

# SPECIFICATIONS FOR OLED MODULE



MODEL NO.  
BL1602HM-WRNJU68J\$  
VER.01

FOR MESSRS:

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ON DATE OF:

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APPROVED BY:

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## 1. Numbering System

B	L	1602	DM	-	W	R	N	J	U	68J	\$	
0	1	2	3		4	5	6	7	8	9	10	11

0	Bolymin	B				
1	Module Type	L	OLED			
2	Format	1602	16 character type,2lines			
3	Version No.	HM				
	-					
4	LCD Color	L	OLED/Green		E	OLED/Yellow
		W	OLED/White		R	OLED/RED
		K	OLED/BLUE			
5	LCD Type	R	Positive/reflective			
6	Backlight type/color	N	No backlight			
7	CGRAM Font	J	English/Japanese Font		E	English/European Font
		B	English/Japanese/European		C	English/Cyrillic Font
8	View Angle /Operation Temperature	U	6:00/Ultra wide Temperature		H	6:00 /Wide Temperature
9	Special Code	3	3 voltage logic power supply		N	Positive voltage for LCD
		20K	RS 232 I/F		20C	I2C I/F
		20I	SPI I/F		68J	6800 mode,8-bits
		68K	6800 mode,4-bits		80J	8080 mode,8-bits
		80K	8080 mode,4-bits			
10	RoHS	\$				
11	Customer Code	<u>00</u> 0 ~ <u>99</u> 0 、 <u>AA</u> 0 ~ <u>ZZ</u> 0				

## 2. General Specification

### (1) Mechanical Dimension

Item	Standard Value	Unit
Number of Characters	16 characters × 2 Lines	dots
Module dimension (L*W*H)	84.0 x 44.0 x 9.1	mm
View area	58.22 x 13.52	mm
Active area	56.22 x 11.52	mm
Dot size	0.57 x 0.67	mm
Dot pitch	0.60 x 0.70	mm
Character size ( L x W )	2.97 x 5.57	mm
Character pitch ( L x W )	3.55 x 5.95	mm

(2) Controller IC: Compatible with PT0066  
 IC Equivalent (compatible) HD44780, KS0066 , SPLC780 , ST7066 , AIP31066

## 3. Absolute Maximum Ratings

Item	Symbol	Condition	Min	Typ.	Max	Unit
Operating Temperature	TOP		-40	---	+80	°C
Storage Temperature	TST		-40	---	+90	°C
Supply Voltage(Logic)	VDD		-0.3	---	5.5	V
Input Voltage	VI		-0.3	---	5.5	V
Operating life time		80 cd/m <sup>2</sup>	---	70000	---	Hrs

Note 1: All the above voltages are on the basis of “VSS = 0V”.

Note 2: When this module is used beyond the above absolute maximum ratings, permanent breakage of the module may occur.

Note 3: Ta = 25°C, 25% Checkerboard.

Software configuration follows section actual application example Initialization.

End of lifetime is specified as 50% of initial brightness reached. The average operating lifetime at room temperature is estimated by the accelerated operation at high temperature conditions..

## 4. Electrical Characteristics

(Ta=25°C)

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
Supply Voltage (VDD)	VDD	—	2.8	5.0	5.3	V
Input High Vol	V <sub>IH</sub>	—	0.7V <sub>DD</sub>	—	V <sub>DD</sub>	V
Input Low Vol	V <sub>IL</sub>	—	0	—	0.3V <sub>DD</sub>	V
Output High Vol	V <sub>OH</sub>	—	0.7V <sub>DD</sub>	—	V <sub>DD</sub>	V
Output Low Vol.	V <sub>OL</sub>	—	—	—	0.3VDD	V
Supply Current (*)	IDD	—	—	30	—	mA

Note : VDD =5.0V, 25% Display Area Turn on 100 cd/m<sup>2</sup>.

When random texts pattern is running, averagely, about 1/4 of pixels will be on.

