SpeedLane® Pro

True Dual Beam Side-Fire Traffic Sensor and Collector Technical Specification

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SpeedLane® Pro Non-Intrusive Dual FMCW Radar Based Traffic Sensor and Collector

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1.0 General

1.1 Product Description

The SpeedLane® Pro is a true dual-beam high-definition non-intrusive traffic sensor/collector, and 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. The SpeedLane Pro utilizes 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 to achieve the highest standards in the industry for performance and reliability.

1.2 Principle of Operation

The dual FMCW radars in the SpeedLane Pro 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. The Doppler shift of the return signal is taken into account for measuring a moving target. 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 the range to target and target velocity. The patented dual radars setup “virtual speed traps” in 0.375” increments 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.

2.0 Performance Objectives

The SpeedLane Pro is designed to provide:

- Best-in-class data for volume, per-vehicle speeds, average speed, 85th percentile speed, length classification, occupancy, and gap on a per lane or per direction basis, for up to 16 lanes of traffic.
- Unique identification, speed, length, direction of travel, gap measurement, timestamp, and lane assignment for each detected vehicle.
- The lowest power usage of any true dual beam FMCW radar solution.
- Sample rate of 500Hz per radar.
- The simplest, fastest, and most immediately verifiable setup and configuration in the industry through the utilization of:
    - Standard built-in onboard HD video camera
    - Standard companion Windows application with intuitive GUI for configuration of parameters which includes a display of real time plots of the targets, lane by lane counts, and accumulated target histograms
    - Standard ultra-long-range Bluetooth radio for wireless connectivity
    - Standard universal pole mounting bracket
    - A detection range of up to 255 feet (78m) for up to 16 user-configurable lanes, each with the resolution to allow for defining lanes in 1-foot (0.3m) increments.
    - Built-in 1 million vehicle statistics storage memory and 3 months of interval storage memory
- The most streamlined form factor in the industry, with no external modules required for the following options:
    - Cellular modem with GPS for remote access
    - Maximum Power Point Technology (MPPT) solar charger for the addition of solar panel charging
    - 100 Mbps Ethernet port
    - Power over Ethernet (PoE) module
    - Built-in Uninterruptible Power Supply (UPS) with 96 WHr LiFePO4 rechargeable battery

- An expansive range of installation and deployment options including:
    - Quick Adjust Clamps for ease of alignment
    - Solar charging kit with rechargeable battery, solar panel, solar panel mounting bracket, and cabling
    - PoE injector
    - Houston Radar SpeedLane Pro Cable
    - Field interface enclosure
    - Class I Microsoft Windows™-compatible Bluetooth™ dongle

3.0 Radar Detection Zone

The SpeedLane Pro's radar detection zone is defined by its 7°x74° beam and incident angle to the road surface. The strength of the target is determined by its radar cross-section (RCS) and is dependent on the target material, area of exposure, shape, and incident angle of the radar beam. The detection zone's characteristics include:

- Viewable via the standard built-in HD video camera
- Range from 6 feet (2m) up to 255 feet (78m)
    - Advanced detection algorithm allows setbacks as short as 2 feet provided radar is mounted at least 17 feet from the ground
- Can be configured for up to 16 lanes of traffic, which can be defined in 1-foot (0.3m) increments
- Automatic performance enhancement and maintenance via:
    - Automatic Gain Control (AGC) per lane to automatically adjust for weak signals, installation effects and environmental conditions
    - Automatic creation of Clutter Map for stationary targets (traffic signs, structures, fences, etc.), which are removed from the signal
    - Continuous automatic adjustment of the Clutter Map, which can be scheduled via the user-defined Clutter Time Constant (CTC); the Clutter Map adjustment rate is asymmetrical – adjusted up slowly to allow targets to fade away slowly, but adjusted down quickly to facilitate accuracy in zones with high traffic density.

