Display Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 20232 SYH-LY

Product specification   *Version : 3*

28/04/2001

GENERAL SPECIFICATION

MODULE NO. :

DEM 20232 SYH-LY

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	2000/11/09
1	CONTENTS CHANGE	2000/11/16
2	ADD CHARACTER TABLE	2001/03/07
3	ADD TWO BACKLIGHT HOLES	2001/08/08

PREPARED BY: AWQ   DATE: 2001/08/08
APPROVED BY: MH   DATE: 2001/04/28

CONTENTS

1.FUNCTIONS & FEATURES

- DEM 20232 - Series :

MODULE-TYPE	LCD MODEL	LCD-TYPE
DEM 20232 SYH-LY	STN Yellow/Green	Transflective Positive Mode

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 2.7V to 5.5V (typ. 5V)
- Backlight Color : Yellow Green (lightbox)
- V_{LCD} Adjustable For Best Contrast : 4.5 (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 KS0066U-00
- Interface : Easy Interface with a 4-bit or 8-bit MPU

2. MECHANICAL SPECIFICATIONS

- Character Pitch : 5.9 (W) x 10.7 (H) mm
- Character Size : 4.9 (W) x 8.3 (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

2
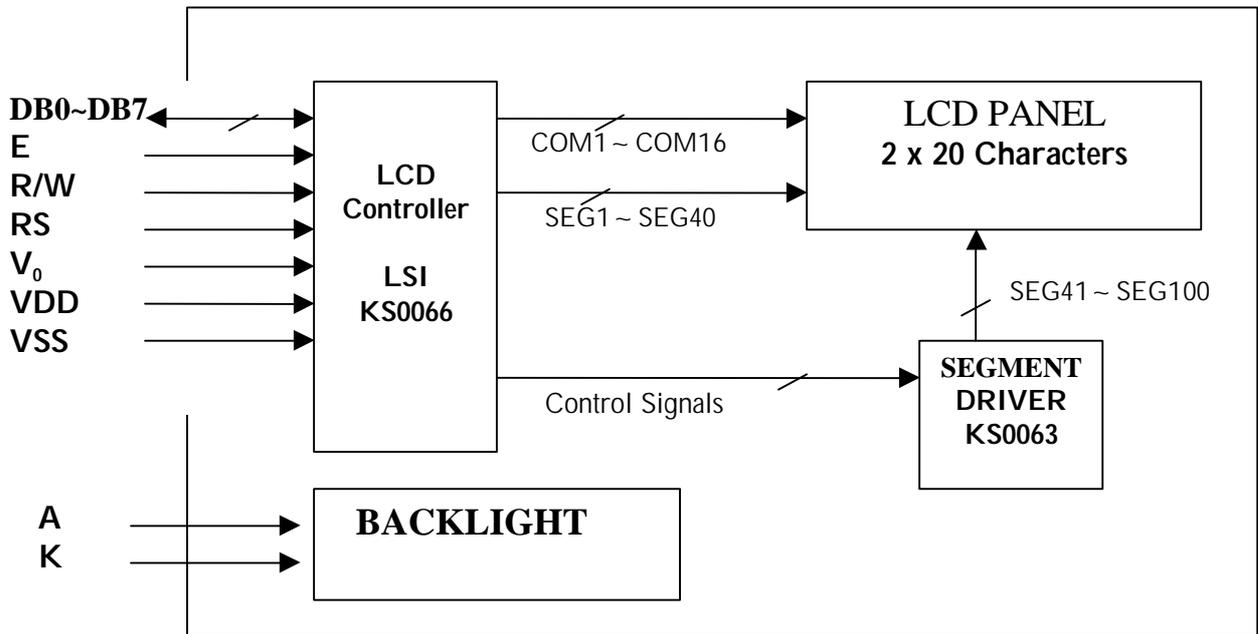
4. EXTERNAL DIMENSIONS
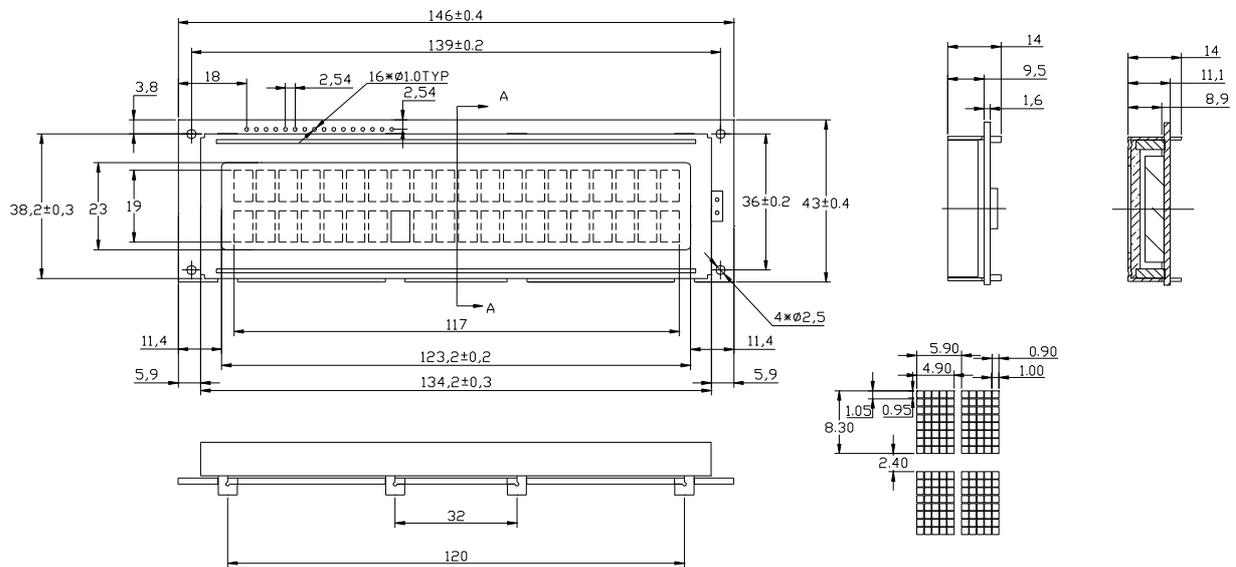
5. PIN ASSIGNMENT

