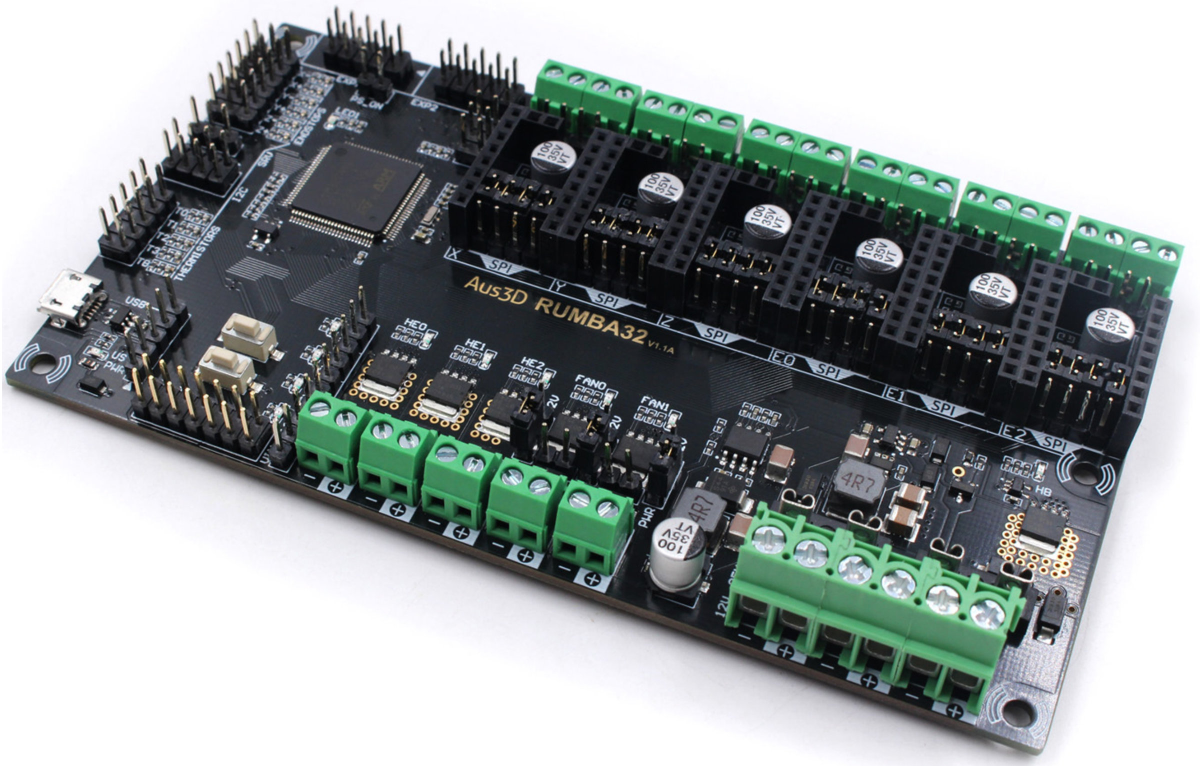
RUMBA32 V1.1 Reference Manual

Revision A



1 INTRODUCTION

1.1 OVERVIEW

This is a user/reference manual for the Aus3D RUMBA32 V1.1 3D printer control board.

Sections of this manual may be relevant to other versions of RUMBA32. However, there are some differences between versions, and may even be differences between boards of the same version when produced by other manufacturers, so it is recommended to always ensure that you are using documentation that matches the board you have.

Where this manual describes specifications and ratings (for instance, current ratings) these are based on the components used in the genuine Aus3D RUMBA32 boards, and on analysis and tests of the performance of these boards. Most manufacturers will likely use components with the same or similar ratings. However, it is always possible that components may be substituted with parts that have different ratings, whether that be for reasons of availability, cost, and so on. Always defer to documentation provided by the specific manufacturer/supplier, and, if none is available, approach the ratings in this document with a margin of safety.

1.2 RELEVANT LINKS

An up-to-date copy of the documentation should always be available at the following links:

- RUMBA32 on GitHub: https://github.com/Aus3D/RUMBA32
- RUMBA32 on Aus3D: https://aus3d.com.au/RUMBA32

1.3 DISCLAIMER

This document is provided for reference only. While the author has made every effort, no warranty or guarantee is provided regarding the accuracy or reliability of the content presented.

Electricity, 3D printers, motors, and heating elements all have the potential to cause significant harm if used incorrectly or in the event of a fault. The correct operation of your 3D printer is dependent not only on RUMBA32, but on many other factors, including that the wiring is done correctly, and that the firmware is configured appropriately. These factors, and many others which may impact the safety of your device, are outside of the author's control. As such, the author assumes no liability for damages of any sort that may arise from the use of RUMBA32, this documentation, or the information contained therein.

If you have purchased a board from Aus3D, and believe it has a fault, we provide a one-year warranty – please contact us at support@aus3d.com.au for support.

1.4 DOCUMENT CHANGELOG

Rev	Date	Author	Notes
A	5/07/2020	Chris Barr	Initial issue

2 TABLE OF CONTENTS

3 SPECIFICATIONS

The main specifications for RUMBA32 V1.1 are as follows:

- Microcontroller: STM32F446VET6
    - Core Frequency: 180MHz
    - Flash Memory: 512kB
    - SRAM: 128kB
- EEPROM: 8kB I2C EEPROM
- Stepper Drivers: 6
    - SPI Communication Supported
    - UART Communication Supported
    - TMC DIAG (sensorless homing) Supported
- MOSFET Outputs: 6
    - 3 Heaters – Maximum Current: 5A
    - 2 Fans – Maximum Current: 2A
    - 1 Bed – Maximum Current: 20A
- Thermistor Connections: 5
- Endstop Connections: 6
- Power Supply
    - Input Voltage (Recommended): 12-24V
    - Input Voltage (Absolute Limits): 6-35V
    - 12V Rail (max. current 4A)
    - 5V Rail (max. current 2A)
    - 3.3V Rail (max. current 600mA)
- Dimensions: 135 x 75mm

4 POWER

4.1 POWER INPUT

Power is supplied to the board through two screw terminals, MAIN-PWR and HB-PWR. HB-PWR is the input for the power supply for the heated bed. The heated bed should be connected to HB-OUT.

