

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16221 SBH-PW-N

Product Specification

Version: 1

22.07.2015

GENERAL SPECIFICATION

MODULE NO. :

DEM 16221 SBH-PW-N

CUSTOMER P/N:

| Version No. | Change Description | Date |
|-------------|--|------------|
| 0 | Original Version | 18.05.2015 |
| 1 | Change External Dimensions and Backlight Drawing | 22.07.2015 |
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PREPARED BY: GJ

DATE: 22.07.2015

APPROVED BY: MH

DATE: 22.07.2015

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1. FUNCTIONS & FEATURES

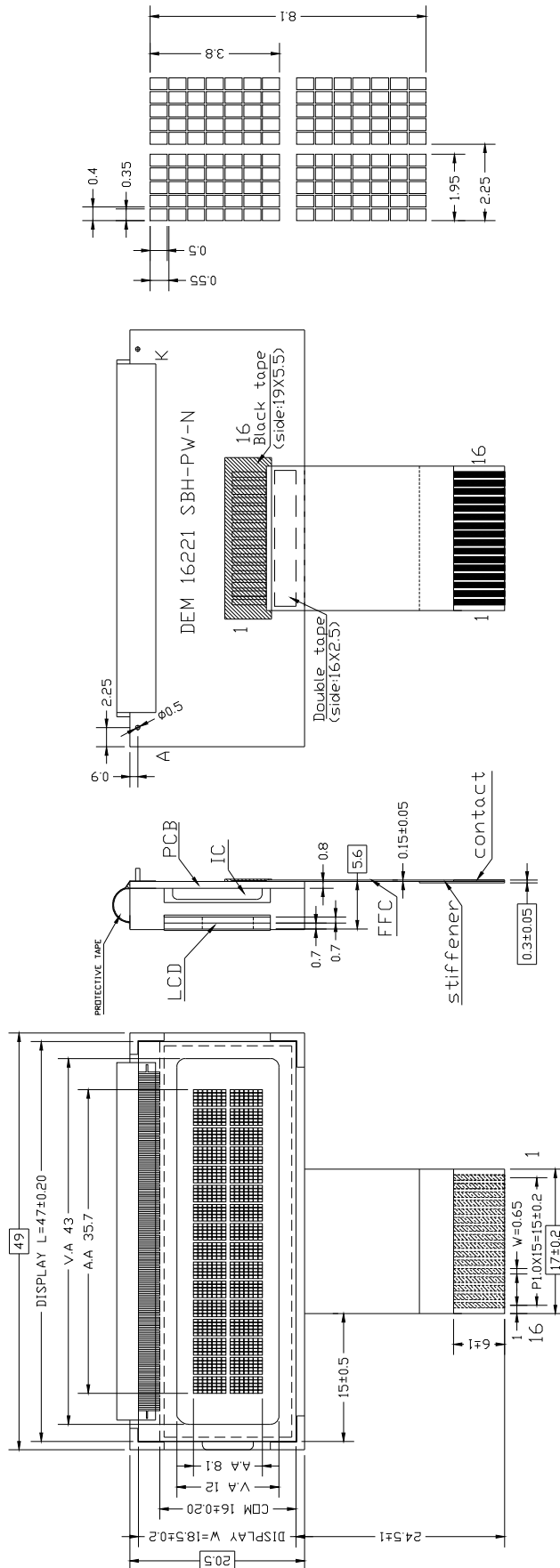
| MODULE NAME | LCD TYPE |
|--------------------|-------------------------------------|
| DEM 16221 SBH-PW-N | STN Blue Transmissive Negative Mode |

- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- VLCD : 4.5 Volt (typ.)
- Display Format : 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

