Microtips TECHNOLOGY

# MODEL No: MTD0200FZS

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# Record of Revision

| Date | Revision No. | Summary |
|---|---|---|
| 2016-12-06 | 1.0 | Rev 1.0 was issued |
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| | | |
| | | |

## 1. Scope

This data sheet is to introduce the specification of MTD0200FZS active matrix TFT module. It is composed of a color TFT-LCD panel, driver IC, FPC and a backlight unit. The 2.0″ display area contains 240(RGB)x320 pixels.

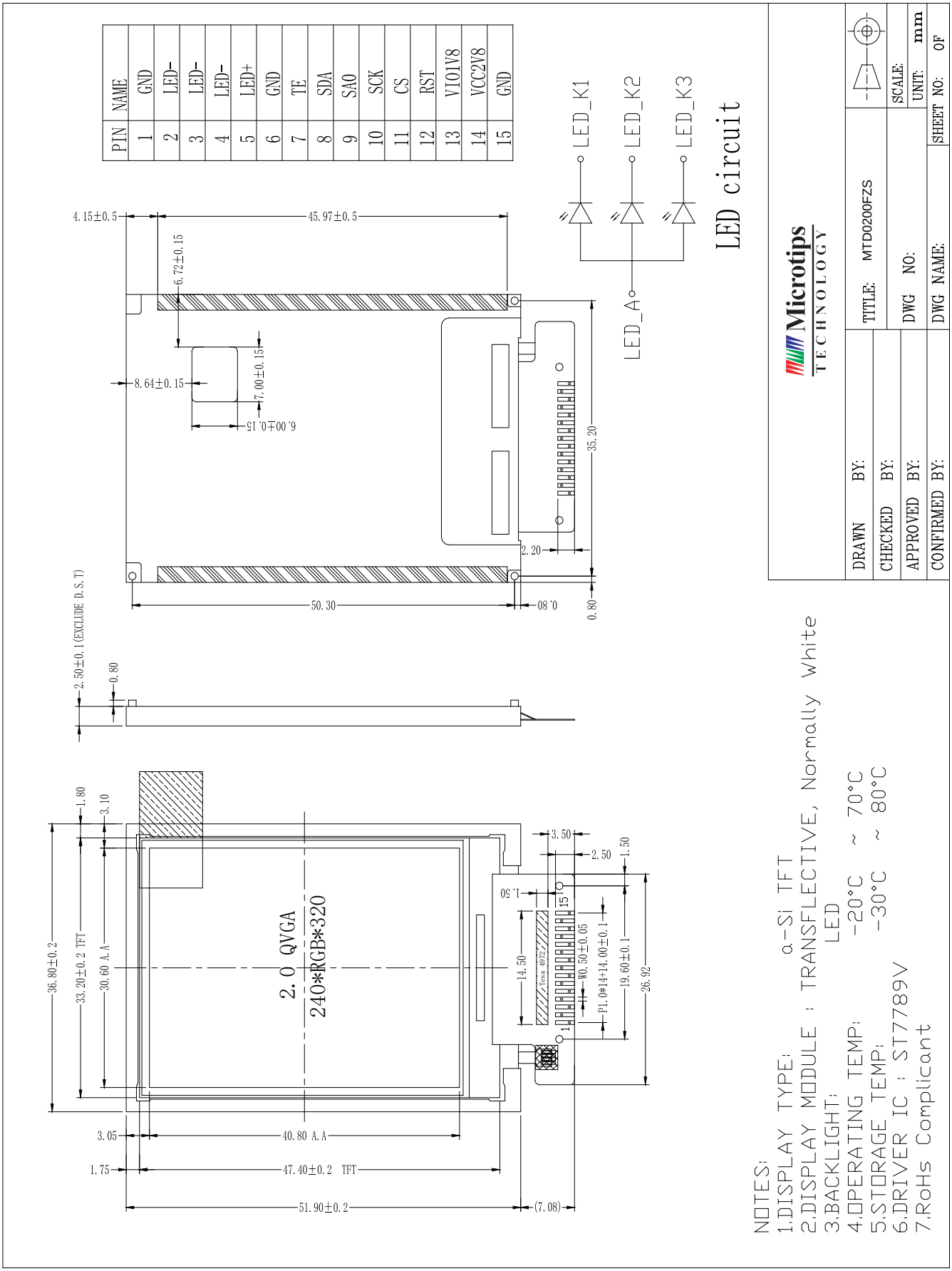
## 2. Application

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

## 3. General Information

| Item | Contents | Unit |
|---|---|---|
| Size | 2.0 | inch |
| Resolution | 240(BGR) x 320 | / |
| Interface | SPI | / |
| Technology type | a-Si TFT | / |
| Pixel pitch | 0.1275 x 0.1275 | mm |
| Pixel Configuration | RGB stripes | |
| Outline Dimension (W x H x D) | 36.80 x 51.90 x 2.50 | mm |
| Active Area | 30.60 x 40.80 | mm |
| Display Mode | Transflective<br>Normally white | / |
| Recommended View Direction | 12:00 | O'clock |
| Backlight Type | LED | / |
| Colors | 262k | / |
| Driver IC | ST7789V | / |

## 4. Outline Drawing



## 5. Interface signals

| Pin | Symbol | I/O | Description | Note |
|---|---|---|---|---|
| 1 | GND | P | Power Ground | - |
| 2 | LED- | P | LED Cathode | |
| 3 | LED- | P | LED Cathode | |
| 4 | LED- | P | LED Cathode | |
| 5 | LED+ | P | LED Anode | |
| 6 | GND | P | Power Ground | |