## 5. Optical Characteristics

Item	Min.	Typ.	Max.	Unit
View Angle	—	Free	—	deg
Dark Room contrast	>10000:1			—
CIE x,y (Color: White)	(0.25,0.27)	(0.29,0.31)	(0.33,0.35)	
Brightness	—	100	—	cd/m <sup>2</sup>

## 6. Interface Pin Function

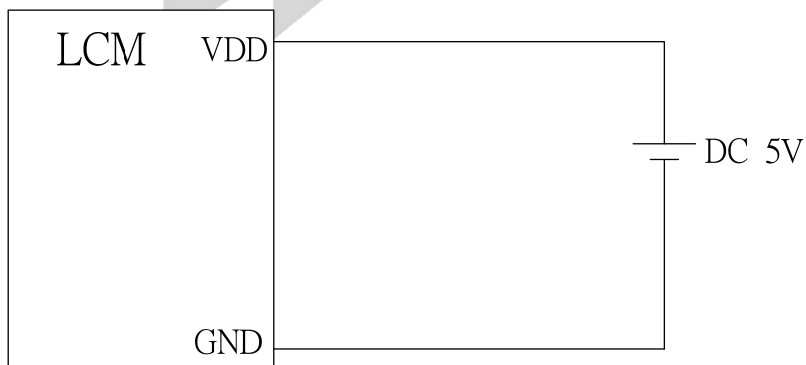
Pin No	Symbol	Level	Description
1	VSS	0V	Ground
2	VDD	5.0V	Supply Voltage for logic.
3	NC	-	No connect.
4	RS	H/L	H:DATA, L:Instruction code
5	R/W	H/L	H:Read(MPU→Module) L:Write(MPU→Module).
6	E	H/L	Chip enable signal.
7	DB0	H/L	Data bit 0.
8	DB1	H/L	Data bit 1.
9	DB2	H/L	Data bit 2.
10	DB3	H/L	Data bit 3.
11	DB4	H/L	Data bit 4.
12	DB5	H/L	Data bit 5.
13	DB6	H/L	Data bit 6.
14	DB7	H/L	Data bit 7.
15	NC	-	No connection
16	NC	-	No connection

Default: 6800 interface 8 bit/4bit (STD)

