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# LCD Module

# Product Specification

## Product: INT043BTFT & INT043BTFT-TS
## 4.3" Integrated TFT Display Module
## (480RGBx272DOTS)

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**January 3, 2013.**

# 1. REVISION RECORD

| VERSION | CHANGES | DATE |
|---|---|---|
| 1.0 | Initial revision | 4 November 2011 |
| 2.0 | Change pin#38 to +5.0V at page 5, 6, & 7. | January 2, 2013 |
| 2.1 | Added voltage and current details for pin#38 at page 8 | January 3, 2013 |
| | | |
| | | |
| | | |

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## 2. Introduction

***INT043BTFT*** and ***INT043BTFT-TS*** are integrated display module based upon a TFT display with a 272 x 480 RGB resolution. The TFT module is mounted on a PCB on which is mounted a Solomon SSD1961 controller with integrated touch screen control and PWM driving circuit for the LED backlight. The TFT module is automatically initialised upon power up by an on-board controller circuit.

## 3. Features

- 8080/6800 MCU Interface (1)
- Built-in 675kbyte (5,529,600bit) frame buffer. Support up to 640 x 480 at 18bpp display
- Deep sleep mode for power saving
- Screen display rotation
- Display mirroring
- Programmable contrast and saturation control
- Auto initialisation (2)
- Embedded 4-Wires Touch Panel Controller
- Embedded PWM control and LED driving circuit for backlight

**Remarks:**

(1) MCU Interface is selected by soldering option as below.
- **8080 interface** (Default setting): R4 is with 0 ohm resistor / R19 is opened.
- **6800 interface** (By request): R19 is with 0 ohm resistor / R4 is opened.
- 8/16/18-bit MCU interface are available.

(2) "Auto Initialisation" takes around half second to complete, customer is suggested to add an one second delay at the beginning of their program.

## 4. General Specifications

| Item | Specification | Unit |
|---|---|---|
| LCD mode | Transmissive | --- |
| Resolution | 480(RGB) | Line |
| | 272 | Line |
| Diagonal Size | 4.3 | Inch |
| Overall Size | 116.20 | mm |
| | 69.70 | mm |
| Active area | 95.04 | mm |
| | 53.86 | mm |
| Optimum Viewing Direction | 6 o'clock | --- |
| Controller IC | Solomon SSD1961;<br>MAX11802 (Touch screen) | --- |
| Interface type | 8080/6800 with 8/16/18 Data Bus Width (1) | --- |
| Colours | 262K | --- |
| Operation temperature range | -20~70 | °C |
| Storage temperature range | -30~80 | °C |

**Remarks:**

(1) MCU Interface is selected by soldering option as below.
- **8080 interface** (Default setting): R4 is with 0 ohm resistor / R19 is opened.
- **6800 interface** (By request): R19 is with 0 ohm resistor / R4 is opened.
- 8/16/18-bit MCU interface are available.
- Maxim MAX11802 is with SPI interface.

(2) Color tune may be changed slightly by temperature and driving voltage.

(3) RoHS compliant.

**Component Life Cycle**

1) Storage Life: min. 1 Year

2) Operation Life (*1): min. 43 x $10^3$ h (24hr/day x 7days/week x 52weeks/year x 5years)
(Not include backlight)

