Speedlane® Pro

True Dual Beam Side-Fire Traffic Sensor and Collector User Manual and Installation Guide

Rev 2.2, November 11, 2019

Speedlane® Pro Non-Intrusive Dual FMCW Radar Based Traffic Sensor and Collector
Protected by Unites States patent US10317525

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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation. The device must be located 20 cm or more from persons. The device must not be co-located with other transmitters.

This device is certified to be used in Canada under “RSS 310”.
Contains FCCID PD420, QOQWT41

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
Any modification or use other than specified in this manual will strictly void the certification to operate the device.

Unit emits low power microwave radar signals through the front. Do not cover with any labels or block for proper operation. Keep unit powered off when not in use.

No user serviceable parts inside. Warranty void if opened.

Note: Specifications may change without notice.
Note: Not liable for typographical errors or omissions.

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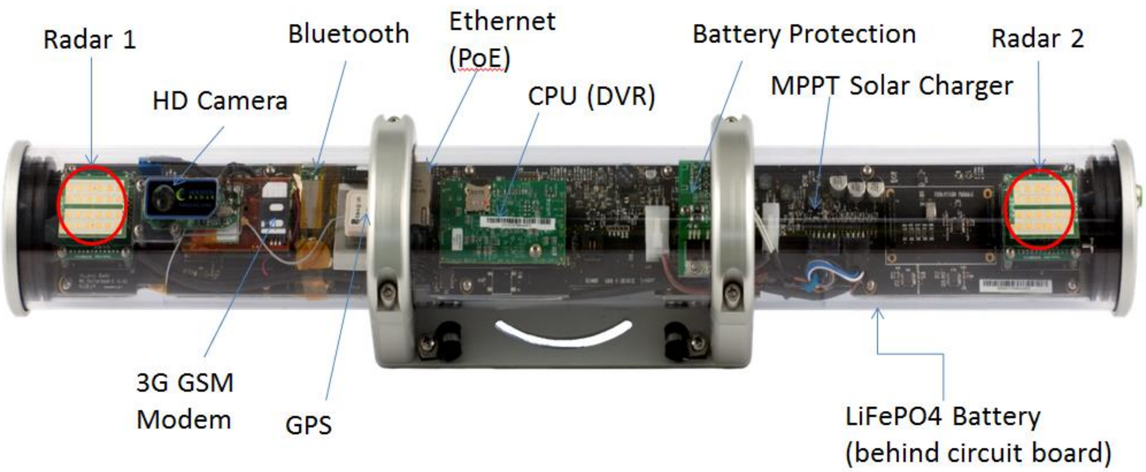
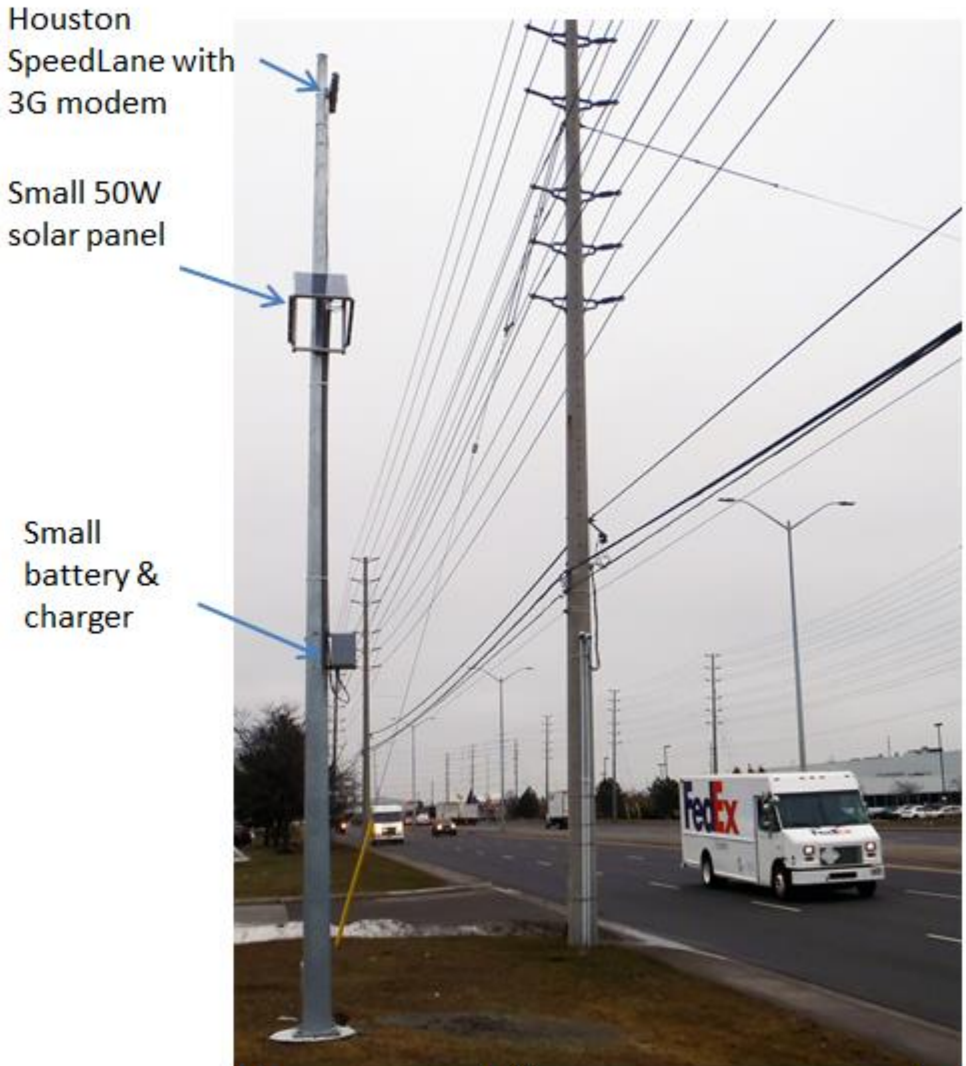
A Look Inside a Speedlane Pro Radar

Inside a 3rd Gen Dual Beam ITS Radar:



SpeedLane™ 3rd Gen Radar

An Example Solar Powered Speedlane Pro Site



Solar powered Speedlane Pro with built-in 3G modem sending data to Tetryon server. A 50W solar panel is sufficient at this location in Ontario Canada.

Introduction

Congratulations on your purchase of the Houston Radar Speedlane Pro true dual beam non-intrusive traffic sensor/collector, traffic flow monitor. This state of the art 24GHz K-band microwave ***frequency modulated continuous wave*** (**FMCW**) ***dual radar*** based counter is specifically designed for license free portable or permanent traffic data measurement and collection.

Utilizing high performance, ultra-low power DSP (Digital Signal Processing) technology and microwave components based on a planar patch array antenna with integrated low power PHEMT oscillator, you will find that this high quality product meets your exacting standards for performance and reliability.

Some of the highlights of this product include:

- World's lowest power usage true dual beam FMCW radar.
- Up to 255ft (78m) detection range
- Simultaneously detects, tracks and logs per-vehicle speeds, lengths of up to sixteen individual targets.
- Logs lane occupancy, gap, average speed
- Sixteen user-configurable lanes allow assignment of targets to specific lanes.
- Unmatched range resolution allows setting lane boundaries in 1 foot (0.3m) increments.
- 1 Mega Pixel HD video camera for snapshots and live streaming video.
- Companion Windows application provides intuitive GUI to set all configuration parameters and display real time plots of the targets, lane by lane counts and accumulated count histograms.
- Firmware "boot loader" allows for field upgrading of the firmware.
- Built-in 1 million vehicle statistics storage memory for stand-alone per-vehicle data gathering.
- FCC, Industry Canada pre-approved with CE mark.
- Optional high-performance maximum power point technology (MPPT) solar charger for long term studies or permanent installations
- Optional GPS to geostamp data collection location.
- Optional 3G modem for remote data access. (Annual data plan subscription required).
- Optional Tetryon server software to connect and collect data from multiple devices in the field.
- Optional 100 Mbps Ethernet Port
- Optional Power over Ethernet (POE)

Principle of Operation

FMCW Radar

The dual FMCW radars modulate the frequency of the transmit signal in a linear fashion. The difference between the frequencies of the local oscillator and the signal returned from the target is proportional to the time delay between these signals and thus is proportional to the distance to target. In case of a moving target we also take into account

Doppler shift of the return signal. Radar utilizes double linear ramp modulation, first increasing and then decreasing the frequency of the signal. Additional information derived from two ramps allows the radar to measure both range to target and target velocity. The patented dual radars setup “virtual speedtraps” in front of the Speedlane Pro which allows measurement of speed, direction of travel and length of each vehicle.

The Speedlane Pro employs advanced target tracking technique based on a proprietary algorithm that allows it to detect, measure and track multiple targets simultaneously. It also features advanced “application filters” pre-configured to optimize performance for a variety of applications.

For a more detailed theoretical description of the principles of FMCW radar operation please see this article on the Internet.

Radar Detection Zone

The radar detection zones has an oval shape and is defined by the beam cone (7ºx74º) and incident angle to the road surface. Note that the beam does not cutoff abruptly at the boundary of the detection zone but rather gradually tapers off. Thus weak targets near the boundaries may be missed while strong targets outside may still get detected. The strength of the target is determined by its radar cross-section (RCS) and depends on the target material, area, shape and incident angle of the radar beam. Large flat metallic surfaces positioned at exactly 90 degrees to the incident radar beam make the best targets. Examples are vehicle sides, front and rear ends. Flat metal surfaces at angles other than perpendicular to the beam tend to reflect the radar signal away and reduce the signal strength. Two or three metal surfaces joined at 90 degree angle, for example a corner of a pickup truck bed create perfect reflector and usually result in a very strong return signal.

Important things to remember about radar detection zone:

1. The radar beam does not end abruptly at the specified angle. Per convention, we specify “half-power” beam angles where the power falls off to half the value from the center of the beam. Thus it is possible for the radar to detect strong targets outside of the oval derived from a trigonometric calculation based on the beam angle.
2. Every target has different microwave reflective characteristics. This is characterized by the RCS and affects how much microwave energy the target returns back to the radar. This is one of the most important factors in reliable detection. Simple rules of thumb are:
    a. Vehicle side typically has larger cross section than vehicle front
    b. Vehicle rear typically has larger cross section than vehicle front
    c. Larger target is likely to have larger RCS, thus a truck will provide a stronger return signal then a passenger car or a motorcycle.

    d. Metal targets have larger cross section than non-metallic targets (like humans, animals, plastics etc.)
    e. Metal surfaces joined at a 90-degree angle create perfect reflector.
    f. Perfectly flat metal surface at an angle other then 90 degrees may reflect the radar beam away and result in a weak target.
3. In a side firing configuration as the vehicle passes in front of the radar, an incident angle momentarily becomes 90º and results in a strong return signal. This effect manifests in a somewhat narrower detection zone compared to what may be expected from the beam geometry.
4. Unlike in a Doppler radar, with FMCW radar there is always a fixed internal design limit for the maximum detection range. No matter how strong the target is, it will not be detected beyond this limit. The maximum detection range may be found in the specification.

Radar Pointing

The radar beam should be pointed across the traffic at 90º to the road. Pointing the radar at an angle substantially different from 90º is not recommended because the signal strength is severely reduced. The industry refers to pointing the radar at 90º as a side firing installation.

Background Clutter

Clutter Map

Since the radar can detect stationary targets; things like fences, road curbs, lane separators, traffic signs and other unwanted targets need to be processed and eliminated from the output. In order to do so the radar maintains a clutter map where it stores all these unwanted targets. The clutter map is subtracted from the signal leaving only true targets to report.

Clutter Map Time Constant

The radar continuously adjusts the clutter map to account for changing conditions. The rate of the adjustment is determined by clutter time constant (CTC). CTC specifies how long does it take for an average target to fade away into the background, e.g. become part of the clutter map and no longer be reported as a valid target. CTC is a user programmable value and can be set from 1 second to 300 minutes (5 hours). For a fast moving traffic CTC may be set to a lower value whereas for a stopped traffic it is appropriate to set it to a higher value. Besides automatic continuous adjustment of the clutter map, the user can issue a command to take and store a quick snapshot of the current clutter map and use it as a new basis the next time the radar is turned on. Typical use cases are:

1. You may issue this command during the setup when road is clear of the vehicles so you do not have to wait for an automatic clutter map adjustment to take place. This is especially handy in applications where a long CTC is required. A snapshot command temporarily overrides long CTC value and speeds up clutter map reconstruction.
2. You want the radar to start with a "mostly good" clutter map after the power cycle in order to reduce initial adjustment time.

The clutter map adjustment rate is asymmetric. The clutter is adjusted up slowly (targets fade away slowly) but is adjusted down fast. This facilitates improved clutter map maintenance in situations where traffic density is high.

You MUST issue the "Initialize Clutter" command via the provided GUI after you have setup the radar in the intended location.

You MUST reissue this command after you adjust the radar pointing, height or angle on the road.

If you use the "Installation Wizard" in the provided Windows setup software this is done automatically. We highly recommend stepping through the Wizard every time you make an adjustment to the radar installation.

Choosing a CTC value

Typically you would set the CTC value to be 5 to 10 times longer than the maximum expected presence time of real targets. Settings the CTC to too short a value may result in real targets fading into the background thus resulting in poor detection.

Typical CTC values are 15 seconds to 15 minutes for highway mode if vehicles are not expected to stop in front of the radar for extended periods of time. If congestion is expected on the road, you may set the CTC to a significantly higher value, perhaps 60 or 90 minutes.

By default the Installation Wizard sets the CTC value to 15 minutes which is appropriate for most locations and traffic conditions. If your traffic conditions warrant it, you may adjust this up or down after stepping through the Installation Wizard steps. We highly recommend contacting our technical support at support@houston-radar.com if you have any questions or require a recommendation. We will be more than happy to help you.

User Configurable Detection Lanes

Lane Definition

A lane is a user-configurable range slot within the radar's detection zone. When a vehicle is present within this slot, the lane gets "activated". Lane activations are used for presence indication whereas vehicle tracking is used for counting. For example if a vehicle has crossed from lane to lane it will be counted once only but both lanes will be sequentially activated. Defining lanes is optional <u>but highly recommended</u>. The provided Windows program can only generate detailed reports if lanes have been defined. The radar will detect and log vehicles with their actual range even if lanes have not been defined, but in this case, direct SQL queries will need to be made to the radar's SQL raw target database. Contact us if you have a need for this feature.

Lane Status over Serial or Ethernet

Target presence information in each lane (lane activation status) is also available in real-time to an attached controller via the external communication ports. An external controller communicates with the radar via the Houston Radar Binary protocol. The same protocol is used to communicate with all radars (Doppler and FMCW) produced by Houston Radar. Please contact us for a "C" or "C#" SDK (software development kit) if you wish to utilize this feature.

Lane Setup

Typically, you would configure one or more detection lanes during initial setup. Please note that the radar measures distance along the line of view from the radar to the target and does not correct for the mounting height. This is usually not a problem as the supplied configuration program accumulates and displays all detected targets as a histogram in real time regardless of lane setup and the user may simply draws the lane boundaries around the histogram peaks. <u>Thus no manual calculations are required</u>.

Historical Per Vehicle Data Collection

The radar measures per-vehicle speeds, direction of travel, vehicle length and per lane counts. Additionally, it keeps track of the number of vehicles detected in each lane, average speed, 85^{th} percentile speed, vehicle gap and lane occupancy during every accumulation interval. Accumulation interval is programmed in minutes via the "Log a New Record" setting on the Stats Analyzer "SpeedLane Setup -> Advanced" tab. These counts are stored in internal memory and may be retrieved later for analysis. You may setup vehicle length bins and speed bins to bin vehicle data for each interval. See later section "Setting Up Interval Data Length and Speed Bins" for details.

Streaming Data

Per vehicle data including speed, range, direction of travel, length, gap from previous vehicle and timestamp is also available on a real time streaming basis. This may be received by a computer or controller connected to a communication port of the Speedlane Pro. A full featured “C” or C# SDK along with a developers application guide is available. Please contact us for more details.

