

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16221 - SERIES

Product Specification

Version : 5.1.2

24/Oct/2008

GENERAL SPECIFICATION

MODULE NO. :

DEM 16221 - SERIES

CUSTOMER P/N

| VERSION NO. | CHANGE DESCRIPTION | DATE |
|-------------|------------------------|------------|
| 0 | ORIGINAL VERSION | 25.01.2001 |
| 1 | ADD VERSION | 30.03.2001 |
| 2 | ADD VERSION | 07.09.2001 |
| 3 | CHANGE MODULE DRAWING | 08.05.2003 |
| 4 | ADD VERSION | 20.04.2005 |
| 5 | CHANGED MODULE DRAWING | 04.05.2006 |
| 5.1.2 | CHANGE IC | 24.10.2008 |
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| | | |
| | | |
| | | |

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DATE: 24.10.2008

APPROVED BY: MH

DATE: 24.10.2008

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1. FUNCTIONS & FEATURES

| MODULE NAME | FFC-CONTACTS | LCD TYPE |
|----------------------------|---------------|--|
| DEM 16221 SYH (solder) | For soldering | STN Yellow-Green Reflective Positive Mode |
| DEM 16221 SYH (solder/tr.) | For soldering | STN Yellow-Green Transflective Positive Mode |
| DEM 16221 SYH (FFCF) | Front | STN Yellow-Green Reflective Positive Mode |
| DEM 16221 SYH (FFCF/tr.) | Front | STN Yellow-Green Transflective Positive Mode |
| DEM 16221 SYH (FFCR) | Rear | STN Yellow-Green Reflective Positive Mode |
| DEM 16221 SYH (FFCR/tr.) | Rear | STN Yellow-Green Transflective Positive Mode |

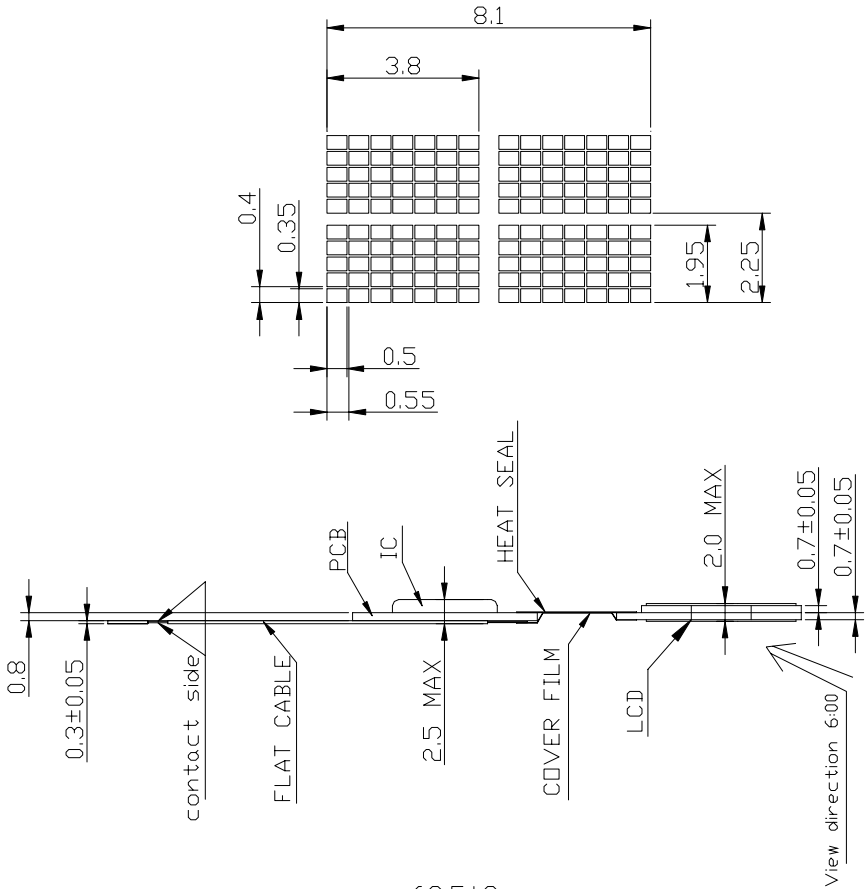
- Viewing Direction : 6 o'clock
- Driving Scheme : 1/16 Duty Cycle, 1/5 Bias
- Power Supply Voltage : 5.0 Volt (typ.)
- VLCD Adjustable For Best Contrast : 4.5 Volt (typ.)
- Display contents : 16x2 Characters
- Internal Memory : CGROM (10,880 bits)
: CGRAM (512 bits)
: DDRAM (80 x 8 bits for Digits)
- Interface : Easy Interface with a 4-bit or 8-bit MPU
- Operating Temperature : -20°C to +70°C
- Storage Temperature : -25°C to +75°C

