DEEP SEA DOGS

Project All-Star

Technical Report
Explorer Class
2025 MATE ROV

Allan Hancock College
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Santa Maria CA 93454

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Jacob Cabrera- Software Engineer
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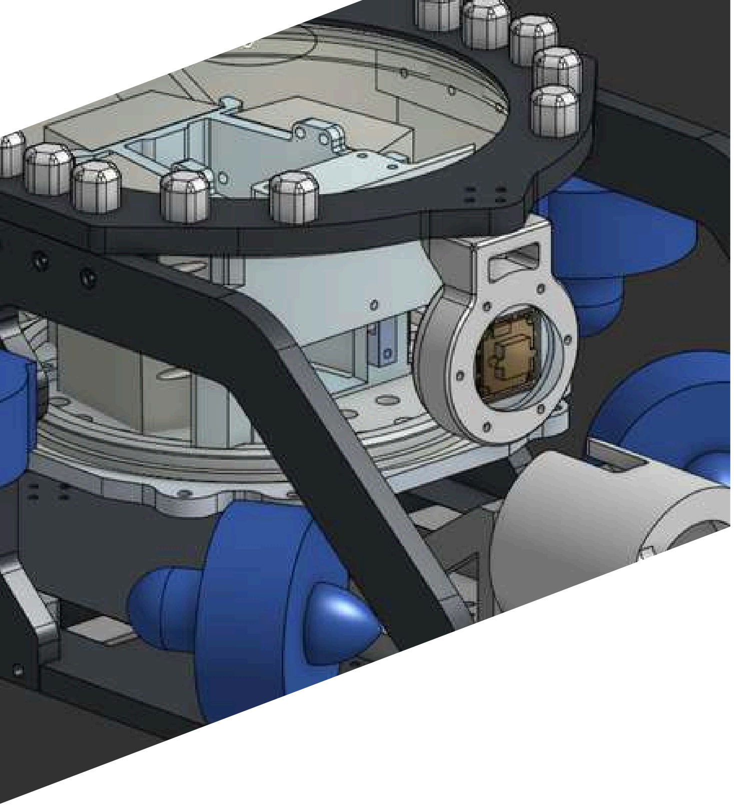


Abstract

This season, Deep Sea Dogs Robotics focused on making strides in engineering, leadership, and community engagement. Over the course of 8 months the Deep Sea Dogs designed and built Project Allstar. This ROV featured a custom-machined frame, a waterproof and pressure-resistant electronics canister, and a functional claw mechanism designed for efficient mission completion.

From a technical perspective, Deep Sea Dogs Robotics pushed innovation by handling nearly all aspects of the build in-house—from structural design to electrical integration. The goal was to emphasize reliability and efficiency while ensuring our ROV could withstand the demanding underwater environment of competition.

Alongside our engineering accomplishments, we also experienced strong team growth. We welcomed two new team leads in marketing and electrical, whose contributions helped us better organize our efforts and communicate our mission. We implemented Trello as a project management tool, which improved our ability to track tasks and stay coordinated throughout the season.

Outreach remained an important part of our mission. We connected with the community by hosting demonstrations and engaging with students on our community college campus, sparking interest in robotics and STEM fields.

As a team, we're proud of our technical achievements and the way we've grown both organizationally and as individuals. The 2024–2025 season has laid a strong foundation for future success.

Sea Dogs Vision

Collaboration

This season we focused on utilizing our connections to help us achieve our goals. We collaborated with our Schools AG department, Machining Club, a local artist, and utilizing teacher and facility knowledge. Our CEO also implemented new strategies to encourage team collaboration to lead us toward sucess.

Communication

Learning from previous years, we desired to heighten communication this year. So, in order to help increase productivity and communication we implemented new strategies. Utilizing Trello and new club standards we were able to achieve these desires.

Project Management

A word from our CEO, Dylan Martin:
"As the CEO of the Deep Sea Dogs, I was in charge of overseeing management and team operations. I coordinated timelines across our different subteams. I introduced Trello as our central task management system to track progress and prioritize our objectives. I led weekly meetings to review our progress, redistribute responsibility as needed, and ensure all teams were aligned on our milestones. Recognizing gaps early in the season, I recruited key members in electronics and marketing, which helped stabilize our workflow and presentation. Running the business side involved ensuring compliance with deadlines, mentoring subteam leads, and establishing an accepting and productive working environment for all club members. My goal as CEO was to create a structure where each member could succeed, and where our final product reflected the strength of our coordination."

Trello was used as our collaborative task management software, allowing us to list specific tasks that need to be completed and assign them to subteams. As the season progressed and our end goals became more clear, the Trello board was updated to include more detailed information and tasks to ensure all team members were on the same page with goals. This system made it easier to help team members prioritize and focus on accomplishing goals towards completing the ROV.

Tasks were arranged by their assigned subteams and assigned deadlines, providing a simple picture of what each group needs to accomplish. To better signify task importance, each task was assigned a point value and compared against intended point totals. This allowed us to monitor our pacing and see if we were falling behind. Motivational goals were incorporated alongside the point values, such as running a team event if a specific target was met.

Starting from Scratch

The Advantage

Design freedom and ROV transport have been problems we have faced in the previous years. By taking the entire design process into our hands we can create an ROV that solves both these problems for seasons to come.

