



## RVT50AQFFWR00

### LCD TFT Datasheet

Rev.1.4

2016-10-17

| ITEM                           | CONTENTS                        | UNIT              |
|--------------------------------|---------------------------------|-------------------|
| LCD Type                       | TFT/Transmissive/Normally white | /                 |
| Size                           | 5.0                             | Inch              |
| Viewing Direction              | 12:00 (without image inversion) | O' Clock          |
| Gray Scale Inversion Direction | 6:00                            | O' Clock          |
| LCM (W × H × D)                | 121.50 x 76.60 x 8.26           | mm <sup>3</sup>   |
| Active Area (W × H)            | 108.00 × 64.80                  | mm <sup>2</sup>   |
| Dot Pitch (W × H)              | 0.045×0.135                     | mm <sup>2</sup>   |
| Number of Dots                 | 800 x (RGB) × 480               | /                 |
| Driver IC                      | FT812                           | /                 |
| Backlight Type                 | 12 LEDs                         | /                 |
| Surface Luminance              | 480                             | cd/m <sup>2</sup> |
| Interface Type                 | SPI/QSPI                        | /                 |
| Color Depth                    | 16.7M                           | /                 |
| Pixel Arrangement              | RGB Vertical Stripe             | /                 |
| Surface Treatment              | Anti-glare                      |                   |
| Input Voltage                  | 3.3                             | V                 |
| With/Without TSP               | Resistive Touch Panel           | /                 |
| Weight                         | TBD                             | g                 |

**Note 1:** RoHS compliant

**Note 2:** LCM weight tolerance: ± 5%.

## REVISION RECORD

| REVNO. | REVDATE    | CONTENTS  | REMARKS |
|--------|------------|---|---------|
| 1.0    | 2015-10-06 | Initial Release   |         |
| 1.1    | 2015-11-30 | Updating drawing about ZIF connector  |         |
| 1.2    | 2016-02-15 | Update LED Backlight Current and Input Voltage for LED Inverter, LCD Timing Characteristics information |         |
| 1.3    | 2016-06-06 | Update Interface description (pin 4 and pin 5)  |         |
| 1.4    | 2016-10-17 | Added Inspection Standards  |         |

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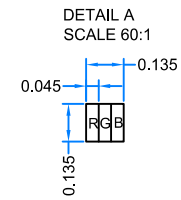
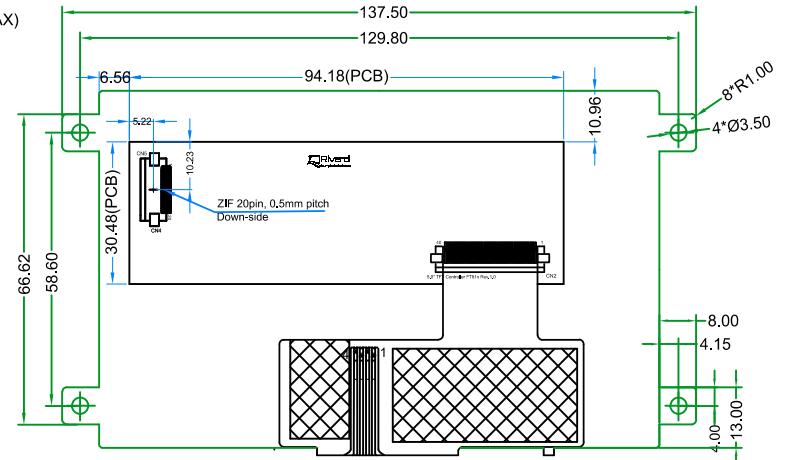
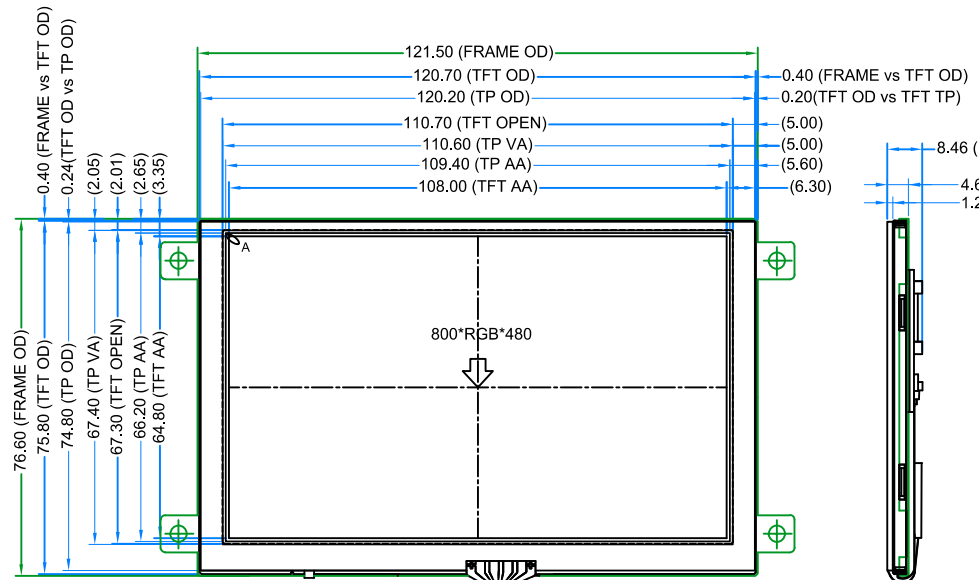
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## 1 MODULE CLASSIFICATION INFORMATION

| <b>RV</b> | <b>T</b> | <b>50</b> | <b>A</b> | <b>Q</b> | <b>F</b> | <b>F</b> | <b>W</b> | <b>R</b> | <b>00</b> |
|-----------|----------|-----------|----------|----------|----------|----------|----------|----------|-----------|
| 1.        | 2.       | 3.        | 4.       | 5.       | 6.       | 7.       | 8.       | 9.       | 10.       |

