SmartSensor HD

USER GUIDE

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Contents

Contents (cont.)

Introduction

In the Introduction

- ■ 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. Classified as Frequency Modulated Continuous Wave (FMCW) radar, the SmartSensor HD 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 reconfigured for optimal performance. This installation 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 back-plate
- ■ Sensor mounting kit
- ■ Sensor cable
- ■ SmartSensor Manager HD (SSMHD) software
- ■ SmartSensor HD User Guide

Check the packing slip for actual contents. If any of these items are missing, note the serial number located on the back of the sensor and contact your distributor.

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

- ■ Click! 172/174™ contact closure adapter
- ■ Click! 200™ surge protector
- ■ Click! 201/202™ AC to DC converter
- ■ Click! 210™ circuit breaker switch
- ■ Click! 230™ AC surge module

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 feet 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 further 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 40-foot 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-foot lateral separation from overhead sign bridges, overpasses, tunnels, parallel walls, and parallel-parked vehicles in order to avoid multiple reflection paths from a single vehicle.
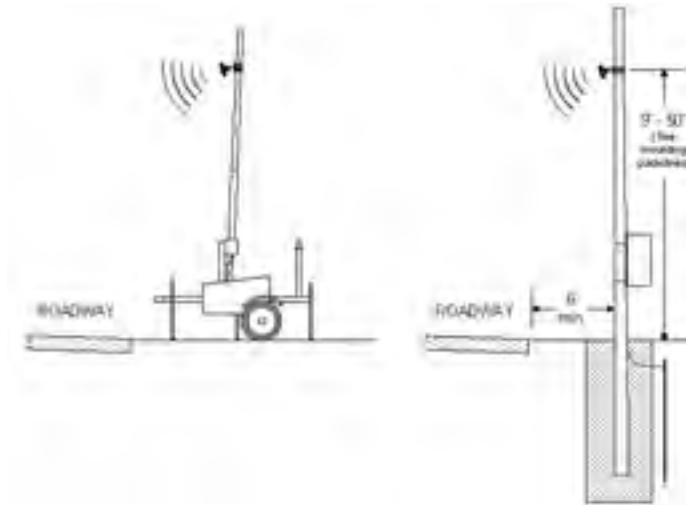
Figure I.1 – Portable (left) and Permanent (right) Sensor Stations

- ◼ **Mounting Height –** The mounting height should be based upon the offset from the lanes of interest. For each offset, the minimum, maximum, and best range of heights is shown in Table 1.1, found in chapter 1. In general, the range of recommended heights is between 9 and 50 feet.

- ◼ **Mounting Offset –** The minimum recommended offset from the edge of the first lane of interest is 6 feet.

- ◼ **Arterial Locations –** Sensor sites on arterials or other roadway segments with regulated stop lines should be selected at mid-block positions to increase accuracy by avoiding positions at which vehicles are often stopped in front of the sensor.

- ◼ **Freeway Locations –** 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 feet if they're using 24 VDC operation and RS-485 communications; for longer connections, alternate wired and wireless options should be considered.

Part I

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 SmartSensor 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 SmartSensor 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 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 introduction and Figure 1.1), use Table 1.1 to select a mounting height.
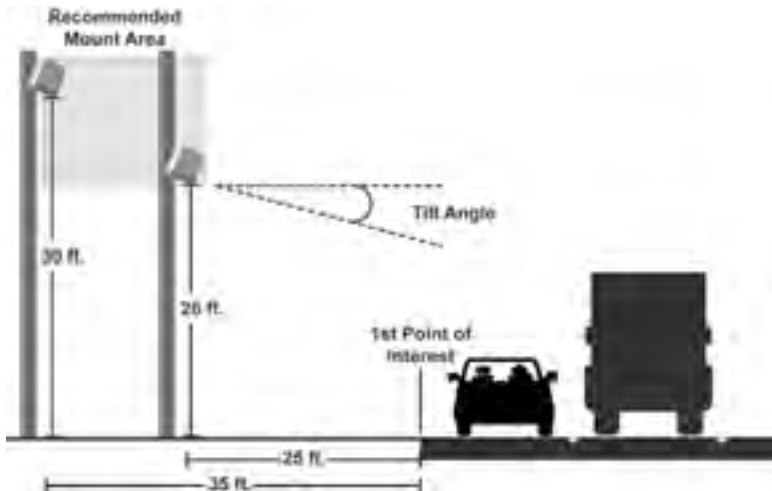
Figure 1.1 – Recommended Mounting Height

Offset from first Detection Lane (ft)	Recommended Mounting Height (ft)	Minimum Mounting Height (ft)	Maximum Mounting Height (ft)
6	12	9	19*
7	12	9	19*
8	12	9	20*
9	12	9	21
10	12	9	22
11	12	9	23
12	13	10	24
13	13	11	25
14	14	11	26

Recommended Offset			
15	15	12	26
16	15	12	27
17	16	13	28
18	17	14	29
19	17	14	30
20	18	15	30
21	19	15	31
22	20	16	31
23	22	16	32
24	24	16	33
25	26	17	33
26	26	17	34
27	27	18	35
28	27	18	35
29	27	18	36
30	29	19	37
31	29	19	37
32	29	19	38
33	30	19	39
34	30	19	39
35	30	20	40
36	30	20	41
37	31	20	41
38	31	21	42
39	33	21	43
40	33	22	43
41	34	22	44
42	34	22	44
43	35	22	45
44	35	23	46
45	36	23	46
46	36	23	47
47	36	24	48
48	38	24	48
49	38	24	49
50	25	24	50

Table 1.1 – Mounting Height Guidelines   *Reduction in number of reported speeds

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 height 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 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.
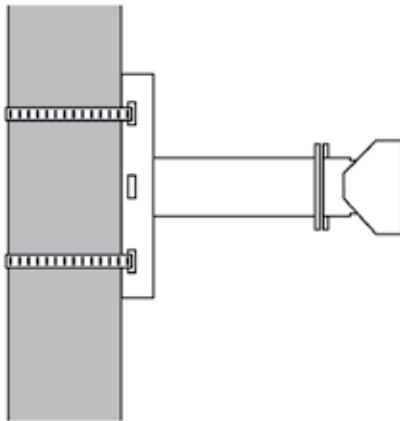
Figure 1.2 – Attaching the Mount Bracket to the Pole

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 back plate with the holes in the mount bracket. The large 25-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.
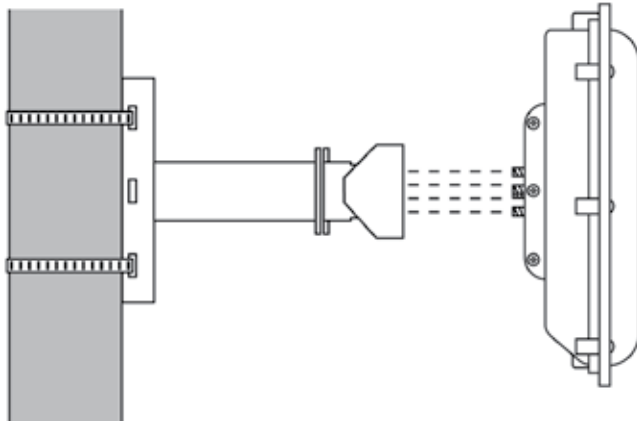
Figure 1.3 – Attaching the Sensor to the Mount Bracket

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).

Tilt the sensor down towards the center of the traffic
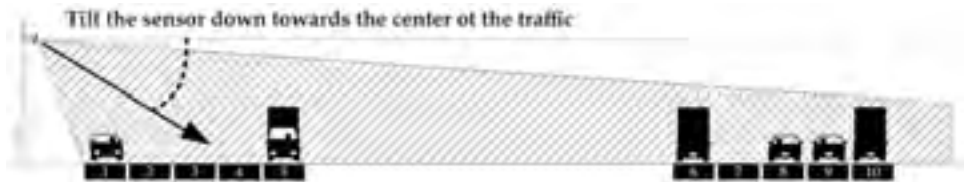
Figure 1.4 – Up-and-down Positioning

2   Adjust the side-to-side angle as close to perpendicular to the flow of traffic as possible (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.