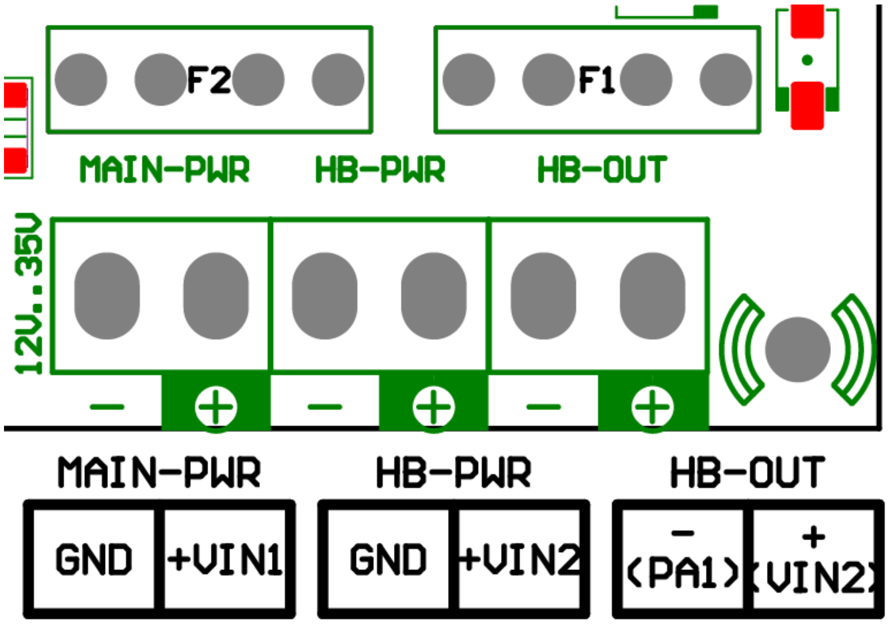


Figure 1: Main Power Terminals

MAIN-PWR supplies power to the entire board, excluding the heated bed. MAIN-PWR passes through fuse holder F2. It is required to install a fuse before power is supplied to the board. It is recommended to use one of the included 10A fuses for F2.

HB-PWR supplies power to the heated bed. HB-PWR passes through fuse holder F1. It is required to install a fuse before power is supplied to the heated bed. It is recommended to use one of the included 20A fuses for F1.

It is not recommended to use a fuse larger than 20A on either MAIN-PWR or HB-PWR, as doing so may exceed the current rating of the screw terminals and risks damaging the board.

In the event of a short circuit or overcurrent event on either the MAIN-PWR or HB-PWR rails, the fuse(s) may blow to protect the board.

MAIN-PWR and HB-PWR are protected against reverse power supply polarity. In the event of the power supply being connected in reverse, the fuse(s) will blow to protect the board.

In the event of a blown fuse, the fuse will need to be replaced to restore the board to correct operation. Spare fuses are included with RUMBA32 boards sold by Aus3D.

4.2 POWER RAILS

RUMBA32 has the following power rails:

- VIN1
    - Power supply as input on MAIN-PWR screw terminal
    - Maximum current draw limited by fuse F2
    - Recommended voltage is 12/24V
    - Maximum voltage must not exceed 35V or board will be damaged
- VIN2
    - Power supply as input on HB-PWR screw terminal
    - Maximum current draw limited by fuse F1
    - Recommended voltage is 12/24V
    - Maximum voltage must not exceed 35V or board will be damaged
- 12V
    - Internal 12V rail generated from VIN1
    - Uses Buck Regulator – AOZ1284
    - Only present when board is powered from > 12V (i.e. 24V PSU)
    - Maximum current draw of 4A
    - Can be used to supply HE2, FAN0, FAN1
- 5V_DCDC
    - Internal 5V rail generated from VIN1
    - Uses Buck Regulator – AP63205
    - Only present when MAIN-PWR is supplied
    - Maximum current draw of 2A
- 5V
    - Internal 5V rail fed from 5V_DCDC and USB
    - Maximum current draw of 2A (if MAIN-PWR is connected) or 200mA (if only USB power)
- 3.3V
    - Internal 3.3V rail generated from 5V
    - Uses Linear Regulator – AP2112K-3.3
    - Maximum current draw of 600mA

5 MOSFET Outputs

5.1 Overview

RUMBA32 has six controllable outputs for driving powered loads. These outputs use low-side N-Channel MOSFETs to switch power to the load on and off.

These outputs can be driven by PWM signals from the microcontroller if desired.

These are grouped as follows:

- Heated Bed (HB):
  - Maximum current draw: 20A
- Heaters (H0, H1, H2)
  - Maximum current draw: 5A
- Fans (F0, F1)
  - Maximum current draw: 2A

HB draws power from the HB-PWR connector.

H0 and H1 draw power from the MAIN-PWR connector.

H2, F0 and F1 can be independently configured via jumper to draw power from either the MAIN-PWR connector, or from the internal 12V regulator. Note that when drawing from the 12V regulator, the combined current draw across H2, F0 and F1 should not exceed the rating of the 12V regulator (4A).

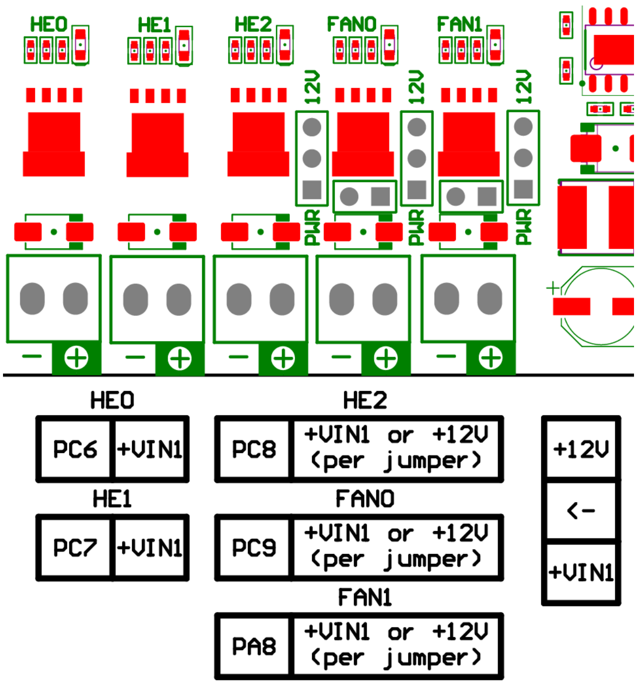


Figure 2: RUMBA32 MOSFET outputs (HB output not shown)

5.2 Remapping Outputs

Note that it is usually possible to re-map the outputs as required in firmware. For instance, if you only need two heater outputs, and want three fans, HE2 can be repurposed as a third fan output.