4.0 Detection Zone Definition and Configuration

The SpeedLane Pro's radar detection zone is oval-shaped, and is defined by its 7°x74° beam and incident angle to the road surface. The SpeedLane Pro's built-in HD video camera provides visual confirmation of the area included within the detection zone. The beam does not end abruptly at the boundary of the detection zone but rather gradually tapers off. 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° 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 a 90° angle, for example a corner of a pickup truck bed, create a perfect reflector and usually results in a very strong return signal.

Per convention, "half-power" beam angles are specified where the power falls off to half the value from the center of the beam. It is possible for the radar to detect strong targets outside of the oval derived from a trigonometric calculation based on the beam angle.

4.1 Alignment

The radar beam should be pointed across the traffic at 90° to the road. Pointing the radar at an angle substantially different from 90° is not recommended because the signal strength is severely reduced. The SpeedLane Pro's built-in HD video camera provides visual confirmation of the radar beam's alignment relative to the desired detection zone.

4.2 Lane Configuration

The SpeedLane Pro comes standard with configuration software, StatsAnalyzer. StatsAnalyzer is a Windows-based graphical user interface application used to establish the lanes of traffic for detection (see Section 12 for additional information on StatsAnalyzer). If lanes are not defined, the SpeedLane Pro will still measure per vehicle speeds, range, lengths, and travel direction, while lane occupancy, gap and average speed will not be recorded, and lane activation features will not operate. Per direction speeds may still be obtained via the SQL interface. It is strongly recommended that lanes be defined.

StatsAnalyzer accumulates and displays all detected vehicles at every range within the detection zone as a histogram in real time to provide lane definition parameters. The histogram plot points are records of the absolute range of each target within the detection zone. A histogram plot point is created for any target that meets the criteria established by the proprietary Houston Radar Tracking Filter. The user may choose to establish the lane boundaries around the histogram peaks, or may exclude a pattern of targets. This confirmation of lane configurations eliminates the automatic creation of incorrect lanes, such as may result from a parking lot or access road being within the detection zone.

StatsAnalyzer displays all defined lanes and allows for the adjustment of lanes in 1-foot (.3 meters) increments.

StatsAnalyzer provides a graphical interface to display current traffic patterns and vehicle-specific information such as Received Signal Strength Indicator (RSSI) and length.

5.0 Performance

The SpeedLane Pro's accuracy statements assume nominal traffic conditions, with proper installation and alignment per the User Manual. Nominal conditions exist when true occupancy is less than 30%, without merging traffic; when average speeds are greater than 10 mph (16 kph) in every lane; when there is less than 20% truck traffic per lane; and when at least 50 cars per lane are counted in the interval.

5.1 Speed Accuracy

Average per lane: +/- 1%
Average per direction: +/- 1%
Per Vehicle: +/- 6% for 90% of vehicles
Range detection: 5-100 MPH (8-160 km/h)

5.2 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
Max number of simultaneous detections: 16

5.3 Length Class Accuracy

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

5.4 Lane Occupancy Accuracy
Typical +/-10% per direction
+/-20% per lane

6.0 Physical Characteristics

The SpeedLane Pro is housed in a tubular NEMA 4X Lexan polycarbonate weather-proof enclosure. The enclosure maintains the following characteristics:

- Injection moldable non-chlorinated/brominated, UV-stabilized, unfilled flame-retardant grade polycarbonate with medium flow
- UV-stabilized
- 26 inches long by 3.33 inches in diameter (66cm by 8.5cm)
- 4.6 pounds (2.1kg) without optional internal UPS; 6.4 pounds (2.9kg) with optional internal UPS
- Built to NEMA 4X standards for wind, moisture exposure, and dust & airborne particles
- IP66 rating
- IP67 M12 data / power connector
- Operating temperature range without optional internal UPS: -40F (-40C) to +167F (+75C); operating temperature range with optional internal UPS:-4F (-20C) to +131F (+55C)

7.0 Power Requirements and Performance

7.1 Power Supply
The power supply to the SpeedLane Pro must be capable of supplying up to 250mA of current (at 12VDC) continuously to account for multiple installed options. Power supply options include:

- DC input voltage range of 9VDC to 28VDC
- 48VDC PoE (Power Over Ethernet) using standard 802.3af. Mode A/Type 1 (power over data pairs)
- Built-in Lithium Iron Phosphate rechargeable 96WHr battery, rechargeable via:
    - External 24V AC to DC adapter
    - External 12V (nominal- up to 21V open circuit) solar panel
    - External 12VDC battery

7.2 Power Consumption
The SpeedLane Pro consumes 1.0 Watts in its standard configuration. Optional installed components may increase its power consumption.

- Base System: 1.0 Watts fully operational (85mA @ 12V)
    - RF Power: 5mW maximum each radar
- With built-in camera enabled: 2.5 Watts streaming video over Ethernet (214mA @ 12V)
- Optional Ethernet: 1.2 Watts with Ethernet cable connected (98mA @ 12V)
- Optional internal modem:
    - Online: 1.3 Watts (111mA @ 12V)
    - Upload: 1.8 Watts (150mA @ 12V)

7.3 Power Protection
The SpeedLane Pro provides built-in protection from power supply irregularities.

- 6.2V undervoltage and 28.5V overvoltage protection shutdown
- Reverse power protection with resettable fuse

8.0 Communication Ports

The SpeedLane Pro features a software-configurable serial interface for RS-232, or RS-422/RS-485. The serial interface supports baud rates of 9600, 19200, 38400, 57600, and 115200 bits per second. The serial interface is used to communicate via the supplied Windows configuration program, StatsAnalyzer, to access statistics data and configure the unit for use.

The SpeedLane Pro features a standard built-in Class 1 long range 2.1 +EDR Bluetooth antenna, capable of delivering a signal across more than 800 feet (243 meters) outdoors. The StatsAnalyzer program can communicate via the Bluetooth interface. An Android smartphone/tablet app is also provided to communicate with the SpeedLane Pro via Bluetooth.

The SpeedLane Pro offers an optional built-in 100 Mbps Ethernet connection. This Ethernet connection implements "Zeroconf" networking (Avahi networking under Linux, or Bonjour under Windows), allowing the user to interface with the radar device by plugging its Ethernet cable directly into an Ethernet port on the user's computer, or a local network switch and without requiring the user the set static IP address on the PC. Multiple SpeedLane Pro's may be present on the same network simultaneously, and all are identified by unique hostnames. The SpeedLane Pro implements a "Houston Radar Discover" protocol to allow for discovery of every SpeedLane Pro on the user's local network. The user can also assign a static IP address, netmask, and gateway to each SpeedLane Pro or acquire the networking parameters via DHCP server if one is present on the network

9.0 Data Protocols

The SpeedLane Pro provides mechanisms to retrieve both real-time and historical data. As the manufacturer, Houston Radar provides the protocol definition on request. The SpeedLane Pro allows multiple requests to be interleaved without having to be set in a specific mode of operation. The SpeedLane Pro supports both client-server (polling mechanism) and publisher-subscriber models (event-driven) for retrieving data.

9.1 Polling Real Time data (Client-Server)

9.1.1 Sensor ID

The SpeedLane Pro provides a mechanism to set a Sensor ID and retrieve it on demand. The Sensor ID shall be persisted across power failures.

9.1.2 Real Time Vehicle Speed Histogram

The SpeedLane Pro supports the retrieval of real-time Speed Histogram Counts for all lanes or for individual lanes at user-configurable speed bins. The minimum speed bin configurable is 1 mph or 1 km/h.

9.1.3 Real Time Vehicle Class Histogram

The SpeedLane Pro supports the retrieval of real-time Class Histogram Counts by lane for up to 8 user-configurable vehicle classification length bins.

