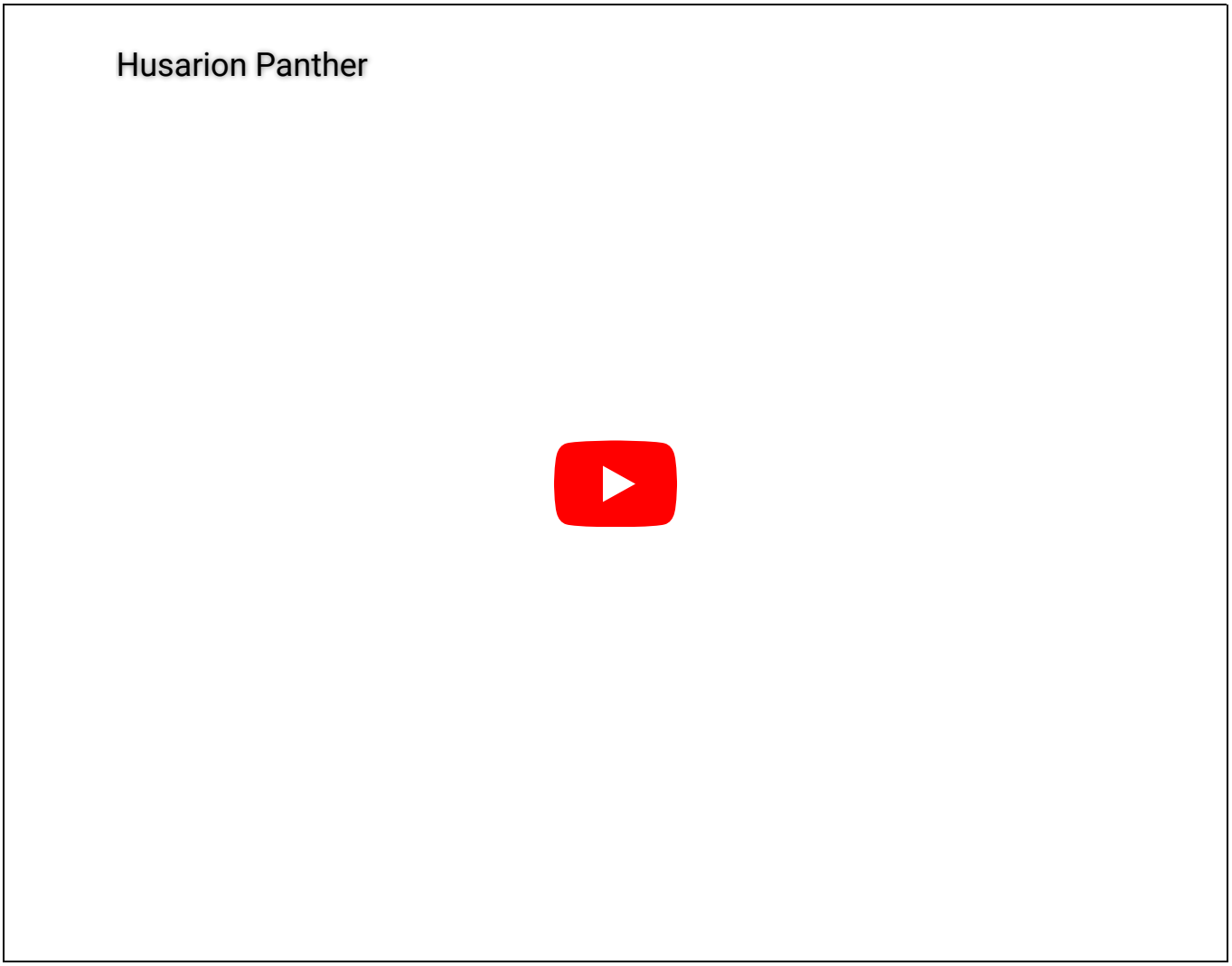
Panther Manual



Overview

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Autonomous, mobile robot (AMR) platform dedicated to an outdoor environment. Compliant with an IP54 or IP66 rate of protection. Depending on the use case, it can be equipped with a robot arm, LIDAR, RGB-D camera, GPS, UWB, and other equipment. It can be used in various application areas, such as agriculture, construction, inspection, and many more.

LOOKING FOR A QUICK START GUIDE?

This is a manual. If you need a **quick start guide** instead, you can find it here

WARNING

Before the First Use

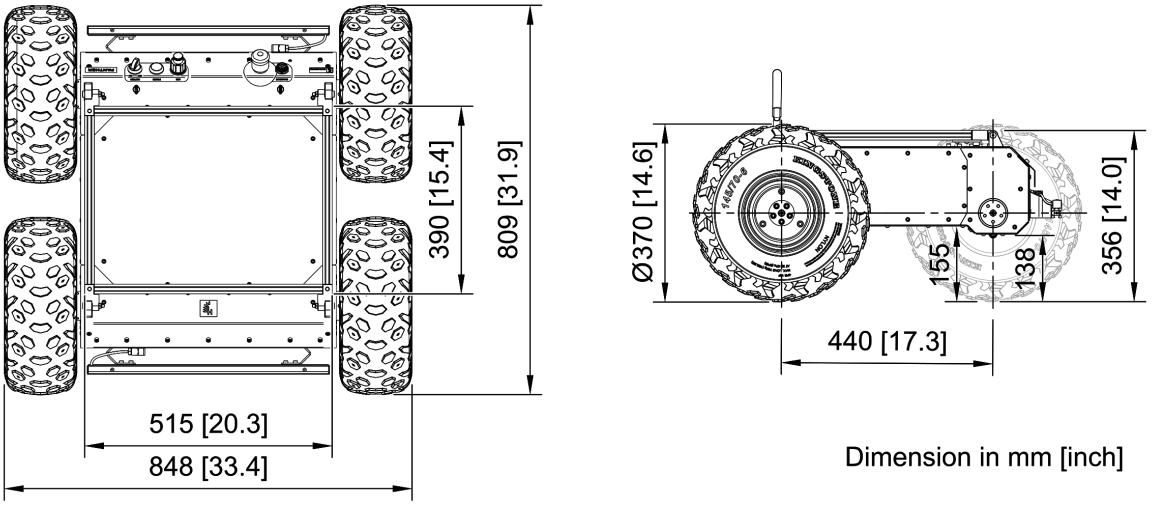
We know that you would really like to Quick start with Panther now, but your safety is the most important thing.

Brief Safety Information

1. Please read the Safety Instructions first.
2. If you are not sure how something works, please read the manual.
3. Please remember that the Emergency Button is available on the robot (a mechanical one) and in the software one (accessible from WebUI and Gamepad). Still, in some cases, you may not be able to use them quickly enough to stop the robot before causing damage.
4. A detailed description of the safety features is available in the Safety section.

Hardware Guide

Specification



Basic Parameters (with WH01 wheels option and a single Battery)

Name	Value	Name	Value
length	809 mm	width	848 mm
platform height	356 mm	weight	55 kg
overall height	370 mm	protection index	IP54 / IP66
wheelbase	440 mm	operating temperature	-20°C to 50°C
track of wheels	695 mm	storage temperature	-20°C to 50°C
maximum ground clearance	155 mm	charging temperature	0°C to 45°C
minimum ground clearance	138 mm	battery type	Li-Ion 36 V

Traction Parameters (with WH01 wheels)

Name	Value	Name	Value
max speed	2 m/s	maximum carrying capacity	100 kg
hill climb grade	96% (44°)	nominal shaft torque	34.5 Nm
climb grade with 50kg cargo	90% (42°)	maximum shaft torque	60 Nm
climb grade with 80kg cargo	60% (31°)	nominal total traction force	725 N
hill grade traversal	80% (39°)	maximum total traction force	1511 N

Great traction, large ramp angles, and high stability are ensured by the low center of gravity, located very close to the center of the robot. Details can be found in the files attached in the section Docs And Link.

International Protection Rating

The platform is offered in two variants of the protection class. The basic variant is dedicated to moderate indoor and outdoor conditions, with a rating of IP54. The upgraded variant is dedicated to an extremely demanding work environment with a rating of IP66. Sales details such as price, lead time, and other conditions are available in the store. More details are also in the Panther Options document.

