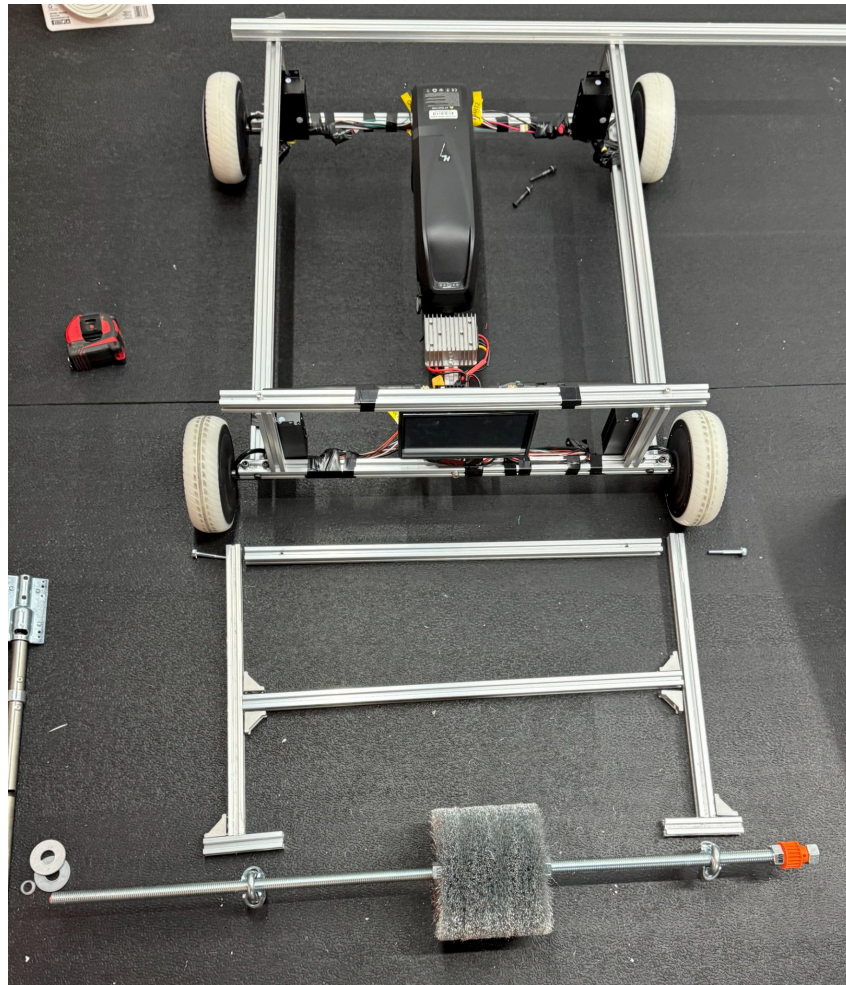


Technical Manual

# **BVR0**

Base Vectoring Rover



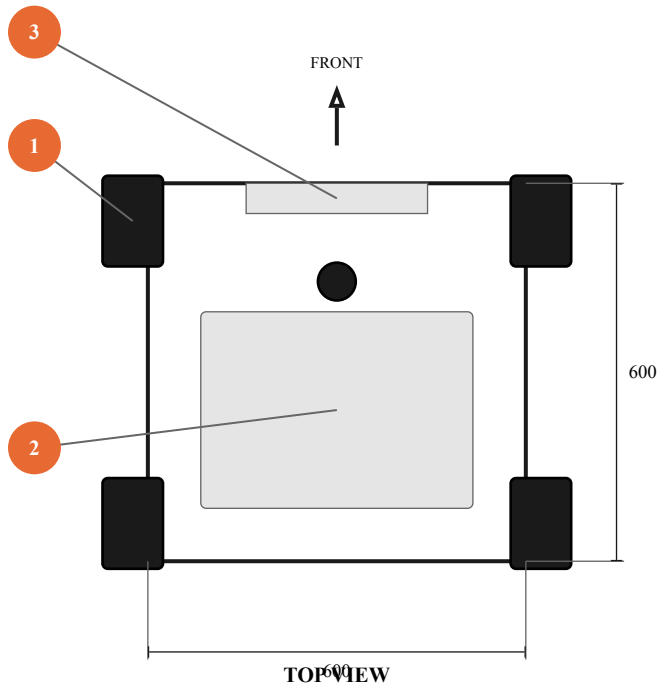
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**Municipal Robotics**  
Cleveland, Ohio  
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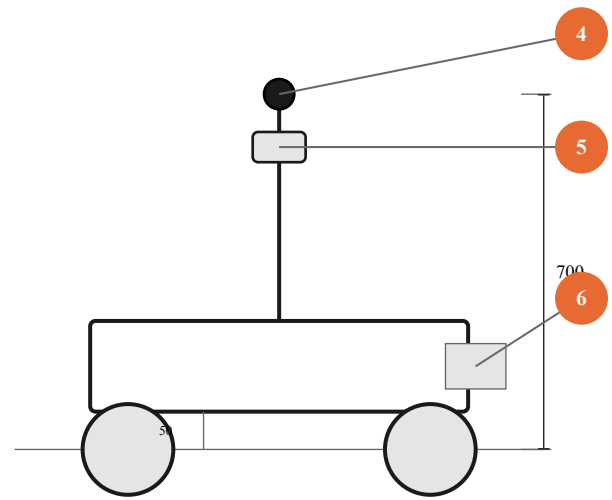
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# 1 Overview



## Components

- 1 Hub motor wheels (×4) — 350W each
- 2 Electronics bay — Jetson, VESCs, power
- 3 Tool mount — quick-attach interface
- 4 360° camera — Insta360 X4
- 5 LiDAR — Livox Mid-360
- 6 Tool attachment point

