



## RVT101HVSFWCA0

## STM32 EMBEDDED 10.1" DISPLAY DATASHEET

Rev.1.1  
2022-02-14

ITEM	CONTENTS	UNIT
LCD Type	TFT/Transmissive/Normally Black/IPS	/
Size	10.1	Inch
Viewing Direction	Free	/
Outside Dimensions (W x H x D)	246.66 x 151.30 x 15.83	mm
Active Area (W x H)	216.96 x 135.60	mm
Pixel Pitch (W x H)	0.1695 x 0.1695	mm
Resolution	1280 x 800	/
Brightness	800	cd/m <sup>2</sup>
Color Depth	16.7 M	/
Pixel Arrangement	RGB Vertical Stripe	/
Driver IC of Board	STM32H747XIH6	/
External SDRAM	64Mbit (32-bit access)	/
External Flash Memory	512Mbit	/
Supply Voltage for Module	6.0-36.0	V
With/Without Touch	With Projected Capacitive Touch Panel	/
CTP Driver	ILI2132A	/
Weight	723	g

**Note 1:** RoHS3 compliant

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

## 1. REVISION RECORD

REV NO.	REV DATE	CONTENTS	REMARKS
1.0	2022-01-10	Initial release	
1.1	2022-02-14	Update the absolute maximum rating of $V_{DD}$ to 0V-48.0V	

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### 3. MODULE CLASSIFICATION INFORMATION

RV	T	101	H	V	S	F	W	C	A0
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.

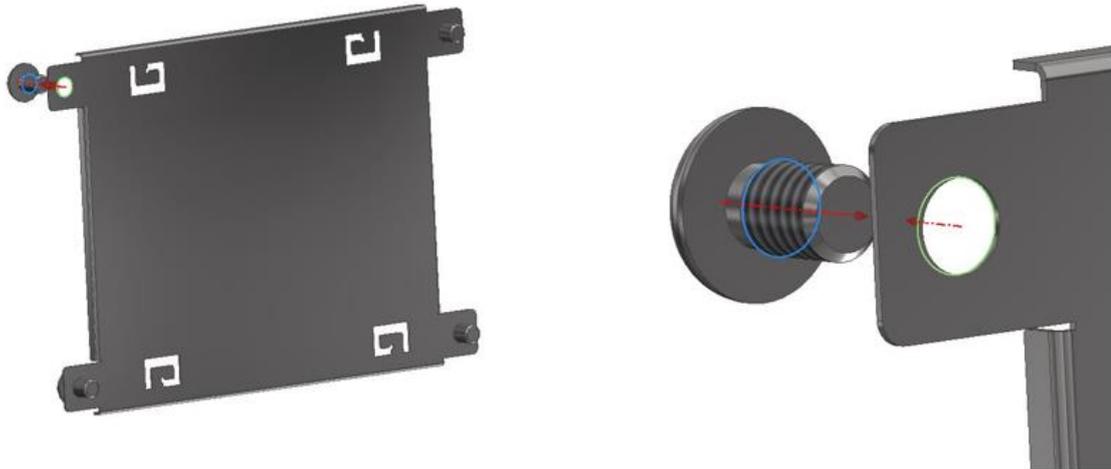
NO.	PARAMETER	SYMBOL
1.	BRAND	RV – Riverdi
2.	PRODUCT TYPE	T – TFT Standard
3.	DISPLAY SIZE	101 – 10.1”
4.	MODEL SERIAL NO.	H – High Brightness, IPS TFT.
5.	RESOLUTION	V – 1280 x 800 px
6.	LCD+CONTROL BOARD	S –STM32 Embedded Display MCU STM32H747XIH6
7.	FRAME	F – With Mounting Metal Frame
8.	BACKLIGHT 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





## 6. ABSOLUTE MAXIMUM RATINGS

PARAMETER	SYMBOL	MIN	MAX	UNIT	NOTE
Supply Voltage for Module	VDD	0	48.0	V	Note 1
Digital I/O signals Voltage	-	-0.5	3.3		Note 1,2
Operating Temperature	T <sub>OP</sub>	-20	70	°C	
Storage Temperature	T <sub>ST</sub>	-30	80	°C	
Storage Humidity (@ 25 ± 5°C)	H <sub>ST</sub>	10	-	% RH	
Operating Ambient Humidity (@ 25 ± 5°C)	H <sub>OP</sub>	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 STM32H747XIH6 for more details.

