

From The Desk of The Robotsmiths

Thank you for your Husky A200 order! As part of the integration, we have prepared this quick reference sheet for you and your team detailing your specific package.

System Operational Tips

For best battery performance and life, it is advised that the batteries be charged regularly. The Lithium pack will indicate four "bars" of charge when full, and should be charged when only one bar is lit.

If the vehicle begins halting unexpectedly, doing one or more of the following may improve performance:

- Reducing motor power draw by lowering acceleration, turning in place less, or limiting the grade of terrain being traversed.
- Reducing peripheral power draw by unplugging or otherwise shutting off devices which are not in use.

Network Information

This Husky is configured to connect to the Base Station originally shipped with your Jackal robot. Before turning on the robot, the base station should be powered on and broadcasting. Once powered on, the robot will act as "bridge repeater" station, extending the base station's wifi signal. When connected to the base station, your computer will be given an IP address by DHCP.

The Base Station may be used as an Internet access point. Simply connect the WAN port on the bottom of the case to a live Internet connection, and any computers connected to the Base Station will be able to access the Internet. If you are having trouble with this function, please speak with your internet administrator. Your building may have safeguards in place to block unauthorized access points.

The Base Station IP address as shipped was **192.168.1.9**. Its login was **administrator/clearpath**.

The Axis PTZ camera is connected to the wider robot network. Therefore, the camera video feed is accessible separately from ROS by visiting its IP address from a web browser.

Parameter	Value
Microhard Radio IP	192.168.1.20
Microhard Radio login	admin/clearpath
Mini-ITX external IP	192.168.1.21
Mini-ITX internal IP (for communication with the Velodyne)	192.168.131.1
Mini-ITX hostname	cpr-uaf02-husky
Mini-ITX login	administrator/clearpath
Axis Camera IP	192.168.1.23
Axis Camera login	root/clearpath
Velodyne IP	192.168.131.201

Software Information

- All nonstandard ROS packages are located in `~/catkin_ws`.
- A custom repository has been created for your robot, located in `catkin_ws/src/uaf02_husky_customization`. It contains all of the custom urdfs and meshes required by your Husky to properly display in rviz. It is good practice to clone this repository into your own account for backup and development.
- This system is pre-configured to start a joystick interface node for teleoperation. At any time, the wireless gamepad may be used to drive the Husky. Hold the "X" button for fast mode or "A" for slow, and steer with the left analog stick.
- The hardware launch script will run on startup. It can be started in the background with `sudo service husky-core-start` and stopped with `sudo service husky-core stop`. It may be launched in the foreground using `sudo husky-core-start`. Your team should never need to start or stop the service—just use `roslaunch` to launch additional nodes which interface with the persistent ones. If you have to stop the service type `rostopic list` to make sure that all the nodes have been stop.

Remote Connection to Husky

For maximum compatibility, we recommend your ROS workstation be configured with ROS Indigo:

- Download and install Ubuntu Desktop 14.04 LTS from Ubuntu.com
- Set up ROS Indigo: <http://wiki.ros.org/indigo/Installation/Ubuntu>
- Install the Desktop packages for Husky:

```
$ sudo apt-get install ros-indigo-husky-desktop
```

To communicate directly with the Husky PC, you can SSH in. It will be necessary to ssh into the robot for tasks such as installing, modifying or removing software and files on the Husky. First turn on the base station, and after about a minute turn on the Husky. Note that you will not be able to use GUI tools such as rviz over an SSH connection. In this example, "Robot 1" is used:

```
$ ssh administrator@192.168.1.21
```

OR

```
$ ssh administrator@cpr-uaf02-husky
```

In order to use rviz and other visualization tools, you must declare the Husky as master. In a console, type:

```
$ export ROS_MASTER_URI=http://cpr-uaf02-husky:11311
```

You should then be able to view a list of topics published by the Husky with:

```
$ rostopic list
```

It will be necessary to declare the Husky as master in every new terminal window, unless you change the master permanently in your ROS environment variables. **If you are unable to connect with the Husky via its hostname**, your computer may not be routing hostnames properly. In Ubuntu on your local computer, open your /etc/hosts file:

```
$ sudo nano /etc/hosts
```

Add the following line immediately below the line that contains 127.0.1.1, substituting in the Husky's current wifi IP address. This address may be obtained by connecting directly to the Husky via Ethernet, and using the "ifconfig" command:

```
192.168.1.21      cpr-uaf02-husky
```

Example Usage

GPS

Verify that the GPS has a fix by checking the gps topic. Note that the “fix” topic will only publish when a valid fix is achieved (green light on the rear of the GPS receiver.) In the command prompt, type:

```
$ rostopic echo /gps/fix
```