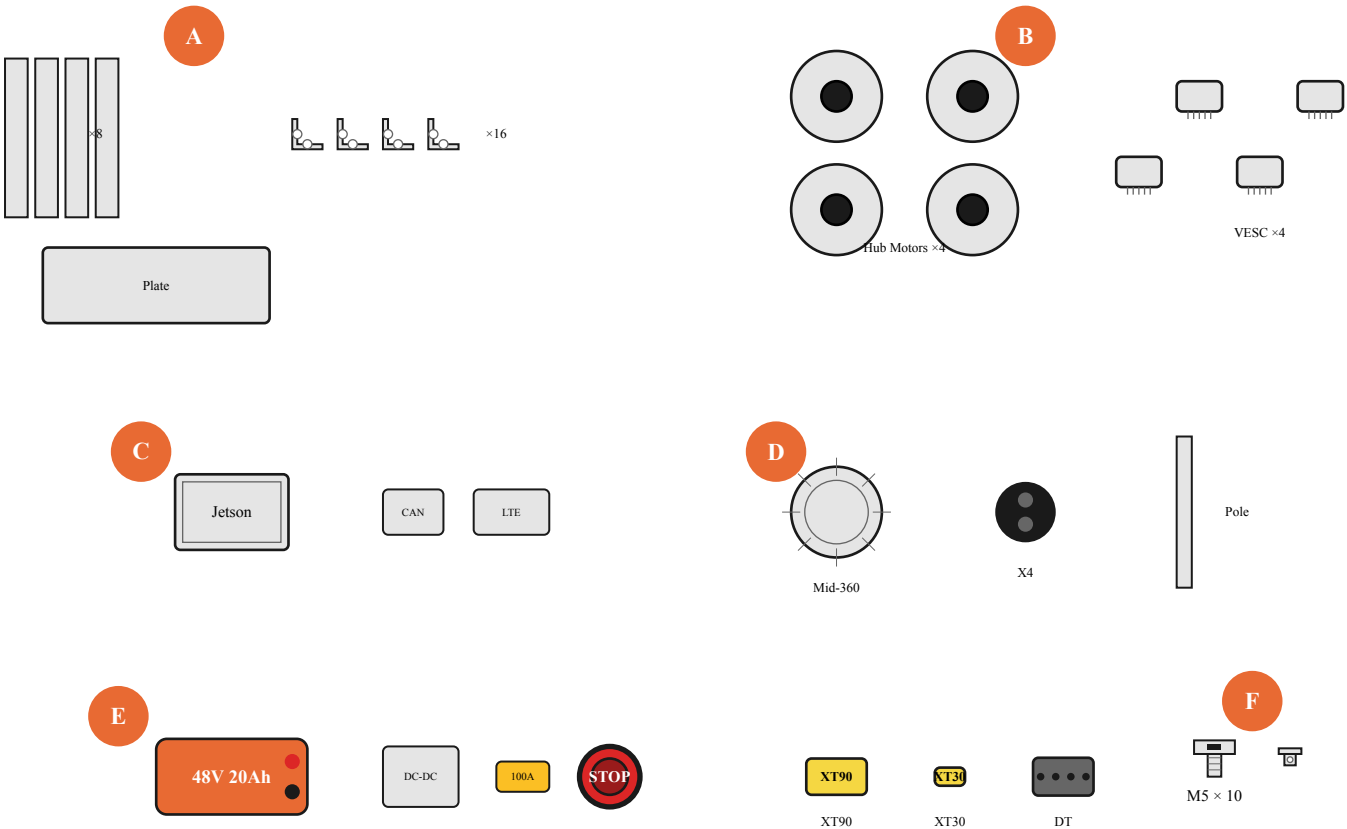


## SIDE VIEW

## Specifications

Dimensions	600 × 600 × 700 mm
Weight	30 kg with battery
Battery	48V 20Ah (960 Wh)
Motors	4× 350W hub motors
Speed	1.0–2.5 m/s
Runtime	4 hours
Temp range	−20°C to +40°C

2 Bill of Materials



Parts Key

A	Chassis: extrusions, brackets, plate	\$150
B	Drivetrain: motors, VESCs, mounts	\$800
C	Electronics: Jetson, CAN, LTE	\$900
D	Perception: LiDAR, camera, pole	\$1,800
E	Power: battery, DC-DC, fuse, E-stop	\$400
F	Hardware: bolts, T-nuts, wire, connectors	\$100

Cost Summary

Chassis	\$150
Drivetrain	\$800
Electronics	\$900
Perception	\$1,800
Power	\$400
Hardware/Wiring	\$100
<b>Total</b>	<b>\$4,150</b>

All parts commercially available. Custom fab limited to plate cutting.

## 3 Assembly

### Required Tools



Hex Keys

2.5, 3, 4, 5mm



Screwdriver

Phillips 2



Wrenches

8, 10, 13mm



Multimeter

V /  $\Omega$  / Cont.