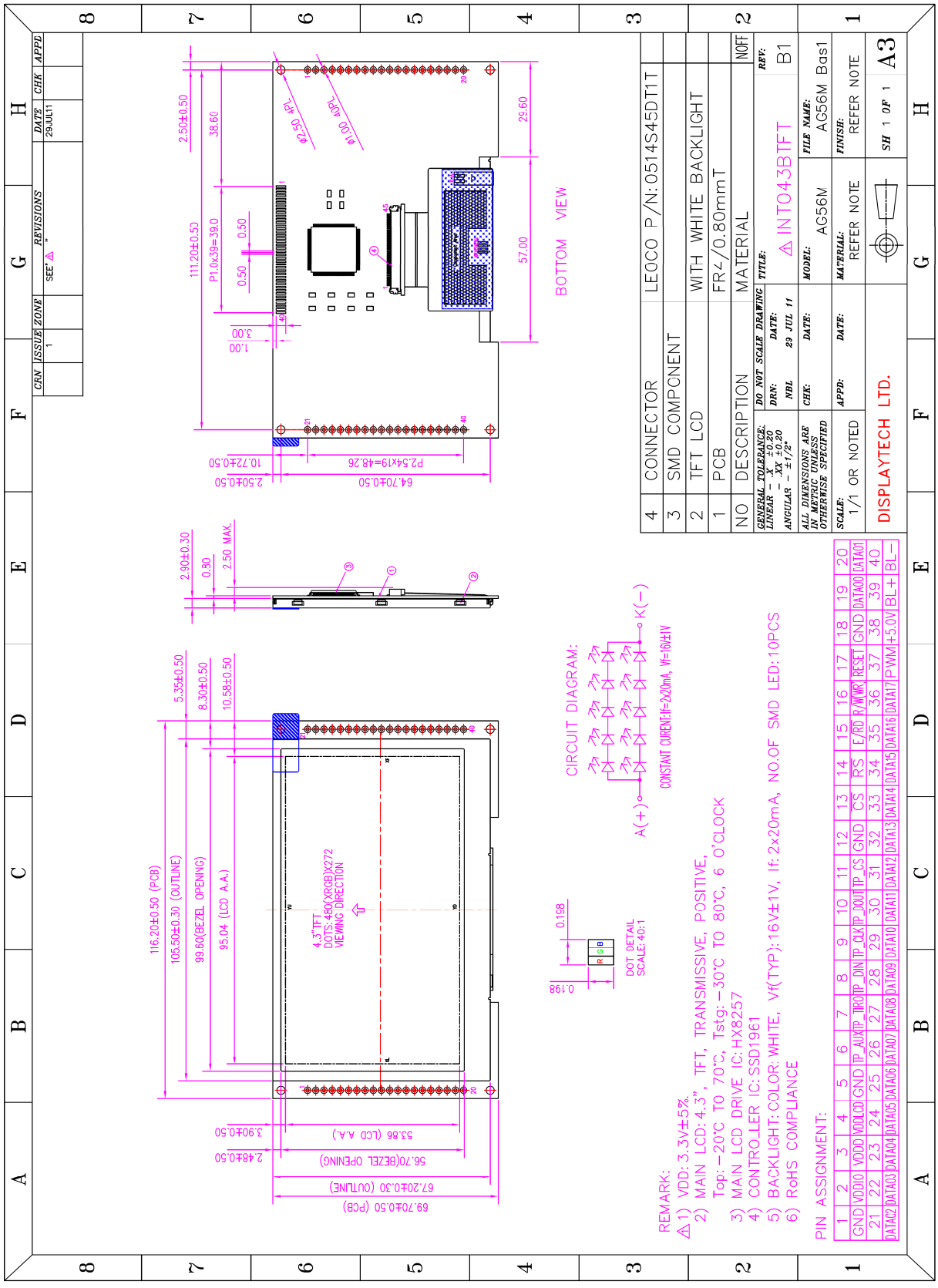
3) Storage and Operation Life Times are defined for a temperature of +25°C

