

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 20488 SBH-PW-N

Product specification

Version : 3

27/July/2005

GENERAL SPECIFICATION

MODULE NO. :

DEM 20488 SBH-PW-N

CUSTOMER P/N

VERSION NO.	CHANGE DESCRIPTION	DATE
0	ORIGINAL VERSION	08/03/2005
1	ADD PCB DRAWING AND DESCRIPTION	14/03/2005
2	CHANGED SERIES	11/04/2005
3	CHANGED PCB DRAWING AND DESCRIPTION	20/04/2005

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DATE: 20/04/2005

APPROVED BY: MH

DATE: 27/07/2005

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1.FUNCTIONS & FEATURES

- LCD Type :

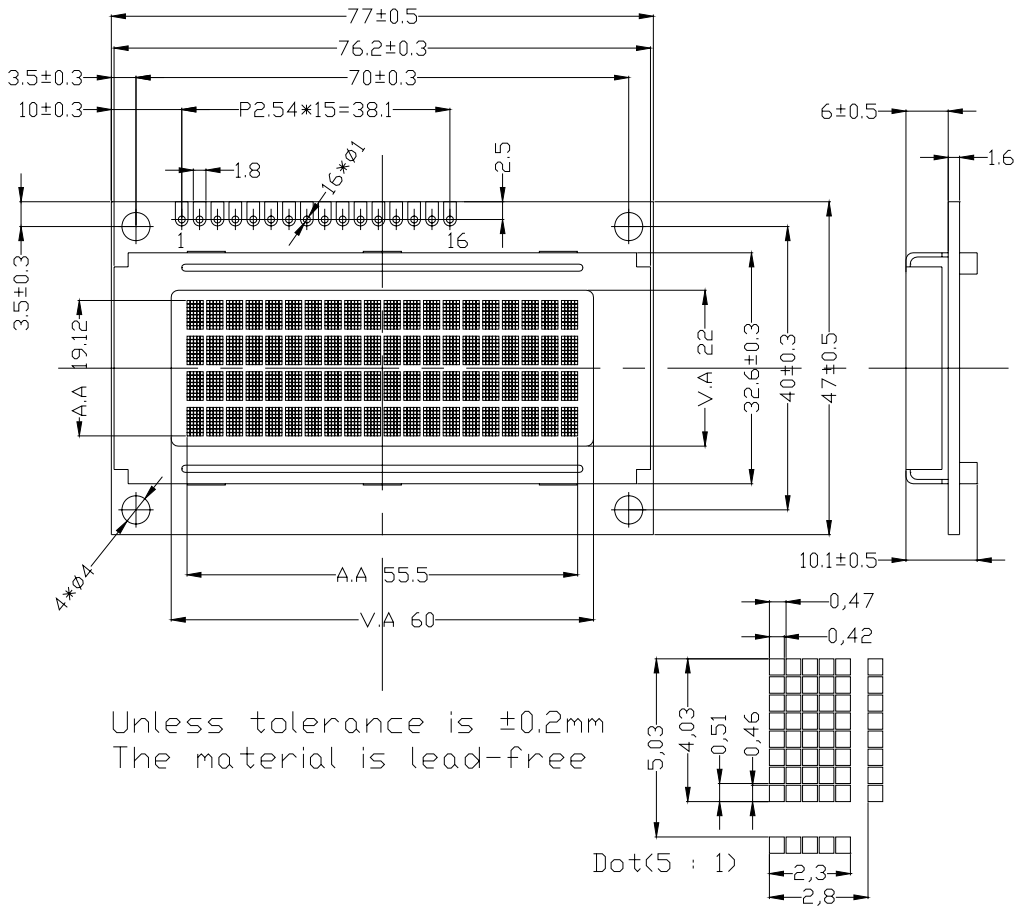
MODULE	LCD TECHNOLOGY	LCD MODE
DEM 20488 SBH-PW-N	STN - BLUE	Transmissive Negative Mode

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- V_{LCD} (VDD-V0) : 4.5 Volt (typ.)
- Op. Temperature : -20°C...+70°C
- Backlight : LED, White, Lightguide
- Display contents : 20x4Characters (5x8 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 ST7066U-0A
- Interface : Easy Interface with a 4-bit or 8-bit MPU