| 7 | TE | O | Output a frame head pulse signal | |
| 8 | SDA | I | SPI interface input | |
| 9 | SA0 | I | SPI command/data selection | |
| 10 | SCK | I | Serial interface clock | |
| 11 | CS | I | Chip selection | |
| 12 | RST | I | LCD Reset terminal active "L" | |
| 13 | VIO1V8 | P | Power supply (1.8V) | |
| 14 | VCC2V8 | P | Power supply (2.8V) | |
| 15 | GND | P | Power Ground | |

## 6. Absolute maximum Ratings

### 6.1. Electrical Absolute max. ratings

| Parameter | Symbol | MIN | MAX | Unit | Remark |
|---|---|---|---|---|---|
| Power supply LCD Voltage1 | IOVCC-VSS | -0.3 | +3.6 | V | |
| Power supply LCD Voltage2 | VCC-VSS | -0.3 | +3.6 | V | |
| Supply current (One LED) | $I_{led}$ | - | 20 | mA | |

### 6.2. Environment Conditions

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

Note: Absolute maximum ratings means the product can withstand short-term, NOT more than 120 hours. If the product is a long time to withstand these conditions, the life time would be shorter.

# 7. Electrical Specifications

## 7.1 Electrical characteristics

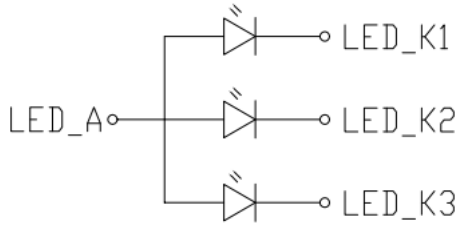
GND=0V, Ta=25℃

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Logic Supply Voltage | IOVCC | +1.65 | +1.8 | +3.6 | V | |
| | VCC | +2.65 | +2.8 | +3.6 | V | |
| Logic input voltage | VIL | GND | -- | 0.3xIOVCC | V | |
| | VIH | 0.7xIOVCC | -- | IOVCC | V | |
| Logic output voltage | VOL | GND | -- | 0.2xIOVCC | V | |
| | VOH | 0.8xIOVCC | -- | VIOCC | V | |

