

**TENTATIVE**

All information in this technical data sheet is tentative  
and subject to change without notice.

**Preliminary**

**10.4" SVGA**

**TECHNICAL SPECIFICATION**

Sample Product Name : AA104SL12-DE-01

**mitsubishi electric corp.**

Date: May.23,'13

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# 1. APPLICATION

This specification applies to color TFT-LCD module, AA104SL12-DE-01.

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## (1) Standard Usage

Computers, office equipment, factory automation equipment, test and measurement equipment, communications, transportation equipment(automobiles, ships, trains, etc.), provided, however, that operation is not influenced by TFT-LCD directly.

## (2) Special Usage

Medical equipment, safety equipment, transportation equipment, provided, however, that TFT-LCD is necessary to its operation.

## (3) Specific Usage

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## 2. OVERVIEW

AA104SL12-DE-01 is 10.4" color TFT-LCD (Thin Film Transistor Liquid Crystal Display) module composed of LCD panel, driver ICs, control circuit, LED driver, backlight unit, touch panel, and cover glass.

By applying 6 bit or 8 bit digital data,  $800 \times 600$ , 262k-color or 16.7M-color images are displayed on the 10.4" diagonal screen. Input power voltage is 3.3 V for LCD driving.

The type of data and control signals are digital and transmitted via LVDS interface per Typ. 40MHz clock cycle.

Driver circuit for LED backlight is not included in this module. General specifications are summarized in the following table:

| ITEM                           |                   | SPECIFICATION                                                            |
|--------------------------------|-------------------|--------------------------------------------------------------------------|
| Display Area (mm)              |                   | 211.2 (H) $\times$ 158.4 (V)<br>(10.4-inch diagonal)                     |
| Number of Dots                 |                   | $800 \times 3$ (H) $\times$ 600 (V)                                      |
| Pixel Pitch (mm)               |                   | 0.264 (H) $\times$ 0.264 (V)                                             |
| Color Pixel Arrangement        |                   | RGB vertical stripe                                                      |
| Display Mode                   |                   | Normally white                                                           |
| Number of Color                |                   | 262k(6 bit/color), 16.7M(8 bit/color)                                    |
| Luminance (cd/m <sup>2</sup> ) |                   | (960)                                                                    |
| Viewing Angle (CR $\geq$ 10)   |                   | -80~80°(H), -60~80°(V)                                                   |
| Cover glass                    | Surface Treatment | Anti-reflection                                                          |
|                                | Thickness (mm)    | 1.8                                                                      |
|                                | Glass Type        | Strengthened glass                                                       |
| Electrical Interface           |                   | LVDS (6 bit/8 bit)                                                       |
| Viewing Direction              |                   | Higher Contrast ratio: 6 o'clock<br>Less gray scale reversal: 12 o'clock |
| Module Size (mm)               |                   | 240.6 (W) $\times$ 190.8 (H) $\times$ 14.7(D)                            |
| Module Mass (g)                |                   | TBD                                                                      |
| Backlight Unit                 |                   | LED, edge-light, Unreplaceable                                           |
| Touch Panel                    |                   | Projective capacitive                                                    |
| Touch Panel Interface          |                   | UART / USB *1)                                                           |

Characteristic value without any note is typical value.

\*1) UART: Universal Asynchronous Receiver Transmitter  
UART and USB are used exclusively.

### 3. ABSOLUTE MAXIMUM RATINGS

| ITEM                                                                           | SYMBOL                      | MIN. | MAX.     | UNIT |
|--------------------------------------------------------------------------------|-----------------------------|------|----------|------|
| Power Supply Voltage for LCD                                                   | VCC                         | -0.3 | 4.0      | V    |
| Logic Input Voltage                                                            | VI                          | -0.3 | VCC+0.3  | V    |
| Backlight (LED) Current                                                        | IF                          | 0    | 180      | mA   |
| Touch Panel Voltage                                                            | VDD5                        | 0    | 6.0      | V    |
| Touch Panel Input Voltage                                                      | VI <sub>TP</sub>            | -0.3 | VDD5+0.3 | V    |
| Operation Temperature (Touch Panel) <span style="float:right">Note 1,2)</span> | T <sub>op(TouchPanel)</sub> | -30  | 70       | °C   |
| Operation Temperature (Ambient) <span style="float:right">Note 2)</span>       | T <sub>op(Ambient)</sub>    | -30  | 70       | °C   |
| Storage Temperature <span style="float:right">Note 2)</span>                   | T <sub>stg</sub>            | -30  | 80       | °C   |

[Note]

1) Measured at the center of active area and at the center of panel back surface

2) Top, Tstg ≤ 40°C : 90%RH max. without condensation

Top, Tstg > 40°C : Absolute humidity shall be less than the value of 90%RH at 40°C without condensation.

### 4. ELECTRICAL CHARACTERISTICS

(1) TFT-LCD

Ambient temperature: Ta = 25°C

| ITEM                            |      | SYMBOL | MIN.    | TYP. | MAX.    | UNIT  | Remarks      |
|---------------------------------|------|--------|---------|------|---------|-------|--------------|
| Power Supply Voltages for LCD   |      | VCC    | 3.0     | 3.3  | 3.6     | V     | *1)          |
| Power Supply Currents for LCD   |      | ICC    | --      | 300  | 430     | mA    | *2)          |
| Permissive Input Ripple Voltage |      | VRP    | --      | --   | 100     | mVp-p | VCC = +3.3 V |
| Logic Input Voltage             | High | VIH    | 0.8×VCC | --   | VCC     | V     | MODE, SC     |
|                                 | Low  | VIL    | 0       | --   | 0.2×VCC | V     | MODE, SC     |

\*1) Power and signals sequence:

$$0.1 \text{ ms} \leq t1 \leq 10 \text{ ms}$$

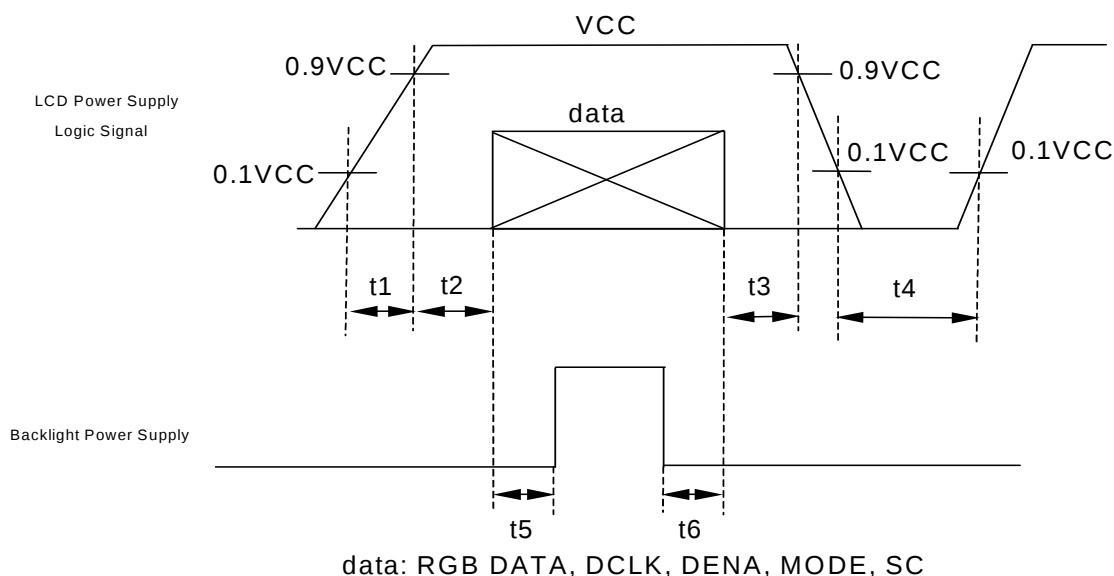
$$200\text{ms} \leq t4$$

$$0 < t2 \leq 50\text{ms}$$

$$200\text{ms} \leq t5$$

$$0 < t3 \leq 50\text{ms}$$

$$0 \leq t6$$

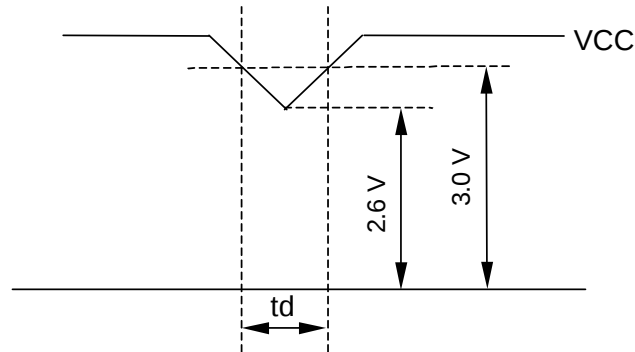


VCC-dip conditions:

1) When  $2.6 \text{ V} \leq V_{CC} < 3.0 \text{ V}$ ,  $t_d \leq 10 \text{ ms}$

2) When  $V_{CC} < 2.6 \text{ V}$

VCC-dip conditions should also follow the power and signals sequence.



\*2)  $V_{CC} = +3.3 \text{ V}$ ,  $f_H = 37.9 \text{ kHz}$ ,  $f_V = 60 \text{ Hz}$ ,  $f_{CLK} = 40 \text{ MHz}$

Display image at typical power supply current value is 256-gray-bar pattern (8 bit), 600 line mode.