2. MECHANICAL SPECIFICATIONS

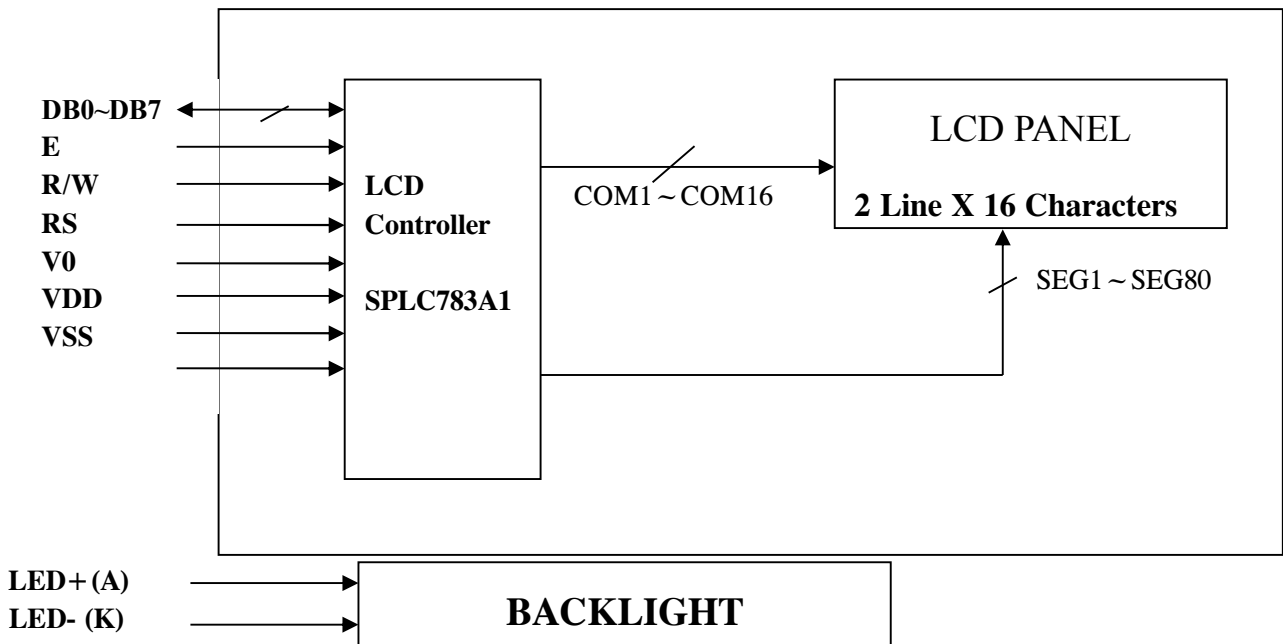
- Module Size : 49.00 x 20.50 x 5.60 mm
- Character Pitch : 2.25 x 4.30 mm
- Character Size : 1.95 x 3.80 mm
- Character Font : 5 x 7 dots
- Dot Size : 0.35 x 0.50 mm
- Dot Pitch : 0.40 x 0.55 mm
- Dot Gap : 0.05 mm

