

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16221 FGH-PW

Product Specification

Version: 2

08.01.2016

GENERAL SPECIFICATION

MODULE NO. :

DEM 16221 FGH-PW

CUSTOMER P/N:

Version No.	Change Description	Date
0	Original Version	18.05.2015
1	Change External Dimensions and Backlight Drawing	22.07.2015
2	Change External Dimensions Drawing	08.01.2016

PREPARED BY: GJJ

DATE: 08.01.2016

APPROVED BY: MHO

DATE: 08.01.2016

CONTENTS

1. FUNCTIONS & FEATURES 2

2. MECHANICAL SPECIFICATIONS 2

3. EXTERNAL DIMENSIONS 3

4. BLOCK DIAGRAM 4

5. PIN ASSIGNMENT 4

6. BACKLIGHT VOLTAGE AND CURRENT 5

7. DISPLAY DATA RAM (DDRAM)..... 6

8. MAXIMUM ABSOLUTE POWER RATINGS 6

9. DC CHARACTERISTICS 6

10. AC CHARACTERISTICS 7

11. CHARACTER GENERATOR ROM (SPLC783A1-001B)..... 8

12. INSTRUCTION TABLE 9

13. RESET FUNCTION 10

14. THE MODULE ACCEPT QUALITY LEVEL (AQL) 12

15. RELIABILITY TEST 12

16. QUALITY DESCRIPTION..... 13

17. LCD MODULES HANDLING PRECAUTIONS 14

18. OTHERS 14

1. FUNCTIONS & FEATURES

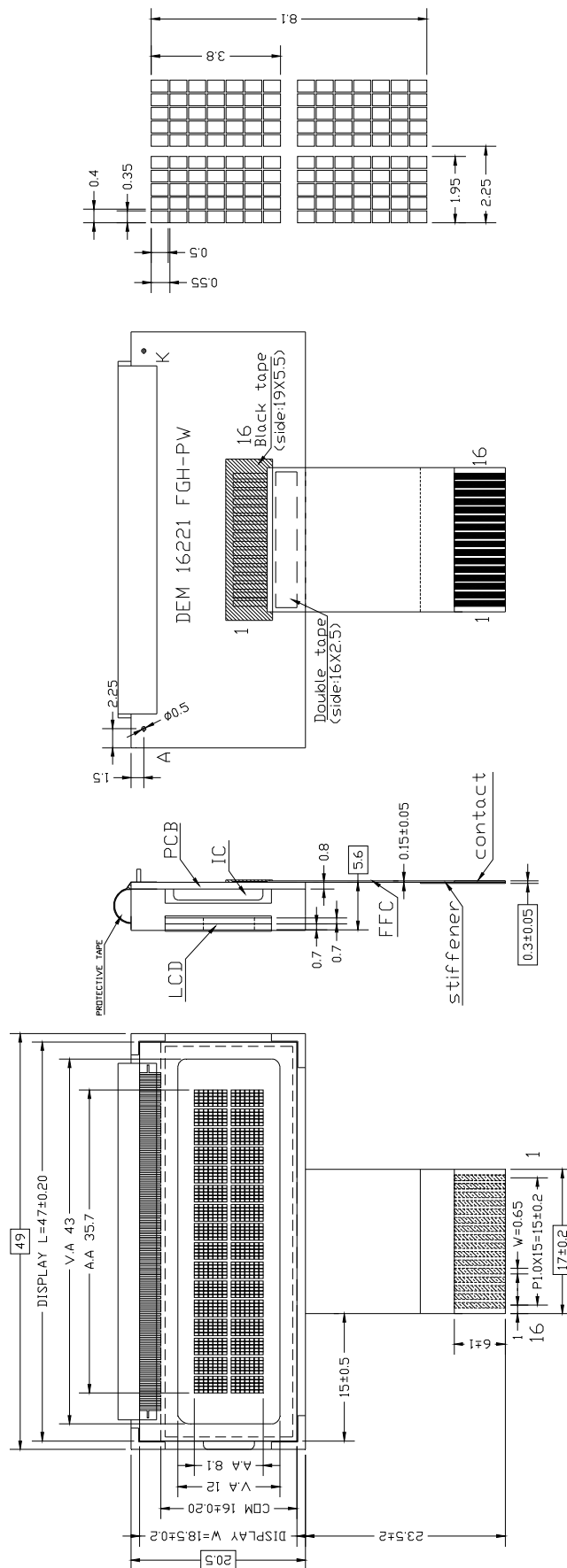
Module	LCD Type	Remark
DEM 16221 FGH-PW	FSTN Transflective Positive Mode	-

