JTW Astronomy

Manticore

User Manual

NEVER STOP EVOLVING

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Specifications

- Compact size - 90 mm x 70 mm
- USB-C/WiFi/Ethernet connectivity
- 2x ESP32S Processors
- 12 VDC
- Open source OnStepX control system
- Can be flashed remotely
- BiSS-C Encoder support for closed loop motion control (e.g. Renishaw)
- Supports up to 26-bit (0.02" resolution)
- Kalman filter
- PID control
- Trinamic stepper drivers via UART (TMC2209)
- 256x Microstepping
- 2000 mA continuous current per axis
- StealthChop2 (silent running)
- StallGuard4
- CoolStep (reduced power consumption)
- ST4 port for handpad or Smart Hand Controller 2+
- PEC sensor support
- Homing sensor support
- Overtravel sensor support
- Two work light channels (LED PWM)
- Real time clock with battery backup
- I2C breakout header
- GPS support
- BME sensor support
- Magnetic brake for friction drive and harmonic drive during power off
- Status LEDs
- Header for external power switch
- Motor drivers and 5v regulator are easy to replace
- Fuse holder
- Buzzer

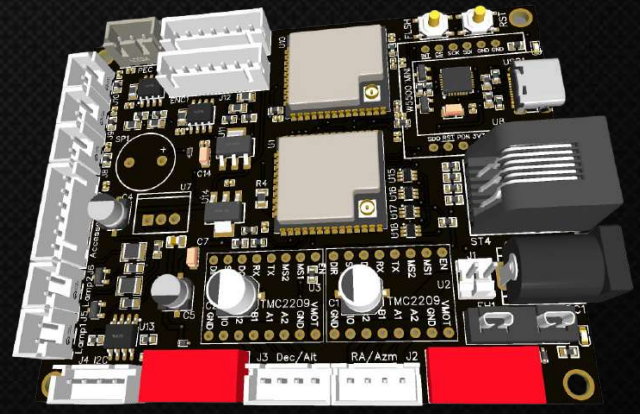
Getting Started

Basic Information

The JTW Manticore is an OnStepX based control system, available as PCB that can be mounted internally or as a standalone external controller. It is compatible with any mount that uses stepper motors.