Steps to do this vary by firmware. When using Marlin, one solution is to edit the pins_RUMBA32_common.h file, comment out the entry for HEATER_2, and add an extra entry for a third fan to replace it. This is shown in Figure 3.

```
//
// Heaters / Fans
//
#define HEATER_0_PIN                          PC6
#define HEATER_1_PIN                          PC7
//#define HEATER_2_PIN                        PC8   //  <<--
#define HEATER_BED_PIN                        PA1

#define FAN_PIN                               PC9
#define FAN1_PIN                              PA8
#define FAN2_PIN                              PC8   //  <--
```

Figure 3: Adding a third fan in Marlin

6 ENDSTOP CONNECTORS

RUMBA32 has six endstop inputs, designated X-MIN, X-MAX, Y-MIN, Y-MAX, Z-MIN and Z-MAX.

Most bed sensors / z-probes may also be connected through one of these connectors. It is fairly common to use the Z-MIN connector for this (specific details will vary by sensor type and firmware configuration).

Each endstop connector has a power pin, ground pin, and signal pin.

The power pins are supplied by the 3.3V rail by default. They can be set to supply 5V by modifying the board jumpers (see Configuration Jumpers).

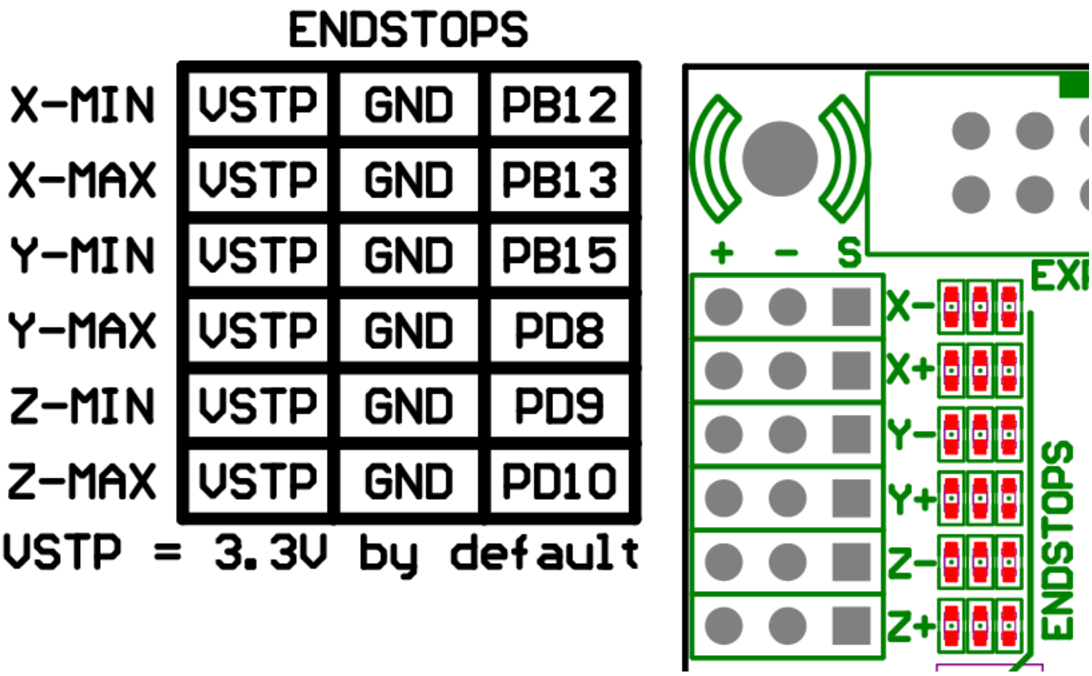


Figure 4: Endstop Connectors

Each signal pin is pulled-up to 3.3V (or 5V) by a 4.7K resistor. Additionally, each endstop signal passes through an RC filter, consisting of a 10K resistor and a 2.2nF capacitor. As this 10K resistor limits the current that the microcontroller will sink in the event of an overvoltage, the endstop signal pins can be safely connected to 12/24V without damaging the board. However, it is not recommended to operate the board in this condition.

Note: It is recommended to disable endstop pull-up resistors in your firmware. The hardware pull-up resistors accomplish this, and the internal pull-ups enabled by firmware will form a divider with the series resistor and may prevent correct reading under some circumstances.

Note: The endstop signals can also be controlled by attached stepper drivers if they feature a diagnostic output pin (such as TMC drivers with StallGuard detection). If a stepper driver with this pin is connected, it may override the connected endstop and prevent correct detection. Refer to Diagnostic Input (StallGuard) for more information.

7 THERMISTOR CONNECTORS

RUMBA32 has five thermistor inputs, designated T0, T1, T2, T3 and TB.

Each thermistor signal passes through an RC filter, consisting of a 10K resistor and a 1uF capacitor.

Thermistors are not polarised – it does not matter which wire connects to ground, and which to the signal pin.

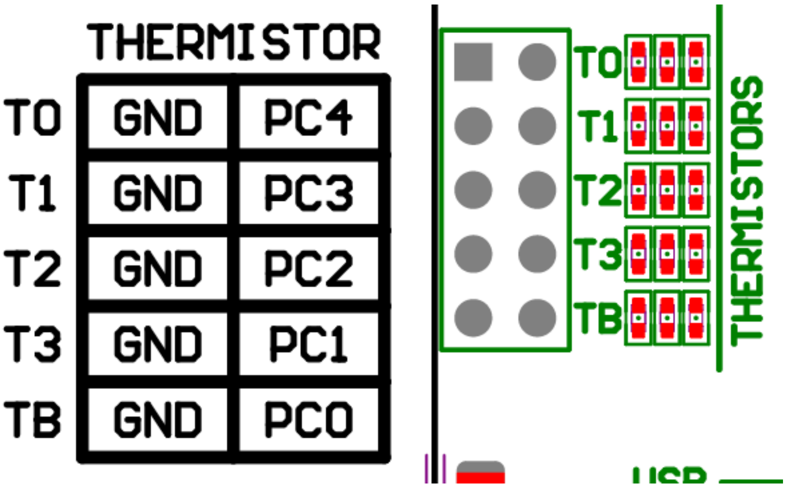


Figure 5: Thermistor Connectors

8 I2C CONNECTORS

RUMBA32 has two dedicated I2C connectors. As I2C is a bus, the pins on both connectors are identical.