2. MECHANICAL SPECIFICATIONS

- Module Size : 47.00 x 44.00 x 2.50 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

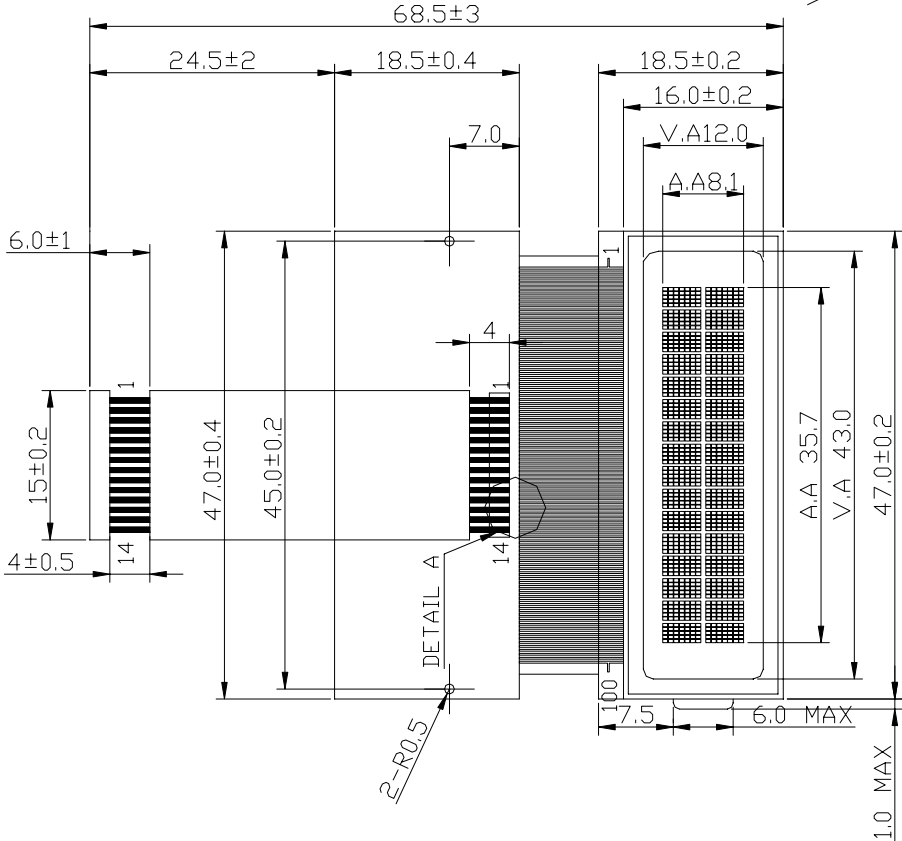
3. EXTERNAL DIMENSIONS

3.1 DEM 16221 SYH (soldering) + DEM 16221 SYH (soldering/tr)

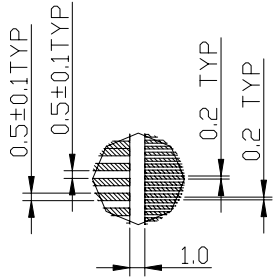


(4 : 1)

