

DATA SHEET

BCD MODULE

DEC 480160A BWH

8,7"

480 x160 Bi-Stable
Cholesteric Display

Product Specification

Ver.: 3

30.07.2019

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1. Technology Description

BCD (Bi-stable Cholesteric Display) is a sunlight readable reflective LCD with extremely low power consumption characteristics. Due to the non-volatile memory feature of the technology, zero power is required to retain the image of the display. Energy is only required to change the displayed image. No backlighting is required, only ambient lighting from the surrounding is required. Readability when under direct sunlight is excellent and good contrast from viewing at very wide angles are possible.

2. Typical Applications

This module is intended for general purpose graphic and character display applications. Suggested uses include instrumentation, meeting name label, remote control, electronic product or price label, point of sale display, general purpose indoor or outdoor signage and information display.

3. General Description

The Features of LCD are as follows

- * Passive Matrix Bistable Cholesteric LCD Graphic Module
- * Color : Blue & White
- * Display Mode : BCD
- * Driver / Controller IC : UCi7701c & UCi7702c *2
- * Interface Input Data : Parallel Interface (8-Bit)
- * Driving Scheme : Special BCD Driving Scheme
- * Driving Method : 1/160 Duty, 1/7 Bias
- * Viewing Direction : Full Viewing

4. Mechanical Specifications

The mechanical detail is shown in Fig. 1 and summarized in Table 1 below.

Table 1

| Item | Specification | Unit |
|----------------|-----------------------|------|
| Module Size | 229.50 x 66.80 x 4,40 | mm |
| Viewing Area | 219.50 x 56.80 | mm |
| Active Area | 215.99 x 54.39 | mm |
| Number of Dots | 480 x 160 Dots | - |
| Dot Size | 0.33 x 0.44 | mm |
| Dot Pitch | 0.34 x 0.45 | mm |

5. Interface Signals

Table 2

| Pin No. | Pin Name | Function |
|---------|----------|---|
| 1 | VDD | Power supply |
| 2 | GND | Ground. |
| 3 | V0 | Boas power supply pins for LCD drive voltage. |
| 4 | M | AC-converting signal input for LCD drive waveform. |
| 5 | DISPOFF | Control input for output of non-select level. |
| 6 | FLM | Frame signal. |
| 7 | LP_C | Shift clock input for shift register at common mode. |
| 8 | LP_S | Latch pulse input for display data at segment mode. |
| 9 | XCK | Clock input for taking display data at segment mode. |
| 10-17 | D0-D7 | Input pin for display data 8-bit parallel input mode, input data into the 8 pins D0 ~ D7. Display data input. |
| 18 | BIAS_CTR | Bias control. High Bias while this pin is high. |
| 19 | VLCD_CTR | VLCD voltage control. High voltage while this pin is high. |
| 20 | VLCD_EN | VLCD output Enable. Active while this pin is high. |
| 21 | A0 | Digital input. User-defined address bit 0.(NC) |
| 22 | SDA | Digital I/O. I2C-bus serial bidirectional data line; open-drain. (NC) |
| 23 | A1 | Digital input. User-defined address bit 1. (NC) |
| 24 | SCL | Digital input. I2C-bus serial clock input. (NC) |

