

Display Elektronik GmbH

DATA SHEET

**LCD MODULE**

**DEM 16224 SYH**

*Product Specification*

*Version: 2*

14.04.2003

**CONTENTS**

- 1. FUNCTIONS & FEATURES-----2
- 2. MECHANICAL SPECIFICATION-----2
- 3. BLOCK DIAGRAM-----2
- 4. EXTERNAL DIMENSIONS-----3
- 5. PIN ASSIGNMENT-----3
- 6. PCB DRAWING-----4
- 7. MAXIMUM ABSOLUTE LIMIT-----4
- 8. ELECTRICAL CHARACTERISTICS-----5
  - 8-1. DC CHARACTERISTICS-----5
  - 8-2. AC CHARACTERISTICS-----6
    - 8-2-1. WRITE MODE-----6
    - 8-2-2. READ MODE-----7
- 9. DISPLAY DATA RAM (DDRAM)-----7
- 10. CONTROL AND DISPLAY COMMAND-----8
- 11. LCM INITIALIZING BY INSTRUCTION-----9
  - 11-1. 8-BIT INTERFACE MODE-----9
  - 11-2. 4-BIT INTERFACE MODE-----10
- 12. CHARACTER GENERATOR-----11
- 13. FRAME FREQUENCY-----12
- 14. LCD MODULES HANDLING PERCAUTIONS-----13
- 15. OTHERS-----13

**1.FUNCTIONS & FEATURES**

- DEM 16224-Series LCD Type:

MODULE TYPE*	LCD MODEL*	LCD TYPE*
DEM 16224 SYH	STN Yellow/Green	Reflective Positive Mode

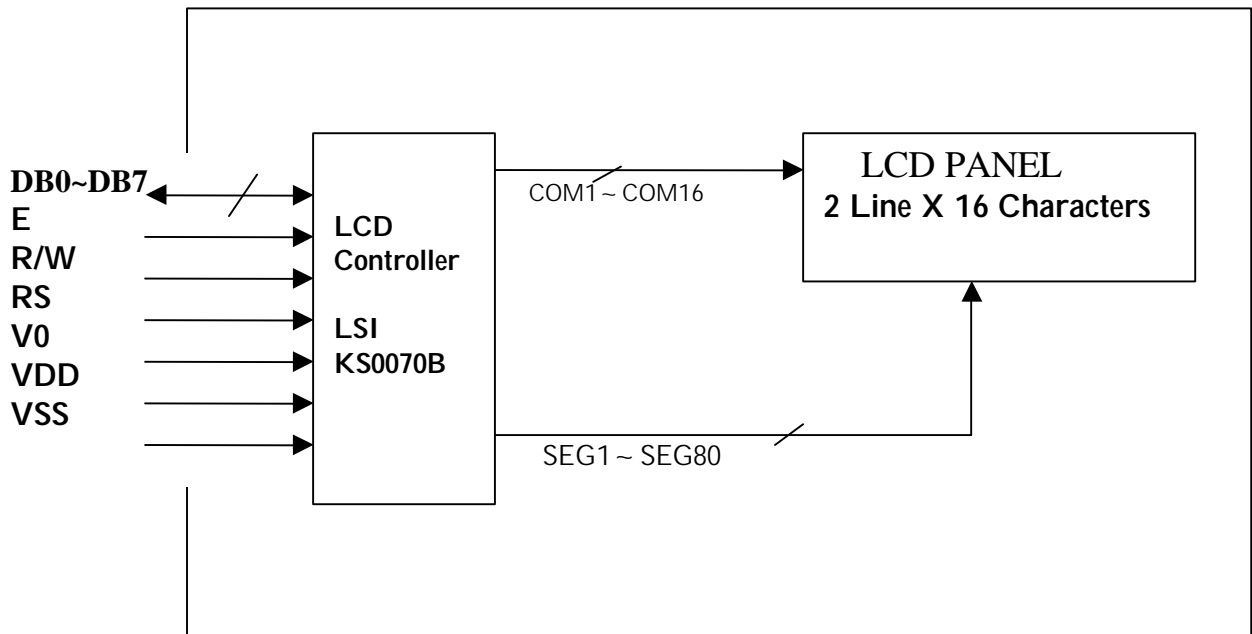
\*other versions on request

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 2.7V to 5.5V (typ. 5V)
- V<sub>LCD</sub> (VDD-V0) : 4.5 (typ.)
- 16 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 KS0070-B00
- Interface : Easy Interface with a 4-bit or 8-bit MPU