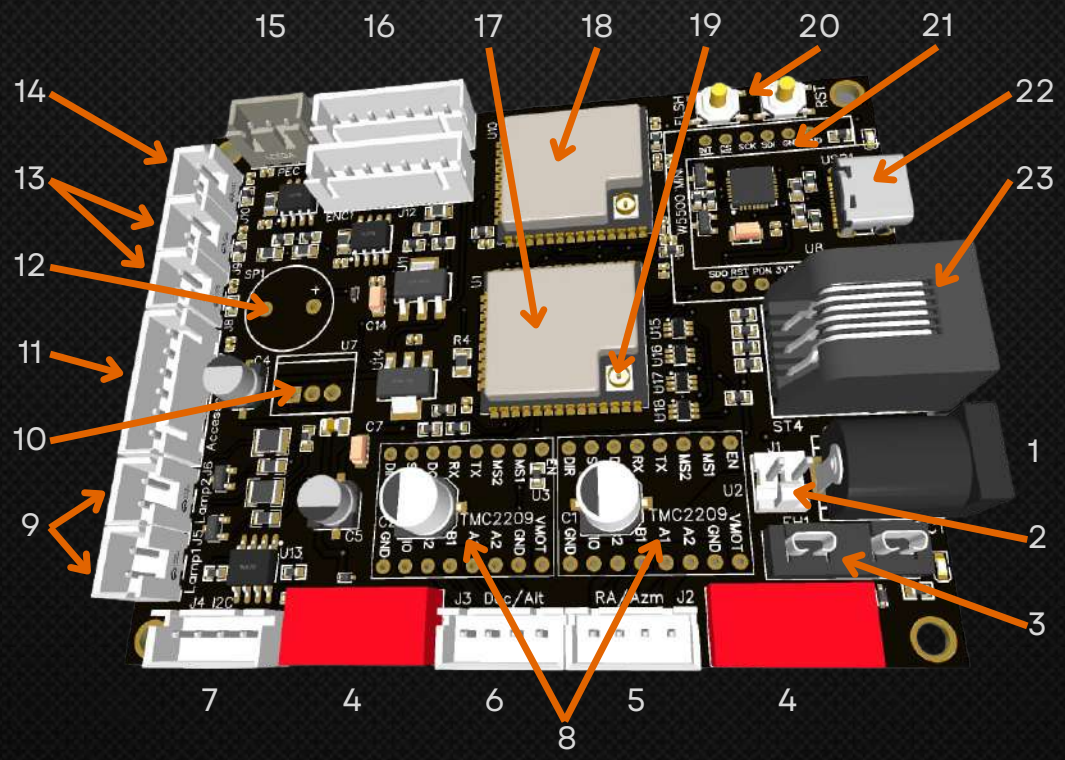
Further reading/useful links -

- OnStepX ASCOM Driver
- Sky Planetarium
- OnStep Flashing Instructions
- Standard Firmware Downloads