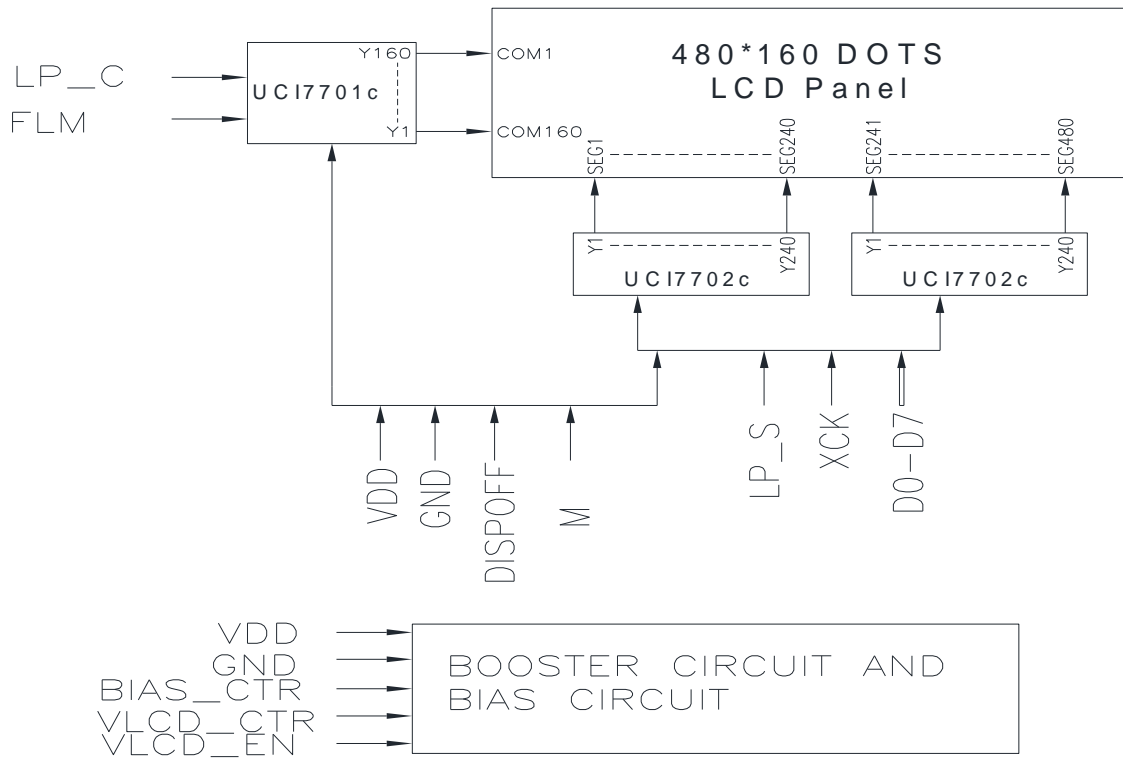


Figure 2: Block Diagram

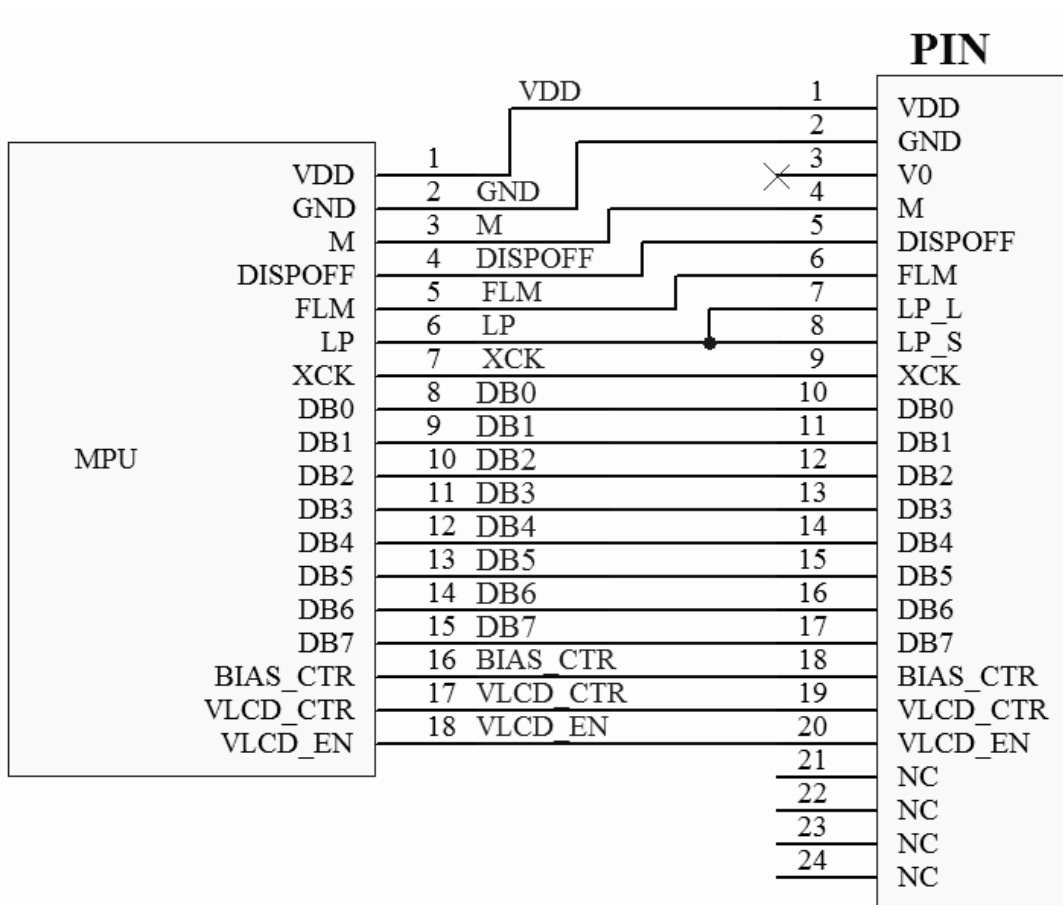


Figure 3: Circuit Diagram

6. Absolute Maximum Ratings

6.1 Electrical Maximum Ratings-For IC Only

Table3

| Parameter | Symbol | Conditions | Min. | Max. | Unit |
|----------------|----------|---|----------------|----------------|------|
| Supply Voltage | V_{DD} | TA=+25°C, Referenced to $V_{SS} = 0V$ | -0.3 | +7.0 | V |
| | V_0 | | -0.3 | +42 | V |
| Input Voltage | V_{in} | | $V_{SS} - 0.3$ | $V_{DD} + 0.3$ | V |

Note1: TA = +25°C

Note2: The maximum applicable voltage on any pin with respect to VSS (0V).

Note3: The modules may be destroyed if they are used beyond the absolute maximum ratings.

6.2 Environmental Condition

Table4

| Item | Operating Temperature (Topr) | | Storage Temperature (Tstg) | | Remark |
|-------------------------------------|---|-------|----------------------------|-------|-----------------|
| | Min. | Max. | Min. | Max. | |
| Ambient Temperature | -20°C | +70°C | -30°C | +80°C | Dry |
| Humidity | 90% max. RH for Ta ≤ 40°C < 50% RH for 40°C < Ta ≤ Maximum operating temperature | | | | No Condensation |
| Packing Vibration(GB/T5170.14-2009) | Frequency Range:10Hz~50Hz Acceleration of gravity:5G X,Y,Z 30 min for each direction. | | | | 3 Directions |

Note : Product cannot sustain at extreme storage conditions for long time.

7. Electrical Specifications

7.1 Typical Electrical Characteristics

At $T_a = 25^\circ\text{C}$, $V_{DD} = +5.0\text{V} \pm 5\%$, $V_{SS} = 0\text{V}$.