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 SmartSensor Cable

The sensor connector is keyed to ensure proper connection; simply twist the 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 (see Figure 1.8). Two communication ports (either RS-232 or RS-485) are available to connect the SmartSensor HD to a modem or other communication device. Typically, one RS-485 and one RS-232 port are available.

Figure 1.8 – Service End

In this Chapter

- ■ Connecting Lightning Surge Protection
- ■ Connecting AC Power Conversion
- ■ Connecting DC Power
- ■ Wiring Communication

Once the sensor is installed, it will need to be wired for power and surge protection. This chapter will explain how to connect lightning surge protection, AC power conversion, DC power and basic communication.

Wavetronix Click! products allow you to quickly and easily connect power and surge protection to your sensor application. Please refer to the Click! quick-start guides for more comprehensive product instructions. Chapter 9 contains information on how Click! products make the sensor compatible with all standard control cabinets.

A pinout diagram showing the sensor cable's pinout and appropriate connection points can be found in Appendix B of this document.

Connecting Lightning Surge Protection

It is strongly recommended that the sensor be connected to a surge protection device. The Wavetronix Click! 200 and equivalent devices are designed to prevent electrical surges conducted along underground cables from damaging the sensor and/or the cabinet. The service end of the sensor cable should be connected to the PROTECTED side of the Click! 200 in a cabinet mounted on the sensor pole. This will help protect the sensor when lightning strikes the ground in the vicinity of the cabinet (see Figure 2.1).
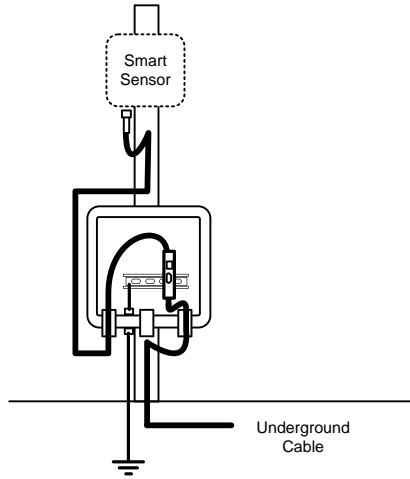
Figure 2.1 – Protecting the Sensor

Note

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

In many installations, the pole-mount cabinet is also connected to a main traffic cabinet via an underground homerun cable. To protect the traffic cabinet, a second surge device is strongly recommended. Follow the steps below to include surge protection using Click! 200 devices (see Figure 2.2):

1   Install one Click! 200 device in a pole-mount box on the same pole as the sensor being protected.

2   Install another Click! 200 in the main traffic cabinet.

3   Connect the SmartSensor cable from the sensor to the PROTECTED side of the Click! 200 in the pole-mount cabinet. The SmartSensor cable should be kept as short as possible.

4   Connect a SmartSensor cable from the UNPROTECTED side of the Click! 200 on the pole to the UNPROTECTED side of the Click! 200 in the main traffic cabinet.
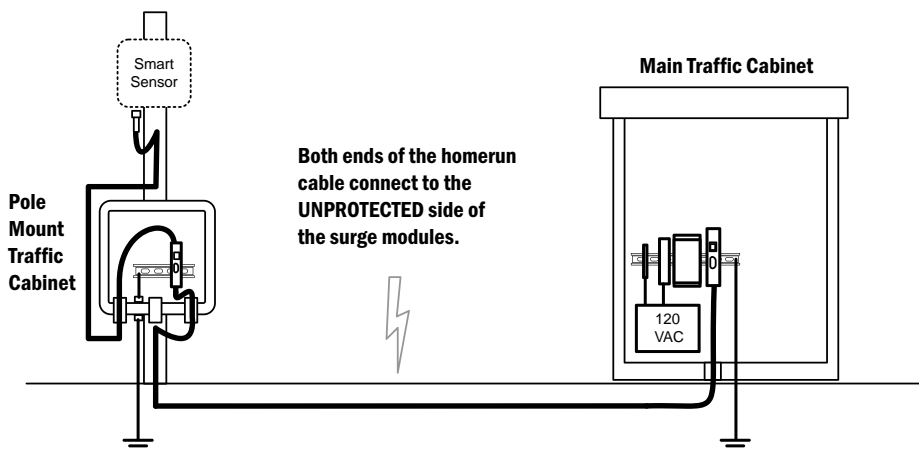
Figure 2.2 – Typical Cable Run

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 the connector to plug into only one specific jack. This both simplifies the wiring process and reduces the possibility of wiring errors.

The back four terminals consist of one +DC power, -DC and two surge ground connections; the middle four terminals are for RS-485 communication and consist of a +485 connection, a -485 connection, an RS-232 ground connection and a surge ground connection; the front four terminals are for RS-232 communication and consist of TD, RD, CTS and RTS.
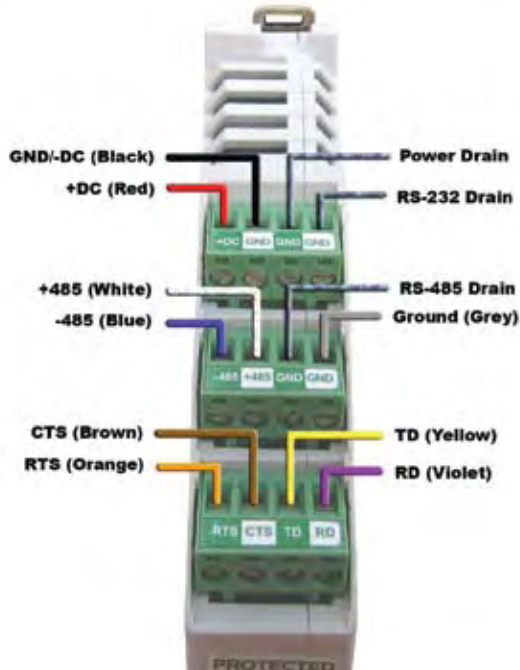
Figure 2.3 – Surge Protected Terminal Connections (Top)

Figure 2.3 above shows the PROTECTED side of the Click! 200. The UNPROTECTED side of the Click! 200 contains the same screw terminal connections, but are reversed from left to right.

Note

See Appendix C for a description of how to wire the Click! 200 using the old SmartSensor cable as well as for a cable connector pin out diagram.

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-foot 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 box.

2   Connect another grounding wire from the exterior lug bolt to earth ground (see Figure 2.4).

Figure 2.4 – Earth Ground Connections

Connecting AC Power Conversion

Since the sensor operates on 10-30 VDC, it is necessary to provide AC power conversion when reliable DC power is not already available. Wavetronix recommends using the following three Click! components:

◼ Click! 201/202 AC to DC converter
◼ Click! 205 AC surge module
◼ Click! 206 circuit breaker and switch

Warning

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

A Click! 201 provides 1 amp of power and is capable of powering a single sensor, while a Click! 202 provides 2 amps and can power two sensors. The Click! 205 helps limit current surges on the power lines; the Click! 206 interrupts power during overload conditions and provides a convenient way to turn power on and off.

Depending on your configuration, these Click! modules may be mounted in the pole-mount cabinet or the main traffic cabinet. When mounted in the main traffic cabinet, a homerun cable is used to conduct DC power and communication signals to the pole-mount cabinet. For connections shorter than 600 feet, use the SmartSensor cable as your homerun cable. This will simplify the wiring process and ensure reliable connections.

> **Caution**
>
> 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 a Circuit Breaker and Switch

The Click! 206 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.

