

|                  |            |                  |            |
|------------------|------------|------------------|------------|
| MDT0130CIS-MULTI | 240 x 240  | MULTI Interface  | TFT Module |
| Specification    |            |                  |            |
| Version: 1       |            | Date: 29/08/2019 |            |
| Revision         |            |                  |            |
| 1                | 28/08/2019 | First issue      |            |

| Display Features      |                        |  |                  |
|-----------------------|------------------------|-------------------------------------------------------------------------------------|------------------|
| Display Size          | 1.30"                  |                                                                                     |                  |
| Resolution            | 240 x 240              |                                                                                     |                  |
| Orientation           | Square                 |                                                                                     |                  |
| Appearance            | RGB                    |                                                                                     |                  |
| Logic Voltage         | 3.3V                   |                                                                                     |                  |
| Interface             | Parallel/ SPI/ RGB     |                                                                                     |                  |
| Brightness            | 470 cd/m <sup>2</sup>  |                                                                                     |                  |
| Touchscreen           | ---                    |                                                                                     |                  |
| Module Size           | 26.16 x 29.22 x 1.79mm |                                                                                     |                  |
| Operating Temperature | -20°C ~ +70°C          |                                                                                     |                  |
| Pinout                | 45 way FFC             |                                                                                     |                  |
| Pitch                 | 0.3mm                  | Box Quantity                                                                        | Weight / Display |
|                       |                        | ---                                                                                 | ---              |

\* - For full design functionality, please use this specification in conjunction with the ST7789V specification.(Provided Separately)

| Display Accessories |             |
|---------------------|-------------|
| Part Number         | Description |
|                     |             |
|                     |             |
|                     |             |

| Optional Variants |         |
|-------------------|---------|
| Appearances       | Voltage |
|                   |         |
|                   |         |
|                   |         |

\* Description

This is a color active matrix TFT (Thin Film Transistor) LCD (liquid crystal display) that uses amorphous silicon TFT as a switching device. This model is composed of a Transmissive type TFT-LCD Panel, driver circuit, back-light unit. The resolution of a 1.3" TFT-LCD contains 240X240 pixels, and can display up to 65K/262K colors

\* Features

- Low Input Voltage: 3.3V (TYP)
- Display Colors of TFT LCD: 65K/262K colors
- TFT Interface: 8/9/16/18Bit MCU;  
3/4SPI+16/18Bit RGB  
3-line/4-line Serial Interface

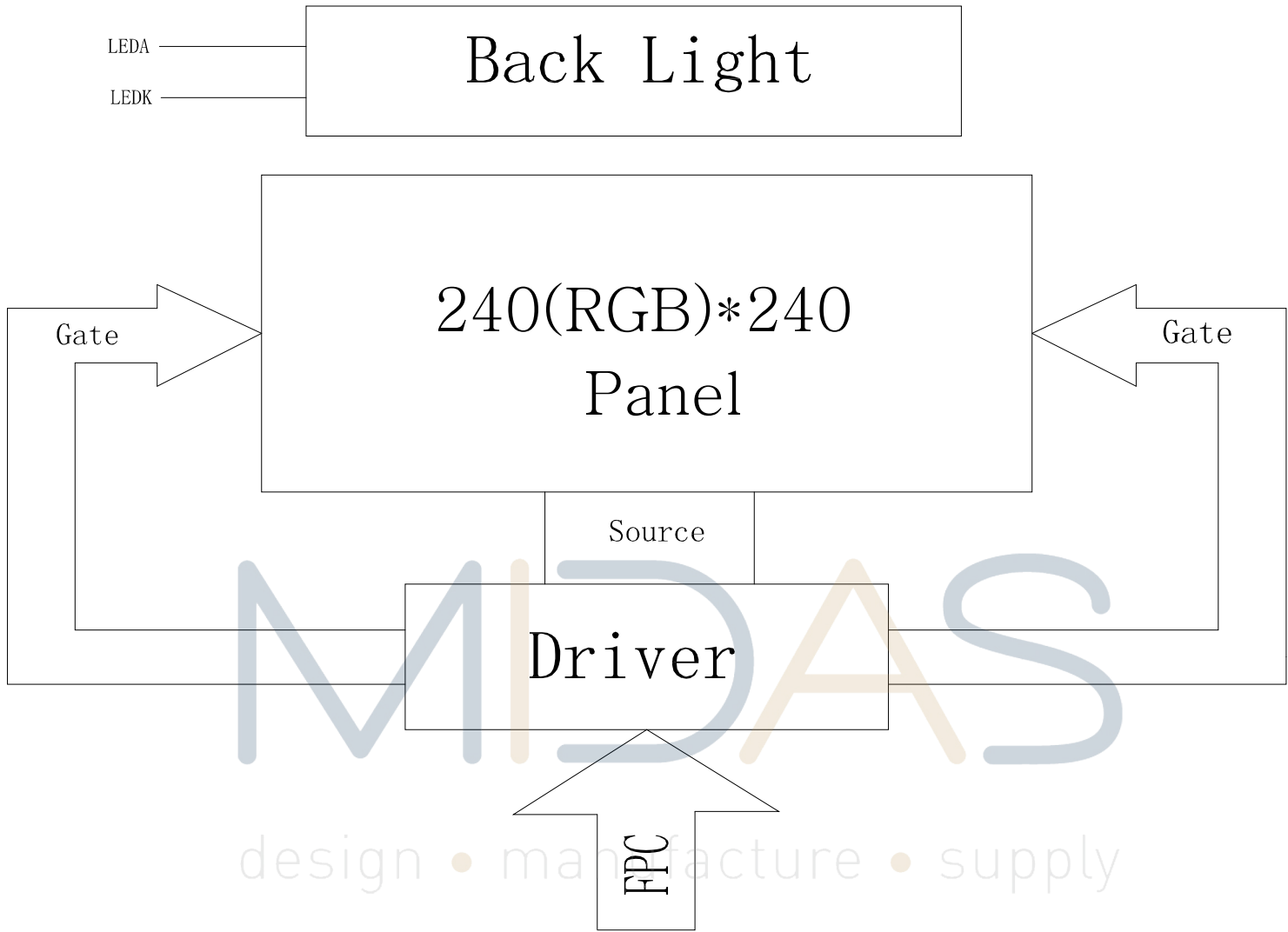
| General Information Items | Specification               | Unit    | Note |
|---------------------------|-----------------------------|---------|------|
|                           | Main Panel                  |         |      |
| Display area(AA)          | 23.4(H) *23.4(V) (1.3inch ) | mm      | -    |
| Driver element            | TFT active matrix           | -       | -    |
| Display colors            | 65K/262K                    | colors  | -    |
| Number of pixels          | 240(RGB)*240                | dots    | -    |
| TFT Pixel arrangement     | RGB vertical stripe         | -       | -    |
| Pixel pitch               | 0.0975 (H) x 0.0975 (V)     | mm      | -    |
| Viewing angle             | ALL                         | o'clock | -    |
| TFT Controller IC         | ST7789V                     | -       | -    |
| Display mode              | Transmissive/Normally Black | -       | -    |
| Operating temperature     | -20~+70                     | ℃       | -    |
| Storage temperature       | -30~+80                     | ℃       | -    |

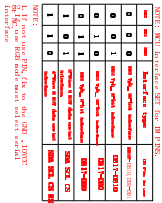
\* Mechanical Informations

| Item        |               | Min. | Typ.  | Max. | Unit | Note |
|-------------|---------------|------|-------|------|------|------|
| Module size | Horizontal(H) |      | 26.16 |      | mm   | -    |
|             | Vertical(V)   |      | 29.22 |      | mm   | -    |
|             | Depth(D)      |      | 1.79  |      | mm   | -    |
| Weight      |               |      | TBD   |      | g    | -    |



1. Block Diagram





## Input terminal Pin Assignment

| NO.   | SYMBOL   | DISCRIPTION                                                                                                                                                                                                        | I/O |
|-------|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 1     | LEDA     | Anode pin of backlight                                                                                                                                                                                             | P   |
| 2     | NC       | --                                                                                                                                                                                                                 | --  |
| 3     | LEDK     | Cathode pin OF backlight                                                                                                                                                                                           | P   |
| 4     | NC       | --                                                                                                                                                                                                                 | --  |
| 5     | GND      | Ground.                                                                                                                                                                                                            | P   |
| 6     | GND      |                                                                                                                                                                                                                    |     |
| 7     | VCC/VCI  | Supply voltage(3.3V).                                                                                                                                                                                              | P   |
| 8     | VCC/VCI  |                                                                                                                                                                                                                    |     |
| 9     | IOVCC    | Supply voltage(1.65-3.3V).                                                                                                                                                                                         | P   |
| 10    | SDO      | SPI interface output pin.<br>The data is output on the falling edge of the SCL signal.<br>If not used, let this pin open.                                                                                          | O   |
| 11-28 | DB17-DB0 | 18-bit parallel bi-directional data bus for MCU system and RGB i<br>nterface mode .<br>Fix to GND level when not in use                                                                                            | I/O |
| 29    | DIN(SDA) | When IM3: Low, SPI interface input/output pin.<br>When IM3: High, SPI interface input pin.<br>The data is latched on the rising edge of the SCL signal.<br>If not used, please fix this pin at IOVCC or DGND level | I/O |
| 30    | PCLK     | Dot clock signal for RGB interface operation.<br>Fix this pin at IOVCC or GND when not in use.                                                                                                                     | I   |
| 31    | DE       | Data enable signal for RGB interface operation.<br>fix this pin at IOVCC or GND when not in use.                                                                                                                   | I   |
| 32    | HSYNC    | Line synchronizing signal for RGB interface operation.<br>fix this pin at IOVCC or GND when not in use.                                                                                                            | I   |
| 33    | VSYNC    | Frame synchronizing signal for RGB interface operation.<br>fix this pin at IOVCC or GND when not in use.                                                                                                           | I   |
| 34    | RD       | Serves as a read signal and MCU read data at the rising edge.<br>fix this pin at IOVCC or GND when not in use.                                                                                                     | I   |