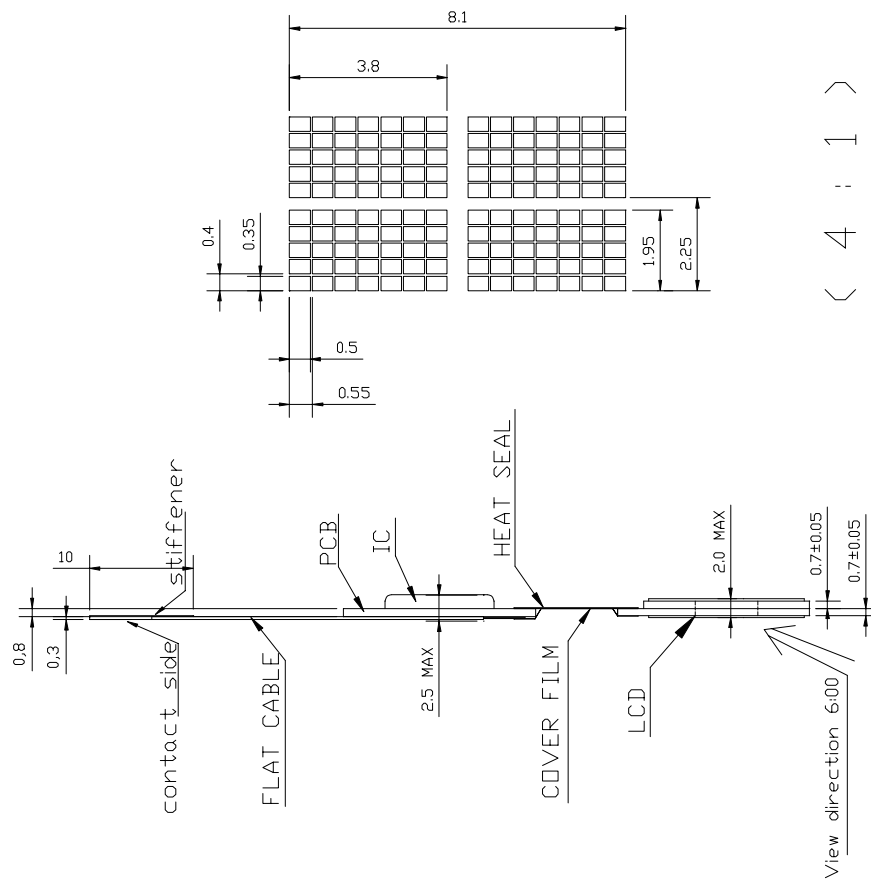
Remarks:
1, Unmarked tolerance is ±0.3,
2, The material comply with RoHS,
3, open contacts for soldering process



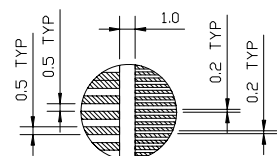
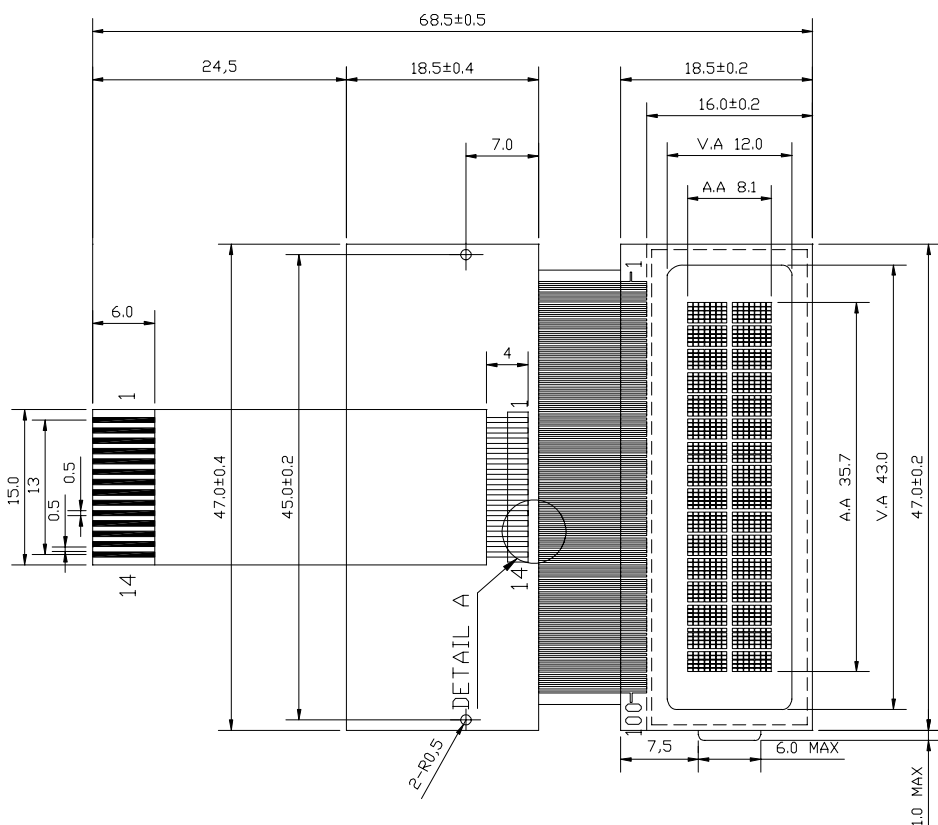
DETAIL A (3 : 1)



