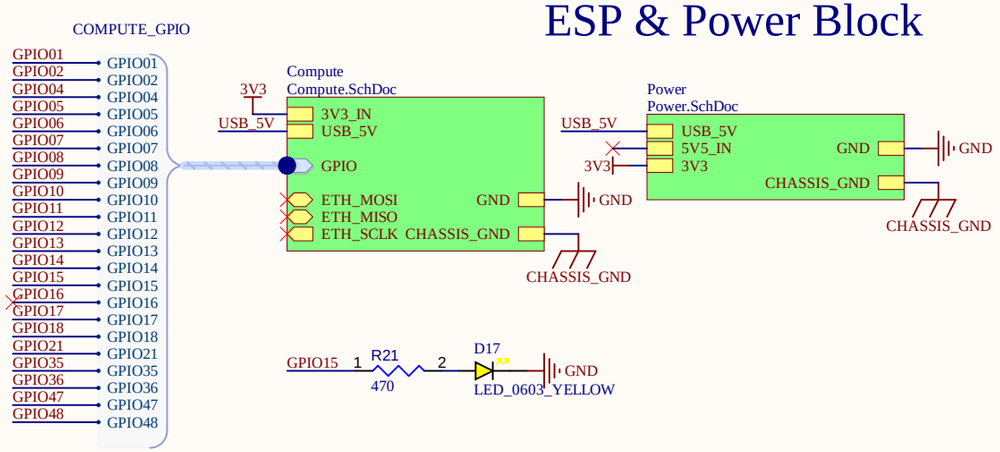
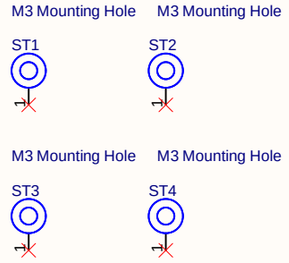
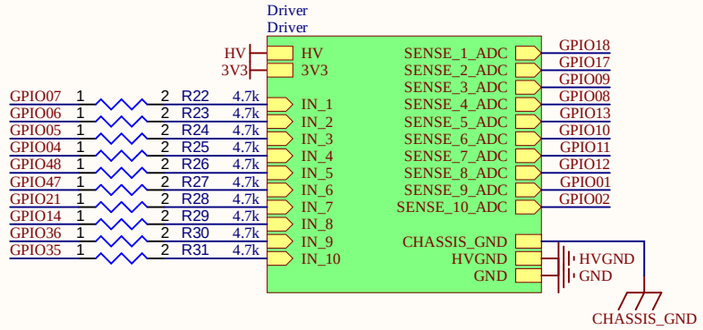
ESP & Power Block



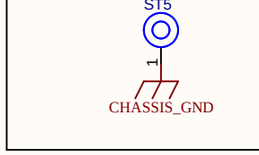
Mounting Holes



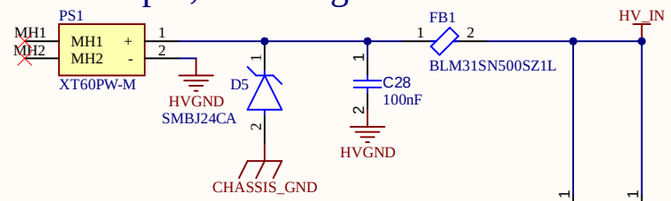
High Side Drivers



Chassis Ground

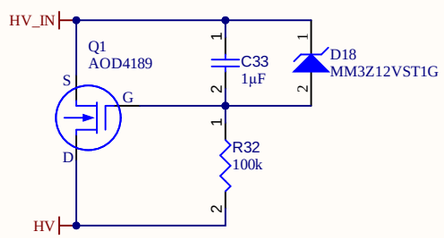


Power Input, Filterring



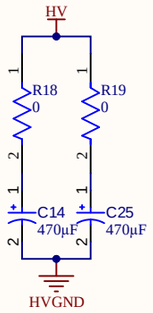
Filterring:
The ferrite bead helps damp HF noise and is just 1.6 mOhm at DC, making it not heat up much at all. The 470uF capacitors are hybrids, so great capacitance at a voltage rating of 35V. Poly caps don't have to worry about voltage derating like ceramics. We need high capacitance due to the inductance of the actuators, to avoid having the voltage rail rise due to inductive kickback. 1uf and 0.1uf are ceramics to help damp noise more. The Resistors can be populated to act as ESR for the poly caps.

