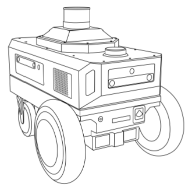
Nova Carter

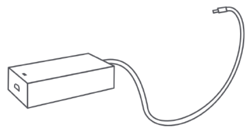
Product Manual

Table of Contents

Packing Contents



Nova Carter Robot *1
(3D Mapping Top Module Pre-installed)



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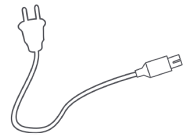
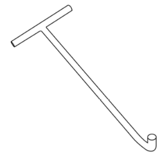
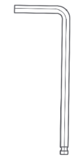


AC Cable *1

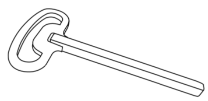


Tow Hook *1

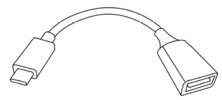


Hex Wrench *1

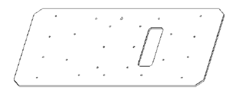
Controller *1



Key to Battery Lock *1



USB-C to USB-A Dongle *1



Basic Cargo Top Module *1

Note: Controller model: CFI-ZCT1NA

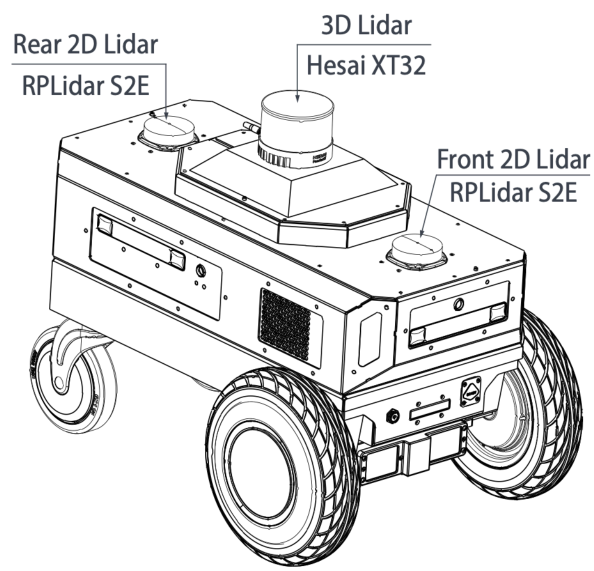
Specifications

Refer to RMP220 wheelbase manual for additional details.

Item	**Parameter**
Model	Nova Carter P1
Computing Platform	NVIDIA Jetson AGX Orin™ 64GB module (with 2TB SSD and 10 GbE PCIe card)
Vehicle Size	722*500*556mm
Vehicle Weight	49.6kg
Maximum Payload	50kg
Top Speed	≥12km/h Unloaded
Tire Size	Front wheel 11 inches (280mm)
Operating Temperature	0~35 °C
Obstacle Clearance	25mm
Operation Hours	≥8h
Battery Capacity	1033Wh
Battery Replacement	Supported
Battery IP Rating	IPX7
Charging Time	5h
Charger	Input 100~240V 50~60Hz 2.5A and output 42V 5.0A
Additional External Connections	Ethernet (10GbE), Displayport, USB-C 3.2 Gen 2 (for flashing NVIDIA Jetson AGX Orin™ and general purpose use)
Connectivity	Wi-Fi 5 with 2x2 MIMO; Bluetooth 5.0/BLE; Optimized Fast Roaming support - 802.11 k,v & r.
Certifications	UL2271, MSDS, UN38.3/EMC, GOST-R, RoHS, EU Battery Directive

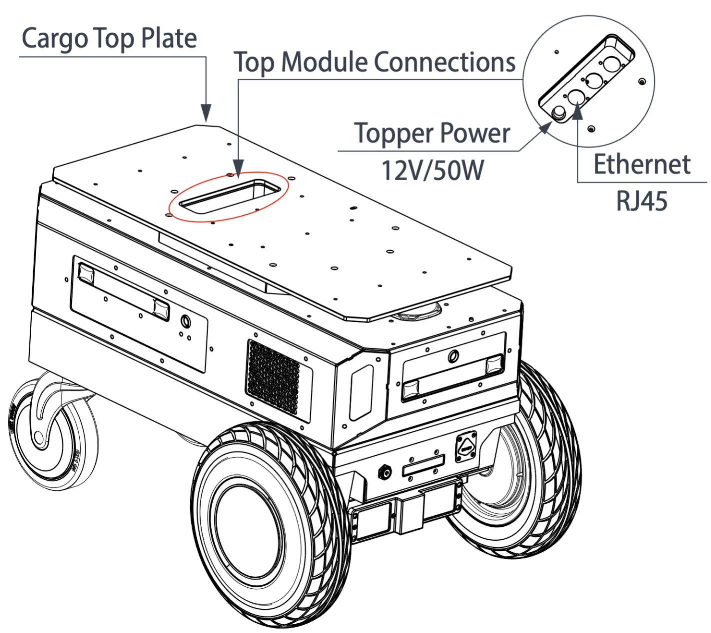
Product Overview

Nova Carter products can be assembled into two configurations:



3D Mapping Configuration

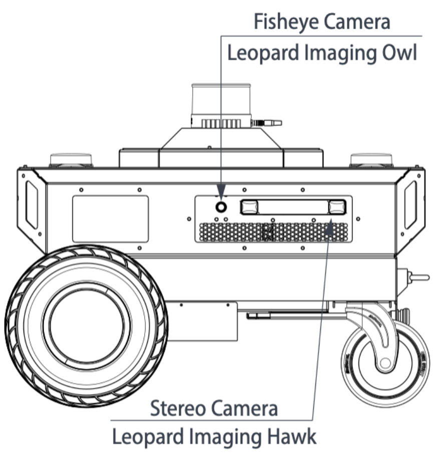
Getting started guide is based on the 3D Mapping Configuration



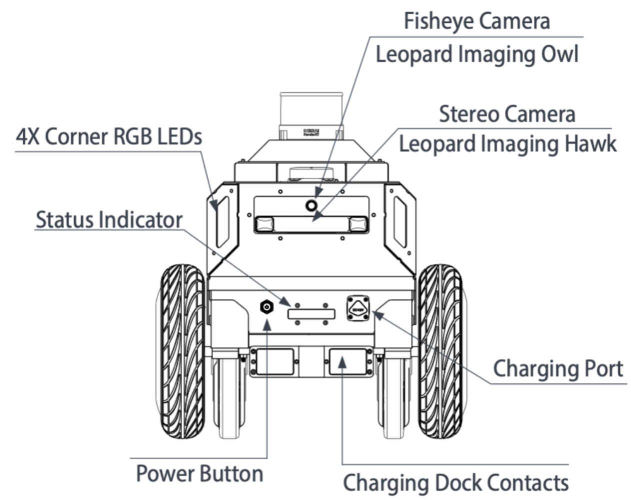
Basic Cargo Top Configuration

Alternate product configuration

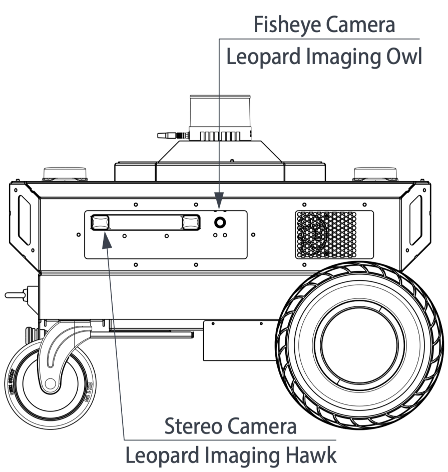
Presentation from various angles:



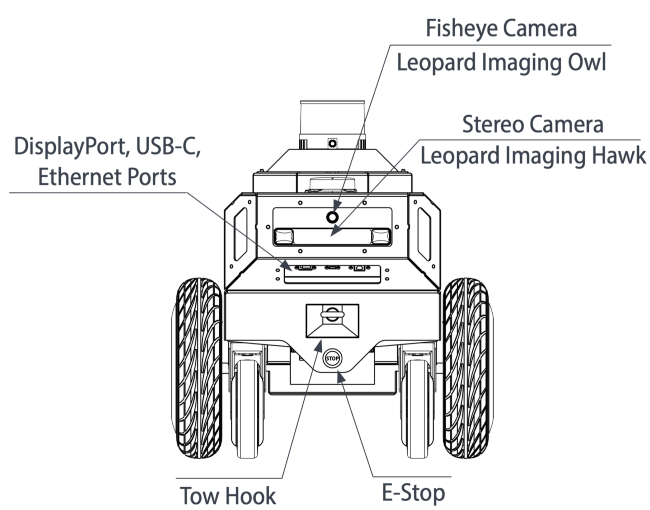
Left View



Front View



Right View



Back View

Important Safety Information

- The Nova Carter robot is a small and light robot; it is designed to carry a payload of 50kg. The main hazard is impact from the robot itself, where moderate harm could result from a worst-case direct collision. Robot operators should take the following precautions:
    - Familiarize yourself with the Nova Carter controls and dynamics in an open area away from bystanders.
    - Be aware of the speed at which Nova Carter can accelerate, decelerate, and turn.
    - Be aware that stopping Nova Carter quickly while it's moving forward may cause it to overshoot and move backwards.
- In the event of a safety incident, inspect the Nova Carter robot for the following:
    - Damage to the robot chassis (including dents/punctures to the housing or drivetrain)
    - Damage to the sensors that emit IR (including scratches and pits on the optical window)
- If there is damage, do not power on the Nova Carter robot. Use the tow handle to move the robot and contact your Segway representative immediately. Nova Carter has a tow handle to easily transport the robot manually. It's located above the caster wheels.
- A red emergency stop (ESTOP) button is located above the caster wheels, below the tow handle. Pushing the ESTOP button will disconnect power to the motors, but the Nova Carter robot may continue to coast in the direction it was previously moving. It can also roll if placed on a sloped surface while the ESTOP is pressed. Compute and sensors will remain powered ON while the ESTOP is engaged.
- Do not open or remove any panels from the robot, and do not loosen or remove any sensors.
- If you need further details on Isaac Robot safety information, contact your Segway representative.
- The screw torque for the top cover panel and top modules SHALL NOT EXCEED 2 N*m. (Please refer to the Top Modules section of this manual for installation instructions.).

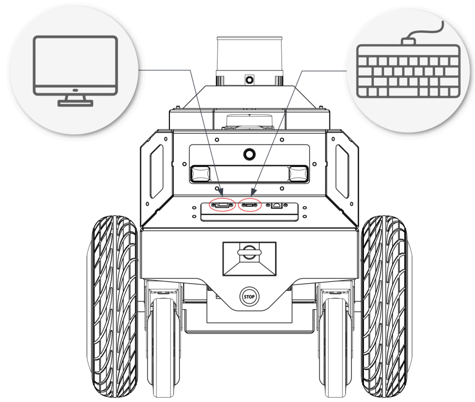
Getting Started with Nova Carter

Step 1: Remove the Lidar Cover

Remove screws holding the LIDAR cover in place using included 2.5 mm hex driver. Reinstall the screws once the cover is removed.

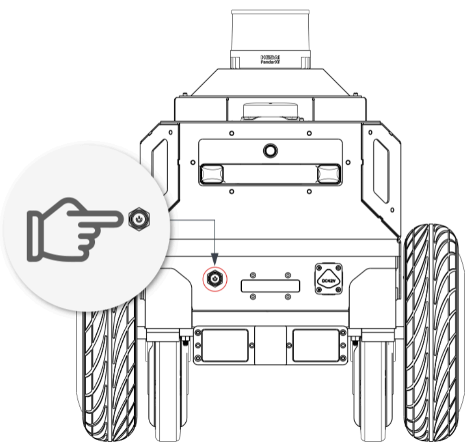
Step 2: Connect Monitor, Keyboard, and Mouse

Connect peripherals to the rear IO panel. You may use the provided USB-C to USB-A dongle for convenience.



Step 3: Power On

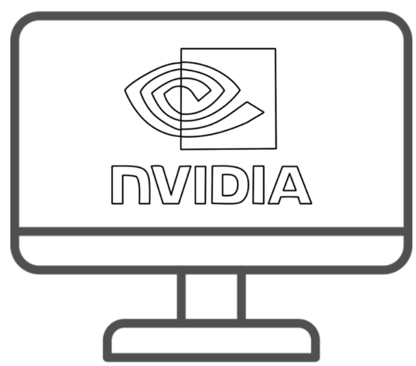
Hold the power button to turn the robot on.



Step 4: Start Using Jetson

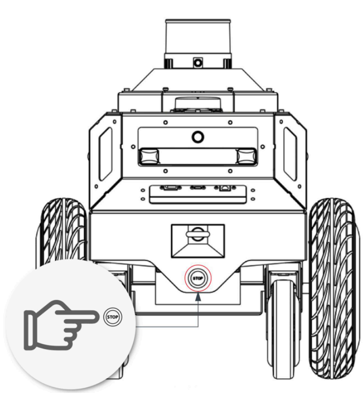
Begin developing your robot using the familiar NVIDIA Jetson AGX Orin™ Linux environment.

Default Username: nvidia
Password: nvidia



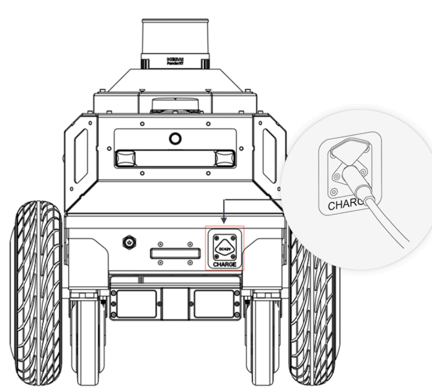
Emergency Stop Use

Press the Emergency Stop (E-Stop) button to immediately cut motor power. The front indicator light will blink red while the E-Stop is engaged. To release the E-Stop, twist the button clockwise



Charging the Robot

To charge Nova Carter, connect the included wall charger to the charge port. The charger may be used while the robot is on or off. Nova Carter will not respond to movement commands while charging.



NVIDIA Isaac™ Software

Nova Carter is the reference robot for Isaac™, and several sample apps are available for Nova Carter.

When using Isaac™ AMR refer to the NVIDIA Isaac™ AMR documentation: https://developer.nvidia.com/isaac/amr

When using ROS refer to NVIDIA Isaac™ ROS (https://developer.nvidia.com/isaac-ros) and the repository for Nova Carter https://github.com/NVIDIA-ISAAC-ROS/nova_carter

Hardware Information

Nova Carter is based on the NVIDIA Isaac Nova Orin™ (https://developer.nvidia.com/isaac/nova-orin) compute and sensor architecture, which prescribes a specific list of sensor requirements and the system design for an Autonomous Mobile Robot (AMR) built around NVIDIA® Jetson Orin™. Nova Carter uses the NVIDIA® Jetson AGX Orin™ Developer Kit as its compute platform, and the Segway RMPLite 220 as its wheelbase platform.