Table 5

| Parameter | Symbol | Conditions | Min. | Typ. | Max. | Unit |
|------------------------------|----------|--------------------------|---------------|------|-------------|------|
| Supply Voltage (System) | VDD-VSS | $T_a = 25^\circ\text{C}$ | 4.75 | 5.0 | 5.25 | V |
| | V0-VSS | $T_a = 25^\circ\text{C}$ | - | 20 | - | V |
| Input Signal Voltage Low | V_{IL} | $T_a = 25^\circ\text{C}$ | - | - | $0.2V_{DD}$ | V |
| Input Signal Voltage High | V_{IH} | $T_a = 25^\circ\text{C}$ | $0.8V_{DDIO}$ | - | - | V |
| Supply Current | IDD | VDD=5.0V | - | 10.5 | - | mA |

* Internally Generated

7.2 TIMING Specifications

At $T_a = +25^\circ\text{C}$, $V_{DD} = 5.0\text{V} \pm 5\%$

Table 6

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|--|------------|------|------|------|---------------|----------------------------------|
| Shift clock period | tWLP | 250 | - | - | ns | $t_r, t_f \leq 20\text{ns}$ |
| Shift clock "H" pulse width | tWLPH | 15 | - | - | ns | $V_{DD} = +5.0\text{V} \pm 10\%$ |
| | | 30 | - | - | ns | $V_{DD} = +2.5 - +4.5\text{V}$ |
| Data setup time | tSU | 30 | - | - | ns | |
| Data hole time | tH | 50 | - | - | ns | |
| Input signal rise time | t_r | | - | 50 | ns | |
| Input signal fall time | t_f | | - | 50 | ns | |
| $\overline{\text{DISPOFF}}$ Removal time | tSD | 100 | - | - | ns | |
| $\overline{\text{DISPOFF}}$ enable pulse width | tWDL | 1.2 | - | - | μs | |
| Output delay time (1) | tDL | - | - | 200 | ns | $C_L = 15\text{pF}$ |
| Output delay time (2) | tpd1, tpd2 | - | - | 1.2 | μs | $C_L = 15\text{pF}$ |
| Output delay time (3) | tpd3 | - | - | 1.2 | μs | $C_L = 15\text{pF}$ |