Soft Start



Soft-Start works by creating and RC filter. The gate slowly discharges, which slowly turns on the MOSFET. C can be adjusted to increase or decrease the time constants if needed. The zener prevents the V_SG from dropping below 12V, as the MOSFET has a max V_SG of 20V. The chosen MOSFET has a R_DS of 22 mOhm which means at 5A the voltage drop is ~0.125V, which is small enough to not be an enough and the DPAK package has good thermal resistance so would only rise by ~30C for 5-6A continuous.

Bulk Capacitors



Large capacitors are neccessary since if we switch the solenoids quickly the inductive kickback has significantly drop the supply rail. This are hybyrid caps, so they have great ripple performance, high capacitance, and high voltage ratings.

Title		
Size: B	Number	Revision
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HVGND
GND
3V3
HV
CHASSIS_GND

The reason the mapping of OUT to pin is weird is because it makes routing easier, leave me alone - Aidan

Using 3-pin GX12s so that we can connect pin 3 to shielding, since connecting it to the node before the resistor is not ideal.

Nominal current is 0.5A. Across the 0.1ohm resistor, that is 50mV. It's best to have that in the middle of the ADC's range (for the sake of resolution and headroom). The default ESP32 reference voltage is 1.1V. So we should amplify with a gain of 22. The Gain of hte INA4180 A1 model is to set 20, which is good enough

U1
TPS4H160AQPWPRQ1
VS
IN1
IN2
IN3
IN4
DIAG EN
THER
ST1
ST2
ST3
ST4
CL
OUT1
OUT2
OUT3
OUT4
NC
Thermal Pad
GND
C1 1µF
C30 1nF
IN_1
IN_2
IN_3
IN_4
OUT_1
OUT_2
OUT_3
OUT_4

This small capacitor is to help prevent huge ground bounces, as it will behave as a short at high freq.

U3
C2 1µF
C31 1nF
IN_5
IN_6
IN_7
IN_8
OUT_5
OUT_6
OUT_7
OUT_8

U7
C3 1µF
C32 1nF
IN_9
IN_10
OUT_9
OUT_10

F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11
3587
C15 C16 C17 C18 C19 C20 C21 C22 C23 C24
1µF
R1 R2 R3 R4 R5 R6 R7 R8 R9 R10
50m
SENSE_1 SENSE_2 SENSE_3 SENSE_4 SENSE_5 SENSE_6 SENSE_7 SENSE_8 SENSE_9 SENSE_10
SOL_1 SOL_2 SOL_3 SOL_4 SOL_5 SOL_6 SOL_7 SOL_8 SOL_9 SOL_10
D1 D2 D3 D4 D6 D7 D8 D9 D10 D11
SMBJ24CA
J1 J2 J3 J4 J5 J17 J18 J19 J20 J21
GX12-3 Jack

C4 C5 C13
100nF
U2A U2B U2C U2D
U4A U4B U4C U4D
U8A U8B
INA4180A1IPWR
SENSE_1_ADC
SENSE_2_ADC
SENSE_3_ADC
SENSE_4_ADC
SENSE_5_ADC
SENSE_6_ADC
SENSE_7_ADC
SENSE_8_ADC
SENSE_9_ADC
SENSE_10_ADC