Nova Sensor Suite

Sensor Type	Sensor Name	I/O	Part Name	Manufacturer	Details	HFOV	VFOV
Stereo Camera	Front Stereo	GMSL2	Hawk LI-AR0234CS-STEREO-GMSL2	Leopard Imaging	2.3 MP RGGB	121.5	73.5
Stereo Camera	Rear Stereo	GMSL2	Hawk LI-AR0234CS-STEREO-GMSL2	Leopard Imaging	2.3 MP RGGB	121.5	73.5
Stereo Camera	Left Stereo	GMSL2	Hawk LI-AR0234CS-STEREO-GMSL2	Leopard Imaging	2.3 MP RGGB	121.5	73.5
Stereo Camera	Right Stereo	GMSL2	Hawk LI-AR0234CS-STEREO-GMSL2	Leopard Imaging	2.3 MP RGGB	121.5	73.5
Camera	Front Fisheye	GMSL2	Owl LI-AR0234CS-GMSL2-OWL	Leopard Imaging	2.3 MP RGGB	202.0 +/- 3	127.2 +/- 2
Camera	Rear Fisheye	GMSL2	Owl LI-AR0234CS-GMSL2-OWL	Leopard Imaging	2.3 MP RGGB	202.0 +/- 3	127.2 +/- 2
Camera	Left Fisheye	GMSL2	Owl LI-AR0234CS-GMSL2-OWL	Leopard Imaging	2.3 MP RGGB	202.0 +/- 3	127.2 +/- 2
Camera	Right Fisheye	GMSL2	Owl LI-AR0234CS-GMSL2-OWL	Leopard Imaging	2.3 MP RGGB	202.0 +/- 3	127.2 +/- 2
IMU	Front Stereo IMU	I2C	BMI088	Bosch	12.5 - 1600 Hz	-	-
IMU	Chassis IMU	I2C	BMI088	Bosch	12.5 - 1600 Hz	-	-
Magnetometer	Chassis Magnetometer	I2C	BMM150	Bosch	10 Hz	-	-
Barometer	Chassis Barometer	I2C	BMP390	Bosch	≤ 200 Hz	-	-
2D Lidar	Front 2D Lidar	Ethernet	RPLidar S2E	Slamtec	10 Hz 0.12 deg resolution 0.05-30m range	360	-
2D Lidar	Back 2D Lidar	Ethernet	RPLidar S2E	Slamtec	10 Hz 0.12 deg resolution 0.05-30m range	360	-
3D Lidar	3D Mapping Top Module	Ethernet	Hesai XT32	Hesai	5-20 Hz 0.09-0.36 deg resolution 0.05-120m range	360	31 (+15 / -16)

Compute & System Devices

Device Name	I/O	Part Name	Manufacturer	Details
Primary Compute	Misc.	Jetson AGX Orin™ Developer Kit	NVIDIA	Please refer to the [NVIDIA Jetson AGX Orin™ Developer Kit User Guide]().
WiFi/BT Card	M.2, 2.4GHz, 5GHz	AW-CB375NF	Azurewave	Included with Jetson AGX Orin™ Developer Kit
GMSL Adapter Board	CSI, I2C to GMSL2	LI-JAG-ADP-GMSL2-8CH	Leopard Imaging	8-CH GMSL2 board for NVIDIA® Jetson AGX Orin™ Developer Kit
GPIO Board	CAN, USB	-	Segway Robotics	Provides CAN transceivers and RGB LED control. Specific for Nova Carter and not for individual sale.
Data Storage	M.2 NVMe	980 PRO 2TB SSD	Samsung	Mounted at /mnt/nova_ssd/
Network Interface Card	PCIe, 10 GbE	X540-10G-2T-X8	Intel	External-facing network connections. Connected to rear IO panel.
Ethernet Switch	1 GbE	TL-SG1005I	TP-Link	Internal sensor network connections. Connected to 10 GbE port on Jetson.
Wheelbase	CAN	RMPLite 220	Segway Robotics	Handles motor control and battery management. Provides system power.

System Architecture

The block diagram below illustrates how the Nova system architecture is implemented on Nova Carter. Specifics on the sensors and other system components used are also provided in tables.

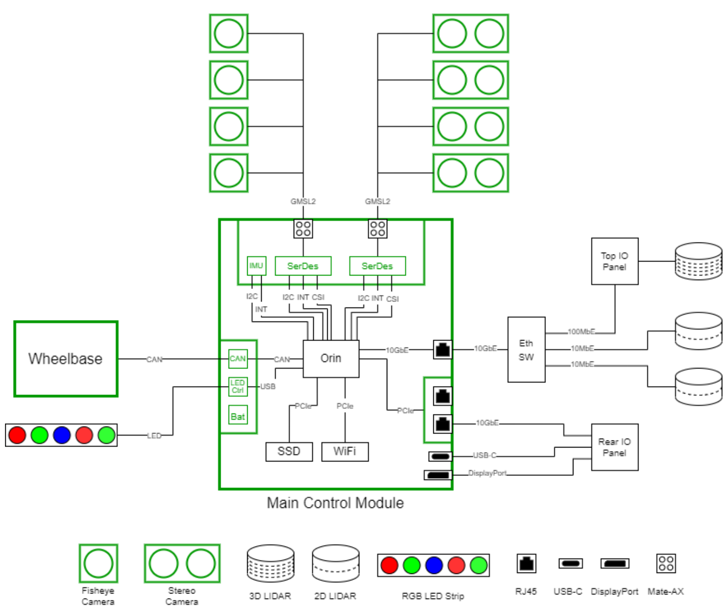


Figure 1 - Nova Carter System Block Diagram

External Interfaces

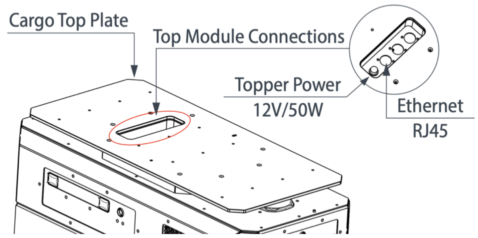


Figure 1 - Enlarged Top View

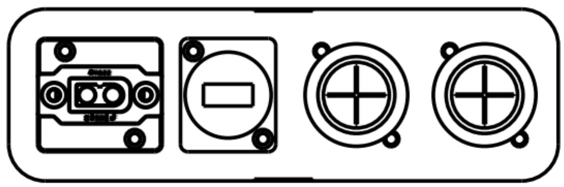


Figure 2 - Power, Ethernet

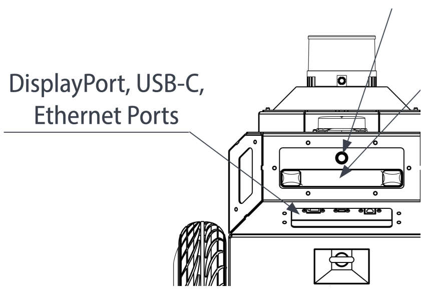


Figure 3 - Enlarged Back View

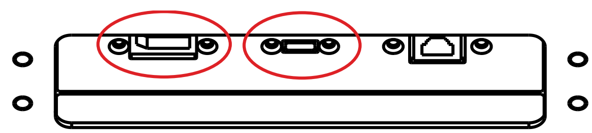


Figure 4 - USB-C, DisplayPort, Ethernet

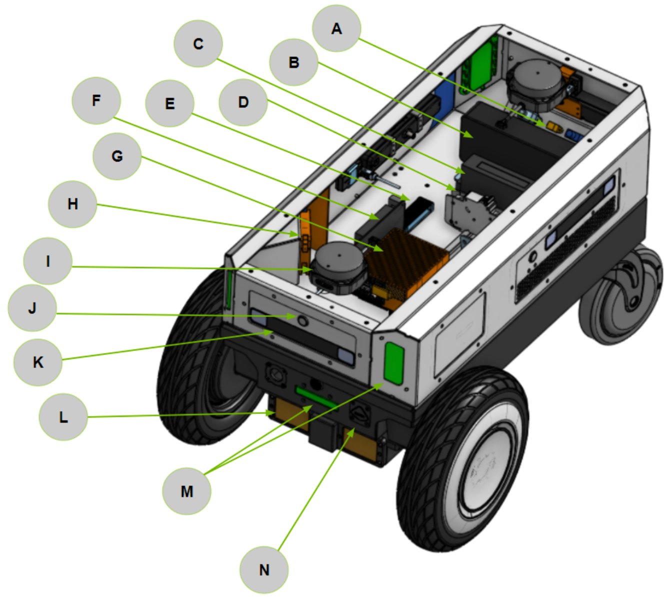
Location	**Connection**	**Details**
Rear IO Panel	USB-C	Connected to Jetson USB-C flashing port. (UFP and DFP)
	DisplayPort	Video and Audio from Jetson DisplayPort.
	Ethernet	10 GbE, external network connection via PCIe NIC
Top IO Panel	Power	12V DC, 50W (fused)
	Ethernet	1 GbE, internal Nova sensor network on Jetson 10 GbE port
	Unpopulated	Empty panel connections for optional user expansion

