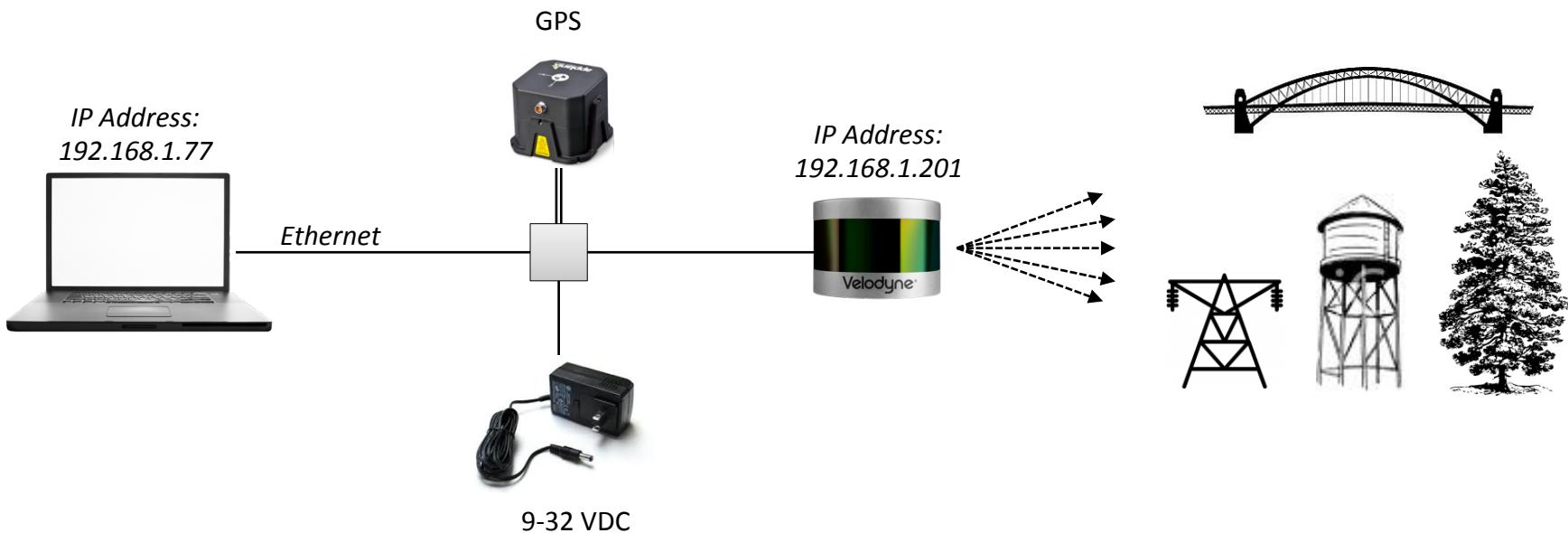


Velodyne® LiDAR

Webserver User Guide VLP-16 & HDL-32E



Basic Sensor Setup



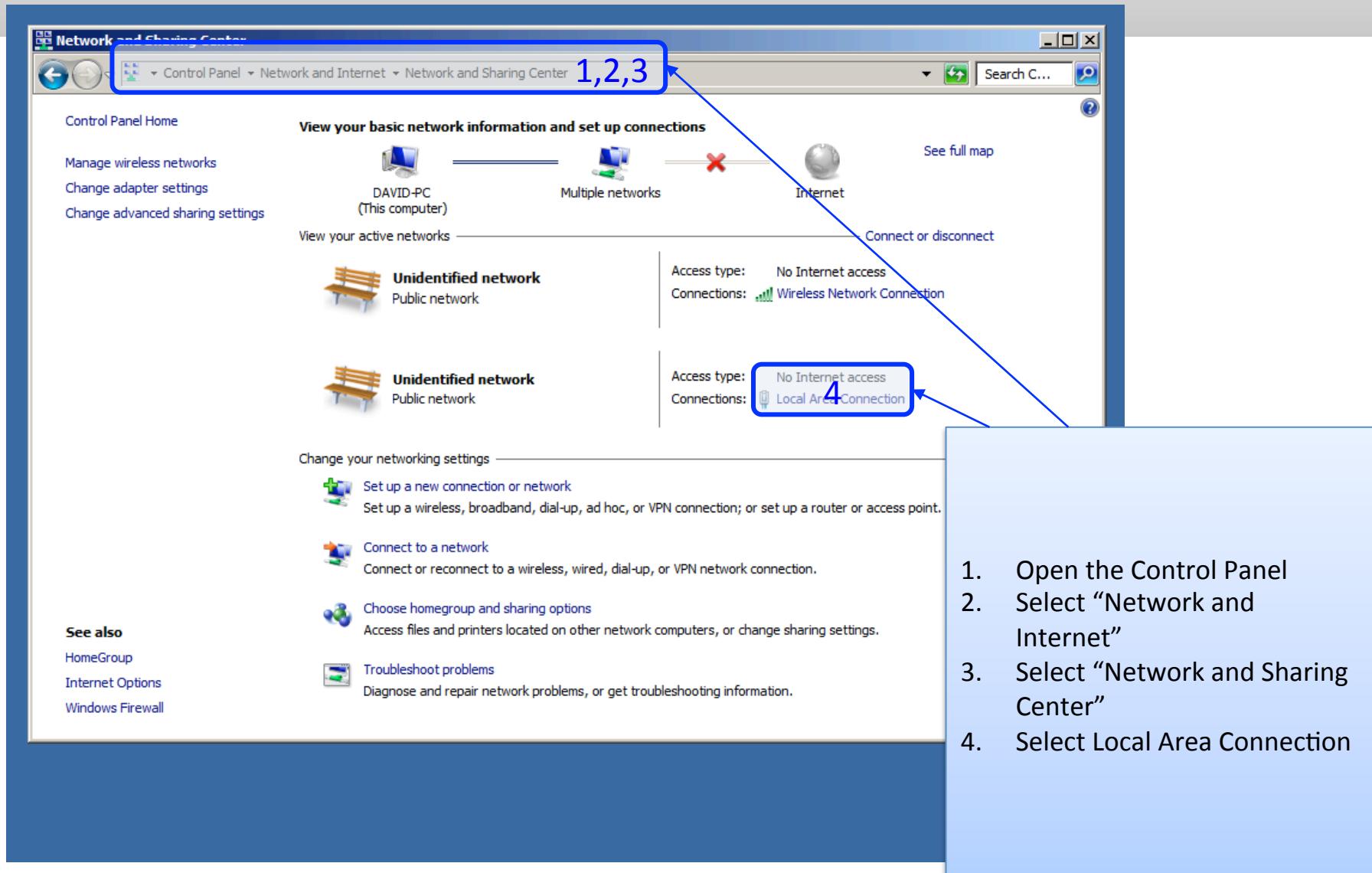
Setting up the computer to communicate with the sensor

- Connect the computer to the interface box with an Ethernet Cable
 - A GPS connection is not necessary at this point.
- Apply power to the sensor.
- For now, disable the WiFi connection on your computer.
- Configure your computer's IP address on its Ethernet port to manual mode.
- Set your computer's IP address to 192.168.1.77
 - “77” can be anything except 0,255, or 201
- Set the subnet mask to 255.255.255.0
- Pull up the sensor's webserver interface by typing the sensor's network address, 192.168.1.201, into the address bar in your web browser.

Configure the Ethernet connection on your computer (Windows 7)

