DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16215 SYH-LY-CYR22

Product specification ***Version: 2***

27/January/2005

GENERAL SPECIFICATION

MODULE NO. :

DEM 16215 SYH-LY-CYR22

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	**DATE**
0	ORIGINAL VERSION	23/02/2004
1	CHANGED FUNCTIONS&FEATURES&PCB DRAWING AND DESCRIPTION	18/03/2004
2	CHANGED SERIES	25/03/2004

PREPARED BY: CHJ DATE: 25/01/2005
APPROVED BY: MH DATE: 27/01/2005

CONTENTS

1.FUNCTIONS & FEATURES

- DEM 16215 - Series LCD Type :

MODULE	LCD MODEL	LCD TYPE
DEM 16215 SYH-LY-CYR22	STN Yellow Green	Transflective Positive Mode

- Viewing Direction : 6 o'clock
- Driving Scheme :1/16 Duty Cycle,1/5Bias
- Power Supply Voltage : 2.7 to 5.5 Volt (5 Volt typ.)
- Backlight Color : Yellow Green (Lightbox)
- VLCD Adjustable For Best Contrast : 4.5 Volt (typ.)
- Display contents :16 x 2 Characters (5 x 8 dots, Format: 192Kinds)
- Internal Memory : CGROM (8,320bits)
  : CGRAM (64 x 8 bits)
  : DDRAM (80 x 8 bits for 80 Digits)
- Interface : Easy Interface with a 4-bit or 8-bit MPU

2. MECHANICAL SPECIFICATIONS

- Character Pitch : 6.00 (W) x 10.45 (H) mm
- Character Size : 5.20 (W) x 9.55 (H)mm
- Character Font : 5 x 8 dots
- Dot Size : 1.00 (W) x1.15 (H) mm
- Dot Pitch : 1.05 (W) x1.20 (H) mm