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	
8	DB1	
9	DB2	
10	DB3	Display Data Signal
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.

3

6.1 PCB DRAWING AND DESCRIPTION
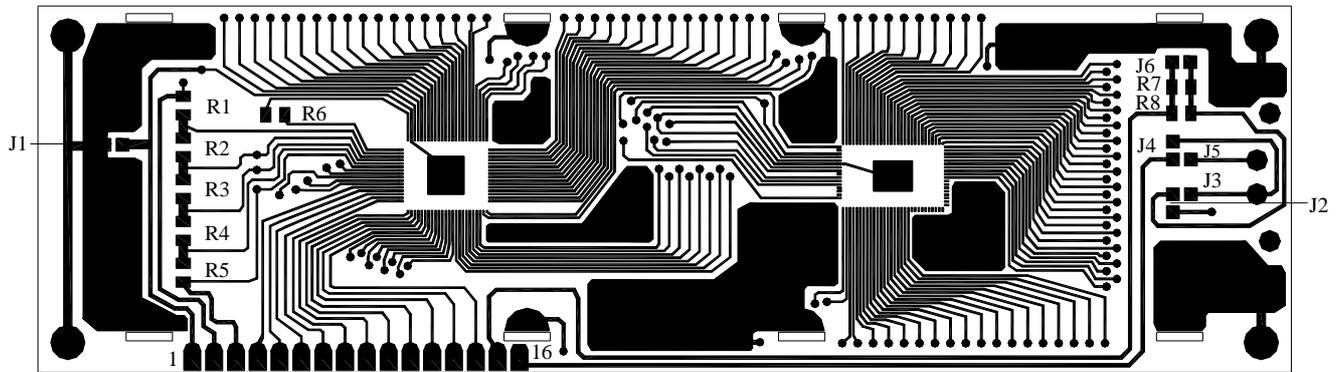
DESCRIPTION:

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

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

6-1-2.The metal-bezel should be on ground when the J1 is solder-Bridge.