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- VLCD : 4.5 Volt (typ.)
- Display contents : 16 Characters x 2 line
- Internal Memory : CGROM (13,200 bits)
: CGRAM (512 bits)
: DDRAM (80 x 8 bits for Digits)
- Interface : Easy Interface with a 4-bit or 8-bit MPU
- LED Backlight : Lightguide, White
- RoHS : Compliant

2. MECHANICAL SPECIFICATIONS

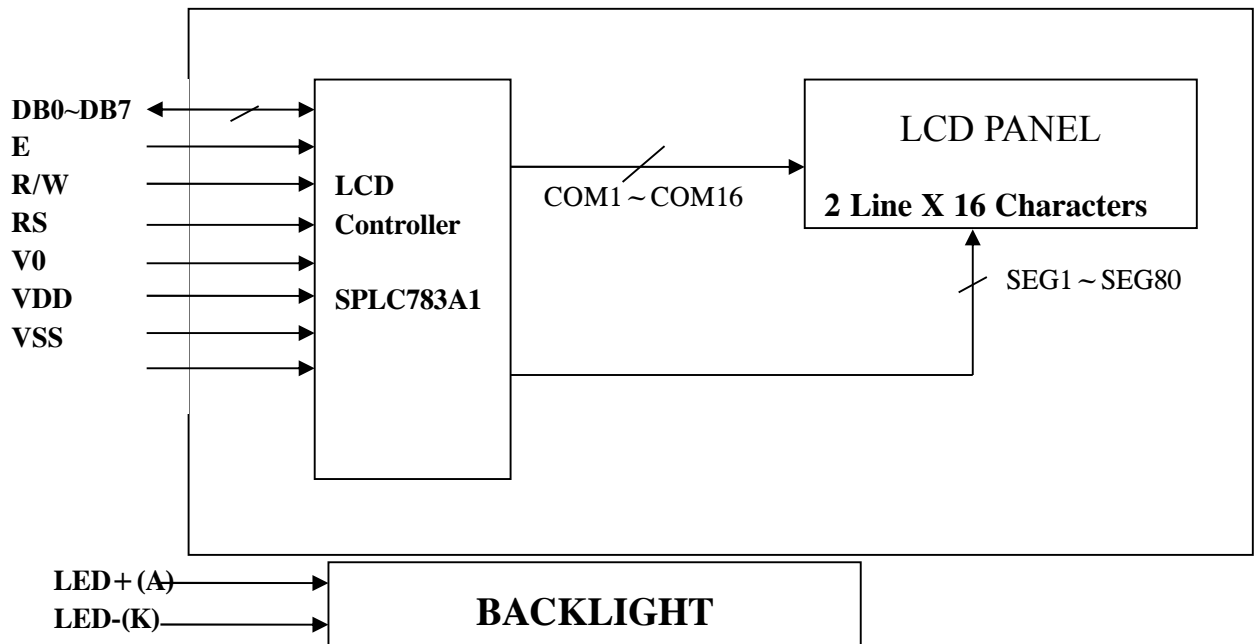
- Module Size : 49.00 x 20.50x 5.60 mm
- Character Pitch : 2.25 x 4.30 mm
- Character Size : 1.95 x 3.80 mm
- Character Font : 5 x 7 dots
- Dot Size : 0.35 x 0.50 mm
- Dot Pitch : 0.40 x 0.55 mm
- Dot Gap : 0.05mm

3. EXTERNAL DIMENSIONS



Remarks:
 1, Unmarked tolerance is ± 0.3 ,
 2, The material comply with RoHS.
 3. ...critical dimension.

