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Quanser Traffic Light

User Manual

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

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Caution

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 for ensuring that the equipment will be used by technically qualified personnel only. While the end-effector board provides connections for external user devices, users are responsible for certifying any modifications or additions they make to the default configuration.

Table of Contents

A. Overview

Quanser's Traffic Light, pictured in Figure 1, is a scaled down infrastructure device as part of Quanser's Self-Driving Car Studio (SDCS). The Quanser Traffic Light is designed to automatically connect to the provided SDCS router using the Quanser_UVS network. It can be controlled using a web server, Python or Simulink from a computer also in the Quanser_UVS network. The traffic light LEDs can be controlled simultaneously for additional status information as required by the user.

Figure 1. Quanser Traffic Light

Figure 2. Quanser Traffic Light Layout

ID	Component	ID	Component
1	Controllable LEDs	3	LED cover plate
2	Base	4	Micro USB power port

Table 1. Quanser Traffic Light Components

B. Configuration

The Quanser Traffic light can be modified in two ways:

- Orientation (landscape to portrait)
- LED cover color (black or yellow)

To modify the color of the LED cover plate, remove the Front Plate Support screws highlighted in Figure 3. To modify the orientation, slide the cover out from the traffic light pole and insert it back in a different orientation using the Orientation Clips. The LED cable might need to be disconnected and connected back after being set in its desired position.

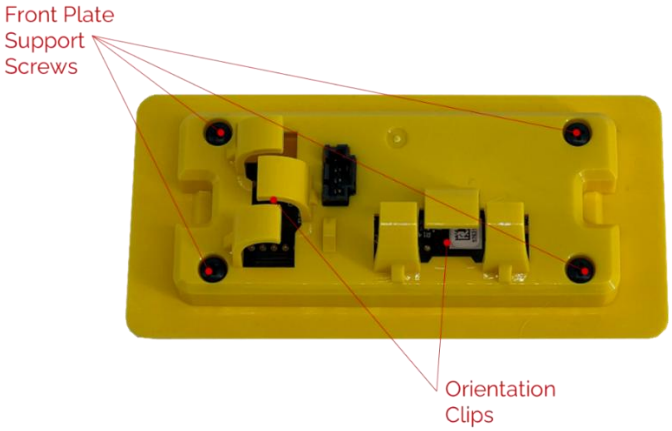
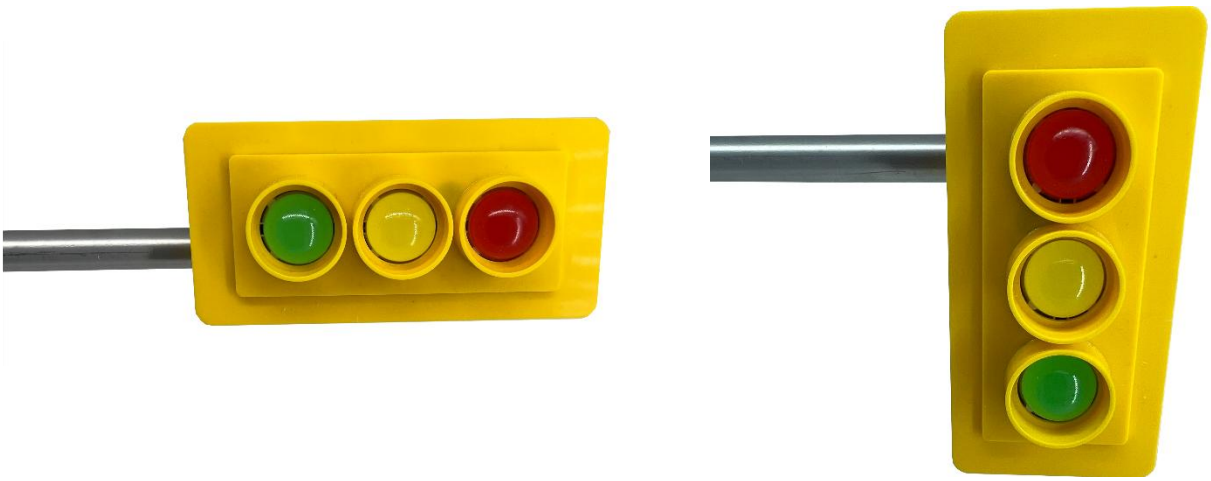


Figure 3. Traffic light cover plate components

Orientation Configurations

Use the orientation clips, shown in Figure 3, to modify the orientation of the traffic light. Use Figure 4 as reference.



a. Landscape traffic light orientation b. Portrait traffic light Orientation

Figure 4. Quanser traffic light supported orientations.

