



深圳市一众显示科技有限公司

SHEN ZHEN TEAM SOURCE DISPLAY TECH. CO, TD.

TFT-LCD Module Specification

Module NO.: TST024QVTS-25

Version: V1.0

APPROVAL FOR SPECIFICATION

APPROVAL FOR SAMPLE

| | |
|------------------------------------|----------------|
| For Customer' s Acceptance: | |
| Approved by | Comment |
| | |

| | | |
|-----------------------------|--------------------|---------------------|
| Team Source Display: | | |
| Presented by | Reviewed by | Organized by |
| | | |

| Version No. | Date | Content | Remark |
|--------------------|-------------|-----------------|---------------|
| V1.0 | 2019-6-14 | Initial Release | |
| | | | |
| | | | |

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1 General Characteristics

| ITEM | Specification | Unit |
|--------------------|---|-------------------|
| LCD Type | a-Si TFT, Transflective, Normally white, TN | - |
| LCD Size | 2.4 | inch |
| Resolution (H x V) | 240(RGB) × 320 | pixel |
| LCM size | 42.92(H) x 59.66(V) x 2.55(T) | mm |
| Active Area | 36.72 (H) x 48.96(V) | mm |
| Pixel Pitch | 0.153(H)x0.153(V) | mm |
| Viewing Direction | 2 O'clock | - |
| Color Depth | 65K | - |
| Pixel Arrangement | RGB-stripe | - |
| Backlight Type | 4 LEDs, 40mA | - |
| Surface Luminance | Min 220, Typ 250 | cd/m ² |
| Surface Treatment | Anti-glare | - |
| Interface Type | MCU | - |
| Input Voltage | 2.8 | V |
| With/Without TP | Without | - |
| Weight | TBD | g |

Note 1: RoHS compliant

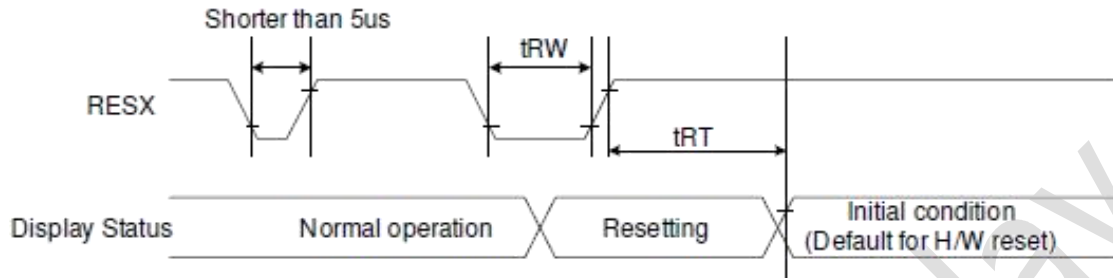
Note 2: LCM weight tolerance: ± 5%.

