



# Microtips

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## TECHNOLOGY

Model No: MTD0130BCP02SF-1

| Approved By |  |
|-------------|--|
|             |  |

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## Record of Revision

| Date       | Revision No. | Summary            |
|------------|--------------|--------------------|
| 2019-02-26 | 1.0          | Rev 1.0 was issued |
|            |              |                    |
|            |              |                    |

## 1. Scope

This data sheet is to introduce the specification of MTD0130BCP02SF-1 active matrix TFT module. It is composed of a color TFT-LCD panel, driver IC, FPC and a backlight unit. The 1.3" display area contains 240(RGB) x 240 pixels.

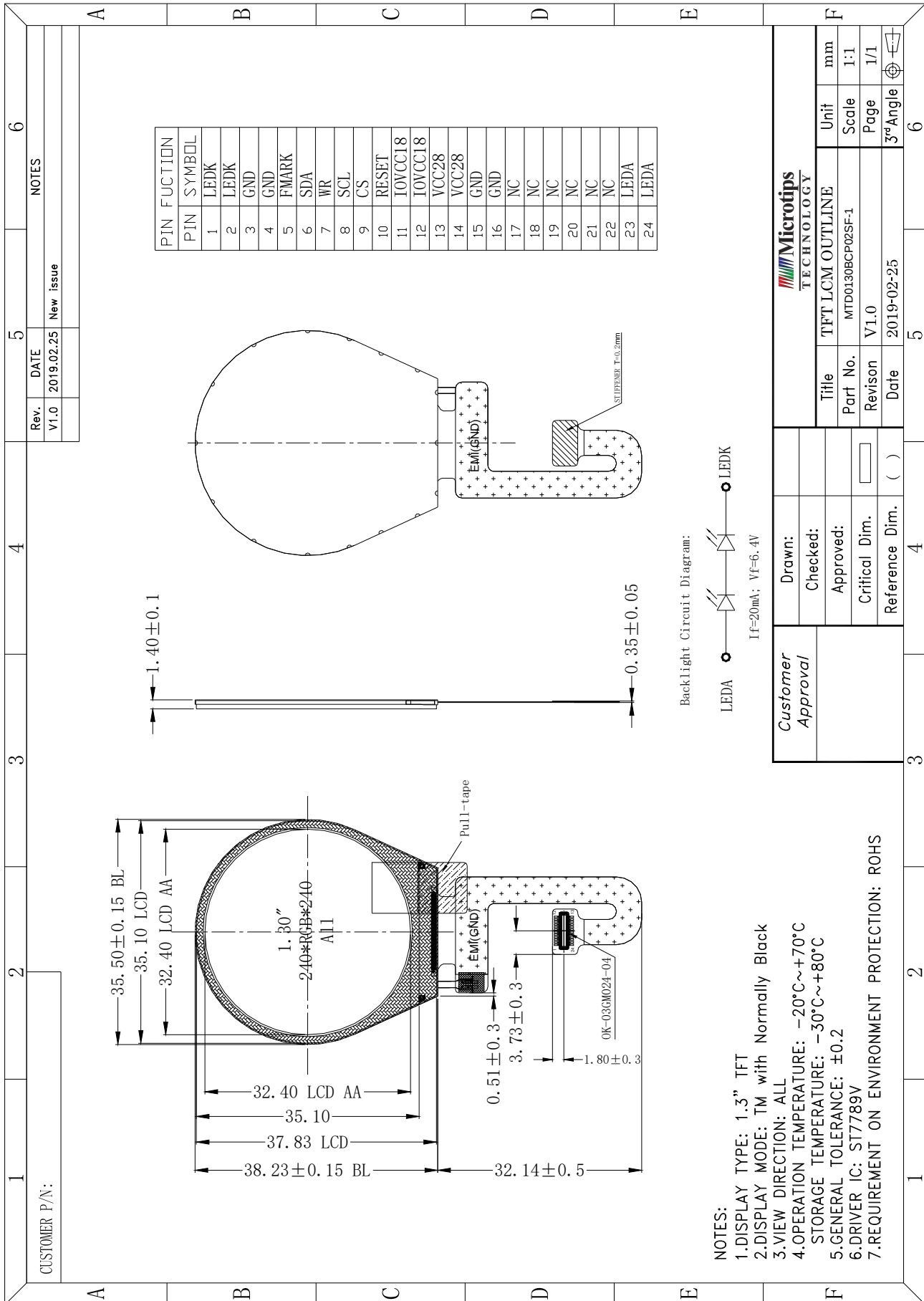
## 2. Application

Digital equipments which need color display, mobile navigator/video systems.