You can find description of connectors at this URL: Download Center - Segway Robotics

Wheelbase

You can find user manual of RMPLite 220 at this URL: Download Center - Segway Robotics

Internal Component Diagram



Callout	Description
A	Rear IO Panel: DisplayPort, USB-C, Ethernet RJ-45
B	DC-DC Power Regulator, 12V output
C	Ethernet Switch
D	12V Power Breaker and Power Rail
E	NVMe SSD
F	PCIe Network Interface Card
G	NVIDIA Jetson AGX Orin™ Developer Kit with GMSL Adapter Board
H	Cooling Fan
I	RPLidar S2E 2D Lidar
J	Leopard Imaging Owl Fisheye Camera
K	Leopard Imaging Hawk Stereo Camera
L	Charging Station Contact Charge Pads
M	Visual Status Indicators
N	AC-DC Charging Adapter Input

LED & Buzzer Status Indicators

Chassis LED	
Solid Yellow	Locked
Solid Green	Protocol Control (one of control mode)
Flashing Green	Contoller Control (one of control mode)
Flashing Red	E-Stop
Solid Red	Error

Buzzer	
Continuous Short beep (Single Duration: 100ms)	Low battery (Battery level below 10%. Will turn off once connected to charger)
Continuous Long beep (Single Duration: 2000ms)	Error
Beep Once	Power On / Off/ Ctrl Mode Changed

Sensor Positions & Fields of View

The sensor reference origin is placed at the center rotation point of the robot at ground level (between the drive wheels). This is located 140 mm behind the frontmost point of the robot, and 585 mm forward of the rearmost point (tow hook). Positive yaw rotation is clockwise about the Z

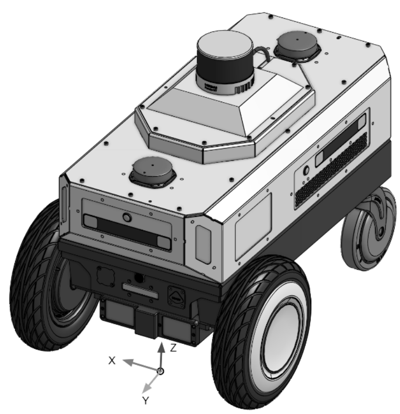


Figure 1 - System Origin On Ground Rotation Axis - Isometric View

axis. All transformations are rounded to the nearest tenths place after the decimal point.

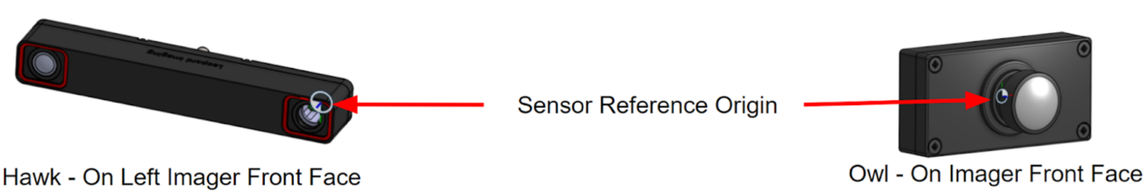


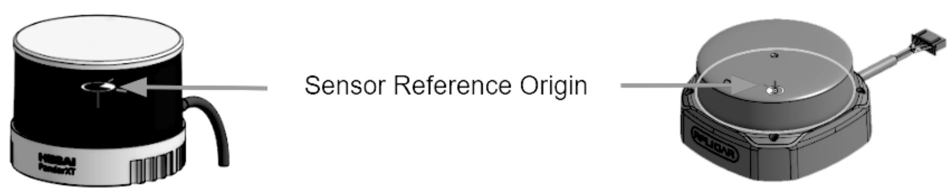
Figure 2 - Hawk Stereo Camera and Owl Fisheye Camera Sensor Reference Origins

Table 1. Hawk Stereo Camera Location Transformations

Hawk	Y (mm)	X (mm)	Z (mm)	Yaw (deg)	Pitch (deg)	Roll (deg)
Front	116.3	0	344.4	0	0	0
Left	-355.4	-166	344.4	90	0	0
Right	-355.4	166	344.4	-90	0	0
Rear	-579.7	0	344.4	180	0	0

Table 2. Owl Fisheye Camera Location Transformations

Owl	Y (mm)	X (mm)	Z (mm)	Yaw (deg)	Pitch (deg)	Roll (deg)
Front	120.1	0	374.4	0	0	0
Left	-231.7	-169.9	344.4	90	0	0
Right	-231.7	169.9	344.4	-90	0	0
Rear	-583.54	0	374.4	180	0	0



XT32 - Manufacturer Sensor Origin

RPLidar S2E - On Bottom of Sensor Window Plane (Highlighted Circle)

Figure 3 - XT32 3D Lidar and RPLid

Table 3. XT32 3D Lidar Location Transformation

	Y (mm)	X (mm)	Z (mm)	Yaw (deg)	Pitch (deg)	Roll (deg)
Center	-231.7	0	526.3	0	0	0

Table 4. RPLidar S2E 2D Lidar Location Transformation

	Y (mm)	X (mm)	Z (mm)	Yaw (deg)	Pitch (deg)	Roll (deg)
Front 2D Lidar	26	0	418	0	0	0
Rear 2D Lidar	-489.4	0	418	180	0	0

The following figures show visualizations of Nova Carter's sensor fields of view.

Note: The illustrated FoVs are approximate, and the ranges have been truncated for improved visualization. Touchdown distances are measured from the Nova Carter Front or Side most facing panels on the electronics enclosures.

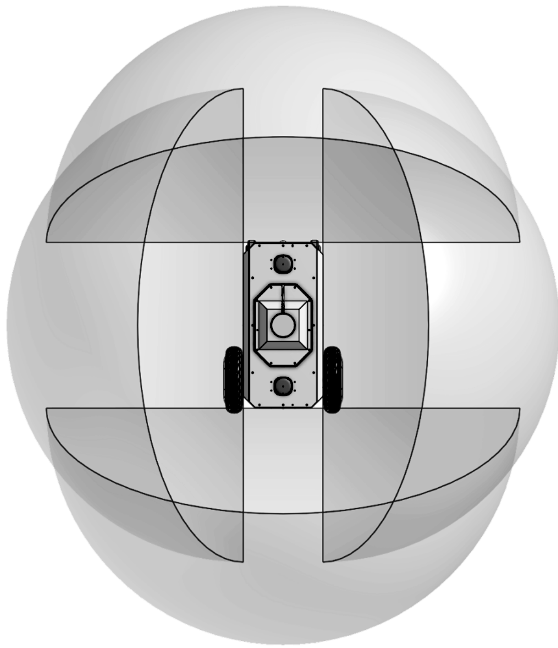


Figure 1 - Fisheye Camera FoV - Top View

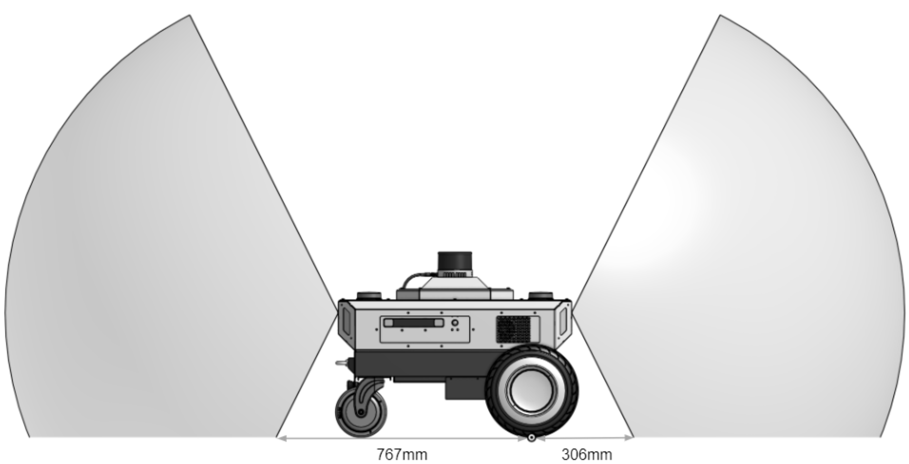


Figure 2 - Fisheye Camera FoV - Side View (Front and Rear sensors)

