PX150

Trajectory Tracking Traffic Radar Sensor and Data Collector User Manual and Installation Guide

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PX150 Non-Intrusive 3D MIMO Radar Based Traffic Sensor and Collector

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This device conforms to the CE mark and conforms to the requirements of the applicable European Directives as follows:

EN 305-550

FCC ID: TIAPX150

This device meets the FCC requirements for RF exposure in public or uncontrolled environments.

This device complies with FCC part 15 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.

Changes or modifications not approved by Houston Radar could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

IC ID: 21838-PX150

This device meets the IC requirements for RF exposure in public or uncontrolled environments.

Cet appareil est conforme aux conditions de la IC en matière de RF dans des environnements publics ou incontrôlée.

IC Warning

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: 1. this device may not cause interference, and 2. this device must accept any interference, including interference that may cause undesired operation of the device.

Cet appareil est conforme avec Industrie Canada RSS standard exempts de licence (s). Son utilisation est soumise à Les deux conditions suivantes: 1. cet appareil ne peut pas provoquer d'interférences et 2. cet appareil doit accepter Toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement du dispositive.

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

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Introduction

Congratulations on your purchase of the Houston Radar PX150 non-intrusive 3D traffic sensor/collector, traffic flow monitor. This state-of-the-art 61GHz V-band mmWave ***frequency modulated continuous wave*** (**FMCW**) ***multiple input/output*** **(MIMO)**-based counter is specifically designed for license free portable or permanent traffic data measurement and collection.

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

Some of the highlights of this product include:

- Up to 300ft (90m) 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.
- 5 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 GPS option to geostamp data collection location.
- Optional 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

Tracking FMCW MIMO Radar

FMCW

FMCW stands for “frequency modulated continuous wave” device. The PX150 radar modulates 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.

MIMO

MIMO stands for "multiple input / multiple output" device. The radar employs 3 transmitters and 4 receivers. Utilizing a phase modulation scheme, these are synthesized into a 12-element virtual array antenna. Increased virtual aperture dramatically improves angular resolution of the radar.

Tracking

The PX150 employs advanced target tracking techniques based on a proprietary algorithm that allows it to detect, measure and track multiple targets simultaneously.

Detection Zones

Radar tracks are processed by a detection zone filter that generates triggers when the vehicle enters or leaves user specified detection zones.

Radar Detection Zone

The radar FoV (field of view) has an sector shape and is defined by the beam cone (30^{o}x100^{o}) 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 sections 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 than 90 degrees may reflect the radar beam away and result in a weak target.

3. Unlike in a Doppler radar, with FMCW radar there is always a fixed internal design limit to 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

Being a MIMO radar with XY target map output, PX150 supports both side firing (90º to road) as well as front firing configurations. In most cases we recommend to point radar at about 45 degrees to the traffic. This will maximize number of detected lanes and improve detection reliability by allowing longer tracks.

Background Clutter

PX150 radar detects and treats moving and stationary targets differently. Thus, there is no need to maintain a clutter map.

User Configurable Detection Lanes

Lane Definition

A lane is a user-configurable area within the radar's detection FoV. Each lane may have one or more detection zones. Each zone may be configured to detect only certain types of targets, for example only outgoing or only incoming. Zone detections are available for internal event counting, over all supported interfaces and on two hardware trigger outputs.
Defining lanes is optional but highly recommended as radar tracking will work better when lanes are defined. The provided Windows StatsAnalyzer program will help you setup and define lanes and zones.

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 to 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 lanes and zones 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 a detected target path history in real time regardless of lane setup and the user may simply draw the lane boundaries around the built-up history paths. Thus, no manual calculations are required.

Exclusion Zones

The radar allows user to define exclusion zones where it will not detect and track vehicles. For example, user may want to exclude a parking lot adjacent to the roadway.

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 "Record Interval" setting on the configuration tool "Advanced" tab. These counts are stored in internal memory and may be retrieved later for analysis. You may set up 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 in a computer or controller connected to a communication port of the PX150. A full featured "C" or C# SDK along with a developers' application guide is available. Please contact us for more details.

Radar Mounting

Mounting Bracket

The provided mounting bracket allows for complete adjustment of the radar pointing angle for various mounting heights. The user must perform a "camera view" check using the included camera to validate that the radar beam is pointed correctly.

*See section "*Leveling the PX150 during installation:*" for details on using the onboard level meter to assist with ensuring that the unit is parallel to the road surface.*

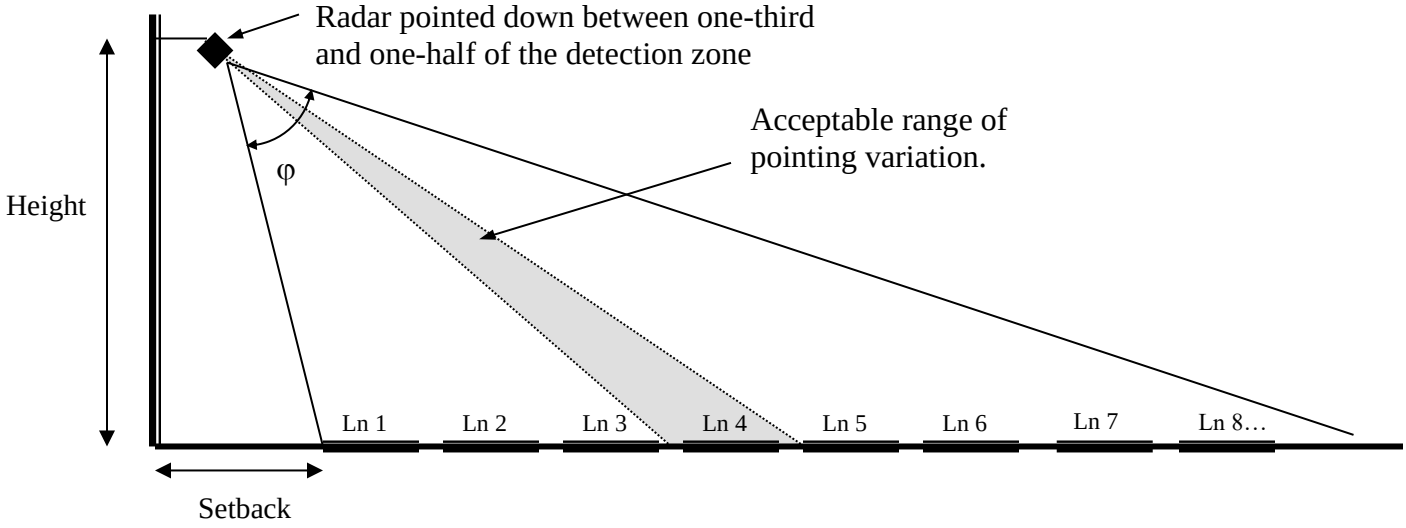
Location

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 fall withing exclusion zone and thus be discarded..

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.