**Notes:**

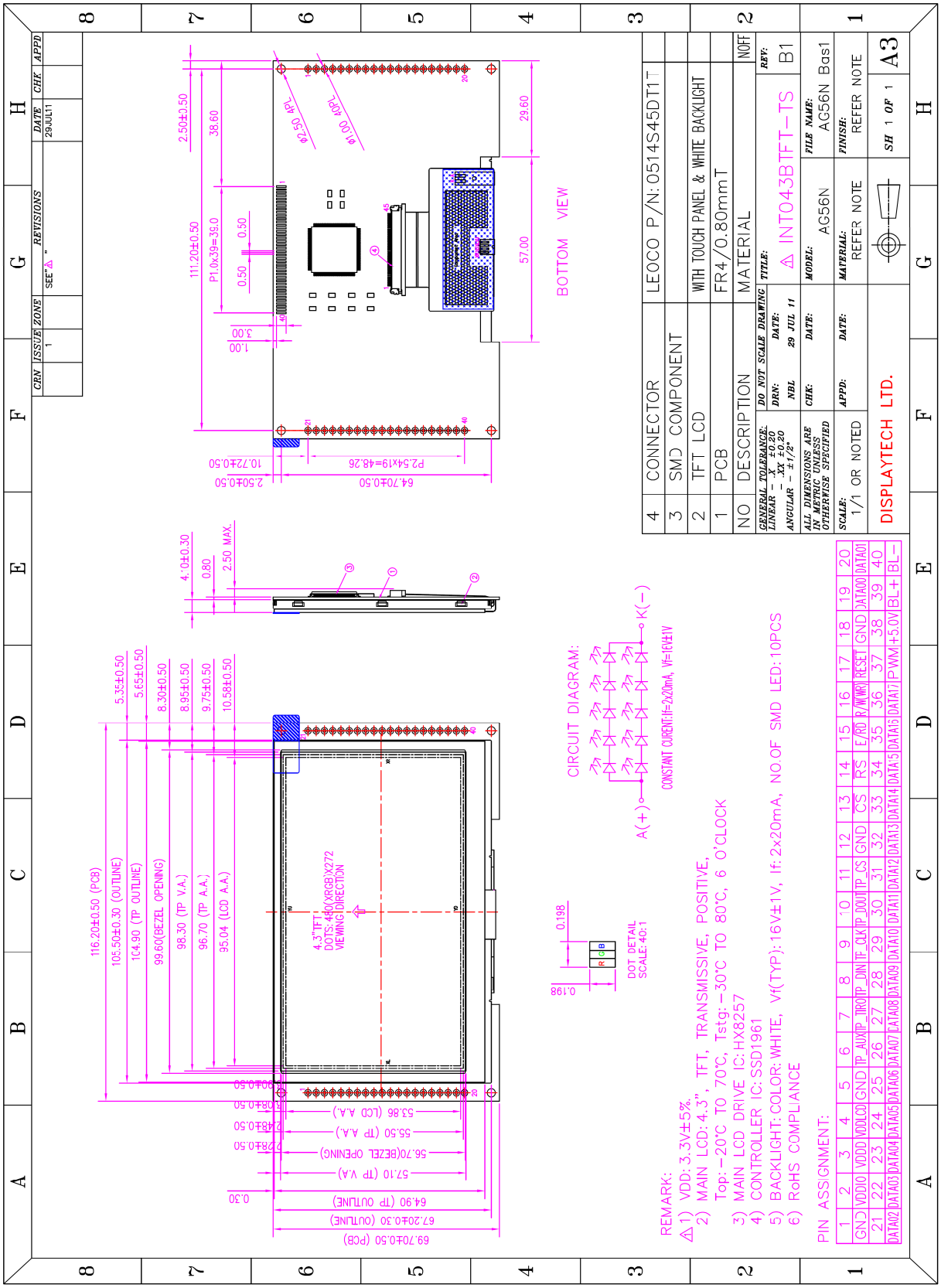
*1. Operation life ends when one of the listed faults occurs:
- The on/off response-times reach 1.5 times of the max. value specified for a new display
- The contrast is reduced to 0.5 of the original contrast value
- Loss of function
- The number of cosmetic defects exceeds the maximum defined