Optional: I2C

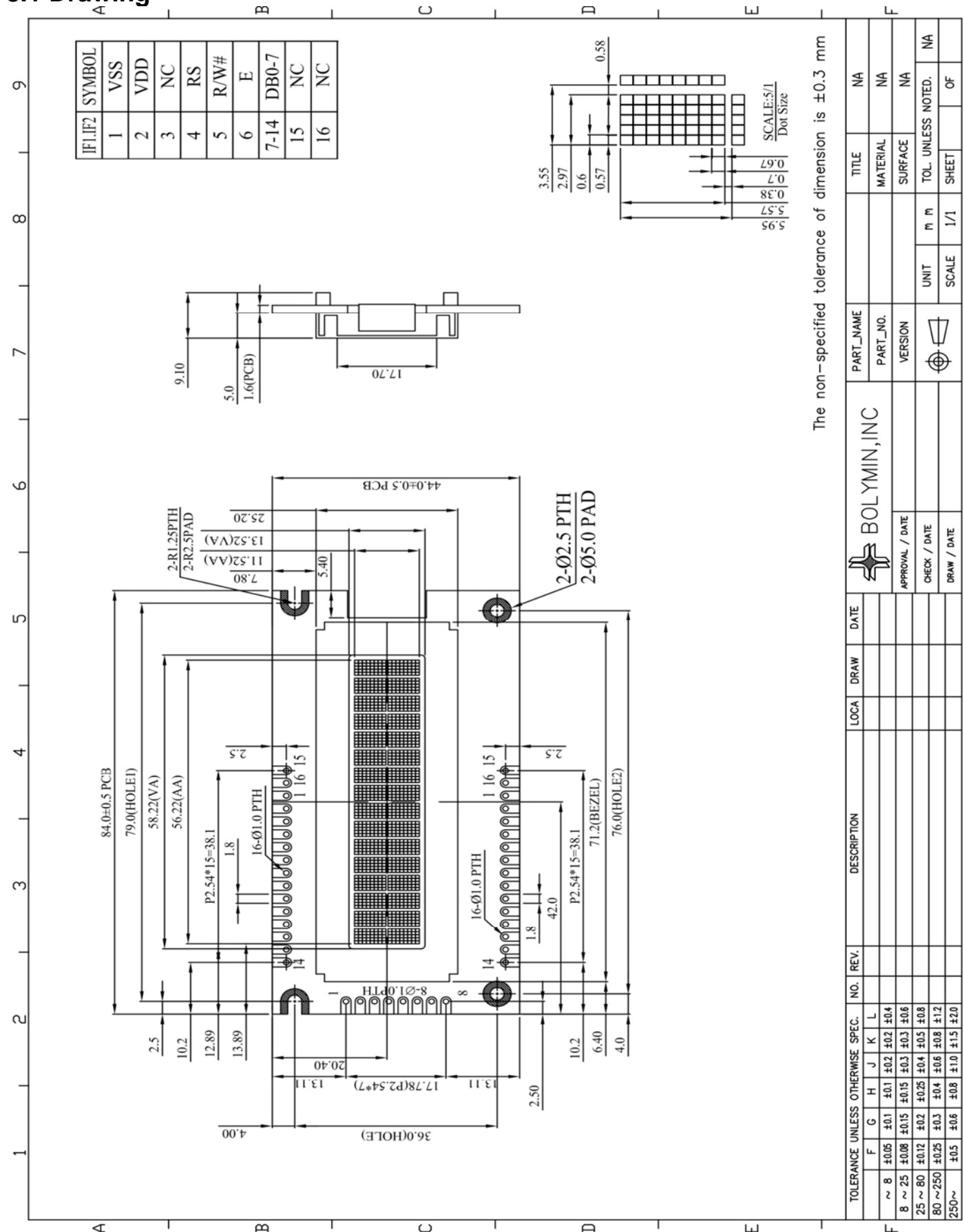
## 7. Power supply for LCD Module

\* LCM operating on "DC 5.0V " input with built-in positive voltage



## 8. Drawing & Block Diagram

### 8.1 Drawing





## 9. Controller Data

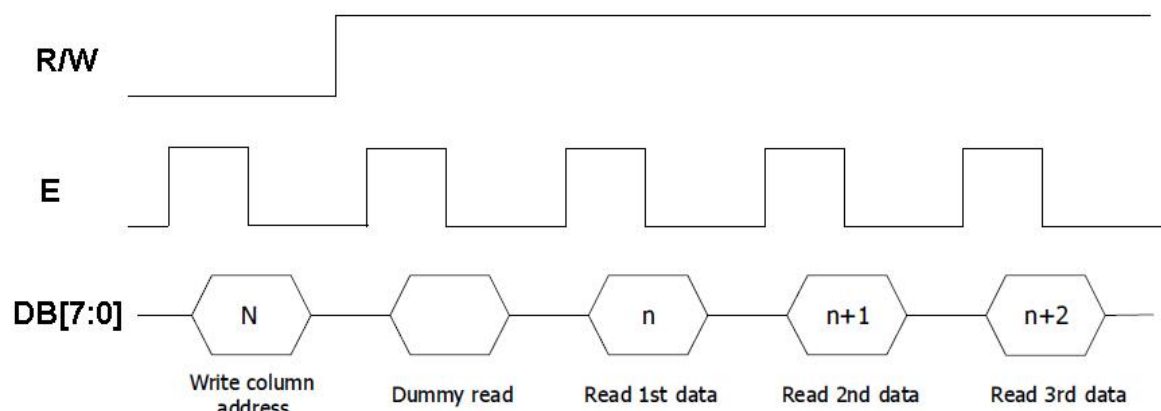
### 9.1 MPU Parallel 6800-series Interface

The parallel interface consists of 8 bi-directional data pins (DB[7:0]), R/W, RS, E.  
 A LOW in R/W indicates WRITE operation and HIGH in R/W indicates READ operation.  
 A LOW in RS indicates COMMAND read/write and HIGH in RS indicates DATA read/write.  
 The E input serves as data latch signal. Data is latched at the falling edge of E signal.