Radar Mounting

Side firing installations

Typically SpeedLane radars will be used in a side firing installations where the radar points across the traffic, e.g. radar beam is at 90 degree angle to the road and covers one or more lanes. Free-flowing traffic is required for accurate counting. Stop-and-go traffic will result in reduced accuracy.
In this mode vehicles traveling on the road are detected for a short duration of time while they are crossing the beam and their velocity is mostly tangential (at right angle to the beam) with a negligible radial (along the beam) component.

Mounting Bracket

The provided mounting bracket allows for sufficient adjustment of the radar pointing angle for various mounting heights. The user must perform a “camera view” check using the included snapshot camera to validate that the radar beam is pointed correctly. If the camera sees at least part of the vehicle, the radar will detect it.
Installation must also ensure that the Speedlane Pro is rigidly mounted. Support structures that are affected by wind are not a good choice. Swaying action changes radar’s field of view and affects the performance.

See section "Leveling the Speedlane Pro during installation:" *for details on using the onboard level meter to assist with ensuring that the unit is parallel to the road surface.*

Using a 3/16" hex key loosen the 4 hex bolts about 2 to 3 turns till the clamps allow the tube to rotate freely. Adjust the pitch to the desired pointing and then tighten the bolts all the way till the split washer is compressed flat. The clamps are designed to properly grasp the tube when they are tightened all the way. A 3/16" hex key is provided with all SpeedLanes.

For temporary installations which may be moved often (for example on a trailer), we also offer tool-less quick adjust clamps (pictured above). These can be loosened by hand and then snapped back to lock down the tube once the pitch adjustment has been made.

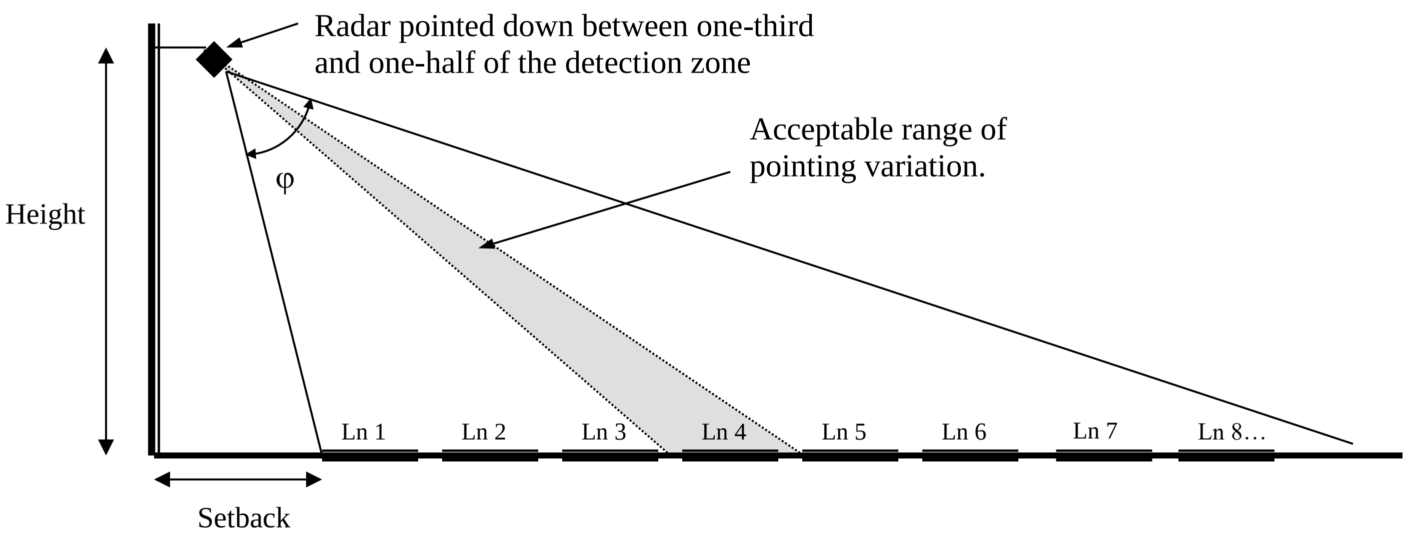
<u>Location</u>

Places that have a lot of wall area such as tunnels and overpasses are not a good location for the radar. Walls can bounce the radar beam and create ghost targets.
Note: when beam bounce or multi-pass propagation creates ghost targets it is sometimes possible to adjust the radar location in such way that these ghost targets would fall outside of the user defined lanes or lanes traveling in the opposite direction and thus be discarded. Supplied Windows Configuration Utility should always be used to verify the setup.

Setback and Mounting Height

In the side fire multi-lane installation the radar must be mounted in such way that it may see over the top of the closer vehicles. This requires it to be mounted higher than the tallest vehicle it will encounter in a closer lane. An exception to this rule is a situation where you are detecting only the closer lane, e.g. a turn lane or an exit only. In which case the radar can be mounted at target height and pointed horizontally. This may also be used in locations with very low traffic density where the probability of simultaneous vehicles in adjacent lanes is very low.
For optimal performance, the setback must be increased with the mounting height as suggested in the table below. Insufficient setback may result in lane misdetection for the closer lanes.

As a general rule of thumb, the installation height should be about 1.2x the setback and not be more than 1.4X the setback distance from the closest lane to be measured.



See setup table on the next page.

Recommended Mounting

Speedlane Pro Installation Table (in feet)			
Offset from 1st lane	Recommended Height (ft)	Minimum Height (ft)	Maximum Height (ft)
3 feet to 7 feet	17 (see note 1)	8(measure only closest lane)	19
7	17	8(measure only closest lane)	19
8	17	8(measure only closest lane)	20
9	17	8(measure only closest lane)	21
10	17	8(measure only closest lane)	22
11	17	8(measure only closest lane)	23
12	17	8(measure only closest lane)	24
13	17	11	25
14	18	11	26
15	20	12	26
16	20	12	27
17	21	13	28
18	22	14	29
19	22	14	30
20	23	15	30
21	23	15	31
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34	30	19	39
35	30	20	40
36	30	20	41
37	30	20	41
38	31	21	42
39	31	21	43
40	33	22	43
41	33	22	44
42	34	22	44
43	34	22	45
44	35	23	46
45	35	23	46

Note1: See Appendix C for mounting radar behind pole to maximize setback.
Maximum range is limited to about 60 feet due to beam angle. Contact us for details.

Speedlane Pro Installation Table (in meters)			
Offset from 1st lane (m)	Recommended Height (m)	Minimum Height (m)	Maximum Height (m)
1 m to 2m	6 (see note 1)	2 (measure only closest lane)	6
2	5	2	6
3	5	2	6
3	5	3	7
4	5	3	8
5	6	4	8
5	6	4	9
5	7	4	9
6	7	4	9
6	7	5	9
7	7	5	9
7	8	5	10
8	8	5	11
9	8	5	11
9	9	6	11
10	9	6	12
11	9	6	12
12	9	6	13
12	10	7	13
13	11	7	14
14	11	7	14

Recommended Mounting

Note1: See Appendix C for mounting radar behind pole to maximize setback.
Maximum range is limited to about 19m due to beam angle. Contact us for details.

Setup Tutorial Video

A step by step installation and setup training video is available. We highly recommend watching this video before attempting to install the Speedlane Pro.

https://youtu.be/Tc072PymqRQ

Speedlane Installation Wizard

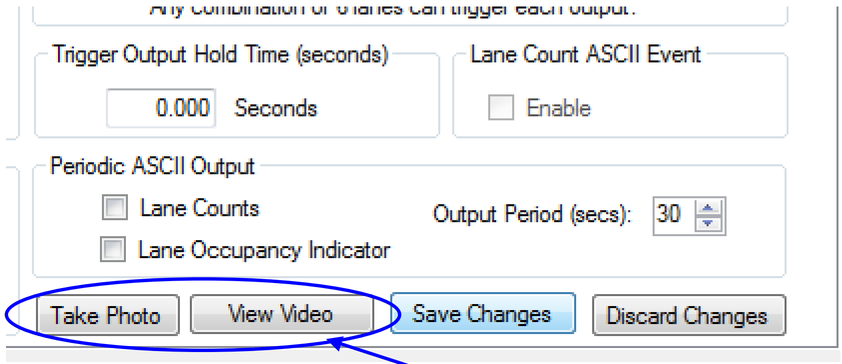
Sighting Camera

The Speedlane Pro has a built-in color HD (1.3 mega pixel) sighting camera. You may take a snapshot via the supplied configuration tool and examine the view of the camera that approximately matches the view of the radar. This makes verifying the pointing quite simple and convenient.

An example photo from the Speedlane Pro sighting camera showing proper pointing for a 4 lane highway.

In the example photo above note that the 4 lanes are approximately centered in the frame and the radar is mounted high enough and with enough setback to allow an unblocked view of traffic in all lanes.

In this example, the Speedlane Pro was mounted with a 40 foot setback from the closest lane and about 20 feet high. The far lane is about 135 feet away. Note the concrete barrier after the 2nd lane. It is handled by the Speedlane Pro without much trouble.



Click the "Take Photo" button to take a snapshot of the radar view of the road. This is a very convenient feature of the SpeedLane to verify proper pointing both in the vertical and horizontal direction. Ensure you are pointed as close to 90° to the passing traffic as possible for the best results.

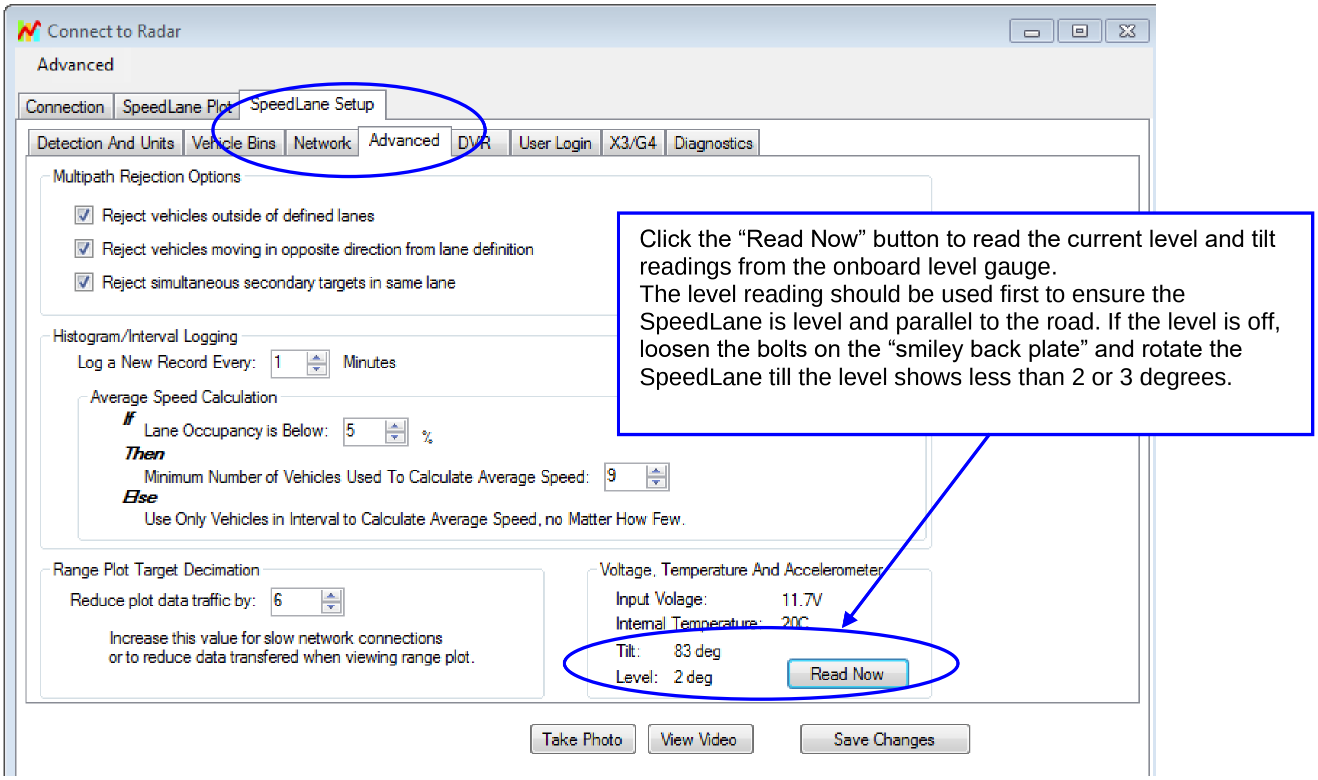
The photo is also saved in the stats analyzer database and you can later view it once you import the data from the unit.

Alternatively, if you have SpeedLane with Ethernet or modem, you may click the "View Video" button to get a live view of traffic on the road.

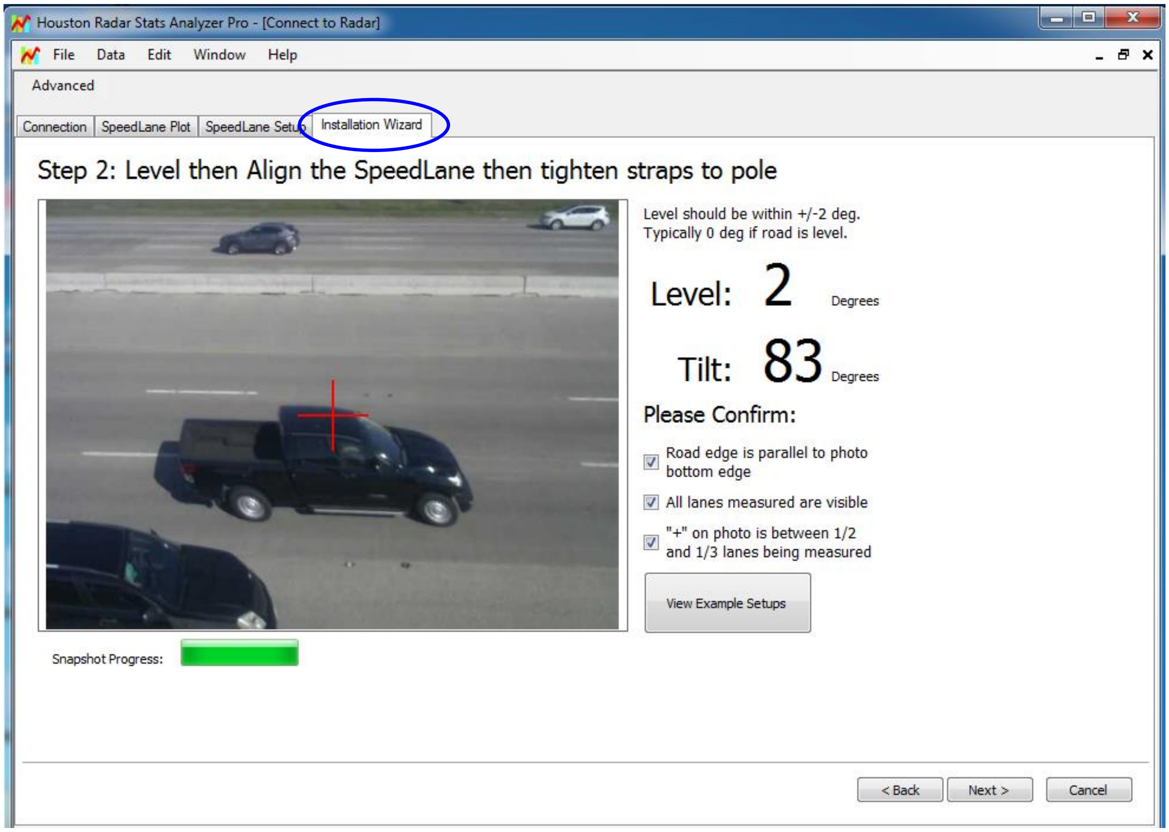
You must have the Ethernet or 3G modem option to stream and view live video. If you are not connected over Ethernet then the "View Video" button will not be visible. You may still take a snapshot via a serial or Bluetooth connection.

Leveling the Speedlane Pro during installation:

The Speedlane Pro includes an **electronic level gauge** that can be read via the provided software. Level gauge should be used to level the Speedlane Pro parallel to the road surface during installation. Together with the camera this facilitates proper pointing and alignment.