9.1.4 Volume, Speed, Occupancy, Headway, Gap

The SpeedLane Pro supports the retrieval of real-time per-lane Volume, average Speed (km/h or mph), 85th Percentile speed (km/h or mph), average Lane Occupancy (%), average Headway (in milliseconds), and average Gap (in milliseconds) per-lane. The SpeedLane Pro supports configurable time intervals to average per-lane data.

9.2 Realtime Events (Publisher-Subscriber)
The SpeedLane Pro allows the ability to:

- Permanently or temporarily enable the streaming of real-time events.
- Permanently or temporarily disable the streaming of real-time events.

9.2.1 Presence Information
The SpeedLane Pro supports the streaming of per-lane real-time presence information.

9.2.2 Volume, Speed, and Occupancy
The SpeedLane Pro supports the streaming of Volume, average Speed, and average Occupancy at user-configurable time intervals on a per-lane basis.

9.2.3 Vehicle Events
The SpeedLane Pro supports the real-time streaming of vehicle events containing the following information for each vehicle event:

- Cycle Start Timestamp in milliseconds
- Presence Time in milliseconds
- Signal Magnitude
- Lane in which Vehicle is traveling
- Direction of Travel
- Length (in centimeters or centifeet)
- Speed (in centi km/h or centi mph)
- Range to target (in centimeters or centifeet)

9.3 Historical Data

9.3.1 Mechanisms
The SpeedLane Pro supports the retrieval of historical data using the following mechanisms:

- By running SQL queries against the onboard SQL database inside the SpeedLane Pro
- Using the REST API interface over HTTP

9.3.2 Data Points
The SpeedLane Pro supports the retrieval of the following per-lane historical data:

1. Interval Histogram
2. Vehicle Class Histogram
3. Speed Histogram
4. Direction Histogram
5. Individual Vehicle Data

9.3.2.1 Interval Histogram
The SpeedLane Pro supports the retrieval of user-configurable interval data per-lane containing the following information for the interval:

- Unique Sequence Number
- Interval in Minutes
- Interval Number (incrementing log count)
- Date and Time when the interval data was logged
- Lane
- Average Speed (in mph or km/h)
- 85th Percentile Speed (in mph or km/h)
- Occupancy (in %)

- Volume
- Gap (in milliseconds)
- Headway (in milliseconds)

9.3.2.2 Vehicle Class Histogram

The SpeedLane Pro supports the retrieval of Vehicle Class Histograms at up to 8 user-configurable length bins on a per-lane basis containing the following information for the interval:

- Unique Sequence Number
- Interval in Minutes
- Interval Number (incrementing log count)
- Date and Time when the interval data was logged
- Lane
- Bin Number
- Count

9.3.2.3 Speed Histogram

The SpeedLane Pro supports the retrieval of binned Vehicle Speed Histograms at user-configurable speed bin widths on a per-lane basis containing the following information for the interval:

- Unique Sequence Number
- Interval in Minutes
- Interval Number (incrementing log count)
- Date and Time when the interval data was logged
- Lane
- Bin Number
- Count

9.3.2.4 Direction Histogram

The SpeedLane Pro supports the retrieval of Vehicle Direction Histograms on a per-lane basis containing the following information for the interval:

- Unique Sequence Number
- Interval in Minutes
- Interval Number (incrementing log count)
- Date and Time when the interval data was logged
- Lane
- Direction
- Count

9.3.2.5 Individual Vehicle Data

The SpeedLane Pro supports the retrieval of Individual Vehicle data containing the following information:

- Unique Sequence Number
- Speed (in mph or km/h)
- Length (in feet or centimeters)
- Lane Number
- Direction of Travel
- Cycle Start Timestamp in milliseconds
- Date and Time when the vehicle was logged
- Interval Number (incrementing log count)
- Range to Vehicle (in feet or centimeters)

9.4 Data Retention

- The SpeedLane Pro stores the configuration in non-volatile memory.
- The SpeedLane Pro contains a temperature compensated low drift Real-Time Clock (RTC) with a battery backup to keep accurate time even when the primary power is turned off.
- The SpeedLane Pro stores 3 months of interval data (assuming interval bin size is set to 5 minutes).
- The SpeedLane Pro stores at least 1,000,000 individual vehicle records.
- The SpeedLane Pro automatically removes the oldest records to make room to store new interval and individual vehicle records.