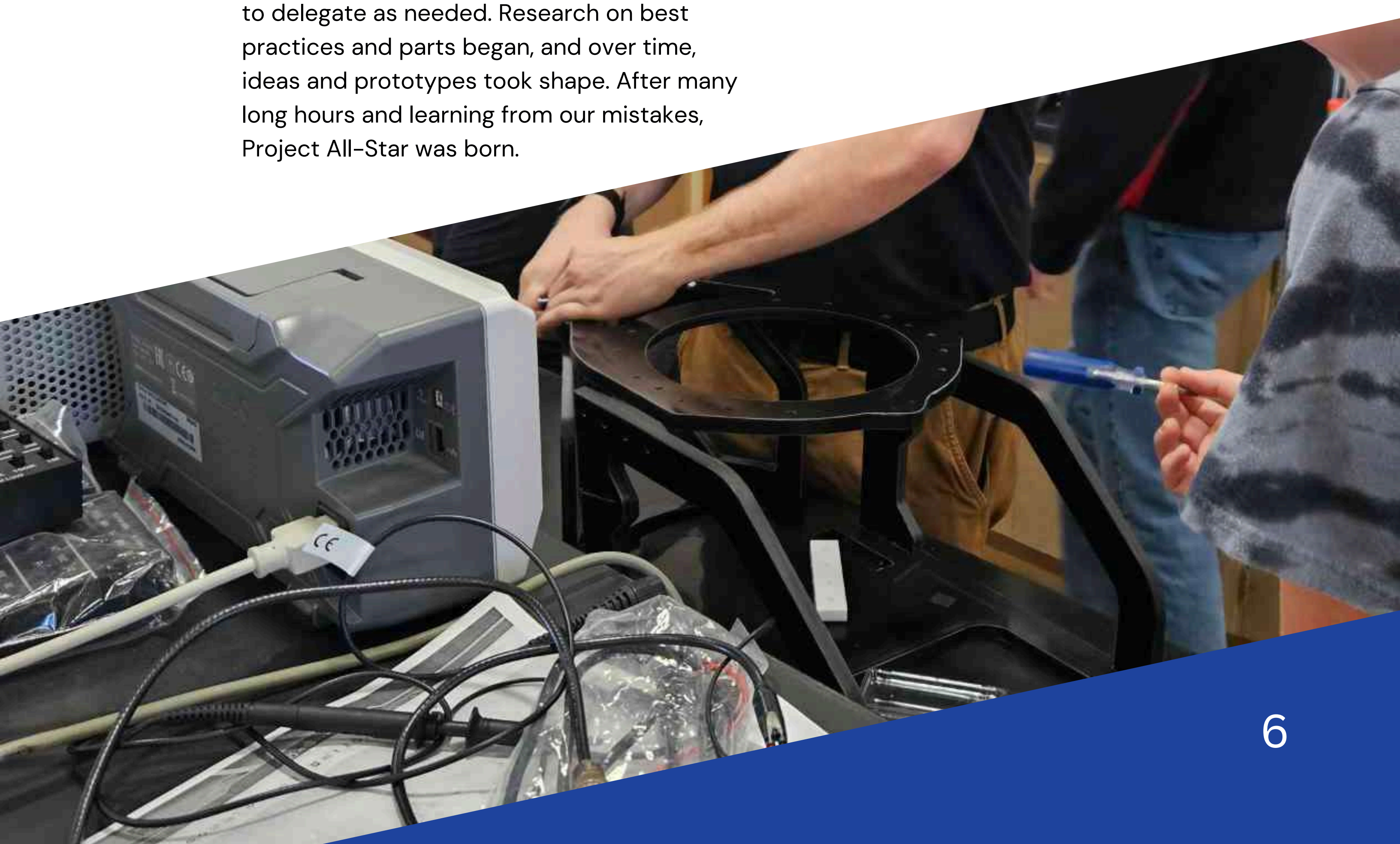
The Challenge

Getting it to all fit. After many design iterations we were able to land on a design that balanced all of our needs. Many a late night was spent doing CAD and Electrical Sketching to work out the kinks.