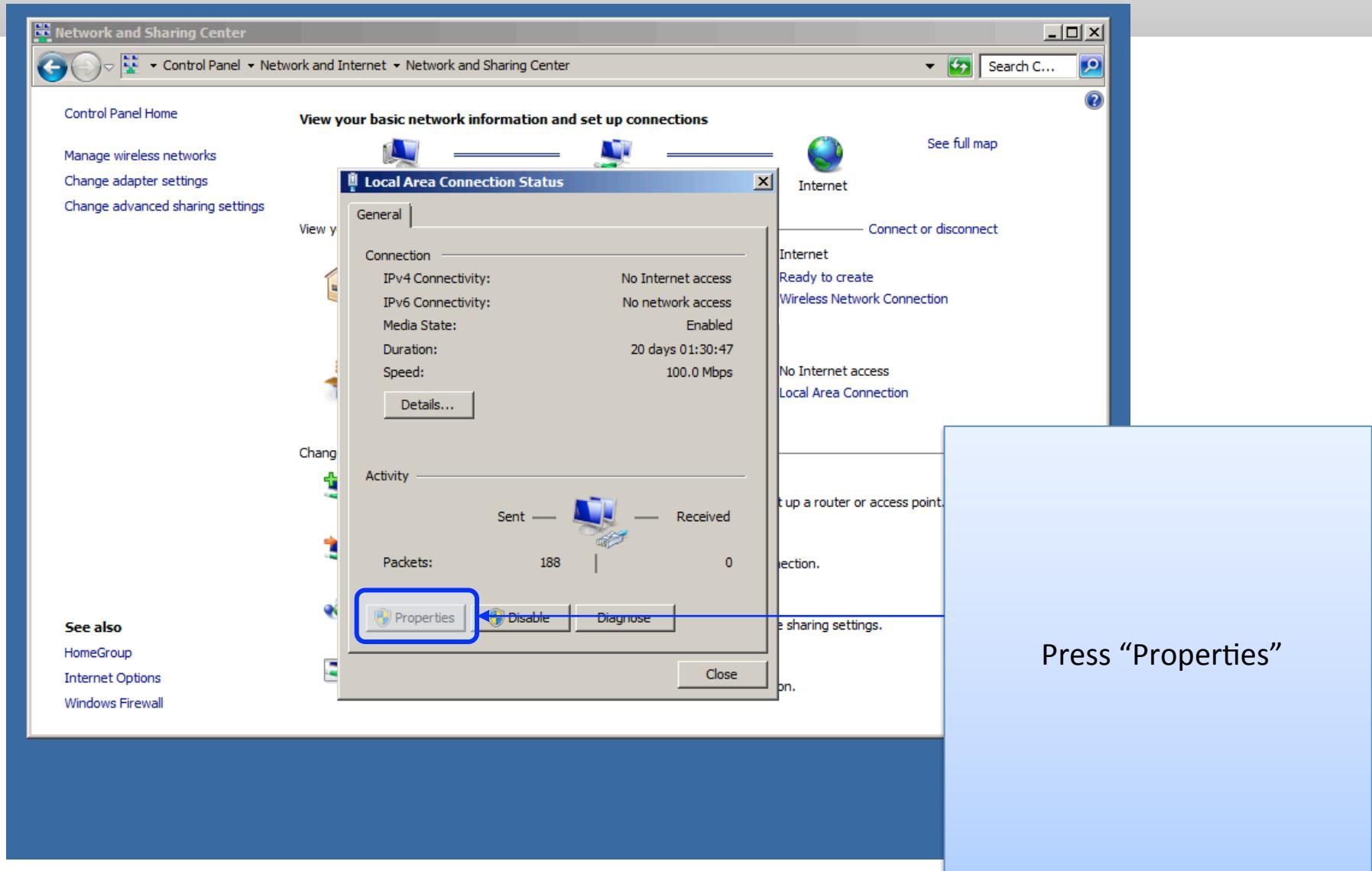
Manual IP Configuration – Windows

1 of 6



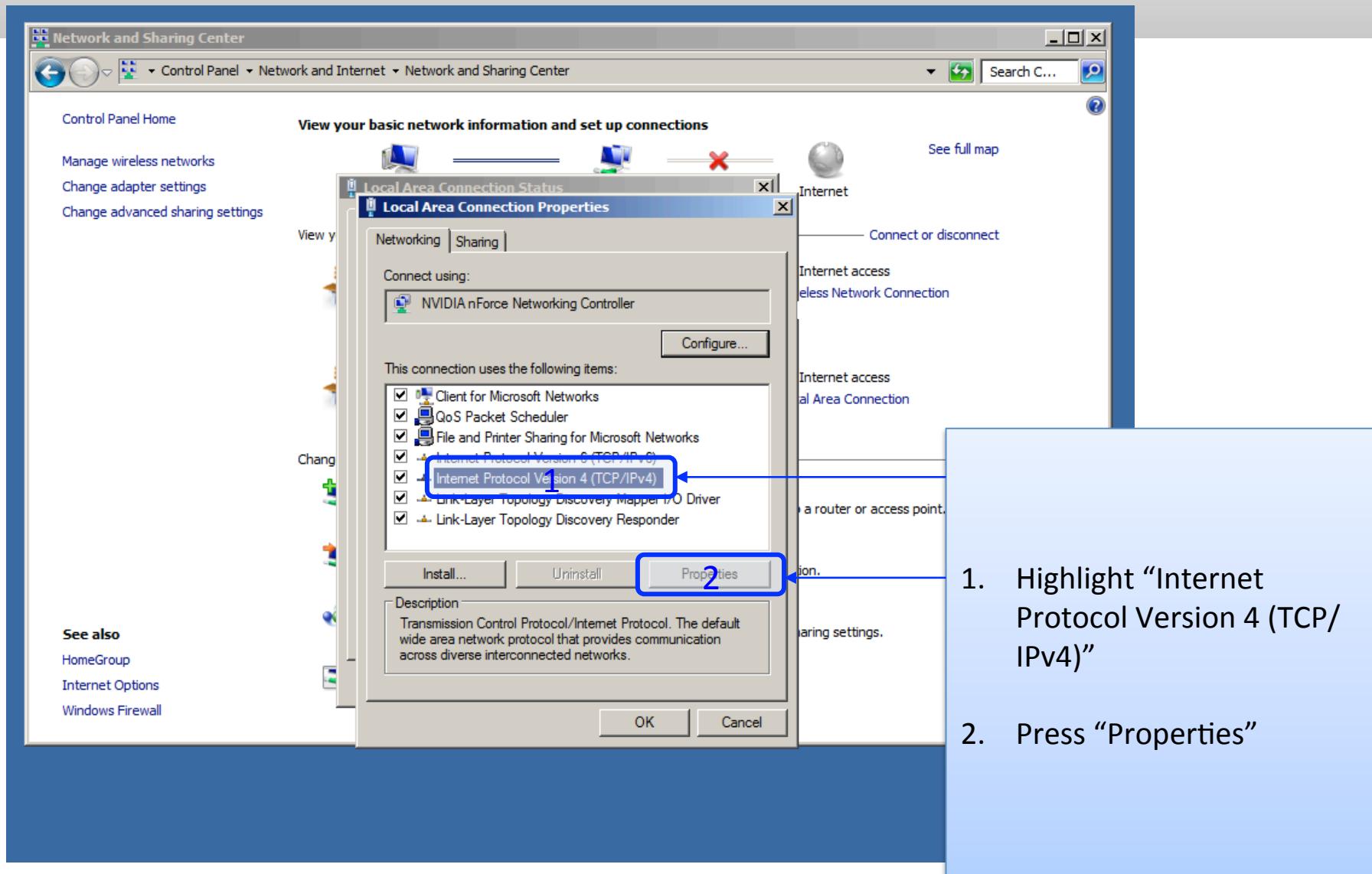
Manual IP Configuration – Windows

2 of 6



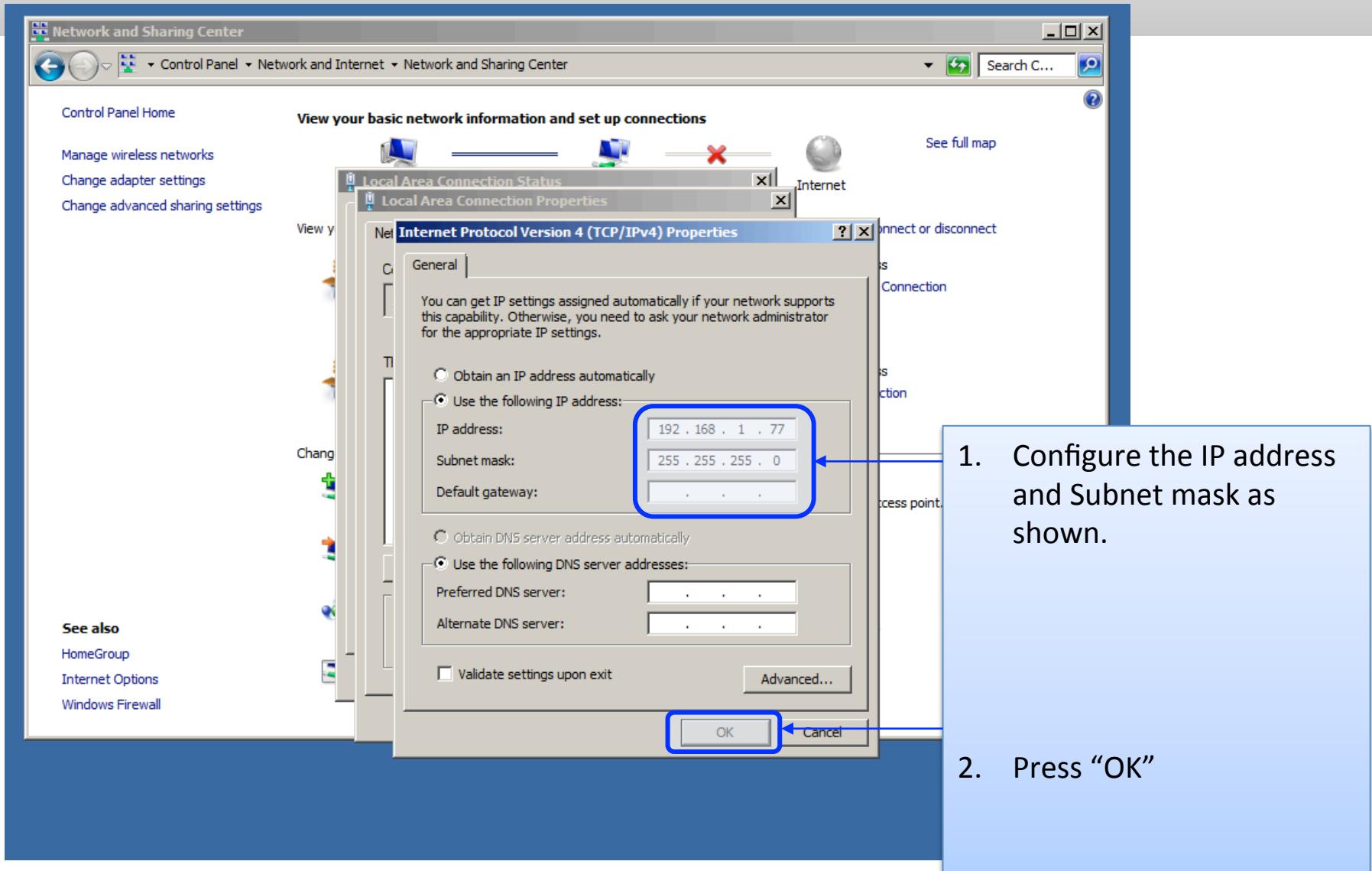