10.0 Radar Design

The SpeedLane Pro employs a dual radar design. Each of the two radars shall have one transmit channel and two receive channels. Physical separation of the radars shall be at least 20 inches. In order to achieve accurate per vehicle speed measurements, two physically separated radars are necessary so that a speed trap type speed measurement can be performed.

10.1 Frequency stability.

The SpeedLane Pro conforms to FCC Section 15.249 requirements for 24.0–24.25 GHz band. The circuitry shall not utilize any manual tuning elements such as trim pots that could lead to human error and degraded performance. Radar's occupied bandwidth must remain stable over the specified temperature range and service life. Radar's transmit chirp quality shall be maintained over the specified temperature range and service life as well to achieve reliable target acquisition and tracking.

10.2 Antenna design

The SpeedLane Pro antenna two-way pattern is 7x74 degrees.

The wide vertical angle of 74 degrees enables the SpeedLane Pro to provide simultaneous detection from a lane located at the minimum offset to a lane located at the maximum range. The vertical beam width of a radar determines the field of view in which it can detect traffic. If this field of view does not encompass all lanes, then the radar will be unable to detect vehicles over the entire range.

A narrow horizontal beam width allows the SpeedLane Pro to resolve closely following vehicles (congested traffic) at the farthest ranges. If the horizontal beam width is too large, a trailing vehicle may be merged with the vehicle in front.

The sidelobes in the SpeedLane Pro two-way antenna pattern is -40 dB or less. Low sidelobes ensure that the performance from the antenna beam widths is fully achieved.

10.3 Resolution

The SpeedLane Pro is approved by the FCC to transmit a signal utilizing the whole allowed band of 24.0–24.25 GHz and automatically utilizes the optimum bandwidth to achieve the best performance based on the installation conditions. The SpeedLane Pro's proprietary dynamic allocation of the transmit signal within the allowable bandwidth translates directly into radar resolution, which contributes directly to detection performance.

11.0 Configuration and Reporting Software

Data from the SpeedLane Pro can be viewed, manipulated, and downloaded via multiple methods.

11.1 StatsAnalyzer Software

The SpeedLane Pro comes standard with configuration and reporting software, Houston Radar's StatsAnalyzer. StatsAnalyzer is a Windows-based graphical user interface application designed to aid in the setup, configuration, and data gathering for the SpeedLane Pro. Features of the software include:

- User selectable 1-minute to 60-minute binning and storage intervals
- Live histogram creation to monitor real-time traffic from the radar for local and remote monitoring applications
- Stats collection utilizing any communication port (see Section 8.0 Communication Ports for additional information)
- Store and organize data in individual projects
- Generate weekly views of hourly counts and average speeds
- Generate average monthly views by weekday hour of counts and speeds
- Generate detailed hourly counts, average speed, max speed, and 85th percentile reports
- Generate interactive raw data scatter graphs of speed vs time, counts vs time
- Join and trim data sets to manage data effectively

11.2 Tetryon Cloud Server Software

Houston Radar's Tetryon Cloud Server is a customizable cloud server used to aggregate data from multiple SpeedLane Pro devices in one central location. Features of the software include:

- Aggregation of data into a common SQL database
- Runs under Linux OS in the cloud or on a local server (installer package available to customer)
- Comprehensive, browser-based interactive graphing and reporting of live and historical data
- Recovers up to three months of collected data from the SpeedLane Pro's internal memory in the event of a communication outage to backfill missing data
- Maps SpeedLane Pro locations using embedded GPS coordinates
- Able to automatically capture stills from the SpeedLane Pro built-in camera
- Allows users to create alerts that provide visual or email notifications of traffic conditions
- Provides ability to automatically schedule radar firmware upgrades
- Dashboard summary view provides simple, one-page layout of the live updated speed and status of multiple SpeedLane Pro devices
- Built-in map view provides live updated speed and status of multiple SpeedLane Pro devices on Satellite Maps
- Simultaneous access by multiple users via the most common browsers e.g. Chrome and MS Edge
- Allows multi-level user account security
- Allows radars to be grouped into separate accounts
- Data may be downloaded in a spreadsheet format
- Includes a mobile-friendly website interface

12.0 Quality Control in Manufacturing

12.1 Build Standards

The SpeedLane Pro is built to the highest operating and performance standards in the industry.