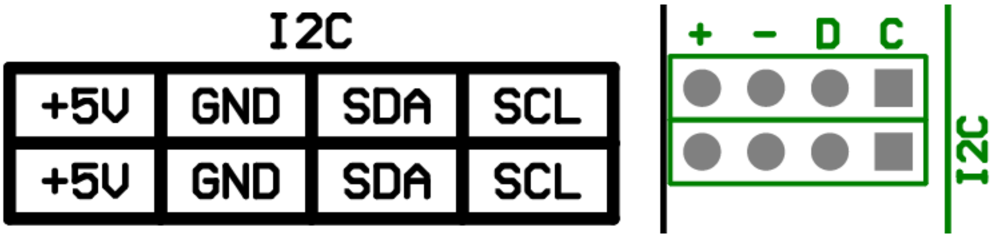


Figure 6: I2C Connectors

The I2C signals are additionally available through the EXP3 header (see EXP3 – General Expansion Header).

9 Servo Connector

RUMBA32 has one dedicated connector for RC servo motors. This connector provides 5V power, along with a control signal from the microcontroller.

Figure 7: Servo Connector

10 USB INTERFACE

USB connection to RUMBA32 is via a standard Micro-USB socket. This can be used to provide 5V power to the board, to communicate over USB serial, and to upload firmware to the board.

There is a 200mA PTC resettable fuse in line with the power from the USB connector. This prevents RUMBA32 from drawing excessive current and potentially damaging the host device if there is a short circuit or other wiring problem.

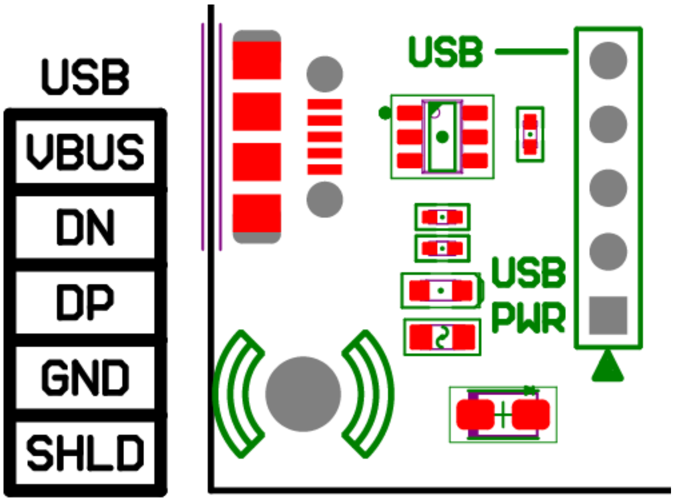


Figure 8: USB Connector

The USB pin header provides additional access to the USB signals. It matches the internal USB pinout used by ATX motherboards and can be used to connect external USB connectors – such as a panel mount connector, as shown in Figure 9.

Figure 9: Example USB Panel-Mount Connector

11 EXP1 AND EXP2 – LCD CONNECTORS

EXP1 and EXP2 can be used to connect a variety of displays that use this common pinout.

EXP1

GND	PE14	PE12	PE9	PE8
+5V	PE15	PE13	PE10	PE7

EXP2

GND	PB0	PB1	PB2	PA6 MISO
PC5	RST	PA7 MOSI	PA2	PA5 SCK

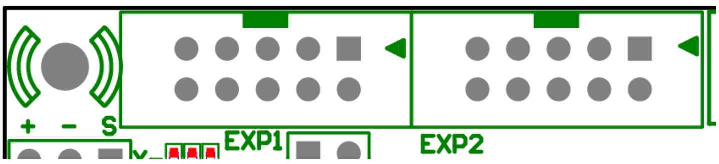


Figure 10: EXP1 and EXP2 Connectors

Examples of displays that use this pinout include the RRD Graphic Smart Controller or the RRD LCD Smart Controller (see Figure 11). Both types of displays shown have been tested with RUMBA32 and work correctly. Most displays that use these connectors are similar and should also work, but it is possible that some displays will not work correctly with the 3.3V logic levels.

Note that any display connected will require enabling/configuring in firmware before it can be used.

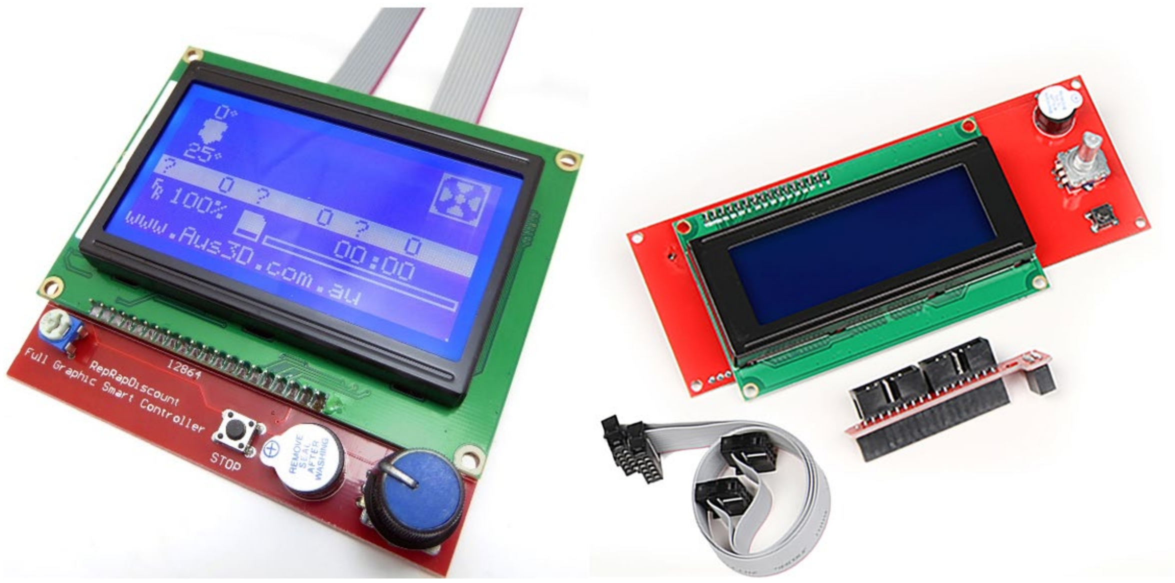


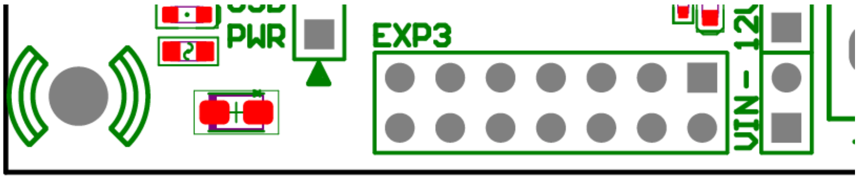
Figure 11: RRD Graphic Smart Controller (left) and RRD Character Smart Controller (right)

12 EXP3 – General Expansion Header

12.1 Overview

EXP3 is an expansion header consisting of two rows of seven pins. The EXP3 header is a consistent header pinout that has been present on all RUMBA32, RUMBA+ and RUMBA boards.