\*3) Fuse

| Parameter | Fuse Type Name | Supplier                  | Remark |
|-----------|----------------|---------------------------|--------|
| VCC       | FCC16102AB     | Kamaya Electric Co., Ltd. | *)     |

\*) The power supply capacity should be designed to be more than the fusing current.

(2) Backlight

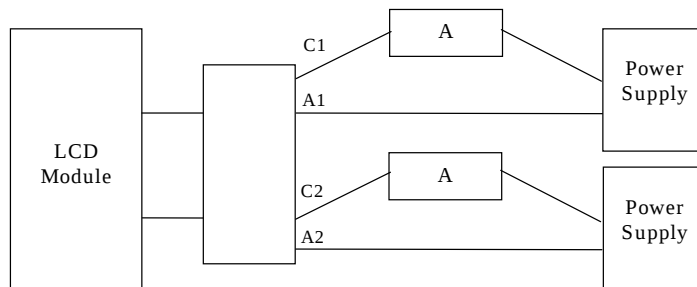
| ITEM          | SYMBOL | MIN.   | TYP.    | MAX. | UNIT | Remarks                                                  |
|---------------|--------|--------|---------|------|------|----------------------------------------------------------|
| LED Voltage   | VF     | --     | (24)    | 29.1 | V    | IF = 130 mA, Ta = 25°C, *2)                              |
|               |        | --     | --      | 29.8 | V    | IF = 130 mA, Ta = 0°C                                    |
|               |        | --     | --      | 30.7 | V    | IF = 130 mA, Ta = -30°C                                  |
| LED Current   | IF     | --     | 130     | 140  | mA   | Ta = 25°C, *1), *3)                                      |
| LED Life Time | LT     | 80,000 | 100,000 | --   | h    | IF = 130 mA, Ta = 25°C<br>*4), *5), Continuous operation |

[Note]

\*1) Constant Current Drive

\*2) The Voltage deviation between strings:  $|V_{f1} - V_{f2}| \leq 2 \text{ V}$

\*3) LED Current measurement method



\*4) LED life time is defined as the time when the brightness becomes 50% of the initial value.

\*5) The life time of the backlight depends on the ambient temperature. The life time will decrease under high temperature.

### (3) Touch Panel

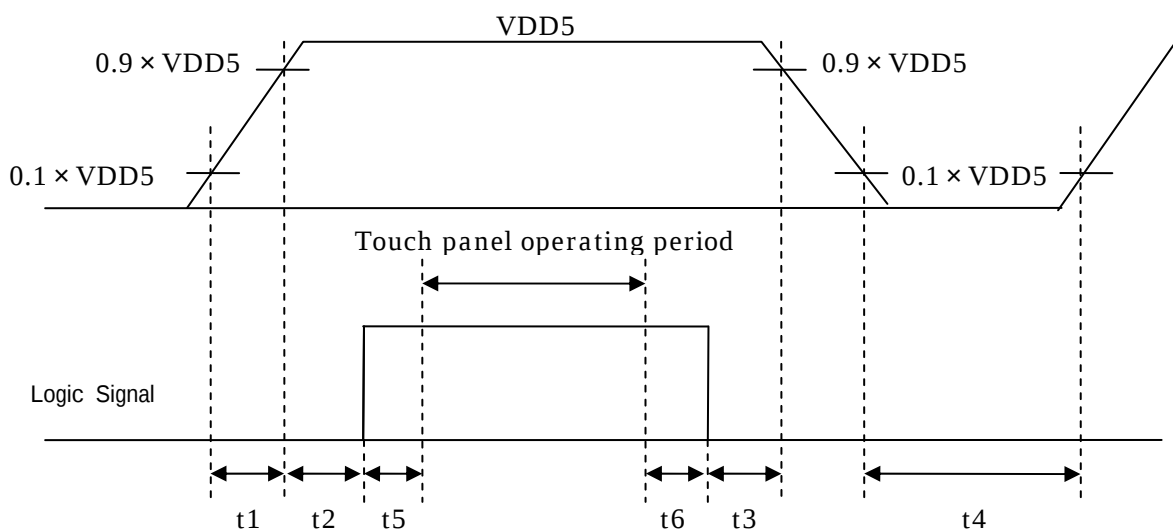
#### Electrical Characteristics

Ambient temperature: Ta = 25°C

| ITEM                                       |             | SYMBOL                     | MIN.     | TYP. | MAX.     | UNIT  | Remarks                          |
|--------------------------------------------|-------------|----------------------------|----------|------|----------|-------|----------------------------------|
| Touch Panel Voltage                        |             | VDD5                       | 4.5      | 5.0  | 5.5      | V     | *1)                              |
| Touch Panel Current                        |             | ICCtp                      | --       | 50   | 200      | mA    |                                  |
| Permissive Input Ripple Voltage            |             | VRPtp                      | --       | --   | 100      | mVp-p | VDD5 = +5.0 V<br>*2)             |
| Logic Input Voltage                        | High        | VIHtp                      | 0.8×VDD5 | --   | VDD5     | V     | *3)<br>CKW<br>SC<br>DIN<br>RESET |
|                                            | Low         | VILtp                      | 0        | --   | 0.2×VDD5 | V     |                                  |
| Logic Output Current                       | High        | IOH                        | −5.0     | --   | 0        | mA    |                                  |
|                                            | Low         | IOL                        | 0        | --   | 5        | mA    |                                  |
| Multi-Touch Points                         |             |                            | --       | 2    | --       | point |                                  |
| Position Accuracy                          | $\Delta Ex$ |                            | −3       | --   | 3        | mm    | Inner area*4)                    |
|                                            | $\Delta Ey$ |                            | −4.5     | --   | 4.5      | mm    | Outer frame*4)                   |
| Position Coordinate Output Rate (standard) | --          |                            | --       | 100  | --       | sps   | Single touch<br>*5)              |
|                                            | --          |                            | --       | 60   | --       |       | Dual touch                       |
| Dual Touch Detection Distance              |             | $\Delta dx$<br>$\Delta dy$ | 35       | --   | --       | mm    | *4)                              |

\*1) Power and signals sequence:

$$\begin{array}{ll}
 0.1 \text{ ms} \leq t1 \leq 10 \text{ ms} & 200 \text{ ms} \leq t4 \\
 0 < t2 \leq 50 \text{ ms} & 2000 \text{ ms} \leq t5 \\
 0 < t3 \leq 50 \text{ ms} & 0 \leq t6
 \end{array}$$



Initialization of touch panel controller (calibration of touch panel) is carried out during period between power supply turning on and start of touch panel operation ( $t1+t2+t5$ ), therefore please do not touch surface with finger, hold hands near touch surface, nor put conductive material like metal on touch panel.

If the calibration is not able to be carried out successfully at the initialization process, touch panel may not work properly for sometime.

\*2) Ripple noise of touch panel power supply affects stability of touch detection and position accuracy. Therefore please use stabilized power supply to touch panel.

\*3) Applied to CKW(2pin),SC(3pin),DIN(5pin),RESET(9pin).

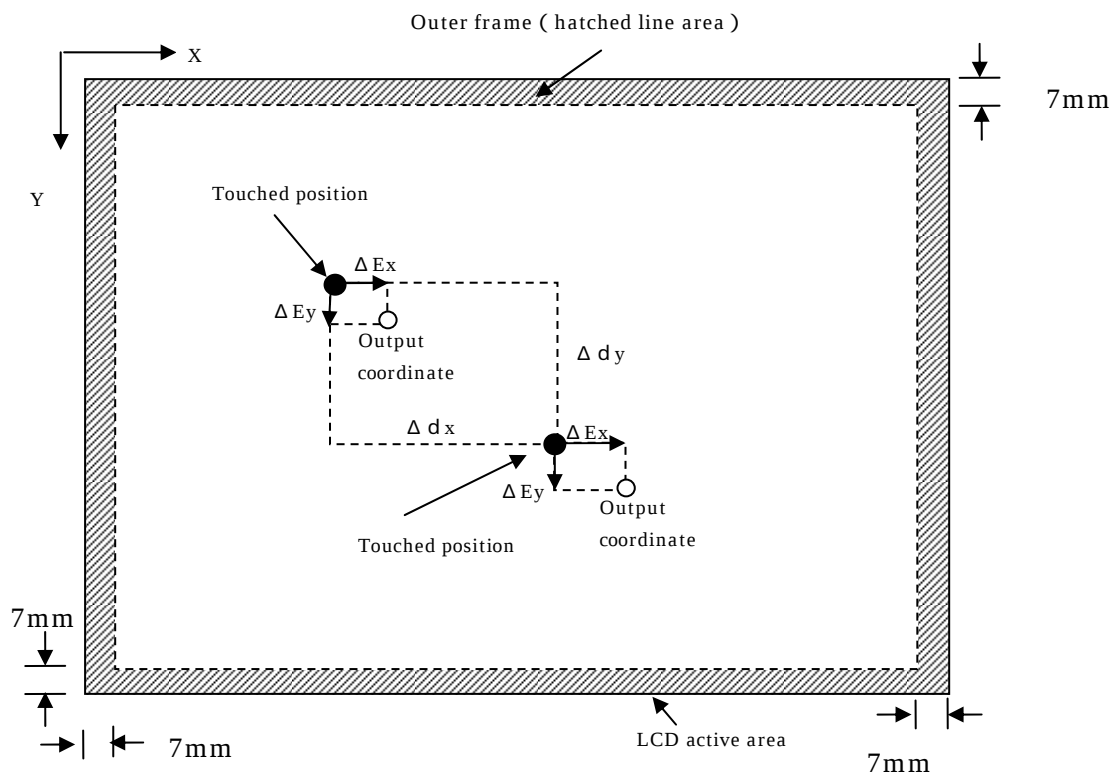
For, please input signal of USB2.0 compliance to D− (10pin) & D+(11pin).