3. BLOCK DIAGRAM

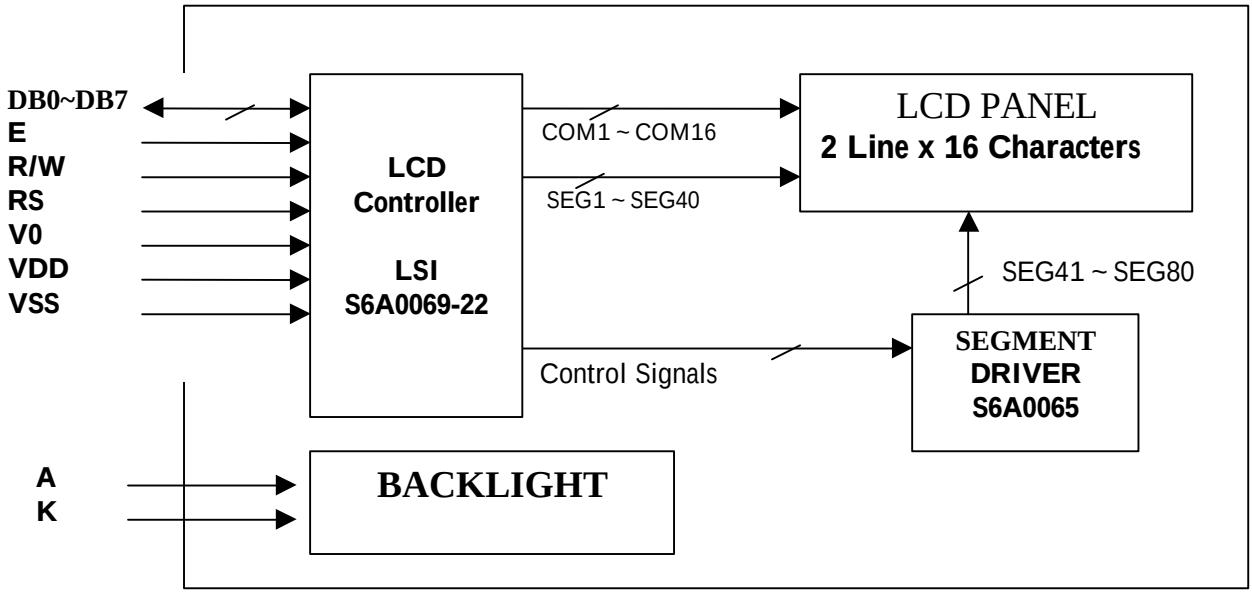


Figure 1.0

4. EXTERNAL DIMENSIONS

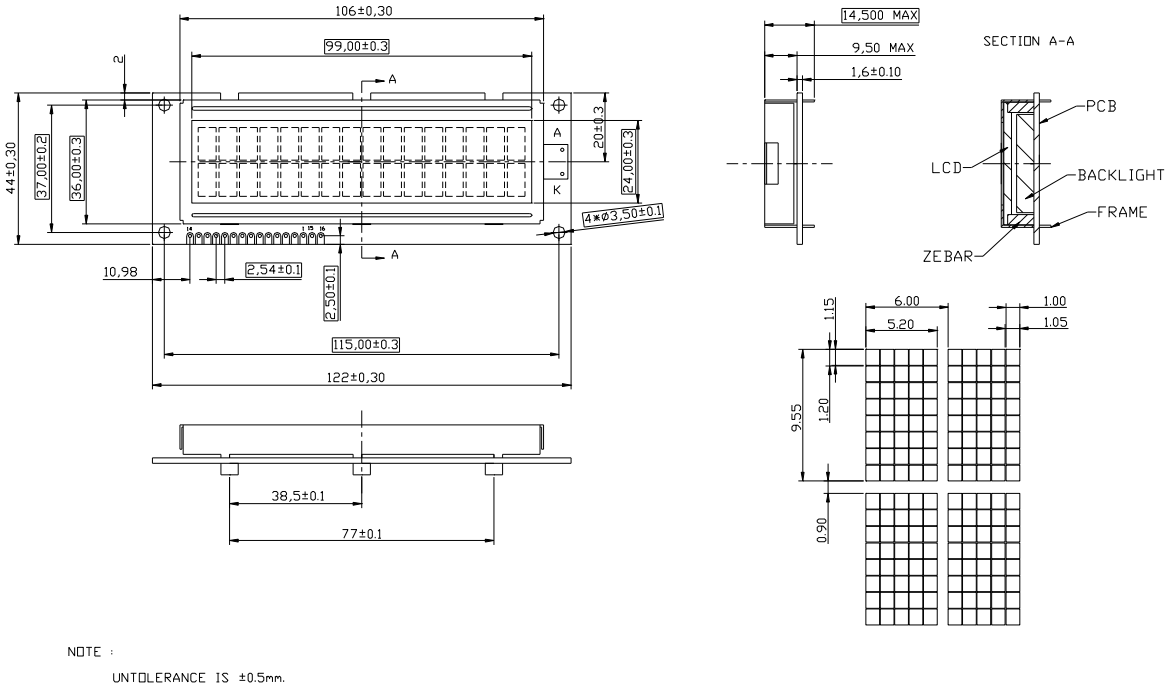


Figure:2.0

5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	VSS	Ground
2	VDD	Power supply
3	V0	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-	Cathode of Backlight. Please refer to 7.1 PCB drawing and description.
16	LED+	Anode of Backlight. Please refer to 7.1 PCB drawing and description.

6. MAXIMUM ABSOLUTE LIMIT

Item	Symbol	Standard value	Unit
Power supply voltage (1)	V_{DD}	-0.3 ~ +7.0	V
Power supply voltage (2)	V_0	V_{DD}-15.0 ~ V_{DD}+0.3	V
Input voltage	V_{IN}	-0.3 ~ V_{DD}+0.3	V
Volt. For BL	VLED1	4 ~ 4.5	V
Operating temperature	Topr	-20 ~ +70	°C
Storage temperature	Tstg	-25 ~ +75	°C

