H2004A
LCD MODULE MANUAL

Character 20X4

Contents

1. Precautions in use of LCD Modules

(1)Avoid applying excessive shocks to the module or making any alterations or modifications to it.
(2)Don't make extra holes on the printed circuit board, modify its shape or change the components of LCD module.
(3)Don't disassemble the LCM.
(4)Don't operate it above the absolute maximum rating.
(5)Don't drop, bend or twist LCM.
(6)Soldering: only to the I/O terminals.
(7)Storage: please storage in anti-static electricity container and clean environment.

2. General Specification

Item	Dimension	Unit
Number of Characters	20 characters x 4Lines	-
Module dimension	98.0 x 60.0 x 13.6(MAX)	mm
View area	77.0 x 25.2	mm
Active area	70.4 x 20.8	mm
Dot size	0.55 x 0.55	mm
Dot pitch	0.60 x 0.60	mm
Character size	2.95 x 4.75	mm
Character pitch	3.55 x 5.35	mm
LCD type	STN, Positive	
Duty	1/16	
View direction	6 o'clock	
Backlight Type	LED	

3. Absolute Maximum Ratings

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	T_{OP}	-20	-	+70	-
Storage Temperature	T_{ST}	-30	-	+80	-
Input Voltage	V_I	V_{SS}	-	V_{DD}	V
Supply Voltage For Logic	V_{DD}-V_{SS}	-0.3	-	7	V
Supply Voltage For LCD	V_{DD}-V_0	-0.3	-	13	V

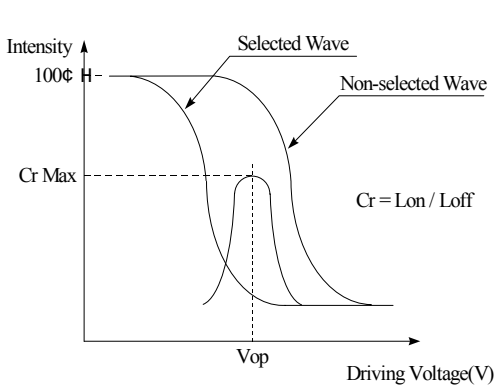
4. Electrical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	V_{DD}-V_{SS}	-	4.5	-	5.5	V
Supply Voltage For LCD	V_{DD}-V_0	Ta=-20°C	-	-	5.5	V
		Ta=25°C	-	4.5	-	V
		Ta=70°C	3.8	-	-	V
Input High Volt.	V_{IH}	-	2.2	-	V_{DD}	V
Input Low Volt.	V_{IL}	-	-	-	0.6	V
Output High Volt.	V_{OH}	-	2.4	-	-	V
Output Low Volt.	V_{OL}	-	-	-	0.4	V
Supply Current	I_{DD}	V_{DD}=5V	-	1.6	-	mA

5. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) θ	CR≥2	10	-	105	deg
	(H) φ	CR≥2	-30	-	30	deg
Contrast Ratio	CR	-	-	3	-	-
Response Time	T rise	-	-	150	200	ms
	T fall	-	-	150	200	ms

Definition of Operation Voltage (Vop) **Definition of Response Time (Tr , Tf)**



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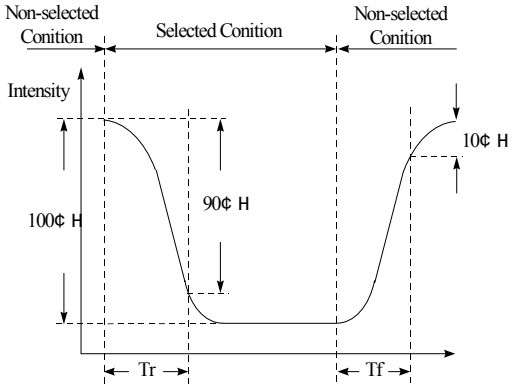