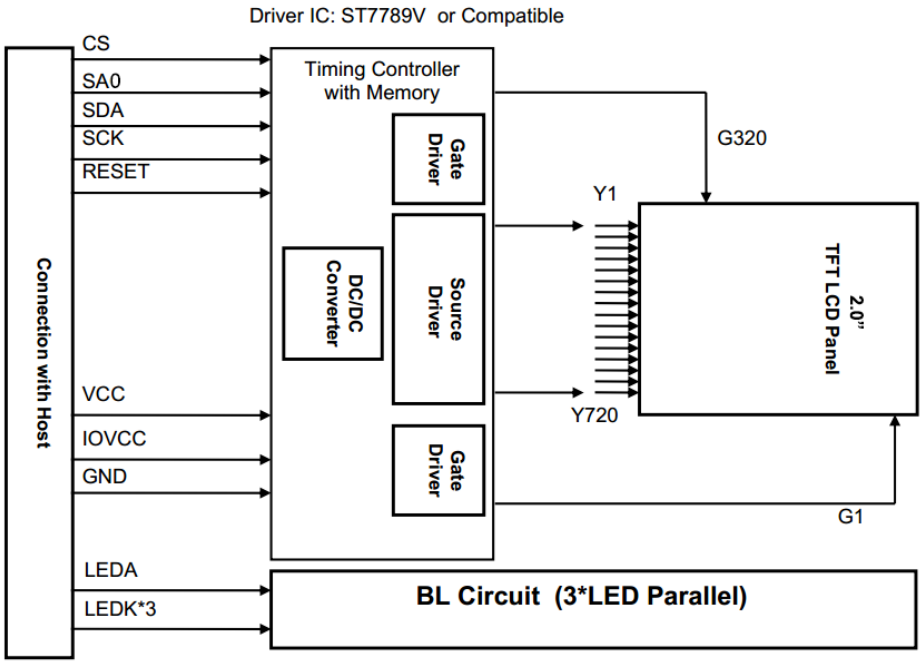
## 7.2 LED Backlight

| Item | Symbol | MIN | TYP | MAX | Unit | Remark |
|---|---|---|---|---|---|---|
| Forward Current | IF | | 60 | | mA | |
| Forward Voltage | VF | 2.8 | 3.2 | 3.4 | V | IF=60mA; Ta=25℃ |
| Power consumption | | 168 | 192 | 204 | mW | IF=60mA |

Using condition : constant current driving method If= 20mA (+/- 10%)