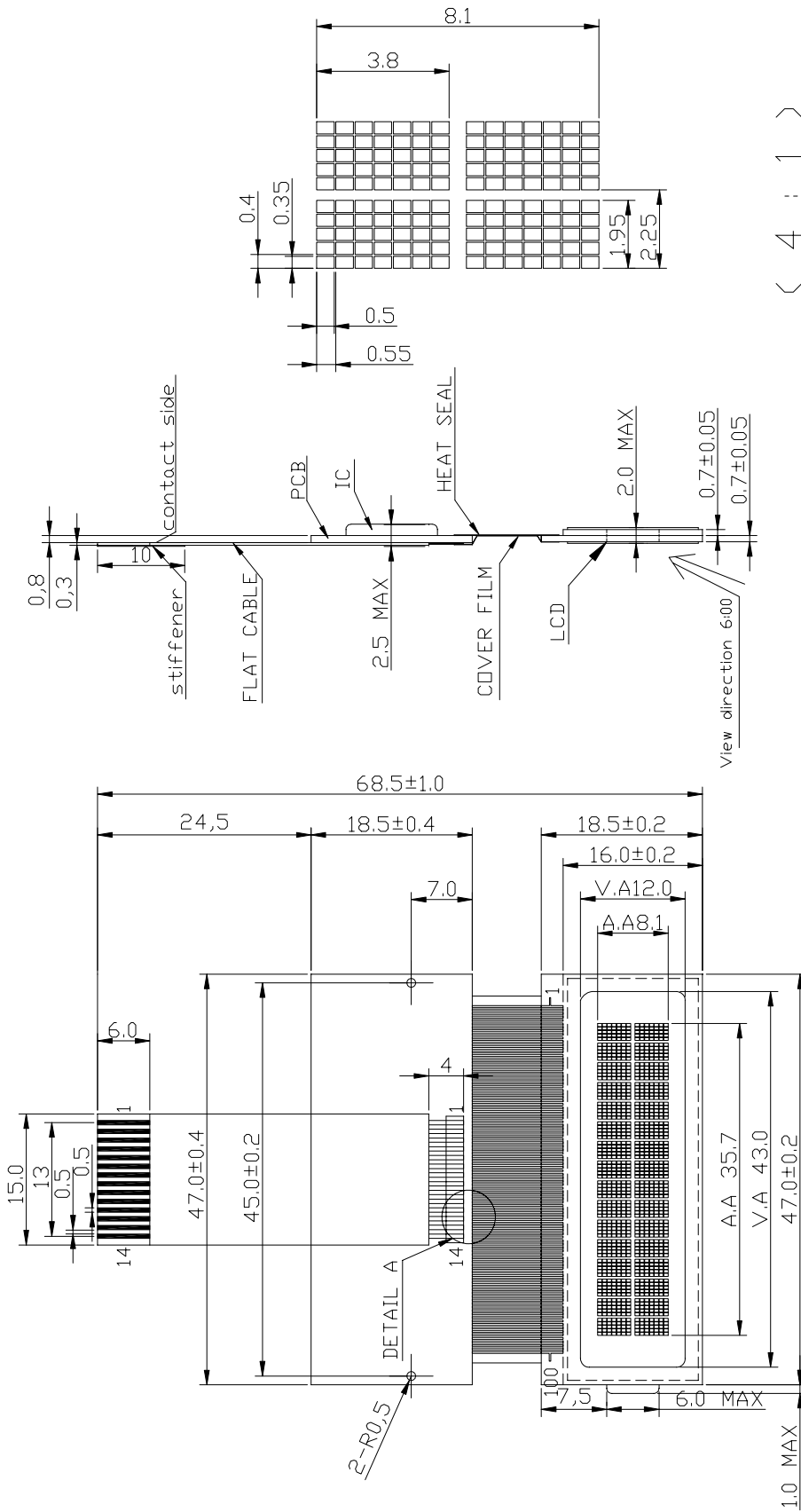
3.2 DEM 16221 SYH (FFCF) + DEM 16221 SYH (FFCF/tr)



UNLISTED TOLERANCE IS ±0.3
THE MATERIAL IS LEAD-FREE.