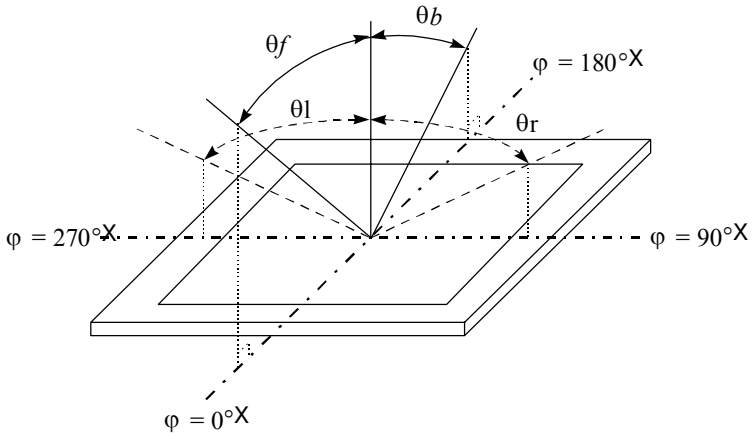
[positive type]

Conditions :

Operating Voltage : Vop Viewing Angle(θ) : 0°

Frame Frequency : 64 HZ Driving Waveform : 1/N duty , 1/a bias

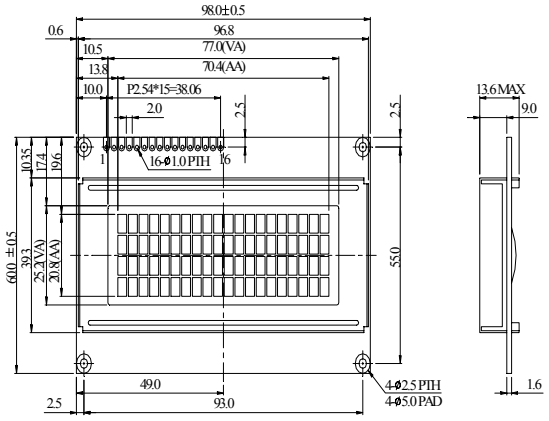
Definition of viewing angle(CR≥2)



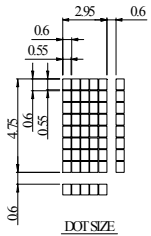
6. Interface Pin Function

Pin No.	Symbol	Level	Description
1	V_{SS}	0V	Ground
2	V_{DD}	5.0V	Supply Voltage for logic
3	VO	(Variable)	Operating voltage for LCD
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,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	A	4.2V-4.6V	LED +
16	K	0V	LED -

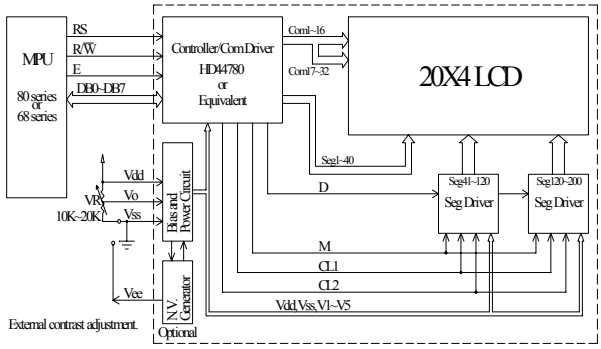
7. Contour Drawing &Block Diagram



PIN NO.	SYMBOL
1	Vss
2	Vdd
3	Vo
4	RS
5	R/W
6	E
7	DB0
8	DB1
9	DB2
10	DB3
11	DB4
12	DB5
13	DB6
14	DB7
15	A
16	K

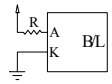


The non-specified tolerance of dimension is ±0.3mm

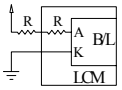


LED B/L Drive Method

1.Drive from A,K



2.Drive from pin15, pin16



(Will never get Vee output from pin15)

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

8. Function Description

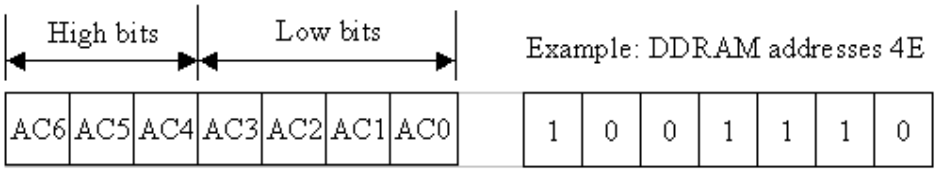
The LCD display Module is built in a LSI controller, the controller has two 8-bit registers, an instruction register (IR) and a data register (DR).
The IR stores instruction codes, such as display clear and cursor shift, and address information for display data RAM (DDRAM) and character generator (CGRAM). 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 relationships between DDRAM addresses and positions on the liquid crystal display.