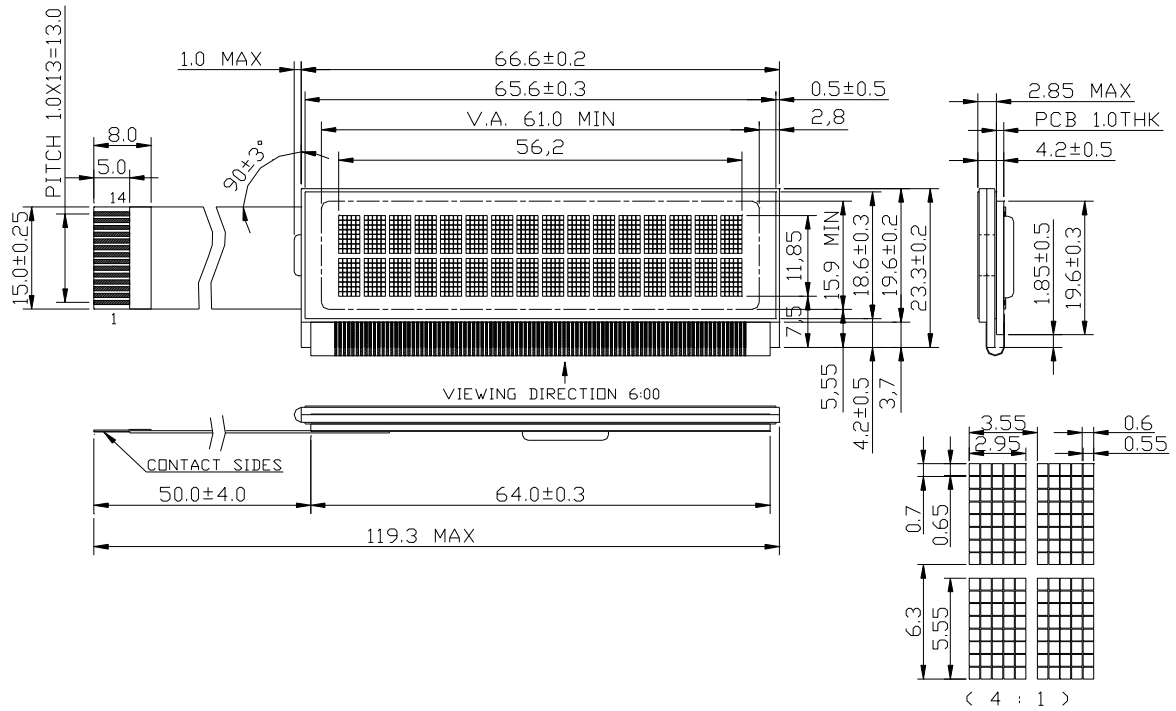
**2. MECHANICAL SPECIFICATIONS**

- Character Pitch : 3.55 (W) x 6.30 (H) mm
- Character Size : 2.95 (W) x 5.55 (H) mm
- Character Font : 5 x 8 dots
- Dot Size : 0.55 (W) x 0.65 (H) mm
- Dot Pitch : 0.60 (W) x 0.70 (H) mm

**3. BLOCK DIAGRAM**



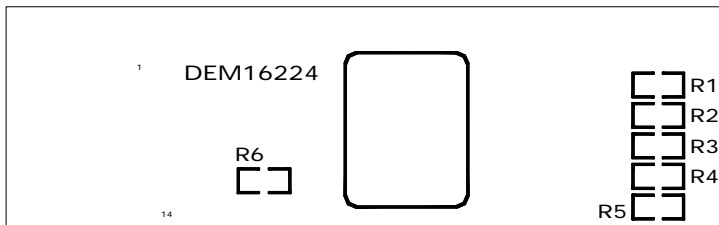
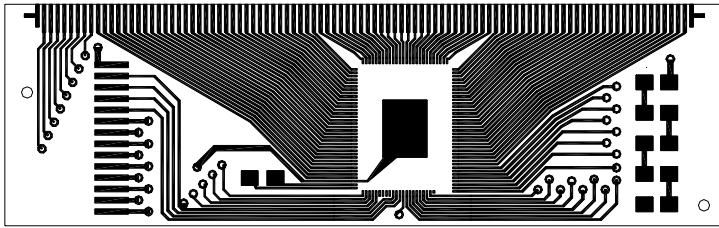
**4. EXTERNAL DIMENSIONS**



