



RVT50HQSFWN00

STM32 EMBEDDED 5.0" DISPLAY DATASHEET

Rev.1.0

2023-05-24

| ITEM | CONTENTS | UNIT |
|--------------------------------|--|-------------------|
| LCD Type | TFT/Transmissive/Normally Black/IPS | / |
| Size | 5.0 | Inch |
| Viewing Direction | Free | / |
| Outside Dimensions (W x H x D) | 137.50 x 76.60 x 10.81 | mm |
| Active Area (W x H) | 108.00 x 64.80 | mm |
| Pixel Pitch (W x H) | 0.135 x 0.135 | mm |
| Resolution | 800 x 480 | / |
| Brightness | 1000 | cd/m ² |
| Color Depth | 16.7 M | / |
| Pixel Arrangement | RGB Vertical Stripe | / |
| Micro Controller Unit | STM32U599NJH6Q or STM32U5A9NJH6Q in Mass Production 4MB Flash, 2.5MB RAM | / |
| External Flash Memory | 512Mbit | / |
| Supply Voltage for Module | 6.0 - 48.0 | V |
| With/Without Touch | Without Touch Panel | / |
| Weight | TBD | g |

Note 1. RoHS3 compliant

Note 2. LCM weight tolerance: $\pm 5\%$.



1. REVISION RECORD

| REV NO. | REV DATE | CONTENTS | REMARKS |
|---------|------------|-----------------|---------|
| 1.0 | 2023-05-24 | Initial Release | |



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3. MODULE CLASSIFICATION INFORMATION

| RV | T | 50 | H | Q | S | F | W | N | 00 |
|----|----|----|----|----|----|----|----|----|-----|
| 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 | 50 – 5.0” |
| 4. | MODEL SERIAL NO. | H – High Brightness, IPS TFT |
| 5. | RESOLUTION | Q – 800x480 px |
| 6. | LCD+CONTROL BOARD | S –STM32 Embedded Display MCU STM32U599NJH6Q or STM32U5A9NJH6Q |
| 7. | FRAME | F – With Mounting Metal Frame |
| 8. | BACKLIGHT TYPE | W – LED White |
| 9. | TOUCH PANEL | N – Without Touch Panel |
| 10. | VERSION | 00 – (00-99) |

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.