We highly recommend using the Installation Wizard to complete the installation and initial setup of the SpeedLane. The Wizard will guide you through all the steps required to properly align the unit and setup lanes. You may then click thorough the remaining setup tabs in the configuration tool to finish configuration.



Hookup:

<u>Power Input:</u>

The Speedlane Pro radar features wide operating input voltage range of 9VDC to 28VDC. Optional POE is another way of powering the unit. In a typical application SpeedLane Pro may be powered from a nominal 12V DC source and will feature best in class operational power consumption of 0.9 Watts (please see Speedlane Pro SPECIFICATIONS for additional details). There is no other single or dual beam radar in the world that even comes close to this ultra-low power usage. Competing products may consume up to 10 times more power.

This ultra-low operational power translates directly into a longer battery life or gives you an option to power the unit from smaller batteries and smaller solar panels.

Note: The radar employs aggressive power saving measures that include turning off parts of the circuit that are not being used at any instant. To get a true measure of the power usage of the circuit use a multi-meter that has an averaging function and does not suffer from autoranging “hunting” during measurements. Without averaging function, you will get current readings that fluctuate.

The power supply for the radar must be capable of supplying up to 2W (160mA at 12V) of current for up to 30 seconds at a time. Startup current is higher than operating current as the radar is initializing its internal systems.

You may alternatively power the Speedlane Pro via “Power Over Ethernet” (PoE) option. This option must be purchased when ordering the Speedlane Pro from the factory and is an additional feature for the Ethernet option. Please note that since the Speedlane Pro uses only 4 wires for Ethernet, you must use the “power over data pairs” standard. This is referred to as 802.3af. Mode A/ Type 1 POE.

Alternatively, you may purchase Speedlane Pro with a built-in Lithium Ion Phosphate (LiFePO4) rechargeable battery. The battery may be charged from an external solar panel, from 24V AC to DC adapter connected to solar input or from POE. Additionally, it is possible to charge the battery from an external 12V battery connected directly to regular power input found on 12-pin M12 connector. This feature may be used to augment the runtime of the Speedlane Pro internal battery by adding an inexpensive external lead-acid battery.

Serial Connection:

The Speedlane Pro features universal serial interface that can be configured as RS232, RS422 or RS485. The baud rate can be set to any of the following: 9600, 19200, 57600, 115200, 230400. When in RS422/RS485 mode, 120 Ohm termination can be turned “On” or “Off”. When in RS232 mode, RTS/CTS flow control can be turned “On” or “Off”. It is recommended to use full duplex (4 wires plus ground) RS422 mode for wire runs exceeding 100 feet. Use of half-duplex (2 wire plus ground) RS485 is discouraged and is relegated to legacy applications. Whenever possible, use high baud rate (e.g. 115200) to allow real-time display of the targets. RTS/CTS flow control is not required by the radar. Use it only when a host device (computer or modem) needs it.
Serial interface can be used to communicate via supplied Windows configuration program, our “C” or C# SDK, access statistics data and configure the unit as explained later in this document.

Wire Signal Descriptions

12-pin M12 connector: Power, RS232, RS422/RS485, Ethernet

Connector Pin #	Signal Name	Direction (wrt Radar)	Color	Description
1	Data+/RTS/TX+	Output	Brown	Software configurable: RS485 Mode: Data+ RS232 Mode: RTS RS422 Mode: TX+
2	Data -/TXD/TX-	Output	Blue	Software configurable: RS485 Mode: Data- RS232 Mode: TX RS422 Mode: TX-
3	RXD/RX+	Input	White	Software configurable: RS485 Mode: N/A RS232 Mode: RX RS422 Mode: RX+
4	CTS/RX-	Input	Green	Software configurable: RS485 Mode: N/A RS232 Mode: CTS RS422 Mode: RX-
5	+VCC	DC Power	Yellow	+9VDC to +28VDC power
6	Reserved1	N/A	Grey	Do not connect
7	DC Return	DC Return	Pink	Radar “-“/ground (battery “–“ terminal)
8	Reserved2	N/A	Black	Do not connect
9	Ethernet TR+	Output	Red	Ethernet TX+
10	Ethernet TX-	Output	Violet	Ethernet TX-
11	Ethernet RX+	Input	Grey/Pink	Ethernet RX+
12	Ethernet RX-	Input	Red/Blue	Ethernet RX-

We recommend purchasing our optional high quality M12 cable. It is 40 ft long and breaks the signals out into DB9, power barrel and RJ45 Ethernet. Signal pairs are appropriately twisted to preserve signal integrity and the PUR jacket is designed to withstand wide temperature range.

DB9 female connector pinout:

DB9 Pin Number	Signal Name	Direction (wrt Radar)	Description
1	+12V DC	Input	Radar "+" power supply. Connect to battery +9.0VDC to +28VDC.
2	Data-/TXD/TX-	Output	Software configurable: RS485 Mode: Data- RS232 Mode: TX RS422 Mode: TX-
3	RXD/RX+	Input	Software configurable: RS485 Mode: N/A RS232 Mode: RX RS422 Mode: RX+
4	Reserved1	N/A	Do not connect
5	GND	Input	Power return, system ground. Connect to battery "-".
6	Reserved2	N/A	Do not connect
7	CTS/RX-	N/A	Software configurable: RS485 Mode: N/A RS232 Mode: CTS RS422 Mode: RX-
8	Data+/RTS/TX+	N/A	Software configurable: RS485 Mode: Data+ RS232 Mode: RTS RS422 Mode: TX+
9	N/A	N/A	Do not connect

Barrel DC Power Connector pinout:
Pin 1 (inside terminal) "+", radar positive power connection
Pin 2 (outside terminal) "-", radar negative power connection, radar ground
Note: power and ground pins on DB9 connector are also wired to the barrel connector. If you supply power over barrel connector this power rail will also show up on pins 1 and 5 of DB9 connector.

RJ45 Connector pinout:
This is a standard 100 Mbaud Ethernet connector.

Initial Setup

We highly recommend using the Installation Wizard to perform the initial setup. It will walk you through all the essential steps required to setup the unit correctly.

The Installation Wizard is included in the supplied configuration software. A training video for the wizard is available online and we highly recommend that you watch it before installing the SpeedLane.

You must initially configure the radar for your intended application at the installation site to ensure proper operation. At least an appropriate clutter time constant should be selected, clutter map initialized. Optionally lanes could also be defined. If lanes are not defined, the radar will still log each vehicle in the "targets" database table, but periodic summary information in the "histogram" tables will not be saved. You will also not be able to use our Windows Stats Analyzer program to generate reports. In general, radar works better with lanes defined. **We highly recommend setting up lanes in the radar.**

Selecting Clutter Time Constant and Performing Clutter Initialization

Use provided Windows Configuration Utility to set clutter time constant (CTC). Clutter time constant should be 5-10 times longer than the maximum expected duration of the stopped traffic. For example if a vehicle stops in front of the radar for a maximum of 1 minute, CTC should be set to 5-10 minutes. After the time constant is set, wait for clear road and initialize clutter map. Clutter map initialization takes 15 seconds. Occupancy should be low during this time. Clutter map initialization is not absolutely required. Without initialization it will take the radar about ten CTC to initialize the clutter map on its own and start operating normally.

*Clutter map must be re-initialized after adjusting radar pointing, height or location. Re-initialization is **not** required after adjusting lanes.*

We highly recommend using the Installation Wizard to perform the initial setup and again after any changes to the physical installation. It will walk you through all the essential steps required to setup the unit correctly.

Defining Lanes

Use provided Windows Configuration Utility to define lanes. If lanes are not defined, the Speedlane Pro will still measure per vehicle speeds, range, lengths and travel direction. You may also obtain per direction average speeds via the SQL interface.

However lane occupancy, gap and average speed will not be recorded and lane activation features will not operate. You only have to define lanes that you are interested in.

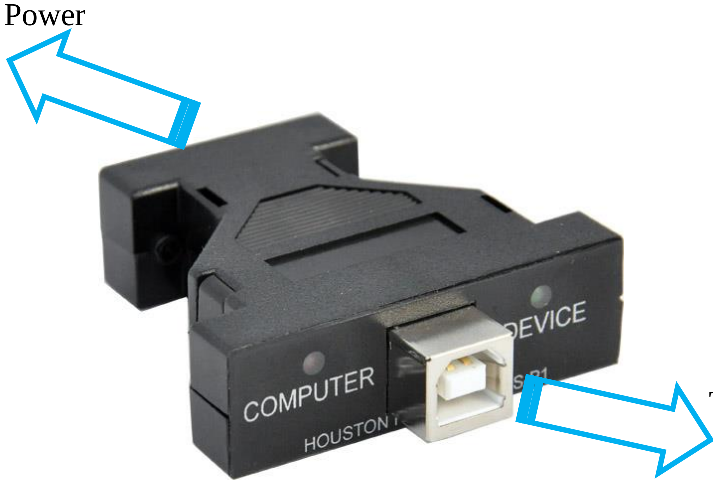
Optimal Performance Checklist

- ✓ Tunnel and under overpass locations should be avoided.
- ✓ The radar should be rigidly mounted to minimize wind action.
- ✓ Radar should be pointed across the direction of traffic (side-firing) so that the side of passing vehicle is visible to the radar and vertical angle adjusted to cover all configured lanes.
- ✓ The radar should be within +/-2 degrees level to the road surface.
- ✓ The radar beam should be within +/-5 degrees from perpendicular to the direction of travel of the vehicles.
- ✓ Radar should be mounted high enough to “see” over the top of the highest expected target. At least 17 feet of height is recommended in case of truck traffic. This requirement increases as you try to detect far lanes.
- ✓ Appropriate background clutter compensation time constant must be selected and clutter map initialized.
- ✓ Lanes should optionally be configured and stored in the radar.
- ✓ “RSS” (return signal strength) should be checked for targets in all lanes to ensure at least 3 out of 5 bars.

Configuring the Radar via the provided Houston Radar Configuration Tool GUI:

1. Install the provided Houston Radar Advanced Stats Analyzer Windows program on a Windows 7, 8 or 10 computer. Both 32 and 64 bit versions are supported.
2. Connect the radar RS232 port to the PC's RS232 serial port. If the PC does not have a serial port you may purchase a USB to serial converter dongle (e.g. from BestBuy or any Internet store). You may alternatively connect via the built-in Bluetooth wireless connection or Ethernet if you purchased that option.
3. Power up the radar. **Wait about 35 seconds for the unit to power up and initialize**. Power must be provided externally unless you have purchased and are using the Houston Radar powered USB dongle (part #USB-RS-P1) which provides a COM port to the PC and boosts the USB 5V to 12V for the radar all in a single device.
4. Start the Houston Radar Stats Analyzer program.
5. Click on "Connect to Radar" button. "Connect to Radar" window will pop up.
6. Select desired connection method and click on "Connect To Radar" button.
7. Ensure you see a "Radar found on" and "Radar System Information" pop-up windows. Review the content and close both windows by clicking "OK".
8. Now you are ready to configure the radar.

To Radar RS232 + 12VDC Power

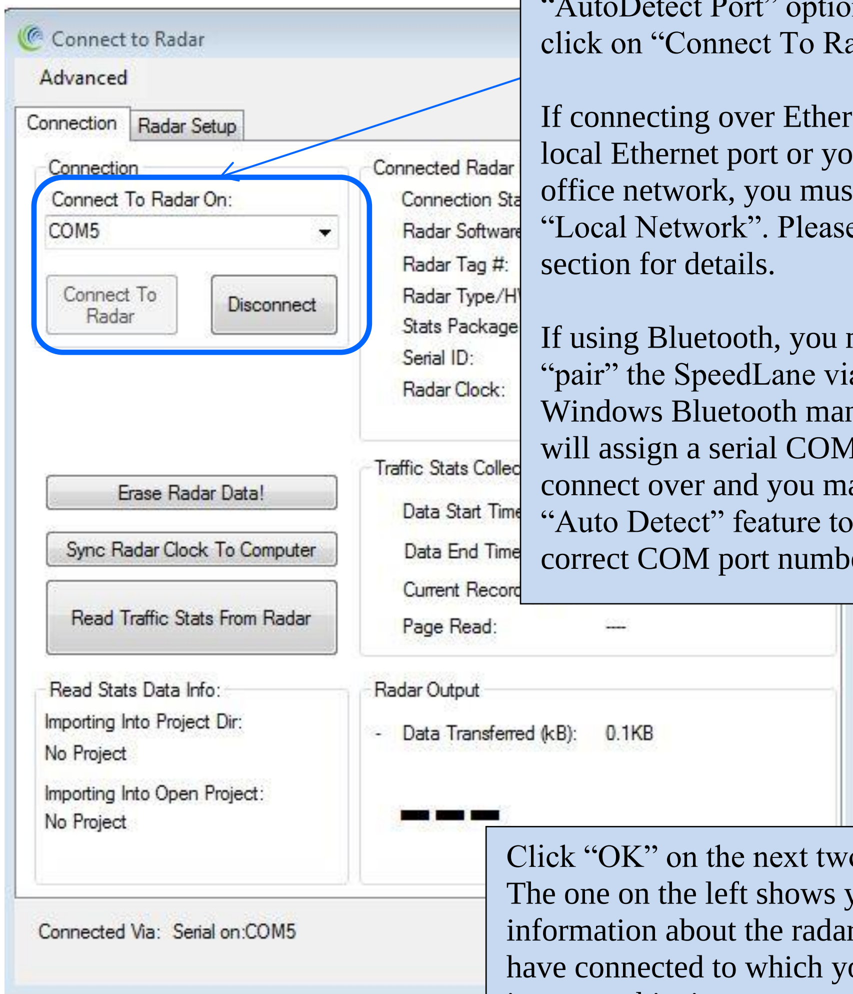


To Windows PC USB port

Houston Radar USB-RS-P1 USB powered RS232 interface to the radar.

For a quick and easy connection from a Windows computer to the radar, we suggest purchasing our USB-RS-P1 powered USB dongle (shown above). This device connects to a USB port on a Windows computer and provides a RS232 connection and 12VDC power to all Houston Radar devices. You can be up and talking to the radar within a few minutes of receiving your device.

Connecting to The Radar

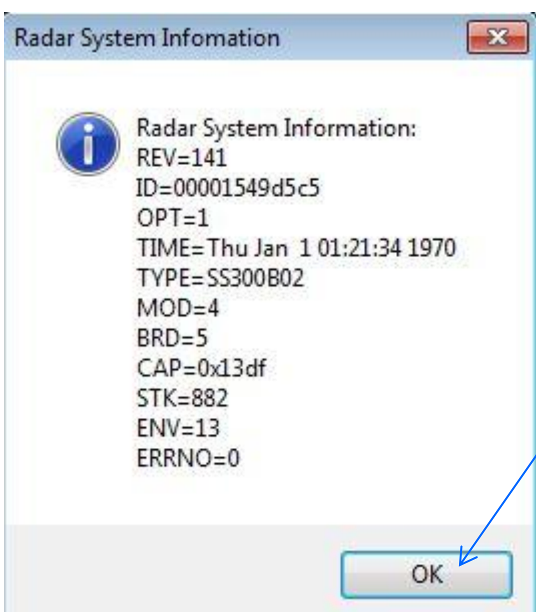


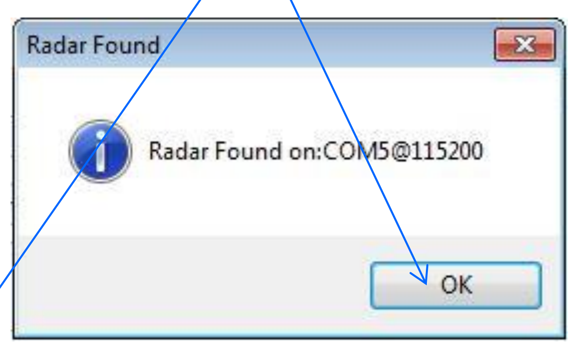
Select your COM port (or "AutoDetect Port" option) and then click on "Connect To Radar".