## 3. General Information

| Item                          | Contents                     | Unit |
|-------------------------------|------------------------------|------|
| Size                          | 1.3                          | inch |
| Resolution                    | 240(RGB) x 240               | /    |
| Interface                     | SPI                          | /    |
| Technology type               | IPS                          | /    |
| Pixel pitch                   | 0.135 x 0.135                | mm   |
| Pixel Configuration           | RGB stripes                  |      |
| Outline Dimension (W x H x D) | 35.50 x 38.23 x 1.40         | mm   |
| Active Area                   | 32.40 x 32.40                | mm   |
| Display Mode                  | Transmissive, Normally Black | /    |
| Backlight Type                | LED                          | /    |
| Viewing Direction             | ALL                          | /    |
| Driver IC                     | ST7789V                      |      |
| Weight                        | TBD                          | g    |

## 4. Outline Drawing



## 5. Interface signals

| Pin No | Symbol  | Function                                     |
|--------|---------|----------------------------------------------|
| 1      | LEDK    | Power for LED Backlight Cathode              |
| 2      | LEDK    | Power for LED Backlight Cathode              |
| 3      | GND     | Power ground                                 |
| 4      | GND     | Power ground                                 |
| 5      | FMARK   | Tearing effect signal pin                    |
| 6      | SDA     | Serial data input pin                        |
| 7      | WR      | Second data lane in 2 data lane pin          |
| 8      | SCL     | Serial interface clock pin                   |
| 9      | CS      | Chip select                                  |
| 10     | RESET   | Reset pin                                    |
| 11     | IOVCC18 | A power supply for the internal logic (1.8V) |
| 12     | IOVCC18 | A power supply for the internal logic (1.8V) |
| 13     | VCC28   | A power supply for the internal logic (2.8V) |
| 14     | VCC28   | A power supply for the internal logic (2.8V) |
| 15     | GND     | Power ground                                 |
| 16     | GND     | Power ground                                 |
| 17     | NC      | No connection                                |
| 18     | NC      | No connection                                |
| 19     | NC      | No connection                                |
| 20     | NC      | No connection                                |
| 21     | NC      | No connection                                |
| 22     | NC      | No connection                                |
| 23     | LEDA    | Power for LED Backlight Anode                |
| 24     | LEDA    | Power for LED Backlight Anode                |

## 6. Absolute maximum Ratings

### 6.1. Electrical Absolute max. ratings

| Parameter              | Symbol  | MIN | MAX  | Unit | Remark |
|------------------------|---------|-----|------|------|--------|
| Power supply for Logic | VCC-VSS | 2.4 | 3.3  | V    |        |
| Power supply for LCD   | VGH-VSS | 10  | 15   | V    |        |
| Input voltage          | VGL     | -13 | -7.5 | V    |        |

## 6.2. Environment Conditions

| Item                  | Symbol | MIN | MAX | Unit | Remark |
|-----------------------|--------|-----|-----|------|--------|
| Operating Temperature | TOPR   | -20 | 70  | °C   |        |
| Storage Temperature   | TSTG   | -30 | 80  | °C   |        |

## 7. Electrical Specifications

### 7.1 Electrical characteristics

Ta = 25 °C

| Item           | Symbol | MIN  | TYP       | MAX | Unit      | Remark |
|----------------|--------|------|-----------|-----|-----------|--------|
| Supply Voltage | VCC    | 2.6  | 2.8       | 3.3 | V         |        |
|                | IOVCC  | 1.65 | 1.8       | 3.3 | V         |        |
| Input voltage  | “H”    | VIH  | 0.7*IOVCC | --  | IOVCC     | V      |
|                | “L”    | VIL  | VSS       | --  | 0.3*IOVCC | V      |
| Output voltage | “H”    | VOH  | 0.8*IOVCC | --  | IOVCC     | V      |
|                | “L”    | VOL  | VSS       | --  | 0.2*IOVCC | V      |

### 7.2 LED Backlight

Ta=25°C

| Item            | Symbol | MIN | TYP    | MAX | Unit | Remark  |
|-----------------|--------|-----|--------|-----|------|---------|
| Forward Current | IF     | -   | 20     | -   | mA   |         |
| Forward Voltage | VF     | 5.6 | 6.4    | 7   | V    | If=40mA |
| LED Life time   | -      | -   | 30,000 | -   | Hrs  | Note    |

Note: The “LED life time” is defined as the module brightness decrease to 50% original brightness at Ta=25°C and IF=20mA. The LED life time could be decreased if operating IF is larger than 20mA.

