

Display Elektronik GmbH

# DATA SHEET

***TFT MODULE***

**DEM 240320K TMH-PW-N  
(C1-TOUCH)**

**2,8" TFT + PCT**

Product Specification

Ver.: 3

12.06.2023

**Revision History**

| <b>Revision</b> | <b>Date</b> | <b>Detail</b>  | <b>Remarks</b>                       |
|-----------------|-------------|--|--------------------------------------|
| 0               | 12.06.2017  | Initial Release  | -                                    |
| 1               | 06.06.2020  | Modify Touch Screen Panel<br>Specifications<br>Modify Luminance<br>Modify Reliability Specification<br>Add some detail<br>Modify Outline Drawing | P6<br>P7<br>P31<br>P32<br>P33<br>P35 |
| 2               | 21.08.2020  | Modify Inspection Specification<br>Modify Outline Drawing  | P26<br>P34                           |
| 3               | 12.06.2023  | Modify Module Outline<br>Modify Optical Glue<br>Modify Packaging<br>Modify Outline Drawing   | P4<br>P6<br>P34<br>P35               |
|                 |             |  |                                      |
|                 |             |  |                                      |
|                 |             |  |                                      |
|                 |             |  |                                      |
|                 |             |  |                                      |

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**1. General Description**

The specification is a transmissive type color active matrix liquid crystal display (LCD) which uses amorphous thin film transistor (TFT) as switching devices. This product is composed of a TFT-LCD panel, driver ICs, a touch panel and a backlight unit. This TFT Module is having an universal interface pin layout to access all relevant interfaces of the TFT Driver IC. It allows to be flexible in case of TFT diver IC changes.

**2. Module Parameter**

| Features                       | Details   | Unit       |
|--------------------------------|---|------------|
| Display Size (Diagonal)        | 2.8"  | -          |
| LCD Type                       | TN TFT  | -          |
| Display Mode                   | Transmissive / Normally White   | -          |
| Resolution                     | 240 x RGB x 320   | Pixels     |
| View Direction                 | 6 o'clock   | Best Image |
| Gray Scale Inversion Direction | 12 o'clock  | -          |
| Module Outline                 | 56.00 x 75.20 x 4.45 ( Note1 )  | mm         |
| Active Area                    | 43.20 x 57.60   | mm         |
| Pixel Size                     | 0.180 x 0.180   | mm         |
| Pixel Arrangement              | R.G.B. Vertical Stripe  | -          |
| Polarizer Surface Treatment    | Anti-Glare  | -          |
| Display Colors                 | 262k  | -          |
| Interface                      | 8/9/16/18 MPU Interface or<br>3-Wire 9-Bit Interface + RGB Interface or<br>4-Wire 8-Bit Interface + RGB Interface | -          |
| With or without touch panel    | With Capacitive Touch   | -          |
| Driver IC                      | ILI9341V (Ilitek)   | -          |
| Operating Temperature          | -20°C to +70°C  | °C         |
| Storage Temperature            | -30°C to +80°C  | °C         |
| Weight                         | 28  | g          |

Note 1: Exclusive hooks, posts, FFC/FPC tail etc.

**3. Absolute Maximum Ratings**

$V_{SS}=0V$ ,  $T_a=25^{\circ}C$

| Item                  | Symbol    | Min. | Max. | Unit |
|-----------------------|-----------|------|------|------|
| Supply Voltage        | Logic     | -0.3 | 4.6  | V    |
|                       | Analog    | -0.3 | 4.6  | V    |
| Storage Temperature   | $T_{STG}$ | -30  | +80  | °C   |
| Operating Temperature | $T_{OP}$  | -20  | +70  | °C   |

Note 1: If  $T_a$  below +50°C, the maximal humidity is 90%RH, if  $T_a$  over +50°C, absolute humidity should be less than 60%RH.

Note 2: The response time will be extremely slow when the operating temperature is around -10°C, and the back ground will become darker at high temperature operating.

**4. DC Characteristics**

| Item                             |        | Symbol                           | Min.      | Typ.    | Max.      | Unit |
|----------------------------------|--------|----------------------------------|-----------|---------|-----------|------|
| Supply Voltage                   | Logic  | IOVCC                            | 1.65      | 1.8/2.8 | 3.3       | V    |
|                                  | Analog | VCC                              | 2.4       | 2.8     | 3.3       | V    |
| Logic Low Input Voltage          |        | V <sub>IL</sub>                  | GND       | -       | 0.3*IOVCC | V    |
| Logic High Input Voltage         |        | V <sub>IH</sub>                  | 0.7*IOVCC | -       | IOVCC     | V    |
| Logic Low Output Voltage         |        | V <sub>OL</sub>                  | GND       | -       | 0.2*IOVCC | V    |
| Logic High Output Voltage        |        | V <sub>OH</sub>                  | 0.8*IOVCC | -       | IOVCC     | V    |
| Current Consumption<br>All Black | Logic  | I <sub>CC+</sub> I <sub>IN</sub> | -         | 10      | -         | mA   |
|                                  | Analog |                                  |           |         |           |      |

**5. Backlight Characteristic**

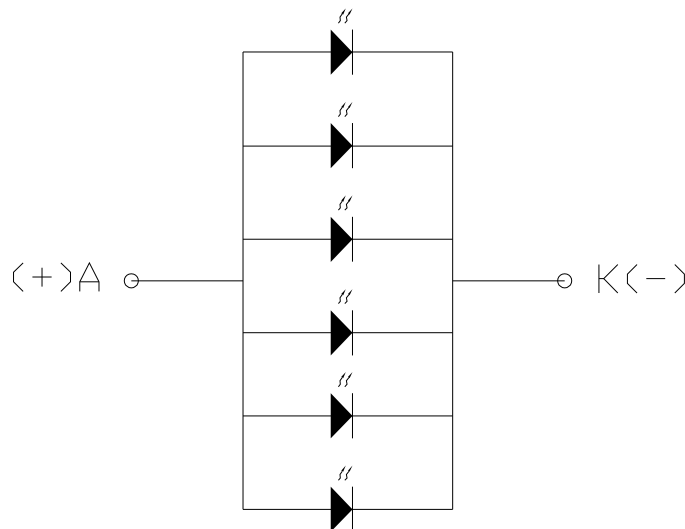
**5.1. Backlight Characteristics**

| Item                 | Symbol                   | Condition                                       | Min.   | Typ.   | Max. | Unit |
|----------------------|--------------------------|---|--------|--------|------|------|
| Forward Voltage      | V <sub>F</sub>           | T <sub>a</sub> =25 °C, I <sub>F</sub> =20mA/LED | 2.9    | 3.2    | 3.4  | V    |
| Forward Current      | I <sub>F</sub>           | T <sub>a</sub> =25 °C, V <sub>F</sub> =3.2V/LED | -      | 120    | -    | mA   |
| Power Dissipation    | P <sub>D</sub>           |   | -      | 384    | -    | mW   |
| LED Lifetime (25 °C) | -                        | -   | 20.000 | 30.000 | -    | Hr   |
| Uniformity           | Avg                      |   | -      | 80     | -    | %    |
| Drive Method         | Constant Current         |   |        |        |      |      |
| LED Configuration    | 6 White LEDs in parallel |   |        |        |      |      |

Note: LED life time defined as follows: The final brightness is at 50% of original brightness.

The environmental conducted under ambient air flow, at T<sub>a</sub>=25°C±2 °C,  
60%RH±5%, I<sub>F</sub>=20mA/LED.

**5.2. Backlighting Circuit**



**6. Touch Screen Panel Specifications**

| Item | CTP Description          |               |
|------|--------------------------|---------------|
| 1    | IC                       | FT5446        |
| 2    | Interface                | I2C           |
| 3    | Operating Voltage        | 2.8V ~ 3.3V   |
| 4    | Interface Signal Voltage | 2.8V ~ 3.3V   |
| 5    | Surface Hardness         | >6H           |
| 6    | Operating Temperature    | -20°C ~ +70°C |
| 7    | Storage Temperature      | -30°C ~ +80°C |
| 8    | Strengthened Type        | Chemical      |
| 9    | Transmittance            | >85%          |
| 10   | Origin of Coordinates    | T/L           |
| 11   | Resolution Ratio         | 240 x 320     |

| Item | Main Layer Define | Thickness/Material |
|------|-------------------|--------------------|
| 1    | Lens              | 0.7mm/Glass        |
| 2    | Optical Glue      | 0.2mm              |
| 3    | Sensor            | 0.55mm/Glass       |

7. Optical Characteristics

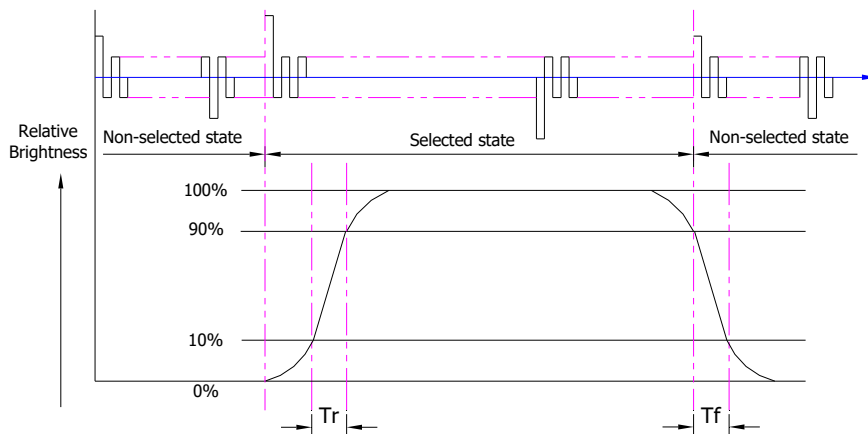
7.1. Optical Characteristics

Ta=25°C, V<sub>DD</sub>=2.8V, TN LC+ Polarizer

|                                  | Item                                       | Symbol                         | Condition  | Specification |       |       | Unit              |      |
|----------------------------------|--|--------------------------------|--|---------------|-------|-------|-------------------|------|
|                                  |  |                                |  | Min.          | Typ.  | Max.  |                   |      |
| Backlight On (Transmissive Mode) | Luminance on TFT(I <sub>f</sub> =20mA/LED) | Lv                             | Normally viewing angle<br>θ <sub>x</sub> = φ <sub>y</sub> = 0° | 490           | 610   | -     | cd/m <sup>2</sup> |      |
|                                  | Contrast Ratio (See 7.3)                   | CR                             |  | 400           | 500   | -     |                   |      |
|                                  | Response Time (See 7.2)                    | T <sub>R</sub> +T <sub>F</sub> |  | -             | 16    | 32    | ms                |      |
|                                  | Chromaticity Transmissive (See 7.5)        | Red                            | X <sub>R</sub>   | Center CR≥10  | 0.567 | 0.617 | 0.667             |      |
|                                  |  |                                | Y <sub>R</sub>   |               | 0.306 | 0.356 | 0.406             |      |
|                                  |  | Green                          | X <sub>G</sub>   |               | 0.238 | 0.288 | 0.338             |      |
|                                  |  |                                | Y <sub>G</sub>   |               | 0.542 | 0.592 | 0.642             |      |
|                                  |  | Blue                           | X <sub>B</sub>   |               | 0.094 | 0.144 | 0.194             |      |
|                                  |  |                                | Y <sub>B</sub>   |               | 0.030 | 0.080 | 0.130             |      |
|                                  | White                                      | X <sub>W</sub>                 | 0.223  | 0.273         | 0.323 |       |                   |      |
|                                  |  | Y <sub>W</sub>                 | 0.253  | 0.303         | 0.353 |       |                   |      |
|                                  | Viewing Angle (See 7.4)                    | Horizontal                     | θ <sub>x+</sub>  | Center CR≥10  | 50    | 60    | -                 | Deg. |
|                                  |  |                                | θ <sub>x-</sub>  |               | 50    | 60    | -                 |      |
|                                  |  | Vertical                       | φ <sub>y+</sub>  |               | 50    | 60    | -                 |      |
| φ <sub>y-</sub>                  |  |                                | 40   |               | 50    | -     |                   |      |
| NTSC Ratio (Gamut)               |  |                                |  | -             | 60    | -     | %                 |      |

7.2. Definition of Response Time

7.2.1. Normally Black Type (Negative)

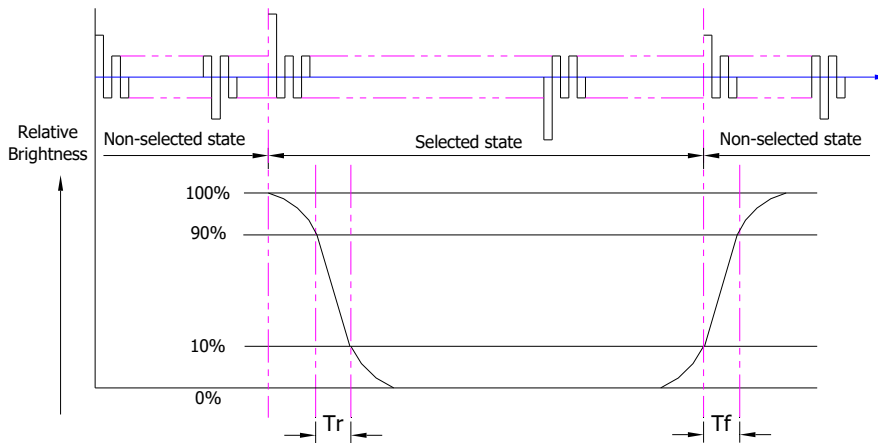


Tr is the time it takes to change from non-selected stage with relative luminance 10% to selected state with relative luminance 90%;

Tf is the time it takes to change from selected state with relative luminance 90% to non-selected state with relative luminance 10%.

