TECHNICAL MEMORANDUM

Crush Depth ROV: A Remotely Operated Vehicle for the MATE ROV World Championship

Competition seasons 2025 and 2026

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Abstract. Crush Depth's ROV performs simulated environmental-research and industrial-inspection tasks for the MATE ROV competition. Eight Blue Robotics T200 thrusters are driven from a Raspberry Pi 5 through ESCs and a PCA9685; four cameras in SLA-printed waterproof housings give the pilot vision; power arrives at 48 V DC on the tether and is stepped down through buck converters. The structure is custom, SolidWorks-modeled and FDM-printed. As the team's Co-CEO / CTO, I led the electrical and software domains and designed the vehicle's internal electronics mounts and its service stand; the chassis, housings, and manipulator are the work of the team's mechanical group. The vehicle competed at the World Championship in 2025 and 2026, and I received the Engineering Presentation MVP award in 2026.

1 Mechanical Design

The vehicle's structure is custom, modeled in SolidWorks and printed FDM on Bambu Lab machines: an outer chassis, an internal housing that carries the electronics stack, and a TPU foam ballast printed to shape. A custom manipulator, designed against the competition's mission tasks, is the vehicle's working end. The four cameras sit in SLA-printed waterproof cases that interface with FDM-printed mounts, using SLA where the sealing surfaces need its resolution and FDM elsewhere for speed.

Waterproofing is handled as a vehicle-level strategy rather than a per-part fix. Every penetration, housing, and connector has to hold at mission depth for the vehicle to score at all.

My mechanical contributions were on the serviceability side. The tether penetrators are epoxied into the backplate, so a vehicle set down on its backplate loads the epoxy joints; I designed a stand that holds the backplate clear of the bench so the vehicle can be worked on and shown without pressing on the penetrators. I also designed the mounts that locate the electronics inside the housing.