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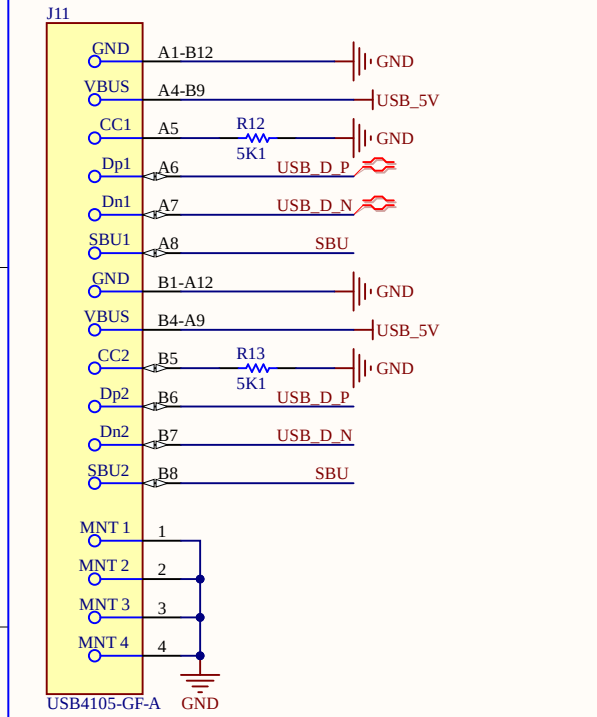
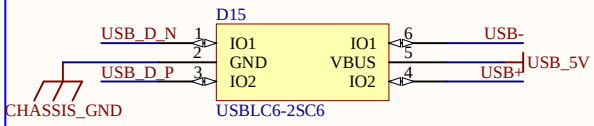
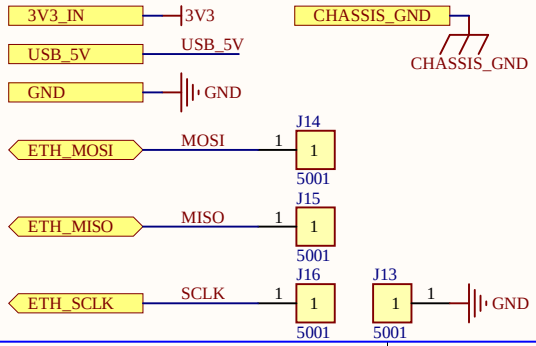
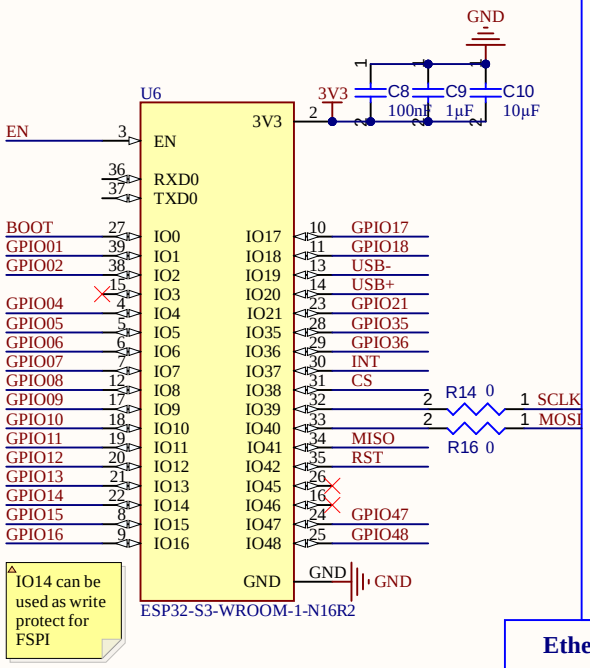
USB & ESD Protection



