



RVT70HSBFWCA0

EVE4 IPS 7.0" LCD TFT DATASHEET

Rev.1.4
2021-12-06

| ITEM | CONTENTS | UNIT |
|--------------------------------|---|-------------------|
| LCD Type | TFT/Transmissive/Normally Black/IPS | / |
| Size | 7.0 | Inch |
| Viewing Direction | Free | / |
| Outside Dimensions (W x H x D) | 181.60 x 100.60 x 14.19 | mm |
| Active Area (W x H) | 154.21 x 85.92 | mm |
| Pixel Pitch (W x H) | 0.1506 x 0.1432 | mm |
| Resolution | 1024 (RGB) x 600 | / |
| Brightness | 800 | cd/m ² |
| Color Depth | 16.7 M | / |
| Pixel Arrangement | RGB Vertical Stripe | / |
| Driver IC of Board | BT817Q | / |
| Rectangular pixel correction | Yes | / |
| Interface | SPI/QSPI | / |
| Host Connector | RiBUS, ZIF 20 pin, 0.5mm pitch, down-side contact | / |
| With/Without Touch | With Projected Capacitive Touch Panel | / |
| CTP Driver | ILI2132A | / |
| Supply Voltage for Module | 3.3 | V |
| Supply Voltage for Backlight | 5.0 (TYP.) | V |
| Weight | 258 | g |

Note 1: RoHS3 compliant**Note 2:** LCM weight tolerance: ± 5%.



1. REVISION RECORD

| REV NO. | REV DATE | CONTENTS | REMARKS |
|---------|------------|---|---------|
| 1.0 | 2021-04-19 | Initial Release | |
| 1.1 | 2021-06-03 | Updating the drawing | |
| 1.2 | 2021-07-20 | Updating the supply voltage for backlight | |
| 1.3 | 2021-07-30 | Updating the drawing (dimensions in inches, adding the speaker) | |
| | | New template | |
| 1.4 | 2021-12-06 | Add the accessory link of Riverdi louder speaker: RVA-SPK1.5W-C150, which is matched with Riverdi's all EVE4 series displays. | |



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3. MODULE CLASSIFICATION INFORMATION

| RV | T | 70 | H | S | B | F | W | C | A0 |
|----|----|----|----|----|----|----|----|----|-----|
| 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. |

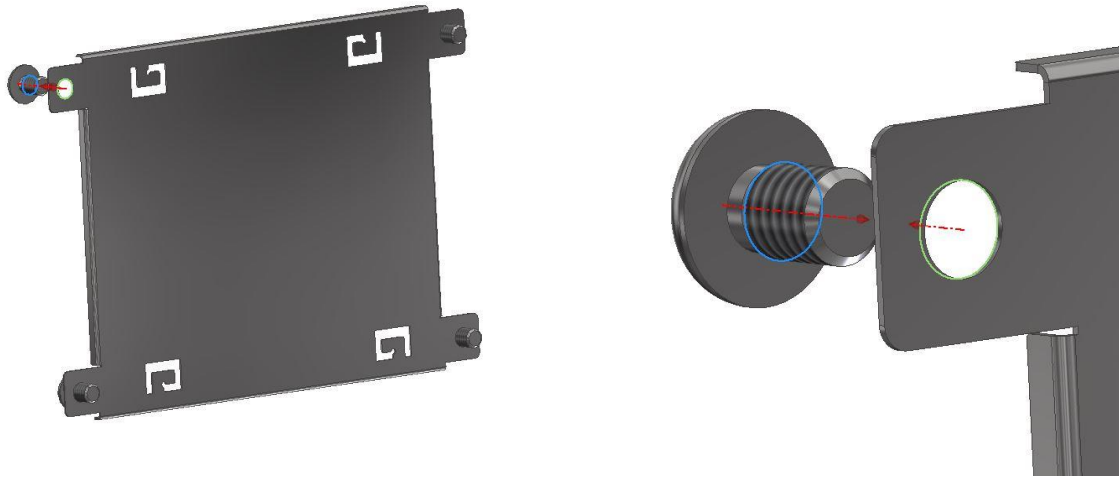
| NO. | PARAMETER | SYMBOL |
|-----|------------------|---------------------------------|
| 1. | BRAND | RV – Riverdi |
| 2. | PRODUCT TYPE | T – TFT Standard |
| 3. | DISPLAY SIZE | 70 – 7.0” |
| 4. | MODEL SERIAL NO. | H – High Brightness, IPS |
| 5. | RESOLUTION | S – 1024 x 600 px |
| 6. | INTERFACE | B – SPI/QSPI |
| 7. | FRAME | F – With Mounting Metal Frame |
| 8. | BACKLIGHT TYPE | W – LED White |
| 9. | TOUCH PANEL | C – With Capacitive Touch Panel |
| 10. | VERSION | A0 – aTouch |