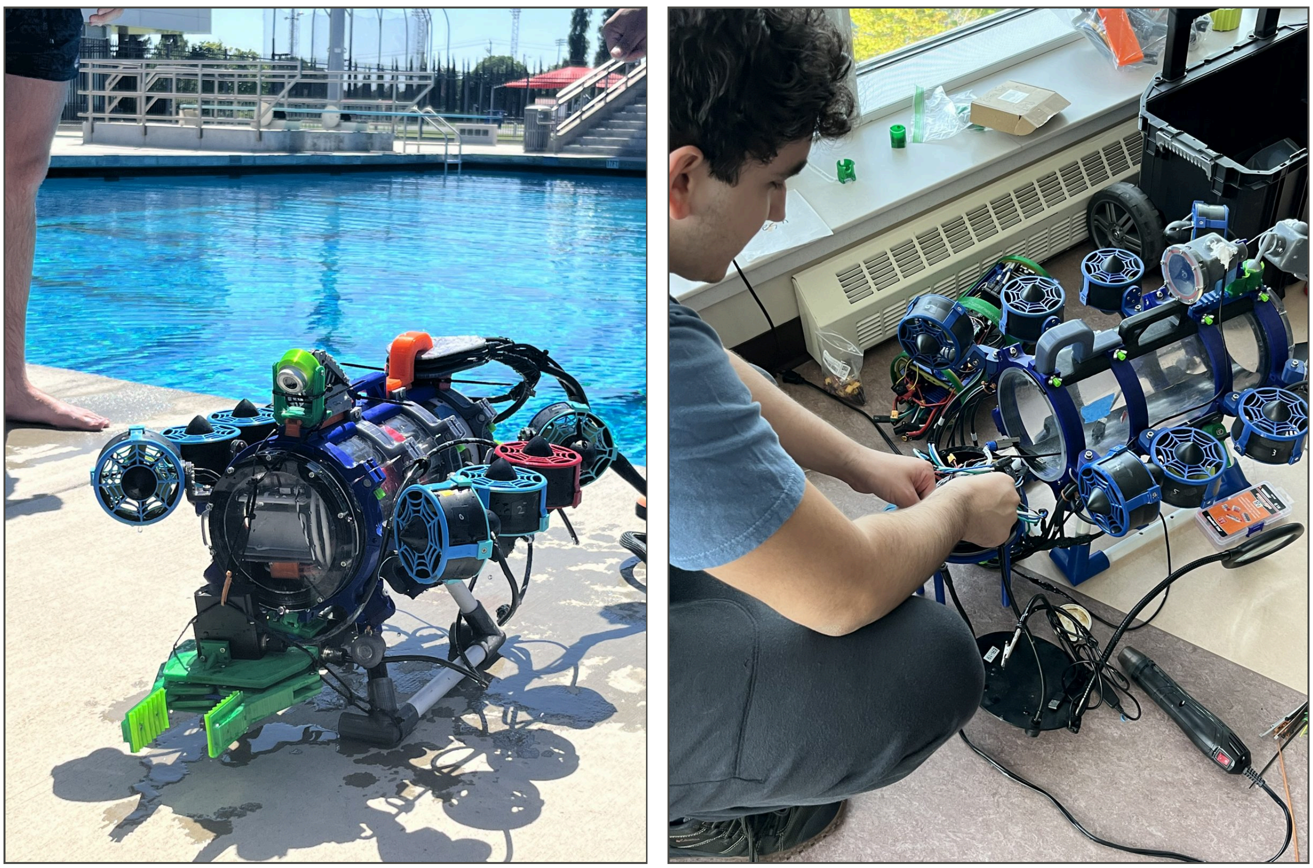

Figure 1. Left: the vehicle on deck before a pool session. Right: working on the electronics stack with the vehicle open.

2 Electronics and Power

A Raspberry Pi 5 is the vehicle computer. It drives eight Blue Robotics T200 thrusters through ESCs via a PCA9685 PWM driver, reads an MPU6050 IMU for attitude sensing, and carries four camera feeds for the pilot. The tether delivers 48 V DC from a 30 A supply through a 30 A fuse; two 48-to-12 V 40 A converters feed the thruster ESCs through power distribution boards, with a 3×1000 µF capacitor bank on each, and a separate 48-to-12 V 5 A converter and 12-to-5 V 5 A converter carry the Pi and its peripherals. Two UBECs supply the manipulator servos at 6 V. The full-load current in water is 26.25 A, and the 30 A fuse was selected from it, following the MATE fuse-sizing rule for the 2026 season. Figure 2 is the system interconnect diagram I drew for the 2026 vehicle.