3.3 DEM 16221 SYH (soldering) + DEM 16221 SYH (soldering/tr)

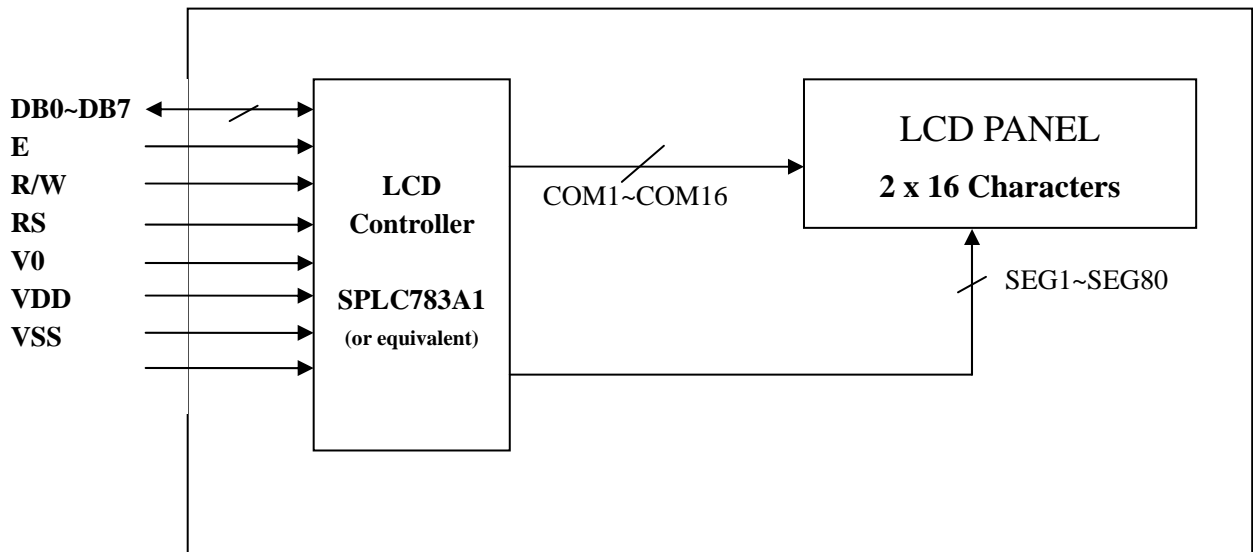


UNLISTED TOLERANCE IS ±0.3
THE MATERIAL IS LEAD-FREE.

(4 : 1)

DETAIL A (3 : 1)