To add a Click! 206 circuit breaker and switch (see Figure 2.5):

1   Mount the Click! 206 onto the DIN rail.

2   Connect power in to either side of the module.

3   Connect power out to the other side.
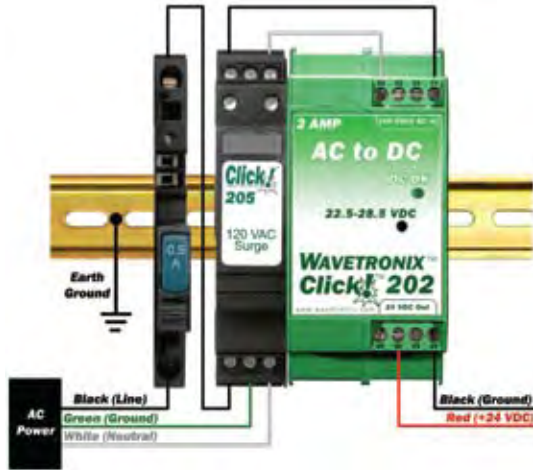
Figure 2.5 – AC Surge Protection

Wiring AC Surge Protection

To include AC surge protection in your installation (see Figure 2.3):

1   Mount the Click! 205 onto the DIN rail.

2   Connect the line conductor (hot) from the Click! 206 to terminal 5 on the IN side of the Click! 205.

3   Connect the neutral wire from the AC terminal block or cord to the

terminal marked 1 on the Click! 205.

4 Connect the ground wire from the AC terminal block or cord to the terminal marked 3 on the Click! 205.

5 Connect the outgoing and protected line wire to the terminal marked 2 on the Click! 205.

6 Connect the outgoing and protected neutral wire to the terminal marked 6 on the Click! 205.

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 AC Power Into the Click! 201/202

Follow the steps below to properly wire an AC to DC power conversion module (see Figure 2.6):

1 Mount the Click! 201/202 onto the DIN rail.

2 Connect the line (hot) wire from the Click! 205 into the L screw terminal on the top of the Click! 201/202. The line wire is usually black.

3 Connect the neutral wire from the Click! 205 to the N screw terminal to the top of the Click! 201/202. The neutral wire is usually white.

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.

Wiring 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 connect to the terminal block on the bottom of the Click! 201 with screw terminals marked DCOK, +, - and -.

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 DC Power

To power the sensor, 10-30 VDC needs to be connected to the Click! 200 in the pole-mount cabinet. Additionally, if there is a main traffic cabinet connected by a homerun cable, you will need to connect DC power to the Click! 200 in that cabinet.

In the Pole-Mount Cabinet

Whether DC voltage comes from a homerun cable or from a Click! 201/202 within the pole-mount cabinet, you can always wire the DC wires to the last screw terminal on the UNPROTECTED side of the Click! 200 module. This will protect your sensor from surges.

To wire DC power into the Click! 200:

1   Connect +DC (usually a red wire) to the +DC screw terminal.

2   Connect -DC (usually a black wire) to the GND screw terminal next to the

+DC terminal.

If the DC power comes from a Click! 201/202 in the pole-mount cabinet that is surge protected using a Click! 205, you can also connect power to the T-bus using a 5-position screw terminal. To wire DC power directly into a 5-position screw terminal (see Figure 2.8):

1   Connect +DC (24VDC) to the top screw terminal.

2   Connect –DC to the second screw terminal.
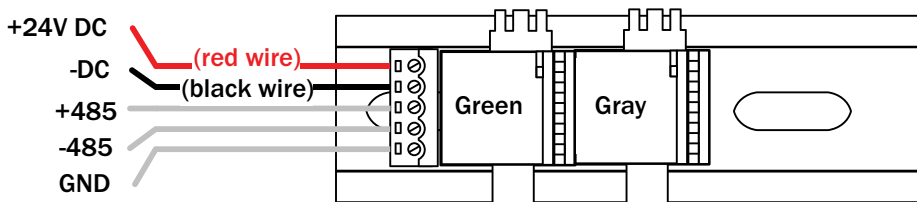
Figure 2.8 – Connecting Power Directly to the T-bus

Note

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

In the Main Traffic Cabinet

If DC voltage is sent across a homerun connection, AC power conversion is provided in the main cabinet. In the main cabinet, the DC wires out of the Click! 201/202 should be wired to the PROTECTED side and the homerun cable should be connected to the UNPROTECTED side of the Click! 200.

Note

The purpose of the Click! 200 in the main cabinet is not to protect the sensor, but the electrical equipment inside of the main cabinet.

The last screw terminal block on the PROTECTED side of the Click! 200 module contains a +DC, -DC and two surge ground connections (see Figure 2.9).

1   Connect +DC (usually a red wire) to the +DC screw terminal.

2   Connect -DC (usually a black wire) to the GND screw terminal next to the +DC terminal.
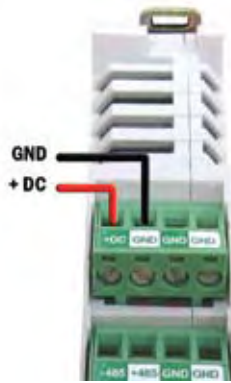
Figure 2.9 – Wiring DC Power into the Click! 200

Wiring Communication

After wiring the sensor cable into the PROTECTED side of the Click! 200 in the pole mount cabinet, two isolated serial connections are available. The sensor's native RS-232 port is available via the DB-9 connector on the faceplate.

In addition, the sensor's native RS-485 connection is available in the pole mount cabinet via the following three ports on the Click! 200:

■   Screw terminals on the bottom
■   RJ-11 connector on the faceplate
■   T-bus backplane

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

One common way to connect communications back to a main cabinet is to use a SmartSensor cable as your homerun cable. See Appendix D for information about maximum cable lengths for wired communication. Wavetronix Click! products facilitate a wide variety of additional wired and wireless communication options. Contact a Wavetronix-authorized technical representative to find out which options are best suited for your application.

Contact Closure Connections

While any of the RS-485 ports on the Click! 200 can be connected to contact closure modules, it is often easiest to connect from the RJ-11 port. In some cases, several contact closure cards can be daisy-chained together. However, the chain

should not be connected until each card has been independently programmed (see Figure 2.10).

Figure 2.10 – Connecting Contact Closure Modules

Note

Wait to connect contact closure communications until after the sensor is programmed using the configuration software.

See Chapter 9 for more information on contact closure communications.

Part II

Using SmartSensor Manager HD

In this Chapter

- ■ **Installing SSMHD**
- ■ **Microsoft .NET Framework**

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 the software that enables users to configure and interact with the SmartSensor HD. This software is contained on a compact disc that is shipped with each sensor.

Note

You can check the Wavetronix portal to ensure that you have the latest version of SmartSensor Manager HD. To access the portal, open a web browser, go to portal.wavetronix.com, and log in with the username "guest" and password "wavetronix." In the menu on the left side, select **SmartSensor Products**. The latest version of the software, along with the release date, will be listed under SS125 Software.

Installing SSMHD

SSMHD can be run on a Windows® PC and on a Windows® CE device. 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.

Follow these steps to install SSMHD on a PC:

1   Place the CD in the CD drive.

2   Double click the **Setup.exe** icon listed in the contents of the CD. This executes a setup program that will copy all the necessary files to the 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

3   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

4   Click the Install Now button.

5   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

6   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.

7   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.

Use these steps to install SSMHD on a Pocket PC® (Windows Mobile):

1   Ensure the Pocket PC 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 is installed (ActiveSync is a program that is used to communicate with a Pocket PC device). If the ActiveSync program is found, the option of installing SSMHD to a Pocket PC device will become available.

3   Click the **Pocket PC** checkbox and then the **Next>>** button to install SSMHD on a connected Pocket PC 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 – Pocket PC Installation Program

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

Figure 3.5 – Adding SSMHD to a Pocket PC

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

Microsoft .NET Framework

The SSMHD setup program will automatically detect whether Microsoft .NET Compact Framework v1.1 is installed on your PC. If it is not installed, you will be prompted to install it (see Figure 3.6).

