

SmartSensor HD

USER GUIDE

SmartSensor HD

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Introduction

In this chapter

- SmartSensor HD Package
- Selecting a Mounting Location

The Wavetronix SmartSensor HD traffic sensor utilizes the latest technology to collect and deliver traffic statistics. The SmartSensor HD collects information through the use of a 24.125 GHz (K band) operating radio frequency and is capable of measuring traffic volume and classification, average speed, individual vehicle speed, lane occupancy and presence. The SmartSensor HD uses what is classified as frequency modulated continuous wave (FMCW) radar; it detects and reports traffic conditions simultaneously over as many as ten lanes of traffic.

Once SmartSensor HD is installed, the configuration process is quick and easy. After installation, this unit will require little or no on-site maintenance and can be remotely re-configured for optimal performance. This user guide outlines the step-by-step process of installing and configuring the SmartSensor HD. Any questions about the information in this guide should be directed to Wavetronix or your distributor.

SmartSensor HD Package

A standard SmartSensor HD package contains the following items:

- SmartSensor HD SS125 detector with installed backplate
- SmartSensor HD quick-reference guides

The following items are not included but are necessary for installation:

- Sensor mount

- Sensor cable

Additional products may be purchased through your distributor. The following optional items are not included unless specifically ordered (check packing list for actual inventory):

- Contact closure adapter such as the Click 100, 104, 110, 112/114, or 172/174.
- Click 200 surge protector
- Click 201/202 AC to DC converter
- Click 210 circuit breaker
- Click 230 AC surge protector
- SmartSensor HD User Guide (doesn't have to be purchased, but does have to be requested from Wavetronix)

Selecting a Mounting Location

Consider the following guidelines when selecting a mounting location:

- **Lane Coverage** - Sensor mounting locations should be selected so that all monitored lanes are within 6 to 250 ft. (1.8 to 76.2 m) of the sensor and run parallel with each other. Multiple sensors should be considered if more than 10 lanes need to be simultaneously monitored. If lanes do not need to be simultaneously monitored, up to 22 lanes can be configured for collection by a single sensor.
- **Parallel Lanes** - When the sensor is used to collect both mainline and ramp data, the pole position should be selected so that the on and off ramp lanes run parallel with the mainline. If lanes are not parallel, installation of multiple SmartSensor HD units should be considered to achieve the sensor's ± 2 degree side-to-side angle requirement.
- **Sensors on the Same Pole** - When multiple sensors are mounted on the same pole, they will not be subject to interference if they are configured to operate using different RF channels and are separated vertically by a few feet. The higher sensor would typically be used for the lanes farther from the pole in order to minimize occlusion.
- **Sensors on Opposing Poles** - SmartSensor HD units facing each other on opposing poles should operate on different RF channels and be separated by a 70-ft. (21.3-m) lateral offset, if possible.
- **Line of Sight** - The SmartSensor HD is designed to work accurately in the presence of barriers, but in general if there is an alternate mounting location that would avoid any type of structural occlusion, this is preferred. Avoid occlusion by trees, signs, and other roadside structures.
- **Neighboring Structures and Parallel Walls** - For best performance, it is preferred that sensor locations have a 30-ft. (9.1-m) lateral separation from overhead signs, overpasses, tunnels, parallel walls, and parallel-parked vehicles in order to avoid multiple reflection paths from a single vehicle.

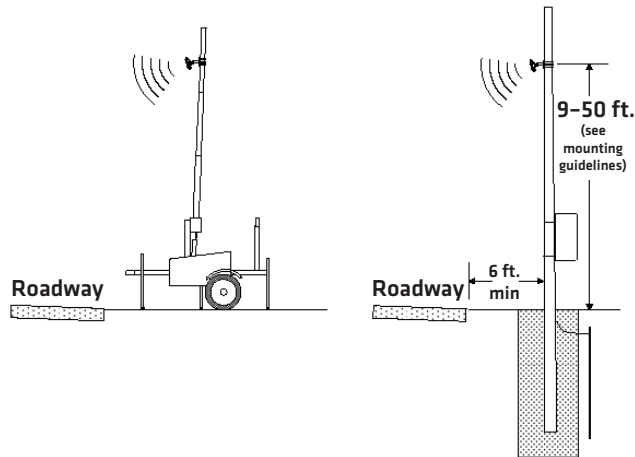


Figure I.1 - Portable (left) and Permanent (right) Sensor Stations

- **Mounting Height** - The mounting height should be based upon the offset from the lanes of interest. For each offset, the minimum, maximum, and best heights are shown in Table 1.1, found in Chapter 1. In general, the range of recommended heights is between 9 and 50 ft. (2.7 to 15.2 m).
- **Mounting Offset** - The minimum recommended offset (distance from the sensor to the edge of the first lane of interest) is 6 ft. (1.8 m).
- **Arterial Locations** - Sensor sites on arterials or other roadway segments with regulated stop lines should be selected at midblock positions to increase accuracy by avoiding positions at which vehicles are often stopped in front of the sensor.
- **Freeway Locations** - The SmartSensor HD is often used at permanent ATR (automatic traffic recorder) stations. The number of stations along a single roadway and the distance between stations should be selected to achieve adequate levels of statistical confidence. Permanent ATR stations, which are selected to cover interstate, principal arterial, and other national and state highways, are used to establish seasonal adjustment factors for count data from temporary collection sites (see Figure I.1).
- **Cable Lengths** - Ensure that you have sufficient homerun and sensor cabling. Cables can be as long as 600 ft. (182.9 m) if they're using 24 VDC operation and RS-485 communications; for longer connections, alternate wired and wireless options should be considered.
- **Signaling Delay** - After a vehicle passes in front of the sensor there will be a slight delay before the data for that vehicle is sent from the sensor. In a time-sensitive application—for instance, to supply a dynamic message sign with per vehicle warning messages—it will be necessary to ensure the sensor is sufficiently far upstream from the sign that the system has time to collect the data, process it, and send it to the sign by the time the vehicles reach the problem area. For specifics about signaling delay, see Appendix E.

Part I

Installing the SmartSensor HD

Chapter 1 - Installing the SmartSensor HD

Chapter 2 - Connecting Power and Surge

Installing the SmartSensor HD

In this chapter

- Selecting the Mounting Height
- Attaching the Mount Bracket to the Pole
- Attaching the Sensor to the Mount Bracket
- Aligning the Sensor to the Roadway
- Applying Silicon Dielectric Compound
- Connecting the Cable

Installing the SmartSensor HD is quick and easy. Once installed, the SmartSensor HD configures automatically and requires little or no on-site maintenance.

The installation process includes attaching the mounting bracket to the pole; attaching the sensor to the mounting bracket; aligning the sensor; applying a silicon dielectric compound to the sensor connector; and connecting the cable to the sensor.

Warning

Do not attempt to service or repair this unit. This unit does not contain any components and/or parts serviceable in the field. Any attempt to open this unit, except as expressly written and directed by Wavetronix, will void the customer warranty. Any visible damage to exterior seal labels will void the warranty. Wavetronix is not liable for any bodily harm or damage caused if unqualified persons attempt to service or open the back cover of this unit. Refer all service questions to Wavetronix or an authorized distributor.

Caution

Use caution when installing any sensor on or around active roadways. Serious injury can result when installation is performed using methods that are not in accordance with authorized local safety policy and procedures. Always maintain an appropriate awareness of the traffic conditions and safety procedures as they relate to specific locations and installations.

Selecting the Mounting Height

After selecting a mounting location within the recommended range of offsets (see the introduction and Figure 1.1), use Table 1.1 to select a mounting height.

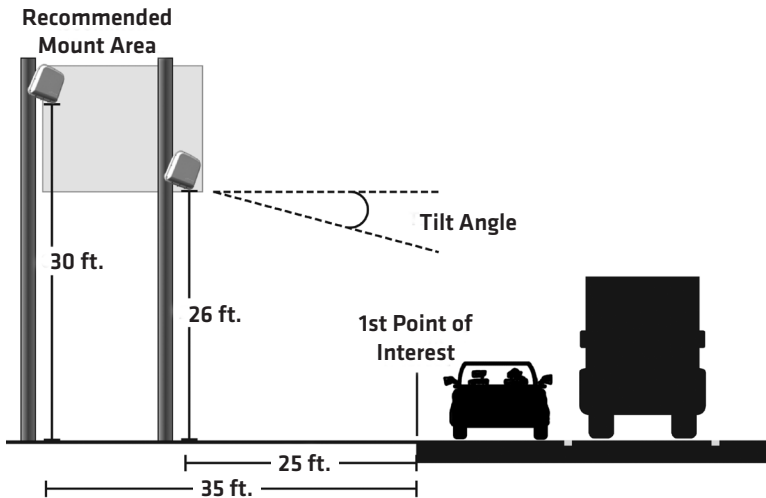


Figure 1.1 – Recommended Mounting Height

Offset from first Detection Lane (ft / m)	Recommended Mounting Height (ft / m)	Minimum Mounting Height (ft / m)	Maximum Mounting Height (ft / m)
6 / 1.8	12 / 3.7	9 / 2.7	19 / 5.8*
7 / 2.1	12 / 3.7	9 / 2.7	19 / 5.8*
8 / 2.4	12 / 3.7	9 / 2.7	20 / 6.1*
9 / 2.7	12 / 3.7	9 / 2.7	21 / 6.4
10 / 3	12 / 3.7	9 / 2.7	22 / 6.7
11 / 3.4	12 / 3.7	9 / 2.7	23 / 7
12 / 3.7	13 / 4	10 / 3	24 / 7.3
13 / 4	13 / 4	11 / 3.4	25 / 7.6

	14 / 4.3	14 / 4.3	11 / 3.4	26 / 7.9
	15 / 4.6	15 / 4.6	12 / 3.7	26 / 7.9
	16 / 4.9	15 / 4.6	12 / 3.7	27 / 8.2
	17 / 5.2	16 / 4.9	13 / 4	28 / 8.5
	18 / 5.5	17 / 5.2	14 / 4.3	29 / 8.8
	19 / 5.8	17 / 5.2	14 / 4.3	30 / 9.1
	20 / 6.1	18 / 5.5	15 / 4.6	30 / 9.1
	21 / 6.4	19 / 5.8	15 / 4.6	31 / 9.4
	22 / 6.7	20 / 6.1	16 / 4.9	31 / 9.4
	23 / 7	22 / 6.7	16 / 4.9	32 / 9.8
	24 / 7.3	24 / 7.3	16 / 4.9	33 / 10.1
Recommended Offset	25 / 7.6	26 / 7.9	17 / 5.2	33 / 10.1
	26 / 7.9	26 / 7.9	17 / 5.2	34 / 10.4
	27 / 8.2	27 / 8.2	18 / 5.5	35 / 10.7
	28 / 8.5	27 / 8.2	18 / 5.5	35 / 10.7
	29 / 8.8	27 / 8.2	18 / 5.5	36 / 11
	30 / 9.1	29 / 8.8	19 / 5.8	37 / 11.3
	31 / 9.4	29 / 8.8	19 / 5.8	37 / 11.3
	32 / 9.8	29 / 8.8	19 / 5.8	38 / 11.6
	33 / 10.1	30 / 9.1	19 / 5.8	39 / 11.9
	34 / 10.4	30 / 9.1	19 / 5.8	39 / 11.9
	35 / 10.7	30 / 9.1	20 / 6.1	40 / 12.2
	36 / 11	30 / 9.1	20 / 6.1	41 / 12.5
	37 / 11.3	31 / 9.4	20 / 6.1	41 / 12.5
38 / 11.6	31 / 9.4	21 / 6.4	42 / 12.8	
39 / 11.9	33 / 10.1	21 / 6.4	43 / 13.1	
40 / 12.2	33 / 10.1	22 / 6.7	43 / 13.1	
41 / 12.5	34 / 10.4	22 / 6.7	44 / 13.4	
42 / 12.8	34 / 10.4	22 / 6.7	44 / 13.4	
43 / 13.1	35 / 10.7	22 / 6.7	45 / 13.7	
44 / 13.4	35 / 10.7	23 / 7	46 / 14	
45 / 13.7	36 / 11	23 / 7	46 / 14	
46 / 14	36 / 11	23 / 7	47 / 14.3	
47 / 14.3	36 / 11	24 / 7.3	48 / 14.6	
48 / 14.6	38 / 11.6	24 / 7.3	48 / 14.6	
49 / 14.9	38 / 11.6	24 / 7.3	49 / 14.9	
50-230 / 15.2-70.1	39 / 11.9	25 / 7.6	Must be < offset	

Table 1.1 – Mounting Height Guidelines in Feet / Meters

Attaching the Mount Bracket to the Pole

Before attaching the mount bracket to the pole, first make sure that your cables are long enough to reach the sensor and to stretch across the distance from the sensor to the cabinet.

Follow the steps below to correctly attach the mount to the pole (see Figure 1.2):

- 1 Insert the stainless steel straps through the slots in the mount bracket.
- 2 Position the mount bracket on the pole so that the head of the mount is pointing towards the middle of the lanes of interest.
- 3 Tighten the strap screws.

Note

The sensor will need to be adjusted later, to fine-tune the alignment, so be sure to keep the straps adjustable.

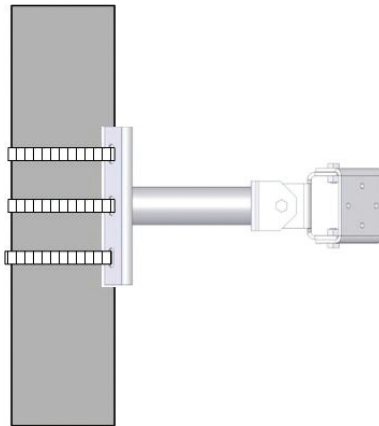


Figure 1.2 - Attaching the Mount Bracket to the Pole

Attaching the Sensor to the Mount Bracket

Use the following steps to securely fasten the sensor to the mount bracket:

- 1 Align the bolts on the sensor's backplate with the holes in the mount bracket. The large 26-pin connector at the bottom of the unit should be pointing towards the ground.
- 2 Place the lock washers onto the bolts after the bolts are in the mount bracket holes.
- 3 Thread on the nuts and tighten (see Figure 1.3).

Note

Do not over-tighten the fasteners.

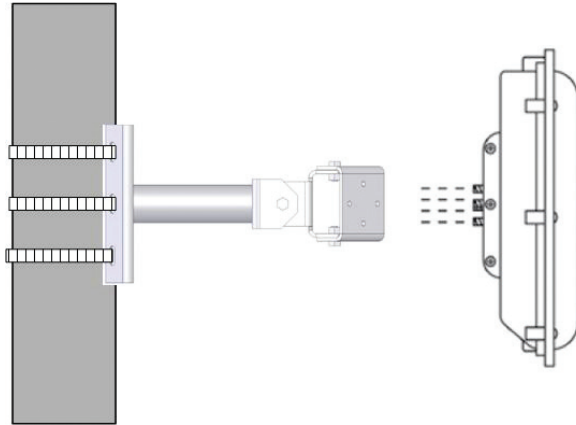


Figure 1.3 - Attaching the Sensor to the Mount Bracket

Aligning the Sensor to the Roadway

Use the following steps to correctly mount and align the SmartSensor HD:

- 1 Tilt the sensor down so that the front is aimed at the center of the detection area (see Figure 1.4).

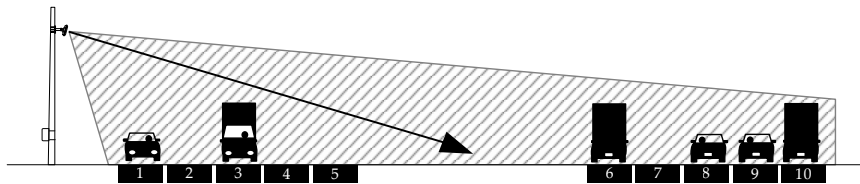


Figure 1.4 - Up-and-down Positioning

- 2 Adjust the side-to-side angle so that it is about two or three degrees right of perpendicular (see Figure 1.5).

Note

The side-to-side alignment will eventually be fine-tuned for better accuracy using SmartSensor Manager HD (SSMHD). That step will be addressed in Chapter 6, after SSMHD has been installed.

**Side-to-side alignment should
be almost perpendicular**

Figure 1.5 – Side-to-side Positioning

Applying Silicon Dielectric Compound

Use the following steps to correctly apply the silicon dielectric compound:

- 1 Tear the tab off of the tube of silicon dielectric compound.
- 2 Squeeze about 25% of the silicon into the connector at the base of the SmartSensor HD (see Figure 1.6). Be sure to wipe off any excess compound.



Figure 1.6 – Applying Silicon Dielectric Compound

Connecting the Cable

The sensor connector is keyed to ensure proper connection; once you have plugged the cable connector into the sensor connector, simply twist the cable connector clockwise until

you hear it click into place. To avoid undue movement from the wind, strap the cable to the pole or run it through a conduit, but leave a small amount of slack at the top of the cable to reduce cable strain (see Figure 1.7).