Specification of given ratings:

Class	Solid	Fluid
IP54	dust protected	protection against splashes of water from any direction
IP66	dust-tight	protection against strong water jets (100 l / min) poured on the housing from any side

Components

Component	Quantity	Description
Built-in Computer	1	Quad-core 64-bit SoC @ 1.5GHz and 4GB RAM. Used to manage all the basic functions of a mobile platform.
User Computer*	1	**ASUS® NUC** (Intel® Core i7-1360P, 16GB RAM, 500GB SSD, GPU: Intel® Iris® Xe), **Lenovo ThinkStation P360 Tiny** (Intel® Core i7-12700T, 16GB RAM, 512GB SSD, GPU: NVIDIA® T1000), or **NVIDIA® Jetson Orin NX** (ARM® Cortex® A78AE, 16GB RAM, 512GB SSD, GPU: NVIDIA® Ampere). See Panther Options for details.
Router	1	Teltonika RUTX11 - Dual-band (2.4 GHz / 5 GHz), Access Point / Client Mode, 4G LTE CAT 6, Bluetooth 4.0 LE, GNSS (GPS, GLONASS, BeiDou, Galileo and QZSS) - This multifunctional device ensures reliable external wireless communication and Ethernet link between internal components of the robot system. More details.
Antenna	2	Dual-band (2.4 GHz / 5 GHz) placed on the rear of the robot. See all Panther Options.
IMU (Inertial Measurement Unit)	1	PhidgetSpatial 3/3/3 Precision (3-axis compass, a 3-axis gyroscope, and a 3-axis accelerometer). More details.
Front and Rear Bumper Lights	2	Signal lighting made of 46 pcs. APA102C LED chips built into an aluminum profile on the robot's bumpers.
Brushless Motor with planetary gearbox	4	80PMB800K.80RBL-100 - Drive implemented on 4 durable motors with 473 watts of power (900 W instantaneous power) each and planetary gears with a maximum torque of 60 Nm allows the robot to move at a speed of 2 m/s even uphill with a slope of 40% with a load of 50 kg.
Wheel	4	WH01 - 370mm standard off-road wheels, WH02 - 203mm mecanum wheels. A recommended tire pressure for WH01 option is 1.0 to 1.5 bar (14 to 22 psi).
Additional kits**		Together with the robot, you can get an integrated lidar, depth camera, manipulator, and more. See all Panther Options

***NUMBER OF USER COMPUTERS**

By default, there is only up to one User Computer in the robot. For detailed information, see Panther Options.

****MOUNTING OF EXTERNAL MODULES**

Most of the external modules are attached to the profiles on the top of the platform. More details.

Communication

Available as standard

- Ethernet
- USB
- Wi-Fi (2.4GHz & 5GHz)

Possible to extend

- LTE
- GNSS (including GPS)
- CAN
- RS232
- RS485

See all at Panther Options.

Block Diagram

Graphic representation of Panther components and connections between them. A full, more detailed version of the block diagram can be found in the Docs and Links chapter.

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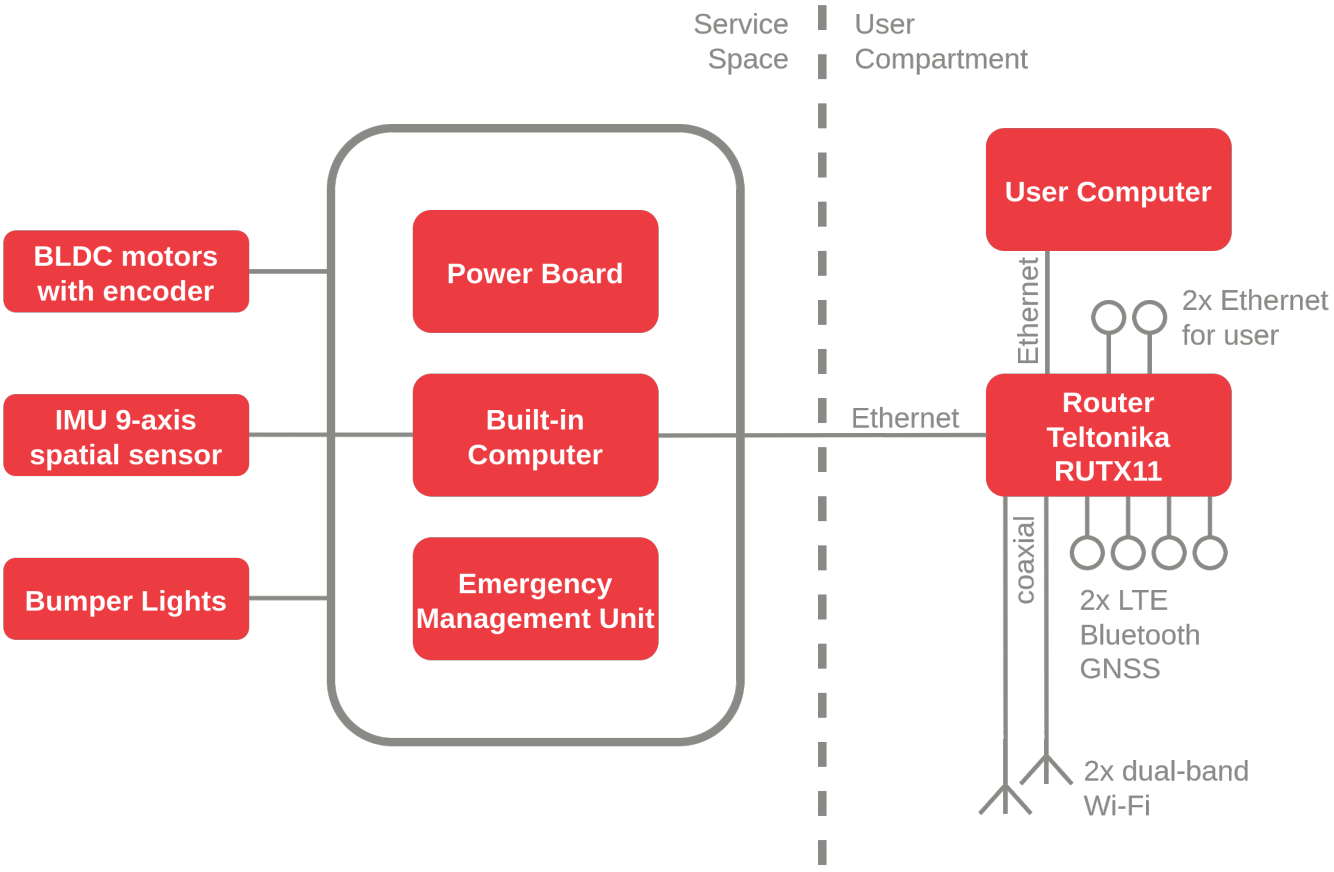

Rear Panel Description

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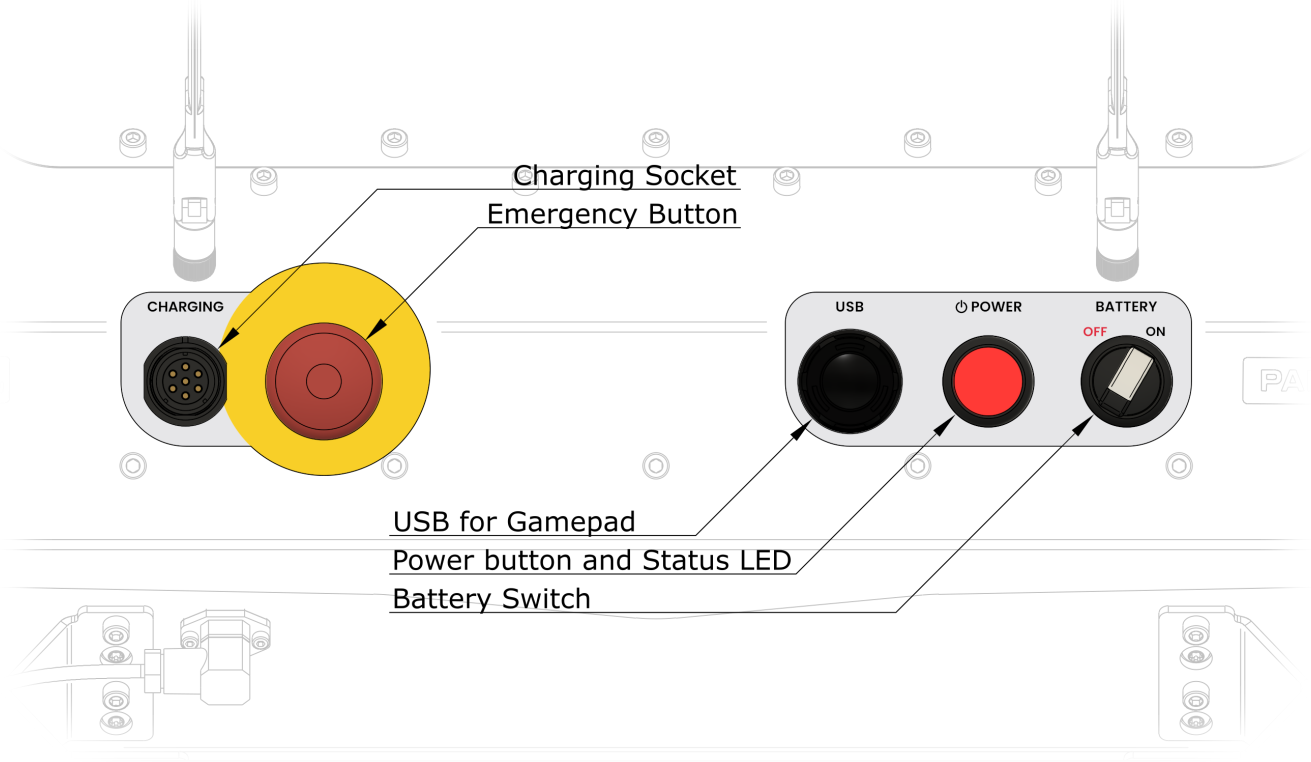
On the Rear Panel of the robot, there are:

- Power controls for the robot - two-position Battery Switch and Power Button.

- USB connection (by default used for Gamepad).
- Emergency Button.
- And the robot's Charging Socket.



Battery Switch

The Battery Switch is used to cut off the Battery voltage from the robot's electrical circuits. Use this switch for long-time storage and shipping. In the event of a robot malfunction, setting the Battery Switch to the OFF position will turn off the robot immediately, without waiting for the operating system to shutdown.

Battery Switch position	Knob position	Power state
OFF	left	battery disconnected
ON	right	battery connected

DATA LOSS

Cutting off power using the Battery Switch may cause data loss on the Built-in Computer as well as on User Computers.

DANGER

Cutting off power by putting the Battery Switch in the OFF position is **NOT** the same as taking out the Battery. When it is necessary to interfere with the internal components of the robot, it is important to remove the Battery from the robot first!

Power Button and Status LED

Power Button action is triggered with a press and hold of the button for 1 second.

Battery Switch position	Robot status	Power Button action
OFF	powered OFF	no action

Battery Switch position	Robot status	Power Button action
ON	powered OFF	power ON
ON	powered ON	initialize shutdown

The Power Button is equipped with an LED that indicates the robot's status:

LED state	Status of the robot
ON	powered on
blinking	shutting down
OFF	powered off

SHUTDOWN TIMEOUT

When the Power Button is blinking the shutdown process is ongoing. Normally the button should stop blinking after about 10 to 20 seconds. The robot is waiting for the Built-in Computer to indicate a graceful shutdown. In case of an error of Built-in Computer hardware logic will timeout after 140 seconds and cut off the power anyway.

CONFIGURING GRACEFUL SHUTDOWN

The behavior of the robot after pressing the Power Button can be modified to suit your needs. See Panther Manager for more information.

Emergency Button

The Emergency Button is connected directly to the Emergency Management Unit, and it is one of the inputs triggering the E-stop signal. Pushing it runs several actions on the robot. There is a possibility to program the behavior of the platform in emergency situations, however, the default actions are:

- Activate the E-stop signal and latch it.
- Actively brake the robot using motors.
- Toggle an SPDT relay (external E-stop output).

You can read more about the E-stop in the chapter Safety.

USB for Gamepad

There is an EDAC 690-W04-260-014 connector, which provides a direct USB connection to the Built-in Computer. It is dedicated to connecting the Logitech F710 Pad with a modified waterproof USB receiver, but the port can be used to connect any USB 2.0 device to the computer. Information on how to use the Gamepad with the robot can be found in the chapter Controlling Panther Robot.

Charging Socket

There is a Weipu SP2112/S7 connector mounted on the Rear Deck of the robot with a waterproof cap. The necessary details on charging can be found in the chapter Charging Panther.

Battery & Charging

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Battery

The Panther power supply is available with a couple of options for easily swappable battery packs. While purchasing the platform, you can choose the basic 720 Wh Battery (BAT01) or the doubled version of 1440 Wh (BAT02). Read more about it in the section Panther Options.

The Battery packs are made of Lithium-Ion cells with a rated voltage of 36 V and 20 Ah or 40 Ah capacity, which gives the Panther enough energy to move around in demanding terrain and perform calculations for about 3.5 hours in the standard version and 7 hours in the doubled version. Moving the robot in friendly terrain allows for a significant extension of the robot's working time, up to 8 hours (standby time up to 40 hours) for the single Battery variant. You can check more specific information about Panther power consumption calculated for the basic version of the Battery.

When the Battery level is low, the Bumper Lights display this status through two distinct animations that are shown periodically. If the Battery level drops below 40% (36 volts), the bumper light displays an animation of two orange stripes moving toward the center. If the Battery level drops below 10% (33 volts), an animation consisting of two red stripes moving towards the center is displayed.

For more information about the Bumper Lights, please see the Panther Lights and Bumper Lights sections, respectively.

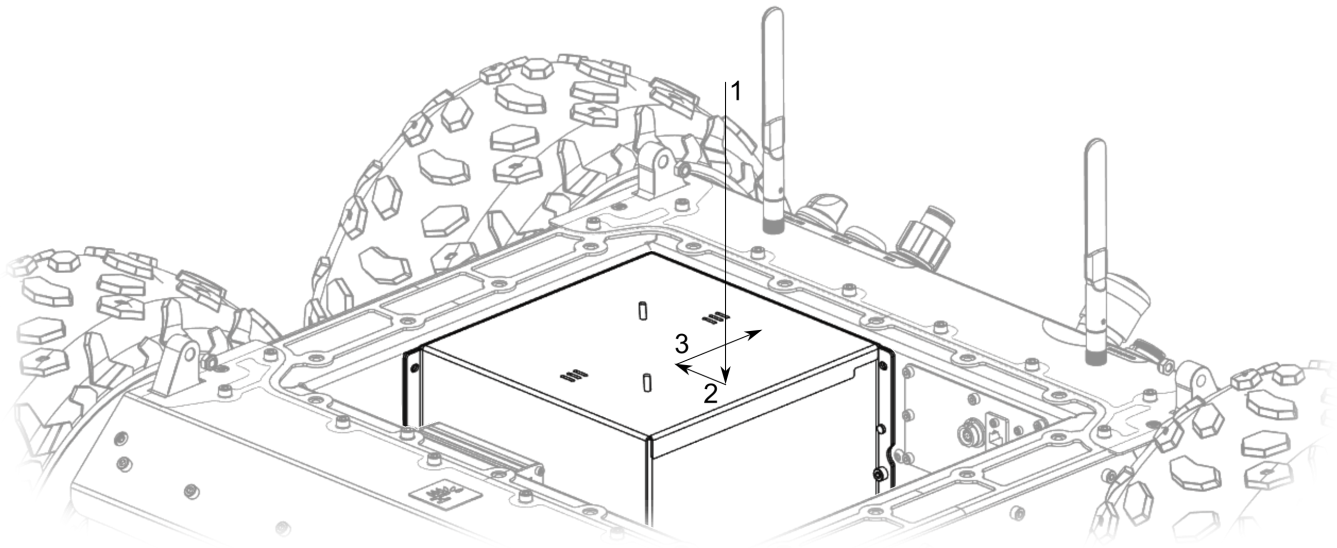
Battery parameter	Value for BAT01	Value for BAT02
battery capacity	720 Wh	1440 Wh
runtime	3.5 h - 8 h	7 h - 16 h
standby time	40 h	80 h
total output power	1.0 kW	2.0 kW
maximum peak power	1.8 kW	3.2 kW

Battery Swap

To remove, insert, or replace the Battery, you require access to the User Compartment. You will learn how to do it in the chapter User Compartment.

The Battery is attached to the inner walls of the robot with DIN 912 M5x12 bolts (4 mm Allen key). After removing the bolts (2 pcs for BAT01 and 4 pcs for BAT02) holding the Battery in place, slide the Battery out of the electrical connector by sliding the package towards the front of the robot by approximately 10 mm. After that, the Battery can be lifted by the handle located on its upper surface.

