

# *Crystalfontz America, Inc.*

## **SPECIFICATION**

**CUSTOMER :** \_\_\_\_\_

**MODULE NO.:** **CFAH2004L-NYG-EP**

<b>SALES BY</b>	<b>APPROVED BY</b>	<b>CHECKED BY</b>	<b>PREPARED BY</b>
<b>ISSUED DATE:</b>			

### **Crystalfontz America, Inc.**

12412 East Saltese Avenue  
Spokane Valley, WA 99216-0357

Phone: (888) 206-9720

Fax: (509) 892-1203

Email: [techinfo@crystalfontz.com](mailto:techinfo@crystalfontz.com)

URL: [www.crystalfontz.com](http://www.crystalfontz.com)

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# 1.Module Classification Information

CFA H 2004 L - NYG - EP  
 ① ② ③ ④ ⑤ ⑥ ⑦ ⑧

①	Brand : <b>CRYSTALFONTZ AMERICA, INCORPORATED</b>	
②	Display Type : <b>H</b> → Character Type, G→ Graphic Type	
③	Display's logical dimensions: <b>20</b> columns by <b>04</b> lines	
④	Model serials no.	
⑤	Backlight Type :	<b>N</b> → Without backlight B→ EL, Blue green D→ EL, Green W→ EL, White F→ CCFL, White Y→ LED, Yellow Green  A→ LED, Amber R→ LED, Red O→ LED, Orange G→ LED, Green
⑥	LCD Mode :	B→ TN Positive, Gray N→ TN Negative, G→ STN Positive, Gray <b>Y</b> → <b>STN Positive, Yellow Green</b> M→ STN Negative, Blue F→ FSTN Positive  T→ FSTN Negative
⑦	LCD Polarize Type/ Temperature range/ View direction	A→ Reflective, N.T, 6:00 D→ Reflective, N.T, 12:00 <b>G</b> → <b>Reflective, W. T, 6:00</b> J→ Reflective, W. T, 12:00 B→ Transflective, N.T,6:00 E→ Transflective, N.T,12:00  H→ Transflective, W.T,6:00 K→ Transflective, W.T,12:00 C→ Transmissive, N.T,6:00 F→ Transmissive, N.T,12:00 I→ Transmissive, W. T, 6:00 L→ Transmissive, W.T,12:00
⑧	Special Code	<b>EP : English and European standard font</b>

## **2.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.

## **3.General Specification**

<b>Item</b>	<b>Dimension</b>	<b>Unit</b>
Number of Characters	20 characters x 4 Lines	-
Module dimension	146.0 x 62.5 x 10.1(MAX)	mm
View area	123.5 x 43.0	mm
Active area	118.84x 38.47	mm
Dot size	0.92 x 1.1	mm
Dot pitch	0.98 x 1.16	mm
Character size	4.84 x 9.22	mm
Character pitch	6.0 x 9.75	mm
LCD type	STN , Positive , Reflective , Yellow Green	
Duty	1/16	
View direction	6 o'clock	
Backlight Type	NA	

## **4. Absolute Maximum Ratings**

Item	Symbol	Min	Typ	Max	Unit
Operating Temperature	$T_{OP}$	-20	-	+70	°C
Storage Temperature	$T_{ST}$	-30	-	+80	°C
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