Note: Measuring machine: LCD-5100

**7.2.2. Normally White Type (Positive)**



Tr is the time it takes to change from non-selected stage with relative luminance 90% to selected state with relative luminance 10%;

Tf is the time it takes to change from selected state with relative luminance 10% to non-selected state with relative luminance 90%;

Note: Measuring machine: LCD-5100 or EQUI

**7.3. Definition of Contrast Ratio**

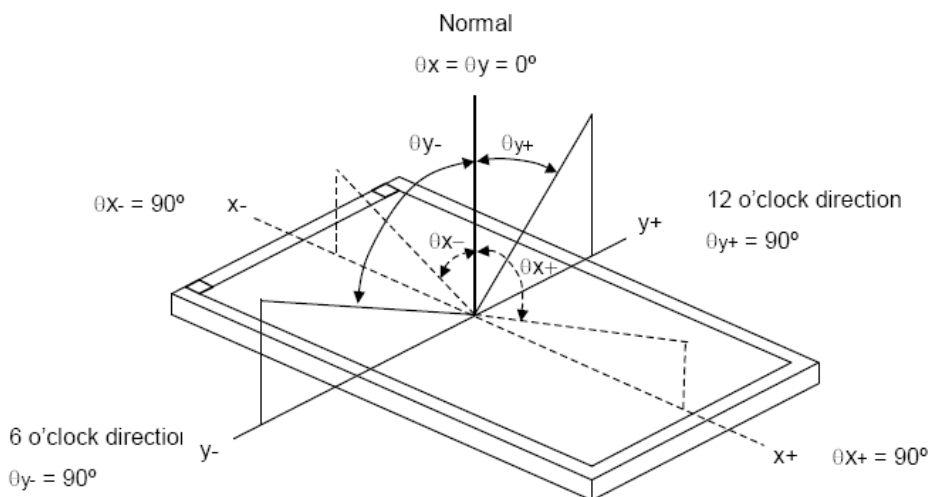
Contrast is measured perpendicular to display surface in reflective and transmissive mode.

The measurement condition is:

|                          |   |
|--------------------------|---|
| Measuring Equipment      | Eldim or Equivalent                       |
| Measuring Point Diameter | 3mm//1mm                                  |
| Measuring Point Location | Active Area centre point                  |
| Test pattern             | A: All Pixels white<br>B: All Pixel black |
| Contrast setting         | Maximum                                   |

Definitions: CR (Contrast) = Luminance of White Pixel / Luminance of Black Pixel

**7.4. Definition of Viewing Angles**



Measuring machine: LCD-5100 or EQUI

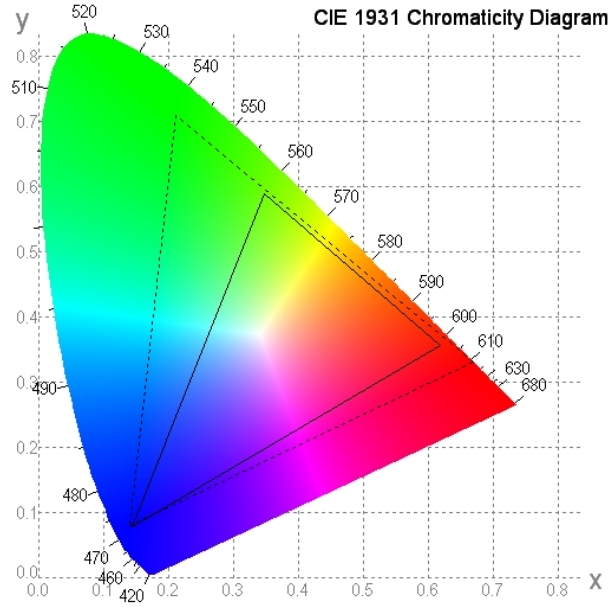


**7.5. Definition of Color Appearance**

R,G,B and W are defined by (x, y) on the IE chromaticity diagram

NTSC=area of RGB triangle/area of NTSC triangleX100%

Measuring picture: Red, Green, Blue and White (Measuring machine: BM-7)



**7.6. Definition of Surface Luminance, Uniformity and Transmittance**

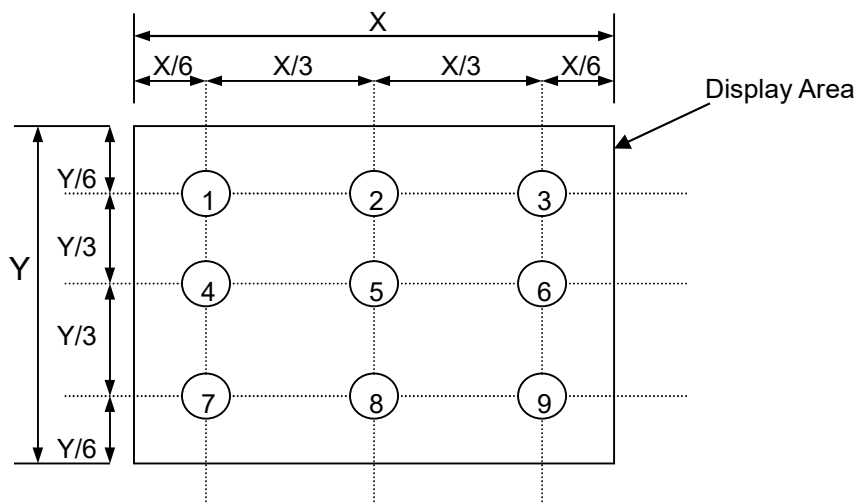
Using the transmissive mode measurement approach, measure the white screen luminance of the display panel and backlight.

7.6.1. Surface Luminance:  $L_v = \text{average} (L_{P1}:L_{P9})$

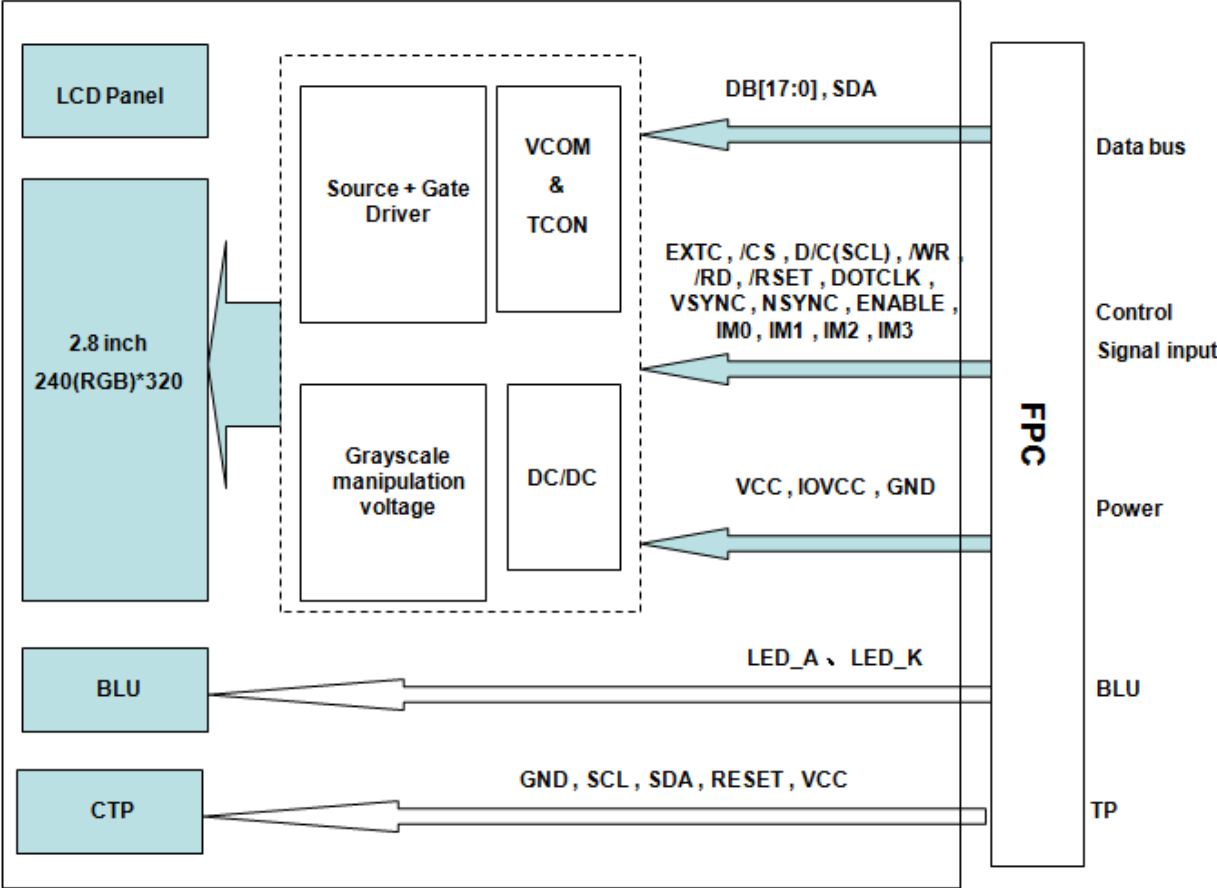
7.6.2. Uniformity =  $\text{Minimal} (L_{P1}:L_{P9}) / \text{Maximal} (L_{P1}:L_{P9}) * 100\%$

7.6.3. Transmittance =  $L_v \text{ on LCD} / L_v \text{ on Backlight} * 100\%$

Note: Measuring machine: BM-7



8. Block Diagram and Power Supply



**9. Interface Pins Definition****9.1 TFT pin:**

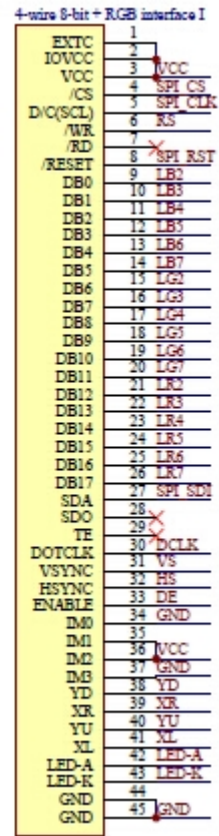
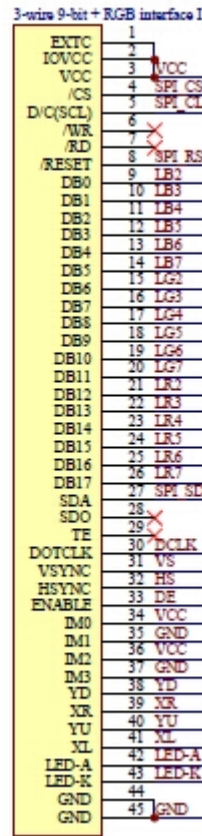
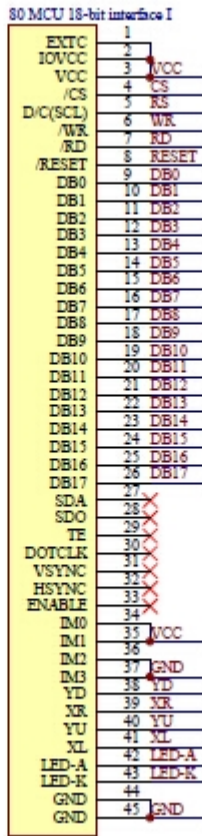
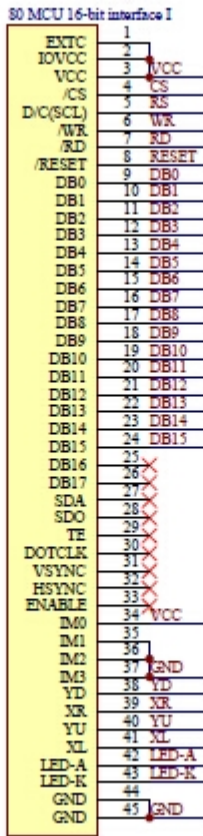
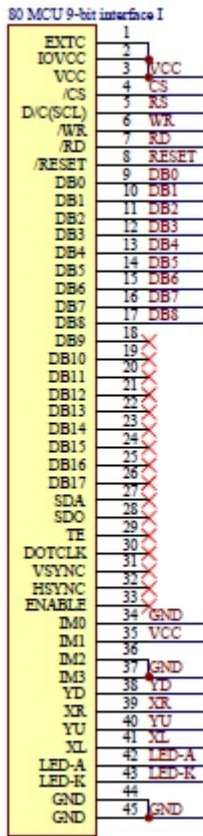
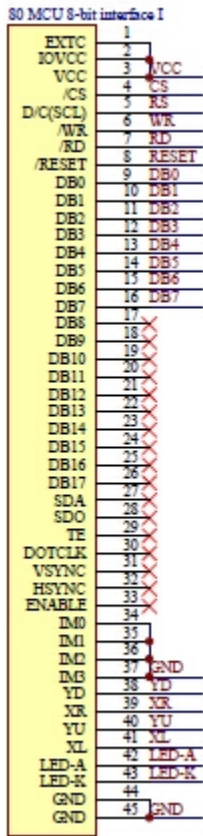
| No. | Symbol          | Function  |
|-----|-----------------|---|
| 1   | EXTC            | Extended command set enable. High: extended command set is accepted. EXTC must be set "H" to read/write extended registers. |
| 2   | IOVCC(1.8/2.8V) | Digital Supply Power.   |
| 3   | VCC(2.8V)       | Analog Supply Power.  |
| 4   | /CS             | Chip Select Signal (Low: active).   |
| 5   | D/C(SCL)        | D/C: Data/Commander Selection.<br>SCL: Serial clock in 3-wire 9-bit/4-wire 8-bit serial data interface.                     |
| 6   | /WR             | 8080-system: Serves as Write Signal.<br>4-line system: Serves as the selector of command or parameter.                      |
| 7   | /RD             | Read Signal.  |
| 8   | /RESET          | Reset Signal.   |
| 9   | DB0             | Data Bus.   |
| 10  | DB1             | Data Bus.   |
| 11  | DB2             | Data Bus.   |
| 12  | DB3             | Data Bus.   |
| 13  | DB4             | Data Bus.   |
| 14  | DB5             | Data Bus.   |
| 15  | DB6             | Data Bus.   |
| 16  | DB7             | Data Bus.   |
| 17  | DB8             | Data Bus.   |
| 18  | DB9             | Data Bus.   |
| 19  | DB10            | Data Bus.   |
| 20  | DB11            | Data Bus.   |
| 21  | DB12            | Data Bus.   |
| 22  | DB13            | Data Bus.   |
| 23  | DB14            | Data Bus.   |
| 24  | DB15            | Data Bus.   |
| 25  | DB16            | Data Bus.   |
| 26  | DB17            | Data Bus.   |
| 27  | SDA             | SPI interface input pin.  |
| 28  | SDO             | SPI interface output pin.   |
| 29  | TE              | Tearing effect output pin to synchronize MPU to frame writing, active by S/W command.                                       |
| 30  | DOTCLK          | Pixel clock signal in RGB I/F mode.   |
| 31  | VSYNC           | Vertical sync. Signal in RGB I/F mode.  |
| 32  | HSYNC           | Horizontal sync. Signal in RGB I/F mode.  |
| 33  | ENABLE          | Data enable signal in RGB I/F mode.   |