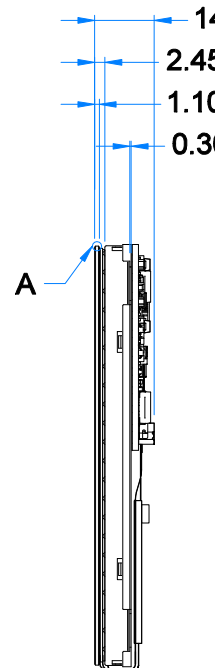
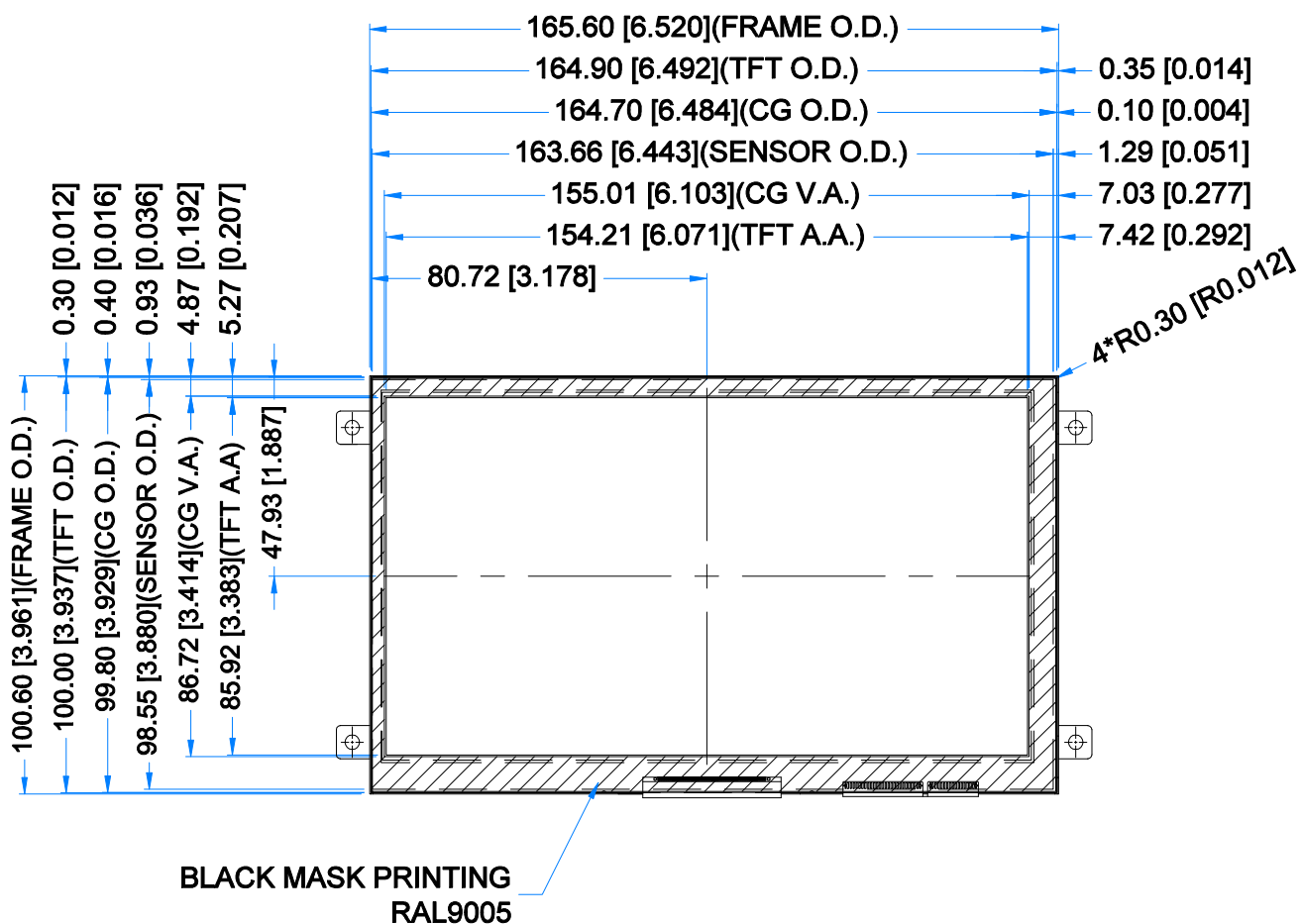
4. ASSEMBLY GUIDE

4.1 Mounting frame

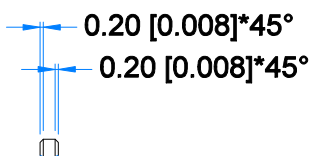
For dimensions 3.5", 4.3", 5.0", 7.0" and 10.1", the product with mounting frame version is available. Thanks to the four catches attached to the side, frame provides strong assembly to the surface by mounting element (like the screw, see Figure 1). The frames are specially designed to fit Riverdi products perfectly. The diameter of the mounting hole is 3.5mm.

Figure 1. Mounting frame

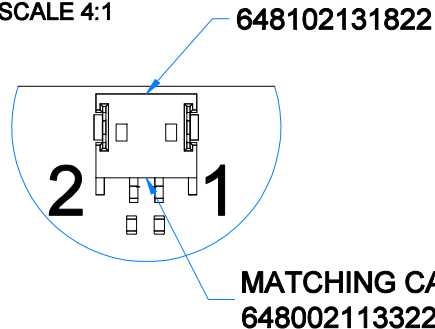




DETAIL A
 SCALE 4:1



DETAIL B
 SCALE 4:1



LCD NOTES:

1. LCD TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 1024x600
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 800 cd/m²
5. DRIVING IC ON THE BOARD: BT817Q
6. INTERFACE: SPI/QSPI
7. SUPPLY VOLTAGE FOR MODULE: 3.3V
8. SUPPLY VOLTAGE FOR BACKLIGHT:5.0V(TYP.), BUILT-IN LED INVERTER

TP NOTES:

1. TP STRUCTURE: G+G
2. CG THICKNESS: 1.10 mm
3. SURFACE HARDNESS: 7H
4. DRIVER IC: ILI2132A
5. INTERFACE: SPI/QSPI VIA RIBUS AND BT817Q

GENERAL NOTE:

1. OPERATING TEMPERATURE
2. STORAGE TEMPERATURE
3. WITHOUT INDI...
4. RoHS3 COMPLIANT



6. ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MIN | MAX | UNIT | NOTE |
|---|-----------------|------|-----|------|-----------|
| Supply Voltage for Module | VDD | 0 | 3.6 | V | NOTE 1 |
| Digital I/O signals (SPI/QSPI/GPIO) Voltage | - | -0.5 | 3.3 | | NOTE 1, 2 |
| Supply voltage for Backlight | BLVDD | -0.3 | 5.5 | | NOTE 1 |
| Operating Temperature | T _{OP} | -20 | 70 | °C | |
| Storage Temperature | T _{ST} | -30 | 80 | °C | |
| Storage Humidity (@ 25 ± 5°C) | H _{ST} | 10 | 90 | % RH | |
| Operating Ambient Humidity (@ 25 ± 5°C) | H _{OP} | 10 | 90 | % RH | |

Note 1. Exceeding the maximum values may cause improper operation or permanent damage to the unit.