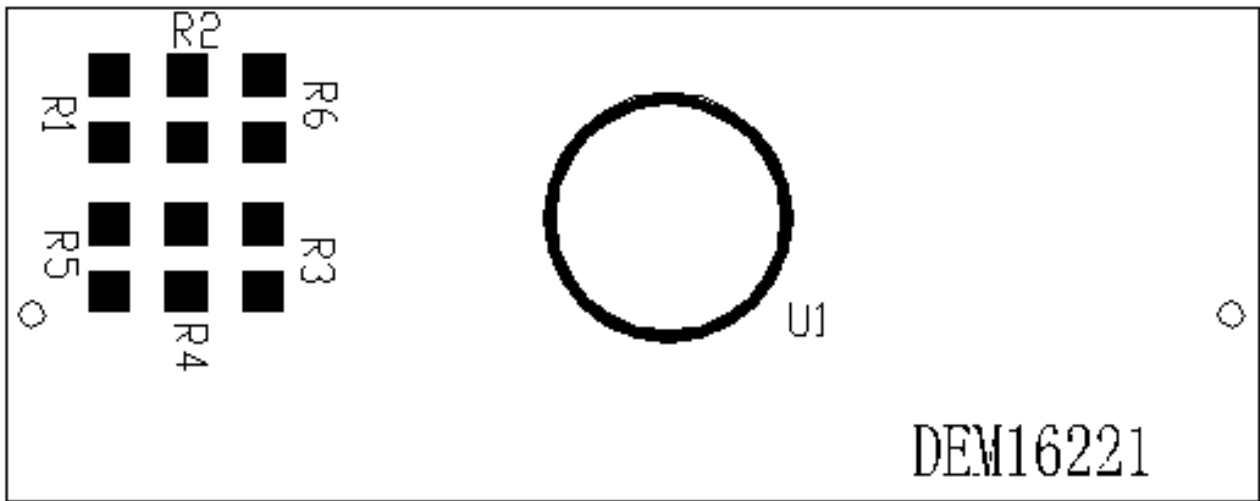
4. BLOCK DIAGRAM



5. PIN ASSIGNMENT

| Pin No. | Symbol | Function |
|---------|-----------------|--|
| 1 | V _{SS} | Ground terminal of module |
| 2 | V _{DD} | Supply terminal of module 5.0 V |
| 3 | V ₀ | 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 | |

6. PCB DRAWING AND DESCRIPTION



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 (Ta=25°C)

| 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 | T _{opr} | -20~+70 | °C |
| Storage Temperature | T _{stg} | -25~+75 | °C |

9. DC CHARACTERISTICS

(V_{DD}=5.0V, Ta=25°C)

| Item | Symbol | Standard Value | | | Test Condition | Unit |
|---------------------|------------------|----------------|-----|------|---------------------------------|------|
| | | MIN | TYP | MAX | | |
| Operating Voltage | V _{DD} | 4.7 | 5 | 5.3 | ----- | V |
| LCD Driving Voltage | V _{LCD} | 4.2 | 4.5 | 4.8 | V _{DD} -V ₀ | V |
| Supply Current | I _{DD} | ---- | TBD | ---- | ----- | mA |

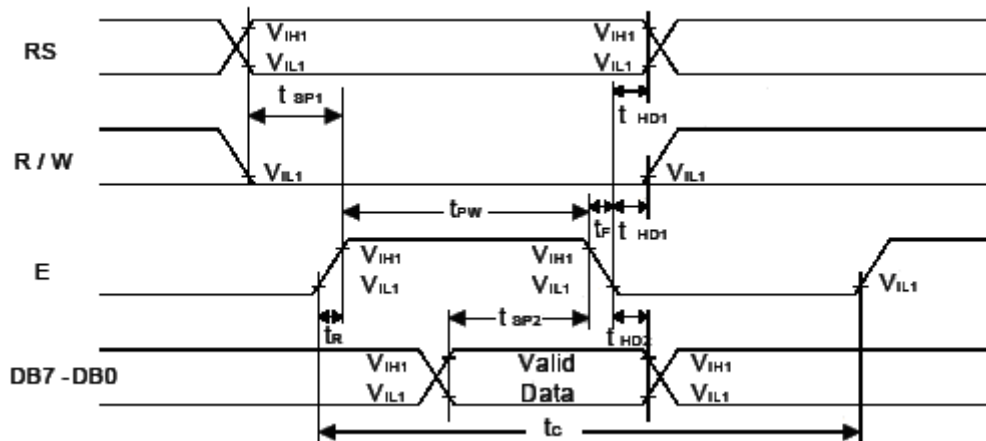
*Note: F_{OSC} = 270KHZ, V_{DD} = 5.0V, pin E = .L., RS, R/W, DB0 - DB7 are open, all outputs are no loads.

10. AC CHARACTERISTICS

Write mode (writing data from MPU to SPLC783A1)

($V_{DD}=5.0V$, $T_a=25^{\circ}C$)