|    |             |                                                                                                                                                                                                                                  |    |
|----|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| 35 | WR(SPI-RS)  | Write enable in MCU parallel interface.<br>Display data/command selection pin in 4-line serial interface.<br>Second Data lane in 2 data lane serial interface.<br>If not used, please fix this pin at IOVCC or DGND.             | I  |
| 36 | RS(SPI-SCL) | Display data/command selection pin in parallel interface.<br>This pin is used to be serial interface clock.<br>RS='1': display data or parameter.<br>RS='0': command data.<br>If not used, please fix this pin at IOVCC or DGND. | I  |
| 37 | CS          | Chip select input pin ("Low" enable).<br>fix this pin at IOVCC or GND when not in use.                                                                                                                                           | I  |
| 38 | RESET       | This signal will reset the device and must be applied to properly initialize the chip.                                                                                                                                           | I  |
| 39 | IM0         | MPU Parallel interface bus and serial interface select If use RGB Interface must select serial interface.<br>Fix this pin at IOVCC and GND.                                                                                      | I  |
| 40 | IM1         |                                                                                                                                                                                                                                  |    |
| 41 | IM2         |                                                                                                                                                                                                                                  |    |
| 42 | NC          | --                                                                                                                                                                                                                               | -- |
| 43 | NC          | --                                                                                                                                                                                                                               | -- |
| 44 | NC          | --                                                                                                                                                                                                                               | -- |
| 45 | NC          | --                                                                                                                                                                                                                               | -- |

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# LCD Optical Characteristics

## 1. Optical specification

| Item                      |                    | Symbol      | Condition                          | Min.  | Typ.  | Max.  | Unit. | Note   |
|---------------------------|--------------------|-------------|------------------------------------|-------|-------|-------|-------|--------|
| Contrast Ratio            |                    | CR          | $\Theta=0$<br>Normal viewing angle | 640   | 800   | --    |       | (1)(2) |
| Response time             | Rising+<br>Falling | $T_{R+T_F}$ |                                    | --    | 30    | 35    | msec  |        |
| Color gamut               |                    | S(%)        |                                    | --    | 50    | --    | %     | (1)    |
| Color Filter Chromaticity | White              | $W_X$       |                                    | 0.246 | 0.286 | 0.326 |       | (1)    |
|                           |                    | $W_Y$       |                                    | 0.280 | 0.320 | 0.360 |       |        |
|                           | Red                | $R_X$       |                                    | 0.547 | 0.587 | 0.627 |       |        |
|                           |                    | $R_Y$       |                                    | 0.316 | 0.356 | 0.396 |       |        |
|                           | Green              | $G_X$       |                                    | 0.279 | 0.319 | 0.359 |       |        |
|                           |                    | $G_Y$       |                                    | 0.314 | 0.354 | 0.394 |       |        |
|                           | Blue               | $B_X$       |                                    | 0.111 | 0.151 | 0.191 |       |        |
|                           |                    | $B_Y$       |                                    | 0.063 | 0.103 | 0.143 |       |        |
| Viewing angle             | Hor.               | $\Theta_L$  | CR>10                              | 60    | 80    | --    |       | (1)    |
|                           |                    | $\Theta_R$  |                                    | 60    | 80    | --    |       |        |
|                           | Ver.               | $\Theta_U$  |                                    | 60    | 80    | --    |       |        |
|                           |                    | $\Theta_D$  |                                    | 60    | 80    | --    |       |        |
| Option View Direction     |                    | ALL         |                                    |       |       |       |       |        |

## 2. Measuring Condition

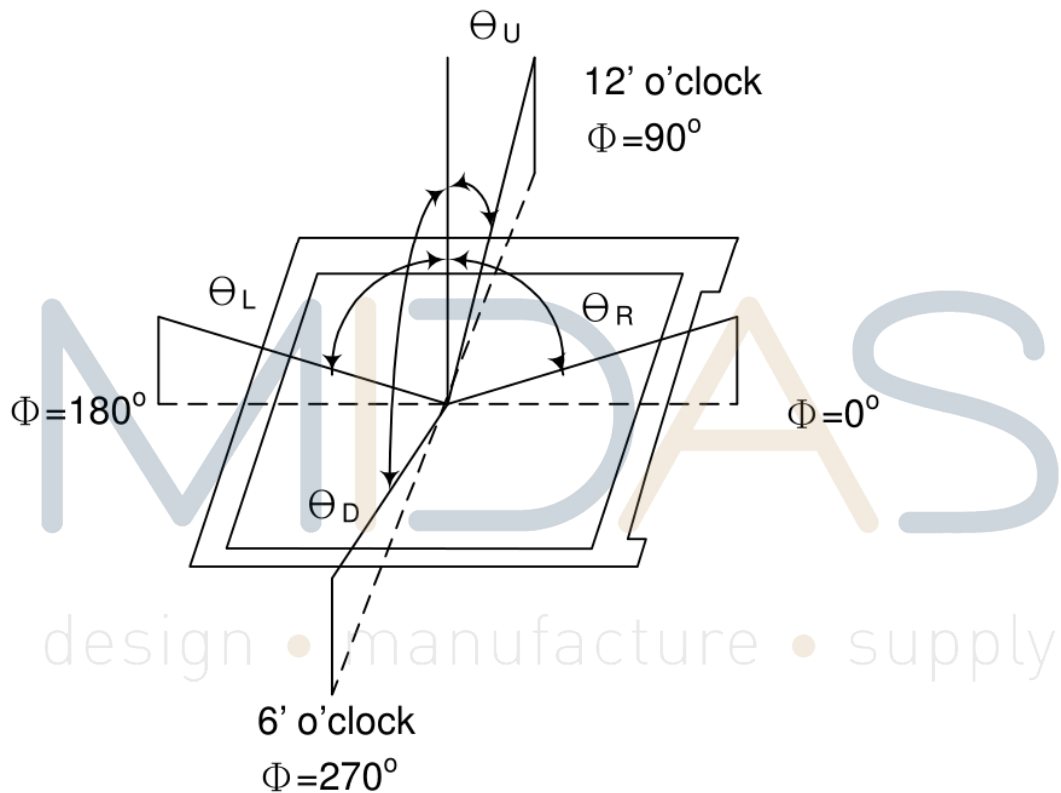
- Measuring surrounding : dark room
- Ambient temperature :  $25\pm 2^{\circ}\text{C}$
- 15min. warm-up time.



### 3. Measuring Equipment

FPM520 of Westar Display technologies, INC., which utilized SR-3 for Chromaticity and BM-5A for other optical characteristics.

Note (1) Definition of Viewing Angle:



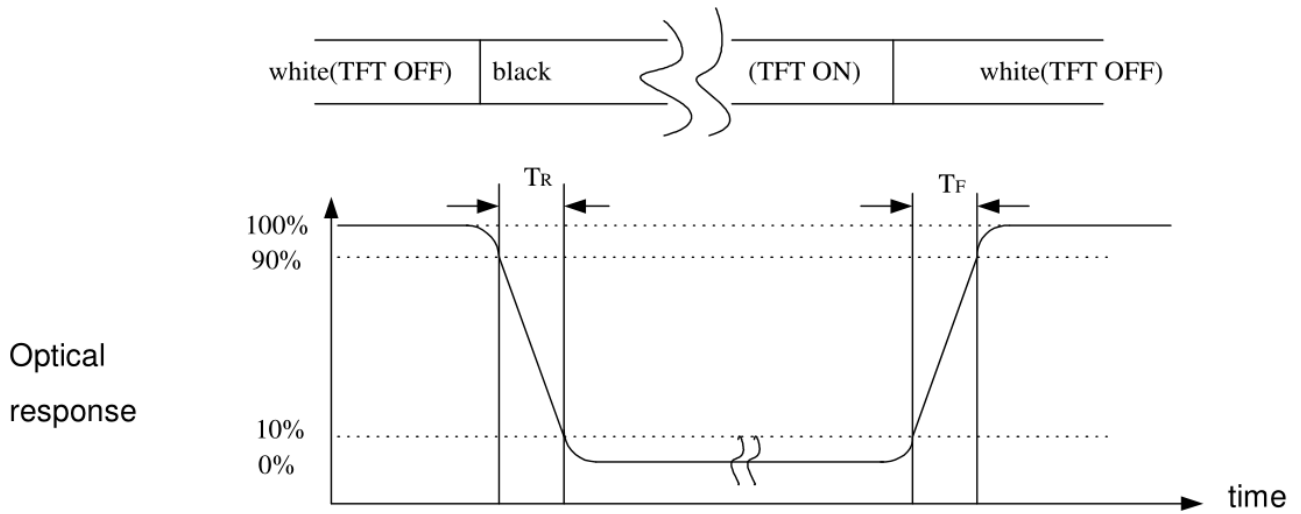
Note (2) Definition of Contrast Ratio (CR):  
measured at the center point of panel

$$CR = \frac{\text{Luminance with all pixels white}}{\text{Luminance with all pixels black}}$$