|     |                         |   |
|-----|-------------------------|---|
| 1.  | <b>BRAND</b>            | <b>RV</b> – Riverdi   |
| 2.  | <b>PRODUCT TYPE</b>     | <b>T</b> – TFT Standard<br><b>F</b> – TFT Custom  |
| 3.  | <b>DISPLAY SIZE</b>     | <b>35</b> – 3.5”<br><b>43</b> – 4.3”<br><b>50</b> – 5.0”<br><b>70</b> – 7.0”  |
| 4.  | <b>MODEL SERIAL NO.</b> | <b>A</b> (A-Z)  |
| 5.  | <b>RESOLUTION</b>       | <b>Q</b> – 800x480 px   |
| 6.  | <b>INTERFACE</b>        | <b>T</b> – TFT LCD, RGB<br><b>L</b> – TFT LCD, LVDS<br><b>S</b> – TFT + Controller SSD1963<br><b>F</b> – TFT + Controller FT812 |
| 7.  | <b>FRAME</b>            | <b>N</b> – No Frame<br><b>F</b> – Mounting Frame  |
| 8.  | <b>BACKLIGHT TYPE</b>   | <b>W</b> – LED White  |
| 9.  | <b>TOUCH PANEL</b>      | <b>N</b> – No Touch Panel<br><b>R</b> – Resistive Touch Panel<br><b>C</b> – Capacitive Touch Panel                              |
| 10. | <b>VERSION</b>          | <b>00</b> (00-99)   |

| TFT PINOUT |           |
|------------|-----------|
| PIN        | DESC      |
| 1          | VDD       |
| 2          | GND       |
| 3          | SPL_SCLK  |
| 4          | MISO/IO1  |
| 5          | MOSI/IO0  |
| 6          | CS        |
| 7          | INT       |
| 8          | PD        |
| 9          | NC        |
| 10         | AUDIO_OUT |
| 11         | GPIO0/IO2 |
| 12         | GPIO1/IO3 |
| 13         | GPIO2     |
| 14         | GPIO3     |
| 15         | NC        |
| 16         | NC        |
| 17         | BLVDD     |
| 18         | BLVDD     |
| 19         | BLGND     |
| 20         | BLGND     |



- NOTES:
1. DISPLAY TYPE: TFT, TRANSMISSIVE, NORMALLY WHITE
  2. OPERATING VOLTAGE: VDD=3.3V
  3. VIEWING DIRECTION: 12 O'CLOCK.
  4. IC DRIVER: FT812
  5. OPERATING TEMP: -20°C ~ 70°C.
  6. STORAGE TEMP: -30°C ~ 80°C.
  7. LED BACKLIGHT: 12 WHITE LED.
  8. LCM SURFACE LUMINANCE: 480cd/m<sup>2</sup>.
  9. GENERAL TOLERANCE: ±0.2.
  10. RoHS COMPLIANT.

| 1.2  | Update pin description                 | 2016.06.06 |
|------|--|------------|
| 1.1  | Adding information about ZIF connector | 2015.11.30 |
| 1.0  | Initial case                           | 2015.10.06 |
| Ver. | DESCRIPTION                            | DATE       |

|          |           |                        |             |
|----------|-----------|------------------------|-------------|
| CUSTOMER |           |                        |             |
| DRAWN    | SCALE 1:1 | TITLE<br>RVT50AQFFWR00 |             |
| DFTG CHK | UNIT mm   | MODEL                  |             |
| ENGR CHK | APPROVAL  | DWG NO                 |             |
|          |           | Rev. 1.1               | PAGE<br>1/1 |
|          |           |                        |             |

### 3 ABSOLUTE MAXIMUM RATINGS

| PARAMETER                      | SYMBOL          | MIN     | MAX            | UNIT |
|--------------------------------|-----------------|---------|----------------|------|
| Supply Voltage For Logic       | VDD             | -0.3    | 4.0            | V    |
| Input Voltage For Logic        | VIN             | VSS-0.5 | VDD+0.3        | V    |
| LED forward current (each LED) | IF              | -       | 60             | mA   |
| Operating Temperature          | T <sub>OP</sub> | -20     | 70             | °C   |
| Storage Temperature            | T <sub>ST</sub> | -30     | 80             | °C   |
| Humidity                       | RH              | -       | 90% (Max 60°C) | RH   |

### 4 ELECTRICAL CHARACTERISTICS

| PARAMETER                      | SYMBOL                   | MIN    | TYP | MAX    | UNIT | NOTES      |
|--------------------------------|--------------------------|--------|-----|--------|------|------------|
| Supply Voltage For Module      | VDD                      | 3.0    | 3.3 | 3.6    | V    |            |
| Input Voltage for LED Inverter | BLVDD                    | 2.8    | 3.3 | 5.5    | V    |            |
| LED Backlight Current          | IDD <sub>backlight</sub> | -      | 290 | 363    | mA   | BLVDD=3.3V |
| LED Backlight Current          | IDD <sub>backlight</sub> | -      | 180 | 225    | mA   | BLVDD=5V   |
| Input Leakage Current          | I <sub>LKG</sub>         | -      | -   | -      | μA   |            |
| Input Voltage ' H ' level      | V <sub>IH</sub>          | 0.8VDD | -   | VDD    | V    |            |
| Input Voltage ' L ' level      | V <sub>IL</sub>          | -0.3   | -   | 0.2VDD | V    |            |

**Note:** The LED life time is defined as the module brightness decrease to 50% original brightness at Ta=25°C.

### 5 BACKLIGHT CHARACTERISTICS

| ITEM                      | SYMBOL         | MIN   | TYP   | MAX  | UNIT |
|---------------------------|----------------|-------|-------|------|------|
| Voltage for LED backlight | V <sub>i</sub> | 17.4  | 18.3  | 19.6 | V    |
| Current for LED backlight | I <sub>i</sub> | 30    | 40    | 50   | mA   |
| LED Life Time             | -              | 30000 | 50000 | -    | Hrs  |