Function	E	R/W	RS
Write command	↓	L	L
Read status	↓	H	L
Write data	↓	L	H
Read data	↓	H	H

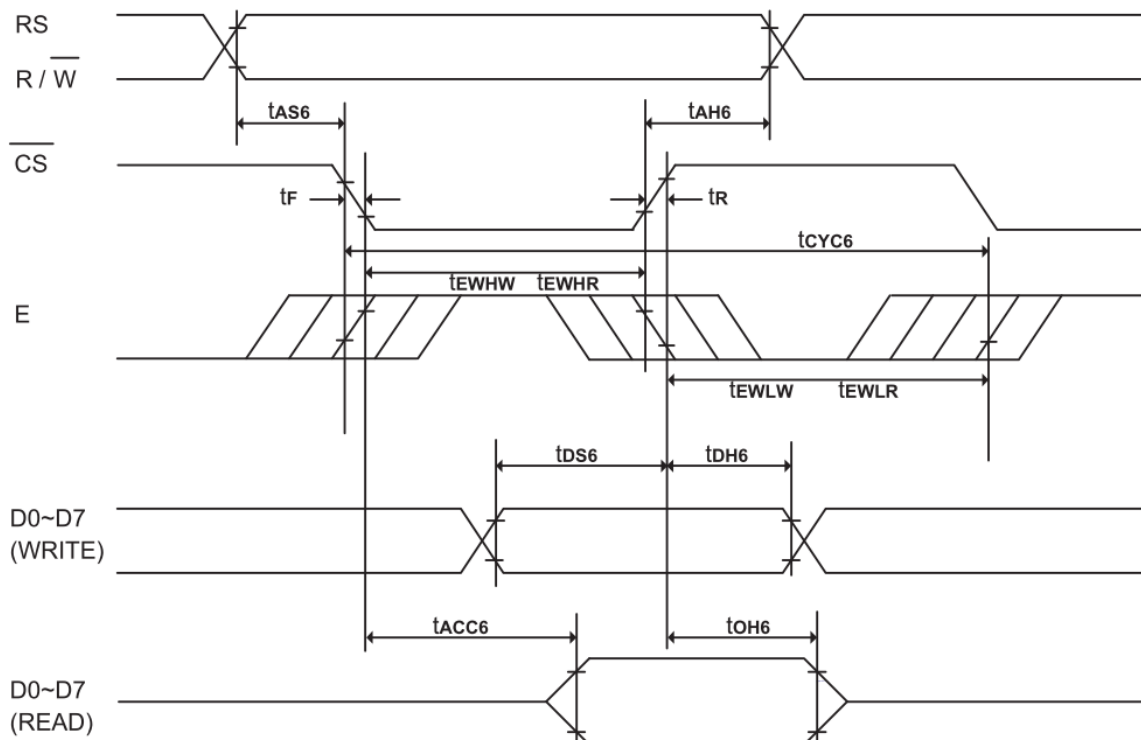
Control pins of 6800 interface

In order to match the operating frequency of display RAM with that of the microprocessor, some pipeline processing is internally performed which requires the insertion of a dummy read before the first actual display data read.



Data read back procedure - insertion of dummy read

## 9.2 System buses Read/Write Characteristics (For the 6800 Series Interface MPU)



	Parameter	Min.	Typ.	Max.	Unit	Condition
$t_{CYC6}$	System cycle time	500	-	-	ns	
$t_{AS6}$	Address setup time	0	-	-	ns	
$t_{AH6}$	Address hold time	0	-	-	ns	
$t_{DS6}$	Data setup time	66	-	-	ns	
$t_{DH6}$	Data hold time	25	-	-	ns	
$t_{OH6}$	Output disable time	16	-	140	ns	$C_L = 100pF$
$t_{ACC6}$	Access time	-	-	280	ns	$C_L = 100pF$
$t_{EWHW}$	Enable H pulse width (Write)	166	-	-	ns	
$t_{EWHR}$	Enable H pulse width (Read)	200	-	-	ns	
$t_{EWLW}$	Enable L pulse width (Write)	166	-	-	ns	
$t_{EWLR}$	Enable L pulse width (Read)	166	-	-	ns	
$t_{TR}$	Rise time	-	-	25	ns	
$t_{TF}$	Fall time	-	-	25	ns	

