customer's end product.
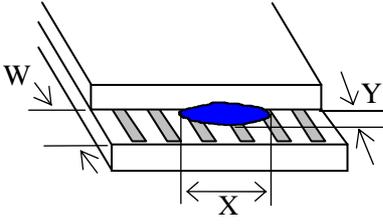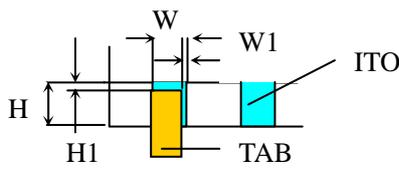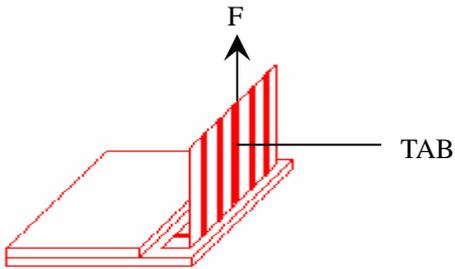
12.3 Reliability of LCM

Reliability test condition:

Item	Condition	Time (hrs)	Assessment
High temp. Storage	80°C	48	No abnormalities in functions and appearance
High temp. Operating	70°C	48	
Low temp. Storage	-30°C	48	
Low temp. Operating	-20°C	48	
Humidity	40°C/ 90%RH	48	
Temp. Cycle	0°C ← 25°C →50°C (30 min ← 5 min → 30min)	10cycles	

Recovery time should be 24 hours minimum. Moreover, functions, performance and appearance shall be free from remarkable deterioration within 50,000 hours under ordinary operating and storage conditions room temperature (20$\pm$8°C), normal humidity (below 65% RH), and in the area not exposed to direct sun light.

12.4 Precaution for using LCD/LCM

LCD/LCM is assembled and adjusted with a high degree of precision. Do not attempt to make any alteration or modification. The followings should be noted.

12.5   General Precautions:

1. LCD panel is made of glass. Avoid excessive mechanical shock or applying strong pressure onto the surface of display area.
2. The polarizer used on the display surface is easily scratched and damaged. Extreme care should be taken when handling. To clean dust or dirt off the display surface, wipe gently with cotton, or other soft material soaked with isoproply alcohol, ethyl alcohol or trichlorotriflorothane, do not use water, ketone or aromatics and never scrub hard.
3. Do not tamper in any way with the tabs on the metal frame.
4. Do not make any modification on the PCB without consulting LONGTECH
5. When mounting a LCM, make sure that the PCB is not under any stress such as bending or twisting. Elastomer contacts are very delicate and missing pixels could result from slight dislocation of any of the elements.
6. Avoid pressing on the metal bezel, otherwise the elastomer connector could be deformed and lose contact, resulting in missing pixels and also cause rainbow on the display.
7. Be careful not to touch or swallow liquid crystal that might leak from a damaged cell. Any liquid crystal adheres to skin or clothes, wash it off immediately with soap and water.

12.6 Static Electricity Precautions:

1. CMOS-LSI is used for the module circuit; therefore operators should be grounded whenever he/she comes into contact with the module.
2. Do not touch any of the conductive parts such as the LSI pads; the copper leads on the PCB and the interface terminals with any parts of the human body.
3. Do not touch the connection terminals of the display with bare hand; it will cause disconnection or defective insulation of terminals.
4. The modules should be kept in anti-static bags or other containers resistant to static for storage.
5. Only properly grounded soldering irons should be used.
6. If an electric screwdriver is used, it should be grounded and shielded to prevent sparks.
7. The normal static prevention measures should be observed for work clothes and working benches.
8. Since dry air is inductive to static, a relative humidity of 50-60% is recommended.

12.7 Soldering Precautions:

1. Soldering should be performed only on the I/O terminals.
2. Use soldering irons with proper grounding and no leakage.
3. Soldering temperature: $280°C \pm 10°C$
4. Soldering time: 3 to 4 second.
5. Use eutectic solder with resin flux filling.
6. If flux is used, the LCD surface should be protected to avoid spattering flux.
7. Flux residue should be removed.

12.8 Operation Precautions:

1. The viewing angle can be adjusted by varying the LCD driving voltage Vo.
2. Since applied DC voltage causes electro-chemical reactions, which deteriorate the display, the applied pulse waveform should be a symmetric waveform such that no DC component remains. Be sure to use the specified operating voltage.
3. Driving voltage should be kept within specified range; excess voltage will shorten display life.
4. Response time increases with decrease in temperature.
5. Display color may be affected at temperatures above its operational range.
6. Keep the temperature within the specified range usage and storage. Excessive temperature and humidity could cause polarization degradation, polarizer peel-off or generate bubbles.
7. For long-term storage over $40°C$ is required, the relative humidity should be kept below 60%,and avoid direct sunlight.

12.9 Limited Warranty

LONGTECH LCDs and modules are not consumer products, but may be incorporated by LONGTECH's customers into consumer products or components thereof, LONGTECH does not warrant that its LCDs and components are fit for any such particular purpose.

1. The liability of LONGTECH is limited to repair or replacement on the terms set forth below. LONGTECH will not be responsible for any subsequent or consequential events or injury or damage to any personnel or user including third party personnel and/or user. Unless otherwise agreed in writing between LONGTECH and the customer, LONGTECH will only replace or repair any of its LCD which is found defective electrically or visually when inspected in accordance with LONGTECH general LCD inspection standard . (Copies available on request)
2. No warranty can be granted if any of the precautions state in handling liquid crystal display above has been disregarded. Broken glass, scratches on polarizer mechanical damages as well as defects that are caused accelerated environment tests are excluded from warranty.
3. In returning the LCD/LCM, they must be properly packaged; there should be detailed description of the failures or defect.