If connecting over Ethernet on the local Ethernet port or your local office network, you must pick "Local Network". Please see later section for details.

If using Bluetooth, you must first "pair" the SpeedLane via the Windows Bluetooth manager. This will assign a serial COM port to connect over and you may use the "Auto Detect" feature to find the correct COM port number.

Click "OK" on the next two boxes. The one on the left shows you information about the radar that you have connected to which you may ignore at this time.





Setup Tutorial Video

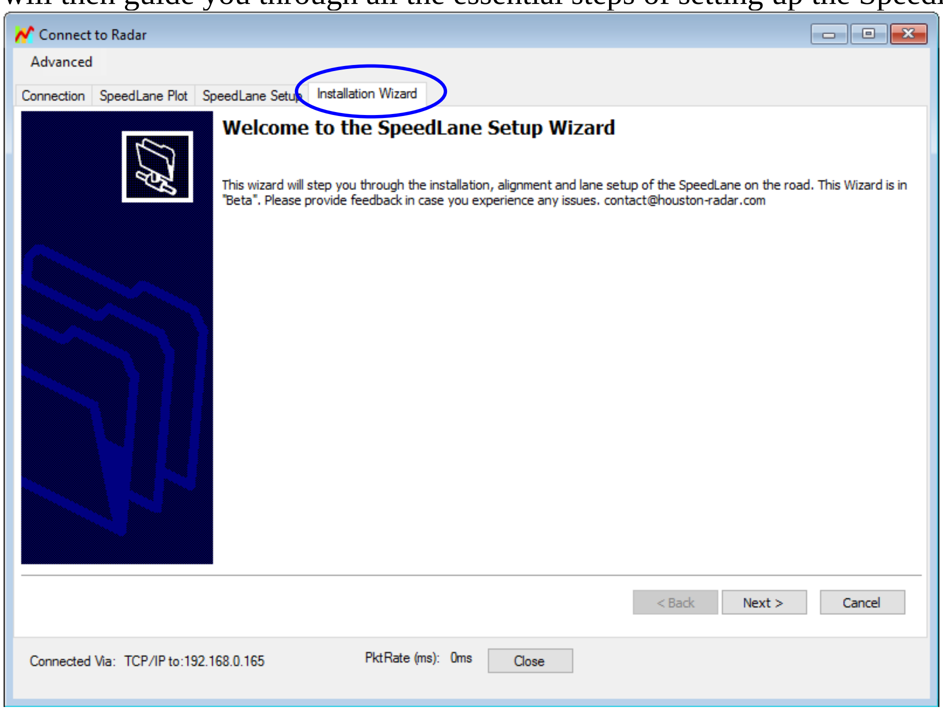
A step by step installation and setup training video is available. We highly recommend watching this video before attempting to install the Speedlane Pro.

https://youtu.be/Tc072PymqRQ

Speedlane Installation Wizard

Using the Installation Wizard

After radar is found, click on the "Installation Wizard" tab to access the Wizard which will then guide you through all the essential steps of setting up the Speedlane Pro.

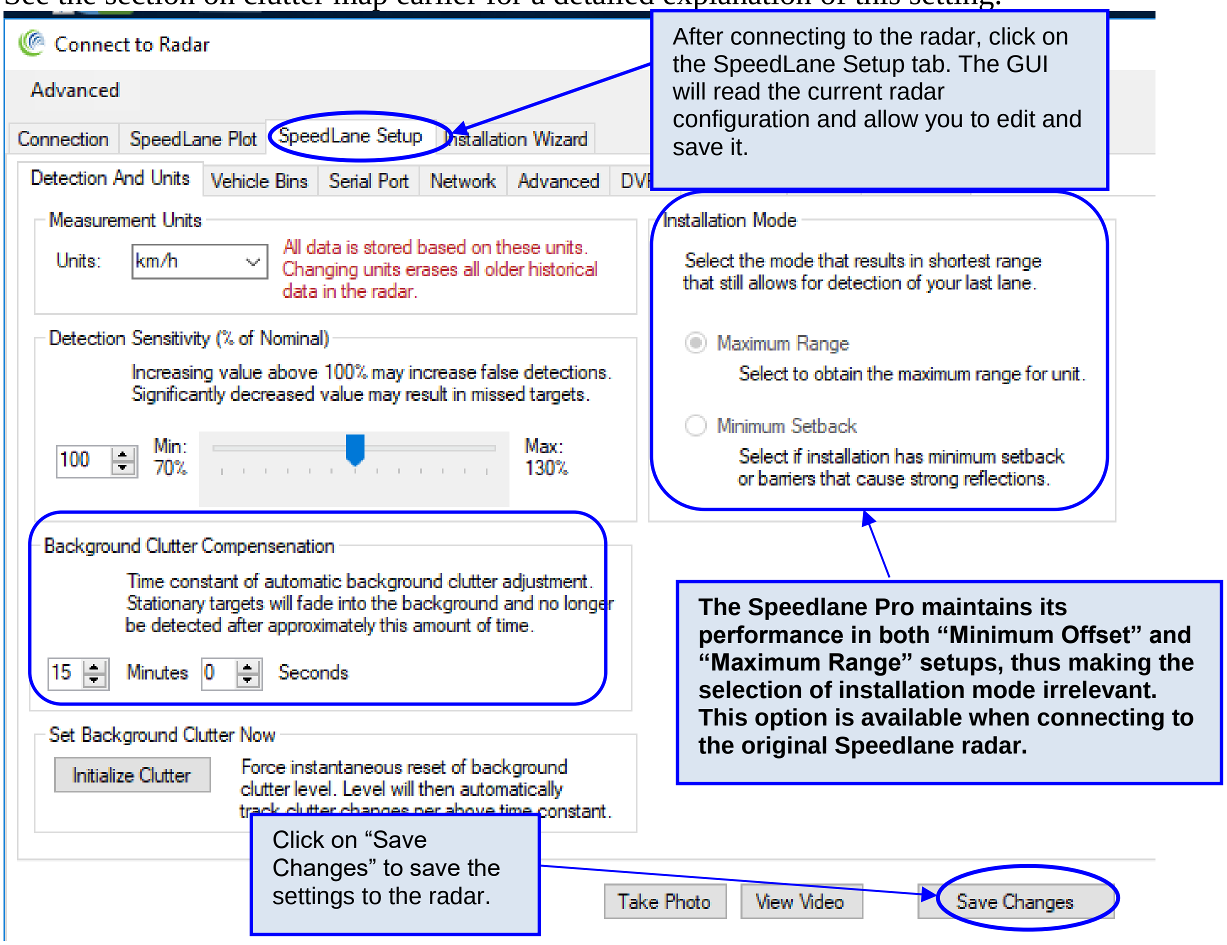


The following instructions shows the steps to take if you wish to bypass the Wizard.

Speedlane Pro Basic Application Setup

STEP #1: Select background clutter time constant and Installation Mode

See the section on clutter map earlier for a detailed explanation of this setting.



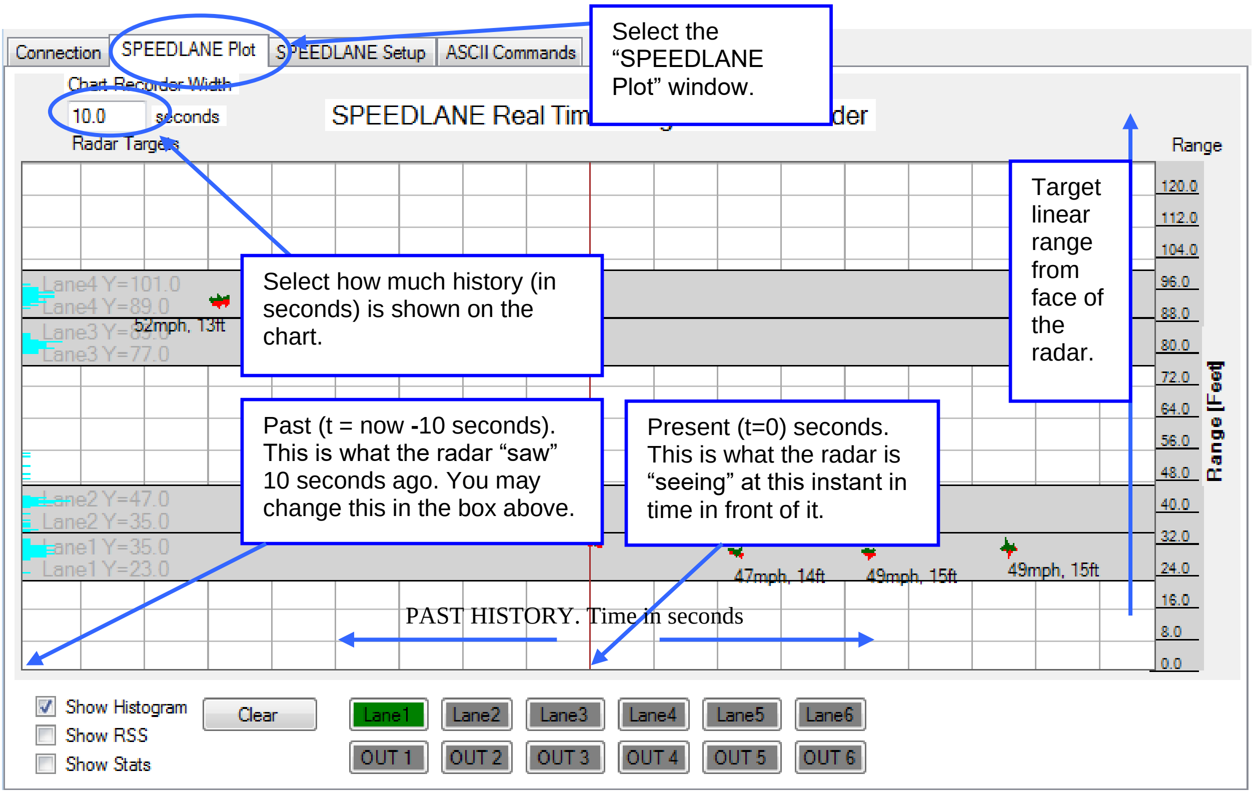
STEP #2: Initialize clutter to correct startup value.

The Speedlane Pro continuously adjusts clutter map to account for changes in the background with the time constant specified above. However, to speed up the process, it’s advantageous to preset the initial clutter level and eliminate fixed targets when no real targets are present in the radar’s view.

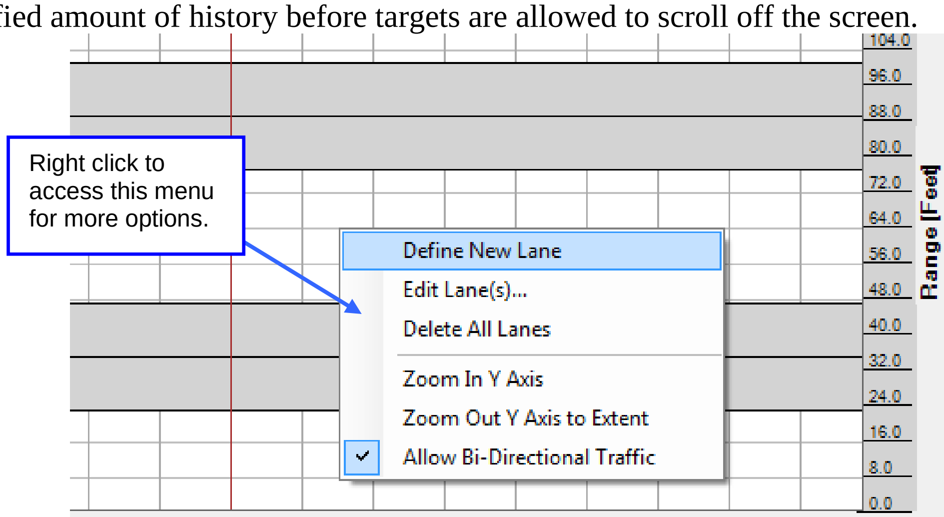
To do this, ensure radar is securely mounted in desired position, wait for the field in front of the radar to clear of any real targets and then click on the “Initialize Clutter” button in the screen shown above. If you now click over the “Speedlane Pro Plot” window, no new targets should be streaming from the x=0 (right most) side. Of course you may still have older targets showing on the plot but they will scroll eventually off the chart. **You should re-initialize clutter if you make any changes to the radar mounting (height or angle).**

STEP #3: Check target signal strength and location on the real time range plot.

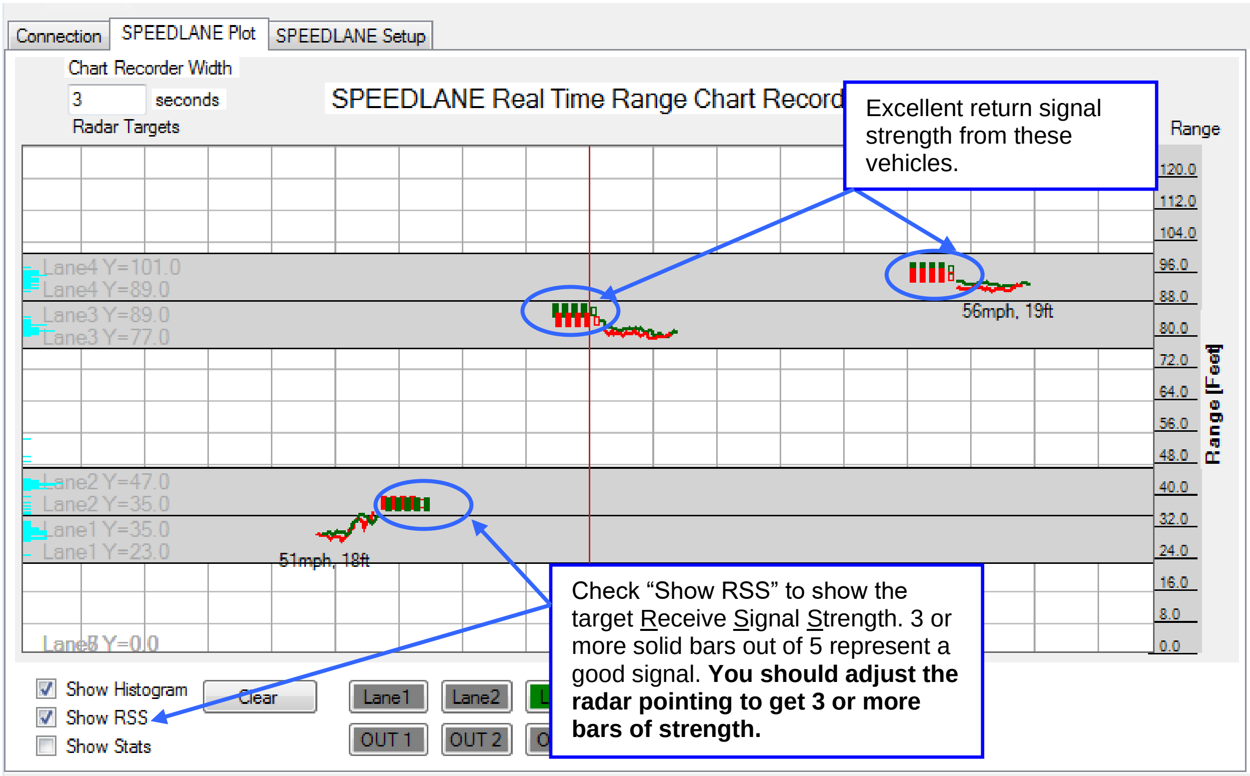
After initializing the background clutter map in the SPEEDLANE Setup Tab, click on the "SPEEDLANE Plot" tab. This will bring up a real time "chart recorder" type plot of tracked targets as shown below.



Please review the layout of the real time range plot above. All the targets that dual radars detect will be shown here as red and green lines. The actual real-time range is plotted. Every red and green line is a target that is tracked by the two radars. The plot keeps track of a specified amount of history before targets are allowed to scroll off the screen.