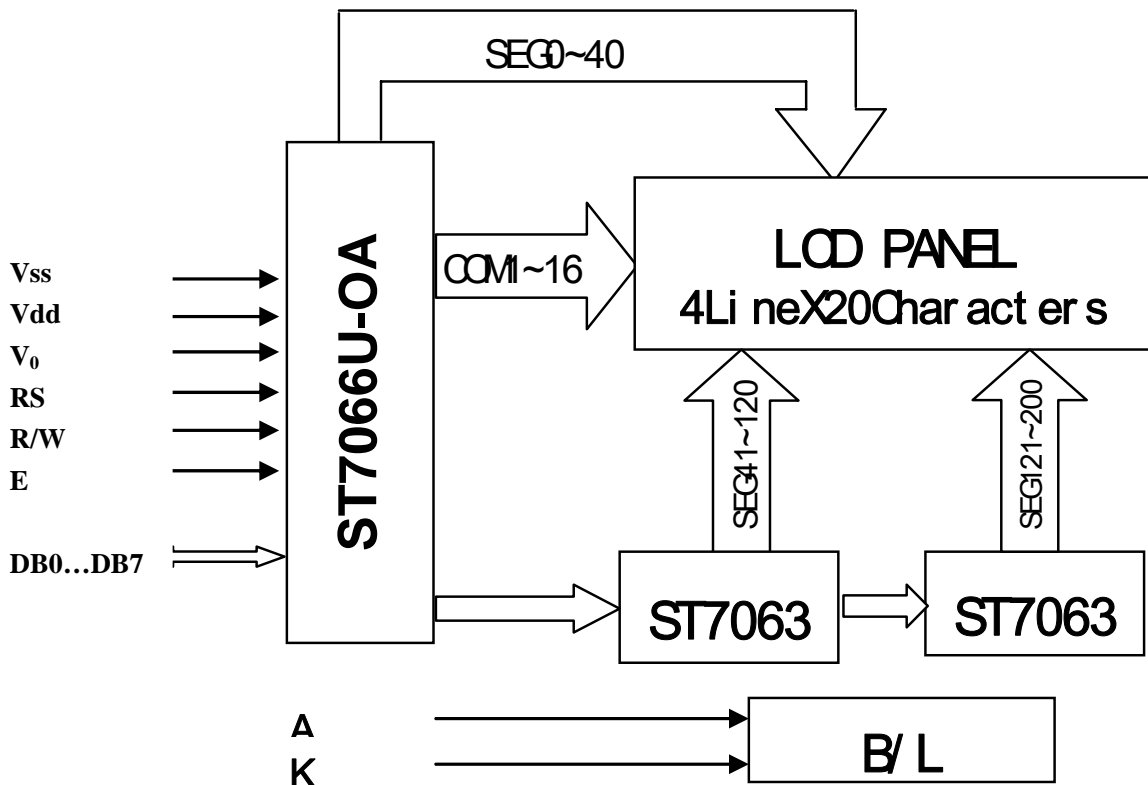
2. MECHANICAL SPECIFICATIONS

- Module Size : 77.0 x 47.0 x 10.1 (max.) mm
- Viewing Area : 60.0 x 22.0 mm
- Active Area : 55.5 x 19.12 mm
- Character Pitch : 2.8 x 5.03 mm
- Character Size : 2.3 x 4.03 mm
- Character Font : 5 x 8 dots
- Dot Pitch : 0.47 x 0.51 mm
- Dot Size : 0.42 x 0.46 mm
- Dot Gap : 0.05 mm