3 Interface description

| PIN NO. | Symbol | description | | | | | | | | | | | | | | | | | | | | | | | | | |
|---------|------------|--|------------|-------------|-----|-----------|----------|---|---|---|----------|---------|---|---|---|-----------|----------|---|---|---|------------|-------------|---|---|---|------------|-------------|
| 1-2 | VSS | System Ground. (0V) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | VCI | Power supply. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | IOVCC | Interface Operation Voltage. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | VSS | System Ground. (0V) | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | RESET | This signal will reset the device and it must be applied to properly initialize the chip. Signal is active low. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | CS | Chip selection pin. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | RS/SPI_SCL | Display data/command selection pin in parallel interface. This pin is used to be serial interface clock. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | WR/SPI_RS | Write enable in MCU parallel interface. Display data/command selection pin in 4-line serial interface. Second Data lane in 2 data lane serial interface. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | SPI_SDA | SPI interface input/output pin. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11-26 | D0-D15 | Data bus | | | | | | | | | | | | | | | | | | | | | | | | | |
| 27-29 | IM0-IM3 | <table border="1"> <thead> <tr> <th>IM2</th> <th>IM1</th> <th>IM0</th> <th>Interface</th> <th>Data Pin</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>MCU8-bit</td> <td>DB[7:0]</td> </tr> <tr> <td>0</td> <td>0</td> <td>1</td> <td>MCU16-bit</td> <td>DB[15:0]</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>3-line SPI</td> <td>SDA: in/out</td> </tr> <tr> <td>1</td> <td>1</td> <td>0</td> <td>4-line SPI</td> <td>SDA: in/out</td> </tr> </tbody> </table> | IM2 | IM1 | IM0 | Interface | Data Pin | 0 | 0 | 0 | MCU8-bit | DB[7:0] | 0 | 0 | 1 | MCU16-bit | DB[15:0] | 1 | 0 | 1 | 3-line SPI | SDA: in/out | 1 | 1 | 0 | 4-line SPI | SDA: in/out |
| IM2 | IM1 | IM0 | Interface | Data Pin | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 0 | MCU8-bit | DB[7:0] | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 0 | 1 | MCU16-bit | DB[15:0] | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 0 | 1 | 3-line SPI | SDA: in/out | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | 1 | 0 | 4-line SPI | SDA: in/out | | | | | | | | | | | | | | | | | | | | | | | |
| 30 | RD | Read enable in 8080 MCU parallel interface. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 31 | TE | Tearing effect signal is used to synchronize MCU to frame memory writing | | | | | | | | | | | | | | | | | | | | | | | | | |
| 32 | BL_A | Backlight A Anode input pin. | | | | | | | | | | | | | | | | | | | | | | | | | |
| 33 | BL_K | Backlight K Cathode input pin. | | | | | | | | | | | | | | | | | | | | | | | | | |

4 LCM Interface Timing

4.1 Reset Timing



| Signal | Symbol | Parameter | Min | Max | Unit |
|--------|--------|----------------------|-----|---------------------|------|
| RESX | tRW | Reset pulse duration | 10 | | uS |
| | tRT | Reset cancel | | 5 (note 1,5) | mS |
| | | | | 120 (note 1,6,7) | mS |

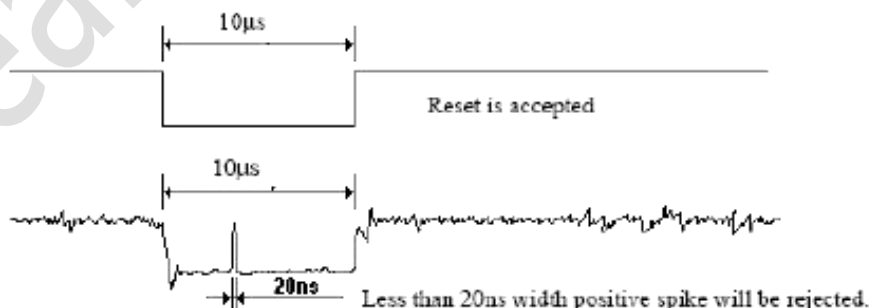
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

Note 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 5us | Reset Rejected |
| Longer than 10us | Reset |
| Between 5us and 10us | Reset starts |

Note 3: During the Resetting period, the display will be blanked (The display is entering blanking sequence, which maximum time is 120 ms, 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.