4. BLOCK DIAGRAM



5. PIN ASSIGNMENT

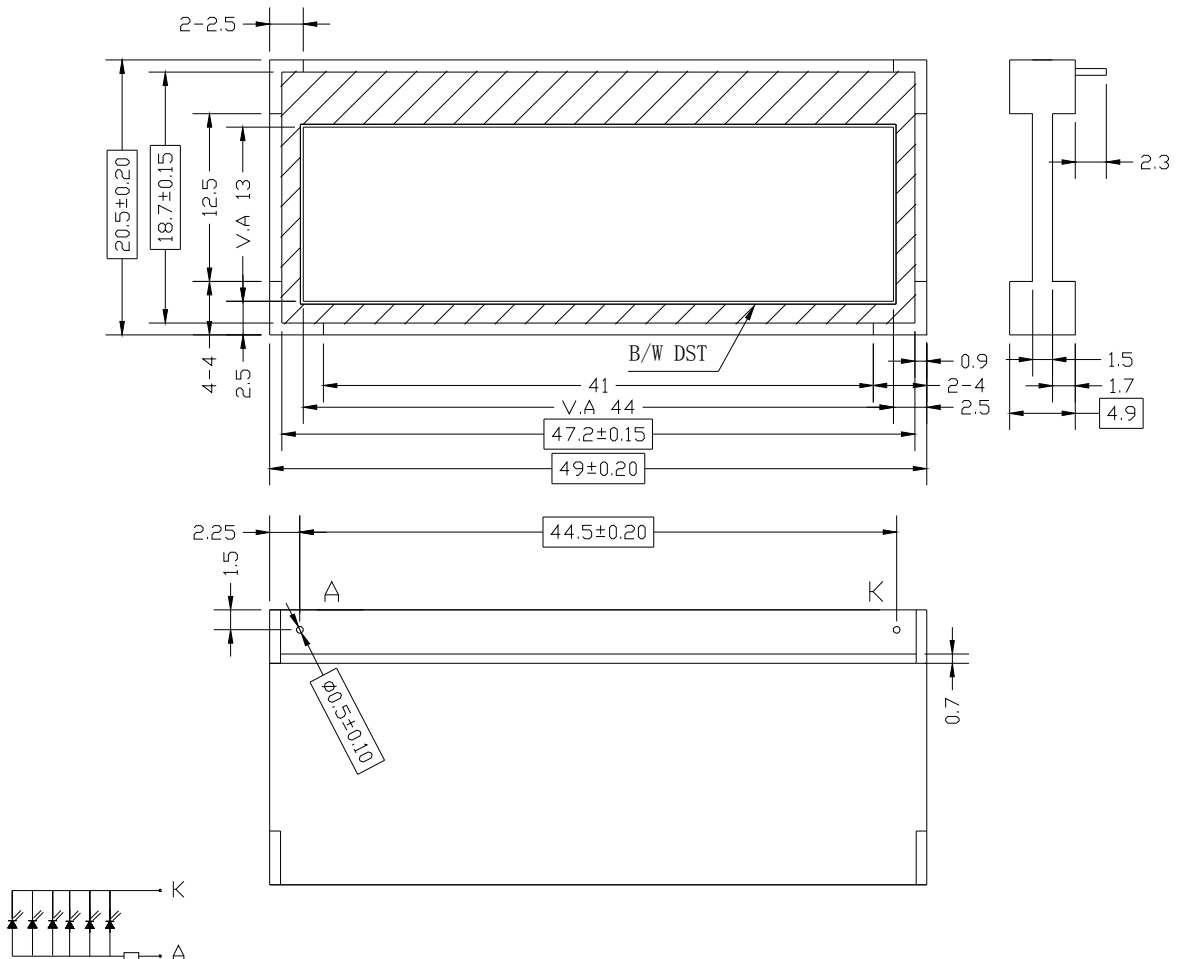
Pin No.	Symbol	Function
1	VSS	Ground terminal of module
2	VDD	Supply terminal of module 5.0 V
3	V0	Power Supply for Liquid crystal Drive
4	RS	Register select RS = 0...Instruction register RS = 1...Data register
5	R/W	Read /Write R/W = 1...Read R/W = 0... Write
6	E	A start signal for reading or writing data
7	DB0	Bi-directional data bus, data transfer is performed once, thru DB0 to DB7, in the case of interface data. Length is 8-bits; and twice, thru DB4 to DB7 in the case of interface data length is 4-bits. Upper four bits first then lower four bits.
8	DB1	
9	DB2	
10	DB3	
11	DB4	
12	DB5	
13	DB6	
14	DB7	
15	LED+(A)	Anode of Backlight
16	LED-(K)	Cathode of Backlight