Manual IP Configuration – Windows

3 of 6



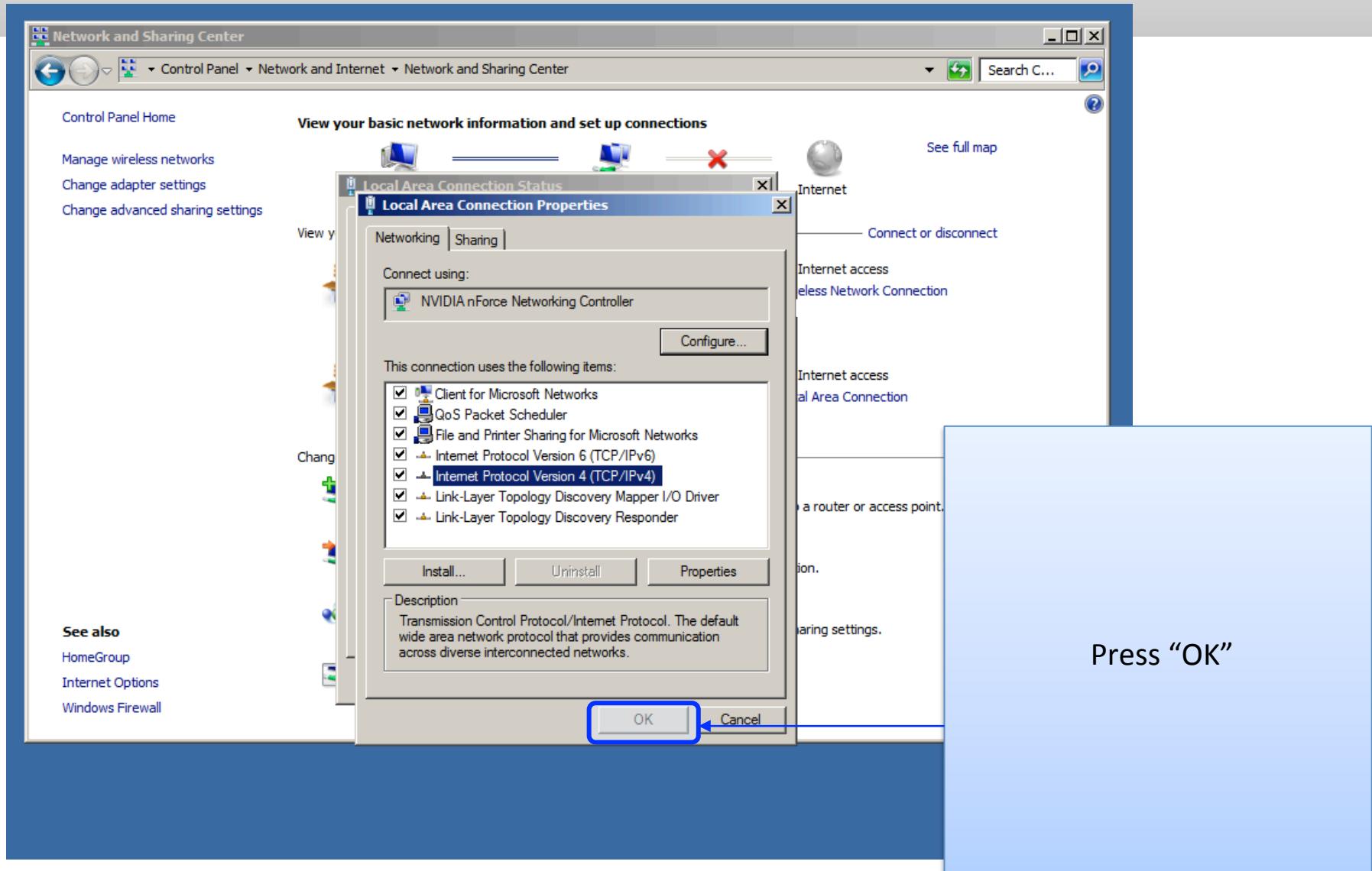
Manual IP Configuration – Windows

4 of 6



Manual IP Configuration – Windows

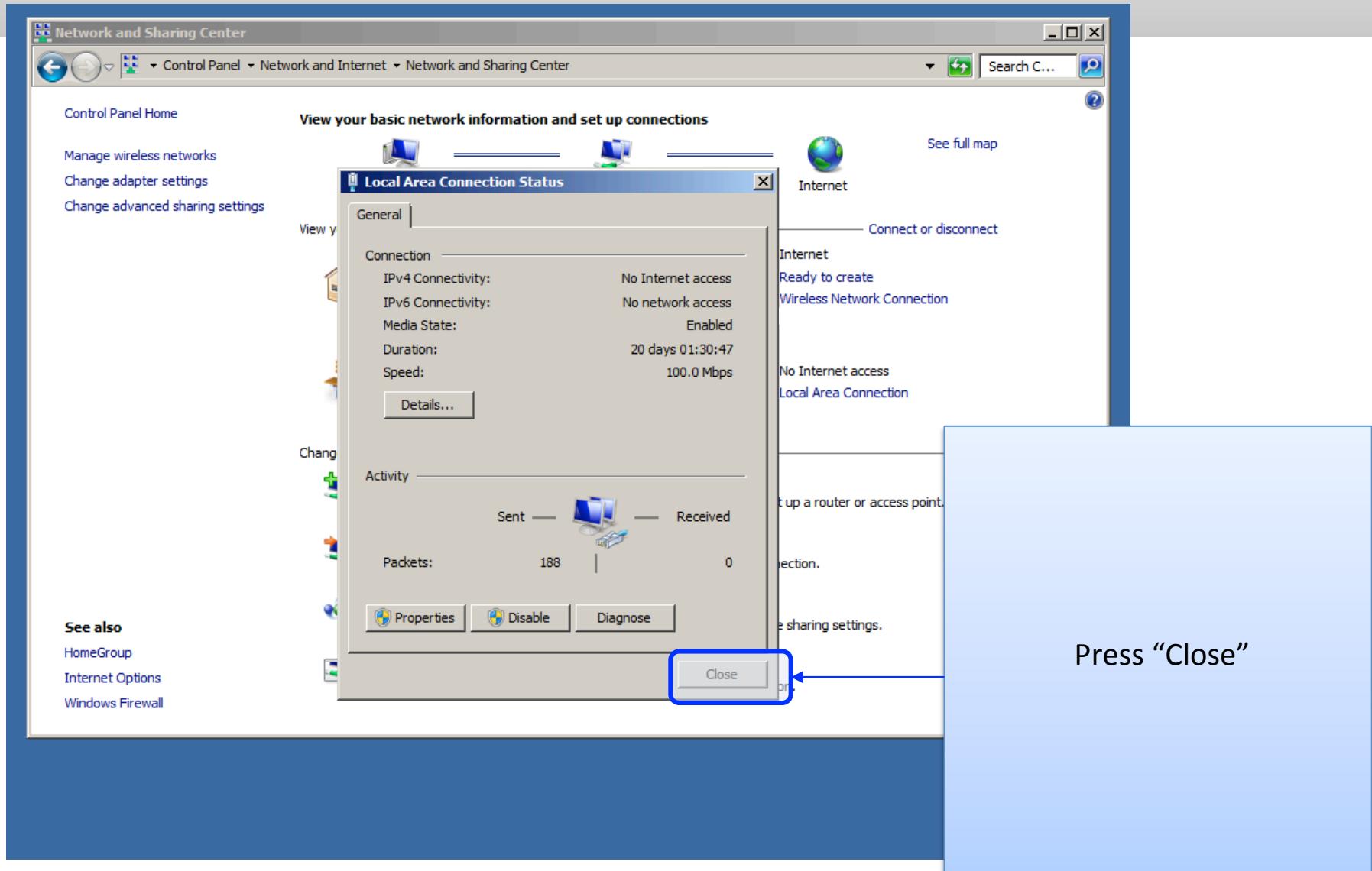
5 of 6



Press “OK”