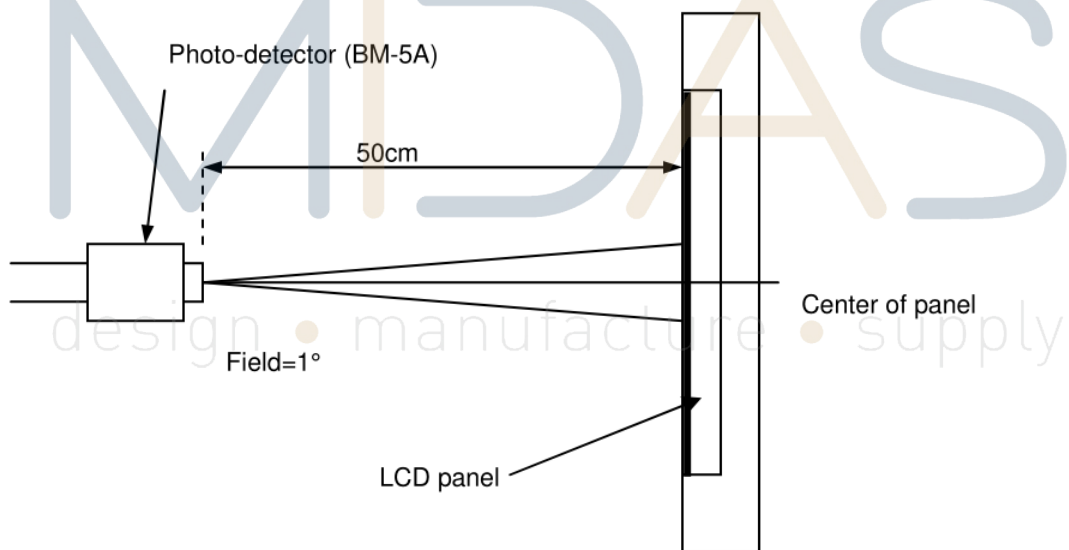




Note (3) Definition of Response Time: Sum of  $T_R$  and  $T_F$



Note (4) Definition of optical measurement setup



# Electrical Characteristics

## 1. Absolute Maximum Rating (Ta=25 VSS=0V)

| Characteristics             | Symbol          | Min. | Max. | Unit |
|-----------------------------|-----------------|------|------|------|
| Digital Supply Voltage      | VCC             | -0.3 | 4.6  | V    |
| Interface Operation Voltage | IOVCC           | -0.3 | 4.6  | V    |
| Operating temperature       | T <sub>OP</sub> | -20  | +70  | °C   |
| Storage temperature         | T <sub>ST</sub> | -30  | +80  | °C   |

NOTE: If the absolute maximum rating of even is one of the above parameters is exceeded even momentarily, the quality of the product may be degraded. Absolute maximum ratings, therefore, specify the values exceeding which the product may be physically damaged. Be sure to use the product within the range of the absolute maximum ratings.

## 2. DC Electrical Characteristics

| Characteristics                 | Symbol          | Min.      | Typ. | Max.      | Unit | Note |
|---------------------------------|-----------------|-----------|------|-----------|------|------|
| Digital Supply Voltage          | VCC             | 2.4       | 3.3  | 3.6       | V    |      |
| Interface Operation Voltage     | IOVCC           | 1.65      | 1.8  | 3.3       | V    |      |
| Normal mode Current consumption | IDD             | --        | 7    | --        | mA   |      |
| Level input voltage             | V <sub>IH</sub> | 0.7 Iovcc |      | Iovcc     | V    |      |
|                                 | V <sub>IL</sub> | GND       |      | 0.3 Iovcc | V    |      |
| Level output voltage            | V <sub>OH</sub> | 0.8 Iovcc |      | Iovcc     | V    |      |
|                                 | V <sub>OL</sub> | GND       |      | 0.2 Iovcc | V    |      |



3. LED Backlight Characteristics

The back-light system is edge-lighting type with 2 chips White LED

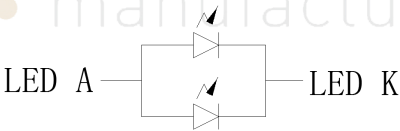
| Item            | Symbol | Min.  | Typ. | Max. | Unit  | Note    |
|-----------------|--------|-------|------|------|-------|---------|
| Forward Current | $I_F$  | 35    | 40   | --   | mA    |         |
| Forward Voltage | $V_F$  | --    | 3.3  | --   | V     |         |
| LCM Luminance   | $L_V$  | 420   | 470  | --   | cd/m2 | Note3   |
| LED life time   | Hr     | 50000 | --   | --   | Hour  | Note1,2 |
| Uniformity      | AVg    | 80    | --   | --   | %     | Note3   |

SNote (1) LED life time (Hr) can be defined as the time in which it continues to operate under the condition:

$T_a=25\pm3\text{ }^{\circ}\text{C}$ , typical IL value indicated in the above table until the brightness becomes less than 50%.

Note (2) The “LED life time” is defined as the module brightness decrease to 50% original brightness at  $T_a=25^{\circ}\text{C}$  and  $I_L=40\text{mA}$ . The LED lifetime could be decreased if operating  $I_L$  is larger than 40mA. The constant current driving method is suggested.

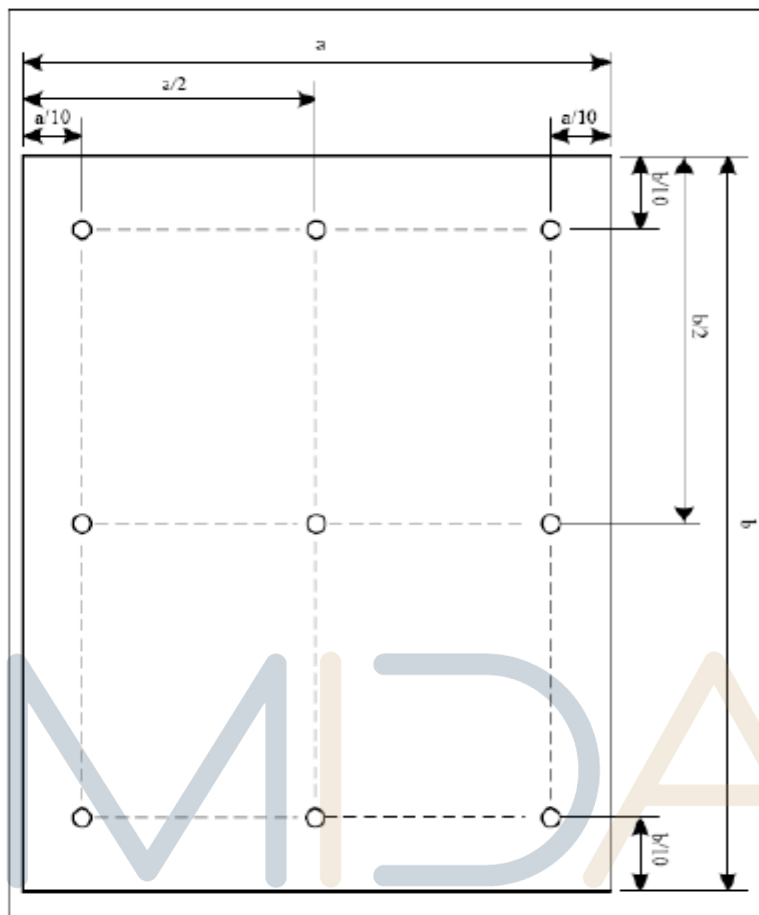
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CIRCUIT DIAGRAM



NOTE 3: Luminance Uniformity of these 9 points is defined as below:

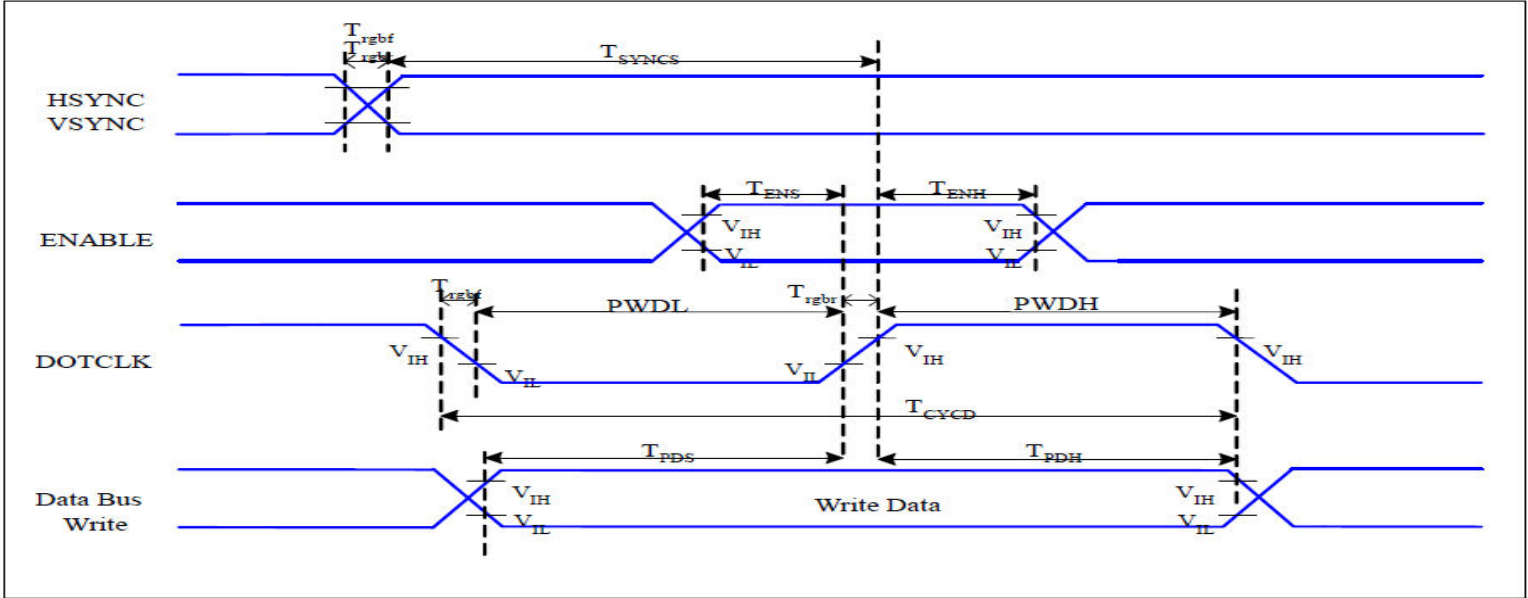


$$\text{Uniformity} = \frac{\text{minimum luminance in 9 points (1-9)}}{\text{maximum luminance in 9 points (1-9)}}$$

$$\text{Luminance} = \frac{\text{Total Luminance of 9 points}}{9}$$

AC Characteristic

1. RGB Interface Characteristics



VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

| Signal       | Symbol            | Parameter                     | MIN | MAX | Unit | Description |
|--------------|-------------------|-------------------------------|-----|-----|------|-------------|
| HSYNC, VSYNC | $T_{\text{SYNC}}$ | VSYNC, HSYNC Setup Time       | 30  | -   | ns   |             |
| ENABLE       | $T_{\text{ENS}}$  | Enable Setup Time             | 25  | -   | ns   |             |
|              | $T_{\text{ENH}}$  | Enable Hold Time              | 25  | -   | ns   |             |
| DOTCLK       | PWDH              | DOTCLK High-level Pulse Width | 60  | -   | ns   |             |
|              | PWDL              | DOTCLK Low-level Pulse Width  | 60  | -   | ns   |             |
|              | $T_{\text{CYCD}}$ | DOTCLK Cycle Time             | 120 | -   | ns   |             |
|              | Trghr, Trghf      | DOTCLK Rise/Fall time         | -   | 20  | ns   |             |
| DB           | $T_{\text{PDS}}$  | PD Data Setup Time            | 50  | -   | ns   |             |
|              | $T_{\text{PDH}}$  | PD Data Hold Time             | 50  | -   | ns   |             |

Table 7 18/16 Bits RGB Interface Timing Characteristics

| Signal       | Symbol            | Parameter               | MIN | MAX | Unit | Description |
|--------------|-------------------|-------------------------|-----|-----|------|-------------|
| HSYNC, VSYNC | $T_{\text{SYNC}}$ | VSYNC, HSYNC Setup Time | 25  | -   | ns   |             |
| ENABLE       | $T_{\text{ENS}}$  | Enable Setup Time       | 25  | -   | ns   |             |

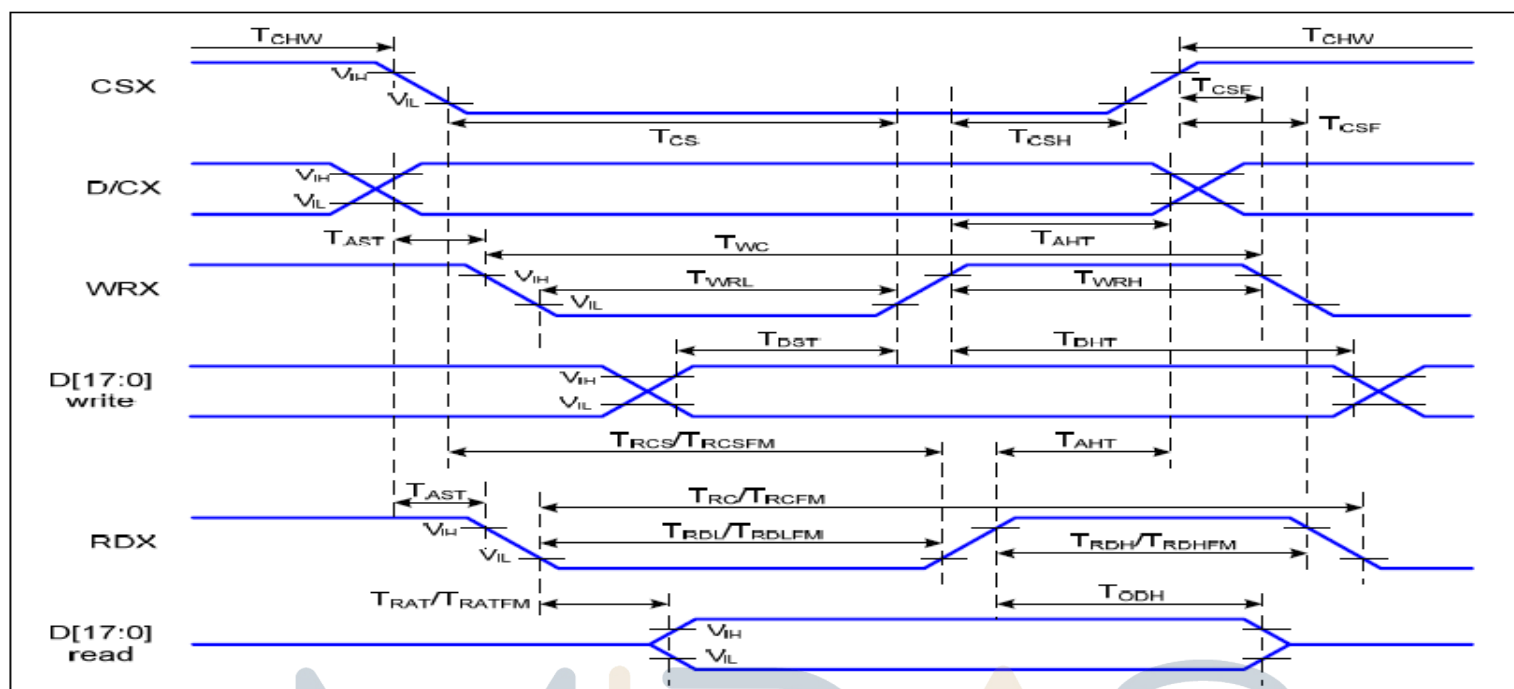
|        |                   |                               |    |    |    |  |
|--------|-------------------|-------------------------------|----|----|----|--|
|        | $T_{\text{ENH}}$  | Enable Hold Time              | 25 | -  | ns |  |
| DOTCLK | PWDH              | DOTCLK High-level Pulse Width | 25 | -  | ns |  |
|        | PWDL              | DOTCLK Low-level Pulse Width  | 25 | -  | ns |  |
|        | $T_{\text{CYCD}}$ | DOTCLK Cycle Time             | 55 | -  | ns |  |
|        | Trghr, Trghf      | DOTCLK Rise/Fall time         | -  | 10 | ns |  |
| DB     | $T_{\text{PDS}}$  | PD Data Setup Time            | 25 | -  | ns |  |
|        | $T_{\text{PDH}}$  | PD Data Hold Time             | 25 | -  | ns |  |