## 7. ELECTRICAL CHARACTERISTICS

PARAMETER	SYMBOL	MIN	TYP	MAX	UNIT	
Supply Voltage for Module	VDD_IN	6.0	12.0	36.0	V	
POWER 'ENABLE' = '0'	Current Drawn from VDD_IN @6.0V	I <sub>VDD_IN=6.0V</sub>	-	60	-	uA
	Current Drawn from VDD_IN @12.0V	I <sub>VDD_IN=12.0V</sub>	-	147	-	uA
	Current Drawn from VDD_IN @24.0V	I <sub>VDD_IN=24.0V</sub>	-	388	-	uA
	Current Drawn from VDD_IN @36.0V	I <sub>VDD_IN=36.0V</sub>	-	629	-	uA
POWER 'ENABLE' = '1'	Current Drawn from VDD_IN @6.0V	I <sub>VDD_IN=6.0V</sub>	-	851	-	mA
	Current Drawn from VDD_IN @12.0V	I <sub>VDD_IN=12.0V</sub>	-	412	-	mA
	Current Drawn from VDD_IN @24.0V	I <sub>VDD_IN=24.0V</sub>	-	226	-	mA
	Current Drawn from VDD_IN @36.0V	I <sub>VDD_IN=36.0V</sub>	-	160	-	mA
Input Voltage "H" Level	V <sub>IH</sub>	2.0	-	3.3	V	
Input Voltage "L" Level	V <sub>IL</sub>	0	-	0.8	V	

**Note.** POWER 'ENABLE' refers to pin 3, 'ENABLE' of the power input connector.

By default, POWER 'ENABLE' = '1',

When POWER 'ENABLE' = '0', the device is turned off.

## 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	θ=0° φ=0° Ta=25 °C	-	25	35	ms	FIG 2.	4
Contrast Ratio	Cr		800	1000	-	---	FIG 3.	1
Luminance Uniformity	δ WHITE		-	75	-	%	FIG 3.	3
Surface Luminance	Lv		-	800	-	cd/m <sup>2</sup>	FIG 3.	2
Viewing Angle Range	θ	φ = 90°	75	85	-	deg	FIG 4.	6
		φ = 270°	75	85	-	deg	FIG 4.	
		φ = 0°	75	85	-	deg	FIG 4.	
		φ = 180°	75	85	-	deg	FIG 4.	
CIE (x, y) Chromaticity	Rx	θ=0° φ=0° Ta=25 °C	0.22	0.26	0.30	-	FIG 3.	5
	Ry		0.20	0.24	0.28	-		
	Gx		0.34	0.38	0.42	-		
	Gy		0.50	0.54	0.58	-		
	Bx		0.10	0.14	0.18	-		
	By		0.09	0.13	0.17	-		
	Wx		0.28	0.32	0.36	-		
	Wy		0.29	0.33	0.37	-		

**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

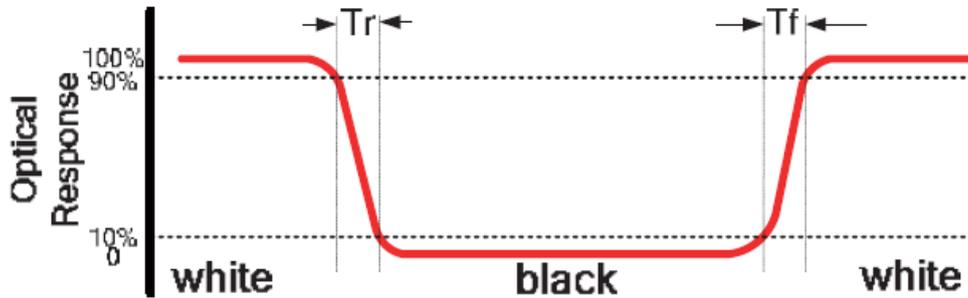
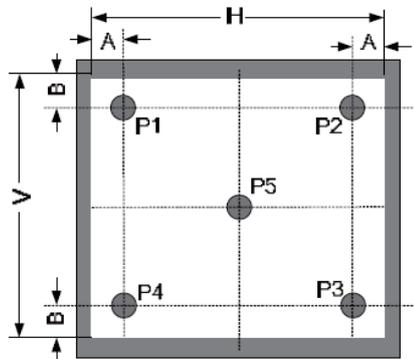