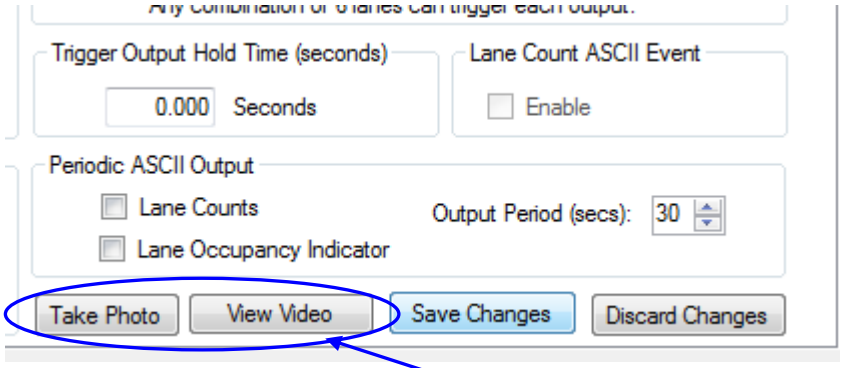
Sighting Camera

The PX150 has an inbuilt color HD (5 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 PX150 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 PX150 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 PX150 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 PX150 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 best results.

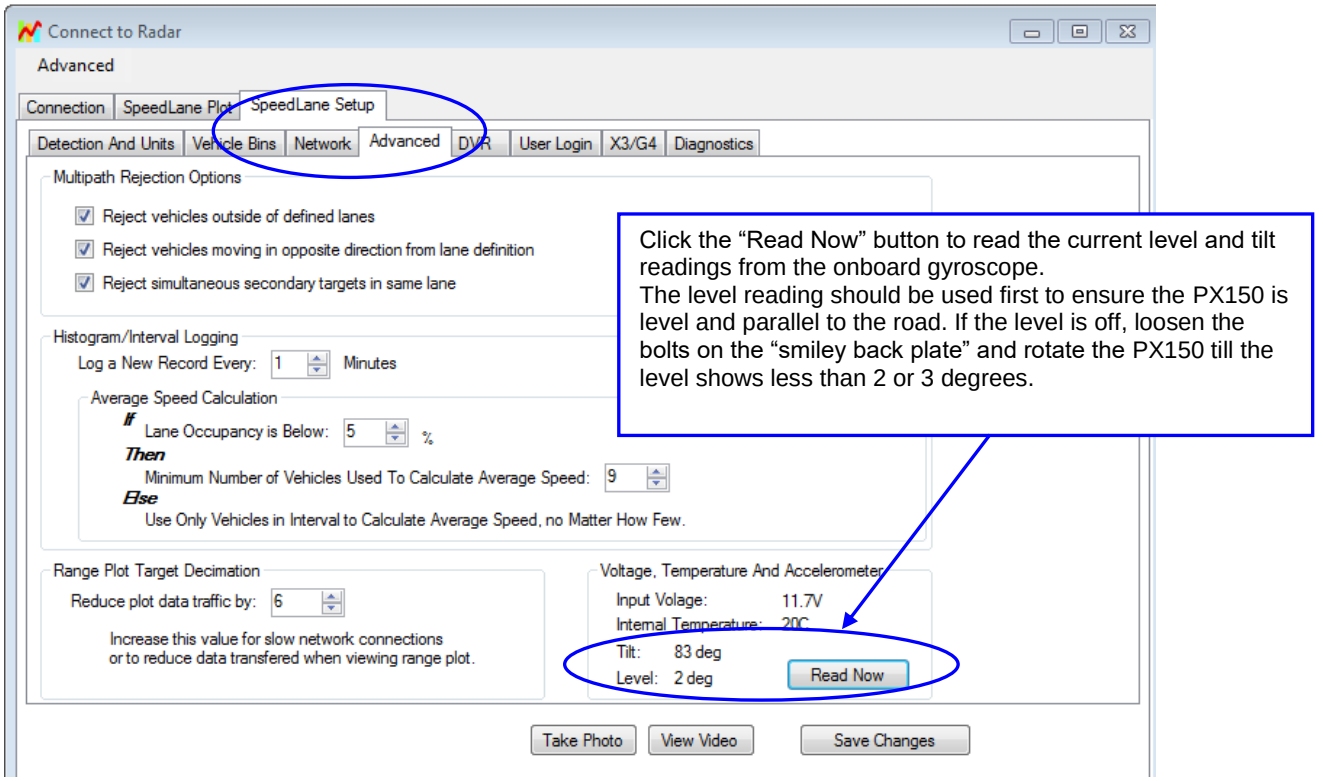
The photo is also saved in the stats analyzer database and you can later view it once you import the data from the unit.

Alternatively, if you have an Ethernet enabled PX150; you may click the "View Video" button to get a live view of traffic on the road.

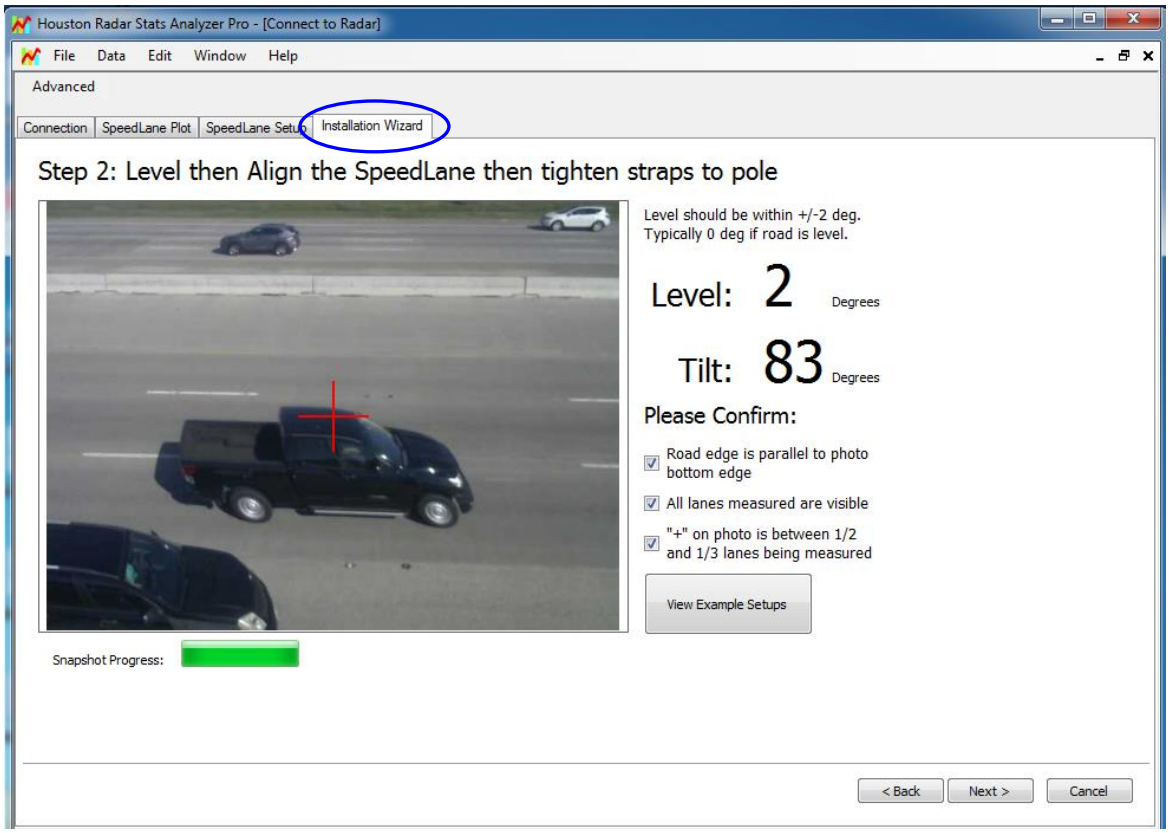
You must have the Ethernet, 4G modem, or WiFi option to stream and view live video. If you are not connected over one of these interfaces, then the "View Video" button will not be visible. You may still take a static snapshot via a serial or Bluetooth connection.