Note 2. Digital I/O signals are to be connected to pins 3 ÷ 9, 11 and 12 pins at RiBUS connector (P1).

7. ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT |
|---------------------------|------------------|-----|-----|-----|------|
| Supply Voltage for Module | VDD | 3.0 | 3.3 | 3.6 | V |
| Current drawn from VDD | I _{VDD} | TBD | 235 | TBD | mA |
| Input Voltage "H" Level | V _{IH} | 2.0 | - | 3.3 | V |
| Input Voltage "L" Level | V _{IL} | - | - | 0.8 | V |

8. BACKLIGHT ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT | NOTE |
|--------------------------------|-------------------------|-----|--------|-----|-------|---------------------------|
| Supply Voltage for Backlight | BLVDD | TBD | 5.0 | 6.0 | V | |
| Current drawn from BLVDD @5.0V | I _{BLVDD=5.0V} | TBD | 362 | TBD | mA | 100% of backlight, Note 1 |
| Current drawn from BLVDD@5.0V | I _{BLVDD=5.0V} | TBD | 173 | TBD | | 50% of backlight, Note 1 |
| Current drawn from BLVDD @3.3V | I _{BLVDD=3.3V} | TBD | 1086 | TBD | | 100% of backlight, Note 1 |
| Current drawn from BLVDD@3.3V | I _{BLVDD=3.3V} | TBD | 424 | TBD | | 50% of backlight, Note 1 |
| Lifetime | - | - | 50,000 | - | hours | Note 2 |

Note 1. Backlight intensity is driven by BT817Q controller by PWM wave from GPIO pin. Please refer to subchapter 11.4.

Note 2. Operating life means the period in which the LED brightness goes down to 50% of the initial brightness. Typical operating lifetime is the estimated parameter.



9. ELECTRO-OPTICAL CHARACTERISTICS

Optical characteristics are determined after the unit has been 'ON' and stable for approximately 30 minutes in a dark environment at 25 °C. The values specified are at an approximate distance 500mm from the LCD surface at a viewing angle of Φ and θ equal to 0°.

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT | RMK | NOTE |
|----------------------------|-------------------|--|-------|-------|-------|-------------------|--------|------|
| Response Time | Tr+Tf | $\theta=0^\circ$ $\phi=0^\circ$ Ta=25 °C | - | 35 | - | ms | FIG 2. | 4 |
| Contrast Ratio | Cr | | - | 800 | - | --- | FIG 3. | 1 |
| Luminance Uniformity | δ WHITE | | - | 75 | - | % | FIG 3. | 3 |
| Surface Luminance | Lv | | - | 800 | - | cd/m ² | FIG 3. | 2 |
| Viewing Angle Range | θ | $\phi = 90^\circ$ | - | 85 | - | deg | FIG 4. | 6 |
| | | $\phi = 270^\circ$ | - | 85 | - | deg | FIG 4. | |
| | | $\phi = 0^\circ$ | - | 85 | - | deg | FIG 4. | |
| | | $\phi = 180^\circ$ | - | 85 | - | deg | FIG 4. | |
| CIE (x, y) Chromaticity | Rx | $\theta=0^\circ$ $\phi=0^\circ$ Ta=25 °C | 0.578 | 0.618 | 0.658 | - | FIG 3. | 5 |
| | Ry | | 0.489 | 0.329 | 0.369 | - | | |
| | Gx | | 0.376 | 0.416 | 0.456 | - | | |
| | Gy | | 0.493 | 0.533 | 0.573 | - | | |
| | Bx | | 0.071 | 0.111 | 0.151 | - | | |
| | By | | 0.108 | 0.148 | 0.188 | - | | |
| | Wx | | 0.270 | 0.310 | 0.350 | - | | |
| | Wy | | 0.290 | 0.330 | 0.370 | - | | |

Note 1. Contrast Ratio (CR) is defined mathematically as below, for more information see Figure 3.

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

Note 2. Surface luminance is the LCD surface from the surface with all pixels displaying white. For more information see Figure 3.

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

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

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

Note 4. Response time is the time required for the display to transition from white to black (Rise Time, Tr) and from black to white (Decay Time, Tf). For additional information see Figure 2. 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 calculating the 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 LCD surface. For more information see Figure 4.

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.

Figure 2. The definition of response time

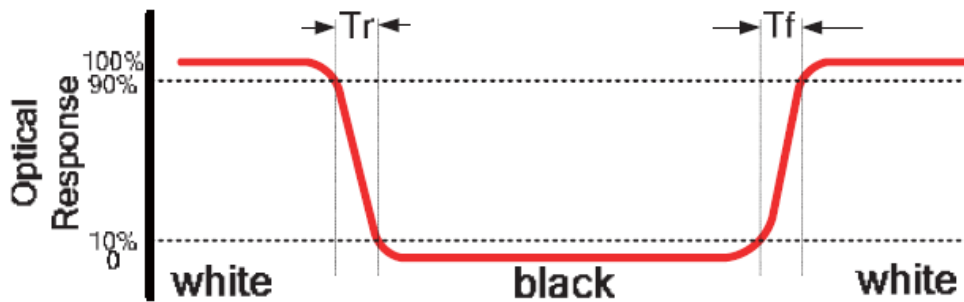
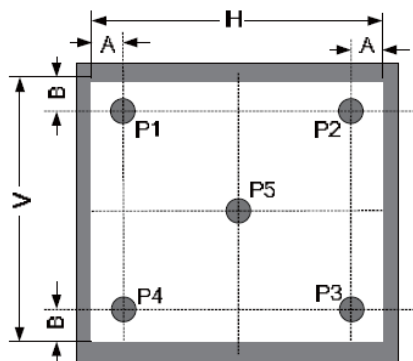