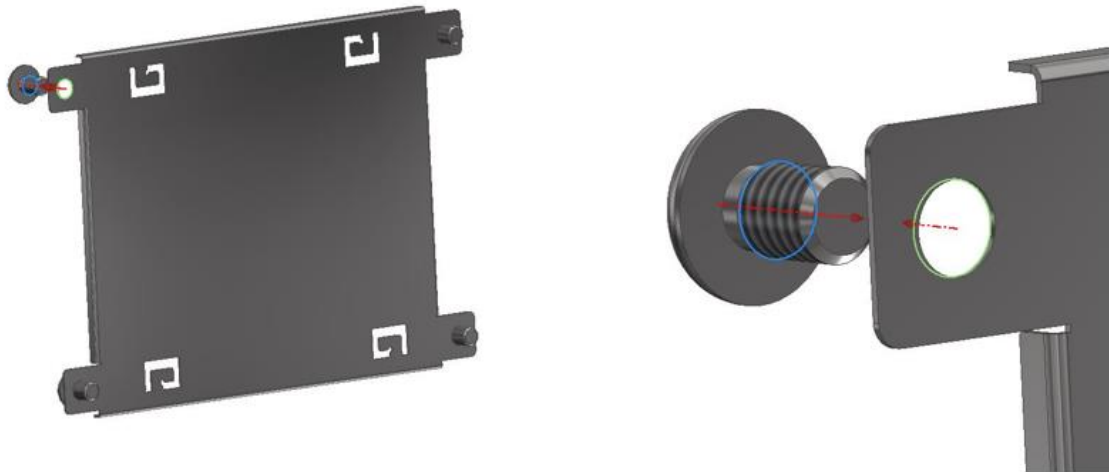
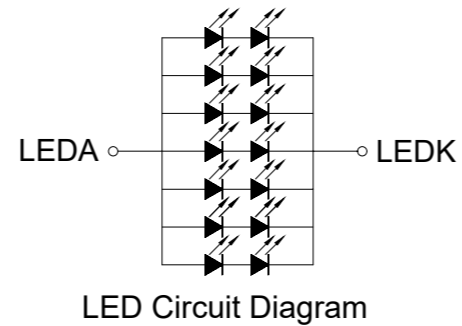
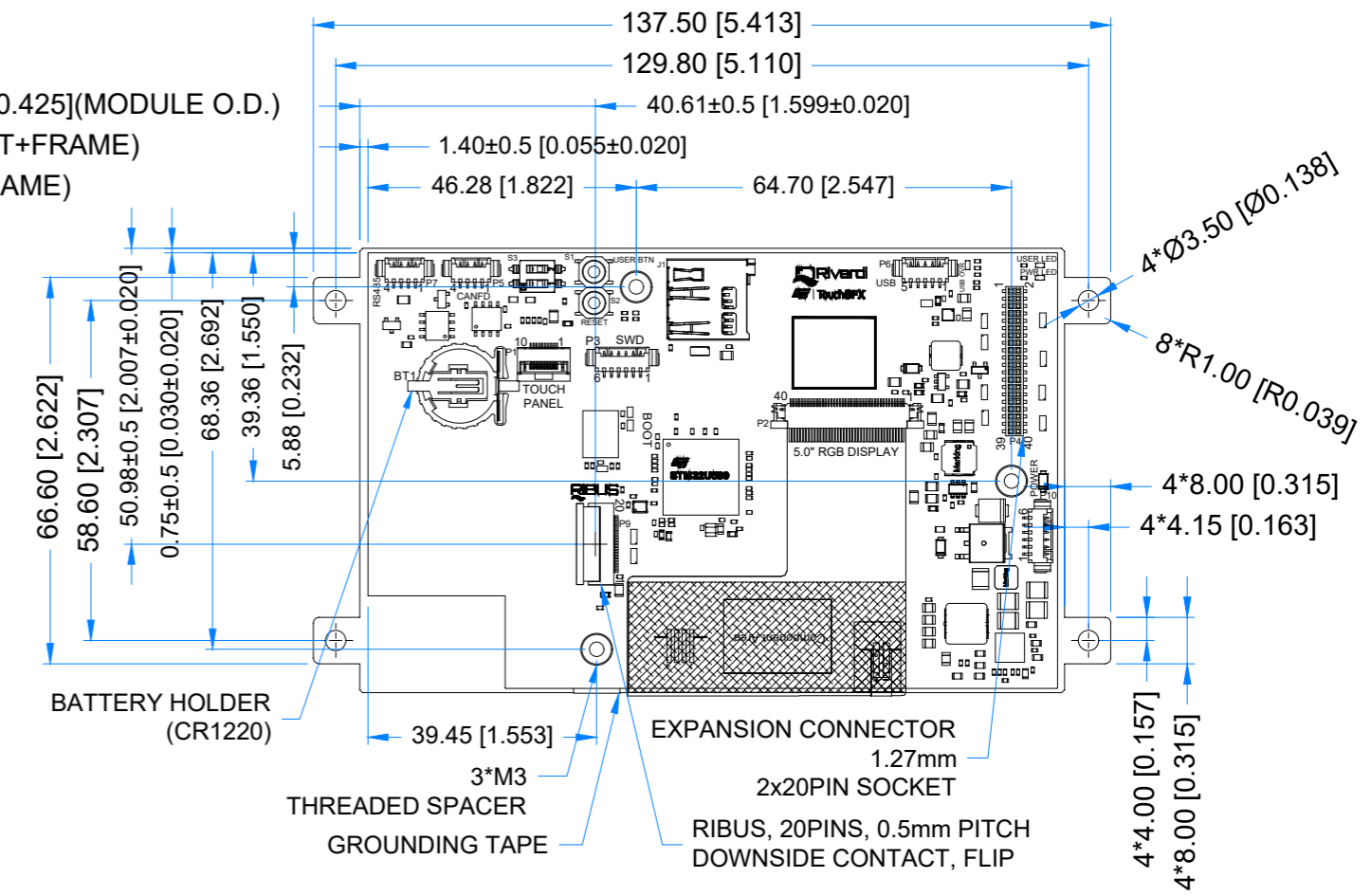