6-1-3.The LED resistor should be bridged when the J6 is solder-Bridge.

6-1-4.The R7 and the R8 are the LED resistor. (R7＝R8＝5,6Ω)

4

VERSION: 3

6.2 Example application

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

J6

R7

R8
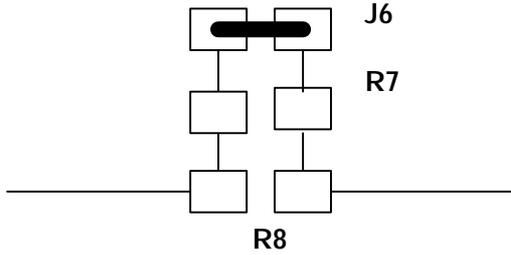
6-2-2. The 15 pin is the cathode and the 16 pin is the anode as following.

J4　　　　　　**J3**

J2

J5

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

J4　　　　**J3**

J2

J5

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

J1
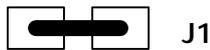
6.3 The module NO. Is printed on the PCB.

R1　R6

J1

R2

R3

R4

R5

U1　　　　　U2

J6
R7
R8　　K
J4　J5　　−
J3
J2　　　+
　　　　A

DEM20232

1　　　　　16

VERSION: 3
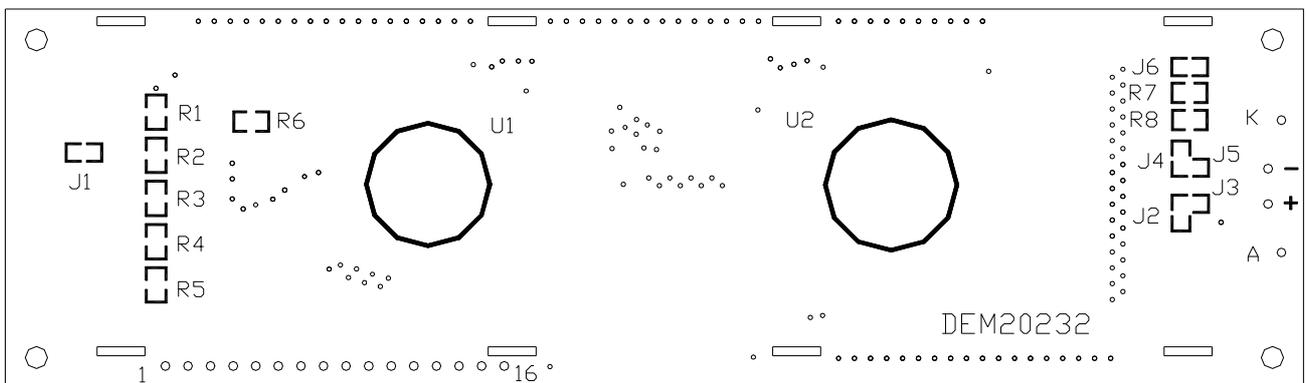
7. MAXIMUM ABSOLUTE LIMIT

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, $V_{DD} \geq V1 \geq V2 \geq V3 \geq V4 \geq V5$.

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	$V_{DD}=5V, fosc=270kHz$	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	Vd_{COM}	-----	---	1	$Io=\pm01.\ mA$	V
	Vd_{SEG}	------	---	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	$Rf = 91k\pm2\%$ $(V_{DD}=5V)$	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

6

8-1-2 BACKLIGHT & SWITCH (Ta = -20 ~ +70°C)

Item	Symbol	Standard Value	Unit	Applicable Terminal
Backlight Voltage	V	5.0	V	LED+ / LED-
Backlight Current	I	~ 245	mA	