Backlight Circuit Diagram:



## 8. Command/AC Timing

### 8.1 AC Characteristics

#### 8.1.1 Serial Interface Characteristics (3-line serial)

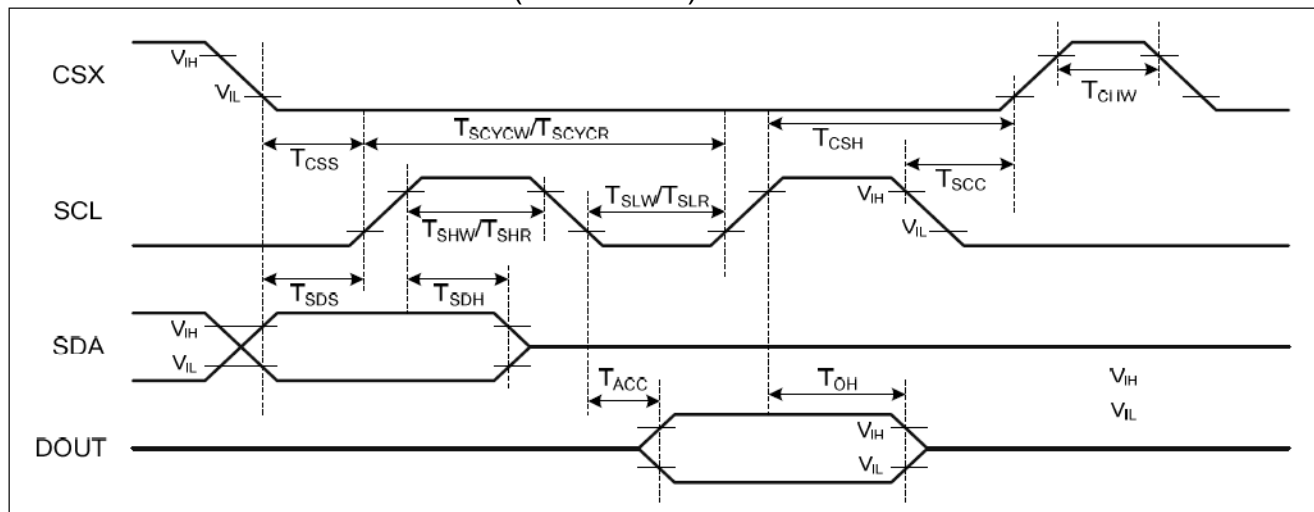


Figure: 3-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 °C

| Signal    | Symbol      | Parameter                      | Min. | Max. | Unit | Description                               |
|-----------|-------------|--------------------------------|------|------|------|-------------------------------------------|
| CSX       | $T_{CSS}$   | Chip select setup time (write) | 15   | -    | ns   |                                           |
|           | $T_{CSH}$   | Chip select hold time (write)  | 15   | -    | ns   |                                           |
|           | $T_{CSS}$   | Chip select setup time (read)  | 60   | -    | ns   |                                           |
|           | $T_{SCC}$   | Chip select hold time (read)   | 65   | -    | ns   |                                           |
|           | $T_{CHW}$   | Chip select "H" pulse width    | 40   | -    | ns   |                                           |
| SCL       | $T_{SCYCW}$ | Serial clock cycle (write)     | 66   | -    | ns   |                                           |
|           | $T_{SHW}$   | SCL "H" pulse width (write)    | 15   | -    | ns   |                                           |
|           | $T_{SLW}$   | SCL "L" pulse width (write)    | 15   | -    | ns   |                                           |
|           | $T_{SCYCR}$ | Serial clock cycle (read)      | 150  | -    | ns   |                                           |
|           | $T_{SHR}$   | SCL "H" pulse width (read)     | 60   | -    | ns   |                                           |
|           | $T_{SLR}$   | SCL "L" pulse width (read)     | 60   | -    | ns   |                                           |
| SDA (DIN) | $T_{SDS}$   | Data setup time                | 10   | -    | ns   |                                           |
|           | $T_{SDH}$   | Data hold time                 | 10   | -    | ns   |                                           |
| DOUT      | $T_{ACC}$   | Access time                    | 10   | 50   | ns   | For maximum CL=30pF<br>For minimum CL=8pF |
|           | $T_{OH}$    | Output disable time            | 15   | 50   | ns   |                                           |