**5. PIN ASSIGNMENT**

Pin No.	Symbol	Function
1	VDD	Power Supply
2	V0	Power Supply for LCD
3	RS	Select Display Data ("H") or Instructions ("L")
4	R/W	Read or Write Select Signal
5	E	Read/Write Enable Signal
6	DB0	Display Data Signal
7	DB1	
8	DB2	
9	DB3	
10	DB4	
11	DB5	
12	DB6	
13	DB7	
14	VSS	Ground

**6. PCB DRAWING**



**7. MAXIMUM ABSOLUTE LIMIT**

Item	Symbol	Standard value	Unit
Power supply voltage(1)	$V_{DD}$	-0.3 ~ +7.0	V
Power supply voltage(2)	$V_{LCD}$	$V_{DD}-15.0 \sim V_{DD}+0.3$	V
Input voltage	$V_{IN}$	-0.3 ~ $V_{DD}+0.3$	V
Operating temperature	$T_{opr}$	-20 ~ +70	°C
Storage temperature	$T_{stg}$	-25 ~ +75	°C

**8. ELECTRICAL CHARACTERISTICS**

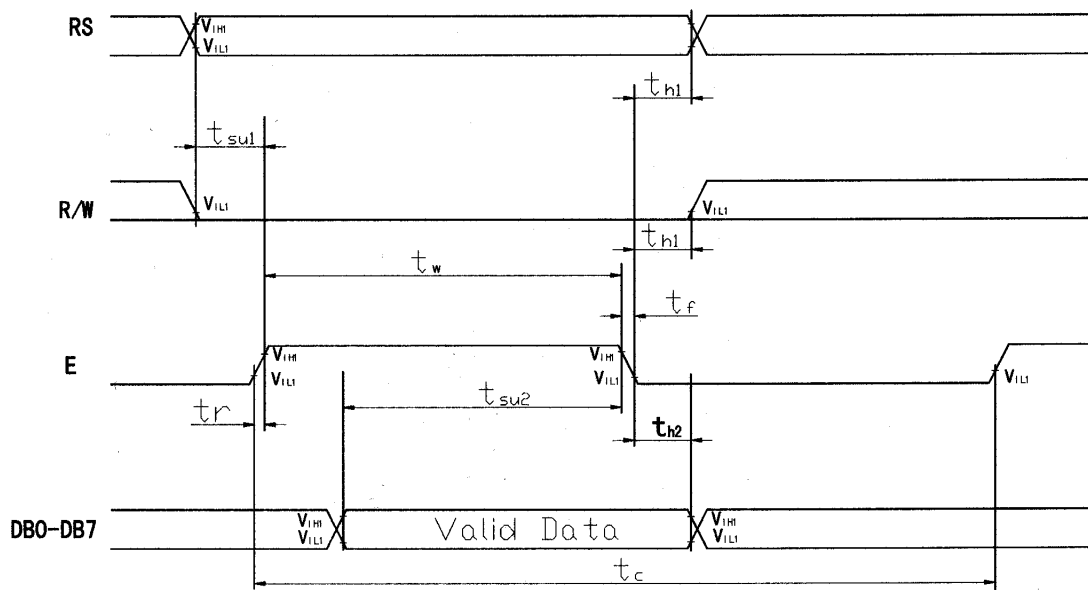
**8-1. DC Characteristics (VDD = 4.5V ~ 5.5V, Ta = -20 ~ +75°C)**