33 x 2 DICES

VERSION: 3
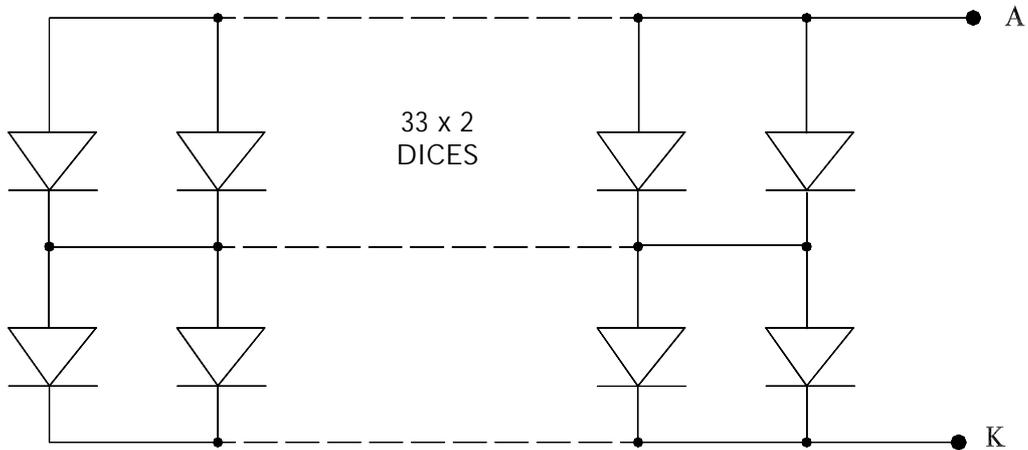
8-2 AC Characteristics (V_{DD} = 4.5V ~ 5.5V , Ta = -20 ~ +70°C)
8-2-1 Write mode (writing data from MPU to DEM20232-Series)

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
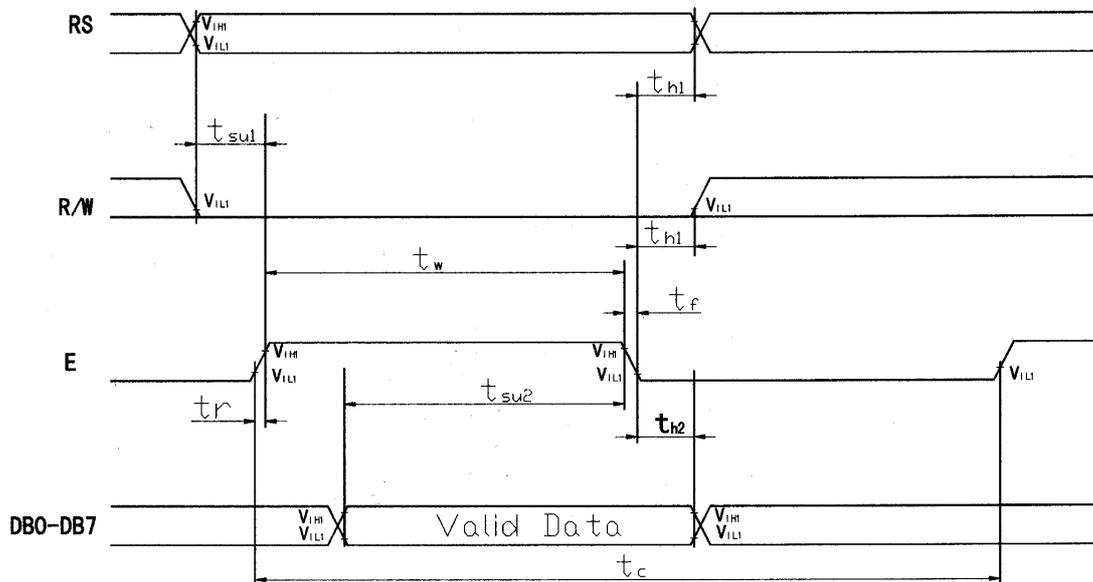
8-2-2 Read mode (reading data from MPU to DEM 20232-Series)