## 9.3 Display Control Instruction

Instruction	Instruction Code										Description
	RS	R/W	DB7	DB6	DB5	DB4	DB3	DB2	DB1	DB0	
Clear Display	0	0	0	0	0	0	0	0	0	1	Clear entire display area.(POR = 01H)
Return Home	0	0	0	0	0	0	0	0	1	—	Counter with DDRAM address 00H. (POR = 10H)
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.
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. (POR = 08H)
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	—	—	Shift display or move cursor..
Function Set	0	0	0	0	1	DL	N	F	—	—	Set number of display line (N), and character font (F). (POR = 30H)
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.
Read Busy Flag and Address	0	1	BF	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Read Busy Flag (BF) and Address Counter (POR = 00H)
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data to CG RAM or DD RAM. (POR= 00H)
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from CG RAM or DD RAM. (POR = 00H)

The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).

The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). The IR can only be written from the MPU. The DR temporarily stores data to be written or read from DDRAM or CGRAM. When address information is written into the IR, then data is stored into the DR from DDRAM or CGRAM. By the register selector (RS) signal, these two registers can be selected.

RS	R/W	Operation
0	0	IR write as an internal operation (display clear, etc.)
0	1	Read busy flag (DB7) and address counter (DB0 to DB7)
1	0	Write data to DDRAM or CGRAM (DR to DDRAM or CGRAM)
1	1	Read data from DDRAM or CGRAM (DDRAM or CGRAM to DR)

### Busy Flag (BF)

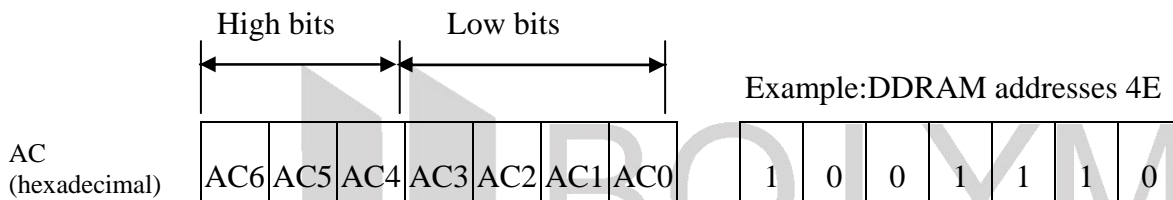
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

### Address Counter (AC)

The address counter (AC) assigns addresses to both DDRAM and CGRAM

### Display Data RAM (DDRAM)

This DDRAM is used to store the display data represented in 8-bit character codes. Its extended capacity is 80×8 bits or 80 characters. Below figure is the relationship between DDRAM addresses and positions on the liquid crystal display.



### DDRAM Address

Display position DDRAM address

1	2	3	4	5	6	7	8	9	10	11	12	13	14	14	16
00	01	02	03	04	05	06	07	40	41	42	43	44	45	46	47

Example: 1-Line by 16-Character Display

### Character Generator ROM (CGROM)

The CGROM generate 5×8 dot character patterns from 8-bit character codes. See Table 2.