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

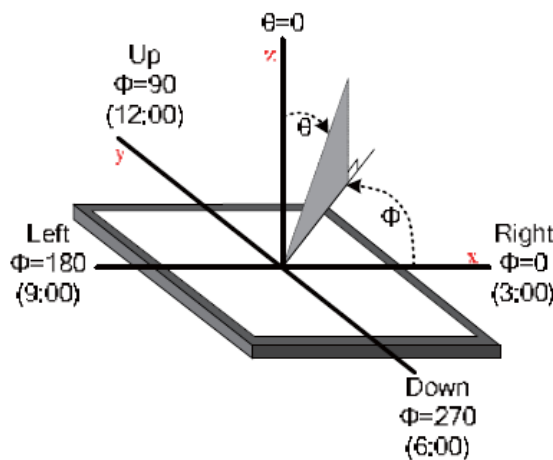
B: 5mm

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 4. The definition of viewing angle





10. INTERFACES DESCRIPTION

10.1 P1 connector - RiBUS description

| PIN NO. | CONNECTOR | DESCRIPTION | NOTE |
|---------|-------------|--|--------|
| 1 | VDD | Supply voltage for module; TYP 3.3 V | |
| 2 | GND | Ground | |
| 3 | SPI_SCLK | SPI SCK signal | |
| 4 | MISO/ IO.1 | SPI MISO signal / SPI Quad mode: SPI data line 1 | |
| 5 | MOSI/ IO.0 | SPI MOSI signal / SPI Quad mode: SPI data line 0 | |
| 6 | CS | SPI chip select signal | |
| 7 | INT | Interrupt signal from device to the system, Active Low, Internally 47k Pull UP | |
| 8 | RST/PD | Reset / Power down signal, Active Low, Internally Pulled UP 47k | |
| 9 | GPIO.0 | GPIO.0 | |
| 10 | DISP_AUDIO | Display audio in/out | NOTE 1 |
| 11 | GPIO.1/IO.2 | SPI Single/Dual mode: General purpose IO0. QSPI mode: SPI data line 2 | |
| 12 | GPIO.2/IO.3 | SPI Single/Dual mode: General purpose IO1. QSPI mode: SPI data line 3 | |
| 13 | NC | Not connected | |
| 14 | NC | Not connected | |
| 15 | NC | Not connected | |
| 16 | NC | Not connected | |
| 17 | BLVDD | Supply voltage for backlight | |
| 18 | BLVDD | Supply voltage for backlight | |
| 19 | BLGND | Backlight Ground, Internally connected to GND | |
| 20 | BLGND | Backlight Ground, Internally connected to GND | |

Note 1. Requirements for audio external signal voltage will be announced after samples have been tested.

10.2 P2 connector description

| PIN NO. | SYMBOL | DESCRIPTION | NOTE |
|---------|-----------|---------------------------|--------|
| 1 | SPEAKER + | Speaker coil "+" terminal | NOTE 1 |
| 2 | SPEAKER - | Speaker coil "-" terminal | |

The audio circuit allows for the following 3 things:

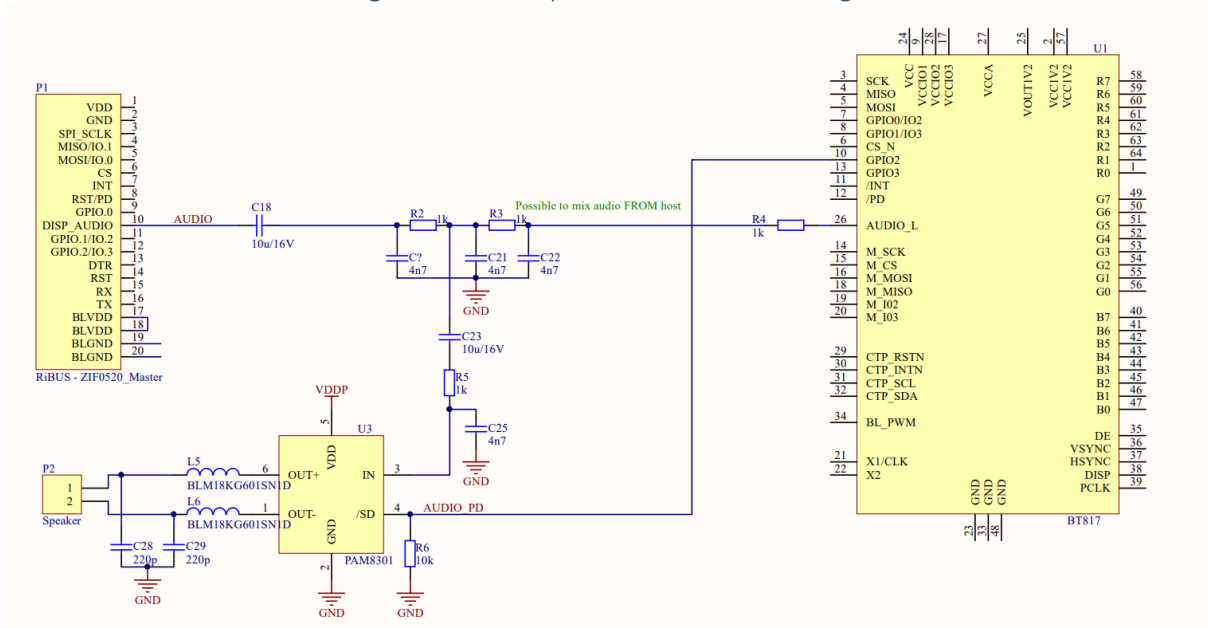
1. To play sounds from BT817Q on internal amplifier U3.
2. To play sounds from host on internal amplifier U3.
3. To play sounds from BT817Q on external amplifier.

Note 1. A matched louder speaker for Riverdi's all EVE4 series displays, RVA-SPK1.5W-C150, is developed by Riverdi. Below is the link to this accessory.