Table: 3-line serial Interface Characteristics

### 8.1.2 Serial Interface Characteristics (4-line serial)

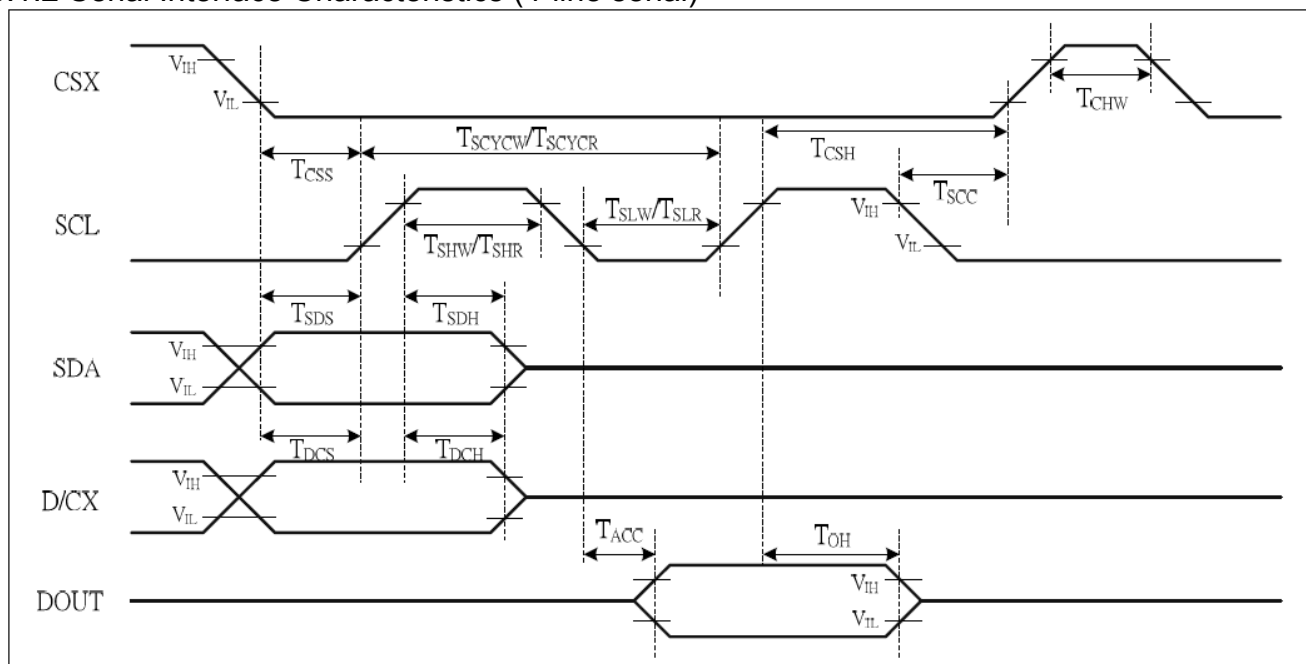


Figure: 4-line serial Interface Timing Characteristics

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta= -30 to 70 °C

| Signal    | Symbol      | Parameter                      | Min. | Max. | Unit | Description                               |
|-----------|-------------|--------------------------------|------|------|------|-------------------------------------------|
| CSX       | $T_{CSS}$   | Chip select setup time (write) | 15   | -    | ns   |                                           |
|           | $T_{CSH}$   | Chip select hold time (write)  | 15   | -    | ns   |                                           |
|           | $T_{CSS}$   | Chip select setup time (read)  | 60   | -    | ns   |                                           |
|           | $T_{SCC}$   | Chip select hold time (read)   | 65   | -    | ns   |                                           |
|           | $T_{CHW}$   | Chip select "H" pulse width    | 40   | -    | ns   |                                           |
| SCL       | $T_{SCYCW}$ | Serial clock cycle (write)     | 66   | -    | ns   | -write command & data ram                 |
|           | $T_{SHW}$   | SCL "H" pulse width (write)    | 15   | -    | ns   |                                           |
|           | $T_{SLW}$   | SCL "L" pulse width (write)    | 15   | -    | ns   |                                           |
|           | $T_{SCYCR}$ | Serial clock cycle (read)      | 150  | -    | ns   | -read command & data ram                  |
|           | $T_{SHR}$   | SCL "H" pulse width (read)     | 60   | -    | ns   |                                           |
|           | $T_{SLR}$   | SCL "L" pulse width (read)     | 60   | -    | ns   |                                           |
| D/CX      | $T_{DCS}$   | D/CX setup time                | 10   | -    | ns   |                                           |
|           | $T_{DCH}$   | D/CX hold time                 | 10   | -    | ns   |                                           |
| SDA (DIN) | $T_{SDS}$   | Data setup time                | 10   | -    | ns   |                                           |
|           | $T_{SDH}$   | Data hold time                 | 10   | -    | ns   |                                           |
| DOUT      | $T_{ACC}$   | Access time                    | 10   | 50   | ns   | For maximum CL=30pF<br>For minimum CL=8pF |
|           | $T_{OH}$    | Output disable time            | 15   | 50   | ns   |                                           |