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

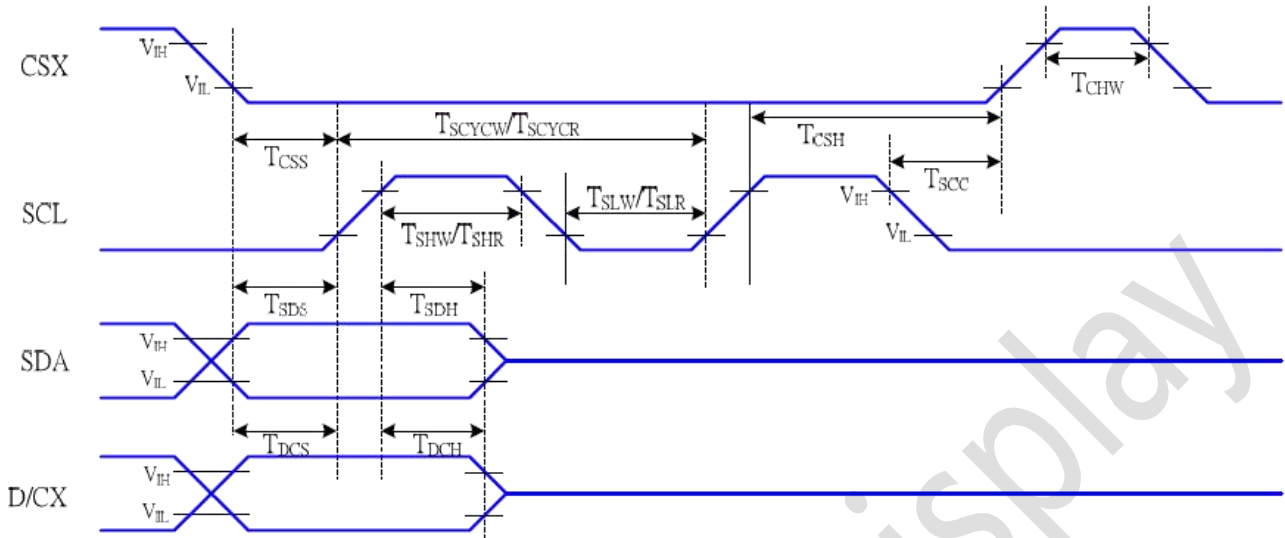


Note 5: When Reset applied during Sleep In Mode.

Note 6: When Reset applied during Sleep Out Mode.

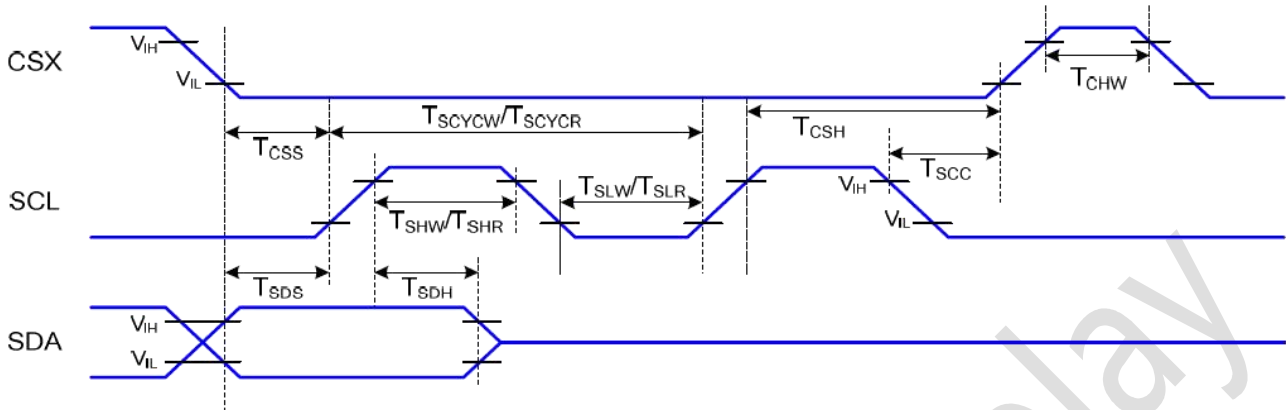
Note 7: It is necessary to wait 5msec after releasing RESX before sending commands. Also Sleep Out command cannot be sent for 120msec.