# MIDAS

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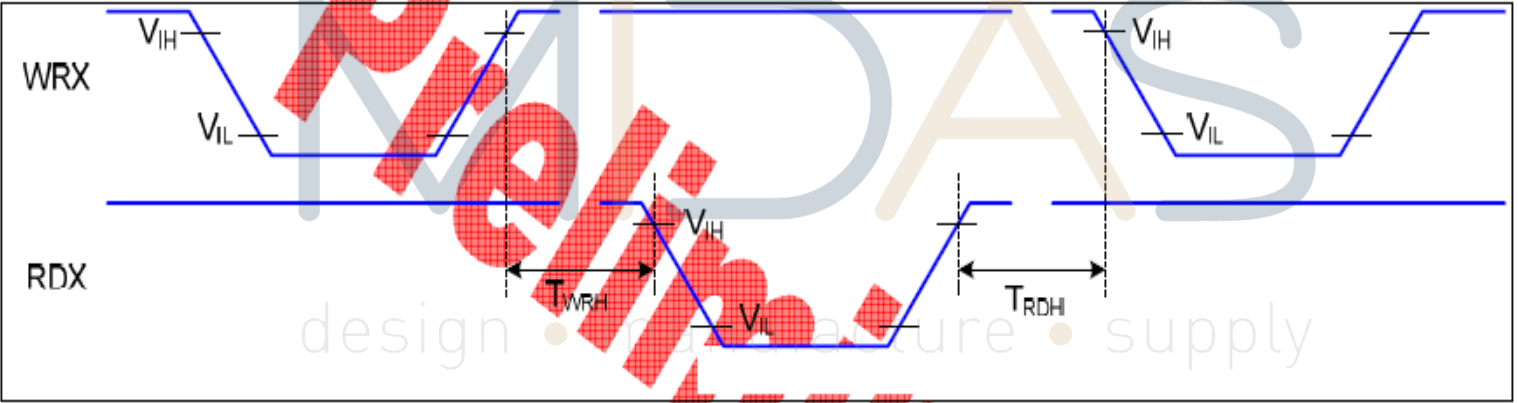
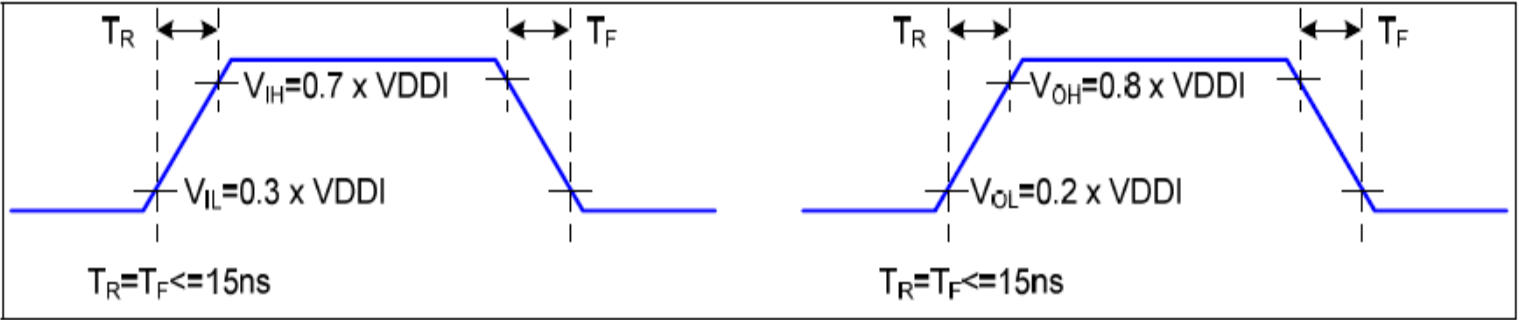


## 2. 8080 Series MCU Parallel Interface Characteristics: 18/16/9/8-bit Bus



| 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 |

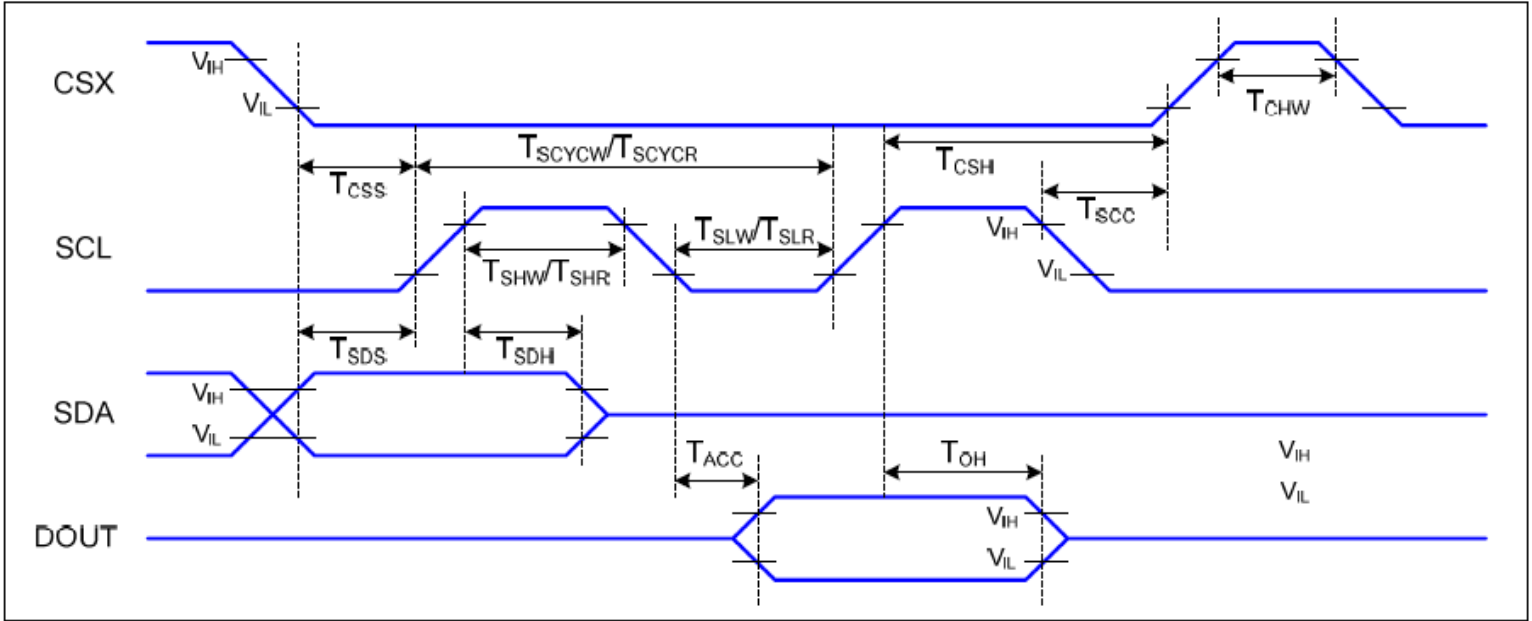


Note: The rising time and falling time ( $T_r$ ,  $T_f$ ) of input signal and fall time are specified at 15 ns or less. Logic high and low levels are specified as 30% and 70% of  $V_{DDI}$  for Input signals.





3. Serial Interface Characteristics (3-line serial)

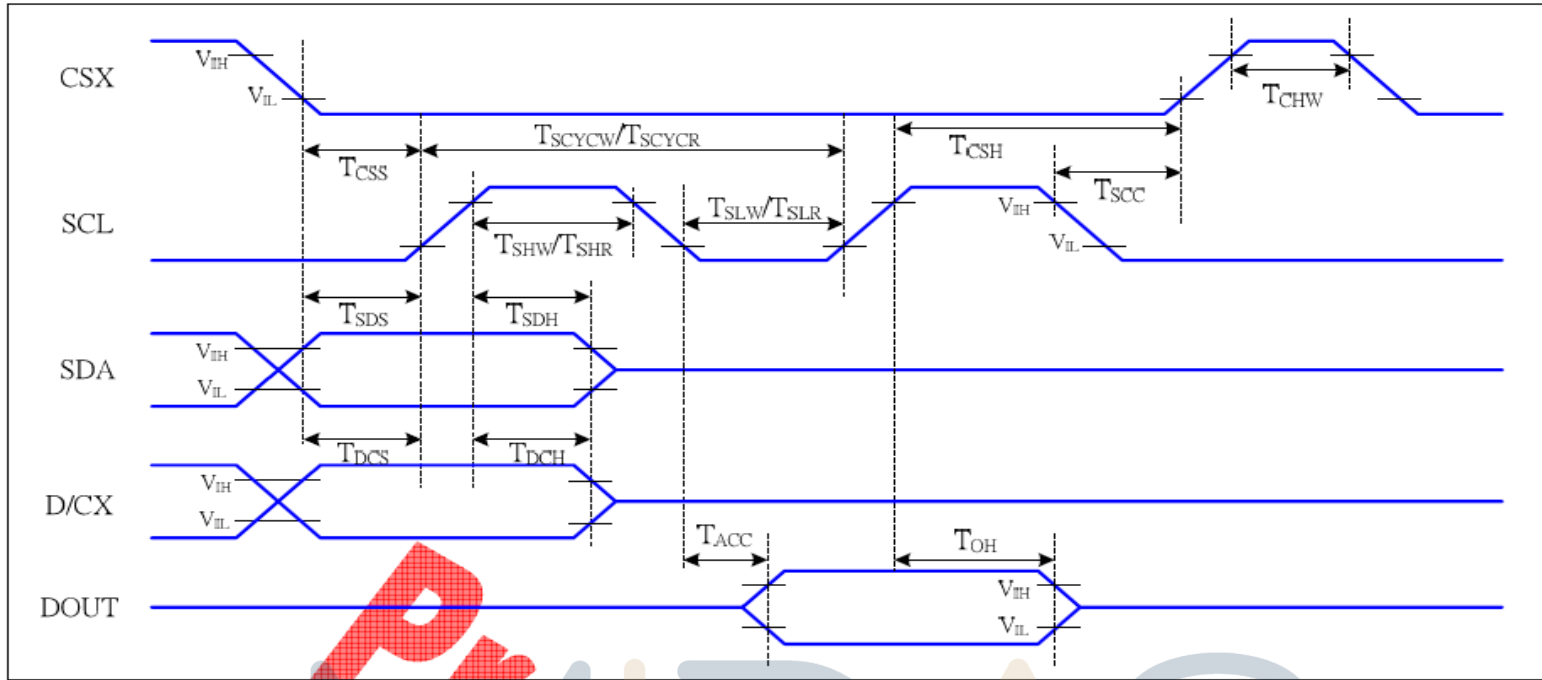


VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=-30 to 70 °C

| 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<br>(DIN) | $T_{SDS}$   | Data setup time                | 10  |     | ns   |                     |
|              | $T_{SDH}$   | Data hold time                 | 10  |     | ns   |                     |
| DOUT         | $T_{ACC}$   | Access time                    | 10  | 50  | ns   | For maximum CL=30pF |
|              | $T_{OH}$    | Output disable time            | 15  | 50  | ns   | For minimum CL=8pF  |