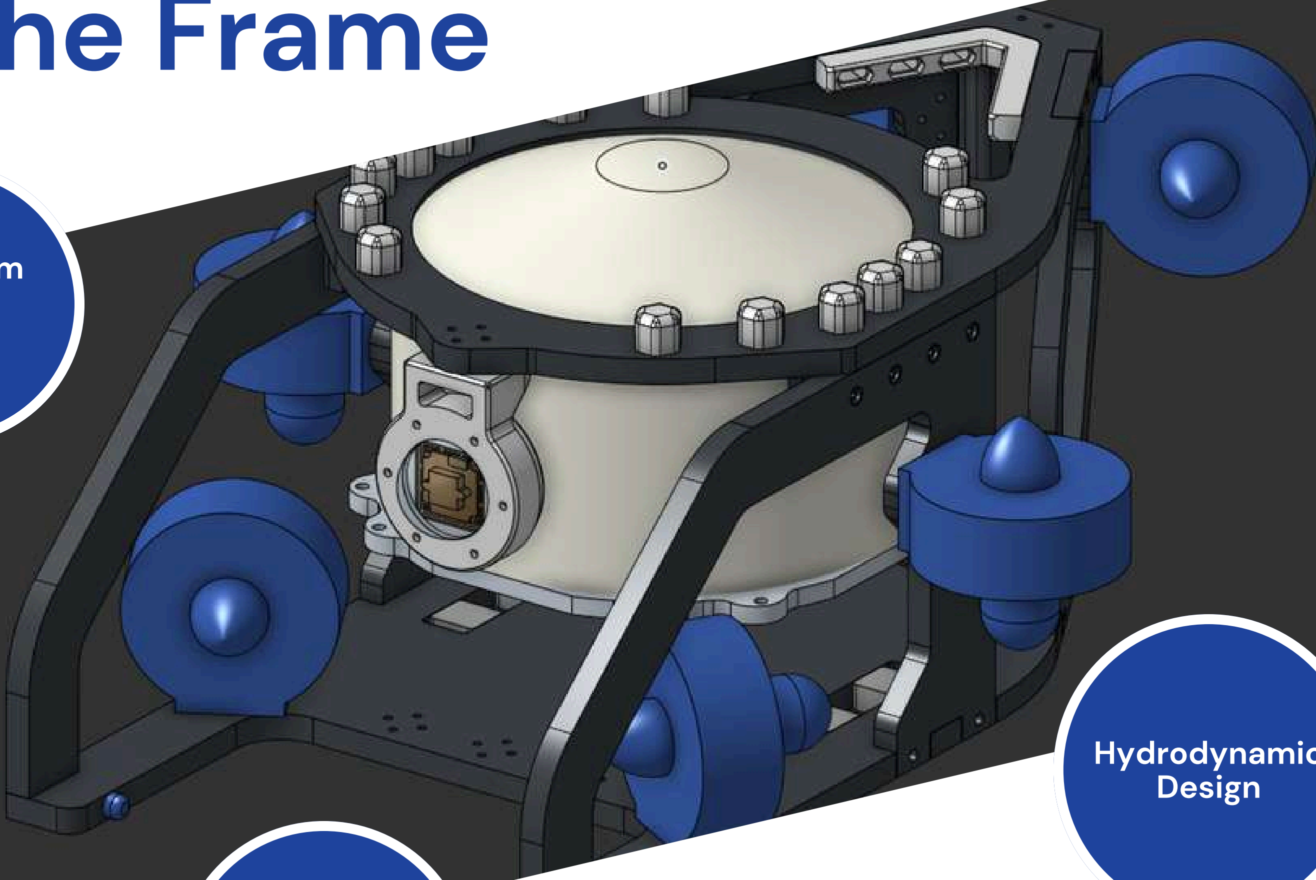
The Process

By utilizing our new productivity strategies, we sectioned off duties to each of the leads to delegate as needed. Research on best practices and parts began, and over time, ideas and prototypes took shape. After many long hours and learning from our mistakes, Project All-Star was born.

- Efficient Maintenance
- Upgraded Power Control
- Enhanced Hydrodynamics
- Economical Transport



The Frame



Aluminum
HDPE
PVC

Optimized for
6 thrusters

Hydrodynamic
Design

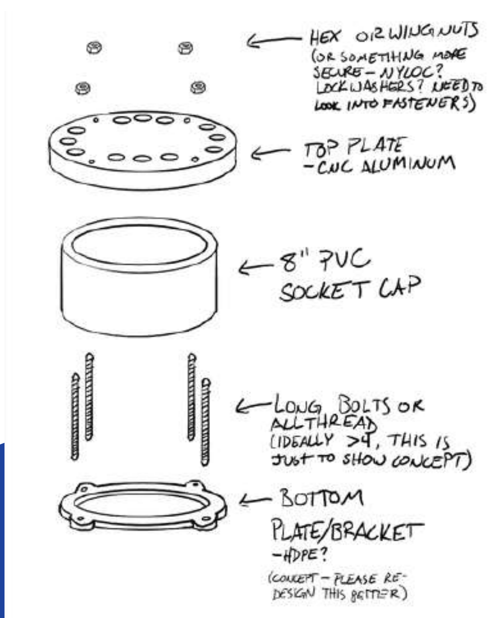
The frame of Project All-Star is made primarily out of CNC-machined high-density polyethylene (HDPE), as well as having some components 3D printed out of polyethylene terephthalate glycol (PETG), CNC-machined 6061 aluminum, PVC pipe, and 304 stainless steel hardware. HDPE was chosen for the frame due to multiple favorable characteristics – it's lightweight so it doesn't contribute much to the overall weight of the vehicle; it's close to neutrally buoyant in water, so less ballast is needed to counteract it; it is easily machinable, making manufacturing and assembly incredibly easy; it's durable, making for solid structural integrity of the ROV; and it's cost-effective compared to many other materials, lessening the overall cost of the vehicle.

To improve flexibility in mounting components, the screw arrangement for the T200 thruster base was used across the entire ROV frame. This allows us to mount the thrusters in a variety of locations should we wish to change the arrangement later, and simplifies modeling other accessories as we will know they fit wherever we place them. For securing core structural components, we stuck with standardized Metric M3 and M5 screws to prevent issues with trying to locate non-standard hardware.

The Dome

One of our primary goals for our latest ROV was to make the electronics housing more accessible and easier to maintain. Our previous robot used a long canister with plastic lids that were difficult to remove, and relied on O-rings that were susceptible to damage. Our team decided that the best way to remedy this problem was to increase the diameter of the electronics canister and reduce its length, allowing us to pursue a "sandwich" design for housing the electronics. We ultimately settled on using a PVC end cap suitable for 8" PVC pipe, as it not only met the dimensional requirements but also provided several other benefits. To start with PVC end caps proved to be inexpensive, did not require any manufacturing processes to create the shape. They are also extremely durable, watertight, and hold up to pressure. So all this paired with the low cost helped us decide this was the best plan of action

The Dome (as we have come to call it) is an 8-inch PVC socket cap, a 6061 Aluminum end cap, and PETG electronic internal housing. The electronics mounting plate (or end cap) was manufactured out of 6061 aluminum, chosen for its balance between machinability, strength, corrosion resistance, light weight, and for its heat transfer abilities to act as a heat sink for the electronics. To waterproof the canister, a channel was machined into the electronics mounting plate, designed to hold a custom gasket that was made out of urethane rubber. A secondary channel was machined into the vertical wall of the electronics mounting plate that mates with the interior of the canister, holding an o-ring to act as an auxiliary seal. The electronics canister is compressed on to the end cap by long stainless steel bolts that also attach the canister onto the chassis of the ROV. Inside The Dome we have sandwiched in all our necessary electrical components as will be referenced in the next section.