|                      |                          | IM3          | IM2 | IM1 | IM0 | MPU interface Mode                    | DB pin              |                      |
|----------------------|--------------------------|--------------|-----|-----|-----|---------------------------------------|---------------------|----------------------|
|                      |                          |              |     |     |     |                                       | Register            | Gram                 |
| 34<br>35<br>36<br>37 | IM0<br>IM1<br>IM2<br>IM3 | 0            | 0   | 0   | 0   | 80 MCU 8-bit bus interface I          | DB[7:0]             | DB[7:0]              |
|                      |                          | 0            | 0   | 0   | 1   | 80 MCU 16-bit bus interface I         | DB[7:0]             | DB[15:0]             |
|                      |                          | 0            | 0   | 1   | 0   | 80 MCU 9-bit bus interface I          | DB[7:0]             | DB[8:0]              |
|                      |                          | 0            | 0   | 1   | 1   | 80 MCU 18-bit bus interface I         | DB[7:0]             | DB[17:0]             |
|                      |                          | 0            | 1   | 0   | 1   | 3-wire 9-bit data Serial interface I  | SDA: in/out         |                      |
|                      |                          | 0            | 1   | 1   | 0   | 4-wire 8-bit data Serial interface I  | SDA: in/out         |                      |
|                      |                          | 1            | 0   | 0   | 0   | 80 MCU 16-bit bus interface II        | DB[8:1]             | DB[8:1]<br>DB[17:10] |
|                      |                          | 1            | 0   | 0   | 1   | 80 MCU 8-bit bus interface II         | DB[17:10]           | DB[17:10]            |
|                      |                          | 1            | 0   | 1   | 0   | 80 MCU 18-bit bus interface II        | DB[8:1]             | DB[17:0]             |
|                      |                          | 1            | 0   | 1   | 1   | 80 MCU 9-bit bus interface II         | DB[17:10]           | DB[17:9]             |
|                      |                          | 1            | 1   | 0   | 1   | 3-wire 9-bit data Serial interface II | SDI: in<br>SDO: out |                      |
|                      |                          | 1            | 1   | 1   | 0   | 4-wire 8-bit data Serial interface II | SDI: in<br>SDO: out |                      |
|                      |                          | 38           | NC  | NC  |     |                                       |                     |                      |
| 39                   | NC                       | NC           |     |     |     |                                       |                     |                      |
| 40                   | NC                       | NC           |     |     |     |                                       |                     |                      |
| 41                   | NC                       | NC           |     |     |     |                                       |                     |                      |
| 42                   | LED-A                    | LED Anode.   |     |     |     |                                       |                     |                      |
| 43                   | LED-K                    | LED Cathode. |     |     |     |                                       |                     |                      |
| 44                   | GND                      | Ground.      |     |     |     |                                       |                     |                      |
| 45                   | GND                      | Ground.      |     |     |     |                                       |                     |                      |

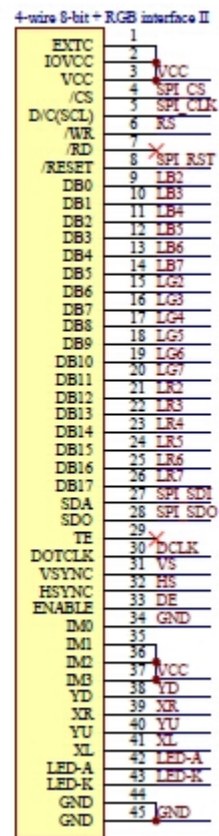
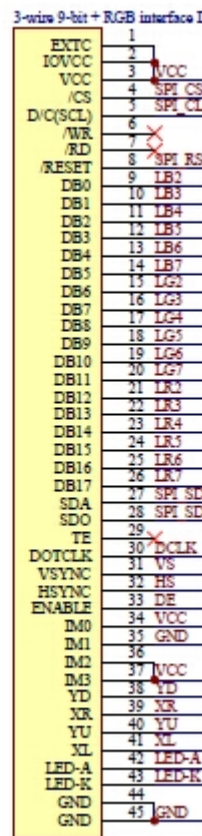
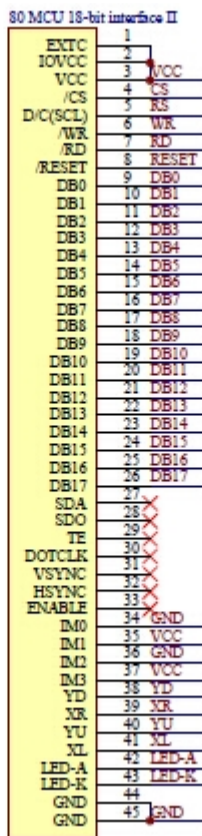
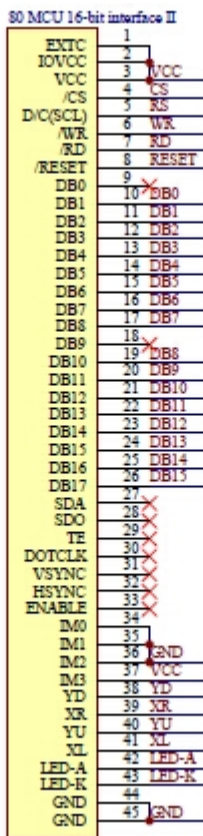
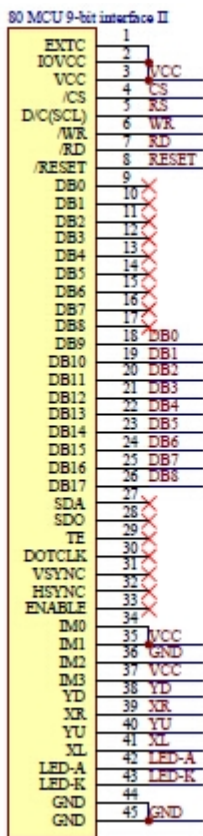
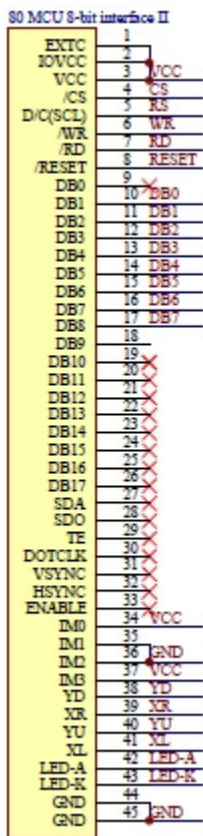
9.2 CTP pin:

| No. | Symbol | Function     |
|-----|--------|--------------|
| 1   | GND    | Ground       |
| 2   | SCL    | Clock        |
| 3   | SDA    | Data         |
| 4   | INT    | Interrupt    |
| 5   | RESET  | Reset        |
| 6   | VCC    | Power supply |

80 MCU Interface I



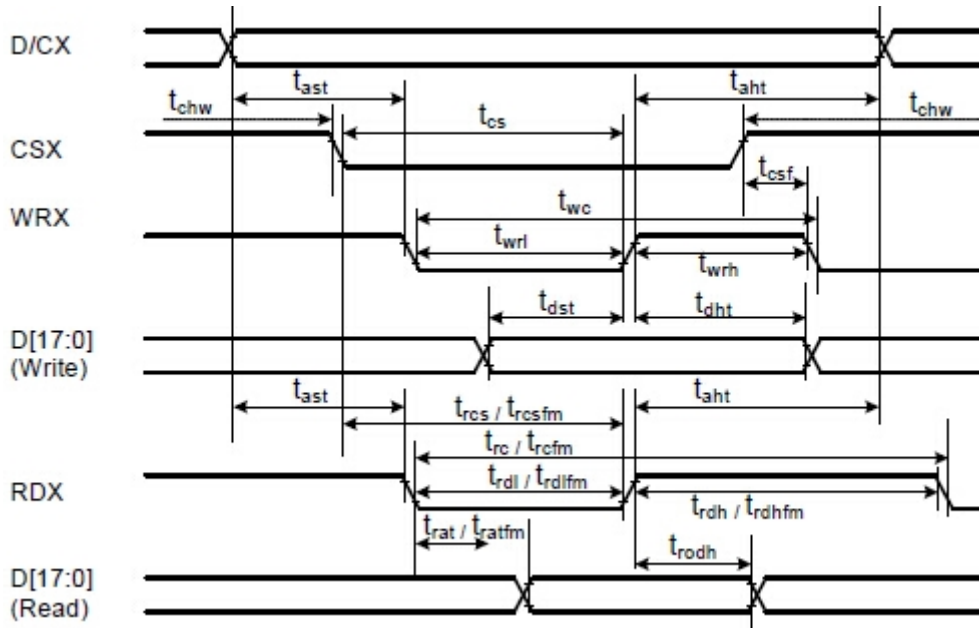
80 MCU Interface II





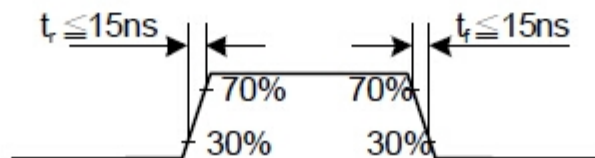
10. AC Characteristics

10.1 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-I system)

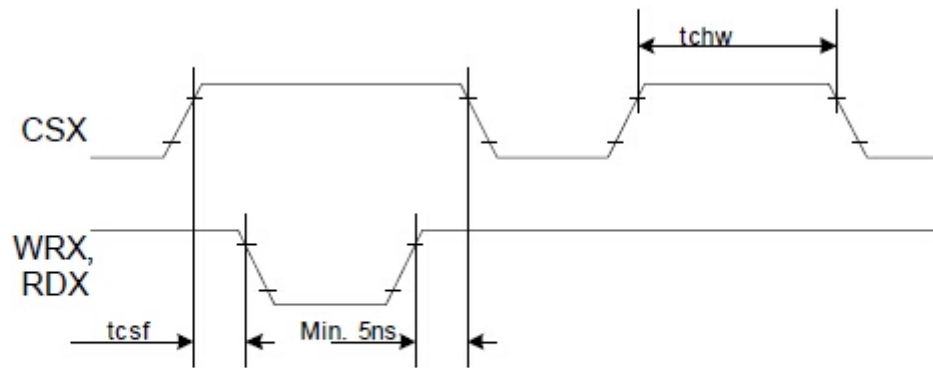


| Signal                                    | Symbol | Parameter                          | min | max | Unit | Description                               |
|---|--------|------------------------------------|-----|-----|------|---|
| DCX                                       | tast   | Address setup time                 | 0   | -   | ns   |   |
|   | taht   | Address hold time (Write/Read)     | 0   | -   | ns   |   |
| CSX                                       | tchw   | CSX "H" pulse width                | 0   | -   | ns   |   |
|   | tcs    | Chip Select setup time (Write)     | 15  | -   | ns   |   |
|   | trcs   | Chip Select setup time (Read ID)   | 45  | -   | ns   |   |
|   | trcsfm | Chip Select setup time (Read FM)   | 355 | -   | ns   |   |
|   | tcsf   | Chip Select Wait time (Write/Read) | 10  | -   | ns   |   |
| WRX                                       | twc    | Write cycle                        | 66  | -   | ns   |   |
|   | twrh   | Write Control pulse H duration     | 15  | -   | ns   |   |
|   | twrl   | Write Control pulse L duration     | 15  | -   | ns   |   |
| RDX (FM)                                  | trcfm  | Read Cycle (FM)                    | 450 | -   | ns   |   |
|   | trdhfm | Read Control H duration (FM)       | 90  | -   | ns   |   |
|   | trdlfm | Read Control L duration (FM)       | 355 | -   | ns   |   |
| RDX (ID)                                  | trc    | Read cycle (ID)                    | 160 | -   | ns   |   |
|   | trdh   | Read Control pulse H duration      | 90  | -   | ns   |   |
|   | trdl   | Read Control pulse L duration      | 45  | -   | ns   |   |
| D[17:0],<br>D[15:0],<br>D[8:0],<br>D[7:0] | tdst   | Write data setup time              | 10  | -   | ns   | For maximum CL=30pF<br>For minimum CL=8pF |
|   | tdht   | Write data hold time               | 10  | -   | ns   |   |
|   | trat   | Read access time                   | -   | 40  | ns   |   |
|   | tratfm | Read access time                   | -   | 340 | ns   |   |
|   | trod   | Read output disable time           | 20  | 80  | ns   |   |