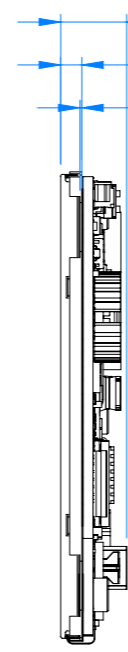
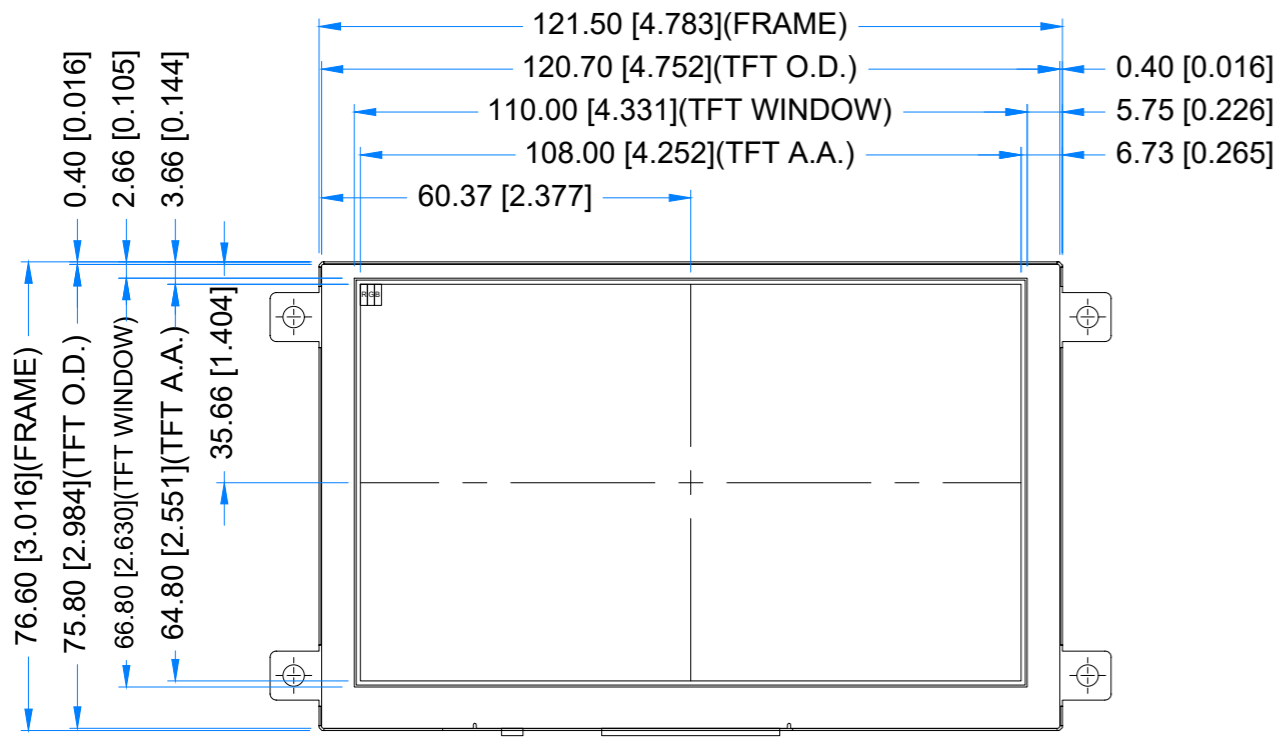