**Note:** The LED Supply Voltage is defined by the numbers of LED at Ta=25°C and I<sub>L</sub>= 40mA.

### 6 ELECTRO-OPTICAL CHARACTERISTICS

| ITEM                       | SYMBOL  | CONDITION             | MIN | TYP   | MAX   | UNIT              | REMARK   | NOTE |
|----------------------------|---------|-----------------------|-----|-------|-------|-------------------|----------|------|
| Response Time              | Tr+Tf   | θ=0°<br>φ=0°<br>Ta=25 | -   | 20    | -     | ms                | Figure 1 | 4    |
| Contrast Ratio             | Cr      |                       | -   | 500   | -     | ---               | Figure 2 | 1    |
| Luminance Uniformity       | δ WHITE |                       | 75  | 80    | -     | %                 | Figure 2 | 3    |
| Surface Luminance          | Lv      |                       | 440 | 480   | -     | cd/m <sup>2</sup> | Figure 2 | 2    |
| Viewing Angle Range        | θ       | φ = 90°               | 40  | 50    | -     | deg               | Figure 3 | 6    |
|                            |         | φ = 270°              | 60  | 70    | -     | deg               | Figure 3 |      |
|                            |         | φ = 0°                | 60  | 70    | -     | deg               | Figure 3 |      |
|                            |         | φ = 180°              | 60  | 70    | -     | deg               | Figure 3 |      |
| CIE (x, y)<br>Chromaticity | Red     | θ=0°<br>φ=0°<br>Ta=25 | x   | 0.540 | 0.590 | 0.640             | Figure 2 | 5    |
|                            |         |                       | y   | 0.300 | 0.350 | 0.400             |          |      |
|                            | Green   |                       | x   | 0.298 | 0.348 | 0.398             |          |      |
|                            |         |                       | y   | 0.520 | 0.570 | 0.620             |          |      |
|                            | Blue    |                       | x   | 0.095 | 0.145 | 0.195             |          |      |
|                            |         |                       | y   | 0.060 | 0.110 | 0.160             |          |      |
|                            | White   |                       | x   | 0.270 | 0.320 | 0.370             |          |      |
|                            |         |                       | y   | 0.310 | 0.360 | 0.410             |          |      |

**Note 1.** Contrast Ratio(CR) is defined mathematically as below, for more information see Figure 1.

$$\text{Contrast Ratio} = \frac{\text{Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Average Surface Luminance with all black pixels (P1, P2, P3, P4, P5)}}$$

**Note 2.** Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see Figure 2.

$L_v$  = Average Surface Luminance with all white pixels (P1, P2, P3, P4, P5)

**Note 3.** The uniformity in surface luminance  $\delta$  WHITE is determined by measuring luminance at each test position 1 through 5, and then dividing the maximum luminance of 5 points luminance by minimum luminance of 5 points luminance. For more information see Figure 2.

$$\delta \text{ WHITE} = \frac{\text{Minimum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}{\text{Maximum Surface Luminance with all white pixels (P1, P2, P3, P4, P5)}}$$

**Note 4.** Response time is the time required for the display to transition from white to black (Rise Time,  $T_r$ ) and from black to white (Decay Time,  $T_f$ ). For additional information see FIG 1. The test equipment is Autronic-Melchers's ConoScope series.

**Note 5.** CIE (x, y) chromaticity, the x, y value is determined by measuring luminance at each test position 1 through 5, and then make average value.

**Note 6.** Viewing angle is the angle at which the contrast ratio is greater than 2. For TFT module the contrast ratio is greater than 10. The angles are determined for the horizontal or x axis and the vertical or y axis with respect to the z axis which is normal to the LCD surface. For more information see Figure 3.

**Note 7.** For viewing angle and response time testing, the testing data is based on Autronic-Melchers's ConoScope series. Instruments for Contrast Ratio, Surface Luminance, Luminance Uniformity, CIE the test data is based on TOPCON's BM-5 photo detector.

**Note 8.** For TFT module, Gray scale reverse occurs in the direction of panel viewing angle.

Figure 1. The definition of response time

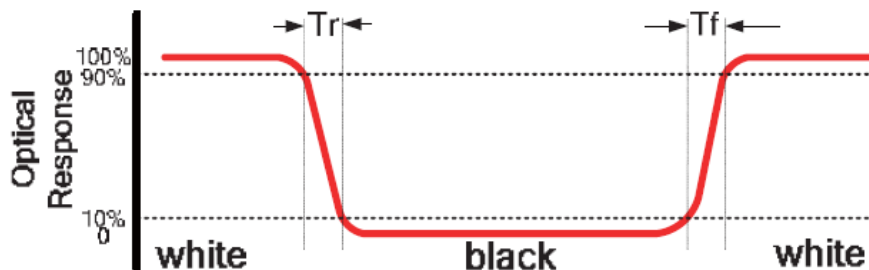


Figure 2. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

A : 5 mm  
 B : 5 mm  
 H, V : Active Area  
 Light spot size  $\varnothing=5\text{mm}$ , 500mm distance from the LCD surface to detector lens  
 measurement instrument is TOPCON's luminance meter BM-5

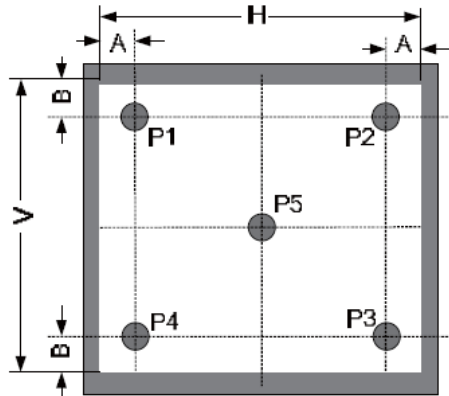
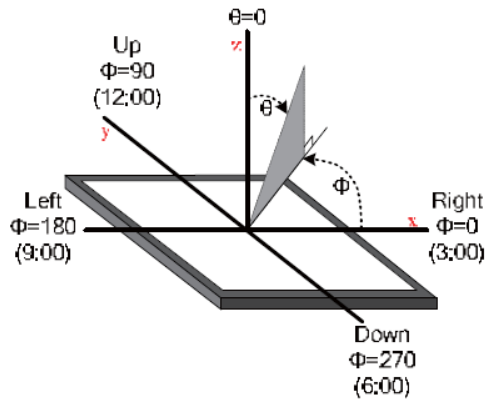