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V <sub>DD</sub>	4.5	5	5.5	-----	V
Supply Current	I <sub>DD1</sub>	----	0.7	1.0	VDD=5V, fosc=250kHz	mA
	I <sub>DD2</sub>		0.4	0.6	VDD=5V, fosc=270kHz	
Input Voltage(1) (except OSC1)	V <sub>IL1</sub>	-0.3	--	0.6	-----	V
	V <sub>IH1</sub>	2.2	--	V <sub>DD</sub>	-----	
Input Voltage(2) ( OSC1)	V <sub>IL2</sub>	-0.2	--	1.0	-----	V
	V <sub>IH2</sub>	V <sub>DD</sub> -1.0	--	V <sub>DD</sub>	-----	
Output Voltage (1) (DB0 to DB7)	V <sub>OL1</sub>	---	----	0.4	I <sub>OL</sub> =1.2uA	V
	V <sub>OH1</sub>	2.4	---	----	I <sub>OH</sub> =-0.205mA	
Output Voltage (2) (except DB0 to DB7)	V <sub>OL2</sub>	-----	---	0.1V <sub>DD</sub>	I <sub>OL</sub> =40uA	V
	V <sub>OH2</sub>	0.9V <sub>DD</sub>	---	-----	I <sub>OH</sub> =-40uA	
Voltage Drop	V <sub>dCOM</sub>	-----	---	1	I <sub>O</sub> =±01. mA	V
	V <sub>dSEG</sub>	-----	---	1		
Input Leakage Current	I <sub>IL</sub>	-1	---	1	V <sub>IN</sub> =0 V to V <sub>DD</sub>	uA
Input Low Current	I <sub>IN</sub>	-50	-125	-250	V <sub>IN</sub> =0V, V <sub>DD</sub> =5V(pullup)	uA
Internal Clock (external Rf)	F <sub>IC</sub>	190	270	350	Rf = 91kΩ ± 2% (V <sub>DD</sub> =5V)	kHz
External Clock	F <sub>EC</sub>	150	270	350	----	kHz
	Duty	45	50	55	----	%
	t <sub>R</sub> , t <sub>F</sub>	---	---	0.2	----	us
LCD Driving Voltage	V <sub>LCD</sub>	4.6	---	10.0	V <sub>DD</sub> -V <sub>5</sub> (1/5 Bias)	V

**8-2 AC Characteristics** (VDD = 4.5V ~ 5.5V , Ta = -20 ~ +75°C)

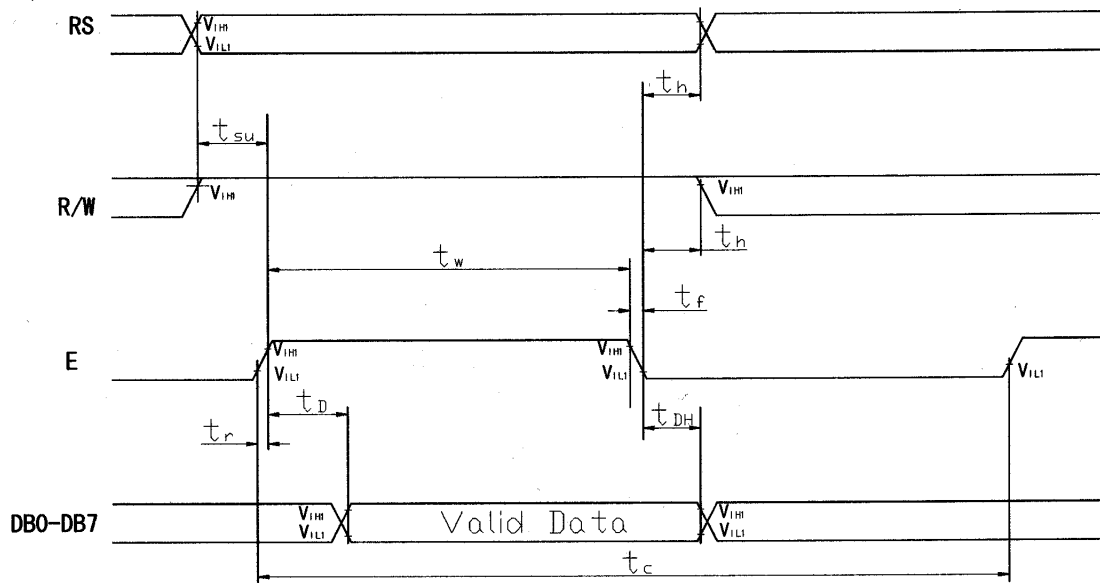
**8-2-1 Write mode (writing data from MPU to DEM 16224-Series)**