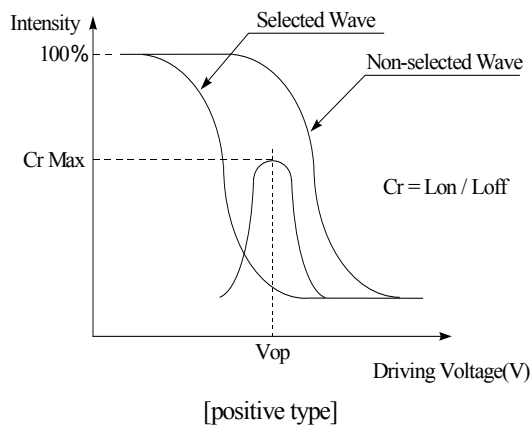
## **5. Electrical Characteristics**

Item	Symbol	Condition	Min	Typ	Max	Unit
Supply Voltage For Logic	$V_{DD}-V_{SS}$	-	4.5	-	5.5	V
Supply Voltage For LCD	$V_{DD}-V_0$	$T_a=0^{\circ}\text{C}$	-	-	4.5	V
		$T_a=25^{\circ}\text{C}$	-	4.2	-	V
		$T_a=50^{\circ}\text{C}$	3.9	-	-	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	$I_{DD}$	$V_{DD}=5\text{V}$	-	1.2	-	mA

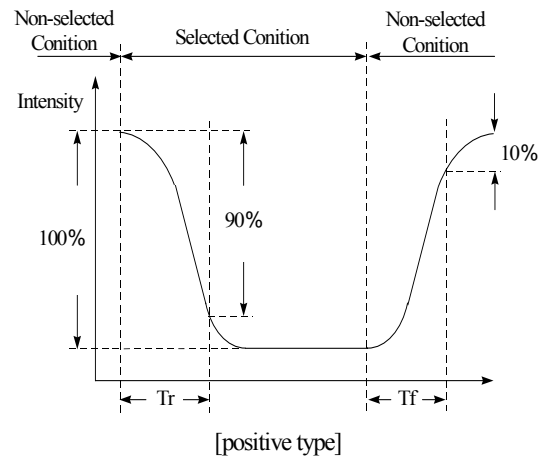
# 6. Optical Characteristics

Item	Symbol	Condition	Min	Typ	Max	Unit
View Angle	(V) $\theta$	$CR \geq 2$	20	-	40	deg
	(H) $\phi$	$CR \geq 2$	-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)



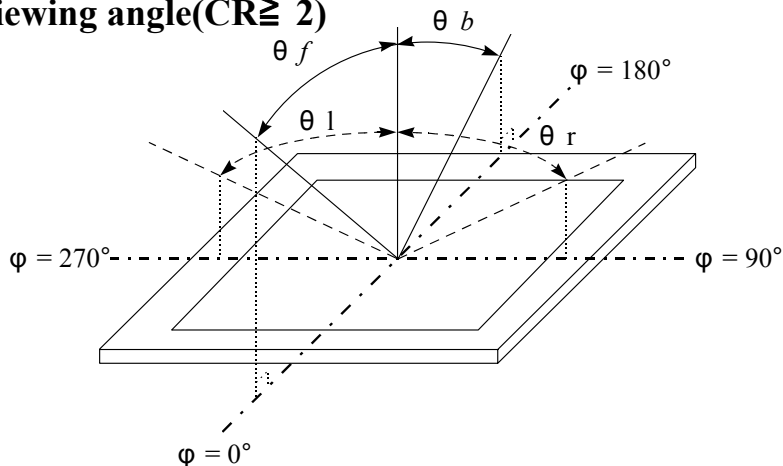
### Conditions :