EXP3 provides access to power from the 5V and 12V rails, along with several IO, including PWM outputs, analog inputs, I2C and UART.



EXP3

PD13	PA9 U1TX	SCL	PA4	PD14	GND	+12V
PD12	PA10 U1RX	SDA	PA3	PD15	GND	+5V

Figure 12: EXP3 Connector

12.2 EXP3 Modules

EXP3 is a convenient way to attach add-on modules to the RUMBA family of boards. There are currently two EXP3 modules developed by Aus3D.

12.2.1 RUMBA WiFi Adaptor

This module integrates an ESP8266 WiFi module into a plug-and-play module that can be connected directly to RUMBA boards, without the need for any additional wiring. It can be used to access and control the printer using a web interface over WiFi. The printer firmware needs to be configured to support this (typically be enabling serial on USART1).

For more information on this adaptor, visit: https://github.com/Aus3D/RUMBA-WIFI

12.2.2 RUMBA MKS-TFT Adaptor

This is an adaptor that makes it possible to connect a range of TFT displays from Makerbase. The printer firmware needs to be configured to support this (typically be enabling serial on USART1).

For more information on this adaptor, visit: https://github.com/Aus3D/RUMBA-TFT

13 Stepper Drivers

13.1 Overview

RUMBA32 has sockets for up to six stepper drivers, designated X, Y, Z, E0, E1 and E2.

Note that the purpose of these stepper drivers can typically be remapped in firmware – for instance, Marlin firmware will allow the use of E0/E1/E2 as a second Z axis stepper driver.

Each stepper driver socket can be individually set to control a stepper driver in the following modes:

- Traditional – configure the stepper driver by setting the MS1, MS2 and MS3 jumpers.
- SPI – configure the stepper driver using the SPI interface.
- UART – configure the stepper driver using the UART interface.

Note that not all stepper drivers from all manufacturers and suppliers use the same pinout for SPI and UART modes. Some stepper drivers may offer multiple pinouts as selected by solder jumpers and may be set differently by default by different suppliers.

RUMBA32 has been designed to work with the following stepper driver pinouts:

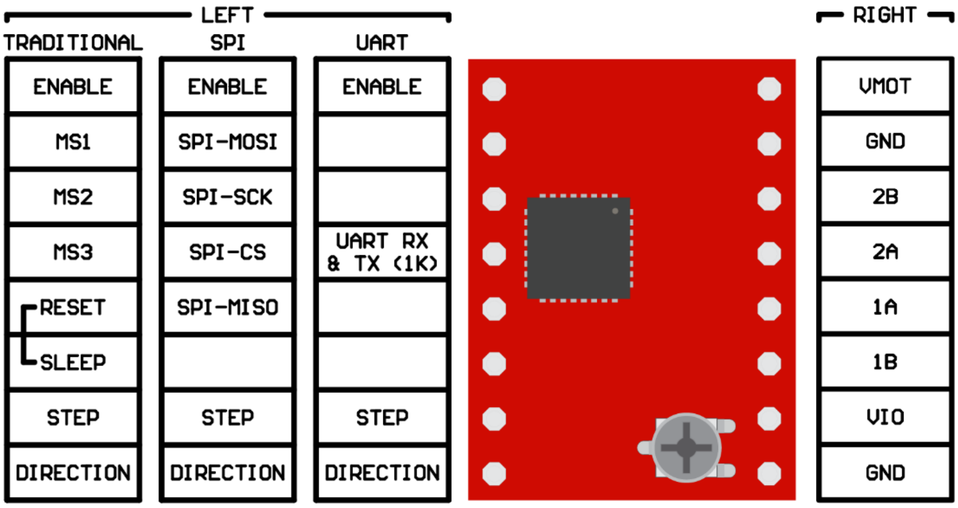


Figure 13: Stepper Driver Socket Pinout

The jumpers underneath each stepper driver are used to configure the mode. They have the following pinout:

STEPPER DRIVER JUMPER PINOUT

SLP	MS3	MS2	MS1
SLP	+3V3	+3V3	+3V3
RST	MS3	MS2	MS1
SPI-MISO	SPI-CS UART	SPI-SCK	SPI-MOSI

Figure 14: Stepper Driver Jumper Pinout

Example jumper configurations for common stepper drivers are given in Stepper Driver Jumper Examples.

13.2 Diagnostic Input (StallGuard)

RUMBA32 provides an easy way to connect stepper drivers to the endstop pins. This can be useful when using TMC stepper drivers with StallGuard detection, in order to implement sensorless homing.

Each stepper driver socket features a pin that can connect the stepper driver to an associated endstop input. This requires the stepper driver to have the DIAG pin installed. An example of such a driver is shown in Figure 15.

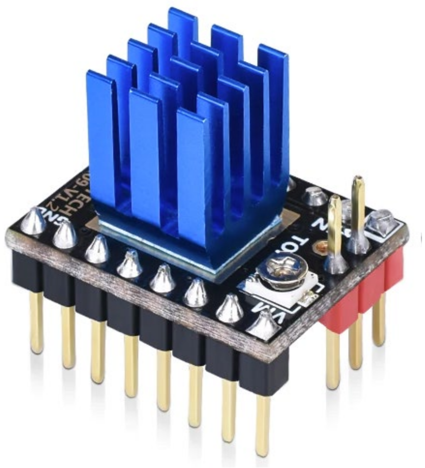


Figure 15: TMC2209 with DIAG pin (red pin, third from edge) installed

The drivers and endstops are matched as follows:

Stepper Driver	Endstop Signal	Microcontroller Pin
X	X-MIN	PB12
Y	Y-MIN	PB15
Z	Z-MIN	PD9
E0	X-MAX	PB13
E1	Y-MAX	PD8
E2	Z-MAX	PD10

For TMC stepper drivers that have this DIAG pin, sensorless homing can be enabled in firmware without requiring any additional wiring.

