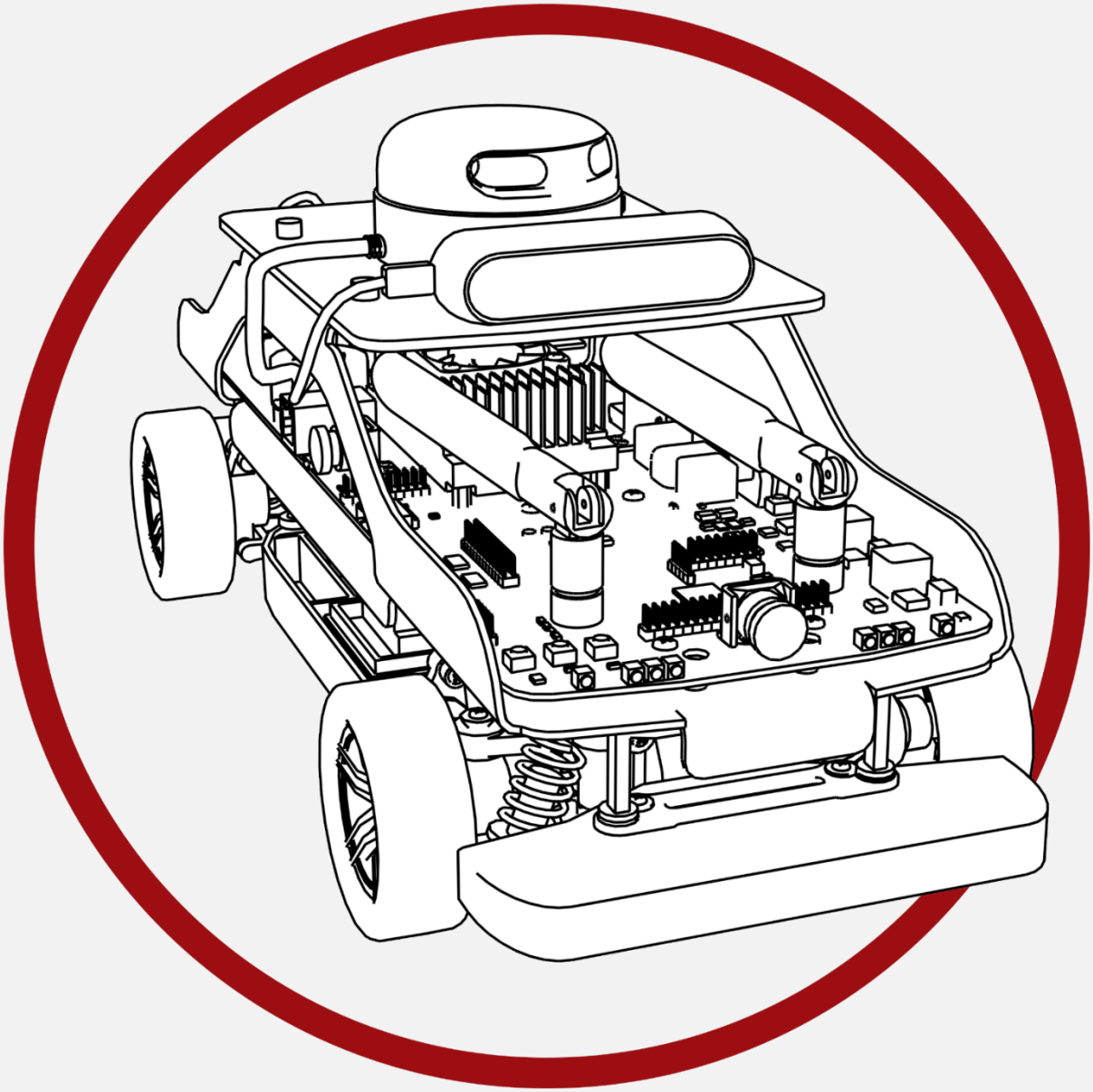
QUANSER
INNOVATE·EDUCATE



# SELF-DRIVING CAR STUDIO


Quanser Inc.
119 Spy Court
Markham, Ontario
L3R 5H6
Canada

info@quanser.com
Phone: 19059403575
Fax: 19059403576
Printed in Markham, Ontario.