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
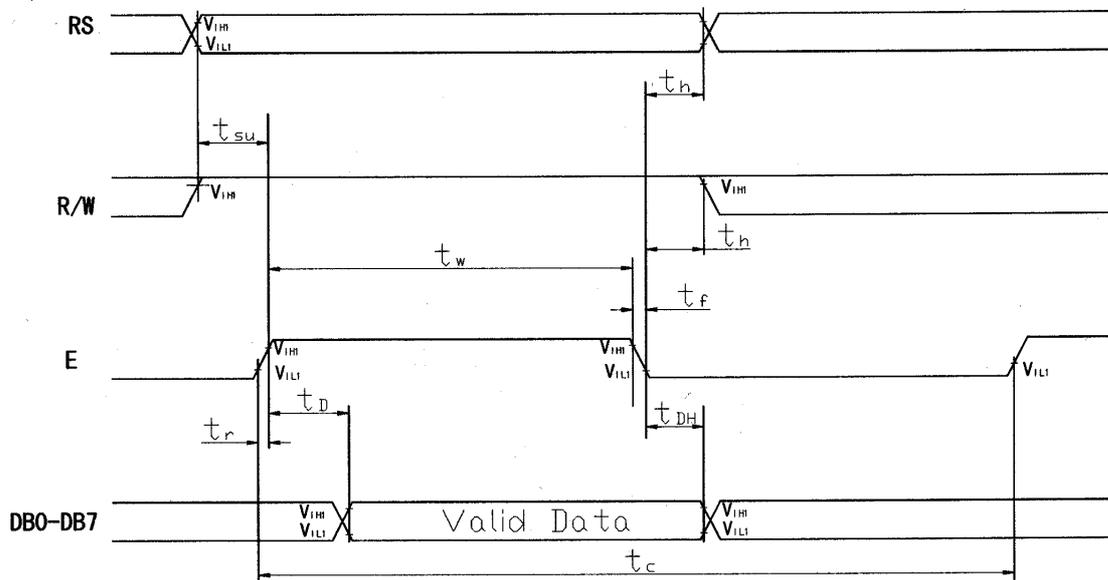
9. CONTROL AND DISPLAY COMMAND

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	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><tr><td rowspan=2>I/D</td><td>H</td><td>Increase</td></tr><tr><td>I</td><td>Decrease</td></tr></table>SH:Specifies shift of display <table><tr><td rowspan=2>SH</td><td>H</td><td>Display is shifted</td></tr><tr><td>L</td><td>Display is not shifted</td></tr></table>
Display on/off control	L	L	L	L	L	L	H	D	C	B	39us	Display <table><tr><td rowspan=2>D</td><td>H</td><td>Display on</td></tr><tr><td>L</td><td>Display off</td></tr></table>Cursor <table><tr><td rowspan=2>C</td><td>H</td><td>Cursor on</td></tr><tr><td>L</td><td>Cursor off</td></tr></table>Blinking <table><tr><td rowspan=2>B</td><td>H</td><td>Blinking on</td></tr><tr><td>L</td><td>Blinking off</td></tr></table>
Cursor or Display Shift	L	L	L	L	L	H	S/C	R/L	---	---	39us	<table><tr><td rowspan=2>SC</td><td>H</td><td>Display shift</td></tr><tr><td>L</td><td>Cursor move</td></tr><tr><td rowspan=2>R/L</td><td>H</td><td>Right shift</td></tr><tr><td>L</td><td>Left shift</td></tr></table>
function Set	L	L	L	L	H	DL	N	F	---	---	39us	<table><tr><td rowspan=2>DL</td><td>H</td><td>8bits interface</td></tr><tr><td>L</td><td>4bits interface</td></tr><tr><td rowspan=2>N</td><td>H</td><td>2 line display</td></tr><tr><td>L</td><td>1 line display</td></tr><tr><td rowspan=2>F</td><td>H</td><td>Display on</td></tr><tr><td>L</td><td>Display off</td></tr></table>
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><tr><td rowspan=2>BF</td><td>H</td><td>Busy</td></tr><tr><td>L</td><td>Ready</td></tr></table>-Reads BF indication internal operating is being performed -Reads address counter contents
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

```
            ┌─────────────────────────────┐
            │          Power on           │
            └─────────────────────────────┘
                          │
                          ▼
            ┌─────────────────────────────┐
            │  Wait for more than 30ms    │
            │  after VDD rises to 4.5V    │
            └─────────────────────────────┘
```