Display position DDRAM address

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

2-Line by 16-Character Display

Character Generator ROM (CGROM)

The CGROM generate 5×8 dot or 5×10 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, and for 5×10 dots, four 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.

Relationship between CGRAM Addresses, Character Codes (DDRAM) and Character patterns

Table 1.

For 5 * 8 dot character patterns

Character Codes (DDRAM data)	CGRAM Address	Character Patterns (CGRAM data)
7 6 5 4 3 2 1 0	5 4 3 2 1 0	7 6 5 4 3 2 1 0
High Low	High Low	High Low
0 0 0 0 * 0 0 0	0 0 0 0 0 0	* * * ■ ■ ■ ■ 0
	0 0 1	* * * ■ 0 0 0 ■
	0 1 0	* * * ■ 0 0 0 ■
	0 1 1	* * * ■ ■ ■ ■ 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 * 0 0 1	0 0 1 0 0 0	* * * ■ 0 0 0 ■
	0 0 1	* * * 0 ■ 0 ■ 0
	0 1 0	* * * ■ ■ ■ ■ ■
	0 1 1	* * * 0 0 ■ 0 0
	1 0 0	* * * ■ ■ ■ ■ ■
	1 0 1	* * * 0 0 ■ 0 0
	1 1 0	* * * 0 0 ■ 0 0
	1 1 1	* * * 0 0 0 0 0
	0 0 0	* * *
	0 0 1	
0 0 0 0 * 1 1 1	1 1 1 1 0 0	
	1 0 1	
	1 1 0	
	1 1 1	* * *

Character pattern(1)

Cursor pattern

Character pattern(2)

Cursor pattern

For 5 * 10 dot character patterns

Character Codes (DDRAM data)	CGRAM Address	Character Patterns (CGRAM data)
7 6 5 4 3 2 1 0	5 4 3 2 1 0	7 6 5 4 3 2 1 0
High Low	High Low	High Low
0 0 0 0 * 0 0 0	0 0 0 0 0 0 0	* * * 0 0 0 0 0 0
	0 0 0 1	* * * 0 0 0 0 0 0
	0 0 1 0	* * * ■ 0 ■ ■ ■ 0
	0 0 1 1	* * * ■ ■ 0 0 ■
	0 1 0 0	* * * ■ 0 0 0 ■
	0 1 0 1	* * * ■ 0 0 0 ■
	0 1 1 0	* * * ■ ■ ■ ■ ■ 0
	0 1 1 1	* * * ■ 0 0 0 0 0
	1 0 0 0	* * * ■ 0 0 0 0 0
	1 0 0 1	* * * ■ 0 0 0 0 0
	1 0 1 0	* * * 0 0 0 0 0 0
	1 1 1 1	* * * * * * * * *

Character pattern

Cursor pattern

■ : " High "

9. Character Generator ROM Pattern

Table.2

Upper 4 bit / Lower 4 bit	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)															