Leveling the PX150 during installation:

The PX150 includes an **electronic level gauge** that can be read via the provided software. This should be used to level the PX150 parallel to the road surface during installation on the pole. This will allow proper pointing adjusting using the camera.



We highly recommend using the Installation Wizard to complete the installation and initial setup of the PX150. 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:

Power Input:

The PX150 radar features wide operating input voltage range of 9VDC to28V (48VDC PoE is an option). In a typical application it may be powered from a nominal 12V DC source with consumption of about 5 Watts (please see PX150 SPECIFICATIONS for details).

You may alternatively power the PX150 via “Power Over Ethernet” (PoE) option. This option must be purchased when ordering the PX150 from the factory and is an additional feature to the Ethernet option. Please note that since the PX150 uses only 4 wires for Ethernet, you must use the “power over data pairs” standard. This is called the 802.3af. Mode A/ Type 1.

Serial Connection:

The PX150 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 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:

Power, RS232, RS422/RS485, Ethernet 12 Pin M12 connector on right side of unit:

M12 Pin #	Signal Name	Direction (Radar Perspective)	Color	Description
10	Data+/RTS/ TX+	Output	Brown	Software configurable: RS485 Mode: Data+ RS232 Mode: RTS RS422 Mode: TX+
11	Data -/TXD/TX-	Output	Brown/White	Software configurable: RS485 Mode: Data- RS232 Mode: TX RS422 Mode: TX-
12	RXD/RX+	Input	Blue	Software configurable: RS485 Mode: N/A RS232 Mode: RX RS422 Mode: RX+
8	CTS/RX-	Input	Blue/White	Software configurable: RS485 Mode: N/A RS232 Mode: CTS RS422 Mode: RX-
1	+VCC	PWR	Red	+9VDC to +28VDC
3	Trig1	In/Out	Yellow	Open Drain & Trigger
2	DC Return	DC Return	Black	Radar - (battery "–" terminal)
9	Trig2	In/Out	Grey	Open Drain & Trigger
7	Ethernet TR+	Output	Orange/White	Ethernet TX+
6	Ethernet TX-	Output	Orange	Ethernet TX-
5	Ethernet RX+	Input	Green/White	Ethernet RX+
4	Ethernet RX-	Input	Green	Ethernet RX-

DB9 female Connector if installed on end of power + RS232 serial cable:

B9 Pin #	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	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 on end of cable:
Pin 1 (inside terminal) +VCC
Pin 2 (outside terminal) -

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 this wizard is available online and we highly recommend that you watch it before installation the PX150.

You must initially configure the radar for your intended application at the installation site to ensure proper operation. Lanes should 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. We highly recommend setting up lanes in the radar.

Defining Lanes

Use provided Windows Configuration Utility to define lanes and detection zones. If lanes are not defined, the PX150 will still measure per vehicle speeds, range, lengths and travel direction. However lane occupancy, gap and average speed will not be recorded and lane activation features will not operate. If open drain outputs are used, make sure they are correctly mapped to zones. You only have to define lanes that you are interested in.

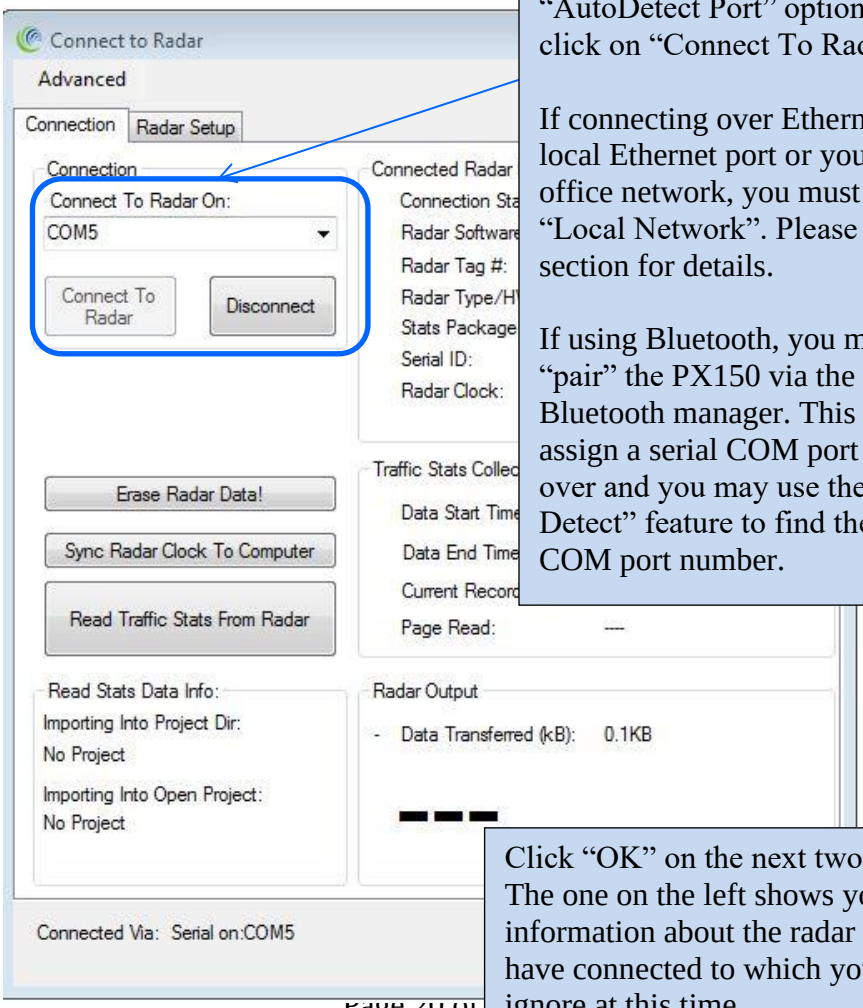
Optimal Performance Checklist

- ✓ Tunnel and under overpass locations should be avoided.
- ✓ The radar should be rigidly mounted to minimize wind action.
- ✓ Radar should be pointed so that FoV covers all the lanes of interest and observed track length is maximized.
- ✓ The radar should be within +/-2 degrees level to the road surface.
- ✓ 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.
- ✓ Lanes and zones should 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 (or Houston Radar Configuration) Windows program on a Windows 10 (or later) computer.
2. Connect the radar RS232 port to the PC's RS232 serial port. If the PC does not have a serial port you may buy a USB serial converter dongle (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.
4. Start the Houston Radar Stats Configuration tool program
5. Click on Start->Connect to Radar…
6. Click on "Connect" button.
7. Ensure you see a "Radar found on COM" message. The COM # will depend on your computer
8. Click on OK. Now you are ready to configure the radar.