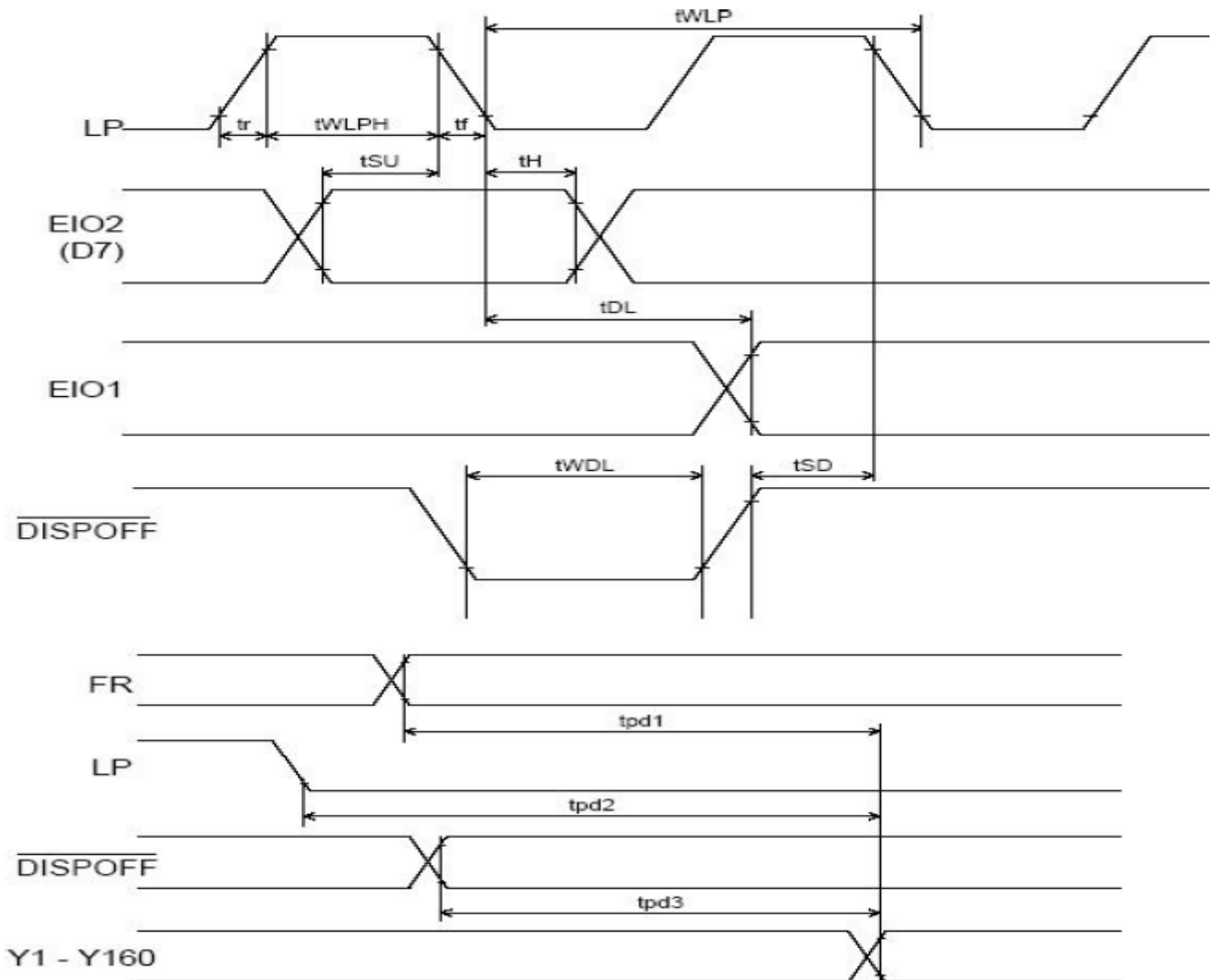


Figure 4: Timing waveform of the common mode

Table 7

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Condition |
|---|--------------------|------|------|------|---------------|--------------------------------------|
| Shift clock period | t_{WCK} | 50 | - | | ns | $t_r, t_f \leq 10\text{ns}$, Note 1 |
| Shift clock "H" pulse width | t_{WCKH} | 15 | - | | ns | |
| Shift clock "L" pulse width | t_{WCKL} | 15 | - | | ns | |
| Data setup time | t_{DS} | 10 | - | | ns | |
| Data hold time | t_{DH} | 12 | - | | ns | |
| Latch pulse "H" pulse width | t_{WLPH} | 15 | - | | ns | |
| Shift clock rise to Latch pulse rise time | t_{LD} | 0 | - | | ns | |
| Shift clock fall to Latch pulse fall time | t_{SL} | 30 | - | | ns | |
| Latch pulse rise to Shift clock rise time | t_{LS} | 25 | - | | ns | |
| Latch pulse fall to Shift clock rise time | t_{LH} | 25 | - | | ns | |
| Input signal rise time | t_r | | - | 50 | ns | Note 2 |
| Input signal fall time | t_f | | - | 50 | ns | Note 2 |
| Enable setup time | t_S | 10 | - | | ns | |
| DISPOFF Removal time | t_{SD} | 100 | - | | ns | |
| DISPOFF enable pulse width | t_{WDL} | 1.2 | - | | μs | |
| Output delay time (1) | t_D | | - | 30 | ns | $CL = 15\text{pF}$ |
| Output delay time (2) | t_{pd1}, t_{pd2} | | - | 1.2 | μs | $CL = 15\text{pF}$ |
| Output delay time (3) | t_{pd3} | | - | 1.2 | μs | $CL = 15\text{pF}$ |