Manual IP Configuration – Windows

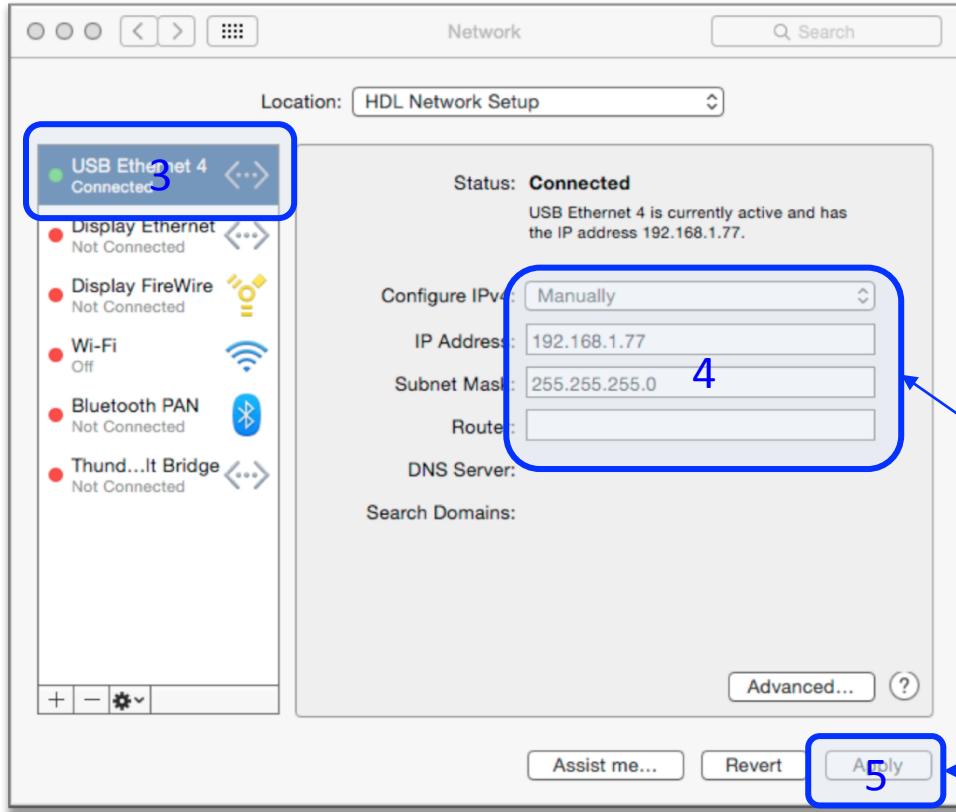
6 of 6



Press “Close”

Configure the Ethernet connection on your computer (Mac OS)

Manual IP Configuration – Mac



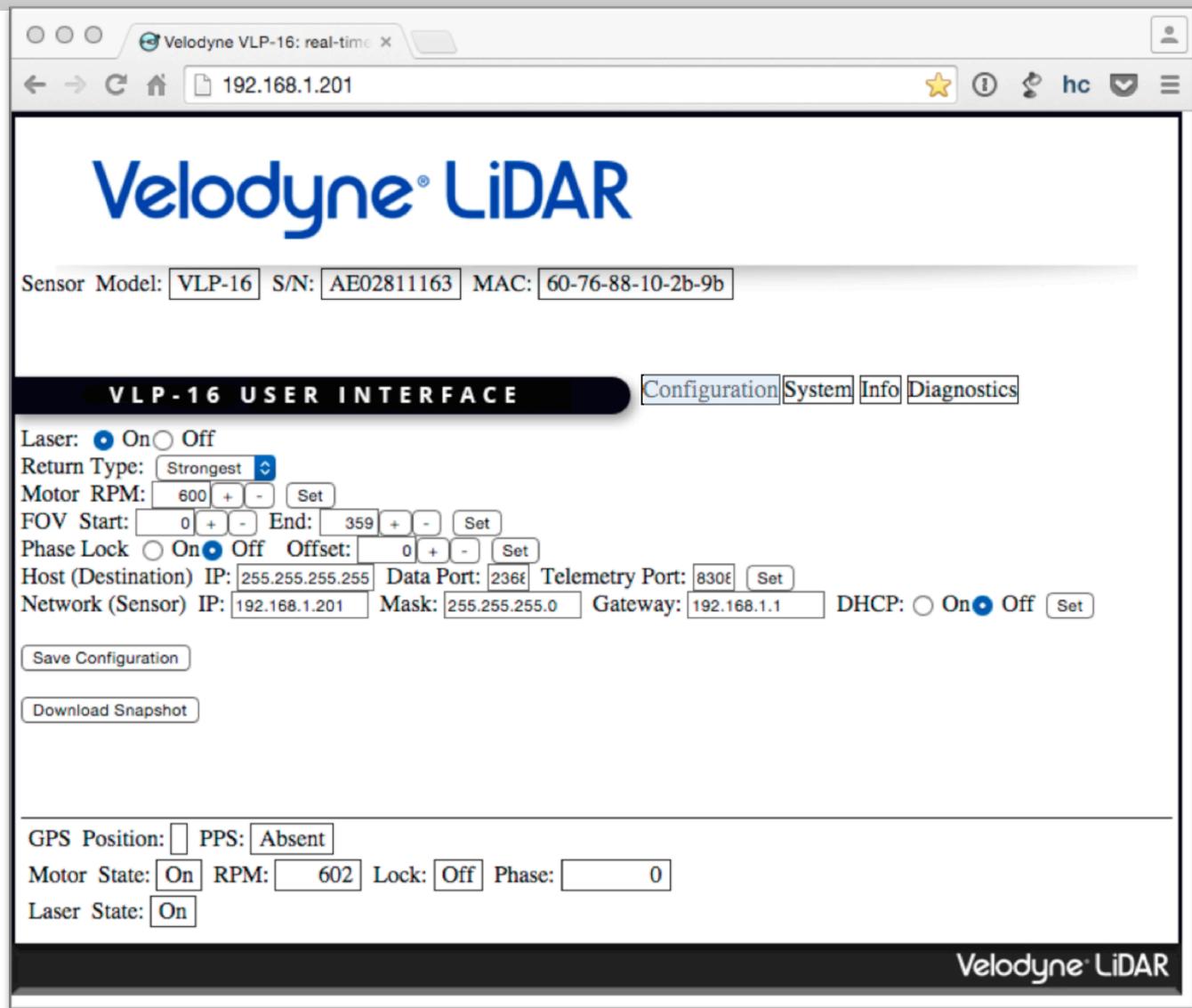
1. Go to System Preferences
2. Select “Network”
3. Select the Ethernet Connection
4. Configure the IP address as shown
5. Press “Apply”
6. Close window