Connecting to The Radar

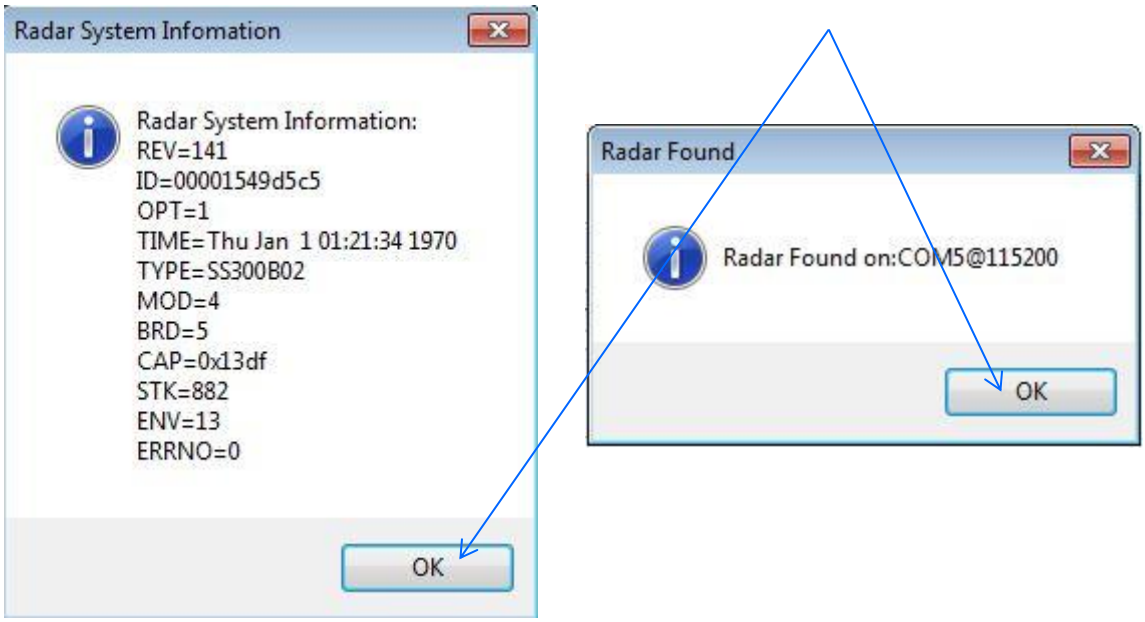


Select your COM port (or "AutoDetect Port" option) and then click on "Connect To Radar".

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.

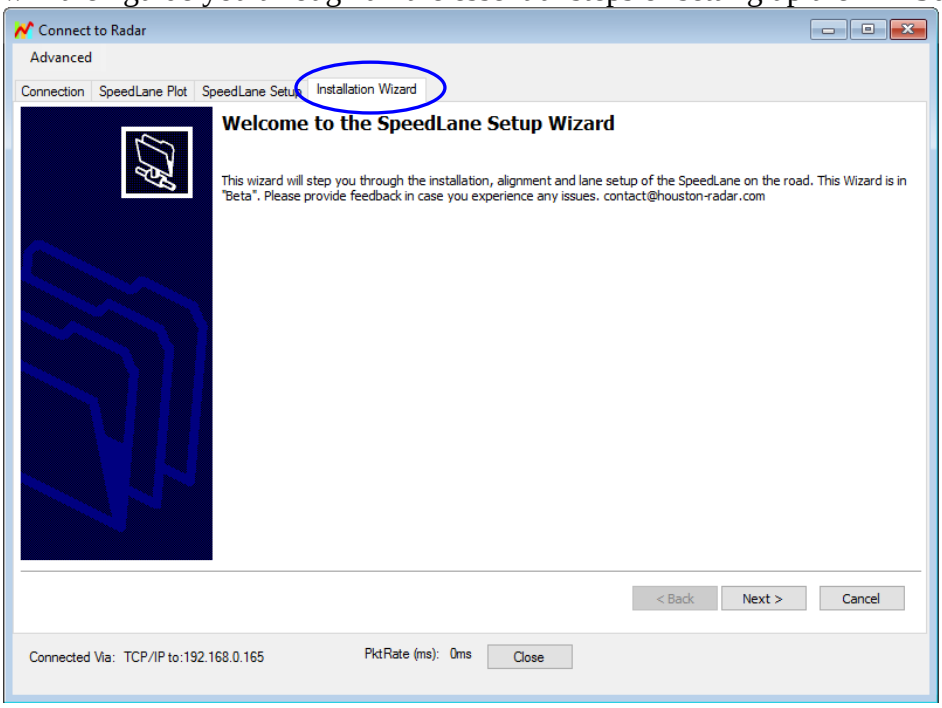
If using Bluetooth, you must first "pair" the PX150 via the Windows Bluetooth manager. This will assign a serial COM port to connect over and you may use the "Auto Detect" feature to find the correct COM port number.

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.


Radar System Infomation
Radar System Information:
REV=141
ID=00001549d5c5
OPT=1
TIME=Thu Jan 1 01:21:34 1970
TYPE=SS300B02
MOD=4
BRD=5
CAP=0x13df
STK=882
ENV=13
ERRNO=0
OK
Radar Found
Radar Found on:COM5@115200
OK

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 PX150.



Improving Performance in Installations with Multi-Path Reflections:

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 PX150 features different configuration options that may be enabled as required to deal with this issue and improve performance in an installation. For example user may define exclusion zone to prevent detection of ghost targets outside lanes.

Setting Up Interval Data Vehicle Length and Speed Bins

The PX150 tracks all vehicles by range, angle and Doppler speed. This data is stored in an onboard power fail safe SQL DB that holds the last 1 million vehicles detected. Older data is deleted to make space for new vehicles. ***All reports generated using the Houston Radar Stats Analyzer Pro Windows program use this individual target data***.

In addition to the individual targets, the PX150 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 following parameters are computed over the past interval and saved in the onboard SQL DB. The last 3 months of data are retained.

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

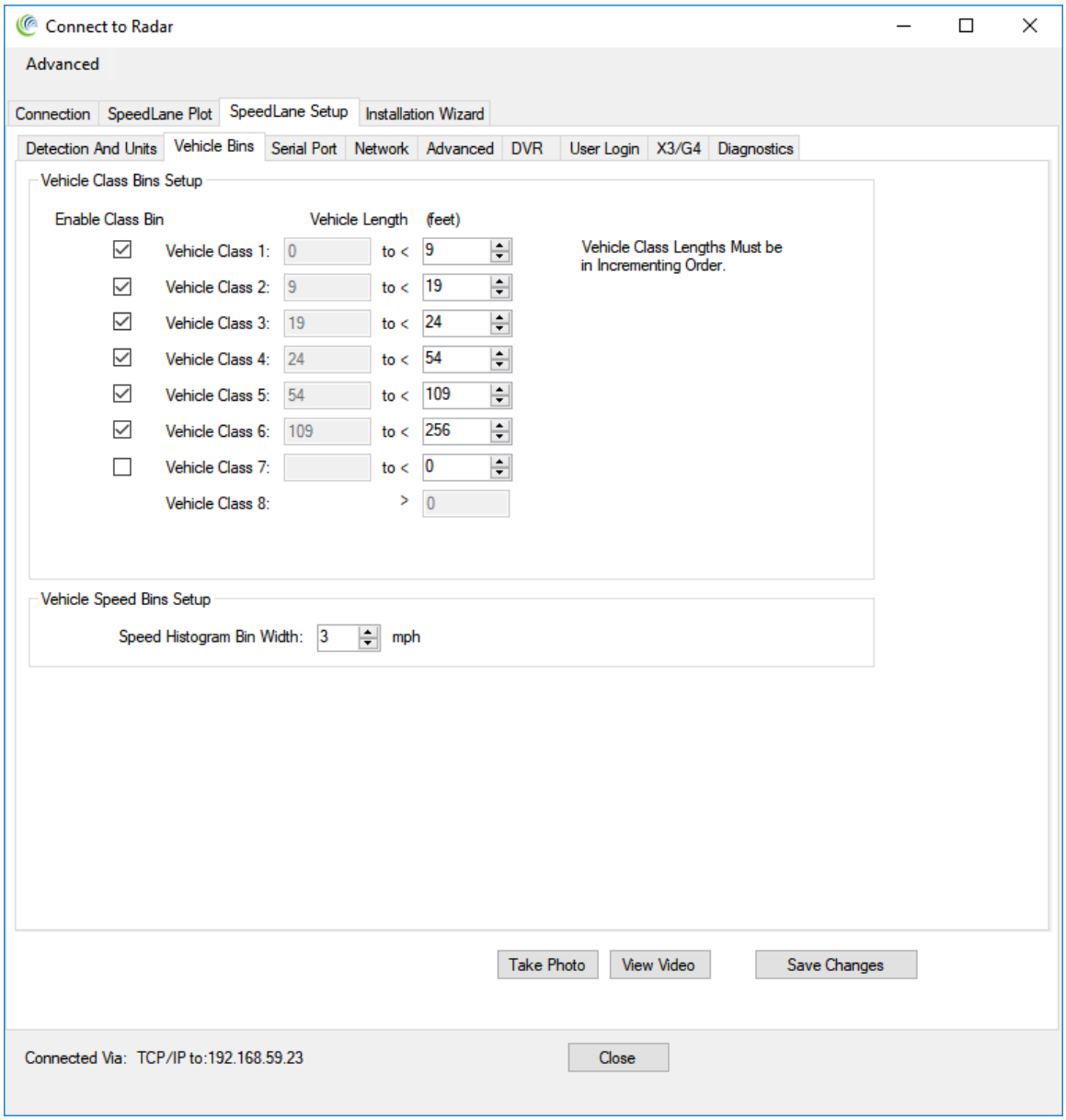
Vehicle lengths are rounded and binned into a maximum of 8 user defined bins for length measurement.