Figure 3. The definition of viewing angle



## 7 INTERFACE DESCRIPTION

| PIN NO. | SYMBOL    | DESCRIPTION  |
|---------|-----------|--|
| 1       | VDD       | Power Supply   |
| 2       | GND       | Ground   |
| 3       | SPI_SCLK  | SPI SCK Signal, Internally 47k Pull UP                               |
| 4       | MISO/ IO1 | SPI MISO Signal / SPI Quad mode: SPI data line 1                     |
| 5       | MOSI/ IO0 | SPI MOSI Signal / SPI Quad mode: SPI data line 0                     |
| 6       | CS        | SPI Chip Select Signal , Internally 47k Pull UP                      |
| 7       | INT       | Interrupt Signal, Active Low, Internally 47k Pull UP                 |
| 8       | PD        | Power Down Signal, Active Low, Internally 47k Pull UP                |
| 9       | NC        | Not Connected  |
| 10      | AUDIO_OUT | Audio Out Signal   |
| 11      | GPIO0/IO2 | SPI Single mode: General purpose IO0/ SPI Quad mode: SPI data line 2 |
| 12      | GPIO1/IO3 | SPI Single mode: General purpose IO1/ SPI Quad mode: SPI data line 3 |
| 13      | GPIO2     | General purpose IO2  |
| 14      | GPIO3     | General purpose IO3 or analog input for ADC                          |
| 15      | NC        | Not Connected  |
| 16      | NC        | Not Connected  |
| 17      | BLVDD     | Backlight Power Supply, Can Be Connected to VDD                      |
| 18      | BLVDD     | Backlight Power Supply, Can Be Connected to VDD                      |
| 19      | BLGND     | Backlight Ground, Internally connected to GND                        |

|    |       |   |
|----|-------|---|
| 20 | BLGND | Backlight Ground, Internally connected to GND |
|----|-------|---|

## 8 FT812 CONTROLLER SPECIFICATIONS

FT812 or EVE (Embedded Video Engine) simplifies the system architecture for advanced human machine interfaces (HMIs) by providing functionality for display, audio, and touch as well as an object oriented architecture approach that extends from display creation to the rendering of the graphics.

### 8.1 Serial host interface

Figure 4. SPI interface connection

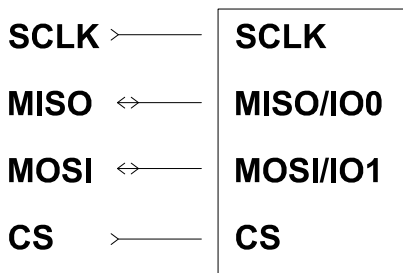
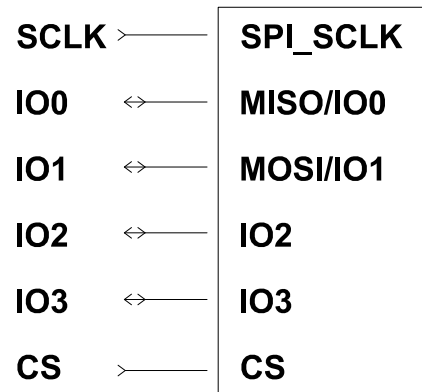


Figure 5. .SPI interface connection



**SPI Interface** – the SPI slave interface operates up to 30MHz.

Only SPI mode 0 is supported. The SPI interface is selected by default (MODE pin is internally pulled low by 47k resistor).

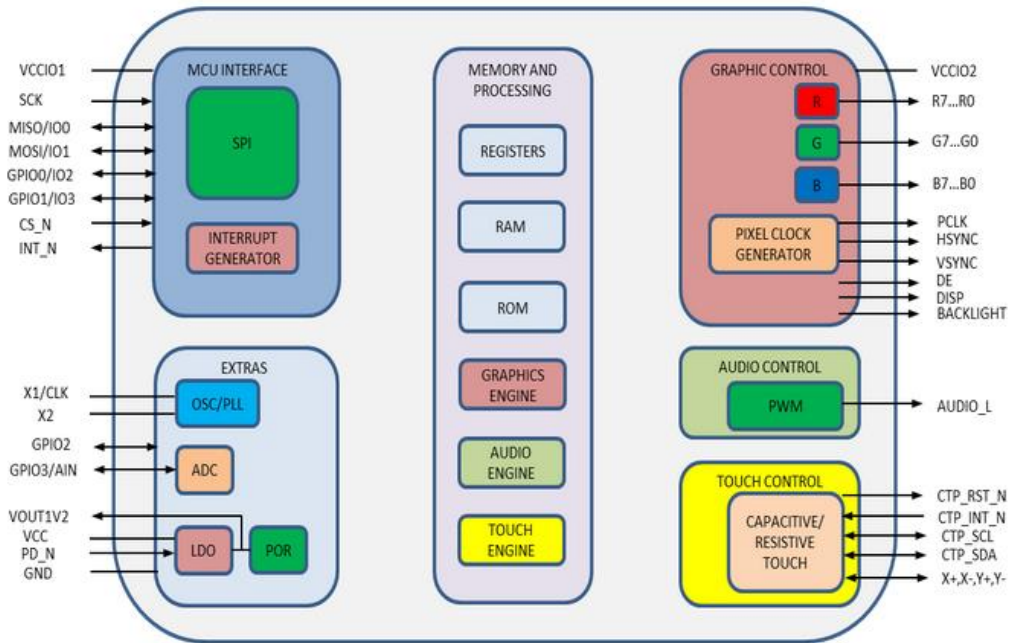
**QSPI Interface** – the QSPI slave interface operates up to 30MHz. Only SPI mode 0 is supported. The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD data bus modes.