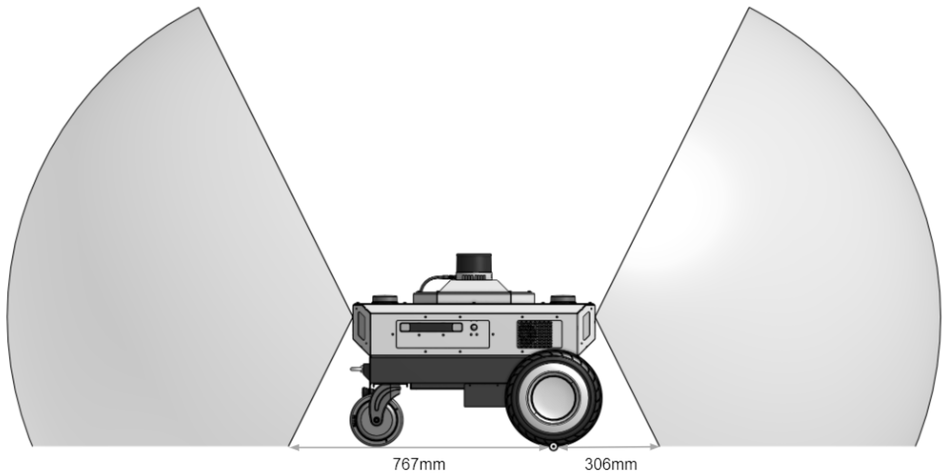


Figure 3 - Fisheye Camera FoV - Back View (Left and Right sensors)

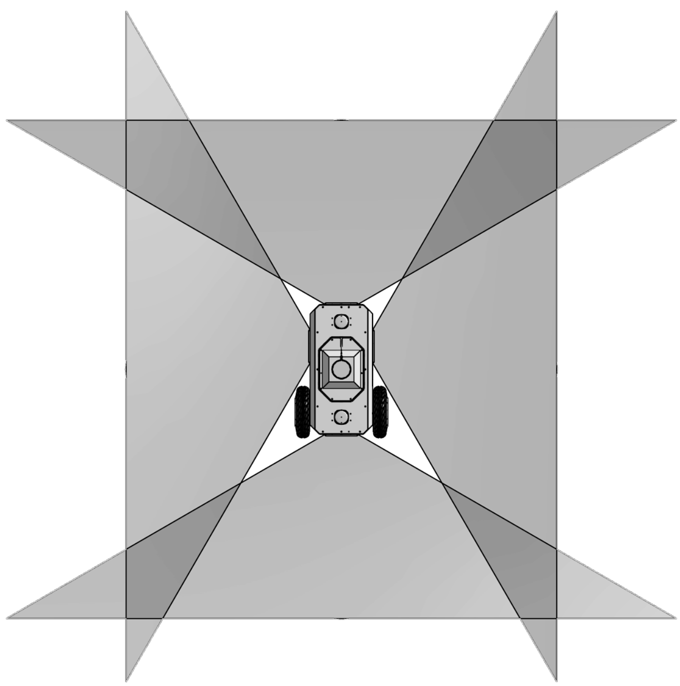


Figure 4 - Stereo Camera FoV - Top View

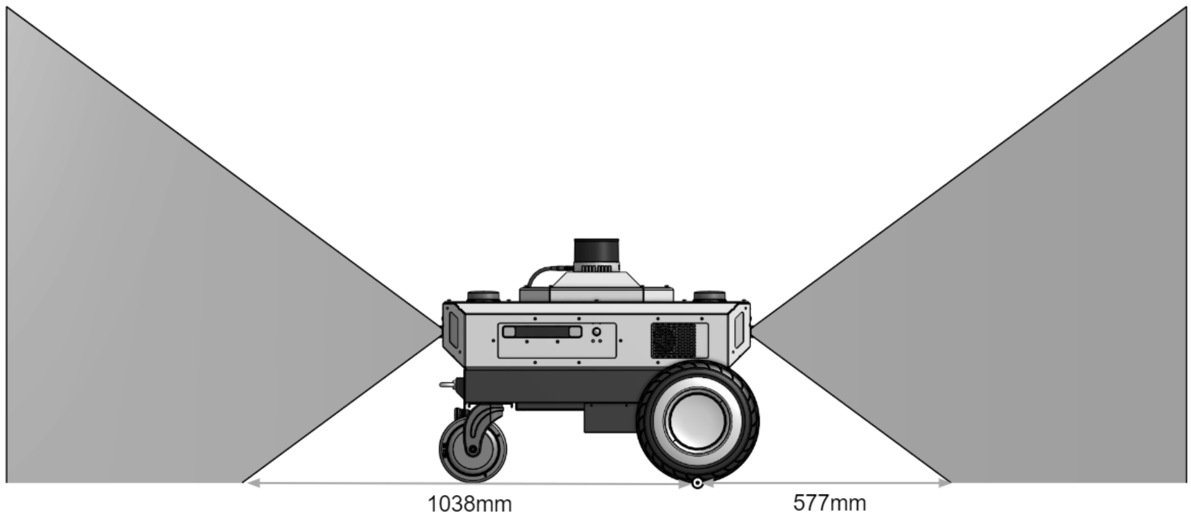


Figure 5 - Stereo Camera FoV - Side View (Front and Rear sensors)

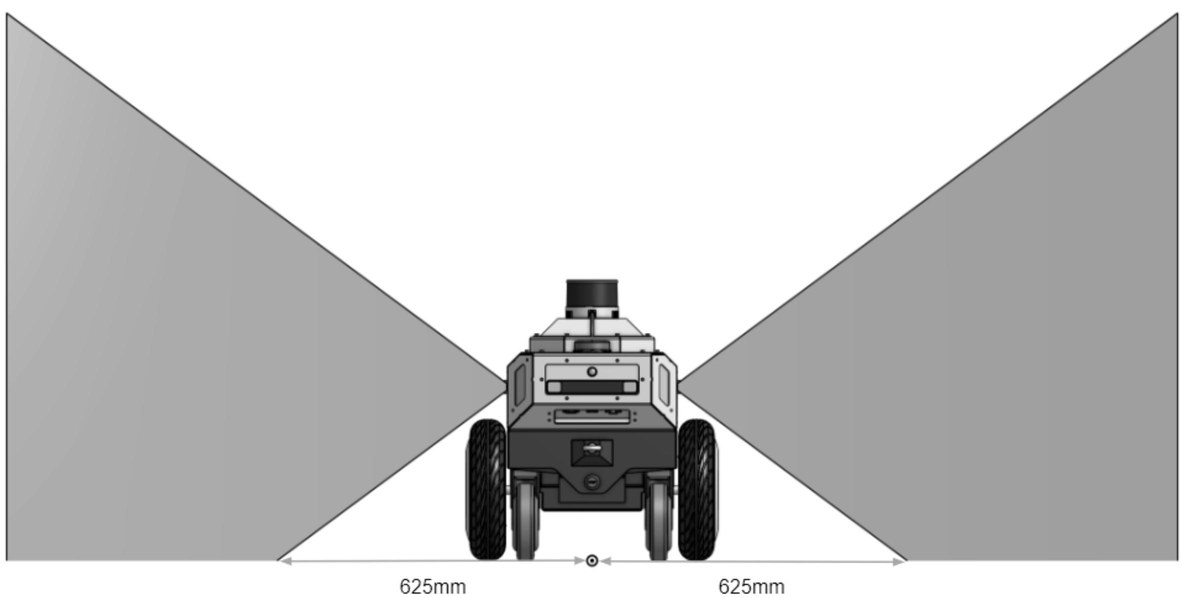


Figure 6 - Stereo Camera FoV - Back View (Left and Right sensors)