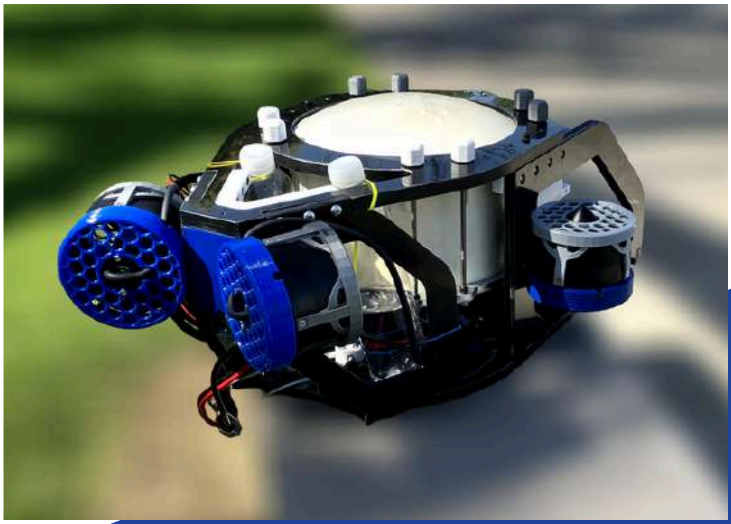
Additional Components

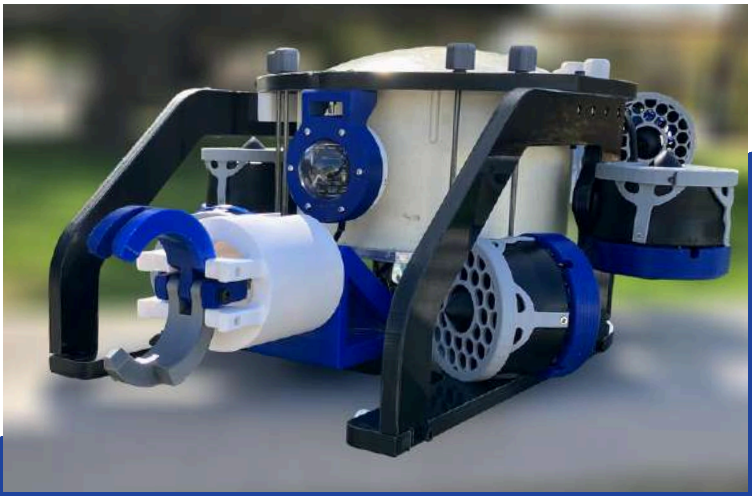
Ballast and Floatation

Although HDPE is almost naturally buoyant, combined with the weight from the dome, thrusters, claw, and other parts is not naturally buoyant. In order to counteract this reality, we have added buoyancy to the rear of the vehicle. This placement keeps it out of the way of the claw and its attachment to the frame, camera, along with balancing out the weight from the front of the vehicle.

The Claw

After reviewing the missions for this year's competition, we realised a claw with three degrees of motion would help us achieve maximum efficiency. The claw was also designed to maximize its capability of clamping onto anything, even if the object is slightly too large for the anticipated circumference. The process involved configuring both the ability to cinch for a better grip and brackets to make a functional, secure pincer. The servo serves as the operation mechanism, culminating with the brackets, which effectively require little movement to tighten and loosen. The whole claw mechanism is attached to a servo that allows for the third degree of motion. Then this entire mechanism is attached solidly to the frame of the ROV. To ensure environment safety, all screws were implemented to be sunk-in to the prints, as well as rounding the edges without sacrificing integrity.





Electrical

Project All-Star is powered by a surface-supplied 48V DC source (RSP-2000-48). Onboard the ROV, this voltage is stepped down to 12V and 5V using three 48V-to-12V buck converters, each rated for 40A continuous output. Each converter supplies power for two T200 thrusters each. Along with the Buck Converters there is an additional DC/DC 48V-5V, 5A supply for the RaspberryPi and Arduino boards.
See Appendix C for full power calculations.

Raspberry Pi + Arduino

The Brains

A powerful duo. The RaspberryPi 5 contains a chip that allows efficient video transmission for control. Meanwhile, the Arduino board excels at real-time sensor interfacing and low-latency control. With their powers combined this creates the perfect environment smooth control