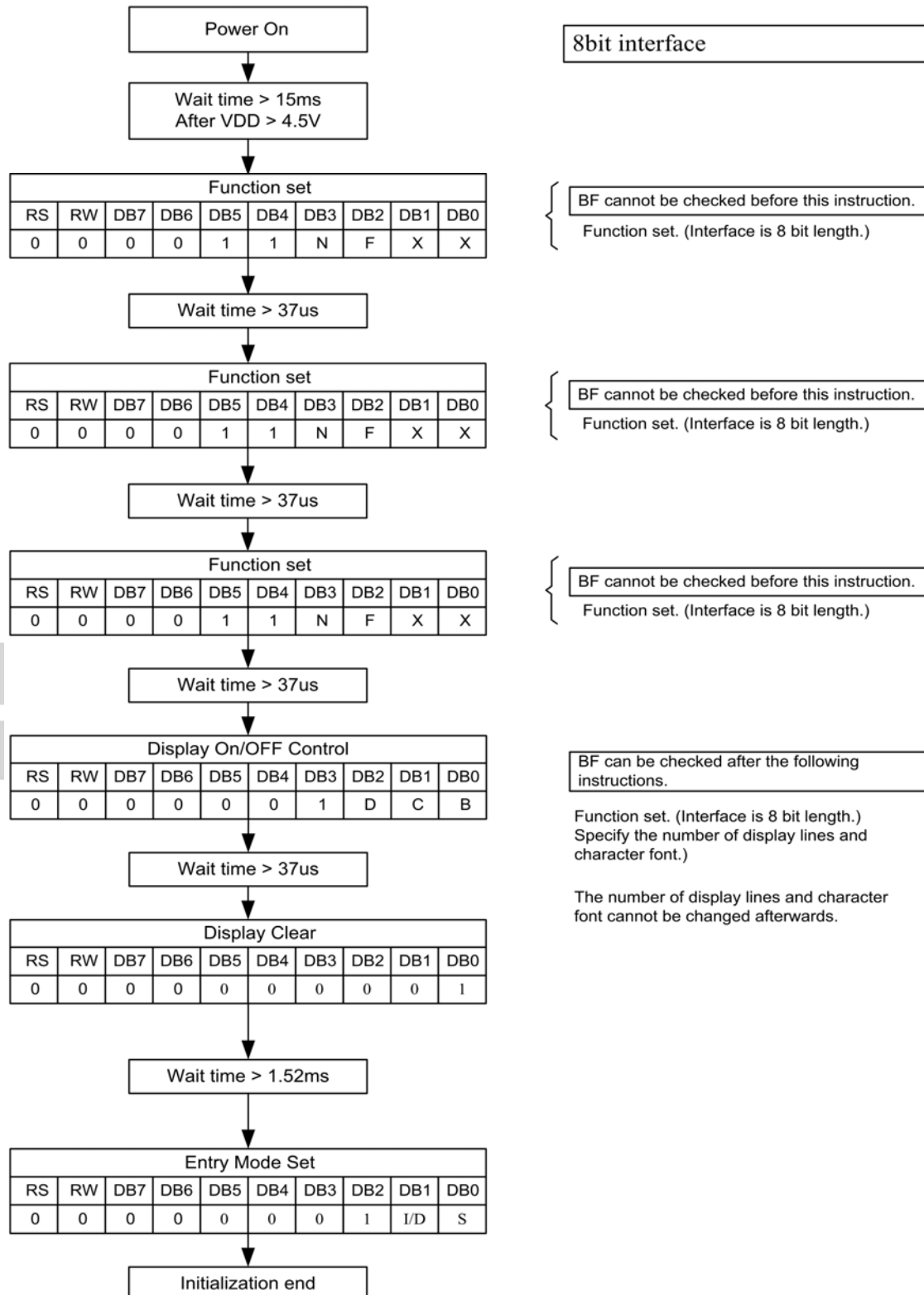
### Character Generator RAM (CGRAM)

In CGRAM, the user can rewrite character by program. For 5×8 dots, eight character patterns can be written.