4.2 4-line Serial Interface Timing Characteristics



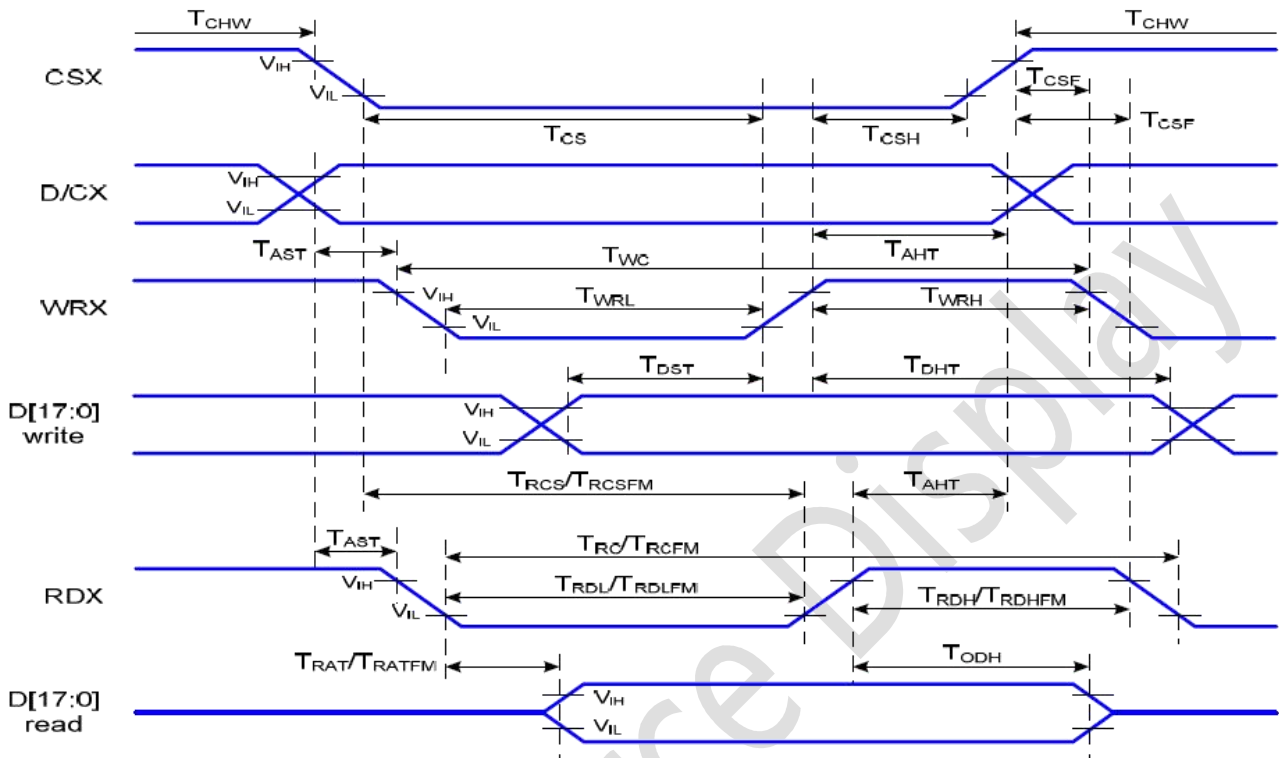
| Signal | Symbol | Parameter | MIN | MAX | Unit | Description |
|-----------|--------------------|--------------------------------|-----|-----|------|---------------------------|
| CSX | T _{CSS} | Chip select setup time (write) | 15 | | ns | |
| | T _{CSH} | Chip select hold time (write) | 15 | | ns | |
| | 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 | |

4.3 3-line Serial Interface Timing Characteristics



| 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 | |

4.4 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



| Signal | Symbol | Parameter | Min | Max | Unit | Description |
|----------|--------------------|------------------------------------|-----|-----|------|-----------------------------|
| D/CX | T _{AST} | Address setup time | 0 | | ns | - |
| | T _{AHT} | Address hold time (Write/Read) | 10 | | ns | |
| CSX | T _{CHW} | Chip select "H" pulse width | 0 | | ns | - |
| | T _{CS} | Chip select setup time (Write) | 15 | | ns | |
| | T _{RCS} | Chip select setup time (Read ID) | 45 | | ns | |
| | T _{RCSFM} | Chip select setup time (Read FM) | 355 | | ns | |
| | T _{CSF} | Chip select wait time (Write/Read) | 10 | | ns | |
| | T _{CSH} | Chip select hold time | 10 | | ns | |
| WRX | T _{WC} | Write cycle | 66 | | ns | |
| | T _{WRH} | Control pulse "H" duration | 15 | | ns | |
| | T _{WRL} | Control pulse "L" duration | 15 | | ns | |
| RDX (ID) | T _{RC} | Read cycle (ID) | 160 | | ns | When read ID data |
| | T _{RDH} | Control pulse "H" duration (ID) | 90 | | ns | |
| | T _{RDL} | Control pulse "L" duration (ID) | 45 | | ns | |
| RDX (FM) | T _{RCFM} | Read cycle (FM) | 450 | | ns | When read from frame memory |
| | T _{RDHFM} | Control pulse "H" duration (FM) | 90 | | ns | |
| | T _{RDLFM} | Control pulse "L" duration (FM) | 355 | | ns | |
| D[17:0] | T _{DST} | Data setup time | 10 | | ns | For CL=30pF |

| | | | | | | |
|--|--------------------|-----------------------|----|-----|----|--|
| | T _{DHT} | Data hold time | 10 | | ns | |
| | T _{RAT} | Read access time (ID) | | 40 | ns | |
| | T _{RATFM} | Read access time (FM) | | 340 | ns | |
| | T _{ODH} | Output disable time | 20 | 80 | ns | |