To pull up the VLP-16 webserver user interface

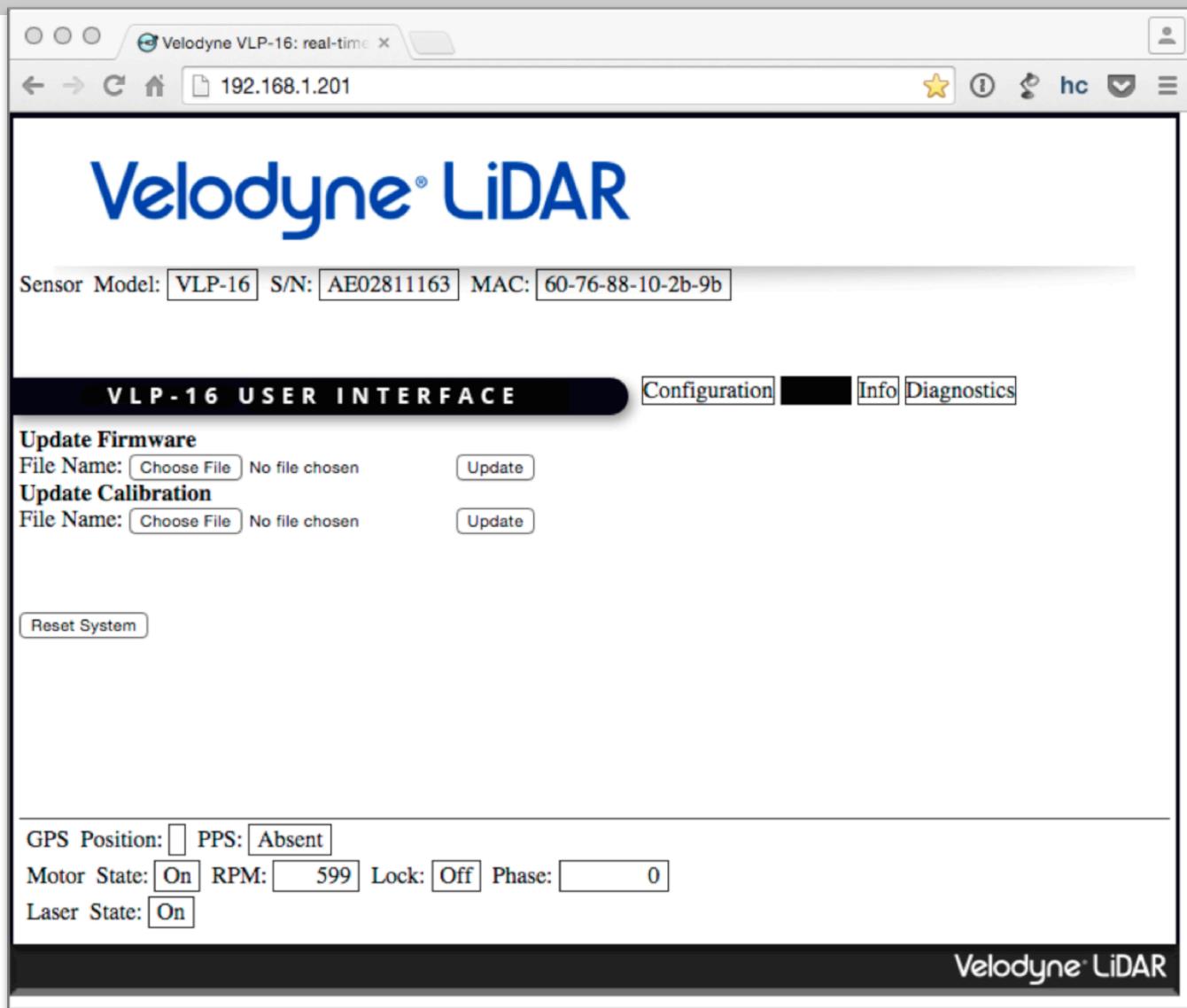
Type “<http://192.168.1.201>”

into your web browser’s address bar

Configuration Screen



System Screen



Info Screen

The screenshot shows a web browser window titled "Velodyne VLP-16: real-time" with the URL "192.168.1.201". The main content area displays the "Velodyne® LiDAR" logo and sensor details: Sensor Model: VLP-16, S/N: AE02811163, MAC: 60-76-88-10-2b-9b. Below this, a navigation bar includes the "VLP-16 USER INTERFACE" tab (which is active) and links to Configuration, System, and Diagnostics.

FPGA

Board	Mode	Type	HW Version	SOPC SYSID	SW Version
Top	Application Watchdog:Enabled	1	3.0.26.0	hdltop(10)	3.0.26.0
Bottom	Application Watchdog:Enabled	2	3.0.26.0	hdlbot(03)	3.0.26.0

Firmware

Image	Version	SOPC SYSID
Failsafe	3.0.15.0	boot(00)
Application	3.0.26.0	hdlbot(03)

GPS Position: PPS: Absent
Motor State: On RPM: 598 Lock: Off Phase: 0
Laser State: On

Velodyne® LiDAR

Diagnostics Screen

The screenshot shows a web browser window titled "Velodyne VLP-16: real-time" with the URL "192.168.1.201". The page displays the "Velodyne® LiDAR" logo and identifies the Sensor Model as "VLP-16", S/N as "AE02811163", and MAC as "60-76-88-10-2b-9b". A navigation bar at the top includes links for Configuration, System, and Info.

VLP - 16 USER INTERFACE

Top Board (Scaled)

HV	A/D TD	Temp	5v	2.5v	3.3v	5v (Raw)	1.2v
-162.7 V	0.771 V	32.74 °C	5.083 V	2.502 V	3.289 V	5.415 V	1.210 V
VHV: 268							

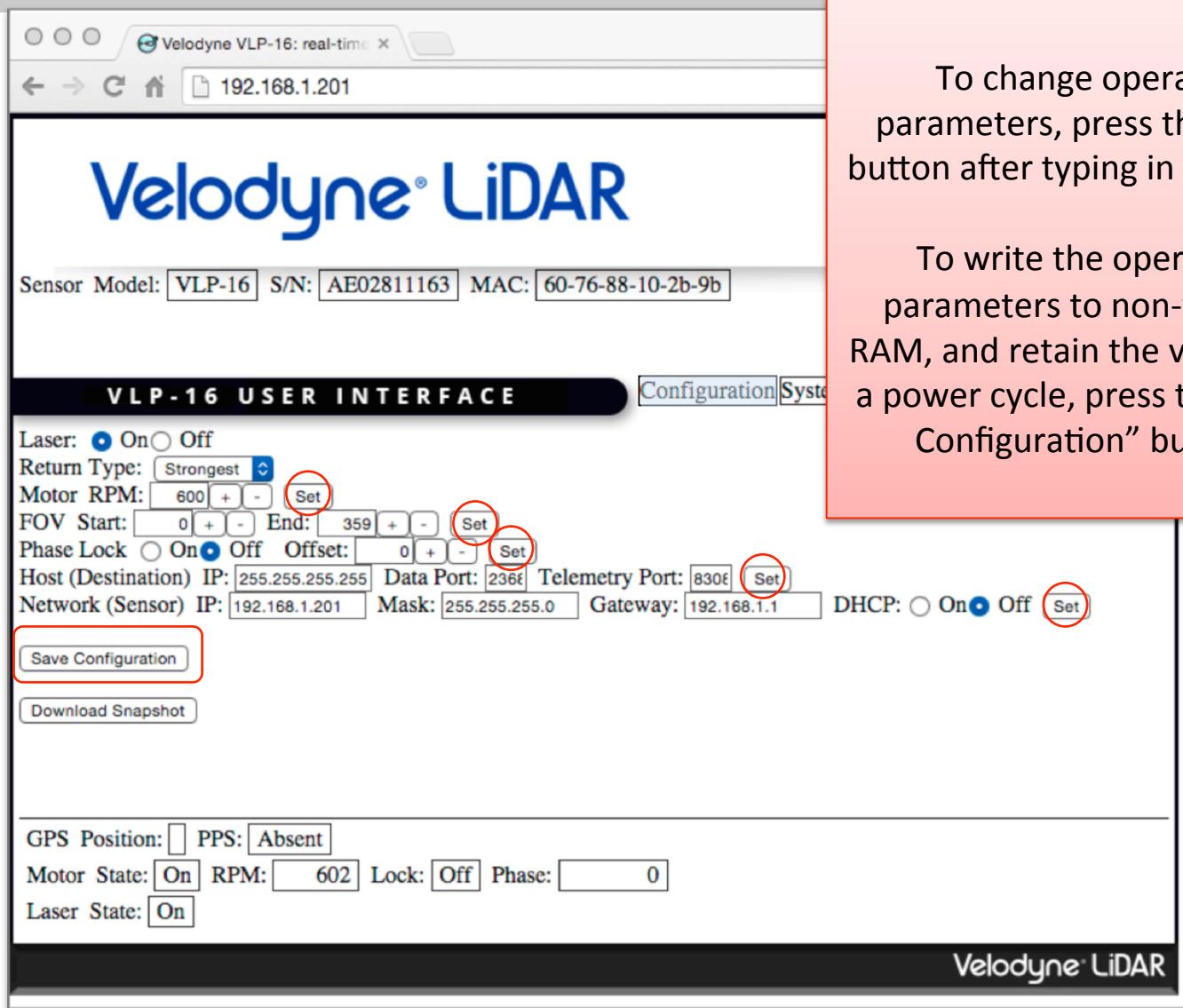
Bottom Board (Scaled)

I out	1.2v	Temp	5v	2.5v	3.3v	V in	1.25v
0.415 A	1.206 V	33.264 °C	5.000 V	2.502 V	3.306 V	11.951 V	0.001 V

GPS Position: PPS: Absent
Motor State: RPM: 598 Lock: Off Phase: 0
Laser State:

Velodyne® LiDAR

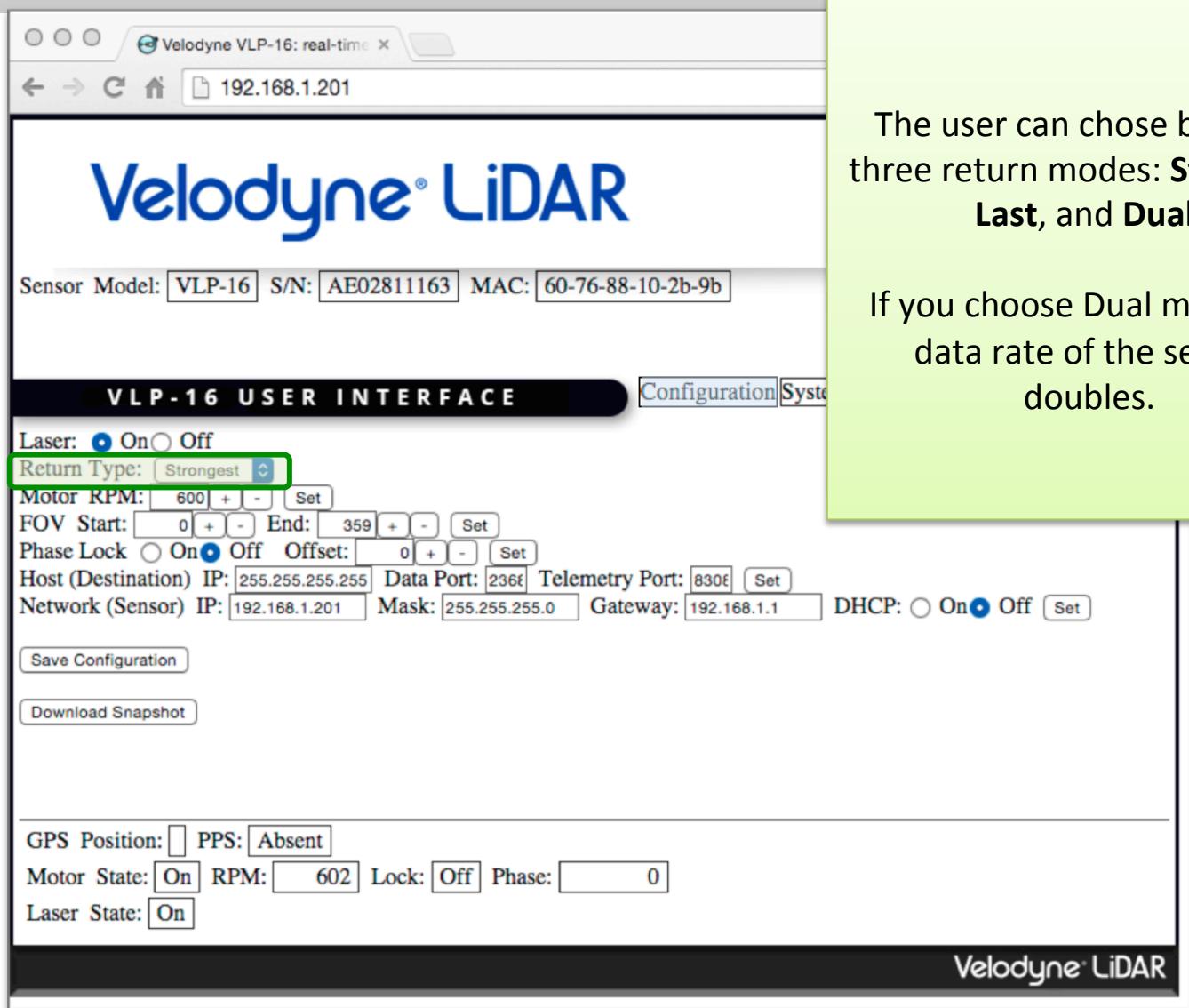
Changing Operating Parameters



To change operating parameters, press the “Set” button after typing in a change.

To write the operating parameters to non-volatile RAM, and retain the value over a power cycle, press the “Save Configuration” button.

Changing The Return Type



The user can choose between three return modes: **Strongest**, **Last**, and **Dual**.

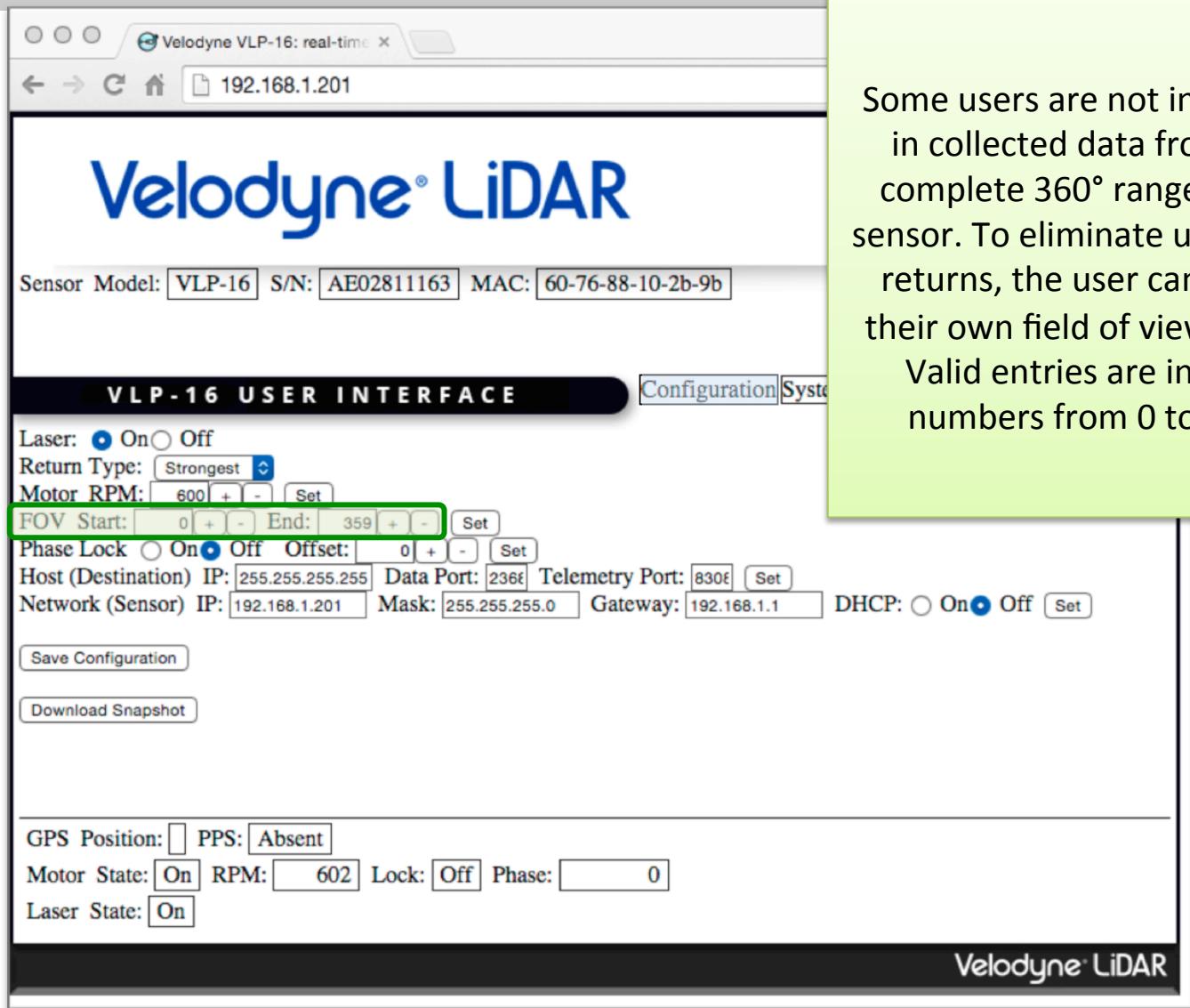
If you choose Dual mode the data rate of the sensor doubles.

Changing The RPM

The screenshot shows the Velodyne VLP-16 real-time configuration interface. At the top, it displays the sensor model (VLP-16), serial number (AE02811163), and MAC address (60-76-88-10-2b-9b). Below this, the title "Velodyne® LiDAR" is prominently displayed. The main area is titled "VLP-16 USER INTERFACE". A green box highlights the "Motor RPM" input field, which is set to 600. The interface includes various configuration options such as Laser On/Off, Return Type (Strongest), FOV Start/End, Phase Lock, Host/Destination IP, Data Port, Telemetry Port, Network/Sensor IP, Mask, Gateway, and DHCP settings. Buttons for "Save Configuration" and "Download Snapshot" are also present. At the bottom, status information is shown: GPS Position (Absent), Motor State (On), RPM (602), Lock (Off), Phase (0), and Laser State (On). The "Velodyne LiDAR" logo is at the bottom right.