<https://riverdi.com/product/rva-spk1-5w-c150/>



Figure 5. The simplified audio circuit design



Note 2. Controller board in RVT70HSBFWCA0 is equipped with the separate 512Mb flash memory chip, which allows to store up to 170 full resolution (1024 * 600 pixels, JPG) images. If you need to change the memory size, please contact us: contact@riverdi.com

11. BT817Q CONTROLLER SPECIFICATION

BT817Q or EVE4 (Embedded Video Engine 4) 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.

11.1 Serial host interface

Figure 6. SPI single/dual interface connection

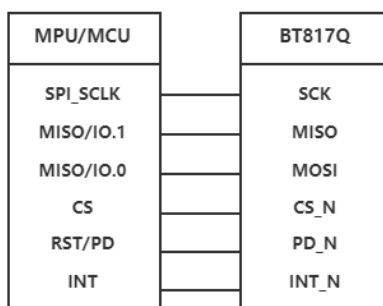
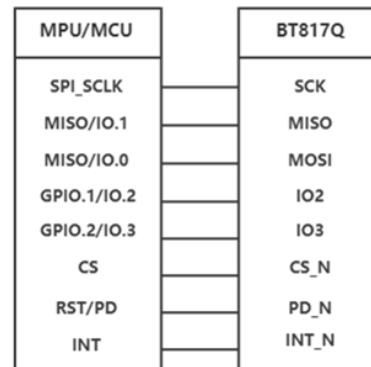


Figure 7. QSPI interface connection



SPI Interface – the SPI slave interface operates up to 30MHz (It depends on EVE4 system clock frequency and needs verification in Riverdi lab).

Only SPI mode 0 is supported. The SPI interface is selected by default.

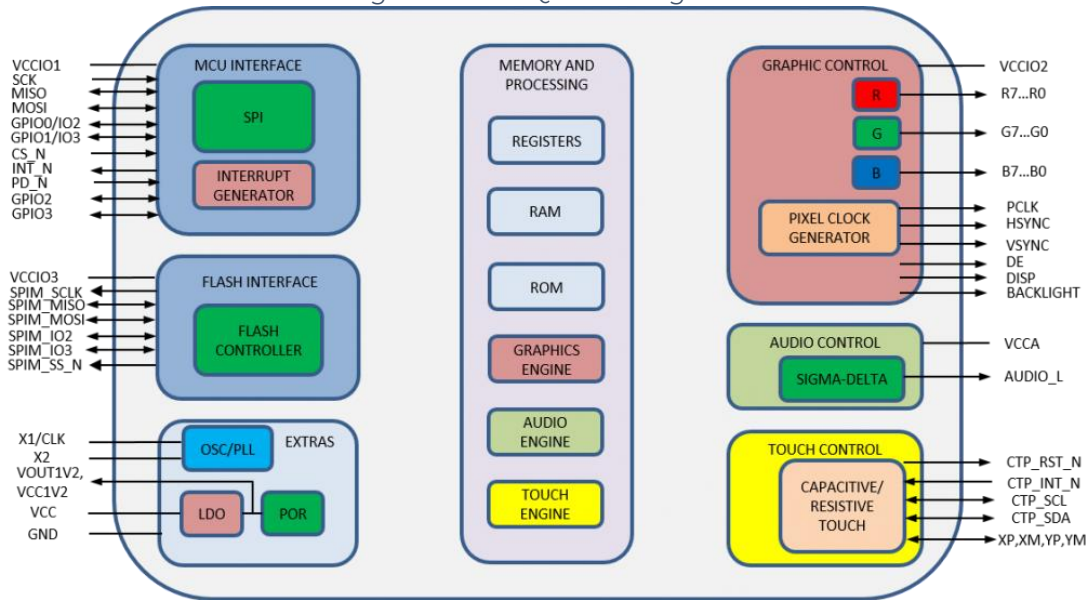
QSPI Interface – the QSPI slave interface operates up to 30MHz (It depends on EVE 4 system clock frequency and will be verified in Riverdi lab). Only SPI mode 0 is supported.

The QSPI can be configured as a SPI slave in SINGLE, DUAL or QUAD channel 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_SPLWIDTH.

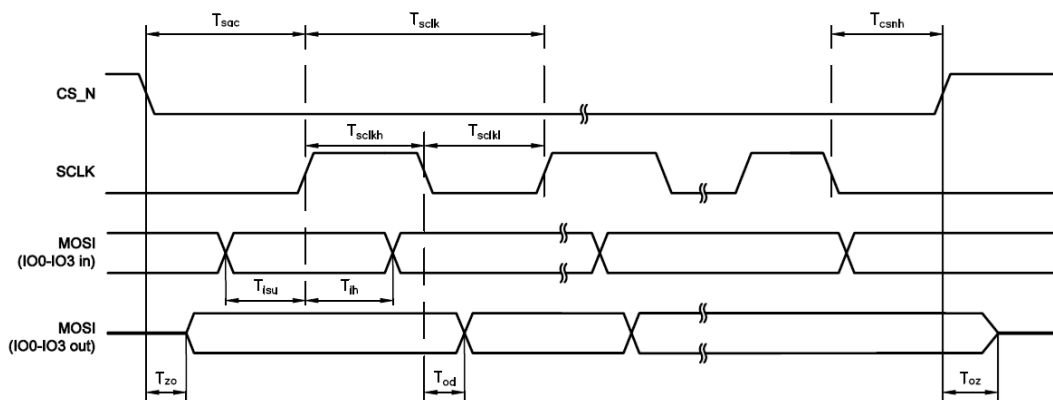
11.2 Block Diagram

Figure 8. BT817Q Block diagram



11.3 Host interface SPI mode 0

Figure 9. SPI timing diagram



The meanings of the timings in the Figure 9 are defined in the table below.