7.1 PCB DRAWING AND DESCRIPTION

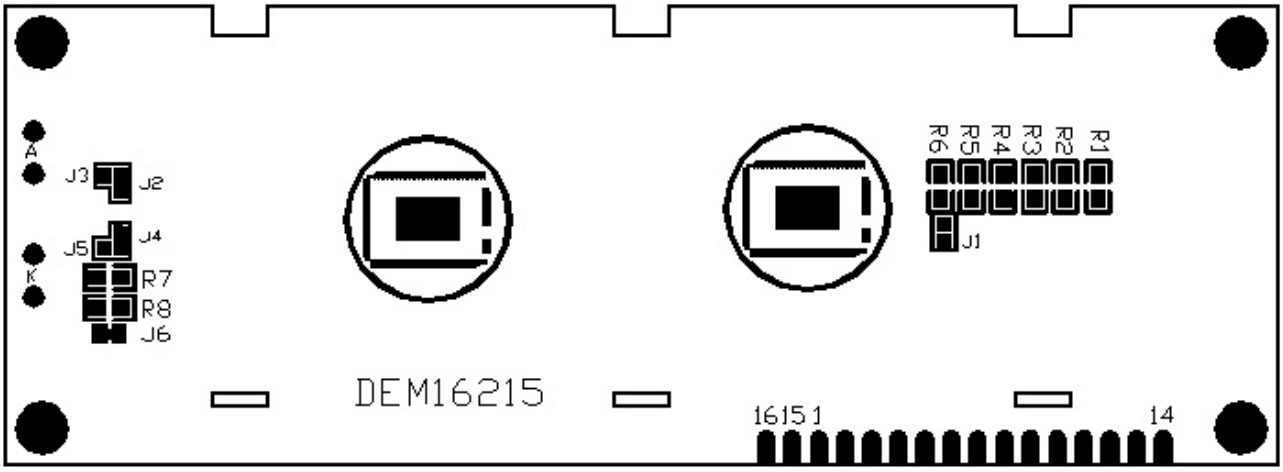


Figure: 3.0

DESCRIPTION:

7-1-1 The polarity of the pin 15 and the pin 16:

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

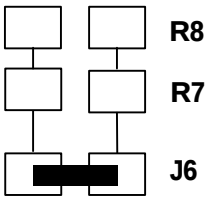
7-1-2. The metal-bezel is set on ground when the J1 is closed.

7-1-3. The LED resistor can be bridged when the J6 is closed.

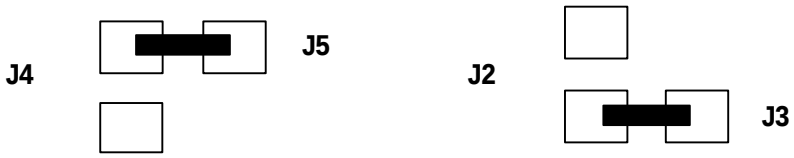
7-1-4. The R7,R8, are the LED resistors. (R7 = R8 = 10Ω)

7.2 Example application

7-2-1. The LED resistor should be bridged as following.

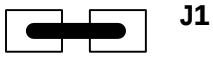


7-2-2. The 15 pin is the cathode and the 16 pin is the anode as following.



7-2-3.The 15 pin is the anode and the 16 pin is the cathode as following.

7-2-4. The metal-bezel is on ground as following.



7.3 The module No. DEM16215 is printed on the PCB.

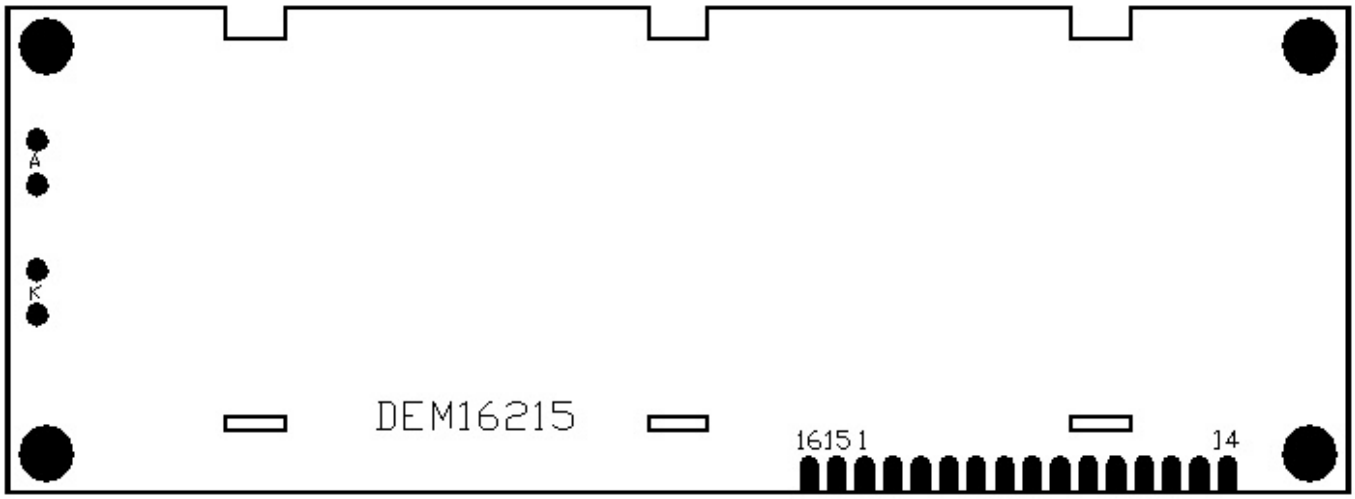


Figure: 4.0

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

Item	Symbol	Standard Value	Unit	Applicable Terminal
Backlight Voltage	V	5	V	LED+ / LED-
Backlight Current	I	~ 195	mA	