By default the SPI slave operates in the SINGLE channel mode with MOSI as input from the master and MISO as output to the master. DUAL and QUAD channel modes can be configured through the SPI slave itself. To change the channel modes, write to register REG\_SPI\_WIDTH.



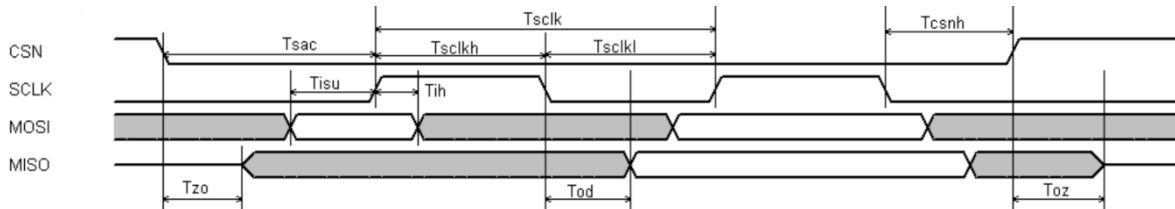
### 8.2 Block Diagram

Figure 6. FT812 Block diagram



### 8.3 Host interface SPI mode 0

Figure 7. SPI timing diagram



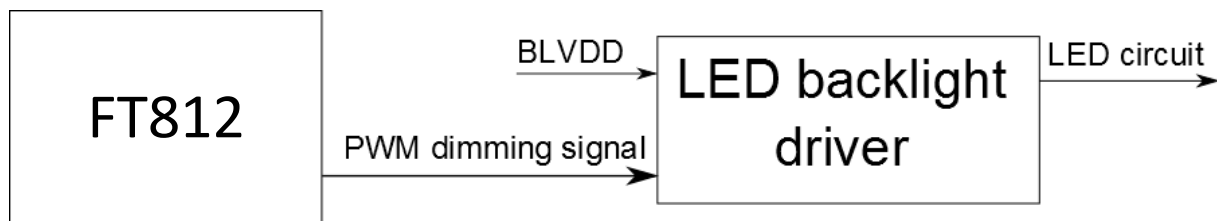
For more information about FT812 controller please go to official FT81x website.

<http://www.ftdichip.com/Products/ICs/FT81X.html>

### 8.4 Backlight driver block diagram

Backlight enable signal is internally connected to FT812 Backlight control pin. This pin is controlled by two FT812's registers. One of them specifies the PWM output frequency, second one specifies the duty cycle. Refer to FT812 datasheet for more information.