Operating Voltage : Vop

Viewing Angle( $\theta$  ,  $\phi$ ) :  $0^\circ$  ,  $0^\circ$

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

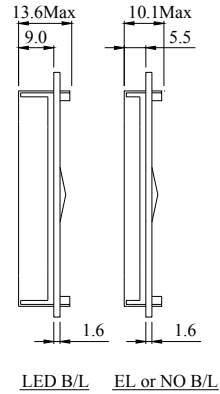
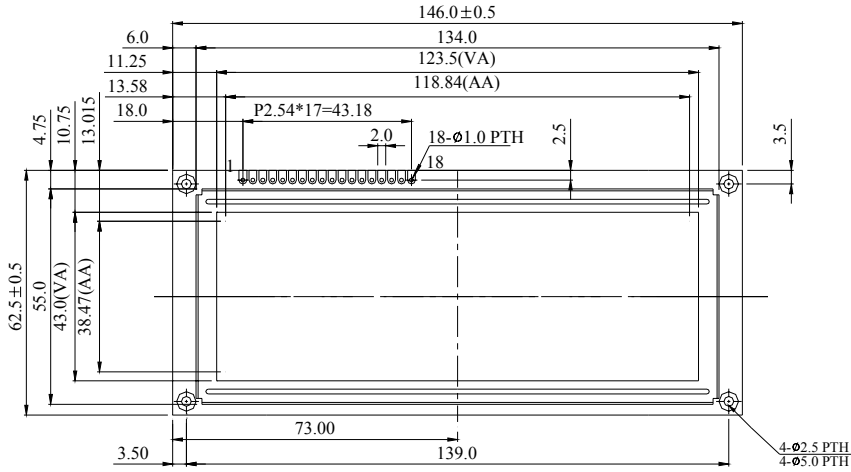
### Definition of viewing angle( $CR \geq 2$ )



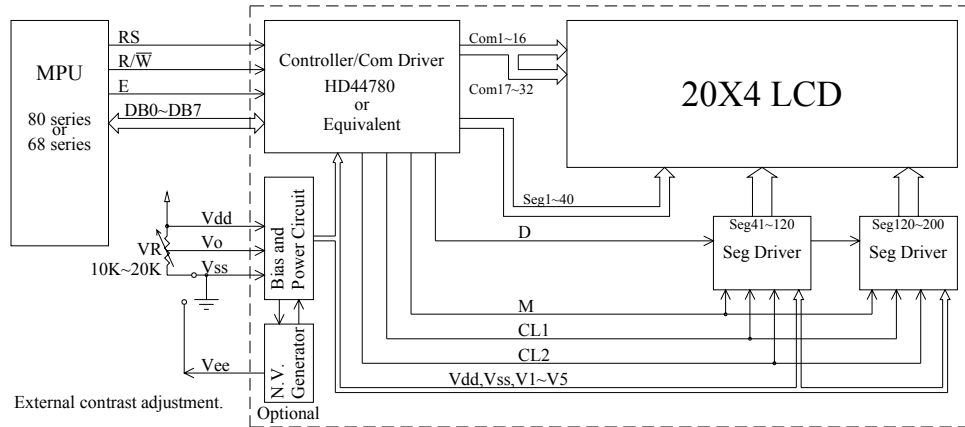
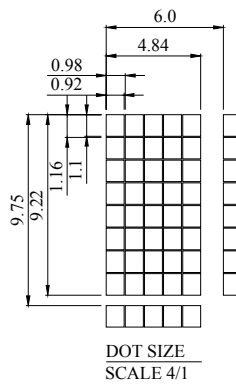
## **7.Interface Pin Function**

<b>Pin No.</b>	<b>Symbol</b>	<b>Level</b>	<b>Description</b>
1	V <sub>SS</sub>	0V	Ground
2	V <sub>DD</sub>	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	-	NC
16	K	-	NC
17	Vee	-	NC
18	NC	-	-

# 8. 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
17	Vee
18	NC



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



## 9. 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)

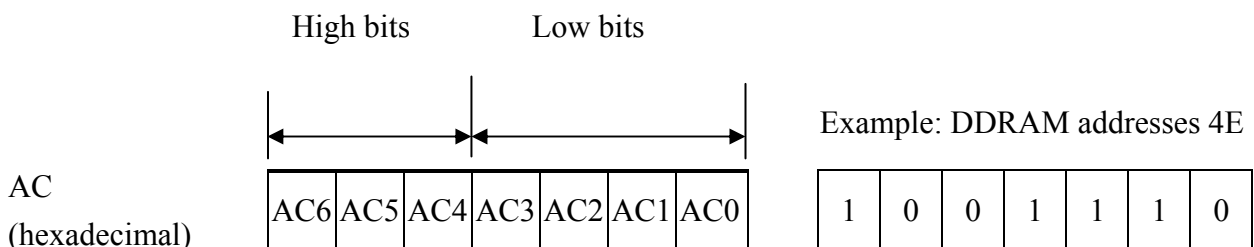
When the busy flag is 1, the controller LSI is in the internal operation mode, and the next instruction will not be accepted. When RS=0 and R/W=1, the busy flag is output to DB7. The next instruction must be written after ensuring that the busy flag is 0.