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V

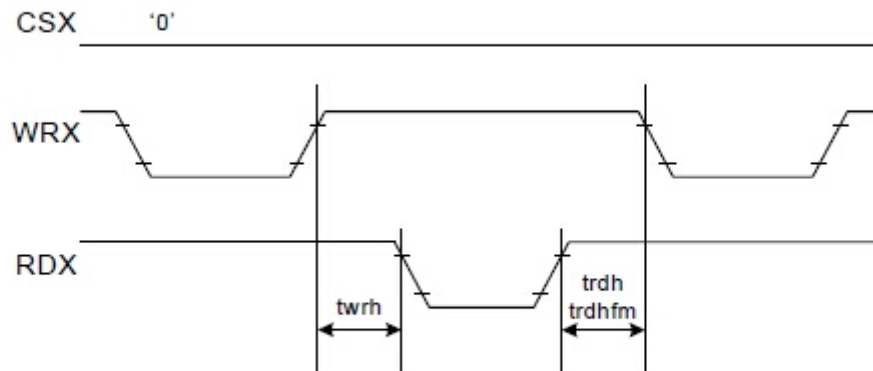


CSX timings :



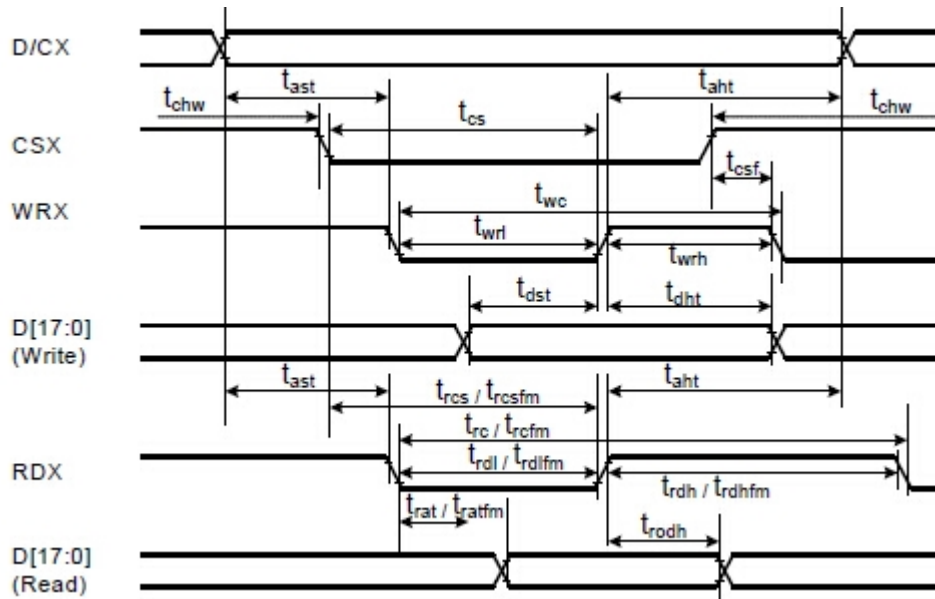
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



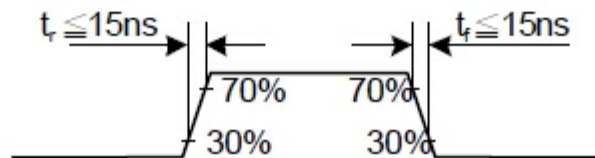
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

10.2 Display Parallel 18/16/9/8-bit Interface Timing Characteristics (8080-II system)



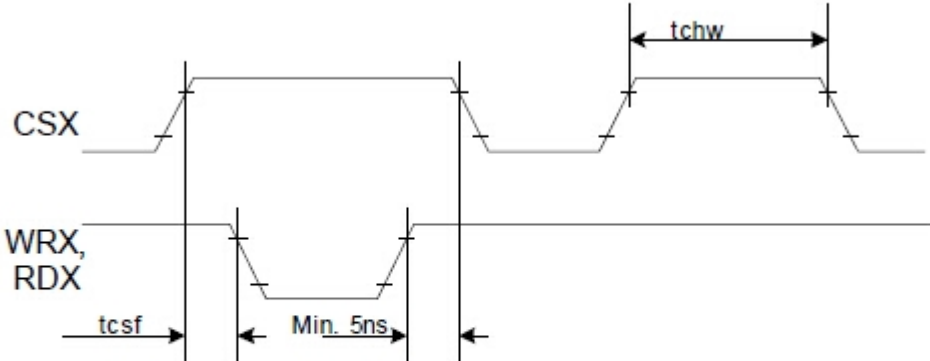
| Signal   | Symbol             | Parameter                        | min | max | Unit | Description                               |
|--|--------------------|----------------------------------|-----|-----|------|---|
| DCX  | t <sub>ast</sub>   | Address setup time               | 0   | -   | ns   |   |
|  | t <sub>ah</sub>    | Address hold time (Write/Read)   | 0   | -   | ns   |   |
| CSX  | t <sub>chw</sub>   | CSX "H" pulse width              | 0   | -   | ns   |   |
|  | t <sub>cs</sub>    | Chip Select setup time (Write)   | 15  | -   | ns   |   |
|  | t <sub>rcs</sub>   | Chip Select setup time (Read ID) | 45  | -   | ns   |   |
|  | t <sub>rcsfm</sub> | Chip Select setup time (Read FM) | 355 | -   | ns   |   |
| WRX  | t <sub>wc</sub>    | Write cycle                      | 66  | -   | ns   |   |
|  | t <sub>wrh</sub>   | Write Control pulse H duration   | 15  | -   | ns   |   |
|  | t <sub>wrl</sub>   | Write Control pulse L duration   | 15  | -   | ns   |   |
| RDX (FM)   | t <sub>rcfm</sub>  | Read Cycle (FM)                  | 450 | -   | ns   |   |
|  | t <sub>rdhfm</sub> | Read Control H duration (FM)     | 90  | -   | ns   |   |
|  | t <sub>rdlfm</sub> | Read Control L duration (FM)     | 355 | -   | ns   |   |
| RDX (ID)   | t <sub>rc</sub>    | Read cycle (ID)                  | 160 | -   | ns   |   |
|  | t <sub>rdh</sub>   | Read Control pulse H duration    | 90  | -   | ns   |   |
|  | t <sub>rdl</sub>   | Read Control pulse L duration    | 45  | -   | ns   |   |
| D[17:0],<br>D[17:10]&D[8:1],<br>D[17:10],<br>D[17:9] | t <sub>dst</sub>   | Write data setup time            | 10  | -   | ns   | For maximum CL=30pF<br>For minimum CL=8pF |
|  | t <sub>dht</sub>   | Write data hold time             | 10  | -   | ns   |   |
|  | t <sub>rat</sub>   | Read access time                 | -   | 40  | ns   |   |
|  | t <sub>ratfm</sub> | Read access time                 | -   | 340 | ns   |   |
|  | t <sub>rod</sub>   | Read output disable time         | 20  | 80  | ns   |   |

Note: T<sub>a</sub> = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, VSS=0V.



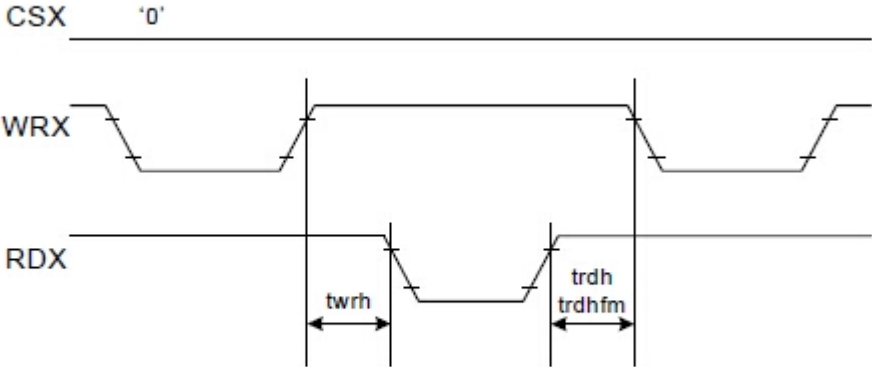


CSX timings :



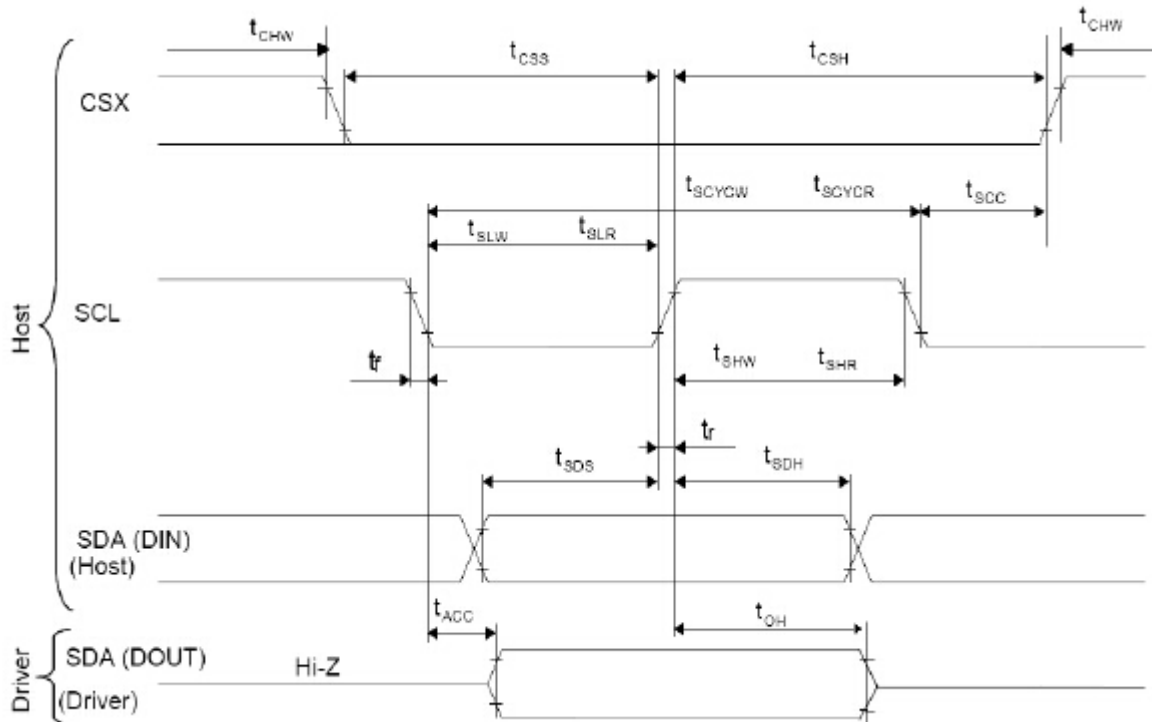
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

Write to read or read to write timings:



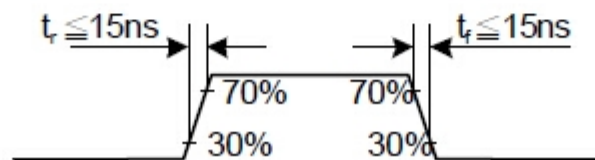
Note: Logic high and low levels are specified as 30% and 70% of VDDI for Input signals.