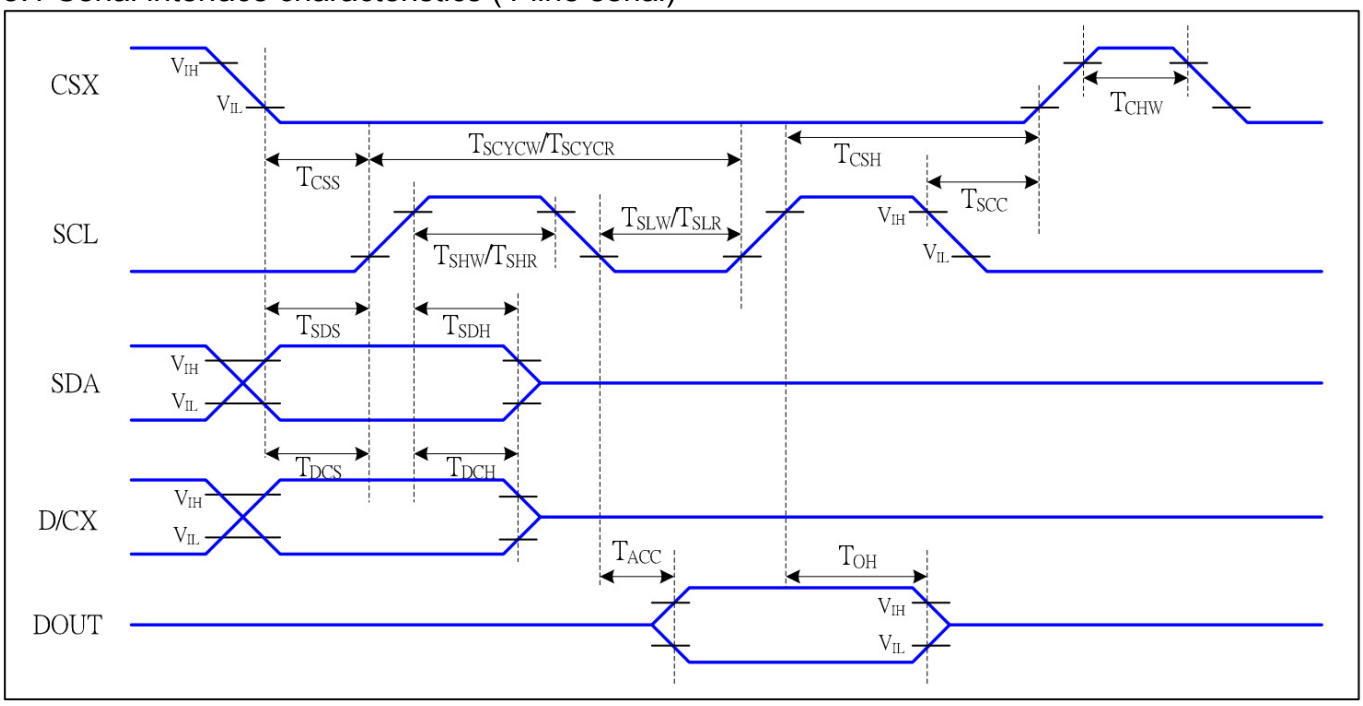



## 7.3 Block Diagram



# 8. Command/AC Timing

## 8.1 Serial interface characteristics (4-line serial)



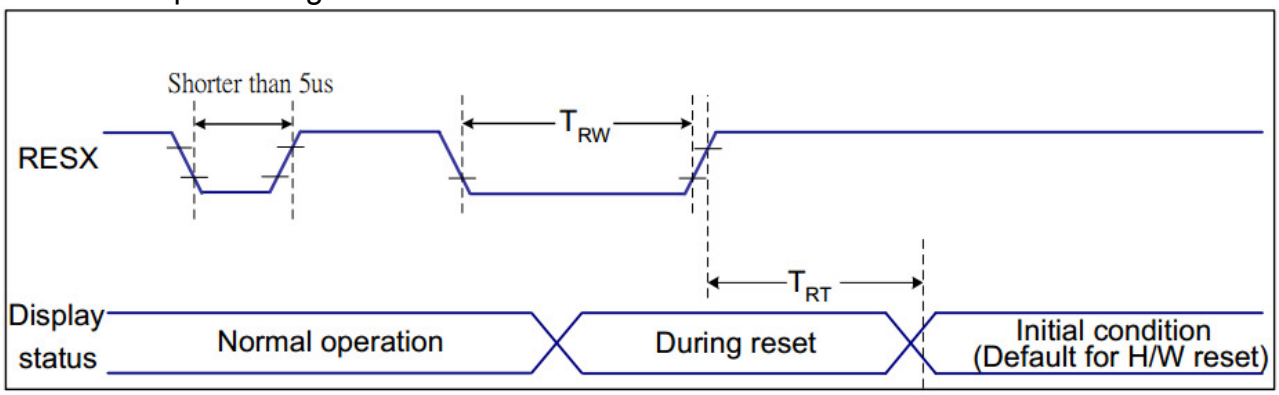

**4-line Serial interface timing characteristics**

*IOVCC=1.65 to 3.3V, VCC=2.4 to 3.3V, AGND=DGND=0V, Ta=-20 to 70 ℃*

| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|---|---|---|---|---|---|---|
| CSX | TCSS | Chip select setup time (Write) | 15 | | ns | |
| | TCSH | Chip select hold time (Write) | 15 | | ns | |
| | TCSS | Chip select setup time (Read) | 60 | | ns | |
| | TSCC | Chip select hold time (Read) | 65 | | ns | |
| | TCHW | Chip select “H” pulse width | 40 | | ns | |
| SCL | TSCYCW | Serial clock cycle (Write) | 66 | | ns | -write command & data ram |
| | TSHW | SCL “H” pulse width (Write) | 15 | | ns | |
| | TSLW | SCL “L” pulse width (Write) | 15 | | ns | |
| | TSCYCR | Serial clock cycle (Read) | 150 | | ns | -read command & data ram |
| | TSHR | SCL “H” pulse width (Read) | 60 | | ns | |
| | TSLR | SCL “L” pulse width (Read) | 60 | | ns | |
| D/CX | TDCS | D/CX setup time | 10 | | ns | |
| | TDCH | D/CX hold time | 10 | | ns | |
| SDA (DIN) (DOUT) | TSDS | Data setup time | 10 | | ns | For maximum CL=30pF For minimum CL=8pF |
| | TSDH | Data hold time | 10 | | ns | |
| | TACC | Access time | 10 | 50 | ns | |
| | TOH | Output disable time | 15 | 50 | ns | |

Note : The rising time and falling time (Tr, Tf) of input signal are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

8.2 Reset Input Timing




Reset Timing

| Related Pins | Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|---|
| RESX | tRW | Reset pulse duration | 10 | - | us |
| | tRT | Reset cancel | - | 5 (Note1, 5) | ms |
| | | | | 120 (Note1,6,7) | ms |

Notes :