5 Absolute Maximum Ratings

| PARAMETER | SYMBOL | MIN | MAX | UNIT |
|---------------------------|--------|------|----------------|------|
| Supply Voltage (Analog) | VCI | -0.3 | 4.6 | V |
| Logic signal voltage(I/O) | IOVCC | -0.3 | 4.6 | V |
| Operating Temperature | TOP | -20 | 70 | ° C |
| Storage Temperature | TST | -30 | 80 | ° C |
| Humidity | RH | - | 90%(Max 60° C) | RH |

6 Electrical Characteristics

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT |
|--------------------------|--------|------|-----|-----|------|
| Analog operating voltage | VCI | 2.5 | 2.8 | 3.3 | V |
| Logic operating voltage | IOVCC | 1.65 | 1.8 | 3.3 | V |

7 Backlight Characteristics

| ITEM | SYMBOL | MIN | TYP | MAX | UNIT |
|---------------------------|--------|-------|-------|-----|------|
| Voltage for LED backlight | V_f | - | 6.0 | - | V |
| Current for LED backlight | I_f | - | 40 | - | mA |
| Power consumption | Wbl | - | 240 | - | mW |
| Uniformity | Avg | 80 | - | - | % |
| LED Life Time | - | 30000 | 40000 | - | Hrs |

Note:

- 1.The LED life time is defined as the module brightness decrease to 50% original brightness at $T_a=25^{\circ}\text{C}$, 60%RH $\pm 5\%$.
2. The life time of LED will be reduced if LED is driven by high current, high ambient temperature and humidity conditions.
3. Typical operating life time is an estimated data.
4. Permanent damage to the device may occur if maximum values are exceeded or reverse voltage is loaded .Functional operation should be restricted to the conditions described under normal operating conditions.

8 LCD Optical specifications

| Item | Symbol | Condition | Specification | | | Unit | Remark |
|--------------------------------------|--------|--------------------|---------------|-------|--------------|------|------------|
| | | | Min | Typ | Max | | |
| Response time (By Quick) | Tr+Tf | $\theta = 0^\circ$ | - | 40 | - | ms | Note 5 |
| Contrast ratio | CR | $\theta = 0^\circ$ | 110 | 150 | - | | Note 2,6 |
| Viewing angle | Top | $CR \geq 10$ | 40 | 50 | - | Deg. | Note 2,6,7 |
| | Bottom | $CR \geq 10$ | 30 | 40 | - | | |
| | Left | $CR \geq 10$ | 40 | 50 | - | | |
| | Right | $CR \geq 10$ | 30 | 40 | - | | |
| Color Filter Chromacity with C light | Wx | $\theta = 0^\circ$ | Typ -0.03 | 0.300 | Typ +0.03 | | Note 3 |
| | Wy | | | 0.332 | | | |
| NTSC | | | - | 40 | % | | Note 3 |

Note 1: Ambient temperature = 25°C.

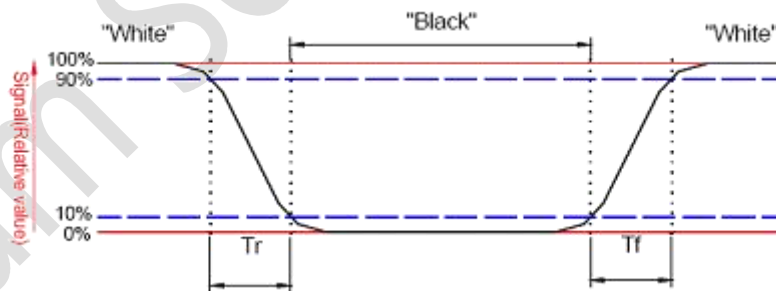
Note 2: To be measured with a viewing cone of 2°by Topcon luminance meter BM-5A.