Figure 3. Measuring method for Contrast ratio, surface luminance, Luminance uniformity, CIE (x, y) chromaticity



A: 5mm

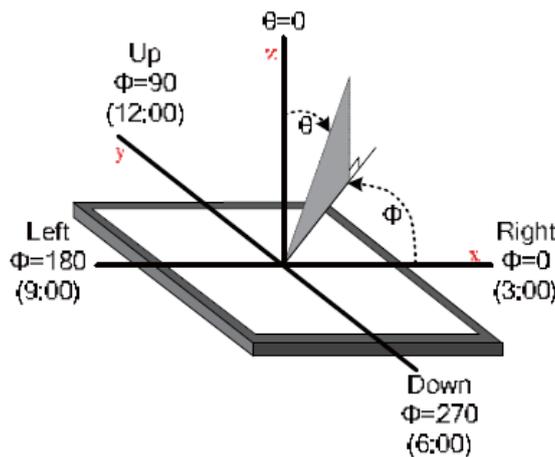
B: 5mm

H, V: Active Area

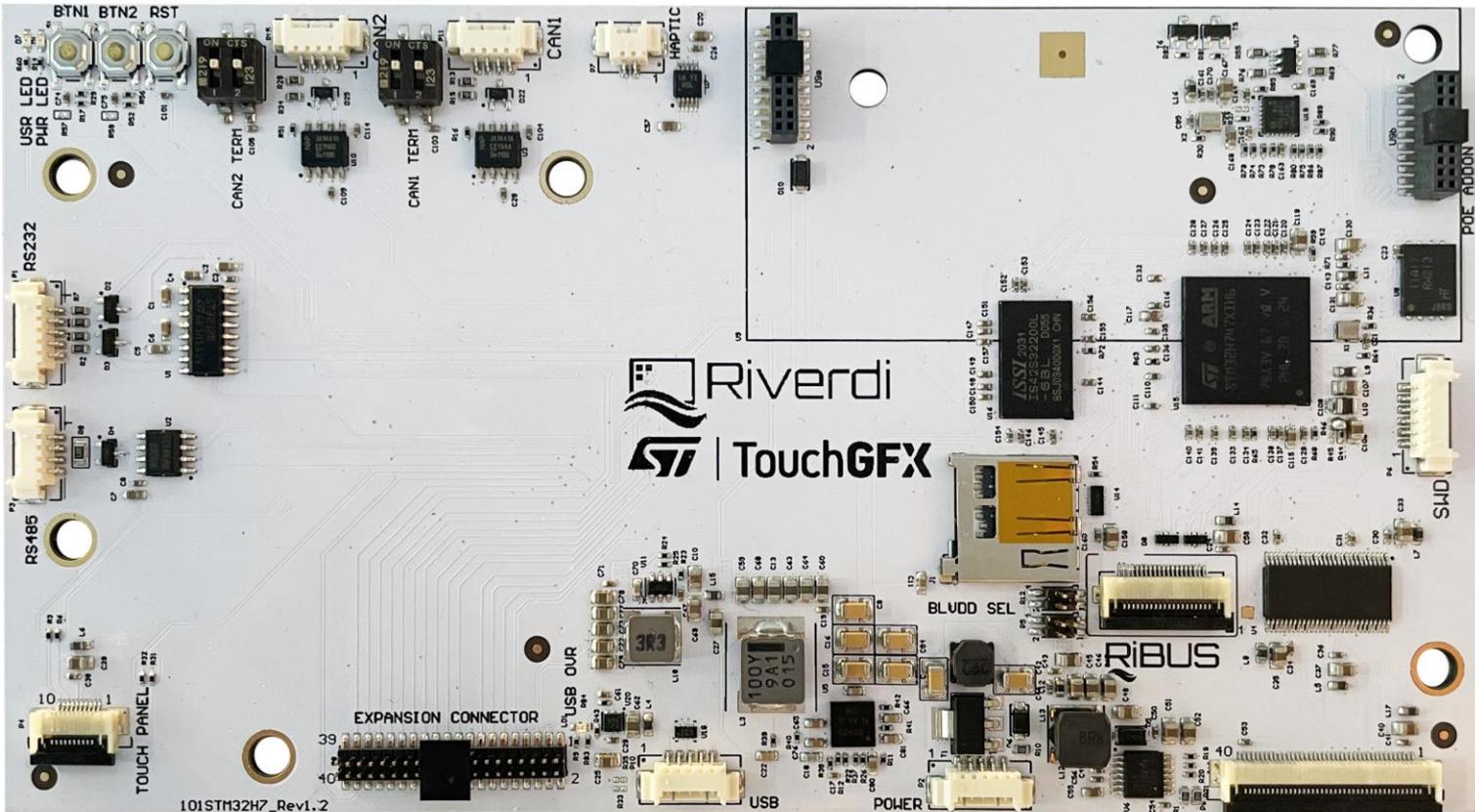
Light spot size  $\varnothing=5\text{mm}$ , 500mm distance from the LCD surface to detector lens.