Note

If you run the cable through the pole, do not drill through the sensor mount, as the sensor and sensor mount may need to be adjusted in the future.



Figure 1.7 – Sensor Connector

The service end of the cable has a +DC and GND for a power supply of 12 to 24 VDC. Two communication ports (either RS-232 or RS-485) are available to connect the Smart-Sensor HD to a modem or other communication device. Typically, one RS-485 and one RS-232 port are available.

Note

It is important to note that there are two different cables that you may be using, the 8-conductor cable and the 10-conductor cable. This will be discussed in greater depth in the next chapter.

In this chapter

- Connecting Lightning Surge Protection
- Wiring to Earth Ground
- Installing the Power Plant
- Connecting the Power Plant to Your Installation
- Wiring Communication

Once the sensor is installed, it will need to be wired for power and surge protection. Wavetronix Click products allow you to quickly and easily include power and surge protection in your sensor application. Please refer to the Click quick-reference guides for more comprehensive product instructions.

There are several ways your sensor might be set up:

- A two-part installation, with components in two areas: first, a pole by the road holds your sensor plus a pole-mount box with a surge protector inside. Second, a main traffic cabinet holds power and communications devices. The cabinet and pole are connected via a homerun cable that runs underground.

Note

This chapter assumes the box and cabinet are connected by an underground cable run, but in certain circumstances they might not be.

- A single-part installation, with all components on the same pole. This pole holds your sensor. Power and communications devices (most likely wireless) are in a pole-mount box or there is a traffic cabinet at the base of the pole; either way there is no underground cable run. Power comes from the pole itself or from a battery and/or solar panels at the pole.

How you set up the devices in this chapter will vary depending on which of these installations you are using.

Connecting Lightning Surge Protection

The sensor should be connected to at least one surge protection device. The Click 200 and equivalent devices are designed to prevent electrical surges along cables from damaging the sensor and/or the cabinet. It is also a convenient spot to terminate the cable coming from your sensor, as it has terminals for all the wires.

Note

If you choose not to use surge protection in your installation, please contact Wavetronix Technical Services for assistance.

If you are using the one-part installation option above—no underground cable run—put a Click 200 in the pole-mount box/traffic cabinet (whichever is being employed) as a termination point for the cable from the sensor, and as a way to protect the box/cabinet. When there is no underground cable run, it is safest practice, as well as Wavetronix standard procedure, to connect the cable from the sensor in the UNPROTECTED side of the Click 200.

- 1 Install a Click 200 in the pole-mount cabinet/traffic cabinet by snapping it onto the DIN rail. Your power and communications devices will most likely also be on this DIN rail; make sure the Click 200 is connected to them via wires or the shared communication bus (connecting power will be covered later in this chapter; for how to connect to communications devices, see the Click Series User Guide).
- 2 Wire the cable from the sensor to the UNPROTECTED side of the Click 200.

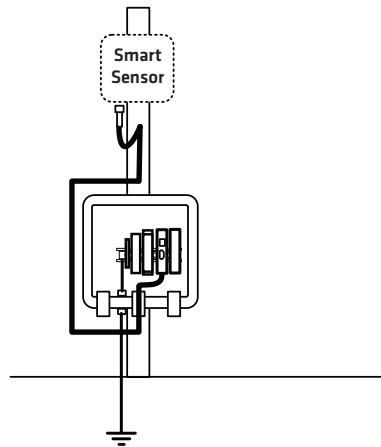


Figure 2.1 – Using a Single Click 200

Note

The different cables available and how to wire them into the Click 200 will be covered later in this section.

If you are using the two-part installation option above, you'll have an underground cable run as part of your installation, connecting the power and comms devices in the main traffic cabinet to the pole-mount box and sensor. When there is an underground cable run, it is safest practice, as well as Wavetronix standard procedure, to use two Click 200s, one on each end of the cable: one in the main traffic cabinet and the other in the pole-mount cabinet. Both ends of the cable should be connected to the UNPROTECTED side of their Click 200s. This is important because the underground cable run will be susceptible to surges caused by lightning striking the ground near it.

If this run is shorter than 600 ft. (182.9 m), you can use a Wavetronix cable; see Appendix D for more on cable lengths.

- 1 Install one Click 200 device in a pole-mount cabinet on the same pole as the sensor being protected. Install it by snapping it onto the DIN rail.
- 2 Connect the cable from the sensor to the PROTECTED side of this Click 200. This cable should be kept as short as possible.
- 3 Install another Click 200 in the main traffic cabinet. You will likely have power and communications devices in this cabinet; make sure the Click 200 is connected to them via wires or the shared communication bus (connecting power will be covered later in this chapter; for how to connect to communication devices, see the Click Series User Guide).
- 4 Connect the pole-mount box and the main traffic cabinet by running a cable from the UNPROTECTED side of the Click 200 in the pole-mount box to the UNPROTECTED side of the Click 200 in the main traffic cabinet.

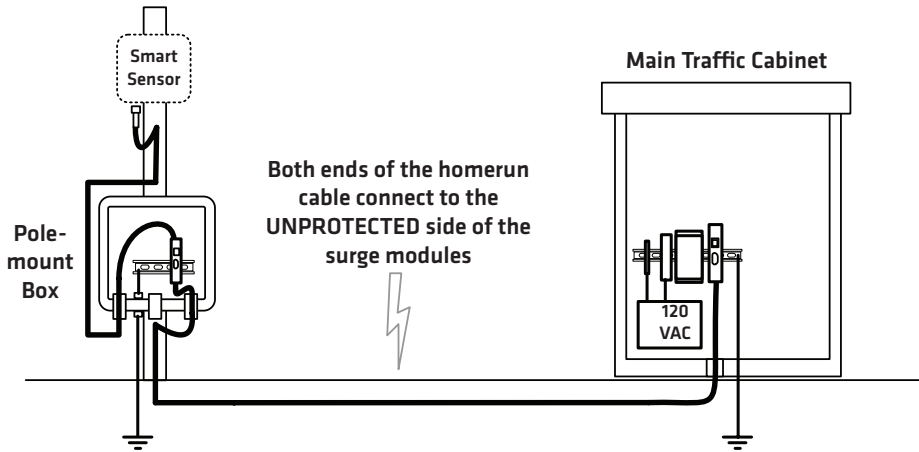


Figure 2.2 - Underground Cable Run

Wiring the Click 200

There are two cables that may be used with your sensor, the 8-conductor cable and the 10-conductor cable. Which one you use is based largely on the connector on your SmartSensor HD—that is, the connector where the cable will be plugged into the sensor.

There are two different connectors that may be found on a SmartSensor HD:

- The 10-pin connector is used with the new 22-lane SmartSensor HD. It currently only comes installed on the 8-conductor cable.
- The 26-pin connector is used with legacy HDs, retrofitted HDs, and the limited lane/feature versions. It can be installed on the 8-conductor cable or the old 9-conductor cable.

Note

There may be compatibility issues if you use a 8-conductor/26-pin connector cable with a SmartSensor HD that was manufactured in or before 2008. Contact Wavetronix Technical Services for details and assistance.

The wiring for these two cables is almost identical; the differences are pointed out below.

Note

If you have an underground cable run that stretches more than 600 ft (182.9 m), you will likely need to use a different cable; in that case the colors won't match the figure below.

The Click 200 contains three terminal connectors on both the top and the bottom of the module (see Figure 2.3). The terminal connectors are removable and are red-keyed, allowing each connector to plug into only one specific jack. This both simplifies the wiring process and reduces the possibility of wiring errors.

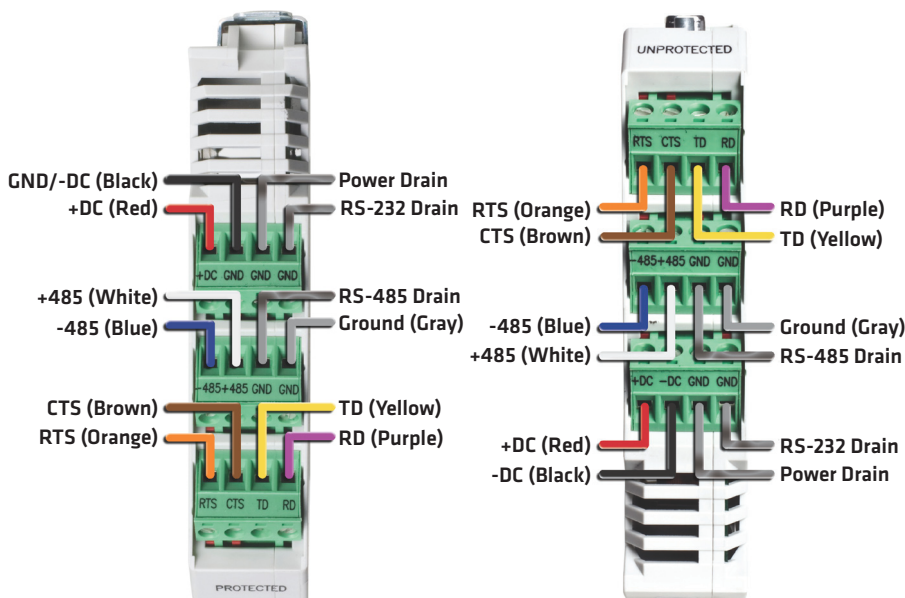


Figure 2.3 – Click 200 Terminal Connections (protected and unprotected sides)

If you have an 8-conductor cable, it will have the following wiring differences:

- There is no gray ground wire.
- Instead of three drains, there is only one. This drain can be connected into any of the screw terminals marked GND.
- The white +485 wire will have a blue stripe.

Note

See Appendices A and B for cable pinout diagrams for the two different connectors found on SmartSensor HDs.

Wiring to Earth Ground

All Click 200 devices should be mounted on a DIN rail that is connected to earth ground either through an earth-grounded chassis or a 16 AWG or larger grounding wire attached to a 7-ft. (2.1-m) grounding rod. Follow the steps below to correctly wire to earth ground:

- 1 Connect the grounding wire from either the DIN rail or a GND screw terminal on the UNPROTECTED side of the Click 200 to the lug bolt on the inside of the pole-mount cabinet.
- 2 Connect another grounding wire from the exterior lug bolt to earth ground (see Figure 2.4).



Figure 2.4 - Earth Ground Connections

Installing the Power Plant

Provide power to your installation using the Click power plant. This set of modules includes the following:

- Click 201/202 AC to DC converter
- Click 210 circuit breaker and switch
- Click 230 AC surge module

A Click 201 provides 1 A of power and is capable of powering a single sensor, while a Click 202 provides 2 A and can power two sensors. (There is also a Click 204 which provides 4 A of power, but that will usually not be necessary in an installation such as the one outlined below.) The Click 230 helps limit current surges on the power lines; the Click 210 interrupts power during overload conditions and provides a convenient way to turn power on and off.

The power plant will either be in a pole-mount box or in a main traffic cabinet. If it's in a traffic cabinet, the power will be sent to the pole via an underground cable run. How to install the power plant and then wire to a Click 200 will be covered in the rest of this section.

It should be noted that if you have ordered a Wavetronix preassembled cabinet, all of this wiring and installation will already be done.

Note

An authorized electrical technician should perform installation and operation of this unit. Persons other than authorized and approved electrical technicians should NOT attempt to connect this unit to a power supply and/or traffic control cabinet, as there is a serious risk of electrical shock through unsafe handling of the power source. Extreme caution should be used when connecting this unit to an active power supply.

Wiring in AC

The first step is to get AC power into the enclosure. (Sometimes the power source is actually DC; to see Wavetronix's selection of DC power modules, see the Click Series User Guide.) If you're using a main traffic cabinet, wire from its power source; if you're using a pole-mount box, the power lines or cable can be brought in through the conduit on the bottom-left.

Note

Make sure power to AC mains is disconnected while wiring AC input.

Wiring the Click 210

The first device in the power plant, as seen in Figure 2.5, is the Click 210. This is a compact circuit breaker DIN rail device designed to interrupt an electric current under overload conditions. The breaker is trip-free and can be easily reset after a current interruption by pushing the reset button.

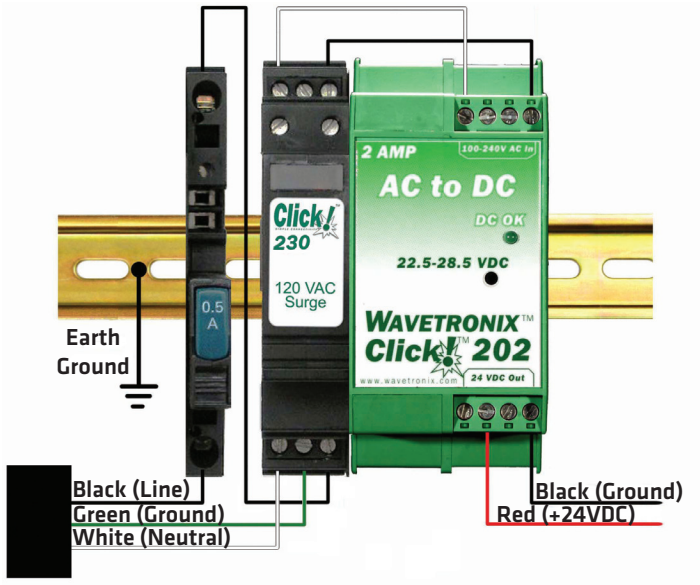


Figure 2.5 – AC Surge Protection

To add a Click 210 circuit breaker and switch (see the left side of Figure 2.5):

- 1 Mount the Click 210 onto the DIN rail.
- 2 Connect the line conductor (usually black) from the AC terminal block or cord in to either side of the module.
- 3 Wire out of the other side.

Note

For ease in troubleshooting, it is recommended that you follow the wire color scheme outlined in this chapter.

Wiring the Click 230

The next device in the power plant is the Click 230, which is the AC surge protector (see Figure 2.5). To install:

- 1 Mount the Click 230 onto the DIN rail next to the Click 210.
- 2 Connect the line conductor (black) from the Click 210 to terminal 5 on the IN side of the Click 230.
- 3 Connect the neutral (usually white) wire from the AC terminal block or cord to the terminal marked 1 on the Click 230.
- 4 Connect the ground wire from the AC terminal block or cord to the terminal marked 3 on the Click 230.

- 5 Connect an outgoing and protected line wire to the terminal marked 2 on the Click 230. The line wire should be black.
- 6 Connect an outgoing and protected neutral wire to the terminal marked 6 on the Click 230. The neutral wire should be white.

The terminal blocks 3 and 4 are directly bonded via the metal mounting foot of the base element to the DIN rail. There is no need for any additional grounding between terminals 3 and 4 and the DIN rail.

Wiring the Click 201/202

The final device in the power plant should be either a Click 201 or 202 (as shown in Figure 2.5). These are AC to DC converters, also occasionally called the power supplies. As noted above, the difference between the two is that the Click 201 outputs 1 A and the Click 202 outputs 2 A (the Click 204 outputs 4 A but will probably not be needed for an HD installation). Choose which device suits your installation best, then follow the steps below to install it (see Figure 2.6):

- 1 Mount the Click 201/202 onto the DIN rail next to the Click 230.
- 2 Connect the line (black) wire from the Click 230 into the L screw terminal on the top of the Click 201/202.
- 3 Connect the neutral (white) wire from the Click 230 to the N screw terminal to the top of the Click 201/202.



Figure 2.6 – Wiring AC Power into the Click 201/202

Note

The NC screw terminal is not connected internally. Connecting a wire to a no connect (NC) terminal simply gives it a convenient termination point.

To wire the newly converted DC power out of the Click 201/202:

- 1 Connect a +DC conductor (usually a red wire) to the + screw terminal on the bottom of the Click 201/202 (see Figure 2.7).
- 2 Connect a -DC conductor (usually a black wire) to either of the – screw terminals on the bottom of the Click 201/202.



Figure 2.7 – Wiring DC Power Out of the Click 201/202

Note

Do not wire into the screw terminal marked DC OK; it provides only 20 mA and should be used only for monitoring the power supply.

The screw terminal connectors on the top and bottom of the module are removable to simplify wiring and are red-keyed, allowing the connector to plug into only one correct jack.

Connecting the Power Plant to Your Installation

Now the power plant is complete and you have reliable, safe DC power. The next step is to get that power to the rest of the installation.

If the power plant is in a pole-mount box, this involves getting that power onto the T-bus; from there it will power any communication devices that may be on it. It will also power the Click 200, which will send the necessary 10–30 VDC, along with communications, to the sensor.