Valid values for the RPM are integer numbers in the range of 300 to 1200.

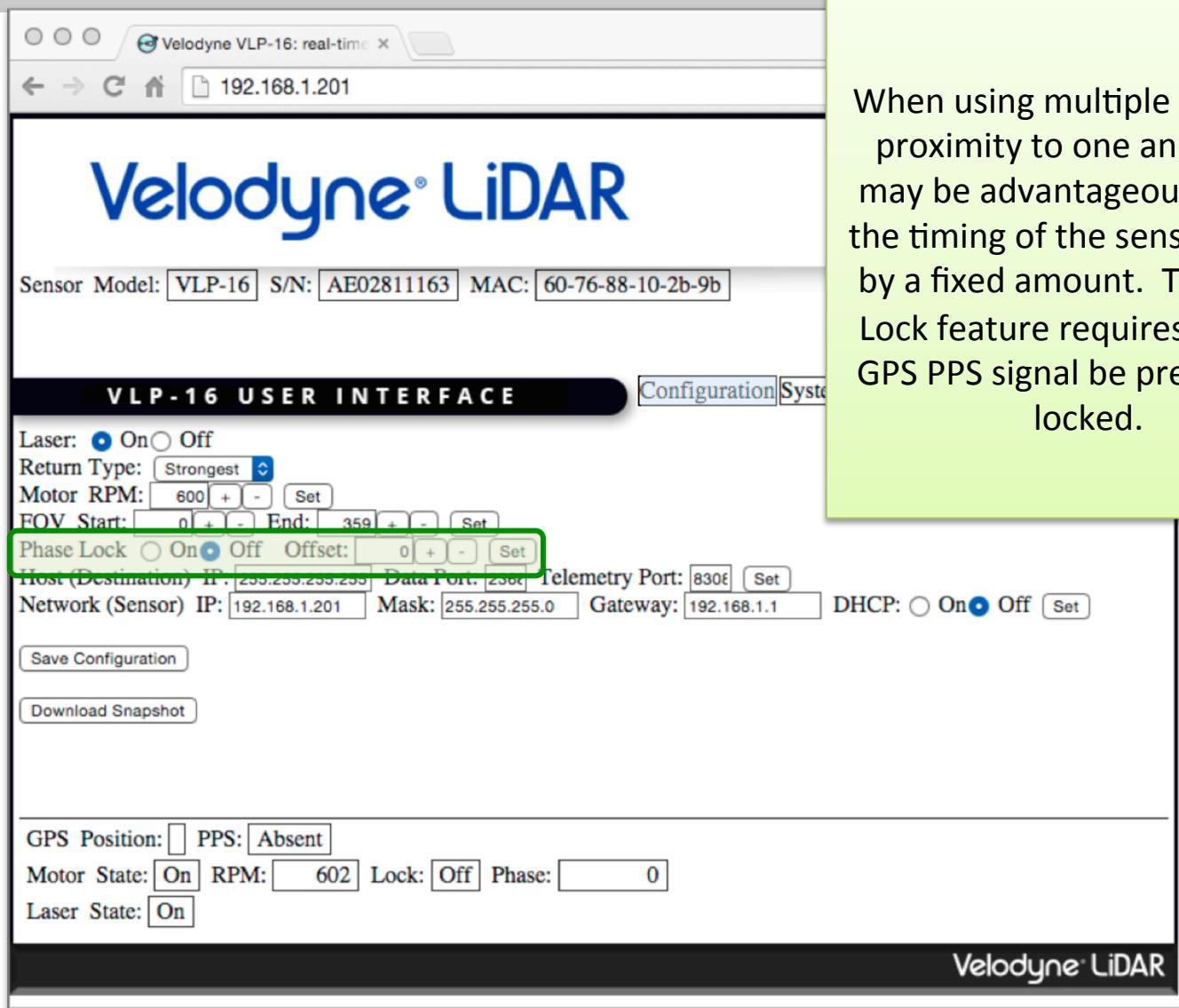
Changing The Field of View



Some users are not interested in collected data from the complete 360° range of the sensor. To eliminate unwanted returns, the user can select their own field of view (FOV).

Valid entries are integer numbers from 0 to 359.

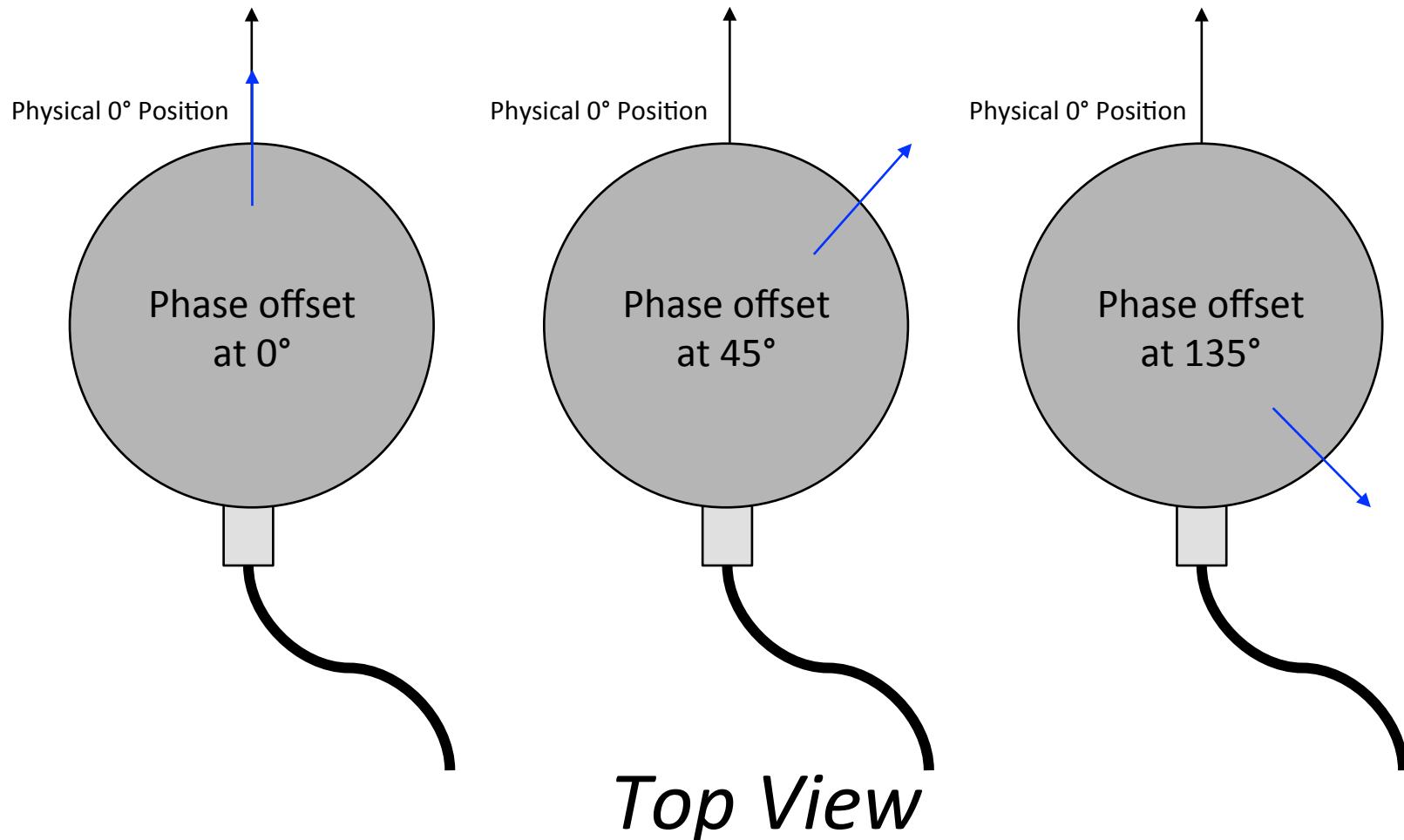
Using the Phase Lock Feature



When using multiple sensors in proximity to one another, it may be advantageous to have the timing of the sensors offset by a fixed amount. The Phase Lock feature requires that the GPS PPS signal be present and locked.

Phase Lock Example

The blue arrow indicates the direction of the sensor's laser firing at the moment it receives the rising edge of the PPS signal.



Changing The Network Address

The screenshot shows the Velodyne VLP-16 real-time web interface at the URL 192.168.1.201. The page displays sensor information (Sensor Model: VLP-16, S/N: AE02811163, MAC: 60-76-88-10-2b-9b) and a user interface for configuration. The configuration section includes fields for Laser (On), Return Type (Strongest), Motor RPM (600), FOV Start (0), End (359), Phase Lock (On), Host (Destination) IP (255.255.255.255), Data Port (236), Telemetry Port (8300), Network (Sensor) IP (192.168.1.201), Mask (255.255.255.0), Gateway (192.168.1.1), and DHCP (Off). Below the configuration are status indicators for GPS Position (Absent), Motor State (On), RPM (602), Lock (Off), Phase (0), and Laser State (On). The interface features a dark-themed header and footer with the Velodyne LiDAR logo.