## 5. Mechanical Drawing

- **INT043BTFT**



- **INT043BTFT-TS**



## 6. Interface Description

| Pin no | Symbol | I/O | Description |
|---|---|---|---|
| 1 | GND | --- | Power ground 0V |
| 2 | VDDIO | --- | Power supply for digital I/O pads |
| 3 | VDDD | --- | Power supply for internal digital circuit |
| 4 | VDDLCD | --- | Power supply for LCD interface related pads |
| 5 | GND | --- | Power ground 0V |
| 6 | TP_AUX | I | Auxiliary Input: Analog input that used to monitor external conditions such as battery voltage or temperature. (INT043BTFT-TS only: for MAX11802) |
| 7 | TP_TIRQ | O | Active-Low Touch Interrupt Output: Active-low interrupt, indicating that a touch is present (CINT) or has been initiated (EINT) in DCM, or that new data is available in the FIFO in ACM. (INT043BTFT-TS only: for MAX11802) |
| 8 | TP_DIN | I | SPI Serial Data Input. (INT043BTFT-TS only: for MAX11802) |
| 9 | TP_CLK | I | SPI Serial Data Clock Input. (INT043BTFT-TS only: for MAX11802) |
| 10 | TP_DOUT | I | SPI Data Output. (INT043BTFT-TS only: for MAX11802) |
| 11 | TP_CS | I | SPI Chip-Select Input. (INT043BTFT-TS only: for MAX11802) |
| 12 | GND | --- | Power ground 0V |
| 13 | /CS | I | Chip select (for Controller SSD1961) |
| 14 | /RS | I | Data/Command select |
| 15 | E(/RD) | I | 6800 mode: E (enable signal)<br>8080 mode: /RD (read strobe signal) |
| 16 | R/W(/WR) | I | 6800 mode: R/W<br>0: Write cycle<br>1: Read cycle<br>8080 mode: /WR (write strobe signal) |
| 17 | /RESET | I | Master synchronize reset |
| 18 | GND | --- | Power ground 0V |
| 19<br>\|<br>36 | DATA00<br>\|<br>DATA17 | I/O | Data bus. Pins not used should be floating |
| 37 | NC (PWM) | --- | No connection |
| 38 | +5.0V | I | Power supply for backlight |
| 39 | NC (BL+) | --- | No connection |
| 40 | NC (BL-) | --- | No connection |

## 7. Absolute Maximum Ratings

(GND=VSS=0V; Ta=25°C)

| Item | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| I/O power supply | VDDIO | -0.5 | 4.6 | V |
| Digital Core power supply | VDDD | -0.5 | 1.8 | V |
| LCD Interface power supply | VDDLCD | -0.5 | 4.6 | V |
| Input Voltage | VIN | -0.5 | 4.6 | V |
| Output Voltage | VOUT | -0.5 | 4.6 | V |
| Operating Temperature | TOP | -20 | +70 | °C |
| Storage Temperature | TST | -30 | +80 | °C |

Note:

- When temperature is below 0°C, the response time of liquid crystal (LC) will be slower and the color of panel will be darker.
- If module driving condition exceeds the absolute maximum ratings, permanent damaged may be resulted. If module is driven within the absolute maximum ratings but exceeded the DC characteristics, mal-function may be resulted.
- VDD/VCC > VSS

## 8. Electrical Characteristics

DC Characteristics

(GND=VSS=0V; Ta=25°C)

| Item | | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| I/O power supply | | VDDIO | 3.135 | 3.3 | 3.465 | V |
| Digital Core power supply | | VDDD | 1.08 | 1.2 | 1.32 | V |
| LCD Interface power supply | | VDDLCD | 1.65 | 3.3 | 3.6 | V |
| Input signal voltage | Low level | VIL | --- | --- | 0.2VDDIO | |
| | High level | VIH | 0.8VDDIO | --- | VDDIO + 0.5 | V |
| Output signal voltage | Low level | VOL | --- | --- | 0.2VDDIO | V |
| | High level | VOH | 0.8VDDIO | --- | --- | V |
| Power supply for backlight (pin#38) | | | 4.75 | 5.0 | 5.25 | V |
| Current consumption for backlight (pin#38) | | | 112 | 140 | 210 | mA |

## 9. Display Controller /Power Supply Timing

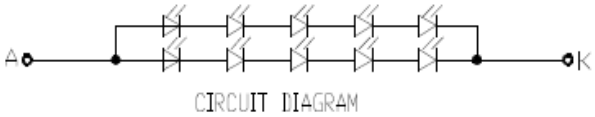
See Display and Touch Screen Controller Specification: **Solomon SSD1961 & Maxim MAX11802**

## 10.Backlight specification

(VDDIO=3.3V, GND=VSS=0V, Ta=25°C)

| Item | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|
| **Supply voltage** | Vf | If=40mA | 15.0 | 16.0 | 17.0 | V | 2 |
| **Forward current** | If | | --- | --- | 40 | mA | 1, 2 |
| **Uniformity** | ΔBp | If=40mA | 70 | --- | --- | % | |
| **Color coordination** | X | | 0.275 | --- | 0.317 | --- | |
| | Y | | 0.275 | --- | 0.317 | --- | |

LED circuit diagram:




Constant current If=2x20mA=40mA; Vf=16.0V(typ)

Note:

1) The LED's driver mode needs to be constant current mode.
2) Permanent damage to the device may occur if maximum values are exceeded. Functional operation should be restricted to the conditions described under normal operating conditions.