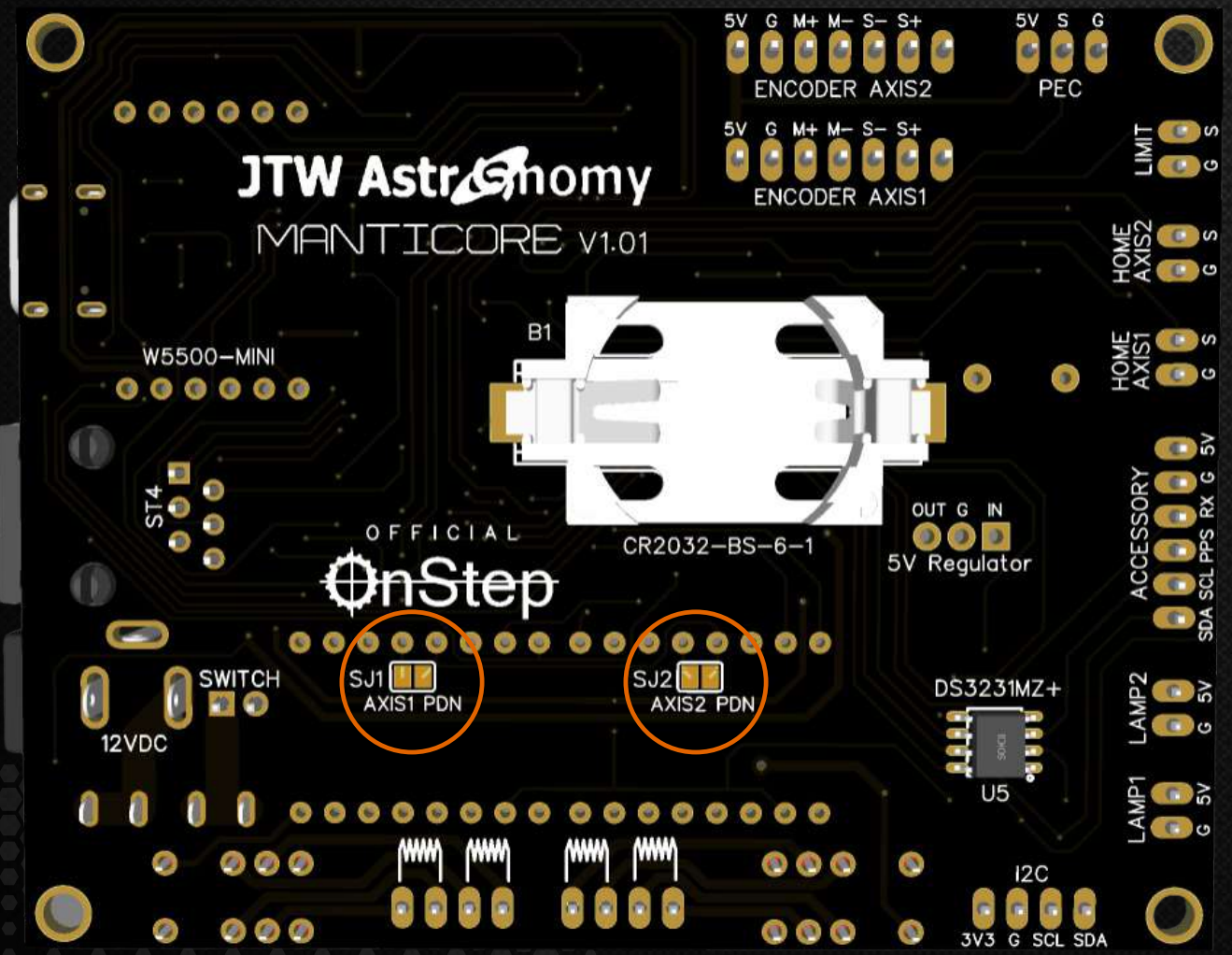
PCB Overview

1. 12 VDC In, 2.1 mm jack
2. Power switch header
3. Fuse holder
   - Littelfuse Micro
   - 0297003.WXT
4. Magnetic brake relay
5. Axis 1 motor
6. Axis 2 motor
7. I2C Breakout
8. Motor driver
   - TMC2209 UART
9. LED PWM Output
10. 5v Buck converter
    - OKI-78SR-5/1.5-W36-C



11. Accessory port
12. Buzzer
13. Home limit
    - Individual Ax1 & Ax2
14. Overtravel limit
15. PEC Sensor
16. Encoders
    - BiSS-C Protocol
17. Main processor
18. Co-processor
19. WiFi antenna mount
20. Manual Boot/Reset
21. Ethernet header
22. USB
23. ST4 Port

PCB Pinout