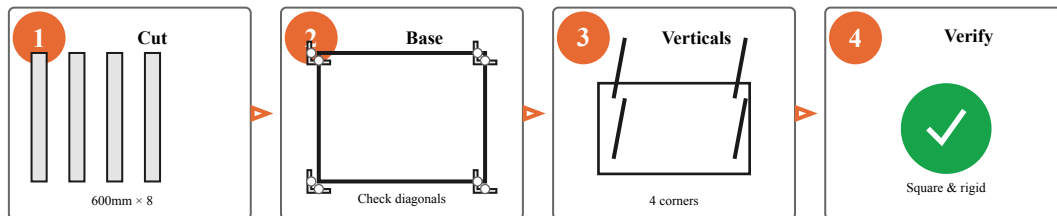


4 Nm

Torque

All M5 bolts

### 3.1 Phase 1: Chassis Frame



### 3.2 Phase 2: Motor Mounting

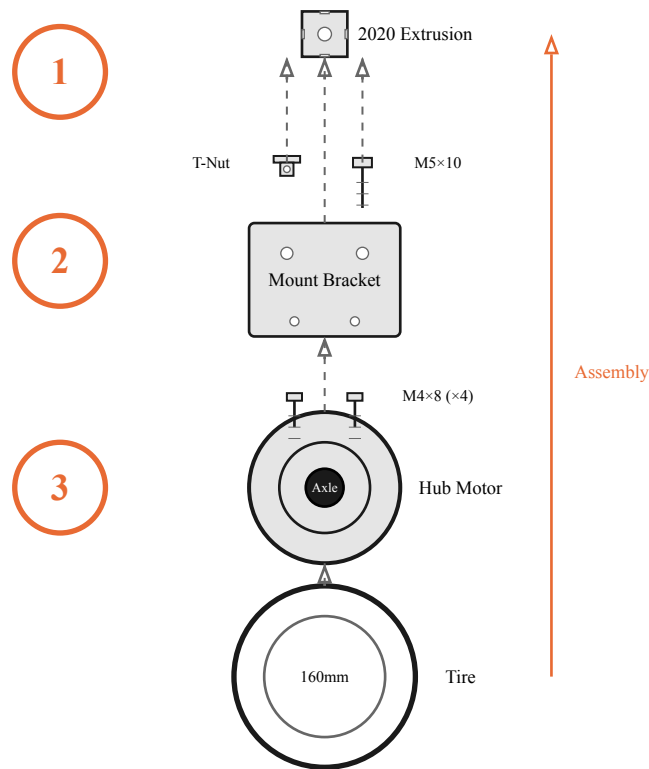


Figure 5: Exploded view: (1) Insert T-nuts into extrusion, (2) Bolt bracket to frame, (3) Attach motor and tire

### 3.3 Phase 3: Electronics Mounting

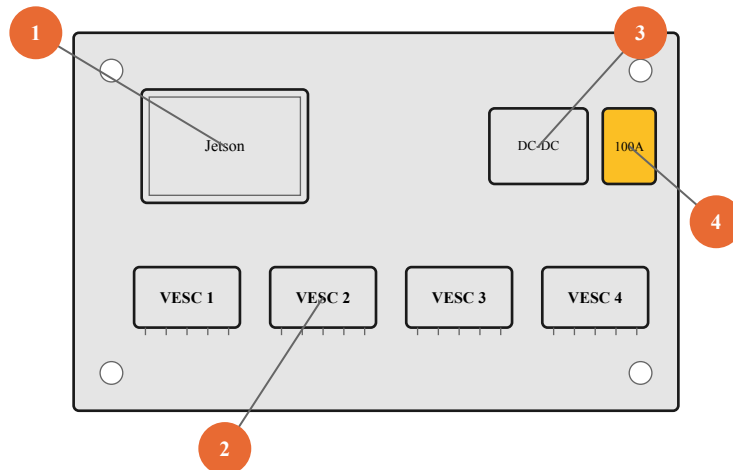


Figure 6: Electronics plate: (1) Jetson Orin NX, (2) VESC motor controllers, (3) DC-DC converter, (4) Main fuse

### 3.4 Phase 4: Wiring

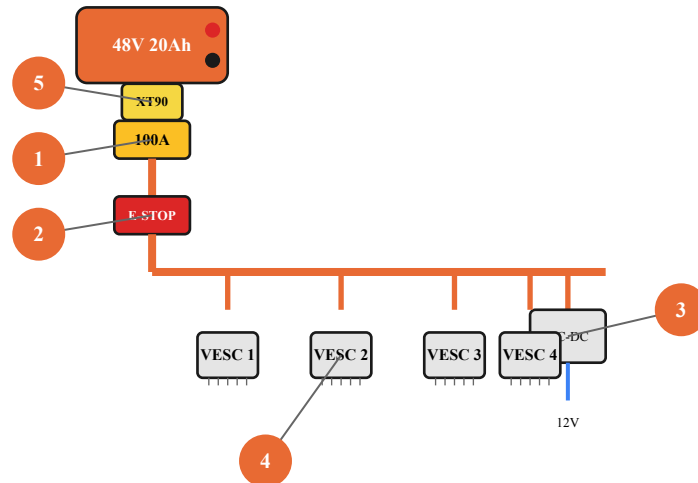


Figure 7: Power distribution: (1) Main fuse, (2) E-Stop relay, (3) DC-DC converter, (4) VESCs, (5) XT90 disconnect