Color Configurations

Remove the front plate support screws shown in Figure 4, to change the color of the Quanser Traffic Light cover plate. The two options for the cover plate color are shown in Figure 5.

a. Yellow Front Plate

b. Black front plate

Figure 5. Quanser traffic light color combinations.

C. Power and Startup Sequence

Power Up

Connect the traffic light using the provided external power supply using the USB to magnetic cable. Snap the magnetic side into the back of the traffic light. The Out 1A port on the external power supply should be enough to power the traffic light as shown in Figure 6.

Figure 6. Power up connections for power supply

Startup Sequence

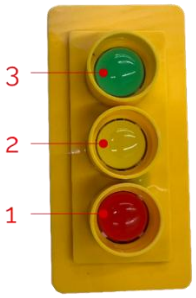


Figure 7. LED number conventions

Upon power up the LEDs of the traffic light will flash in the following sequence:

1. LED 2 (Yellow) will **pulse ON** to indicate power-up
2. LED **1**,2,3 (Red, Yellow, Green) will **flash ON** to indicate it has powered on successfully.
3. By default, the traffic is configured to connect to the **Quanser_UVS** network SSID. It will obtain an IPV4 address with the following structure **192.168.2.XXX**.
4. The LEDs on the traffic light will flash to indicate what the obtained IPV4 address is. The IPV4 address is broken down into 4 sections and the periods act as section dividers.

Sections A-D flash using LED 3, and LED 2 (Green and Yellow) using the following color convention:

   a. LED 3 will flash based on the individual number.
   b. LED 2 will flash once to designate a digit change.
   c. ***IF USING OLDER FIRMWARE*** **LED 1** will flash once to designate a section change.

E.g.: If Section **D** of the IPV4 address of the Quanser Traffic Light is **14** the LED sequence will be:

   a. LED 3 flash **ON** once
   b. LED 3 **OFF**, LED 2 flash **ON** once
   c. LED 3 flash **ON** 4 times

5. ***IF USING OLDER FIRMWARE*** **LED 1** will flash **ON** and **OFF** indicating the current section has finished and changed to a new section.

> ⚠ **Note**: If the Quanser Traffic Light has the **latest** firmware, and it is connected to the **Quanser_UVS** network, only the digits in section D will flash using the convention defined in step 4.

Troubleshooting

Note: If the traffic light is turned on and there is no IP address sequence flashing (All lights stay turned on) do the following sequence:

1. Make sure only one traffic light is on at a time. If another one is connected, it will make this process harder.
2. Login to the Quanser UVS router. To do this, use a PC and using a web browser, type the following in the bar at the top of your browser
    a. 192.168.2.1
    b. (Username: Admin, Password Quanser_123)
3. Check under the **connected devices** pane for the hostname **TRAFFICLIGHT**, an IPV4 address will match the traffic light currently turned on. Note this IP.
4. Use a command line tool such as PuTTY to connect to the traffic light using an SSH connection.
    a. Username: pi
    b. Password: raspberry
5. Rerun the file TrafficLight.py found at the root level directory using the following command: `python TrafficLight.py`
6. Wait for the Flask Server to start running and move to section D for sending commands to the traffic light.

D. Communication

Modes of Operation

The traffic light system operates in two distinct modes: **Serial** Mode and **Streaming** Mode.

Serial Mode enables direct control of the traffic light using asynchronous commands via a web API. In this mode, users can interact with the traffic light only through a web API or Python applications, executing functions to control the LEDs, set specific colors, or configure automatic or custom timed sequences.

