

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 20232 SBH-PW-N

Product specification

Version : 3

01/03/2005

GENERAL SPECIFICATION

MODULE NO. :

DEM 20232 SBH-PW-N/V

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	18/02/2004
1	CHANGED ELECTRICAL CHARACTERISTICS	26/02/2004
2	CHANGED BACKLIGHT AND PCB DRAWING	10/07/2004
3	CHANGED SERIES	01/03/2005

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DATE: 11/03/2005

APPROVED BY: MH

DATE: 11/03/2005

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1.FUNCTIONS & FEATURES

- LCD type :

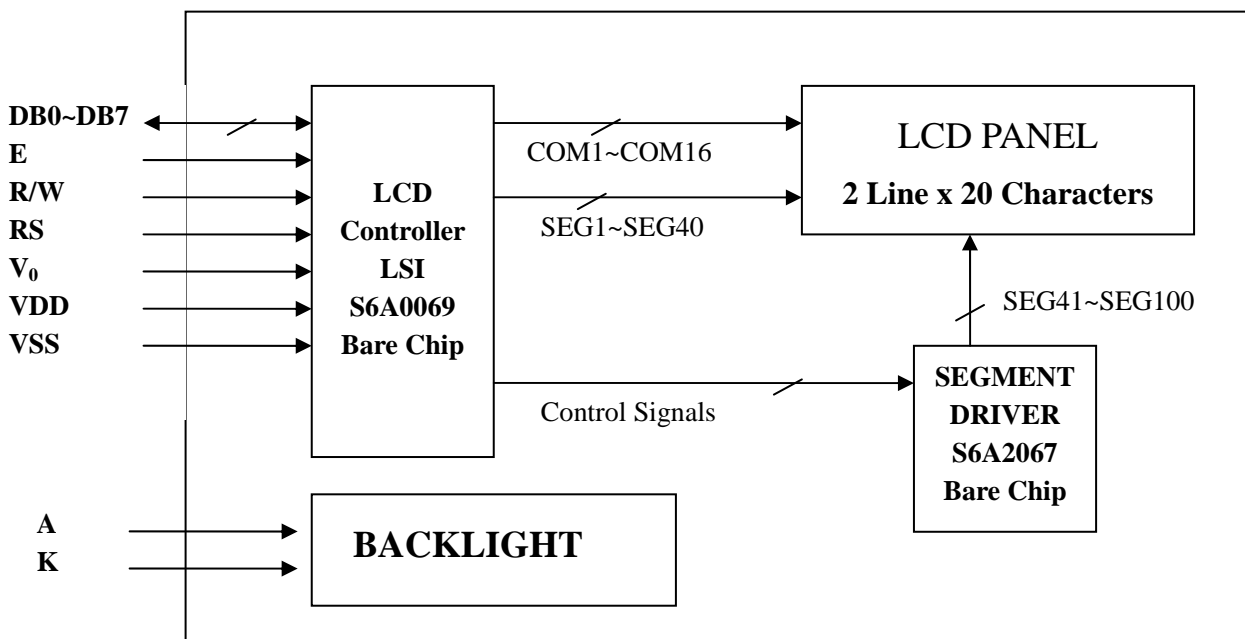
MODULE	LCD MODEL	POLARIZER TYPE
DEM 20232 SBH-PW-N	STN BLUE	Transmissive Negative Mode

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0V (typ.)
- Backlight Color : White (Lightguide)
- Operating Temperature : -20°C ~ 70°C
- Storage Temperature : -30°C ~ 80°C
- V_{LCD} Adjustable for Best Contrast : 4.5V (typ.)
- Display contents : 20 x 2 Characters (5 x 8 dots, Format : 208 Kinds)
- Internal Memory : CGROM (10,080 bits)
: CGRAM (64 x 8 bits)
: DDRAM (80 x 8 bits for Digits)
- CGROM : CGROM of the S6A0069
- Interface : Easy Interface with a 4-bit or 8-bit MPU