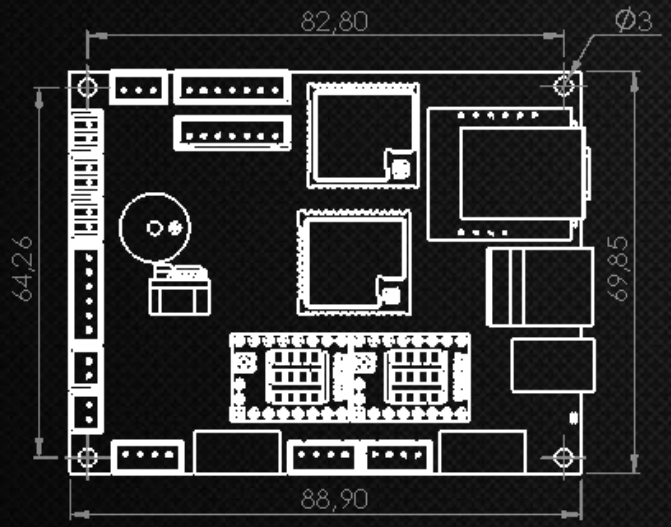


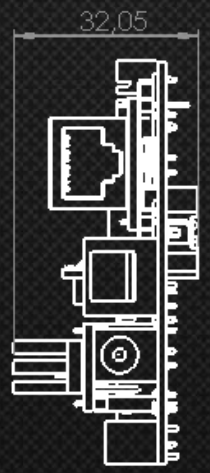
The rear of the PCB has markings to show the pinout of all the connectors.

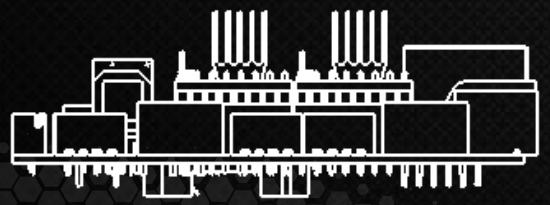
Circled in orange are two solder bridges for the PDN signal to the motor drivers. Depending on manufacturer of the motor drivers the Rx and Tx pin can be reversed.

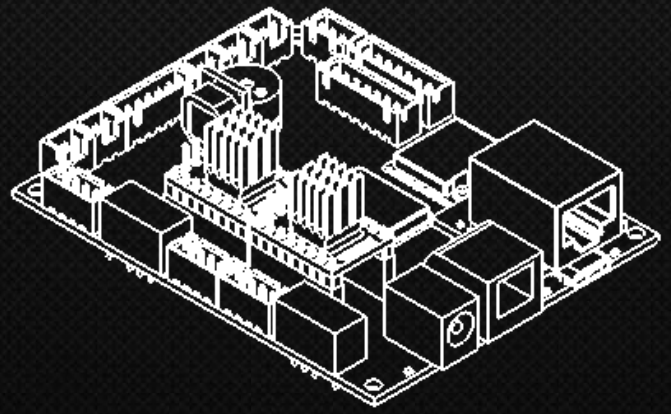
The board is designed for a motor driver with Rx on the 4th pin, if the Rx pin is on pin 5 it is necessary to solder this bridge and to clip the 4th pin from the motor driver. The Tx pin is not used.