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	$t_c$	500	---	---	ns	E
E Rise Time	$t_R$	---	---	25	ns	E
E Fall Time	$t_F$	---	---	25	ns	E
E Pulse width (High,Low)	$t_w$	220	---	---	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	$t_{SU2}$	60	---	---	ns	DB0~DB7
Data Hold Time	$t_{H2}$	10	---	---	ns	DB0~DB7

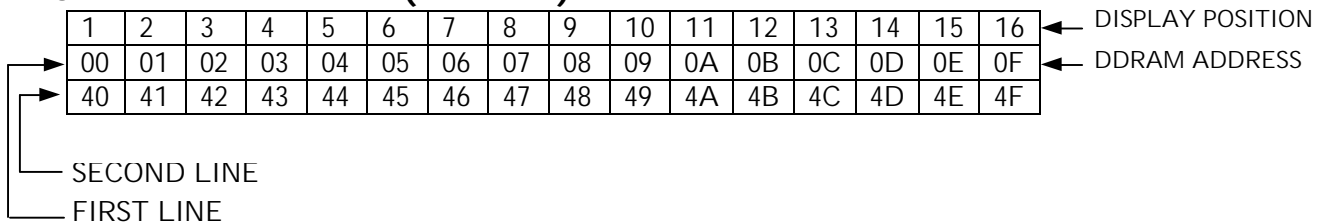


8-2-2 Read mode (Reading data from DEM 16224-Series to MPU )

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	$t_c$	500	---	---	ns	E
E Rise Time	$t_R$	---	---	25	ns	E
E Fall Time	$t_F$	---	---	25	ns	E
E Pulse width (High, Low)	$t_w$	220	---	---	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	$t_{DH2}$	20	---	---	ns	DB0~DB7