Table: 4-line serial Interface Characteristics

## 9. Optical Specification

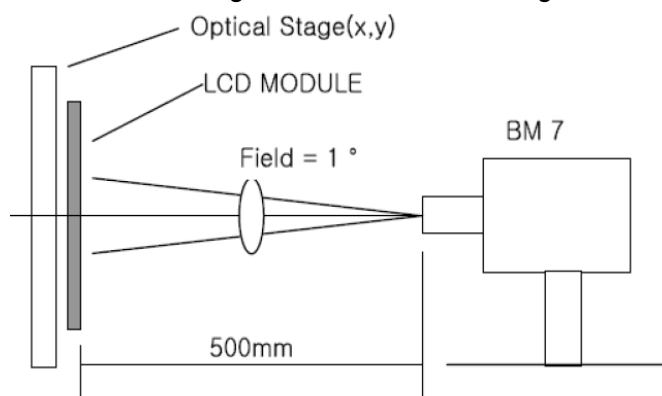
Ta=25°C

| Item           |       | Symbol    | Condition           | Min | Typ.  | Max. | Unit              | Remark          |
|----------------|-------|-----------|---------------------|-----|-------|------|-------------------|-----------------|
| Contrast Ratio |       | CR        | $\theta=0^{\circ}$  | -   | 800   | -    |                   | Note1<br>Note2  |
| Response Time  |       | Ton/ Toff | 25℃                 | -   | 30    | 35   | ms                | Note1<br>Note3  |
| View Angles    |       | ΘT        | $CR \cong 10$       | -   | 80    | -    | Degree            | Note 4          |
|                |       | ΘB        |                     | -   | 80    | -    |                   |                 |
|                |       | ΘL        |                     | -   | 80    | -    |                   |                 |
|                |       | ΘR        |                     | -   | 80    | -    |                   |                 |
| Chromaticity   | White | x         | Brightness<br>is on | -   | 0.308 | -    |                   | Note5,<br>Note1 |
|                |       | y         |                     | -   | 0.331 | -    |                   |                 |
|                | Red   | x         |                     | -   | 0.641 | -    |                   |                 |
|                |       | y         |                     | -   | 0.337 | -    |                   |                 |
|                | Green | x         |                     | -   | 0.274 | -    |                   |                 |
|                |       | y         |                     | -   | 0.560 | -    |                   |                 |
|                | Blue  | x         |                     | -   | 0.141 | -    |                   |                 |
|                |       | y         |                     | -   | 0.113 | -    |                   |                 |
| Luminance      |       | L         |                     | 160 | -     | -    | cd/m <sup>2</sup> | Note1<br>Note6  |
| Uniformity     |       | U         |                     | 80  | -     | -    | %                 | Note1<br>Note7  |
| NTSC Ratio     |       | S         |                     | -   | 60    | -    | %                 |                 |

Note 1: Definition of optical measurement system.