Figure 1. Mounting frame

| | | |
|-----------|--------------|------------|
| Revision: | Changes: | Date: |
| 1.0 | Initial Case | 2023.05.24 |



1.25 MM MOLEX CONNECTORS

| NO. | TYPE | MATE WITH |
|-------------|------------|------------|
| P3 (SWD) | 53261-0671 | 51021-0600 |
| P5 (CAN) | 53261-0471 | 51021-0400 |
| P6 (USB) | 53261-0571 | 51021-0500 |
| P7 (RS485) | 53261-0471 | 51021-0400 |
| P10 (POWER) | 53261-0671 | 51021-0600 |

1.27MM PIN SOCKET

| NO. | TYPE | MATE WITH |
|-----|----------------|-------------------------------|
| P4 | CBC1402M100-2P | CH51402M100-0P OR CH51402V100 |

TFT NOTES:

1. DISPLAY TYPE: TRANSMISSIVE, NORMALLY BLACK, IPS
2. RESOLUTION: 800x480
3. VIEWING ANGLE: FREE
4. SURFACE LUMINANCE: 1000 cd/m²
5. MCU ON THE BOARD: STM32U599NJH6Q OR STM32U5A9NJH6Q IN MASS PRODUCTION
6. EXTERNAL FLASH MEMORY SIZE: 512Mbit
7. SUPPLY VOLTAGE FOR MODULE: 6.0V - 48.0V

GENERAL NOTES:

1. OPERATING TEMPERATURE: -20°C ~ 70°C
2. STORAGE TEMPERATURE: -30°C ~ 80°C
3. WITHOUT INDIVIDUAL TOLERANCE: ±0.3mm[0.012inch]
4. TOLERANCE OF PCB PLACEMENT: ±0.5mm[0.020inch]
5. RoHS3 COMPLIANT

| | | | |
|--------------------|------------|--------|--|
| PN: RVT50HQSFWN00 | | | |
| SN: | | | |
| DRAWN: M.Natywa | 2023.05.15 | 1:1.24 | |
| CHECKED: Carol Gao | 2023.05.24 | [mm] | |
| APPR: | | ISO A3 | |



6. ABSOLUTE MAXIMUM RATINGS

| PARAMETER | SYMBOL | MIN | MAX | UNIT | NOTE |
|---|-----------------|------|------|------|----------|
| Supply Voltage for Module | VDD_IN | 0.0 | 60.0 | V | Note 1 |
| Digital I/O signals Voltage | - | -0.5 | 3.3 | | Note 1,2 |
| Operating Temperature | T _{OP} | -20 | 70 | °C | |
| Storage Temperature | T _{ST} | -30 | 80 | °C | |
| Storage Humidity (@ 25 ± 5°C) | H _{ST} | 10 | - | % RH | |
| Operating Ambient Humidity (@ 25 ± 5°C) | H _{OP} | 10 | - | % RH | |

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

Note 2. Most of the GPIOs have the 5.0 V tolerant input voltage, please refer to the datasheet of MCU for more details.

7. ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT |
|---------------------------|-----------------|-----|------|--------|------|
| Supply Voltage for Module | VDD_IN | 6.0 | 12.0 | 48.0 | V |
| Power Enable Voltage | VEN | 0 | - | VDD_IN | V |
| Input Voltage "H" Level | V _{IH} | 2.0 | - | 3.3 | V |
| Input Voltage "L" Level | V _{IL} | 0 | - | 0.8 | V |

| PARAMETER | CONDITION | SYMBOL | 1%BL | 50% BL | 100% BL | UNIT |
|----------------------------------|-------------------------|---------------------|------|--------|---------|------|
| Current Drawn from VDD_IN @6.0V | POWER 'ENABLE' = '0' | I _{VDD_IN} | 60 | | | uA |
| Current Drawn from VDD_IN @12.0V | | | 149 | | | |
| Current Drawn from VDD_IN @24.0V | | | 388 | | | |
| Current Drawn from VDD_IN @36.0V | | | 630 | | | |
| Current Drawn from VDD_IN @48.0V | | | 872 | | | |
| Current Drawn from VDD_IN @6.0V | POWER 'ENABLE' = '1' | I _{VDD_IN} | 94 | 248 | 405 | mA |
| Current Drawn from VDD_IN @12.0V | | | 46 | 121 | 202 | |
| Current Drawn from VDD_IN @24.0V | | | 24 | 62 | 104 | |
| Current Drawn from VDD_IN @36.0V | | | 16 | 43 | 71 | |
| Current Drawn from VDD_IN @48.0V | | | 13 | 34 | 56 | |

Note 1. POWER 'ENABLE' refers to pin 4, 'ENABLE' of the power input connector(P10).

POWER 'ENABLE' = '1' is when EN pin is floating or shorted to VDD_IN.

POWER 'ENABLE' = '0' is when EN pin is shorted to GND.

By default, POWER 'ENABLE' is set to "1".