Conversely, in Streaming Mode, the traffic light allows for real-time communication and control via Simulink or Python applications.

Serial Mode

It is recommended that when using Python. you use the Serial Mode

Note: Before running the Python example, ensure that the streaming connection is closed. You can do this by running the `'stop_stream.bat'` file.

In **Serial Mode**, users can control the traffic light's LEDs directly using Python functions. This mode allows you to perform a variety of operations such as checking the status of the lights, setting the traffic lights to automatic mode, manually turning on the Red, Yellow, or Green LEDs and cycle through LEDs at custom time provided.

For detailed information on how to use these functions and interact with the traffic light system, please refer to the `traffic_light_commands_example.py` file under examples/sdcs/traffic_light.

Note for using serial mode: if using the functions auto or timed more than once in the traffic light (e.g., every time the code starts) make sure to first call light.off() and do a sleep for the total amount of time the light cycle was supposed to last for. For auto that is 30+30+3. This will ensure that the cycle properly stops, if not, the traffic light might start flashing in unexpected ways. Another option is to just unplug and plug in the light again.

Streaming Mode

In **Streaming Mode**, users can control the traffic light in real time. This is the only Mode that supports control via MATLAB/Simulink. To initiate this mode:

1. Run the `'start_stream.bat'`
2. Enter the IP address of the traffic light when prompted and press enter

```
Enter the IP address (e.g., 192.168.2.3):
```

All 3 of the traffic light LEDs will flash once to indicate a successful change to Streaming Mode.

MATLAB/Simulink

You can now use the provided Simulink model `traffic_light_stream.slx` (in the examples directory) to control the traffic light, change its colors, and implement custom control logic within the Simulink environment.

Python

Users can enable **Streaming** mode and control the traffic light using **Python** by leveraging QUARC's Basic Stream API. This mode allows you to establish a streaming connection between your Python script and the traffic light, enabling real-time data exchange.

For detailed instructions on how to send color data to the traffic light using Python in Streaming Mode, please refer to the `TrafficLight_stream_example.py` file in the *examples/sdcs/traffic_light* directory.

To switch out of the Streaming mode, use the provided `'stop_stream.bat'` file.

Web API

Note: Before running, ensure that the streaming connection is closed. You can do this by running the `'stop_stream.bat'` file.

On a PC connected to the Quanser_UVS network type the following in the address bar:

```
http://192.168.2.XXX:5000
```

A successful response will show:

I'm a light at 192.168.2.XXX:5000

You can use the following commands in your web browser to control the traffic light:

1. Check Status:
   ```
   http://192.168.2.XXX:5000/status
   ```
2. Automatic Mode (if running this more than once, first use immediate and wait for the total amount of time originally set before using it again):
   ```
   http://192.168.2.XXX:5000/timed/0/0/0
   ```
3. Set Immediate Color:
   ```
   http://192.168.2.XXX:5000/immediate/{color}
   ```
   Replace `{color}` with one of the following:
   - red
   - yellow
   - green
4. Set Timed Colors:
   ```
   http://192.168.2.XXX:5000/timed/{redT}/{yellowT}/{greenT}
   ```
   Replace {redT}, {yellowT}, and {greenT} with the desired time duration for each color (in seconds).

   For example, for 5 seconds in red, 2 in yellow and 10 in green, use:
   ```
   http://192.168.2.XXX:5000/timed/5/2/10
   ```

F. Specifications

The battery bank at full charge the operating

Battery Life (h)	$8h$

Table 2. Traffic Light Battery life
[+]durations tested at room temperature

G. Environmental

The Traffic Light is designed to function under the following environmental conditions:

- Indoor use only
- Atmospheric conditions
  - Temperature - 15°C to 35°C
  - Altitude - up to 2000 m
  - Relative humidity - 30% to 60%
  - Air Pressure – 86 kPa (860 mbar) – 106 kPa (1060 mbar)

H. Electrical Considerations

Caution The Quanser Traffic Light is not waterproof.

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