10.3 Display Serial Interface Timing Characteristics (3-line SPI system)

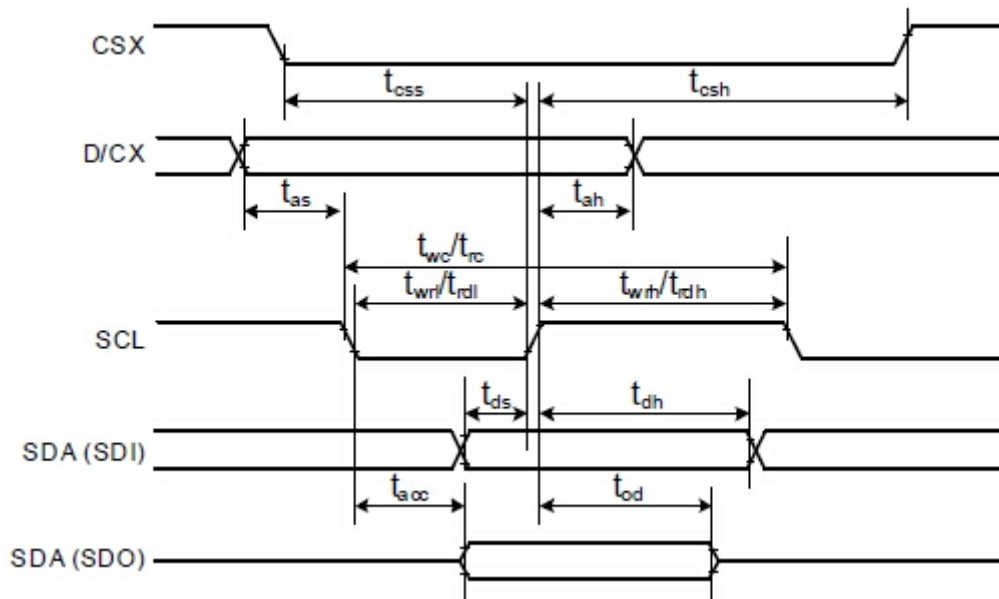


| Signal             | Symbol | Parameter                   | min | max | Unit | Description |
|--------------------|--------|-----------------------------|-----|-----|------|-------------|
| SCL                | tscycw | Serial Clock Cycle (Write)  | 100 | -   | ns   |             |
|                    | tshw   | SCL "H" Pulse Width (Write) | 40  | -   | ns   |             |
|                    | tslw   | SCL "L" Pulse Width (Write) | 40  | -   | ns   |             |
|                    | tscycr | Serial Clock Cycle (Read)   | 150 | -   | ns   |             |
|                    | tshr   | SCL "H" Pulse Width (Read)  | 60  | -   | ns   |             |
|                    | tslr   | SCL "L" Pulse Width (Read)  | 60  | -   | ns   |             |
| SDA / SDI (Input)  | tsds   | Data setup time (Write)     | 30  | -   | ns   |             |
|                    | tsdh   | Data hold time (Write)      | 30  | -   | ns   |             |
| SDA / SDO (Output) | tacc   | Access time (Read)          | 10  | -   | ns   |             |
|                    | toh    | Output disable time (Read)  | 10  | 50  | ns   |             |
| CSX                | tsc    | SCL-CSX                     | 20  | -   | ns   |             |
|                    | tchw   | CSX "H" Pulse Width         | 40  | -   | ns   |             |
|                    | tcss   | CSX-SCL Time                | 60  | -   | ns   |             |
|                    | tcs    |                             | 65  | -   | ns   |             |

Note: Ta = 25 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V

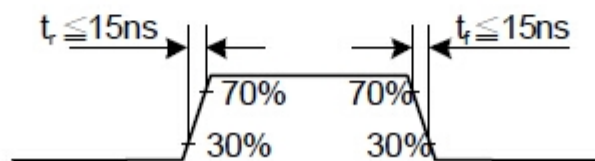


10.4 Display Serial Interface Timing Characteristics (4-line SPI system)

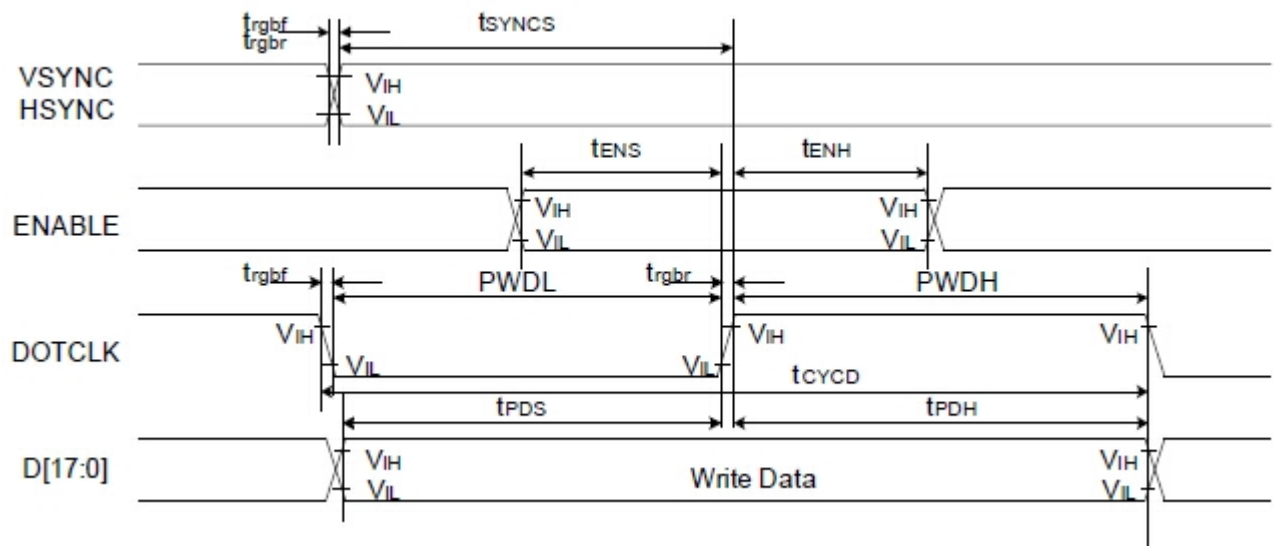


| Signal             | Symbol    | Parameter                     | min | max | Unit | Description         |
|--------------------|-----------|-------------------------------|-----|-----|------|---------------------|
| CSX                | $t_{css}$ | Chip select time (Write)      | 40  | -   | ns   |                     |
|                    | $t_{csh}$ | Chip select hold time (Read)  | 40  | -   | ns   |                     |
| SCL                | $t_{wc}$  | Serial clock cycle (Write)    | 100 | -   | ns   |                     |
|                    | $t_{wrh}$ | SCL "H" pulse width (Write)   | 40  | -   | ns   |                     |
|                    | $t_{wrl}$ | SCL "L" pulse width (Write)   | 40  | -   | ns   |                     |
|                    | $t_{rc}$  | Serial clock cycle (Read)     | 150 | -   | ns   |                     |
|                    | $t_{rdh}$ | SCL "H" pulse width (Read)    | 60  | -   | ns   |                     |
|                    | $t_{rdl}$ | SCL "L" pulse width (Read)    | 60  | -   | ns   |                     |
| D/CX               | $t_{as}$  | D/CX setup time               | 10  | -   |      |                     |
|                    | $t_{ah}$  | D/CX hold time (Write / Read) | 10  | -   |      |                     |
| SDA / SDI (Input)  | $t_{ds}$  | Data setup time (Write)       | 30  | -   | ns   |                     |
|                    | $t_{dh}$  | Data hold time (Write)        | 30  | -   | ns   |                     |
| SDA / SDO (Output) | $t_{acc}$ | Access time (Read)            | 10  | -   | ns   | For maximum CL=30pF |
|                    | $t_{od}$  | Output disable time (Read)    | 10  | 50  | ns   | For minimum CL=8pF  |

Note:  $T_a = 25\text{ }^\circ\text{C}$ ,  $V_{DDI}=1.65\text{V to }3.3\text{V}$ ,  $V_{CI}=2.5\text{V to }3.3\text{V}$ ,  $AGND=VSS=0\text{V}$

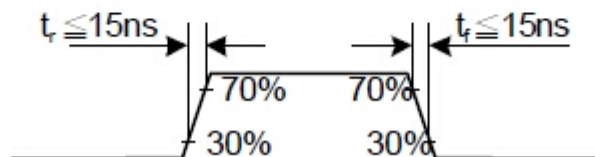


10.5 Parallel 18/16/6-bit RGB Interface Timing Characteristics

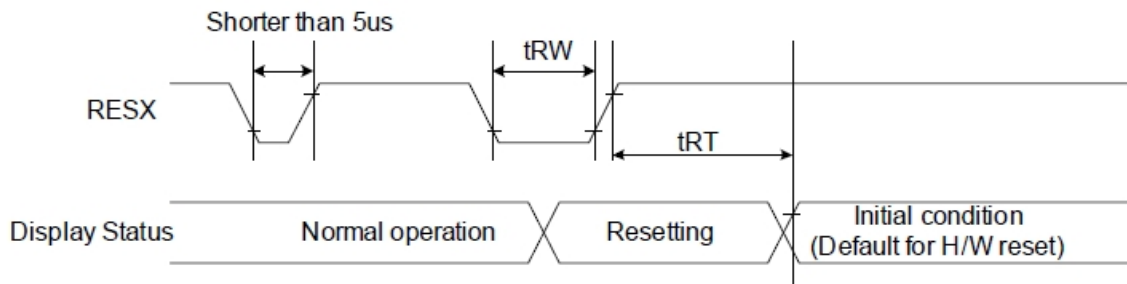


| Signal        | Symbol       | Parameter                         | min | max | Unit | Description                      |                              |
|---------------|--------------|-----------------------------------|-----|-----|------|----------------------------------|------------------------------|
| VSYNC / HSYNC | tSYNCS       | VSYNC/HSYNC setup time            | 15  | -   | ns   | 18/16-bit bus RGB interface mode |                              |
|               | tSYNCH       | VSYNC/HSYNC hold time             | 15  | -   | ns   |                                  |                              |
| DE            | tENS         | DE setup time                     | 15  | -   | ns   |                                  |                              |
|               | tENH         | DE hold time                      | 15  | -   | ns   |                                  |                              |
| D[17:0]       | tPOS         | Data setup time                   | 15  | -   | ns   |                                  |                              |
|               | tPDH         | Data hold time                    | 15  | -   | ns   |                                  |                              |
| DOTCLK        | PWDH         | DOTCLK high-level period          | 15  | -   | ns   |                                  |                              |
|               | PWDL         | DOTCLK low-level period           | 15  | -   | ns   |                                  |                              |
|               | tCYCD        | DOTCLK cycle time                 | 100 | -   | ns   |                                  |                              |
|               | trqbr, trqbf | DOTCLK,HSYNC,VSYNC rise/fall time | -   | 15  | ns   |                                  |                              |
| VSYNC / HSYNC | tSYNCS       | VSYNC/HSYNC setup time            | 15  | -   | ns   |                                  | 6-bit bus RGB interface mode |
|               | tSYNCH       | VSYNC/HSYNC hold time             | 15  | -   | ns   |                                  |                              |
| DE            | tENS         | DE setup time                     | 15  | -   | ns   |                                  |                              |
|               | tENH         | DE hold time                      | 15  | -   | ns   |                                  |                              |
| D[17:0]       | tPOS         | Data setup time                   | 15  | -   | ns   |                                  |                              |
|               | tPDH         | Data hold time                    | 15  | -   | ns   |                                  |                              |
| DOTCLK        | PWDH         | DOTCLK high-level pulse period    | 15  | -   | ns   |                                  |                              |
|               | PWDL         | DOTCLK low-level pulse period     | 15  | -   | ns   |                                  |                              |
|               | tCYCD        | DOTCLK cycle time                 | 50  | -   | ns   |                                  |                              |
|               | trqbr, trqbf | DOTCLK,HSYNC,VSYNC rise/fall time | -   | 15  | ns   |                                  |                              |

Note: Ta = -30 to 70 °C, VDDI=1.65V to 3.3V, VCI=2.5V to 3.3V, AGND=VSS=0V



**11. Reset Timing**



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

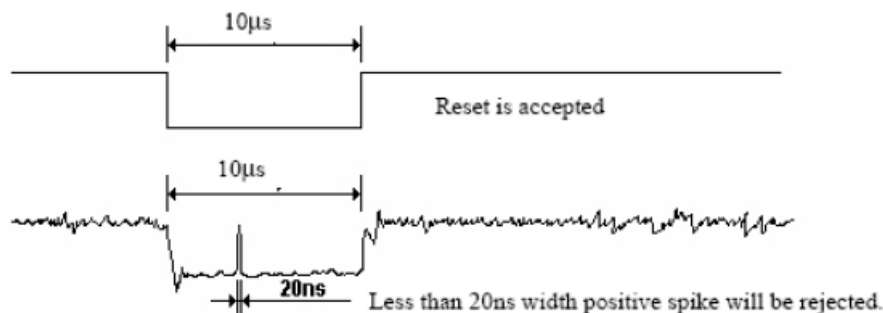
Note 1: The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NV memory to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.

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.

## **12. Quality Assurance**

### **12.1. Purpose**

This standard for Quality Assurance assures the quality of LCD module products supplied to customer.

### **12.2. Standard for Quality Test**

#### 12.2.1 Sampling Plan:

GB2828.1-2012

Single sampling, normal inspection.

#### 12.2.2 Sampling Criteria:

Visual inspection: AQL 1.5

Electrical functional: AQL 0.65.

#### 12.2.3 Reliability Test:

Detailed requirement refer to Reliability Test Specification.

### **12.3. Nonconforming Analysis & Disposition**

#### 12.3.1 Nonconforming analysis:

12.3.1.1 Customer should provide overall information of non-conforming sample for their complaints.

12.3.1.2 After receipt of detailed information from customer, the analysis of nonconforming parts usually should be finished in one week.