3. EXTERNAL DIMENSIONS



4. BLOCK DIAGRAM

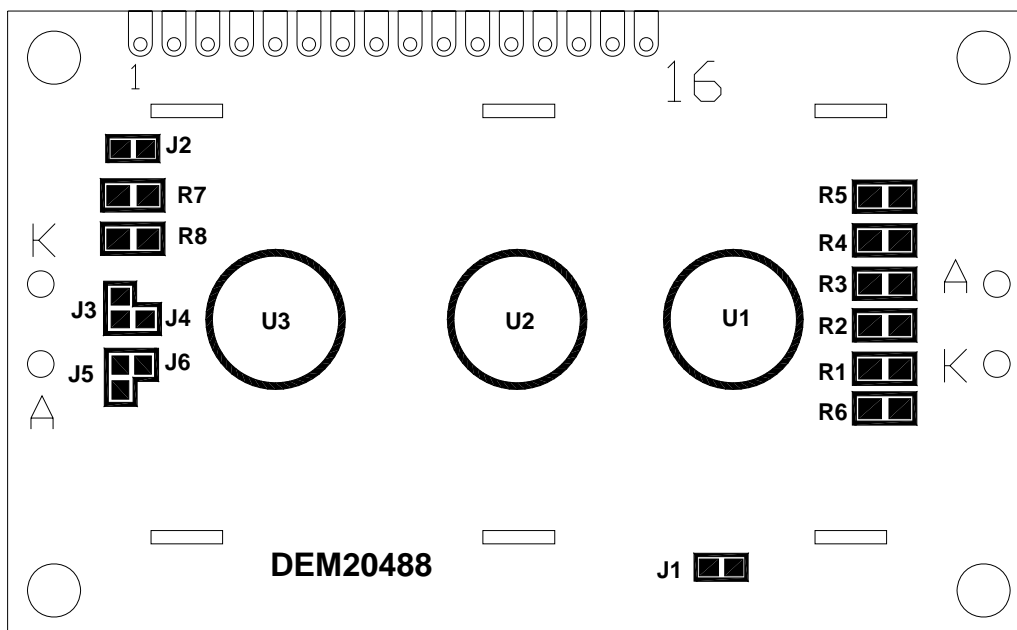


5. PIN ASSIGNMENT

Pin No.	Symbol	Function
1	Vss	Ground (0V)
2	VDD	Power supply(VDD>VSS)
3	V0	Operating voltage for LCD
4	RS	Select registers. 0: Instruction register (for write) busy flag; address counter (for read); 1: Data register (for write and read)
5	R/W	Select read or write. 0: Write mode; 1: Read mode
6	E	Start enable signal to read or write the data
7~10	DB0~DB3	Four low order bi-directional there-state data bus lines. Use for data transfer between the MPU and the LCD module. These four are not used during 4-bit operation.
11~14	DB4~DB7	Four high order bi-directional there-state data bus lines. Used for data transfer between the MPU and the LCD module. DB7 can be used as a busy flag.
15	LED(-)	Please refer to 6-2-1
16	LED(+)	Please refer to 6-2-1

6. PCB DRAWING AND DESCRIPTION

6.1 PCB DRAWING



6.2 DESCRIPTION:

6-2-1. The polarity of the pin 15 and the pin 16:

symbol	symbol state	J3, J5	J4, J6	LED Polarity	
				15 Pin	16 Pin
J4, J6	Each solder-bridge	Each open	Each closed	Anode	Cathode
J3, J5	Each solder-bridge	Each closed	Each open	Cathode	Anode

Note: In application module: J3 = J5 = closed, J4 = J6 = open

6-2-2. The metal-bezel is set on ground when the J1 is closed.

Note: In application module: J1 = closed

6-2-3. The LED resistor can be bridged when the J2 is closed

Note: In application module: J2 = open

6-2-4. The R7 and the R8 are the LED resistor.

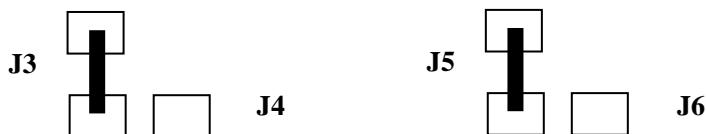
Note: In application module: R7 = R8 = 68 Ω

6.3 Example application

6-3-1. The 15 pin is the anode and the 16 pin is the cathode as following.



