

DISPLAY Elektronik GmbH

DATA SHEET

LCD MODULE

DEM 16207 FGH-PW

Product Specification

Version : 4

01.09.2017

GENERAL SPECIFICATION

MODULE NO. :

DEM 16207 FGH-PW

CUSTOMER P/N

| Version NO. | Change Description | Date |
|-------------|---|------------|
| 0 | Specification Released | 07.02.2013 |
| 1 | Revised Optical Characteristics | 21.02.2013 |
| 1.0 | Change Production Line | 12.05.2017 |
| 1.1 | Update the dimension 4.35mm in page 4 and adding chapter 18/19/20 | 15.05.2017 |
| 2 | Update LCD drawing/Update BL Luminance | 23.05.2017 |
| 3 | Delete the dimension 2.67 on page 4; Update the block diagram on page 5; Update definition of characteristics on page 11-16 | 01.06.2017 |
| 4 | Change Dimension | 01.09.2017 |
| | | |
| | | |
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| | | |
| | | |

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DATE: 01.09.2017

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1. FUNCTIONS &FEATURES

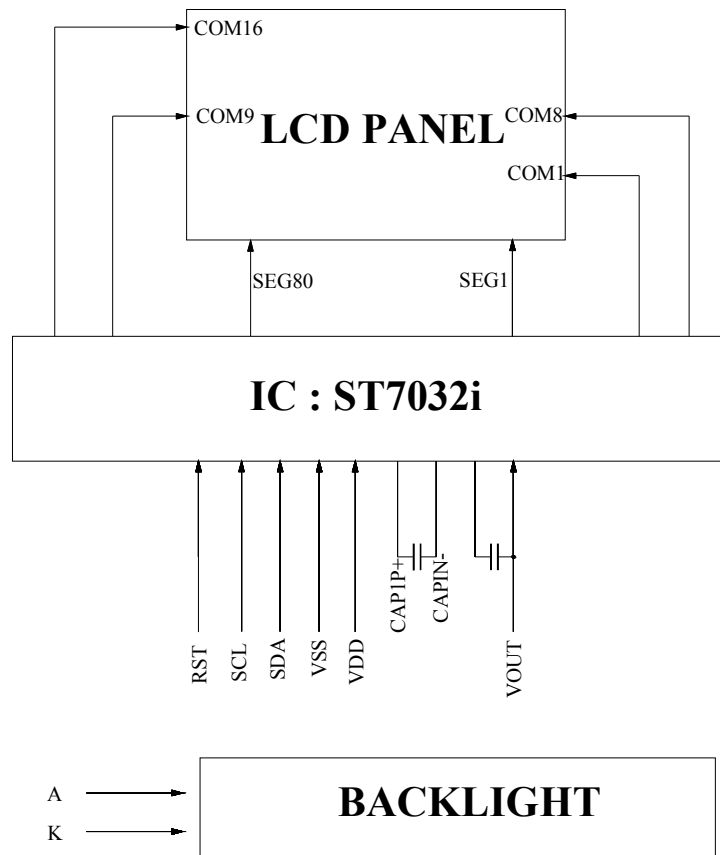
| MODULE NAME | LCD Type |
|--------------------|----------------------------------|
| DEM 16207 FGH-PW | FSTN Transflective Positive Mode |

- Viewing Direction : 6 O'clock
- Driving Scheme : 1/16 Duty, 1/5 Bias
- Supply Voltage : 4.2 Volt (typ.)
- Vop Adjustable For Best Contrast : 4.2 Volt (typ.)
- Driver IC : ST7032i (Sitronix)
- Interface : I²C
- RoHS Compliant

2. MECHANICAL SPECIFICATIONS

- Module Size (without FPC) : 59.00 x 26.00 x 4.35 mm
- Viewing Area : 50.00 x 16.00 mm
- Active Area : 46.70 x 10.00 mm

4. BLOCK DIAGRAM



5. PIN ASSIGNMENT

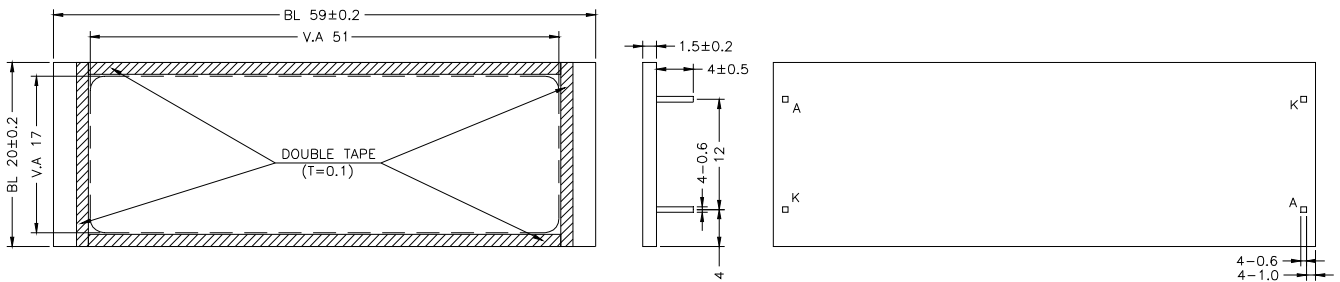
| Pin No. | Name | Description |
|---------|-------|--|
| 1 | RST | Reset Signal Input(Active Low) |
| 2 | SCL | Serial Clock Input |
| 3 | SDA | Serial Data I/O |
| 4 | VSS | Ground. |
| 5 | VDD | Power Supply |
| 6 | CAP1+ | For voltage booster circuit (VDD-VSS) |
| 7 | CAP1- | External capacitor about 0.1uF~4.7uF |
| 8 | VOUT | DC/DC voltage converter. Connect a capacity between this terminal and VDD when the built-in booster is used. |