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

4. Serial Interface Characteristics (4-line serial)



| Signal    | Symbol      | Parameter                      | MIN | MAX | Unit | Description               |
|-----------|-------------|--------------------------------|-----|-----|------|---------------------------|
| CSX       | $T_{CSS}$   | Chip select setup time (write) | 15  |     | ns   | -write command & data ram |
|           | $T_{CSH}$   | 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   |                           |
| DOUT      | $T_{ACC}$   | Access time                    | 10  | 50  | ns   | For maximum CL=30pF       |
|           | $T_{OH}$    | Output disable time            | 15  | 50  | ns   | For minimum CL=8pF        |

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



5. Reset Timing

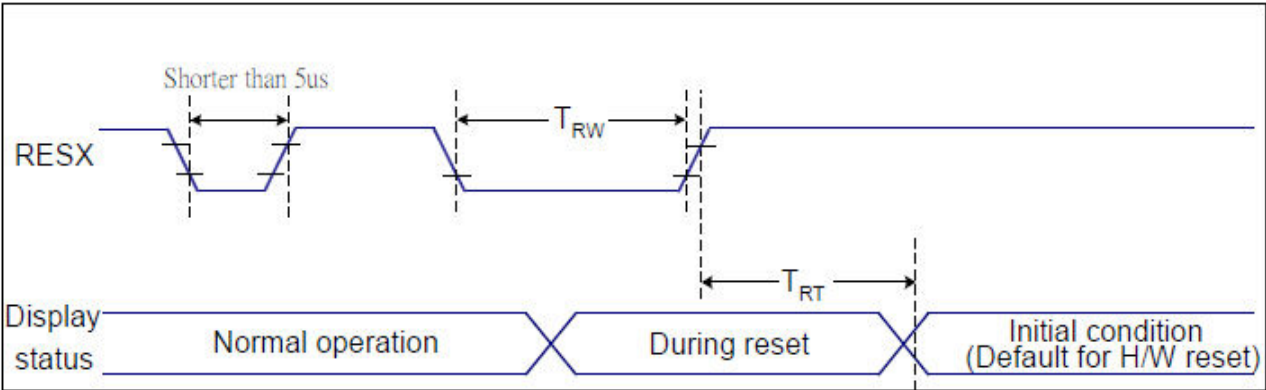


Figure 7 Reset Timing

VDDI=1.65 to 3.3V, VDD=2.4 to 3.3V, AGND=DGND=0V, Ta=25℃

| Related Pins | 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   |

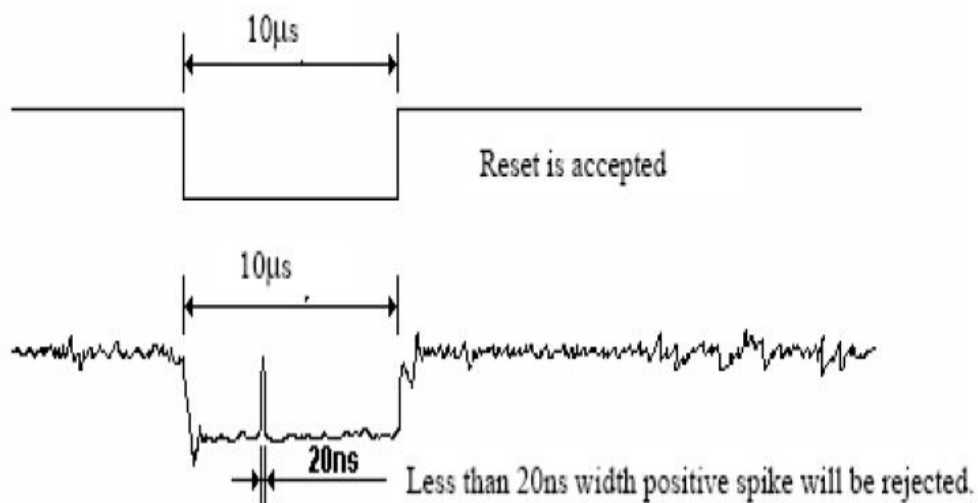
Table 9 Reset Timing

Notes:

1. The reset cancel includes also required time for loading ID bytes, VCOM setting and other settings from NVM (or similar device) to registers. This loading is done every time when there is HW reset cancel time (tRT) within 5 ms after a rising edge of RESX.
2. Spike due to an electrostatic discharge on RESX line does not cause irregular system reset according to the table below:

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

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



5. When Reset applied during Sleep In Mode.

6. When Reset applied during Sleep Out Mode.

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

MIDAS

design • manufacture • supply



# LCD Module Out-Going Quality Level

## 1. VISUAL & FUNCTION INSPECTION STANDARD

### 1.1 Inspection conditions

Inspection performed under the following conditions is recommended.

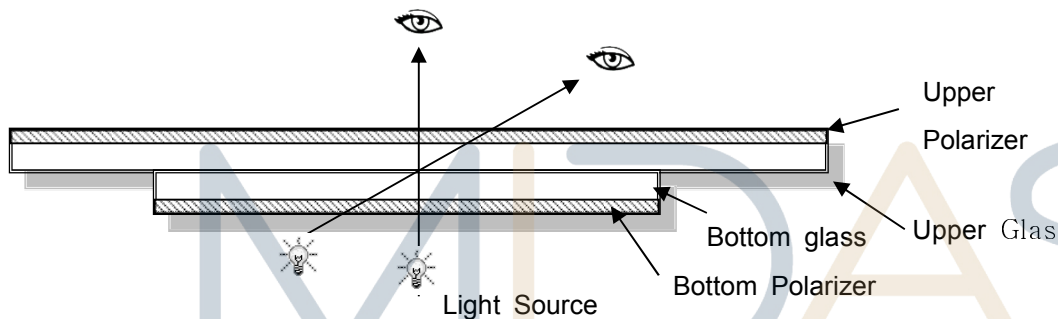
Temperature :  $25 \pm 5^{\circ}\text{C}$

Humidity :  $65\% \pm 10\% \text{RH}$

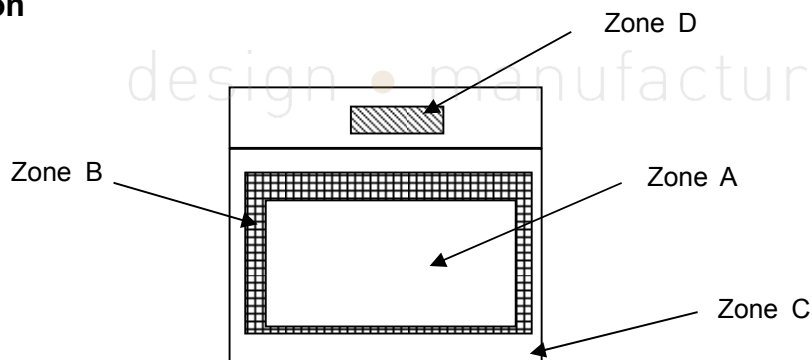
Viewing Angle : Normal viewing Angle.

Illumination: Single fluorescent lamp (300 to 700Lux)

Viewing distance: 30-50cm



### 1.2 Definition



Zone A : Effective Viewing Area(Character or Digit can be seen)

Zone B : Viewing Area except Zone A

Zone C : Outside (Zone A+Zone B) which can not be seen after assembly by customer .)