**9. DISPLAY DATA RAM (DDRAM)**





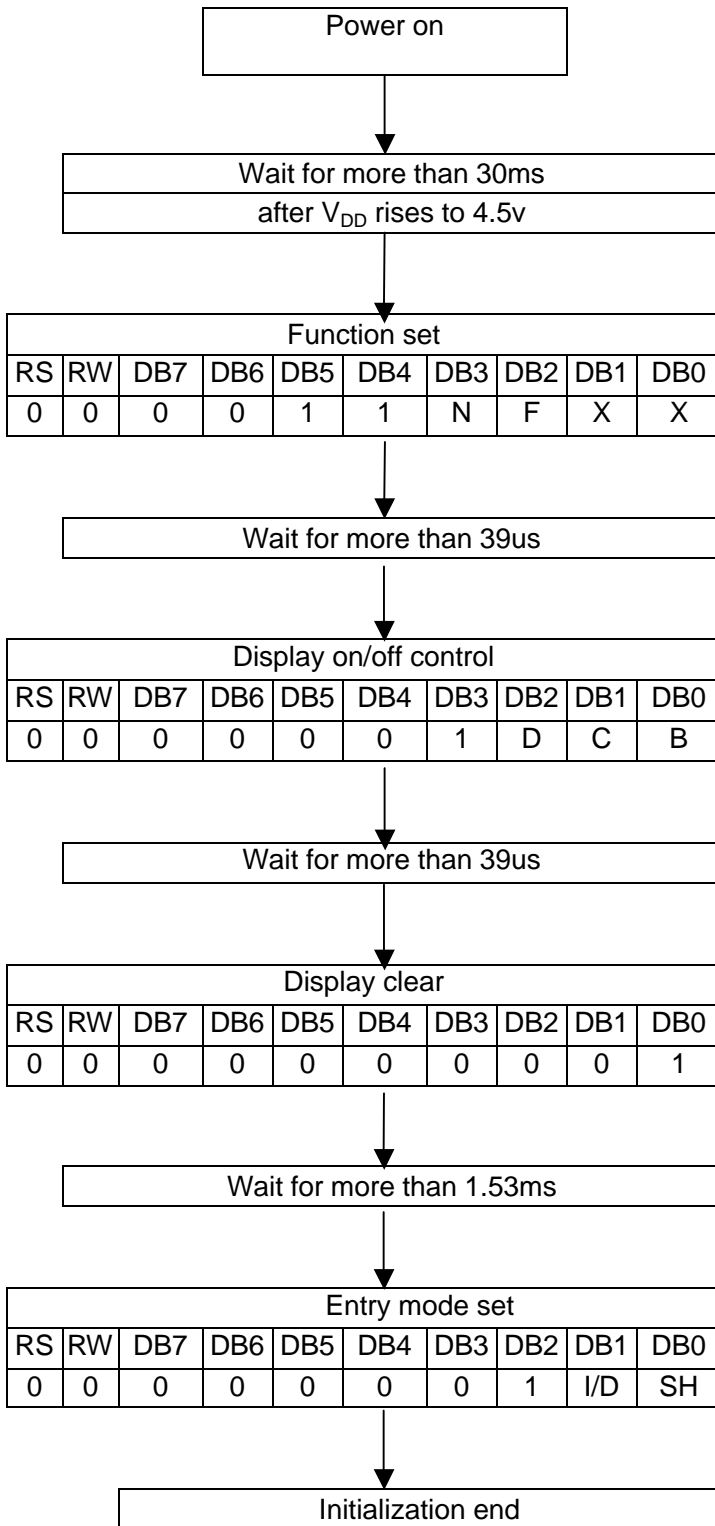
**10.CONTROL AND DISPLAY COMMAND**

Instruction	Instruction code										Execution time (fosc =270KHz)	Description
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0		
Clear Display	0	0	0	0	0	0	0	0	0	1	1.53ms	Write "20H" to DDRAM. And set DDRAM address to "00H" from AC .
Return home	0	0	0	0	0	0	0	0	1	X	1.53ms	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted.
Entry mode set	0	0	0	0	0	0	0	1	I/D	SH	39us	Assign cursor moving direction and enable the shift of entire display
Display on/off control	0	0	0	0	0	0	1	D	C	B	39us	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit .
Cursor or Display shift	0	0	0	0	0	1	S/C	R/L	X	X	39us	Set cursor moving and display shift control bit , and the direction , without changing of DDRAM data .
Function Set	0	0	0	0	1	DL	N	F	X	X	39us	Set interface data length (DL : 4-bit/8-bit), numbers of display line (N : 1-line/2-line, Display font type (F: 0...))
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	39us	Set CGRAM address in address counter.
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	39us	Set DDRAM address in address counter.
Read Busy flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	0us	Whether during internal operation or not can be known by reading BF. The contents of address counter can also be read .
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	43us	Write data into internal RAM ( DDRAM/CGRAM )
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	43us	Read data from internal RAM ( DDRAM/CGRAM )

NOTE : When you make an MPU program with checking the Bus Flag (DB7), it must be necessary 1/2 Fosc for executing the next instruction by falling E signal after the Busy Flag (DB7) goes to "0" .