To view the raw data from the GPS receiver, use the “nmea_sentence” topic instead:

```
$ rostopic echo /gps/nmea_sentence
```

Velodyne LIDAR

You may check that the LIDAR is publishing by using the hz command:

```
$ rostopic hz /velodyne_points
```

Axis Camera

You may view the camera feed from within ROS using the image_view utility:

```
$ rosrun image_view image_view image:=/axis/image_raw compressed
```

The pan-tilt-zoom function of the camera may be manually commanded with:

```
$ rostopic pub /axis/cmd axis_camera/Axis '{ brightness: 5000, pan: 100, tilt: 10,  
zoom: 0, autofocus: True }'
```

Visualizing the Husky in rviz

The Husky may be visualized using rviz. The Axis Camera and sensor arch meshes and transforms have been pre-loaded so that the data they produce is relative to their position on the robot. In order to properly display the meshes that represent your custom configuration, the uaf02_husky_customization package will need to be built on your local PC. The robot must be turned on.

1. First of create a catkin workspace on your local computer. In a command prompt:

```
$ mkdir -p ~/catkin_ws/src
$ cd ~/catkin_ws/src
$ catkin_init_workspace
$ cd ~/catkin_ws/
$ catkin_make
$ source devel/setup.bash
```

2. Then copy the uaf02_husky_customization directory from the robot into the workspace. For example using scp from your host machine, via ethernet:

```
$ scp -r
administrator@192.168.0.11:/home/administrator/catkin_ws/src/uaf02_husky_customization ~/catkin_ws/src
```

3. Build and source the workspace

```
$ cd ~/catkin_ws/
$ catkin_make
$ source devel/setup.bash
```

4. Install the husky_viz package, if not already installed:

```
$ sudo apt-get update
$ sudo apt-get install ros-indigo-husky-viz
```

5. Launch rviz

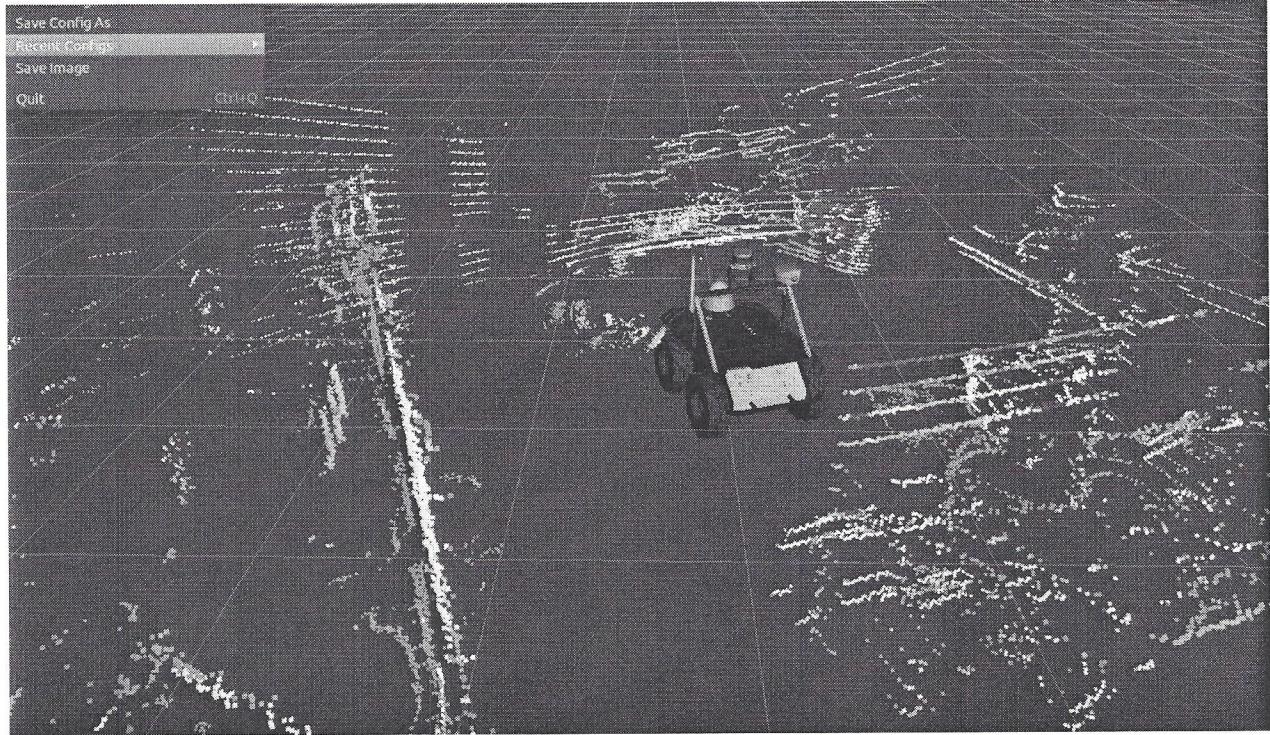
```
$ roslaunch husky_viz view_robot.launch
```

You can rotate the model using your cursor, and zoom in or out by scrolling up or down. Strafe by holding down Shift and dragging the model. The Husky itself may be driven directly from rviz by changing to interact mode. In this mode, arrows appear around the Husky model. Drag the arrows to make the Husky move.