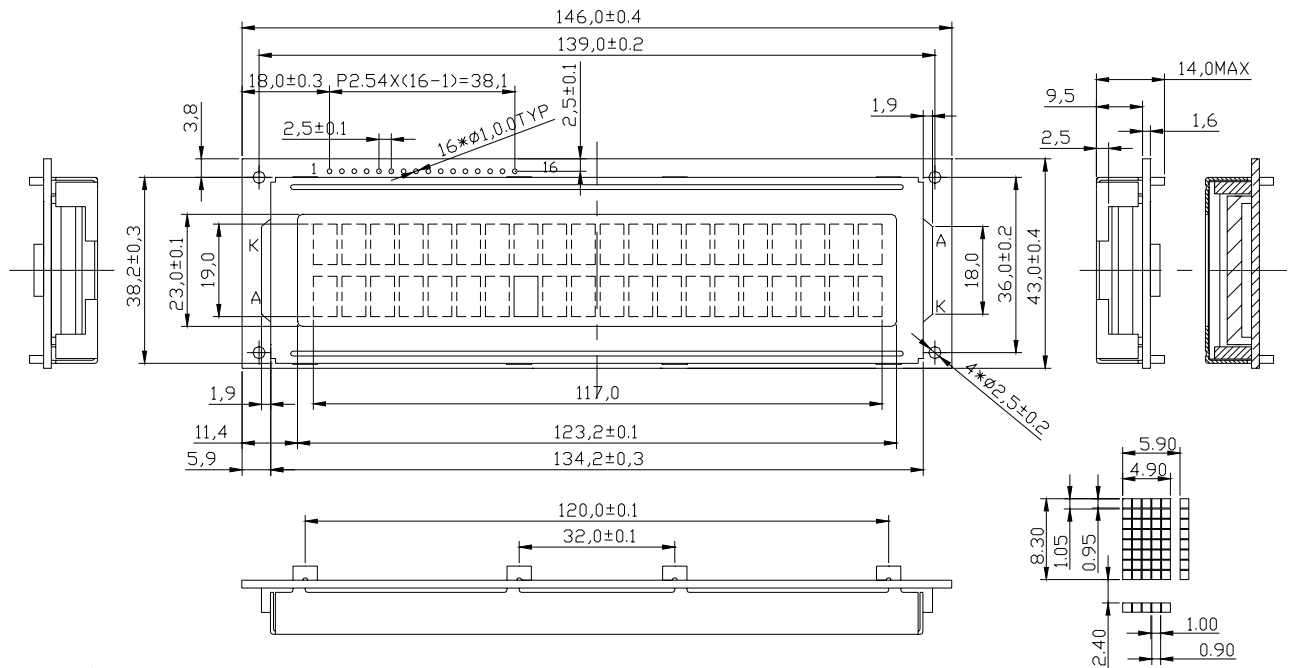
2. MECHANICAL SPECIFICATIONS

- Character Pitch : 5.90 (W) x 10.70 (H) mm
- Character Size : 4.90 (W) x 8.30 (H)mm
- Character Font : 5 x 8 dots
- Dot Size : 0.90 (W) x 0.95 (H) mm
- Dot Pitch : 1.00 (W) x 1.05 (H) mm

3. BLOCK DIAGRAM



4. EXTERNAL DIMENSIONS



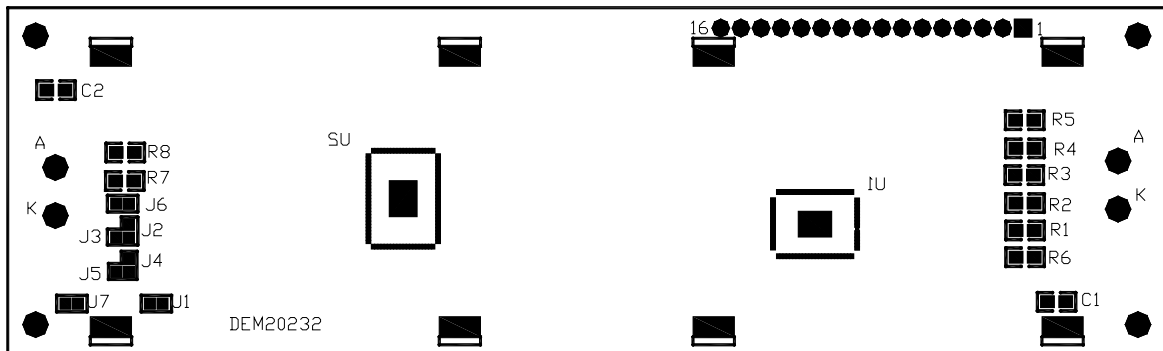
NOTE :
UNTOLERANCE IS ±0.5mm.

SCALE 2:1

5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	V _{SS}	Ground
2	V _{DD}	Power supply
3	V ₀	Power Supply for LCD
4	RS	Select Display Data ("H") or Instructions ("L")
5	R/W	Read or Write Select Signal
6	E	Read/Write Enable Signal
7	DB0	Display Data Signal
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	
15	LED – (K)	Please also refer to 6.1 PCB drawing and description.
16	LED + (A)	Please also refer to 6.1 PCB drawing and description.

6.1 PCB DRAWING AND DESCRIPTION



Note: In application nodule, R1=R2=R3=R4=R5=2.2kΩ , R6=91kΩ , R7=24Ω ,R8=0Ω , C1=C2=0.1uF

DESCRIPTION:

6-1-1.The polarity of the pin 15 and the pin 16:

symbol	state	symbol	J3,J5	J2, J4	LED Polarity	
					15 Pin	16 Pin
J2,J4	Each solder-bridge	Each open	Each closed	Cathode	Anode	
J3,J5	Each solder-bridge	Each closed	Each open	Anode	Cathode	

Note: In application module, J1=J2=J4=closed, J3=J5=J6=J7=open.

6-1-2. The J1 is metal-bezel GND to module GND and J7 is mounting holes GND to module to module GND.

Note: In application module, J1= closed, J7=open.

6-1-3.The LED resistor can be bridged when the J6 is closed.

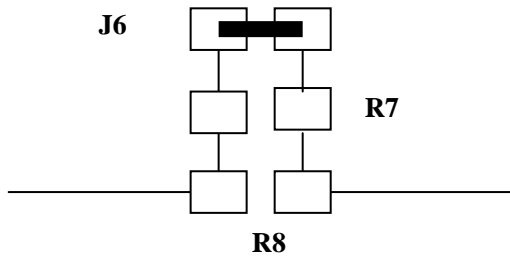
Note: In application module, J6=open

6-1-4.The R7 and the R8 are the LED resistor.