\*4) Area of the finger touch is based on 10 mm in diameter.

Linearity is written as the difference of an actual touch position and the position coordinate which a touch controller outputs as an error ( $\Delta Ex$  and  $\Delta Ey$  stand for error length in the direction of X, Y, respectively). Dual-point touch detection distance is shown in following figure.

The coordinates accuracy of peripheral part is valid when one-point touched.

\* External noise may impact the coordinate accuracy significantly.



\*5) The time interval of touch position coordinate output under an initial parameter condition

\*6) Fuse

| Parameter | Fuse Type Name | Supplier                  | Remark |
|-----------|----------------|---------------------------|--------|
| VDD5      | FCC16501AB     | Kamaya Electric Co., Ltd. | *)     |

\*) The power supply capacity should be designed to be more than the fusing current.

## 5. INTERFACE PIN CONNECTION

### (1) CN 1 (Interface Signal)

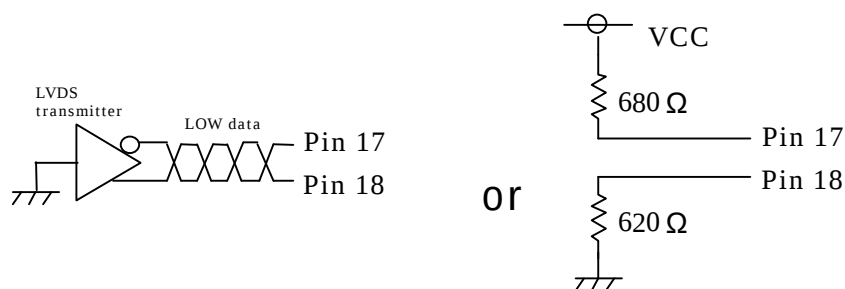
Used connector: 20186-020E-11F (I-PEX) or FI-SEB20P-HFE (JAE)

Corresponding connector: 20197-\*20U-F (I-PEX) or FI-S20S[for discrete Wire],  
FI-SE20ME[for FPC] (JAE)

| Pin No. | Symbol  | Function (ISP 6 bit compatibility mode)                   |                            | Function (ISP 8 bit compatibility mode) |
|---------|---------|-----------------------------------------------------------|----------------------------|-----------------------------------------|
|         |         | 6 bit input                                               | 8 bit input                |                                         |
| 1       | VCC     | +3.3 V Power supply                                       |                            | ←                                       |
| 2       | VCC     | +3.3 V Power supply                                       |                            | ←                                       |
| 3       | GND     | GND                                                       |                            | ←                                       |
| 4       | GND     | GND                                                       |                            | ←                                       |
| 5       | Link 0- | R0, R1, R2, R3, R4, R5, G0                                | R2, R3, R4, R5, R6, R7, G2 | R0, R1, R2, R3, R4, R5, G0              |
| 6       | Link 0+ | R0, R1, R2, R3, R4, R5, G0                                | R2, R3, R4, R5, R6, R7, G2 | R0, R1, R2, R3, R4, R5, G0              |
| 7       | GND     | GND                                                       |                            | ←                                       |
| 8       | Link 1- | G1, G2, G3, G4, G5, B0, B1                                | G3, G4, G5, G6, G7, B2, B3 | G1, G2, G3, G4, G5, B0, B1              |
| 9       | Link 1+ | G1, G2, G3, G4, G5, B0, B1                                | G3, G4, G5, G6, G7, B2, B3 | G1, G2, G3, G4, G5, B0, B1              |
| 10      | GND     | GND                                                       |                            | ←                                       |
| 11      | Link 2- | B2, B3, B4, B5, DENA                                      | B4, B5, B6, B7, DENA       | B2, B3, B4, B5, DENA                    |
| 12      | Link 2+ | B2, B3, B4, B5, DENA                                      | B4, B5, B6, B7, DENA       | B2, B3, B4, B5, DENA                    |
| 13      | GND     | GND                                                       |                            | ←                                       |
| 14      | CLKIN-  | Clock -                                                   |                            | ←                                       |
| 15      | CLKIN+  | Clock +                                                   |                            | ←                                       |
| 16      | GND     | GND                                                       |                            | ←                                       |
| 17      | Link3-  | See: *2)                                                  | R0, R1, G0, G1, B0, B1     | R6, R7, G6, G7, B6, B7                  |
| 18      | Link3+  | See: *2)                                                  | R0, R1, G0, G1, B0, B1     | R6, R7, G6, G7, B6, B7                  |
| 19      | MODE    | Low=ISP 6 bit compatibility mode                          |                            | High=ISP 8 bit compatibility mode       |
| 20      | SC      | Scan direction control. ( Low : Normal , High : Reverse ) |                            | ←                                       |

\*1) Metal frame is connected to signal GND.

\*2) Recommended wiring of Pin 17,18 (6 bit input)



### (2) CN 2 (Backlight)

Backlight-side connector: SM06B-SHLS-TF(LF)(SN) (JST)

Corresponding connector: SHLP-06V-S-B (JST)

| Pin No. | Symbol  | Function                 |
|---------|---------|--------------------------|
| 1       | NC      | This pin should be open. |
| 2       | NC      | This pin should be open. |
| 3       | LED C 1 | LED cathode 1            |
| 4       | LED A 1 | LED anode 1              |
| 5       | LED A 2 | LED anode 2              |
| 6       | LED C 2 | LED cathode 2            |

### (3) CN3 (Touch Panel Interface)

Used connector: SM12B-SHLS-TF(LF)(SN) (JST)

Corresponding connector: SHLP-12V-S-B (JST)

| Pin No. | Symbol      | Function                               | Connection to host equipment *4) |                 |
|---------|-------------|----------------------------------------|----------------------------------|-----------------|
|         |             |                                        | UART                             | USB             |
| 1       | VDD5        | Touch panel power supply(5V) *5)       | Power supply 5V                  | NC              |
| 2       | CKW         | Rotation of coordinate (Clockwise) *3) | CKW                              | CKW             |
| 3       | SC          | Reverse of coordinate *3)              | SC                               | SC              |
| 4       | GND         | Touch panel controller GND             | GND                              | GND             |
| 5       | DIN         | UART receive (H:5V, L:0V) *1)          | DIN                              | NC              |
| 6       | DOUT        | UART send (H:5V, L:0V) *1)             | DOUT                             | NC              |
| 7       | TEST1       | (Internal use) *2)                     | NC                               | NC              |
| 8       | TEST2       | (Internal use) *2)                     | NC                               | NC              |
| 9       | RESET       | Touch panel reset (H:5V, L:0V)         | RESET                            | RESET           |
| 10      | D-          | USB D- Terminal                        | NC                               | D-              |
| 11      | D+          | USB D+ Terminal                        | NC                               | D+              |
| 12      | VUSB (VBUS) | USB power supply (5V) *5)              | NC                               | Power supply 5V |

\*1) Direction of signal;

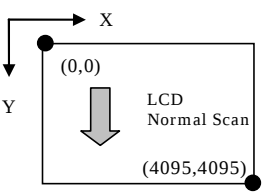
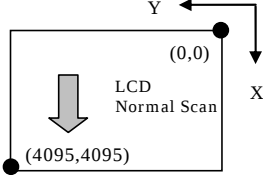
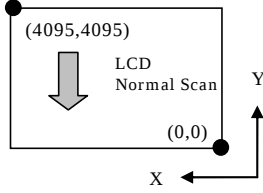
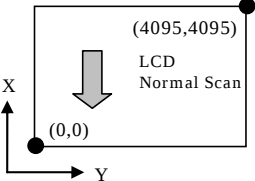
DIN (5pin): Host equipment→ Touch panel controller

DOUT (6pin): Controller→ Host equipment

\*2) Please don't use TEST1 (7pin) and TEST2 (8pin) because they are for internal use only.

\*3) CKW and SC are signals to change zero point of touch panel position coordinate.

If they are not connected, Position Coordinate is Default condition.

| Signal(H:5V,L:0V) |    | Position Coordinate (Zero point)                                                    | Note                  |
|-------------------|----|-------------------------------------------------------------------------------------|-----------------------|
| CKW               | SC |                                                                                     |                       |
| L                 | L  |  | Default condition *3) |
| H                 | L  |  |                       |
| L                 | H  |  |                       |
| H                 | H  |  |                       |

\*4) UART and USB communication are exclusive and connection methods are different.

NC should be open.

\*5) VDD5(1pin) and VUSB(12pin) are connected together on the touch-panel controller board.

Specification of communication between the controller and host are shown below.