If the power plant is in a main traffic cabinet, this also will involve getting DC from the power plant on the T-bus; from there it will power any communication devices on that bus. It will also power the Click 200, which will send that power, along with communications, along the homerun cable to the Click 200 in the pole-mount box. That Click 200 will put the power (and communications) onto the T-bus, powering any communication devices that may be on it. It will also send the necessary 10–30 VDC, along with communications, to the sensor.

To put power on the T-bus, you will first need to connect a 5-screw terminal block to the end of the T-bus, then follow the steps below to wire DC to it:

- 1 Connect +DC (red) from the Click 201/202 to the top screw terminal on the 5-screw terminal block.
- 2 Connect -DC (black) to the second screw terminal.

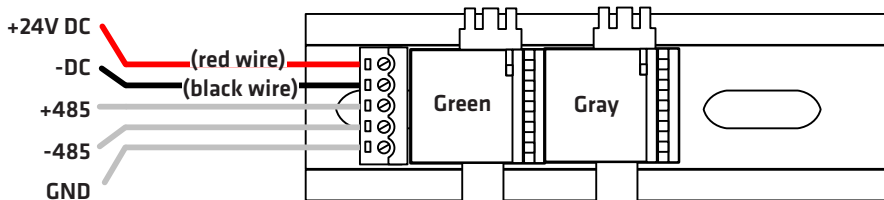


Figure 2.8 - Connecting Power Directly to the T-bus

Note

Green T-bus connectors conduct power and communication on the DIN rail backplate; gray T-bus connectors only conduct power and are used to distribute power without connecting communication.

You can also wire DC to the Click 200 itself; it will then put that power on the T-bus. If you'd like to do that, follow these steps:

- 1 Connect +DC (red) from the Click 201/202 to the +DC screw terminal.
- 2 Connect -DC (black) to a GND screw terminal.

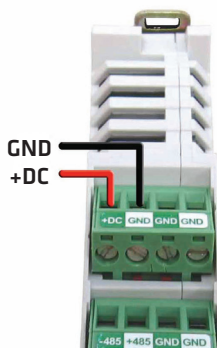


Figure 2.9 - Wiring DC Power into the Click 200

Wiring Communication

The last thing to do is decide how to communicate with the sensor. How you do this will vary based on your installation. If your sensor is connected to a Click 200 in a pole-mount

box, and you want to access that sensor from a main traffic cabinet or from the traffic operations center, you will need some kind of communication between the two spots: either with the homerun cable, which can carry both RS-232 and RS-485 communications, or by using a Wavetronix Click communication device.

Wavetronix has a variety of wired and wireless communication devices, such as the Click 301 serial to Ethernet converter, which lets you communicate with the sensor via Ethernet, or the Click 400, which is a 900 MHz radio that communicates wirelessly with other radios. See the Click Catalog, Click Series User Guide, or ITS Designer Training Guide for more information.

The Click 200 has several ports for other methods of communication. The faceplate has a DB-9 port you could connect to for RS-232 communication. There are also several RS-485 connections:

- T-bus backplane: puts RS-485 on the T-bus. Because the Click 200 is connected to the sensor, this T-bus connection means the sensor, the Click 200, and any other device on the T-bus all communicate with each other.
- RJ-11 connector on the faceplate for connecting to contact closure devices, if desired.

Note

The Click 200 does not convert RS-232 communication to RS-485. It simply provides surge protection for these two independent connections.

Part II

Using SmartSensor Manager HD

Chapter 3 - Installing SmartSensor Manager HD

Chapter 4 - Communication

Chapter 5 - Sensor Settings

Chapter 6 - Lane Setup

Chapter 7 - Data Setup and Collection

Chapter 8 - Tools

In this chapter

- Installing SSMHD
- Installing SSMHD on a Handheld Computer

After the SmartSensor HD is installed, use SmartSensor Manager HD (SSMHD) to configure the sensor to the roadway and change sensor settings. SmartSensor Manager HD is software that enables users to configure and interact with the SmartSensor HD.

Installing SSMHD

SSMHD can be run on a Windows® PC and on a handheld computer running Windows Mobile. Everything needed to install SSMHD to a PC is contained in the SSMHD **Setup.exe** file.

Note

You must have administrator rights to run the setup program.

Note

Microsoft .NET Framework version 3.5 or higher needs to be installed on your computer before installing SSMHD. You can get the .NET Framework from the Microsoft website.

Follow these steps to install SSMHD on a PC:

- 1 To download the install file, go to the Wavetronix website at www.wavetronix.com.
- 2 Click the **Support** link near the top of the page. This will bring up a page with icons from the three different Wavetronix product lines.
- 3 Click the SmartSensor icon. This will bring up drop-down menus allowing you to select a product by name or part number.
- 4 Select SmartSensor HD or WX-SS-125. A list of links will appear.
- 5 Select the **SmartSensor Manager HD** link (it will be near the top) to download the SSMHD install file.
- 6 Once you've downloaded the file, double-click on it. Opening it executes a setup program that will copy all the necessary files to your hard drive and place icons in the Start menu and on the desktop of the PC or laptop (see Figure 3.1).

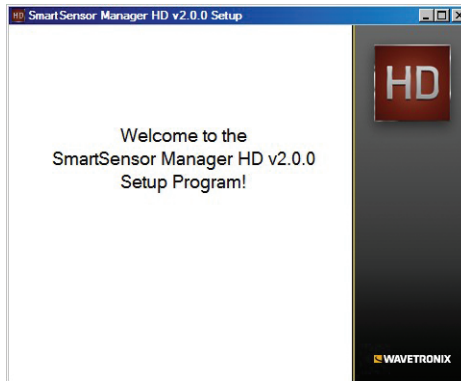


Figure 3.1 - SSMHD Setup Wizard

- 7 Select an installation location. The default location provided is normally “C:\Program Files\Wavetronix.” Click **Browse** to choose another location (see Figure 3.2).

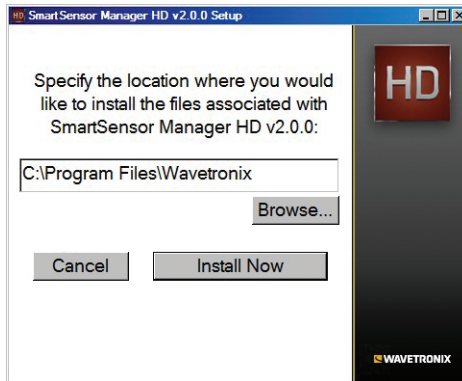


Figure 3.2 – Location to Be Installed

- 8 Click the **Install Now** button.
- 9 After SSMHD is installed, you can create shortcuts to the SSMHD software on the desktop and in the start menu using the corresponding checkboxes (see Figure 3.3). If no shortcuts are desired, uncheck the corresponding boxes.

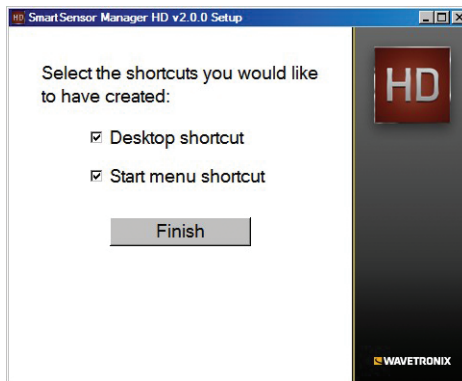


Figure 3.3 – Shortcut Options

- 10 Click the **View release notes when finished** checkbox to view the SSMHD release notes. The release notes contain additional information about the current version of the SSMHD software. A PDF reader program (i.e. Adobe Acrobat Reader) is required to view the release notes.
- 11 Click **Finish** to complete the setup process.

Note

SSMHD is designed to display text with Normal Size display resolution (96 dpi). If your text is too big and does not display properly, you can edit the Advanced Display property settings on your PC to reduce the display resolution from 120 dpi down to 96 dpi.

Installing SSMHD on a Handheld Computer

If you would like to run SSMHD on a handheld computer, consider purchasing a Wavetronix Install Kit, which includes a Socket Mobile SoMo 650 handheld computer that comes preconfigured with SmartSensor Manager HD, as well as Click Supervisor and the Manager software programs for the other Wavetronix sensors. These software programs are tested for and supported on the SoMo 650.

SSMHD can also be installed and will function on a handheld computer other than the SoMo 650. However, because of differing handheld computer technology, Wavetronix does not support any other handheld devices.

Use these steps to install SSMHD on a handheld computer running Windows Mobile:

- 1 Ensure the handheld computer is connected to the PC and synced.
- 2 Click on the **SSMHD Setup.exe** file to run the setup program on the host computer. The SSMHD Setup Wizard will automatically check the host computer to see if Microsoft ActiveSync (Windows XP and older) or Windows Mobile Device Center (Windows Vista and Windows 7) is installed. These are programs that are used to communicate with a handheld device. If one of these programs is found, the option of installing SSMHD to a handheld device will become available.
- 3 Click the **Pocket PC** checkbox and then the **Next>>** button to install SSMHD on a connected handheld device (see Figure 3.4). If both the **Computer** and **Pocket PC** boxes are checked, the setup program will first install the SSMHD software to the PC.

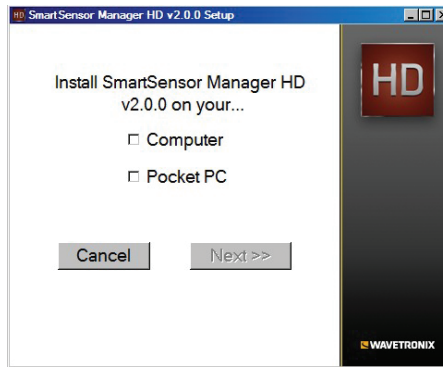


Figure 3.4 – Handheld Computer Installation Program

- 4 Click **Continue>>** to start the handheld computer installation process (see Figure 3.5). The setup program runs the Add/Remove Programs application for Windows handheld devices. If a handheld device is connected to the computer, Add/Remove Programs will immediately begin installing SSMHD on the device. If a handheld device is not connected to the computer, SSMHD will be downloaded the next time a handheld device is connected to the computer.

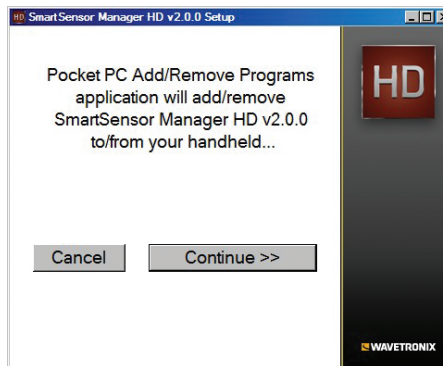


Figure 3.5 – Adding SSMHD to a Handheld Computer

- 5 Click **OK** once the download is complete.

In this chapter

- Serial Connection
- Modem Connection
- Internet Connection
- Virtual Connection
- Viewing Connection Information
- Troubleshooting Connections
- Communication Protocol Type
- Communication Screen Icons
- Uploading the Sensor's Embedded Software

Use the SSMHD software to change settings, view data and configure the sensor to the roadway.

First, physically connect your computer or handheld computer to the sensor. Next, launch SSMHD by either clicking on the icon that was placed on your desktop or clicking the icon found in the Start menu. The SSMHD main screen shown in Figure 4.1 will appear.

The image of the earth in the lower left corner allows you to select the language for SSMHD. To change the language, click on the image and select the desired language from the drop-down list.

The control beneath the earth image allows you to change the size of the window. There are three options; click on a box to change the window to the corresponding size.

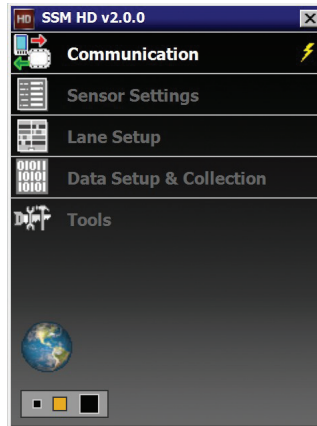


Figure 4.1 – SSMHD Main Screen

To interact with and configure the sensor in SmartSensor Manager HD, connect to the sensor through one of the following four types of connections, all available on the Communication screen:

- **Serial connection** – Made using RS-232 or RS-485 communication
- **Modem connection** – Made to an external analog modem
- **Internet connection** – Made using an IP address and a serial to Ethernet converter
- **Virtual connection** – Can be made for convenience in learning and demonstrating SSMHD functionality.

Communication settings are stored in the system registry each time a connection is established. After the first connection is made to the sensor, SmartSensor Manager HD will save the connection settings that were used. Click the lightning bolt icon on the right side of the communication link on the main SSMHD page to make a connection using the most recent parameters stored in the registry. The lightning bolt will only appear when there is no connection currently established.

Serial Connection

- 1 Click on **Communication** to access the Communication window (see Figure 4.2).
- 2 Select the Serial tab.
- 3 Set **Port** and **Speed** to the desired settings. The SSMHD software defaults to 9600 bps; this baud rate is recommended and most likely will not need to be changed. Click the **Advanced...** button for additional serial settings.
- 4 Click the **Connect** button.

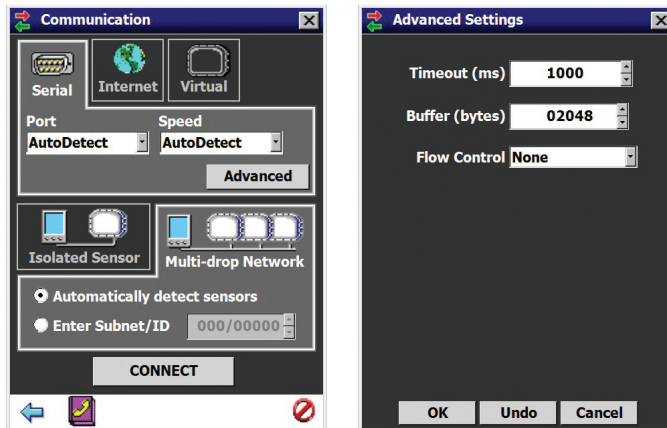


Figure 4.2 - Serial Connection (left) and Advanced Settings (right)

Advanced Settings

The Advanced Settings screen contains the following fields:

- **Timeout (ms)** - Allows you to set an additional amount of time (in milliseconds) that SSMHD will wait for a response when communicating with the sensor.
- **Buffer (bytes)** - Contains the number of bytes used by SSMHD to store data received from the sensor.
- **Flow Control** - Is usually only used if you are connecting through a RS-232 device that requires hardware handshaking.

Note

When connecting directly from a computer running SmartSensor Manager HD to a SmartSensor HD unit (with no modem in between), you should not attempt to connect until after the Flow Control setting in the serial connection's Advanced Settings screen is set to **None**. Otherwise you may not be able to successfully connect.

Modem Connection

Using earlier versions of SmartSensor Manager HD you can connect the SmartSensor HD directly to an external analog modem, to which your PC's modem can then dial up to establish a connection. For example, this could be a regular Plain Old Telephone Service (POTS) analog modem or a wireless modem (GSM, etc.) if service is available in your area.

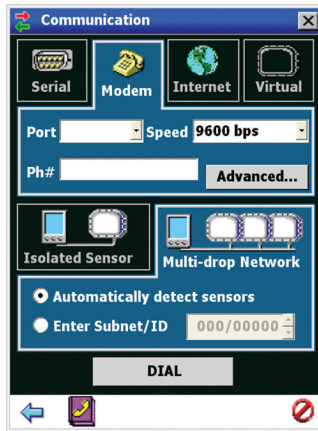


Figure 4.3 - Modem Connection

Use the steps below to connect to the SmartSensor HD using a modem connection (see Figure 4.3):

- 1 Click on **Communication** and the Communication window will appear.
- 2 Click on the **Modem** tab.
- 3 Enter the phone number in the **Phone #** field.
- 4 Click the **Advanced...** button for additional modem settings (see Figure 4.4).
- 5 Click **Dial** to establish the connection.

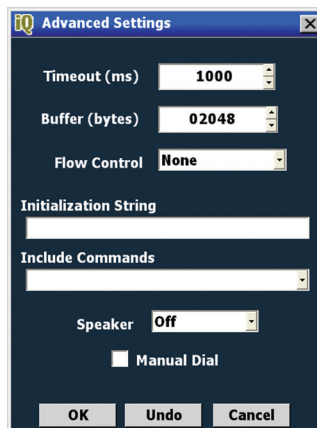


Figure 4.4 - Modem Advanced Settings

Advanced Settings

The Advanced Settings screen contains the following fields:

- **Timeout (ms)** - Allows you to set an additional amount of time (in milliseconds) that SSMHD will use when communicating with the sensor. A modem connection may require a longer timeout setting than a serial connection.