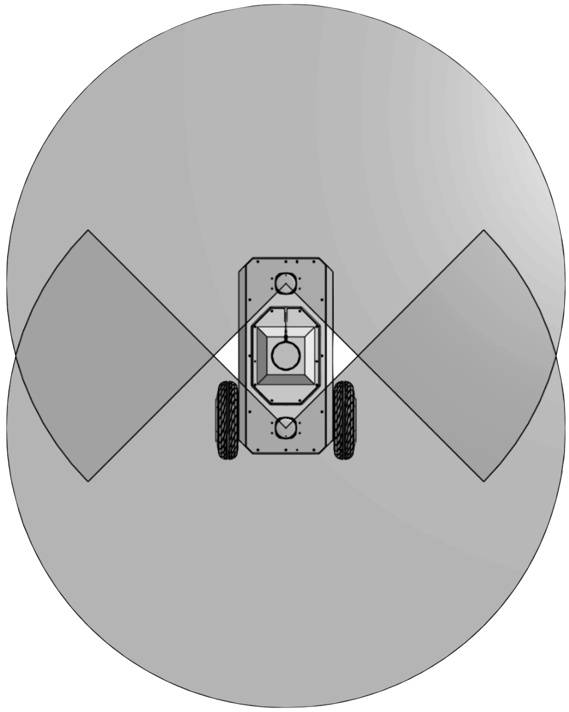


Figure 7 - 2D Lidar FoV - Top View

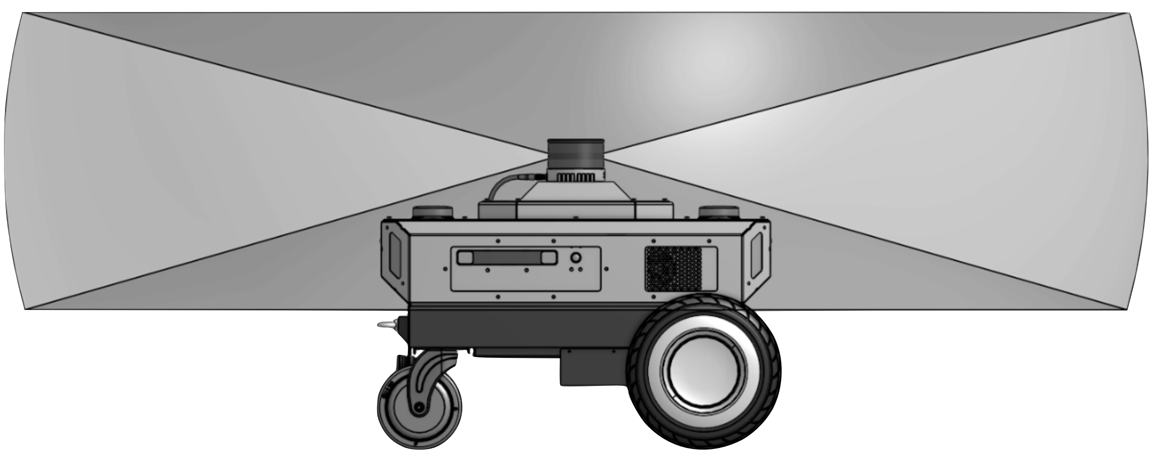


Figure 8 - 3D Lidar FoV - Side View

Top Modules

Nova Carter has a modular design to make it adaptable for multiple use-cases. It ships with two different *Top Modules*:

- **3D Mapping Top Module**: Equipped with Hesai XT-32 3D Lidar for 3D mapping and ground truth depth data collection.
- **Basic Cargo Top Module**: A plate that can be used to enable payload transport while protecting the 2D Lidars from damage.

You can also design your own top modules to use on Nova Carter. The top IO panel provides 50W 12V DC power and an Ethernet connection for the internal Nova sensor network. This is a separate network from the rear IO panel Ethernet port. Blanking plates on empty ports provide expandability for other connections if you want to install your own.

Alignment pins at the top module mechanical interface ensure that topper modules can be removed and reinstalled into the same position. This allows for extrinsic calibration between sensors to be maintained even if multiple top modules are used on the robot.

Changing the Top Module

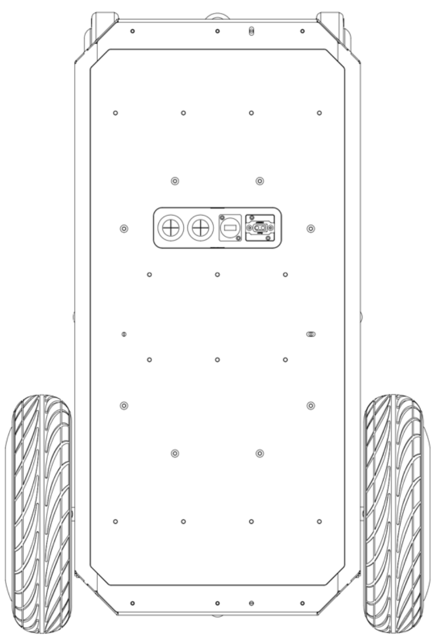
Remove 3D Mapping Top Module

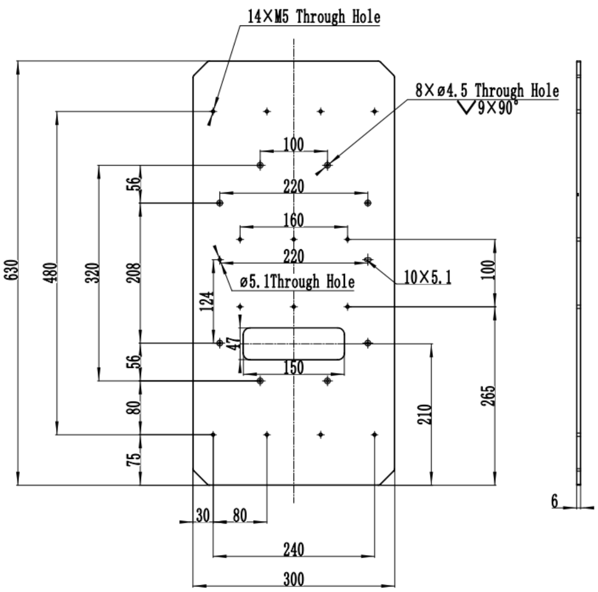
1. Protect the Hesai XT32 Lidar with a cloth cover to prevent damage during this process.
2. Remove the 8x M4 bolts at the corners of the octagonal base of the 3D Mapping Top Module.
3. Carefully lift the 3D Mapping Top Module, exposing the top IO panel connections.
4. Disconnect Lidar power connector and Ethernet connector
5. Store the 3D Mapping Top Module, taking care not to damage the Lidar.
6. Reverse these steps to reinstall.

Install Basic Cargo Top Module

1. Place the Basic Cargo Top Module onto Nova Carter, ensuring that the alignment pins are aligned with the corresponding holes in the Top Module. Take care not to damage the 2D Lidars during installation.
2. Install 8x M4 x 10mm flat head bolts. Use of thread locker is recommended.
3. Reverse these steps to uninstall.

Basic Cargo Top Module Bolt Pattern





Dimension unit: millimeter (mm)

Creating Custom Top Modules

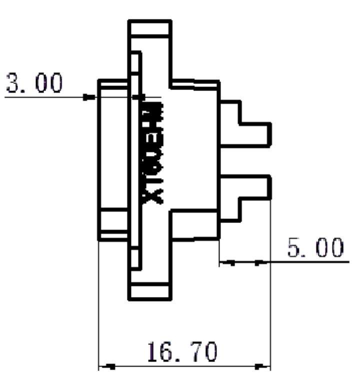
To create your own top module, please refer to the connector and bolt pattern information below.

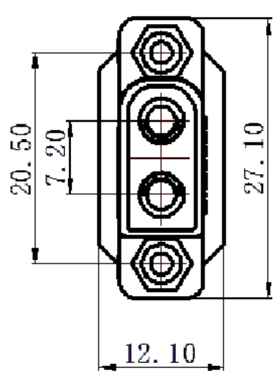
Top IO panel has two connectors: Power socket connector, Ethernet socket connector.