PCB Dimensions









PCB dimensions
- 88.9 mm x 69,9 mm

PCB mounting holes
- 82,8 mm x 64,3 mm
- 3 mm diameter

Maximum thickness
- 32 mm (min)
- Includes heatsinks on motor drivers and back-up battery at rear of PCB

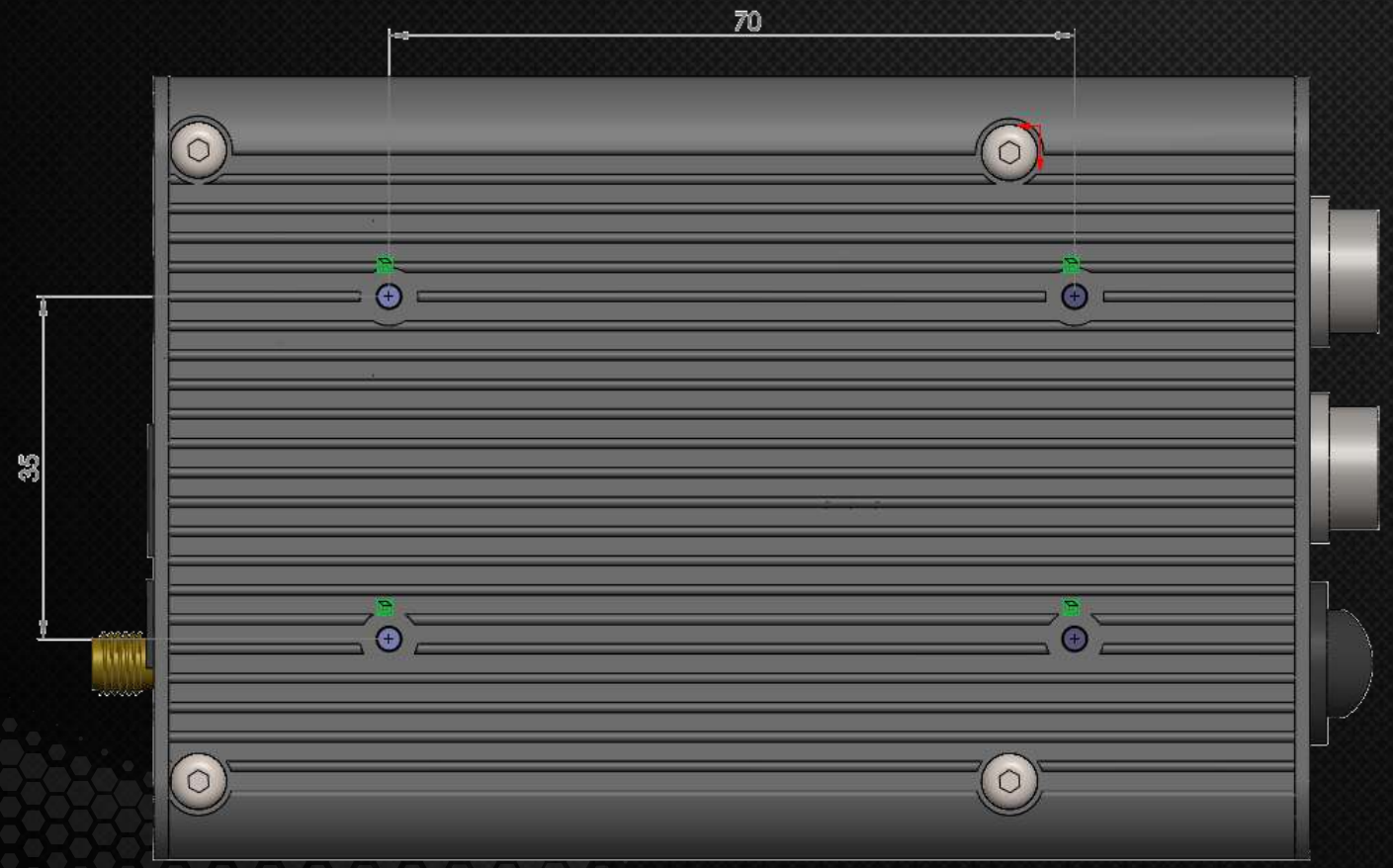
Controller IO’s

1. Power Switch
2. RA Axis
   - Includes PEC sensor
3. DE Axis
   - Includes Home switches
4. AUX Port
   - Not connected on standard version of controller. Can be used as needed for your setup
5. Ext. Port
   - Used for JTW sensor array, wired for GPS and BME sensors

Controller IO’s

1. USB-C
   - Used for computer control & flashing
2. 12 VDC In
3. ST4 Port
   - Functions as regular hand pad port or smart hand controller port
4. Power On LED
5. WiFi Antenna Mount
6. Ethernet Port
7. Status LED 1
8. Status LED 2

Housing Dimensions



Case dimensions

- 120 mm x 80 mm x 45 mm

Details of mounting feature on underside of case -

Mounting pattern

- 70 mm x 35 mm (centered)

Bolt thread

- M3 x 0.5 mm
- 6 mm depth

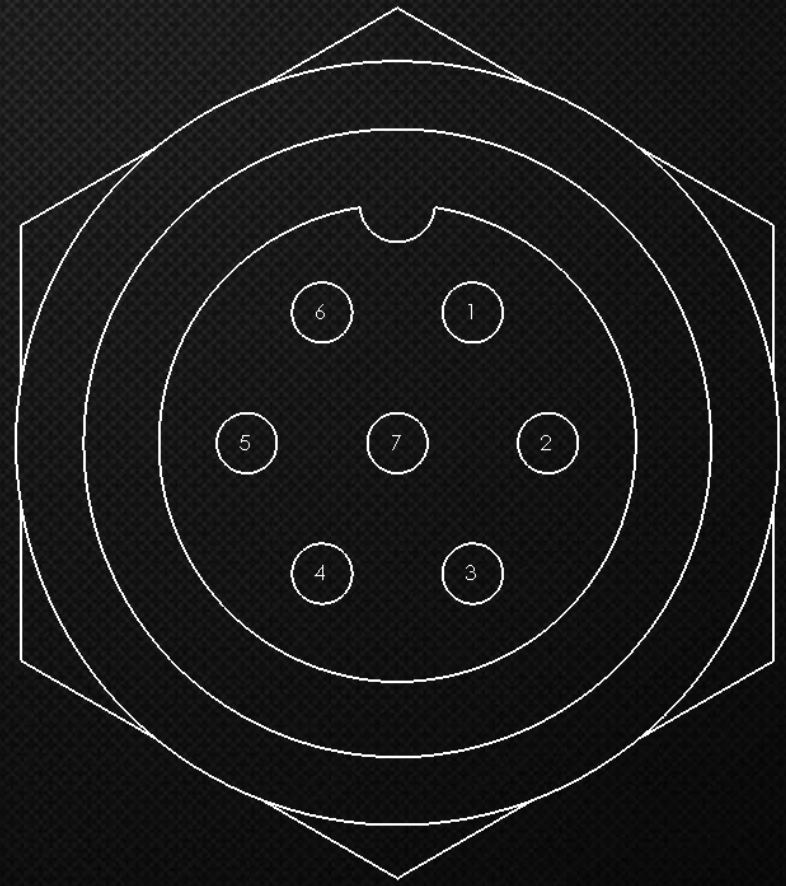
Motor Socket Pinout

RA Motor Socket

Pin	Designation
1	Motor A+
2	Motor A-
3	PEC GND
4	PEC Signal
5	Motor B-
6	Motor B+
7	PEC VCC

DE Motor Socket

Pin	Designation
1	Motor A+
2	Motor A-
3	Ra Home
4	De Home
5	Motor B-
6	Motor B+
7	GND