6. BACKLIGHT VOLTAGE AND CURRENT

ELECTRICAL–OPTICAL CHARACTERISTICS

Ta=25°C. Unless specified, The Ambient temperature Ta=25°C

Item	Symbol	min.	typ.	max.	Unit	Condition
Forward Voltage	Vf	2.8	3.0	3.5	V	If= 36 mA
Power Dissipation	Pd			126	mW	If= 36 mA
Luminous Uniformity	ΔLv	70			%	MIN/MAX*100%
Luminance	Lv	700	1000		cd/m ²	If= 36 mA T=25°C
Color Coordinate	X	0.260		0.320		
	Y	0.260		0.320		
Lifetime	50000(brightness reduce half)				Hours	



Remarks:

- 1.Unmarked tolerance is ±0.3
- 2.All materials comply with RoHs
- 3.□ ...critical dimension.
- 4.Backlight:Colour:White 6PCSLED

7. 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	←DDRAM ADDRESS
SECOND LINE	40	41	42	43	44	45	46	47	48	49	4A	4B	4C	4D	4E	4F	

8. MAXIMUM ABSOLUTE POWER RATINGS

Item	Symbol	Standard value	Unit
Power Supply Voltage(1)	V _{DD}	-0.3~+7.0	V
Power Supply Voltage(2)	V _{LCD}	V _{DD} -12.0~V _{DD} +0.3	V
Input Voltage	V _{IN}	-0.3~V _{DD} +0.3	V°C
Operating Temperature	Topr	-20 to +70	°C
Storage Temperature	Tstg	-25 to +75	°C

9. DC CHARACTERISTICS

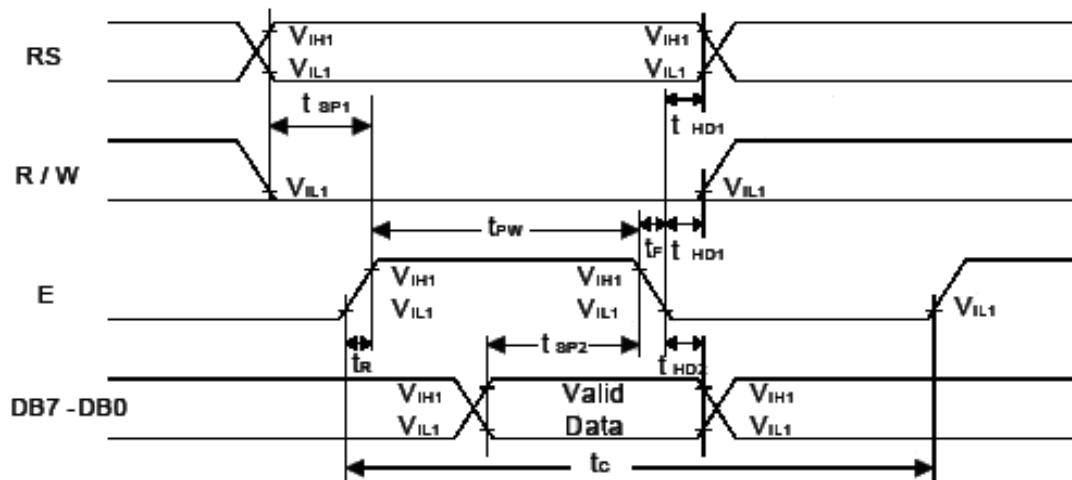
Item	Symbol	Standard Value			Test Condition	Unit
		MIN	TYP	MAX		
Operating Voltage	V _{DD}	4.7	5.0	5.3	-----	V
LCD Driving Voltage	V _{LCD}	4.2	4.5	4.8	V _{DD} -V ₀	V
Supply Current	I _{DD}	----	0.9	1.35	-----	mA

*Note: FOSC = 270 KHz, VDD = 5.0V, pin E = .L, RS, R/W, DB0 - DB7 are open, all outputs are no loads.