Power socket connector description:

XT60E-F (on Nova Carter side)

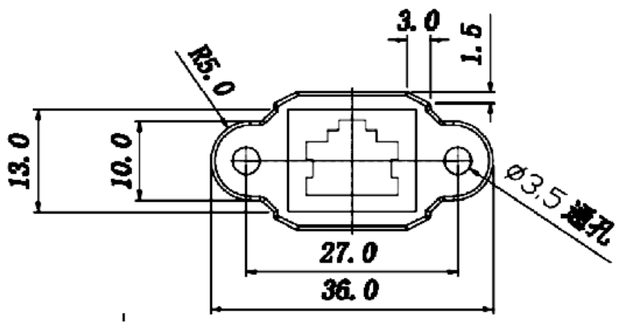
- Withstand Voltage: DC 500V (UL1977)
- Rated Current: 20A 16# (UL1977)

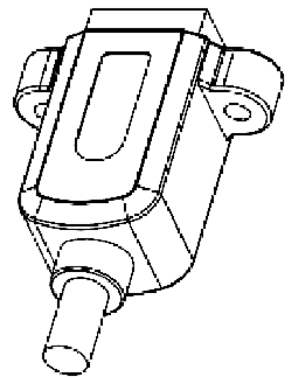


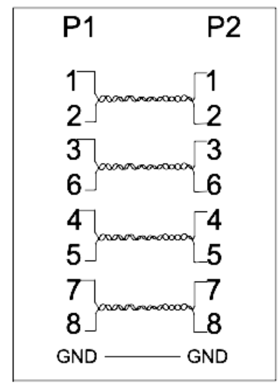


The interface is the power output, and the straight side of the interface shell is the positive pole of the power supply.

Ethernet socket connector description:
RJ45 (on Nova Carter side)



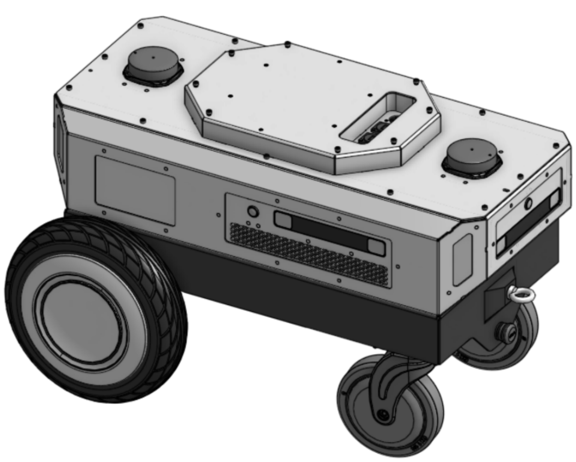


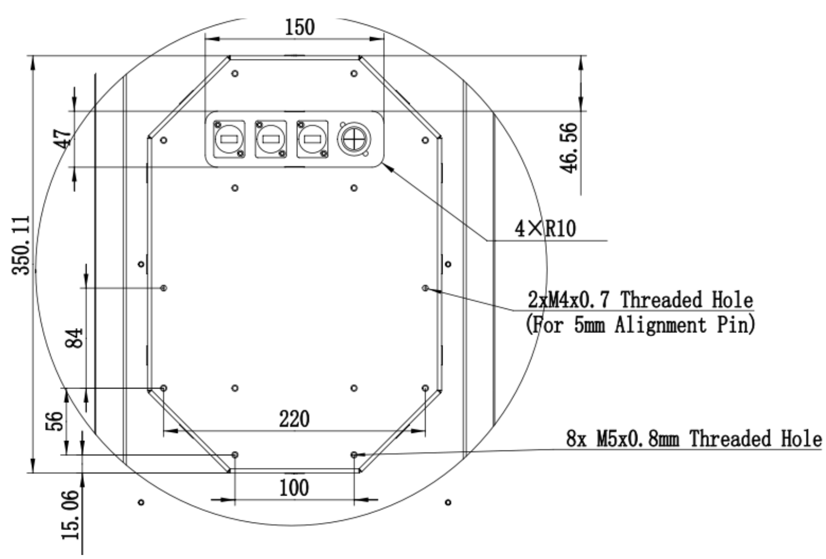


For more information, please refer to the External Interfaces section above.

You can find description of connectors at this URL: [Download Center - Segway Robotics]

Adapter Plate Bolt Pattern





Maintenance

Changing the Battery

Prepare materials

- A new battery
- A 3mm hexagonal wrench
- A 5mm hexagonal wrench
- Battery Lock Key

1. Turn off the robot, press the emergency stop button and unplug the battery power and signal wires at the position shown in *Figure 1*.

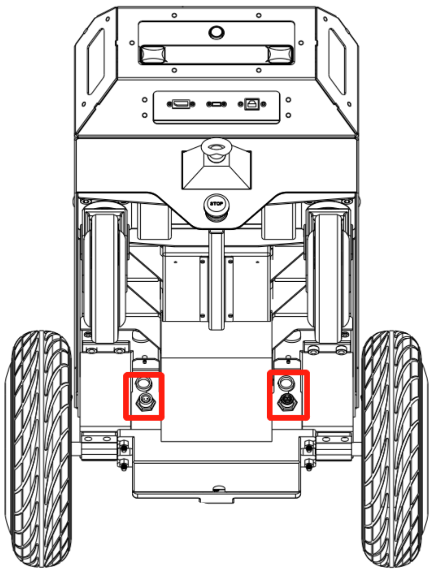


Figure 1

2. Use a 2.5mm hex wrench to remove the 12 M4 screws shown in *Figure 2*.

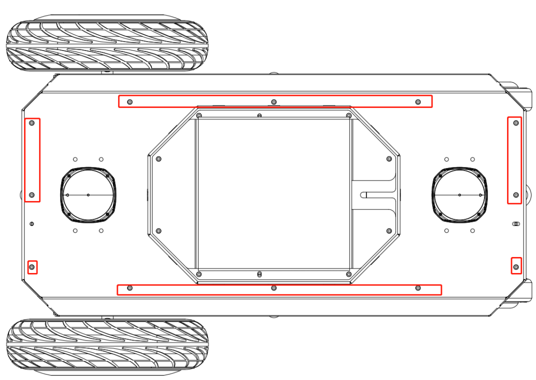


Figure 2

3. Carefully tilt open the lid enough that you can reach in, taking care not to pull on any cables. Unplug one 3D Lidar and two 2D Lidar cables and remove the top cover assembly as shown in Figure 3.

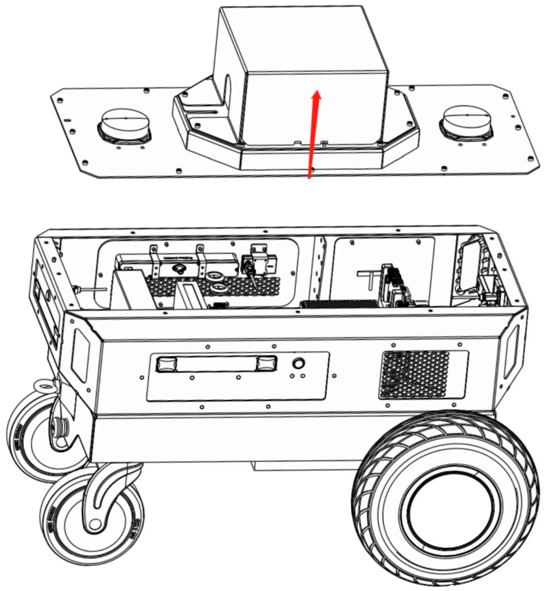


Figure 3

4. Use a 5mm hex wrench to remove the six M6 screws that secure the main enclosure as shown in *Figure 4.*

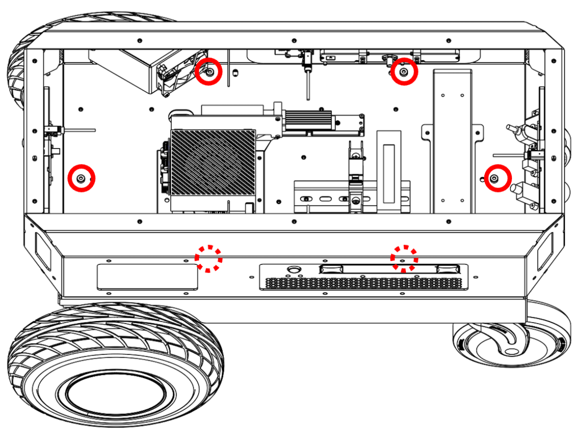


Figure 4

5. Remove the main enclosure and expose the battery. Please take care that the power and signal wires unplugged in step 1 must be fed through the openings in the RMPLite 220 wheelbase.