- UART

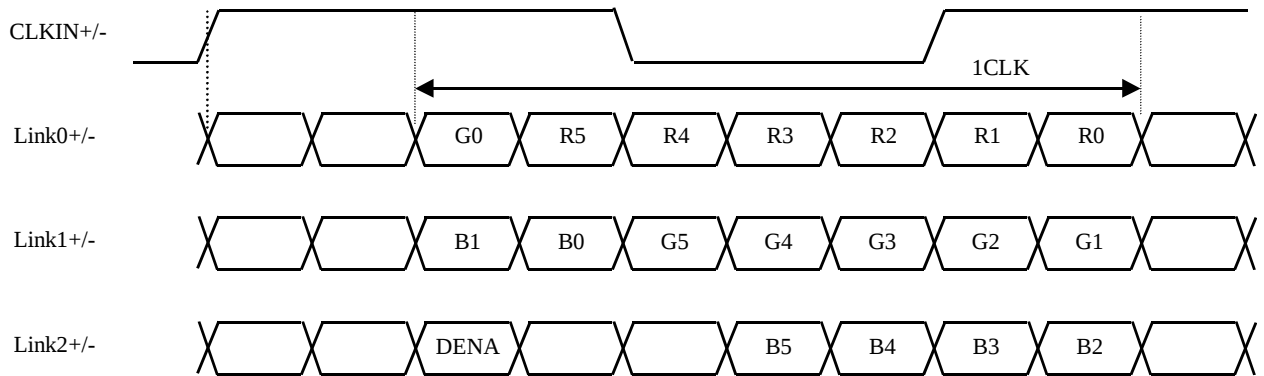
| Item                 | Specifications |
|----------------------|----------------|
| Communication method | UART           |
| Communication speed  | 38400bps       |
| Data length          | 8 bit          |
| Stop bit             | 1 bit          |
| parity               | None           |

- USB

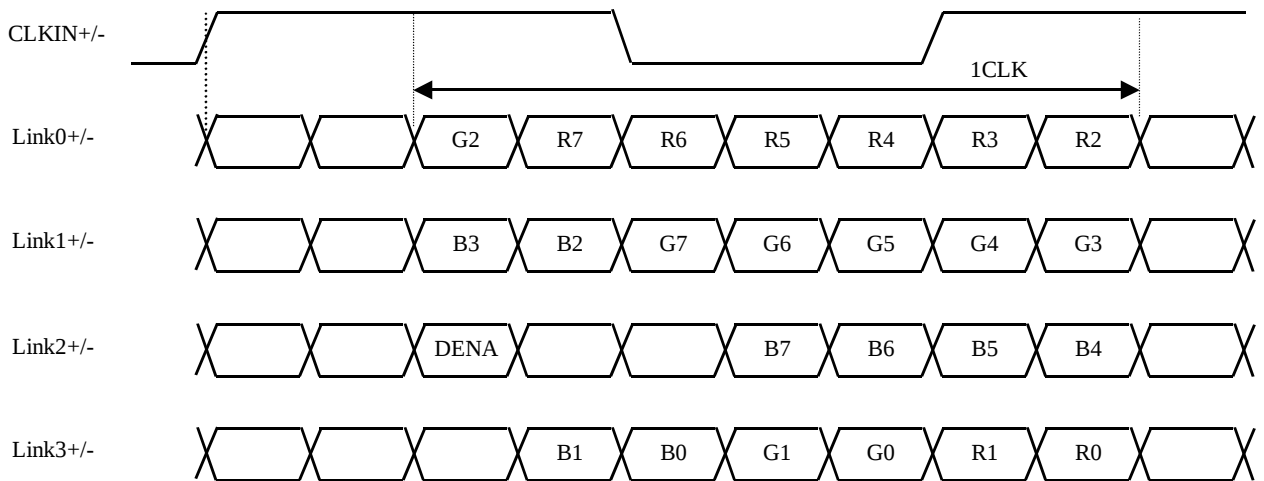
Please follow USB 2.0 standard.

#### (4) ISP data mapping

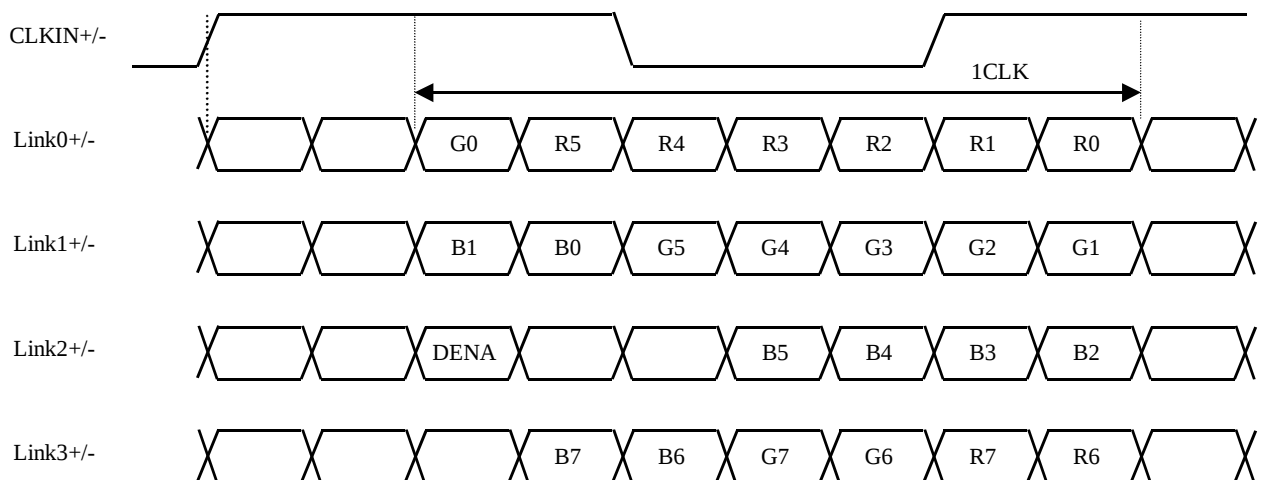
##### a. ISP 6 bit compatibility mode(6 bit input)



##### b. ISP 6 bit compatibility mode(8 bit input)



##### c. ISP 8 bit compatibility mode



## 6. INTERFACE TIMING

LVDS transmitter input signal

### (1) Timing Specifications

| ITEM |            |               | SYMBOL           | MIN. | TYP. | MAX. | UNIT             |
|------|------------|---------------|------------------|------|------|------|------------------|
| DCLK | Frequency  |               | f <sub>CLK</sub> | 35   | 40   | 42   | MHz              |
|      | Period     |               | t <sub>CLK</sub> | 23.8 | 25   | 28.6 | ns               |
| DENA | Horizontal | Active Time   | t <sub>HA</sub>  | 800  | 800  | 800  | t <sub>CLK</sub> |
|      |            | Blanking Time | t <sub>HB</sub>  | 20   | 256  | --   | t <sub>CLK</sub> |
|      |            | Frequency     | f <sub>H</sub>   | 35.2 | 37.9 | 39.2 | kHz              |
|      |            | Period        | t <sub>H</sub>   | 25.5 | 26.4 | 28.4 | μs               |
|      | Vertical   | Active Time   | t <sub>VA</sub>  | 600  | 600  | 600  | t <sub>H</sub>   |
|      |            | Blanking Time | t <sub>VB</sub>  | 3    | 28   | --   | t <sub>H</sub>   |
|      |            | Frequency     | f <sub>V</sub>   | 55   | 60   | 64.2 | Hz               |
|      |            | Period        | t <sub>V</sub>   | 15.6 | 16.7 | 18.2 | ms               |

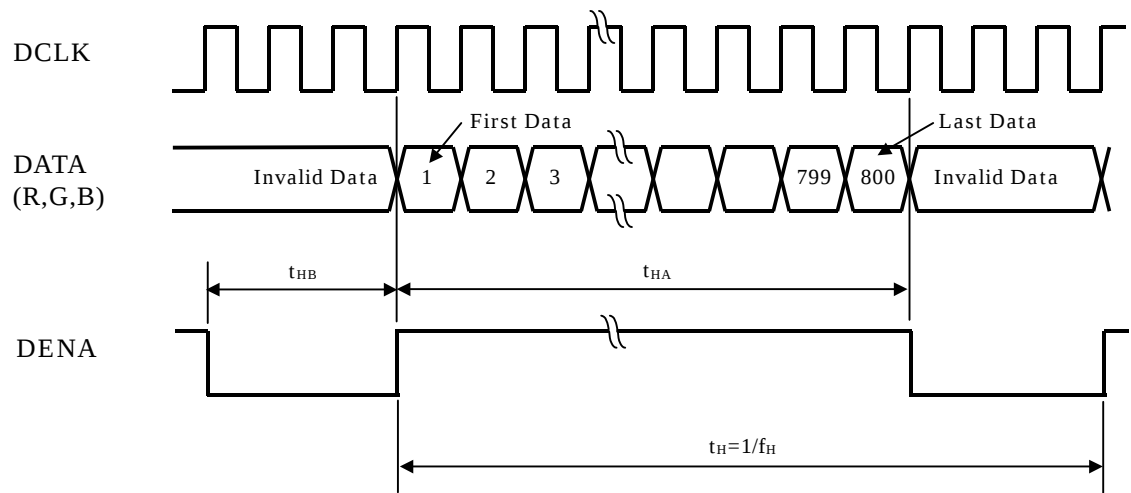
[Note]

- 1) DENA (Data Enable) should always be positive polarity as shown in the timing specification.
- 2) DCLK should appear during all invalid period.
- 3) LVDS timing follows the timing specifications of LVDS receiver IC: THC63LVDF84B(Thine).
- 4) In case of blanking time fluctuation, please use following.