Buck Converters

The Brawn

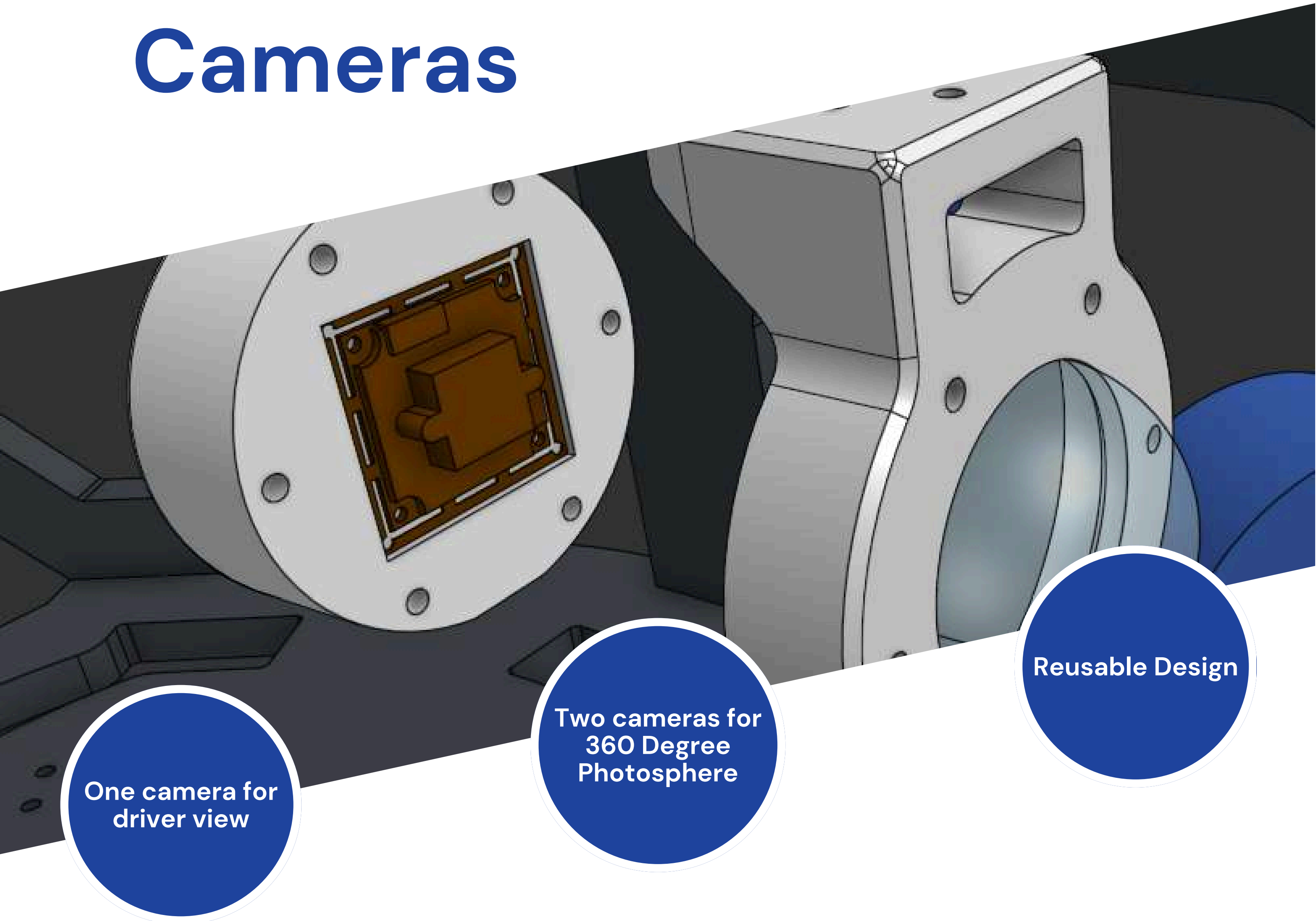
Each T200 thruster operates at 12V and is rated for up to 20A, though typical current draw at 1800 μs PWM is approximately 9A per motor. This results in: 18A per Buck converter under normal operation. Up to 34A per converter under full-throttle conditions (17A × 2 Thrusters)

6 T200 Thrusters

The Boost

T200 Thrusters operates at 12V and is capable of drawing 20A under maximum thrust utilizing a PWM signal of 1900. Equating to a maximum power consumption of 240W per thruster. However, utilizing a 1800 μs PWM current draw averages closer to 9A or 108W per thruster. For all six thrusters operating simultaneously at this signal, total power draw is roughly 648W using the equation P(Watts) = V x I x 6