Check Target Signal Strength:



Typical Real Time Chart Recorder View Showing "RSS"

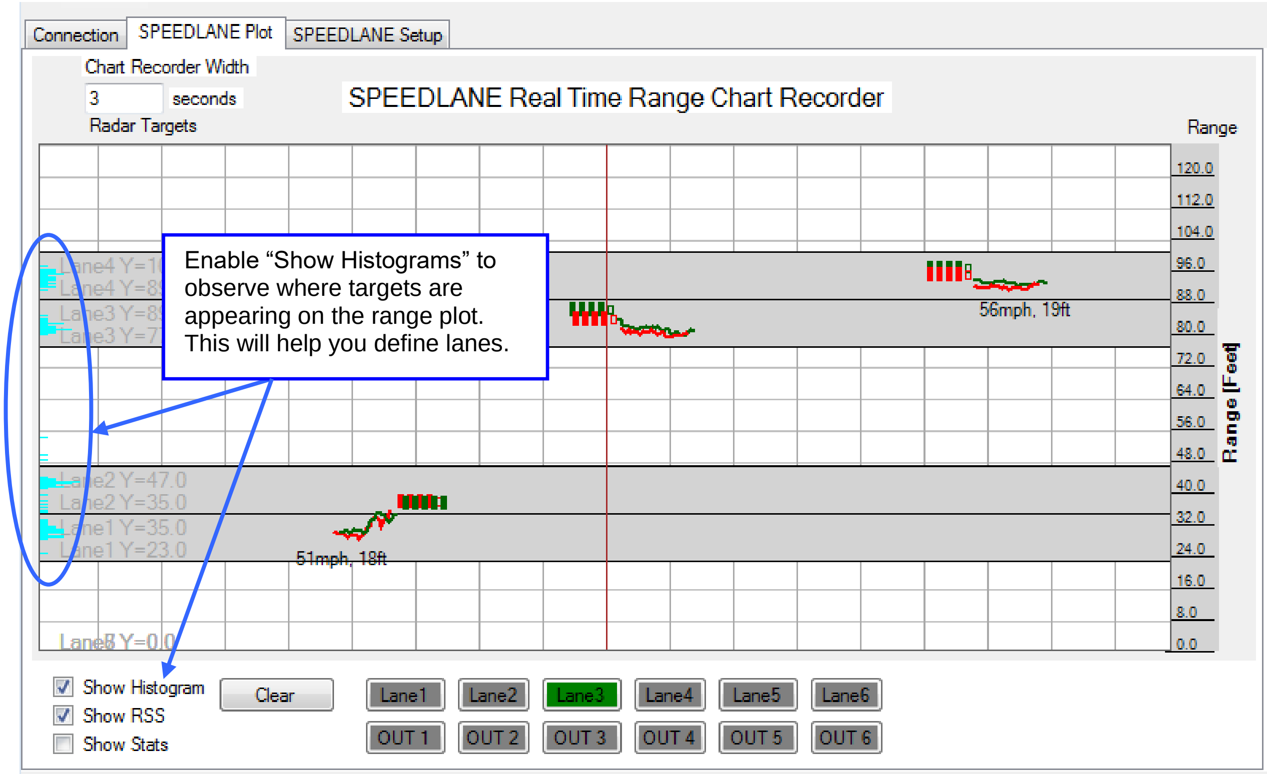
You should enable the "Show RSS" (**r**eceived **s**ignal **s**trength) checkbox to view the signal strength of the return signal from the visible targets.

Note excellent signal strength from each of the shown targets. Each red/green track (a target from both radars) has at least 3 or more filled "RSS" bars. Lower signal strength may indicate a problem with radar installation and/or pointing.

Stationary targets (e.g. curbs, poles etc.) will fade into the background clutter and disappear from view with the "Background Clutter Compensation" time constant. Thus it's very important to set the clutter time constant to a value that is at least 5 to 10 times longer than the normal expected presence time of real targets in front of the radar.

If the targets have inadequate signal strength (e.g. less than 3 bars), then check the following:

- *Is the radar oriented to point at exactly right angle to the vehicles?*
- *Is the pitch (tilt or up/down) pointing correct so that the lanes of interest are centered in the camera frame?*
- *Is the Clutter Time Constant (CTC) value sufficiently large for the presence time of the traffic in front of the radar?*



Typical Real Time Chart Recorder View Showing Lane Location Peaks

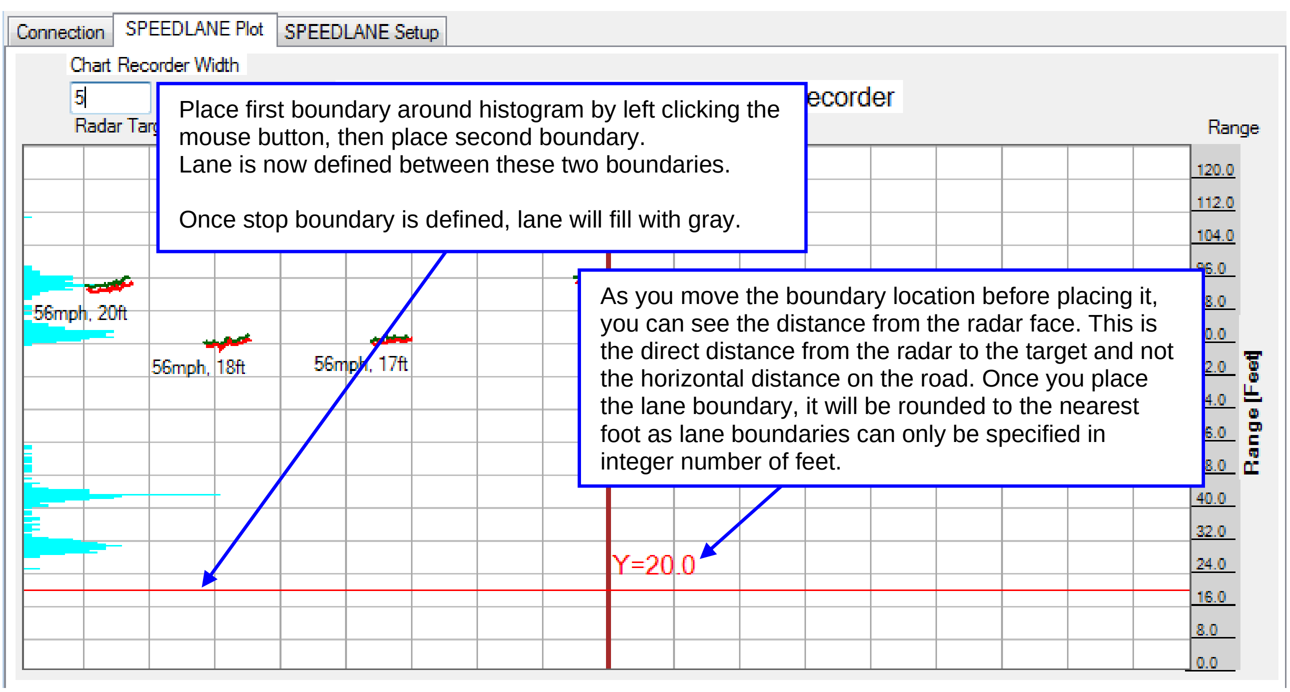
To help determine where to draw lanes, you should enable the "Show Histogram" checkbox. For every target detected the histogram grows by one pixel when the target is no longer in front of the radar. *Note that this feature is a visual guide and is not used by the radar or the Windows software to automatically determine lane locations*.

Targets observed in the last 3 seconds (this is a user setting in the box on the top left) show up as red/green tracks while older targets that have already scrolled off the screen are contributing to the height of the blue histograms on the screen left. As can be clearly seen from the histograms, traffic has created four clearly defined groups. Each group corresponds to a lane on the four-lane highway. Defining lanes is as simple as drawing them around the histogram peaks as shown in the next section.

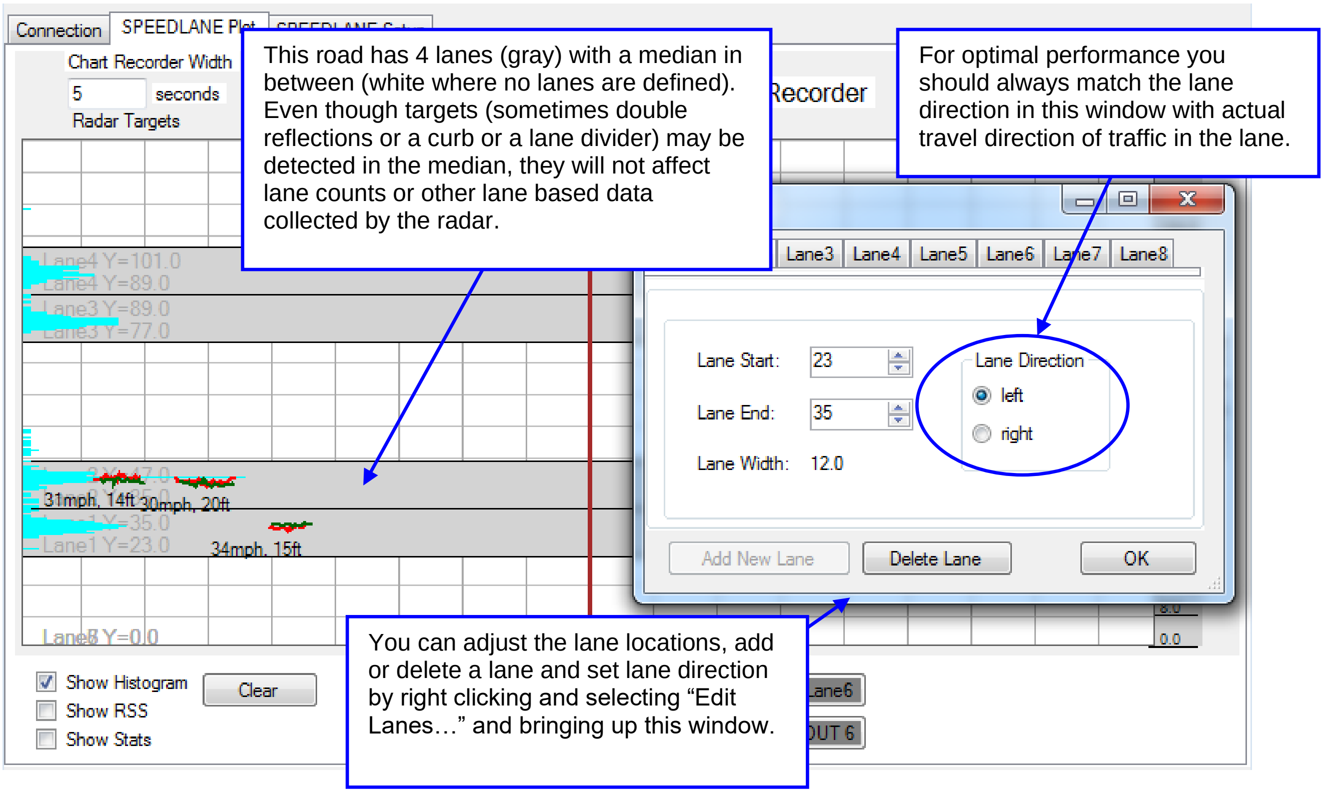
Typically, for a given target length and speed, further targets will result in longer tracks due to the beam diverging as it propagates away from the radar. This can be seen on the example screen shot above.
Similarly, faster targets, all other things being the same, will result in shorter tracks.

Note: The scrolling speed of the target lines is based on the amount of history you select to view. It is not an indication of the speed of the target on the road.
Additionally, even though the SpeedLane can determine direction of travel of the target, by default the targets will always scroll in the direction specified by the lane during setup.
If a target is not in a lane, it will always scroll from right to left.
This may be modified in the future to scroll targets as determined by the radar.

Speedlane Pro Live Lane Setup Step-By-Step Example:



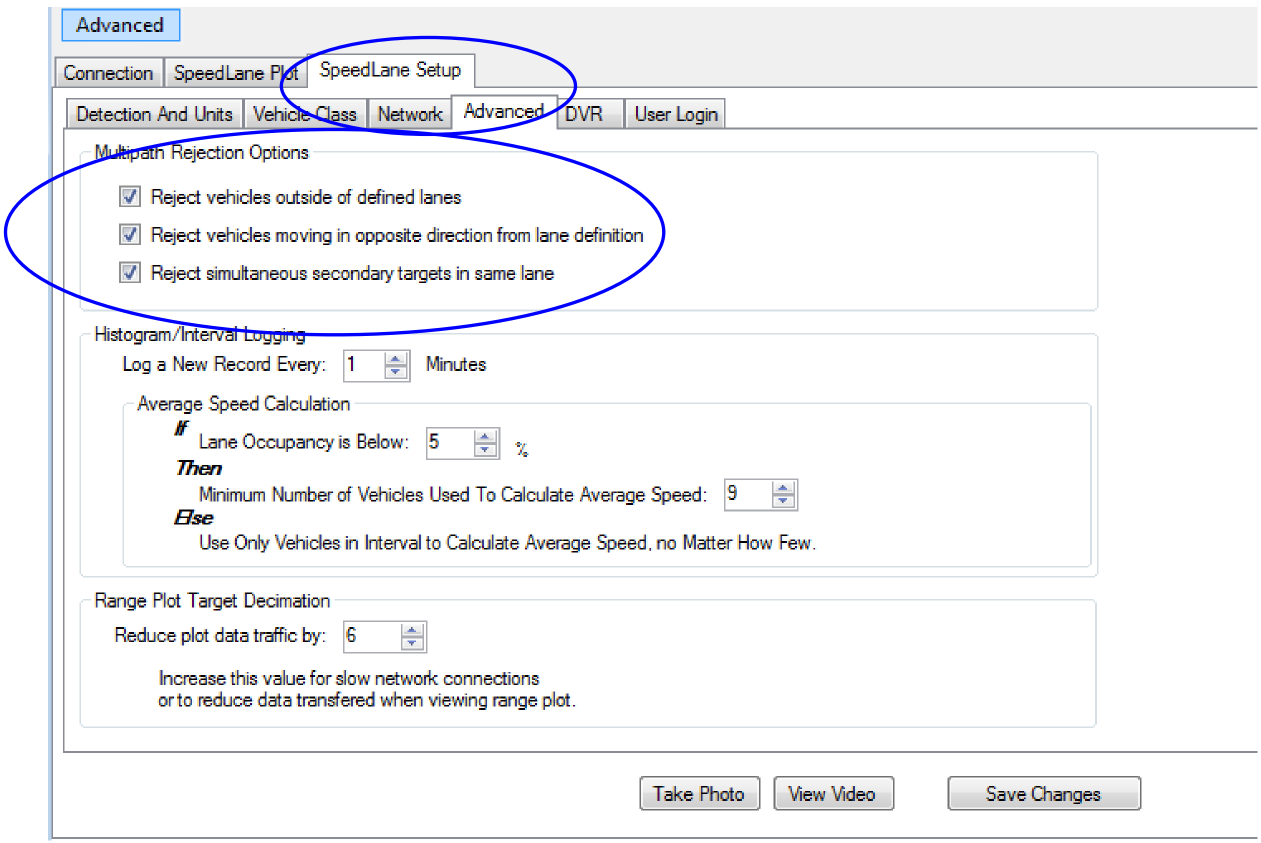
Speedlane Pro Live Lane Setup Step-By-Step Example Continued…



<u>Improving Performance in Installations with Multi-Path Reflections:</u>

Multi-path reflection is a common occurrence in many radar installations. This effect is due to the radar signals taking different paths to and from the target and arriving at different times back at the sensor. This can result in the appearance of "ghost" targets. The Speedlane Pro features 3 different configuration options that may be enabled as required to deal with this issue and improve performance in an installation.

We recommend turning on the following options as required <u>after all lane setup has been performed</u> as described in earlier section. These options should be first disabled before adjusting the lane setup or before initiating the lane setup if device is moved to a different location. <u>If you use the Installation Wizard, this is done automatically for you</u>.



Setting Up Interval Data Vehicle Length and Speed Bins

The SpeedLane Pro measures all vehicles on an individual range, lane, travel direction, speed and length basis. This data is stored in an onboard power fail safe SQL database that holds the last 1 million vehicles detected. Older data is deleted to make space for the new vehicles. ***All reports generated using the Houston Radar Stats Analyzer Windows program use this individual target data***.