Measurement instrument is TOPCON'S luminance meter BM-5

Figure 4. The definition of viewing angle



## 10. BOARD INTERFACES AND CONNECTORS



### 10.1 Power input connector

The 1.25mm, 5-pin Molex connector labeled as “POWER’ 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; 6.0-36.0V	Note 1
2	VDD_IN	Power supply input; 6.0-36.0V	
3	ENABLE	Enable/ Disable power supply.	Note 2
4	GND	Ground	
5	GND	Ground	

**Note 1:** STM32 Embedded Display allows to directly connect one additional display to the system. There is RiBUS connector on the board where you can connect any of intelligent display from Riverdi based on EVE4 (BT817Q). However, please note that it may change power supply requirement as below:

The power supply voltage must range from 7.0V- 14.0 V (TYP. 9V), if [Riverdi EVE4 10.1" series display](#) is connected through RiBUS. At the same time, please also configure the backlight voltage jumpers, P5 and P12, according to subchapter 10.8, note 1.

The power supply voltage ranges from 6.0 V- 36.0V if any of [Riverdi EVE4 3.5",4.3",5.0" and 7.0" series display](#) is connected through RiBUS. At the same time, please also configure the backlight voltage jumpers, P5 and P12, according to subchapter 10.8, note 1.

**Note 2:** By default, pin “ENABLE” is pull up to VDD and enabled. To disable, ground the pin to turn off the device completely.

## 10.2 USB interface

The 1.25mm, 5-pin Molex connector labeled as “USB’ 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 1
5	GND	Ground	

**Note 1.** 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).

## 10.3 RS485 interface

The 1.25mm, 4-pin Molex connector labeled as “RS485’ is RS485 interface.

NO.	PIN	DESCRIPTION	NOTE
1	A	Non-inverting receiver input and non-inverting driver output	
2	B	Inverting receiver input and inverting driver output	
3	GND	Ground	
4	VDD_IN	Power supply input; 6.0-36.0V	

## 10.4 RS232 interface

The 1.25mm, 5-pin Molex connector labeled as “RS232’ is RS232 interface.

NO.	PIN	DESCRIPTION	NOTE
1	RTS	Request to send	
2	CTS	Clear to send	
3	TXD	Transmit Data	
4	RXD	Receive Data	
5	GND	Ground	

## 10.5 2 x CAN FD interfaces

The main board supports 2 channels of the CANFD (Control Area Network Flexible Data-Rate) communication bus, based on the high-speed (2.5-8.0Mbps) CAN transceiver.

2 pcs of 1.25mm, 4-pin Molex connectors labeled as “CAN1” and “CAN2” are respectively interfaces of CAN FD1 and CAN FD2.

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 – 36.0 V	

## 10.6 Haptic feedback connector

The 1.25mm, 2-pin Molex connector labeled as “HAPTIC” is haptic feedback connector.

Haptic feedback P7 is used to connect with the haptic motor directly.

NO.	PIN	DESCRIPTION	NOTE
1	OUT+	Positive haptic driver differential output	Note 1
2	OUT_	Negative haptic driver differential output	

**Note 1:** The haptic driver applies DRV2605L and is controlled by internal I2C1.

## 10.7 SWD (Serial Wire Debug) connector

The 1.25mm, 6-pin Molex connector labeled as “SWD” 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	

## 10.8 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 1
18	BLVDD	Supply voltage for backlight	
19	BLGND	Backlight Ground, internally connected to GND	
20	BLGND	Backlight Ground, internally connected to GND	

**Note 1.** For Riverdi EVE4 10.1" series displays, the backlight voltage (BLVDD) must range from 7.0 - 14.0V (TYP. 9V).

For Riverdi EVE4 series display ranging from sizes of 3.5" to 7.0", the backlight voltage (BLVDD) is 5V.