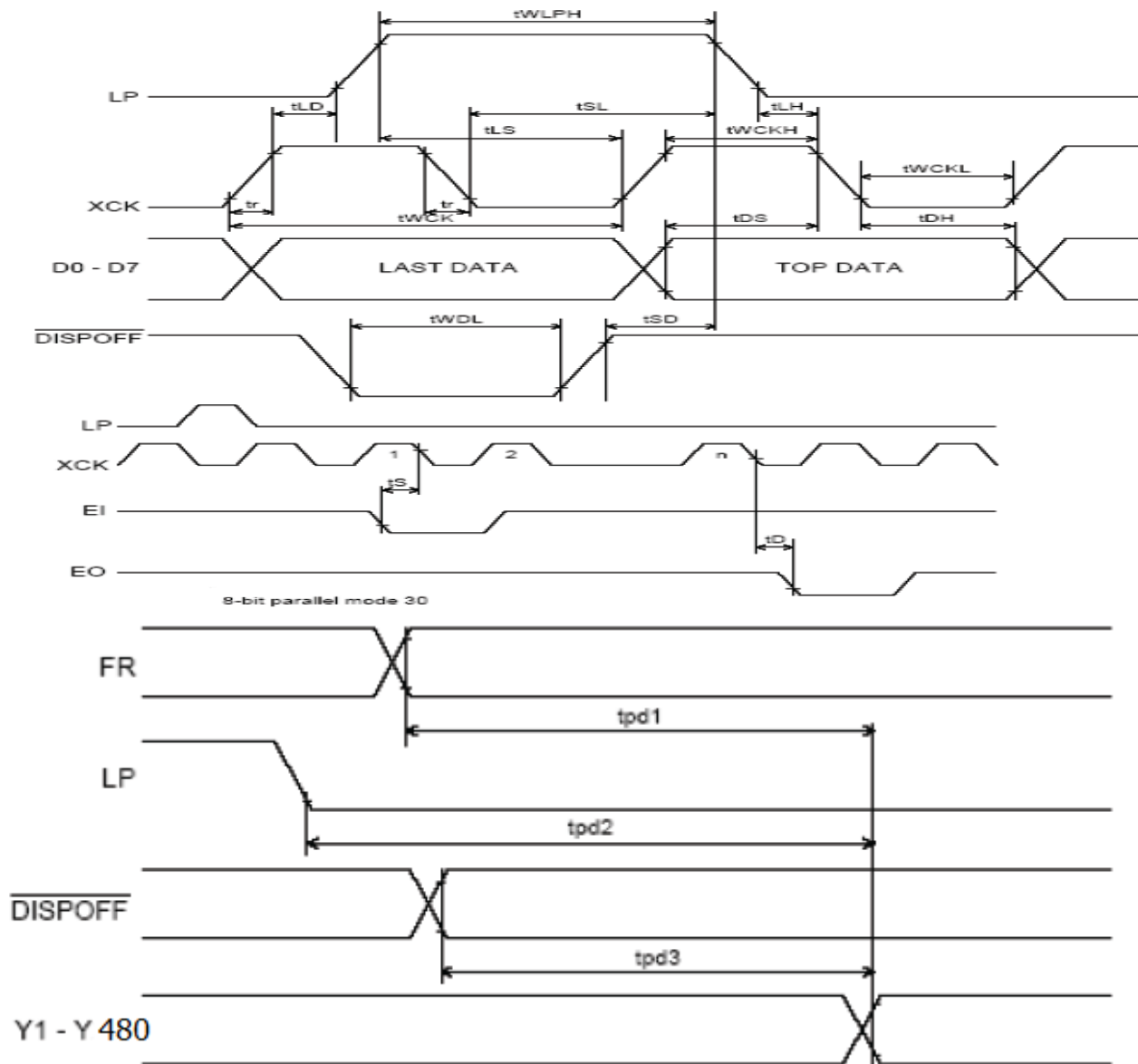


Figure 5: Timing Characteristics of Segment Mode

8. Optical Characteristics at 25°C

Table 8

| Item | Symbol | Value | | | Unit | Condition | |
|--------------------------------|--------|-------|------|------|------|--|----------------------------|
| | | Min. | Typ. | Max. | | | |
| Image Refresh Time | - | - | 12 | - | S | VDD=5.0V, VLCD =24V At Ta = -20 °C | |
| | - | - | 9 | - | S | VDD=5.0V, VLCD =22.6V At Ta = -10 °C | |
| | - | - | 7.5 | - | S | VDD=5.0V, VLCD =21.2V At Ta = 0 °C | |
| | - | - | 6 | - | S | VDD=5.0V, VLCD =20.7V At Ta = +5 °C | |
| | - | - | 5 | - | S | VDD=5.0V, VLCD =20.0V At Ta = +25 °C | |
| | - | - | 4.5 | - | S | VDD=5.0V, VLCD =19.5V At Ta = +50 °C | |
| | - | - | 4 | - | S | VDD=5.0V, VLCD =18.6V At Ta = +70 °C | |
| Contrast Ratio | CR | - | 6 | - | - | - | |
| Optimum Viewing Area Cr ≥ 2 | θ1 | - | >80 | - | DEG | φ = 0° | Vop= Optimum Voltage |
| | θ2 | - | >80 | - | | | |
| | φ1 | - | >80 | - | | φ = 0° | |
| | φ2 | - | >80 | - | | | |

Notes: The above data are for reference only.

8.1 Optical Characteristics Definition

8.1.1 Viewing Angle

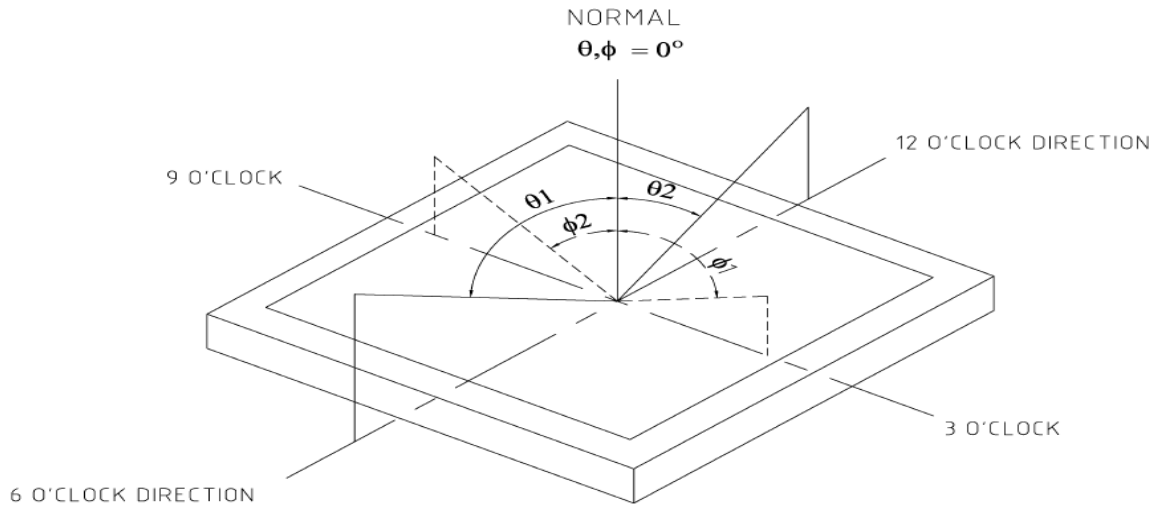
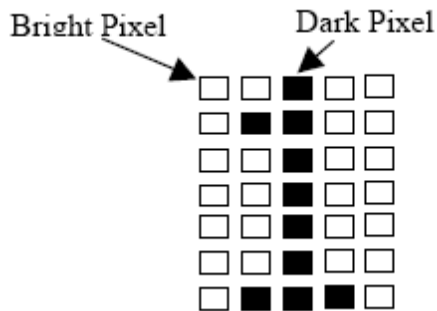


Figure 6

8.1.2 Contrast Ratio

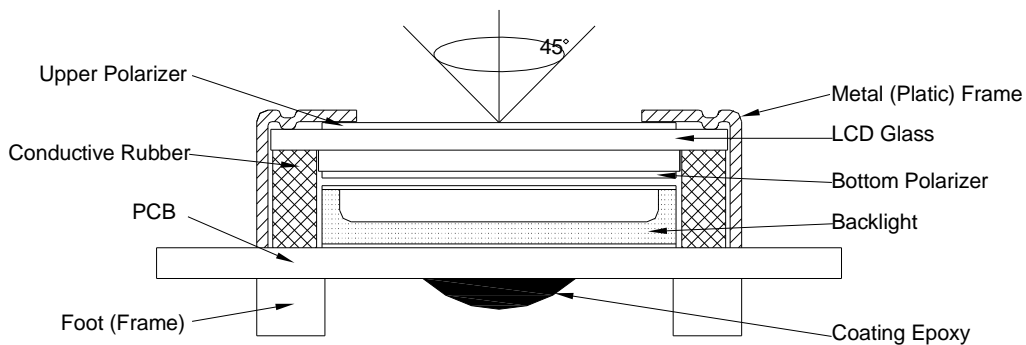
B1 = pixel luminance at stable dark state
 B2 = pixel luminance at stable bright state
 Contrast Ratio = B2/B1