Temperature = 25°C(±3°C)

LED back-light: ON, Environment brightness < 150 lx

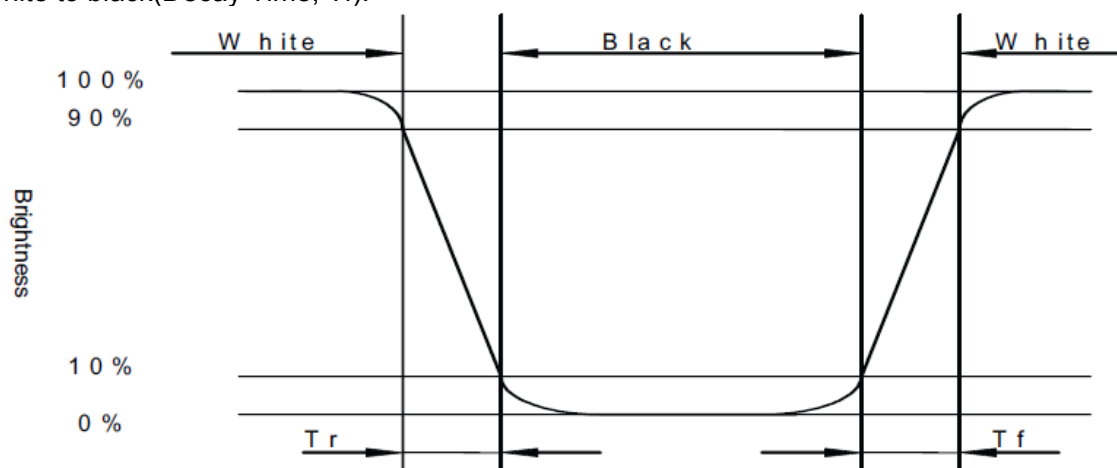


Note 2: Contrast ratio is defined as follow:

$$\text{Contrast Ratio} = \frac{\text{Surface Luminance with all white pixels}}{\text{Surface Luminance with all black pixels}}$$

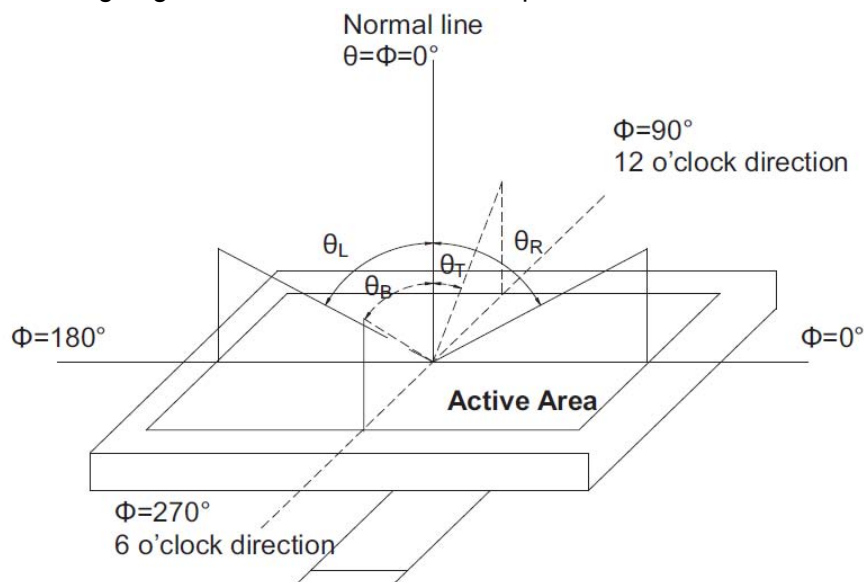
Note 3: Response time is defined as follow:

Response time is the time required for the display to transition from black to white (Rise Time,  $T_r$ ) and from white to black (Decay Time,  $T_f$ ).



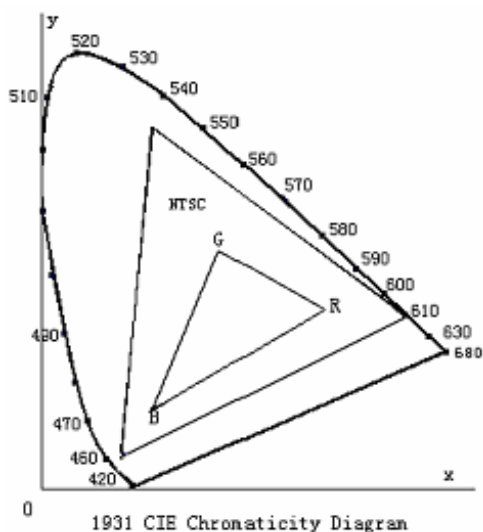
Note 4: Viewing angle range is defined as follow:

Viewing angle is measured at the center point of the LCD.



Note 5: Color chromaticity is defined as follow: (CIE1931)

Color coordinates measured at center point of LCD.



$$S = \frac{\text{area of RGB triangle}}{\text{area of NTSC triangle}} \times 100\%$$

**Note 6:** Luminance is defined as follow:

Luminance is defined as the brightness of all pixels “White” at the center of display area on optimum contrast.