Note: In application module, R7= 24Ω , R8=open

6.2 Example application

6-2-1. The LED resistor can be bridged as following.



6-2-2. The 16 pin is the anode and the 15 pin is the cathode as following.



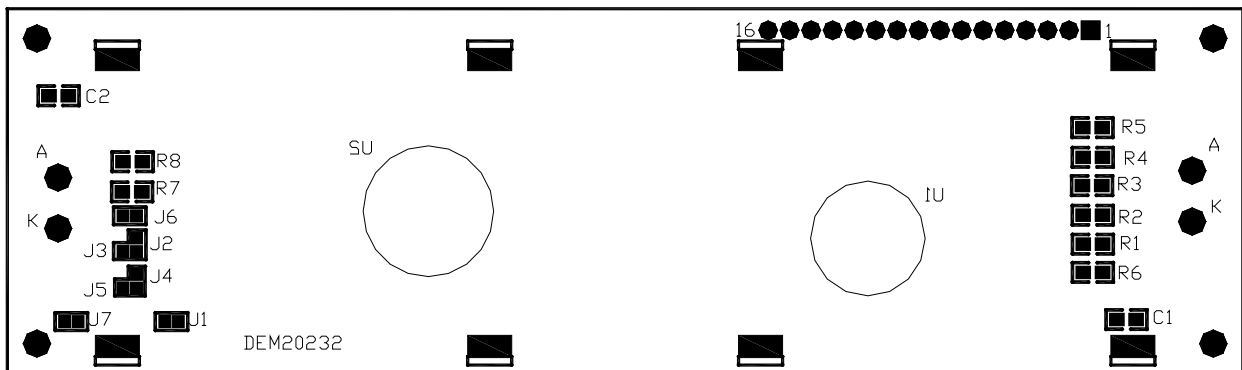
6-2-3. The 15 pin is the anode and the 16 pin is the cathode as following.



6-2-4. The metal-bezel is on ground as following.



6.3 The module No. is printed on the PCB.



7. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	Standard value	Unit
Power supply voltage(1)	V _{DD}	-0.3 ~ +7.0	V
Power supply voltage(2)	V _{LCD}	V _{DD} -15.0 ~ V _{DD} +0.3	V
Input voltage	V _{IN}	-0.3 ~ V _{DD} +0.3	V
Volt. For BL	V _{LED1}	4 ~ 4.5	V
Operating temperature	T _{opr}	-20 ~ +70	°C
Storage temperature	T _{stg}	-30 ~ +80	°C

*Voltage greater than above may damage to the circuit, V_{DD}≥ V1≥ V2≥ V3≥ V4≥ V5 .

8. ELECTRICAL CHARACTERISTICS

8-1-1 DC Characteristics(VDD=4.5V~5.5V,Ta=-20~+70°C)

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V _{DD}	4.5	5	5.5	-----	V
Supply Current	I _{DD}	----	0.35	0.6	V _{DD} =5V,f _{osc} =270kHz	mA
Input Voltage(1) (except OSC1)	V _{IL1}	-0.3	--	0.6	-----	V
	V _{IH1}	2.2	--	V _{DD}	-----	
Input Voltage(2) (OSC1)	V _{IL2}	-0.2	--	1.0	-----	V
	V _{IH2}	V _{DD} -1.0	--	V _{DD}	-----	
Output Voltage (1) (DB0 to DB7)	V _{OL1}	---	----	0.4	I _{OL} =1.2mA	V
	V _{OH1}	2.4	---	----	I _{OH} =-0.205mA	
Output Voltage (2) (except DB0 to DB7)	V _{OL2}	-----	---	0.1V _{DD}	I _{OL} =40uA	V
	V _{OH2}	0.9V _{DD}	---	-----	I _{OH} =-40uA	
Voltage Drop	V _{dCOM}	-----	---	1	I _o =±01. mA	V
	V _{dSEG}	-----	---	1		
Input Leakage Current	I _{IKG}	-1	---	1	V _{IN} =0 V to V _{DD}	uA
Input Low Current	I _{IL}	-50	-125	-250	V _{IN} =0V,V _{DD} =5V(pull up)	uA
Internal Clock (external Rf)	f _{OSC1}	190	270	350	Rf = 91k±2% (V _{DD} =5V)	kHz
External Clock	f _{OSC}	125	270	410	----	kHz
	Duty	45	50	55	----	%
	t _R ,t _F	---	---	0.2	----	us
LCD Driving Voltage	V _{LCD}	3.0	---	13.0	V _{DD} -V ₅ (1/5,1/4 Bias)	V

8-1-2 BACKLIGHT & SWITCH (Ta=25°C)