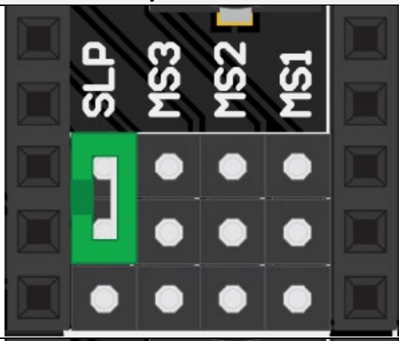
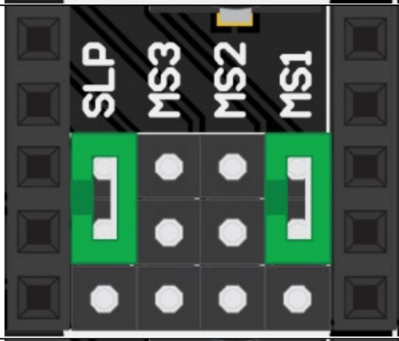
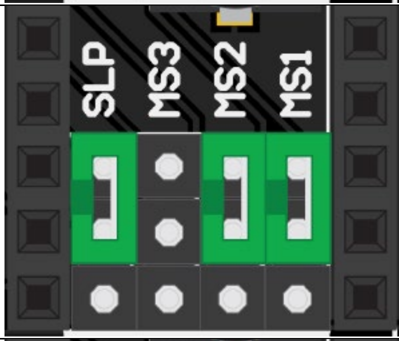
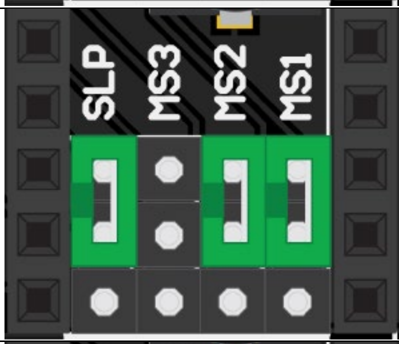
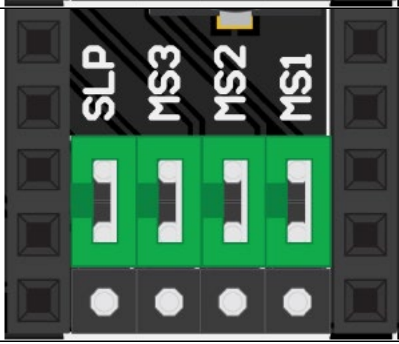
13.2.1 Conflict with Endstop Signal

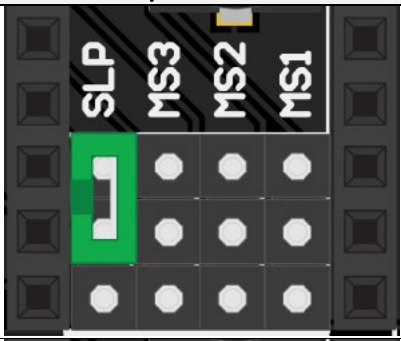
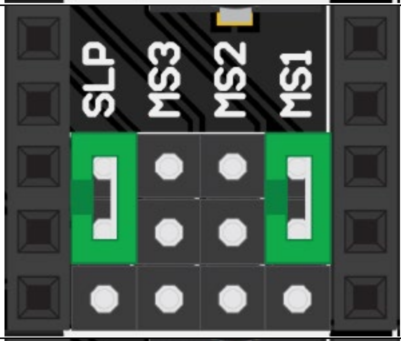
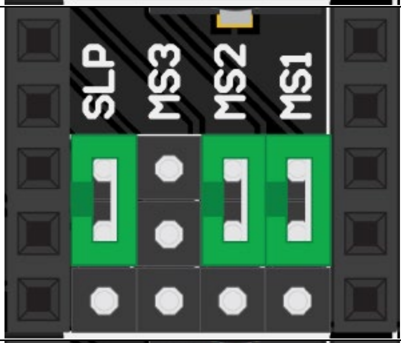
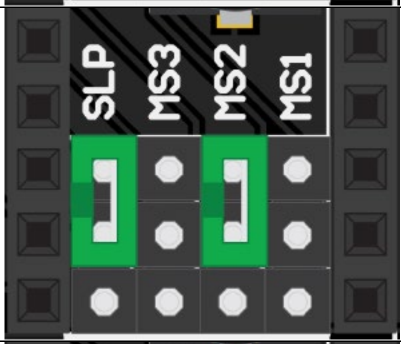
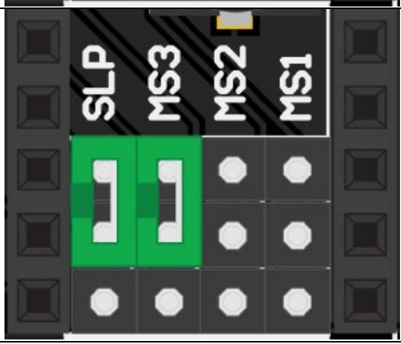
When connecting stepper drivers with the DIAG pin installed, the stepper driver's DIAG signal may override any connected endstop and prevent it from being detected by the firmware.

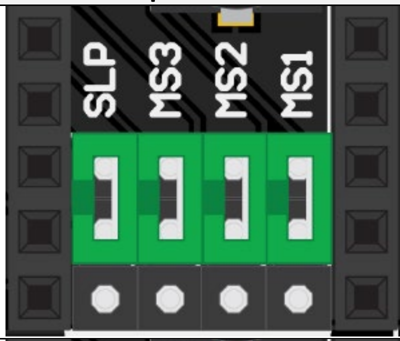
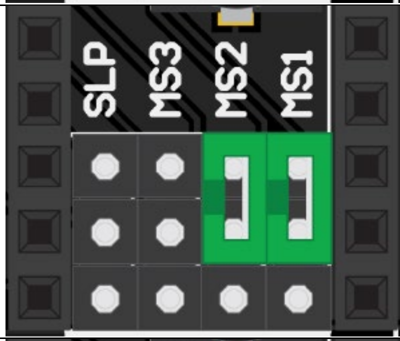
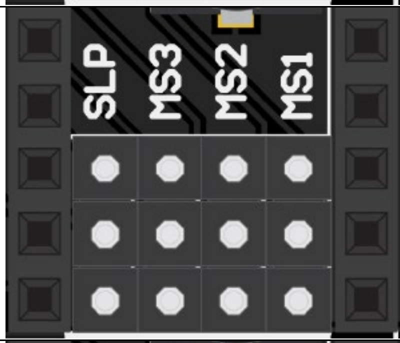
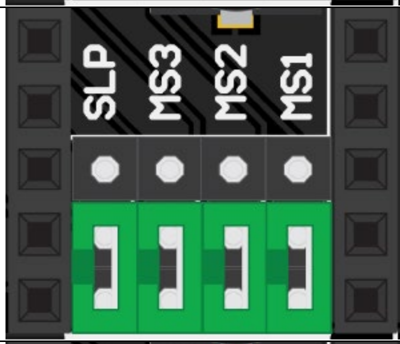
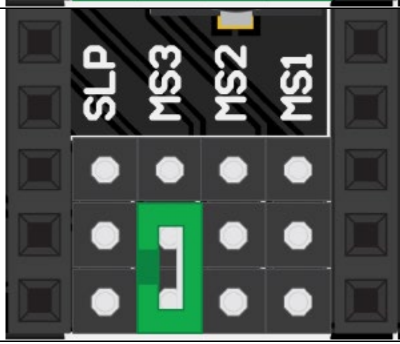
If you are using a stepper driver with the DIAG pin, but do not require StallGuard and intend to use the associated endstop, it is recommended to ensure that the DIAG signal is not connected. This can be achieved the following ways:

- Remove (desolder or trim away) the DIAG pin from the stepper driver
- Remove (desolder or trim away) the DIAG connector in the driver socket on RUMBA32
- Bend the DIAG connector on RUMBA32 so that the driver DIAG pin does not enter it
- Desolder the resistor on RUMBA32 immediately below the DIAG connector

13.3 Stepper Driver Jumper Examples

Stepper Driver	Desired Mode	Jumper Positions
A4988	Microstepping = 1x	
	Microstepping = 2x	
	Microstepping = 4x	
	Microstepping = 8x	
	Microstepping = 16x	

Stepper Driver	Desired Mode	Jumper Positions
DRV8825	Microstepping = 1x	
	Microstepping = 2x	
	Microstepping = 4x	
	Microstepping = 8x	
	Microstepping = 16x	

Stepper Driver	Desired Mode	Jumper Positions
	Microstepping = 32x	
TMC2100	Mode = SpreadCycle Microstepping = 16x	
	Mode = StealthChop Microstepping = 16x Interpolation = 256x	
TMC2130 TMC2160 TMC5160 TMC5161	SPI Communication	
TMC2208 TMC2209	UART Communication	

14 Configuration Jumpers

RUMBA32 features two configuration jumpers on the rear of the board that can be modified to customise functionality.

14.1 STEPPER_DRIVER_LOGIC Jumper

The STEPPER_DRIVER_LOGIC jumper (Figure 16) selects the logic voltage supplied to all stepper driver sockets. By default, it is configured so that 3.3V is supplied to the stepper drivers. All stepper drivers checked should work correctly with 3.3V. However, if there is a requirement for stepper drivers to be supplied with 5V, the track between the centre and 3V pad should be cut, and a solder joint placed over the 5V and centre pad.

Figure 16: STEPPER_DRIVER_LOGIC jumper

14.2 ENDSTOP_VOLTAGE Jumper

The ENDSTOP_VOLTAGE jumper (Figure 17) selects the voltage supplied via all endstop connectors. By default, it is configured so that 3.3V is supplied via the endstop connectors. This should work correctly for most types of endstop, however it is possible some special endstops may require 5V.

If there is a requirement for endstops to be supplied with 5V, the track between the centre and 3V pad should be cut, and a solder joint placed over the 5V and centre pad.

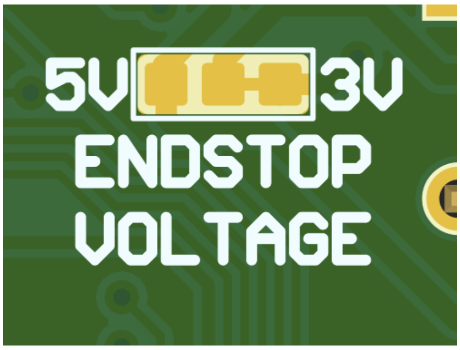


Figure 17: ENDSTOP_VOLTAGE jumper

15 ENTERING BOOTLOADER MODE

The STM32F4 microcontroller features an integrated bootloader that enables the upload of firmware over several interfaces, including via USB DFU and serial UART. This bootloader cannot be overwritten or erased – you cannot "brick" the RUMBA32 board's ability to upload firmware over USB.

To enter the bootloader mode, perform the following steps:

1. Ensure that RUMBA32 is connected to the host PC via the USB cable, and that the board is receiving power from this connection.
2. Press and HOLD the BOOT button.
3. Press and release the RESET button.
4. Release the BOOT button.

This will place the board into bootloader mode. If the USB connection is detected by the board, it will enter USB DFU mode and the on-board LED will flash once.

When correctly in the USB DFU mode, RUMBA32 should appear in the Windows Device Manager under Universal Serial Bus devices as "STM32 BOOTLOADER", as shown in Figure 18.

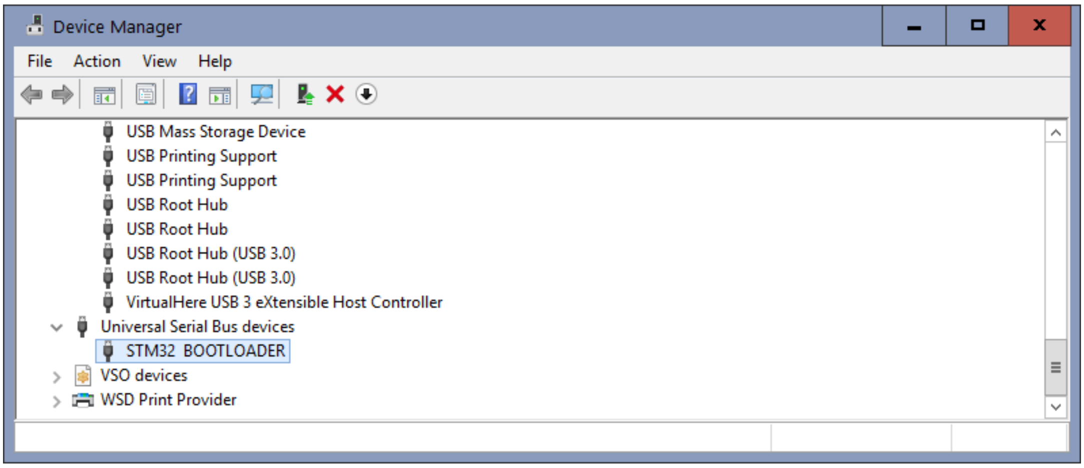


Figure 18: RUMBA32 in USB DFU mode.