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.

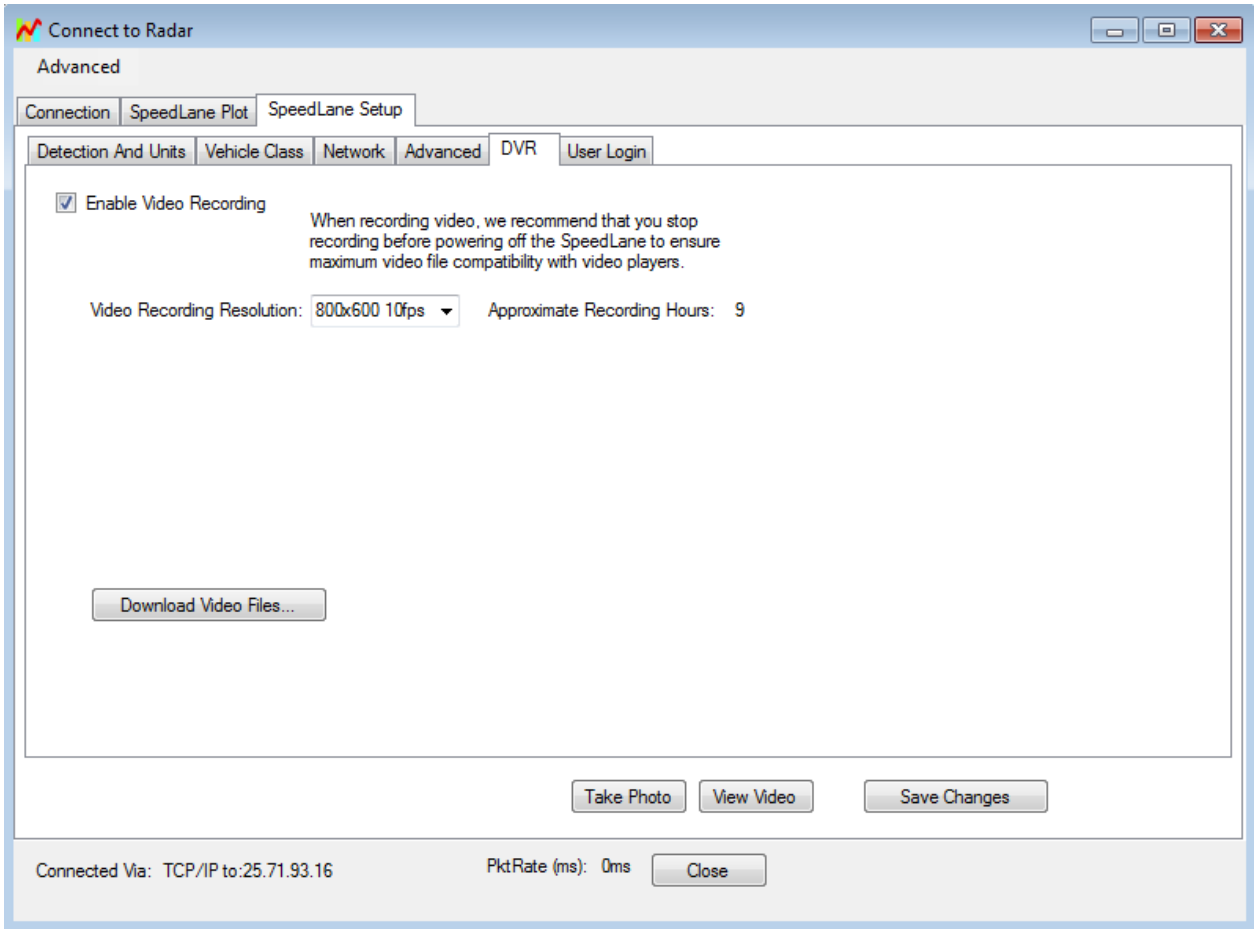


Note: The 2nd column in the GUI above reflects the "up to but not including" bin boundary. So as shown above, the 1st length bin will record only 0 to 8.999 feet targets which are motorcycles.

Recording Video in the PX150:

The PX150 supports, as an option, recording video for the last “n” events. This video is recorded onto internal memory and then downloaded via the Ethernet interface or cell modem at a later time.

The Ethernet option or cell modem option must be purchased to allow a download interface for the recorded video.



In-Radar Logs:

The PX150 keeps a date/time stamped log of each of the last ***one million vehicles*** in an internal SQL database.

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
85^{th} 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.

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 Class I USB Bluetooth adapter even if your computer has a built-in Bluetooth adapter. Built in adapters are usually 10m range Class II adapters and will only allow a connection if you are next to the box. The PX150 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 PX150, 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.