Backlight jumper selectors, P5 and P12, labeled as "BLVDD SEL" are used to configure the backlight voltage range.

**Warning!** When you configure the jumpers, be sure that the module is powered off.

**DO NOT change ANY jumpers while the module has power.** Improper operation might cause permanent damage to the unit.

Please also pay special attention to not misplace the jumpers. **Incorrect jumpers setting may lead to damage to the module as well.**

The P5, P12 jumpers setting are shown below.

Table 1. Backlight power (5.0 V) select jumpers setting.

SETTING	P5, PIN 1 &2	P5, PIN 3 &4	P12, PIN 1 &2	P12, PIN 3 &4
5V (Default)	Short	Open	Short	Open

Figure 5. Backlight jumper setting - 5.0V(Default)

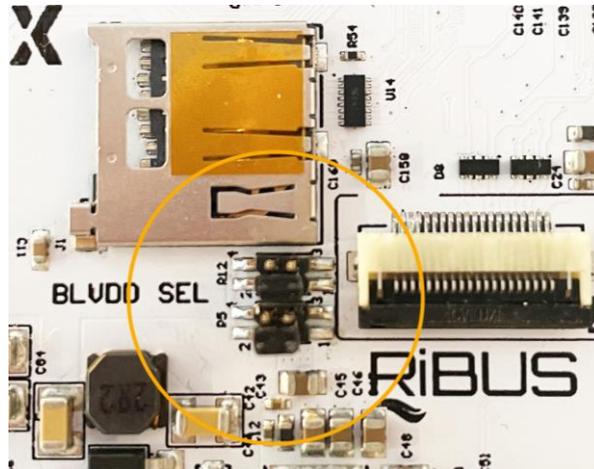
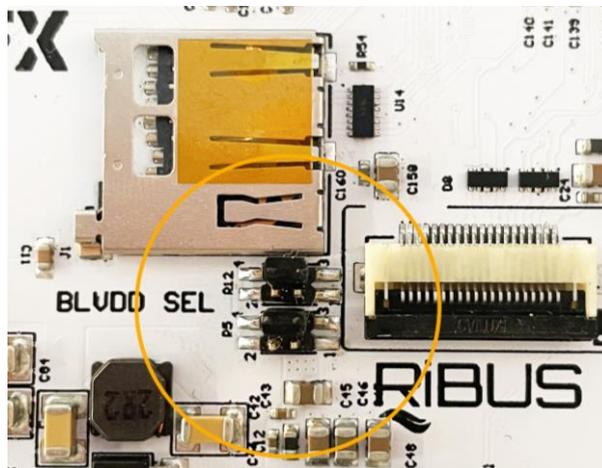


Table 2. Backlight power (7.0V-14.0V) select jumpers setting

SETTING	P5, PIN 1 &2	P5, PIN 3 &4	P12, PIN 1 &2	P12, PIN 3 &4
7.0V - 14.0 V	Open	Short	Open	Short