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



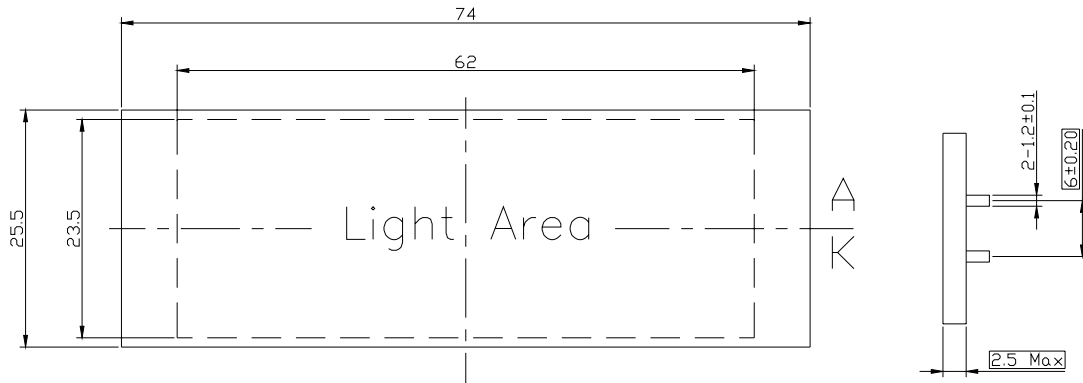
7. BACKLIGHT

7.1 Absolute Maximum Ratings (Ta=25°C)

ITEM	SYMBOL	CONDITIONS	RATING	UNIT
Absolute maximum forward current	Ifm		50	mA
Peak forward current	Ifp	1 msec plus 10% duty cycle	60	mA
Reverse voltage	Vr		1	V
Power dissipation	Pd		150	mW

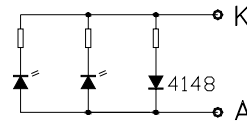
7.2 Electrical-Optical Characteristics

ITEM	SYMBOL	MIN.	TYP.	MAX	UNIT	CONDITION
Forward Current	If	---	25	30	mA	Vf=4.5V
Reverse Current	Ir	---	30	---	uA	Vr=0.8V
Peak Wave length	λP	---	---	---	nm	
Spectral Line Half Width	$\Delta\lambda$	---	30	---	nm	
Luminance	Lv	---	---	---	cd/m ²	Vf=4.5V
Backlight color	White					



NOTE:
 1.UNMARKED TOLERANCE IS ±0.30
 2.BACKLIGHT COLOR IS :White

CIRCUIT DIAGRAM (LED 2X1=2 DIES)



BACKLIGHT, COLOR: WHITE

8. DISPLAY DATA RAM (DDRAM)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FIRST LINE	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F	10	11	12	13
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	50	51	52	53
THIRD LINE	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F	20	21	22	23	24	25	26	27
FOURTH LINE	54	55	56	57	58	59	5A	5B	5C	5D	5E	5F	60	61	62	63	64	65	66	67

← Display position
 ← DDRAM Address

9. MAXIMUM ABSOLUTE POWER RATINGS (Ta = 25°C)

Item	Symbol	Standard value	Unit
Power supply voltage	V _{DD}	-0.3 ~ +7.0	V
LCD Driver voltage	V _{LCD}	V _{DD} -10.0 ~ V _{DD} +0.3	V
Input voltage	V _{IN}	-0.3 ~ V _{DD} +0.3	V
Volt. For BL	VLED1	3.7 ~ 4.1	V
Operating temperature	Topr	-20 ~ +70	°C
Storage temperature	Tstg	-20 ~ +75	°C

10. ELECTRICAL CHARACTERISTICS

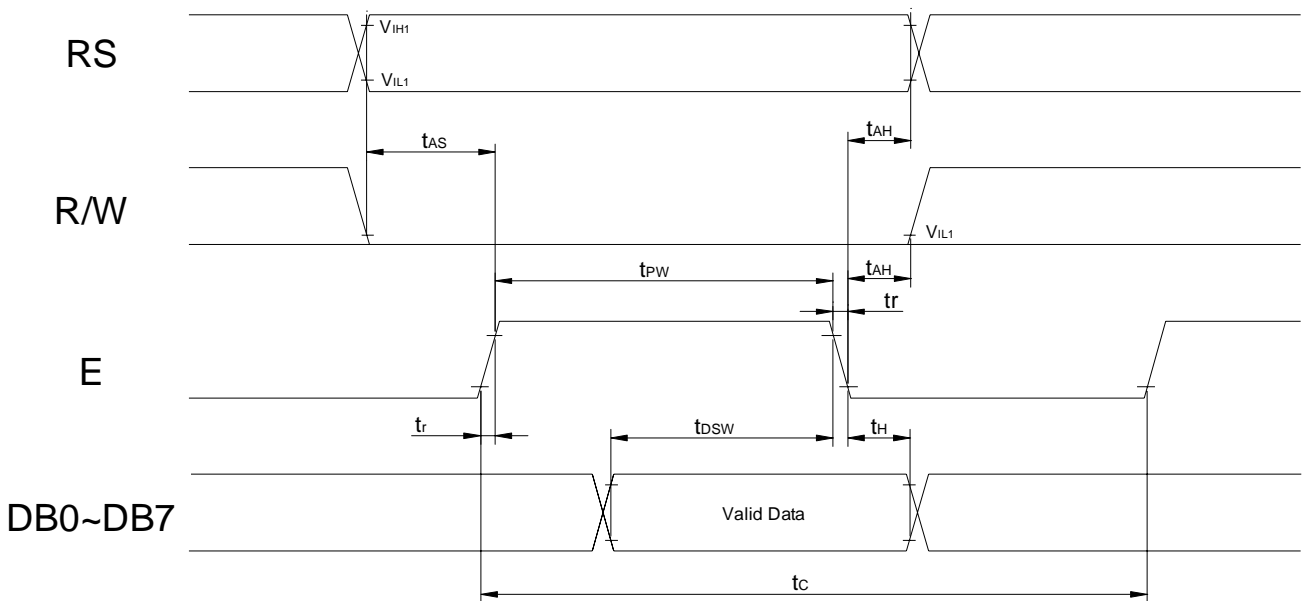
10-1. DC Characteristics (VDD = 4.5V ~ 5.5V, Ta = -20 ~ +70°C)

Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V _{DD}	4.5	5.0	5.5	-----	V
LCD Voltage	V _{LCD}	3.0	4.5	10.0	V _{DD} - V5	V
Supply Current	I _{DD}	---	0.2	0.5	V _{DD} =5V, fosc=270kHz	mA
Input Voltage (1) (except OSC1)	V _{IL1}	-0.3	--	0.6	-----	V
	V _{IH1}	0.7 V _{DD}	--	V _{DD}	-----	
Input Voltage (2) (OSC1)	V _{IL2}	---	---	1.0	-----	V
	V _{IH2}	V _{DD} -1.0	--	V _{DD}	-----	
Output Voltage (1) (DB0 to DB7)	V _{OL1}	---	----	0.4	I _{OL} =0.1mA	V
	V _{OH1}	3.9	---	V _{DD}	I _{OH} =-0.1mA	
Output Voltage (2) (except DB0 to DB7)	V _{OL2}	---	---	0.1V _{DD}	I _{OL} =0.04mA	V
	V _{OH2}	0.9V _{DD}	---	V _{DD}	I _{OH} =-0.04mA	
Common Resistance	R _{COM}	---	2	20	V _{LCD} =4V, Id=0.05mA	kΩ
Segment Resistance	R _{SEG}	---	2	30	V _{LCD} =4V, Id=0.05mA	
Input Leakage Current	I _{LKIG}	-1	---	1	V _{IN} =0 V to V _{DD}	uA
Pull Up MOS Current	I _{PUP}	-50	-110	-180	V _{DD} =5V	uA

10-2 AC Characteristics (VDD = 5V, Ta = -20 ~ +70°C)

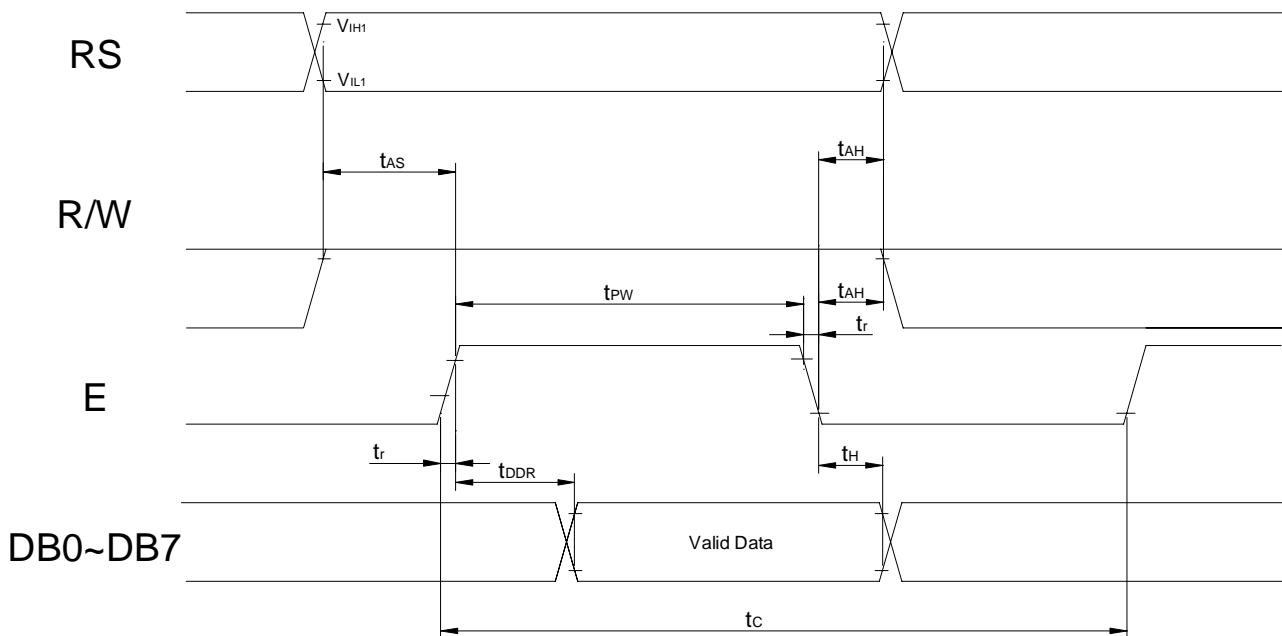
10-2-1 Write Mode (Writing Data From MPU to module)