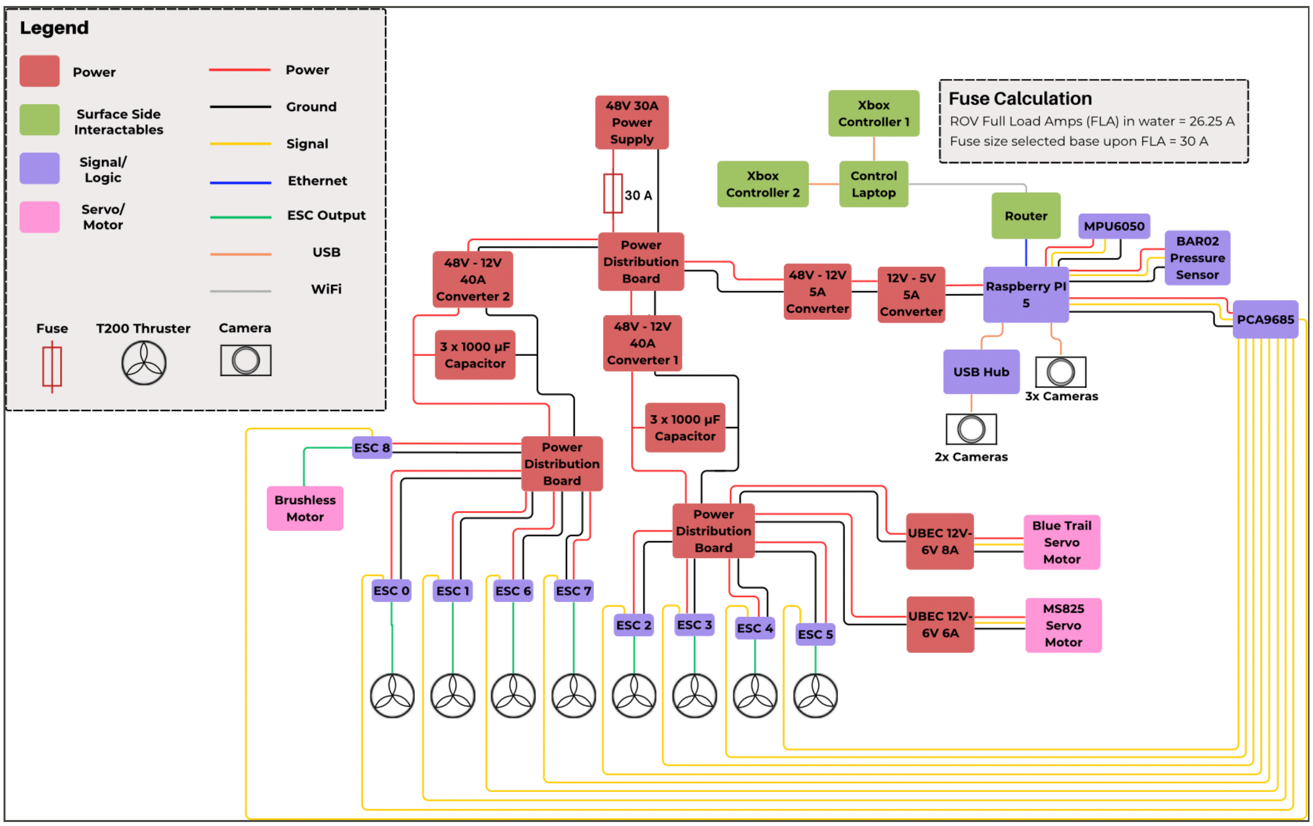

Figure 2. System interconnect diagram, 2026 vehicle. Red: power; black: ground; yellow: signal; blue: Ethernet; green: ESC output. The full-load current in water (26.25 A at 48 V) and the fuse selected from it (30 A) are stated on the diagram as the competition rules require.

Table 1. System summary.

Subsystem	Component	Notes
Vehicle computer	Raspberry Pi 5	control software in C++
Propulsion	8× Blue Robotics T200	ESCs via PCA9685 PWM driver
Attitude	MPU6050 IMU	—
Vision	4× camera	SLA-printed waterproof cases on FDM mounts
Power	48 V DC tether, 30 A supply, 30 A fuse	full load in water 26.25 A
Conversion	2× 48–12 V 40 A; 48–12 V 5 A; 12–5 V 5 A; 2× UBEC 12–6 V	thrusters, Pi, servos
Structure	FDM chassis, housing, TPU ballast	SolidWorks; Bambu Lab printers
End effector	custom manipulator	designed against mission tasks

3 Control Software

The control architecture, written in C++, is designed around pilot ergonomics: the layout of controls and behaviors is chosen for ease of piloting under mission time pressure, rather than for a clean mapping to actuators. Mission scores depend on what the pilot can actually execute.

4 Team and Role

Crush Depth is roughly 47 members of Clovis Community College's Engineering Renaissance Club, structured deliberately like a company per MATE guidelines. I am Co-CEO / CTO, co-managing the team with Luke Salazar, and lead the electrical and software domains, promoted from Float Team Technical Lead. Operations at this scale are their own engineering problem: Gantt scheduling, BOM management, and holding deadlines across subteams.

At the 2026 World Championship I won the **Engineering Presentation MVP** award.

5 Known Limitations

- Converter sizing was validated by operation; per-rail current draw was not logged.
- Manipulator payload capacity is unquantified.