10. AC CHARACTERISTICS

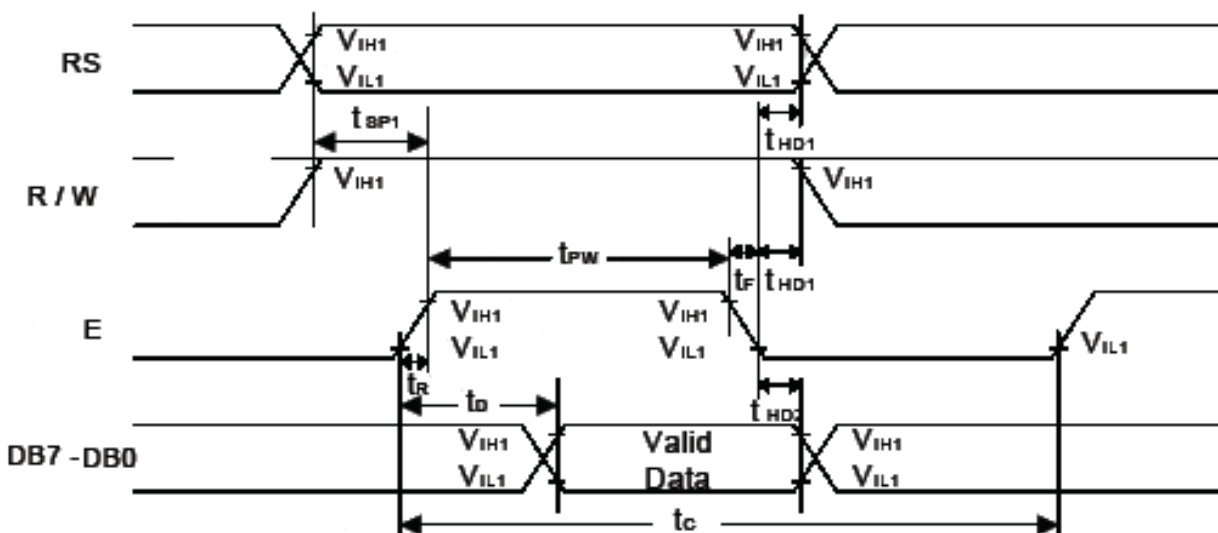
Write mode (writing data from MPU to SPLC783A1)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	500	-	-	ns	Pin E
E Pulse Width	t_{pw}	220	-	-	ns	Pin E
E Rise/Fall Time	t_r, t_f	-	-	25	ns	Pin E
Address Setup Time	t_{sp1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{hd1}	10	-	-	ns	Pins: RS, R/W, E
Data Setup Time	t_{sp2}	60	-	-	ns	Pins: DB0 - DB7
Data Hold Time	t_{hd2}	10	-	-	ns	Pins: DB0 - DB7



Read mode (Reading data from SPLC783A1 to MPU)

Characteristics	Symbol	Limit			Unit	Test Condition
		Min.	Typ.	Max.		
E Cycle Time	t_c	500	-	-	ns	Pin E
E Pulse Width	t_w	220	-	-	ns	Pin E
E Rise/Fall Time	t_r, t_f	-	-	25	ns	Pin E
Address Setup Time	t_{sp1}	40	-	-	ns	Pins: RS, R/W, E
Address Hold Time	t_{hd1}	10	-	-	ns	Pins: RS, R/W, E
Data Output Delay Time	t_d		-	120	ns	Pins: DB0 - DB7
Data Hold Time	t_{hd2}	20	-	-	ns	Pins: DB0 - DB7