Figure 8. Backlight driver block diagram



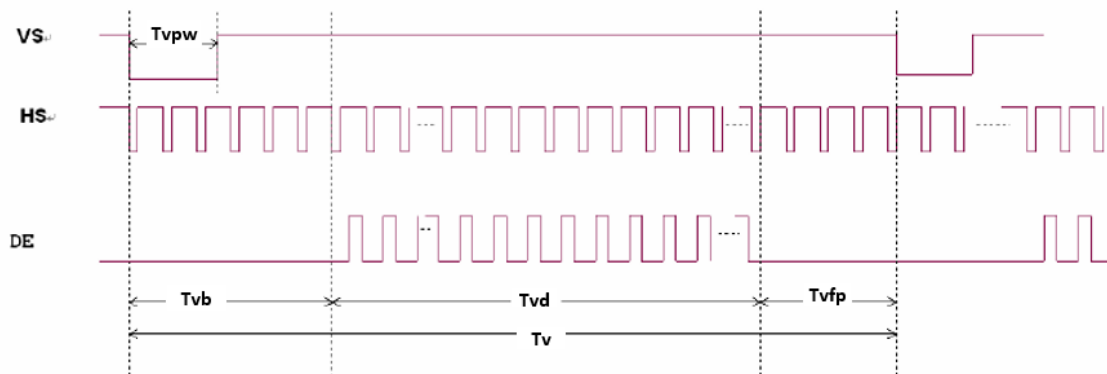
## 9 LCD TIMING CHARACTERISTICS

### 9.1 Clock and data input time diagram

Figure 9. Horizontal input timing diagram



Figure 10. Vertical input timing diagram



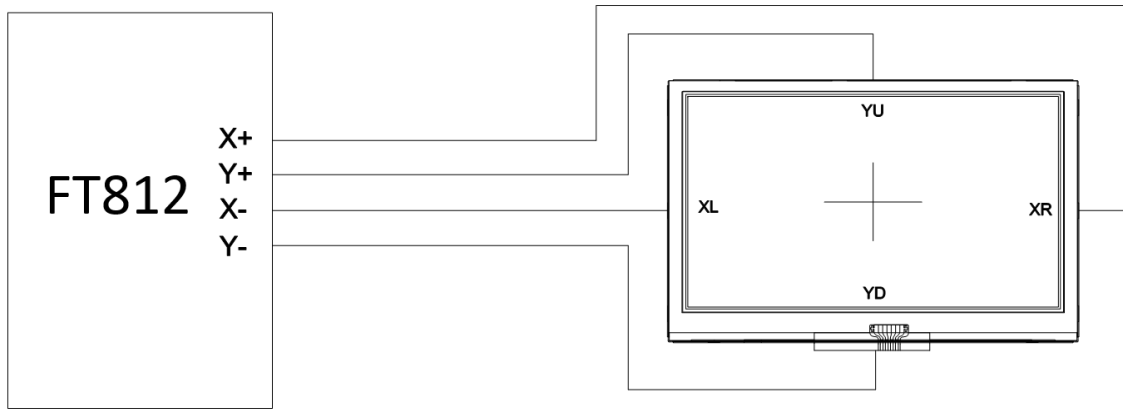
### 9.2 Parallel RGB timing table

| PARAMETER               | SYMBOL | MIN | TYP | MAX  | UNIT |
|-------------------------|--------|-----|-----|------|------|
| Horizontal Display Area | Thd    | -   | 800 | -    | DCLK |
| DCLK Frequency          | Fclk   | -   | 30  | 50   | MHz  |
| One Horizontal Line     | Th     | 889 | 928 | 1143 | DCLK |
| HS pulse width          | Thpw   | 1   | 48  | 255  | DCLK |
| HS Blanking             | Thb    | -   | 88  | -    | DCLK |
| HS Front Porch          | Thfp   | 1   | 40  | 255  | DCLK |
| Vertical Display Area   | Tvd    | -   | 480 | -    | TH   |
| VS period time          | Tv     | 513 | 525 | 767  | TH   |
| VS pulse width          | Tvpw   | 3   | 3   | 255  | TH   |
| VS Blanking             | Tvb    | -   | 32  | -    | TH   |
| VS Front Porch          | Tvfp   | 1   | 13  | 255  | TH   |

## 10 TOUCH SCREEN PANEL SPECIFICATION

Resistive Touch Panel is directly connected to FT812 module. Therefore communication with Resistive touch panel is simplified to read registers of FT812.

Figure 11. Resistive Touch Panel Connection



### 10.1 Electrical characteristics

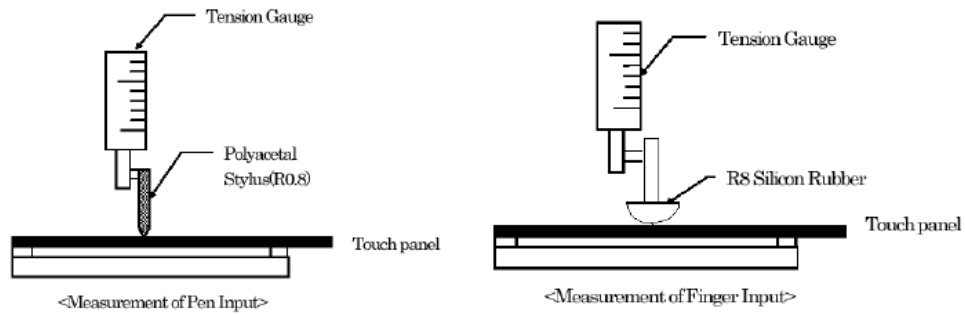
| ITEM                  | VALUE |      |      | UNIT       | REMARK                    |
|-----------------------|-------|------|------|------------|---------------------------|
|                       | Min.  | Typ. | Max. |            |                           |
| Linearity             | -1.5  | -    | 1.5  | %          | Analog X and Y directions |
| Terminal Resistance   | 350   | -    | 1000 | $\Omega$   | X                         |
|                       | 100   | -    | 450  | $\Omega$   | Y                         |
| Insulation Resistance | -     | -    | -    | M $\Omega$ | DC 25V                    |
| Voltage               | -     | -    | 10   | V          | DC                        |
| Chattering            | -     | -    | 10   | ms         | 100k $\Omega$ pull-up     |
| Transparency          | 80    | -    | -    | %          | JIS K7105                 |

**Note:** Avoid operating with hard or sharp material such as a ball point pen or a mechanical pencil except a polyacetal pen (tip R0.8mm or less) or a finger

### 10.2 Mechanical characteristics

| ITEM                          | VALUE         |      |      | UNIT       | REMARK    |
|-------------------------------|---------------|------|------|------------|-----------|
|                               | Min.          | Typ. | Max. |            |           |
| Activation Force              | 80            | -    | -    | gf         | Note 1    |
| Durability-Surface Scratching | Write 100,000 | -    | -    | characters | Note 2    |
| Durability-Surface Pitting    | 1,000,000     | -    | -    | touches    | Note 3    |
| Surface Hardness              | 3             | -    | -    | H          | JIS K5400 |

**Note 1: Force test condition,** Input DC 5V on X direction, Drop off Polyacetal Stylus (R0.8), until output voltage stabilize, then get the R8.0mm Silicon rubber and do finger Activation force test. Next step, 9 points.



**Note 2: Measurement surface area conditions,** Scratch 100,000 times straight line on the film with a stylus change every 20,000 times with Force: 250gf, Speed: 60mm/sec by R0.8 polaceteal stylus.

**Note 3: Pitting test,** Pit 1, 000, 000 times on the film with R0.8 silicon rubber with Force: 250gf and Speed: 2 times/sec.

## 11 INSPECTION

Standard acceptance/rejection criteria for TFT module.

### 11.1 Inspection condition

*Ambient conditions:*

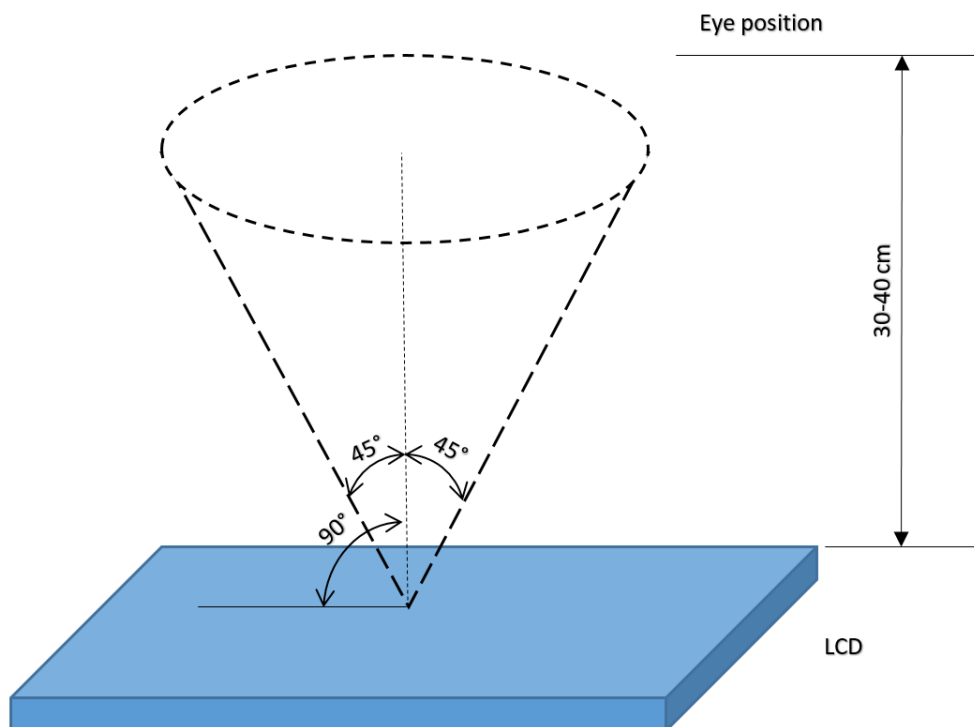
- Temperature:  $25\pm^{\circ}\text{C}$
- Humidity:  $(60\pm 10)\% \text{RH}$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