6. BACKLIGHT ELECTRICAL/OPTICAL SPECIFICATIONS

Electrical/Optical Characteristic

ELECTRICAL–OPTICAL CHARACTERISTICS

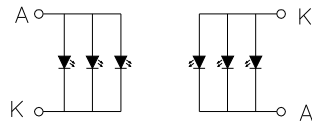
| Item | Symbol | min. | typ. | max. | Unit | Condition |
|---------------------|--------------|------|------|------|-------------------|-----------------------|
| Forward Voltage | Vf | 3.0 | 3.2 | 3.4 | V | If= 60*2 mA |
| Power Dissipation | Pd | 360 | 384 | 408 | mW | If= 60*2 mA |
| Luminous Uniformity | ΔL_v | 70 | | | % | MIN/MAX*100% |
| Luminance | Lv | | 3800 | | cd/m ² | If= 60*2 mA T=25°C |
| Color Coordinate | X | 0.23 | | 0.34 | | |
| | Y | 0.23 | | 0.34 | | |



Remarks:

- 1.Unmarked tolerance is ±0.3
- 2.All materials comply with Rohs
3. [] ...:critical dimension.
- 4.Operation temperature:−20°C to +70°C
Storage temperature:−30°C to +80°C

Circuit Diagram
Color:White



7. ABSOLUTE MAXIMUM RATINGS

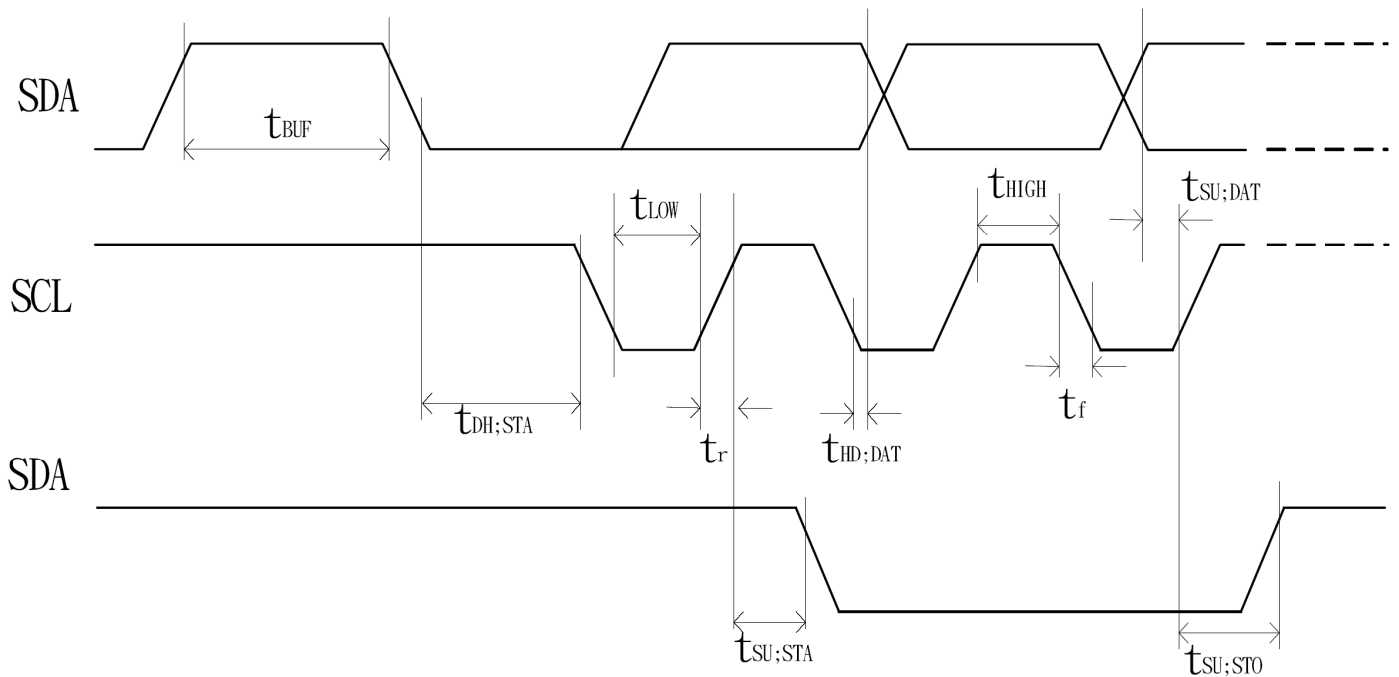
| Characteristic | Symbol | Value | Unit |
|-----------------------|------------------|---|------|
| Power Supply Voltage | VDD | -0.3 to +6.0 | V |
| LCD Driver Voltage | Vop | 7.0 - V _{SS} to -0.3 + V _{SS} | V |
| Input Voltage | V _{IN} | -0.3 to V _{DD} +0.3 | V |
| Operating Temperature | T _{opr} | -20 to +70 | □ |
| Storage Temperature | T _{stg} | -30 to +80 | □ |

8. ELECTRICAL CHARACTERISTICS**8.1 DC CHARACTERISTICS**

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--------------------|-----------------|------|------|------|------|
| Supply Voltage | VDD | 3.9 | 4.2 | 4.5 | V |
| LCD Supply Voltage | Vop | 3.9 | 4.2 | 4.5 | V |
| Supply Current | I _{DD} | --- | TBD | --- | mA |