**Note 7:** Luminance Uniformity is defined as follow:

Active area is divided into 9 measuring areas (Refer Fig. 2). Every measuring point is placed at the center of each measuring area.

$$\text{Uniformity (U)} = \frac{\text{Minimum Luminance( brightness ) in 9 points}}{\text{Maximum Luminance( brightness ) in 9 points}}$$

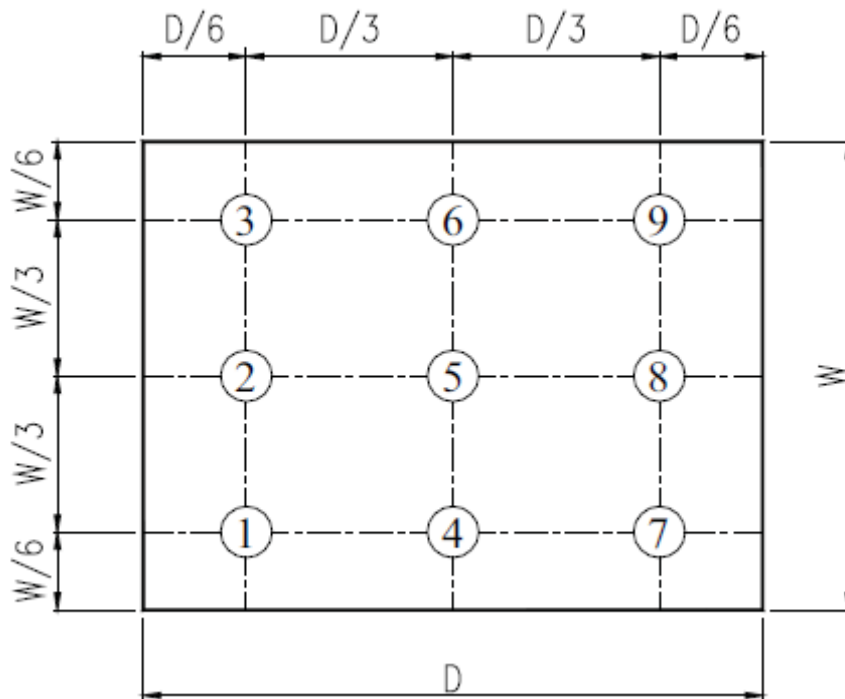


Fig. 2 Definition of uniformity

## 10. Environmental / Reliability Tests

| No | Test Item                         | Condition                                                                                                | Judgment criteria                                           |
|----|-----------------------------------|----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|
| 1  | High Temp Operation               | Ts=+70℃, 96hrs                                                                                           | Per table in below                                          |
| 2  | Low Temp Operation                | Ta=-20℃, 96hrs                                                                                           | Per table in below                                          |
| 3  | High Temp Storage                 | Ta=+80℃, 96hrs                                                                                           | Per table in below                                          |
| 4  | Low Temp Storage                  | Ta=-30℃, 96hrs                                                                                           | Per table in below                                          |
| 5  | High Temp & High Humidity Storage | Ta=+40℃, 90% RH<br>96hours                                                                               | Per table in below<br>(polarizer discoloration is excluded) |
| 6  | Thermal Shock<br>(Non-operation)  | -30℃ 30 min~+80℃ 30 min,<br>Change time:5min, 10 Cycles                                                  | Per table in below                                          |
| 7  | ESD (Operation)                   | C=150pF, R=330Ω , 5points/panel<br>Air:±8KV, 5times;<br>Contact:±4KV, 5 times;                           | Per table in below                                          |
| 8  | Vibration<br>(Non-operation)      | Frequency range:10~55Hz,<br>Stroke:1.5mm<br>Sweep:10Hz~55Hz~10Hz 2 hours<br>for each direction of X.Y.Z. | Per table in below                                          |
| 9  | Shock<br>(Non-operation)          | 60G 6ms, ±X,±Y,±Z 3times,<br>for each direction                                                          | Per table in below                                          |
| 10 | Package<br>Drop Test              | Height:80 cm,<br>1 corner, 3 edges, 6 surfaces                                                           | Per table in below                                          |

| INSPECTION             | CRITERION(after test)                                                               |
|------------------------|-------------------------------------------------------------------------------------|
| Appearance             | No Crack on the FPC, on the LCD Panel                                               |
| Alignment of LCD Panel | No Bubbles in the LCD Panel<br>No other Defects of Alignment in Active area         |
| Electrical current     | Within device specifications                                                        |
| Function / Display     | No Broken Circuit, No Short Circuit or No Black line<br>No Other Defects of Display |

## 11. Precautions for Use of LCD Modules

### 11.1 Safety

The liquid crystal in the LCD is poisonous. Do not put it in your mouth. If the liquid crystal touches your skin or clothes, wash it off immediately using soap and water.