### 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 17 18 19 20

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

4-Line by 20-Character Display

### Character Generator ROM (CGROM)

The CGROM generate  $5 \times 8$  dot or  $5 \times 10$  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  $5 \times 8$  dots, eight character patterns can be written, and for  $5 \times 10$  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	* * *		Character pattern( 1 )	
			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 0
			0 0 1	* * *			0 0 0 0
0 0 0 0 * 0 0 1		0 0 1	1 0 0	* * *		Character pattern( 2 )	
			1 0 1	* * *			0 0
			1 1 0	* * *			0 0
			1 1 1	* * *			0 0
			0 0 0	* * *			0 0 0 0 0
			0 0 1	* * *			0 0 0 0
			0 1 0	* * *			0 0 0 0
			0 1 1	* * *			0 0 0 0
			1 0 0	* * *			0 0 0 0
			1 0 1	* * *			0 0 0 0
			0 0 0	* * *			
			0 0 1	* * *			

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	* * *		Character pattern	
			0 0 0 1	* * *			0 0 0 0 0
			0 0 1 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
			1 0 0 0	* * *			0 0 0 0
			1 0 0 1	* * *			0 0 0 0
			1 0 1 0	* * *	0 0 0 0 0		
			1 1 1 1	* * *	* * * * *		

■ : " High "

# 10.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)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E
LLLH	CG RAM (2)	F	10	11	12	13	14	15	16	17	18	19	20	21	22	23
LLHL	CG RAM (3)	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
LLHH	CG RAM (4)	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
LHLL	CG RAM (5)	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68
LHLH	CG RAM (6)	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83
LHHL	CG RAM (7)	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98
LHHH	CG RAM (8)	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113
HLLL	CG RAM (1)	114	115	116	117	118	119	120	121	122	123	124	125	126	127	128
HLLH	CG RAM (2)	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143
HLHL	CG RAM (3)	144	145	146	147	148	149	150	151	152	153	154	155	156	157	158
HLHH	CG RAM (4)	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173
HHLL	CG RAM (5)	174	175	176	177	178	179	180	181	182	183	184	185	186	187	188
HHLH	CG RAM (6)	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203
HHHL	CG RAM (7)	204	205	206	207	208	209	210	211	212	213	214	215	216	217	218
HHHH	CG RAM (8)	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233