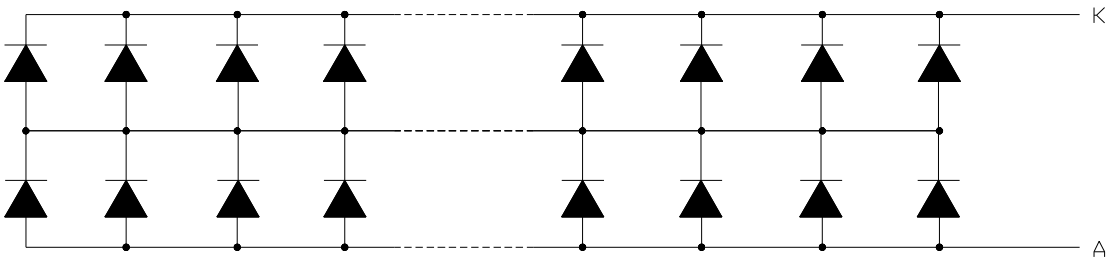


Figure 5.0

9. DISPLAY DATA RAM(DDRAM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	← DISPLAY POSITION
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	← DD RAM ADDRESS
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	

10.INSTRUCTION DESCRIPTION

Outline

To overcome the speed difference between the internal clock of S6A0069 and the MPU clock, S6A0069 performs internal operations by storing control information to IR or DR. The internal operation is determined according to the signal from MPU, composed of read/write and data bus (refer to table 5.)

Instruction can be divided largely into four kinds:

(1) S6A0069 function set instructions (set display methods, set data length, etc.)
(2) Address set instructions to internal RAM.
(3) Data transfer instructions with internal RAM.
(4) Others.

The address of the internal RAM is automatically increased or decreased by 1.

*NOTE: During internal operation, busy flag (DB7) is read "1". Busy flag check must be preceded by the next instruction. When you make an MPU program with checking the busy flag (DB7), it must be necessary 1/2 fosc for executing the next instruction by falling edge of the "E" signal after the busy flag (DB7) goes to "0".

Contents

1) Clear display

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

Clear all the display data by writing "20H" (space code) to all DRAM address, and set the DRAM addresses to "00H" in the AC (address counter). Return cursor to original status, namely, bring the cursor to the left edge on first line of the display. Make entry mode increment (I/D = "1").

2) Return home

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

Return home is the cursor return home instruction. Set DRAM address to "00H" in the address counter. Return cursor to its original site and return display to its original status, if shifted. Contents of DDRAM does not change.

3) Entry mode set

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

Set the moving direction of cursor and display.
I/D: increment/decrement of DDRAM address (cursor or blink).
When I/D = "1", cursor/blink moves to right and DDRAM address is increased by 1.
When I/D = "0", cursor/blink moves to left and DDRAM address is increased by 1.
CGRAM operates the same as DDRAM, when reading from or writing to CGRAM.

SH: shift of entire display

When DDRAM is in read (CGRAM read/write) operation or SH = "0", shift of entire display is not performed.
If SH = "1" and in DDRAM write operation, shift of entire display is performed according to I/D value (I/D = "1": shift left, I/D = "0": shift right).

4) Display ON/OFF control

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

Control display/cursor/blink ON/OFF 1-bit register.

D: Display ON/OFF control bit

When D = "1", entire display is turned on.
When D = "0', display is turned off, but display data remains in DDRAM.

C: cursor or ON/OFF control bit

When C = "1", cursor is turned on.
When C = "0", cursor disappears in current display, but I/D register retains its data.

B: cursor blink ON/OFF control bit

When B = "1", cursor blink is on, which performs alternately between all the "1" data and display characters at the cursor position. When B = "0", blink is off

5) Cursor or display shift

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	0	1	S/C	R/L	X	X

without writing or reading the display data, Shifting right/left cursor position or display
This instruction is used to correct or search display data. (Refer to Table 4)
During 2-line mode display, cursor moves to the 2nd line after the 40th digit of the 1st line.
Note tat display shift is performed simultaneously in all the lines.
When displayed data is shifted repeatedly, each line shifts individually.
When display shift is performed, the contents of the address counter are not changed.