Note 3: To be measured with Otsuta chromacity meter LCF-2100M, CF only measure under C light simulation.

Note 4: BOE shipping status is cell without polarizer. Transmittance of Specification is cell with polarizer. The tolerance of Transmittance is ±10%.

Note 5: Definition of response time:

The output signals of TRD-100 are measured when the input signals are changed to “White” (falling time) and from “White” to “Black” (rising time), respectively. The interval is between the 10% and 90% of amplitudes. Refer to figure as below.

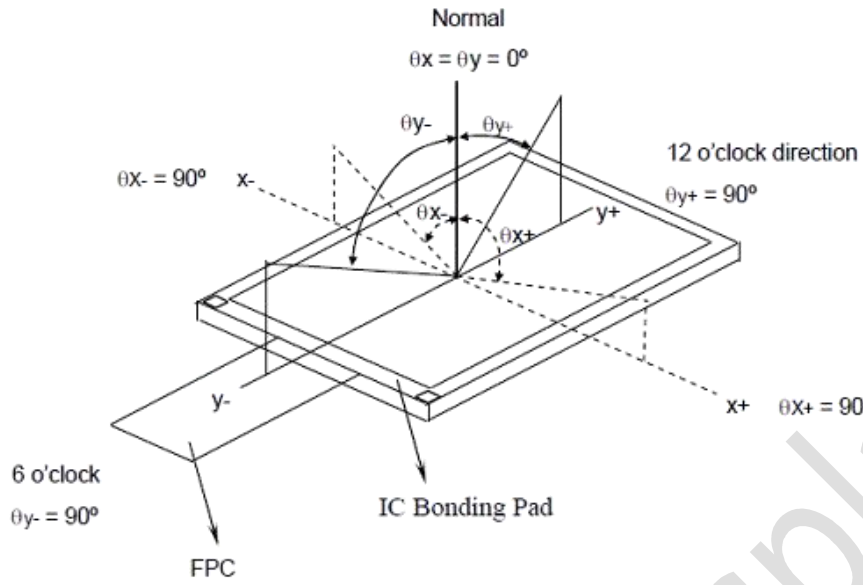


Note 6: Definition of contrast ratio:

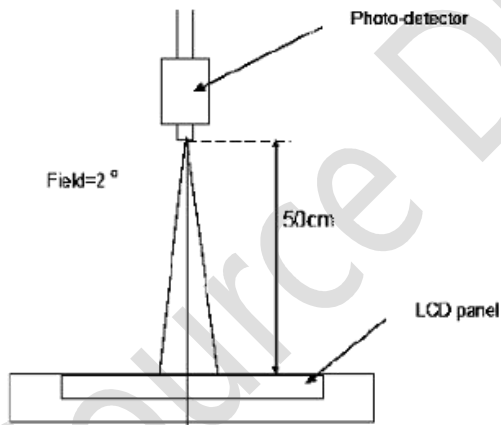
Contrast ratio is calculated by the following formula.

$$\text{Contrast ratio (CR)} = \frac{\text{Brightness on the "white" state}}{\text{Brightness on the "black" state}}$$

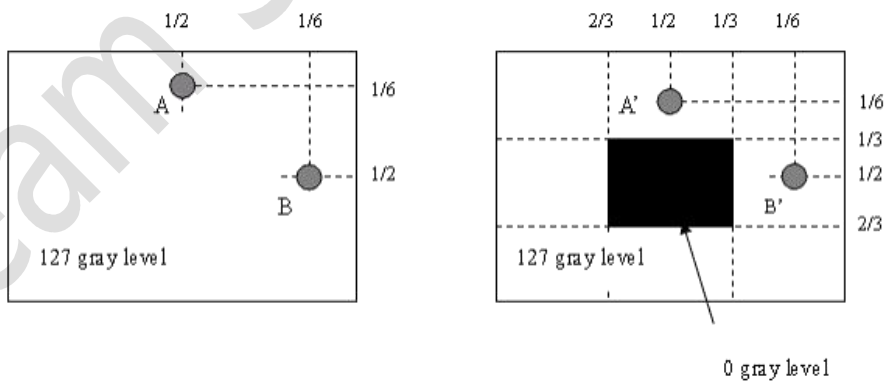
Note 7: Definition of viewing angle



Note 8: Optical characteristic measurement setup.