There are retaining pins pointing out of the Battery, be careful not to damage the seal on the surface of the robot. The Battery is heavy and can damage electronics and wires placed on the User Shelf if not lowered carefully. After lowering (**1**) the Battery to the bottom of the User Compartment, slide it towards the right side (**2**) of the robot and then along this wall to the rear (**3**) of the robot. The locating pins should finally position the Battery, which will slide smoothly into the power socket. The bolts holding the Battery in place should be tightened to a torque of 4 Nm. The steps described above are marked in the figure below.



Charging Panther

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In the set with the robot, we provide a dedicated Charger, which can charge the robot to 80% in 4 hours, and to 100% in 7 hours. The dedicated Charger can be connected directly to the robot's Charging Socket on its housing. There are two types of chargers available. By standard, Panther is shipped with a wired Charger - single or dual (in case of BAT02 option). On the top of these Chargers, there are LED indicators. If all of them are green, that means the Battery is fully charged or not connected. When at least one LED is red, that means the Battery is charging.

Another type of charger is a wireless charger. You can read more about it in the Panther Options section. The wireless charger has also a separate page in manual: Wireless charger.

CHARGING TIME

The charging time for the double Battery (BAT02) should be very close to the single Battery (BAT01). This is possible due to the dedicated Dual Charger for BAT02.

Parameter name	Single Charger	Wireless Charger	Dual Charger
suitable battery options	BAT01	BAT01	BAT02*
input voltage range	100 - 240 V AC	100 - 240 V AC	100 - 240 V AC
input voltage frequency	50 - 60 Hz	50 - 60 Hz	50 - 60 Hz
max output voltage	42 V	42 V	42 V at two channels
max output current	5 A	5 A	2x 5 A
* - The dual Charger can also charge the robot with BAT01.			

DRIVING THE ROBOT WHILE CHARGING

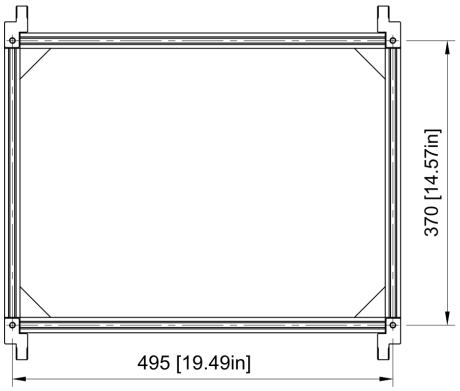
It is forbidden to drive the robot during the charging process!

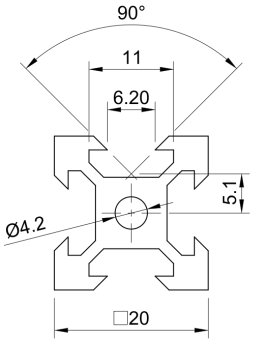
MAINTAINING THE LONG BATTERY LIFE

To maintain the long battery life, it is recommended to disconnect the charger after it finishes the charging process (the green LED(s) are ON).

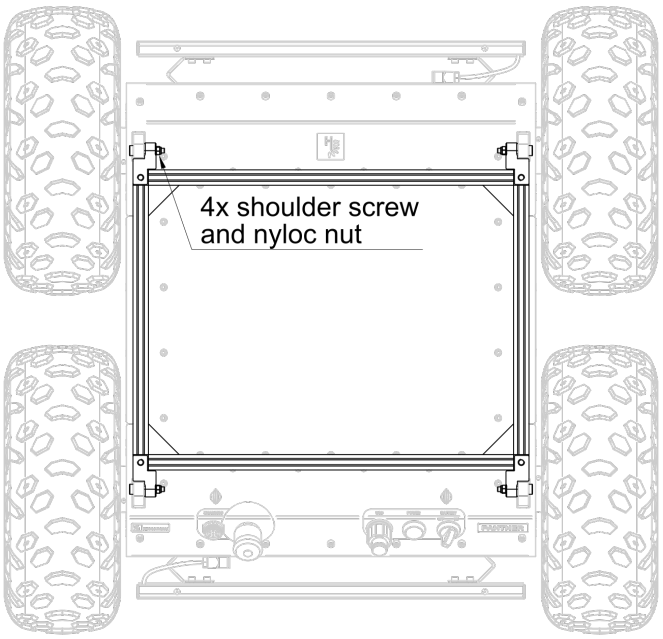
Mounting Rails

Sensors, equipment, and payloads can be attached to the profiles on top of the robot. The profiles used are aluminum V-slot 2020 profiles. The best way to attach the elements to them is to use mounting elements dedicated to this type of profile, such as T-nuts, fittings, and angles.

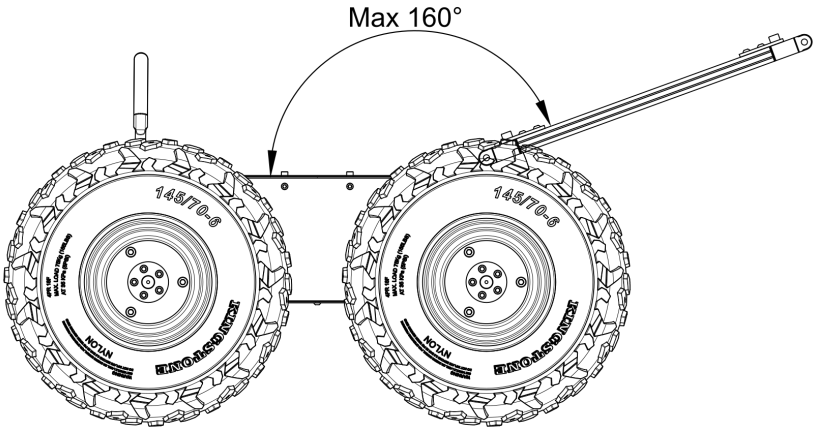




These profiles are fixed to the robot with four ISO 7379 M6x30 shoulder screws with DIN 986 M6 nyloc nuts.



To enable access to the User Compartment, top rails can be pivoted by removing 2x shoulder screw M6x30 and 2x DIN 986 M6 nyloc nut in either the front or back. The maximum opening angle is 160 degrees with the built-in stop.



For more useful information in the field of mechanics, please see the document Panther Overall Dimensions and the chapter CAD models.

> **INFO**
>
> The presence of the Mounting Rails has no effect on the water and dust resistance of the robot.

Bumper Lights

The robot's Bumpers are made of a profile with the same cross-section as the Mounting Rails. They are 0.5 meters wide, and, in addition to buffering shock and reducing potential damage when the robot collides with an obstacle at high speed, sensors can be mounted to them. By default, the signaling lighting is mounted on each Bumper in the form of aluminum profiles with 46 programmable RGB LEDs.

These lights may be widely used to indicate the status of the robot, the direction of movement or the intention to change direction, warn about low Battery charge or other detected errors, signal the status of the charging process, or even to illuminate the area in front of the robot. More details regarding Bumper Lights and their control are available in the section Panther Lights.

User Compartment

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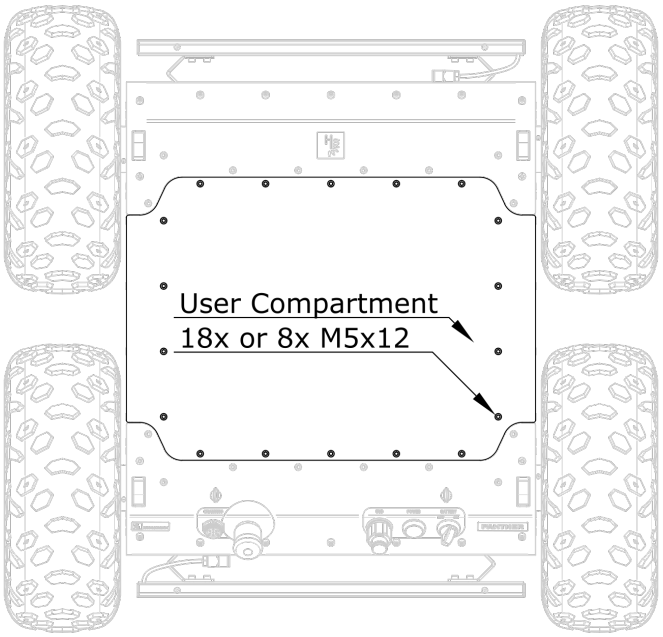
The robot's volume has been divided into five parts. The central space, called the User Compartment, is dedicated to the user's components and electronics. The User Computer (for example, PC02 from Panther Options), the RUTX11 router, as well as the robot's Battery are located there.