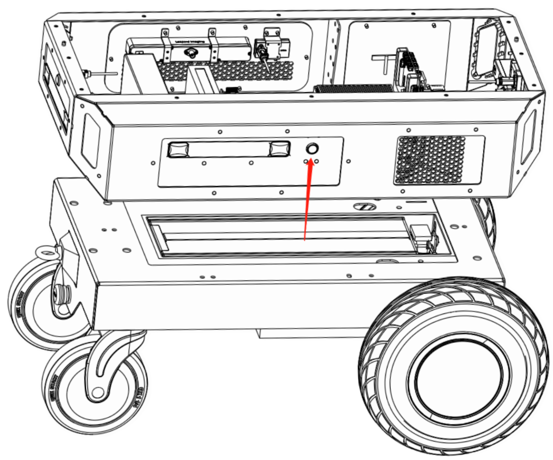


Figure 5

6.Unplug the battery power cord.

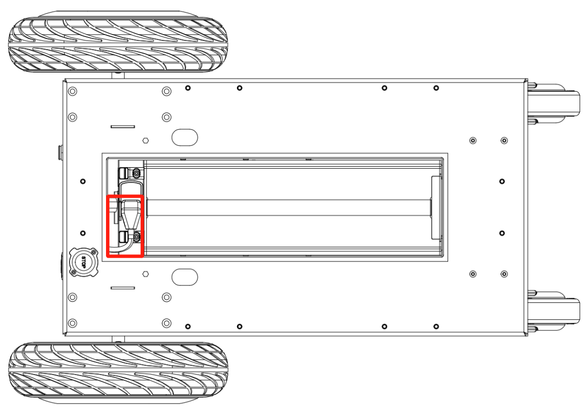


Figure 6

7.Insert the key from the bottom of the vehicle and rotate it 90 degrees counterclockwise.

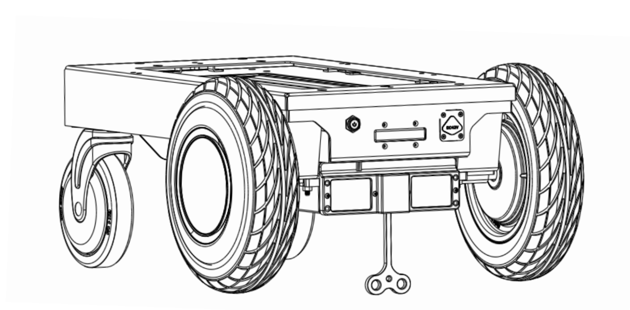


Figure 7

8.Remove the old battery and replace it with a new one. Install with the battery connector near the drive wheels, and lower into the robot at an angle, making sure to engage the alignment features at the rear."

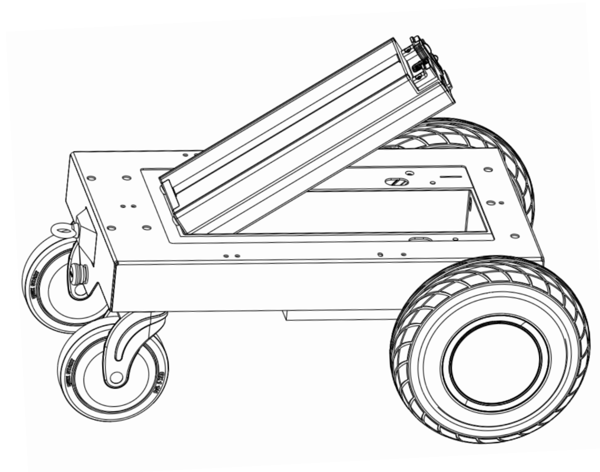


Figure 8

Description: after replacing the new battery, reverse the above steps to reassemble the entire robot.

Battery Environmental Specifications

Operating Temperature	Charging Temperature Range	0°C～+45°C
	Discharging Temperature Range	-20°C～+50°C
Storage Temperature	-20°C～+60°C	1 Month
	-20°C～+45°C	3 Months
	-20°C～+25°C	12 Months

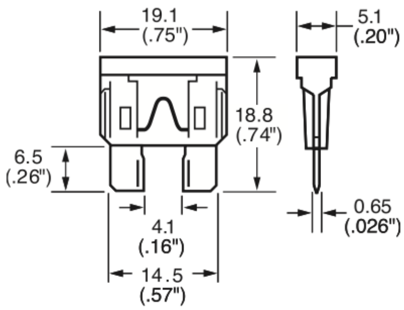
Drive Wheel Tires Pressure

The inflation pressure of the tire is 35 PSI.
If the tire is worn out and cannot be used normally, please contact us directly at the contact information in this manual.

Replaceable Fuse

The 12V power connection at the Top IO Panel is fused with an in-line 5A replaceable automotive fuse. To access the fuse for inspection and replacement, please follow 2 & 3 of the battery removal procedure outlined above to remove the Top Cover Assembly.
Fuse body size: 19mm * 19mm

Dimensions in mm



Part Number	Current Rating (A)	Housing Material Color	Typ. Voltage Drop (mV)	Cold Resistance (mΩ)	I^2t (A^2s)
0287001._	1		176	123	0.4
0287002._	2		141	53.5	1.4
0287003._	3		137	31.1	7.4
0287004._	4		136	22.8	14
0287005._	5		128	17.85	26
028707.5_	7.5		116	10.91	60

Service Contact

Please visit Segway official website or communicate directly with the following business email:
support@robotics.segway.com

Certifications

Note: Standards mentioned below are about battery certification.

Item	Standard	Qualified or not	Certification report or not
CB/CE-safety	IEC/EN 62133-2: 2017	Qualified	Yes
UL2271	UL2271 (sent from UL)	Qualified	Yes
EU Battery Directive	2013/56/EC	Qualified	Yes
RoHS/REACH/PoPs	/	Qualified	Yes
UN38.3	S/SG/AC.10/11, Article 38.3, Dangerous Goods Transport Simulation Test of United Nations	Qualified	Yes
SDS/MSDS	/	Qualified	Yes
EMC	ECE R10	Qualified	No
GOST-R	/	Qualified	Yes

Software Documentation

Segway RMPLite 220 Wheelbase

The chassis of the Nova Carter is Segway's RMPLite 220 chassis and its user manual contains complete product instructions, software instructions and firmware upgrade methods.
You can find it at this URL : Download Center - Segway Robotics

Firmware and host-side drivers for the Nova Carter's RMPLite 220 wheelbase can be found at the following location:

https://github.com/SegwayRoboticsSamples/RMP220-SDK

Nova Carter Init

On first setup of Nova Carter, or after a re-flashing of Jetpack on Jetson™ AGX Orin™ Developer Kit, Nova Init is required to configure the Jetson™, peripherals and sensors for use with Isaac™ AMR or Isaac™ ROS software. Refer to https://registry.ngc.nvidia.com/orgs/nvidia/teams/isaac/resources/nova_carter_init for details.

Re-flashing Jetson on Nova Carter

The Jetson AGX Orin™ Developer Kit on Nova Carter can easily be re-flashed with a fresh Jetpack SDK image (https://developer.nvidia.com/embedded/jetpack) without any need to open the robot. Run NVIDIA SDK Manager (https://developer.nvidia.com/sdk-manager) on a Linux host machine, and connect it to the USB-C port on Nova Carter's rear IO panel. Please see the Jetson AGX Orin™ Developer Kit User Guide (https://developer.nvidia.com/embedded/learn/jetson-agx-orin-devkit-user-guide/index.html) for more information.

After re-flashing Jetpack, you may also want to re-install Nova Carter Init. (see instructions above) Please take care to use compatible versions of JetPack and Nova Carter Init.