12.1.1 NEMA

- TS2-2016 for shock resistance, vibration resistance, electromagnetic pulse, and temperature variations
- 300v for power surge protection
- 4X for wind, moisture exposure, dust & airborne particles

12.1.2 IEC

- 1000-4-5 for power surge protection
- 68-2-27 for shock resistance (test a)
- 68-2-30 for vibration resistance (test Fc)
- 60529:2013 for dust (IP6x) and water ingress (IPx6)

12.1.3 ETSI EN

- 61000-4-2 for power surge protection
- 300-440 V2.1.1 for wireless interference

12.1.4 FCC

- CFR 47, Part 15, Section 15.249 for field disturbance

12.2 Quality Control

A stringent Quality Control (QC) process is undertaken for each SpeedLane Pro. The following tests are conducted during the manufacturing process:

- Continuity tests on cables to ensure that anomalies, such as openings, shorts, crimps or defects, are not present
- Continuity tests on stranded conductors using a meter having a minimum input resistance of 20,000 Ω per volt and show that each conductor has a resistance of not more than that specified by the wire/cable manufacturer.
- Measure the insulation resistance between isolated conductors and between each conductor, ground, and shield using a meter designed for measuring insulation resistance. Perform all resistance testing after final termination and cable installation, but prior to the connection of any electronic or field devices.
- Replace any cable that fails to meet these parameters, or if any testing reveals defects in the cable, and retest new cable.
- Demonstrate the following before shipment of finished product:
    - Verify that physical construction has been completed
    - Inspect the quality and tightness of ground and surge protector connections
    - Check power supply voltages and outputs
    - Verify that device connects to power sources
    - Verify that the installation of specified cables and connections between all external accessories or options
    - Demonstrate that the remote system is fully operational and performing all specified types of detection, including data storage functions, with a laptop computer
    - Verify detector accuracy by conducting sample ground counts

13.0 Installation

The SpeedLane Pro is a side firing radar solution. The radars beam point across traffic at a 90° angle to the roadway, and covers one or more lanes. The SpeedLane Pro is mounted so that vehicles traveling on the roadway are detected for a duration of time while they are crossing the radar beams and their velocity is mostly tangential (at right angle to the beam) with a negligible radial (along the beam) component.

Installation locations should be selected to allow for open-air unobstructed radar beam access to free-flow traffic.

13.1 Mounting Bracket

The SpeedLane Pro has a pole mounting bracket included as standard. The mounting bracket allows for sufficient adjustment of the radars pointing angle at various mounting heights and setback lengths. The mounting bracket provides user access to adjustment mechanisms so that the SpeedLane Pro is rigidly mounted to a structure. The

structure to which the SpeedLane Pro is affixed shall not be affected by wind or incur sway. The mounting bracket consists of the following features and mechanisms:

- Adjustable clamps to secure the SpeedLane Pro to the mounting bracket
- Four (4) hex bolts to manipulate the adjustable clamps to achieve the proper tilt (or pitch)
- Four (4) bolts to adjust the SpeedLane Pro horizontally to achieve a level installation

13.2 Setback Length and Mounting Height

The setback length is the distance the SpeedLane Pro is mounted from the closest lane of traffic to be detected. The setback length, or offset, is a minimum of 6 feet (2 meters) from the closest lane of traffic to be detected. The appropriate setback length may vary by installation location.