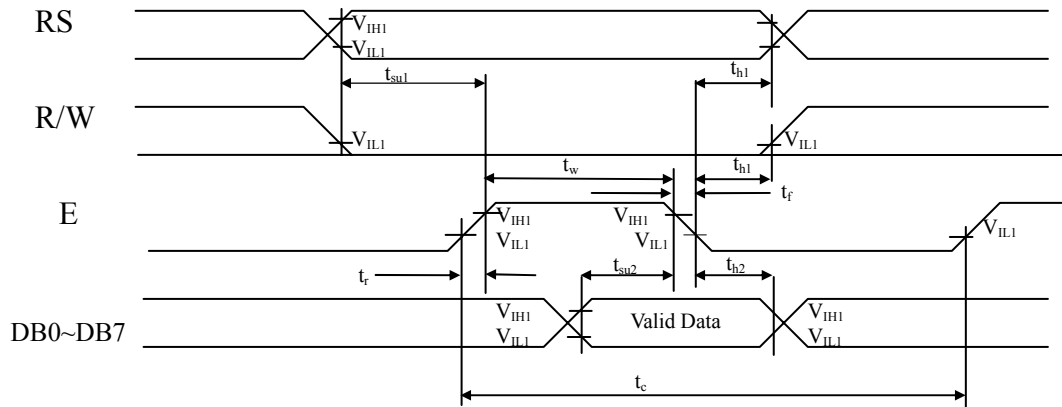
# 11. Instruction Table

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	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	0	1	I/D	SH	Assign cursor moving direction and enable the shift of entire display.	39μ s
Display ON/OFF Control	0	0	0	0	0	0	0	1	D	C	B	Set display (D), cursor (C), and blinking of cursor (B) on/off control bit.	39μ s
Cursor or Display Shift	0	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.	39μ s
Function Set	0	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)	39μ s
Set CGRAM Address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	39μ s
Set DDRAM Address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter.	39μ 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.	0μ s
Write Data to RAM	1	0	D7	D6	D5	D4	D3	D2	D1	D0		Write data into internal RAM (DDRAM/CGRAM).	43μ s
Read Data from RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data from internal RAM (DDRAM/CGRAM).	43μ s

\* " - " : don't care

# 12. Timing Characteristics

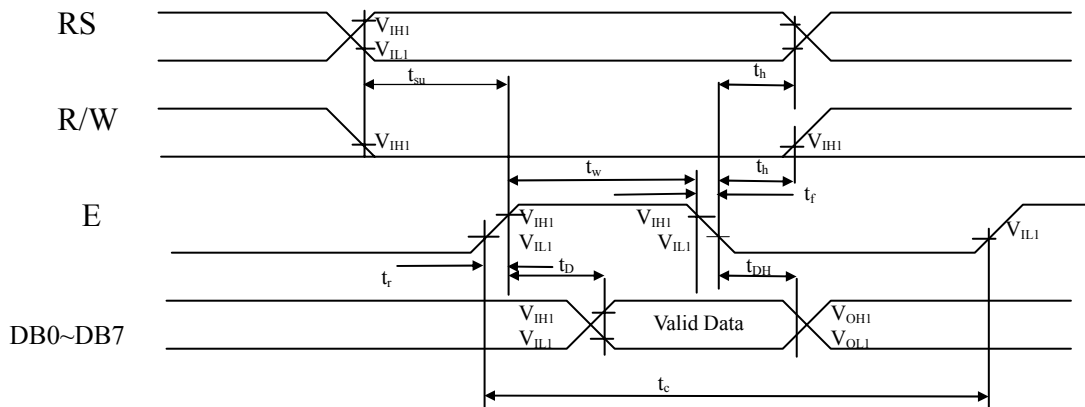
## 12.1 Write Operation



( $V_{DD}=4.5V\sim 5.5V$ ,  $T_a=-30\sim +85^{\circ}C$ )

Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Write Mode	E cycle Time	$t_c$	500	-	-	ns
	E Rise/Fall Time	$t_R, t_F$	-	-	20	
	E Pulse Width (High, Low)	$t_w$	230	-	-	
	R/W and RS Setup Time	$t_{su1}$	40	-	-	
	R/W and RS Hold Time	$t_{h1}$	10	-	-	
	Data Setup Time	$t_{su2}$	80	-	-	
	Data Hold Time	$t_{h2}$	10	-	-	