- **Buffer (bytes)** – Contains the number of bytes used by SSMHD to store data received from the sensor. This field should always be set to 02048 or greater.
- **Flow Control** – Is usually only used if you are connecting your computer to an RS-232 device that requires hardware handshaking. If you have a slower RS-232 modem that requires hardware handshaking, select Hardware from the drop-down menu. You will need to make sure you have connected the RTS and CTS lines. For information on how to configure hardware handshaking on the sensor, see HW Handshaking in the Advanced Tab section of Chapter 5.
- **Initialization String** – Allows you to configure the office modem being used to dial the field modem. If the string field is left blank, the application will use a default string to communicate with the modem.
- **Include Commands** – Contains numerous modem settings that will automatically set the initialization string when selected.
- **Speaker** – Allows you to adjust the volume of the modem’s speaker.
- **Manual Dial** – Allows you to manually dial the modem number.

Internet Connection

The SmartSensor HD can be connected to the Internet, allowing access to the sensor from anywhere with Internet access. Below is a list of three ways to connect the SmartSensor to the Internet:

- **Serial to Ethernet Converter** – The SmartSensor HD can be connected to a local area network (LAN) by using a serial to Ethernet converter. As an option, the SmartSensor HD can be shipped with a Click 301 serial to Ethernet converter that is Internet addressable, which makes it possible to connect to the sensor from anywhere the adapter’s address is accessible.
- **Serial to 802.11b Wireless** – The Click 420 is a serial to 802.11b converter that provides serial devices with an IP address on a wireless 802.11b network. The Click 420 has been tested to work over a -34° C to 74° C temperature range.
- **Internet Service Providers** – Cellular providers of wireless Internet services maintain networks in most metropolitan areas in the United States and coverage continues to expand. The SmartSensor HD can be equipped with an optional external modems—for example, CDMA, GMS or GPRS—and assigned an Internet address on these networks.

Use the steps below to connect to the SmartSensor HD using an Internet connection:

- 1 Click on **Communication**.
- 2 Click the Internet tab and the Internet setting options will appear (see Figure 4.5).
- 3 Enter the IP address or URL of the sensor of interest. The IP address consists of four numbers ranging from 0–255 separated by dots. Enter the IP address assigned to either the CDMA modem or the Click 301 serial to Ethernet converter.
- 4 Enter the port number assigned to the CDMA modem or the Click 301 serial to Ethernet converter in the **Port** field. This will be an integer value in the range of 0–65536.

The Click 301 port number automatically defaults to 10001.

- 5 Click the **Advanced...** button for additional settings.
- 6 Click the **Connect** button to connect to the sensor.

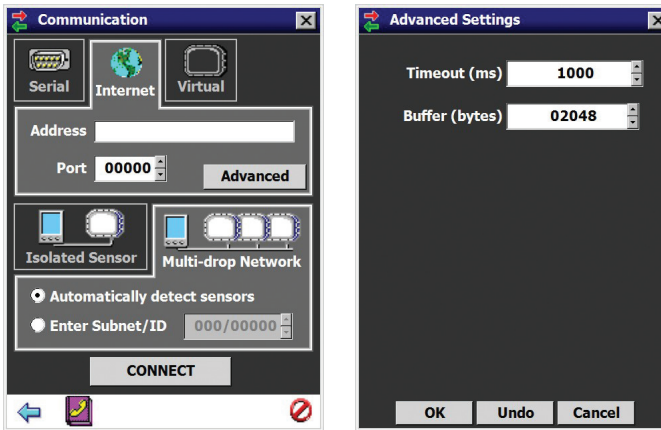


Figure 4.5 - Internet Connection (left) and Advanced Settings (right)

Advanced Settings

The Advanced Settings contain the following fields:

- **Timeout (ms)** - Allows you to set an additional amount of time (in milliseconds) that SSMHD will use when communicating with the sensor.
- **Buffer (bytes)** - Contains the number of bytes used by SSMHD to store data received from the sensor. This should always be set to 02048 or greater.

Virtual Connection

A virtual connection allows you to use the SSMHD software without being connected to an actual sensor. Making a virtual connection can be useful for the following reasons:

- To view a saved sensor setup file.
- To play back previously logged traffic.
- To demonstrate functionality for different applications.
- To review how the software works.

Use the following steps to make a virtual connection:

- 1 Click the **Communication** button.
- 2 Select the Virtual tab (see Figure 4.6).
- 3 Select or create a virtual sensor file (.ss125) by clicking the magnifying glass icon. Click the **Options...** button for more options.
- 4 Click the **Connect** button.

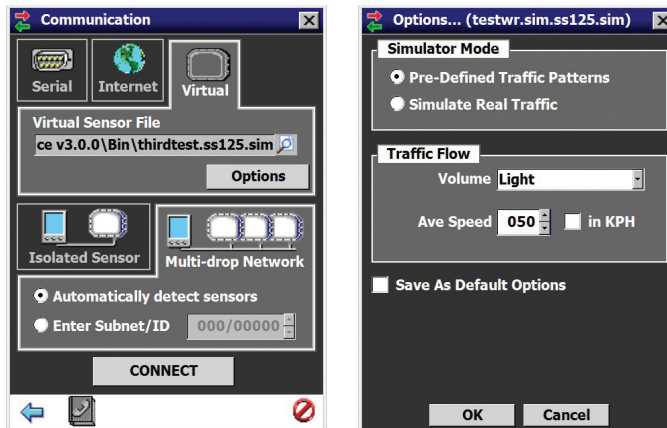


Figure 4.6 - Virtual Connection (left) and Virtual Options (right)

Additional Settings

The Options window contains the following settings:

- **Simulator Mode** - This section allows you to set a desired traffic pattern for the simulator.
- **Traffic** - Allows you to set the traffic volume and speed for the simulated traffic.

The **Save as Default Options** radio button saves the changes made to default settings.

Virtual Sensor File

Since a virtual connection is not made to an actual sensor, a virtual sensor file (.ss125) is used to save the configuration settings much like an actual sensor's flash memory. If you are making a virtual connection for the first time, you will need to create a virtual sensor file by clicking on the magnifying glass icon and entering a file name.

Note

When you are connected using a virtual sensor file, changes that would normally be saved to a sensor's flash memory will automatically be saved to the virtual sensor file.

Backing up a virtual sensor file will change the file to a sensor setup file (.ssc) that can be restored to an actual sensor. To convert a sensor setup file to a virtual sensor file, make a virtual connection and then use the **Restore Sensor Setup** tool in the **Tools** menu. To convert a virtual sensor file to a sensor setup file, use the **Back-up Sensor Setup** tool.

Viewing Connection Information

Once a connection is made to the SmartSensor HD, the main menu will appear and all configuration options will become available (see Figure 4.7).

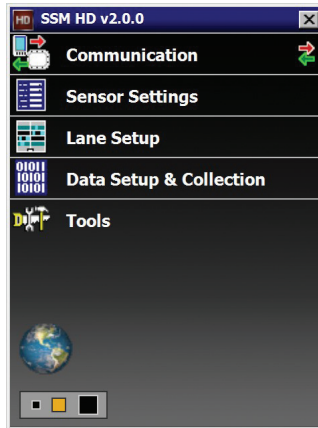


Figure 4.7 – SSMHD Main Screen (connected)

Once connected, you can view additional information about the connection you have established by clicking on the moving arrows icon on the top right of the main menu page or on the bottom right of the Communication screen. These arrows are only visible when there is an established connection.

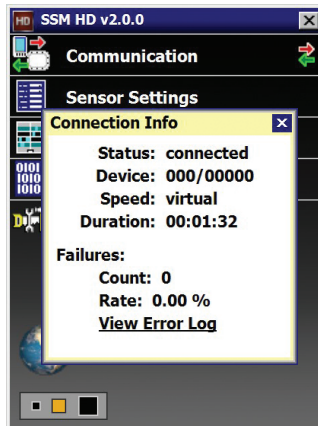


Figure 4.8 – Connection Info Screen

Below is a list of the information available on the Connection Info screen:

- **Status** – Shows that you are connected.
- **Device** – Shows the subnet and sensor ID.
- **Speed** – Shows the baud rate.
- **Duration** – Shows how long you have been connected.

- **Failures** - Shows the amount of failures during the connection, the percentage rate of failure and a link to the communication error log.

Troubleshooting Connections

If you have problems connecting, use the following steps to find the problem:

- 1 Make sure that all power and communication wiring is correct.
- 2 Check the port settings (baud rate, port ID).
- 3 Make sure that the sensor ID is correct.

Connection failure can occur for various reasons; if a failure occurs repeatedly, call Wavetronix Technical Services at 801-764-0277 for assistance.

Communication Protocol Type

Once the communication parameters are selected, choose the communication protocol type to be used for the connection.

Connecting to an Isolated Sensor

This protocol option is recommended when only one sensor exists on the remote end of the connection (see Figure 4.9).

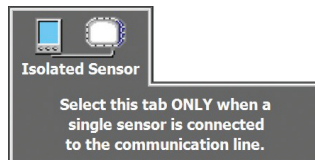


Figure 4.9 - Isolated Sensor

Connecting to a Sensor in a Multi-drop Network

Connecting to a sensor in a multi-drop network is recommended when more than one sensor exists on the remote end of a connection. To connect to a sensor on a multi-drop network, either click the radio button next to **Automatically detect sensors** or select **Enter Subnet/ID** and enter the multi-drop sensor ID of the sensor you are connecting to (see Figure 4.10).

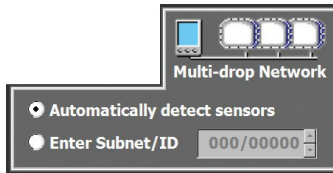


Figure 4.10 - Multi-drop Network

Communication Screen Icons

At the bottom of the communication screen there is a white bar with icons. This section will explain the purpose of those icons.

Address Book

The Address Book allows you to save device connection settings for future use. Click the book icon located at the bottom of the Communication page to add new connection settings to the Address Book (see Figure 4.11).

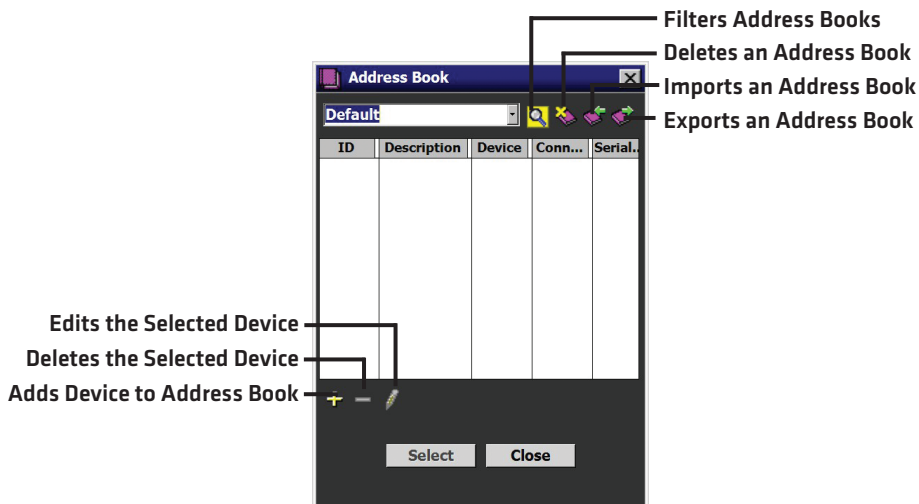


Figure 4.11 - Address Book

Password

The key icon allows you to create a password for SSMHD. Passwords are associated with the sensor in order to keep the connection and configuration secure. After clicking the icon, enter the desired password in both text boxes then click **OK**. This password will now have to be entered each time you attempt to make a connection (see Figure 4.12).



Figure 4.12 – Enter Password Window

If you forget the sensor password, use the **Click Here** link and a new window will open providing information about how to get a new password.

Communication Error Log

The error log contains all errors stored in the sensor's memory buffer. If you are having trouble connecting, using the error log may be helpful in the troubleshooting process. If you continue having trouble, save the error log file and contact Wavetronix Technical Services.

Note

The error log is cleared every time you close SSMHD< so if you need to save the file, do so before shutting the program down.

Click the **View Error Log** link to view the communications error log (see Figure 4.13). The error log can also be accessed by clicking on the error log icon at the bottom of the Communication screen.

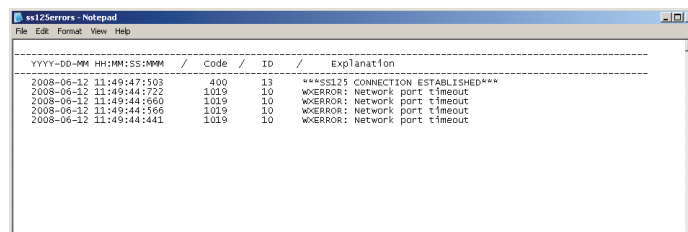


Figure 4.13 – Communication Error Log

Uploading the Sensor's Embedded Software

After clicking the Connect button, the software will check to see if your software version matches the version of the sensor's embedded software. If a discrepancy is detected, the Version Control screen may appear asking you to install firmware upgrades (see Figure 4.14). If you think you have reached this screen in error, clicking the **Recheck** button will

have the software retry and ensure that there has not been a communication issue. Clicking the **Details** button will display the current sensor and software information. Click the **Install Upgrade** button to upgrade the software.

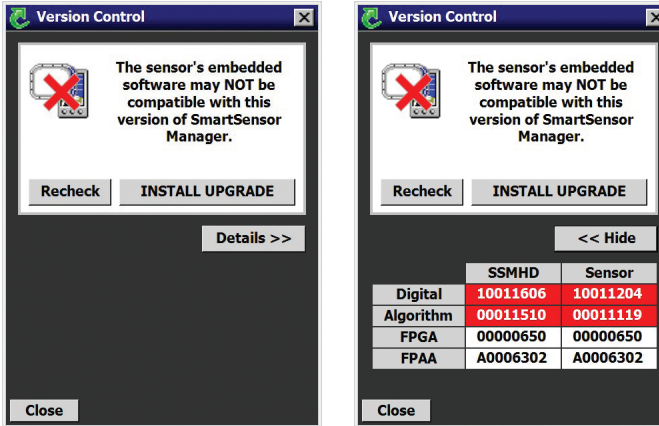


Figure 4.14 – Version Control (left) and Software Upgrade Details (right)

Note

Clicking the **Close** button and continuing configuration may cause problems with functionality.

The figure below shows how the firmware numbers are interpreted (see Figure 4.15). The month number is written in hexadecimal, meaning the months of October, November and December will be written as A, B and C respectively.

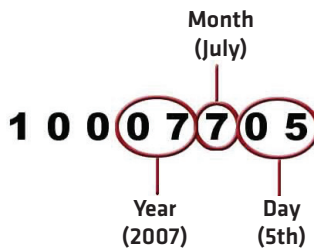


Figure 4.15 – Install Upgrade Numbers

If the row marked Digital is highlighted in red, the firmware upgrade may need to be installed. Compare the sensor number with the SSMHD number in the digital row of the details table. If the SSMHD firmware version date is more recent than the sensor firmware version date, the firmware upgrade will need to be installed; if the sensor's firmware date is more recent than the SSMHD firmware version date, a warning will appear notifying you that the sensor firmware could be downgraded (see Figure 4.16).



Figure 4.16 - Downgrading the Sensor

If the downgrade message appears, it simply means that the sensor firmware is newer than the version of SSMHD that was used to connect to the sensor. The newest version of SSMHD can be updated by downloading the software from www.wavetronix.com.

Click the **INSTALL UPGRADE** button to install the firmware embedded in SSMHD onto the SmartSensor HD. The **Recheck** button will query the sensor to see if the firmware bundled in SSMHD is different from the version running on the sensor.

In this chapter

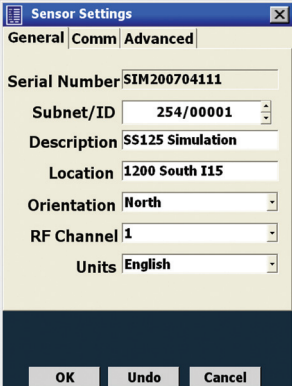
- General Tab
- Comm Tab
- Advanced Tab

Click the **Sensor Settings** link on the main menu to change and save settings on the sensor.

The Sensor Settings window contains the **General**, **Comm** and **Advanced** tabs.

General Tab

The General tab contains the following fields (see Figure 5.1):



The screenshot shows a dialog box titled "Sensor Settings" with three tabs: "General", "Comm", and "Advanced". The "General" tab is selected. The fields are as follows:

Serial Number	SIM200704111
Subnet/ID	254/00001
Description	SS125 Simulation
Location	1200 South I15
Orientation	North
RF Channel	1
Units	English

At the bottom of the dialog box are three buttons: "OK", "Undo", and "Cancel".