In addition to the individual targets, the SpeedLane Pro also records “Interval Data”. An interval is a user defined period of time that generates a record with accumulated data over the last user specified interval (one minute or slower). The last 3 months of data are retained. The following parameters are computed over the past interval and saved in the onboard SQL DB:

- Per lane aggregate counts
- Per lane average speed
- Per lane 85th percentile speeds
- Per lane average headway in milliseconds
- Per lane average gap in milliseconds
- Per lane road occupancy (percentage of time the lane in front of the radar had a vehicle present)
- Per lane aggregate counts by user defined length bins
- Per lane aggregate counts by user defined speed bins

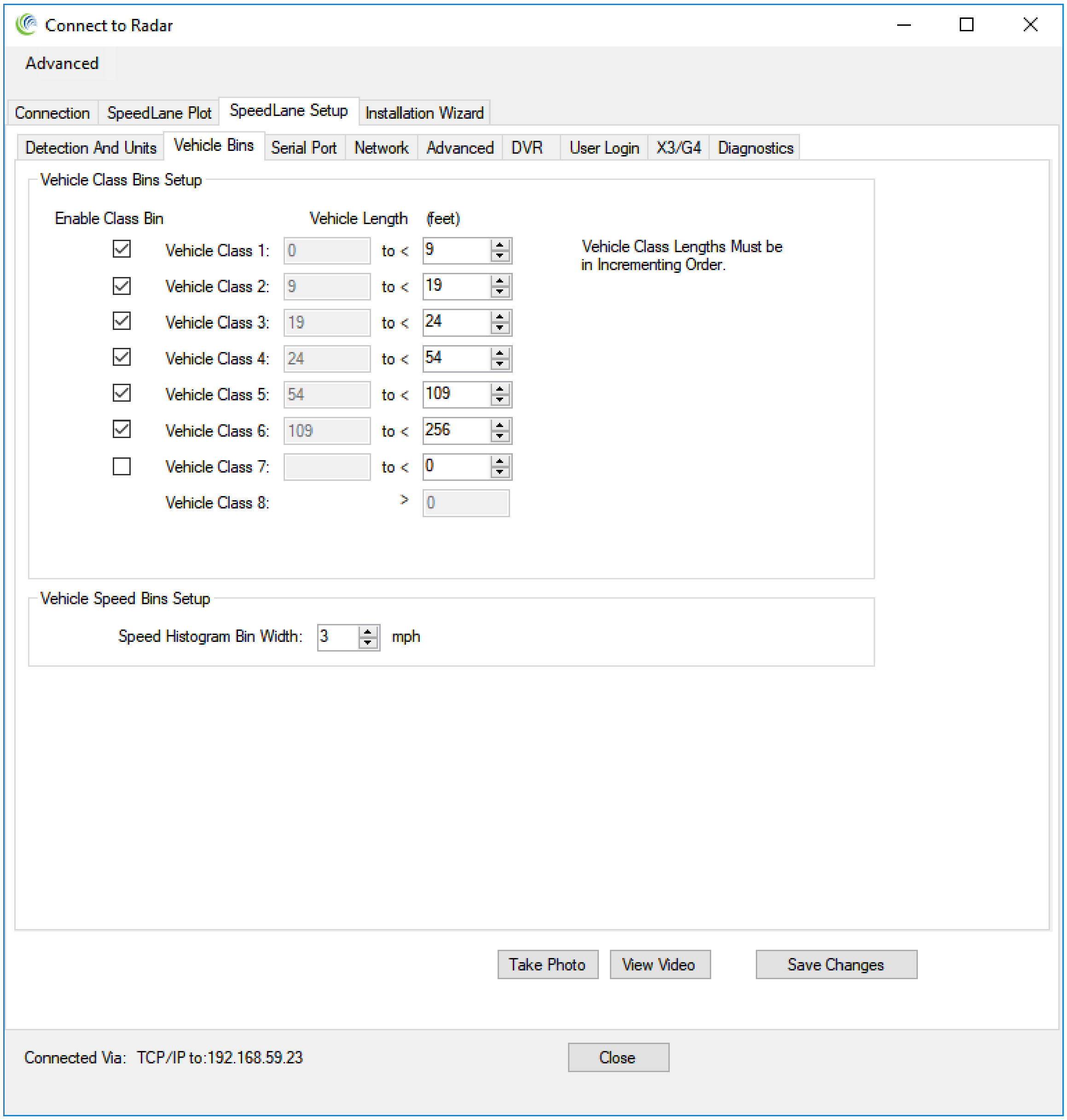
Vehicle lengths are rounded and binned into a maximum of 8 user defined bins for length measurement.

The minimum recordable length for a 4 wheeler (or larger) vehicle is 9 feet in US customary units and 274 cm in metric units.

All motorcycles are rounded to 8 feet in US customary units or 244 cm in metric units (regardless of the actual length of the motorcycle).

If you wish to separate out motorcycles, you should set the 1st length bin to 9 feet for US units and 2.7m for metric units.

All reports generated using the Houston Radar Tetryon cloud server use the interval data and not the individual target data. You may choose to upload the individual targets data by syncing the “targets table” (see Tetryon user manual) but this data may only be downloaded as “Raw .csv” file from the Tetryon. Also note that targets table can be as large as 100 Mbytes.



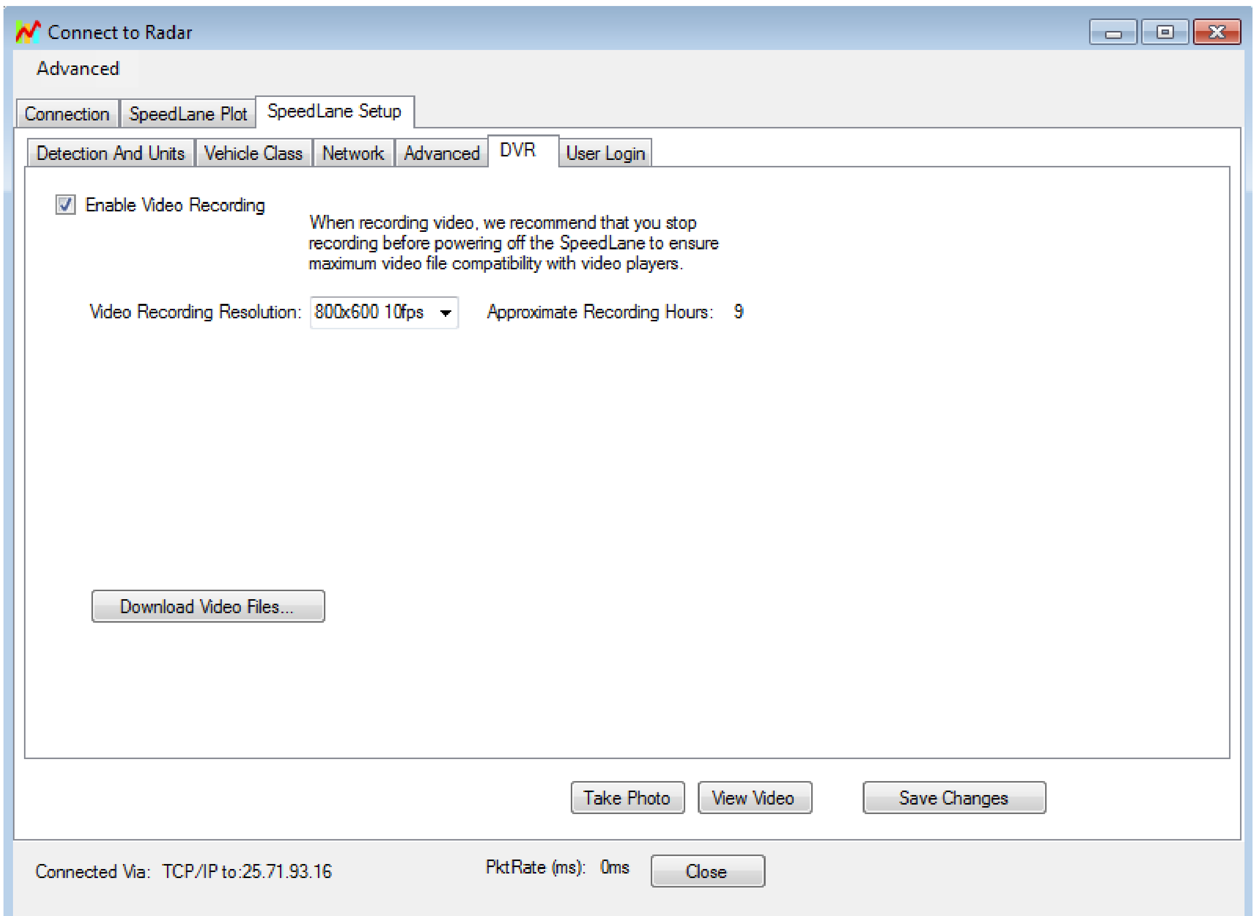
Note: The 2nd column in the GUI above reflects the “up to but not including” bin boundary. So as shown above, the 1st length bin will record only 0 to 8.999 feet targets which are motorcycles.

Recording Video in the Speedlane Pro:

The Speedlane Pro supports, as an option, recording video for the last "n" hours. The amount of video recorded depends on the option purchased. Options of up to 9 or 16 hours of video recording may be purchased.

This video is recorded onto internal memory and then downloaded via the Ethernet interface at a later time.

The Ethernet option must be purchased as well to allow a download interface for the recorded video.



In-Radar Logs:

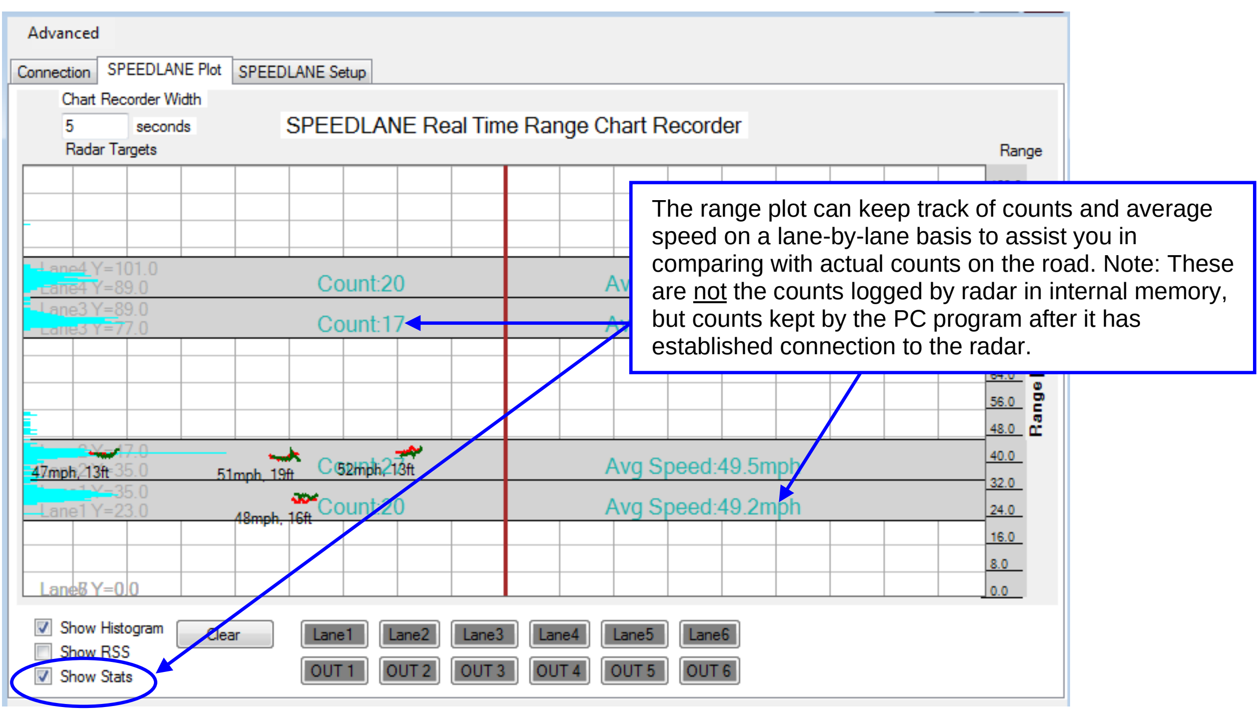
The Speedlane Pro keeps a date/time stamped log of each of the last ***one million vehicles*** in an internal SQL database. For each vehicle, as a minimum the following information is stored:

Date/Time
Vehicle speed in native units (mph or Km/h, configured via the UN variable or GUI)
Vehicle travel direction
Vehicle length in native units (feet for US customary or cm for metric)

Additionally, for each defined lane the following information is stored based on the value specified in seconds in the "BN" variable.

Total vehicle counts
Average lane speed
Average lane gap between vehicles
Average lane occupancy
85th percentile speed
Counts of vehicles by user defined speed bins
Counts of vehicles by user defined length bins (class)
Counts of vehicles by direction

This database may be queried by an external user/host using our binary protocol which is available under a no-cost license. Please contact us for more information.



The Real Time Range Chart Recorder Plot has a helpful "Counts and Average Speed per lane" feature that you can use to verify the accuracy of lane-by-lane counts during initial setup.

Retrieve data using the built in Bluetooth wireless interface:

You must have a Bluetooth adapter on your computer to make a Bluetooth connection. Bluetooth is indicated by the icon in the task bar.

We highly recommend using a <u>Class I</u> USB Bluetooth adapter even if your computer already has a built-in Bluetooth adapter. Built in adapters are usually 10m range <u>Class II</u> adapters and will only allow a connection if you are next to the radar. The Speedlane Pro has a high performance very long range Class I adapter that will perform best when paired with the provided Class I adapter.

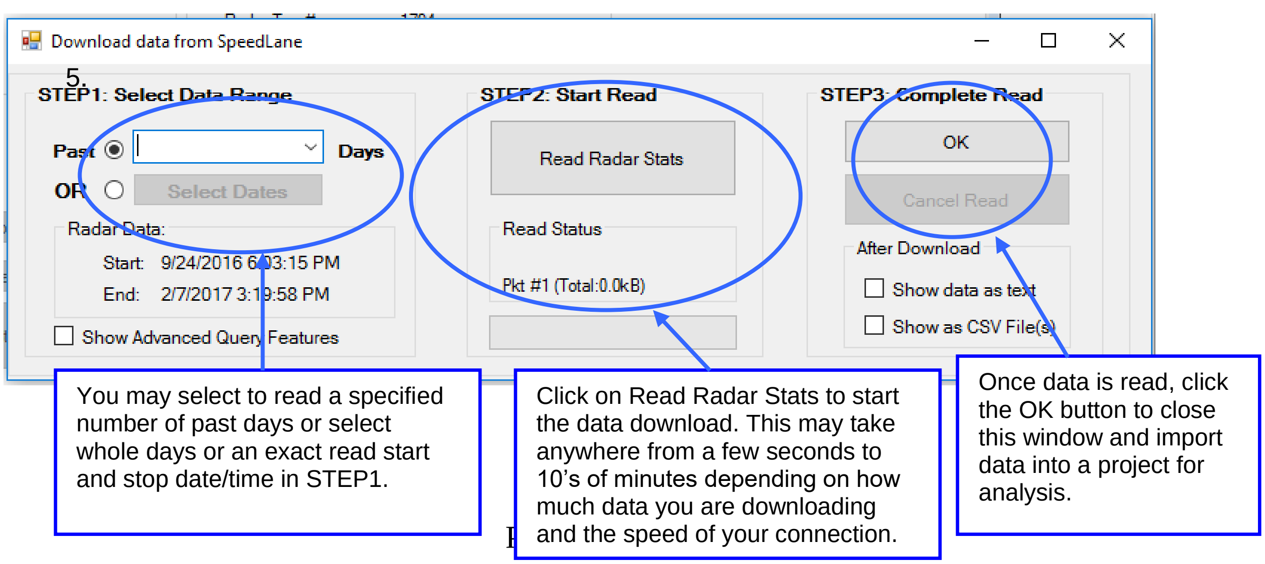
If you have **previously paired** your computer's Bluetooth adapter with the Speedlane Pro, you can **skip to the next section**. If this is the **first time** you are connecting to this particular box, you must **first pair the two Bluetooth** adapters.