Table 4. shift patterns according to S/C and R/L bits

S/C	R/L	operation
0	0	Shift cursor to the left, AC is decreased by 1
0	1	Shift cursor to the right, AC is decreased by 2
1	0	Shift all the display to the left, cursor moves according to the display
1	1	Shift all the display to the right, cursor moves according to the display

6) Function set

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	0	0	1	DL	N	F	X	X

DL: Interface data length control bit
When DL = "1", it means 8-bit bus mode with MPU.
When DL = "0", it means 4-bit bus mode with MPU. So to speak, DL is a signal to select 8-bit or 4-bit bus mode.
When 4- bit bus mode, it needs to transfer 4-bit data in two parts.
N: display line number control bit
When N = "1", 2-line display mode is set.
When N = "0", 1-line display mode is set.

F: display font type control bit
When F = "0", 5 x 7 dots format display mode.
When F = "1", 5 x 10 dots format display mode.

7) Set CGRAM address

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

Set CGRAM address to AC. This instruction makes CGRAM data available from MPU.

8) Set DDRAM address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0

Set DDRAM address to AC. This instruction makes DDRAM data available from MPU. In 1-line display mode (N=0,NW=0), DDRAM address is from "00H" to "4FH". In 2-line display mode (N=1,NW=0), DDRAM address in the 1st line is from "00H" to "27H", and DDRAM address in the 2nd line is from "40H" to "67H".

9) Read busy flag & address

RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0
0	0	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0

This instruction shows whether S6A0069 is in internal operation or not. If the resultant BF is "High", it means the internal operation is in progress and your have to wait until BF to "low". and then the next instruction can be performed. In this instruction your can also read the value of the address counter can also be read.

10) Write data to RAM

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

Write binary 8-bit data to DRAM /CRAM/SEAGRAM. The selection of RAM from DRAM, CRAM or SEAGRAM, is set by the previous address set instruction: DDRAM address set, CGRAM address set, SEAGRAM address set, RAM set instruction can also determine the AC direction to RAM.
After write operation, the address is automatically increased/decreased by 1, according to the entry mode.

11) Read data from RAM

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

Read binary 8-bit data from DDRAM/CRAM.
The selection of RAM is set by the previous address set instruction. If the address set instruction of RAM is not performed before this instruction, the data that is read first is invalid, because the direction of AC is not determined. If the RAM data is read several times without RAM address set instruction before read operation, the correct RAM data from the second, but the first data would be incorrect, as there is not time to transfer RAM data. In case of DDRAM read operation, cursor shift instruction plays the same role as DDRAM address set instruction; it also transfers RAM data to the output data register.
After read operation the address counter is automatically increased/decreased by 1 according to the entry mode. After CGRAM read operation, display shift may not be executed correctly.

***** In case of RAM write operation, AC is increased/decreased by 1 like read operation. In this time, AC indicates the next address position, but the previous data can only by the read instruction.

Table 5. Instruction table

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

NOTE: when you make an MPU program with checking the busy flag (DB7), it must be necessary 1/2F osc for executing the next instruction by the falling edge of the 'E' signal after the busy flag (DB7) goes to "0"

11.ELECTRICAL CHARACTERISTICS

11-1-1 DC Characteristics (V_{DD} = 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
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}	---------	
LCD Driving Voltage	V_{LCD}	3.0	4.5	13.0	V_{DD}-V5 (1/5, 1/4 Bias)	V

11-2 AC Characteristics (VDD = 4.5V ~ 5.5V, Ta = -20 ~ +70°C)

11-2-1 Write mode (writing data from MPU to LCD-module).

Characteristic	Symbol	Min	Typ.	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