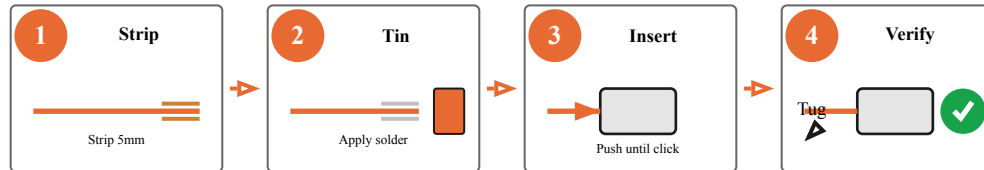
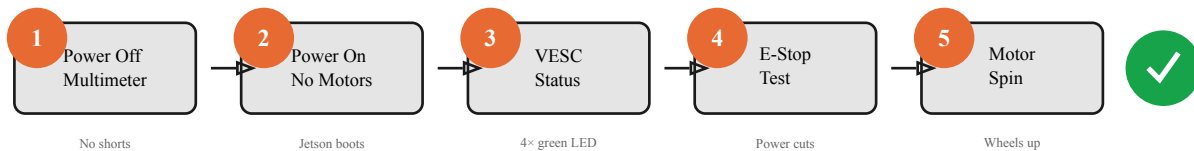


Figure 8: CAN wiring sequence: (1) Strip 5mm insulation, (2) Tin exposed wire, (3) Insert into JST connector, (4) Verify with gentle tug test

### 3.5 Phase 5: Testing



#### Quality Checklist

- ☐ All bolts torqued to 4 Nm
- ☐ No exposed wiring
- ☐ CAN bus termination verified
- ☐ E-Stop cuts power in 100ms

- ☐ All wheels spin freely
- ☐ Battery secure
- ☐ All connectors clicked
- ☐ Thermal management OK