Figure 6. Backlight jumper setting - 12.0V

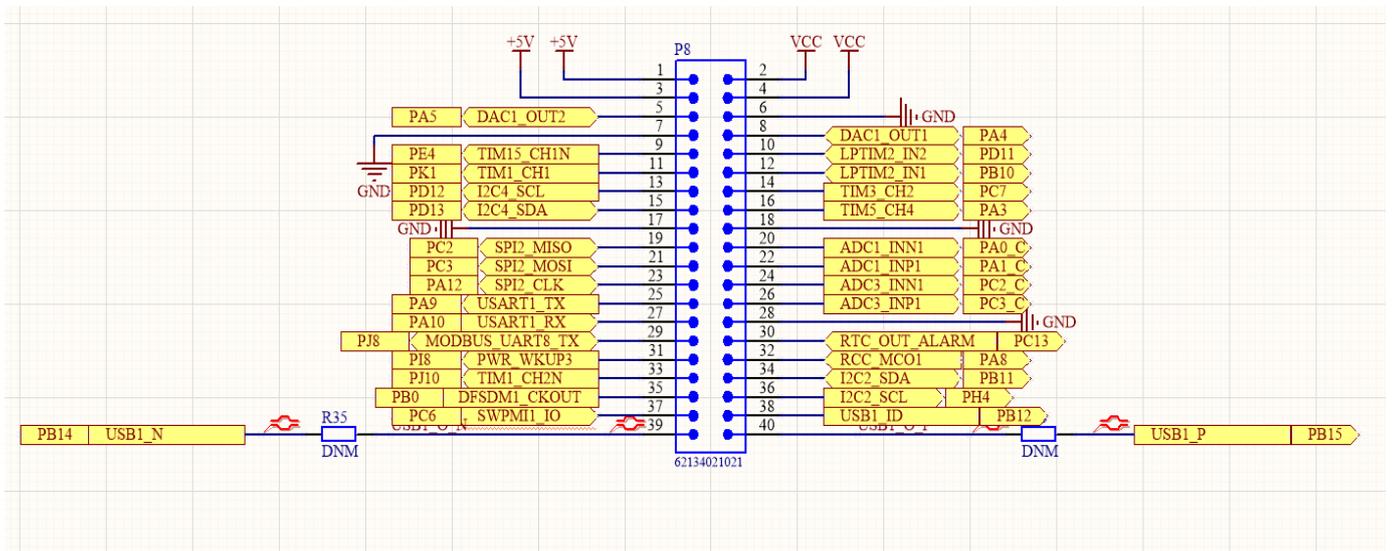


### 10.9 Expansion connector

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

It provides direct access to below GPIOs of MCU STM32H747XIH6, which make it possible to easily extend a daughterboard for a specific application.

- 2 x I<sup>2</sup>C
- 1 x UART
- 1 x USART
- 1 x SPI
- 1 x USB
- 7 x PWMs
- 2 x DACs (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 STM32H747XIH6](#) 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	PE4	9	10	PD11	I/O
I/O	PK1	11	12	PB10	I/O
I/O	PD12	13	14	PC7	I/O
I/O	PD13	15	16	PA3	I/O
P	GND	17	18	GND	P
I/O	PC2	19	20	PA0_C	I/O
I/O	PC3	21	22	PA1_C	I/O
I/O	PA12	23	24	PC2_C	I/O
I/O	PA9	25	26	PC3_C	I/O
I/O	PA10	27	28	GND	P

I/O	PJ8	29	30	PC13	I/O
I/O	P18	31	32	PA8	I/O
I/O	PJ10	33	34	PB11	I/O
I/O	PB0	35	36	PH4	I/O
I/O	PC6	37	38	PB12	I/O
I/O	PB14	39	40	PB15	I/O

**Note.** The total output current  $I_{VCC=5V}$  from pin 1 and pin3 is maximum 1A.

The total output current  $I_{VCC=3.3V}$  from pin 2 and pin 4 is maximum 500mA.

### 10.10 Micro SD slot

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

### 10.11 2 x 20-pin, 1.27 mm pin sockets for POE Add-on Board

The 2 x 20-pin, 1.27 mm, pin sockets, labeled as U9a and U9b, are used to connect the Riverdi POE Add-on Board.

The Riverdi POE Add-on Board features 10/100M Ethernet Port with Power-Over-Ethernet enabled. It allows you to power the module through the Ethernet port.