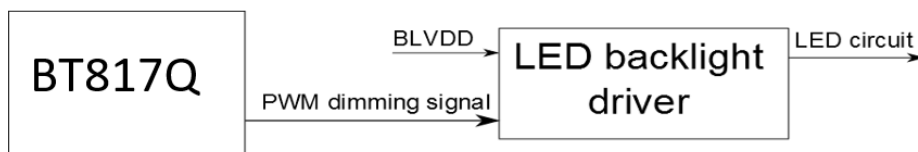
| PARAMETER | DESCRIPTION | VCCIO=1.8V | | VCCIO=2.5V | | VCCIO=3.3V | | UNIT |
|-------------------|-------------------------|------------|-----|------------|-----|------------|-----|------|
| | | Min | Max | Min | Max | Min | Max | |
| T _{sclk} | SPI clock period | 33.3 | - | 33.3 | - | 33.3 | - | ns |
| T _{sckl} | SPI clock low duration | 13 | - | 13 | - | 13 | - | |
| T _{sckh} | SPI clock high duration | 13 | - | 13 | - | 13 | - | |
| T _{sac} | SPI access time | 4 | - | 3.5 | - | 3 | - | |
| T _{isu} | Input Setup | 4 | - | 3.5 | - | 3 | - | |
| T _{ih} | Input Hold | 0 | - | 0 | - | 0 | - | |
| T _{zo} | Output enable delay | - | 16 | - | 13 | 11 | - | |
| T _{oz} | Output disable delay | - | 13 | - | 11 | 10 | - | |
| T _{od} | Output data delay | - | 15 | - | 12 | 11 | - | |
| T _{csnh} | CSN hold time | 0 | - | 0 | - | 0 | - | |

For more information about BT817Q controller please go to official BT81x website. <https://brtchip.com/bt81x/>

11.4 Backlight driver block diagram

Backlight enable signal is internally connected to BT817Q backlight control pin. This pin is controlled by two BT817Q's registers. One of them specifies the PWM output frequency, second one specifies the duty cycle. Refer to BT817Q datasheet for more information. After we have done the test on samples, more detailed description will be given in this document.

Figure 10. Backlight driver block diagram

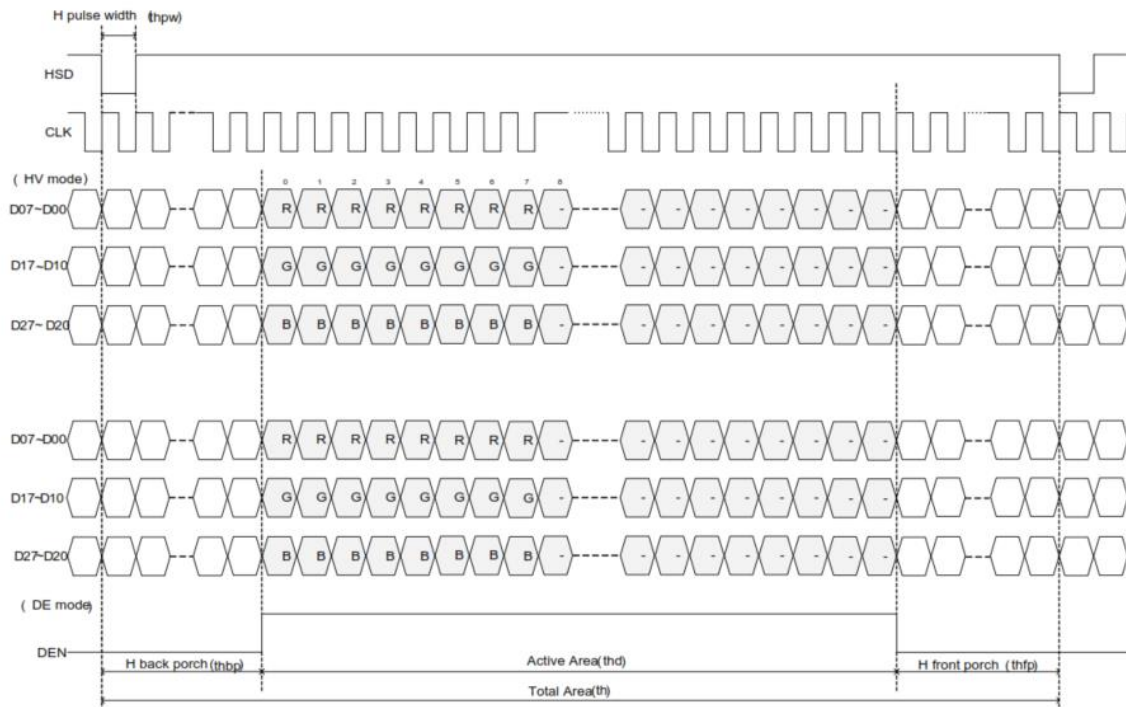


The LED backlight driver used in this module does not burst the LED current. Therefore, it does not generate audible noises on the output capacitor. It is equipped with soft start subsystem, which increases LED lifetime, as LED current peaks are reduced significantly.

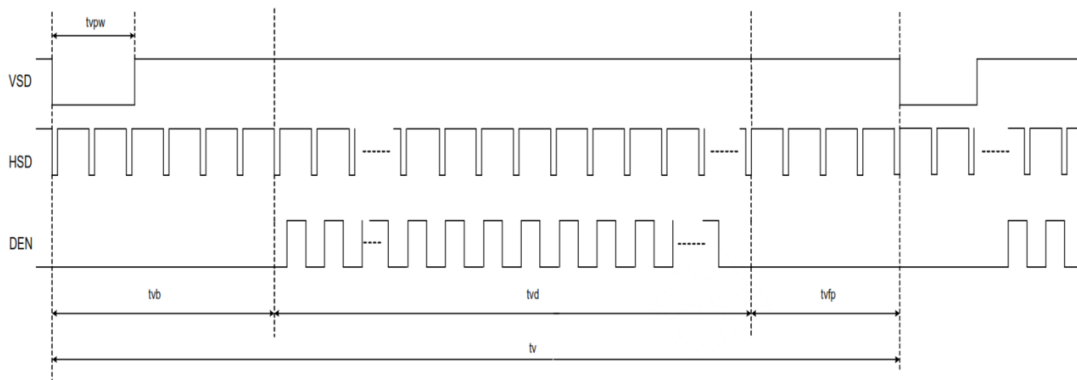


12. TFT LCD TIMING CHARACTERISTICS

12.1 Horizontal input timing



12.2 Vertical input timing





12.3 Parallel RGB timing characteristics

Note: DE/SYNC mode select. Pin is internally pulled high. H: DE Mode. L: HS/VS mode.
When select DE mode, MODE = "1", VS and HS must be pulled high.