## 4 Electrical System

### 4.1 Power Distribution

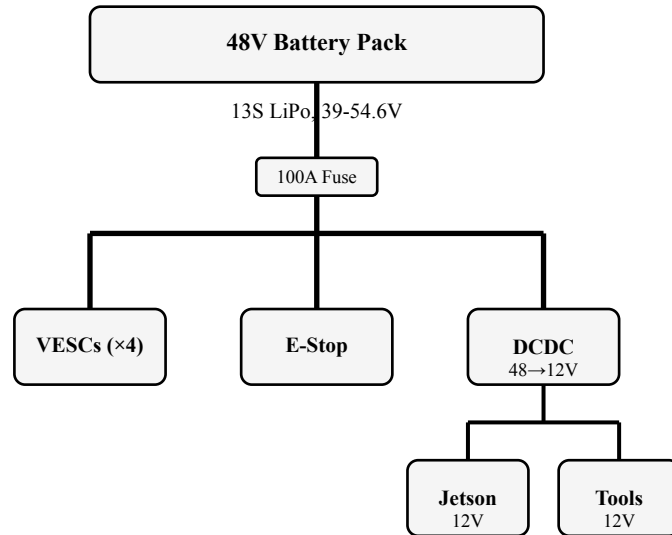


Figure 10: Power distribution from 48V battery to all subsystems

### 4.2 CAN Bus

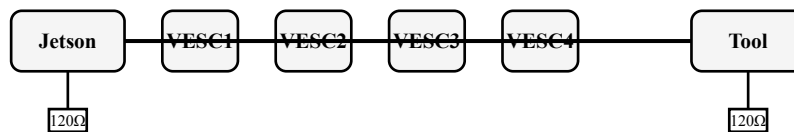


Figure 11: CAN bus daisy chain with 120Ω termination at each end

### 4.3 Connectors

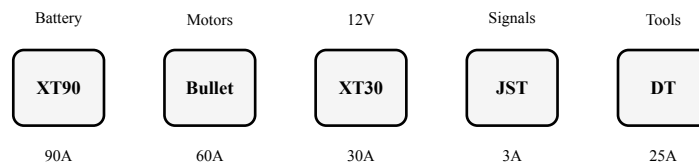


Figure 12: Connector types used throughout the rover

4.4 VESC Configuration

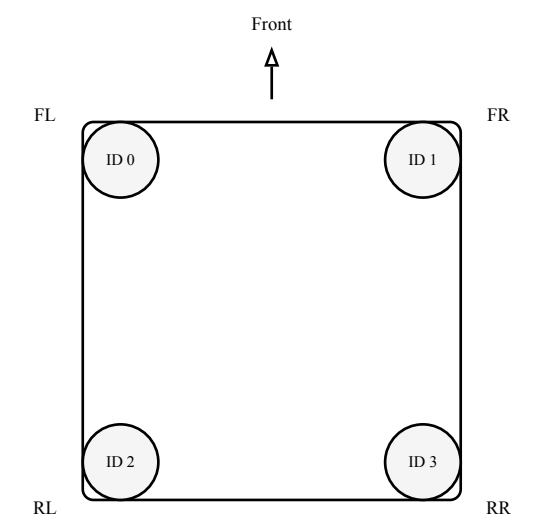


Figure 13: CAN ID assignment by wheel position

Setting	Value
Controller ID	0-3 (unique per VESC)
CAN Mode	VESC
CAN Baud Rate	CAN_500K
Send CAN Status	Enabled
CAN Status Rate	50 Hz