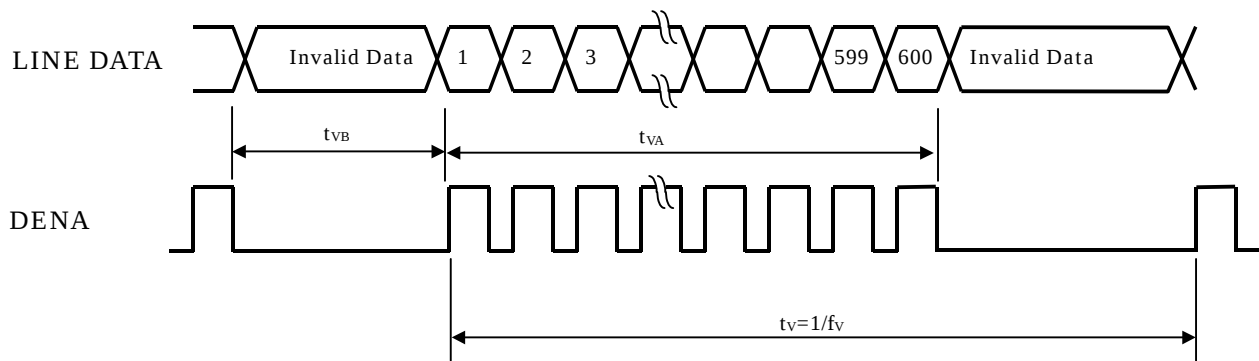
$$t_{VBn} > t_{VBn-1} - 3(t_H)$$

(2) Timing Chart

a. Horizontal Timing Chart



b. Vertical Timing Chart



### (3) Color Data Assignment

#### a. 6 bit input

| COLOR          |           | INPUT DATA |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|----------------|-----------|------------|----|----|----|----|-----|--------|----|----|----|----|-----|--------|----|----|----|----|-----|
|                |           | R DATA     |    |    |    |    |     | G DATA |    |    |    |    |     | B DATA |    |    |    |    |     |
|                |           | R5         | R4 | R3 | R2 | R1 | R0  | G5     | G4 | G3 | G2 | G1 | G0  | B5     | B4 | B3 | B2 | B1 | B0  |
|                |           | MSB        |    |    |    |    | LSB | MSB    |    |    |    |    | LSB | MSB    |    |    |    |    | LSB |
| BASIC<br>COLOR | BLACK     | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | RED(63)   | 1          | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | GREEN(63) | 0          | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | BLUE(63)  | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   |
|                | CYAN      | 0          | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   | 1      | 1  | 1  | 1  | 1  | 1   |
|                | MAGENTA   | 1          | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   |
|                | YELLOW    | 1          | 1  | 1  | 1  | 1  | 1   | 1      | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | WHITE     | 1          | 1  | 1  | 1  | 1  | 1   | 1      | 1  | 1  | 1  | 1  | 1   | 1      | 1  | 1  | 1  | 1  | 1   |
| RED            | RED(1)    | 0          | 0  | 0  | 0  | 0  | 1   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | RED(2)    | 0          | 0  | 0  | 0  | 1  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                | RED(62)   | 1          | 1  | 1  | 1  | 1  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | RED(63)   | 1          | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
| GREEN          | GREEN(1)  | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 1   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | GREEN(2)  | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 1  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                | GREEN(62) | 0          | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 0   | 0      | 0  | 0  | 0  | 0  | 0   |
|                | GREEN(63) | 0          | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   | 0      | 0  | 0  | 0  | 0  | 0   |
| BLUE           | BLUE(1)   | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 1   |
|                | BLUE(2)   | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 1  | 0   |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                |           |            |    |    |    |    |     |        |    |    |    |    |     |        |    |    |    |    |     |
|                | BLUE(62)  | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 0   |
|                | BLUE(63)  | 0          | 0  | 0  | 0  | 0  | 0   | 0      | 0  | 0  | 0  | 0  | 0   | 1      | 1  | 1  | 1  | 1  | 1   |

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

Higher n means brighter level.

2) Data

1:High, 0: Low

b. 8 bit input

| COLOR          |            | INPUT DATA |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|----------------|------------|------------|----|----|----|----|----|-----|-----|--------|----|----|----|----|----|-----|-----|--------|----|----|----|----|----|-----|----|
|                |            | R DATA     |    |    |    |    |    |     |     | G DATA |    |    |    |    |    |     |     | B DATA |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            | R7         | R6 | R5 | R4 | R3 | R2 | R1  | R0  | G7     | G6 | G5 | G4 | G3 | G2 | G1  | G0  | B7     | B6 | B5 | B4 | B3 | B2 | B1  | B0 |
| MSB            |            |            |    |    |    |    |    | LSB | MSB |        |    |    |    |    |    | LSB | MSB |        |    |    |    |    |    | LSB |    |
| BASIC<br>COLOR | BLACK      | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | RED(255)   | 1          | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | GREEN(255) | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | BLUE(255)  | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   |    |
|                | CYAN       | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 1      | 1  | 1  | 1  | 1  | 1  | 1   |    |
|                | MAGENTA    | 1          | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   |    |
|                | YELLOW     | 1          | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 1      | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | WHITE      | 1          | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 1      | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 1      | 1  | 1  | 1  | 1  | 1  | 1   |    |
| RED            | RED(1)     | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | RED(2)     | 0          | 0  | 0  | 0  | 0  | 0  | 1   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                | RED(255)   | 1          | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
| GREEN          | GREEN(1)   | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 1   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
|                | GREEN(2)   | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 1  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                | GREEN(255) | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   | 1   | 0      | 0  | 0  | 0  | 0  | 0  | 0   |    |
| BLUE           | BLUE(1)    | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 1  | 0   |    |
|                | BLUE(2)    | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 1  | 0  |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                |            |            |    |    |    |    |    |     |     |        |    |    |    |    |    |     |     |        |    |    |    |    |    |     |    |
|                | BLUE(255)  | 0          | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 0      | 0  | 0  | 0  | 0  | 0  | 0   | 0   | 1      | 1  | 1  | 1  | 1  | 1  | 1   |    |

[Note]

1) Definition of gray scale

Color (n) --- n indicates gray scale level.

Higher n means brighter level.

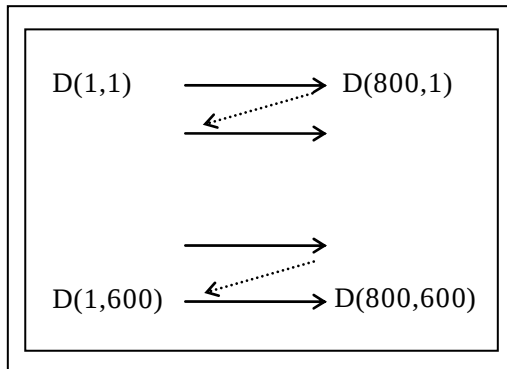
2) Data

1:High, 0: Low

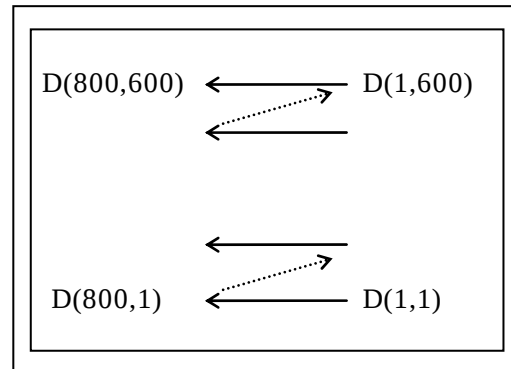
#### (4) Display Position and Scan Direction

D(X,Y) shows the data number of input signal.