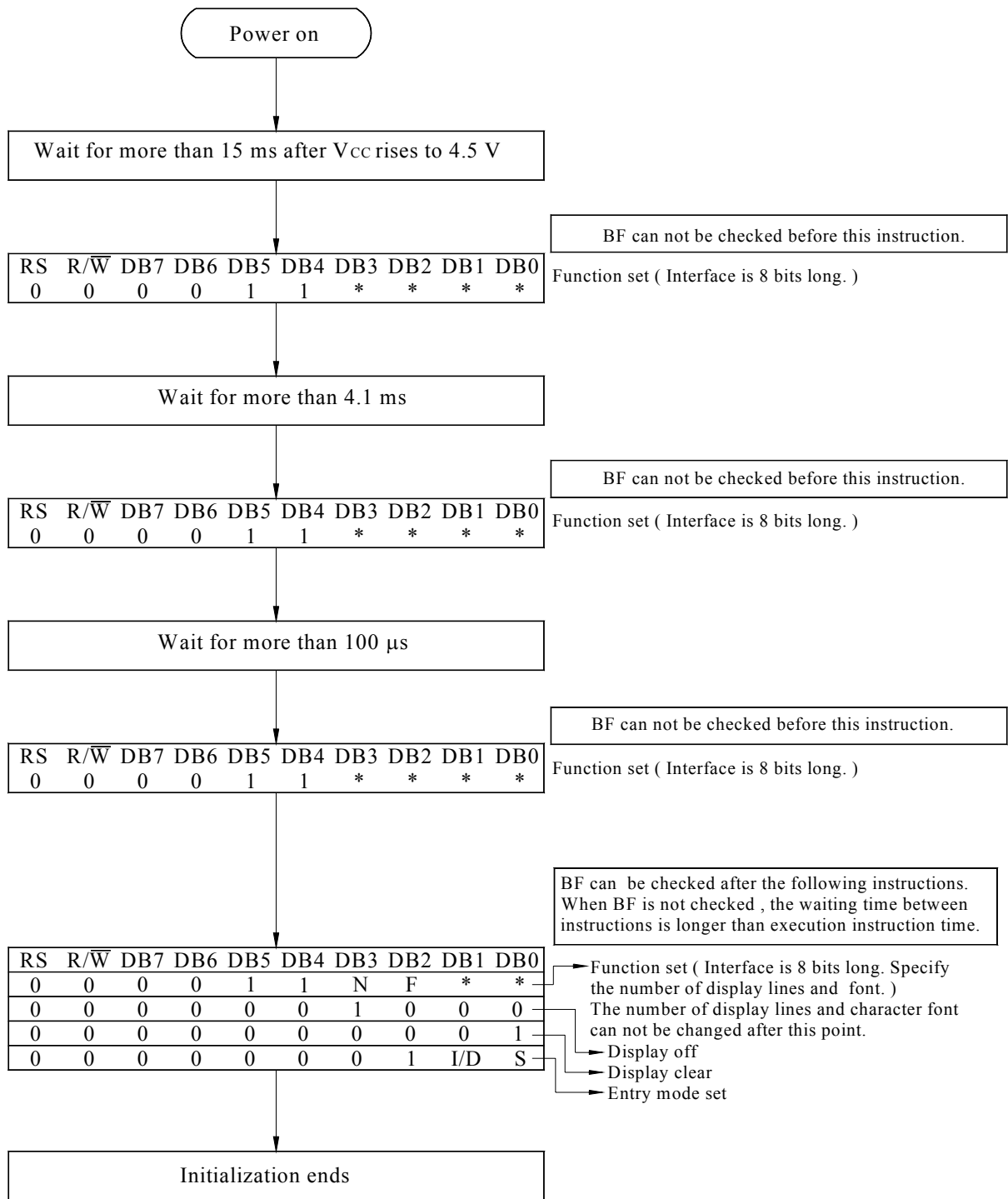
## 12.2 Read Operation



( $V_{DD}=4.5V\sim 5.5V$ ,  $T_a=-30\sim +85^{\circ}C$ )