Zone D : IC Bonding Area

Note:

As a general rule ,visual defects in Zone C can be ignored when it doesn't effect product function or appearance after assembly by customer

1.3 Sampling Plan

According to GB/T 2828-2003 ; , normal inspection, Class II  
AQL:

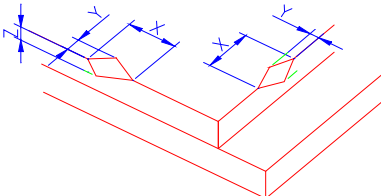
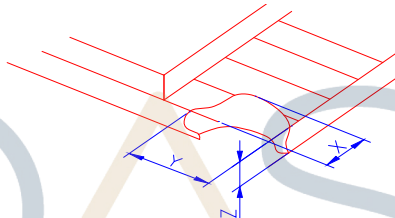
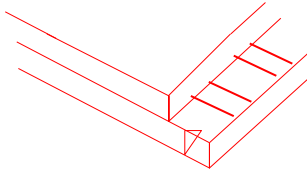
|              |              |
|--------------|--------------|
| Major defect | Minor defect |
| 0.65         | 1.5          |

LCD: Liquid Crystal Display , TP: Touch Panel , LCM: Liquid Crystal Module

| No | Items to be inspected | Criteria                                                                                                                              | Classification of defect<br>s |
|----|-----------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|
| 1  | Functional defects    | 1) No display, Open or miss line<br>2) Display abnormally, Short<br>3) Backlight no lighting, abnormal lighting.<br>4) TP no function | Major                         |
| 2  | Missing               | Missing component                                                                                                                     |                               |
| 3  | Outline dimension     | Overall outline dimension beyond the drawing is not allowed                                                                           |                               |
| 4  | Color tone            | Color unevenness, refer to limited sample                                                                                             | Minor                         |
| 5  | SpotLine defect       | Light dot, Dim spot,Polarizer Bubble ;<br>Polarizer accidented spot.                                                                  |                               |
| 6  | Soldering appearance  | Good soldering , Peeling off is not allowed.                                                                                          |                               |
| 7  | LCD/Polarizer/TP      | Black/White spot/line, scratch, crack, etc.                                                                                           |                               |



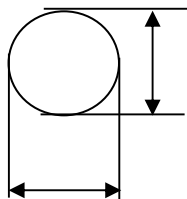
1.4 Criteria (Visual)

| Number                                                                                                              | Items                                                                                                                                                                                               | Criteria(mm)                                                                                                                                                                                                                      |    |   |        |        |                                |    |
|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|---|--------|--------|--------------------------------|----|
| 1.0 LCD<br>Crack/Broken<br>NOTE:<br>X: Length<br>Y: Width<br>Z: Height<br>L: Length of IT<br>O,<br>T: Height of LCD | (1) The edge of LCD broken                                                                                                                                                                          | <div></div> <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td>&lt;Inner border line of the seal</td><td>≤T</td></tr></table> | X  | Y | Z      | ≤3.0mm | <Inner border line of the seal | ≤T |
|                                                                                                                     | X                                                                                                                                                                                                   | Y                                                                                                                                                                                                                                 | Z  |   |        |        |                                |    |
|                                                                                                                     | ≤3.0mm                                                                                                                                                                                              | <Inner border line of the seal                                                                                                                                                                                                    | ≤T |   |        |        |                                |    |
| (2)LCD corner broken                                                                                                | <div></div> <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td>≤3.0mm</td><td>≤L</td><td>≤T</td></tr></table> | X                                                                                                                                                                                                                                 | Y  | Z | ≤3.0mm | ≤L     | ≤T                             |    |
| X                                                                                                                   | Y                                                                                                                                                                                                   | Z                                                                                                                                                                                                                                 |    |   |        |        |                                |    |
| ≤3.0mm                                                                                                              | ≤L                                                                                                                                                                                                  | ≤T                                                                                                                                                                                                                                |    |   |        |        |                                |    |
| (3) LCD crack                                                                                                       | <div></div> <div>Crack<br/>Not allowed</div>                                                                    |                                                                                                                                                                                                                                   |    |   |        |        |                                |    |



2.0

Spot defect



Y

X

$$\Phi=(X+Y)/2$$

① light dot (LCD/TP/Polarizer black/white spot , light dot, pinhole, dent, stain)

| Zone<br>Size (mm)       | Acceptable Qty                   |   |   |
|-------------------------|----------------------------------|---|---|
|                         | A                                | B | C |
| $\Phi \leq 0.10$        | Ignore                           |   |   |
| $0.10 < \Phi \leq 0.20$ | 3( distance $\geq 10\text{mm}$ ) |   |   |
| $0.20 < \Phi \leq 0.25$ | 2                                |   |   |
| $\Phi > 0.3$            | 0                                |   |   |

②Dim spot (LCD/TP/Polarizer dim dot, light leakage、dark spot)

| Zone<br>Size (mm)       | Acceptable Qty                   |   |   |
|-------------------------|----------------------------------|---|---|
|                         | A                                | B | C |
| $\Phi \leq 0.1$         | Ignore                           |   |   |
| $0.10 < \Phi \leq 0.20$ | 3( distance $\geq 10\text{mm}$ ) |   |   |
| $0.20 < \Phi \leq 0.25$ | 2                                |   |   |
| $\Phi > 0.3$            | 0                                |   |   |

③ Polarizer accidented spot

| Zone<br>Size (mm)     | Acceptable Qty                   |   |   |
|-----------------------|----------------------------------|---|---|
|                       | A                                | B | C |
| $\Phi \leq 0.2$       | Ignore                           |   |   |
| $0.3 < \Phi \leq 0.5$ | 2( distance $\geq 10\text{mm}$ ) |   |   |
| $\Phi > 0.5$          | 0                                |   |   |

④Pixel bad points (light dot, Dim dot, color dot)

| Zone<br>Size (mm)      | Acceptable Qty                   |   |   |
|------------------------|----------------------------------|---|---|
|                        | A                                | B | C |
| $\Phi \leq 0.1$        | Ignore                           |   |   |
| $0.15 < \Phi \leq 0.2$ | 2( distance $\geq 10\text{mm}$ ) |   |   |
| $\Phi > 0.2$           | 0                                |   |   |

⑤ Polarizer Bubble

| Zone<br>Size (mm)     | Acceptable Qty         |   |   |
|-----------------------|------------------------|---|---|
|                       | A                      | B | C |
| $\Phi \leq 0.2$       | Ignore                 |   |   |
| $0.3 < \Phi \leq 0.4$ | 3(distance $\geq 10$ ) |   |   |
| $0.4 < \Phi \leq 0.5$ | 2                      |   |   |
| $\Phi > 0.5$          | 0                      |   |   |





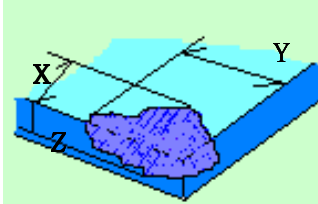
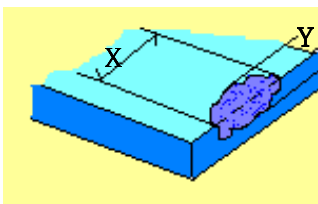
|                                     |                                                                               |                                                                                                                                                                                                                                                             |                                    |                                  |              |                   |
|-------------------------------------|-------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|----------------------------------|--------------|-------------------|
| 3.0                                 | Line defect (LCD/TP<br>/Polarizer backlight black/white line, scratch, stain) | <div>Width(mm)</div>                                                                                                                                                                                                                                        | <div>Length(m<br/>m)</div>         | <div>Acceptable Qty</div>        |              |                   |
|                                     |                                                                               |                                                                                                                                                                                                                                                             |                                    | <div>A</div>                     | <div>B</div> | <div>C</div>      |
|                                     |                                                                               | <div><math>\Phi \leq 0.03</math></div>                                                                                                                                                                                                                      | <div>Ignore</div>                  | <div>Ignore</div>                |              | <div>Ignore</div> |
|                                     |                                                                               | <div><math>0.03 &lt; W \leq 0.04</math></div>                                                                                                                                                                                                               | <div><math>L \leq 3.0</math></div> | <div><math>N \leq 2</math></div> |              |                   |
|                                     |                                                                               | <div><math>0.04 &lt; W \leq 0.05</math></div>                                                                                                                                                                                                               | <div><math>L \leq 2.0</math></div> | <div><math>N \leq 1</math></div> |              |                   |
| <div><math>0.05 &lt; W</math></div> | <div>Define as spot defect</div>                                              |                                                                                                                                                                                                                                                             |                                    |                                  |              |                   |
| 4.0                                 | Electronic Components SMT                                                     | Not allow missing parts, solderless connection, cold solder joint, mismatch, The positive and negative polarity opposite                                                                                                                                    |                                    |                                  |              |                   |
| 5.0                                 | Display color & Brightness                                                    | <div>1. Color: Measuring the color coordinates, The measurement standard according to the data sheet or samples.</div> <div>2. Brightness: Measuring the brightness of White screen, The measurement standard according to the data sheet or Samples.</div> |                                    |                                  |              |                   |
| 6.0                                 | LCD Mura                                                                      | By 5% ND filter invisible.                                                                                                                                                                                                                                  |                                    |                                  |              |                   |

|     |                |                                         |                     |   |   |
|-----|----------------|-----------------------------------------|---------------------|---|---|
| 7.0 | RTP<br>Related | TP film bub<br>ble/ accide<br>nted spot | Acceptable Qty      |   |   |
|     |                |                                         | Size Φ(mm)          |   |   |
|     |                |                                         | A                   | B | C |
|     |                |                                         | Ignore              |   |   |
|     |                |                                         | 3 (distance ≥ 10mm) |   |   |
|     |                |                                         | 2                   |   |   |
|     |                |                                         | 0                   |   |   |