Access to the User Compartment

To access the User Compartment, pivot the Mounting Rails by removing 2x ISO 7379 M6x30 shoulder screws with DIN 986 M6 nyloc nuts. Then unscrew the Cover fastened with 8x (IP54) or 18x (IP66) bolts DIN912 M5x12.

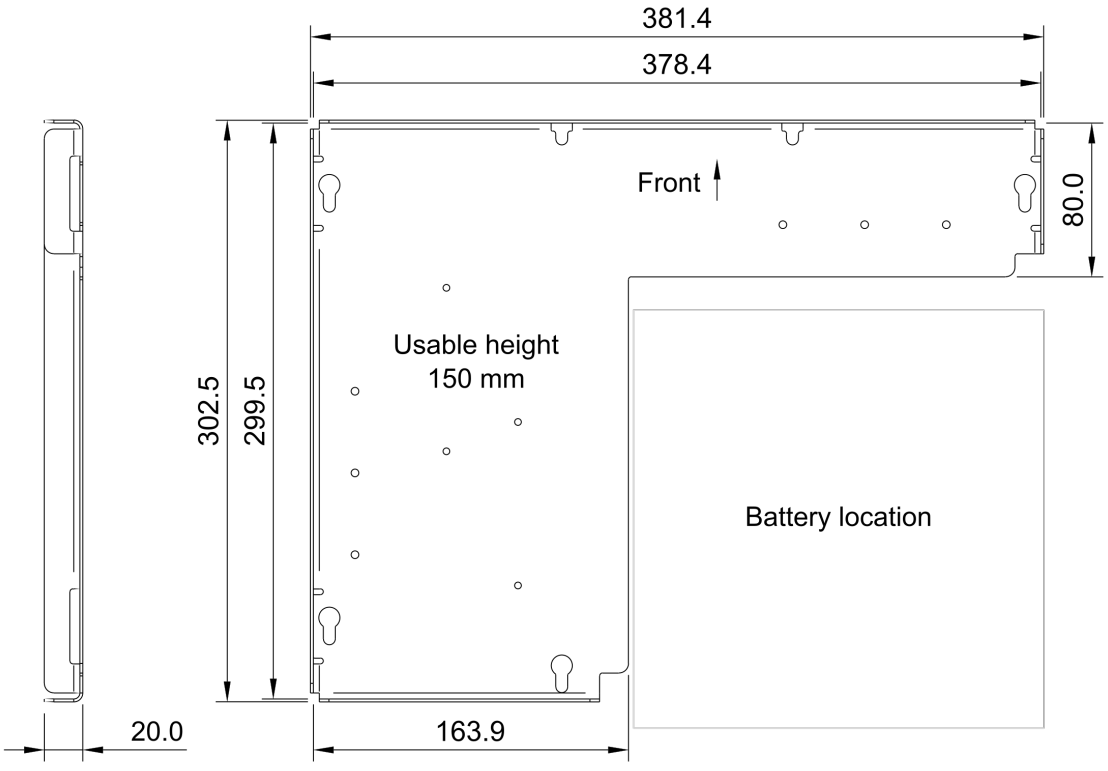


CAUTION

To ensure the tightness of the robot, make sure that there are no foreign objects on the seal when assembling the skin element and tighten the bolts with a torque of **4 - 5 Nm**.

User Shelf

The volume of the User Compartment is approximately 13.6 liters (3.6 US gallons) with the BAT01 option or 10.0 liters (2.6 US gallons) with the BAT02 option. This part of the robot has the same water and dust tightness class as the robot. At the bottom of this volume is an easily removable User Shelf to which devices located in this space are attached, excluding the Battery.



The usable space above the User Shelf is 150 mm high. The top surface of the BAT01 Battery module is 72.5 mm above the User Shelf. The

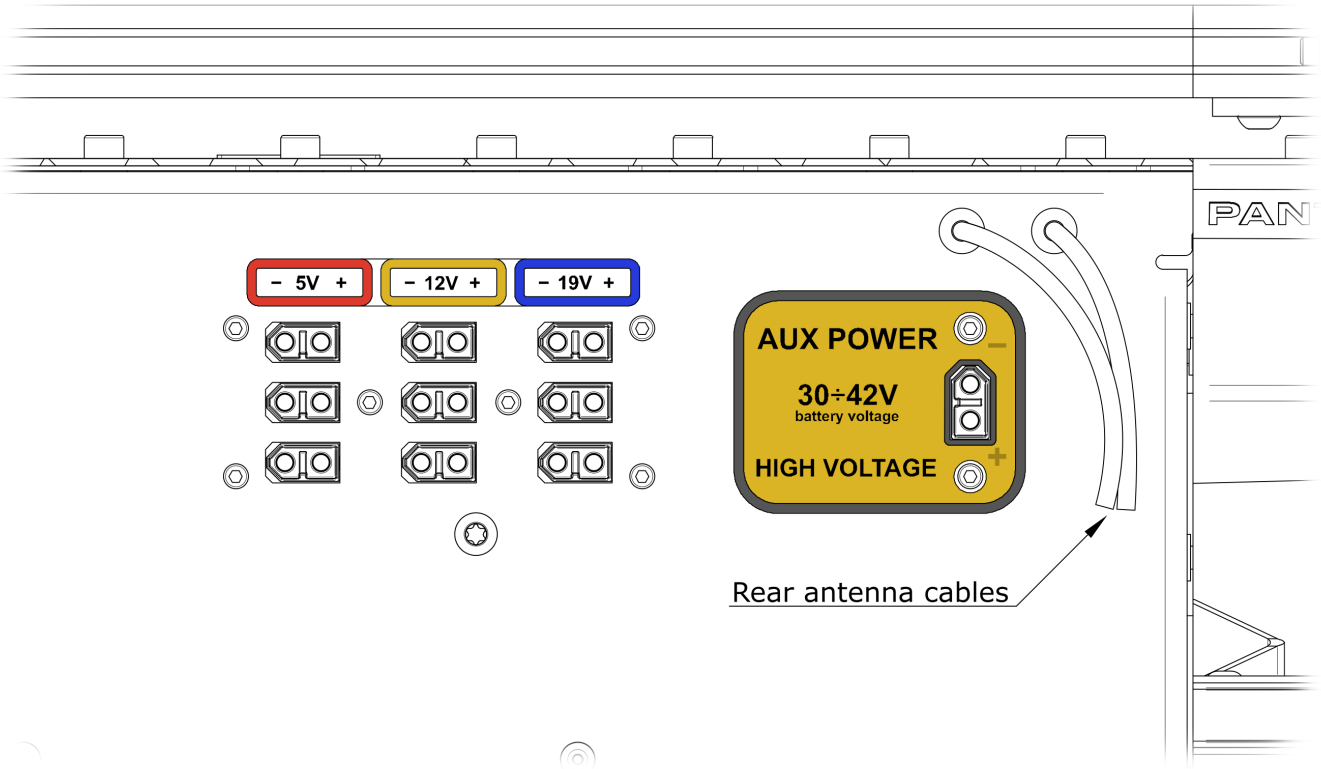
usable space above this Battery is 77.5 mm high. There is no usable space above the Battery when the BAT02 is mounted.

To remove the User Shelf, loosen the DIN912 M5x12 bolts located around its perimeter and move the User Shelf towards the back of the robot, then lift it up. When planning to place components on the User Shelf, keep clearance around the heads of the mounting bolts to allow the User Shelf to be pushed back into place later. Usually, 4 out of 6 bolts are enough to fix the User Shelf properly.

On the front and rear walls of this User Compartment, above the User Shelf, there are connectors that provide power and allow the user to communicate with the robot.

User Power Panel

The User Power Panel distributes electric power for user applications. The image below shows its labels and arrangement:



To meet the user's needs, the robot is equipped with 10 high-current electrical connectors that are able to provide up to 720 W of electrical power to the user's devices. The supply voltages available on the User Power Panel are:

- **5 V** limited to 15 A (3x female XT60),
- **12 V** limited to 25 A (3x female XT60),
- **19 V** limited to 10 A (3x female XT60).
- **AUX Power** which is the Battery voltage (32 - 42 V) rated at 10 A max. This output is **disabled by default**. AUX Power can be enabled and disabled separately from the Built-in Computer via ROS (Service `/panther/hardware/aux_power_enable`). See section Panther ROS for more details.