Updating Firmware

Prerequistes

Install the following items -

- Arduino IDE
- ESP32 Board manager
- Additional libraries

https://onstep.groups.io/g/main/wiki/32776

- Latest version of OnStepX
- Latest version of Smart Web Server

https://github.com/hjd1964/OnStepX

- Latest config.h for OnStepX and SWS

https://www.jtwastronomy.com/pages/manuals-and-drivers

Instructions

Connect the Manticore to the computer via USB cable. Select the correct COM port in the Arduino IDE. Use the following upload settings -

- **Tools->Boards** pick **ESP32 Dev Module**.
- **Tools->CPU Frequency** pick **240MHz** is.
- **Tools->Partition Scheme** pick **Huge App**.
- **Tools->Erase All Flash Before Sketch Upload** pick **Enabled**.

After uploading the OnStepX firmware it is necessary to upload the Smart Web Server firmware. Open the Serial Monitor, select the correct baud rate (default is 230400) and type **:ESPFLASH#** and press enter. The controller can now have the SWS firmware uploaded to it.

General Information

This board only supports 12V operation since the motor shunting relays are directly attached to the main DC power rail. Those relays are, however, available in a 24VDC form and if those were installed it could instead be used at 24VDC only. The whole board draws about 0.2A at 12V with nothing attached but fully populated and operating including the W5500. The 5V switching regulator is supplying about 0.5A in this case, mostly from the demands of the 3.3V regulators. The switch connector Molex KK contacts are 3A rated and this sets the maximum supported current draw at 12V. The fuse would be 2A rated for the typical use case.

The stepper drivers can be either TMC2209's or TMC2226's which are basically the same thing but in a larger package so a little better current handling. In theory these can handle up to 2.8A peak current but will need to be well cooled near those maximums. Without active cooling (which there is no fan header provision for) this design will be ok for pretty much any NEMA17 stepper motor and perhaps for some lower current (short body) NEMA23 too. At 2A TMC2209's get good and warm so probably about 1.7A and down would be best given the case this is mounted in. Note that since stepper motor current ratings are at their design voltage the actual current used is not simply a matter of adding numbers. For example a 1.7A rated motor (design voltage = 2.8V) would draw 1.7*(2.8/12)*0.707*2 = 0.56A at the rated peak current and so for two 1.1A at 12V which is the maximum recommended setting.

For the I2C connector there is SDA, SCL, Gnd, and 3.3V. The I2C lines are not protected from ESD (beyond what the ESP32 has). The 3.3V line has a limit of 50 mA. The ESP32's already pull a fair bit of current from the 3.3V regulators and you have the W5500 and USB bridge etc. so they get warm and it’s not advised to put much more load on them.

General Information

The Lamp1/2 connectors have Gnd (switched) and 5V present. The 5V side of each passes through a 51 Ohm resistor and the ground is switched by an n-channel MOSFET. So the maximum current (dead short) each of these can draw is 5/51 = 0.1A so 0.2A total at 5V for both.

The Accessory connector has Gnd, 5V, GPS RX, PPS, SDA, SCL. Again there is no additional ESD protection beyond what the ESP32 on I2C, RX, or PPS. The 5V draw on this connector is anticipated to be <= 0.1A.

The Home and Limit sense connectors have Gnd and a Sense pin. The sense pin has a 0.1uF capacitor and 2K pullup resistor which helps with noise suppression and ESD protection. Shorting the respective sense pin to Gnd changes the pin state and these have a negligible power requirement.

The PEC connector has Gnd, 5V, and a Sense pin. The sense pin has a 0.1uF capacitor which helps with noise suppression and ESD protection. The 5V draw on this connector is anticipated to be <= 0.1A.

The encoder connectors have Gnd, 5V, and balanced MA/SLO signals pins. The SLO/MA pins are TVS protected against ESD (a SIT75179 feature.) The 5V draw on these connectors is anticipated to be <= 0.2A.

The USB-C port D+/D- lines have TVS devices for ESD protection.

General Information

The ST4 port RJ12 has Gnd, 5V, RA+, RA-, DE+, DE- connections. There is no additional ESD protection beyond what the ESP32 provides on RA+, RA-, DE+, DE-. The 5V draw on this connector is anticipated to be <= 0.1A. Note that the ESP32 SHC2+ that may be plugged in here runs at a reduced clock rate and without WiFi enabled so its current demands are significantly reduced vs. running at full speed with WiFi enabled.