12.3.1 DE MODE

| PARAMETER | SYMBOL | VALUE | | | UNIT |
|-------------------------------------|------------------|-------|------|------|------|
| | | MIN. | TYP. | MAX. | |
| DCLK frequency (Frame rate 60Hz) | f_{clk} | 40.8 | 51.2 | 67.2 | MHz |
| Horizontal display area | t_{hd} | 1024 | | | DCLK |
| HSYNC period time | t_h | 1114 | 1344 | 1400 | |
| HSYNC blanking | $t_{hb}+t_{hfp}$ | 90 | 320 | 376 | |
| Vertical display area | t_{vd} | 600 | | | H |
| VSYNC period time | t_v | 610 | 635 | 800 | |
| VSYNC blanking | $t_{vb}+t_{vfp}$ | 10 | 85 | 200 | |

12.3.2 HV MODE - Horizontal input timing

| PARAMETER | SYMBOL | VALUE | | | UNIT |
|-------------------------------------|-----------|-------|------|------|------|
| | | MIN. | TYP. | MAX. | |
| Horizontal display area | t_{hd} | 1024 | | | DCLK |
| DCLK frequency (frame rate 60Hz) | f_{clk} | 44.9 | 51.2 | 63 | MHz |
| 1 Horizontal Line | t_h | 1200 | 1344 | 1400 | DCLK |
| HSYNC pulse width | t_{hpw} | 1 | - | 140 | |
| HSYNC back porch | t_{hbp} | 160 | 160 | 160 | |
| HSYNC front porch | t_{hfp} | 16 | 160 | 216 | |

12.3.3 HV MODE - Vertical input timing

| PARAMETER | SYMBOL | VALUE | | | UNIT |
|-----------------------|-----------|-------|------|------|------|
| | | MIN. | TYP. | MAX. | |
| Vertical display area | t_{vd} | 600 | | | H |
| VSYNC period time | t_v | 624 | 635 | 750 | |
| VSYNC pulse width | t_{vpw} | 1 | - | 20 | |
| VSYNC back porch | t_{vb} | 23 | 23 | 23 | |
| VSYNC front porch | t_{vfp} | 1 | 12 | 127 | |



13. CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

13.1 Mechanical characteristics

| DESCRIPTION | | SPECIFICATION | REMARK |
|--------------------------|--|----------------------|--------|
| Touch Panel Size | | 7.0 inch | aTouch |
| Outline Dimension of CTP | | 164.70 mm x 99.80 mm | |
| Product Thickness | | 2.45 mm | |
| Glass Thickness | | 1.1 mm | |
| CTP View Area | | 155.01 mm x 86.72 mm | |
| Sensor Active Area | | 156.68 mm x 88.52 mm | |
| Structure type | | Glass + Glass | |
| Surface Hardness | | 7H | |

13.2 Electrical characteristics

| DESCRIPTION | | SPECIFICATION | REMARK |
|-------------------------|-------------|---------------|--------|
| Power Consumption (IDD) | Active Mode | 96 mA | Note 1 |
| | Sleep Mode | 10 mA | Note 1 |
| Linearity | | +/- 1.5mm | |
| Controller | | ILI2132A | |
| Resolution | | 1024 x 600 | |

Note 1. These 2 values will be verified on the real samples.



14. MODULE INITIALIZATION

1. There is no need to set touch calibration matrix (REG_TOUCH_TRANSFORM_A-F registers in BT817Q) as touch panel resolution and orientation are the same as display, so default values in BT817Q are correct.
2. Initialization data, timings and example codes are available on the Riverdi GitHub, at address: <https://github.com/riverdi/riverdi-eve>
3. REGISTER VALUES:

| | |
|---------------|-------|
| REG_HSIZE | 1024 |
| REG_VSIZE | 600 |
| REG_HCYCLE | 1344 |
| REG_HOFFSET | 160 |
| REG_HSYNC0 | 0 |
| REG_HSYNC1 | 70 |
| REG_VCYCLE | 635 |
| REG_VOFFSET | 23 |
| REG_VSYNC0 | 0 |
| REG_VSYNC1 | 10 |
| REG_PCLK | 1 |
| REG_SWIZZLE | 0 |
| REG_PCLK_POL | 1 |
| REG_CSPREAD | 0 |
| REG_DITHER | 0 |
| REG_PCLK_FREQ | 0xD12 |
| REG_PCLK_2X | 0 |