*Viewing distance:*

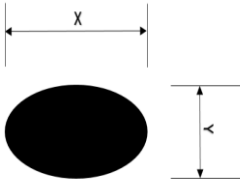
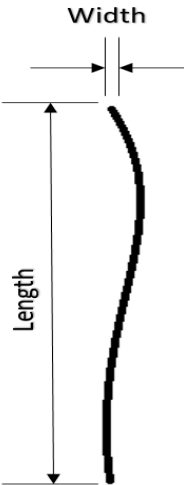
$35\pm 5\text{cm}$  between inspector bare eye and LCD.

*Viewing Angle:*

U/D:  $45^{\circ}/45^{\circ}$ , L/R  $45^{\circ}/45^{\circ}$



11.2 Inspection standard

| Item   | Criterion   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
|--|---|---------------|--|------------------|---------------|------------|---------------|---------------------|----------|---------------------|---------|-----------------|---|---------|-----------------|---|----------|---|------------|--|--|--------|-------|---------------|---|----------|---------|---------|-----------------|---|---------|-----------------|---|----------|---|
| <p><b>Black spots, white spots, light leakage, Foreign Particle (round Type)</b></p> | <div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="2" style="background-color: #cccccc;">Size &lt; 5"</th> </tr> <tr> <th>Average Diameter</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>D &lt; 0.2 mm</td> <td>Ignored</td> </tr> <tr> <td>0.2 mm &lt; D &lt; 0.3 mm</td> <td>3</td> </tr> <tr> <td>0.3 mm &lt; D &lt; 0.5 mm</td> <td>2</td> </tr> <tr> <td>0.5 mm &lt; D</td> <td>0</td> </tr> </tbody> </table> </div> <div style="text-align: center; margin: 10px 0;"> <math display="block">D = \frac{(x + y)}{2}</math> </div> <p>*Spots density: 10 mm</p>   | Size < 5"     |  | Average Diameter | Qualified Qty | D < 0.2 mm | Ignored       | 0.2 mm < D < 0.3 mm | 3        | 0.3 mm < D < 0.5 mm | 2       | 0.5 mm < D      | 0 |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| Size < 5"  |   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| Average Diameter   | Qualified Qty   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| D < 0.2 mm   | Ignored   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| 0.2 mm < D < 0.3 mm  | 3   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| 0.3 mm < D < 0.5 mm  | 2   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| 0.5 mm < D   | 0   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| <p><b>LCD black spots, white spots, light leakage (line Type)</b></p>                | <div style="display: flex; align-items: center; justify-content: center;">  <table border="1" style="margin-left: 20px;"> <thead> <tr> <th colspan="3" style="background-color: #cccccc;">Size &lt; 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W &lt; 0.02</td> <td>Ignored</td> </tr> <tr> <td>L &lt; 3.0</td> <td>0.02 &lt; W &lt; 0.05</td> <td rowspan="2">2</td> </tr> <tr> <td>L &lt; 2.5</td> <td>0.05 &lt; W &lt; 0.08</td> </tr> <tr> <td>-</td> <td>0.08 &lt; W</td> <td>0</td> </tr> </tbody> </table> </div> <div style="text-align: center; margin: 10px 0;"> <table border="1" style="background-color: #cccccc;"> <thead> <tr> <th colspan="3" style="background-color: #cccccc;">Size &gt;= 5"</th> </tr> <tr> <th>Length</th> <th>Width</th> <th>Qualified Qty</th> </tr> </thead> <tbody> <tr> <td>-</td> <td>W &lt; 0.02</td> <td>Ignored</td> </tr> <tr> <td>L &lt; 3.0</td> <td>0.02 &lt; W &lt; 0.05</td> <td rowspan="2">4</td> </tr> <tr> <td>L &lt; 2.5</td> <td>0.05 &lt; W &lt; 0.08</td> </tr> <tr> <td>-</td> <td>0.08 &lt; W</td> <td>0</td> </tr> </tbody> </table> </div> <p>*Spots density: 10 mm</p> | Size < 5"     |  |                  | Length        | Width      | Qualified Qty | -                   | W < 0.02 | Ignored             | L < 3.0 | 0.02 < W < 0.05 | 2 | L < 2.5 | 0.05 < W < 0.08 | - | 0.08 < W | 0 | Size >= 5" |  |  | Length | Width | Qualified Qty | - | W < 0.02 | Ignored | L < 3.0 | 0.02 < W < 0.05 | 4 | L < 2.5 | 0.05 < W < 0.08 | - | 0.08 < W | 0 |
| Size < 5"  |   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| Length   | Width   | Qualified Qty |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| -  | W < 0.02  | Ignored       |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| L < 3.0  | 0.02 < W < 0.05   | 2             |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| L < 2.5  | 0.05 < W < 0.08   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| -  | 0.08 < W  | 0             |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| Size >= 5"   |   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| Length   | Width   | Qualified Qty |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| -  | W < 0.02  | Ignored       |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| L < 3.0  | 0.02 < W < 0.05   | 4             |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| L < 2.5  | 0.05 < W < 0.08   |               |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |
| -  | 0.08 < W  | 0             |  |                  |               |            |               |                     |          |                     |         |                 |   |         |                 |   |          |   |            |  |  |        |       |               |   |          |         |         |                 |   |         |                 |   |          |   |