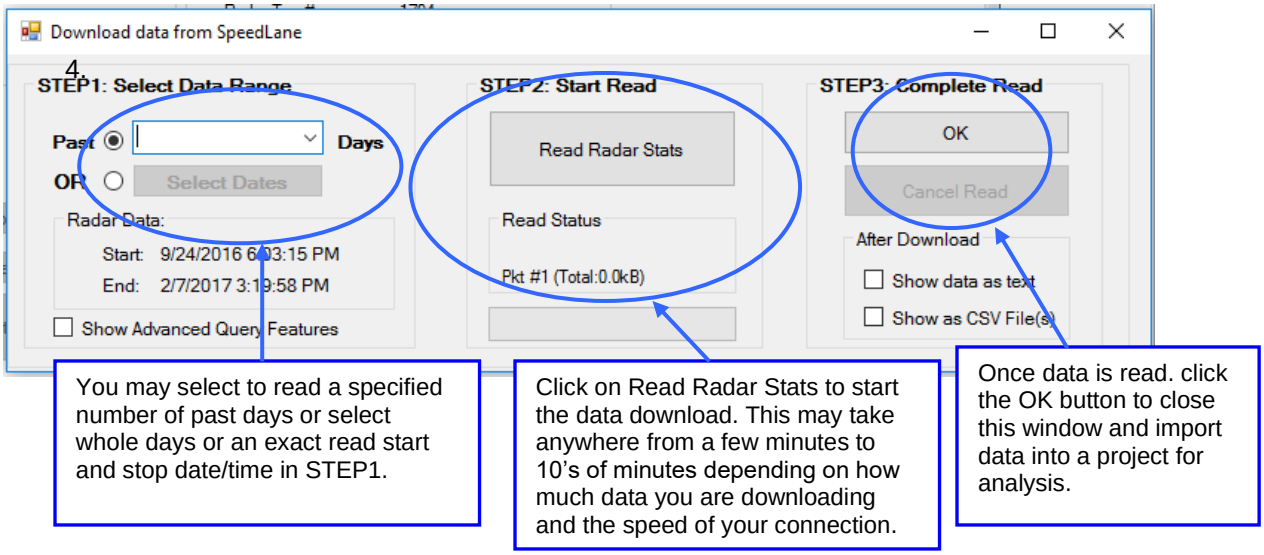
1. Open the Bluetooth interface on your computer by clicking on the icon and then scan for devices (or click on "*Add a device*"). All Houston Radar Bluetooth device names start with "***HR-BT***" and the complete and unique name is also printed on the box. **You must pair once with each PX150 from your PC.**
2. Once the scan locates the PX150, 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 will also be available in the Android Play Store that will allow you to connect, take snapshots and configure the PX150 via a smart phone or Android tablet devices.

Reading Historical Data from PX150

1. Connect to the radar via the File->Connect To Radar… menu, then click "Connect".
2. Once the radar is found, click on the "Read Traffic Stats From Radar" button.
3. The following query Window is shown. You have to choice to run a predefined query for the most common types of data users collect, or as an advanced option you may run your own query against the database. For predefined queries you can select the type and amount of data to import.

4.



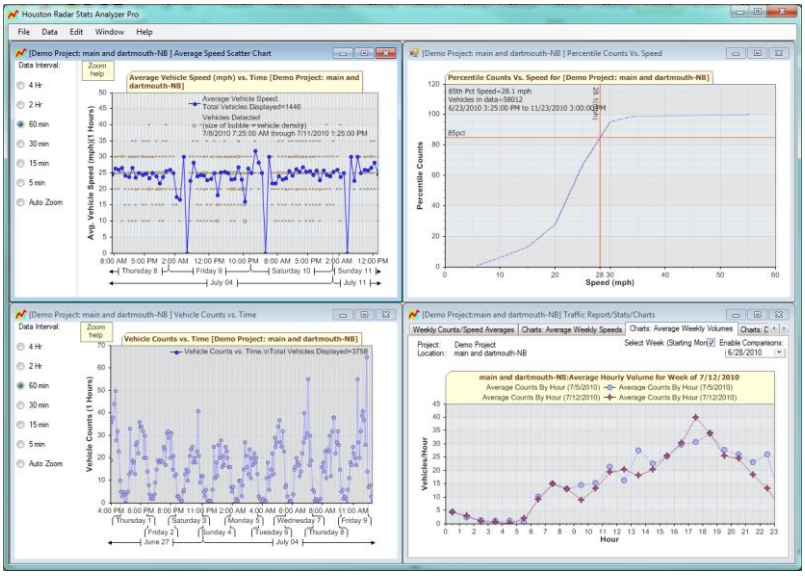
After you click the “Read Radar Stats” button, progress is shown and all data is saved in a .dat file. This .dat file may then be imported into the stats analyzer and detailed reports and graphs generated. Once you click OK, you will be provided an opportunity to import the .dat file into a project via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

If you check the “Show Advanced Query Features” checkbox, the actual SQL commands issued by the Windows program to the PX150 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 PX150 as it allows you to retrieve selected detailed, aggregate or summary data as you wish directly and quickly without having to download all the 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 the provided **USB drive** for a detailed tutorial on analyzing the data.
The latest version of this file is always 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.

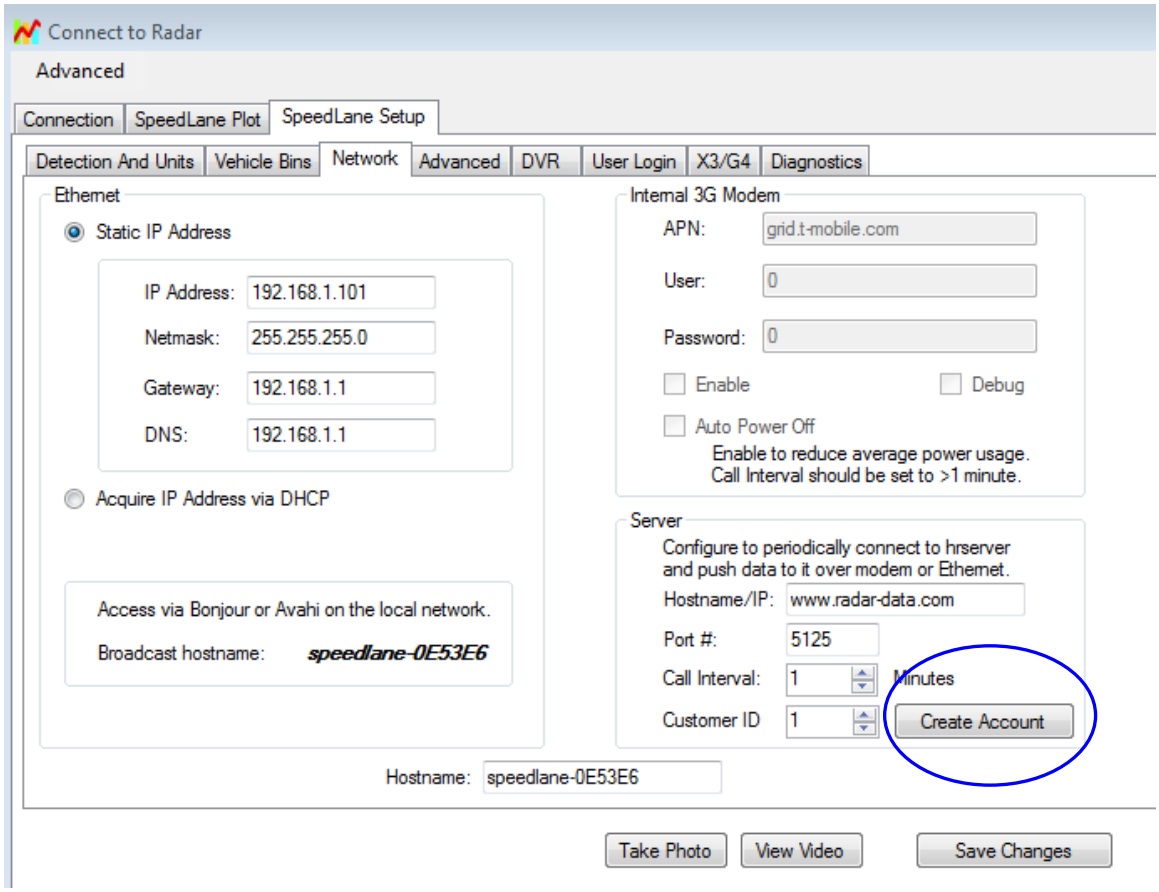
Pushing Data to the Tetryon Server in the Cloud

The PX150 can periodically connect to a Houston Radar "Tetryon" server over TCP/IP network interface like Ethernet or 4G modem. This "Tetryon" is available to host on a customers' Linux server or you may request a demo account on our radar-data.com server in the cloud.