9. Quality Specifications

9.1. LCM Appearance and Electric inspection Condition

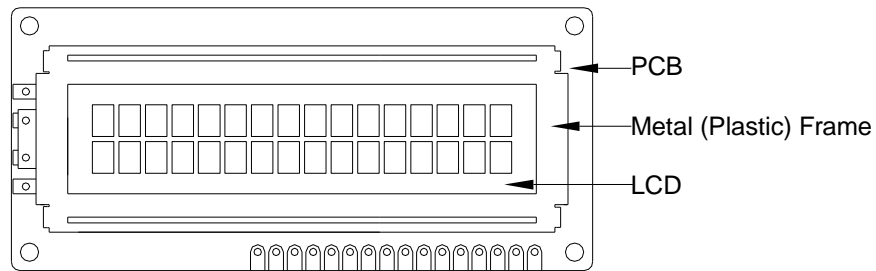
9.1.1 Inspection will be done by placing LCM 30cm away from inspector's eyeballs under normal illumination.



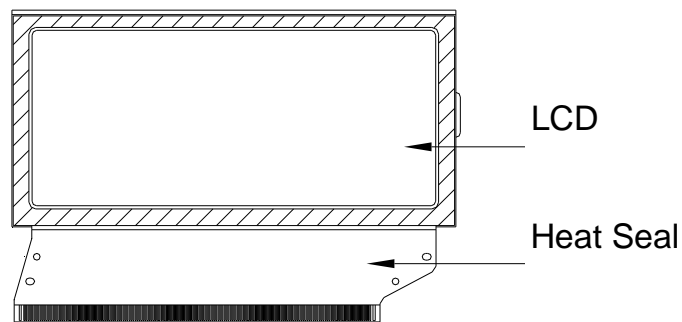
9.1.2 View Angle: with in 45° around perpendicular line.

9.2. Definition

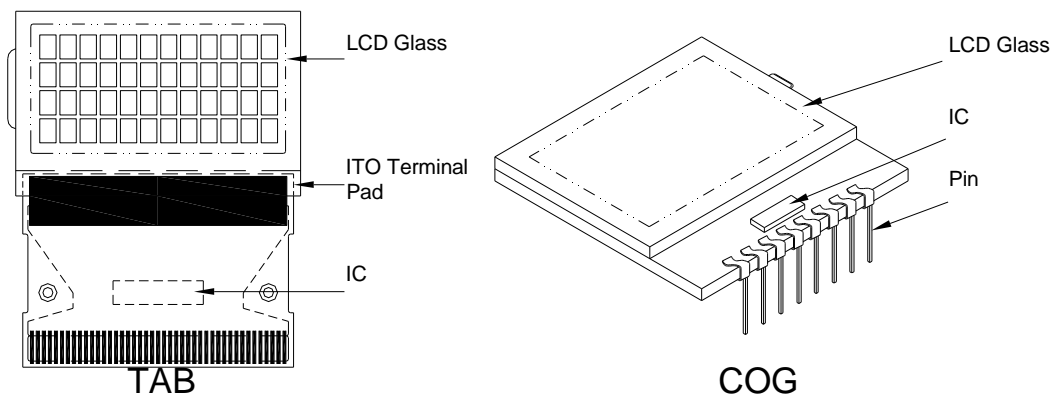
9.2.1 COB



9.2.2 Heat Seal



9.2.3 TAB and COG



9.3. Sampling Plan and Acceptance

9.3.1 Sampling Plan

MIL - STD - 105E (||) ordinary single inspection is used.

9.3.2 Acceptance

Major defect: AQL = 0.65%

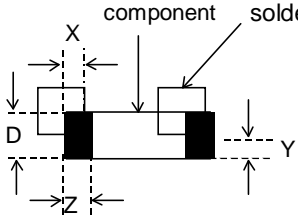
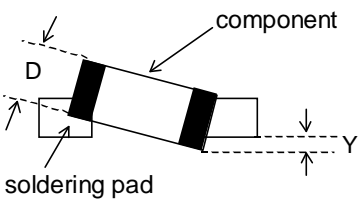
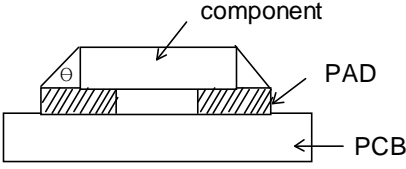
Minor defect: AQL = 1.5%

9.4. Criteria

9.4.1. COB

| Defect | Inspection Item | Inspection Standards | |
|--------|-------------------------------|--|--------|
| Major | PCB copper flakes peeling off | Any copper flake in viewing Area should be greater than 1.0mm ² | Reject |
| Major | Height of coating epoxy | Exceed the dimension of drawing | Reject |
| Major | Void or hole of coating epoxy | Expose bonding wire or IC | Reject |
| Major | PCB cutting defect | Exceed the dimension of drawing | Reject |