Figure 3.6 – Microsoft .NET Framework Prompt

Use the following steps to install Microsoft .NET Framework:

1   Click the **Install Framework** button.

2   Click the **I Agree** radio button when the License Agreement appears (see Figure 3.7).

Figure 3.7 – License Agreement

3   Click **Install**. A window will appear stating that the .NET Framework has been installed successfully.

4   Click **OK** and you will be returned to the SmartSensor Manager HD Setup program.

Communication

4

In this Chapter

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

Once the SS125 is installed, use the SSMHD software to change settings, view data, and configure the sensor to the roadway.

First, physically connect your computer or Pocket PC to the SS125. 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.

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: a serial connection, made using RS-232 or RS-485 communication; a modem connection, made to an external analog modem; an Internet connection, made using an IP address and a serial to Ethernet converter; and a virtual connection, which 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 SS125, the SSMHD software 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-recently-used 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 baud; 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

The SmartSensor HD can be connected 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 (see Figure 4.3).

Figure 4.3 – Modem Connection

Use the steps below to connect to the SmartSensor HD using a modem connection:

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).

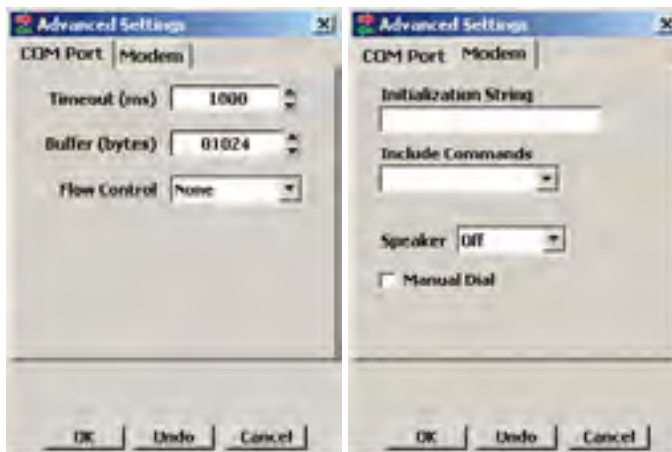**5**   Click **Dial** to establish the connection.

Figure 4.4 – COM Port Settings (left) and Modem Settings (right)

Advanced Settings

The COM Port tab on 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.

The Modem tab in the Advanced Settings window contains the following fields:

■   **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:

1   **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.

2   **Serial to 802.11b Wireless** – The Click! 401™ is a serial to 802.11b converter that provides serial devices with an IP address on a wireless 802.11b network. The Click! 401 has been tested to work over a –34° C to +74° C temperature range.

3   **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 field 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.

When a connection is made to the SmartSensor HD, the main menu will appear and all configuration options will become available (see Figure 4.7). Click **Continue** to view the current sensor configuration.

Figure 4.7 – SSMHD Main Screen (connected)

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 4.8).

Figure 4.8 – 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 4.9).

Figure 4.9 – Multi-drop Network

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 4.10).

Filters Address Books by Serial, Modem or Internet Connection

Deletes an Address Book

Imports an Address Book

Exports an Address Book

Edits the Selected Device

Adds a Device to the Address Book

Deletes the Selected Device
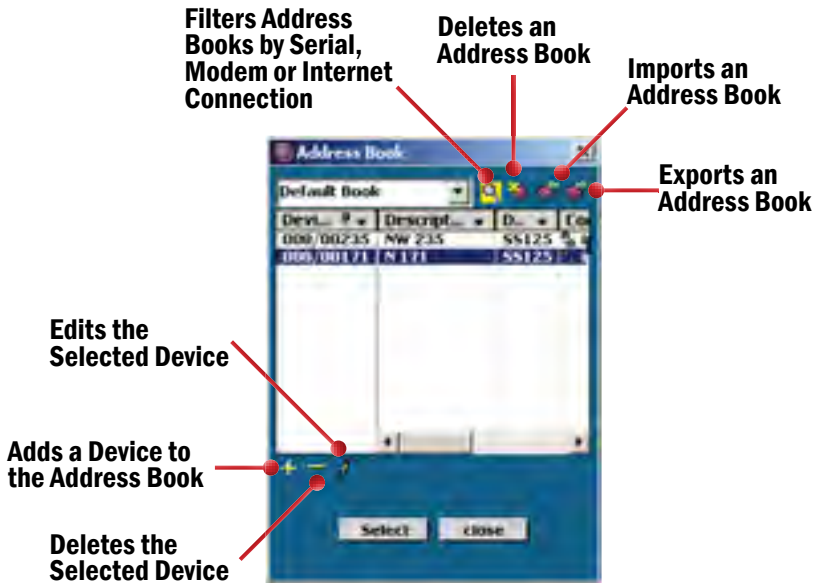
Figure 4.10 – Address Book

Viewing Connection Information

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 (see Figure 4.11). These arrows are only visible when there is an established connection.

Figure 4.11 – 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.

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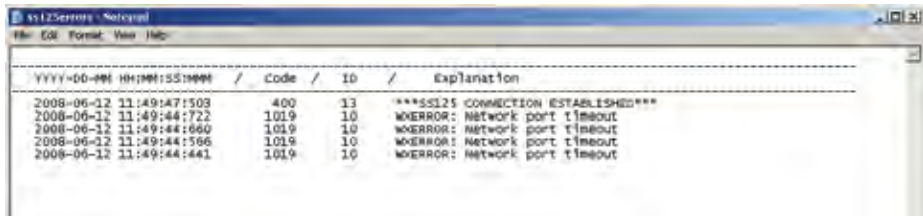
> **Note**
>
> The error log is cleared every time you close SSMHD, so if you need to save the file, do so before shutting the program down.

Click the **View Error Log** link to view the communications error log (see Figure 4.12). The error log can also be accessed by clicking on the error log icon at the bottom of the Communication screen.

Figure 4.12 – 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 4.13). 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 4.13 – 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 4.14). 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 4.14 – 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 SSMCE 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 4.15).

Figure 4.15 – 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 the Wavetronix Portal.

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 than the version running on the sensor.

In this Chapter

- ■ General Tab
- ■ Communication 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

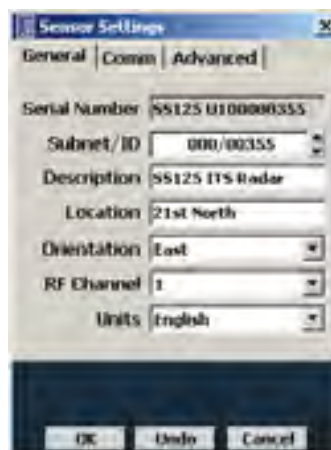The General tab contains the following fields (see Figure 5.1):

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 –** This section allows you to set the baud rate for RS-232, RS-485, Expansion 1 and Expansion 2. The green arrow indicates 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 –** This is 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

■   **Replay –** Allows you to turn replay on or off. Replay is a special demonstration mode, used for testing and training purposes, that requires additional hardware to be installed in the sensor. If the hardware is not installed on the sensor, the Replay switch will be in the "Off" position and disabled.

