



SmartSensor 125

Installation Guide

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Product Notifications

FCC Part 15 Compliance



This equipment complies with Part 15 of the Federal Communications Commission (FCC) rules. Any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his or her own expense.

Risk of Electrical Shock



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.

Technical Service



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.

Installation Safety Precaution



Caution should be used 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.

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Symbol Legend



The lightning bolt within an equilateral triangle symbol is intended to alert the user to the risk of electric shock.



The exclamation point within an equilateral triangle is intended to alert the user to the presence of important installation, operating, and maintenance instructions.

SmartSensor HD Installation Guide

Introduction

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, 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 provides 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.

Unpacking the Sensor

A typical sensor package contains the following items:

- SmartSensor HD SS125 detector with installed back-plate
- Sensor mount bracket and nuts
- Sensor cable
- SmartSensor HD Installation Guide
- CD and/or diskette with software

If any of these items are missing, note the serial number located on the side of the sensor and contact Wavetronix support. Additional products may be purchased through your distributor; software and firmware may be obtained through Wavetronix Sales.

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 1 Amp AC to DC converter
- Click! 202 2 Amp AC to DC converter
- Click! 300 RS-232 to RS-485 adapter
- Click! 301 Ethernet to Serial adapter
- Click! 400 900 MHz Spread Spectrum Radio
- Click! 401 Serial to 802.11 Converter
- Click! 403 Bluetooth to Serial Converter
- Click! 700 Serial to Fiber Optic Converter

Installing the SmartSensor HD

The SmartSensor HD installation process involves the following six steps:

1. Applying silicon dielectric compound
2. Attaching the SmartSensor HD to the mounting bracket
3. Mounting the SmartSensor HD to a pole
4. Connecting the SmartSensor cable
5. Connecting the SmartSensor HD to Power and Communication Devices
6. Configuring the SmartSensor HD using SmartSensor Manager HD

Each step is described in detail in this section.

1. Applying Silicon Dielectric Compound

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

1. Take the tube of Silicon Dielectric Compound and tear off the tab.
2. Squeeze about 25% of the silicon into the connector at the base of the SmartSensor HD (see Figure 1). Be sure to wipe off any excess compound.



Figure 1 – Applying Silicon Dielectric Compound

2. Attaching SmartSensor HD to the Mounting Bracket

Align the threaded holes on the bracket mount with the bolts on the back of the SmartSensor HD. Using the fasteners, attach the bracket mount to the SmartSensor HD and tighten until firm (see Figure 2).

NOTE: Do NOT over-tighten the fasteners.

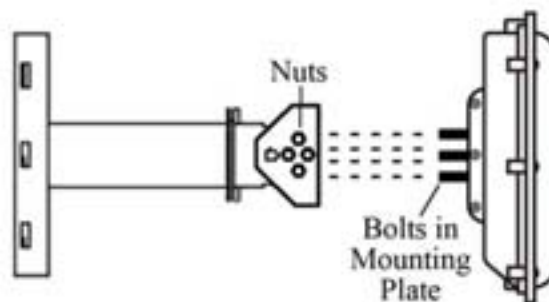


Figure 2 - Sensor Attachment

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3. Mounting SmartSensor HD to a Pole

Use the following steps to continue the SmartSensor HD installation:

1. Firmly secure the SmartSensor HD to a pole or fixed location according to Table 1 below (see Figure 3 for mounting illustration).