1. Open the Bluetooth interface on your computer by clicking on the icon and then scan for devices (or click on "`Add a device`"). All Houston Radar Bluetooth device names start with "***HR-BT***" and the complete and unique name is also printed on the box. **<u>You must pair once with each Speedlane Pro from your PC.</u>**
2. Once the scan locates the Speedlane Pro, right click and select "pair" and establish the connection. Windows will then assign a COM port to this paired connection. A pairing key is not required but in case it is requested, **enter 1234**.

An Android app is also available in the Google Play Store that will allow you to connect, take snapshots and configure the Speedlane Pro via a smart phone or Android tablet devices.

Reading Historical Data from Speedlane Pro

1. Connect to the radar by clicking "Connect To Radar" button.
2. Once connection is established, click on the "Read Traffic Stats From Radar" button.
3. Accept default filename or enter your own filename and folder. Default file name is very convenient as is contains radar serial number and download date/time.
4. The following query Window is shown. You have a choice to run a predefined query for the most common types of data, or to use an advanced option where you may run your own custom query against the database. For predefined queries you can select the type and amount of data to import.



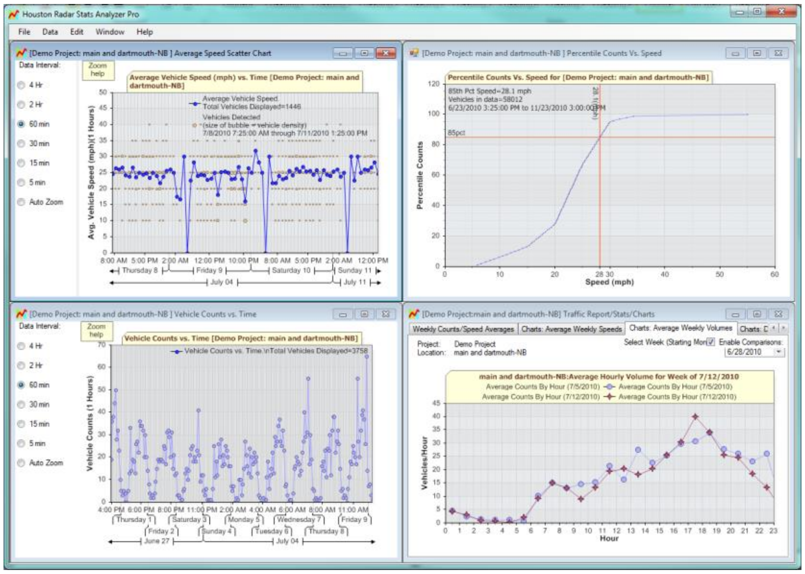
After you click the “Read Radar Stats” button, progress is shown and all data is saved in a .dat file. This .dat file may then be imported into the Stats Analyzer and detailed reports and graphs generated. Once you click OK, you will be provided an opportunity to import the .dat file into a project via the Data Import Wizard.

If you check the “Show Advanced Query Features” checkbox, the actual SQL commands issued by the Windows program to the SpeedLane are also shown in the SQL command box above. This is for reference only and can serve as a useful hint in case you would like to issue your own custom SQL queries against the database. The ability to respond to an SQL query against all logged data is an extremely powerful feature of the SpeedLane as it allows you to retrieve selected detailed, aggregate or summary datasets directly and quickly without having to download all the target data first.
Please contact us if you wish to use this feature and need more information or examples of queries you can run.

Analyzing Data

Please refer to the ***Houston Radar Advanced Stats Analyzer user manual*** (supplied as a PDF file) on provided USB memory stick for a detailed tutorial on analyzing the data.
The latest version of this file is also available on our website at:

http://www.houston-radar.com/user-manuals/HoustonRadarAdvancedStatsAnalyzerUserManualRelease.pdf



Scan the QR code with smart phone to download manual in pdf format.

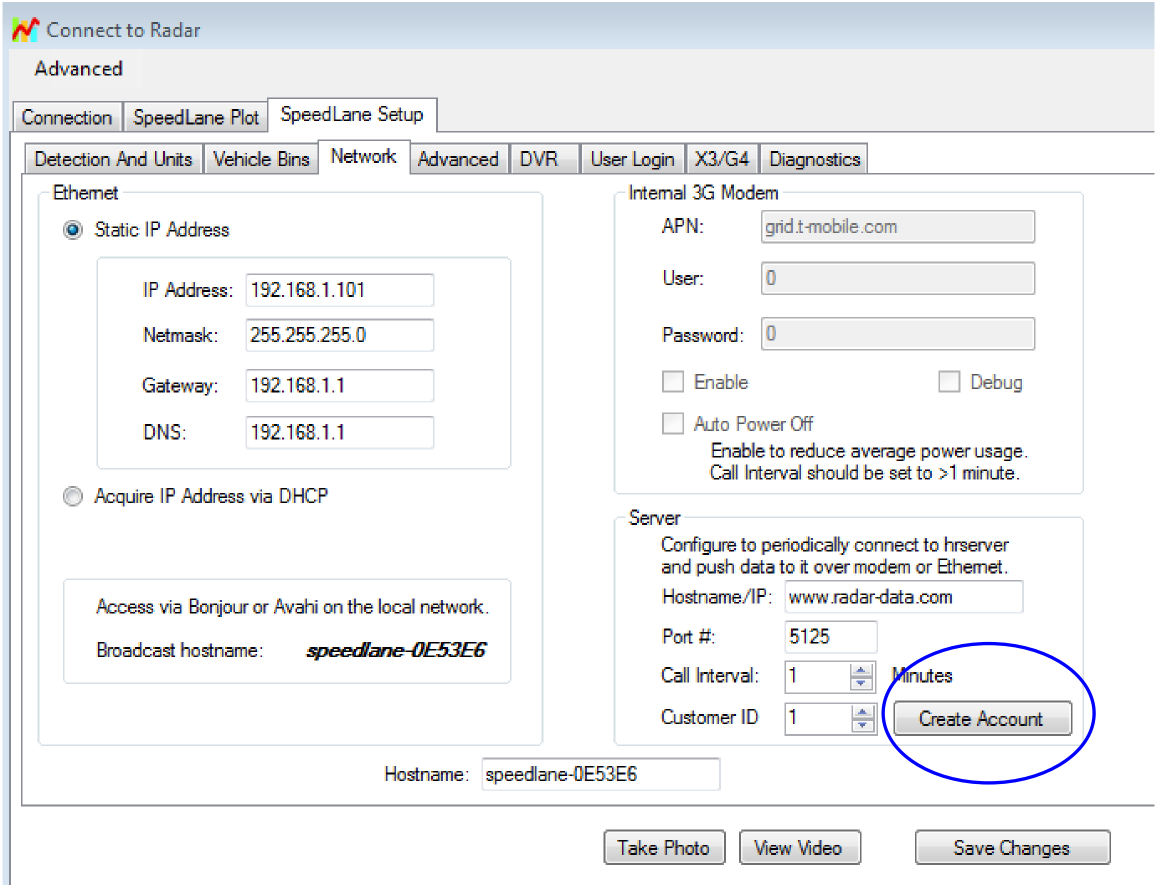
Collecting Data with Tetryon Cloud Server

The Speedlane Pro can periodically connect to a Houston Radar "Tetryon" server over TCP/IP network interface like Ethernet or built in 3G modem. The cloud server software is available to our customers' for installation on their own Linux servers or we may host it for you as a service.

Multiple Speedlane Pro radars can connect and push data to a single Tetryon server. Thus the server will aggregate data from multiple units in a centralized SQL database. Data is segregated per customer account.
Tetryon users can generate live or historical reports and charts via web browser. See an example demo video here:

http://houston-radar.com/videos/radar-data.mp4

To connect to the demo server and request an account, connect to a Speedlane Pro and then click the "Create Account" button on the "Network" tab as shown below.
Alternatively, click on the following link:
http://www.radar-data.com/newaccount



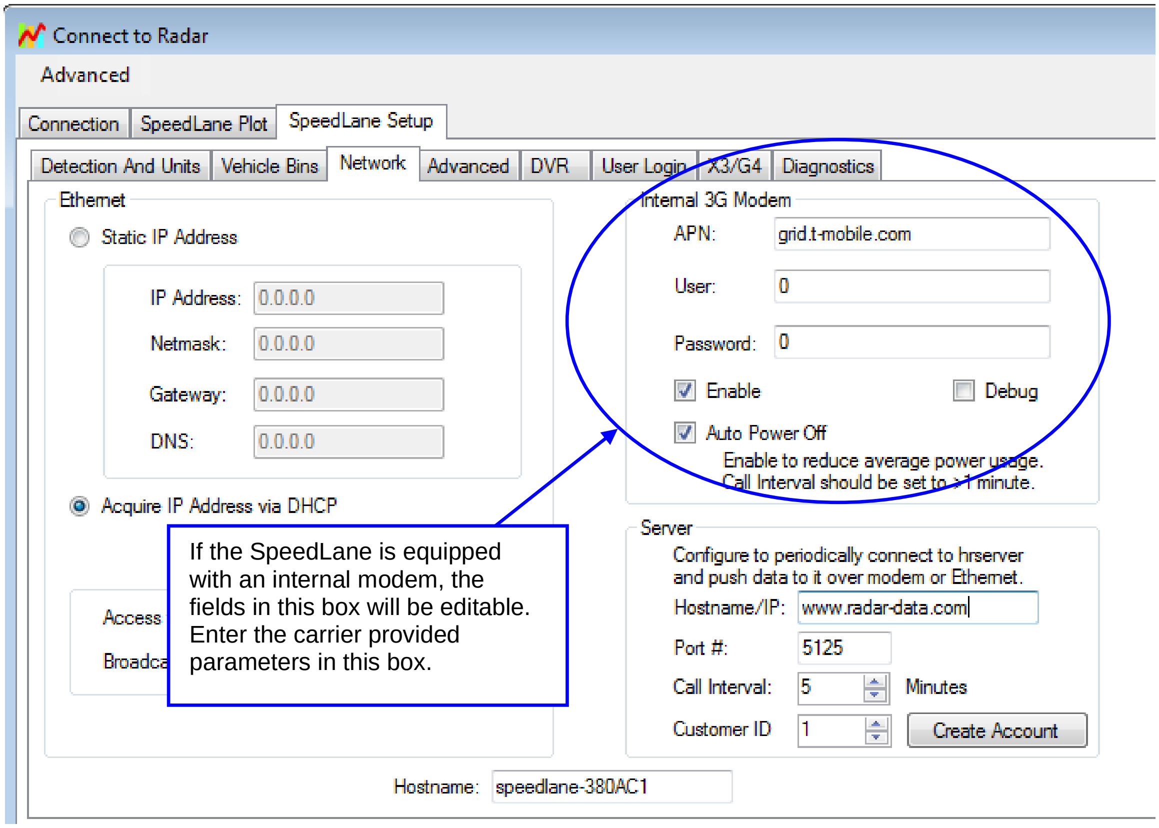
Using the Built-in 3G Modem

The Speedlane Pro can be ordered with a low power consumption, high bandwidth built-in modem. This modem is compatible with all GSM networks around the world. This is the most convenient method to push data to the server, especially when paired with the built-in rechargeable battery and solar charger. This forms a “monitoring node” that can be deployed in tens of minutes literally on any road in the world and provide traffic data on the network. There is no need for trenching or digging or even a junction box on the pole. Only Speedlane Pro and a small solar panel is required to monitor the road and send traffic data.

The modem power can be regulated and enabled only when new data is to be pushed to the server. This is a user configured setting and may be as frequently as once per minute or as infrequently as once per day.

This approach drastically reduces the average power usage of the modem.

For example, if new data is only required once every 15 minutes and it takes approximately 45 seconds for the modem to power up, connect to the network and transfer the new data, the average duty cycle of the modem will be around 5%. Thus the average power usage of the modem is only 22mW for a total Speedlane Pro power usage of only 0.922W.

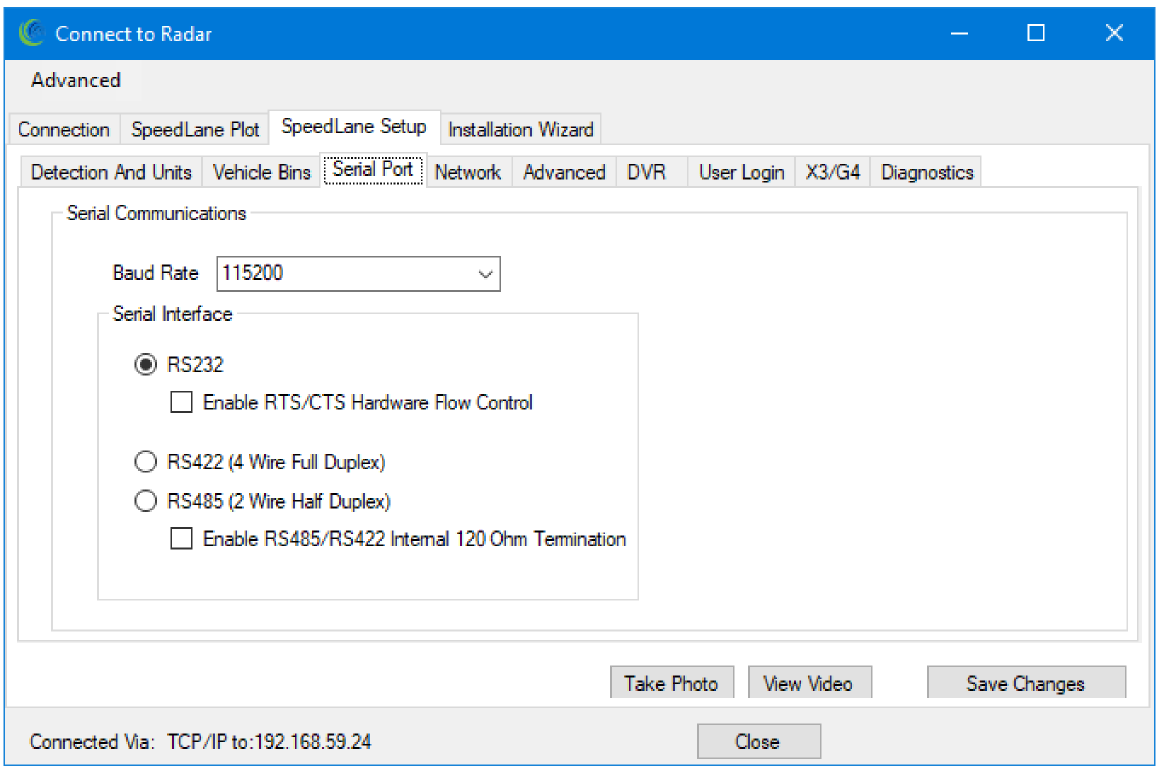


Configuring Serial Connection Baud, RS232 or RS485

Default from the factory, the serial interface in SpeedLane Pro is configured as RS232. For long range connections (e.g. exceeding 100ft/30m) you may reconfigure the interface as half duplex RS485 or full duplex RS422. Termination resistors may be switched on or off via the GUI - there is no need to open the unit and change any physical jumpers.

To configure, navigate to the SpeedLane Setup tab and then to the Serial Port tab. You may configure the baud rate and set interface as RS232, 4-wire full-duplex RS422 or 2-wire half-duplex RS485. For RS232 you may turn RTS/CTS hardware flow control on or off. For RS422/RS485 modes you may turn on/off 120 Ohm termination.

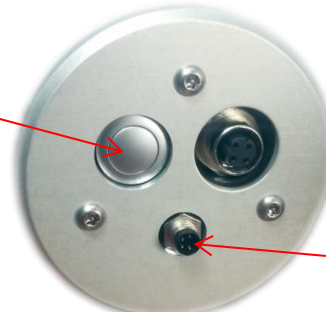
If you plan to use RS485, we highly recommend using the 4-wire full duplex RS422 mode as the SpeedLane Pro requires a full duplex connection to the Houston Radar Windows Program. Half duplex mode may be used for legacy polling protocols like the RTMS X3/G4.