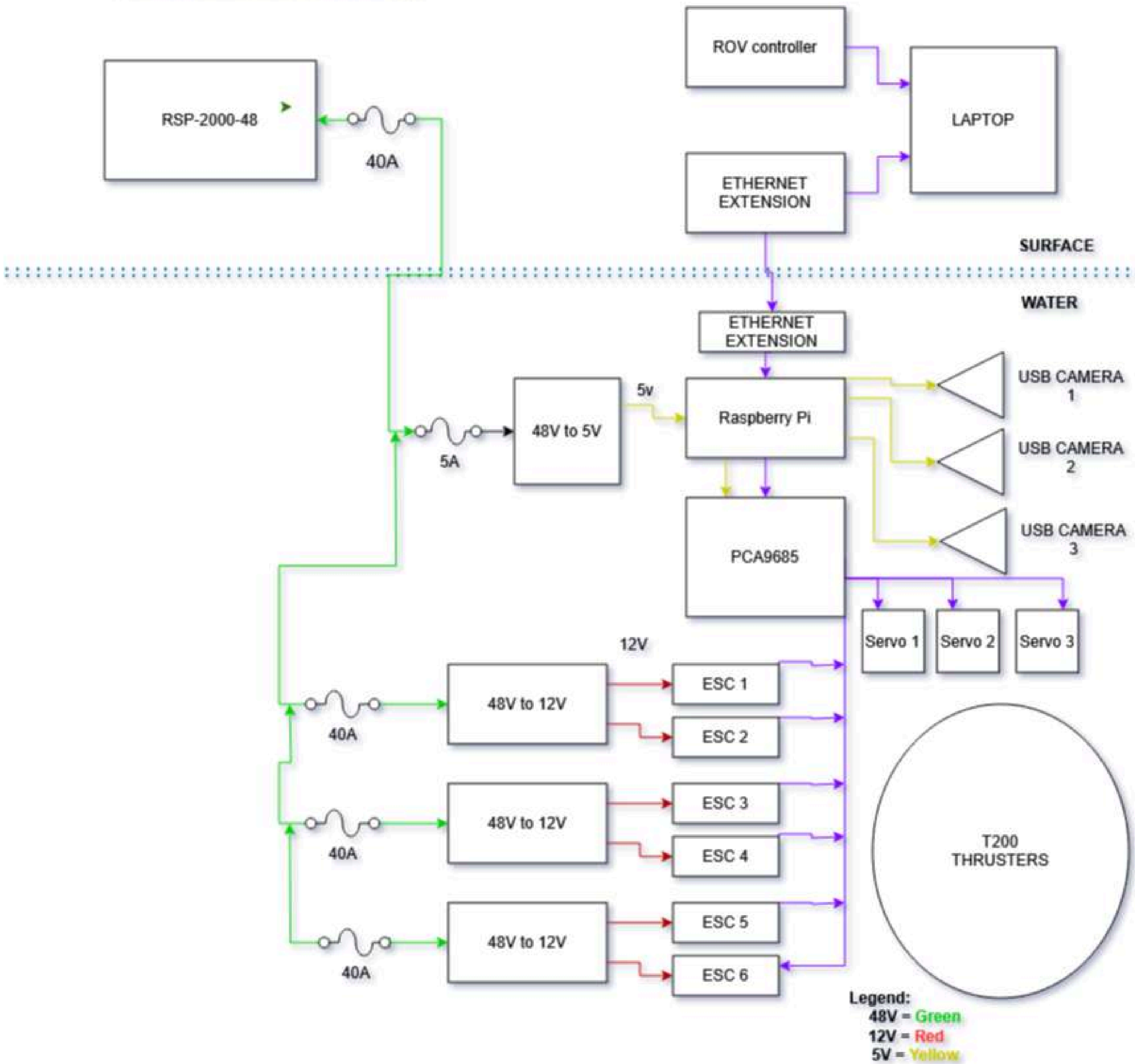
Cameras



On Project All-Star we utilize three cameras to achieve maximum mission success. A sole camera is used to aid the driver in driving and claw manipulation, while the other two are used to capture the 360 degree photosphere. Power and data are routed through a direct USB connection linking the onboard Raspberry Pi to the mounted camera, allowing simultaneous power delivery and real-time video transmission.
The camera mount was designed with simplified assembly in mind and protecting the internal electronics. The design was inspired by the camera holder of our previous ROV, which utilized a plastic dome on the front that locked into a plastic cover. We utilized a 3D printed base and small plastic dome that covered the camera, providing maximum visibility in a small package. Once a gasket maker sealant was applied around the base, screws were utilized to connect the camera to the mounting bracket and apply pressure to the sealant. This design allows for efficient replacement of parts and adjustable frame positioning, allowing us to change placement on the fly according to mission needs.

SID

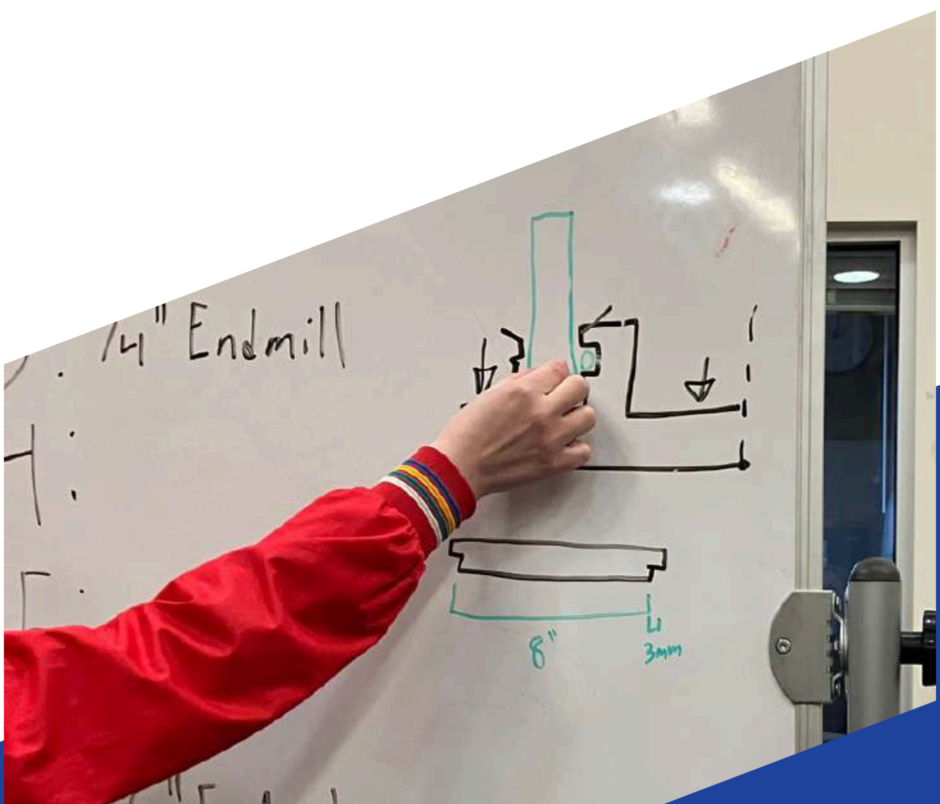
Condition: Full down thrust, Full Forward / Reverse thrust
ROV Full Load Amps (FLA) in water = 34 Amps
Fuse size selected based on FLA: 40 amps



Control Station & Safety Practices

Safety was a high priority for our team during the 2025 season. Products were designed around avoiding potential hazards to the team, such as installing bulky screw covers and keeping wires protected. During our partnership with the AHC Manufacturing Club to create the frame and endcap for Project All-star, the highest safety standards were met during machining. After machining, we took care while drilling the final holes by clamping down parts and using the necessary PPE protection.