8. BACKLIGHT ELECTRICAL CHARACTERISTICS

| PARAMETER | SYMBOL | MIN | TYP | MAX | UNIT | NOTE |
|-----------|--------|-----|--------|-----|-------|--------|
| Lifetime | - | - | 50,000 | - | hours | Note 1 |

Note 1. 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

| ITEM | SYMBOL | CONDITION | MIN | TYP | MAX | UNIT | RMK | NOTE |
|----------------------------|-------------------|---|-------|-------|-------|-------------------|--------|------|
| Response Time | Tr+Tf | | - | 30 | - | ms | FIG 2. | 4 |
| Contrast Ratio | Cr | $\theta=0^\circ$ | 800 | 1000 | - | --- | | 1 |
| Luminance Uniformity | δ WHITE | $\varnothing=0^\circ$ Ta=25 °C | - | 75 | - | % | FIG 3. | 3 |
| Surface Luminance | Lv | | - | 1000 | - | cd/m ² | | 2 |
| Viewing Angle Range | θ | $\varnothing = 90^\circ$ | - | 80 | - | deg | FIG 4. | 6 |
| | | $\varnothing = 270^\circ$ | - | 80 | - | | | |
| | | $\varnothing = 0^\circ$ | - | 80 | - | | | |
| | | $\varnothing = 180^\circ$ | - | 80 | - | | | |
| CIE (x, y) Chromaticity | Rx | $\theta=0^\circ$ $\varnothing=0^\circ$ Ta=25 °C | 0.575 | 0.615 | 0.655 | - | FIG 3. | 5 |
| | Ry | | 0.296 | 0.336 | 0.376 | - | | |
| | Gx | | 0.352 | 0.392 | 0.432 | - | | |
| | Gy | | 0.512 | 0.552 | 0.592 | - | | |
| | Bx | | 0.100 | 0.140 | 0.180 | - | | |
| | By | | 0.085 | 0.125 | 0.165 | - | | |
| | Wx | | 0.274 | 0.316 | 0.358 | - | | |
| | Wy | | 0.294 | 0.336 | 0.378 | - | | |

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 BM-7A.



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. 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. Viewing angle is measured at the center point of the LCD by CONOSCOPE (ergo-80). For response time testing, the testing data is based on BM-7A. Instruments for Contrast Ratio, Surface Luminance, Luminance Uniformity, Chromaticity the test data is based on SR-3A.