## 11.Optical Characteristics

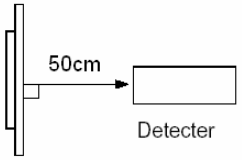
(VDDIO=3.3V, GND=VSS=0V, Ta=25°C)

| Item | | Symbol | Condition | Min | Typ | Max | Unit | Note |
|---|---|---|---|---|---|---|---|---|
| **Brightness** | | Bp | θ=0º Φ=0º | 220 | --- | --- | cd/m² | 1 |
| **Uniformity** | | ΔBp | | 70 | --- | --- | % | 1, 2 |
| **Viewing Angle** | | θ1 (Φ=90° or 270°) | Cr≥10 | -70 ~ 50 | | | deg | 3 |
| | | θ2 (Φ=0° or 180°) | | -70 ~ 70 | | | | |
| **Contrast ratio** | | Cr | θ=0º Φ=0º | 400 | 450 | --- | --- | 4 |
| **Response Time** | | Tr | | --- | 20 | 30 | ms | 5 |
| | | Tf | | | | | | |
| **CIE (x,y) Chromaticity** | **White** | x | θ=0º Φ=0º | 0.273 | 0.323 | 0.373 | --- | 1, 6 |
| | | y | | 0.298 | 0.348 | 0.398 | | |
| | **Red** | x | | 0.536 | 0.586 | 0.636 | | |
| | | y | | 0.307 | 0.357 | 0.407 | | |
| | **Green** | x | | 0.294 | 0.344 | 0.394 | | |
| | | y | | 0.427 | 0.577 | 0.527 | | |
| | **Blue** | x | | 0.104 | 0.154 | 0.204 | | |
| | | y | | 0.052 | 0.102 | 0.152 | | |
| **NTSC Ratio** | | S | | --- | 50 | --- | % | |

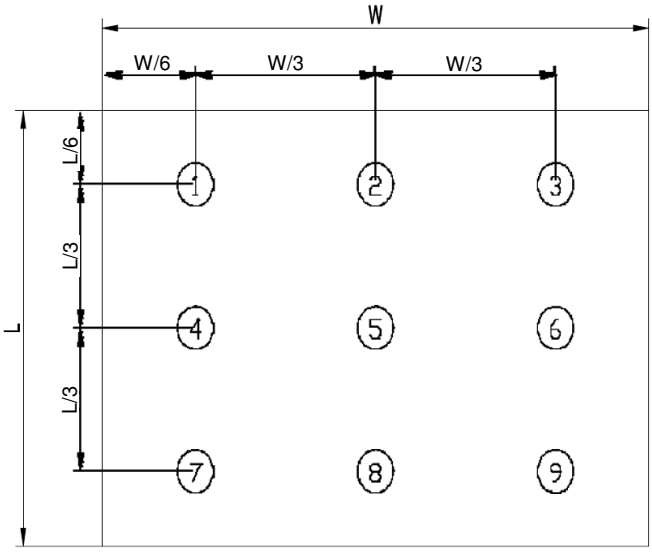
Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white.
The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)

Measuring condition:
- Measuring surroundings: Dark room.
- Measuring temperature: Ta=25°C.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

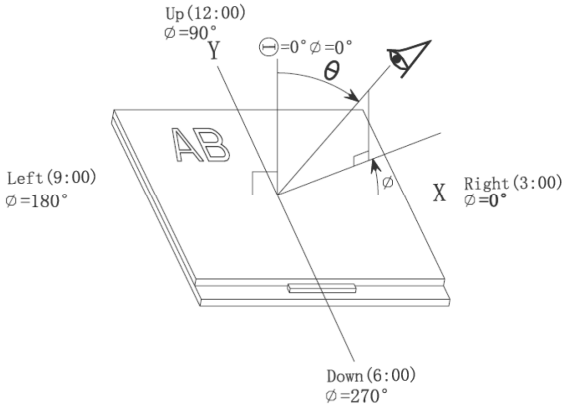



Note 2: The luminance uniformity is calculated by using following formula.
ΔBp = Bp (Min.) / Bp (Max.)×100 (%)
Bp (Max.) = Maximum brightness in 9 measured spots
Bp (Min.) = Minimum brightness in 9 measured spots.