TOTAL POWER OUTPUT

The total power from 5 V, 12 V, and 19 V outputs is limited to 360 W of power.

USED CONNECTORS

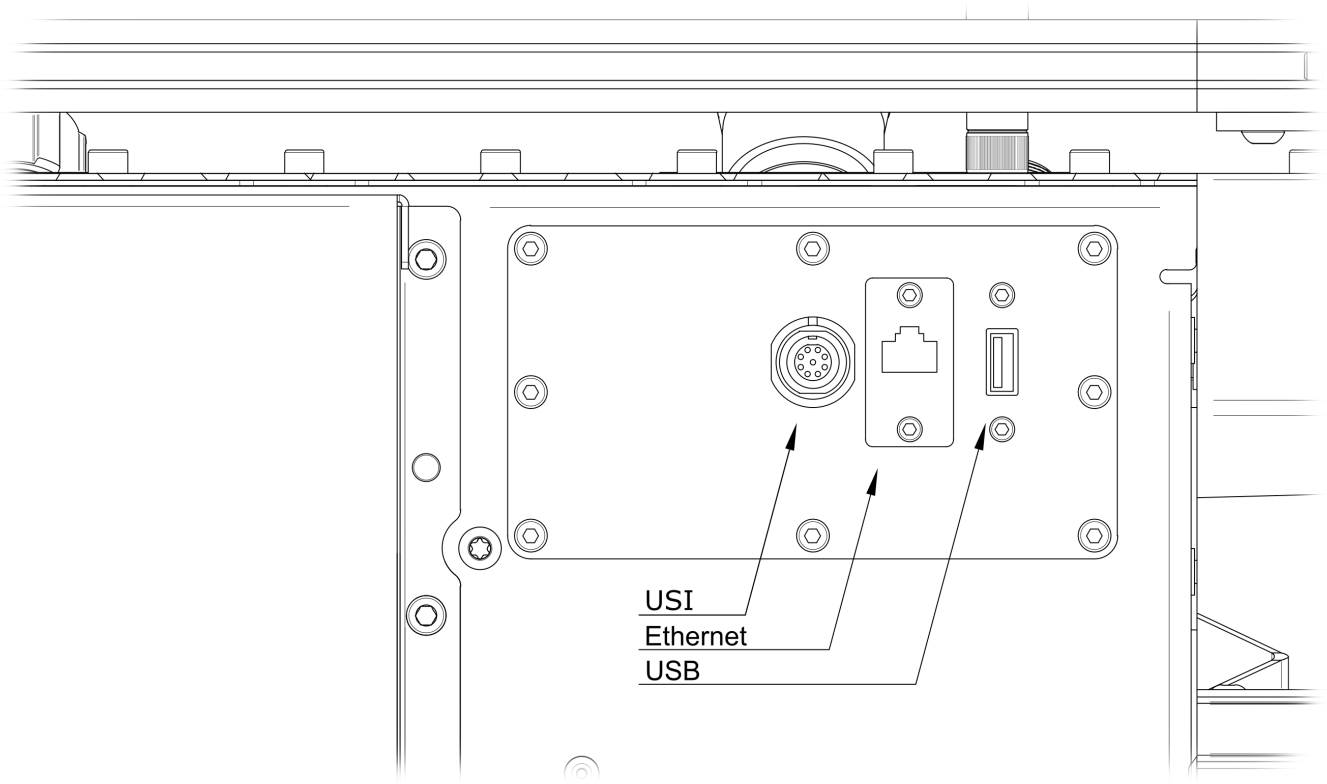
One 19 V output is used by an optional User Computer and one 12 V output is used by a Router.

ANTENNAS CONFIGURATION

These coaxial antenna cables are only present with the ANT01 option. In the ANT02 option, these wires are absent. Read more about Panther Options.

Communication Panel

On the Rear Panel, there are sockets for connecting the Battery and communication with the robot. By default, there are Ethernet and USB connectors for the Built-in Computer and the User Safety Interface (USI) connected to the Emergency Management:



Service Spaces

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The four remaining spaces around the User Compartment are intended for the internal components of the robot and some elements of the additional option sets. In this case, the relevant information can be found in the description of the given option in Panther Options.

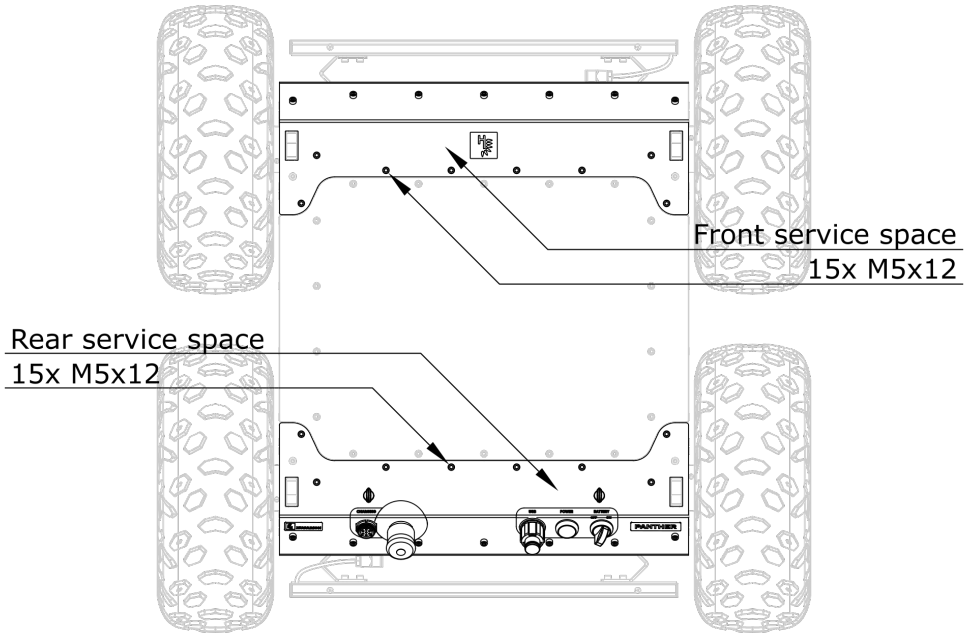
NO NEED TO ENTER SERVICE SPACE

It is usually not necessary for the user to access those spaces. Opening them is mainly meant for service work.

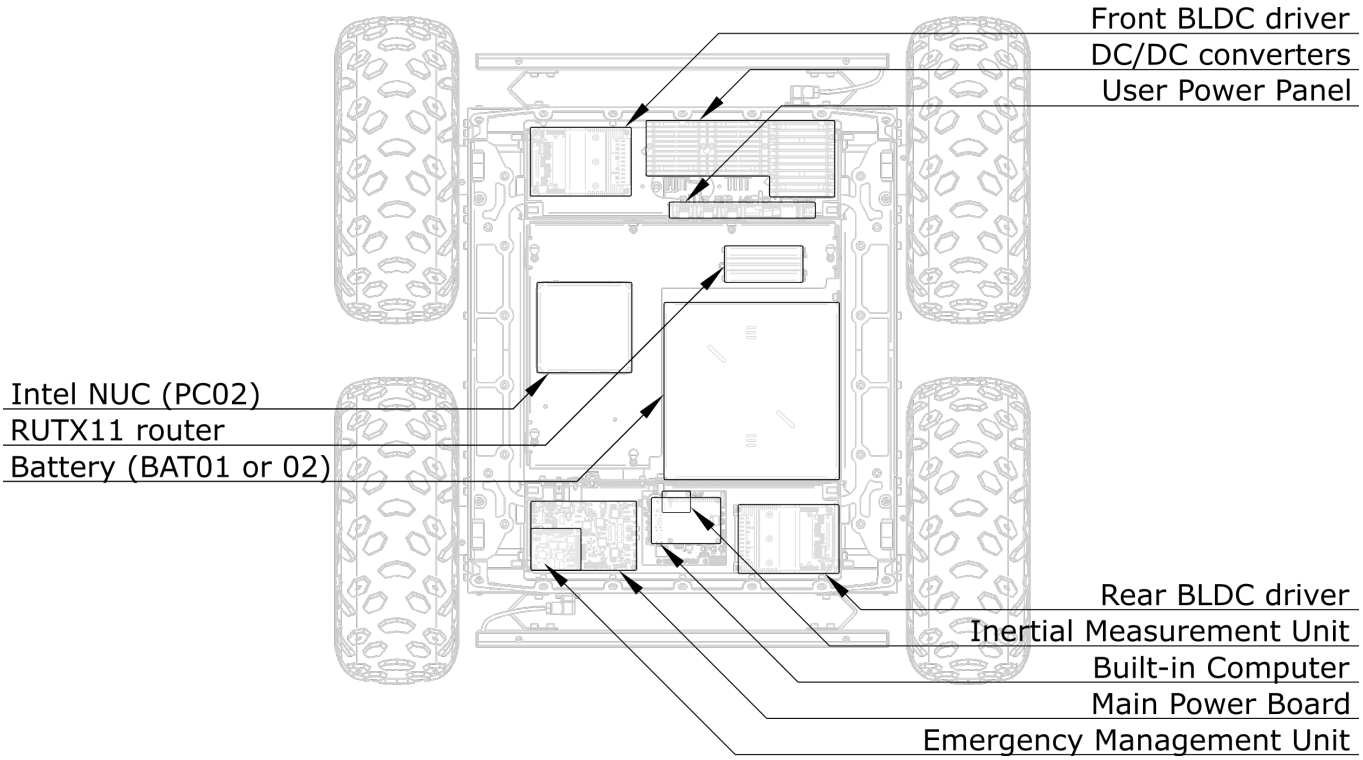
Access to the Front and Rear Service Spaces