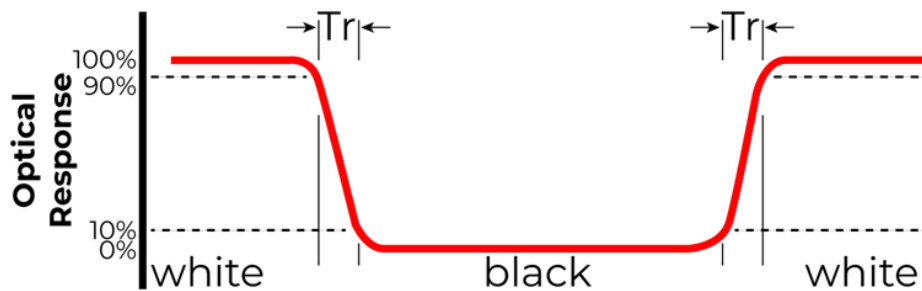


Figure 2. The definition of response time

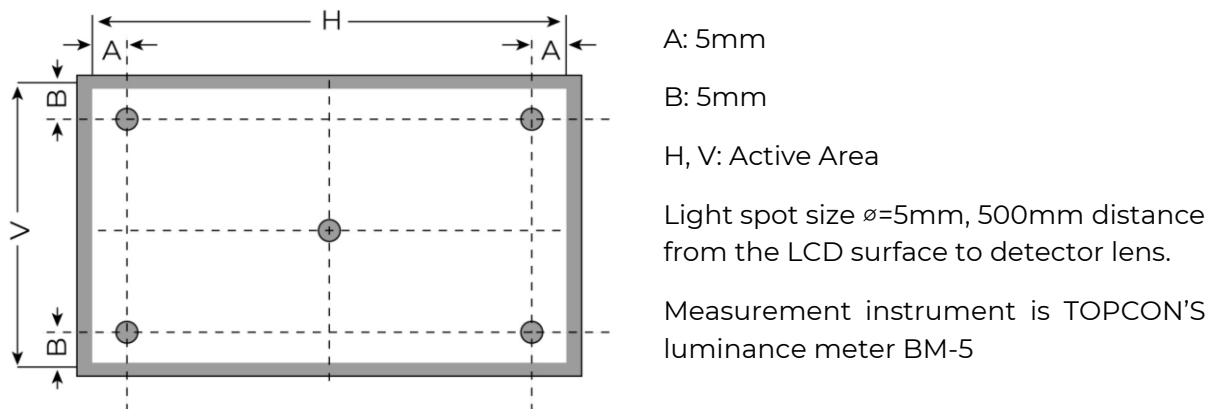


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity

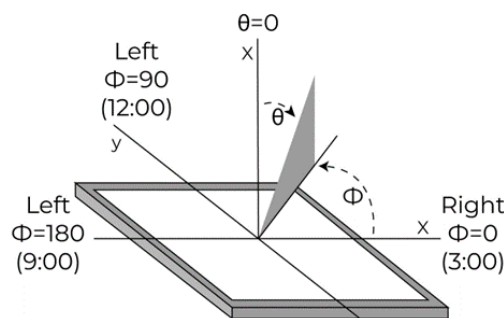


Figure 4. The definition of viewing angle



10. BOARD INTERFACES AND CONNECTORS

10.1 Power input connector

The 1.25mm, 6-pin Molex connector labeled as "POWER' (P10) is power input connector.

There is an internal reverse polarity protection which ensures that the device is not damaged if the power supply polarity is reversed.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|--------|-------------------------------|--------|
| 1 | VDD_IN | Power supply input; 6.0-48.0V | Note 1 |
| 2 | VDD_IN | Power supply input; 6.0-48.0V | |
| 3 | VDD_IN | Power supply input; 6.0-48.0V | |
| 4 | ENABLE | Enable/ Disable power supply | Note 2 |
| 5 | GND | Ground | |
| 6 | GND | Ground | |

Note 1. The STM32 Embedded Display system allows for the direct connection of an additional display through the RiBUS connector on the board. You can connect any intelligent display from Riverdi based on EVE4 (BT817Q). Please see chapter 10.6 for detailed info.

Note 2. The "ENABLE" pin is internally pulled up to VDD_IN.

To enable the device, please leave the EN pin unconnected or short it to the "VDD_IN" pin.

To disable the device, short the EN pin to GND.

Note 3. Matched Riverdi power supply cable: RVA-0106M-1.25FF-1.

10.2 USB interface

The 1.25mm, 5-pin Molex connector labeled as "USB' (P6) is USB interface.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|---------|---------------------------------|--------|
| 1 | VCC_USB | Power supply | Note 1 |
| 2 | D- | USB data- | |
| 3 | D+ | USB data+ | |
| 4 | ID | USB OTG ID; Host /Device detect | Note 2 |
| 5 | GND | Ground | |

Note 1. The maximum current drawn from VCC_USB is 500mA.

Note 2. Configuration of the USB Host/Device mode:

Host Mode: Pin 4 (ID) should be connected to GND.

In this mode, it can provide +5V output voltage to the connected USB device and Max output current 500 mA.

Device Mode: Pin 4 (ID) should be not connected (floating).

Note 3. Matched Riverdi cable accessory: RVA-0105M-1.25FF



10.3 RS485 interface

The 1.25mm, 4-pin Molex connector labeled as "RS485" (P7) is RS485 interface.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|--------|--|------|
| 1 | VDD_IN | Power supply input; 6.0-48.0V | |
| 2 | A | Non-inverting receiver input and non-inverting driver output | |
| 3 | B | Inverting receiver input and inverting driver output | |
| 4 | GND | Ground | |

Note 1. The termination resistor R18 (120 ohms) is mounted.

Note 2. Matched Riverdi cable accessory: RVA-0104M-1.25FF.

10.4 CAN FD interface

The 1.25mm, 4-pin Molex connector labeled as 'CANFD'(P5) is CANFD (Control Area Network Flexible Data-Rate) communication bus, based on the high-speed (2.5-8.0Mbps) CAN transceiver.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|--------|---------------------------------|------|
| 1 | GND | Ground | |
| 2 | CAN_L | CAN Low-Level Voltage | |
| 3 | CAN_H | CAN High-Level Voltage | |
| 4 | VDD_IN | Power supply input; 6.0 – 48.0V | |

Note 1. Termination resistors R35,R36 (both 60R) are mounted. Dip switch S3 is used to enable and disable the termination resistors.