8-2. AC Characteristics

| Item | Signal | Symbol | Condition | VDD=2.7 to 4.5V Rating | | VDD=4.5 to 5.5V Rating | | Units |
|--|----------|--------------|-----------|------------------------|------|------------------------|------|-------|
| | | | | Min. | Max. | Min. | Max. | |
| SCL clock frequency | SCL | f_{SCLK} | — | DC | 400 | DC | 400 | KHz |
| SCL clock low period | | t_{LOW} | | 1.3 | — | 1.3 | — | |
| SCL clock high period | | t_{HIGH} | | 0.6 | — | 0.6 | — | |
| Data set-up time | SI | $t_{SU;DAT}$ | — | 180 | — | 100 | — | ns |
| Data hold time | | $t_{HD;DAT}$ | | 0 | 0.9 | 0 | 0.9 | |
| SCL,SDA rise time | SCL, SDA | t_r | — | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | ns |
| SCL,SDA fall time | | t_f | | $20+0.1C_b$ | 300 | $20+0.1C_b$ | 300 | |
| Capacitive load represent by each bus line | | C_b | — | — | 400 | — | 400 | pf |
| Setup time for a repeated START condition | SI | $t_{SU;STA}$ | — | 0.6 | — | 0.6 | — | us |
| Start condition hold time | | $t_{HD;STA}$ | — | 0.6 | — | 0.6 | — | |
| Setup time for STOP condition | | $t_{SU;STO}$ | — | 0.6 | — | 0.6 | — | us |
| Bus free time between a Stop and START condition | SCL | t_{BUF} | — | 1.3 | — | 1.3 | — | us |



9. INSTRUCTION

| Instruction | Instruction Code | | | | | | | | | | Description | Instruction Execution Time | | |
|----------------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|--|----------------------------|------------|------------|
| | RS | R/W | DB7 | DB6 | DB5 | DB4 | DB3 | DB2 | DB1 | DB0 | | OSC=380KHz | OSC=540KHz | OSC=700KHz |
| Clear Display | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | Write "20H" to DDRAM. and set DDRAM address to "00H" from AC | 1.08 ms | 0.76 ms | 0.59 ms |
| Return Home | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | x | Set DDRAM address to "00H" from AC and return cursor to its original position if shifted. The contents of DDRAM are not changed. | 1.08 ms | 0.76 ms | 0.59 ms |
| Entry Mode Set | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | I/D | S | Sets cursor move direction and specifies display shift. These operations are performed during data write and read. | 26.3 us | 18.5 us | 14.3 us |
| Display ON/OFF | 0 | 0 | 0 | 0 | 0 | 0 | 1 | D | C | B | D=1:entire display on C=1:cursor on B=1:cursor position on | 26.3 us | 18.5 us | 14.3 us |
| Function Set | 0 | 0 | 0 | 0 | 1 | DL | N | DH | *0 | IS | DL: interface data is 8/4 bits N: number of line is 2/1 DH: double height font IS: instruction table select | 26.3 us | 18.5 us | 14.3 us |
| Set DDRAM address | 0 | 0 | 1 | AC6 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set DDRAM address in address counter | 26.3 us | 18.5 us | 14.3 us |
| 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 | 0 | 0 |
| Write data to RAM | 1 | 0 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Write data into internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |
| Read data from RAM | 1 | 1 | D7 | D6 | D5 | D4 | D3 | D2 | D1 | D0 | Read data from internal RAM (DDRAM/CGRAM/ICONRAM) | 26.3 us | 18.5 us | 14.3 us |

Note * : this bit is for test command , and must always set to "0"

| Instruction table 0(IS=0) | | | | | | | | | | | | | | |
|---------------------------|---|---|---|---|-----|-----|-----|-----|-----|-----|--|---------|---------|---------|
| Cursor or Display Shift | 0 | 0 | 0 | 0 | 0 | 1 | S/C | R/L | x | x | S/C and R/L: Set cursor moving and display shift control bit, and the direction, without changing DDRAM data. | 26.3 us | 18.5 us | 14.3 us |
| Set CGRAM | 0 | 0 | 0 | 1 | AC5 | AC4 | AC3 | AC2 | AC1 | AC0 | Set CGRAM address in address counter | 26.3 us | 18.5 us | 14.3 us |

| Instruction table 1(IS=1) | | | | | | | | | | | | | | |
|---------------------------------|---|---|---|---|---|---|-----|------|------|------|--|---------|---------|---------|
| Internal OSC frequency | 0 | 0 | 0 | 0 | 0 | 1 | BS | F2 | F1 | F0 | BS=1:1/4 bias BS=0:1/5 bias F2~0: adjust internal OSC frequency for FR frequency. | 26.3 us | 18.5 us | 14.3 us |
| Set ICON address | 0 | 0 | 0 | 1 | 0 | 0 | AC3 | AC2 | AC1 | AC0 | Set ICON address in address counter. | 26.3 us | 18.5 us | 14.3 us |
| Power/ICON control/Contrast set | 0 | 0 | 0 | 1 | 0 | 1 | Ion | Bon | C5 | C4 | Ion: ICON display on/off Bon: set booster circuit on/off C5,C4: Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |
| Follower control | 0 | 0 | 0 | 1 | 1 | 0 | Fon | Rab2 | Rab1 | Rab0 | Fon: set follower circuit on/off Rab2~0: select follower amplified ratio. | 26.3 us | 18.5 us | 14.3 us |
| Contrast set | 0 | 0 | 0 | 1 | 1 | 1 | C3 | C2 | C1 | C0 | Contrast set for internal follower mode. | 26.3 us | 18.5 us | 14.3 us |