Multiple PX150's can connect to push data to this server which accumulates data in a central SQL database. Data is segregated by customer account name.
Customers can then generate live or historical reports via their web browsers. See an example demo video here.

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

To connect to the demo server, or request an account, connect to a PX150 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



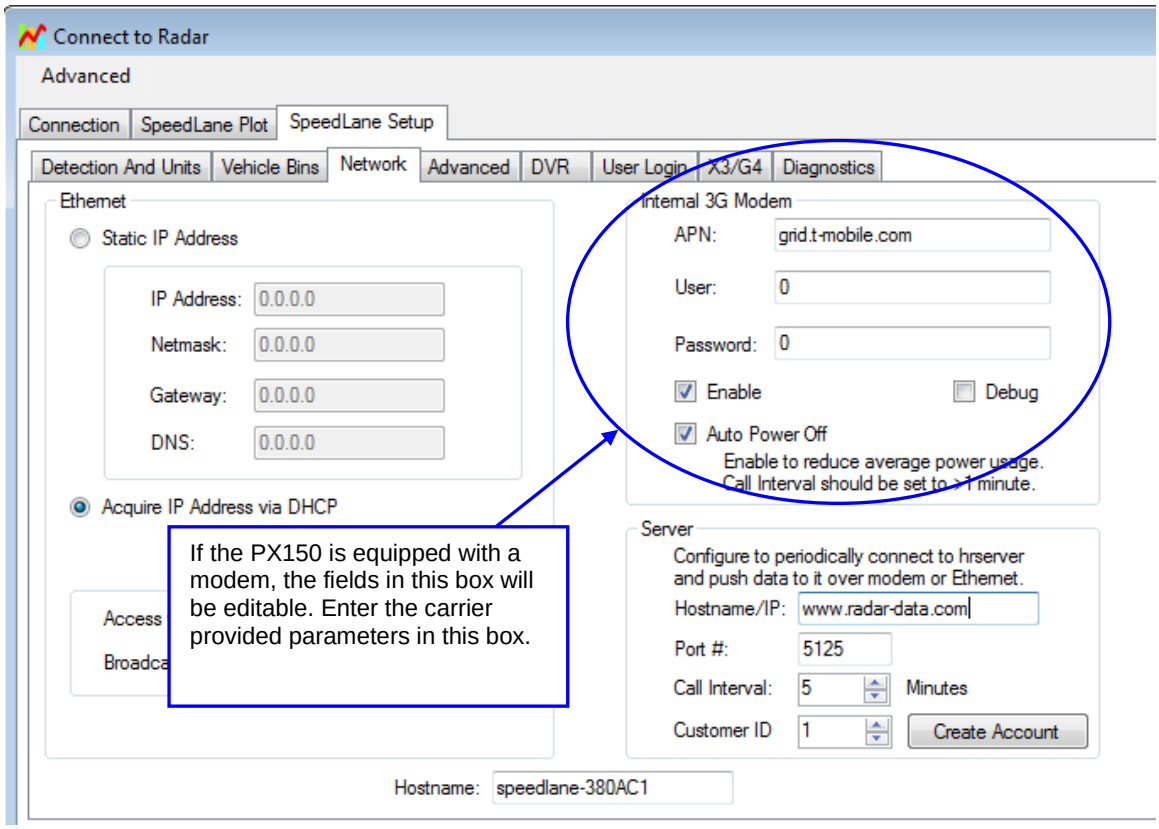
Using the 4G Modem

The PX150 can be ordered with a low power consumption, high bandwidth 4G modem. This modem is compatible with all GSM networks around the world. This is the most convenient method to push data to the server. This forms a “monitoring node” that can be deployed in tens of minutes literally on any road in the world and traffic data available on the network. There is no need for trenching or digging or even a junction box on the pole. Just a PX150 and power source is required to monitor the road and send data.

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

This has the potential to drastically reduce 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 to power on the modem, connect to the network and transfer new data, the average “ON” duty cycle of the modem is only 5%. Thus the average power usage of the modem is only 22mW for a total PX150 power usage of only 4.5W.



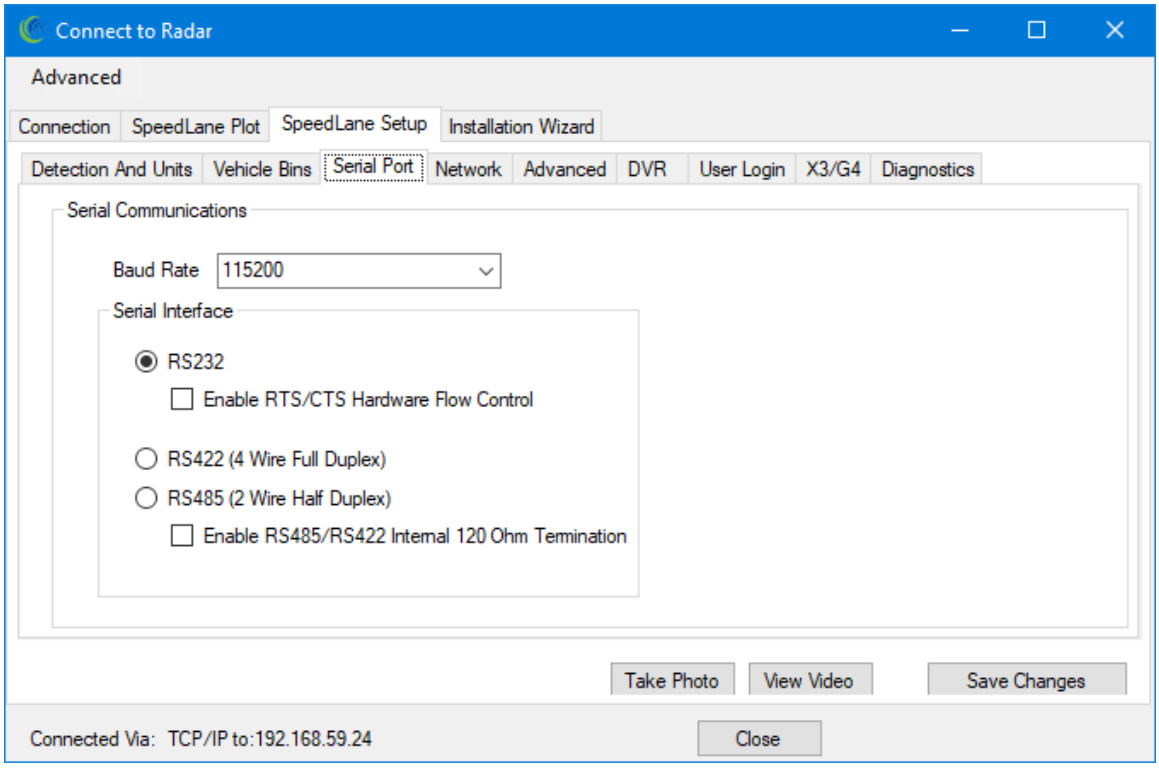
Configuring Serial Connection Baud, RS232 or RS485

The serial interface in the PX150 may be configured to RS232 (default from the factory) or for long range connections, half duplex or full duplex RS485. Termination may be switched on or off via the GUI. No physical jumpers need to be set in the unit.