Measurement equipment PR-705 (Φ8mm)

Note 3: The definition of viewing angle:
Refer to the graph below marked by $\theta$ and Φ

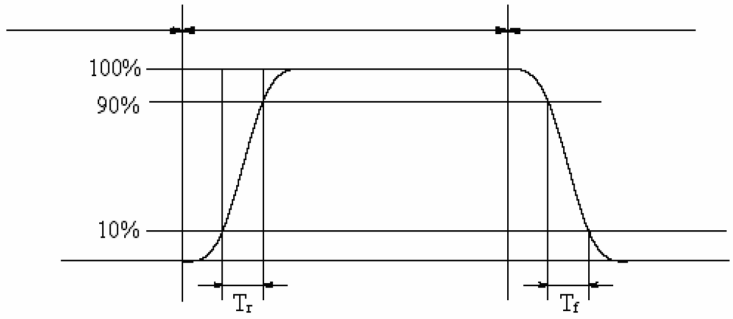


Note 4: The definition of contrast ratio (Test LCM using PR-705):

$$\text{Contrast Ratio (CR)} = \frac{\text{Luminance When LCD is at "White" state}}{\text{Luminance When LCD is at "Black" state}}$$

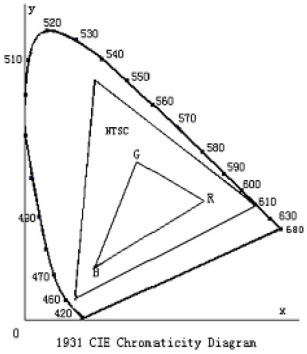
(Contrast Ratio is measured in optimum common electrode voltage)

Note 5: Definition of Response time. (Test LCD using DMS501):
The output signals of photo detector are measured when the input signals are changed from "black" to "white" (falling time) and from "white" to "black" (rising time), respectively.
The response time is defined as the time interval between the 10% and 90% of amplitudes. Refer to figure as below.




The definition of response time

Note 6: Definition of Color of CIE Coordinate and NTSC Ratio.




**Color gamut:**

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

## 12. Safety Precaution

Handling precautions:

- This device is susceptible to Electro-Static Discharge (ESD) damage. Observe Anti-Static precautions.

Power supply precautions:

- Identify and, at all times, observe absolute maximum ratings for both logic and LC drivers. Note that there is some variance between models.
- Prevent the application of reverse polarity to VCC and GND, however briefly.
- Use a clean power source free from transients. Power up conditions are occasionally “jolting” and may exceed the maximum ratings of the modules.
- The VCC power of the module should also supply the power to all devices that may access the display. Don’t allow the data bus to be driven when the logic supply to the module is turned off.

Operating precautions:

- DO NOT plug or unplug the module when the system is powered up.
- Minimize the cable length between the module and host MPU.
- Operate the module within the limits of the modules temperature specifications.

Mechanical/Environmental precautions:

- Improper soldering is the major cause of module difficulty. Use of flux cleaner is not recommended as they may seep under the elastomeric connection and cause display failure.
- Mount the module so that it is free from torque and mechanical stress.
- Surface of the LCD panel should not be touched or scratched. The display front surface is an easily scratched, plastic polarizer. Avoid contact and clean only when necessary with soft, absorbent cotton dampened with petroleum benzene.
- Always employ anti-static procedure while handling the module.
- Prevent moisture build-up upon the module and observe the environmental constraints for storage temperature and humidity.
- Do not store in direct sunlight
- If leakage of the liquid crystal material should occur, avoid contact with this material, particularly ingestion. If the body or clothing becomes contaminated by the liquid crystal material, wash thoroughly with water and soap

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