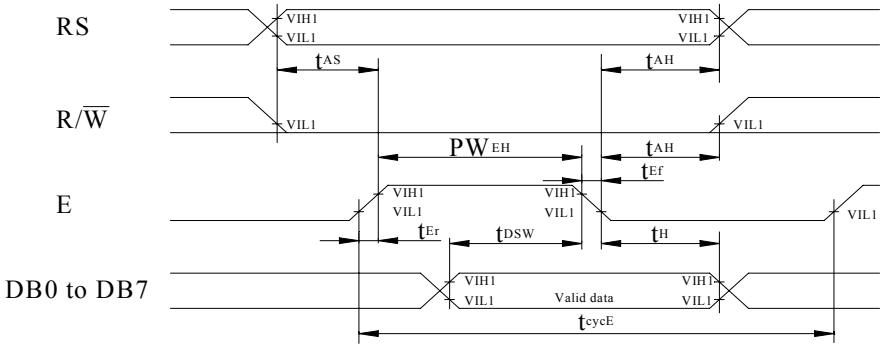
10. Instruction Table

Instruction	Instruction Code										Description	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 “00H” to DDRAM and set DDRAM address to “00H” from AC	1.53ms
Return Home	0	0	0	0	0	0	0	0	1	—	Set DDRAM address to “00H” from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed.	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.	39 μ s
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.	39 μ s
Cursor or Display Shift	0	0	0	0	0	1	S/C	R/L	—	—	Set cursor moving and display shift control bit, and the direction, without changing of DDRAM data.	39 μ s
Function Set	0	0	0	0	1	DL	N	F	—	—	Set interface data length (DL:8-bit/4-bit), numbers of display line (N:2-line/1-line)and, display font type (F:5×11 dots/5×8 dots)	39 μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0	Set CGRAM address in address counter.	39 μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0	Set DDRAM address in address counter.	39 μ s
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.	0 μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0	Write data into internal RAM (DDRAM/CGRAM).	43 μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0	Read data from internal RAM (DDRAM/CGRAM).	43 μ s

I/D = 1 : Increment	C = 1 : Cursor ON	R/L = 1 : Right Shift	F = 0 : 5x7 Dots
I/D = 0 : Decrement	C = 0 : Cursor OFF	R/L = 0 : Left Shift	F = 1 : 5x10 Dots
S = 1 : Display shift	B = 1 : Blink ON	DL = 1 : 8 Bits	BF = 1 : Busy
S = 0 : No display shift	B = 0 : Blink OFF	DL = 0 : 4 Bits	BF = 0 : Can Accept Data
D = 1 : Display ON	S/C = 1 : Display Shift	N = 1 : 2 Lines	A_{CG} : CG RAM Address
D = 0 : Display OFF	S/C = 0 : Cursor Move	N = 0 : 1 Line	A_{DD} : DD RAM Address
			* : don't care

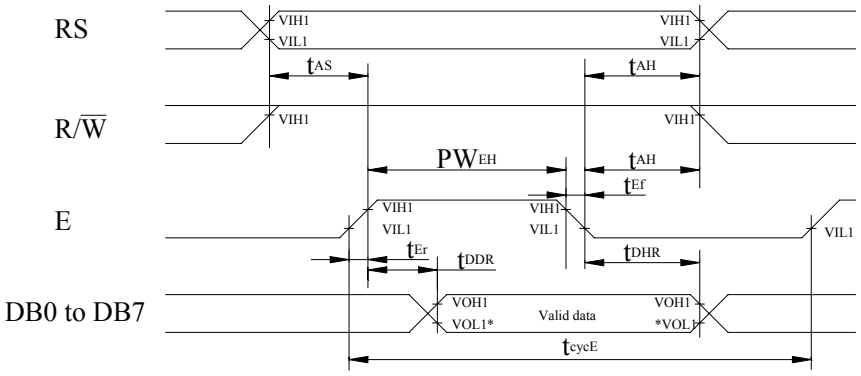
11. Timing Characteristics

11.1 Write Operation



Ta=25°C, VDD=5.0± 0.5V

Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	400	-	-	ns
Enable pulse width (high level)	PW_{EH}	150	-	-	ns
Enable rise/fall time	t_{Er},t_{Ef}	-	-	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	30	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data set-up time	t_{DSW}	40	-	-	ns
Data hold time	t_H	10	-	-	ns



NOTE: *VOL1 is assumed to be 0.8V at 2 MHZ operation.