The Front and Rear Service Spaces are occupied by motors and built-in electronics.

To access the components in the Service Spaces, pivot the Mounting Rails by removing 2x ISO 7379 M6x30 shoulder screws with DIN 986 M6 nyloc nuts. Then unscrew the Front Deck (with the Husarion logo) or the Rear Deck (with the Emergency Button). Each is fastened with 15x DIN912 M5x12.



Under the Front Deck, you will find among others standard power converters (5 V, 12 V, 19 V), distribution of higher voltages for the user, high voltage converter (24 V / 48 V) connection, front motor controller, and the Fan connection. Under the Rear Deck, you will find among others a Battery connector, the Built-in Computer with its microSD card, the Bumper Lights driver, the Power Board, the Charging Socket line and Rear Panel buttons connections, the rear motor driver, and antenna connections.



Access to the Side Service Spaces

Stringers (the structural elements located on the sides of the robot) also contain subassemblies.

To access these spaces, it is necessary to remove the wheels on the relevant side. Read more about removing wheels in the article Panther WH03 - Wheel Swap. Then you need to remove the Side Cover which is fastened with 12x bolts DIN912 M5x16.

By default, the Right Stringer has the Fan used for forced air circulation inside the robot (the Fan can be controlled via ROS service `/panther/hardware/fan_enable`). There are also cable harnesses in both Stringers. For some of Panther's options, additional equipment

may be installed in these spaces. In such cases, the necessary information can be found in the description of the option in the article Panther Options.

CAUTION

To ensure the tightness of the robot, make sure that there are no foreign objects on the seal when assembling the skin element and tighten the bolts with a torque of **4 - 5 Nm**.

CAD Models

To facilitate the work with the project based on the Panther platform, we have prepared CAD models for download in three extension formats:

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	STEP HQ	STEP LQ	F3D	online model
Pth v1.2x	zip	zip	zip	Online model

MODEL COMPATIBILITY

These CAD models are applicable to **Panther v1.2/v1.21/v1.22** robot revisions.

Software Guide

Panther is equipped with a Raspberry Pi 4 (Built-in Computer) running a custom Ubuntu-based OS with everything needed for ROS. Each Panther robot includes a microSD card with this OS, which contains drivers for all components.

The primary way to interact with Panther's hardware is via the Robot Operating System (ROS), with all drivers written in ROS. You can find the source code in the GitHub repository husarion/panther_ros. The robot supports both ROS and ROS 2, with similar APIs and behavior.

ROS

ROS is a set of software libraries and tools for building robot applications, offering a common framework for development. It is open-source, making it free to use and modify.

Software Resources

ROS **ROS 2**

- ROS 2 API - Learn about the robot API.
- Robot Management and Configuration - Tools and information for robot configuration during development.
- ROS 2 Packages Overview - Detailed information on individual packages.

By default, Panther ROS is deployed using Docker, which simplifies deployment, management, and updates of the ROS system. While the default setup is within a Docker container, you can run Panther ROS drivers natively. Instructions are available on the panther_ros GitHub page.

AUTOSTART NATIVE ROS DRIVER

Natively built ROS packages do not include autostart functionality. Users need to add it, for example, by creating a systemd service.

The provided Panther ROS system is designed to compose all the basic functionalities of the robot. It allows to control of the robot with

velocity commands and provides the user with odometry information, which can be used for robot localization. The Panther ROS system is also designed to monitor the robot's state and perform safety features that will prevent any hazardous behavior. The basic states of the robot are represented by the Bumper Lights signals. This allows the user to recognize if the robot is ready to operate or in E-stop mode, informs about the Battery state, or displays an animation indicating the occurrence of an error in the system. More detailed information about the state of the robot can be acquired using ROS topics. Errors in the system are also logged into the system and can be easily accessed using the Docker interface. The Panther ROS system includes a robot description, which can be used to visualize the robot with all its components.

The Panther ROS system is designed to be easy to use and maintain. It is also designed to be extensible so that it can be easily customized for different applications.

Network

By default the network mask is `255.255.255.0` and the devices' IPs begin with `10.15.20.XX`. The default static IPs are:

- RUTX11 `10.15.20.1` - an internal router with an access point and a DHCP server,
- Built-in Computer `10.15.20.2` - a SBC with Panther's driver,
- Additional: User Computer `10.15.20.3` - look at Computer (PC),
- Additional: a manipulator `10.15.20.4` - look at Manipulators (MAN).

More information about User Computer network settings can be found here.

Overview

Panther is equipped with a Teltonika RUTX11 router running open-source firmware OpenWRT, which provide the following interfaces:

Ethernet

- 1x WAN 10/100/1000 Mbps (by default configured as a LAN port)
- 3x LAN 10/100/1000 Mbps
- 3 ports are available for user equipment

Wireless

- Two radios (2.4GHz and 5GHz)
- Support for 802.11ac (Wi-Fi 5) with link rate up to 867 Mbps, fast roaming with 802.11r
- Works as access point (AP) and/or as a client/station (STA)
- External antennas with 2 dBi gain

Cellular

- Dual-Sim with fail-over
- LTE (4G) Cat 6
- External antennas with 3dBi gain (Panther Options - ANT02)
- Support for exact frequency bands depends on your locale. By default we equip Panther with version suitable for shipping address. For more details go here.

GNSS

- Support for GPS, GLONASS, Galileo and BeiDou
- Integrated into ROS GNSS API
- 1Hz refresh rate
- CEP-50 of 2.5m
- External antenna (Panther Options - ANT02)

Each form of connectivity can be part of an automatic WAN fail-over in order to provide a continuous connection to external services. More information is available on the manufacturer site. Some RUTX11 configuration scripts are available on our GitHub repository.

Connecting to Panther's Hotspot

Panther provides a hotspot with a default SSID `Panther_<serial_number>` and `Panther_5G_<serial_number>` for 2.4GHz and 5GHz band respectively with password `husarion`.

> **QUICKSTART TUTORIAL**
> You can find a step-by-step tutorial on how to connect your Panther to Wi-Fi in Panther - quick start.

Connecting Panther to a Wi-Fi

Panther can be connected to Wi-Fi on the 2.4GHz or 5GHz band. It will be used as a WAN source and be prioritized over cellular connection. Single radio can act simultaneously as AP (access point) and STA (client).

By default, Panther scans for available networks and connects to the first one provided in the configuration file. In case of a low signal level or loss of signal, the next one on the list will chosen (if available). This behavior can be modified by the user.

> **SCANNING NETWORKS IN 5GHZ AP**
> Due to the limitation of the Wi-Fi chipset, it is not possible to scan for available networks, while providing AP on a 5GHz interface. It's advised to use 2.4GHz for WAN uplink. For more information, go to documentation on our GitHub repository

Remote Access

You can access your Panther over the Internet, from any place in the world. You can use the preinstalled Husarnet VPN service. To access your robot follow the steps from here.

Access to Router WebUI

By utilizing either the WebUI or SSH, you can effectively manage and configure your RUTX router. Further configuration details can be found in the Teltonika RUTX11 manual.

Method	Address	Username	Password
WebUI	10.15.20.1	admin	Husarion1
SSH	10.15.20.1	root	Husarion1

> **WEBUI AVAILABILITY**
> You have to be connected to Panther's network to access WebUI.