For more information on the solutions Quanser Inc. offers, please visit the web site at:
http://www.quanser.com

Self-Driving Car Studio

# Instructor Guide

## Self-Driving Car Studio

Quanser's Self-Driving Car Studio contains curriculum designed to get students familiar with topics related to autonomous vehicles. Topics are intuitively subcategorized for convenience. Coding lab guides are developed in python and can be used with both a physical and virtual implementation of the QCar.

This equipment is designed to be used for educational and research purposes and is not intended for use by the public. The user is responsible to ensure that the equipment will be used by technically qualified personnel only.

## A. Getting Started

Depending on the configuration purchased for the Self-Driving Car Studio Table 1 is a summary of what is available.

| SDCS components | |
|---|---|
| **1** | QCar |
| **2** | Control Station and Infrastructure |
| **3** | Studio Maps |
| **4** | Studio Walls |
| **5** | Traffic Light |
| **6** | Infrastructure peripherals |

Table 1. SDCS Components

In the following sections we will be going through the steps necessary to set up the Self-Driving Car Studio and which documents to follow depending on the development environment you wish to use.

## B. Roadmap Setup

For the complete Self-Driving Car Research Studio 2 maps come with the complete studio. Figure and Figure describe the components and dimensions of the two maps.

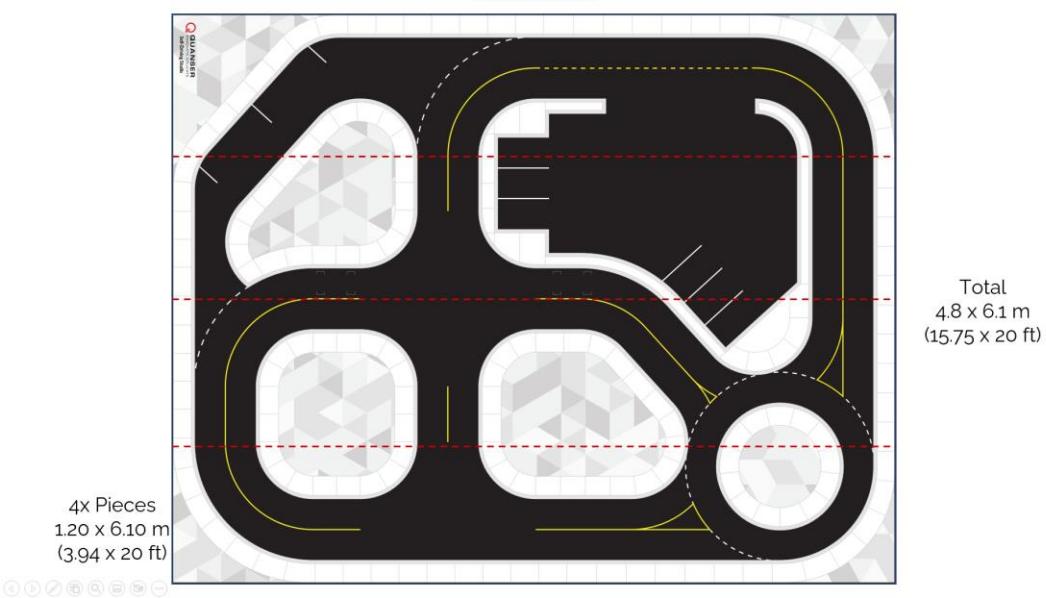



Figure 1: Large roadmap layout and dimensions

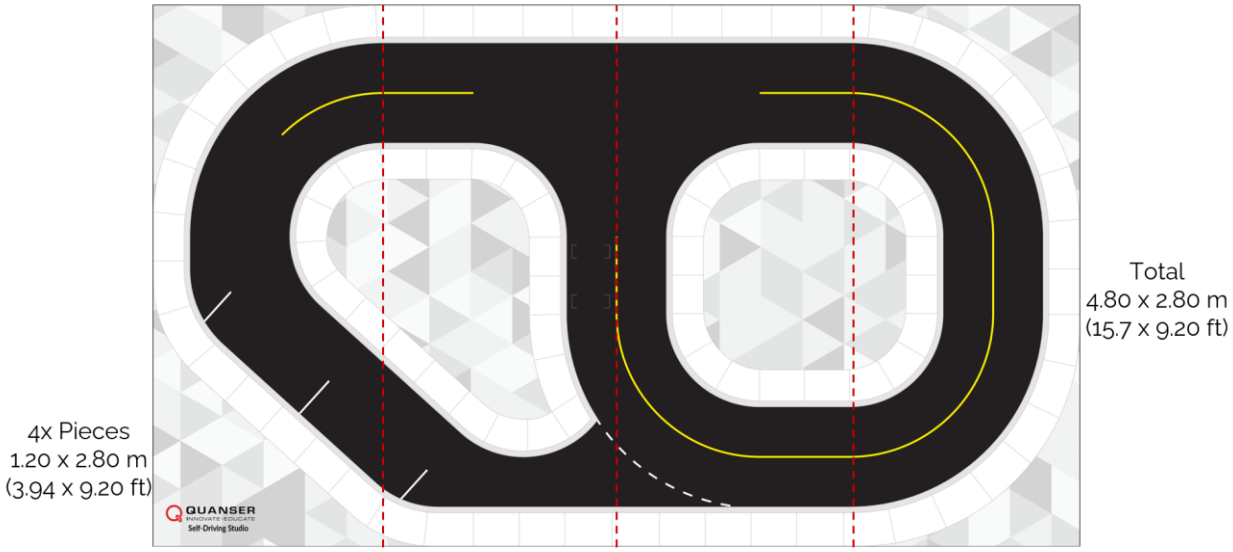



Figure 2: Small roadmap layout and dimensions

The studio also contains clear walls for setting up a consistent perimeter around the large or small roadmaps.

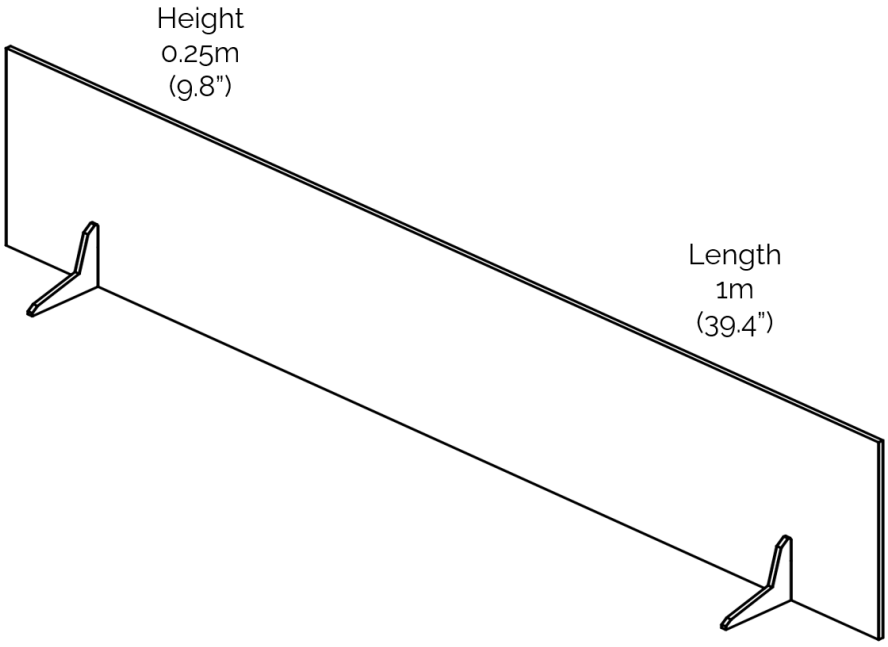



Figure 3: Studio walls dimensions

## C. Peripheral Set Up

The ground control station comes with:

- 3 monitors
- 1 PC w/ keyboard and mouse
- 1 High performance router

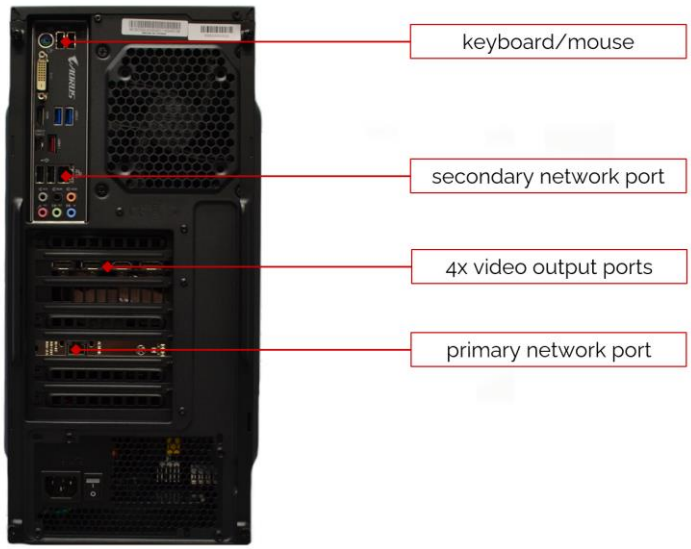



Figure 4: Self-Driving Car Studio PC peripheral inputs.

To wire the Self-Driving Research studio in this scenario please use Figure 4 as reference. Use the primary network port to connect the provided router. You may use the secondary network port available on the PC to connect any additional networks required by your institution. During the setup for the ground station, it is always recommended the user always have a full view of the workspace where the QCar will be operating, as shown in Figure 5.

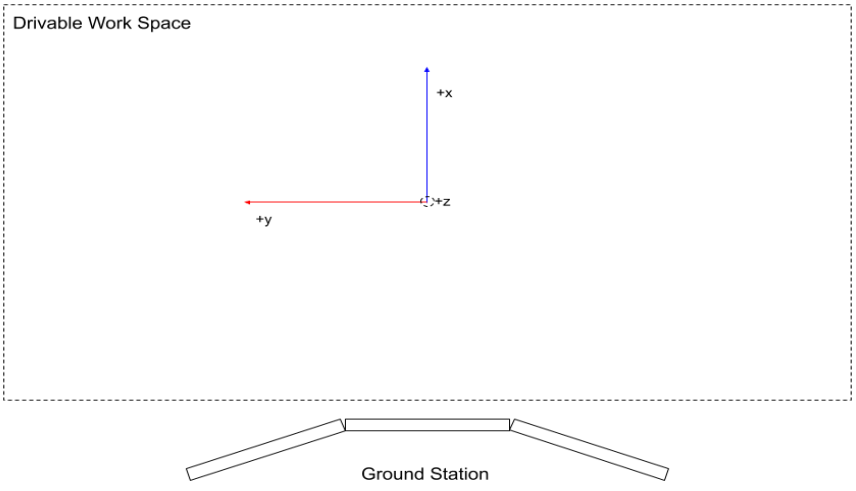



Figure 5: Recommended Self-Driving Car Research Studio layout

The QCar product comes with the following peripherals:

- LiPo battery charger
- LiPo 3300 mAh batteries
- Wall power supply

If you are planning on running the QCar for extended periods of time, please make sure the QCar is fully charged to ensure the best performance. For an in-depth explanation on how to use the QCar with either a battery or the provided power supply please review the **System Hardware** document found under the user guides for the Self-Driving Car Studio.