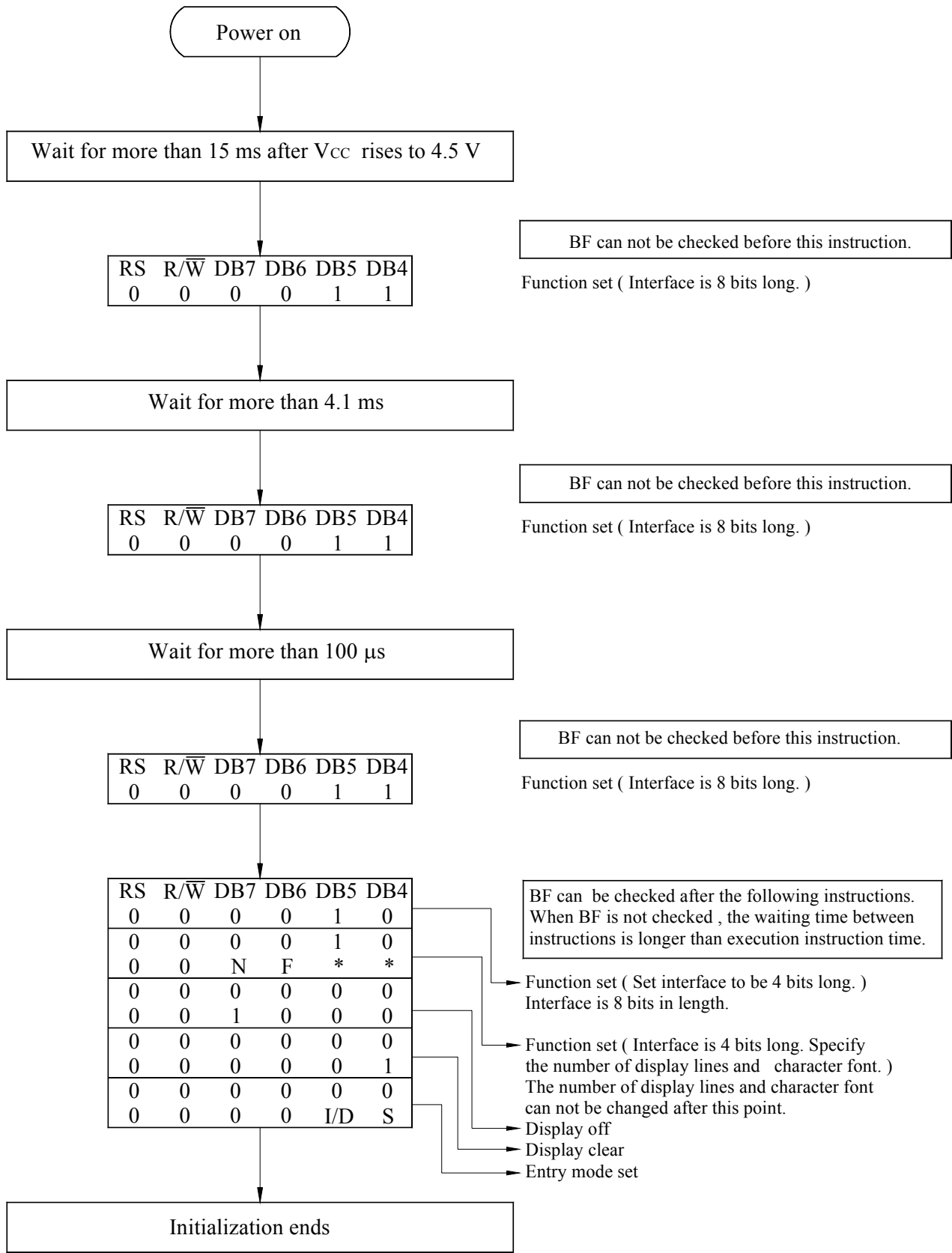
Mode	Characteristic	Symbol	Min.	Typ.	Max.	Unit
Read Mode	E cycle Time	$t_c$	500	-	-	ns
	E Rise/Fall Time	$t_R, t_F$	-	-	20	
	E Pulse Width (High, Low)	$t_w$	230	-	-	
	R/W and RS Setup Time	$t_{su}$	40	-	-	
	R/W and RS Hold Time	$t_h$	10	-	-	
	Data Output Delay Time	$t_D$	-	-	120	
	Data Hold Time	$t_{DH}$	5	-	-	