Be careful not to change the network address to a value that is unreachable from your computer.

Never set the Network (sensor) address to 255.255.255.255.

If you can't reach your sensor via the web server interface, use a program like Wireshark to determine the network address of your sensor.

It's best to operate the sensor on its own network segment. Due to the volume of data produced by the sensor, avoid using the sensor on a corporate network.

GPS Synchronization

- The goal of the GPS Synchronization is to match the time stamp from the sensor to UTC time.
- Two things must occur for this to happen.
 - The sensor must see a \$GPRMC on its serial line.
 - The sensor must receive a valid PPS signal.
- To ensure synchronization, the user's software should do two things:
 - Check the PPS Synchronization Status field in the position packet (location offset 0x00F4)
 - Check to see the *Navigation Receiver Warning* field in the \$GPRMC message is “A,” indicating a valid fix (location offset 0x0106)

PPS Synchronization Status Field

- The data at location offset 0x00F4 in the position packet indicates the status of the PPS lock.
- The possible states are:
 - 0: Absent
 - 1: Attempting to Synchronize
 - 2: Locked
 - 3: Error

GPS Synchronization

The screenshot shows the Velodyne VLP-16 real-time web interface at 192.168.1.201. The main title is "Velodyne® LiDAR". Below it, sensor details are listed: Sensor Model: VLP-16, S/N: AE02811163, MAC: 60-76-88-10-2b-9b. A red box highlights the "Configuration" tab and the "VLP-16 USER INTERFACE" section. This section contains various configuration parameters: Laser (radio button selected for "On"), Return Type (dropdown set to "Strongest"), Motor RPM (input field 600), FOV Start (input field 0), End (input field 359), Phase Lock (radio button selected for "On"), Offset (input field 0), Host (Destination) IP (input field 255.255.255.255), Data Port (input field 236f), Telemetry Port (input field 830f), Network (Sensor) IP (input field 192.168.1.201), Mask (input field 255.255.255.0), and Gateway (input field 192.168.1.1). Buttons for "Save Configuration" and "Download Snapshot" are also present. At the bottom, a red box highlights the "GPS Position" and "PPS" fields, which show "Absent". Other status fields include Motor State (On), RPM (602), Lock (Off), Phase (0), and Laser State (On). The footer displays "Velodyne® LiDAR".

When there is no GPS connected, the position field will be empty and the PPS field will read “Absent.”

GPS Synchronization 2

The screenshot shows the Velodyne VLP-16 real-time web interface at 192.168.1.201. The main title is "Velodyne® LiDAR". Below it, the sensor model is listed as "Sensor Model: VLP-16" with serial number "S/N: AE02811163" and MAC address "MAC: 60-76-88-10-2b-9b". A navigation bar includes a "Configuration" tab. The "VLP-16 USER INTERFACE" section contains various configuration parameters:

- Laser: On (radio button selected)
- Return Type: Strongest
- Motor RPM: 600
- FOV Start: 0, End: 359
- Phase Lock: Off (radio button selected)
- Host (Destination) IP: 255.255.255.255
- Data Port: 236f
- Telemetry Port: 830f
- Network (Sensor) IP: 192.168.1.201
- Mask: 255.255.255.0
- Gateway: 192.168.1.1

Buttons include "Save Configuration" and "Download Snapshot". At the bottom, status information is displayed:

GPS Position: 37 08.3294N 121 39.5276W PPS: Absent

Motor State: On RPM: 598 Lock: Off Phase: 0

Laser State: On

A red box highlights the "GPS Position" and "PPS: Absent" fields. To the right, a red callout box contains the following text:

When a pre-programmed Garmin GPS (available from Velodyne) is connected, the Garmin provides its last known position, but if the GPS is not locked on the satellites, the PPS field will read absent.

The behavior of other GPS receivers may vary.

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GPS Synchronization 3

The screenshot shows the Velodyne VLP-16 real-time web interface at 192.168.1.201. The main title is "Velodyne® LiDAR". Below it, the sensor model is listed as "Sensor Model: VLP-16" and the serial number as "S/N: AE02811163". The MAC address is "MAC: 60-76-88-10-2b-9b". A navigation bar at the top includes icons for back, forward, search, and refresh, along with the IP address and a user profile icon.

The interface has a tab labeled "VLP-16 USER INTERFACE" and a "Configuration" tab. Under "VLP-16 USER INTERFACE", there are various configuration options:

- Laser: On (radio button selected)
- Return Type: Strongest (dropdown menu)
- Motor RPM: 600 (text input with +, - buttons and Set button)
- FOV Start: 0 (text input with +, - buttons and Set button)
- End: 359 (text input with +, - buttons and Set button)
- Phase Lock: Off (radio button selected)
- Offset: 0 (text input with +, - buttons and Set button)
- Host (Destination) IP: 255.255.255.255
- Data Port: 236f
- Telemetry Port: 830f
- Network (Sensor) IP: 192.168.1.201
- Mask: 255.255.255.0
- Gateway: 192.168.1.1

Buttons at the bottom include "Save Configuration" and "Download Snapshot".

At the bottom of the interface, there is a summary section:

GPS Position:	37 16.7188N 121 53.4385W	PPS:	Locked
Motor State:	On	RPM:	599
Lock:	Off	Phase:	22891
Laser State:	On		

A red callout box highlights the "Locked" status in the PPS field. Another red callout box contains the following text:

When a GPS is connected, and the PPS is present, the PPS status field will read "Locked."

Note - this does not indicate the time is synchronized.

The footer of the interface says "Velodyne® LiDAR".

Position Packet Example – Not Sync'd

PPS Synchronization
Status field = 0
indicates PPS absent

0000 ff ff ff ff ff ff 60 76 88 10 2b 9b 08 00 45 00`v ..+...E.
0010 02 1c fd 7a 00 00 40 11 b8 e5 c0 a8 01 c9 ff ffz..@.
0020 ff ff 20 74 20 74 02 08 54 9d 00 00 00 00 00 00 00	... t t.. T.....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 75 51 73 24 00 00 00 24 47 50 52 4d 43 2c 32	uQs4.....\$GPRMC,2
0100 30 33 30 33 2c 56 2c 33 37 30 38 2e 33 32 39	03034,V,3708.329
0110 34 2c 4e 2c 31 32 31 33 39 2e 35 32 37 36 2c 57	4,N,1213.9.5276,W
0120 2c 2c 32 36 30 37 31 35 2c 30 31 33 2e 38 2c	,,2607.15,013.8,
0130 45 2c 4e 2a 31 34 0d 0a 00 00 00 00 00 00 00 00 00	E,N*14.....
0140 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

The “V” in the \$GPRMC
Navigation Receiver
Warning field indicates the
GPS receiver cannot
guarantee the accuracy of
the position fix.

Position Packet Example – Sync'd

PPS Synchronization
Status Field = 2
indicates sensor has
locked on the PPS.

0000 ff ff ff ff ff ff 60 76 88 10 2b 9b 08 00 45 00`v ..+...E.
0010 02 1c a2 0a 00 00 40 11 14 56 c0 a8 01 c9 ff ff@. V.....
0020 ff ff 20 74 10 74 02 08 98 50 00 00 00 00 00 00 00	.. t t.. .P.....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0040 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0050 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0060 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0070 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0080 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0090 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00f0 df f5 e8 05 02 00 00 24 47 50 52 4d 43 2c 32	\$GPRMC, 2
0100 30 35 39 34 05 2c 41 2c 33 37 31 36 2e 36 36 39	05948,A, 3716.669
0110 34 2c 4e 2c 31 32 31 35 33 2e 34 35 35 30 2c 57	4,N,123 3.4550,W
0120 2c 30 30 30 2e 30 2c 30 37 38 2e 34 2c 32 36 30	,000.0,0 78.4,260
0130 37 31 35 2c 30 31 33 2e 39 2c 45 2c 44 2a 30 37	715,013. 9,E,D*07
0140 0d 0a 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0150 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0160 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0170 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0180 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0190 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01a0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01b0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01c0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01d0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01e0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
01f0 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0200 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0210 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
0220 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

For time synchronization to occur, the PPS field must be locked and the sensor must be receiving valid \$GPRMC messages with an an “A” in the *Navigation Receiver Warning* field.

It is the user’s responsibility to check that both conditions are met.

The “A” in the \$GPRMC *Navigation Receiver Warning* field indicates a valid location fix and time.

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Thank You!