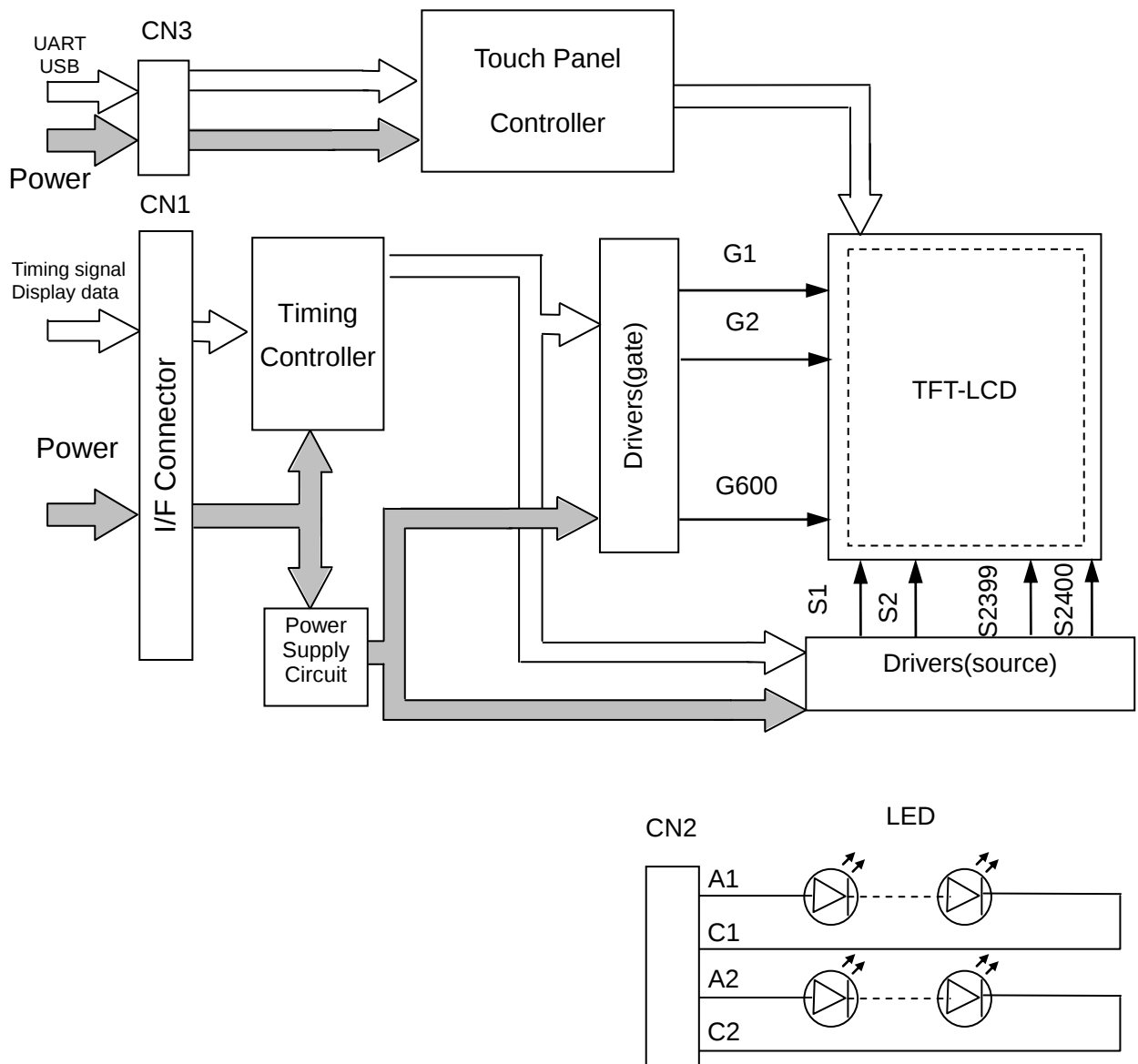
SC: Low



SC: High

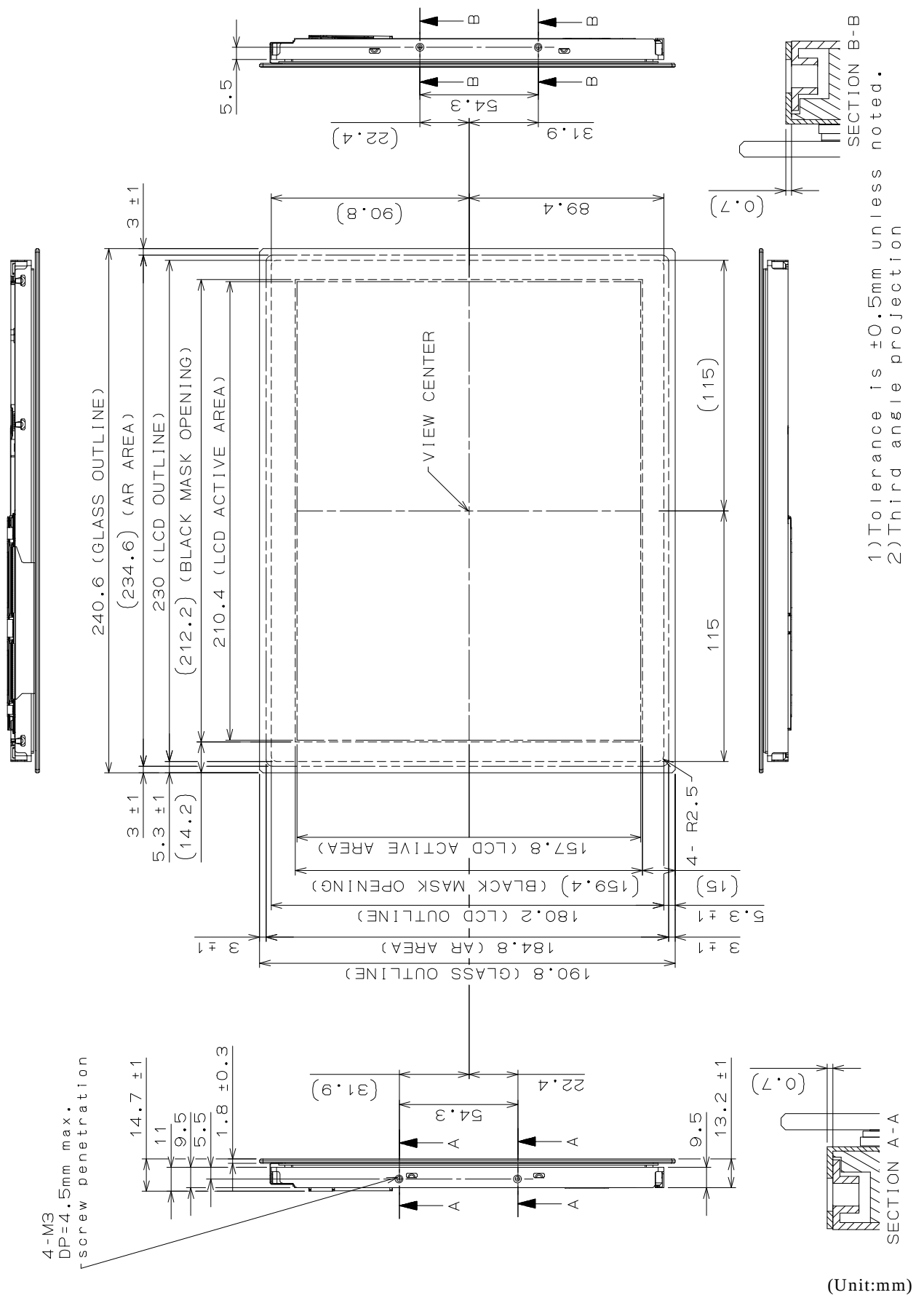


## 7. BLOCK DIAGRAM

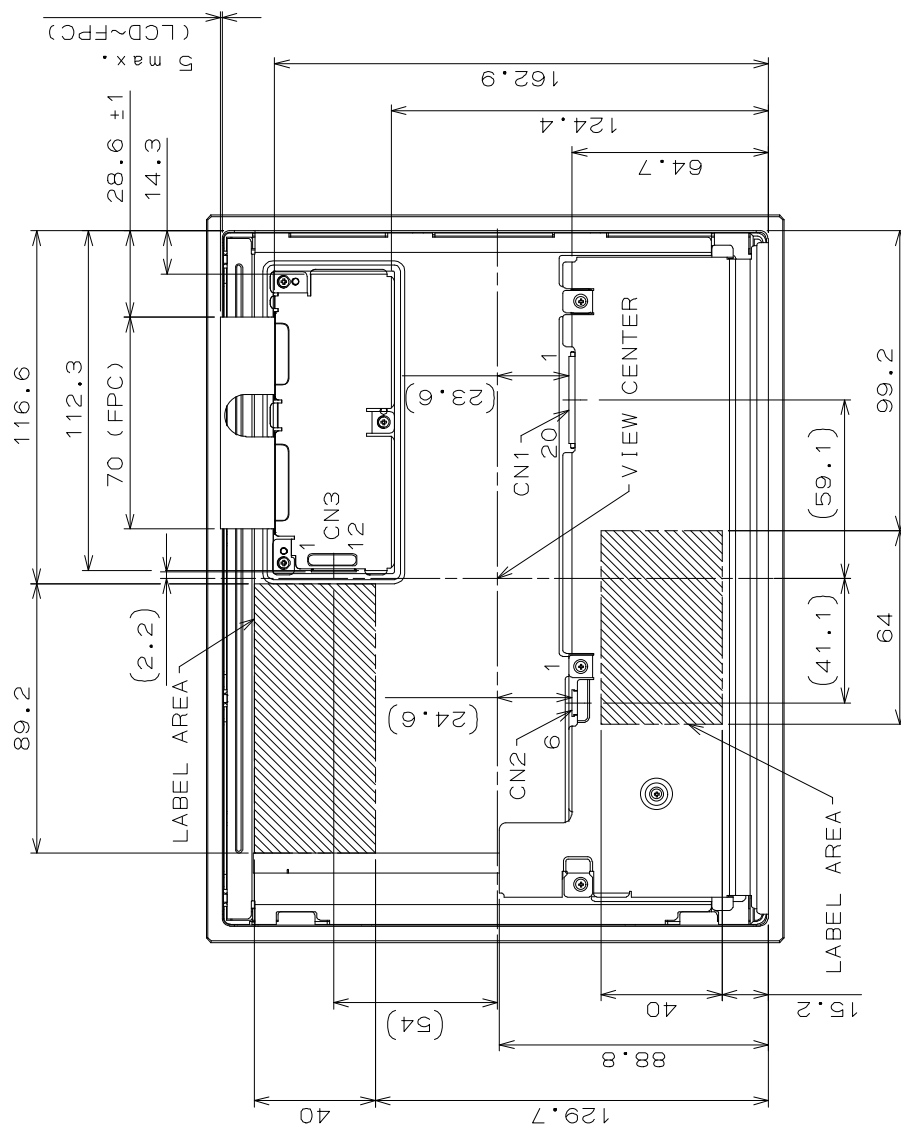


## 8. MECHANICAL SPECIFICATIONS

### (1) Front Side



(2) Rear Side



(Unit:mm)

CN1:20186-020E-11F (I-PEX) or FI-SEB20P-HFE (JAE)

CN1: 20186-020E-TF (I-PEX) or F  
CN2: SM06B-SHLS-TF(LF)(SN) (JST)

CN1: ZU18B-SHLS-TF (LF) (JST) (JST)  
CN2: SM06B-SHLS-TF (LF) (SN) (JST)  
CN3: SM12B-SHLS-TF (LF) (SN) (JST)

1) Tolerance is  $\pm 0.5\text{mm}$  unless noted.