Condition : fosc=270khz

		0	1-line mode
N		1	2-line mode

Function set

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	1	N	F	X	X

		0	display off
F		1	display on

Wait for more than 39us

Display on/off control

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	1	D	C	B

		0	display off
D		1	display on

		0	cursor off
C		1	cursor on

Wait for more than 39us

		0	blink off
B		1	blink on

Display clear

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	0	0	1

Wait for more than 1.53ms

		0	decrement mode
I/D		1	increment mode

Entry mode set

RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	0	1	I/D	SH

Initialization end

		0	entire shift off
SH		1	entire shift on

10-2. 4-bit interface mode
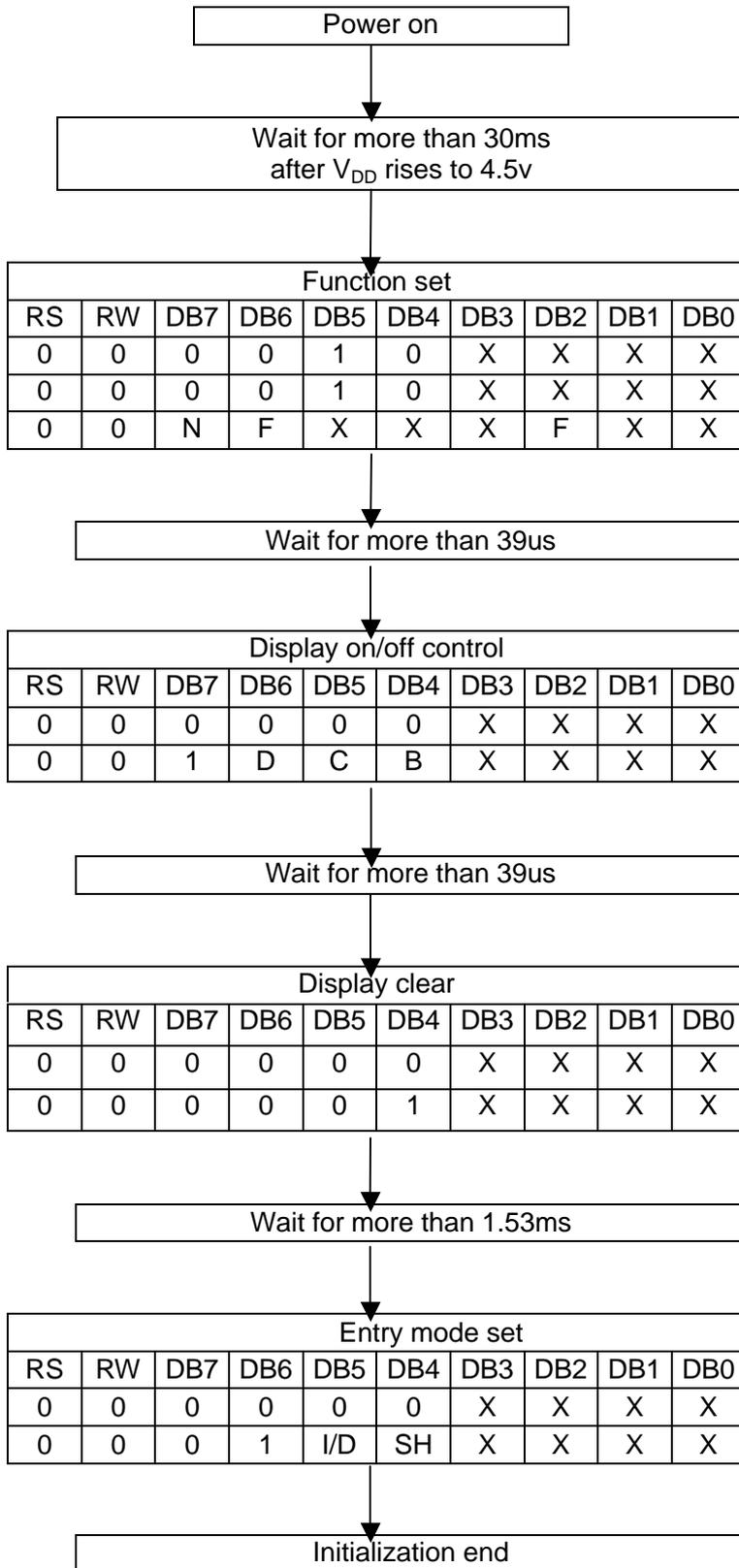
```
┌─────────────────────────────┐
│          Power on            │
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐        Condition : fosc=270khz
│    Wait for more than 30ms   │
│    after V_DD rises to 4.5v  │
└─────────────────────────────┘
              │
              ▼
```