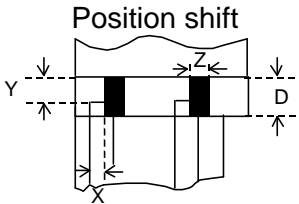
9.4.2. SMT

| Defect | Inspection Item | Inspection Standards | |
|--------|---|---------------------------------|------------------|
| Minor | Component marking not readable | | Reject |
| Minor | Component height | Exceed the dimension Of drawing | Reject |
| Major | Component solder defect (missing , extra, wrong component or wrong orientation) | | Reject |
| Minor | <p>Component position shift</p>  | $X < 3/4Z$ $Y > 1/3D$ | Reject Reject |
| Minor | <p>Component tilt</p>  | $Y > 1/3D$ | Reject |
| Minor | <p>Insufficient solder</p>  | $\theta \leq 20^\circ$ | Reject |

9.4.3. Metal (Plastic) Frame

| Defect | Inspection Item | Inspection Standards | | |
|--|--|---------------------------------|-----------------------|------------------------------|
| Major | Crack / Breakage | Anywhere | | |
| Minor | Frame Scratch | W | L | Acceptable of Scratch |
| | | $w < 0.1\text{mm}$ | Any | Ignore |
| | | $0.1 \leq w < 0.2\text{mm}$ | $L \leq 5.0\text{mm}$ | 2 |
| | | $0.2 \leq w < 0.3\text{mm}$ | $L \leq 3.0\text{mm}$ | 1 |
| | | $w \geq 0.3\text{mm}$ | Any | 0 |
| Note : 1. Above criteria applicable to scratch lines with distance greater than 5mm. 2. Scratch on the back side of frame (not visible) can be ignored . | | | | |
| Minor | Frame Dent , Prick $\Phi = \frac{L + W}{2}$ | | | Acceptable of Dents / Pricks |
| | | $\Phi \leq 1.0\text{mm}$ | | 2 |
| | | $1.0 < \Phi \leq 1.5\text{mm}$ | | 1 |
| | | $1.5\text{mm} < \Phi$ | | 0 |
| Note : 1. Above criteria applicable to any two dents / pricks with distance greater than 5mm 2. Dent / prick on the back side of frame (not visible) can be ignored | | | | |
| Minor | Frame Deformation | Exceed the dimension of drawing | | |
| Minor | Metal Frame Oxidation | Any rust | | |

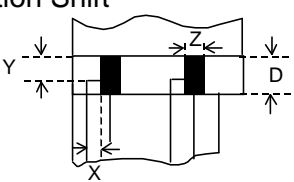
9.4.4. Flexible Film Connector (FFC)

| Defect | Inspection Item | Inspection Standards | |
|--------|---|-----------------------------|------------|
| Minor | Tilted Soldering | Within the angle $+5^\circ$ | Acceptable |
| Minor | Uneven solder Joint / Bump | | Reject |
| Minor | Hole $\Phi = \frac{L + W}{2}$ | Expose the conductive line | Reject |
| | | $\Phi > 1.0\text{mm}$ | Reject |
| Minor |  | $Y > 1/3D$ | Reject |
| | | $X > 1/2Z$ | Reject |

9.4.5. Screw

| Defect | Inspection Item | Inspection Standards | |
|--------|------------------------|----------------------------------|--------|
| Major | Screw Missing / Loosen | | Reject |
| Minor | Screw Oxidation | Any Rust | Reject |
| Minor | Screw Deformation | Difficult to accept Screw Driver | Reject |

9.4.6. Heatseal ,TCP,FPC

| Defect | Inspection Item | Inspection Standards | |
|--------|--|-----------------------------|--------|
| Major | Scratch expose Conductive Layer | | Reject |
| Minor | HS Hole $\Phi = \frac{L+W}{2}$ | $\Phi > 0.5\text{mm}$ | Reject |
| Major | Adhesion Strength | Less than the specification | Reject |
| Minor | Position Shift  | $Y > 1/3D$ | Reject |
| | | $X > 1/2Z$ | Reject |
| Major | Conductive Line Break | | Reject |

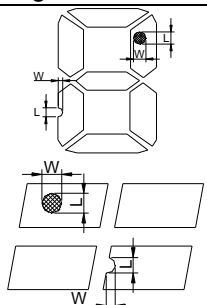
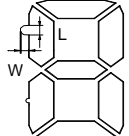
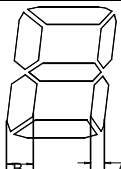
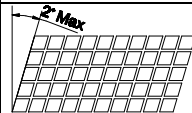
9.4.7. LED Backing Protective Film and Others

| Defect | Inspection Item | Inspection Standards | |
|--------|----------------------|---|--------|
| Minor | LED Dirty, Prick | Acceptable number of units | |
| | | $\Phi \leq 0.10\text{mm}$ | Ignore |
| | | $0.10 < \Phi \leq 0.15\text{mm}$ | 2 |
| | | $0.15 < \Phi \leq 0.2\text{mm}$ | 1 |
| | | $\Phi > 0.2\text{mm}$ | 0 |
| | | The distance between any two spots should be $\geq 5\text{mm}$ Any spot/dot/void outside of viewing area is acceptable | |
| Minor | Protective Film Tilt | Not fully cover LCD | Reject |
| Major | COG Coating | Not fully cover ITO circuit | Reject |

9.4.8. Electric Inspection

| Defect | Inspection Item | Inspection Standards | |
|--------|-----------------|----------------------|--------|
| Major | Short | | Reject |
| Major | Open | | Reject |