11. CHARACTER GENERATOR ROM (SPLC783A1-001B)

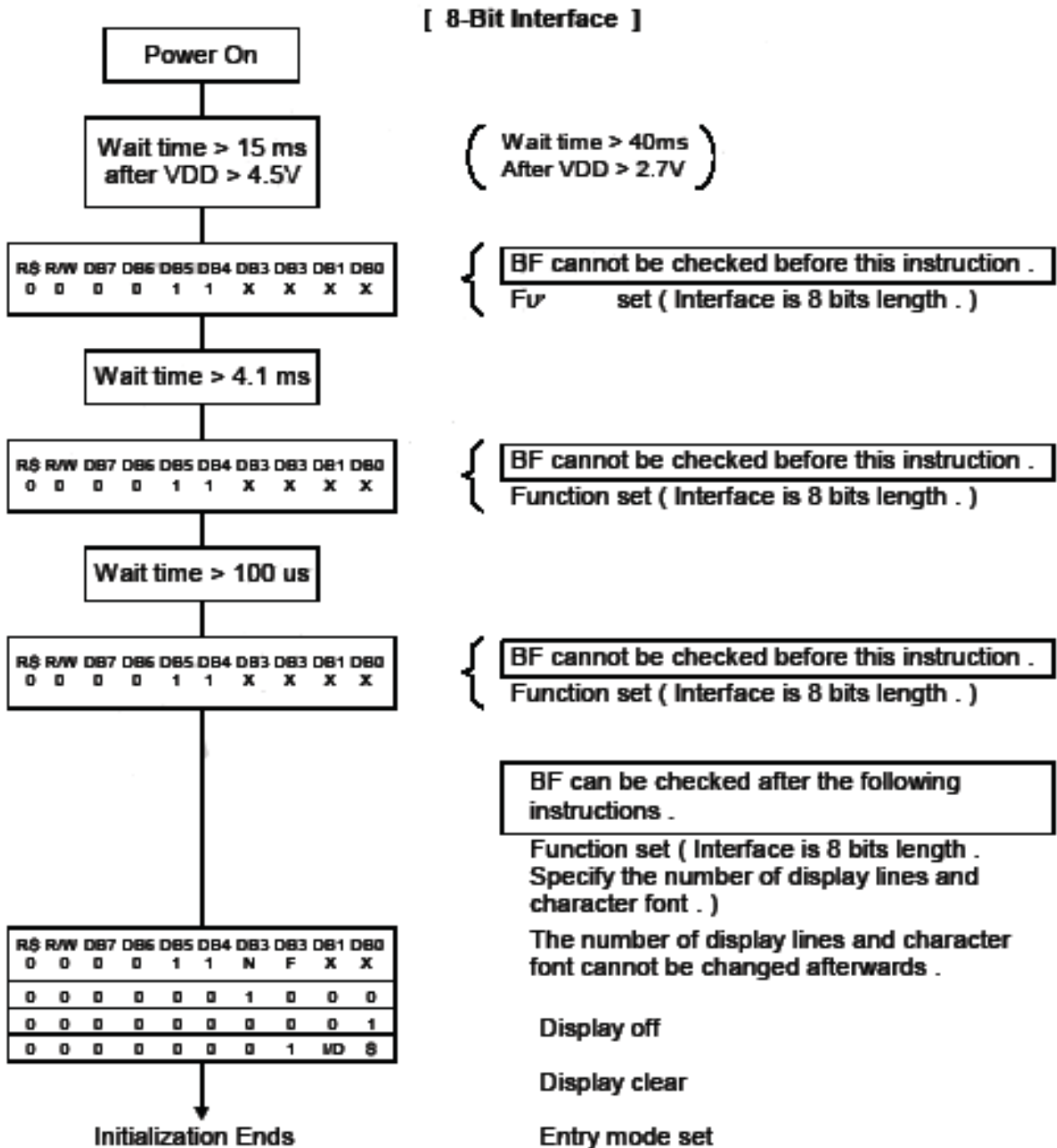
Upper(4bit) Lower(4bit)	LLLL	LLHL	LLHH	LHLL	LHLH	LHHL	LHHH	HLLL	HLLH	HLHL	HLHH	HLLL	HHLH	HHLL	HHHH
LLLL	CGRAM (1)														
LLHH	(2)														
LLHL	(3)														
LLHH	(4)														
LHLL	(5)														
LHLH	(6)														
LHHL	(7)														
LHHH	(8)														
HLLL	(1)														
HLLH	(2)														
HLHL	(3)														
HLHH	(4)														
HLLL	(5)														
HHLH	(6)														
HHLL	(7)														
HHHH	(8)														