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

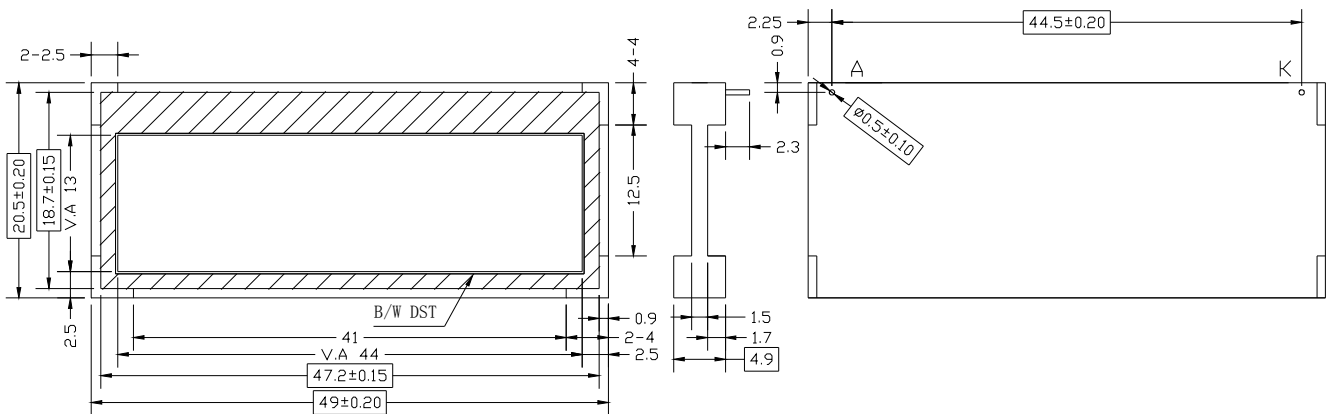
| Pin No. | Symbol | Function |
|---------|---------|--|
| 1 | VSS | Ground terminal of module |
| 2 | VDD | Supply terminal of module 5.0 V |
| 3 | V0 | Power Supply for Liquid crystal Drive |
| 4 | RS | Register select RS = 0 (Instruction register) RS = 1 (Data register) |
| 5 | R/W | Read /Write R/W = 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 | 100.8 | 108 | 126 | mW | If= 36 mA |
| Luminous Uniformity | ΔL_v | 70 | | | % | MIN/MAX*100% |
| Luminance | Lv | 800 | 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 |
| Operating Temperature | Topr | -20~+70 | □ |
| Storage Temperature | Tstg | -25~+75 | □ |

9. DC CHARACTERISTICS

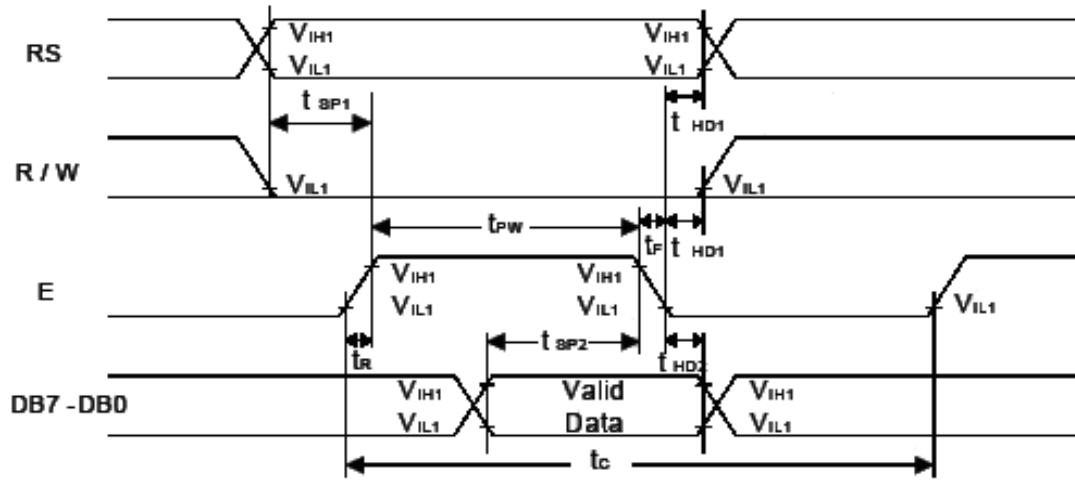
| Item | Symbol | Standard Value | | | Test Condition | Unit |
|---------------------|------------------|----------------|-----|------|---------------------------------|------|
| | | MIN | TYP | MAX | | |
| Operating Voltage | V _{DD} | 4.7 | 5.0 | 5.3 | ----- | V |
| LCD Driving Voltage | V _{LCD} | 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