Depending on other drivers installed, RUMBA32's DFU mode may be assigned the wrong driver by Windows – in this case, it will show up under a different name in Device Manager. In this case, refer to the following link for more detailed instructions:

https://github.com/Aus3D/RUMBA32/wiki/Entering-USB-DFU-Mode

16 Pinout

EXP1

GND	PE14	PE12	PE9	PE8
+5V	PE15	PE13	PE10	PE7

EXP2

GND	PB0	PB1	PB2	PA6 MISO
PC5	RST	PA7 MOSI	PA2	PA5 SCK

PS_ON

GND	PE11

SWD

PA13 SWDIO	+3V3
PA14 SWCLK	BT0
RST	GND

PIN \ DRV	X	Y	Z	E0	E1	E2
ENABLE	PC11	PE3	PB7	PC12	PD4	PD0
DIRECTION	PC15	PE6	PE2	PB6	PD7	PD3
STEP	PA0	PE5	PE1	PB5	PD6	PD2
SPI_CS UART_RX	PC14	PE4	PE0	PC13	PD5	PD1
UART_TX	PA14	PA13	PB10	PD11	PB3	PB4
DIAG	PB12 (X-MIN)	PB15 (Y-MIN)	PD9 (Z-MIN)	PB13 (X-MAX)	PD8 (Y-MAX)	PD10 (Z-MAX)

STEPPER MOTOR PINOUT

1B	1A	2A	2B

STEPPER DRIVER SOCKET PINOUT

LEFT: TRADITIONAL	LEFT: SPI	LEFT: UART	RIGHT
ENABLE	ENABLE	ENABLE	VMOT
MS1	SPI-MOSI		GND
MS2	SPI-SCK		2B
MS3	SPI-CS	UART RX & TX (1K)	2A
RESET	SPI-MISO		1A
SLEEP			1B
STEP	STEP	STEP	VIO
DIRECTION	DIRECTION	DIRECTION	GND

ENDSTOPS

X-MIN	VSTP	GND	PB12
X-MAX	VSTP	GND	PB13
Y-MIN	VSTP	GND	PB15
Y-MAX	VSTP	GND	PD8
Z-MIN	VSTP	GND	PD9
Z-MAX	VSTP	GND	PD10

VSTP = 3.3V by default

SERVO

GND	+5V	PA15

I2C

+5V	GND	SDA	SCL
+5V	GND	SDA	SCL

THERMISTOR

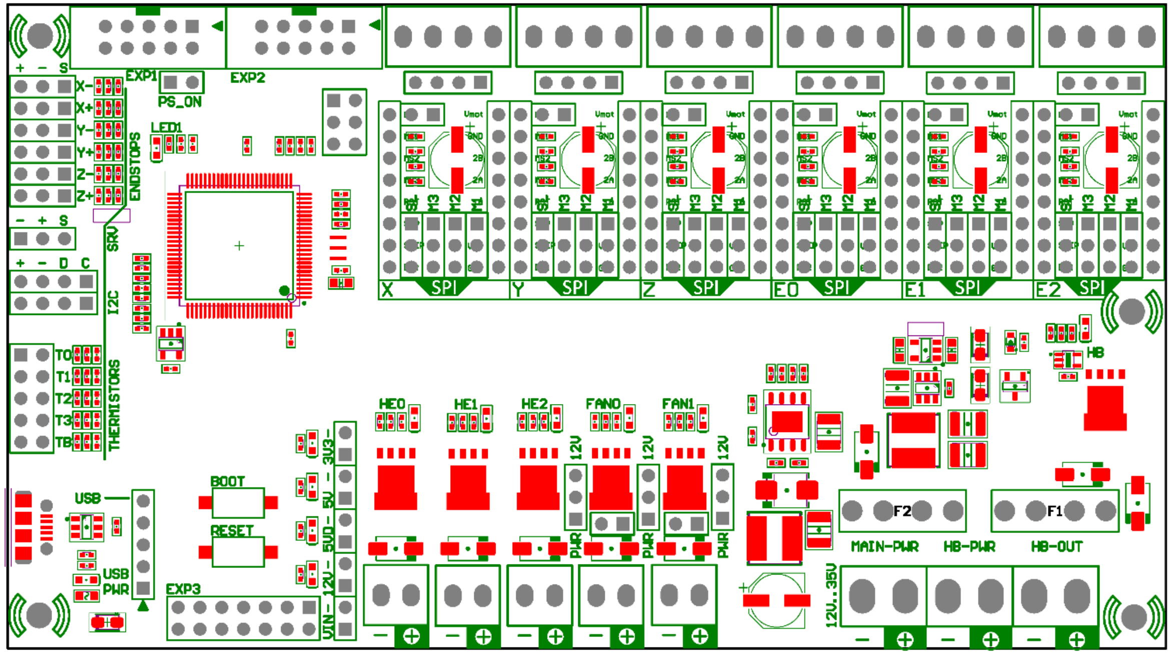
T0	GND	PC4
T1	GND	PC3
T2	GND	PC2
T3	GND	PC1
TB	GND	PC0

PWR

GND
+3V3
GND
+5V
GND
+5VDC
GND
+12V
GND
+VIN1

USB

VBUS
DN
DP
GND
SHLD



DIAG PINOUT

	DIAG

STEPPER DRIVER JUMPERS

SLP	MS3	MS2	MS1
SLP	+3V3	+3V3	+3V3
RST	MS3	MS2	MS1
SPI-MISO	SPI-CS UART	SPI-SCK	SPI-MOSI

EXP3

PD13	PA9 U1TX	PB8 SCL	PA4	PD14	GND	+12V
PD12	PA10 U1RX	PB9 SDA	PA3	PD15	GND	+5V

HE0

- (PC6)	+ (VIN1)

HE1

- (PC7)	+ (VIN1)

HE2

- (PC8)	+VIN1 or +12V (per JMP)

FAN0

- (PC9)	+VIN1 or +12V (per JMP)

FAN1

- (PA8)	+VIN1 or +12V (per JMP)

JMP x3

+12V
<-
+VIN1

MAIN-PWR

GND	+VIN1

HB-PWR

GND	+VIN2

HB-OUT

- (PA1)	+ (VIN2)

17 Dimensions