| Item                              | Criterion                        |               |
|-----------------------------------|----------------------------------|---------------|
| Clear spots                       | Size < 5"                        |               |
|                                   | <b>Average Diameter</b>          | Qualified Qty |
|                                   | <b>D &lt; 0.2 mm</b>             | Ignored       |
|                                   | <b>0.2 mm &lt; D &lt; 0.3 mm</b> | 3             |
|                                   | <b>0.3 mm &lt; D &lt; 0.5 mm</b> | 2             |
|                                   | <b>0.5 mm &lt; D</b>             | 0             |
|                                   | Size >= 5"                       |               |
|                                   | <b>Average Diameter</b>          | Qualified Qty |
|                                   | <b>D&lt;0.2 mm</b>               | Ignored       |
|                                   | <b>0.2 mm &lt; D &lt; 0.3 mm</b> | 4             |
|                                   | <b>0.3 mm &lt; D &lt; 0.5 mm</b> | 2             |
|                                   | <b>0.5 mm &lt; D</b>             | 0             |
|                                   | *Spots density: 10 mm            |               |
|                                   | Polarizer bubbles                | Size < 5"     |
| <b>Average Diameter</b>           |                                  | Qualified Qty |
| <b>D &lt; 0.2 mm</b>              |                                  | Ignored       |
| <b>0.2 mm &lt; D &lt; 0.5 mm</b>  |                                  | 3             |
| <b>0.5 mm &lt; D &lt; 1 mm</b>    |                                  | 2             |
| <b>1 mm &lt; D</b>                |                                  | 0             |
| <b>Total Q'ty</b>                 |                                  | 3             |
| Size >= 5"                        |                                  |               |
| <b>Average Diameter</b>           |                                  | Qualified Qty |
| <b>D&lt;0.25 mm</b>               |                                  | Ignored       |
| <b>0.25 mm &lt; D &lt; 0.5 mm</b> |                                  | 3             |
| <b>0.5 mm &lt; D</b>              |                                  | 0             |
| Electrical Dot Defect             |                                  | Size < 5"     |
|                                   |                                  | <b>item</b>   |
|                                   | <b>Black do defect</b>           | 4             |
|                                   | <b>Bright dot defect</b>         | 2             |
|                                   | <b>Total Dot</b>                 | 5             |
|                                   | Size >= 5"                       |               |
|                                   | <b>item</b>                      | Qualified Qty |
|                                   | <b>Black do defect</b>           | 5             |
|                                   | <b>Bright dot defect</b>         | 2             |
|                                   | <b>Total Dot</b>                 | 5             |

| Item                           | Criterion                         |                |               |
|--------------------------------|-----------------------------------|----------------|---------------|
| Touch panel spot               | Size < 5"                         |                |               |
|                                | <b>Average Diameter</b>           | Qualified Qty  |               |
|                                | <b>D &lt; 0.2 mm</b>              | Ignored        |               |
|                                | <b>0.2 mm &lt; D &lt; 0.4 mm</b>  | 5              |               |
|                                | <b>0.4 mm &lt; D &lt; 0.5 mm</b>  | 2              |               |
|                                | <b>0.5 mm &lt; D</b>              | 0              |               |
|                                | Size >= 5"                        |                |               |
|                                | <b>Average Diameter</b>           | Qualified Qty  |               |
|                                | <b>D&lt;0.25 mm</b>               | Ignored        |               |
|                                | <b>0.25 mm &lt; D &lt; 0.5 mm</b> | 4              |               |
| <b>0.5 mm &lt; D</b>           | 0                                 |                |               |
| Touch panel White Line Scratch | Size < 5"                         |                |               |
|                                | <b>Length</b>                     | <b>Width</b>   | Qualified Qty |
|                                | -                                 | W< 0.02        | Ignored       |
|                                | <b>L &lt; 3.0</b>                 | 0.02 < W <0.05 | 2             |
|                                | <b>L &lt; 2.5</b>                 | 0.05 < W <0.08 |               |
|                                | -                                 | 0.08 < W       | 0             |
|                                | Size >= 5"                        |                |               |
|                                | <b>Length</b>                     | <b>Width</b>   | Qualified Qty |
|                                | -                                 | W< 0.03        | Ignored       |
|                                | <b>L &lt; 5.0</b>                 | 0.03 < W <0.05 | 2             |
| -                              | 0.05 < W                          | 0              |               |



## 12 RELIABILITY TEST

| NO. | TEST ITEM                  | TEST CONDITION   |
|-----|----------------------------|--|
| 1   | High Temperature Storage   | 80±2°C/240hours  |
| 2   | Low Temperature Storage    | -30±2°C/240hours   |
| 3   | High Temperature Operating | 70±2°C/240hours  |
| 4   | Low Temperature Operating  | -20±2°C/240hours   |
| 5   | Temperature Cycle          | -30±2°C~25~80±2°C × 20 cycles<br>(30min.) (5min.) (30min.)   |
| 6   | Damp Proof Test            | 60°C ±5°C × 90%RH/240hours   |
| 7   | Vibration Test             | Frequency 10Hz~55Hz<br>Amplitude of vibration : 1.5mm<br>Sweep: 10Hz~55Hz~10Hz, 12min<br>X, Y, Z 2 hours for each direction. |
| 8   | Package Drop Test          | Height:60 cm<br>1 corner, 3 edges, 6 surfaces  |
| 9   | ESD Test                   | Air: ±4KV 150pF/330Ω 5 times<br>Contact: ±2KV 150pF/330Ω 5 time  |