On Project All-Star we considered our impact on placing our ROV in an ecosystem. By printing thruster covers to protect fish and keep out debris we ensured we would not physically damage said ecosystem. 3D printed caps and sleeves were also utilized to cover any exposed screws and eliminate safety hazards, along with improving structural integrity in several locations. We took the waterproofing of our electronics seriously as to not damage any ecosystem and keep costs low from possible replacements. Under full load, the Raspberry Pi 5 draws approximately 3A, with the USB camera adding an additional 250mA. To ensure reliable operation, a 5V power supply rated for up to 5A was selected. The ROV is powered by a surface-supplied 48V DC source (RSP-2000-48). Onboard the ROV, this voltage is stepped down to 12V and 5V using three 48V-to-12V buck converters, each rated for 40A continuous output. Each converter supplies two T200 thrusters for six thrusters and an Additional DC/DC 48V-5V, 5A supply for the logic



Marketing and Financing

Teaching

Building Community and Team skills

- CAD Workshop
- School Wide Recruitment
- Open Lab Days

Inspiring

Engaging local High school students

- AG Focused Robotics
- Creating Challenges for Students
- Showing off MATE

Connecting

Participation in college wide events

- Maker's Fairs
- STEM and Diversity Day
- Support from MESA, AHC, and Local Donors

Networking

Collaborating with other teams and clubs

- CTE Demo & C6-LSAMP
- Machining Club & AG Department
- Cuesta and Cal Poly ROV Teams

Community Impact

Our goal this season was simple: Inspire our fellow students and the students of the future. During the fall semester we held a CAD workshop day to encourage people to come learn the basics of Computer Aided Design and its uses. The whole team helped put up posters around campus and talked about the opprotuinity with fellow classmates to help spread awareness of the day. During that both semesters we participated in multiple of our colleges "Bulldog Bounds" where local highschool students come get a taste of what Allan Hancock College has to offer. We showed off our previous years ROV along with our "Land Robot" Cosmic, which we let the students drive to promote the AG department and how robotics is used in our AG based community.

In order to generate a little pocket change along with doing outreach Deep Sea Dogs participated in 2 makers fairs where we recruited members while selling 3d printed parts. We set up a booth at AHC's STEM Diversity day and showed off Cosmic and engaged students and faculty about MATE and our seasons goals.

Collaboration has been the name of the game this year. During Bulldog Bound's we partnered with the AG department, we colaborated with the machining club to build our frame, and kept close contact with U-ROV at CalPoly and Cuesta Robotics to help support and learn from them.

Lessons Learned

Teach-Do Balance

Colson Pulsey: “...balancing between guiding other members so that I am not just doing the work for them, but also helping them enough to ensure they do not get lost.”

Real World Experiance

Cai McCray: “Real world trial and error became central to how I learned. Every unexpected challenge helped deepen my understanding...”

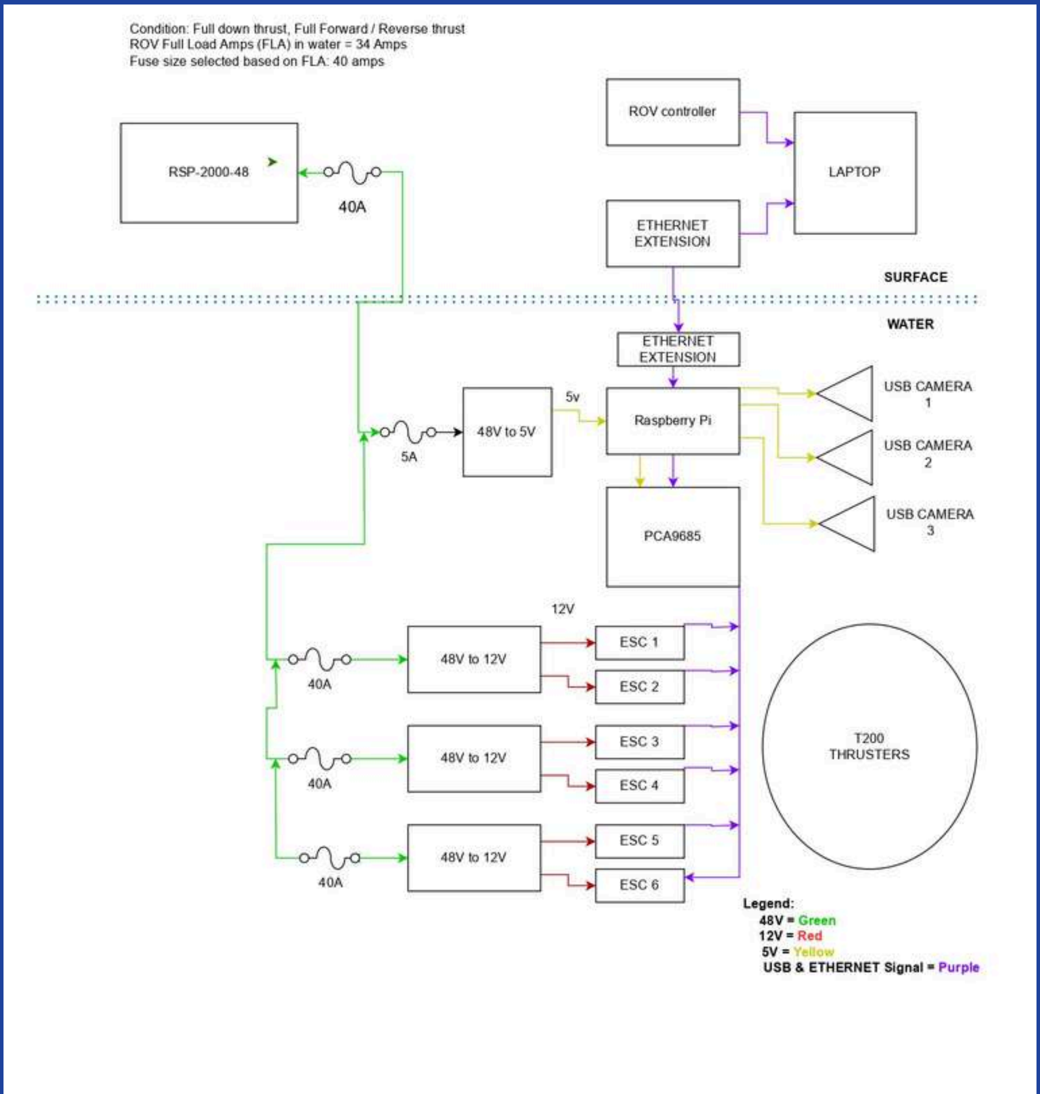
Team Management

Dylan Martin: “ My goal as CEO was to create a structure where each member could succeed, and where our final product reflected the strength of our coordination.”