12.3.1.3 If cannot finish the analysis on time, customer will be notified with the progress status.

#### 12.3.2 Disposition of nonconforming:

12.3.2.1 Non-conforming product over PPM level will be replaced.

12.3.2.2 The cause of non-conformance will be analyzed. Corrective action will be discussed and implemented.

### **12.4. Agreement Items**

Shall negotiate with customer if the following situation occurs:

12.4.1 There is any discrepancy in standard of quality assurance.

12.4.2 Additional requirement to be added in product specification.

12.4.3 Any other special problem.

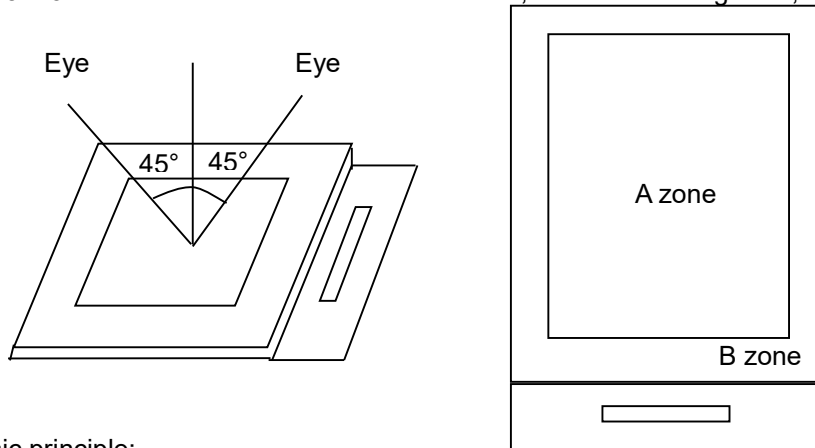
**12.5. Standard of the Product Visual Inspection**

12.5.1 Appearance inspection:

12.5.1.1 The inspection must be under illumination about 1000 – 1500 lx, and the distance of view must be at 30cm ± 2cm.

12.5.1.2 The viewing angle should be 45° from the vertical line without reflection light or follows customer's viewing angle specifications.

12.5.1.3 Definition of area: A Zone: Active Area, B Zone: Viewing Area,



12.5.2 Basic principle:

12.5.2.1 A set of sample to indicate the limit of acceptable quality level must be discussed by both us and customer when there is any dispute happened.

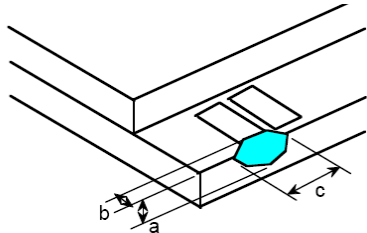
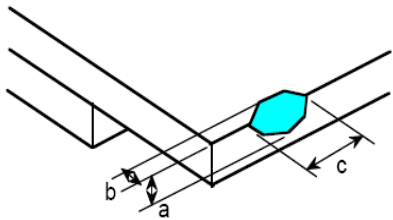
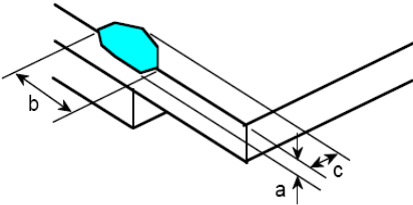
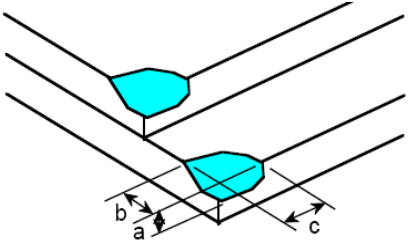
12.5.2.2 New item must be added on time when it is necessary.

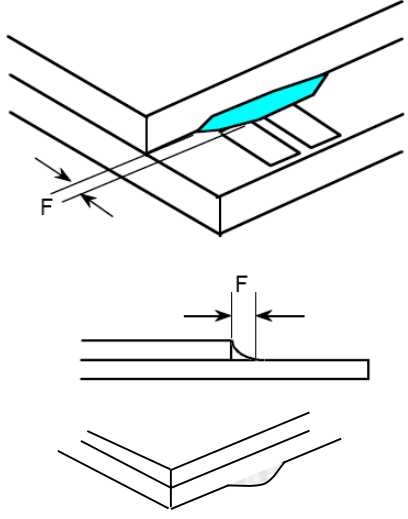
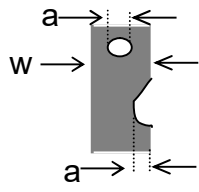
**12.6. Inspection Specification**

| No.                     | Item  | Criteria (Unit: mm)  |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
|-------------------------|---|--|------|------|----------|------------------|--|--------|-------------------------|--|---|-------------------------|--|---|---------------|--|---|-------|--|-------------------------------|
| 01                      | Black / White spot<br>Foreign material (Round type)<br>Pinholes<br>Stain<br>Particles inside cell. (Minor defect) | <p><math>\phi = (a + b) / 2</math></p> <p>Distance between 2 defects should more than 3mm apart.</p> <table border="1"> <thead> <tr> <th>Size</th> <th>Area</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>\phi \leq 0.10</math></td> <td></td> <td>Ignore</td> </tr> <tr> <td><math>0.10 &lt; \phi \leq 0.15</math></td> <td></td> <td>2</td> </tr> <tr> <td><math>0.15 &lt; \phi \leq 0.25</math></td> <td></td> <td>1</td> </tr> <tr> <td><math>0.25 &lt; \phi</math></td> <td></td> <td>0</td> </tr> <tr> <td>Total</td> <td></td> <td>2 no include <math>\phi \leq 0.10</math></td> </tr> </tbody> </table> | Size | Area | Acc. Qty | $\phi \leq 0.10$ |  | Ignore | $0.10 < \phi \leq 0.15$ |  | 2 | $0.15 < \phi \leq 0.25$ |  | 1 | $0.25 < \phi$ |  | 0 | Total |  | 2 no include $\phi \leq 0.10$ |
| Size                    | Area  | Acc. Qty   |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
| $\phi \leq 0.10$        |   | Ignore   |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
| $0.10 < \phi \leq 0.15$ |   | 2  |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
| $0.15 < \phi \leq 0.25$ |   | 1  |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
| $0.25 < \phi$           |   | 0  |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |
| Total                   |   | 2 no include $\phi \leq 0.10$  |      |      |          |                  |  |        |                         |  |   |                         |  |   |               |  |   |       |  |                               |

| 02  | Electrical Defect<br>(Minor defect)  | <table border="1"> <tr> <th></th> <th>Display Area</th> <th>Total</th> <th rowspan="3">Note1</th> </tr> <tr> <td>Bright dot</td> <td>0</td> <td>0</td> </tr> <tr> <td>Dark dot</td> <td><math>N \leq 2</math></td> <td><math>N \leq 2</math></td> </tr> <tr> <td>Total dot</td> <td><math>N \leq 2</math></td> <td><math>N \leq 2</math></td> <td rowspan="2">Note 2</td> </tr> <tr> <td>Mura</td> <td colspan="2">Not visible through 5% ND filters.</td> </tr> </table>  |              | Display Area | Total    | Note1 | Bright dot    | 0      | 0            | Dark dot             | $N \leq 2$ | $N \leq 2$   | Total dot            | $N \leq 2$ | $N \leq 2$ | Note 2    | Mura | Not visible through 5% ND filters. |  |   |
|---|--|--|--------------|--------------|----------|-------|---------------|--------|--------------|----------------------|------------|--------------|----------------------|------------|------------|-----------|------|------------------------------------|--|---|
|   |  |  | Display Area | Total        | Note1    |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
|   |  | Bright dot   | 0            | 0            |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
|   |  | Dark dot   | $N \leq 2$   | $N \leq 2$   |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
|   |  | Total dot  | $N \leq 2$   | $N \leq 2$   | Note 2   |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| Mura  | Not visible through 5% ND filters.   |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| Remark:   |  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| 1. Bright dot caused by scratch and foreign object accords to item 1.   |  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
|   |  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| 03  | Black and White line<br>Scratch<br>Foreign material<br>(Line type)<br>(Minor defect) |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
|   |  | <table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td><math>W \leq 0.03</math></td> <td>Ignore</td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.03 &lt; W \leq 0.05</math></td> <td>3</td> </tr> <tr> <td><math>L \leq 2.5</math></td> <td><math>0.05 &lt; W \leq 0.10</math></td> <td>2</td> </tr> <tr> <td>/</td> <td><math>0.1 &lt; W</math></td> <td>0</td> </tr> <tr> <td colspan="2">Total</td> <td>3</td> </tr> </tbody> </table> | Length       | Width        | Acc. Qty | /     | $W \leq 0.03$ | Ignore | $L \leq 2.5$ | $0.03 < W \leq 0.05$ | 3          | $L \leq 2.5$ | $0.05 < W \leq 0.10$ | 2          | /          | $0.1 < W$ | 0    | Total                              |  | 3 |
|   |  | Length   | Width        | Acc. Qty     |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| /   | $W \leq 0.03$  | Ignore   |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| $L \leq 2.5$  | $0.03 < W \leq 0.05$   | 3  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| $L \leq 2.5$  | $0.05 < W \leq 0.10$   | 2  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| /   | $0.1 < W$  | 0  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| Total   |  | 3  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| Distance between 2 defects should more than 3mm apart. Scratches not viewable through the back of the display are acceptable. |  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| 04  | Glass Crack<br>(Minor defect)  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |
| Crack is potential to enlarge, any type is not allowed.   |  |  |              |              |          |       |               |        |              |                      |            |              |                      |            |            |           |      |                                    |  |   |



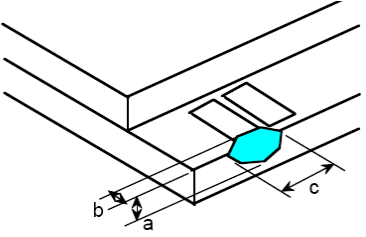
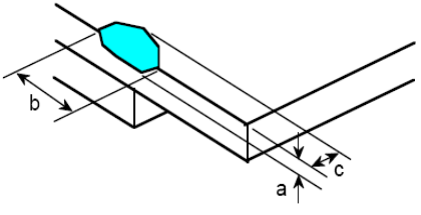
| <p>05</p>                    | <p>Glass Chipping Pad Area:<br/>(Minor defect)</p>           | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &gt; 3.0, b &lt; 1.0</math></td> <td>1</td> </tr> <tr> <td><math>c &lt; 3.0, b &lt; 1.0</math></td> <td>3</td> </tr> <tr> <td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td> </tr> </tbody> </table>  | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1      | $c < 3.0, b < 1.0$           | 3 | $a < \text{Glass Thickness}$ |   |                              |  |
|------------------------------|---|--|------------------|----------|--------------------|--------|------------------------------|---|------------------------------|---|------------------------------|--|
| Length and Width             | Acc. Qty  |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c > 3.0, b < 1.0$           | 1   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 1.0$           | 3   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $a < \text{Glass Thickness}$ |   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| <p>06</p>                    | <p>Glass Chipping Rear of Pad Area:<br/>(Minor defect)</p>   | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &gt; 3.0, b &lt; 1.0</math></td> <td>1</td> </tr> <tr> <td><math>c &lt; 3.0, b &lt; 1.0</math></td> <td>2</td> </tr> <tr> <td><math>c &lt; 3.0, b &lt; 0.5</math></td> <td>4</td> </tr> <tr> <td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1      | $c < 3.0, b < 1.0$           | 2 | $c < 3.0, b < 0.5$           | 4 | $a < \text{Glass Thickness}$ |  |
| Length and Width             | Acc. Qty  |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c > 3.0, b < 1.0$           | 1   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 1.0$           | 2   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 0.5$           | 4   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $a < \text{Glass Thickness}$ |   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| <p>07</p>                    | <p>Glass Chipping Except Pad Area:<br/>(Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &gt; 3.0, b &lt; 1.0</math></td> <td>1</td> </tr> <tr> <td><math>c &lt; 3.0, b &lt; 1.0</math></td> <td>2</td> </tr> <tr> <td><math>c &lt; 3.0, b &lt; 0.5</math></td> <td>4</td> </tr> <tr> <td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c > 3.0, b < 1.0$ | 1      | $c < 3.0, b < 1.0$           | 2 | $c < 3.0, b < 0.5$           | 4 | $a < \text{Glass Thickness}$ |  |
| Length and Width             | Acc. Qty  |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c > 3.0, b < 1.0$           | 1   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 1.0$           | 2   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 0.5$           | 4   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $a < \text{Glass Thickness}$ |   |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| <p>08</p>                    | <p>Glass Corner Chipping:<br/>(Minor defect)</p>           | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &lt; 3.0, b &lt; 3.0</math></td> <td>Ignore</td> </tr> <tr> <td colspan="2"><math>a &lt; \text{Glass Thickness}</math></td> </tr> </tbody> </table>  | Length and Width | Acc. Qty | $c < 3.0, b < 3.0$ | Ignore | $a < \text{Glass Thickness}$ |   |                              |   |                              |  |
| Length and Width             | Acc. Qty  |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $c < 3.0, b < 3.0$           | Ignore  |  |                  |          |                    |        |                              |   |                              |   |                              |  |
| $a < \text{Glass Thickness}$ |   |  |                  |          |                    |        |                              |   |                              |   |                              |  |