> **Note**
>
> If the sensor is in 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 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.
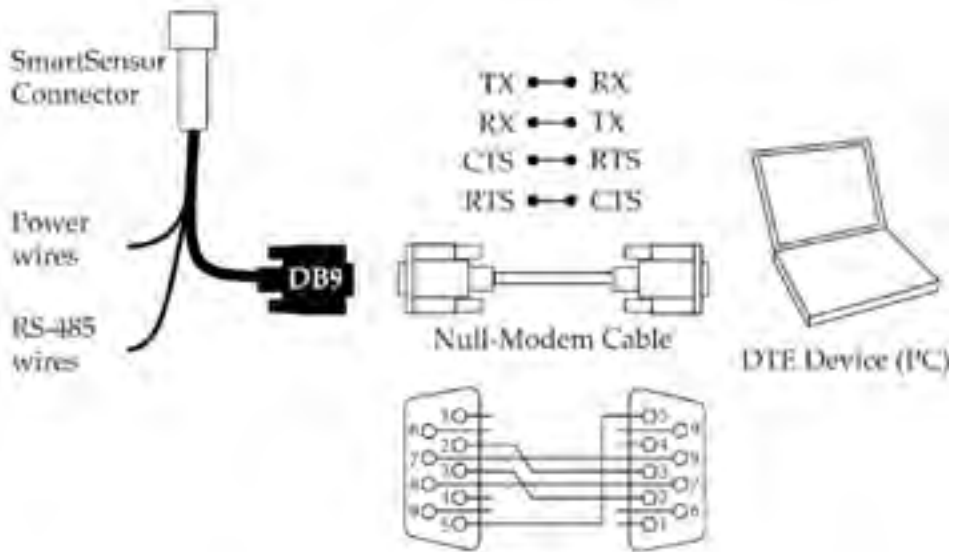
Figure 5.4 – RS-232 Connections

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 de-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.

Lane Setup

6

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.
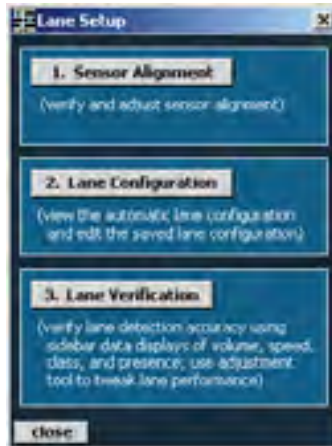
Figure 6.1 – Lane Setup Screen

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; a yellow or red arrow means the sensor is NOT correctly aligned with the roadway (see Figure 6.2). For audio verification, check the **Sound On** box.

Figure 6.2 – Sensor Alignment

> **Note**
>
> In order for the sensor alignment tool to function properly, traffic must be flowing freely. 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.
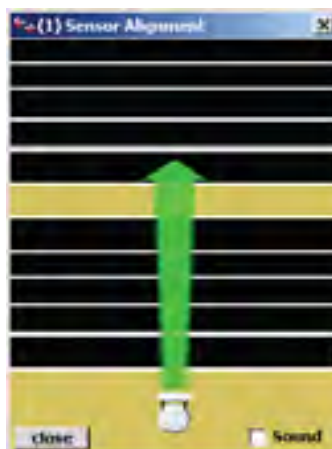
It may be difficult to align the sensor if there are non-parallel lanes of traffic. In this case, mark the non-parallel lanes as "Inactive" or "Excluded" in the lane configuration screen, and the sensor alignment tool will ignore vehicles traveling in these lanes.

> **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.

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).
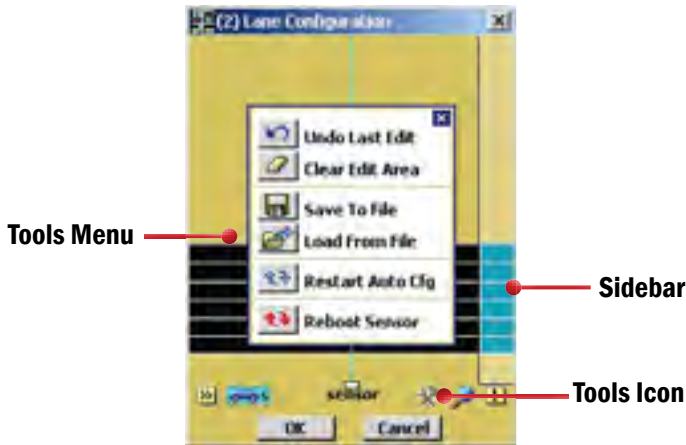
Figure 6.3 – Buttons Used in Automatic Lane Configuration

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 and select Show Auto Lanes for the automatically discovered lanes to appear.

Depending on the sensor's mounting and 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

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 available on the Lane Configuration screen.

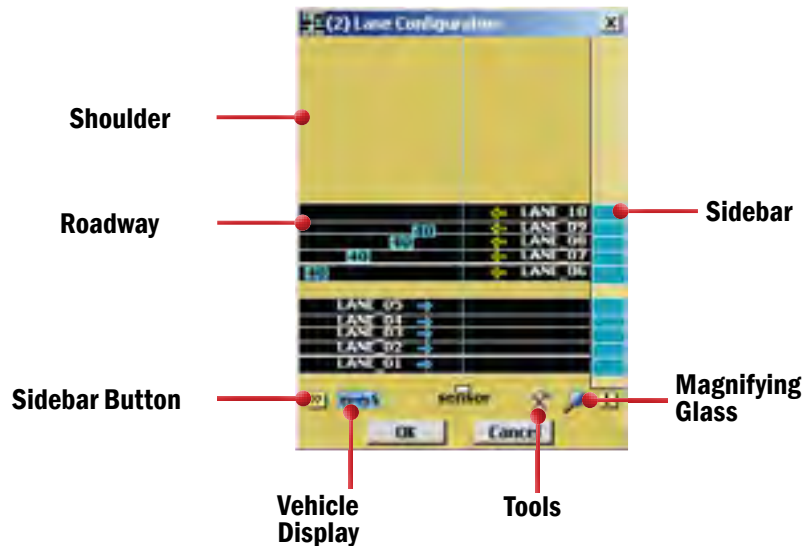**Figure 6.5 – Lane Configuration Screen**

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

1   **Auto Cfg** – Shows the lanes that are automatically configured by the sensor.
2   **Saved Cfg** – Shows the lanes that are saved on the sensor.
3   **Scale** – Shows the distance from the SmartSensor HD to each lane.
4   **Centers** – Shows the relative occurrence of events. Larger arrows indicate a greater number of vehicles at a given range.
5   **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) 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.
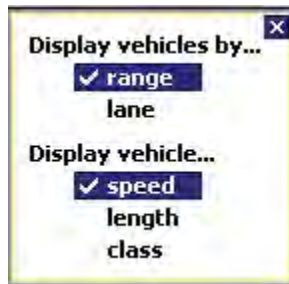

Figure 6.7 – Vehicle Display Options

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).
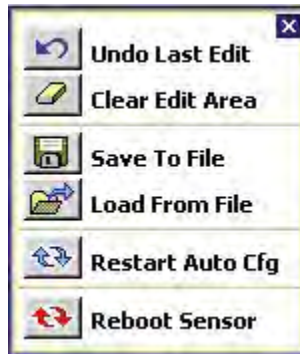
Figure 6.8 – Tools Options

Magnifying Glass

The **Magnifying Glass** button opens a menu that allows you to show or hide automatically configured lanes, change lane names and vehicle direction and 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.

Edit Area

Click in the shoulder and the Shoulder Area window will appear, allowing you to add or exclude 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.
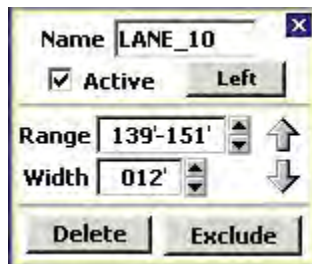
Figure 6.11 – Lane Adjustment Window

Click the **Exclude** button to exclude a lane or click the **Delete** button to delete a lane (the lane will turn red once it has been excluded). 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**.

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).
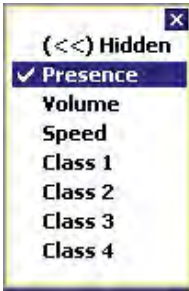
Figure 6.12 – Lane Verification Sidebars with Four Classes

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 or extension time. 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 200%, 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).

■ **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%.

Data Setup & Collection

7

In this Chapter

- ■ Interval Data
- ■ Per Vehicle Data
- ■ Loop Emulation
- ■ Data Storage & Download
- ■ Bin Definitions
- ■ Approaches
- ■ Date and 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 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)

The interval data screen displays the following information for each lane or approach, depending on which tab you've selected:

■ **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.

■ **Speed –** Indicates the average lane speed during the interval.