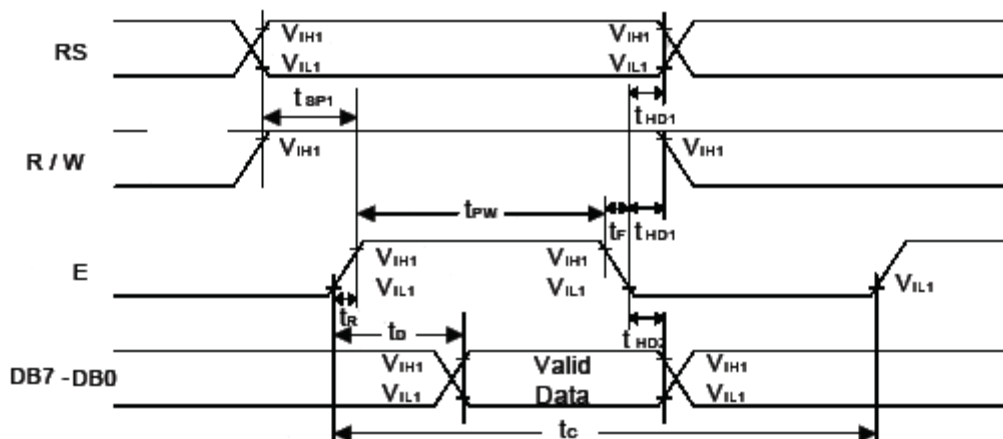
| Characteristics | Symbol | Limit | | | Unit | Test Condition |
|--------------------|------------|-------|------|------|------|------------------|
| | | Min. | Typ. | Max. | | |
| E Cycle Time | t_C | 500 | - | - | ns | Pin E |
| E Pulse Width | t_{PW} | 220 | - | - | ns | Pin E |
| E Rise/Fall Time | 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)

($V_{DD}=5.0V$, $T_a=25^{\circ}C$)

| 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)

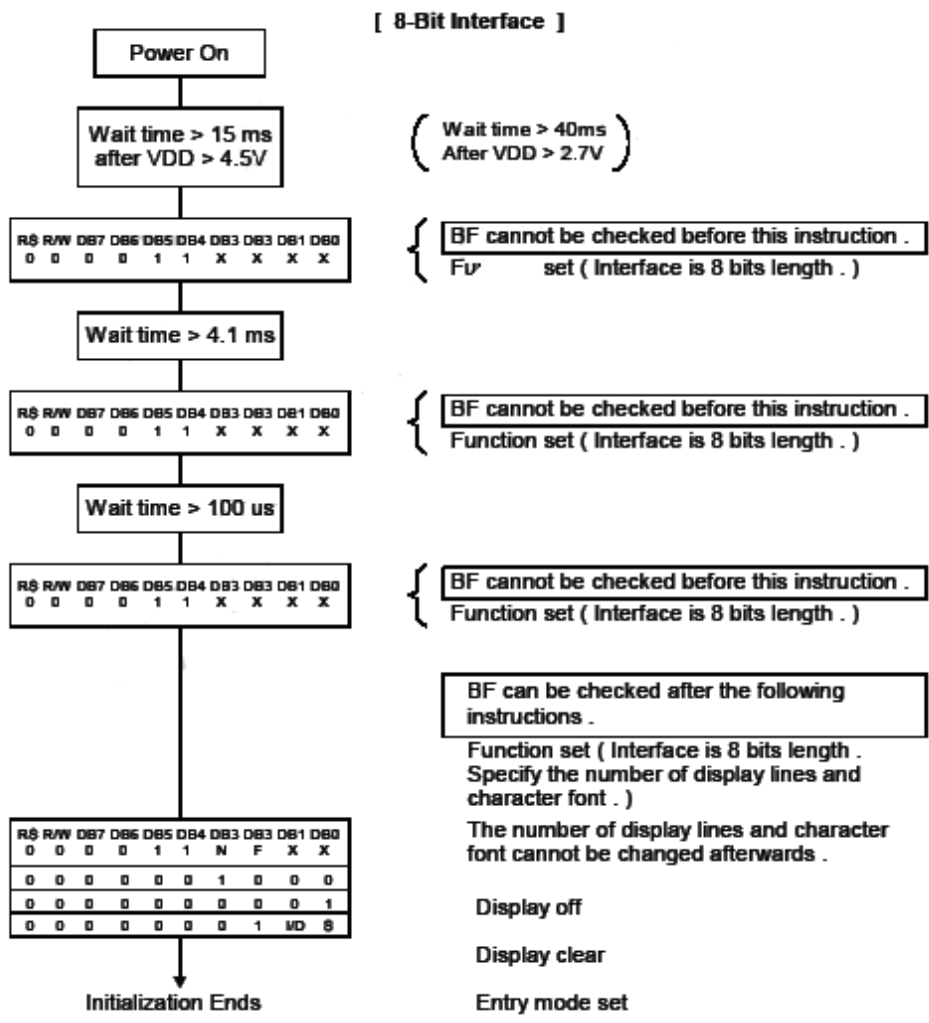
| Upper(4bit) \ Lower(4bit) | LLLL | LLHL | LLHH | LHLL | LHLH | LHHL | LHHH | HLLL | HLLH | HLHL | HLHH | HLLL | HHLH | HHHL | HHHH |
|---------------------------|---------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| LLLL | CG RAM (1) | | | | | | | | | | | | | | |
| 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) | | | | | | | | | | | | | | |
| HHHL | (7) | | | | | | | | | | | | | | |
| HHHH | (8) | | | | | | | | | | | | | | |