Figure 5.1 – General Tab

- **Serial Number** - Contains the sensor serial number and cannot be edited.
- **Subnet/ID** - Allows you to enter the subnet and ID. A subnet can be used to create groupings of sensors. The subnet default is 000 and the ID default is the last five digits of the sensor serial number. The ID can be changed, but no two sensors should have the same ID. The ID must be unique for all sensors on a multi-drop bus.
- **Description** - Allows you to enter a description for each sensor. Limited to 32 characters.
- **Location** - Allows you to enter the location of the sensor. Limited to 32 characters.
- **Orientation** - Allows you to enter the direction the sensor is pointing. This field is purely for informational purposes and has no effect on performance or the sensor's physical mounting.
- **RF Channel** - Displays which radio frequency channel the sensor is transmitting on. Using multiple sensors in close proximity will require each sensor to be set to a different RF channel (see the introduction for more information about mounting sensors in close proximity).
- **Units** - Allows you to display either English (mph/feet) or metric (kph/meters) units.

Comm Tab

The Comm (communication) tab contains the following settings (see Figure 5.2):

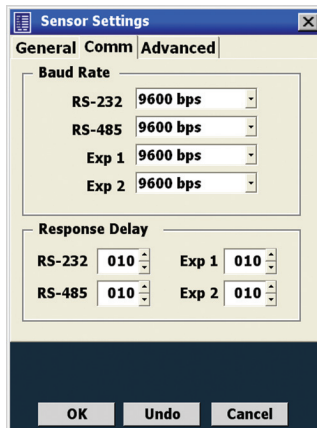


Figure 5.2 – Comm Tab

- **Baud Rate** - Allows you to set the baud rate for RS-232, RS-485, Expansion 1 and Expansion 2. A green arrow will indicate the communication link (port) on which SSMHD is connected. The default value is 9600 bps.

Note

The two expansion ports are currently not available for use.

- **Response Delay** – Used to configure how long the sensor will wait before responding to a message received. This is useful for some communications devices that are unable to quickly change transmission direction. The default value is 10 milliseconds.

Advanced Tab

The Advanced tab contains the following settings (see Figure 5.3):

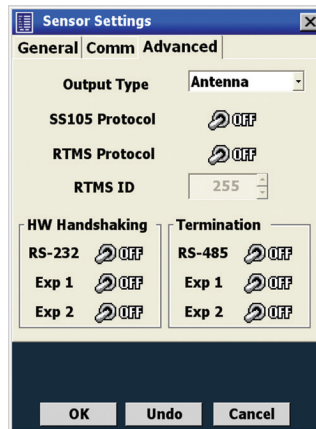


Figure 5.3 – Advanced Tab

- **Output Type** – Allows you to determine what information is reported. There are two options: Antenna reports data as detected by the antenna in the sensor, and Diagnostic reports made-up data for testing and training purposes. Sensors outfitted with extra hardware that allows replay will also have a Replay output type, which is a special demonstration mode used for testing and training purposes.

Note

If the sensor is in Diagnostic or Replay mode, it will not detect live traffic.

- **SS105 Protocol** – Allows you to turn SS105 protocol on or off. SS105 protocol must be turned on when being used with Click communication and contact closure devices (it is not necessary if you are only using Click surge and power devices). This does not turn

off native SSHD protocol. By default, the SS105 Protocol switch should remain on.

- **RTMS Protocol** - Allows you to turn RTMS protocol emulation on or off; only a subset of RTMS data reporting commands are emulated. This does not turn off native SSHD protocol. By default, the RTMS Protocol should remain off.

Note

If you are using a SmartSensor HD in an RTMS-based system, there are two ways to collect data from the sensor. If your system is set up to poll the sensor, the RTMS protocol must be turned on so the sensor can respond to RTMS commands. If your system is simply listening for data pushes from the sensor, the RTMS protocol does not need to be turned on. See Chapter 7 for more information on data push.

- **RTMS ID** - Allows you to enter the RTMS ID number. The RTMS ID field will only be editable if the RTMS Protocol switch is turned on.
- **HW Handshaking** - Turns hardware handshaking for each communication port on the sensor on or off. If you are connecting your sensor to an RS-232 device (such as some modems), you may need to turn hardware handshaking on. These devices sometimes require flow control handshaking because they cannot keep up with the data rates of higher-performance devices like personal computers and SmartSensor HD. SmartSensor Manager HD and SmartSensor HD have built-in support for RS-232 flow control hardware handshaking; this support allows the SmartSensor HD and SmartSensor Manager HD to work with these slower modem connections. Table 5.1 gives a brief description of each RS-232 line.

Line	Description
TX	Transmit data line
RX	Data receive line
RTS	Request to send flow control hardware handshaking line
CTS	Clear to send flow control hardware handshaking line

Table 5.1 - RS-232 Lines

Figure 5.4 shows the connections when SmartSensor HD connects directly to the computer running SmartSensor Manager HD.

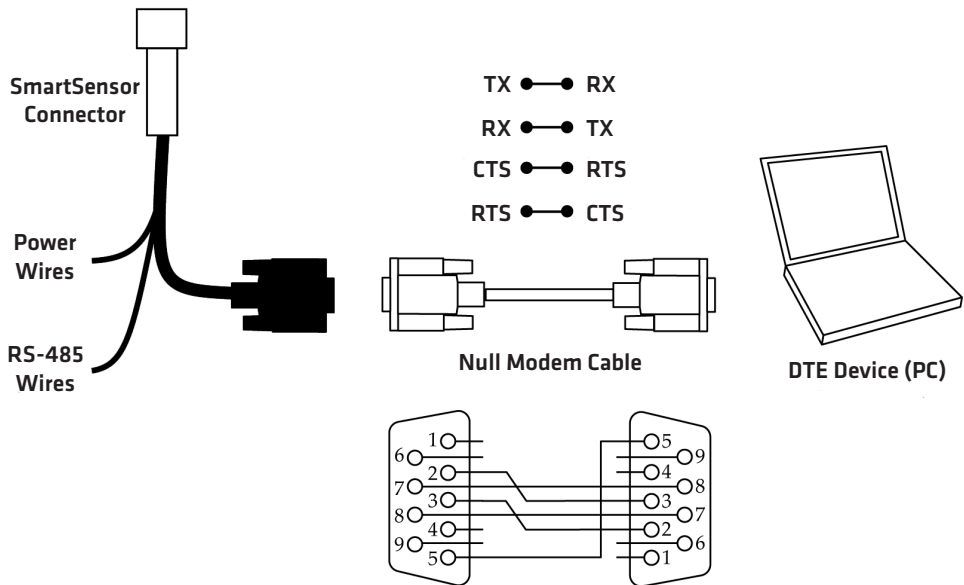


Figure 5.4 - RS-232 Connections

In order to use hardware handshaking, the sensor's RTS and CTS signals must be properly connected. If the **Flow Control** option under the Serial and/or Modem Connection screens' Advanced Settings is set to **Hardware**, you will not be able to connect if the sensor's HW handshaking setting has been previously turned off. The reason you cannot connect is that the sensor's RTS line is not asserted; as that line is connected to the computer's CTS line, the computer will not forward data messages it is given by SmartSensor Manager HD. To successfully connect, simply change the **Flow Control** setting in the Advanced Settings menu to **None**.

- **Termination** - Electronically turns communication bus termination on or off. This termination applies only to RS-485 ports. Only the end devices on a RS-485 bus should be terminated. In general, the termination can be left in the default on position until a multi-drop bus becomes overloaded.

In this chapter

- 1. Sensor Alignment
- 2. Lane Configuration – Automatic
- 2. Lane Configuration – Manual
- 3. Lane Verification

Click the **Lane Setup** link on the main menu to align and configure the sensor, and to verify functionality (see Figure 6.1).

- **Sensor Alignment** – Allows you to verify and adjust the sensor’s side-to-side alignment to the roadway.
- **Lane Configuration** – Allows you to automatically configure the sensor, manually adjust the lanes (if needed) and edit and save the configuration.
- **Lane Verification** – Allows you to verify that the sensor is detecting accurately and to modify individual lane performance.

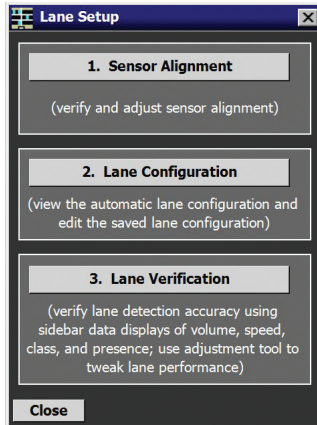


Figure 6.1 - Lane Setup Screen

1. Sensor Alignment

The sensor should be properly aligned before beginning lane configuration, so SSMHD includes an alignment feature that gives visual and audio confirmation when the perpendicular alignment of a sensor is correct. Follow the steps below to access the sensor alignment feature:

- 1 Click on the **Lane Setup** link on the main menu.
- 2 Click on the **Sensor Alignment** button.

Adjust the sensor according to the sensor displayed in the Sensor Alignment window. A green arrow means the sensor is correctly positioned for optimal performance (see Figure 6.2); a yellow or red arrow means the sensor is NOT correctly aligned with the roadway. For audio verification, check the **Sound** box.



Figure 6.2 - Sensor Alignment

Note

In order for the sensor alignment tool to function properly, traffic must be flowing freely. Also, if the sensor is not already aligned close to perpendicular to the flow of traffic, the sensor alignment tool will display a message indicating that the sensor is too far out of alignment for the tool to function properly. Realign the sensor manually and then fine-tune the alignment with the tool. After each adjustment of the sensor, several vehicles must pass before the alignment tool's output is valid.

It may be difficult to align the sensor if there are non-parallel lanes of traffic. In this case, mark the non-parallel lanes as Inactive or Excluded in the lane configuration screen, and the sensor alignment tool will ignore vehicles traveling in these lanes.

Note

In cases where traffic lanes are not exactly parallel, the percentage of vehicles with reported speeds may decrease in the lanes that are skewed.

2. Lane Configuration – Automatic

The Lane Configuration screen can be used to automatically or manually configure the roadway, manipulate lanes, and control how you see the information onscreen. To reach the screen, click the **Lane Configuration** button.

One of the advantages of the SmartSensor HD is the fast and simple lane auto-configuration function, where the sensor automatically configures the roadway and sets up the lanes based on passing traffic (see Figure 6.3).

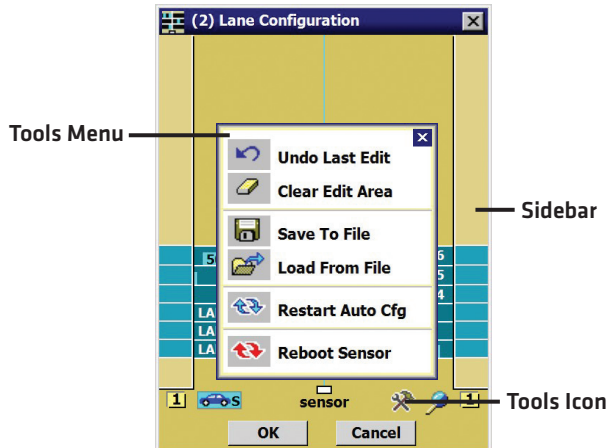


Figure 6.3 – Buttons Used in Automatic Lane Configuration

Follow the steps below to automatically configure the SmartSensor HD:

- 1 Once the Lane Configuration window appears, click the **Tools** icon and select **Clear Edit Area**.
- 2 Click the Tools icon again and then click **Restart Auto Cfg**.

Note

You may need to click on the magnifying glass icon and select **Show Auto Lanes** for the automatically discovered lanes to appear.

Depending on where the sensor is mounted and on the amount of traffic, the configuration process could take a few minutes. Once the SmartSensor HD has detected vehicles and created the appropriate lanes, click **OK** and a window will appear asking you to save the changes to the configuration. Click **Yes** and the configuration will be saved.

Follow the steps below if only a portion of the automatically defined lanes are desired:

- 1 Click anywhere in the Lane Configuration screen.
- 2 Check the **Hide Auto-Lanes** box and the automatically configured lanes will disappear.
- 3 Click on the desired automatic lane in sidebar (when the sidebar is set to 1) and the Automatic Lane window will appear (see Figure 6.4). This window allows you to select the lanes you want to appear in the roadway. To have all lanes appear in the roadway, click the **Copy Sidebar** button; to have individual lanes appear in the roadway, click the **Copy Lane** button. You can also copy the entire sidebar and then delete the unwanted lanes by clicking on them and selecting **Delete**.

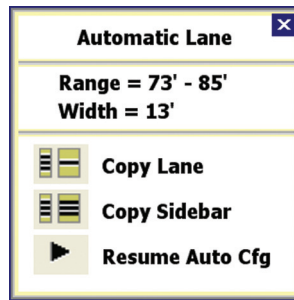


Figure 6.4 - Automatic Lane Window

2. Lane Configuration - Manual

The Lane Configuration screen can also be used to manually configure and adjust lanes (see Figure 6.5). The following functions and tools are available on the Lane Configuration screen.

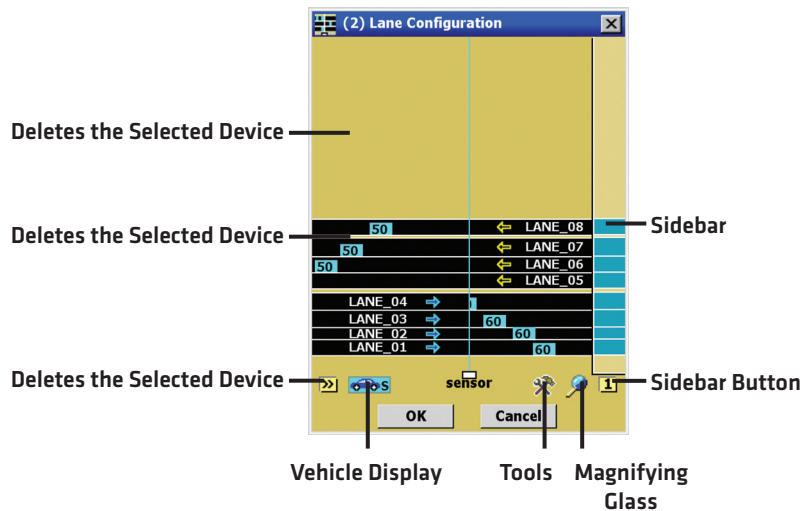


Figure 6.5 - Lane Configuration Screen

Sidebars

The sidebar buttons on either side of the Lane Configuration window control the sidebar display. Click and hold the button to see a list of the following different display modes (see Figure 6.6):

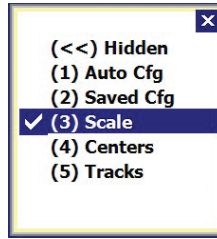


Figure 6.6 – Lane Configuration Sidebar Options

- **Auto Cfg** – Shows the lanes that are automatically configured by the sensor.
- **Saved Cfg** – Shows the lanes that are saved on the sensor.
- **Scale** – Shows the distance from the SmartSensor HD to each lane.
- **Centers** – Shows the relative occurrence of events. Larger arrows indicate a greater number of vehicles at a given range.
- **Tracks** – Shows a track for each detected vehicle; a line is drawn at the center of each vehicle that passes. This sidebar is very useful for manually adding lanes. Click on the tracks sidebar to clear all tracks and start again.

Vehicle Display

The **Vehicle Display** button opens a menu that allows you to configure how vehicles are drawn and what information is displayed on them.

In range mode, vehicles are drawn at the correct range regardless of lane definitions. In lane mode, only vehicles detected in configured lanes will be displayed.

SSMHD is able to display the detected speed, length, length-based class (see Bin Definitions in Chapter 7) or no information for each vehicle (see Figure 6.7). To choose to show no information for the vehicle, click again on the option that is currently checked to deselect all options.

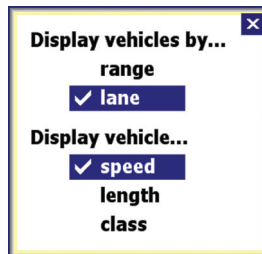


Figure 6.7 – Vehicle Display Options

Tools

The **Tools** button opens a menu that allows you to automatically configure the sensor, save and load configurations to files and reboot the sensor (see Figure 6.8). Saving or loading the

configuration only saves or loads lane configuration information (see the Tools section on the main menu to save all sensor configuration parameters).

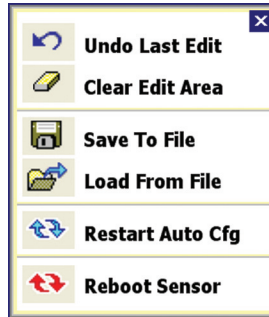


Figure 6.8 – Tools Options

Magnifying Glass

The **Magnifying Glass** button opens a menu that allows you to show or hide automatically configured lanes, lane names and vehicle direction; you can also view a compass (see Figure 6.9). Many of these options can also be turned on or off simply by clicking on them in the edit area.