Mounting Height Guidelines

Offset from first detection lane	Recommended Mounting Height	Minimum Mounting Height	Maximum Mounting Height
6	16	9	19
7	16	9	19
8	16	9	20
9	16	9	21
10	16	9	22
11	16	9	23
12	17	10	24
13	17	11	25
14	18	11	26
15	20	12	26
16	20	12	27
17	21	13	28
18	22	14	29
19	22	14	30
20	23	15	30
21	23	15	31
22	23	16	31
23	25	16	32
24	25	16	33
25	26	17	33
26	26	17	34
27	27	18	35
28	27	18	35
29	27	18	36
30	29	19	37
31	29	19	37
32	29	19	38
33	30	19	39
34	30	19	39
35	30	20	40
36	30	20	41
37	30	20	41
38	31	21	42
39	31	21	43

Recommended Offset

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40	33	22	43
41	33	22	44
42	34	22	44
43	34	22	45
44	35	23	46
45	35	23	46
46	36	23	47
47	36	24	48
48	38	24	48
49	38	24	49
50' to 180'	39	25	Height must be less than the offset (i.e. if offset = 80' the maximum height is also 80')

Table 1 – Mounting Height Guidelines

2. Firmly secure the mounting bracket on a vertical or horizontal pole using the ½ inch band straps included in the shipment. The bracket is adjustable and has 70 degrees of tilt adjustability.
3. Aim the front of the sensor at the center of the detection area.
4. Adjust the side-to-side angle as close to perpendicular to the flow of traffic as possible (see Figure 4). Later in the installation process, this will be fine-tuned for accurate speeds.
5. Connect the power/communication cable to the SmartSensor HD. Secure the loose cable to the pole with minimum slack to avoid undue movement from wind.

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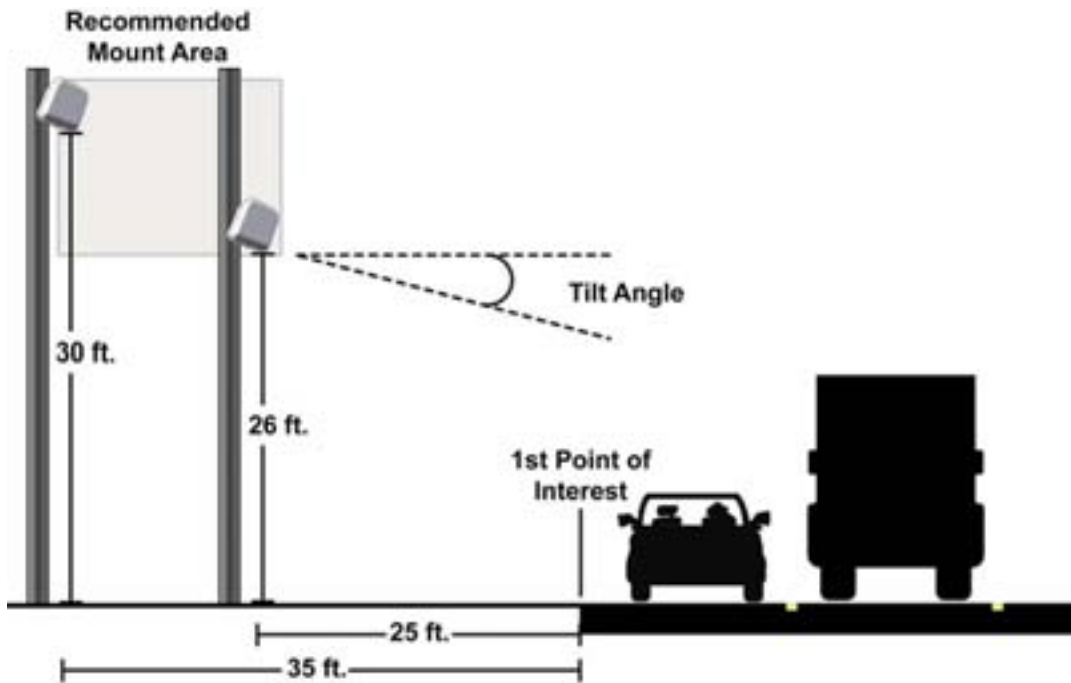