## 2) Third angle projection

### (3) Touch Panel Design Guide

#### 1) Operating Precautions

- Please operate touch panel by finger. It does not sense by tip of nail.
- Sensing is affected by how strongly touched (touched finger area), glove thickness (distance) and material.

#### 2) Assembly Precautions

- Please connect touch panel controller GND to the earth ground.  
When there is no connection to the earth ground, please make bypass between touch panel controller GND and the earth ground to prevent noise.
- Please use non-conductive material for customer side housing around touch panel.  
When conductive material is used for the housing, please make space more than 2mm from touch panel surface, and also please design the housing strong enough not to change its distance. Please design the housing to prevent electrical noise. (Ex. to connect to GND)
- Please keep space between FPC and noise source like metal parts and signal cables. Please keep space more than 2mm from FPC and also design not to change its distance.
- Please do not make an impact on the cover glass edge.

## 9. OPTICAL CHARACTERISTICS

Ta=25°C, VCC=3.3V, Input Signals: Typ. values shown in Section 6

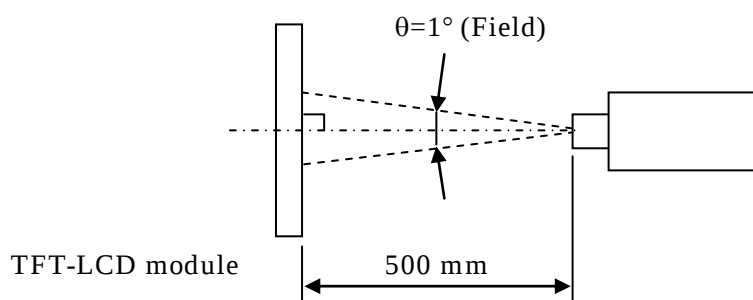
| ITEM                 |            | SYMBOL          | CONDITION                            | MIN    | TYP    | MAX   | UNIT              | Remarks   |
|----------------------|------------|-----------------|--------------------------------------|--------|--------|-------|-------------------|-----------|
| Contrast Ratio       |            | CR              | $\theta_v=0^\circ, \theta_H=0^\circ$ | 450    | 700    | --    | --                | *1)*2)*5) |
| Luminance            |            | L <sub>w</sub>  | $\theta_v=0^\circ, \theta_H=0^\circ$ | (760)  | (960)  | --    | cd/m <sup>2</sup> | *1)*5)    |
| Luminance Uniformity |            | $\Delta L_w$    | $\theta_v=0^\circ, \theta_H=0^\circ$ | --     | --     | 30    | %                 | *1)*3)*5) |
| Response Time        |            | t <sub>r</sub>  | $\theta_v=0^\circ, \theta_H=0^\circ$ | --     | 4      | --    | ms                | *1)*4)*5) |
|                      |            | t <sub>f</sub>  | $\theta_v=0^\circ, \theta_H=0^\circ$ | --     | 12     | --    | ms                | *1)*4)*5) |
| Viewing Angle        | Horizontal | $\theta_H$      | CR ≥ 10                              | -65~65 | -80~80 | --    | °                 | *1)*5)    |
|                      | Vertical   | $\theta_v$      |                                      | -45~65 | -60~80 | --    | °                 | *1)*5)    |
| Image sticking       |            | t <sub>is</sub> | 2 h                                  | --     | --     | 2     | s                 | *6)       |
| Color Coordinates    | Red        | R <sub>x</sub>  | $\theta_v=0^\circ, \theta_H=0^\circ$ | 0.528  | 0.568  | 0.608 | --                | *1)*5)    |
|                      |            | R <sub>y</sub>  |                                      | 0.306  | 0.346  | 0.386 |                   |           |
|                      | Green      | G <sub>x</sub>  |                                      | 0.316  | 0.356  | 0.396 |                   |           |
|                      |            | G <sub>y</sub>  |                                      | 0.517  | 0.557  | 0.597 |                   |           |
|                      | Blue       | B <sub>x</sub>  |                                      | 0.119  | 0.159  | 0.199 |                   |           |
|                      |            | B <sub>y</sub>  |                                      | 0.096  | 0.136  | 0.176 |                   |           |
|                      | White      | W <sub>x</sub>  |                                      | 0.273  | 0.313  | 0.353 |                   |           |
|                      |            | W <sub>y</sub>  |                                      | 0.289  | 0.329  | 0.369 |                   |           |

[Note]

These items are measured using EZContrast (ELDIM) for viewing angle and CS2000 (Minolta) or equivalent equipment for others under the dark room condition (no ambient light) after more than 30 minutes from turning on the backlight unless noted.

Condition: IF = 130 mA

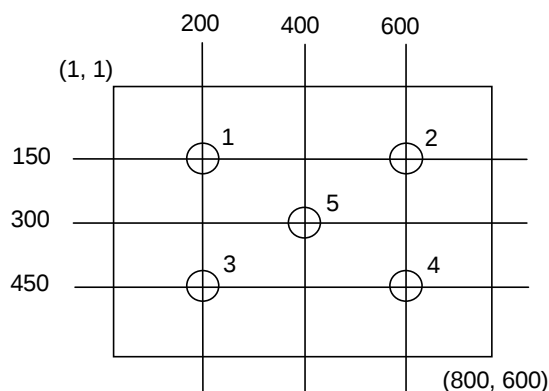
Measurement method for luminance and color coordinates is as follows.



The luminance is measured according to FLAT PANEL DISPLAY MEASUREMENTS STANDARD (VESA Standard).

\*1) Measurement Point

Contrast Ratio, Luminance, Response Time, Viewing Angle, Color Coordinates: Display Center  
Luminance Uniformity: point 1~5 shown in a figure below