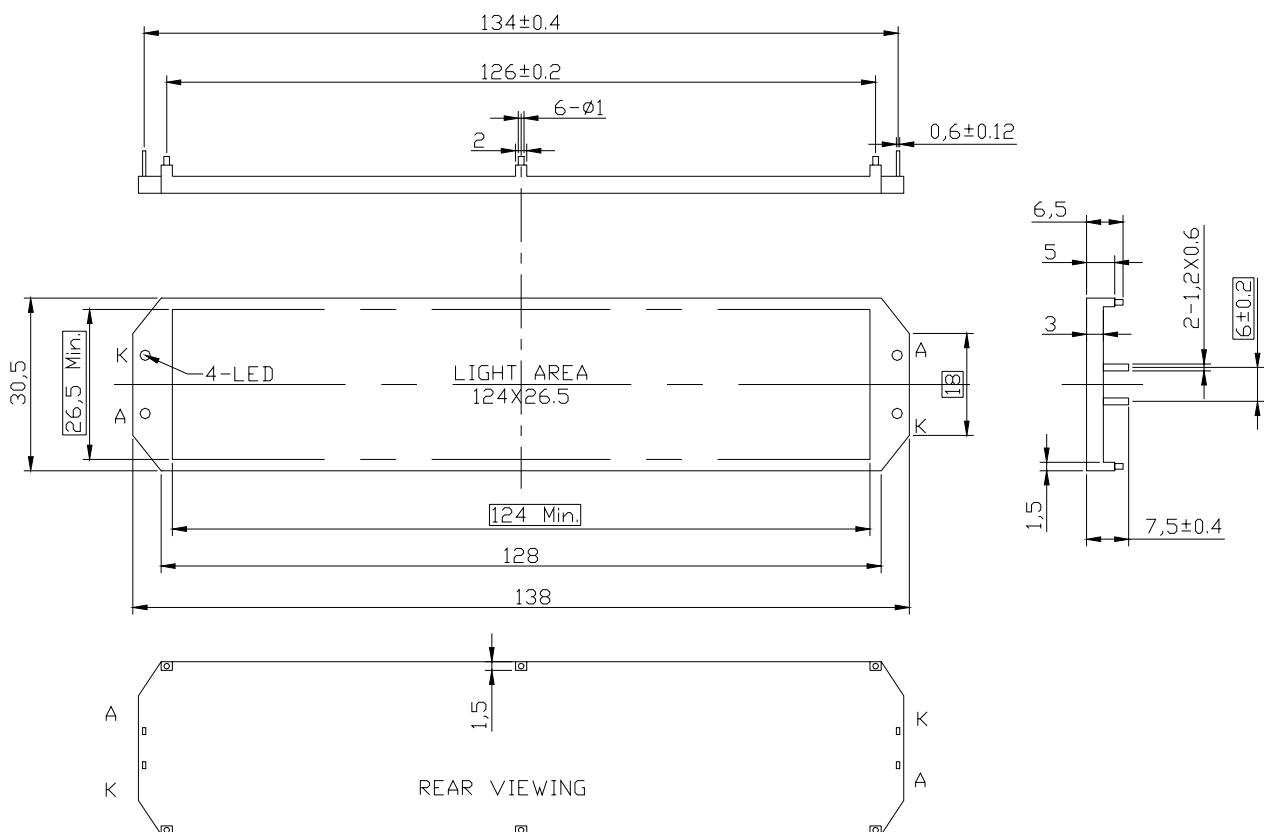
8-1-2-1. ABSOLUTE MAXIMUM RATINGS

Item	Symbol	Conditions	Rating	Unit
Absolute maximum forward current	IFm		40 x 2	mA
Peak forward current	IFp	1 msec plus 10% duty cycle	80 x 2	mA
Reverse voltage	Vr		5	V
Power dissipation	Pd		168 x 2	mW
Operating Temperature Range	Topr		-30 ~ +65	°C
Storage Temperature Range	Tstg		-30 ~ +70	°C

8-1-2-2. ELECTRICAL-OPTICAL CHARACTERISTICS

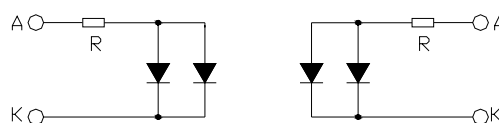
Item	Symbol	MIN	TYPE	MAX	Unit	Condition
Forward Current	If		30 x 2	40 x 2	mA	Vf=4.2V
Reverse Current	Ir		0.2 x 2		mA	Vr=5V
Peak wave length	λ_p		White		nm	Vf=4.2V
Spectral Line Half width	$\Delta \lambda$				nm	Vf=4.2V
Luminance	Lv	130			cd/m ²	Vf=4.2V
Color Chromaticity	X	X=0.250	-----	X=0.300		
	Y	Y=0.250	-----	Y=0.320		