The LIDAR data may be added to the rviz interface by clicking the "Add" button in the bottom left, selecting "By topic," then choosing the "PointCloud" topic from the list. You may also add camera feeds to the rviz interface.

More information on rviz is available here: <http://wiki.ros.org/rviz>

Information on husky_viz is available here: http://wiki.ros.org/husky_viz



Remote Tele-Operation

Full tele-operation of the Husky may be accomplished by installing the Husky core on your "base station" computer, and launching the teleop node in the command prompt:

```
$ sudo apt-get install ros-indigo-husky-robot  
$ roslaunch husky_bringup teleop.launch
```

With the wireless gamepad dongle plugged into your base station computer, it should be possible to drive the Husky remotely. You may remotely view the image from the Husky camera using ROS (we recommend the theora stream).

E-stop Breakout

Husky's internal e-stop loop has been extended to an e-stop breakout connector, located next to the user power connections on the top plate. A bypass plug was connected at time of shipping to allow the Husky to drive normally. To close the loop and allow the motors to drive, simply bridge the pins on the connector. The part number for this connector is Mouser 502-EN3C2M.

Note that opening the e-stop loop will only stop the Husky motors. All other payloads will continue to operate.

High Power Ports

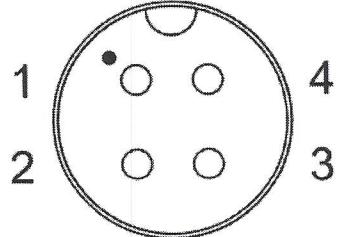
One high power ports (labelled "HPOWER") has been installed adjacent to the regular user power ports on the Husky top plate. It connects directly to the Husky battery, and is always on as long as the Charge Port Dongle is installed.

Top Plate Ports

Your Husky is equipped with several top-plate ports:

- 1 Velodyne Port; direct connection to the velodyne interface box.
- 1 Wifi Antenna port; direct connection to the wifi router via coax cable.
- 2 Ethernet Ports; direct connection to the wifi router via Ethernet.
- 1 Power over Ethernet (POE) port; used by the Axis camera.
- 1 USB 2.0 Port; direct connection to the Mini-ITX computer via USB. (Used by the Gamepad receiver)
- 2 USB 3.0 Ports; direct connection to the Mini-ITX computer via USB.
- 1 High power port; direct connection to Husky battery. Pin 1: +V, Pin 2: GND
- 1 E-Stop Breakout port; as described above.
- 1 GPS interface port; connected to the Mini-ITX via USB and to +24V.
- 2 Regular power ports; connected to Husky user power rails:

Husky power pinout, mating side of receptacle



- | |
|---------------------------|
| 1: +5V |
| 2: +12V |
| 3: +24V (battery voltage) |
| 4: Ground |

Mating connectors for the regular power ports and high power ports have been included with your Husky.

Shore Power Supply

To use the Shore Power Supply, remove the Charge Port Dongle and connect the Power Supply in its place. The Husky may now run indefinitely, as long as AC power is connected.

The Shore Power Supply is only intended for powering the Husky. It will not charge the internal battery pack.

Please note that although Husky will still be able to drive, the large inrush currents required by the motors may cause the Power Supply to brown out. We do not recommend driving Husky while using the Shore Power Supply.



Charging the Lithium Battery Packs

When it is time to charge Husky's batteries, turn off the power and remove the Charge Port Dongle. Connect the charger plug instead. Then, turn on the main charger power (switch on the power bar). The charger array charges each pack individually, so wait until all four chargers display a green light before disconnecting. An empty battery should charge in 3-4 hours.

For shipping purposes, a blank port cover was installed over the charge port. To drive Husky, please first install the Charge Port Dongle to connect the battery packs to the Husky power system.

Learning

If you are new to using ROS, please visit our support page for information on how to get started using your new Husky:

support.clearpathrobotics.com

Please contact our support team directly at support@clearpathrobotics.com if you have any questions that aren't answered on our support page. For ROS-specific questions, we recommend visiting answers.ros.org, which we also keep an eye on.

Sincerely,

The Robotsmiths