# 13. Initializing of LCM



8-Bit Inerface





4-Bit Ineterface

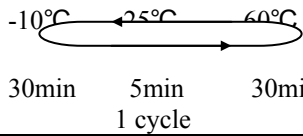
# 14.Quality Assurance

## Screen Cosmetic Criteria

Item	Defect	Judgment Criterion	Partition
1	Spots	<p>A)Clear</p> <p><u>Size: d mm</u>      <u>Acceptable Qty in active area</u></p> <p><math>d \leq 0.1</math>                      Disregard</p> <p><math>0.1 &lt; d \leq 0.2</math>                      6</p> <p><math>0.2 &lt; d \leq 0.3</math>                      2</p> <p><math>0.3 &lt; d</math>                                      0</p> <p>Note: Including pin holes and defective dots which must be within one pixel size.</p> <p>B)Unclear</p> <p><u>Size: d mm</u>      <u>Acceptable Qty in active area</u></p> <p><math>d \leq 0.2</math>                      Disregard</p> <p><math>0.2 &lt; d \leq 0.5</math>                      6</p> <p><math>0.5 &lt; d \leq 0.7</math>                      2</p> <p><math>0.7 &lt; d</math>                                      0</p>	Minor
2	Bubbles in Polarize	<p><u>Size: d mm</u>      <u>Acceptable Qty in active area</u></p> <p><math>d \leq 0.3</math>                      Disregard</p> <p><math>0.3 &lt; d \leq 1.0</math>                      3</p> <p><math>1.0 &lt; d \leq 1.5</math>                      1</p> <p><math>1.5 &lt; d</math>                                      0</p>	Minor
3	Scratch	In accordance with spots cosmetic criteria. When the light reflects on the panel surface, the scratches are not to be remarkable.	Minor
4	Allowable Density	Above defects should be separated more than 30mm each other.	Minor
5	Coloration	Not to be noticeable coloration in the viewing area of the LCD panels. Back-light type should be judged with back-light on state only.	Minor

# 15. Reliability

## Content of Reliability Test

Environmental Test			
Test Item	Content of Test	Test Condition	Applicable Standard
High Temperature storage	Endurance test applying the high storage temperature for a long time.	60°C 200hrs	—
Low Temperature storage	Endurance test applying the high storage temperature for a long time.	-10°C 200hrs	—
High Temperature Operation	Endurance test applying the electric stress (Voltage & Current) and the thermal stress to the element for a long time.	50°C 200hrs	—
Low Temperature Operation	Endurance test applying the electric stress under low temperature for a long time.	0°C 200hrs	—
High Temperature/ Humidity Storage	Endurance test applying the high temperature and high humidity storage for a long time.	60°C,90%RH 96hrs	—
High Temperature/ Humidity Operation	Endurance test applying the electric stress (Voltage & Current) and temperature / humidity stress to the element for a long time.	50°C,90%RH 96hrs	—
Temperature Cycle	Endurance test applying the low and high temperature cycle. 	-10°C/60°C 10 cycles	—
Mechanical Test			
Vibration test	Endurance test applying the vibration during transportation and using.	10~22Hz→ 1.5mmp-p 22~500Hz→ 1.5G Total 0.5hrs	—
Shock test	Constructional and mechanical endurance test applying the shock during transportation.	50G Half sign wave 11 msdc 3 times of each direction	—
Atmospheric pressure test	Endurance test applying the atmospheric pressure during transportation by air.	115mbar 40hrs	—
Others			
Static electricity test	Endurance test applying the electric stress to the terminal.	VS=800V,RS=1.5kΩ CS=100pF 1 time	—

\*\*\*Supply voltage for logic system=5V. Supply voltage for LCD system =Operating voltage at 25°C