To configure, navigate to the PX150 Setup tab and then to the Serial Port tab. You may configure the baud rate, RS232 (with hardware flow control turned on or off), 4 wire full duplex RS485 or 2 wire half duplex RS485.

For RS485 mode, you may turn on 120 Ohm termination (will be only across the receive lines in 4 wire full duplex mode).

If you plan to use RS485, we highly recommend using the 4 wire full duplex RS485 mode as the PX150 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.



PX150 SPECIFICATIONS

General

Operating Band	V-Band
Occupied Bandwidth	61.011 GHz to 61.489 GHz
RF Power Output	16mW
Antenna Beam Pattern	30x100°
Max Range	300 feet (90m)
Range Resolution	1 ft (31 cm)
Polarization	Linear
Supply Voltage	9VDC to 28VDC 6.2V undervoltage and 28.5V overvoltage protection shutdown
Power Consumption:	
Base System:	4.1 Watts fully operational (340mA @ 12V)
With Ethernet:	4.3 Watts with Ethernet cable connected (355mA @ 12V)
With Camera Enabled:	4.9 Watts streaming video over Ethernet (410mA @ 12V)
With 4G Modem:	
On-line	4.5 Watts
Operating Temp.	-40°F to +185°F (-40°C to +85°C)
Weatherproof	Yes, NEMA 4X Polycarbonate enclosure with M12 IP67 weatherproof connector.

Camera

Type	5 MP color video camera with optical barrel distortion correction
Field of View	90°
Supported Resolutions	1920x1080, 1280x720
Video Recording	1920x1080 20fps

Ethernet Option

Type	100 BaseTX FD/HD Auto MDX
Connector	12 pin M12

PoE Option

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

Approvals

Approvals	FCC, CE Mark, IC

Data Interfaces

PC Communication	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 Bluetooth 512 kbps 1x 100 mbps Ethernet
Data & Power Connector	12 pin M12 connector with male pins.
RS485/RS422 Terminator	Yes (120 Ohm, Software Enable On/Off)

Mechanical

Weight	0.6 lb. (270 g)
Dimensions	4.2” L x 3.8” W x 2.4” H (106mm x 96mm x 62mm)

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 PX150 over Ethernet

The PX150 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 PX150's may be present on the same network simultaneously and they all identify themselves by unique hostnames. Additionally, the PX150 also implements a similar but custom "Houston Radar Discover" protocol which is also built-in the Windows program provided with the radar. Thus, you can always discover and connect to a PX150 if it is on your local network or plugged directly into your computer's Ethernet port.

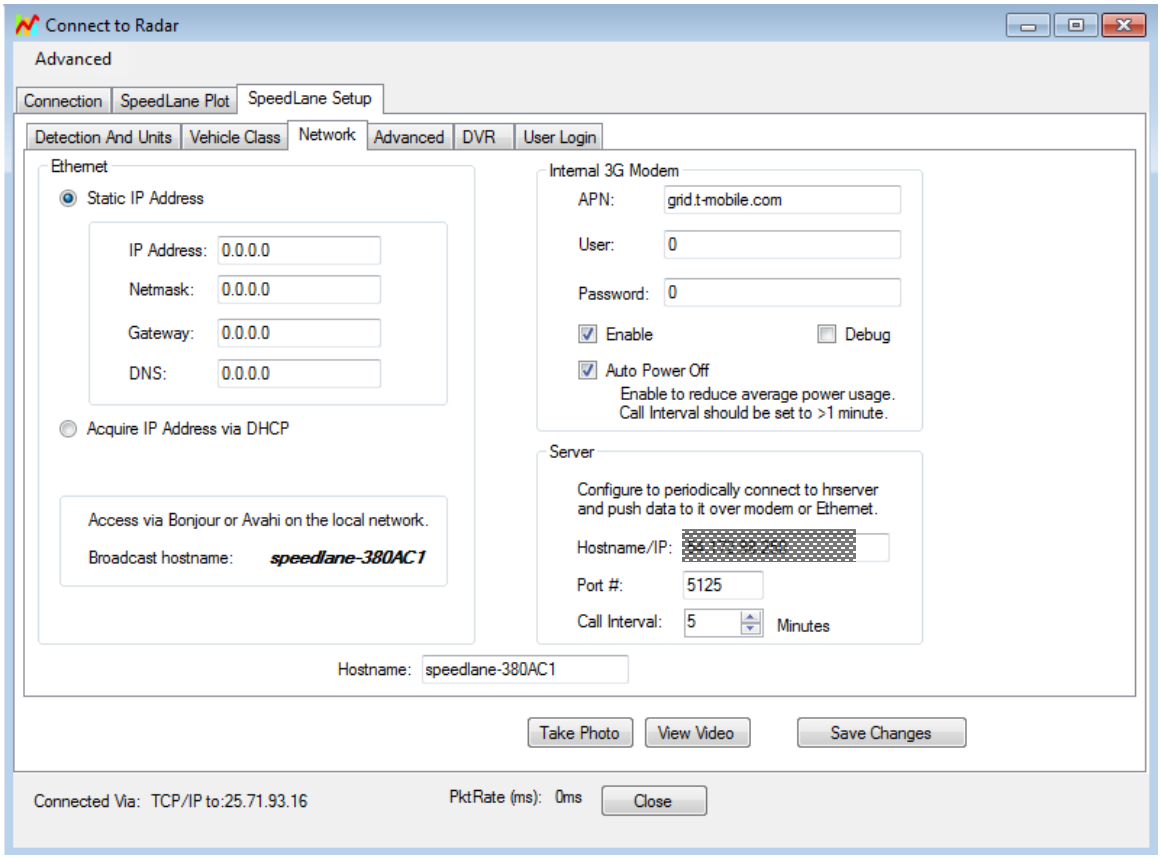
If a static IP address is not configured in the device, the PX150 will first try to acquire an IP address via DHCP if a server is available on your network. If not, then it will auto configure an IP address using Zeroconf in the linklocal range of 169.254.0.0 through 169.254.1.255 and respond to Bonjour and "Houston Radar Discover" requests on the network. Thus you will be able to connect to the PX150 from your computer even if neither have static IP addresses or are able to acquire IP addresses from a DHCP server.

Here are the steps to follow:

1. Connect the PX150 Ethernet port to your network or computer.
2. Ensure the link and activity light on your router/switch/computer Ethernet port come on. These lights are not visible on the PX150 unit itself.
3. In the Houston Radar Configuration/Stats Analyzer program, the File->Connect To Radar->[Pull Down List]->Local Network option searches for PX150's and connects to them using Bonjour, Avahi or "Houston Radar Discover". Bonjor is no longer required to be installed on the Windows computer. It may take up to 45 seconds for the PX150 to be visible on the network after initial power on.

Assigning a static IP address to the PX150

Assign a static IP address, netmask and gateway in the PX150 via the "Ethernet" group on the "PX150 Setup->Network" tab in the GUI.



Once a static IP address is set in the PX150, you will not be able to connect using "direct connection" as described in the previous Appendix A. The reason is that your static IP address will not be in the "autoconfigured" range. However, 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) which will then not have a route to the PX150's IP address.

Please connect to the PX150 via Bluetooth or Serial connection in this case.