**Note:** The Riverdi POE Add-on Board is sold separately.

## 11. USER INTERFACES

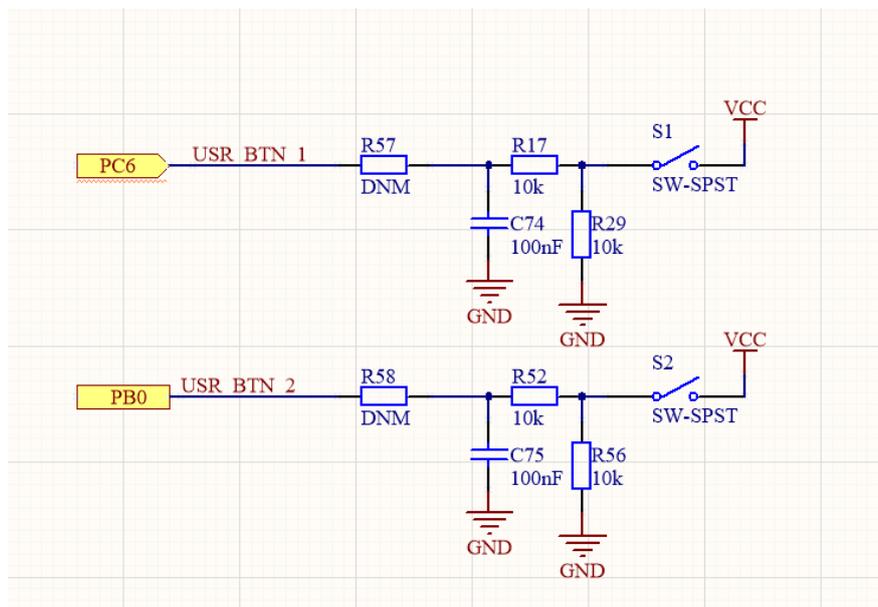
### 11.1 3 x push buttons

Push button labeled as “RST” is used to “RESET” the module.

Another 2 push buttons labeled as BTN1, BTN2 are for user’s development.

- BTN1(S1) is connected to pin 37, PC6, of the expansion connector.
- BTN2(S2) is connected to pin 35, PB0, of the expansion connector.

By default, R57 and R58 are not mounted. Please solder 0402 0R resistor or short R57, R58 to enable the pushbuttons BTN1(S1), BTN2(S2).





## 11.2 3 x LEDs

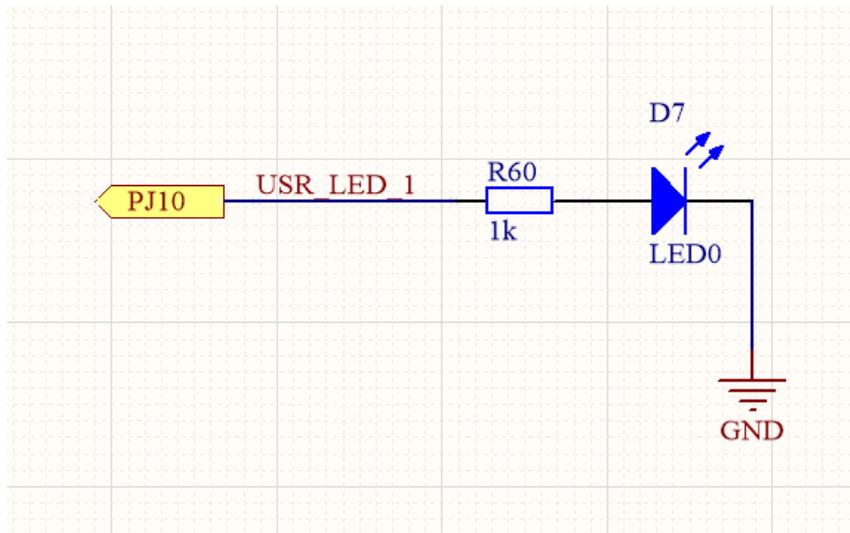
1 x LED, labeled as 'PWR LED', emits green light when the module is powered.

1 x LED, labeled as 'USB OVR', emits red light when VCC\_USB pin is shorted.

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

- The 'USR LED' is connected to pin 33, PJ10, of the expansion connector.

By default, the resistor R60, (1k ohms) is soldered. Please remove R60 to use GPIO channel PJ10.



## 12.DISPLAY SEPCIFICATION

### 12.1 TFT resolution

The supported resolution of the display in this module is 1280\*800.

### 12.2 Full TFT specification

For detailed information on the display, please refer to datasheet of display [RVTI01HVLFWCA0](#).

## 13.CAPACITIVE TOUCH SCREEN PANEL SPECIFICATIONS

### 13.1 Mechanical characteristics

DESCRIPTION	SPECIFICATION	REMARK
Touch Panel Size	10.1 inch	aTouch
Outline Dimension of CTP	229.46 mm x 148.90 mm	
Product Thickness	2.35 mm	
Glass Thickness	1.1 mm	
CTP View Area	217.96 mm x 136.60 mm	
Sensor Active Area	218.96mm x 137.60 mm	
Surface Hardness	7H	

### 13.2 Electrical characteristics

DESCRIPTION		SPECIFICATION	REMARK
Power Consumption (IDD)	Active Mode	90 mA	
	Sleep Mode	10 mA	
Linearity		+/- 1.5mm	
Controller		ILI2132A	
Resolution		1280 x 800	