## 5 Operation

### 5.1 Startup

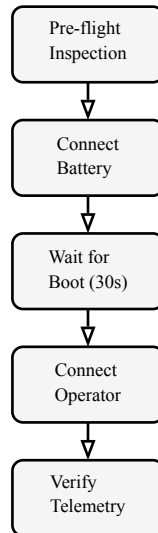


Figure 14: Startup sequence from inspection to operation

### 5.2 Controls

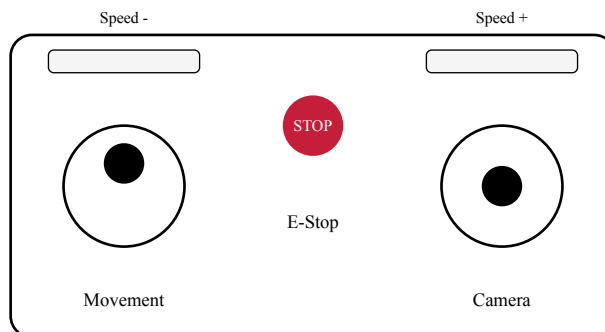


Figure 15: Gamepad control layout for teleoperation

### 5.3 Shutdown

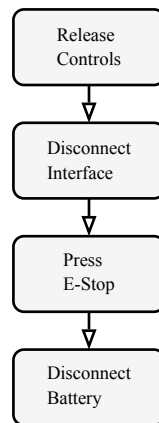


Figure 16: Shutdown sequence

### 5.4 Tool Attachment

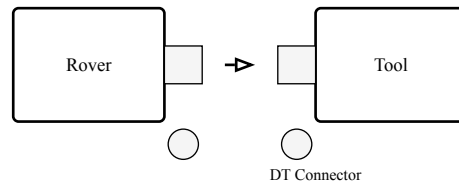


Figure 17: Tool attachment via quick-release mount and DT connector

## 6 Safety

**⚠ DANGER** Heavy powered machine. Can cause serious injury. Maintain situational awareness.

### 6.1 Hazard Zones

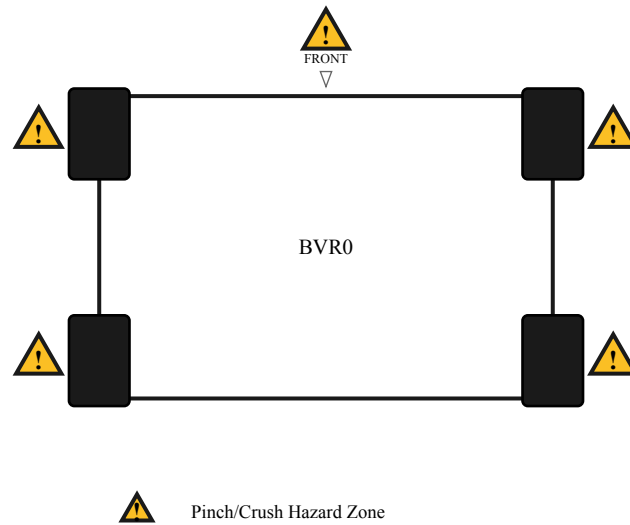


Figure 18: Hazard zones: wheel areas and tool mount require clearance during operation

### 6.2 Battery Safety

**⚠ WARNING** Li-ion batteries can catch fire if damaged or short-circuited.



Figure 19: Battery handling requirements

## 6.3 Emergency Stop

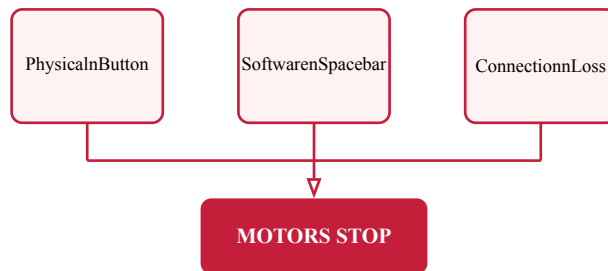


Figure 20: Three independent paths to emergency stop

**i NOTE** To reset: resolve cause, release button, reconnect, verify dashboard.

## 7 Maintenance

### 7.1 Pre-Operation Inspection

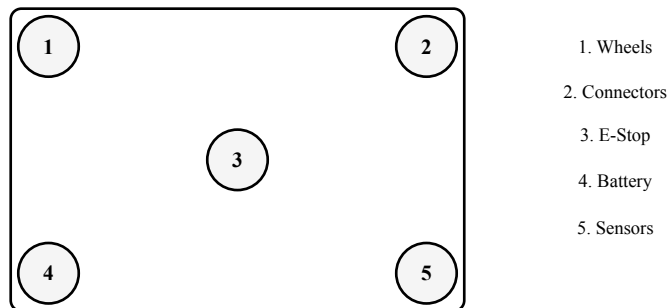