Note 9:



$1 \frac{LA-LA'}{LA} \times 100\% = 2\% \text{ max.}$, LA and LA' are brightness at location A and A'.

$1 \frac{LB-LB'}{LB} \times 100\% = 2\% \text{ max.}$, LB and LB' are brightness at location B and B'.

9 RELIABILITY TEST

| NO. | TEST ITEM | TEST CONDITION | INSPECTION AFTER TEST |
|-----|------------------------------|--|--|
| 1 | High Temperature Storage | 80±2°C/96 hours | Inspection after 2~4 hours storage at room temperature and humidity. The condensation is not accepted. The sample shall be free from defects: 1. Air bubble in the LCD 2. Seal leak 3. Non-display 4. Missing segments 5. Glass crack |
| 2 | Low Temperature Storage | -30±2°C/96 hours | |
| 3 | High Temperature Operating | 70±2°C/96 hours | |
| 4 | Low Temperature Operating | -20±2°C/96 hours | |
| 5 | Temperature Cycle | -30±2°C ~ 25~ 80± 2°C × 10 cycles (30 min.) (5min.) (30min.) | |
| 6 | Damp Proof Test | 60°C ±5°C × 90%RH/96 hours | |
| 7 | Vibration Test | Frequency 10Hz~55Hz Stroke: 1.5mm Sweep: 10Hz~150 Hz~10Hz 2 hours For each direction of X, Y, Z | |
| 8 | Shock Test | Half-sine, wave, 300m/s | |
| 9 | Packing Drop Test | Height: 80 cm 1 corner, concrete floor | |
| 10 | Electrostatic Discharge Test | C=150pF, R=330 Ω Air: ±8KV 150pF/330Ω 30 times Contact: ±4KV,20 times | |

10 Suggestions for using LCD modules

10.1 Handling of LCM

1. The LCD screen is made of glass. Don't give excessive external shock, or drop from a high place.
2. If the LCD screen is damaged and the liquid crystal leaks out, do not lick and swallow. When the liquid is attach to your hand, skin, cloth etc, wash it off by using soap and water thoroughly and immediately.
3. Don't apply excessive force on the surface of the LCM.
4. If the surface is contaminated, clean it with soft cloth. If the LCM is severely contaminated, use Isopropyl alcohol/Ethyl alcohol to clean. Other solvents may damage the polarizer. The following solvents is especially prohibited: water , ketone Aromatic solvents etc.
5. Exercise care to minimize corrosion of the electrode. Corrosion of the electrodes is accelerated by water droplets, moisture condensation or a current flow in a high-humidity environment.
6. Install the LCD Module by using the mounting holes. When mounting the LCD module make sure it is free of twisting, warping and distortion. In particular, do not forcibly pull or bend the I/O cable or the backlight cable.
7. Don't disassemble the LCM.
8. To prevent destruction of the elements by static electricity, be careful to maintain an optimum work environment.
 - Be sure to ground the body when handling the LCD modules.
 - Tools required for assembling, such as soldering irons, must be properly grounded.
 - To reduce the amount of static electricity generated, do not conduct assembling and other work under dry conditions.
 - The LCD module is coated with a film to protect the display surface. Exercise care when peeling off this protective film since static electricity may be generated.
9. Do not alter, modify or change the the shape of the tab on the metal frame.
10. Do not make extra holes on the printed circuit board, modify its shape or change the positions of components to be attached.
11. Do not damage or modify the pattern writing on the printed circuit board.
12. Absolutely do not modify the zebra rubber strip (conductive rubber) or heat seal connector
13. Except for soldering the interface, do not make any alterations or modifications with a soldering iron.
14. Do not drop, bend or twist LCM.

10.2 Storage

1. Store in an ambient temperature of 5 to 45 C, and in a relative humidity of 40% to 60%. Don't expose to sunlight or fluorescent light.
2. Storage in a clean environment, free from dust, active gas, and solvent.
3. Store in antistatic container.