■ **85% –** Shows the 85th percentile speed. Eighty-five percent of the vehicles in the interval were going this speed or slower.

■ **Classes –** Refers to length-based bins (see Bin Definitions later in this chapter). This column shows the number of cars from each length class that were detected during the interval.

■ **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.

Click on a lane in the Interval Data list to view lane information without using the bottom scroll bar (see Figure 7.3).
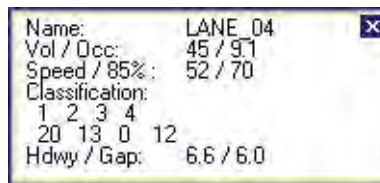
Figure 7.3 – Interval Lane Information

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.

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 7.4). 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.

Figure 7.4 – 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.

■   **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 PDA must be connected to the sensor.

Loop Emulation

Loop emulation allows you to adjust loop size and spacing when the SmartSensor HD is being used to emulate dual loops in one lane (see Figure 7.5).

■   **Loop Size –** Adjusts the size of the loops.

■   **Loop Spacing –** Adjusts the loop spacing.

Figure 7.5 – 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. These settings do NOT modify any data the sensor reports. Therefore, 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 7.6):

■   **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 PDA.

Figure 7.6 – Data Storage and Download

Storage Settings

Click the **Storage Settings** button to specify and initialize the storage options (see Figure 7.7).

Figure 7.7 – Storage Settings

■   **Data Interval Length** – Specifies the Data Interval Length in hours, minutes, and seconds. The Data Interval must be set to 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.

Storage Status

The Storage Status window shows the timeline, current storage remaining, and storage capacity of the sensor (see Figure 7.8).
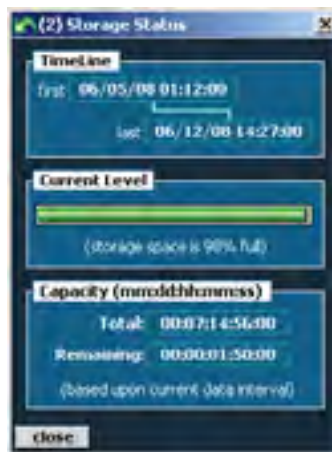
Figure 7.8 – Storage Status

■   **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 than 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 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

Data Download

The Data Download window allows you to specify the time for which stored data will retrieved and the location where it will be saved to file. (see Figure 7.9).

Figure 7.9 – 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.

> **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 7.10). The data can be analyzed by various software tools or loaded into databases by programming custom import routines. Additionally, Wavetronix Command products can retrieve interval data directly into an SQL database.

Figure 7.10 – Data Format

Bin Definitions

The term "bins" refers to classifications of vehicles based on their length, speed or direction. Once they 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 7.11).
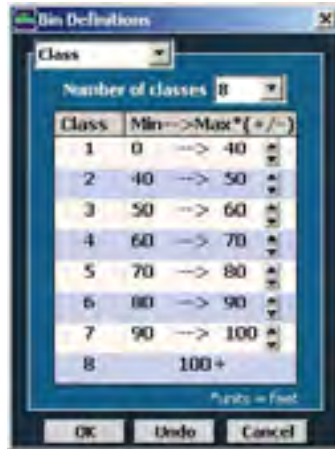
Figure 7.11 – Bin Definitions

Select **Class**, **Speed** or **Direction** from the drop-down list at the top of the screen and make the necessary changes. There are up to 8 length 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 travelling 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 length 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, Table 7.2 may be useful to you; these measurements are an industry standard known as Scheme F, developed by the Maine DOT.

4 Classification Bins	
Lengths	**Scheme F**
0-10	1
10-19	2,3
19-35	4,5,6
35-256	7-13

6 Classification Bins	
Lengths	**Scheme F**
0-10	1
10-19	2
19-24	3
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 7.12).
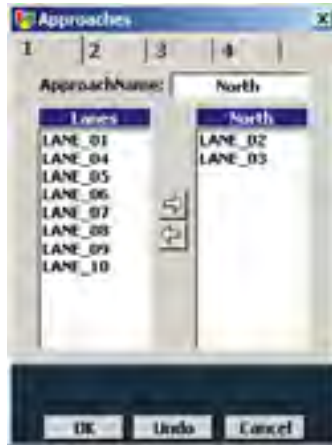
Figure 7.12 – Approaches

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 and Time

Click the **Date and Time** button on the Data Collection window to access the Date & Time window (see Figure 7.13).

Figure 7.13 – 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) connects 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 saving, 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 7.14).

Figure 7.14 – Data Push

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.

To enable data push, select **Event Data, Interval Data** or **Presence Data** from the drop-down list on the top of the page, 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
■   **SS125 Format –** This outputs the data in the native SS125 format (see the *SmartSensor HD Released Communications Protocols* document, available on the Wavetronix portal, 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).

■   **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).

Subnet/ID

This is the destination subnet/ID the sensor will push data to and is only valid for SS125 format data push. Any subnet/ID is valid, but make sure that this subnet/ID is unique for the communications bus in use. The SS125 communications protocol reserves subnet/ID 000/00000 for software applications. The subnet/ID should be set to 000/00000 if the SSHD is pushing data to a custom software application.

Tools

8

The Tools section allows you to backup and export sensor data (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

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.

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.

Export Data

The SSMHD Data Export window allows you to convert log files from the SmartSensor format to other formats to be exported (see Figure 8.3). Currently, 3 Card is the only supported format.

Figure 8.3 – SSMHD Data Export

To convert, click the magnifying glass to select a log file to convert, click **OK**, and then click **Continue>>**. In the following two screens, fill out the requested information, and then click **Finish** to create the 3 Card file. (To see the file immediately, click the **Open 3 Card export file when finished** box.) SSMHD will take the entered information and format the file according to 3 Card standards. For more information on 3 Card, see the FHWA's *Traffic Monitoring Guide*, available from fhwa.dot.gov.

In this Chapter

- ■ **Selecting the Contact Closure Model**
- ■ **Programming Sensors for Use with Contact Closures**
- ■ **Programming Contact Closures**

Often traffic data is collected directly from the sensor via a serial, modem or Internet connection. However, a contact closure module is often needed to use SmartSensor HD with a traffic controller, traffic data recorder or other type of data logger.

Selecting the Contact Closure Model

In some applications, all of the contact closure modules listed in Table 9.1 below could be used, but one model may have major advantages over the others; for example, the Click! 101 is better for midblock applications.

Model Number	Form Factor	Major Advantages
Click! 100	Din rail	Screw terminals for easy wiring to automatic traffic recorders or data loggers
Click! 101	Din rail	Collection from multiple sensors
Click! 172/174	Rack card	Works with standard ITS and intersection detector racks (NEMA TS1/TS2, 170, 2070)
Click! 500	Din rail	User-programmable contact closure development platform for virtually any application.

Table 9.1 – Advantages of Contact Closure Models

■ **Click! 100** – The Click! 100 is a din rail–mounted contact closure that can

be used in cabinets without detector racks and simplifies integration into automatic data recorders and data loggers. The wiring harness of the automatic data recorders can connect directly to the screw terminals of the Click! 100. Application notes for wiring to common automatic traffic recorders can be obtained by contacting your authorized Wavetronix dealer or Wavetronix Technical Services.

Note

Automatic data recorders and data loggers are often used to collect per vehicle (event) information. When large amounts of per vehicle data are captured, it is common practice to aggregate the data in ways that makes the data more meaningful and manageable. SmartSensor HD's built-in data collection system allows for the data to be aggregated in a wide variety of ways. Data can be grouped in small or large time intervals, 15 speed bins, 8 classification bins, and approaches. In addition, SmartSensor HD provides average lane speed, 85% speed and a number of other statistics. When you are planning on using an automatic data recorder or data logger for a particular application, consider whether SmartSensor HD can already provide you with the level of information you really need.