Figure 6.9 – Show/Hide Lanes

Note

The orientation of the compass is based on the orientation chosen under Sensor Settings (see Chapter 5). Changes to the orientation there will result in the compass in the Lane Configuration screen changing to match; conversely, changing the orientation of the compass on the Lane Configuration screen (done by clicking on it) will change the orientation setting under Sensor Settings. The orientation does not affect the alignment or operation of the sensor and is simply for your information.

Shoulder Area

Click in the shoulder and the Shoulder Area window will appear, allowing you to add or exclude the shoulder you just clicked on (see Figure 6.10). This is useful when aligning

the sensor when there are non-parallel lanes in its field of view. Alternatively, it can also stop events from being generated in any non-lane areas. In the Lane Verification screen, and when the sensor is reporting data, any vehicles in non-lane defined areas will not be shown regardless of whether the area is excluded or not. Click in an excluded area and the Excluded Area window will appear, allowing you to include the area again.



Figure 6.10 – Edit Area Window

Lane Window

Click anywhere on a lane and the Lane window will appear, allowing you to change the name, direction and activity of a lane (see Figure 6.11). SSMHD uses “LANE_XX” as the default lane name where “xx” is the number of the lane in range, beginning with “LANE_01.” When a new lane is added, all lanes with the default lane name format will automatically be renamed to indicate their increasing number in range. If this is not desired, the lane names can be changed in any way; lane names are case and symbol sensitive and are limited to eight characters.

For RTMS and Z4 data push types, the mapping of the lanes may be changed using the notation #xx (e.g. #08), where 08 is a lane number between 1 and 99. In this case, ALL lanes in the configuration must be assigned a lane number using the #xx notation in order for the new lane mapping to take effect.

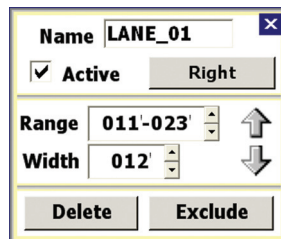


Figure 6.11 – Lane Adjustment Window

The direction button allows you to set the direction for the lane—Left, Right or Bidirectional. The direction chosen determines what data is shown: if Right is the set direction for a lane, only traffic going to the right will be detected; and if Left is the set direction for a lane, only traffic going to the left will be detected (when Direction Protection is on). If the lane is set to Bidirectional, data will be reported for traffic going both directions. This is useful for lanes that change direction depending on the time of day. Selecting Bidirectional is essentially the same as turning off Direction Protection for that lane (see the Lane Ad-

justments section in Chapter 6 for more information on Direction Protection).

Note

All detected vehicles are shown on the Lane Configuration screen, regardless of direction.

Click the **Exclude** button to exclude a lane (the lane will turn red once it has been excluded) or click the **Delete** button to delete a lane. Excluded lanes will not be configured and SSMHD will stop showing events in those particular lanes. Click the excluded lane and click the **Include Area** button to include the lane.

The Lane window also allows you to set a lane as active or inactive. Inactive lanes are useful when a lane has been correctly configured and tuned, but data reporting for the lane is not desired. By making the lane inactive instead of deleting it, the lane may be turned on at any time and will retain the proper configuration and tuning.

Saving the Configuration

Follow the steps below to save the configuration to a file:

- 1 Click on the **Tools** button on the bottom right of the Lane Configuration screen.
- 2 Select **Save to File**.

Undoing Manual Changes

To undo changes you have made to the configuration, click on the **Tools** button in the Lane Configuration screen and select **Undo Last Edit** from the choices displayed. To undo all changes made to the configuration, click the **Tools** button and then select **Clear Edit Area**.

3. Lane Verification

To verify that the lanes were configured properly, close the Lane Configuration screen and select **Lane Verification** from the Lane Setup menu.

The Lane Verification screen allows you to monitor lane detection accuracy and to adjust the lane properties for better detection.

Sidebars

Click and hold the sidebar buttons on either side of the Lane Verification window to view the following options (see Figure 6.12):

- **Presence** - Displays buttons to the side of each lane that will light up while the vehicle is being detected.
- **Volume** - Displays the number of events in each lane.
- **Speed** - Shows the average speed of each individual lane.
- **Classes 1-8** - Show count for each length-based class, which can be created using the Class Definitions feature. The number of class bins that appear in this window will be the same number of class bins that were created (see Bin Definitions in Chapter 7).

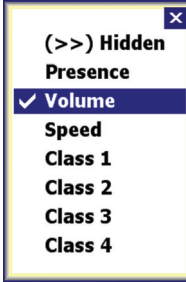


Figure 6.12 – Lane Verification Sidebars with Four Classes

Vehicle Display

The **Vehicle Display** button in the Lane Verification window opens a menu that allows you to view associated speed, length, length-based class or no additional data. To switch the display, click on the **Vehicle Display** button and choose which method to display (see Figure 6.13).

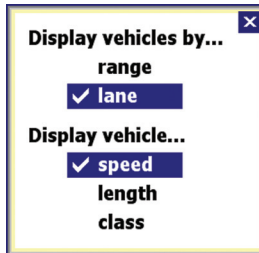


Figure 6.13 – Vehicle Display Window

Play/Pause/Stop Buttons

The **Play**, **Pause** and **Stop** buttons allow you to control the data display. When **Pause** is selected, vehicles traveling on the screen will not be included in the presence, volume, speed or class sidebars. Click the **Play** button to add new vehicles to the running totals for all sidebars; click the **Stop** button to reset all volume, speed and class numbers to zero.

Lane Adjustment

Lane performance can be adjusted by clicking anywhere inside a lane and using the Lane

Adjustment tool (see Figure 6.14). The drop-down list allows you to adjust lane volume, detection, speed, length, extension time or direction protection. To return to default settings, select **Set Defaults** from the drop-down list and click the **OK** button. Each lane adjustment is independent of other lanes; setting one lane back to defaults using the **Set Defaults** option will not affect the other lanes.

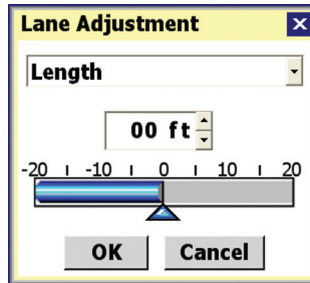


Figure 6.14 - Lane Adjustment Window

- **Volume** - This setting should be adjusted first when a problem with count accuracy is observed. The default is 100%. This setting adjusts the aggressiveness of traffic radar-specific algorithms and is not an arbitrary scale factor. By increasing the percentage by 10% to 15%, you are likely to begin to increase the number of detection, and by decreasing the percentage by 10% to 15%, you are likely to begin to decrease the number of detections. Small adjustments of only 1% or 2% may actually have no impact on the detection performance. Practical values for this setting are typically between 20% and 190%. If the volume lane adjustment is below 20%, many detections in that lane will probably be missed; if it is set greater than 190%, many false detections will probably occur.
- **Detection** - Raises or lowers the threshold for detecting vehicles. The sensor automatically determines where the threshold will be placed, and then adds in this tuning parameter. Entering a larger number will result in fewer detections; entering a small number will result in more detections. The default is 0 dB.

Note

Changing the detection tuning parameter can drastically effect vehicle detection.

- **Speed** - Raises or lowers the speed calculated for all vehicles in each lane. The sensor calculates the speed, and then multiplies the speed by this factor. The default is 100%.
- **Length** - Increases or decreases the length for all vehicles in each lane. The sensor calculates the length and then adds the length factor. The default is 0 (feet or meters depending on sensor units used). Since the occupancy metric that is reported in the interval data is calculated using length, a change in the length tuning parameter will also change the occupancy that is reported. See page 73 for the equation that is used to calculate occupancy and for a more detailed explanation.

- **Extension Time** - Changes the extension time, which the sensor uses to prevent vehicles with trailers from being broken into multiple detections. A longer extension time will prevent this, but can lead to multiple vehicles being merged into a single detection. The sensor automatically determines the extension time and then multiplies by this factor. The default value is 100%.

Note

There must be a minimum of 5.5 ft (1.68 m) between vehicles in order for them to be detected as separate vehicles. This separation requirement may increase as vehicle speeds increase.

- **Direction Protection** - Allows you to turn Direction Protection on or off. When Direction Protection is on (default), data will be shown only for vehicles that are going in the direction set for that lane. For example, if a lane is set for traffic moving north, any traffic in that lane that may be moving south will be ignored. However, if the sensor determines that most vehicles are going a direction different from the one that was configured (e.g. during hurricane evacuation), the sensor will begin reporting vehicles going all directions. Turning off Direction Protection allows SSMHD to always report data from vehicles going both directions.

Note

If a lane has been configured to be bidirectional, Direction Protection will be disabled.

Data Setup and Collection

In this chapter

- Interval Data
- Per Vehicle Data
- Loop Emulation
- Data Storage & Download
- Bin Definitions
- Approaches
- Date & Time
- Data Push

Click the **Data Setup & Collection** link to log interval and per vehicle data; change loop size and spacing; store and download data; set bin definitions; define approaches; synchronize computer and sensor times; and push data (see Figure 7.1).

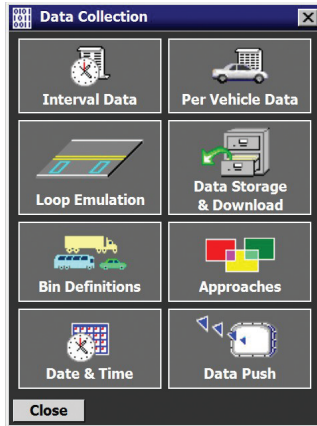


Figure 7.1 - Data Setup & Collection Screen

Interval Data

Interval data refers to the data collected about all the vehicles that pass the sensor in a set amount of time. This interval of time should be carefully chosen because the length of it affects how long the sensor can store data onboard. A shorter interval means the sensor records data more often, which means that the sensor’s onboard memory fills up faster. A longer interval means you can leave the sensor alone for longer periods of time. Ultimately the interval size should be selected to meet the requirements of your application. For example, in real-time applications, onboard storage capacity may not be a concern at all and the data may need to be aggregated over short periods of time (20 seconds) to reduce reporting latency. To access, click the **Interval Data** button in the top left corner of the Data Collection screen (see Figure 7.2). See the Storage Status section in this chapter for more information.

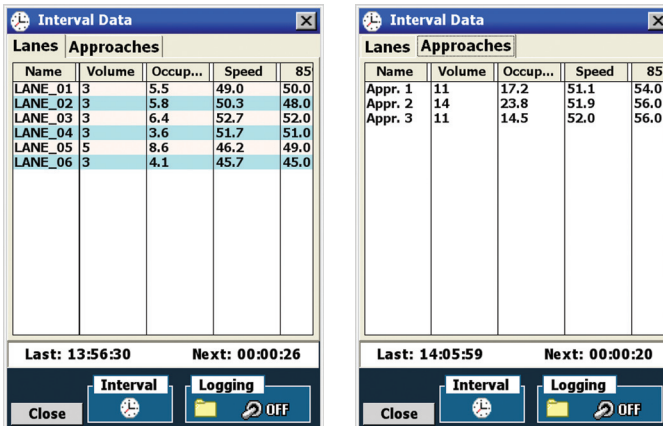


Figure 7.2 - Interval Data for Lanes (left) and Approaches (right)

Note

If the volume in the interval is zero, and the occupancy is less than 20%, the speed in the interval will be the speed of the previous interval. If the volume in the interval is zero, and the occupancy is more than 20%, the speed in the interval will be zero.

The interval data screen displays the following information for each lane or approach, depending on which tab you've selected (to see all columns, use the cursor to click and drag the screen to the right or left):

- **Name** - Displays the name of each lane or approach. To change the name, go to the Lane Configuration screen or the Approaches screen.
- **Volume** - Shows the number of vehicles detected during the interval.
- **Occupancy** - Gives the percentage of time during the interval that the detection zone was occupied.

Occupancy is calculated by summing the durations of all vehicles in the interval and dividing that quantity by the length of the interval. For example, if the interval length is five minutes and 100 vehicles pass the sensor during the interval with a duration of 0.09 seconds each (sum of the durations is 9 seconds), then the occupancy for that interval would be calculated by dividing 9 seconds by 300 seconds, which is 3%.

Rather than using the uncalibrated detection duration, or the time that a vehicle is in the radar beam, in the occupancy calculation, a more accurate occupancy measurement is made by first calculating the vehicle length and then converting that to a duration by adding the simulated loop size and dividing by the speed. Occupancy based on vehicle length is more accurate than occupancy based on uncalibrated detection duration because the vehicle length calculation removes the effect of the antenna beam widening as it gets farther from the sensor. The occupancy calculation is shown in the following equation:

$$\frac{1}{\text{Interval Size}} * \sum_{\text{All Vehicles in the Interval}} \frac{\overbrace{\text{Vehicle Length} + \text{Loop Size}}^{\text{Calibrated Duration}}}{\text{Vehicle Speed}}$$

Note

A change to the length tuning parameter for a given lane will affect the occupancy for that lane since vehicle length is used in the occupancy calculation.

- **Speed** - Indicates the average lane speed during the interval. A negative number will be

reported for speed in the following cases: (1) The lane was configured to the left or right and Direction Protection was on, but traffic was traveling against the configured direction, indicating that the direction of the lane has switched. This is useful in hurricane evacuation scenarios. (2) The lane was configured to the left or right and Direction Protection was off, but more vehicles were detected traveling against the configured direction than were detected traveling with the configured direction for the given data interval.

Unlike per vehicle data, lanes that are configured as bidirectional will always report positive average speeds in the interval data.

- **85%** - Shows the 85th percentile speed. Eighty-five percent of the vehicles in the interval were going this speed or slower.
- **Headway** - Displays the average time separation between vehicles detected during the interval, measured from front bumper to the front bumper of the following car.
- **Gap** - Shows the average time separation between vehicles detected in the interval, measured from the back bumper of the first car to the front bumper of the second.
- **Classes** - Refers to length-, speed-, and direction-based bins (see Bin Definitions later in this chapter). These columns show the number of cars from each length, speed and direction class that were detected during the interval.

To change the interval time, click on the **Interval** icon at the bottom of the screen; the interval time can also be changed in the Data Storage & Download screen.

Note

The Interval Data timestamp displays the ending time of the interval.

Log File

To create a log file, click on the folder icon in the Logging section, select the type of data you want to log and click **OK**. Begin logging the interval data by clicking the **On/Off** switch; logging will be terminated if the Interval Data screen is closed.

Note

Interval data is stored onboard the sensor. To access old interval data information, see the Data Storage & Download section of this chapter.

Per Vehicle Data

Per vehicle data is data that is recorded each time a vehicle is detected. To access, click the **Per Vehicle Data** button in the Data Collection screen (see Figure 7.3). To begin logging

per vehicle data, turn the logging button on by clicking the **On/Off** switch. You can also pause the recording of events by clicking the **Pause** button in the bottom left corner of the screen. Logging will be terminated if the Per Vehicle Data screen is closed.

Lane	Timestamp	Speed	Len...	Ran...
Lane 0	11:44:56.366	60.0	18	24
Lane 4	11:44:56.109	50.0	18	76
Lane 5	11:44:56.237	50.0	18	90
Lane 3	11:44:55.474	50.0	18	63
Lane 2	11:44:55.344	50.0	18	50
Lane 1	11:44:55.216	50.0	18	37
Lane 5	11:44:54.452	40.0	18	90
Lane 0	11:44:55.093	50.0	18	24
Lane 4	11:44:54.329	40.0	18	76
Lane 3	11:44:54.200	40.0	18	63
Lane 2	11:44:54.071	40.0	18	50
Lane 0	11:44:53.308	40.0	18	24
Lane 1	11:44:53.437	40.0	18	37
Lane 5	11:44:53.178	30.0	18	90
Lane 4	11:44:53.049	30.0	18	76
Lane 3	11:44:52.415	30.0	18	63

Events Logging

Close

Off 00:00:00

Figure 7.3 – Per Vehicle Data

The Per Vehicle Data screen displays the following information about each vehicle detected:

- **Lane** – States the lane in which the vehicle was detected.
- **Timestamp** – Displays the time at which the vehicle was detected.
- **Speed** – Shows the speed of the vehicle in miles per hour. A negative number will be reported for speed in the following cases: (1) The lane was configured to the left or right and Direction Protection was on, but traffic was traveling against the configured direction, indicating that the direction of the lane has switched. This is useful in hurricane evacuation scenarios. (2) The lane was configured to the left or right and Direction Protection was off, but more vehicles were detected traveling against the configured direction than were detected traveling with the configured direction for the given data interval. (3) The lane was configured as bidirectional and the lane is traveling to the left (Vehicles traveling to the right have positive per vehicle speeds in bidirectional lanes).
- **Length** – Displays the length of the vehicle in feet.

Note

Per vehicle data is NOT stored onboard the sensor. To collect per vehicle data, a laptop or handheld computer must be connected to the sensor.