9.4.9. Inspection Specification of LCD

| Defect | Inspect Item | Inspection Standards | | | | |
|--------|--|---|---|-------------------------------|-------------------------------|---------------|
| Minor | Linear Defect * Glass Scratch * Polarizer Scratch * Fiber and Linear material | W | $W \leq 0.03$ | $0.03 < W \leq 0.05$ | $W > 0.05$ | |
| | | L | $L < 5$ | $L < 3$ | Any | |
| | | ACC. NO. | 1 | 1 | Reject | |
| | | Note | L is the length and W is the width of the defect | | | |
| Minor | Black Spot and Polarizer Pricked * Foreign material between glass and polarizer or glass and glass * Polarizer hole or protuberance by external force | Φ | $\Phi \leq 0.1$ | $0.1 < \Phi \leq 0.15$ | $0.15 < \Phi \leq 0.2$ | $\Phi > 0.2$ |
| | | ACC. NO. | 3EA / 100mm ² | 2 | 1 | 0 |
| | | Note | Φ is the average diameter of the defect. Distance between two defects > 10mm. | | | |
| Minor | White Spot and Bubble in Polarizer * Unobvious transparent foreign material between glass and glass or glass and polarizer * Air protuberance between polarizer and glass | Φ | $\Phi \leq 0.3$ | $0.3 < \Phi \leq 0.5$ | $0.5 < \Phi$ | |
| | | ACC. NO. | 3EA / 100mm ² | 1 | 0 | |
| | | Note | Φ is the average diameter of the defect. Distance between two defects > 10mm. | | | |
| Minor | Segment Defect  | Φ | $\Phi \leq 0.10$ | $0.10 < \Phi \leq 0.20$ | $0.20 < \Phi \leq 0.25$ | $\Phi > 0.25$ |
| | | ACC. NO. | 3EA / 100mm ² | 2 | 1 | 0 |
| | | Note | W is more than 1/2 segment width | | | Reject |
| | | Note | $\Phi = \frac{L + W}{2}$ Distance between two defect is 10mm | | | |
| Minor | Protuberant Segment  $\Phi = (L + W) / 2$ | Φ | $\Phi \leq 0.10$ | $0.10 < \Phi \leq 0.20$ | $0.20 < \Phi \leq 0.25$ | $\Phi > 0.25$ |
| | | W | Glue | $W \leq 1/2$ Seg $W < 0.2$ | $W \leq 1/2$ Seg $W < 0.2$ | Ignore |
| | | ACC. NO. | 3EA / 100mm ² | 2 | 1 | 0 |
| | | | | | | |
| Minor | Assembly Mis-Alignment   | 1. Segment | | | | |
| | | B | $B \leq 0.4\text{mm}$ | $0.4 < B \leq 1.0\text{mm}$ | $B > 1.0\text{mm}$ | |
| | | B-A | $B-A < 1/2B$ | $B-A < 0.2$ | $B-A < 0.25$ | |
| | | Judge | Acceptable | Acceptable | Acceptable | |
| | | 2. Dot Matrix | | | | |
| | | | | Deformation > 2° | Reject | |
| Minor | Stain on LCD Panel Surface | Accept when stains can be wiped lightly with a soft cloth or a similar one. Otherwise, judged according to the above items: "Black spot" and "White Spot" | | | | |

10. Handling Precaution

(1) Mounting Method

The panel of the LCD Module consists of two thin glass plates with polarizers which easily get damaged since the Module is fixed by utilizing fitting holes in the printed circuit board. Extreme care should be taken when handling the LCD Modules.

(2) Caution of LCD handling & cleaning

When cleaning the display surface, use soft cloth with solvent (recommended below) and wipe lightly.

- Isopropyl alcohol
- Ethyl alcohol
- Trichloro trifloro thane

Do not wipe the display surface with dry or hard materials that will damage the polarizer surface.

Do not use the following solvent:

- Water
- Ketone
- Aromatics

(3) Caution against static charge

The LCD Module use C-MOS LSI drivers, so we recommend that you connect any unused input terminal to VDD or VSS, do not input any signals before power is turned on. And ground your body, Work/assembly table. And assembly equipment to protect against static electricity.

(4) Packaging

- Modules use LCD elements, and must be treated as such. Avoid intense shock and falls from a height.
- To prevent modules from degradation. Do not operate or store them exposed directly to sunshine or high temperature/humidity.

(5) Caution for operation

- It is indispensable to drive LCD's within the specified voltage limit since the higher voltage than the limit shorten LCD life. An electrochemical reaction due to direct current causes LCD deterioration, Avoid the use of direct current drive.
- Response time will be extremely delayed at lower temperature than the operating temperature range and on the other hand at higher temperature LCD's show dark color in them. However those phenomena do not mean malfunction or out of order with LCD's. Which will come back in the specified operating temperature range.
- If the display area is pushed hard during operation, some font will be abnormally displayed but it resumes normal condition after turning off once.
- A slight dew depositing on terminals is a cause for electro-chemical reaction resulting in terminal open circuit.

Usage under the relative condition of 40°C, 50%RH or less is reequired.

(6) Storage

In the case of storing for a long period of time (for instance.) For years) for the purpose or replacement use, The following ways are recommended.

- Storage in a polyethylene bag with sealed so as not to enter fresh air outside in it, And with no desiccant.
- Placing in a dark place where neither exposure to direct sunlight nor light is. Keeping temperature in the specified storage temperature range.
- Storing with no touch on polarizer surface by the anything else. (It is recommended to store them as they have been contained in the inner container at the time of delivery)

(7) Safety

- It is recommendable to crash damaged or unnecessary LCD into pieces and wash off liquid crystal by using solvents such as acetone and ethanol.

Which should be burned up later.

(8) Other

- After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.