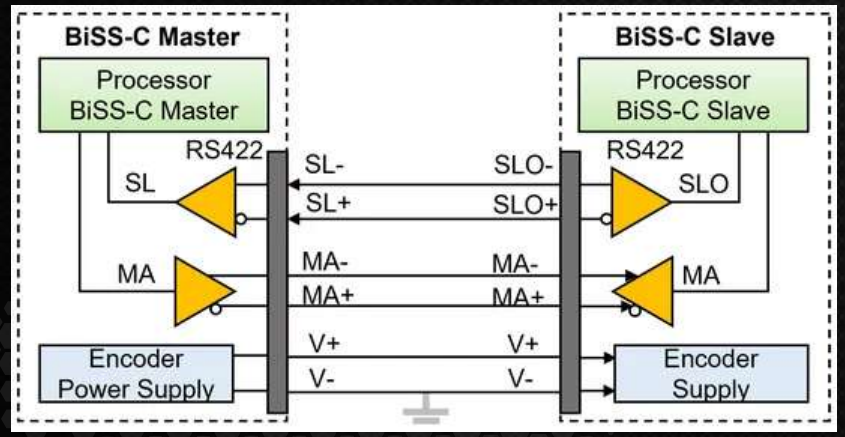
The 3V rails (two AMS1117's) are lightly loaded at only about 0.2 or 0.3A each and they don't get excessively hot since they're just dropping 5V to 3.3V.

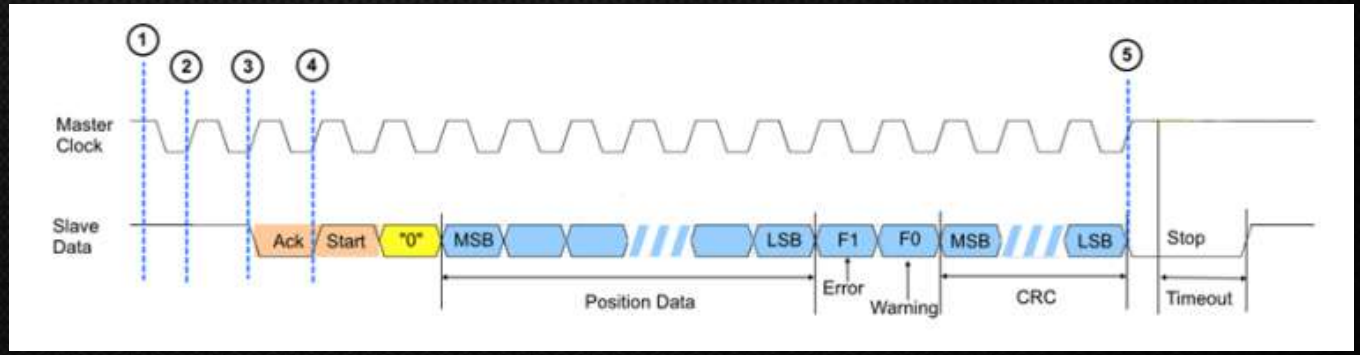
The 5V rail might reach as much as 1.1A total (maximum) where common 5V switching regulators are good to 1.5A (like the OKI-78SR-5) so plenty of margin there as well.

So adding all of those 5V current demands up the 12V rail will see as much as 1.1A * 5/12 = 0.5A plus whatever the stepper drivers need which depends on the motors, but the 1.1A example I gave is roughly in line with most common configurations. Together that's about 1.6A total at 12V where the design limit is nearly twice that on the 12V rail.

BiSS-C Protocol

The JTW Manticore supports BiSS-C absolute encoders for closed loop positioning. Due to the variance between various mounts and encoder brands this will likely require a degree of customization in the firmware, besides the resolution of the single turn count there could also be multiturn data. If assistance is needed please do not hesitate to contact us.





Further Assistance

Please contact us via any of these channels should you require any help with your project

Email - info@jtwastronomy.com
Tel/SMS - 0031642694782
Telegram - https://t.me/JTWastro
WhatsApp - https://wa.me/31642694782
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