■   **Click! 101 –** The Click! 101 has the built-in capability of collecting from multiple HD units simultaneously, making it an excellent choice for midblock applications. This allows one Click! 101 to collect traffic data from all the SmartSensor HD stations pertaining to an intersection. For arterial management, the resulting system is very cost-effective and can be rapidly deployed, especially when wireless communications is included.

Each SmartSensor HD uses its two communication ports to send real-time traffic data to both cabinets for which it is collecting data (see Figure 9.1). The real-time data is used to control the intersection using either local control strategies or closed-loop control systems like ACS-lite.
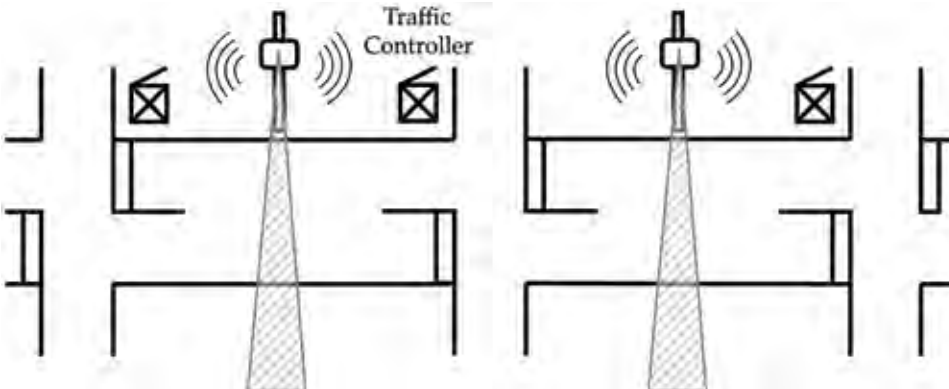
Figure 9.1 – SmartSensor HD Sending Real-time Data to Multiple Approaches Using Dual Ports

■ **Click! 172/174 –** The Click! 172/174 are contact closure cards that allow SmartSensor HD to integrate into standard ITS and intersection detector racks. The Click! 172 has two contact closure outputs and the Click! 174 has four. The Click! 172/174 are commonly used in legacy ITS cabinets or for midblock intersection detection. Multiple Click! 172/174 modules can be daisy-chained together to collect data from all 10 lanes possible with SmartSensor HD.

Unlike the Click! 101, which actively collects information from multiple sensors, each Click! 172/174 is dedicated to a single sensor. During programming, the Click! 172/174 cards transmit configuration information to SmartSensor HD to set up the mode of operation. Once the mode is set up, the rack cards stop transmitting messages and passively listen for data pushed by the sensor.

Tip

In many cases, the traffic data detected by SmartSensor HD is valuable to both operations and planning departments. However, when legacy systems are used, often there is no mechanism to directly share the data. Even with the limitations of legacy systems, contact closures can sometimes provide a way for operations and planning to both get what they need from a single sensor. For example, the operations department can collect traffic data into a traffic controller via a Click! 172/174 over one of SmartSensor HD's two ports. Then the planning department can use the second port to send data to an automatic traffic data recorder via a Click! 100.

■ **Click! 500 –** The Click! 500 is a user-programmable contact closure platform for virtually any application. For example, the Click! 500 can be programmed to activate a contact closure output when vehicles over a specified speed and length are detected. To accelerate development, the Click! 500 will provide developers with SmartSensor HD communication drivers.

For a full description of each module refer to the Click! quick-start guides, user manuals and bid specifications. Or contact your authorized Wavetronix dealer or Wavetronix Technical services for more information.

Programming Sensors for Use with Contact Closures

■ **Click! 100 –** The Click! 100 supports baud rates from 9600 to 57600 bps. When using a Click! 100, make sure SmartSensor HD is set operate at a baud rate in this range. The Click! 100 supports 8 outputs, meaning that only the first 8 of the 10 SmartSensor HD outputs can be used.

- ■ **Click! 101 –** The Click! 101 modules support baud rates from 9600 to 115200 bps. The Click! 101 identifies each sensor by its sensor ID. Before you configure the Click! 101, you can retrieve the sensor ID using SmartSensor Manager HD over a communication link.

- ■ **Click! 172/174 –** The Click! 172/174 modules support baud rates from 9600 to 57600 bps. When using a Click! 172/174 device, make sure SmartSensor HD is set to operate at a baud rate in this range. To select which SmartSensor HD lanes are mapped to the Click! 172/174 outputs, the lane names of SmartSensor HD need to be set up correctly using SmartSensor Manager HD. It is generally easier to begin renaming with the lane farthest from the sensor.

  The first character of the lane name should be a digit (0 to 9). The second character can take on a value R or L to represent the direction traffic is flowing. For example, lane names could be 1R (right to left) or 1L (left to right). However, lane names can be up to 8 characters in length.

Note

The SmartSensor HD default loop size and spacing are used by the Click! 100 and 172/174. These settings will not change the values of SmartSensor HD data, but the Click! modules will change the duration and spacing of contact closures signaled on their output pins.

- ■ **Click! 500 –** The Click! 500 modules support baud rates from 9600 to 115200 bps. Any special programming of SmartSensor HD for an application running on the Click! 500 will be explained in the documentation for that application.

Programming Contact Closures

The contact closure modules have several modes of operation explained in their respective quick-start guides and user manuals. Consult this documentation to determine the mode appropriate for your application. This documentation will explain how to program each mode.

Appendix

In the Appendix

Appendix A - SmartSensor HD Specifications

Parameters	Specifications
Operating Frequency:	24.125 GHz (K-band)
Detection Zones:	Up to 10 traffic lanes simultaneously
Detection Range:	6 to 250 ft (1.8 m to 76.2 m)
Measured Quantities:	Speed, occupancy, volume, presence, classification
Communications:	RS-232 and RS-485 connection
Power:	8.0 watts @ 9-28 VDC
Weight:	Less than 5 lbs. (2.27 kg)
Physical Dimensions:	13.2 in x 10.6 in x 3.3 in (33.5 cm x 27 cm x 8.3 cm)
Zone Resolution:	1 foot (0.3 m)
Ambient Operating Temp:	-40 C to 70 C
Humidity:	Up to 95% RH
Shock:	10 g 10ms half sine wave
Transmitted Power at 3m:	<100dBuV/m @ 24.125Ghz

Table A.1 – SmartSensor HD Specifications

Appendix B - Cable Connector Definitions

The SmartSensor cable is composed of three groups of wires. Each group contains color-coded wires accompanied by a drain wire and surrounded by a shield. Table A.2 below details the pin-out of the cable and the appropriate connection inside the cabinet for each wire:

Wire	Description
Red	+DC
Black	-DC
Drain	GND
Blue	-485
White	+485
Drain	485 GND
Yellow	232 (TD)
Violet	232 (RD)
Drain	GND
Orange	232 (RTS)
Brown	232 (CTS)
Gray	232 GND

Table A.2 – Cabinet Connections

See Figure A.1 for a diagram of the SmartSensor cable's 25-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.
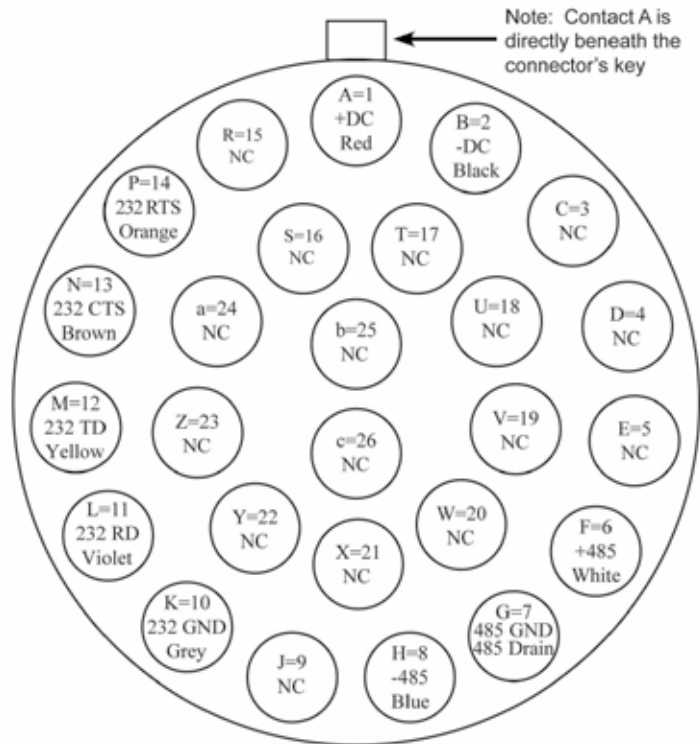
Figure A.1 – SmartSensor HD Plug Connector Socket Assignment as seen from the solder cup side of the connector