## 14. INSPECTION

Standard acceptance/rejection criteria for TFT module

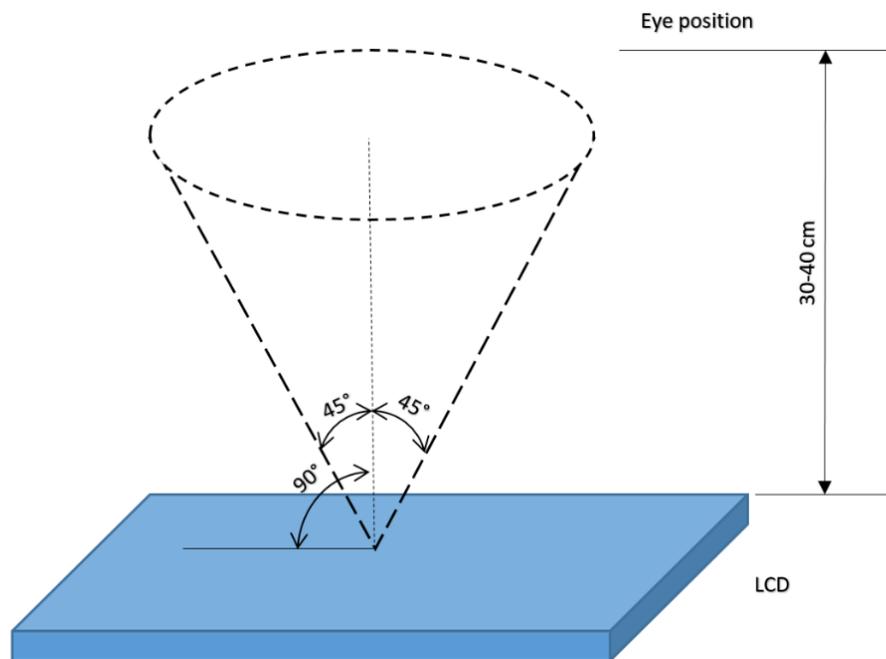
### 14.1 Inspection condition

Ambient conditions:

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

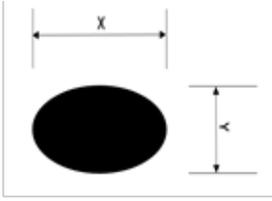
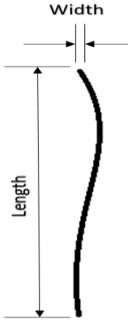
Viewing distance:  $35 \pm 5\text{cm}$  between inspector bare eye and LCD.

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



### 14.2 Inspection standard

The LCD TFT has zero bad pixels. Please refer the item "Bright/Dark dots".

ITEM		CRITERION		
Black spots, white spots, light leakage, Foreign Particle (round Type)	 <p><math>D=(x+y)/2</math> Spots density: 10 mm</p>	Size =10.1"		
		Average Diameter	Qualified Qty	
		$D \leq 0.2$ mm	Ignored	
		$0.2 \text{ mm} < D \leq 0.3$ mm	N≤4	
		$0.5\text{mm} < D$	N = 0	
LCD black spots, white spots, light leakage (line Type)	 <p>Spots density: 10 mm</p>	Size =10.1"		
		Length	Width	Qualified Qty
		-	$W \leq 0.05$	Ignored
		$L \leq 5.0$	$0.05 < W \leq 0.1$	$N \leq 3$
		$5.0 < L$	$0.10 < W$ $5.0 < L$	N = 0
Bright/Dark Dots	Size =10.1"			
	Item		Qualified Qty	
	Bright dots		0	
	Dark dots		0	
	Cluster Bright Dots or Dark Dots		0	
Total Bright and Dark Dots		0		
Clear spots	Size ≥ 5"			
	Average Diameter		Qualified Qty	
	$D < 0.2$ mm		Ignored	
	$0.2 \text{ mm} < D < 0.3$ mm		4	
	$0.3 \text{ mm} < D < 0.5$ mm		2	
	$0.5 \text{ mm} < D$		0	
Spots density: 10 mm				
Touch panel spot	Size ≥ 5"			
	Average Diameter		Qualified Qty	
	$D < 0.25$ mm		Ignored	
	$0.25 \text{ mm} < D < 0.5$ mm		4	
$0.5 \text{ mm} < D$		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		

## 15. 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.



## 16.LEGAL INFORMATION

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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