## D. Network Wiring Setup

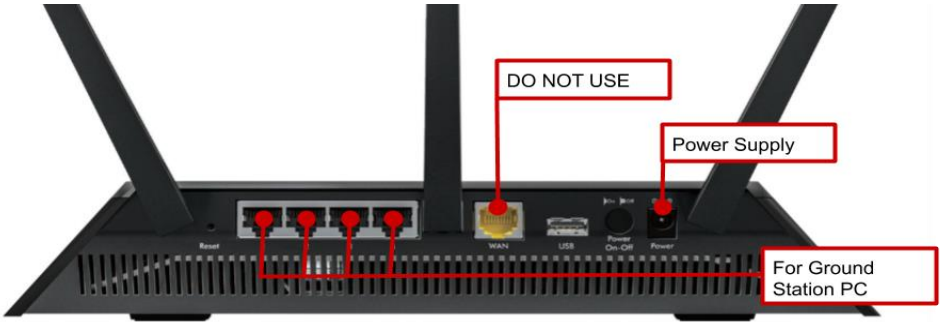
The Self-Driving Car Studio comes with a high-performance router. It is pre-configured to use both 2.4GHz and 5GHz bands for multiple PCs and autonomous vehicles. Figure 6 shows a general network connectivity map, where the QCars and provided Traffic Lights connect to the router on boot automatically using Wi-Fi.


Figure 6: Basic Network Connectivity Map for the Self-Driving Car Studio

a. provided router

b. router power supply

c. ethernet cable




d. wiring the router

Figure 7. Router parts and wiring

Set up sequence:

1. Connect the power supply (Figure 7b) provided with the router to the power port on the back of the router (Figure 7d).
2. Connect the ground control station PC to the router by using the provided ethernet cable (Figure 7c) and one of the four ports on the back of the router labelled 1 to 4 (Figure 7d).

**Note: DO NOT** use the yellow port labelled WAN to connect to the ground control station PC. This port is used to provide an internet connection to the router, which is not recommended, as the router is configured to optimize local traffic only.

3. Connect the other end of the ethernet cable directly into the ground control station PC using the Ethernet port at the bottom (the primary network port, see Figure 4).

**Note: DO NOT** use an ethernet switch or any other device between the router and the ground control station PC

Turn on the router. After a few minutes, the lights on the front of the router (Figure 7a) should start flashing with a white light to indicate to the user that the ports are active.

## E. Connectivity Test

Once the network wiring has been completed you can power on the QCar and use the ping test to confirm connectivity between the QCar and the Ground Station. In Figure 1 the connectivity test was done using the IPv4 address of the QCar which can be found on the LCD display,

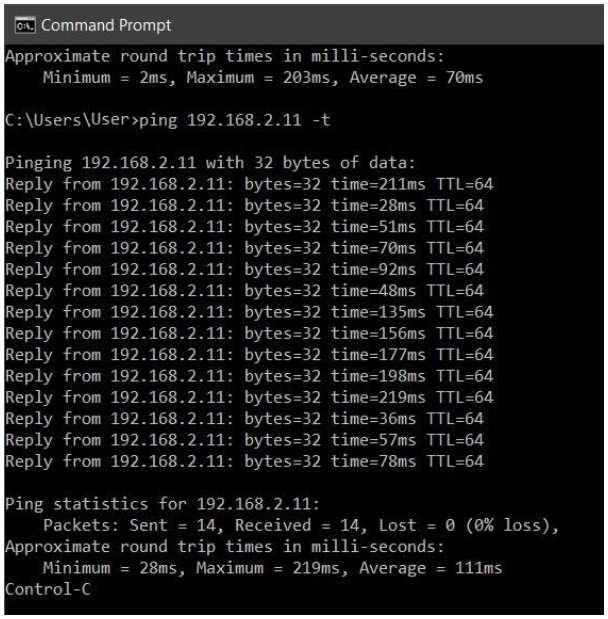



Figure 1: Sample ping test between PC and QCar using IPv4 address.

## F. Software

The Self Driving Car Studio includes a variety of research examples as well as teaching content. The teaching content is primarily focused on Python based labs accompanied with extensive Lab Guides. The research examples include numerous examples for MATLAB/Simulink, Python as well as ROS.

To ensure functionality for the QCars, try running the hardware tests (also included with the research examples). You can run the hardware tests in either MATLAB/Simulink or Python. Find more information on how to do this by navigating to the following location in your Quanser folder.

>> Quanser > examples > self_driving_car_studio > qcar > hardware_tests


Solutions for teaching and research. Made in Canada.