Figure 3 – Recommended Mounting Height

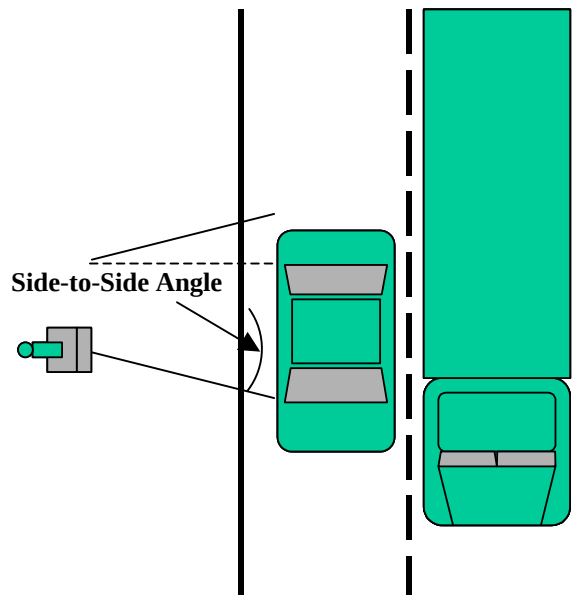


Figure 4 – Side-to-side positioning

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4. 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 (see Figure 5). The cable should be strapped to the pole or run through conduit to reduce cable strain.



Figure 5 – Sensor Connector

The service end of the cable has a +DC and GND for a power supply of 12 to 24 VDC (see Figure 6). 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 6 – Service End

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5. Connecting the SmartSensor HD to Power and Communication Devices

To simplify the connection process, Wavetronix has developed the Click!™ product family which offers an AC to DC power supply (Click! 201/202); surge protection for power and communications (Click! 200/204); a series of modems (Click! 300 series); wireless communications (Click! 400 series); and a series of contact closure modules (Click! 100, 172 and 174).

If you are connecting the SmartSensor HD to any of the Click! devices, please refer to the Quick-Start Guide for each product for instructions; if you are connecting SmartSensor HD to other manufacturer devices, please refer to the user manuals for those products.

Connecting SmartSensor HD to Power and Surge Protection

It is strongly recommended that the SmartSensor HD be connected to a surge-protected device. The Wavetronix Click! 200 and equivalent devices are designed to prevent electrical surges from damaging the sensor.

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

To include surge protection in your installation, please review these important surge design recommendations:

1. To surge protect a SmartSensor HD, a Click! 200 (or equivalent device) must be mounted on the same pole as the SmartSensor HD, and another Click! 200 must be mounted in the cabinet. The SmartSensor cable should be kept as short as possible and must terminate in the unprotected side of the Click! 200.
2. If a long distance cable run (i.e. anything greater than 40 feet) is unavoidable, then a single unspliced, shielded cable must be run between two Click! 200 modules and connected to the unprotected side of each device. The shielded cable must contain three shielded pairs and three conductors equivalent to the Alpha Wire 6010C 3PR 22 AWG shielded cable (<http://www.alphawire.com/pages/228.cfm>).
3. ALL Click! 200 devices must 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 seven foot grounding rod.