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	t_C	1200	---	---	ns	E
E Rise Time	t_R	---	---	25	ns	E
E Fall Time	t_F	---	---	25	ns	E
E Pulse width	t_{PW}	140	---	---	ns	E
Address Setup Time	t_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	t_{AH}	10	---	---	ns	R/W,RS,E
Data Setup Time	T_{DSW}	40	---	---	ns	DB0~DB7
Data Hold Time	t_H	10	---	---	ns	DB0~DB7



10-2-2 Read Mode (Reading Data from module to MPU)

Characteristic	Symbol	Min	Typ	Max	Unit	Test PIN
E Cycle Time	t_C	1200	---	---	ns	E
E Rise Time	t_R	---	---	25	ns	E
E Fall Time	t_F	---	---	25	ns	E
E Pulse width	t_{PW}	140	---	---	ns	E
Address Setup Time	t_{AS}	0	---	---	ns	R/W,RS,E
Address Hold Time	t_{AH}	10	---	---	ns	R/W,RS,E
Data Setup Time	t_{DDR}	---	---	100	ns	DB0~DB7
Data Hold Time	t_H	10	---	---	ns	DB0~DB7



11. CONTROL AND DISPLAY COMMAND

Command	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	Execution time (fosc=270KHz)	Remark
Clear Display	0	0	0	0	0	0	0	0	0	1	1.52ms	Write"20H" to DDRAM. And set DDRAM address to "00H" from AC
Return home	0	0	0	0	0	0	0	0	1	x	1.52ms	Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.
Entry mode Set	0	0	0	0	0	0	0	1	I/D	S	37us	Sets cursor move direction and specifies display shift. These operations are performed during data write and read.
Display on/off control	0	0	0	0	0	0	1	D	C	B	37us	D=1: entire display on C=1: cursor on B=1: cursor position on
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	x	x	37us	Set cursor moving and display shift control bit, and the direction, without changing DDRAM data.
function Set	0	0	0	0	1	DL	N	F	x	x	37us	DL: interface data is 8/4 bits N: number of line is 2/1 F: font size is 5x11/5x8
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set CGRAM address in address counter
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	37us	Set DDRAM address in address counter
Read busy flag& 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	37us	Write data into internal RAM (DDRAM/CGRAM)
Read data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	37us	Read data from internal RAM (DDRAM / CGRAM)

Note:

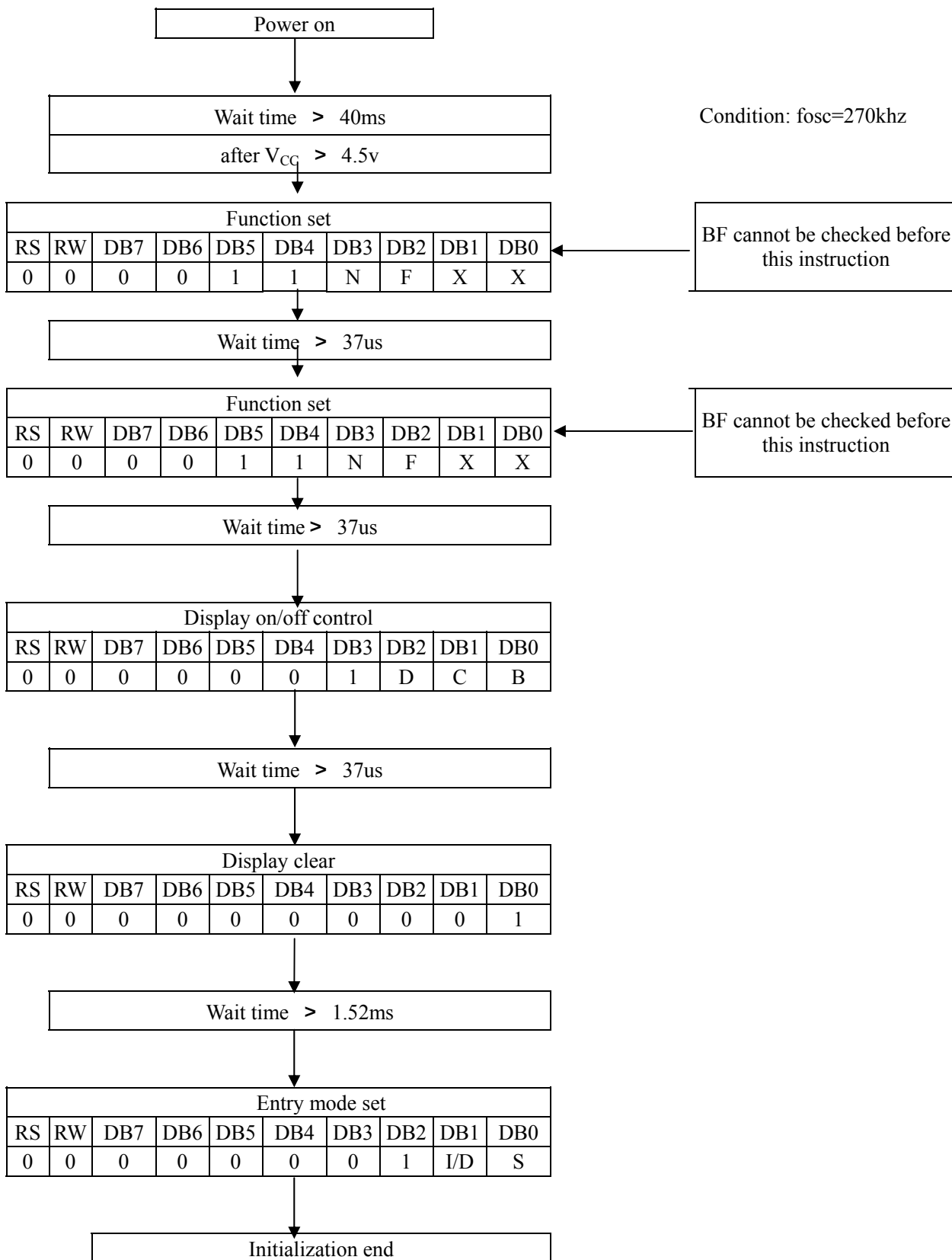
Be sure the ST7066U is not in the busy state (BF=00 before sending an instruction from the MPU to the ST7066U. If an instruction is sent without checking the busy flag, the time between the first instruction and next instruction will take much longer than the instruction time itself. Refer to instruction table for the list of each instruction execution time.

12. STANDARD CHARACTER PATTERN (ST7066U-OA)

Upper (bits) Lower (bits)		0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	10010	1011	1100	1101	1110	1111
0000	CG RAM (1)			0	1	2	3	4	5				6	7	8	9	0
0001	(2)		!	l	A	Q	a	w			e	7	8	9	0	1	2
0010	(3)		"	2	R	r					4	5	6	7	8	9	0
0011	(4)		#	3	S	s					7	8	9	0	1	2	3
0100	(5)		\$	4	D	T	t				1	2	3	4	5	6	7
0101	(6)		%	5	E	U	e	u			.	7	8	9	0	1	2
0110	(7)		&	6	F	V	f	v			7	8	9	0	1	2	3
0111	(8)		'	7	G	W	g	w			7	8	9	0	1	2	3
1000	(1)		(C	H	X	h	x			4	5	6	7	8	9	0
1001	(2))	9	T	Y	y				6	7	8	9	0	1	2
1010	(3)		*	8	J	Z	j	z			7	8	9	0	1	2	3
1011	(4)		+	9	K	L	k	l			7	8	9	0	1	2	3
1100	(5)		,	<	L	F	l	f			7	8	9	0	1	2	3
1101	(6)		-	=	N	I	n	i			7	8	9	0	1	2	3
1110	(7)		.	>	N	n	*				7	8	9	0	1	2	3
1111	(8)		/	?	O	O	*				7	8	9	0	1	2	3