11.2 Read Operation

Ta=25°C, VDD=5.0± 0.5V

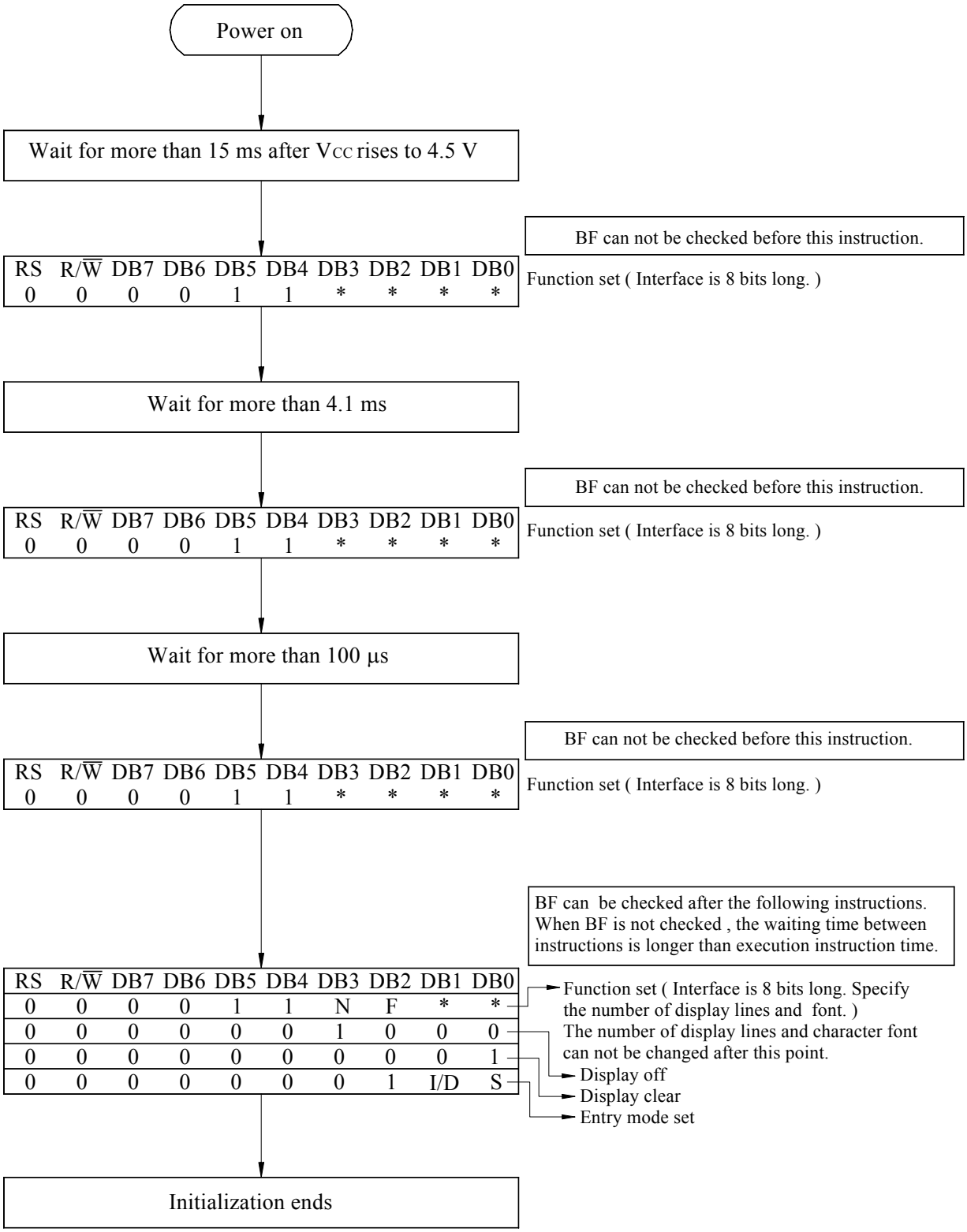
Item	Symbol	Min	Typ	Max	Unit
Enable cycle time	t_{cycE}	400	-	-	ns
Enable pulse width (high level)	PW_{EH}	150	-	-	ns
Enable rise/fall time	t_{Er},t_{Ef}	-	-	25	ns
Address set-up time (RS, R/W to E)	t_{AS}	30	-	-	ns
Address hold time	t_{AH}	10	-	-	ns
Data delay time	t_{DDR}	-	-	100	ns
Data hold time	t_{DHR}	20	-	-	ns