11. LCM INITIALIZING BY INSTRUCTION

11-1. 8-bit interface mode



Condition : fosc=270khz

N	0	1-line mode
	1	2-line mode

F	0	5*7 dots
	1	5*10 dots

D	0	display off
	1	display on

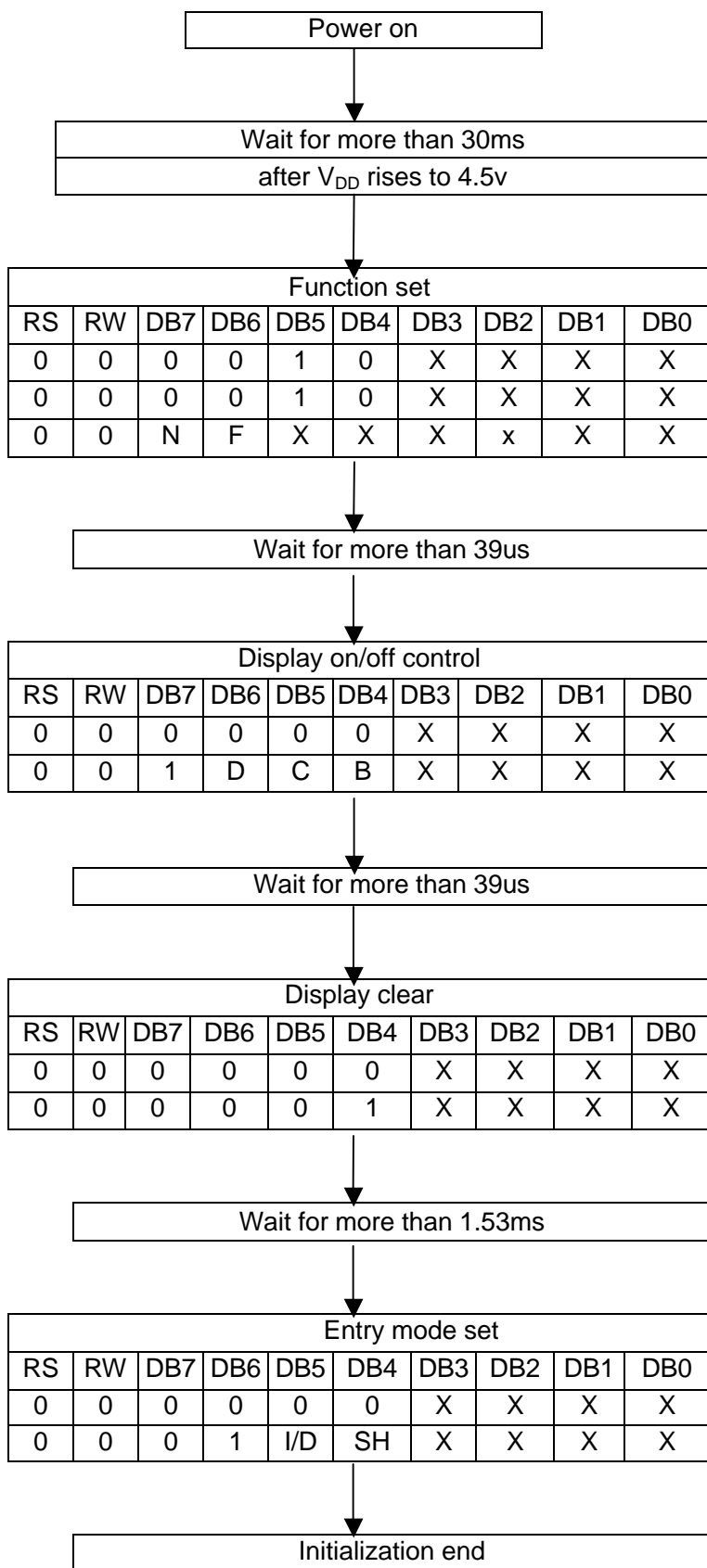
C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

11-2. 4-bit interface mode



Condition : fosc=270khz

N	0	1-line mode
	1	2-line mode
F	0	5*7 dots
	1	5*10 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

12. CHARACTER GENERATOR ROM (KS0070B-00)

Upper(4bit) \ Lower(4bit)		LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HHLL	HHLH	HHHL	HHHH
		CG RAM														
LLLL	(1)															
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)															

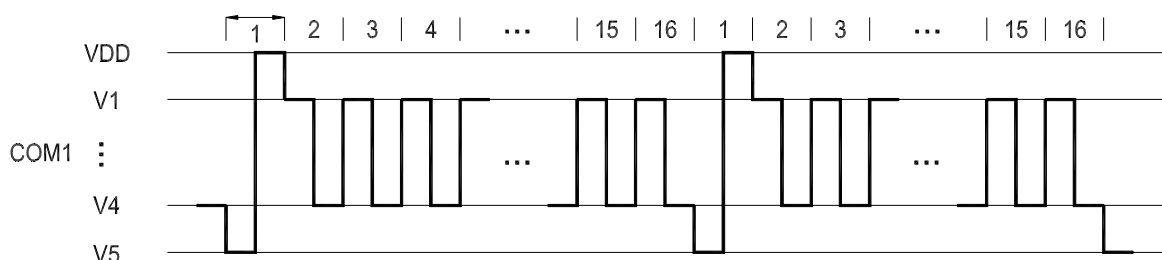
Table 3. Relationship Between character Code (DDRAM) and Character Pattern (CGRAM)

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					0	0	0		
											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					0	0	0		
											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

### 13. FRAME FREQUENCY (1/16 duty cycle )

#### A-type Waveform



Item	Clock / Frequency
Line selection period	200 clocks
Frame frequency	84.4 Hz

\* fosc = 270 kHz (1 clock = 3.7 us )

**14. 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 polarize 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.

**15. 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