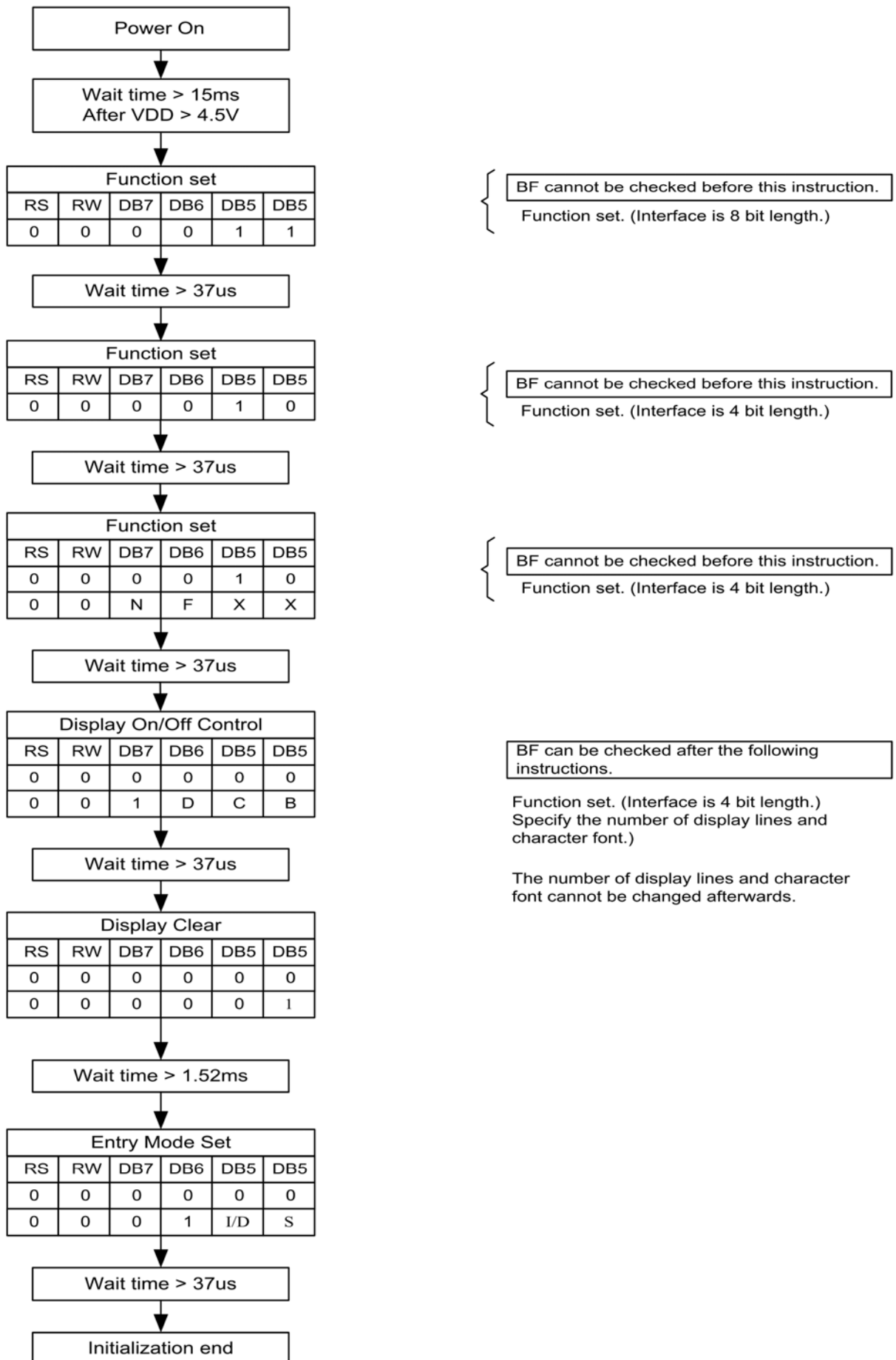
Write into DDRAM the character code at the addresses shown as the left column of table 1. To show the character patterns stored in CGRAM.

## 9.4 Initializing software of LCM

### 8 bit interface mode



## 4 bit interface mode





## 10. Built-in CGROM (Character Generator ROM)

ENGLISH\_JAPANESE

Upper 4bit Lower 4bit	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001	1010	1011	1100	1101	1110	1111
0000	CG RAM (1)	ア	イ	ウ	エ	オ	カ	キ	ク	ケ	コ	サ	シ	ス	セ	ソ
0001	CG RAM (2)	タ	チ	ツ	テ	ト	ナ	ニ	ノ	ハ	ヒ	フ	ヘ	ホ	マ	ミ
0010	CG RAM (3)	ヤ	ユ	ヨ	ラ	リ	ル	レ	ロ	ワ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ
0011	CG RAM (4)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
0100	CG RAM (5)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
0101	CG RAM (6)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
0110	CG RAM (7)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
0111	CG RAM (8)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1000	CG RAM (9)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1001	CG RAM (10)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1010	CG RAM (11)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1011	CG RAM (12)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1100	CG RAM (13)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1101	CG RAM (14)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1110	CG RAM (15)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ
1111	CG RAM (16)	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ	ヱ	ヰ