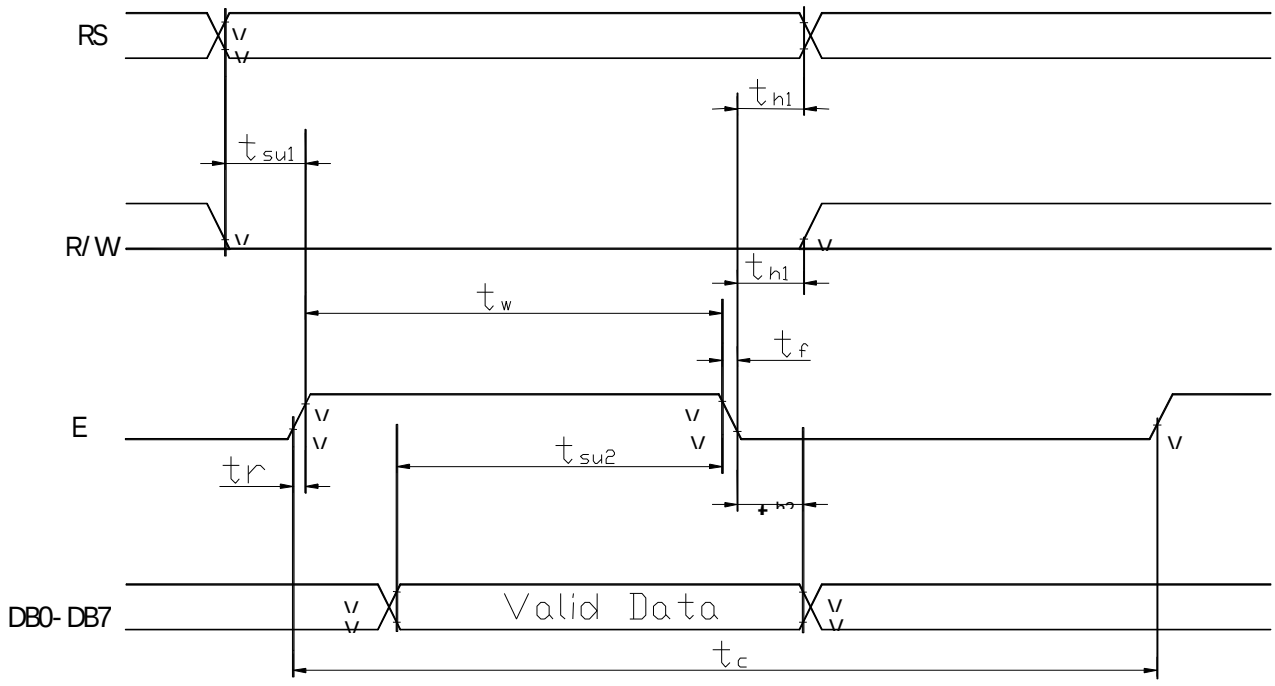


Figure:6.0

11-2-2 Read mode (reading data from LCD-module to MPU)

Characteristic	Symbol	Min	Typ.	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