10. STANDARD CHARACTER PATTERN (ST7032i-0D)

ST7032-0D (ITO option OPR1=0, OPR2=0)

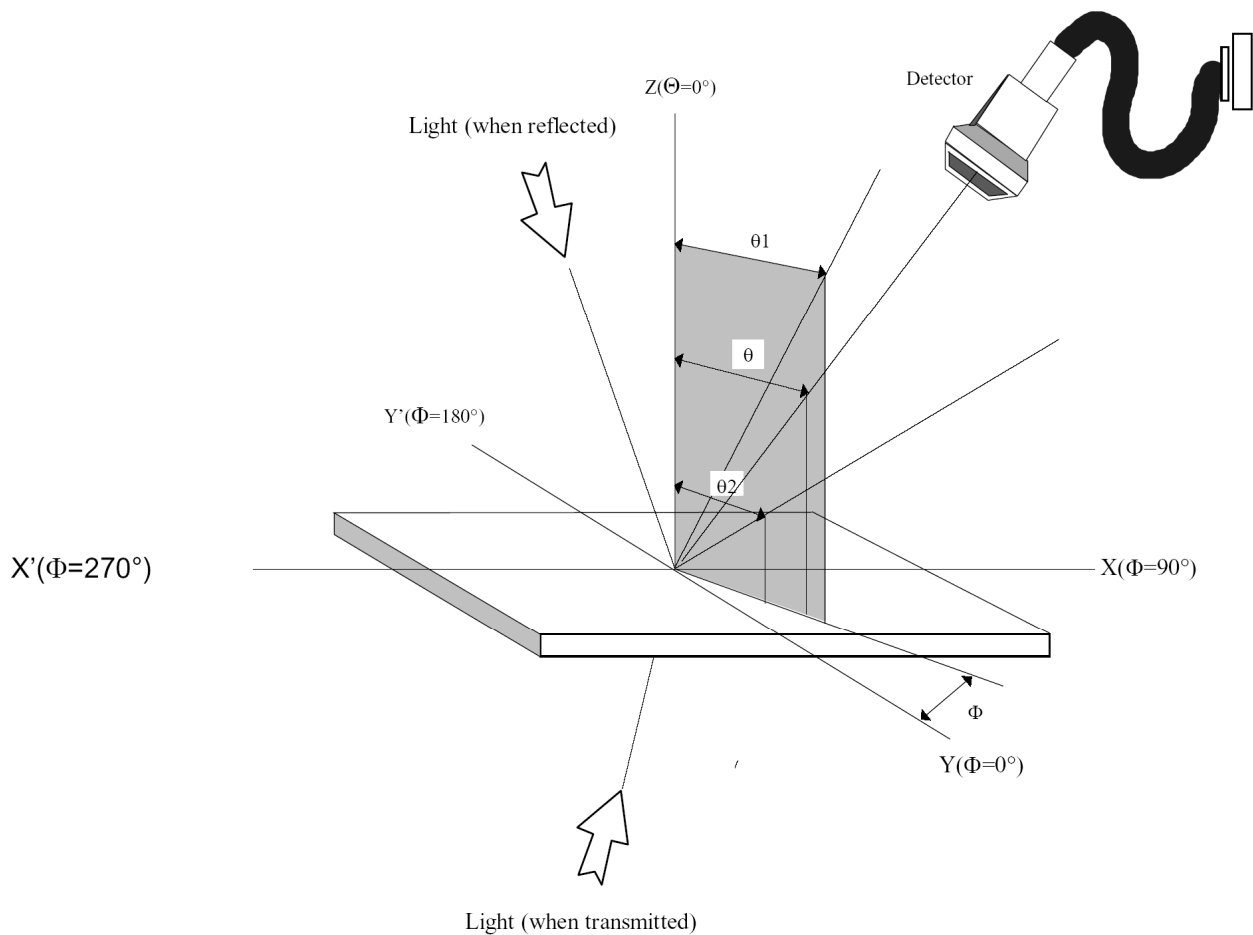
| b7-b4 b0-b0 | 0000 | 0001 | 0010 | 0011 | 0100 | 0101 | 0110 | 0111 | 1000 | 1001 | 1010 | 1011 | 1100 | 1101 | 1110 | 1111 |
|----------------|---------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| 0000 | Replaced By CGRAM Pattern | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0001 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0010 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0011 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0100 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0101 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0110 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 0111 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| 1000 | Replaced By CGRAM Pattern | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1001 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1010 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1011 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1100 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1101 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1110 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |
| 1111 | | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | |

11. LCD ELECTRICAL & OPTICAL CHARACTERISTICS

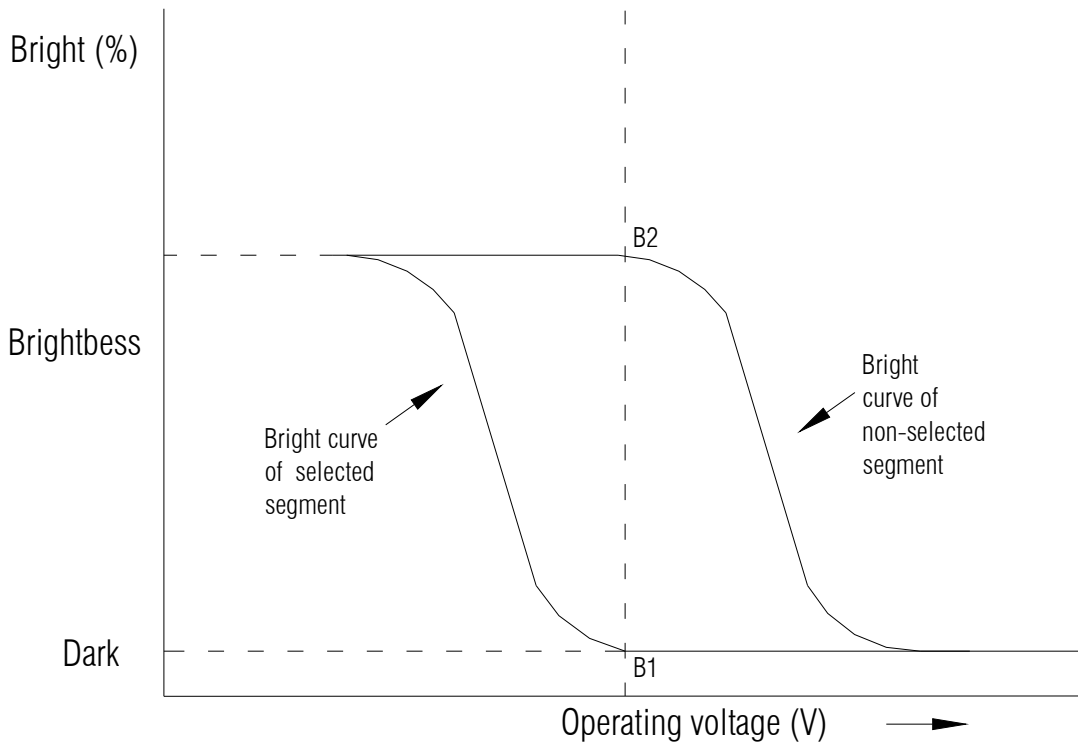
Ta=25°C

| Item | Symbol | Description | Condition | Min. | Typ. | Max. | Unit |
|---------------|---------------------|---------------|--------------------------------|------|------|------|------|
| Contrast | Cr | | $\theta=5^\circ, \Phi=0^\circ$ | 3.0 | | | |
| Viewing Angle | $\theta 2-\theta 1$ | 6o'clock axis | $Cr \geq 2.0 \Phi=0^\circ$ | 30 | | | ° |
| Response Time | T_r | Rise | $\theta=5^\circ, \Phi=0^\circ$ | --- | --- | 240 | ms |
| | T_f | Fall | $\theta=5^\circ, \Phi=0^\circ$ | --- | --- | 220 | |

11.1 Definition of Characteristics.

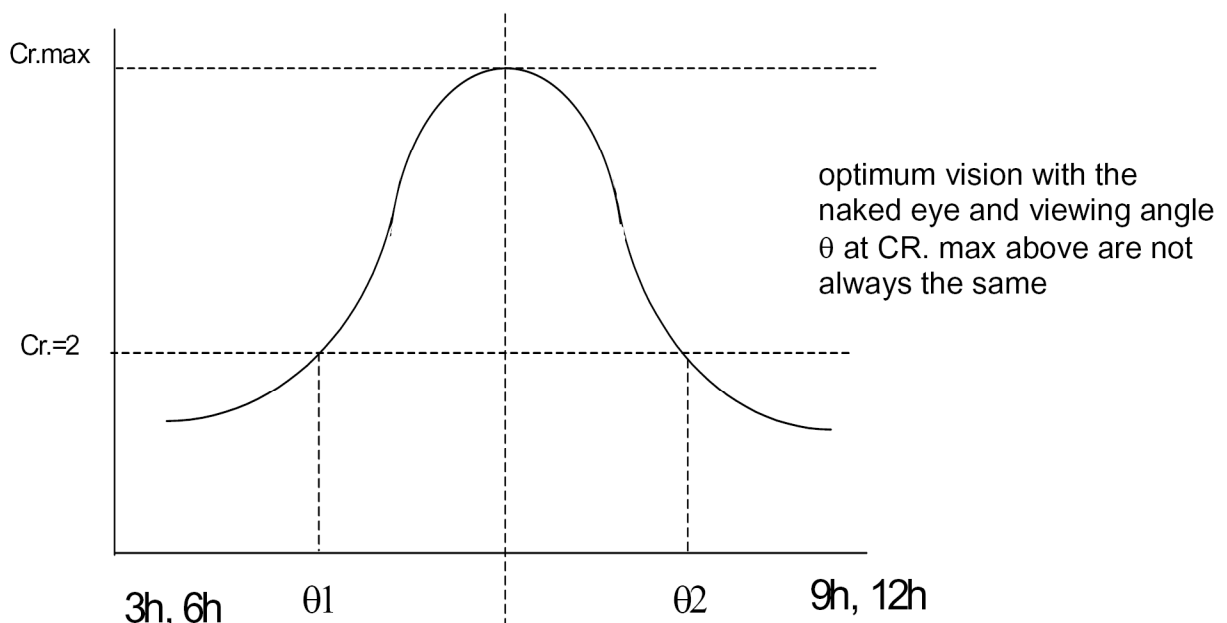


Definition of contrast $Cr. = \frac{B2}{B1} = \frac{\text{Bright curve of not selected segment}}{\text{Bright curve of selected segment}}$