Enable: Set 1&2 to ON **Disable:** Set 1&2 to OFF

Note 2. Matched Riverdi cable accessory: RVA-0104M-1.25FF

10.5 SWD (Serial Wire Debug) connector

The 1.25mm, 6-pin Molex connector labeled as 'SWD' (P3) is SWD interface, which is used for programming the MCU on board.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|-----------|-------------------------------------|------|
| 1 | VCC_+3.3V | Power input | |
| 2 | SW_CLK | Serial wire clock | |
| 3 | GND | Ground | |
| 4 | SW_DIO | Serial wire debug data input/output | |
| 5 | RST | Reset; Active low | |
| 6 | SWO | Serial wire trace output | |

Note 1. Compatible ST-LINK programmer: ST-LINK/V2, ST-LINK/V2-ISOL, ST-LINK/V3

Note 2. To program the board with ST-LINK/V2-ISOL, please use RVA-SWD-06M-C100 V2



10.6 RiBUS

Any size of the Riverdi EVE4 series display can be connected through RiBUS to act as a slave module to the mainboard.

| NO. | PIN | DESCRIPTION | NOTE |
|-----|-------------|--|--------|
| 1 | VCC_+3.3V | Supply voltage for module; TYP3.3V | |
| 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 chips select signal | |
| 7 | INT | Interrupt signal from device to the system, Active Low | |
| 8 | RST/PD | Reset / Power down signal, Active Low, | |
| 9 | GPIO.0 | GPIO.0 | |
| 10 | DISP_AUDIO | Display audio in/out | |
| 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 | Note 2 |
| 18 | BLVDD | Supply voltage for backlight | |
| 19 | BLGND | Backlight Ground, internally connected to GND | |
| 20 | BLGND | Backlight Ground, internally connected to GND | |

Note 1. Matched Riverdi FFC accessory for RiBUS: FFC0520150

Note 2. If any of the Riverdi EVE4 display series (3.5", 4.3", 5.0", or 7.0") is connected through RiBUS, the power supply voltage VDD_IN should be between 6.0V-48.0V. To set up the backlight voltage (BLVDD) at 5.0V, short the pads of the solder bridge labeled 'BLVDD INT'.

If any of the Riverdi EVE4 10.1" display series is connected through RiBUS, the power supply voltage VDD_IN must range between 7.0V-14.0V. To set up the backlight voltage (BLVDD) between 7.0V-14.0V, short the pads of the solder bridge labeled 'BLVDD EXT'



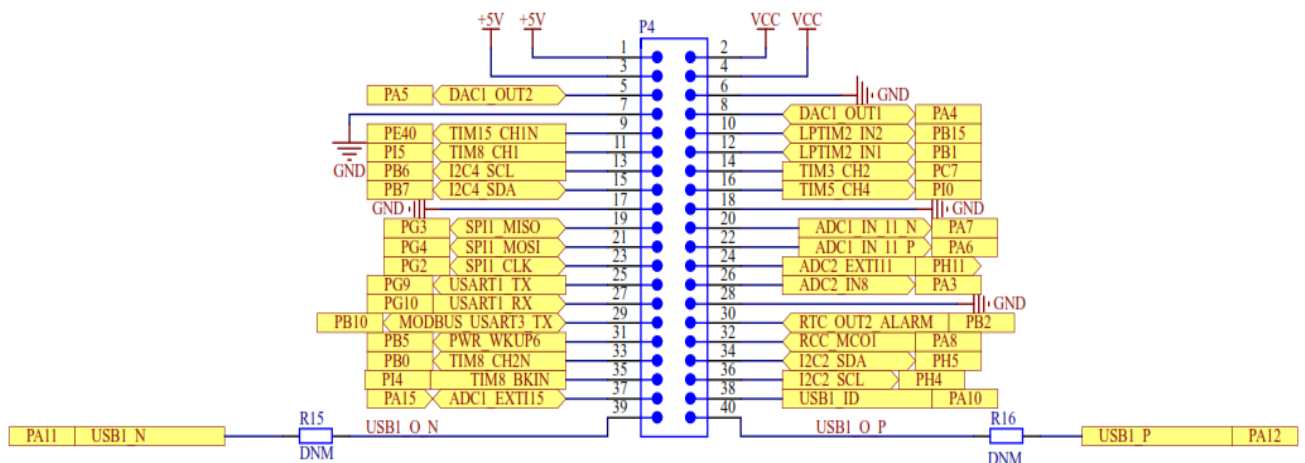
10.7 Expansion connector

The main board has one 1.27mm, 40-pin expansion pin socket which is labeled as P4 is “EXPANSION CONNECTOR”.