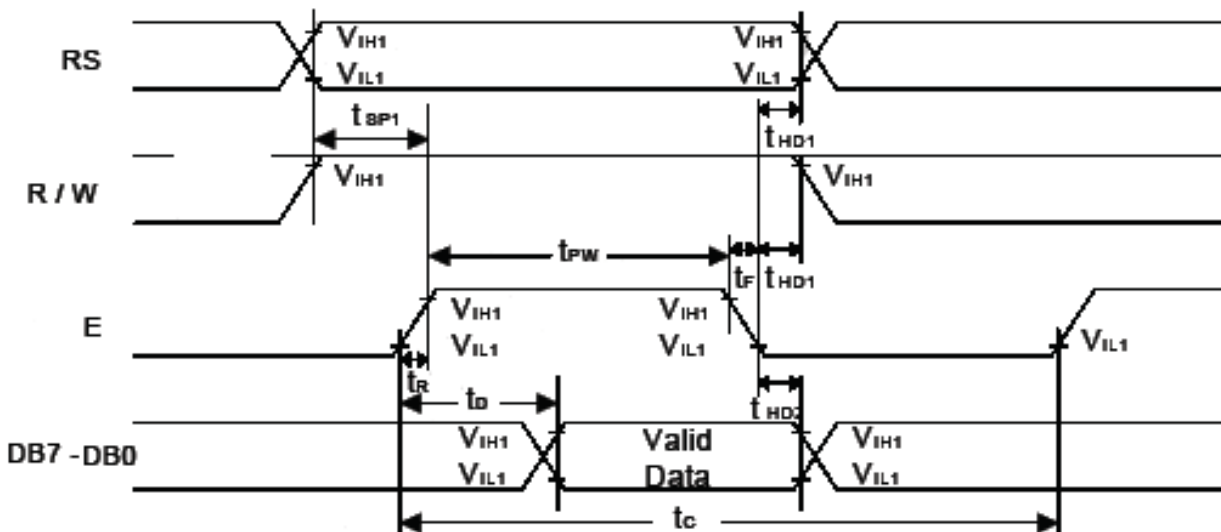
Write mode (writing data from MPU to SPLC783A1)

| 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)