|                      |                             |                                                                                                                                   | <table><tr><th rowspan="2">Width(mm)</th><th rowspan="2">Length (mm)</th><th colspan="3">Acceptable Qty</th></tr><tr><th>A</th><th>B</th><th>C</th></tr><tr><td><math>\Phi \leq 0.03</math></td><td>Ignore</td><td colspan="2">Ignore</td><td rowspan="3">Ignore</td></tr><tr><td><math>0.03 &lt; W \leq 0.04</math></td><td><math>L \leq 3.0</math></td><td colspan="2"><math>N \leq 2</math></td></tr><tr><td><math>0.04 &lt; W \leq 0.05</math></td><td><math>L \leq 2.0</math></td><td colspan="2"><math>N \leq 1</math></td></tr><tr><td><math>0.05 &lt; W</math></td><td colspan="4">Define as spot defect</td></tr></table> | Width(mm) | Length (mm) | Acceptable Qty |  |  | A | B | C | $\Phi \leq 0.03$ | Ignore | Ignore |  | Ignore | $0.03 < W \leq 0.04$ | $L \leq 3.0$ | $N \leq 2$ |  | $0.04 < W \leq 0.05$ | $L \leq 2.0$ | $N \leq 1$ |  | $0.05 < W$ | Define as spot defect |  |  |  |
|----------------------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|-------------|----------------|--|--|---|---|---|------------------|--------|--------|--|--------|----------------------|--------------|------------|--|----------------------|--------------|------------|--|------------|-----------------------|--|--|--|
| Width(mm)            | Length (mm)                 | Acceptable Qty                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      |                             | A                                                                                                                                 | B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | C         |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $\Phi \leq 0.03$     | Ignore                      | Ignore                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Ignore    |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $0.03 < W \leq 0.04$ | $L \leq 3.0$                | $N \leq 2$                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $0.04 < W \leq 0.05$ | $L \leq 2.0$                | $N \leq 1$                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
| $0.05 < W$           | Define as spot defect       |                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      | Assembly deflection         | beyond the edge of backlight $\leq 0.2\text{mm}$                                                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      | Bulge (undulation included) | The ITO film plumped below 0.40mm, it's ok.<br> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |
|                      | Newton Ring                 | <p>Newton Ring area <math>&gt; 1/3</math> TP area<br/>NG</p> <p>Newton Ring area <math>\leq 1/3</math> TP area<br/>OK</p>         |  <p>1 规律性</p>  <p>2 非规律性</p>  <p>似牛顿环</p>                                                                                                                                                                                                                                                                                                                           |           |             |                |  |  |   |   |   |                  |        |        |  |        |                      |              |            |  |                      |              |            |  |            |                       |  |  |  |



|                     |                     |                                                                              |                                                                                                                                                                                                                                                    |   |   |   |                     |                     |                              |                                                                                     |
|---------------------|---------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|---|---|---------------------|---------------------|------------------------------|-------------------------------------------------------------------------------------|
|                     |                     | <p>TP corner broken</p> <p>X : length</p> <p>Y : width</p> <p>Z : height</p> | <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td><math>X \leq 3\text{mm}</math></td><td><math>Y \leq 3\text{mm}</math></td><td><math>Z &lt; \text{COVER thickness}</math></td></tr></table> <p>*</p> <p>*Circuitry broken is not allowed.</p> | X | Y | Z | $X \leq 3\text{mm}$ | $Y \leq 3\text{mm}$ | $Z < \text{COVER thickness}$ |  |
| X                   | Y                   | Z                                                                            |                                                                                                                                                                                                                                                    |   |   |   |                     |                     |                              |                                                                                     |
| $X \leq 3\text{mm}$ | $Y \leq 3\text{mm}$ | $Z < \text{COVER thickness}$                                                 |                                                                                                                                                                                                                                                    |   |   |   |                     |                     |                              |                                                                                     |
|                     |                     | <p>TP edge broken</p> <p>X : length</p> <p>Y : width</p> <p>Z : height</p>   | <table><tr><td>X</td><td>Y</td><td>Z</td></tr><tr><td><math>X \leq 4\text{mm}</math></td><td><math>Y \leq 2\text{mm}</math></td><td><math>Z &lt; \text{COVER thickness}</math></td></tr></table> <p>* Circuitry broken is not allowed.</p>         | X | Y | Z | $X \leq 4\text{mm}$ | $Y \leq 2\text{mm}$ | $Z < \text{COVER thickness}$ |  |
| X                   | Y                   | Z                                                                            |                                                                                                                                                                                                                                                    |   |   |   |                     |                     |                              |                                                                                     |
| $X \leq 4\text{mm}$ | $Y \leq 2\text{mm}$ | $Z < \text{COVER thickness}$                                                 |                                                                                                                                                                                                                                                    |   |   |   |                     |                     |                              |                                                                                     |

#### Criteria ( functional items)

| Number | Items                 | Criteria (mm) |
|--------|-----------------------|---------------|
| 1      | No display            | Not allowed   |
| 2      | Missing segment       | Not allowed   |
| 3      | Short                 | Not allowed   |
| 4      | Backlight no lighting | Not allowed   |
| 5      | TP no function        | Not allowed   |



# Reliability Test Result

| Item                                          | Condition                                                                                                                                        | Inspection after test                                                                                                                                      |
|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| High Temperature Operating                    | 70℃ ,96H                                                                                                                                         | Inspection after<br>2~4hours storage at<br>room temperature, the<br>sample shall be free<br>from defects:                                                  |
| Low Temperature Operating                     | -20℃ , 96HR                                                                                                                                      |                                                                                                                                                            |
| High Temperature Storage                      | 80℃ , 96HR                                                                                                                                       |                                                                                                                                                            |
| Low Temperature Storage                       | -30℃ , 96HR                                                                                                                                      |                                                                                                                                                            |
| High Temperature & High Humidity<br>Operating | +60℃ , 90% RH ,96 hours.                                                                                                                         |                                                                                                                                                            |
| Thermal Shock (Non-operation)                 | -30℃ ,30 min ↔ 80℃ ,30 min, Change time:5min 20CYC.                                                                                              | 1.Air bubble in the<br>LCD;<br>2.Non-display;<br>3.Missing<br>segments/line;<br>4.Glass crack;<br>5. Current IDD is twice<br>higher than initial<br>value. |
| ESD test                                      | C=150pF, R=330,5points/panel<br>Air:±8KV, 5times; Contact:±6KV, 5 times;<br>(Environment: 15℃~35℃ , 30%~60%).                                    |                                                                                                                                                            |
| Vibration (Non-operation)                     | Frequency range: 10~55Hz, Stroke: 1.5mm<br>Sweep:10Hz~55Hz~10Hz 2 hours for each direction of X.Y.Z.<br>(6 hours for total) (Package condition). |                                                                                                                                                            |
| Box Drop Test                                 | 1 Corner 3 Edges 6 faces,80cm(MEDIUM BOX)                                                                                                        |                                                                                                                                                            |

- Remark:
- 1. The test samples should be applied to only one test item.
  - 2. Sample size for each test item is 5~10pcs.
  - 3.For Damp Proof Test, Pure water(Resistance > 10MΩ ) should be used.
  - 4. In case of malfunction defect caused by ESD damage, if it would be recovered to normal state after resetting, it would be judged as a good part.
  - 5. Failure Judgment Criterion: Basic Specification, Electrical Characteristic, Mechanical Characteristic, Optical Characteristic.



# Cautions and Handling Precautions

## 1. Handling and Operating the Module

- (1) When the module is assembled, it should be attached to the system firmly.
- Do not warp or twist the module during assembly work.
- (2) Protect the module from physical shock or any force. In addition to damage, this may cause improper operation or damage to the module and back-light unit.
- (3) Note that polarizer is very fragile and could be easily damaged. Do not press or scratch the surface.
- (4) Do not allow drops of water or chemicals to remain on the display surface.
- If you have the droplets for a long time, staining and discoloration may occur.
- (5) If the surface of the polarizer is dirty, clean it using some absorbent cotton or soft cloth.
- (6) The desirable cleaners are water, IPA (Isopropyl Alcohol) or Hexane.
- Do not use ketene type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contact with hands, legs, or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static; it may cause damage to the CMOS ICs.
- (9) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (10) Do not disassemble the module.
- (11) Protection film for polarizer on the module shall be slowly peeled off just before use so that the electrostatic charge can be minimized.
- (12) Pins of I/F connector shall not be touched directly with bare hands.
- (13) Do not connect, disconnect the module in the "Power ON" condition.
- (14) Power supply should always be turned on/off by the item 6.1 Power On Sequence & 6.2 Power Off Sequence

## 2. Storage and Transportation.

- (1) Do not leave the panel in high temperature, and high humidity for a long time.
- It is highly recommended to store the module with temperature from 0 to 35 °C and relative humidity of less than 70%
- (2) Do not store the TFT-LCD module in direct sunlight.
- (3) The module shall be stored in a dark place. When storing the modules for a long time, be sure to adopt effective measures for protecting the modules from strong ultraviolet radiation, sunlight, or fluorescent light.
- (4) It is recommended that the modules should be stored under a condition where no condensation is allowed. Formation of dewdrops may cause an abnormal operation or a failure of the module.
- In particular, the greatest possible care should be taken to prevent any module from being operated where condensation has occurred inside.
- (5) This panel has its circuitry FPC on the bottom side and should be handled carefully in order not to be stressed.