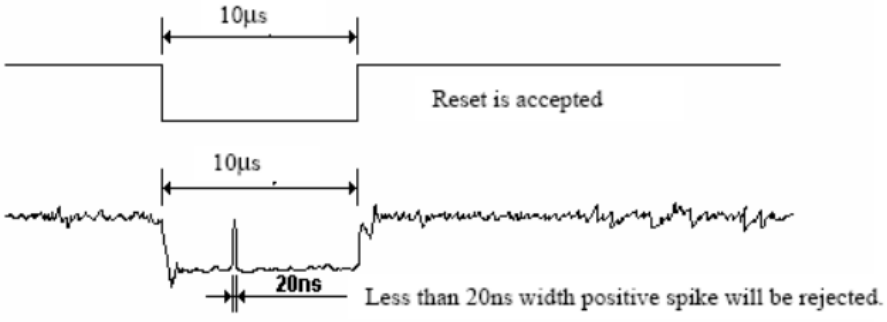
1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from EEPROM (or similar device ) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

| RESX Pulse | Action |
|---|---|
| Shorter than 5 us | Reset Rejected |
| Longer than 9 us | Reset |
| Between 5 us and 9 us | Reset starts |

3. During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120ms, when Reset Starts in Sleep Out –mode. The display remains the blank state in Sleep In –mode.) and then return to Default condition
for Hardware Reset.

4. Spike Rejection also applies during a valid reset pulse as shown below:




5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep In Mode.

7. It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec

## 9. Optical Specification

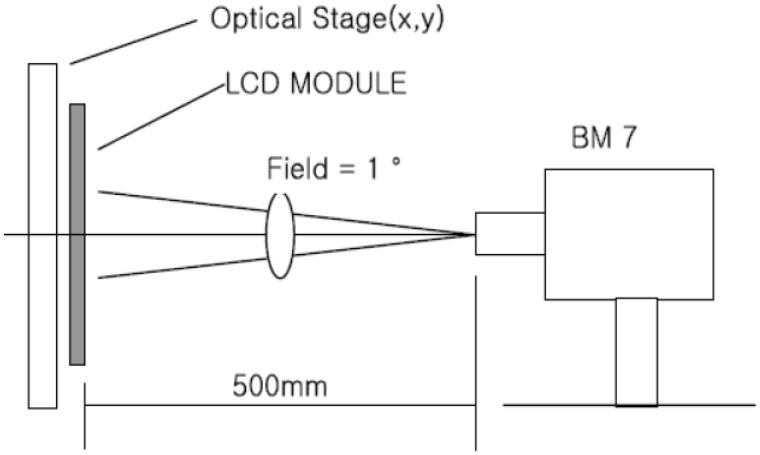
Ta=25℃

| Item | | Symbol | Condition | Min | Typ. | Max. | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| Contrast Ratio | | CR | θ=0° | 500 | 700 | - | | Note1<br>Note2 |
| Response Time | | Ton/ Toff | 25℃ | - | 40 | 60 | ms | Note1<br>Note3 |
| View Angles | | ΘR | CR≧10 | | 70 | - | Degree | Note 4 |
| | | ΘL | | | 70 | - | | |
| | | ΘT | | | 70 | - | | |
| | | θB | | | 60 | - | | |
| Chromaticity | Red | x | Brightness is on | | 0.64 | | | Note5, Note1 |
| | | y | | | 0.32 | | | |
| | Green | x | | | 0.29 | | | |
| | | y | | | 0.58 | | | |
| | Blue | x | | | 0.13 | | | |
| | | y | | | 0.14 | | | |
| | White | x | | | 0.30 | | | |
| | | y | | | 0.35 | | | |
| NTSC | | S | | | 50 | | % | Note5 |
| Luminance | | L | | 200 | 230 | - | $cd/m^2$ | Note1<br>Note6 |
| Uniformity (White) | | U | | 80 | - | - | % | Note1<br>Note7 |

Note 1: Definition of optical measurement system.

Temperature = 25℃(±3℃)