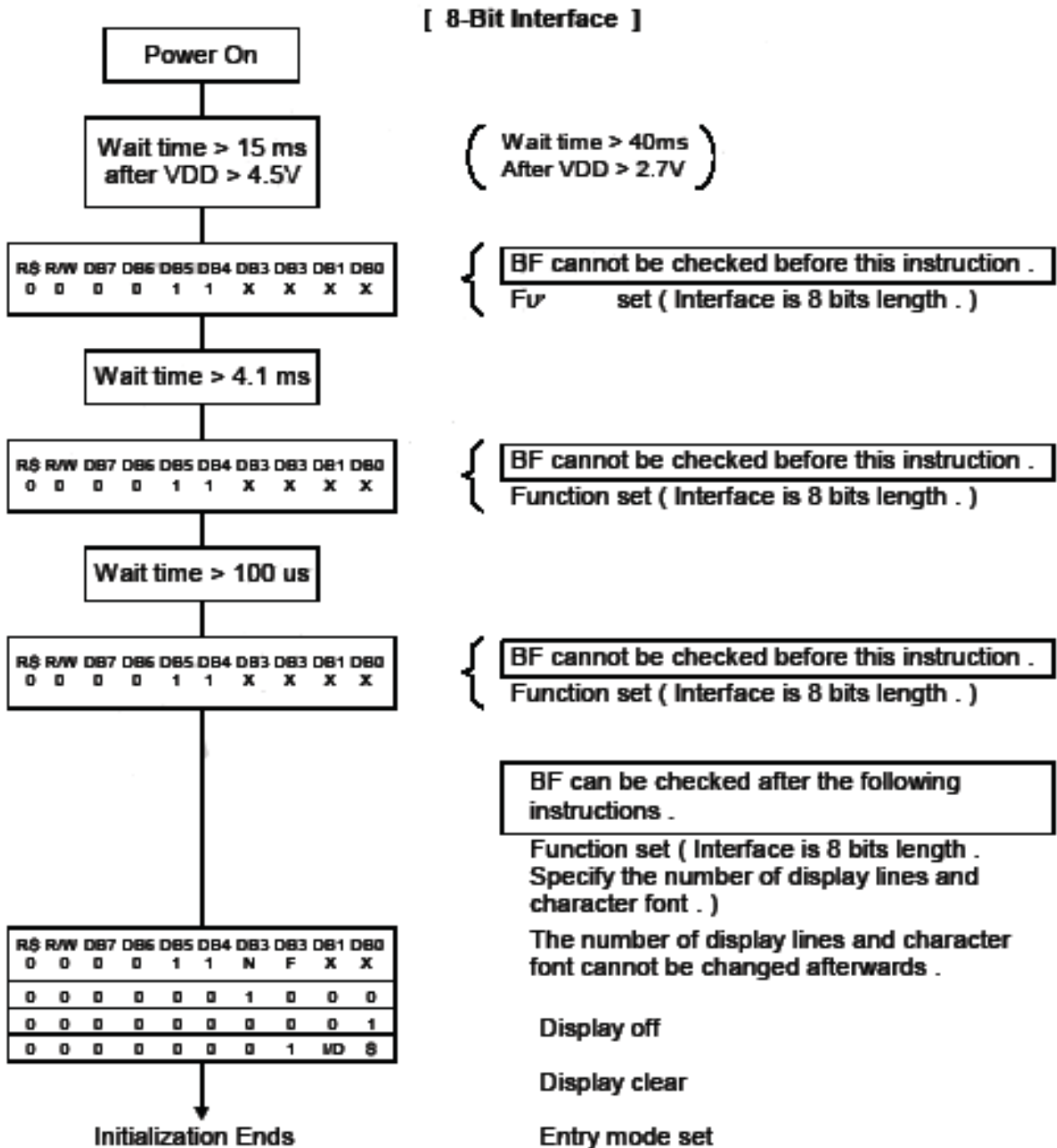
| Upper(4bit) Lower(4bit) | LLLL | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HLLL | HHLH | HHLL | HHHH | |
|----------------------------|--------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-----|
| | CGRAM (1) |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