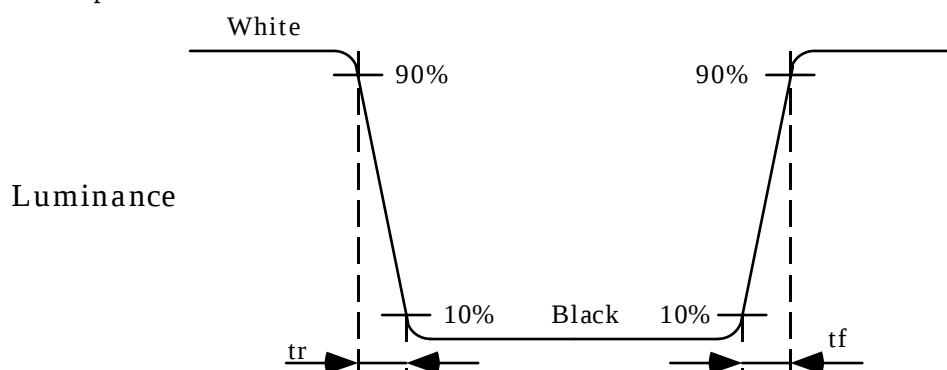
\*2) Definition of Contrast Ratio

CR= Luminance with all white pixels / Luminance with all black pixels

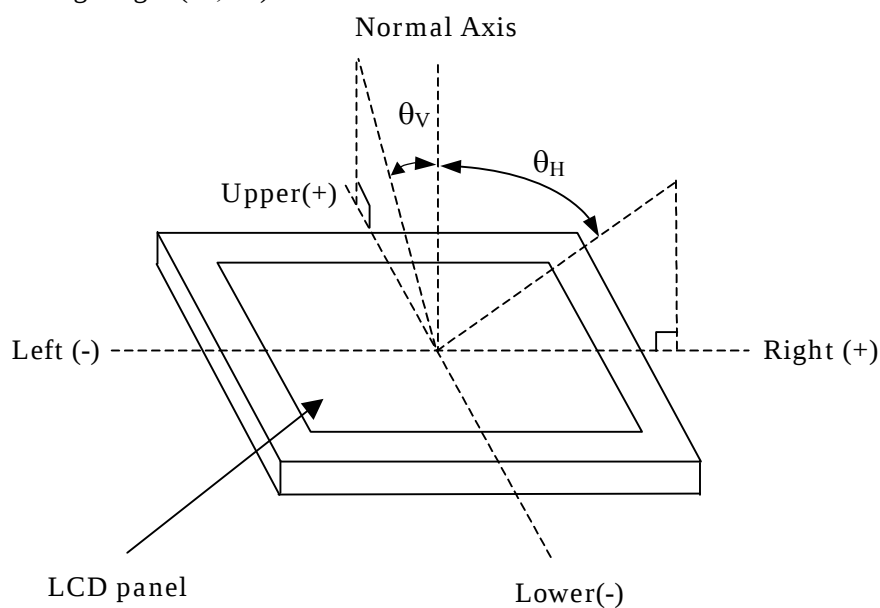
\*3) Definition of Luminance Uniformity

$\Delta Lw = [Lw(\text{MAX})/Lw(\text{MIN}) - 1] \times 100$

\*4) Definition of Response Time

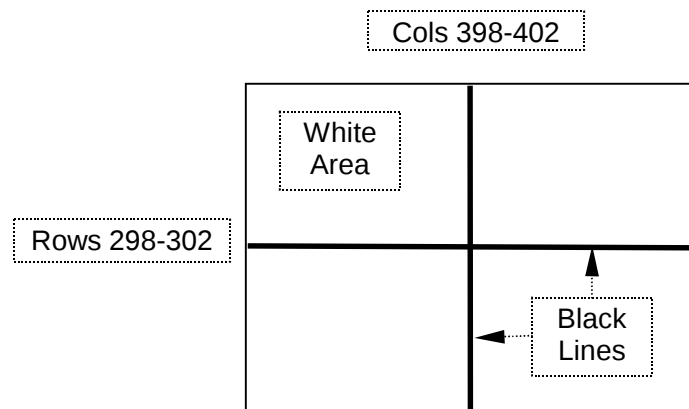


\*5) Definition of Viewing Angle ( $\theta_v$ ,  $\theta_H$ )



\*6) Image sticking:

Continuously display the test pattern shown in the figure below for two-hours. Then display a completely white screen. The previous image shall not persist more than two seconds at 25°C.



TEST PATTERN FOR IMAGE STICKING TEST

## 10. RELIABILITY TEST CONDITION

### (1) Temperature and Humidity

| ITEM                                        | CONDITIONS                              |
|---------------------------------------------|-----------------------------------------|
| HIGH TEMPERATURE<br>HIGH HUMIDITY OPERATION | 40°C, 90%RH, 240 h<br>(No condensation) |
| HIGH TEMPERATURE OPERATION                  | 70°C, 240 h                             |
| LOW TEMPERATURE OPERATION                   | -30°C, 240 h                            |
| HIGH TEMPERATURE STORAGE                    | 80°C, 240 h                             |
| LOW TEMPERATURE STORAGE                     | -30°C, 240 h                            |
| THERMAL SHOCK                               | -30°C (1h) ~ 80°C(1h),<br>100 cycles    |

### (2) Shock & Vibration

| ITEM                         | CONDITIONS                                                                                                                                                                                                                                                                 |
|------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SHOCK<br>(NON-OPERATION)     | Shock level: 980 m/s <sup>2</sup> (100G)<br>Waveform: half sinusoidal wave, 2 ms<br>Number of shocks: one shock input in each direction of three mutually perpendicular axes for a total of six shock inputs                                                               |
| VIBRATION<br>(NON-OPERATION) | Vibration level: 9.8 m/s <sup>2</sup> (1.0G)<br>Waveform: sinusoidal<br>Frequency range: 5 to 500 Hz<br>Frequency sweep rate: 0.5 octave /min<br>Duration: one sweep from 5 to 500 Hz in each of three mutually perpendicular axis(each x,y,z axis: 1 hour, total 3 hours) |

### (3) ESD Test

| ITEM                                    | CONDITIONS                                    |
|-----------------------------------------|-----------------------------------------------|
| CONTACT DISCHARGE<br>(OPERATION)        | 150pF, 330Ω, ±8kV, 10 times at 1 sec interval |
| SIGNAL PIN DISCHARGE<br>(NON-OPERATION) | 200pF, 0Ω, ±200V, 10 times at 1 sec interval  |

### (4) Judgment standard

The judgment of the above tests should be made as follow:

#### a. TFT-LCD

Pass: Normal display image, no damage of the display function. (ex. no line defect)

Partial transformation of the module parts should be ignored.

Fail: No display image, damage of the display function. (ex. line defect)

#### b. Touch Panel

Pass: No damage of the touch function. (ex. touch detection cannot be performed.)

Fail: Touch panel is damaged. (ex. Touch panel does not work, or touch detection cannot be performed.)

## 11. OTHER FEATURE

This LCD module complies with RoHS\*) directive.

\*) RoHS: Restriction of the use of certain hazardous substances in electrical and electronic equipment

UL1950 certified (UL File# E158720)

## 12. HANDLING PRECAUTIONS FOR TFT-LCD MODULE

Please pay attention to the followings in handling TFT-LCD products;

### (1) ASSEMBLY PRECAUTION

- a. Please mount the LCD module by using mounting hole with a screw clamping torque less than 0.5 Nm. Please do not bend or wrench the LCD module in assembling. Please do not drop, bend or twist the LCD module in handling.
- b. Please design display housing in accordance with the following guide lines.
  - (a) Housing case must be designed carefully so as not to put stress on LCD and not to wrench module. If customer uses compression mounting, please evaluate housing case with LCD carefully to avoid image quality issue caused by mechanical stress.
  - (b) Under high temperature environment, performance and life time of LED may heavily shorten. When you design with our LCD product, please consider radiating heat and ventilation for good heat management.
  - (c) Keep sufficient clearance between LCD module back surface and housing when the LCD module is mounted. Approximately 1.0mm of the clearance in the design is recommended taking into account the tolerance of LCD module thickness and mounting structure height on the housing.
  - (d) When some parts, such as, FPC cable and ferrite plate, are installed underneath the LCD module, still sufficient clearance is required, such as 0.5mm. This clearance is, especially, to be reconsidered when the additional parts are implemented for EMI countermeasure.
  - (e) Keep sufficient clearance between LCD module and the others parts, such as inverter and speaker so as not to interfere the LCD module. Approximately 1.0 mm of the clearance in the design is recommended.
  - (f) To avoid local elevation/decrease of temperature, considering location of heating element, heat release, thermal design should be done.
- c. Please do not push or scratch touch panel surface with anything hard.
- d. Do not use or store the product under a condition where the product will be exposed to water, organic solution or acid.
- e. Please wipe off touch panel surface with absorbent cotton or soft cloth in case of it being soiled.
- f. Touch panel glass edge is not rounded. Please take care in handling to avoid injury.
- g. Please do not take a LCD module to pieces and reconstruct it. Resolving and reconstructing modules may cause them not to work well.
- h. Please do not touch metal frames with bare hands and soiled gloves. A color change of the metal frames can happen during a long preservation of soiled LCD modules.
- i. Please handle metal frame carefully because edge of metal frame is very sharp.
- j. Please connect the metal frame of LCD module to GND in order to minimize the effect of external noise and EMI.
- k. Be sure to connect the cables and the connectors correctly.

## **(2) OPERATING PRECAUTIONS**

- a. Please be sure to turn off the power supply before connecting and disconnecting signal input cable.
- b. Please do not change variable resistance settings in LCD module. They are adjusted to the most suitable value. If they are changed, it might happen LCD does not satisfy the characteristics specification.
- c. The interface signal speed is very high. Please pay attention to transmission line design and other high speed signal precautions to satisfy signal specification.
- d. Condensation might happen on the surface and inside of LCD module in case of sudden change of ambient temperature. Do not use touch panel when there is condensation. It could cause touch panel failure.
- e. Please pay attention not to display the same pattern for very long time. Image sticking might happen on LCD. Although image sticking may disappear as the operation time proceeds, screen saver function is recommended not to cause image sticking.
- f. Please obey the same safe instructions as ones being prepared for ordinary electronic products.

## **(3) PRECAUTIONS WITH ELECTROSTATICS**

- a. This LCD module use CMOS-IC on circuit board and TFT-LCD panel, and so it is easy to be affected by electrostatics. Please be careful with electrostatics by the way of your body connecting to the ground and so on.
- b. Please remove protection film very slowly from the surface of touch panel to prevent from electrostatics occurrence.

## **(4) STORAGE PRECAUTIONS**

LCD should be stored in the room temperature environment with normal humidity. The LCD inventory should be processed by first-in first-out method.

## **(5) SAFETY PRECAUTIONS**

- a. When you waste damaged or unnecessary LCDs, it is recommended to crush LCDs into pieces and wash them off with solvents such as acetone and ethanol, which should later be burned.
- b. If any liquid leaks out of a damaged glass cell and comes in contact with the hands, wash off thoroughly with soap and water.

## **(6) OTHERS**

- a. A strong incident light into LCD panel may cause deterioration to touch panel, polarizer film, color filter, and other materials, which will degrade the quality and performance of display.  
Please do not expose LCD module under strong Ultraviolet rays for a long time. If using under direct sunlight condition, please test the reliability and performance completely.
- b. For the packaging box handling, please see and obey with the packaging specification datasheet.