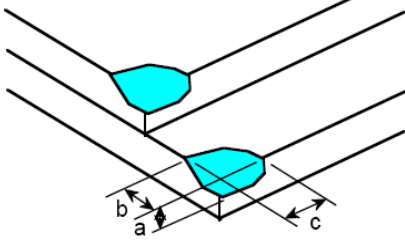
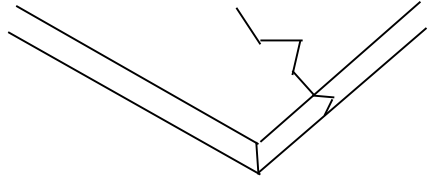

| <p>09</p>                  | <p>Glass Burr:<br/>(Minor defect)</p>    | <table border="1" data-bbox="869 264 1340 353"> <thead> <tr> <th>Length</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>F &lt; 1.0</math></td> <td>Ignore</td> </tr> </tbody> </table> <p>Glass burr don't affect assemble and module dimension.</p>   | Length   | Acc. Qty | $F < 1.0$           | Ignore |                            |   |                            |   |                  |      |
|----------------------------|---|---|----------|----------|---------------------|--------|----------------------------|---|----------------------------|---|------------------|------|
| Length                     | Acc. Qty  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $F < 1.0$                  | Ignore  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| <p>10</p>                  | <p>FPC Defect:<br/>(Minor defect)</p>  | <p>10.1 Dent, pinhole width <math>a &lt; w/3</math>.<br/>(w: circuitry width.)</p> <p>10.2 Open circuit is unacceptable.</p> <p>10.3 No oxidation, contamination and distortion.</p>  |          |          |                     |        |                            |   |                            |   |                  |      |
| <p>11</p>                  | <p>Bubble on Polarizer<br/>(Minor defect)</p>   | <table border="1" data-bbox="742 1299 1212 1512"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>\varphi \leq 0.20</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.20 &lt; \varphi \leq 0.30</math></td> <td>4</td> </tr> <tr> <td><math>0.30 &lt; \varphi \leq 0.50</math></td> <td>1</td> </tr> <tr> <td><math>0.50 &lt; \varphi</math></td> <td>None</td> </tr> </tbody> </table> | Diameter | Acc. Qty | $\varphi \leq 0.20$ | Ignore | $0.20 < \varphi \leq 0.30$ | 4 | $0.30 < \varphi \leq 0.50$ | 1 | $0.50 < \varphi$ | None |
| Diameter                   | Acc. Qty  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $\varphi \leq 0.20$        | Ignore  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.20 < \varphi \leq 0.30$ | 4   |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.30 < \varphi \leq 0.50$ | 1   |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.50 < \varphi$           | None  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| <p>12</p>                  | <p>Dent on Polarizer<br/>(Minor defect)</p>   | <table border="1" data-bbox="742 1556 1212 1769"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>\varphi \leq 0.20</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.20 &lt; \varphi \leq 0.30</math></td> <td>4</td> </tr> <tr> <td><math>0.30 &lt; \varphi \leq 0.50</math></td> <td>1</td> </tr> <tr> <td><math>0.50 &lt; \varphi</math></td> <td>None</td> </tr> </tbody> </table> | Diameter | Acc. Qty | $\varphi \leq 0.20$ | Ignore | $0.20 < \varphi \leq 0.30$ | 4 | $0.30 < \varphi \leq 0.50$ | 1 | $0.50 < \varphi$ | None |
| Diameter                   | Acc. Qty  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $\varphi \leq 0.20$        | Ignore  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.20 < \varphi \leq 0.30$ | 4   |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.30 < \varphi \leq 0.50$ | 1   |   |          |          |                     |        |                            |   |                            |   |                  |      |
| $0.50 < \varphi$           | None  |   |          |          |                     |        |                            |   |                            |   |                  |      |
| <p>13</p>                  | <p>Bezel</p>  | <p>13.1 No rust, distortion on the Bezel.</p> <p>13.2 No visible fingerprints, stains or other contamination.</p>   |          |          |                     |        |                            |   |                            |   |                  |      |


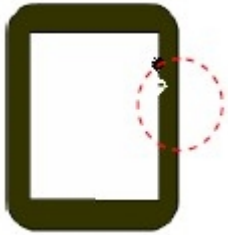
|    |                                  |  |
|----|----------------------------------|--|
| 14 | PCB                              | 14.1 No distortion or contamination on PCB terminals.<br>14.2 All components on PCB must same as documented on the BOM/component layout.<br>14.3 Follow IPC-A-600F.  |
| 15 | Soldering                        | Follow IPC-A-610C standard   |
| 16 | Electrical Defect (Major defect) | The below defects must be rejected.<br>16.1 Missing vertical / horizontal segment,<br>16.2 Abnormal Display.<br>16.3 No function or no display.<br>16.4 Current exceeds product specifications.<br>16.5 LCD viewing angle defect.<br>16.6 No Backlight.<br>16.7 Dark Backlight.<br>16.8 Touch Panel no function. |

Remark: LCD Panel Broken shall be rejected. Defect out of LCD viewing area is acceptable.

Inspection Specification for the Capacitive Touch Panel

| 01                        | Chipping Pad Area(Not include the cover lens):<br>(Minor defect)         | The chip is seriously influence the product's function, any type is not allowed.   |                  |          |                  |            |                           |  |
|---------------------------|---|--|------------------|----------|------------------|------------|---------------------------|--|
| 02                        | Chipping Except Pad Area(Not include the cover lens):<br>(Minor defect)  | <table border="1" data-bbox="885 1657 1348 1792"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &lt; 1.5, b &lt; 1</math></td> <td><math>N \leq 5</math></td> </tr> <tr> <td colspan="2"><math>a &lt; 1/2</math> Glass Thickness</td> </tr> </tbody> </table> | Length and Width | Acc. Qty | $c < 1.5, b < 1$ | $N \leq 5$ | $a < 1/2$ Glass Thickness |  |
| Length and Width          | Acc. Qty  |  |                  |          |                  |            |                           |  |
| $c < 1.5, b < 1$          | $N \leq 5$  |  |                  |          |                  |            |                           |  |
| $a < 1/2$ Glass Thickness |   |  |                  |          |                  |            |                           |  |

| <p>03</p>                 | <p>Corner Chipping(Not include the cover lens):<br/>(Minor defect)</p>  | <table border="1"> <thead> <tr> <th>Length and Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>c &lt; 1.5, b &lt; 0.5</math></td> <td>Ignore</td> </tr> <tr> <td colspan="2"><math>a &lt; 1/2</math> Glass Thickness</td> </tr> </tbody> </table>   | Length and Width | Acc. Qty | $c < 1.5, b < 0.5$ | Ignore | $a < 1/2$ Glass Thickness |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
|---------------------------|--|--|------------------|----------|--------------------|--------|---------------------------|----------|----------------------|---|----------------------|---|-----------|----|----------|----------|------------|--------|---------------------|---|-----------|----|
| Length and Width          | Acc. Qty   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $c < 1.5, b < 0.5$        | Ignore   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $a < 1/2$ Glass Thickness |  |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| <p>04</p>                 | <p>Crack:<br/>(Minor defect)</p>   |  <p>Crack is potential to enlarge, any type is not allowed.</p>  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| <p>05</p>                 | <p>Cover lens must be without any chips, cracks or other damage when viewed from the front.</p>  |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| <p>06</p>                 | <p>Same/Different color spot</p>                                      | <p>D: Diameter W: width L: length</p> <table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>D &lt; 0.20</math></td> <td>Ignore</td> </tr> </tbody> </table> <p>Active Area:</p> <table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>0.20 &lt; D \leq 0.30</math></td> <td>2</td> </tr> <tr> <td><math>0.30 &lt; D \leq 0.50</math></td> <td>1</td> </tr> <tr> <td><math>D &gt; 0.5</math></td> <td>NG</td> </tr> </tbody> </table> <p>Viewing Area :</p> <table border="1"> <thead> <tr> <th>Diameter</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td><math>D &lt; 0.20</math></td> <td>Ignore</td> </tr> <tr> <td><math>0.20 &lt; D \leq 0.5</math></td> <td>3</td> </tr> <tr> <td><math>D &gt; 0.5</math></td> <td>NG</td> </tr> </tbody> </table> <p>Distance between 2 defects should more than 15mm apart.</p> | Diameter         | Acc. Qty | $D < 0.20$         | Ignore | Diameter                  | Acc. Qty | $0.20 < D \leq 0.30$ | 2 | $0.30 < D \leq 0.50$ | 1 | $D > 0.5$ | NG | Diameter | Acc. Qty | $D < 0.20$ | Ignore | $0.20 < D \leq 0.5$ | 3 | $D > 0.5$ | NG |
| Diameter                  | Acc. Qty   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $D < 0.20$                | Ignore   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| Diameter                  | Acc. Qty   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $0.20 < D \leq 0.30$      | 2  |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $0.30 < D \leq 0.50$      | 1  |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $D > 0.5$                 | NG   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| Diameter                  | Acc. Qty   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $D < 0.20$                | Ignore   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $0.20 < D \leq 0.5$       | 3  |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |
| $D > 0.5$                 | NG   |  |                  |          |                    |        |                           |          |                      |   |                      |   |           |    |          |          |            |        |                     |   |           |    |

| 07         | <p>Cover lens line Scratch</p>  | <table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td><math>W \leq 0.08\text{mm}</math></td> <td>Ignore</td> </tr> <tr> <td><math>L \leq 5</math></td> <td><math>0.08 &lt; W \leq 0.15</math></td> <td>2</td> </tr> <tr> <td><math>L \leq 3</math></td> <td><math>0.15 &lt; W \leq 0.20</math></td> <td>1</td> </tr> <tr> <td>-</td> <td><math>W &gt; 0.2</math></td> <td>NG</td> </tr> <tr> <td><math>L &gt; 5</math></td> <td>-</td> <td>NG</td> </tr> </tbody> </table> <p>Distance between 2 defects should more than 15mm apart.</p> | Length   | Width | Acc. Qty | / | $W \leq 0.08\text{mm}$ | Ignore | $L \leq 5$ | $0.08 < W \leq 0.15$ | 2 | $L \leq 3$ | $0.15 < W \leq 0.20$ | 1  | - | $W > 0.2$ | NG | $L > 5$ | - | NG |
|------------|--|---|----------|-------|----------|---|------------------------|--------|------------|----------------------|---|------------|----------------------|----|---|-----------|----|---------|---|----|
|            | Length   | Width   | Acc. Qty |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| /          | $W \leq 0.08\text{mm}$   | Ignore  |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| $L \leq 5$ | $0.08 < W \leq 0.15$   | 2   |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| $L \leq 3$ | $0.15 < W \leq 0.20$   | 1   |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| -          | $W > 0.2$  | NG  |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| $L > 5$    | -  | NG  |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| 08         | <p>Printing sawtooth</p>       | <table border="1"> <thead> <tr> <th>Length</th> <th>Width</th> <th>Acc. Qty</th> </tr> </thead> <tbody> <tr> <td>/</td> <td><math>W \leq 0.2\text{mm}</math></td> <td>2</td> </tr> <tr> <td><math>L \leq 2</math></td> <td><math>0.2 &lt; W \leq 0.3</math></td> <td>1</td> </tr> <tr> <td><math>L \leq 2</math></td> <td><math>W &gt; 0.3</math></td> <td>NG</td> </tr> </tbody> </table>  | Length   | Width | Acc. Qty | / | $W \leq 0.2\text{mm}$  | 2      | $L \leq 2$ | $0.2 < W \leq 0.3$   | 1 | $L \leq 2$ | $W > 0.3$            | NG |   |           |    |         |   |    |
|            | Length   | Width   | Acc. Qty |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| /          | $W \leq 0.2\text{mm}$  | 2   |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| $L \leq 2$ | $0.2 < W \leq 0.3$   | 1   |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |
| $L \leq 2$ | $W > 0.3$  | NG  |          |       |          |   |                        |        |            |                      |   |            |                      |    |   |           |    |         |   |    |

**12.7. Classification of Defects**

12.7.1 Visual defects (Except no / wrong label) are treated as minor defect and electrical defect is major.

12.7.2 Two minor defects are equal to one major in lot sampling inspection.

**12.8. Identification/marketing criteria**

Any unit with illegible / wrong /double or no marking/ label shall be rejected.