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

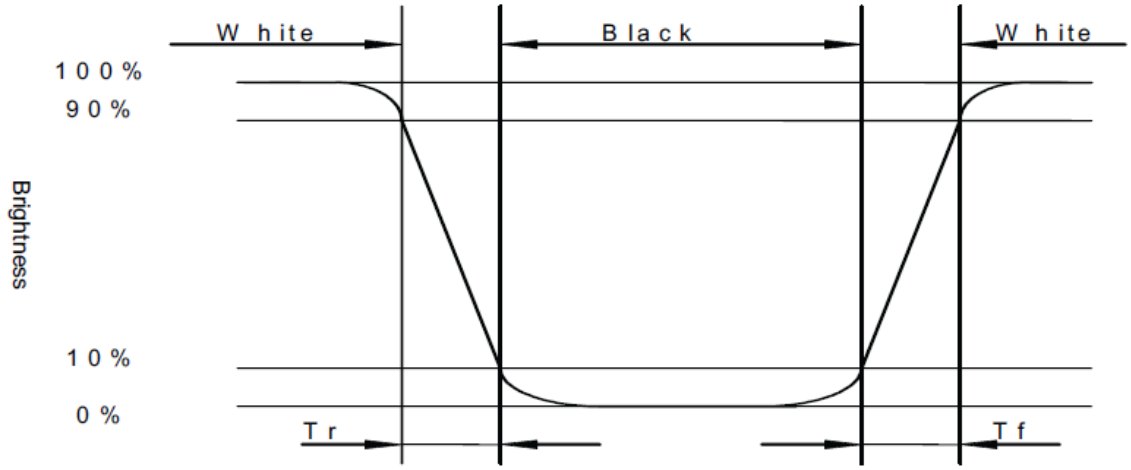



Note 2: Contrast ratio is defined as follow:

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

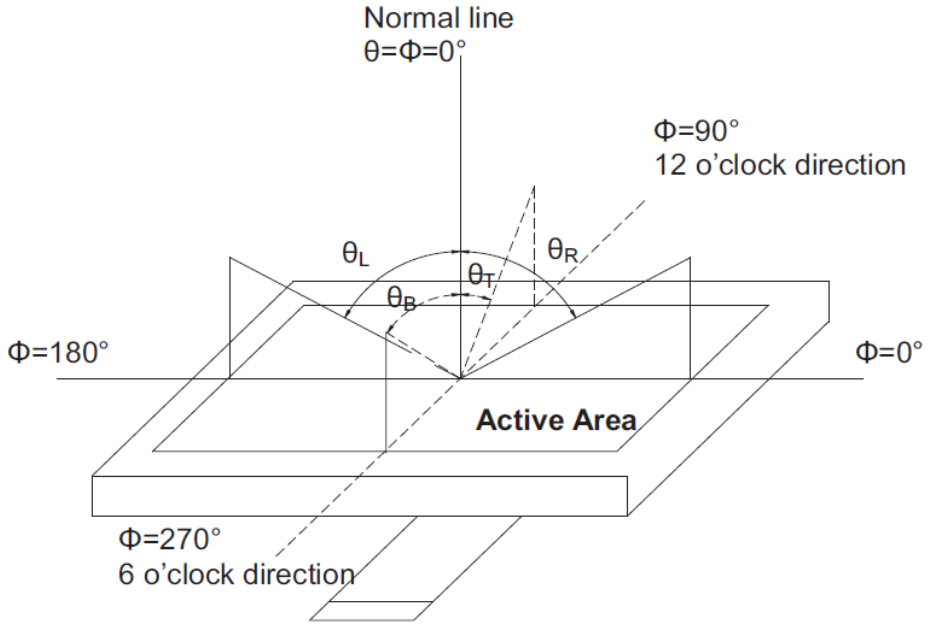
Note 3: Response time is defined as follow:

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



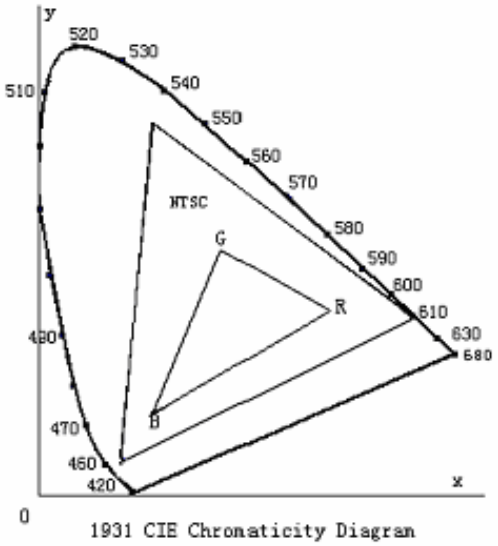
Note 4: Viewing angle range is defined as follow:

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.