Loop Emulation

The SmartSensor HD can emulate dual loops. The Loop Emulation Setup screen allows you to adjust loop size and spacing for this function (see Figure 7.4). The settings changed on this screen will apply to all configured lanes.

- **Loop Size** - Adjusts the size of the loops.
- **Loop Spacing** - Adjusts the loop spacing.

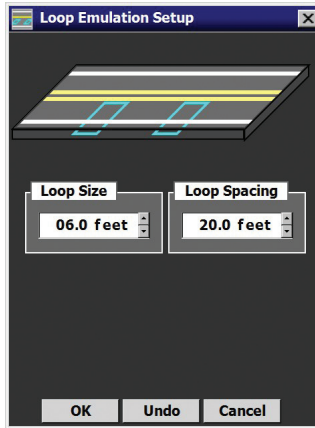


Figure 7.4 - Loop Emulation

These settings are read by a Click contact closure device and used so that the contact closures can be properly timed to emulate a given loop size and spacing. The loop size is also used by the sensor in the occupancy calculation. For example, larger loop sizes will result in higher occupancy numbers in the interval data. However, adjusting these parameters will not modify the reported vehicle length or speed (see the Lane Adjustment section in Chapter 6 of this user guide to accomplish these tasks).

Data Storage & Download

The Data Storage & Download window contains the following three sections (see Figure 7.5):

- **Storage Settings** - Allows you to adjust the data interval length and how data is stored.
- **Storage Status** - Shows a storage timeline, the storage level and the amount of storage space remaining.
- **Data Download** - Allows you to retrieve the data from the sensor and store it in report format to a laptop or handheld computer.

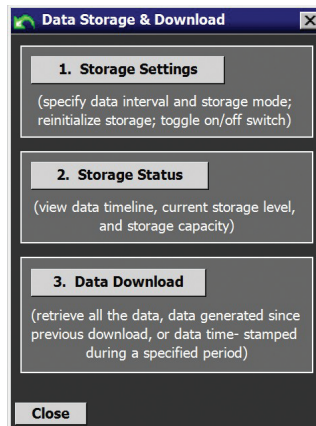


Figure 7.5 – Data Storage and Download

1. Storage Settings

Click the **Storage Settings** button to specify and initialize the storage options (see Figure 7.6).

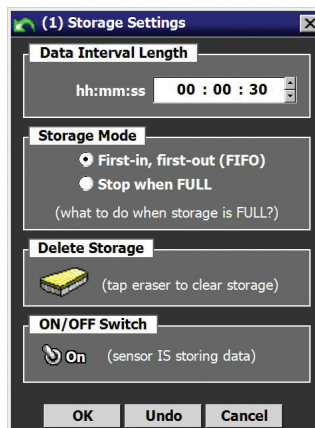


Figure 7.6 – Storage Settings

- **Data Interval Length** – Specifies the data interval length in hours, minutes and seconds. The data interval must be 10 seconds or greater.
- **Storage Mode** – Specifies how the data will be stored and erased once the memory is full. The First-in, first-out (FIFO) option means that the data that was stored first will be the first to be deleted once the storage capacity is reached. The Stop when FULL option means that the sensor will stop storing data once the storage capacity is reached, and consequently all new data will not be saved to memory.
- **Delete Storage** – Deletes the data storage. After clicking the eraser icon, you will be prompted to confirm the delete. Once data storage is deleted, it is not recoverable. Before deleting the data, it is recommended that you run the Data Download option

to store a copy of the data on a PC or laptop.

- **ON/OFF Switch** - Allows you to turn the sensor's data storage feature on or off.

2. Storage Status

The Storage Status window shows the timeline, current storage remaining, and storage capacity of the sensor (see Figure 7.7).

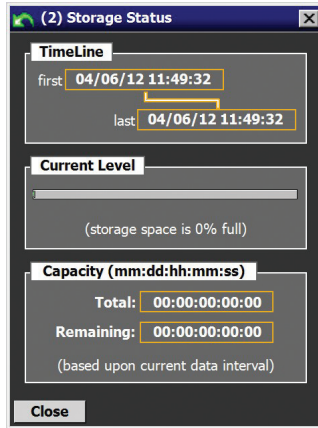


Figure 7.7 – Storage Status

- **Timeline** - Shows the date and time that the first and last interval data packet was stored.
- **Current Level** - Shows you how much storage is remaining by both a status bar and a percentage.
- **Capacity (mm:dd:hh:mm:ss)** - Shows you how long the sensor has been storing data and how long the sensor will continue to store data before reaching maximum capacity. The capacity is tracked in months, days, hours, minutes and seconds and is based upon the current sensor configuration. The total number of intervals stored is dependent upon the number of configured lanes, approaches and bin data types. If data is stored with a different number of lanes, approaches or bin data types from the current sensor configuration, the **Total** field in the Capacity section will be incorrect. In this case, the Current Level section is a better indicator of storage capacity. Additionally, using a virtual connection will also cause the information in this screen to be incorrect.

Note

Some of the settings discussed in this chapter can affect the storage capacity of your sensor. Changing such data collection settings as the length of the interval for collecting interval data and the number of bins and approaches configured will affect how many reports your sensor can store onboard (see Table 7.1 for examples). Always check back to the Storage Status screen after you have changed all other settings to get the most accurate information on how often your sensor will need to have information on how often your sensor will need to have information downloaded from it.

Interval	Lanes & Approaches	Class Bins	Speed Bins	Onboard Storage Capacity
20 sec	4	4	0	17 days
20 sec	12	4	0	6 days
20 sec	12	4	10	3 days
15 min	4	4	0	25 months 29 days
15 min	12	4	0	9 months 26 days
15 min	12	4	10	5 months 3 days
1 hour	4	4	0	103 months 29 days
1 hour	12	4	0	39 months 15 days
1 hour	12	4	10	20 months 13 days

Table 7.1 - Examples of Onboard Storage Time Based upon Configuration

3. Data Download

The Data Download window allows you to specify the time for which stored data will be retrieved and the location where it will be saved to file (see Figure 7.8).

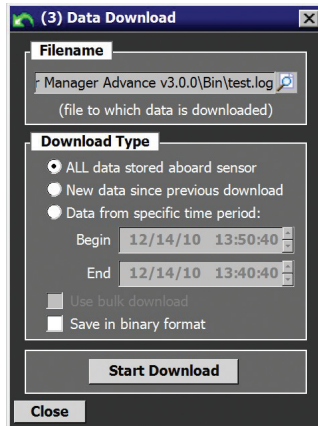


Figure 7.8 – Data Download

- **Filename** – Allows you to specify what file the data is going to be sent to. Click the magnifying glass icon to browse possible downloading destinations.
- **Download Type** – Allows you to select the desired type of data download. To download all data on the SmartSensor HD, click the **ALL data stored aboard sensor** radio button. If the same computer is used each time, the **New data since previous download** will start with the newest data and work back to the previous data download point. The **Data from specific time period** may also be used to download specific data; enter the beginning and ending dates and times to do so. SSMHD also keeps a record of the last interval downloaded from each sensor.

The **Use bulk download** checkbox allows you to download all information from the sensor at one time. This option should only be used with high latency modem connections. The **Save in binary format** option allows you to download and save the file in binary format.

Note

Downloading all the data may take several hours.

Data Formats

SmartSensor Manager HD will download data from the sensor and store it in a tabular ASCII format with a new row for each lane or approach at each time step (see Figure 7.9). The data can be analyzed by various software tools or loaded into databases by programming custom import routines. Wavetronix Command products can also retrieve interval data directly into an SQL database.

#	NAME	VOLUME	Occu- pancy (%)	Speed (MPH)	85% Speed (MPH)	Class Count								HEADWAY	GAP
						C1	C2	C3	C4	C5	C6	C7	C8		
#						10	20	30	255						
#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####	#####
LANE_01		3	23.3	46.7	40.0	0	3	0	0	-	-	-	-	1.6	1.3
LANE_02		3	23.3	46.7	40.0	0	3	0	0	-	-	-	-	1.6	1.3
LANE_03		4	28.6	50.0	60.0	0	4	0	0	-	-	-	-	1.2	0.9
LANE_04		3	20.6	53.3	60.0	0	3	0	0	-	-	-	-	1.6	1.3
LANE_05		3	20.6	53.3	60.0	0	3	0	0	-	-	-	-	1.6	1.3
LANE_06		3	20.6	53.3	60.0	0	3	0	0	-	-	-	-	1.6	1.3
APPR. 1		10	75.2	48.0	70.0	0	10	0	0	-	-	-	-	0.5	0.1
APPR. 2		9	61.8	53.3	70.0	0	9	0	0	-	-	-	-	0.5	0.2

Figure 7.9 – Data Format

Bin Definitions

The term “bins” refers to classifications of vehicles based on their length, speed or direction. Once bins are set, data can be collected for these groupings of vehicles; for instance, the sensor can count for you how many passing vehicles are driving between 90 and 100 mph.

Adding more bins causes data records to be larger, meaning that your sensor’s onboard memory fills up faster and must be downloaded from more often. See the Storage Status section of this chapter for more information on how to figure out how many days’ worth of memory your sensor has based on its current settings.

Click the **Bin Definitions** button in the Data Collection screen to access the Bin Definitions window (see Figure 7.10).

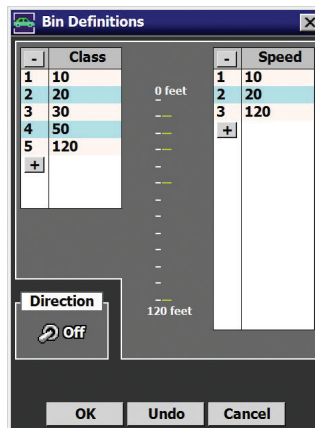


Figure 7.10 – Bin Definitions

There are bins for class, speed and direction. There are up to 8 class bins, 15 speed bins and 2 direction bins; all or none of these bins may be simultaneously configured and the number of configured bins will impact the interval storage capacity, as well as interval data download time.

The direction bins are configured as Right and Wrong. This refers to whether vehicles in a given lane are traveling in the direction the lane is configured (to change lane direction,

use the lane window in the Lane Configuration screen). This is most useful in the case of reversible lanes, where traffic goes different directions in a lane depending on the time of day. In this case, for part of the day the vehicles would be counted in the Right bin; during the other part of the day, the vehicles would be counted in the Wrong bin.

The class bins allow you to classify vehicles by ranges of lengths. If you're not sure what lengths to use, consult your own agency's guidelines. If your agency has no set classification scheme, you can look to the measurements in Table 7.2 as an example; the tables show a scheme called Scheme F, developed by the Maine DOT.

4 Classification Bins		6 Classification Bins	
Lengths	Scheme F	Lengths	Scheme F
0-10	1	0-10	1
10-19	2, 3	10-19	2
19-35	4, 5, 6	19-24	3
35-256	7-13	24-54	4, 5, 6, 7
		54-109	8, 9, 10
		109-256	11, 12, 13

Table 7.2 – Scheme F Length Classifications

Approaches

Approaches are groupings of lanes used in data collection. Using approaches allows you to collect per vehicle-based statistics that you could not otherwise get, such as the 85th percentile speed for all northbound lanes, and to store these statistics onboard the sensor. Be aware that adding approaches will increase the size of your data reports, which will affect the number of these reports your sensor can store in its onboard memory. See the Storage Status section of this chapter for more information.

Click the **Approaches** button in the Data Collection window to group lanes together in four different approaches (see Figure 7.11).

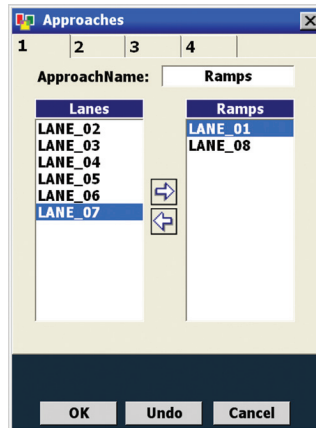



Figure 7.11 – Approaches

Approaches are used in interval data and will contain the same type of information that each lane would. An advantage to using approaches rather than post-processing individual lane data is that approaches gather aggregate data. An example of when this would be useful is in determining speed limits. Using approaches, the sensor could find the 85th percentile speed for all cars in all lanes going one direction, rather than finding it for each lane.

When lanes of differing directions are used, the absolute value of the speed is used to calculate all speed fields. Also, the Right and Wrong direction bins will contain the total number of vehicles traveling with the user-defined direction of the corresponding lanes in the Right bin, and all others in the Wrong bin.

To create an approach, select the desired lanes and click the  button. Each approach can be named to coincide with the purpose of the approach.

Date & Time

Click the **Date & Time** button on the Data Collection window to access the Date & Time window (see Figure 7.12).

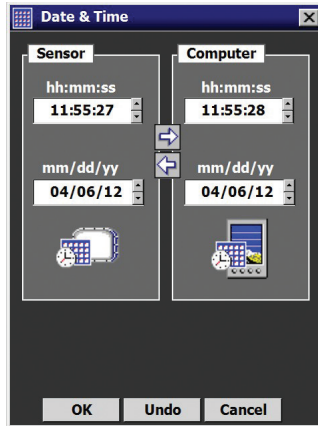


Figure 7.12 – Date & Time

To sync the sensor date and time with the computer, click the  button and click **OK**.

The sensor itself stores time in Coordinated Universal Time (UTC), formerly known as Greenwich Mean Time (GMT), and does not account for daylight saving time. SSMHD uses the local setting of the computer it is running on to display the date and time in local units.

Example

If someone in Pacific Standard Time (PST) connect to a sensor and synchronizes the time, then when someone in Mountain Standard Time (MST) connects to the same sensor the time will be correctly displayed as MST. If the settings on either PC adjusts for daylight savings, then this adjustment will also be correctly displayed.

Data Push

Use the data push function to set your sensor to periodically push data to your computer without waiting for a request from SSMHD. Click the **Data Push** button on the Data Collection window to access the Data Push window (see Figure 7.13).

When data push is required for use with a Click device, it is automatically configured by the Click device during its autobaud process. If data push is required for any other use, it must be manually configured.

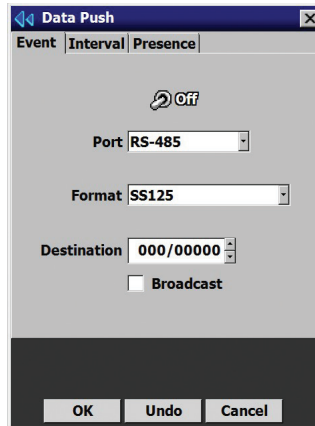


Figure 7.13 – Data Push

To enable data push, select the **Event**, **Interval** or **Presence** tab, then select which method of communication and format you are using and turn the function on.

Port

This allows you to select the SmartSensor HD communications port through which the data will be pushed. If the sensor is pushing data on a half-duplex communication port, the sensor may not respond to commands due to collisions on the communications bus.

Note

SmartSensor HD's native RS-232 and RS-485 ports are both half duplex.

Format

The following formats are available for all three data types:

- **SS125 Format** - This outputs the data in the native SS125 format (see the *SmartSensor HD Released Communications Protocols* document, available at www.wavetronix.com, for information on this format).
- **SS105 Simple Format** - This outputs the data in the SSHD SS105 emulation format without a multi-drop header (see the *SmartSensor HD Released Communications Protocols* document for information on this format).
- **SS105 Multidrop Format** - This outputs the data in the SSHD SS105 emulation format with a multi-drop header (see the *SmartSensor HD Released Communications Protocols* document for information on this format).

For Event Data, there are six additional format options. All of them output the data in Z4 format. Z4 is a Wavetronix-specific protocol that allows sensors to talk to other Wavetronix

devices, such as Click contact closure devices. The specific formats are as follows:

- **Z4 2-Loop** - With this format, speed and duration are measured using the loop size and space determined on the Loop Emulation page.
- **Z4 1-Loop** - With this single-loop format, only duration can be determined.
- **Z4 2-Loop Pulsed** - With this format, the outputs will be held active for 125 ms for each vehicle detected, so only speed will be measured.
- **Z4 1-Loop Pulsed** - This format is simply a presence detector (no speed or duration information).
- **Z4 1-Loop Speed** - This single-loop format has a set vehicle length of 15 feet, so the focus is on speed.

For Interval Data, there are two additional formats:

- **SS125 (legacy)** - This format emulates the interval data from older versions of the SmartSensor HD; it is similar to the current format but lacks speed bins and direction bins and has fewer length-based classes.
- **RTMS Format** - This format is only available in the Interval Data push configuration and will output the data in the SSHD RTMS emulation format (see the *SmartSensor HD Released Communications Protocols* document for information on this format).

For Presence Data, there is one additional format:

- **Z4 Presence** - This outputs data in the Z4 format.