The SpeedLane Pro's mounted height is determined so that the radar detection zone includes all desired traffic lanes, up to 255 feet (78 meters) from the mounting location, and in such a way that the radar beams are not inhibited by taller vehicles in the closest lanes. Typically, the mounting height will not be more than 1.25x the setback distance.

The tables below indicate suggested mounting heights with typical setback distances for optimal performance, with recommendations in bold.

SpeedLane Pro Installation Table (in feet)			
Offset from 1st lane (ft)	Recommended Height (ft)	Minimum Height (ft)	Maximum Height (ft)
7	17	8	19
8	17	8	20
9	17	8	21
10	17	9	22
11	17	9	23
12	17	10	24
Offset from 1st lane (ft)	Recommended Height (ft)	Minimum Height (ft)	Maximum Height (ft)
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
22	23	16	31
23	**25**	16	32
24	**25**	16	33
25	**26**	17	33
26	**26**	17	34
27	**27**	18	35
28	**27**	18	35
29	**27**	18	36
30	**29**	19	37

31	**29**	19	37
32	**29**	19	38
33	**30**	19	39
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

SpeedLane Pro Installation Table (in meters)			
Offset from 1st lane	Recommended Height (m)	Minimum Height (m)	Maximum Height (m)
2	5	2	6
3	5	2	7
4	5	3	8
5	6	4	9
6	7	5	9
Offset from 1st lane	Recommended Height (m)	Minimum Height (m)	Maximum Height (m)
7	8	5	10
8	**8**	5	10
9	**8**	5	11
10	**9**	6	12
11	9	6	12
12	9	6	13
13	10	7	14
14	11	7	14

13.3 StatsAnalyzer Installation Wizard

The Houston Radar StatsAnalyzer software provides an Installation Wizard with step-by-step instructions to ensure proper positioning and alignment. The Installation Wizard includes the following visual aides to properly align the SpeedLane Pro:

- Live video feed from built-in HD camera with on-screen crosshair for alignment confirmation
- Snapshot feed from built-in HD camera with on-screen crosshair for alignment confirmation (for serial or Bluetooth connections that do not allow video)
- Tilt angle identification for vertical adjustments
- Level angle identification for horizontal adjustments

14.0 Service and Support

14.1 Maintenance

The SpeedLane Pro does not require any regular maintenance to maintain optimal performance during deployment. The user may periodically confirm the device's proper alignment using the snapshot or video capabilities of the built-in HD video camera, should there be concern of mounting security.

14.2 Warranty

Houston Radar warrants the SpeedLane Pro for a period of one year from the date of shipment. Warranty is limited to repair or replacement of non-performing products. Houston Radar, at its option, may repair or replace a non-performing product if the non-performing product is returned to Houston Radar at the client's expense. Houston Radar shall ship the replaced or repaired product back to client via UPS Ground or equivalent. Houston Radar shall not be held liable for any incidental or consequential damages arising from the non-performance of product under warranty period. Extended warranties shall be available upon request or contractual requirement.

14.3 Houston Radar Service Department

Houston Radar maintains a full-time Service Department with factory-trained personnel. Service Department personnel are responsible for electronic support of products and services via mail, telephone, fax, email, conferencing services (such as Skype™, GoToMeeting™, or similar applications), and onsite, as needed. Houston Radar shall make the determination of necessary onsite service at its sole discretion, unless expressly agreed upon prior to the need. The Service Department can be contacted as follows:

Houston Radar Service Department
702 Julie Rivers Drive
Sugar Land, Texas 77478
USA

Toll free phone/fax: +1.888.602.3111
Email: support@houston-radar.com
Online Submission: https://houston-radar.com/contact-us/

14.4 Additional Support

Houston Radar maintains support documentation and resources for the products and services it provides. Support documentation and resources include:

- User Manuals
- Quick Start Guides
- Video tutorials
- Supplemental user training materials as required or requested by users and customers
- Community Support Forum at https://houston-radar.com/support-community-forum/