Figure 21: Pre-operation inspection points

- ☐ Battery voltage > 40V
- ☐ No visible damage to chassis or wheels
- ☐ All connectors secure
- ☐ Wheels spin freely
- ☐ E-Stop button functions
- ☐ Sensors clean and unobstructed

### 7.2 Maintenance Schedule

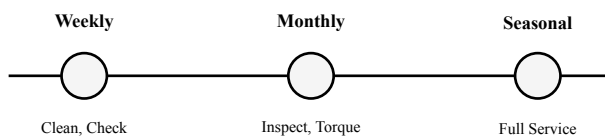


Figure 22: Maintenance schedule intervals

#### Weekly

- Clean wheels/chassis
- Wipe lenses
- Check connections

#### Monthly

- Inspect wiring
- Verify bolt torque
- Clean contacts

#### Seasonal

- Full electrical check
- Check bearings
- Replace worn parts

## 7.3 Storage

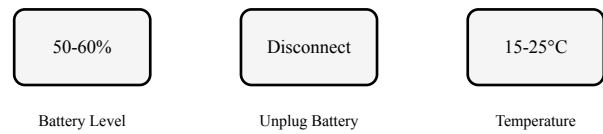


Figure 23: Storage preparation requirements

## 7.4 Troubleshooting

Symptom	Solution
Rover won't power on	Check battery connection, verify fuse
No video feed	Check LTE connection, verify camera USB
Motor not responding	Check CAN wiring, verify VESC ID
E-Stop won't release	Check relay wiring, verify button not stuck
Poor LTE signal	Relocate antenna, check SIM data plan
Erratic movement	Verify VESC IDs match wheel positions

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