Destination

This is the address the sensor will push data to and is only valid for SS125 and Z4 formats. For SS125 format, it is the 8-bit subnet/16-bit ID, and for Z4 format it is a 24-bit address. Any value up to 255/65535 for SS125 format or 16777215 for Z4 format is valid, but make sure that this destination address is unique for the communications bus in use. Checking Broadcast will push the data to the broadcast address (000/65535 for SS125 and 16777215 for Z4). The SS125 communications protocol reserves subnet/ID 000/00000 for software applications. The subnet/ID should be set to 000/00000 if the SmartSensor HD is pushing data to a custom software application.

In this chapter

- Backup/Restore
- Licensed Features

The Tools section allows you to backup sensor data and view the sensor's licensed features (see Figure 8.1).

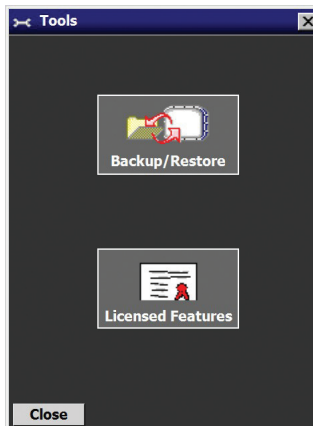


Figure 8.1 - Tools

Backup/Restore

Access Backup/Restore by clicking the **Backup/Restore** button on the Tools screen (see Figure 8.2).

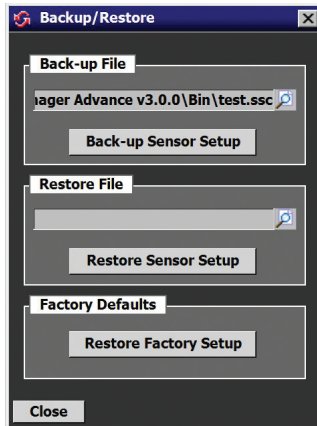


Figure 8.2 - Backup/Restore

Back-up File

The backup function allows you to backup the sensor settings you have changed. To create a backup, click on the magnifying glass icon in the Back-up File section. Choose a destination, type in a filename, and hit **OK**, then click the **Back-up Sensor Setup** button.

Note

The backup will appear as an .ssc file. While this file can be opened as a text file by using a program such as Notepad, do not edit the file, as it will change the settings you backed up.

Restore File

The restore function allows you to restore a set of sensor settings you have backed up. To restore, click on the magnifying glass icon in the Restore File section. Select the backup file you wish to restore, hit **OK**, and then click the **Restore Sensor Setup** button.

Warning

Restoring sensor settings will cause you to lose the settings you currently have, unless they are backed up.

Licensed Features

The Licensed Features window contains all of the current configuration features that are inherent to the sensor:

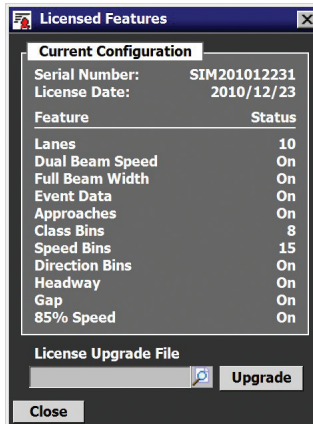


Figure 8.3 – Licensed Features

- **Serial Number** - Shows the serial number of the sensor.
- **License Date** - Shows the date the sensor was licensed.
- **Features** - Lists features inherent to the sensor and shows the status that has been licensed for each feature.

Note

For more information on each feature, see the earlier chapters in this book.

- **License Upgrade File** - In the future this field will be used to upgrade licensed features, but for now it can be ignored.

Appendix

In this chapter

- Appendix A - 10-pin Connector
- Appendix B - 26-pin Connector
- Appendix C - Cable Lengths
- Appendix D - Direct Serial Connections
- Appendix E - Signaling Delays

Appendix A - 10-pin Connector

Many newer SmartSensor HD installations have a 10-pin connector for attaching the cable; this connector is used exclusively with the 8-conductor cable. This cable is composed of eight conductors plus a drain wire, all surrounded by a shield. See Figure A.1 for a diagram of the 8-conductor cable's 10-pin socket assignment. The codes listed in the diagram are to be used to solder wires into the back of the plug where the letters represent the individual solder cups.

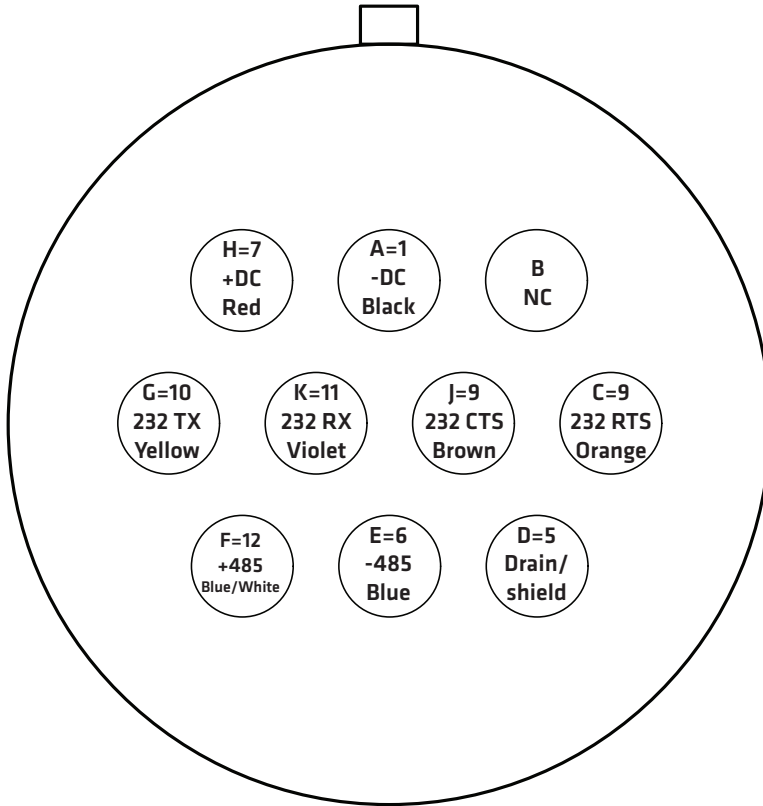


Figure A.1 – 10-pin Plug Connector Socket Assignment (seen from the solder cup side of the connector)

Appendix B - 26-pin Connector

Certain SmartSensor HDs, including the HD legacy, the retrofitted HD, and the limited lane and feature versions, have a 26-pin connector. You can order this connector on two different cables:

- The 8-conductor cable, which is the same cable mentioned above; it can be ordered with either the 10-pin connector or the 26-pin connector.
- The 9-conductor cable. This cable is composed of three groups of wires, each containing color-coded wires and a drain wire surrounded by a shield.

See Figure B.1 for a diagram of the 9-conductor cable's 26-pin socket assignment. The codes listed in the diagram are to be used to solder wires into the back of the plug where the letters represent the individual solder cups.

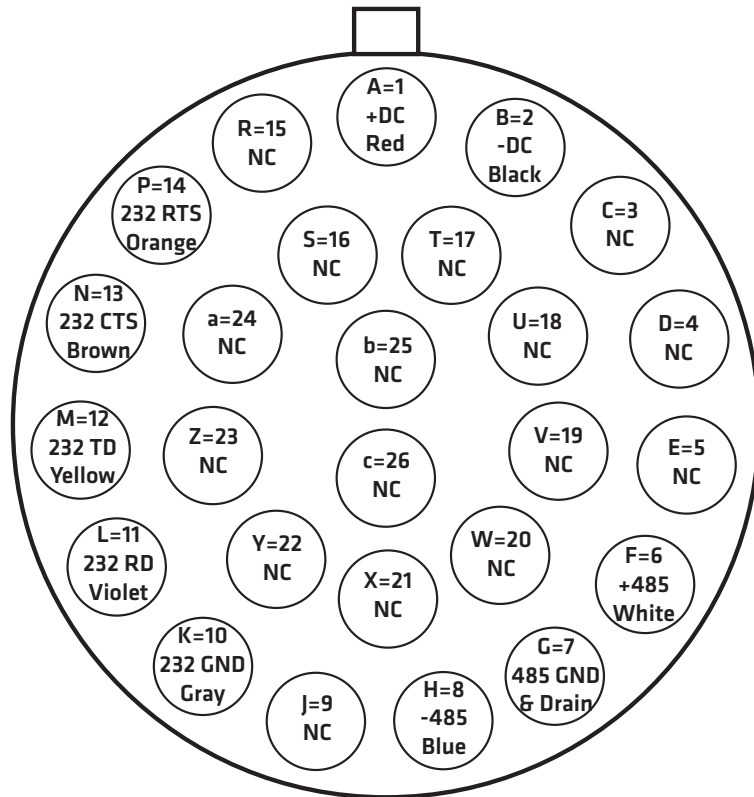


Figure B.1 – 9-conductor cable Plug Connector Socket Assignment (seen from the solder cup side of the connector)

The 8-conductor cable is nearly identical. The differences are as follows:

- The +485 conductor in the cable (assigned to pin F above) is striped white and blue, instead of the plain white found in the 9-conductor cable.
- There's no gray ground cable, meaning nothing is assigned to pin K.
- Instead of three drains, one for each wire bundle, the 8-conductor cable has a single drain wire, but that drain wire does not terminate into any of the pins.

Appendix C - Cable Lengths

The following recommendations allow you to provide reliable power to the SmartSensor HD.

Note

These instructions apply to both the 8-conductor cable and the 9-conductor cable.

The 9-conductor/8-conductor cables' DC (red and black) wires are a 20 AWG wire pair.

The other wires in the cable are 22 AWG and are used for communication, as detailed in the earlier appendices.

Cable Gauge	24 Volts	12 Volts
20 AWG	600 ft. (182.9 m)	110 ft. (33.5 m)
Additional 22 AWG	Add 400 ft. (121.9 m)	Add 75 ft. (22.9 m)
22 AWG	400 ft. (121.9 m)	75 ft. (22.9 m)
Additional 22 AWG	Add 400 ft. (121.9 m)	Add 75 ft. (22.9 m)
14 AWG	2500 ft. (762 m)	450 ft. (137.2 m)
12 AWG	3900 ft. (1188.7 m)	700 ft. (213.4 m)
10 AWG	6000 ft. (1828.8 m)	1050 ft. (320 m)
8 AWG	9900 ft. (3017.5 m)	1750 ft. (533.4 m)
6 AWG	14,000 ft. (4267.2 m)	2500 ft. (762 m)

Table C.1 – Maximum Cable Length for Power

If the cable length is longer than 600 ft. (182.9 m) when operating at 24 VDC, it is possible to increase the maximum cable length by wiring a pair of lines normally used for RS-232 communications with the red and black wires.

In many cases, if the cable length is 200 ft. (61 m) or greater you cannot reliably use RS-232 communications. To add 400 ft. (121.9 m) and achieve a maximum cable length of 1000 ft. (304.8 m), connect the orange wire (normally RTS) to the red wire and the brown wire (normally CTS) to the black wire.

If your cable run is longer than 1000 ft. (304.8 m), it is possible to sacrifice additional communication pairs to increase the maximum cable length for power. However, you may desire to communicate to the sensor over two independent channels, in which case you will need to consider an alternate cable for power. The AWG for wire pairs that achieve a 2000 ft. (609.6 m) maximum cable length or greater at 12 and 24 VDC are listed in Table A.1.

To achieve reliable wired communications, the selected baud rate must be compatible with the length of the cable run. Table C.2 below shows the cable length recommendations for wired communications:

Baud Rate (bps)	RS-232	RS-485
115200	40 ft. (12.2 m)	300 ft. (91.4 m)
57600	60 ft. (18.3 m)	600 ft. (182.9 m)
38400	100 ft. (30.5 m)	800 ft. (243.8)
19200	140 ft. (42.7 m)	1000 ft. (304.8 m)
9600	200 ft. (61 m)	2000 ft. (609.6 m)

Table C.2 – Maximum Cable Length for Wired Communications

To provide two independent communication channels with a homerun cable length over 200 ft. (61 m), convert the RS-232 data into RS-485 using a Click 304 in a pole-mount cabinet mounted next to the sensor. In this case, the homerun connection establishes one RS-485 channel over the normal white/blue wire pair and another RS-485 channel over the yellow/violet wire pair. An additional Click 304 is needed to convert the data sent over the yellow/violet wire pair back to RS-232 before connecting to surge protection.

If you elect to use an alternate cable for power, you may also want to select an alternate cable for RS-485 communications. For example, the Belden 3105A (Paired – EIA Industrial RS-485 PLTC/CM) is a good alternate for the RS-485.

There are many reliable options available for wiring power and communication connections (see Table C.3).

Length	Cable	Comm. Channel 1	Comm. Channel 2
0–200 ft. (0–61 m)	9-conductor or 8-conductor Cable	Native RS-485	Native RS-232
200–1000 ft. (61–304.8 m)	9-conductor or 8-conductor Cable	Native RS-485	Click conversion of RS-232 to RS-485
1000–1400 ft. (304.8–426.7 m)	9-conductor or 8-conductor Cable	Native RS-485	N/A
1400–2000 ft. (426.7–609.6 m)	Alternate power and communications cable	Native RS-485	Click conversion of RS-485 to RS-232

Table C.3 – Cable Length Options

Appendix D - Direct Serial Connections

For most applications, the service end of the 9-conductor or 8-conductor cable terminates in a surge protection device. However, during demonstrations, troubleshooting and certain other situations, it is sometimes convenient to bypass surge protection and connect directly to a personal computer or communications device such as a modem.

The sensor is configured as an RS-232 DTE device. To connect the 9-conductor or 8-conductor cable's RS-232 wires directly to another DTE device (such as a PC), you can use a

standard 9-pin D connector and a null modem cable. To connect directly to a DCE device (such as a modem), you will need a straight-through cable. Figure D.1 illustrates both of these cases.

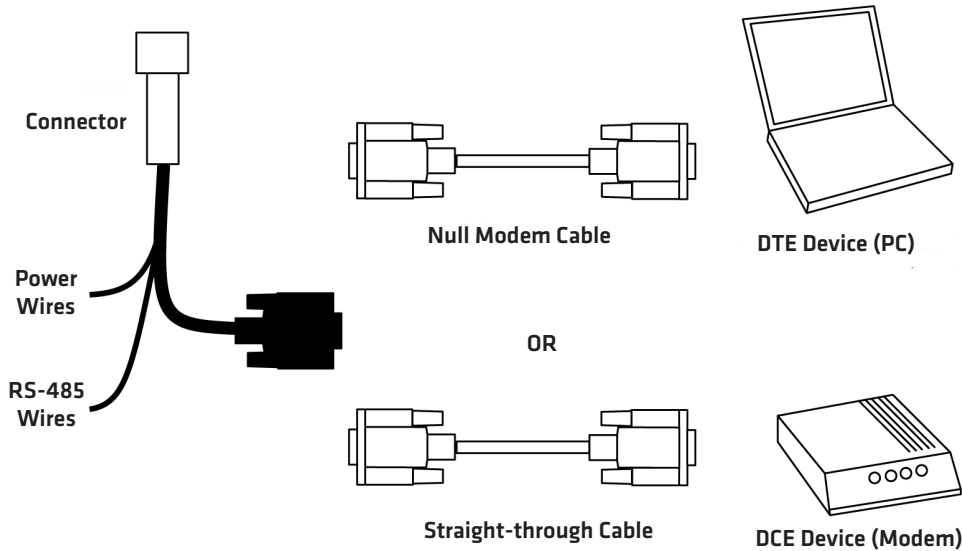


Figure D.1 – Direct Serial Connections

Note

If you do not have the right type or RS-232 physical connection you will not be able to connect using the SmartSensor Manager software. Since null modem cables and straight-through cables look similar, you may want to label them. Alternatively, you may want to use a null modem adapter instead of a null modem cable. If you do, you can turn your straight-through cable into a null modem cable by attaching the adapter on one end.

If you wish to connect the 9-conductor cable's RS-485 wires directly to a PC or modem, this will require that these devices natively support RS-485 communications. Often, modern personal computers do not support RS-485 communications and support USB communications instead. If your computer only supports USB communications, you may want to use a Click serial to USB converter to make a direct connection.

Appendix E - Signaling Delays

Signaling delays vary depending on what equipment is used. These delays may affect decisions about where to install the sensor in relation to other equipment in cases where timeliness in communication is necessary. The following is information about SmartSensor HD

signaling delays.

Total signaling delay from front of vehicle = sensor delay + communications delay + contact closure delay, where:

- Sensor delay = 1 second + (vehicle length in ft)/(vehicle speed in fps)
- Communications delay = $((10/8) * 34 \text{ bytes}) / (\text{baud rate in bps})$
- Contact closure delay for Click 512 = essentially zero
- Contact closure delay for Click 172/174 = detected duration + (effective virtual loop length in ft)/(detected vehicle speed in fps)