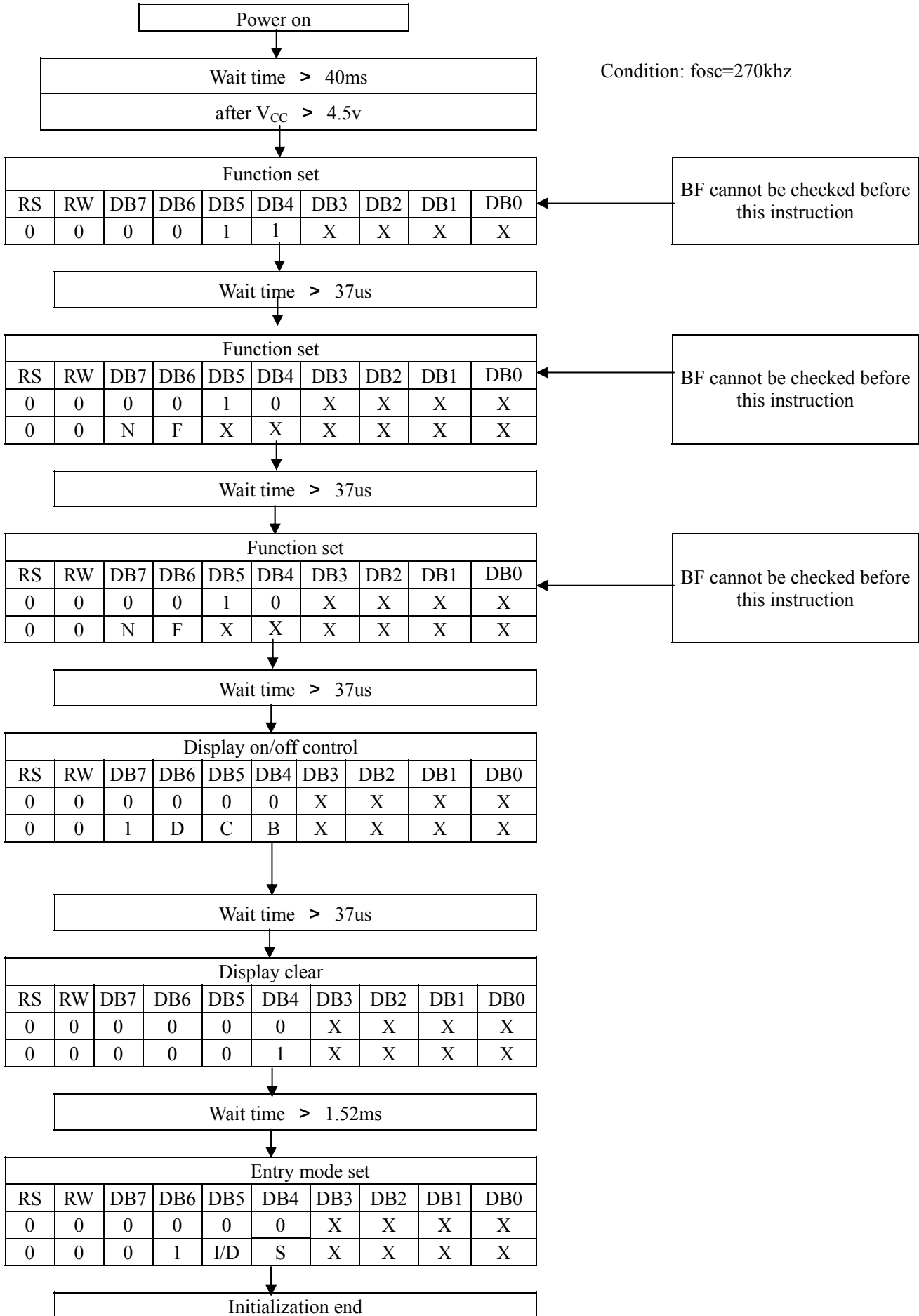
13. LCM INITIALIZING BY INSTRUCTION

13.1. 8-bit Interface Mode



13-2. 4-bit Interface Mode

Condition: fosc=270khz



14. LCD MODULES HANDLING PRECAUTIONS

- Please remove the protection foil of polarizer 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.

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