12. 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	0	1	Write "20H" to DDRAM and set DDRAM address to "00H" from AC.	1.52 ms
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	1.52ms
Entry Mode set	0	0	0	0	0	0	0	0	1	I/D	S	Assign cursor moving direction and enable the shift of entire display.	38us
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.	38us
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.	38us
Function set	0	0	0	0	0	1	DL	N	F	-	-	Set interface data length (DL:4-bit/8-bit), numbers of display line (N:1-line/2-line, display font type (F: 5×10 dots/5×8 dots)	38us
Set CGRAM address	0	0	0	1	AC5	AC4	AC3	AC2	AC1	AC0		Set CGRAM address in address counter.	38us
Set DDRAM address	0	0	1	AC6	AC5	AC4	AC3	AC2	AC1	AC0		Set DDRAM address in address counter.	38us
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).	38us
Read data to RAM	1	1	D7	D6	D5	D4	D3	D2	D1	D0		Read data into internal RAM (DDRAM/CGRAM).	38us

NOTE: "-" don't care

13. RESET FUNCTION



(Wait time > 40ms
After VDD > 2.7V)

BF cannot be checked before this instruction .
Fu set (Interface is 8 bits length .)

BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

BF cannot be checked before this instruction .
Function set (Interface is 8 bits length .)

BF can be checked after the following instructions .

Function set (Interface is 8 bits length .
Specify the number of display lines and
character font .)

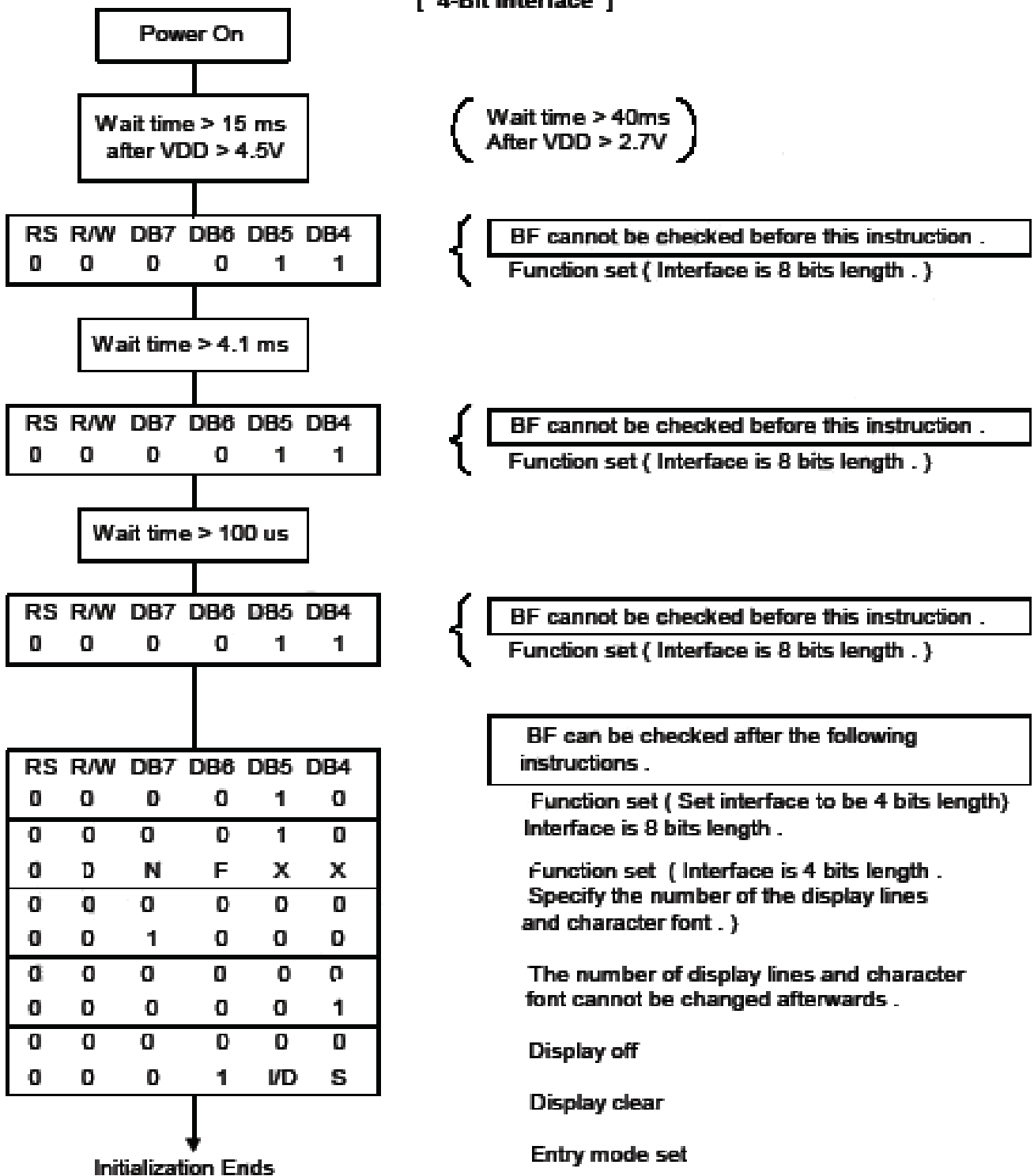
The number of display lines and character
font cannot be changed afterwards .