Speedlane Pro with Built-In LiFePO4 Rechargeable Battery and MPPT Solar Charger

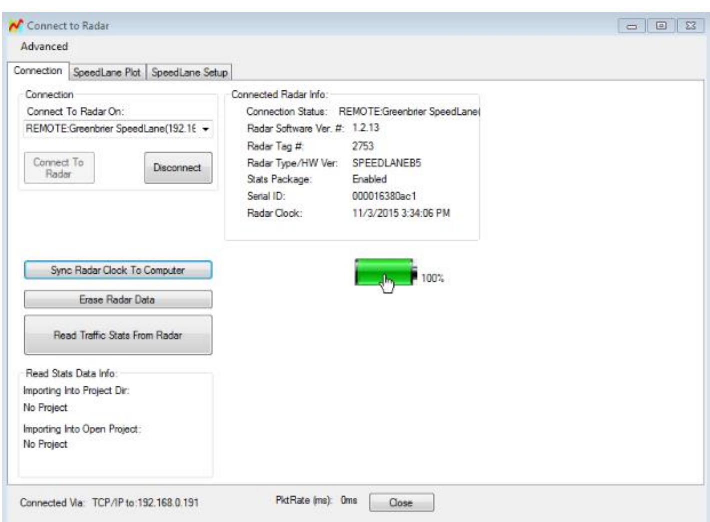
If you purchased a Speedlane Pro with the Uninterruptable Power Supply (UPS) option or a Solar Power package, the device has an on-board high performance LiFePO4 rechargeable battery and a high-performance maximum power point technology (MPPT) charger. The battery charger will utilize any power source connected to the radar to charge the battery: 12-24V DC power on 12-pin M12 connector, POE or solar panel / fast DC charger on 4-pin M8 connector.
For ease of wiring, solar panel (or fast DC charger) is connected via dedicated IP67 rated 4-pin M8 connector as shown below. Only 2 pins of this connector are utilized. The other two pins should not be connected as they may be utilized for other features in the future.

On/Off Battery Switch.
Recessed= ON
Flush (as shown)=OFF
Only affects the battery! The unit will still run with switch OFF when an external power source is connected.



IP67 Rated M8 Connector for 12V nominal solar panel or provided external +24VDC charger. Do not exceed 24V.

Solar-enabled radars are supplied with M8 solar cable and 24VDC fast charger. Solar cable has bare leads on it, marked "+" and "–" for connection to an external 12V (nominal) solar panel.
Battery charge is indicated via the battery icon on connecting with our Stats Analyzer. Click on the battery icon to get a real-time update on the battery charging or discharging status.



Speedlane Pro SPECIFICATIONS

General

Operating Band	K-Band
Occupied Bandwidth	24.020 GHz to 24.230 GHz (opt. 24.050 GHz to 24.250 GHz)
RF Power Output	5mW
Antenna Beam Pattern	7x74°
Max Range	255 feet (78m)
Range Resolution	0.28 inch (0.7 cm) under ideal conditions to a large target
Polarization	Linear
Supply Voltage	9VDC to 28VDC 6.2V undervoltage and 28.5V overvoltage protection shutdown
Power Consumption:	
Base System:	0.98 Watts fully operational (82mA @ 12V)
With Ethernet:	1.2 Watts with Ethernet cable connected (98mA @ 12V)
With Camera Enabled:	2.2 Watts streaming video over Ethernet (185mA @ 12V)
Recording Video	2.0 Watts recording video without Ethernet connected
With 3G Modem:	(built-in modem is option)
On-line	1.2 Watts
Uploading	1.3 Watts
Operating Temp.	-40°F to +167°F (-40°C to +75°C) -4°F to +131°F (-20°C to +55°C) for units with LiFePO4 battery
Weatherproof	Yes, NEMA 4X Polycarbonate enclosure with M12 and M8 IP67 weatherproof connectors.

Camera

Type	1.3 MP color video camera with optical barrel distortion correction
Field of View	60°
Supported Resolutions	1280x960, 800x600, 640x480, 320x240
Video Recording	800x600 10fps

Ethernet Option

Type	100 BaseTX FD/HD Auto MDX

PoE Option

Type	802.3af. Mode A/ Type 1 (power over data pairs)

Bluetooth

Type	Class I long range (typically 800+ feet outdoors)
Antenna	Onboard chip antenna

Approvals

Approvals	FCC, CE Mark, IC, NCC

Data Interfaces

1x Serial, software configurable:
- RS232, RS485 or RS422
- CTS/RTS flow control on/off
- full/half duplex
- 120 Ohm termination on/off
- 9600, 19200, 57600, 115200, 230400 Baud

1x Class I Bluetooth 512 kbps
1x 100 MBPS Ethernet

Connectors

12-pin M12 with male pins (serial, power and Ethernet)
4-pin M8 with male pins (solar)

Mechanical

Weight	Without battery: 4.6 lb (2.1 Kg) With battery: 6.4 lb (2.9 Kg)
Dimensions	3.33" diameter x 26"L tube without brackets

Performance

Speed Accuracy

Average per lane:	+/- 1%
Average per direction:	+/- 1%
Per Vehicle:	+/- 6% for 90% of vehicles

Volume Accuracy

Per Direction Typical:	98 to 99%
Per Direction Minimum:	95%
Per Lane Typical:	98 to 99%
Per Lane Minimum:	90%
Max number of lanes:	16, user defined

Length Class Accuracy

Typical	+/-5.7ft (1.7m) or 15% whichever is larger for 90% vehicles
Max Classes	8 user defined

Lane Occupancy Accuracy

Typical	+/-10% per direction +/-20% per lane

Specifications may change without notice.

Appendix A: Connecting to the Speedlane Pro over Ethernet

Speedlane Pro implements "Zeroconf" networking (also called Avahi under Linux and Bonjour under Windows). This allows you to connect to it simply by plugging it in your local network or directly into your computer's Ethernet port. Multiple Speedlane Pro’s may be present on the same network simultaneously and they all identify themselves by unique hostnames. Additionally, the Speedlane Pro also implements a similar but custom “Houston Radar Discover” protocol which is built into the Windows Stats Analyzer program provided with the radar. Thus, you can always discover and connect to a Speedlane Pro if it is on your local area network or plugged directly into your computer’s Ethernet port.

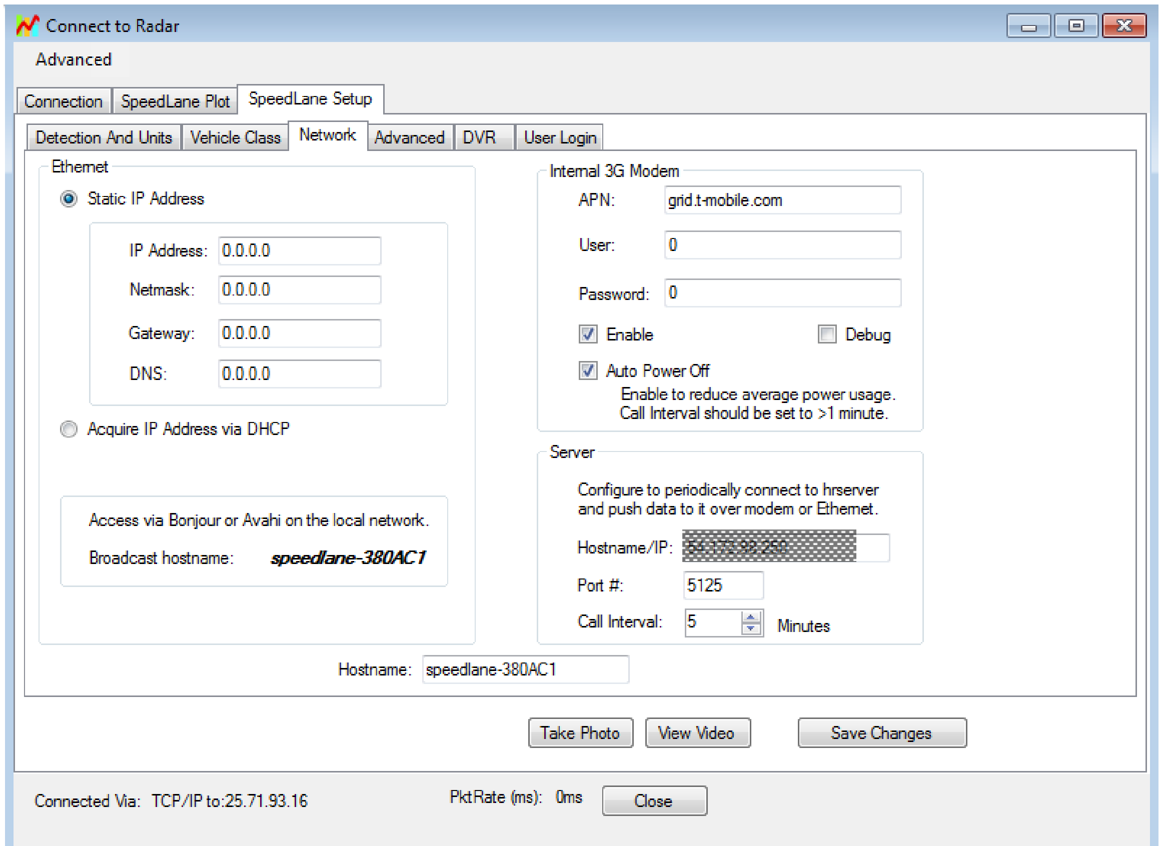
Of course, we also support static IP and DHCP configurations. If a static IP address is not configured in the device, the Speedlane Pro will first try to acquire an IP address via DHCP. If DHCP server is not available on the network, the radar will auto configure an IP address using Zeroconf in the linklocal range of 169.254.0.0 through 169.254.1.255 and respond to Bonjour and “Houston Radar Discover” requests on the network. You will be able to connect to the Speedlane from your computer even if neither have static IP addresses or are not able to acquire IP addresses from DHCP server.

Here are the steps to follow:

1. Connect the Speedlane Pro Ethernet port to your network or computer.
2. Ensure the link and activity light on your router/switch/computer Ethernet port comes on. These lights are not visible on the Speedlane unit itself.
3. In the Houston Radar Configuration/Stats Analyzer program, use Connect To Radar->[Pull Down List]. You will see your radar listed as: Localnetwork:speedlane-xxxxxx.
   Stats Analyzer searches for Speedlane Pro radars and connects using Bonjour, Avahi or “Houston Radar Discover” protocols. Note that Bonjor is no longer required to be installed on the Windows computer. In absence of Bonjour, Stats Analyzar will utilize our custom discovery protocol. **It may take up to 1 minute for the Speedlane Pro to be visible on the network after the initial power up. Discovery operation happens when “Connect to Radar” window first pops up. If the radar comes online after that, you will need to close and reopen this window. If, for any reason, you want Stats Analyzer to search network again, reopen this window.**

Assigning a static IP address to the Speedlane Pro

Assign static IP address, netmask and gateway in the Speedlane Pro via the “Ethernet” group on the “Speedlane Pro Setup->Network” tab in the GUI.



Once a static IP address is set in the SpeedLane Pro, you will not be able to talk to it using “direct connection” as described in the previous Appendix A. The reason is that radar’s static IP address will not be in the “autoconfigured” range. On the other hand, the host computer’s Ethernet port will setup an auto configured IP address (once it times out on trying to acquire an IP address via DHCP). The radar and host will be on two different network segments with no route between them. Additionally, once static IP is configured, the radar will not participate in discovery process.

You may set static IP in PC to be in the same range as radar but you will have to configure radar in Stats Analyzer as remote (use “Setup Remote Radars”). If you cannot set host static IP, you may still connect to the radar via Bluetooth or Serial.

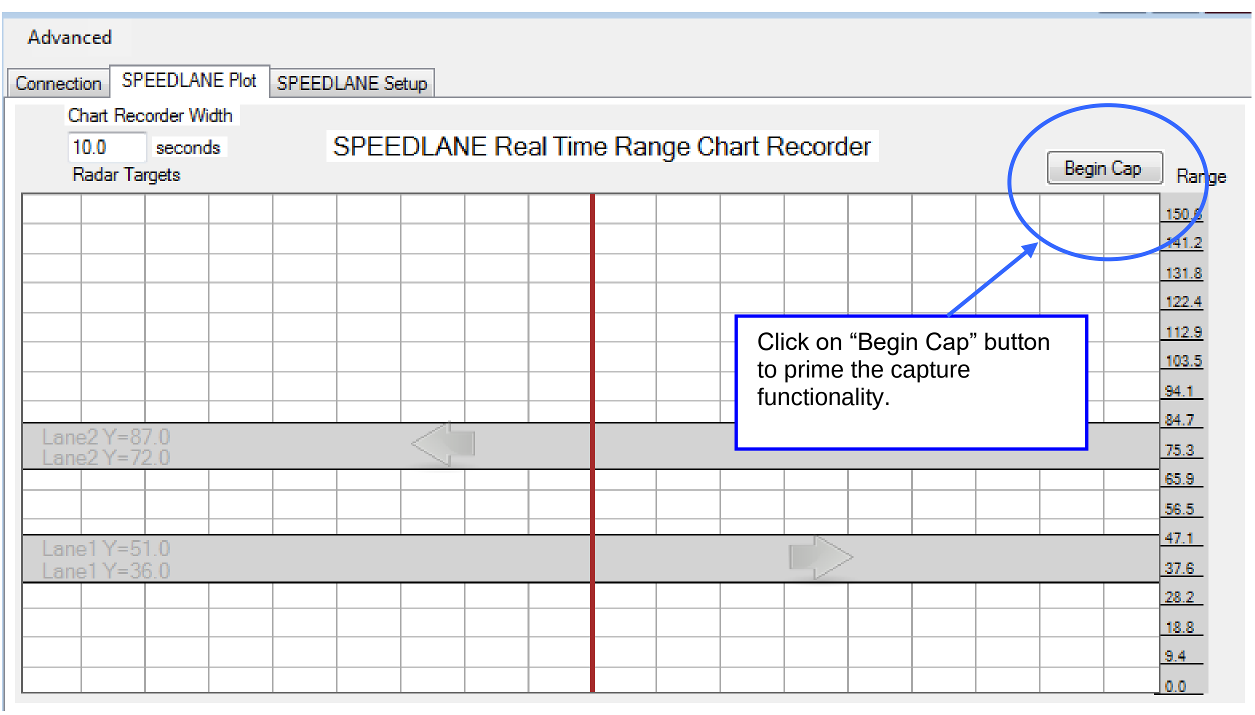
Appendix B: Capturing Debug Data on the Road

It is possible to capture 10 seconds of detailed debug data on the road, for specific detection events to email to us for diagnostic purposes. This includes all the raw radar data and synchronized video. Video is captured even if you have not purchased the "Ethernet + video" option.

This allows us to reproduce any performance symptoms the radar may be experiencing in your installation. Additionally, we can also run the data against any firmware changes/updates to see if those have rectified or improved the detection. This is a very powerful feature that allows us to be "virtually present" at the installation location with all our development tools.

For this feature please use the following steps:

1. Connect to the radar.
2. Click the Advanced->Show debug tab menu.
3. Click over to the "Speedlane Pro Plot" tab. Then click on the "Begin Cap" button as shown. This will prime the debug capture and raw data and video will start to be captured continuously into a 10 second long buffer. Data and video older than 10 seconds will be discarded.



4. Once you witness the detection you wish to capture, press the button again (which should now be saying "Stop Cap". This will save off the last 10 seconds of data.

5. Click over to the "Debug" tab, which should now be visible and click on download data.
6. Select "Captured Debug Video" and "Captured Debug Peaks" and download them to your computer. The total download data will be about 4.5MB and may be downloaded via serial, Ethernet or Bluetooth.
7. Please save the data in a separate folder on your computer and zip up and email us all the files (there will be at least 6, possibly 8 files downloaded, so it's best to save them to a new folder and then zip and email us the entire zipped folder).

Appendix C: Mounting Behind the Pole to Maximize Setback

If sufficient setback (e.g. 20 feet) is not available we recommend mounting the radar behind the pole. This will increase setback by at least the thickness of the pole. The dual radars are located near the end of the radar housing tube and a pole in the center will not interfere with the radar beams.