8-1-2-3. BACKLIGHT DRAWING



NOTE:
 FORWARD VOLTAGE 4.2V
 FORWARD CURRENT 270MA
 LUMINOUS INTENSITY 150cd/m²
 COLOR:WHITE
 TOLERANCE IS ± 0.3

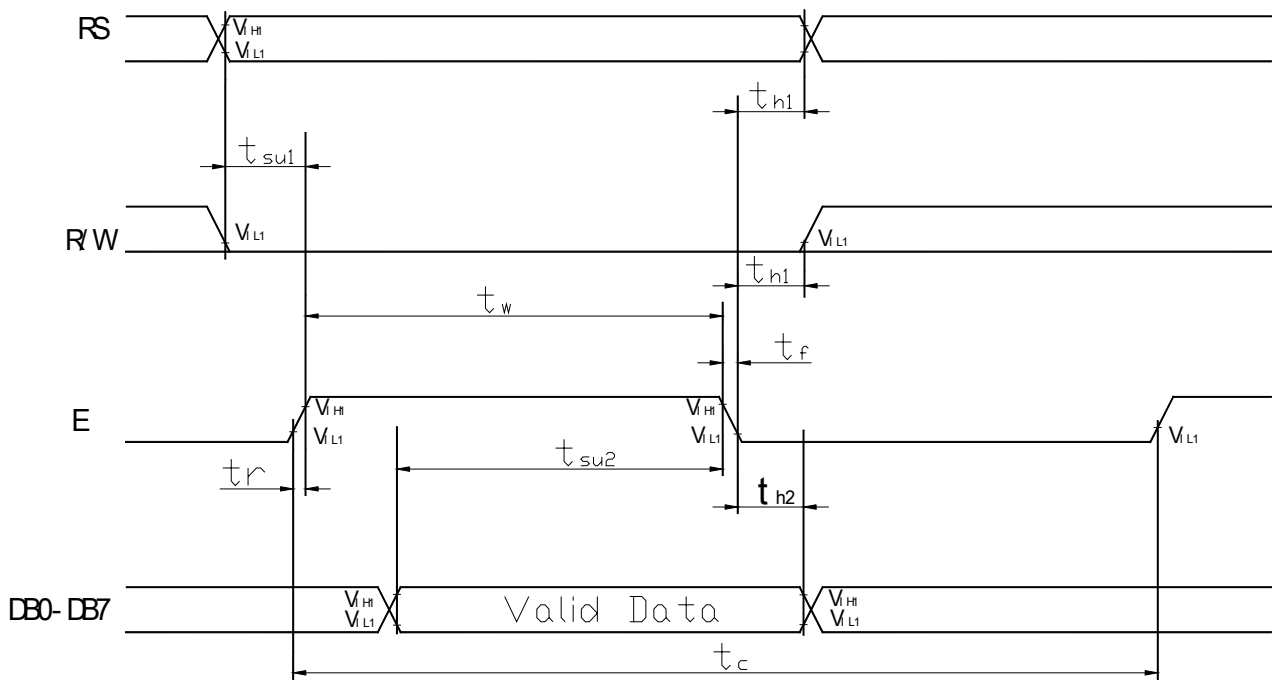
CIRCUIT DIAGRAM (LED 2X2=4 dies)



8-2 AC Characteristics ($V_{DD}=4.5V\sim 5.5V$, $T_a=-20\sim +70^{\circ}C$)

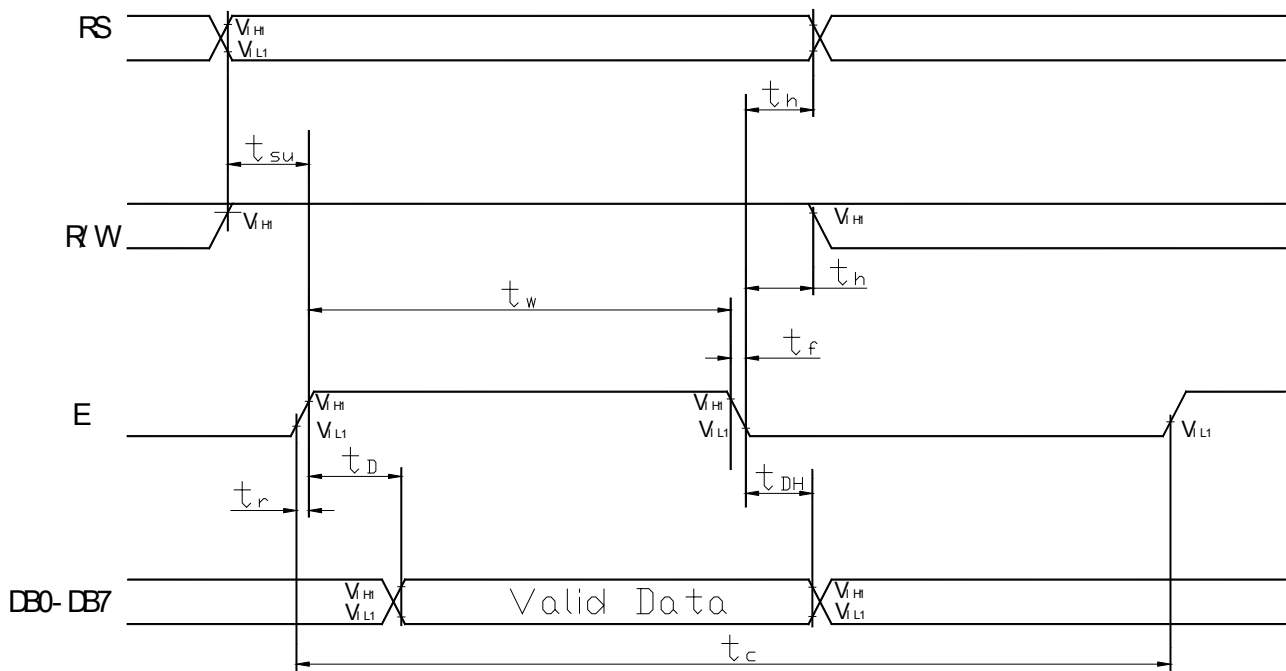
8-2-1 Write mode (writing data from MPU to module)

Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
E Cycle Time	t_c	500	---	---	ns	E
E Rise Time	t_r	---	---	20	ns	E
E Fall Time	t_f	---	---	20	ns	E
E Pulse width (High,Low)	t_w	230	---	---	ns	E
R/W and RS Set-up Time	t_{su1}	40	---	---	ns	R/W,RS
R/W and RS Hold Time	t_{h1}	10	---	---	ns	R/W,RS
Data Set-up Time	t_{su2}	80	---	---	ns	DB0~DB7
Data Hold Time	t_{h2}	10	---	---	ns	DB0~DB7



8-2-2 Read mode (reading data from MPU to module)

Characteristic	Symbol	Min	Type	Max	Unit	Test PIN
E Cycle Time	t_c	500	---	---	ns	E
E Rise Time	t_R	---	---	20	ns	E
E Fall Time	t_F	---	---	20	ns	E
E Pulse width (High, Low)	t_w	230	---	---	ns	E
R/W and RS Set-up Time	t_{su}	40	---	---	ns	R/W,RS
R/W and RS Hold Time	t_h	10	---	---	ns	R/W,RS
Data Output Delay Time	t_D	---	---	120	ns	DB0~DB7
Data Hold Time	t_{DH2}	5	---	---	ns	DB0~DB7

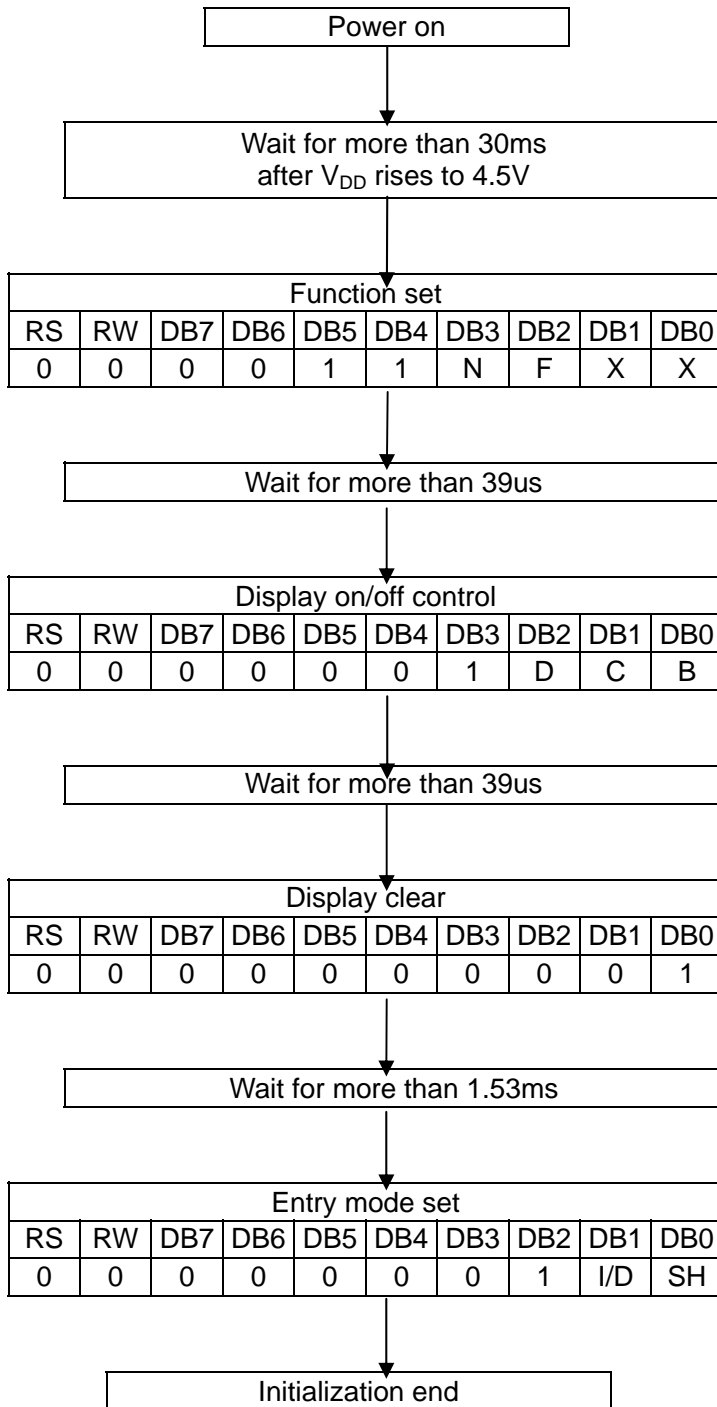


9. CONTROL AND DISPLAY COMMAND

Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Execution time (fosc=270KHz)	Remark																		
clear Display	L	L	L	L	L	L	L	L	L	H	1.53ms	Write "20H" to DDRAM and set DDRAM address to "00H" from AC																		
Return home	L	L	L	L	L	L	L	L	L	H ---	1.53ms	Cursor move to first digit																		
Entry mode set	L	L	L	L	L	L	L	H	I/D	SH	39us	I/D:set cursor move direction <table border="1"> <tr> <td>I/D</td> <td>H</td> <td>Increase</td> </tr> <tr> <td>I/D</td> <td>L</td> <td>Decrease</td> </tr> </table> SH:Specifies shift of display <table border="1"> <tr> <td>SH</td> <td>H</td> <td>Display is shifted</td> </tr> <tr> <td>SH</td> <td>L</td> <td>Display is not shifted</td> </tr> </table>	I/D	H	Increase	I/D	L	Decrease	SH	H	Display is shifted	SH	L	Display is not shifted						
I/D	H	Increase																												
I/D	L	Decrease																												
SH	H	Display is shifted																												
SH	L	Display is not shifted																												
Display on/off control	L	L	L	L	L	L	H	D	C	B	39us	Display <table border="1"> <tr> <td>D</td> <td>H</td> <td>Display on</td> </tr> <tr> <td>D</td> <td>L</td> <td>Display off</td> </tr> </table> Cursor <table border="1"> <tr> <td>C</td> <td>H</td> <td>Cursor on</td> </tr> <tr> <td>C</td> <td>L</td> <td>Cursor off</td> </tr> </table> Blinking <table border="1"> <tr> <td>B</td> <td>H</td> <td>Blinking on</td> </tr> <tr> <td>B</td> <td>L</td> <td>Blinking off</td> </tr> </table>	D	H	Display on	D	L	Display off	C	H	Cursor on	C	L	Cursor off	B	H	Blinking on	B	L	Blinking off
D	H	Display on																												