Function set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	0	X	X	X	X
0	0	0	0	1	0	X	X	X	X
0	0	N	F	X	X	X	F	X	X

	0	1-line mode
N	1	2-line mode
	0	display off
F	1	display on

```
              │
              ▼
┌─────────────────────────────┐
│   Wait for more than 39us    │
└─────────────────────────────┘
              │
              ▼
```

Display on/off control									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	1	D	C	B	X	X	X	X

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

```
              │
              ▼
┌─────────────────────────────┐
│   Wait for more than 39us    │
└─────────────────────────────┘
              │
              ▼
```

Display clear									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	0	0	1	X	X	X	X

```
              │
              ▼
┌─────────────────────────────┐
│   Wait for more than 1.53ms  │
└─────────────────────────────┘
              │
              ▼
```

Entry mode set									
RS	RW	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	0	X	X	X	X
0	0	0	1	I/D	SH	X	X	X	X

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

```
              │
              ▼
┌─────────────────────────────┐
│       Initialization end     │
└─────────────────────────────┘
```

VERSION: 3

11. CHARACTER GENERATOR ROM

■ **KS0066U-00**

Table 3. Relationship Between character Code (DDRAM) and Character Pattern (CGRAM)

Character Code (DDRAM data)								CGRAM Address						CGRAM Data								Pattern number
D7	D6	D5	D4	D3	D2	D1	D0	A5	A4	A3	A2	A1	A0	P7	P6	P5	P4	P3	P2	P1	P0	
0	0	0	0	x	0	0	0	0	0	0	0	0	0	x	x	x	0	■	■	■	0	Pattern 1
											0	0	1				■	0	0	0	■	
											0	1	0				■	0	0	0	■	
											0	1	1				■	■	■	■	■	
											1	0	0				■	0	0	0	■	
											1	0	1				■	0	0	0	■	
											1	1	0				■	0	0	0	■	
											1	1	1				0	0	0	0	0	
0	0	0	0	x	1	1	1	1	1	1	0	0	0	x	x	x	■	0	0	0	■	Pattern 8
											0	0	1				■	0	0	0	■	
											0	1	0				■	0	0	0	■	
											0	1	1				■	■	■	■	■	
											1	0	0				■	0	0	0	■	
											1	0	1				■	0	0	0	■	
											1	1	0				■	0	0	0	■	
											1	1	1				0	0	0	0	0	

"x": don't care

12. FRAME FREQUENCY (1/16 duty cycle)

A-type Waveform
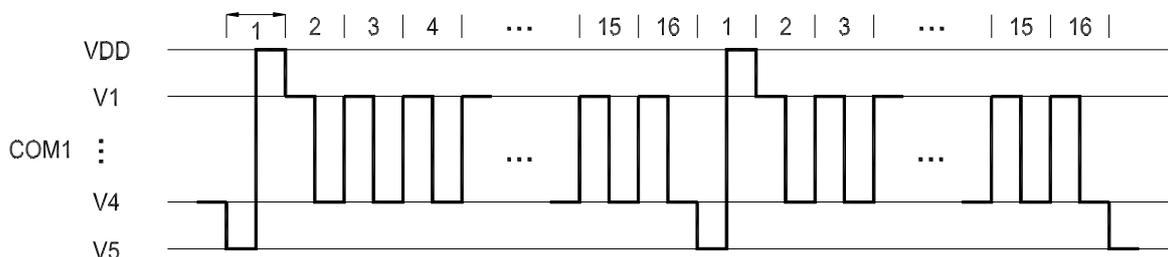
Item	Clock / Frequency
Line selection period	200 clocks
Frame frequency	84.4 Hz

* f_{osc} = 270 kHz (1 clock = 3.7 us)

14

13. LCD Modules Handling Precautions

■ 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.

14. 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