Display off

Display clear

Entry mode set

[4-Bit Interface]



14. THE MODULE ACCEPT QUALITY LEVEL (AQL)

14.1. AQL standard value: Critical defect =0.1, Major defect=0.65; Minor defect =2.5.

14.2. Inspection Standard: MIL-STD-105E Table Normal Inspection Single Sampling Level II.

15. RELIABILITY TEST

Operating life time: 50,000 hours

(at room temperature without direct irradiation of sunlight)

Reliability characteristics shall meet following requirements.

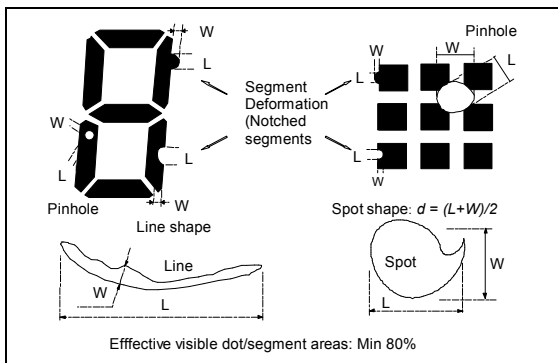
Tests Item	Condition
High temperature storage	+75°C x 96HR
Low temperature storage	-25°C x 96HR
High temperature operation	+70°C x 96HR
Low temperature operation	-20°C x 96HR
High temperature, High humidity	+60°C x 90%RH x 96HR
Thermal shock	-20°C x 30min → 25°C x 10s → +70°C x 30 min x 5 cycles
Vibration test	Frequency x Swing x Time 40Hz x 4mm x 4hrs
Drop test	Height x no. of drop 1.0m x 6 drops

16. QUALITY DESCRIPTION

DEFECT SPECIFICATION:

Specific type-related items are covered in this sheet.

a: Table for Cosmetic defects
 (Note: nc = not counted).
 Sizes and number of defects
 (Max. Qty)



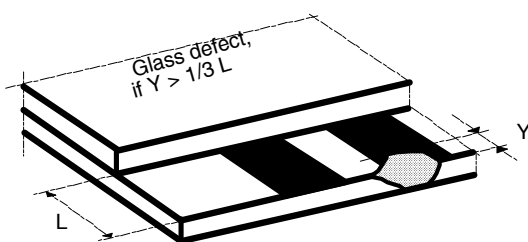
Example

s/ Shapes

b: Glass defects

b1: Glass defects at contact ledge

b2: Glass chipping in other areas shall not be in conflict



with the product's function.

Defect Type	Max. defect size [μm] d or L W	Max. Quantity.
Black or White Spots	$d \leq 150$	nc
	$150 < d \leq 300$	5
Black or White Lines	--	nc
	$L \leq 5000$ $W \leq 30$	3
	$L \leq 2000$ $W \leq 50$	2
Pinhole	$d \leq 150$	nc
	$150 < d \leq 300$	1/segment
(Total defects)		(5)
Segment Deformation	$W \leq 100$	nc
Bubble (e.g. under pola)	$d \leq 150$	nc
	$200 < d \leq 400$	3
	$400 < d \leq 600$	1

17. 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.

18. 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.