> **SECURITY PRECAUTIONS**
> For safety reasons it is strongly advised to **change the default password!**

Using a Cellular Connection

If your Panther is equipped with the (ANT02 option) it is possible to use the cellular connection with failover to a second SIM and priority of WLAN connection over cellular.

Installing a SIM Card(s)

First, open the Cover following instruction, then you can access Teltonika RUTX11 SIM slots, more detail here.

Configuration of SIM Slots

In the default configuration, each SIM slot is enabled with automatic APN and priority of WLAN connection over cellular. To change settings such as PIN code, custom APN, or CHAP/PAP authentication use router's WebUI, more detail here.

Resetting Router to Default Settings

In case of misconfiguration, it is possible to reset the router to working default settings (as shipped to you). To do it press and hold the reset button on powered on RUTX11 for at least 6 seconds. Signal strength LEDs indicate elapsed time. After all five LEDs are lit up, the reset button can be released. After automatic restart router is ready to be used again.

Safety

The robot has been equipped with solutions for the safe use of the equipment, both in the software and hardware layer.

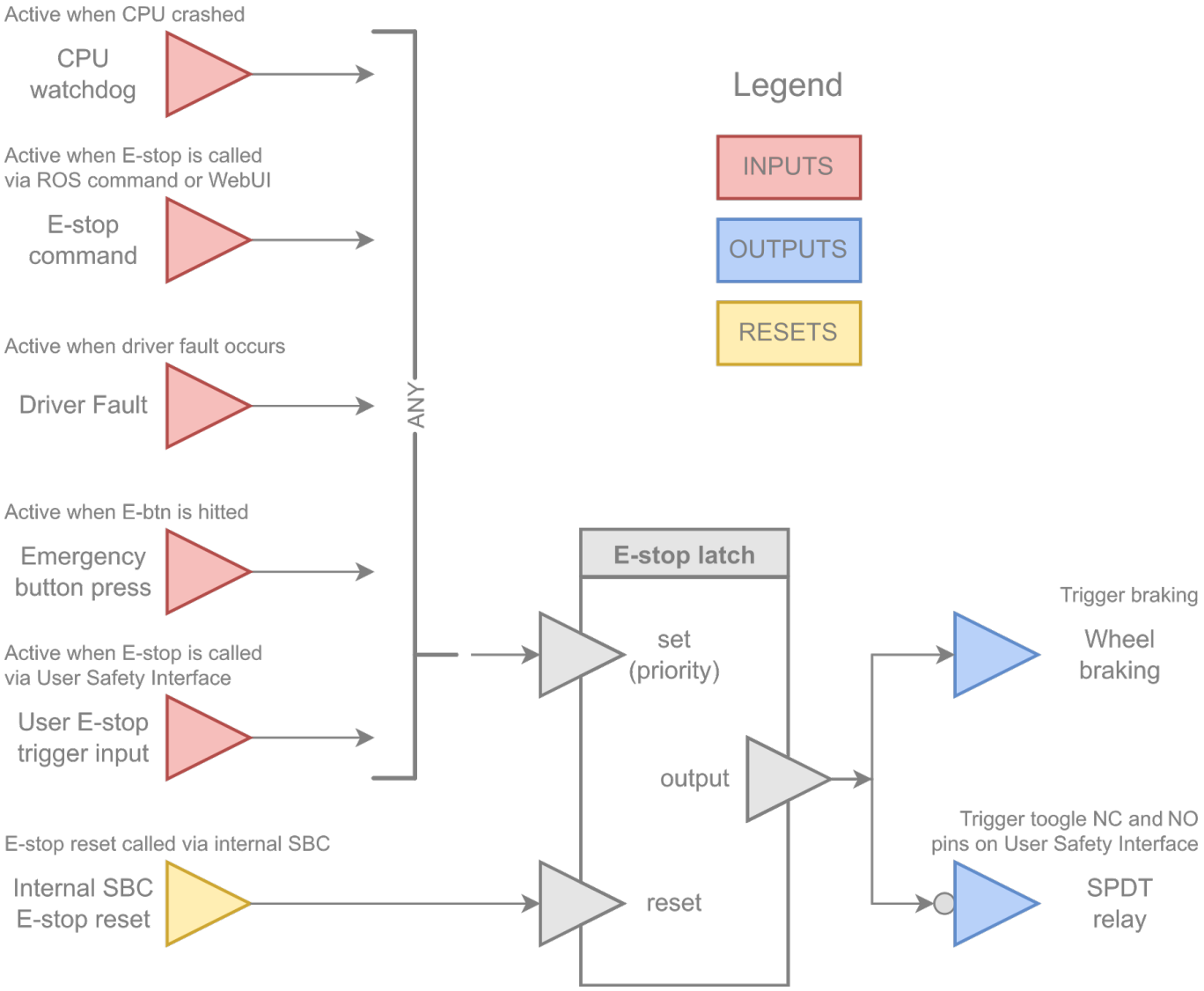
> **WARNING**
> Please take this chapter seriously. Inadequate and irresponsible using of the robot may cause damage to the device, the workplace, and people in the vicinity.

Panther v1.2 **Panther v1.0 - v1.06**

The robot is equipped with an Emergency Management (EMU). It is a system that takes control of the robot's components as well as its power in crisis situations. The EMU can stop the robot's movement, turn off the power of the user's device, or even turn off the entire robot if so configured. It also provides a dedicated electrical User Safety Interface (USI) led out to the User Space.

Due to the appearance of any trigger, such as a Built-in Computer's CPU crash or Emergency Button press, the EMU will call and latch the E-stop signal. This means that in such situations, for the further work of the robot, the problem should be resolved, and then the E-stop latch should be reset.

> **ADVANCED EMU CONFIGURATION**
> This chapter describes only the basic **default** EMU configuration, however, the system is configurable. To learn more about the possibilities and how to configure them, visit a separate article: Emergency Management Unit.



Hardware

Panther v1.2 **Panther v1.0 - v1.06**

Emergency Button

On the rear side of the robot, there is a red push button. Pushing the Emergency Button causes:

- activate the E-stop signal and latch it,
- actively brake the robot using motors,
- toggle a SPDT relay (external E-stop output).

ADVANCED EMU CONFIGURATION

These actions are the **default** EMU configuration. To learn more about the possibilities and how to configure it, visit a separate article: Emergency Management Unit

User Safety Interface (USI)

USI is an electrical hardware interface for EMU designed to integrate Panther with the user's equipment. This thread is covered in detail in the Emergency Management article in the chapter User Safety Interface.

Transporting Panther

Panther is shipped in a wooden box for two reasons: to protect the robot itself, and to comply with transportation safety regulations for

batteries. Li-Ion batteries with a capacity of over 100 Wh are considered dangerous goods. As long as the product with such a battery is properly packaged and marked, it can be transported by various means, including air transport.

If you consider transporting Panther to a remote location, we recommend that you keep the wooden box with the UN3481 marking and Class 9 (batteries) symbol. You will also need to confirm with your carrier that you are working with dangerous goods. For more details, please contact us on support@husarion.com

Before shipping, disarm Panther by setting all switches to the OFF position and pressing the Emergency Button. Also, the Battery charge level should be below 30% (35V). The tires pressure shall be about 1.5 bar for air transportation and 1 bar for ground/sea transport.

Docs and links

All helpful documents and links in one place:

Panther v1.2 **Panther v1.0 - v1.06**

- Safety Instructions - to avoid malfunctioning or damaging your Panther, please read this safety manual before use
- Panther Schematic Block Diagram - basic robot components and connections between them
- Panther Overall Dimensions - three basic projections of the platform in all wheel options

- Panther Power Consumption and Run Time - description of Panther power consumption and run time in different working conditions
- Panther WH03 - wheel swap manual - instructions for the WH03 package option, to swap between off-road and mecanum wheels
- Panther PC02 - installation manual - instructions for PC02 package option, to install User Computer
- Github Repository panther_ros - Packages with ROS hardware drivers of the Husarion Panther robot
- Github Repository panther_msgs - Custom ROS messages and services for Panther
- Docker Image panther-docker - Docker image with a Panther ROS package
- Docker Image panther-gazebo - Docker image with Panther simulation in Gazebo-classic
- Github Repository ros_components_description - URDF models of sensors and other components offered alongside Husarion robots
- Panther Troubleshooting - instructions for common issues.
- Teltonika RUTX11 Manual
- Teltonika RUTX11 Datasheet
- Panther Options

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