12. Backlight Information

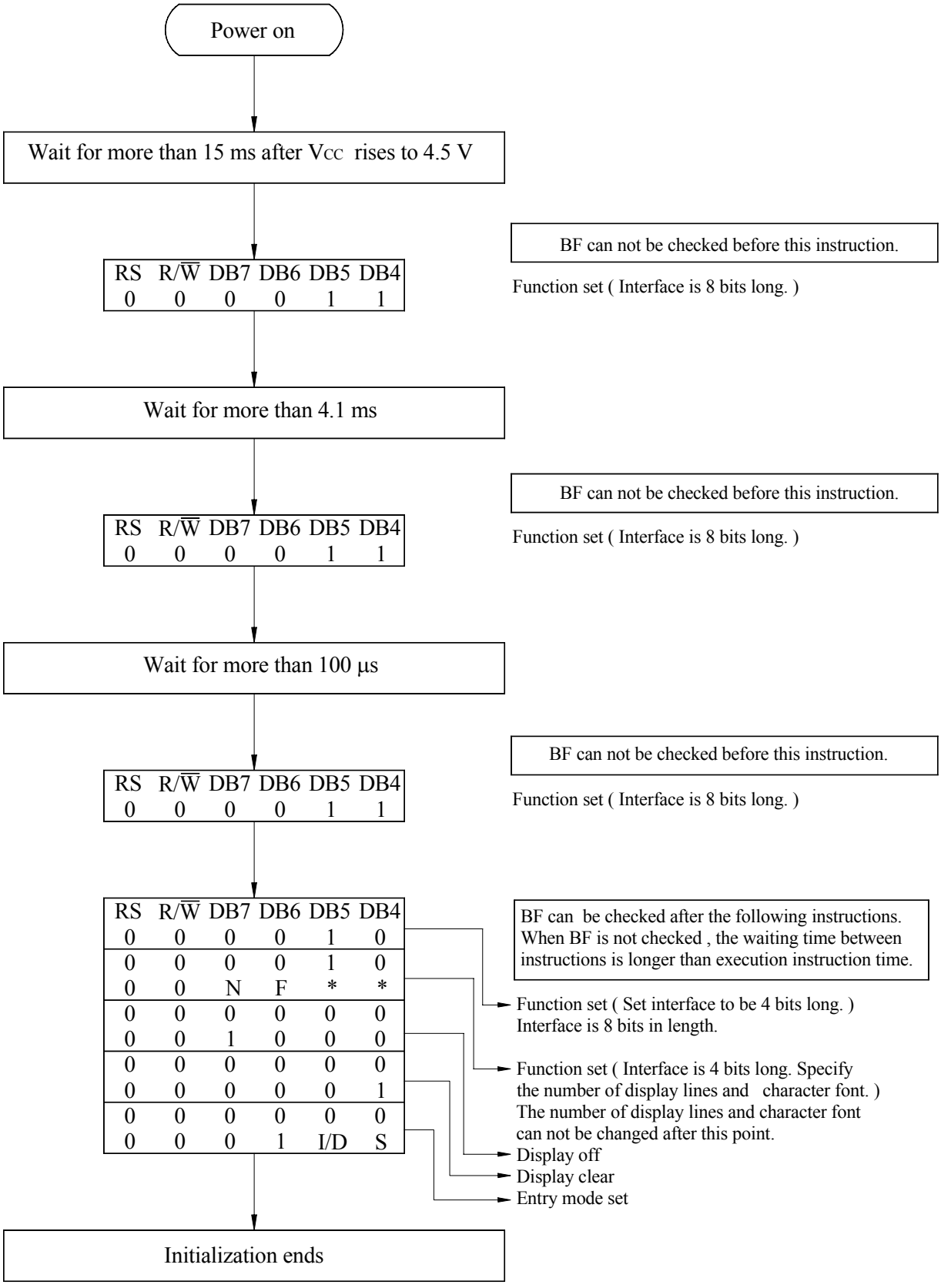
Specification

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	TEST CONDITION
Supply Current	**ILED**	—	**280**	**560**	**mA**	**V=4.2V**
Supply Voltage	**V**	**-**	**4.2**	**4.6**	**V**	**-**
Reverse Voltage	**VR**	**-**	**-**	**10**	**V**	**-**
Luminous Intensity	**IV**	**-**	**180**	**-**	**CD/M^2**	**ILED=280mA**
Wave Length	**λp**	—	**570**	**-**	**nm**	**ILED=280mA**
Life Time	**-**	**-**	**100000**	**-**	**Hr.**	**V ≤ 4.6V**

13. Initializing of LCM



8-Bit Ineterface



4-Bit Ineterface