Challenges and growth

Lydia Nelson: “I learned how to better adapt to shifting priorities, navigate group dynamics, and practice humility and trust in a team environment.”

Appendix A SID



Primary Power System
The ROV is powered by a surface-supplied 48V DC source (RSP-2000-48). Onboard the ROV, this voltage is stepped down to 12V and 5V using three 48V-to-12V buck converters, each rated for 40A continuous output. Each converter supplies two T200 thrusters for six thrusters and an Additional DC/DC 48V-5V, 5A supply for the logic section.
Total Power Draw
Based on typical operating conditions (1800 μs PWM):
Thrusters:
6 × 9A × 12V = 648W
Logic and cameras:
3.75A × 5V = 18.75W
Estimated Total Power Draw:
648W + 18.75W = 667W
This total remains well within the limits of 2000W for the RSP-2000-48.

Appendix B: Finances

Description	Company Expenditures	Donations
Starting funds	$870.00	
Income		
Fundraising	$300.00	
College Funding Bonus	$100.00	
Total	$400.00	
ROV Expenses:		
3D Printer Filament		$50.00
Other Raw Materials		$230.00
Electronics Canister		$50.00
Thrusters		$1,600.00
Strain relief		$25.00
Tether		$121.00
Raspberry Pi		$100.00
O rings		$15.00
Sealants & Lubricants		$62.00
Cameras		$150.00
Servos		$80.00
Buck converters		$110.00
Penetrators		$139.00
Other		$262.00
Total		$2,994.00
Non-ROV expenditures		
PVC props		$150.00
Travel apparel	$300.00	
Tools		$36.00
Lodging		$7,225.00
Travel meals		$3,980.00
Airfare		$6,856.00
Other		$2,500.00
Total		$21,047.00

Appendix C

Buck Allocation

Each T200 thruster operates at 12V and is rated for up to 20A, though typical current draw at 1800 μs PWM is approximately 9A per motor. This results in:

18A per Buck converter under normal operation

Up to 34A per converter under full-throttle conditions (17A × 2 Thrusters)

All converters are well within their rated capacity under both conditions.

Fuse Selection

A 40A inline blade fuse protects each buck converter circuit. This value was selected to allow for full-throttle current draw while still protecting sustained overcurrent conditions. The fuse rating was calculated using a 15% safety margin:

Fuse Rating = Peak Load per Buck Converter × 1.15 = 34A × 1.15 = 39.1A

Rounded up, 40A fuses provide both protection and margin.

Wiring and Distribution

Power is routed through 10 AWG silicone wire.

All high-current paths are terminated with XT60 connectors rated up to 60A

Power distribution is managed via an internal high-current bus-bar system, with each converter on a separate branch.

5V Logic and Camera Power

A separate 48V-to-5V 5A DC/DC converter with an inline fuse rated at 5A powers the Raspberry Pi and three USB cameras. Estimated draw is:

Raspberry Pi: 3A

USB cameras (×3): 0.250A each

Total: 3.75A

The 5V converter is directly wired to logic components and is isolated from the 12V motor system.

Signal Control

Thruster control is handled via a PCA9685 PWM driver, which interfaces with the Raspberry Pi over I2C. Each ESC receives a 50Hz PWM signal, using calibrated pulse widths:

1100 μs = Full Reverse

1500 μs = Neutral

1900 μs = Full Forward

The PCA9685 is powered from the 5V rail and shares a common ground reference with the ESC signal lines.

Appendix D

COLSON: ad JSEA here
Safety and Verification
Each Buck converter circuit is independently connected
Power and logic systems are physically separated
All wiring was tested using multimeters and confirmed operational during in-water thrust trials
System performance remained stable

Deep Sea Dogs JSEA

Job Safety Analysis (JSA)

Project Description:	Research and Development of a Remotely Operated Submersible Vehicle
Potential Project Hazards:	High Voltage/Current, Mechanical Hazards

Personal Protection Equipment Available:	Safety Goggles, protective gloves
Ways to Mitigate Potential Hazards:	Secondary person as a safety, check systems before operating or touching

Steps of the Job

Leads Present	Position of the Lead completing project
Name:	
Cai McCray	Electrical Engineering
Leah Jantzen	Marketing
Colson Pusley	Design
Lindsay Tafoya	CFO
Dylan Martin	CEO
Lydia Nelson	Mechanical Engineering

Start Date:	
Completion Date:	

Thank you

Building Project All-Star this season has been a blast. Along the way we have formed friendships, learned life skills, collaborated with the community, inspired the next generation, and ultimately built an underwater ROV.
We are thankful for the MATE ROV Competition and Allan Hancock College for creating an environment where we can make an impact on our futures and have fun along the way.
We also thank the Allan Hancock College MESA STEM Center for providing our travel and covering many of our ROV costs. To Justin and Greg for supporting us and providing wisdom and fuel to get through the season. Thank you to the independent donors who supplied to our needs when we least expected.