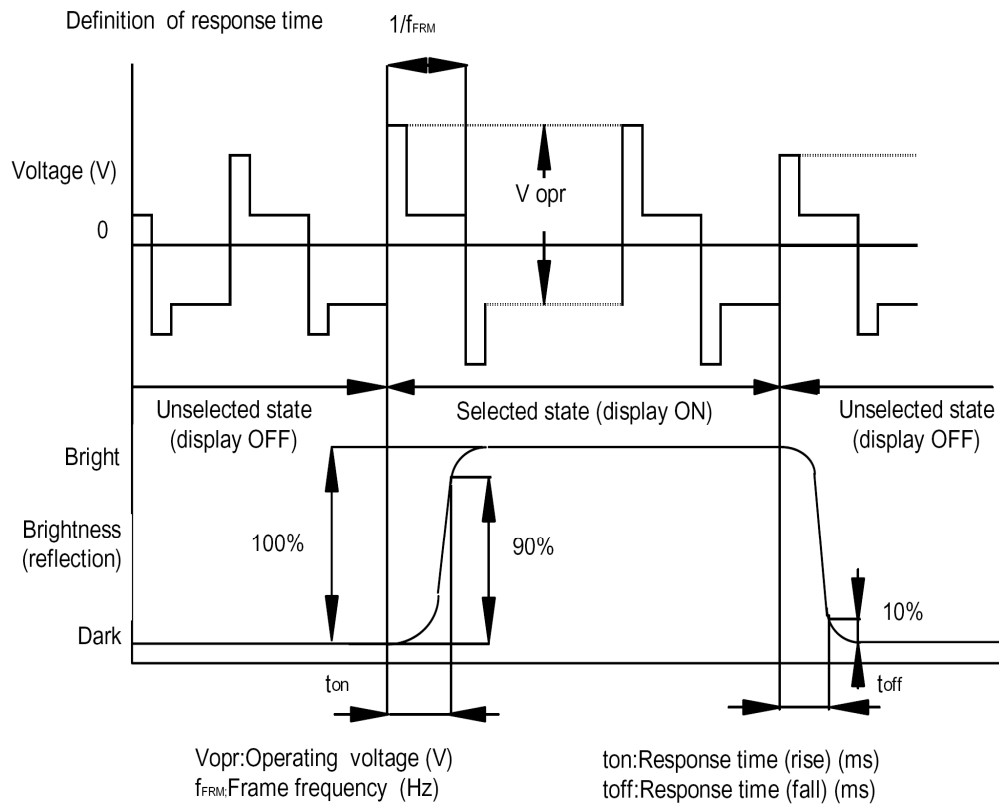


11.2. Definition of Viewing Angle

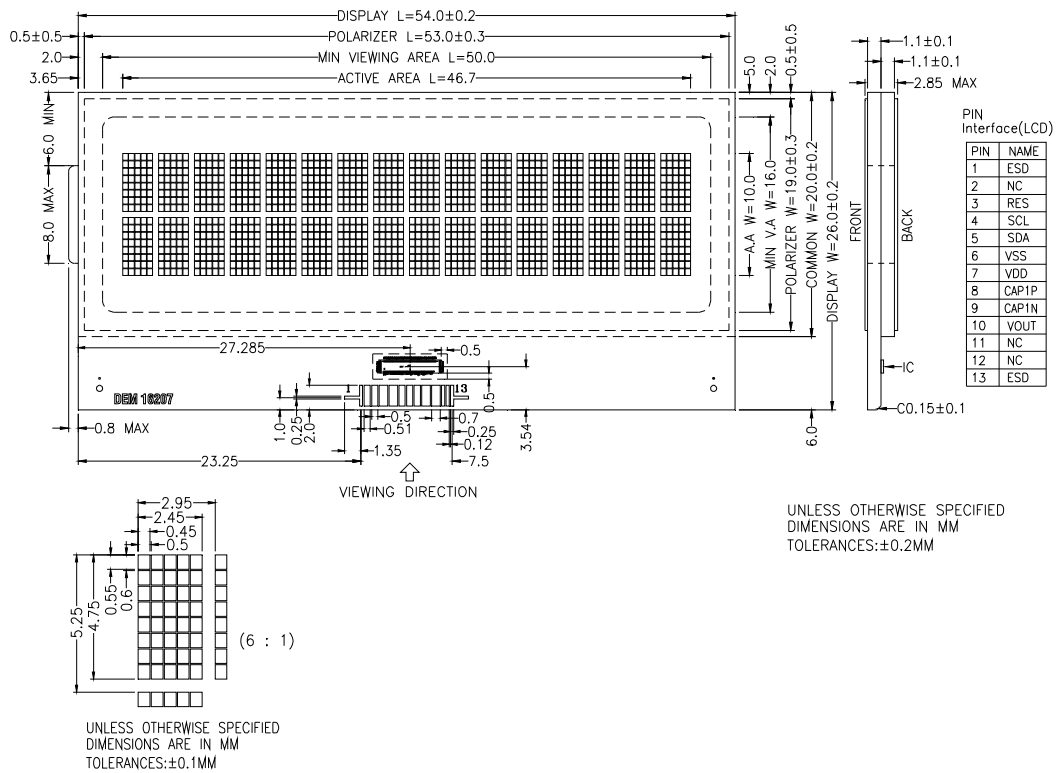
Definition of viewing angle θ_1 and θ_2



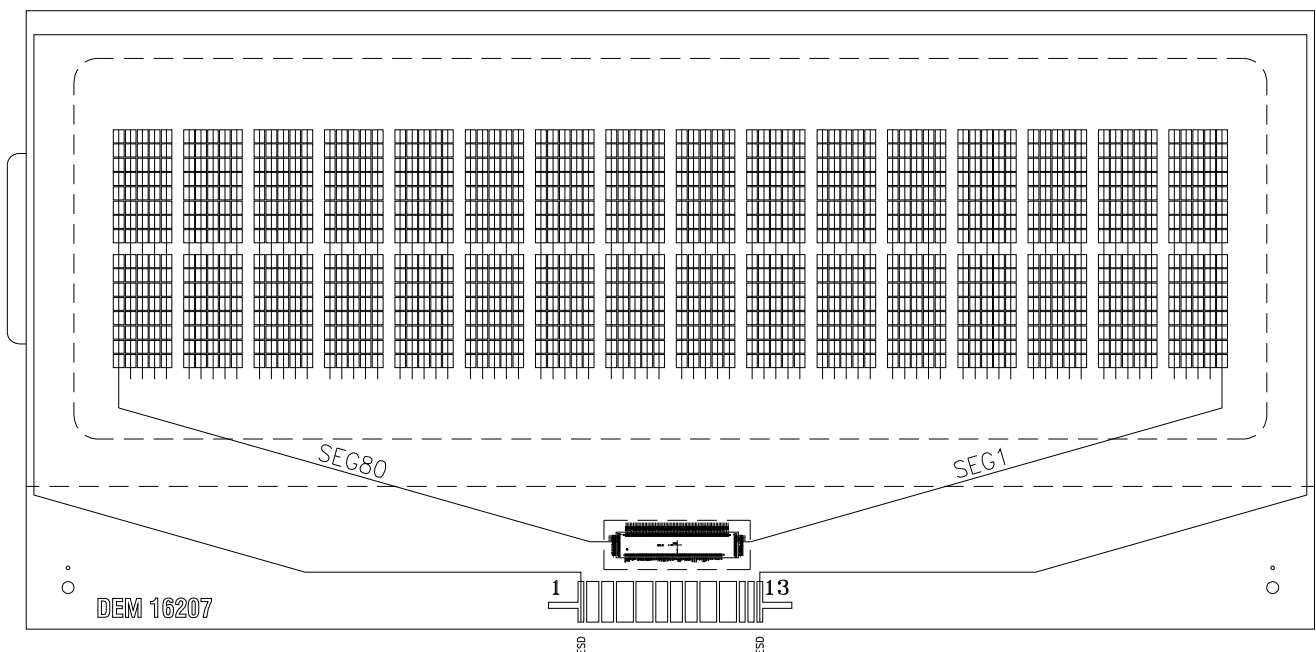
11.3 Definition of Response Time



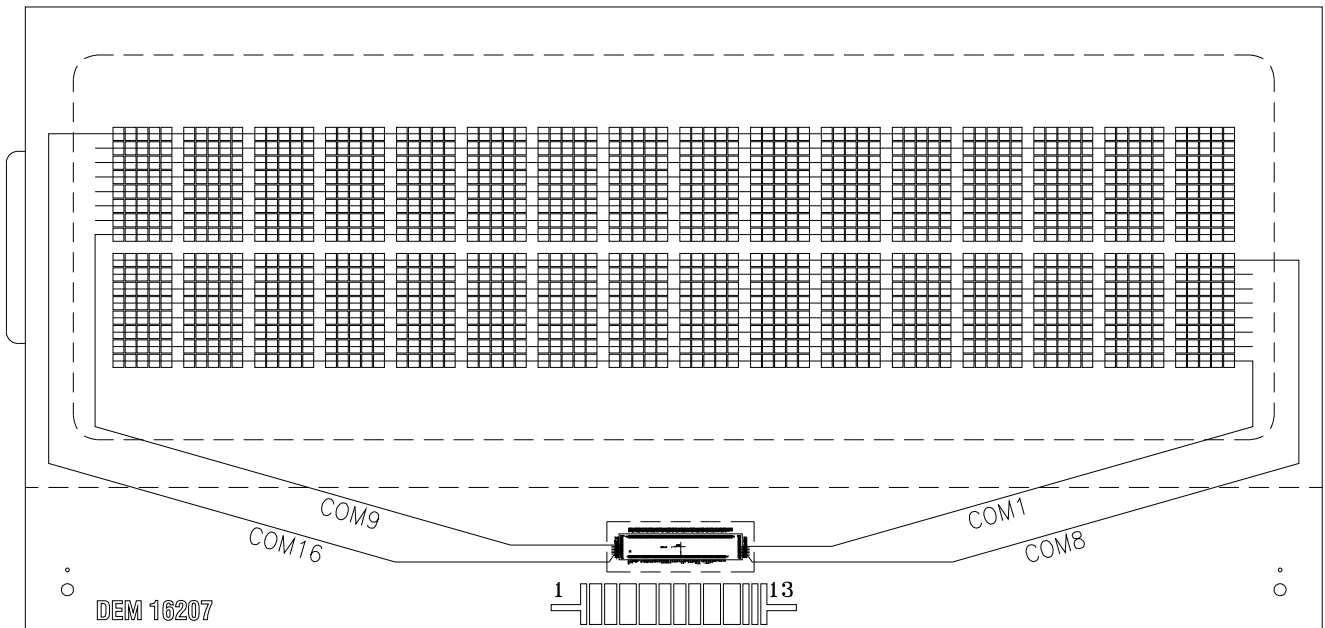
12. LCD ARTWORK



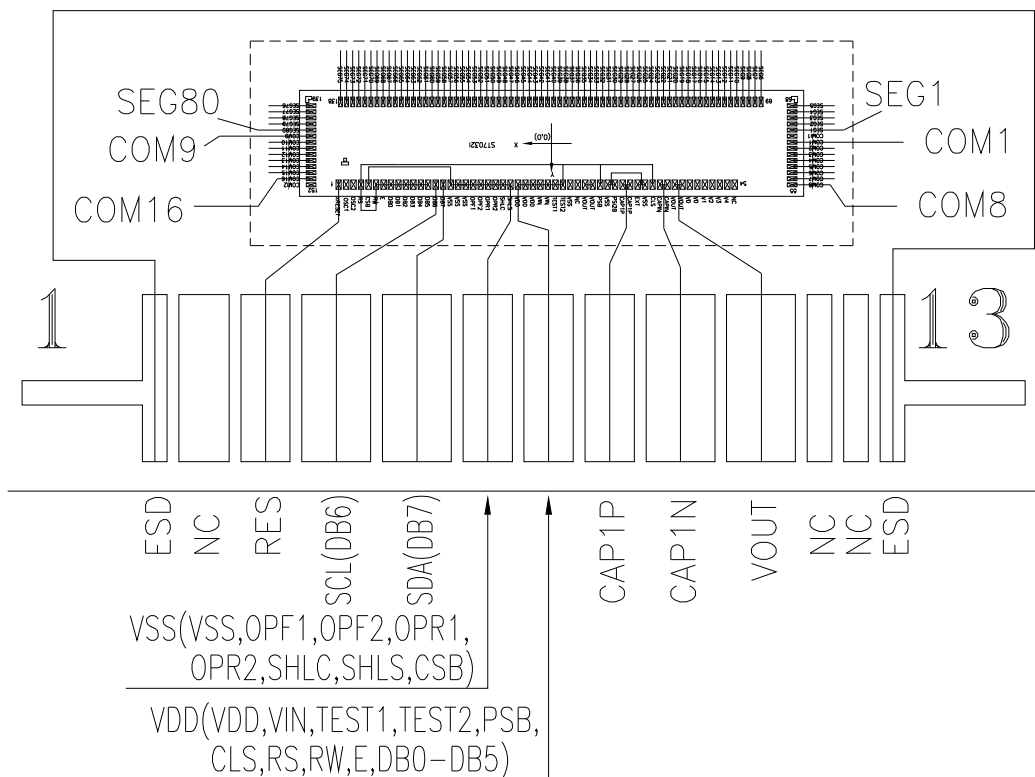
13. SEG LAYOUT



14. COM LAYOUT



15. IC LAYOUT



16. ACCEPT QUALITY LEVEL (AQL)

AQL Standard Value: Critical Defect =0.1, Major Defect=0.65; Minor Defect =2.5.

17. RELIABILITY TEST

Operating life time: 50000 hours (at room temperature without direct irradiation of sunlight)

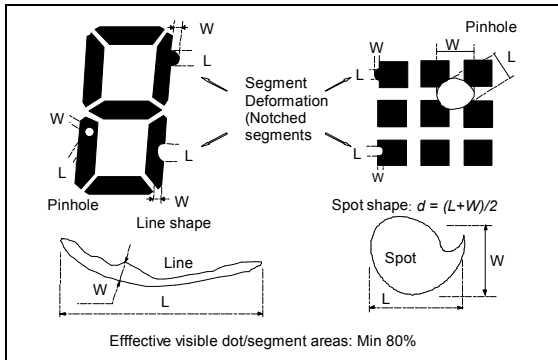