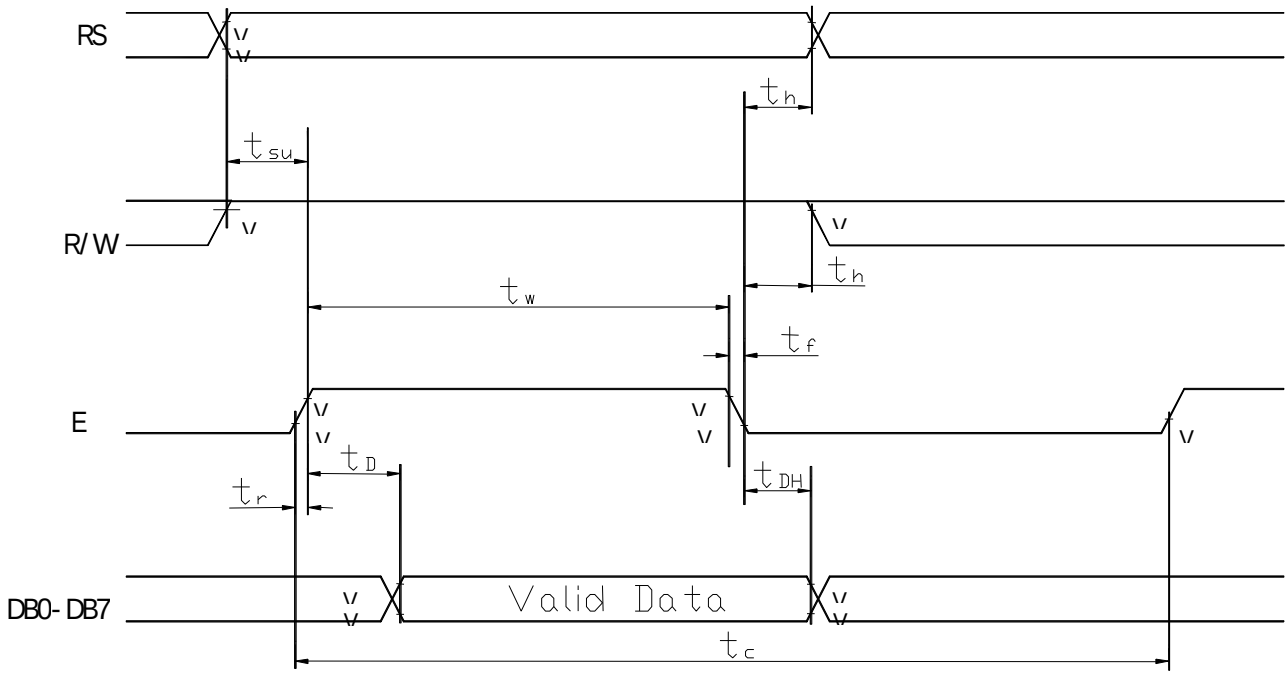


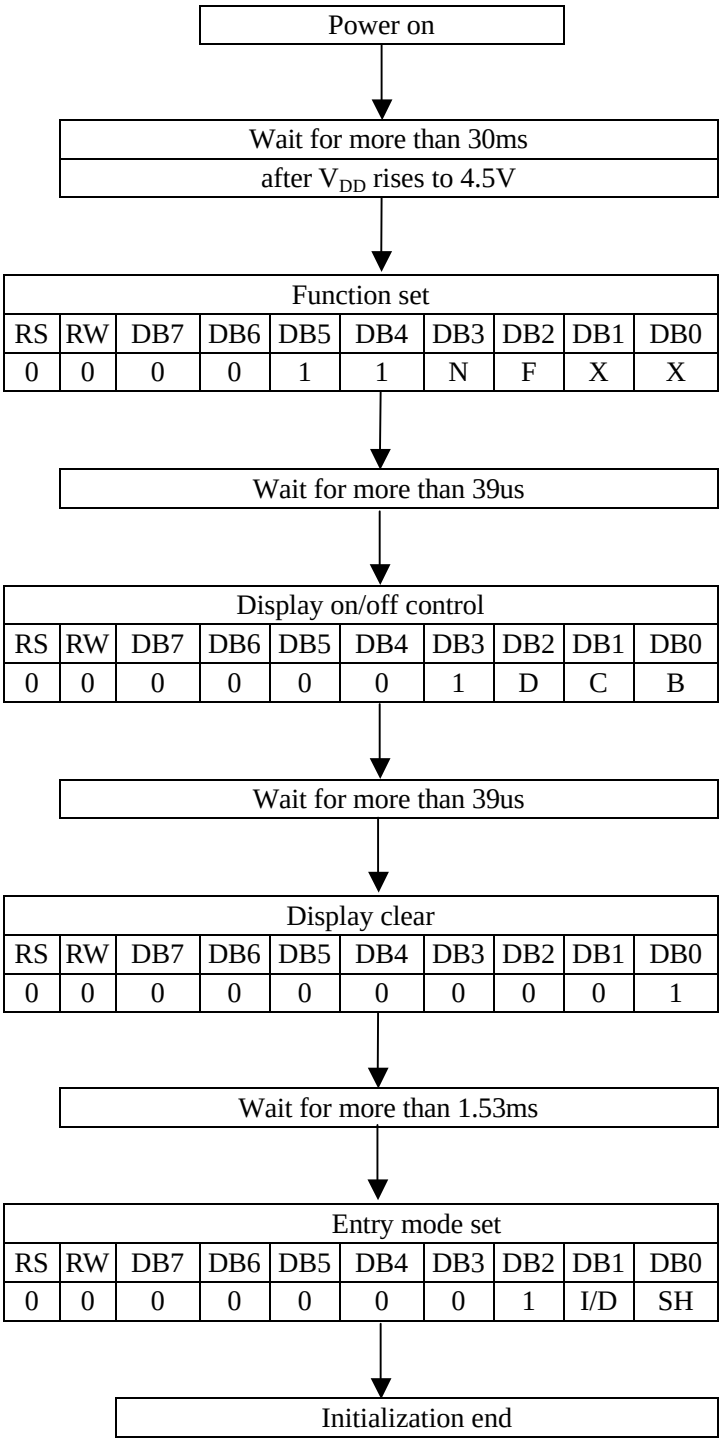
Figure: 7.0

12. 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 I/D: H Increase; l Decrease SH:Specifies shift of display SH: H Display is shifted; L Display is not shifted
Display on/off control	L	L	L	L	L	L	H	D	C	B	39us	Display D: H Display on; L Display off Cursor C: H Cursor on; L Cursor off Blinking B: H Blinking on; L Blinking off
Cursor or Display Shift	L	L	L	L	L	H	S/C	R/L	---	---	39us	SC: H Display shift; L Cursor move R/L: H Right shift; L Left shift
function Set	L	L	L	L	H	DL	N	F	---	---	39us	DL: H 8bits interface; L 4bits interface N: H 2 line display; L 1 line display F: H 5 x 11 dots; L 5 x 8 dots
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	BF: H Busy; L Ready -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