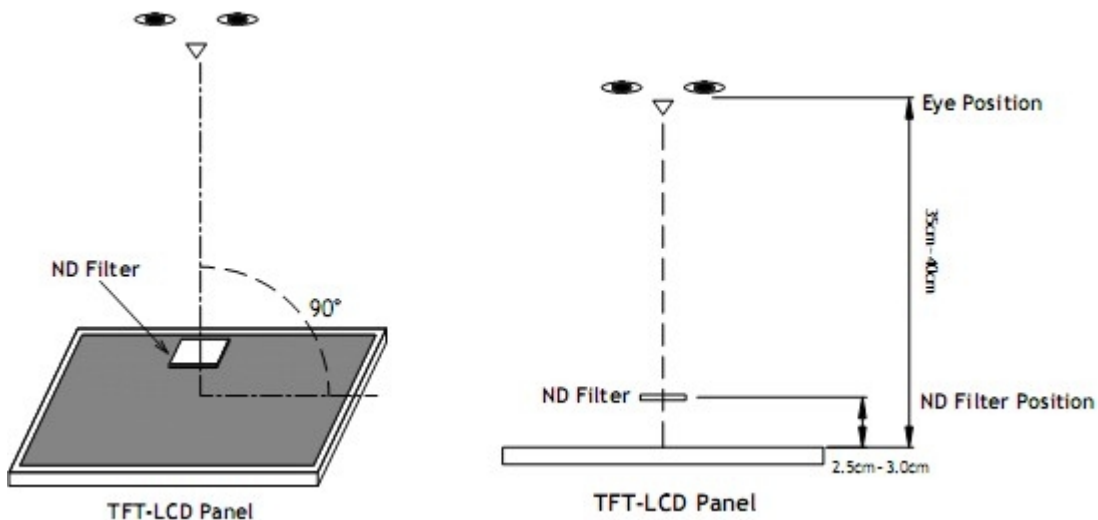
**12.9. Packaging**

12.9.1 There should be no damage of the outside carton box, each packaging box should have one identical label.

12.9.2 Modules inside package box should have compliant mark.

12.9.3 All direct package materials shall offer ESD protection

**Note1:** Bright dot is defined as the defective area of the dot is larger than 50% of one sub-pixel area.



Bright dot: The bright dot size defect at black display pattern. It can be recognized by 2% transparency of filter when the distance between eyes and panel is 350mm±50mm.

Dark dot: Cyan, Magenta or Yellow dot size defect at white display pattern. It can be recognized by 5% transparency of filter when the distance between eyes and panel is 350mm±50mm.

**Note2:** Mura on display which appears darker / brighter against background brightness on parts of display area.

**13. Reliability Specification**

| No | Item                         | Condition   | Quantity | Criteria         |
|----|------------------------------|---|----------|------------------|
| 1  | High Temperature Operating   | +70°C, 96Hrs  | 2        | GB/T2423.2-2008  |
| 2  | Low Temperature Operating    | -20°C, 96Hrs  | 2        | GB/T2423.1-2008  |
| 3  | High Humidity Storage        | +50°C, 90%RH, 96Hrs   | 2        | GB/T2423.3-2016  |
| 4  | High Temperature Storage     | +80°C, 96Hrs  | 2        | GB/T2423.2-2008  |
| 5  | Low Temperature Storage      | -30°C, 96Hrs  | 2        | GB/T2423.1-2008  |
| 6  | Thermal Cycling Test Storage | -20°C, 60min~+70°C, 60min, 20 cycles.   | 2        | GB/T2423.22-2012 |
| 7  | Packing vibration            | Frequency Range: 10Hz~50Hz<br>Acceleration of Gravity: 5G<br>X, Y, Z 30 min for each direction. | 2        | GB/T5170.14-2009 |
| 8  | Electrical Static Discharge  | Air: ±8kV 150pF/330 Ω 5 times   | 2        | GB/T17626.2-2018 |
|    |                              | Contact: ±4kV 150pF/330 Ω 5 times   |          |                  |
| 9  | Drop Test (Packaged)         | Height:80 cm, 1 corner, 3 edges, 6 surfaces.  | 2        | GB/T2423.8-1995  |

Note1. No deflection cosmetic and operational function allowable.

Note2. Total current Consumption should be below double of initial value.

**14. Precautions and Warranty**

**14.1 Safety**

- 14.1.1. 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.
- 14.1.2. Since the liquid crystal cells are made of glass, do not apply strong impact on them. Handle with care.

**14.2. Handling**

- 14.2.1. Reverse and use within ratings in order to keep performance and prevent damage.
- 14.2.2. Do not wipe the polarizer with dry cloth, as it might cause scratch. If the surface of the LCD needs to be cleaned, wipe it swiftly with cotton or other soft cloth soaked with petroleum IPA, do not use other chemicals.

**14.3. Storage**

- 14.3.1. Do not store the LCD module beyond the specified temperature ranges.
- 14.3.2. Strong light exposure causes degradation of polarizer and color filter

**14.4. Metal Pin (Apply to Products with Metal Pins)**

14.4.1. Pins of LCD and Backlight

14.4.1.1. Solder tip can touch and press on the tip of Pin LEAD during the soldering

14.4.1.2. Recommended Soldering Conditions

Solder Type: Sn96.3~94-Ag3.3~4.3-Cu0.4~1.1

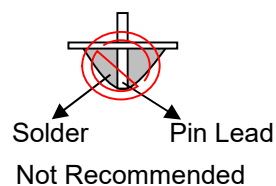
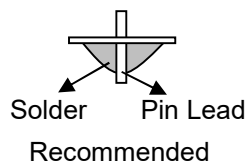
Maximum Solder Temperature: 370°C

Maximum Solder Time: 3s at the maximum temperature

Recommended Soldering Temp: 350±20°C

Typical Soldering Time: ≤3s

14.4.1.3. Solder Wetting



14.4.2. Pins of EL

14.4.2.1. Solder tip can touch and press on the tip of EL leads during soldering.

14.4.2.2. No Solder Paste on the soldering pad on the motherboard is recommended.

14.4.2.3. Recommended Soldering Conditions

Solder type: Nippon Alimit Leadfree SR-34, size 0.5mm

Recommended Solder Temperature: 270~290°C

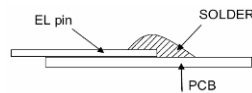
Typical Soldering Time: ≤2s

Minimum solder distance from EL lamp (body):2.0mm

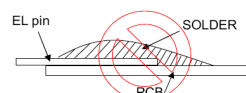
14.4.2.4. No horizontal press on the EL leads during soldering.

14.4.2.5. 180° bend EL leads three times is not allowed.

14.4.2.6. Solder Wetting

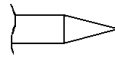


Recommended

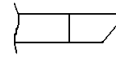


Not Recommended

14.4.2.7. The type of the solder iron:

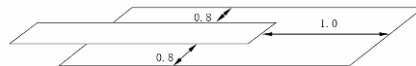


Recommended



Not Recommended

14.4.2.8. Solder Pad



**14.5.Operation**

- 14.5.1. Do not drive LCD with DC voltage
- 14.5.2. Response time will increase below lower temperature
- 14.5.3. Display may change color with different temperature
- 14.5.4. Mechanical disturbance during operation, such as pressing on the display area, may cause the segments to appear “fractured”.
- 14.5.5. Do not connect or disconnect the LCM to or from the system when power is on.
- 14.5.6. Never use the LCM under abnormal condition of high temperature and high humidity.
- 14.5.7. Module has high frequency circuits. Sufficient suppression to the electromagnetic interface shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- 14.5.8. Do not display the fixed pattern for long time (we suggest the time not longer than one hour) because it may develop image sticking due to the TFT structure.

**14.6.Static Electricity**

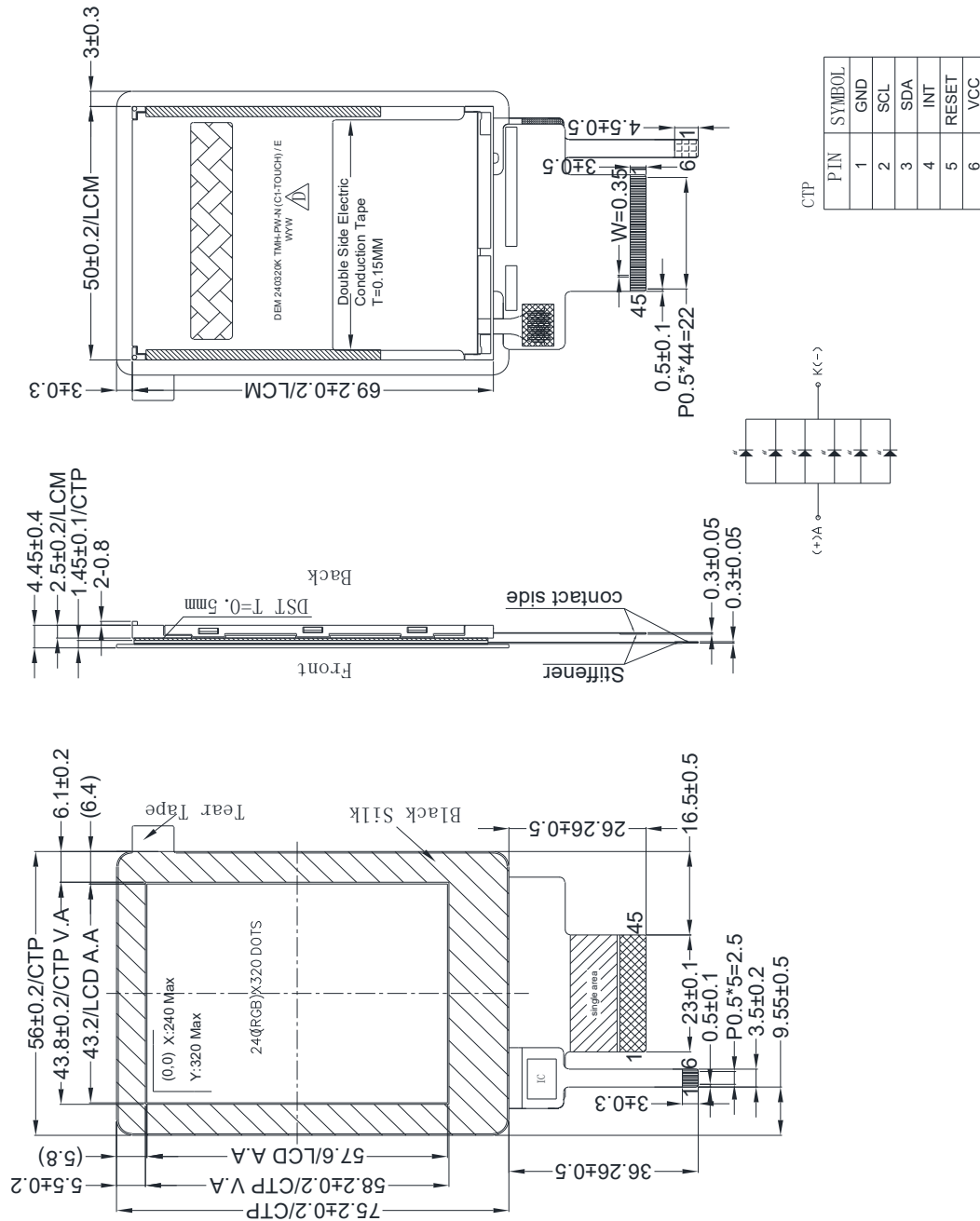
- 14.6.1. CMOS LSIs are equipped in this unit, so care must be taken to avoid the electro-static charge, by ground human body, etc.
- 14.6.2. The normal static prevention measures should be observed for work clothes and benches.
- 14.6.3. The module should be kept into anti-static bags or other containers resistant to static for storage.

**14.7.Limited Warranty**

- 14.7.1. Our warranty liability is limited to repair and/or replacement. We will not be responsible for any consequential loss.
- 14.7.2. If possible, we suggest customer to use up all modules in six months. If the module storage time over twelve months, we suggest that recheck it before the module be used.
- 14.7.3. After the product shipped, any product quality issues must be feedback within three months, otherwise, we will not be responsible for the subsequent or consequential events.



15. Outline Drawing



| PIN | ASSIGNMENT      | PIN | ASSIGNMENT |
|-----|-----------------|-----|------------|
| 1   | EXTC            | 24  | DB15       |
| 2   | IOVCC(1.8/2.8V) | 25  | DB16       |
| 3   | VCC(2.8V)       | 26  | DB17       |
| 4   | /CS             | 27  | SDA        |
| 5   | D/C(SCL)        | 28  | SDO        |
| 6   | /WR             | 29  | TE         |
| 7   | /RD             | 30  | DOTCLK     |
| 8   | /RESET          | 31  | VSYNC      |
| 9   | DB0             | 32  | HSYNC      |
| 10  | DB1             | 33  | ENABLE     |
| 11  | DB2             | 34  | IM0        |
| 12  | DB3             | 35  | IM1        |
| 13  | DB4             | 36  | IM2        |
| 14  | DB5             | 37  | IM3        |
| 15  | DB6             | 38  | NC(YD)     |
| 16  | DB7             | 39  | NC(XR)     |
| 17  | DB8             | 40  | NC(YU)     |
| 18  | DB9             | 41  | NC(XL)     |
| 19  | DB10            | 42  | LED_A      |
| 20  | DB11            | 43  | LED_K      |
| 21  | DB12            | 44  | GND        |
| 22  | DB13            | 45  | GND        |
| 23  | DB14            |     |            |

- NOTES:
1. Display size: 2.8" TFT
  2. Viewing direction: 6 O'CLOCK
  3. Gary Scale inversion direction: 12 O'CLOCK
  4. Display mode: Transmissive/Normal white/Anti-glare
  5. Operation temperature: -20°C~+70°C
  6. Storage temperature: -30°C~+80°C
  7. Driver IC: IL19341V
  8. Power supply voltage: 2.8V
  9. Backlight : White(6 LED)/3.2(TYP)V/120mA
  10. Luminance: 610cd/m2(typ)
  11. Life time: 30000h(typ)
  12. ROHS must be compiled
- \* Unspecification tolerance are ± 0.2mm  
 \* The dimension with mark brackets "()" just for reference