It provides direct access to below GPIOs of MCU, which make it possible to easily extend a daughterboard for a specific application.

- 2 x I²C
- 1 x UART
- 1 x USART
- 1 x SPI
- 1 x USB
- 7 x PWMs
- 1 x DAC(Digital-to-analog)
- 2 x ADCs (Analog-to-digital)

Each of the GPIO pins can be configured by software as output (push-pull or open-drain, with or without pull-up or pull-down), as input (floating, with or without pull-up or pull-down) or as peripheral alternate function. Most of the GPIO pins are shared with digital or analog alternate functions. Please refer to the datasheet of MCU for more details.



| I/O/P | PIN NAME | NO. | NO. | PIN NAME | I/O/P |
|-------|----------|-----|-----|-----------|-------|
| P | VCC_+5V | 1 | 2 | VCC_+3.3V | P |
| P | VCC_+5V | 3 | 4 | VCC_+3.3V | P |
| I/O | PA5 | 5 | 6 | GND | P |
| P | GND | 7 | 8 | PA4 | I/O |
| I/O | PE40 | 9 | 10 | PB15 | I/O |
| I/O | P15 | 11 | 12 | PB1 | I/O |
| I/O | PB6 | 13 | 14 | PC7 | I/O |
| I/O | PB7 | 15 | 16 | P10 | I/O |
| P | GND | 17 | 18 | GND | P |
| I/O | PG3 | 19 | 20 | PA7 | I/O |
| I/O | PG4 | 21 | 22 | PA6 | I/O |
| I/O | PG2 | 23 | 24 | PH11 | I/O |
| I/O | PG9 | 25 | 26 | PA3 | I/O |



| | | | | | |
|-----|------|----|----|------|-----|
| I/O | PG10 | 27 | 28 | GND | P |
| I/O | PB10 | 29 | 30 | PB2 | I/O |
| I/O | PB5 | 31 | 32 | PA8 | I/O |
| I/O | PB0 | 33 | 34 | PH5 | I/O |
| I/O | P14 | 35 | 36 | PH4 | I/O |
| I/O | PA15 | 37 | 38 | PA10 | I/O |
| I/O | PA11 | 39 | 40 | PA12 | I/O |

Note 1. The total output current I@5.0V from pin 1 and pin3 is maximum 1A.

The total output current I@3.3V from pin 2 and pin 4 is maximum 500mA.

10.8 Micro SD card slot

The mainboard is equipped with Micro-SD slot, which supports all types of Micro SD cards.

10.9 Battery coin cell holder

The battery coin cell, labeled as BT1, is suitable for CR1220 (Ø12.5 x 2.0mm) Coin Cell Batteries.

The BT1 is connected to the VBAT pin of MCU, which allows to retain the content of the backup registers, SRAM to keep running RTC when the VDD_IN is turned off and unplugged.

11. USER INTERFACES

11.1 2 x push button

Push button labeled as 'RST' (S2) is used to reset the module.

Another 1 push button labeled as 'USR BTN' is for user's development.

- USR BTN(S1) is connected to GPIO, PJ3, of the MCU.

11.2 3 x LEDs

1 x LED, labeled as 'PWR LED', emits green light when the modules is powered.

1 x LED, labeled as 'USB OVR', emits red light when VCC_USB pin overcurrent occurs.

1 x LED, labeled as 'USR LED', is for user's development.

- The 'USR LED' is connected to GPIO, PE5, of the MCU.



12.DISPLAY SEPCIFICATION

12.1 Full TFT specification

The TFT of the module applies Riverdi high brightness, IPS, 5.0" RGB TFT:
RVT50HQTFWN00

For detailed information, please refer to datasheet of display.

13.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 30mins, 70°C for 30 mins. 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.



14. LEGAL INFORMATION

CE marking is usually obligatory only for a complete end product. Riverdi display modules are semi-finished goods which are used as inputs to become part of the finished products.

Therefore, Riverdi display modules are not CE marked.

Riverdi grants the guarantee for the proper operation of the goods for a period of 12 months from the date of possession of the goods. If in a consequence of this guaranteed execution the customer has received the defects-free item as replacement for the defective item, the effectiveness period of this guarantee shall start anew from the moment the customer receives the defects-free item.

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