13. LCM INITIALIZING BY INSTRUCTION

13-1 8-bit interface mode



Condition: fosc=270khz

N	0	1-line mode
	1	2-line mode

F	0	5 x 8 font
	1	5 x 11 font

D	0	display off
	1	display on

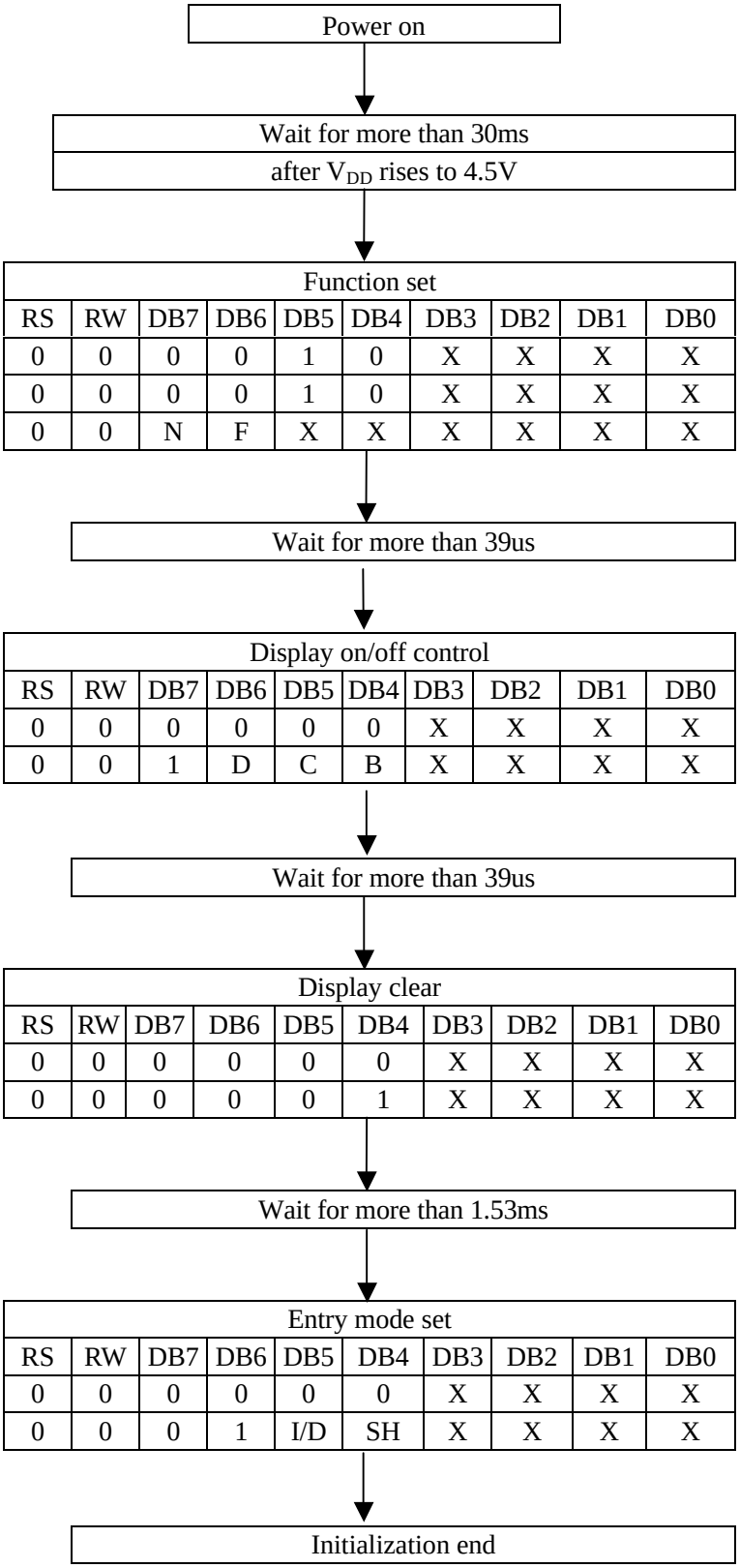
C	0	cursor off
	1	cursor on

B	0	blink off
	1	blink on

I/D	0	decrement mode
	1	increment mode

SH	0	entire shift off
	1	entire shift on

13-2 4-bit interface mode



Condition: fosc=270khz

N	0	1-line mode
	1	2-line mode
F	0	5 x 8 font
	1	5 x 11 font

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

14.CHARACTER GENERATOR ROM (Cyrillic Character Font):

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

15. LCD Modules Handling Precautions

- Please remove 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.

16. 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