### 11.2 Handling

- A. The LCD and touch panel is made of plate glass. Do not subject the panel to mechanical shock or to excessive force on its surface.
- B. Do not handle the product by holding the flexible pattern portion in order to assure the reliability
- C. Transparency is an important factor for the touch panel. Please wear clear finger sacks, gloves and mask to protect the touch panel from finger print or stain and also hold the portion outside the view area when handling the touch panel.
- D. Provide a space so that the panel does not come into contact with other components.
- E. To protect the product from external force, put a covering lens (acrylic board or similar board) and keep an appropriate gap between them.
- F. Transparent electrodes may be disconnected if the panel is used under environmental conditions where dew condensation occurs.
- G. Property of semiconductor devices may be affected when they are exposed to light, possibly resulting in IC malfunctions.
- H. To prevent such IC malfunctions, your design and mounting layout shall be done in the way that the IC is not exposed to light in actual use.

### 11.3 Static Electricity

- A. Ground soldering iron tips, tools and testers when they are in operation.
- B. Ground your body when handling the products.
- C. Power on the LCD module before applying the voltage to the input terminals.
- D. Do not apply voltage which exceeds the absolute maximum rating.
- E. Store the products in an anti-electrostatic bag or container.
- F. Peel off the LCM protective film slowly since static electricity may be generated.

### 11.4 Storage

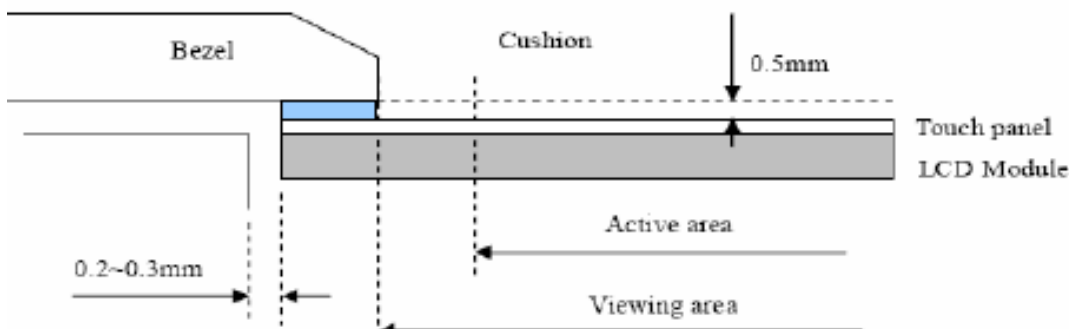
- A. Store the products in a dark place at  $+25^{\circ}\text{C} \pm 10^{\circ}\text{C}$  with low humidity (40% RH to 60% RH). Don't expose to sunlight or fluorescent light.
- B. Storage in a clean environment, free from dust, active gas, and solvent.

### 11.5 Cleaning

- A. Do not wipe the touch panel with dry cloth, as it may cause scratch.
- B. Wipe off the stain on the product by using soft cloth moistened with ethanol. Do not allow ethanol to get in between the upper film and the bottom glass. It may cause peeling issue or defective operation. Do not use any organic solvent or detergent other than ethanol.

### 11.6 Cautions for installing and assembling

- A. Bezel edge must be positioned in the area between the Active area and View area. The bezel may press the touch screen and cause activation if the edge touches the active area. A gap of approximately 0.5mm is needed between the bezel and the top electrode. It may cause unexpected activation if the gap is too narrow. There is a tolerance of 0.2 to 0.3mm for the outside dimensions of the touch panel and tail. A gap must be made to absorb the tolerance in the case and connector.
- B. In order to make the display assembly stable and firm, MTU recommends to design some supporting at the display backside, especially for the display with tape-attached touch panel, such supporting is important and essential, or else, the display may drop-off from front after some period of time.
- C. Do not display the fixed pattern for a long time because it may develop image sticking due to the LCD structure. If the screen is displayed with fixed pattern, use a screen saver.



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