Appendix C - Old Cable Connector Definitions

The previously used SmartSensor cable is composed of six twisted pairs of wire. Each pair is comprised of a black and a red wire, accompanied by a drain wire and surrounded by a shield. A numeric label (1 through 6) identifies each pair of black and red wires. Table A.3 below details the pin out of the cable and the appropriate connection inside the cabinet for each wire:

Wire	Description
Black 1	-DC
Red 1	+DC
Drain of Pair 1	GND
Black 2	-DC
Red 2	+DC
Drain of Pair 2	GND
Black 3	-485

Red 3	+485
Drain of Pair 3	485 GND
Red 4	232 (TD) output from sensor
Black 4	232 (RD) input to sensor
Drain of Pair 4	232 GND
Pair 5	Reserved for future use
Red 6	CTS flow for 232
Black 6	RTS flow for 232

Table A.3 – Cabinet Connections

The Click! 200 has 12 screw terminal connections on both the top and the bottom (see Figure A.2). The screw terminals on the top of the module are surge protected:
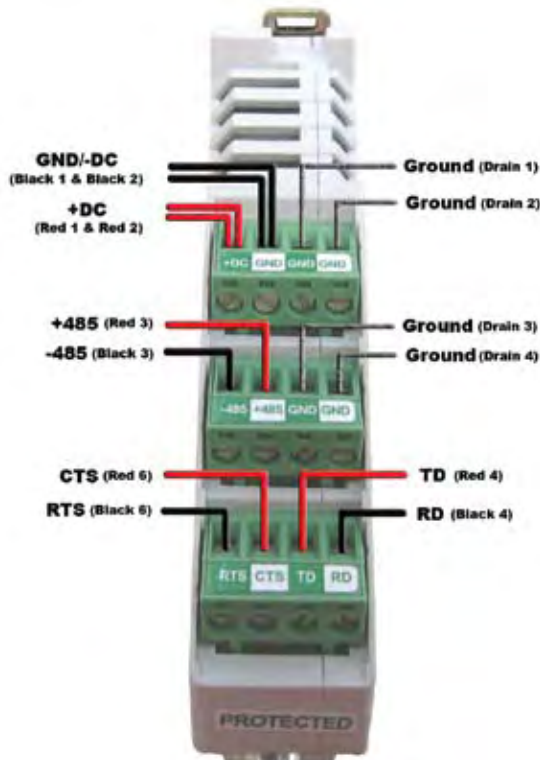

Figure A.2 – Click! 200 Wiring (Old)

The back four terminals consist of one +DC power, -DC and two surge ground connections; the middle four terminals are for RS-485 communication and consist of a +485 connection, a -485 connection and two connections for ground. One of the ground connections is used as ground for RS-485 and the other for RS-232 communication; the front four terminals are for RS-232 communication and consist of TD, RD, CTS and RTS.

See Figure A.3 for a diagram of the previously used SmartSensor cable's 25-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.3 – Old SmartSensor Plug Connector Socket Assignment as seen from the solder cup side of the connector

Appendix D - Cable Lengths

The following recommendations allow the user to provide reliable power to the SmartSensor. The SmartSensor cable's red and black wires provide a 20 AWG wire pair. The other pairs on the SmartSensor cable are 22 AWG and are normally used for communication (see Table A.4).

Cable Gauge	24 Volts	12 Volts
20 AWG (SS Cable)	600 ft	110 ft
Additional 22 AWG	Add 400 ft	Add 75 ft
22 AWG (Old SS Cable)	400 ft	75 ft
Additional 22 AWG	Add 400 ft	Add 75 ft
14 AWG	2500 ft	450 ft

12 AWG	3900 ft	700 ft
10 AWG	6000 ft	1050 ft
8 AWG	9900 ft	1750 ft
6 AWG	14,000 ft	2500 ft

Table A.4 – Maximum Cable Length for Power (ft)

If the cable length is longer than 600 feet when operating at 24 V, 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 feet or greater you cannot reliably use RS-232 communications. To add 400 feet and achieve a maximum cable length of 1000 feet, 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 feet, 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 maximum cable length or greater at 12 and 24 V are listed in Table A.4.

To achieve reliable wired communications, the selected baud rate must be compatible with the length of the cable run. Table A.5 below shows the cable length recommendations for wired communications:

Baud Rate	RS-232	RS-485
115.2	40 ft	300 ft
57.6	60 ft	600 ft
38.4	100 ft	800 ft
19.2	140 ft	1000 ft
9.6	200 ft	2000 ft

Table A.5 – Maximum Cable Length for Wired Communications (ft)

To provide two independent communication channels with a homerun cable length over 200 ft, 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 A.6).

Length (ft)	Cable	Comm. Channel 1	Comm. Channel 2
0-200	SmartSensor Cable	Native RS-485	Native RS-232
200-1000	SmartSensor Cable	Native RS-485	Click! conversion of RS-232 to RS-485
1000-1400	SmartSensor Cable	Native RS-485	NA
1400-2000	Alternate power and communications cable	Native RS-485	Click! conversion of RS-485 to RS-232

Table A.6 – Cable Length Options

Appendix E - Direct Serial Connections

For most applications, the service end of the SmartSensor 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 SmartSensor 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 A.4 illustrates both of these cases.
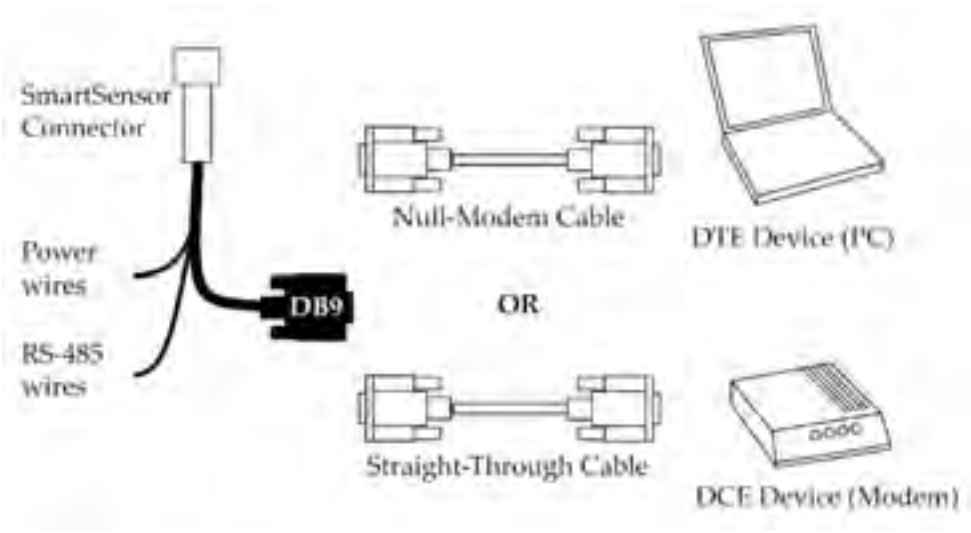
Figure A.4 – Direct Serial Connections

Note

If you do not have the right type of 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 SmartSensor 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.