D	L	Display off																												
C	H	Cursor on																												
C	L	Cursor off																												
B	H	Blinking on																												
B	L	Blinking off																												
Cursor or Display Shift	L	L	L	L	L	H	S/C	R/L	---	---	39us	<table border="1"> <tr> <td>SC</td> <td>H</td> <td>Display shift</td> </tr> <tr> <td>SC</td> <td>L</td> <td>Cursor move</td> </tr> </table> <table border="1"> <tr> <td>R/L</td> <td>H</td> <td>Right shift</td> </tr> <tr> <td>R/L</td> <td>L</td> <td>Left shift</td> </tr> </table>	SC	H	Display shift	SC	L	Cursor move	R/L	H	Right shift	R/L	L	Left shift						
SC	H	Display shift																												
SC	L	Cursor move																												
R/L	H	Right shift																												
R/L	L	Left shift																												
function Set	L	L	L	L	H	DL	N	F	---	---	39us	<table border="1"> <tr> <td>DL</td> <td>H</td> <td>8bits interface</td> </tr> <tr> <td>DL</td> <td>L</td> <td>4bits interface</td> </tr> </table> <table border="1"> <tr> <td>N</td> <td>H</td> <td>2 line display</td> </tr> <tr> <td>N</td> <td>L</td> <td>1 line display</td> </tr> </table> <table border="1"> <tr> <td>F</td> <td>H</td> <td>Display on</td> </tr> <tr> <td>F</td> <td>L</td> <td>Display off</td> </tr> </table>	DL	H	8bits interface	DL	L	4bits interface	N	H	2 line display	N	L	1 line display	F	H	Display on	F	L	Display off
DL	H	8bits interface																												
DL	L	4bits interface																												
N	H	2 line display																												
N	L	1 line display																												
F	H	Display on																												
F	L	Display off																												
Set CGRAM address	L	L	L	H	AC5	AC4	AC3	AC2	AC1	AC0	39us	CGRAM data is sent and received after this setting																		
Set DDRAM address	L	L	H	AC6	AC5	AC4	AC3	AC2	AC1	AC0	39us	DDRAM data is sent and received after this setting																		
Read busy flag& address	L	H	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	0us	<table border="1"> <tr> <td>BF</td> <td>H</td> <td>Busy</td> </tr> <tr> <td>BF</td> <td>L</td> <td>Ready</td> </tr> </table> -Reads BF indication internal operating is being performed -Reads address counter contents	BF	H	Busy	BF	L	Ready												
BF	H	Busy																												
BF	L	Ready																												
Write data to RAM	H	L	D7	D6	D5	D4	D3	D2	D1	D0	43us	Write data into DDRAM or CGRAM																		
Read data from RAM	H	H	D7	D6	D5	D4	D3	D2	D1	D0	43us	Read data from DDRAM or CGRAM																		