12. INSTRUCTION TABLE

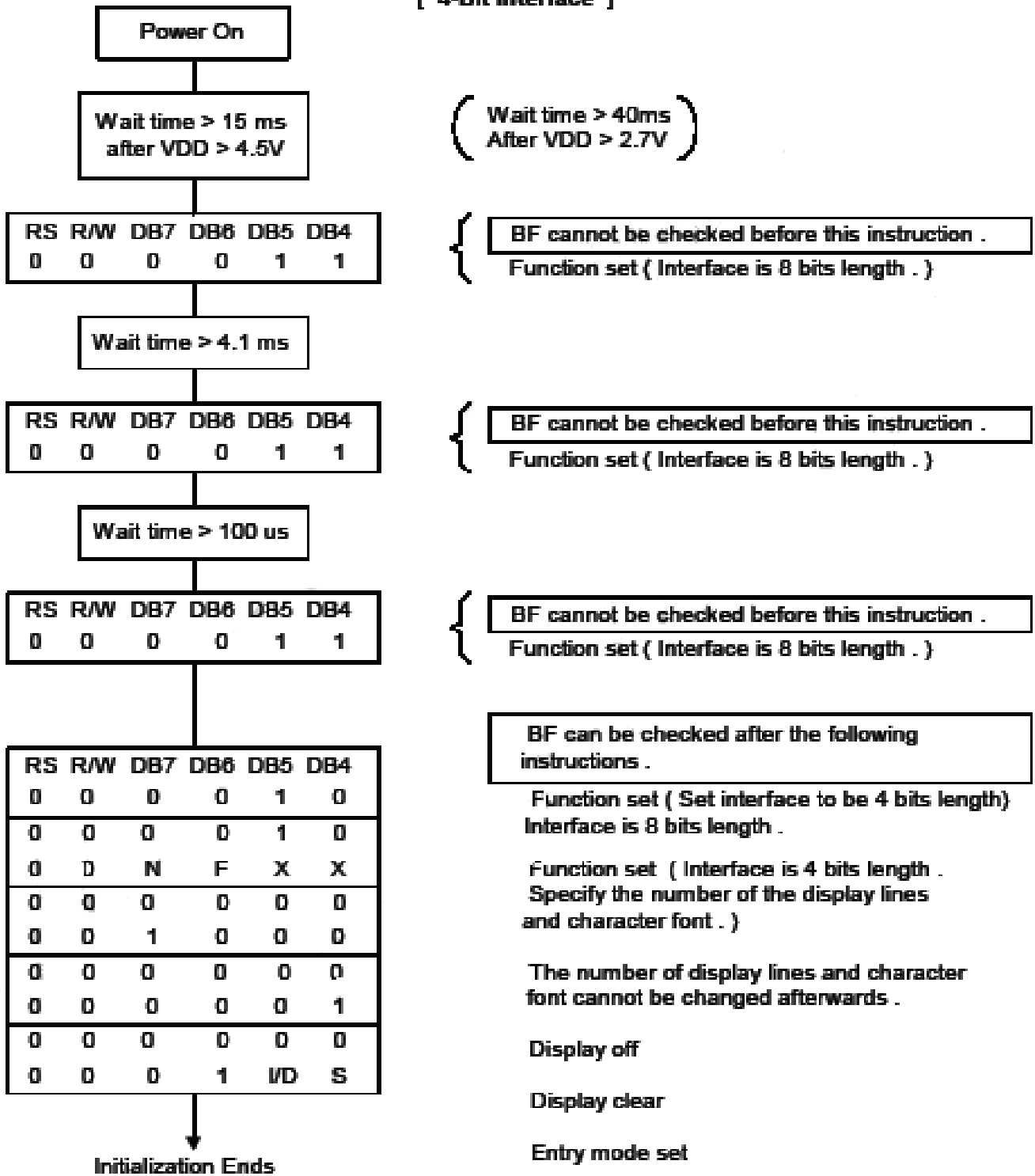
| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270kHz) | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|---|---------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | | |
| 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



[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.

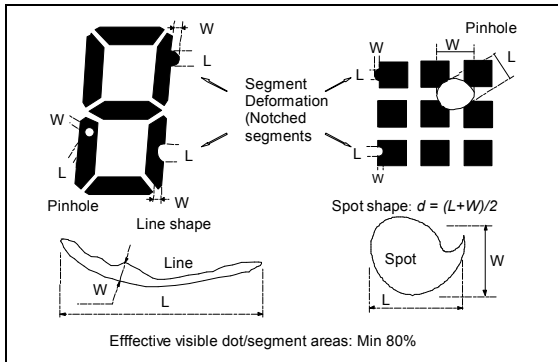
| Tests Item | Condition |
|---------------------------------|---|
| High Temperature Storage | +75°C x 96HR |
| Low Temperature Storage | -25°C x 96HR |
| High Temperature Operation | +70°C x 96HR |
| Low Temperature Operation | -20°C x 96HR |
| High Temperature, High Humidity | +60°C x 90%RH x 96HR |
| 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)



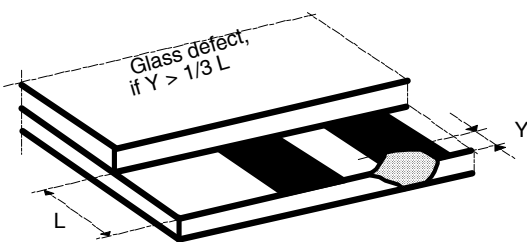
Example

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.

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