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

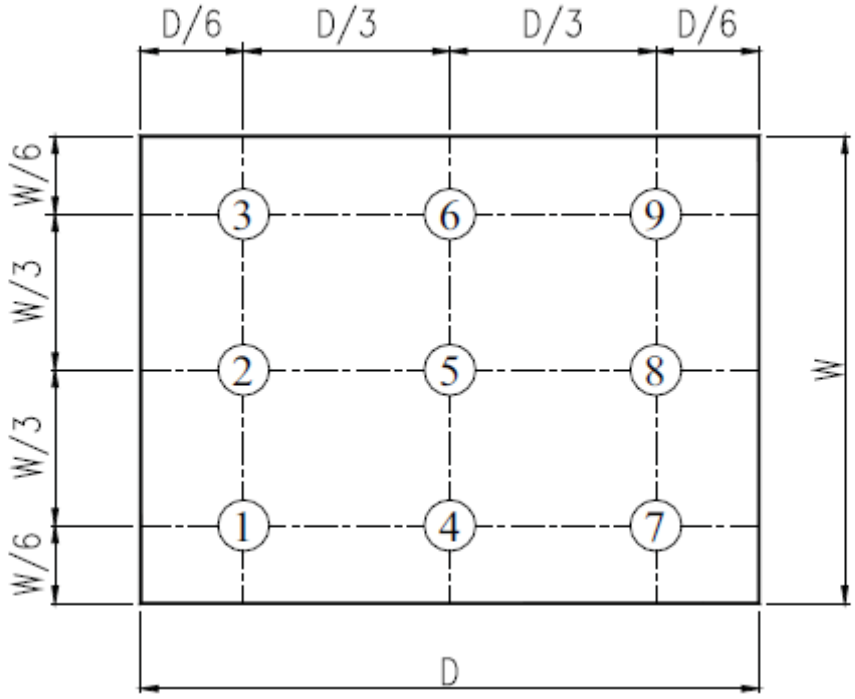
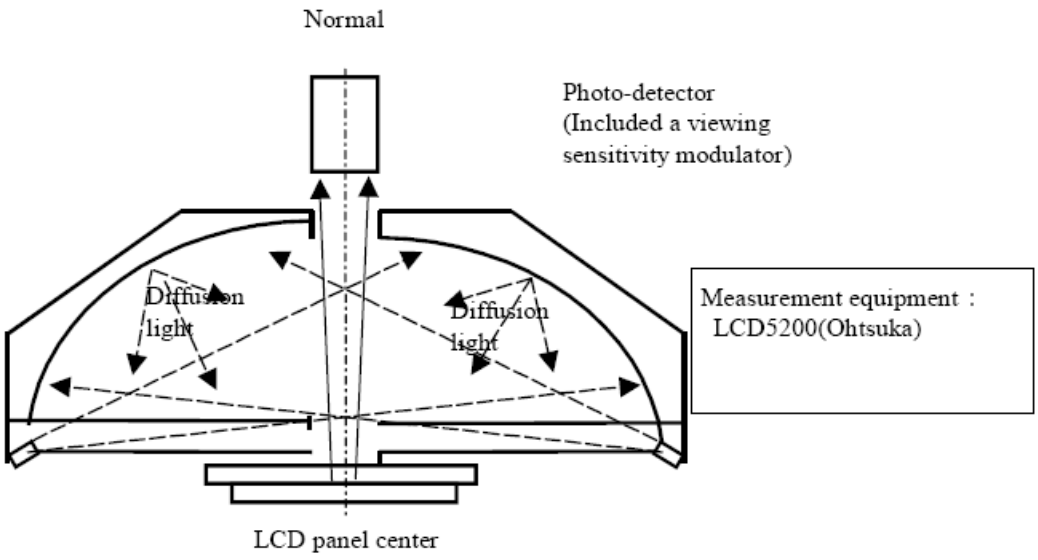



Fig. 2 Definition of uniformity

Note 8: Reflectance measurement system is defined as follow:



## 10. Environmental / Reliability Tests

| No | Test Item | Condition | Judgment criteria |
|---|---|---|---|
| 1 | High Temp Operation | Ts=+70℃, 120hrs | Per table in below |
| 2 | Low Temp Operation | Ta=-20℃, 120hrs | Per table in below |
| 3 | High Temp Storage | Ta=+80℃, 120hrs | Per table in below |
| 4 | Low Temp Storage | Ta=-30℃, 120hrs | Per table in below |
| 5 | High Temp & High Humidity Storage | Ta=+50℃, 90% RH<br>120 hours | Per table in below<br>(polarizer discoloration is excluded) |
| 6 | Thermal Shock (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 (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 | Package Drop Test | Height:100 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.

## 11.4Storage

A. Store the products in a dark place at +25℃±10℃ 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

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.