15. INSPECTION

Standard acceptance/rejection criteria for TFT module

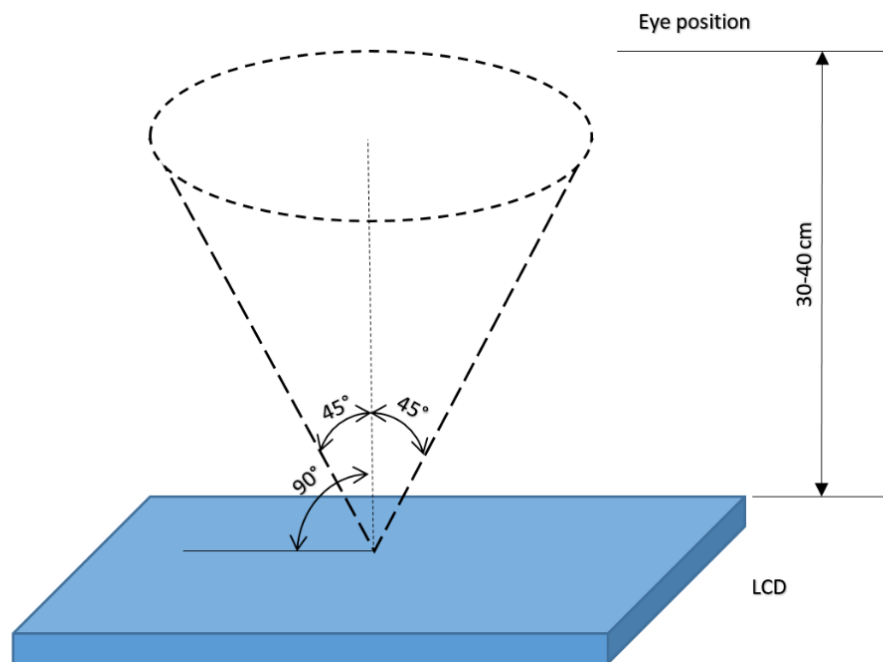
15.1 Inspection condition

Ambient conditions:

- Temperature: $25 \pm 2^{\circ}\text{C}$
- Humidity: $(60 \pm 10) \%RH$
- Illumination: Single fluorescent lamp non-directive (300 to 700 lux)

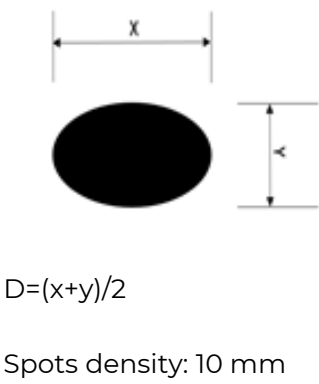
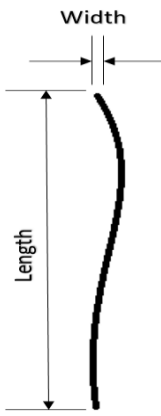
Viewing distance: $35 \pm 5\text{cm}$ between inspector bare eye and LCD.

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





15.2 Inspection standard

| ITEM | | CRITERION | | |
|--|--|--|---------------------|---------------|
| Black spots, white spots, light leakage, Foreign Particle (round Type) |  | Size =7" | | |
| | | Average Diameter | Qualified Qty | |
| | | $D \leq 0.2 \text{ mm}$ | Ignored | |
| | | $0.2 \text{ mm} < D \leq 0.3 \text{ mm}$ | N≤3 | |
| | | $0.5\text{mm} < D$ | Not allowed | |
| LCD black spots, white spots, light leakage (line Type) |  | Size =7" | | |
| | | Length | Width | Qualified Qty |
| | | - | $W \leq 0.05$ | Ignored |
| | | $L \leq 5.0$ | $0.05 < W \leq 0.1$ | 3 |
| | | $5.0 < L$ | $0.10 < W$ | Not allowed |
| Bright/Dark Dots | Size =7" | | | |
| | Item | Qualified Qty | | |
| | Bright dots | $N \leq 2$ | | |
| | Dark dots | $N \leq 3$ | | |
| | Total Bright and Dark Dots | $N \leq 4$ | | |
| Clear spots | Size ≥ 5" | | | |
| | Average Diameter | Qualified Qty | | |
| | $D < 0.2 \text{ mm}$ | Ignored | | |
| | $0.2 \text{ mm} < D < 0.3 \text{ mm}$ | 4 | | |
| | $0.3 \text{ mm} < D < 0.5 \text{ mm}$ | 2 | | |
| | $0.5 \text{ mm} < D$ | 0 | | |
| | Spots density: 10 mm | | | |
| Polarizer bubbles | Size = 7" | | | |
| | Average Diameter | Qualified Qty | | |
| | $D \leq 0.2 \text{ mm}$ | Ignored | | |
| | $0.2 \text{ mm} < D \leq 0.5 \text{ mm}$ | 2 | | |
| | $0.5 \text{ mm} < D$ | 1 | | |
| Touch panel spots | Size ≥ 5" | | | |
| | Average Diameter | Qualified Qty | | |
| | $D < 0.25 \text{ mm}$ | Ignored | | |
| | $0.25 \text{ mm} < D < 0.5 \text{ mm}$ | 4 | | |



| | 0.5 mm < D | | 0 |
|--------------------------------------|------------|-----------------|---------------|
| Touch panel white line scratch | Size ≥ 5" | | |
| | Length | Width | Qualified Qty |
| | - | W < 0.03 | Ignored |
| | L < 5.0 | 0.03 < W < 0.05 | 2 |
| | - | 0.05 < W | 0 |

16.RELIABILITY TEST

| NO. | TEST ITEM | TEST CONDITION | NOTE |
|-----|-------------------------------------|--|--------|
| 1 | High Temperature Storage | 80°C/120 hours | Note 1 |
| 2 | Low Temperature Storage | -30°C/120 hours | |
| 3 | High Temperature Operating | 70 °C /120 hours | |
| 4 | Low Temperature Operating | -20°C/120 hours | |
| 5 | High Temperature and High Humidity | Humidity 40°C, 90%RH, 120Hrs | |
| 6 | Thermal Cycling Test (No operation) | -20°C for 30min, 70°C for 30 min. 100 cycles. Then test at room temperature after 1 hour | Note 2 |
| 7 | Vibration Test | Frequency: 10 ÷ 55 Hz. Stroke: 1.5 mm. Sweep: 10Hz ÷ 55Hz ÷ 10 Hz. 2 hours for each direction of X, Y, Z (Total 6 hours) | |
| 8 | Package Drop Test | Height: 60 cm 1 corner, 3 edges, 6 surfaces | |

Note 1. Sample quantity for each test item is 5 ÷ 10 pcs.

Note 2. Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.



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