10. LCM INITIALIZING BY INSTRUCTION

10-1. 8-bit interface mode



Condition : fosc=270khz

N	0	1-line mode
	1	2-line mode

F	0	5X8 dots
	1	5X11 dots

D	0	display off
	1	display on

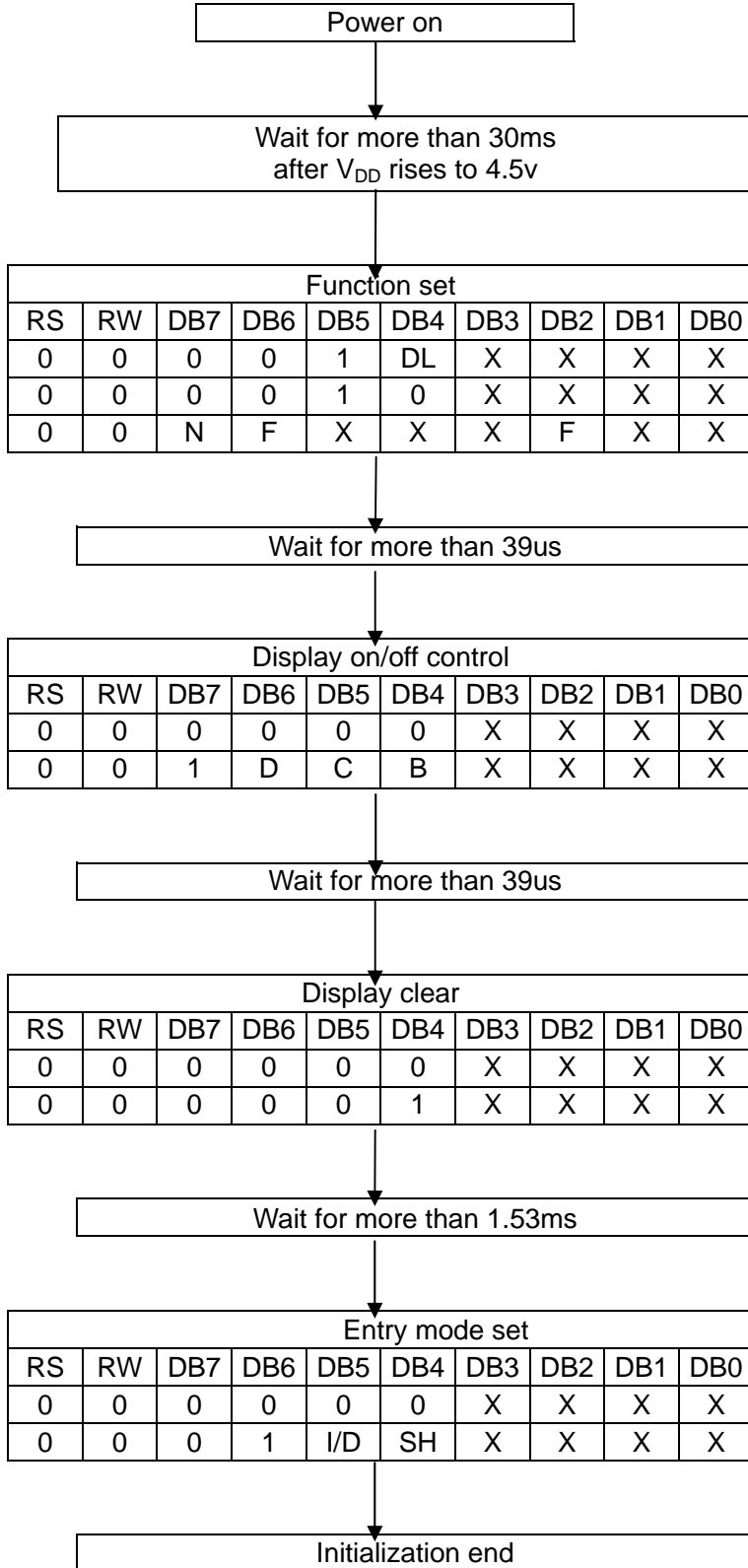
C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

10-2. 4-bit interface mode



Condition : fosc=270khz

DL	0	4-bit mode
	1	8-bit mode
N	0	1-line mode
	1	2-line mode
F	0	5X8 dots
	1	5X11 dots

D	0	display off
	1	Display on
C	0	cursor off
	1	cursor on
B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode
SH	0	entire shift off
	1	entire shift on

11. CHARACTER GENERATOR ROM

■ S6A0069

Upper←br>Lower→br>	LLLL	LLLH	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
LLLL (1) CGRAM																
LLLH (2)																
LLHL (3)																
LLHH (4)																
LHLL (5)																
LHLH (6)																
LHHL (7)																
LHHH (8)																
HLLL (1)																
HLLH (2)																
HLHL (3)																
HLHH (4)																
HHLL (5)																
HHLH (6)																
HHHL (7)																
HHHH (8)																

12. LCD MODULES HANDLING PRECAUTIONS

- Please reveal the protective film on the LCD before using.
- The display panel is made of glass. Do not subject it to a mechanical shock by dropping it from a high place, etc.
- If the display panel is damaged and the liquid crystal substance inside it leaks out, do not get any in your mouth. If the substance come into contact with your skin or clothes promptly wash it off using soap and water.
- Do not apply excessive force to the display surface or the adjoining areas since this may cause the color tone to vary.
- The polarizer covering the display surface of the LCD module is soft and easily scratched. Handle this polarize carefully.
- 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 module.
 - Tools required for assembly, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembly 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.
- Storage precautions
When storing the LCD modules, avoid exposure to direct sunlight or to the light of fluorescent lamps. Keep the modules in bags designed to prevent static electricity charging under low temperature / normal humidity conditions (avoid high temperature / high humidity and low temperatures below 0°C). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

13. OTHERS

- Liquid crystals solidify at low temperature (below the storage temperature range) leading to defective orientation of liquid crystal or the generation of air bubbles (black or white). Air bubbles may also be generated if the module is subjected to a strong shock at a low temperature.
- If the LCD modules have been operating for a long time showing the same display patterns may remain on the screen as ghost images and a slight contrast irregularity may also appear. Abnormal operating status can be resumed to be normal condition by suspending use for some time. It should be noted that this phenomena does not adversely affect performance reliability.
- To minimize the performance degradation of the LCD modules resulting from 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