Reliability characteristics shall meet following requirements.

| Test Item | Test Condition |
|---|---|
| High temperature storage | +80□ x 96hrs |
| Low temperature storage | -30□ x 96hrs |
| High temperature operation | +70□ x 96hrs |
| Low temperature operation | -20□ x 96hrs |
| High temperature, High humidity (storage) | +60□ x 90%RH x 96hrs |
| Thermal shock | -20□ x 30min → +25□ x 10s → +70□ x 30min 5Cycles |
| Vibration test | Frequency x Swing x Time 40Hz x 4mm x 4hrs |
| Drop test | Drop Height x No. of drops 1.0m x 6 drops |

18. QUALITY DESCRIPTION

DEFECT SPECIFICATION:

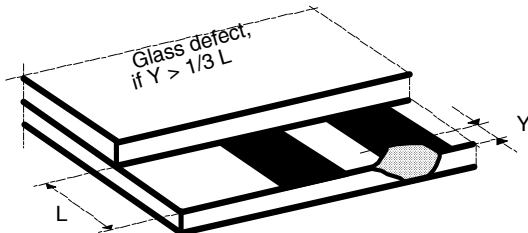
a: Table for Cosmetic defects
 (Note: nc = not counted).
 Sizes and number of defects
 (Max. Qty)



Examples/ 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 |
| | $150 < d \leq 200$ | 3 |
| Black or White Lines | -- $W \leq 10$ | nc |
| | $L \leq 3000$ $W \leq 30$ | 2 |
| | $L \leq 2000$ $W \leq 50$ | 2 |
| Pinhole | $d \leq 150$ $150 < d \leq 300$ | nc 1/segment |
| (Total defects) | | (5) |
| Segment Deformation | $W \leq 100$ | nc |
| Bubble (e.g. under pola) | $d \leq 150$ | nc |
| | $200 < d \leq 400$ | 2 |

19. 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□). Whenever possible, the LCD modules should be stored in the same conditions in which they were shipped from our company.

20. 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