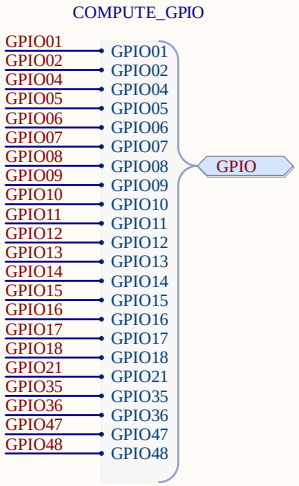


Ports

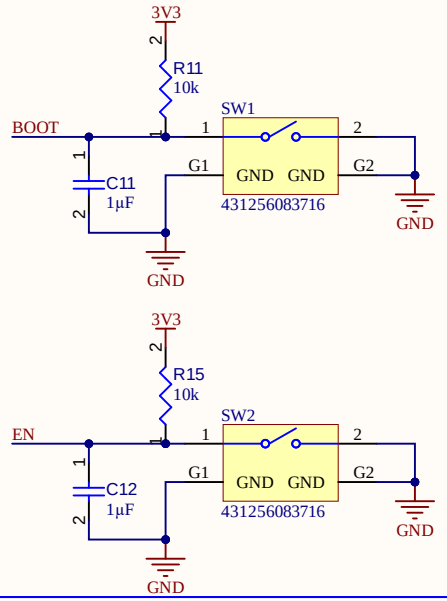




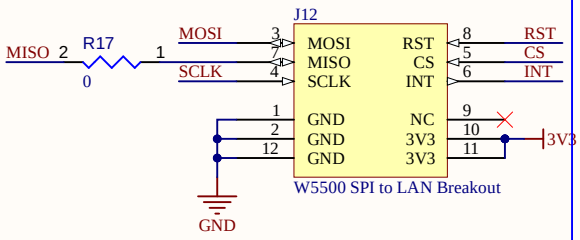
IO14 can be used as write protect for FSPI



Boot & Reset Switches



Ethernet W5500 Breakout



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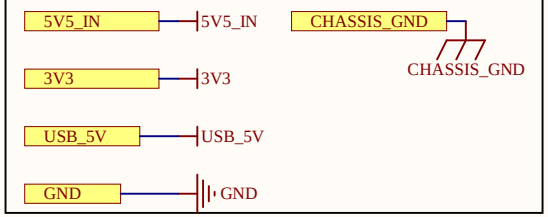
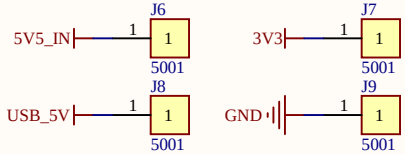
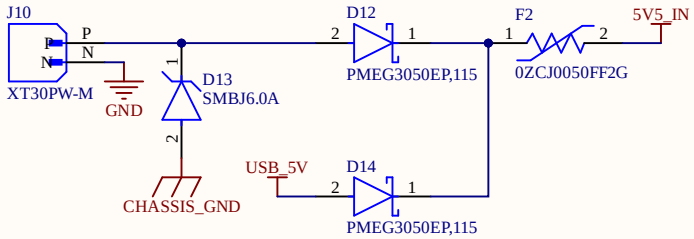
Nets and Ports



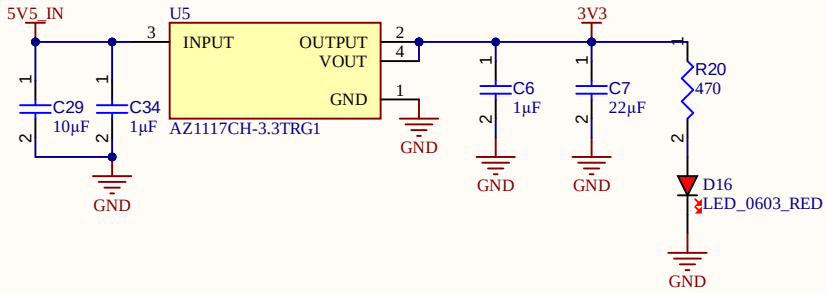
Test Points



Power Input



Clean 5V -> Clean 3.3V LDO



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