12. INSTRUCTION TABLE

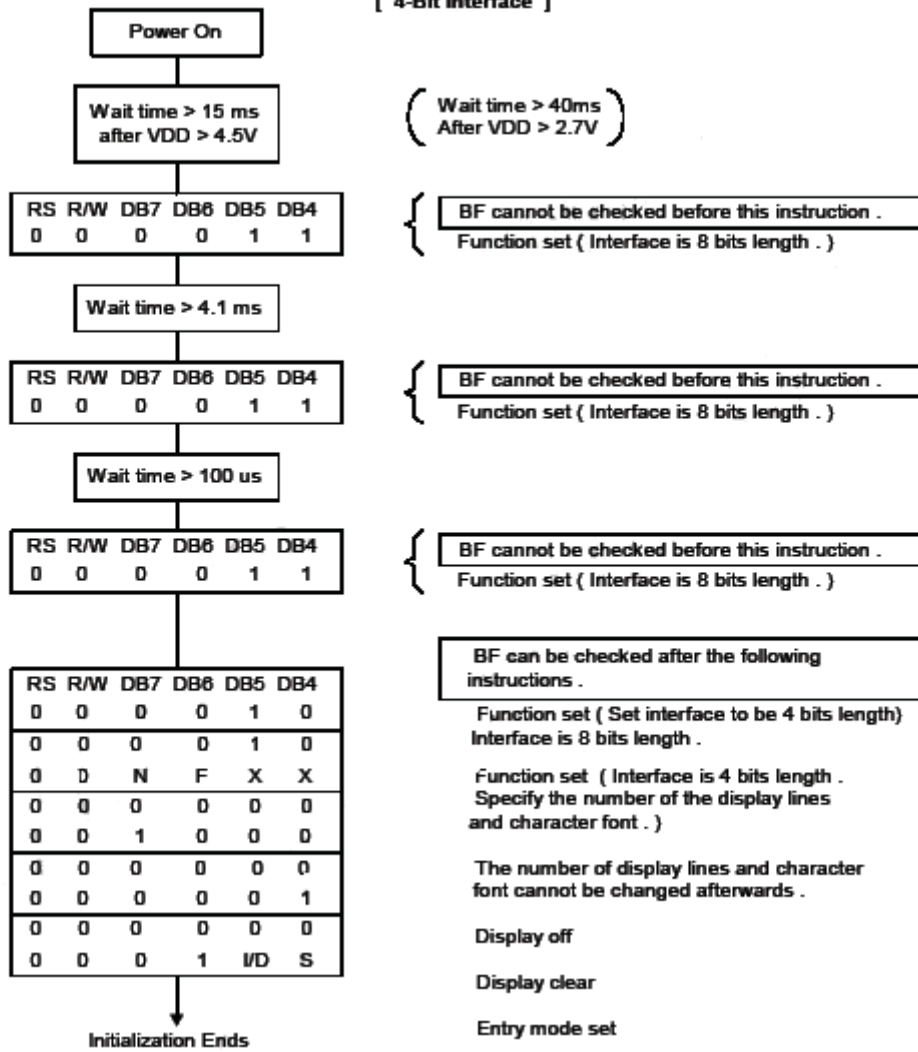
| Instruction | Instruction Code | | | | | | | | | | Description | Execution time (fosc=270kHz) | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-------------|---|---------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | | |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



[4-Bit Interface]



14. 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.

15. 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