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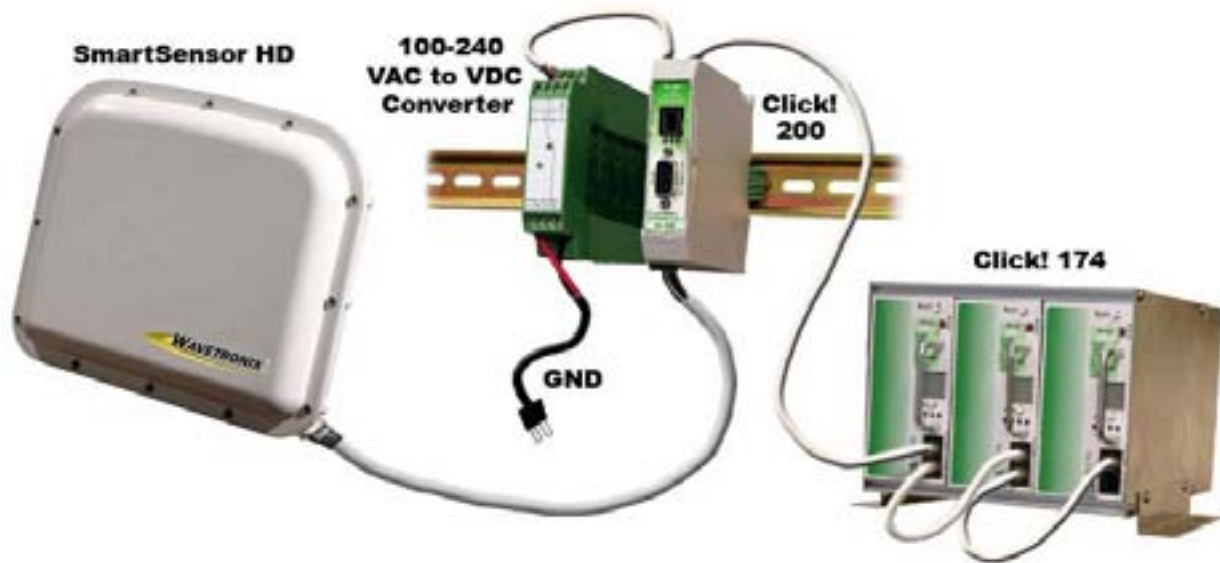


Figure 7 – Short cable run

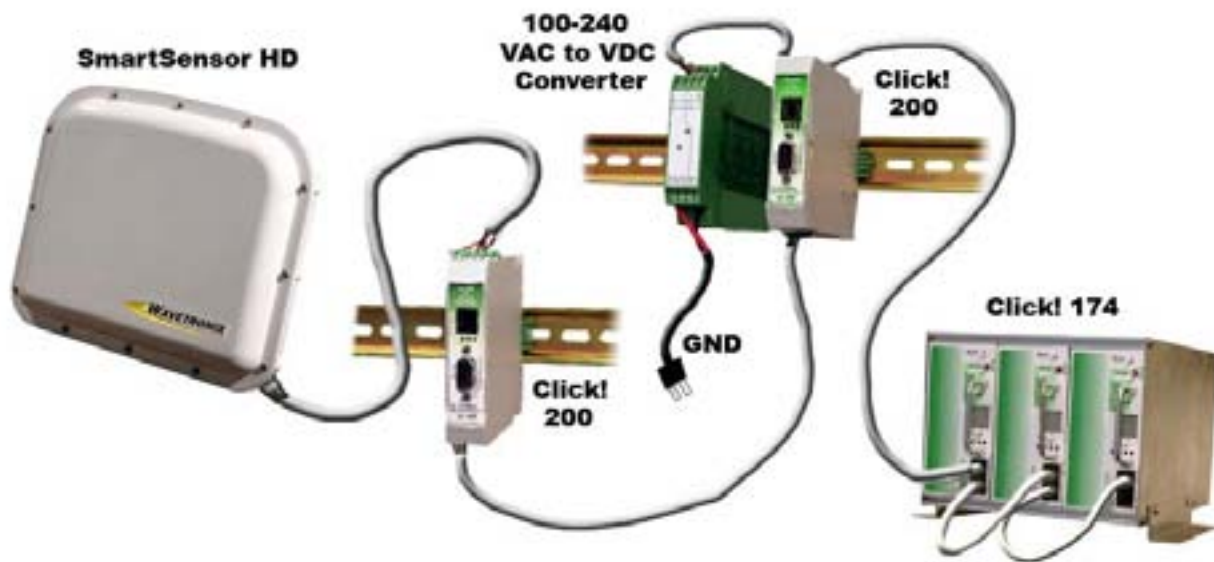


Figure 8 – Long cable run

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Below is a diagram of the SmartSensor HD cable's 25-pin socket assignment (see Figure 9). The codes listed in the diagram represent the individual solder cups (see Table 2 for pin descriptions).

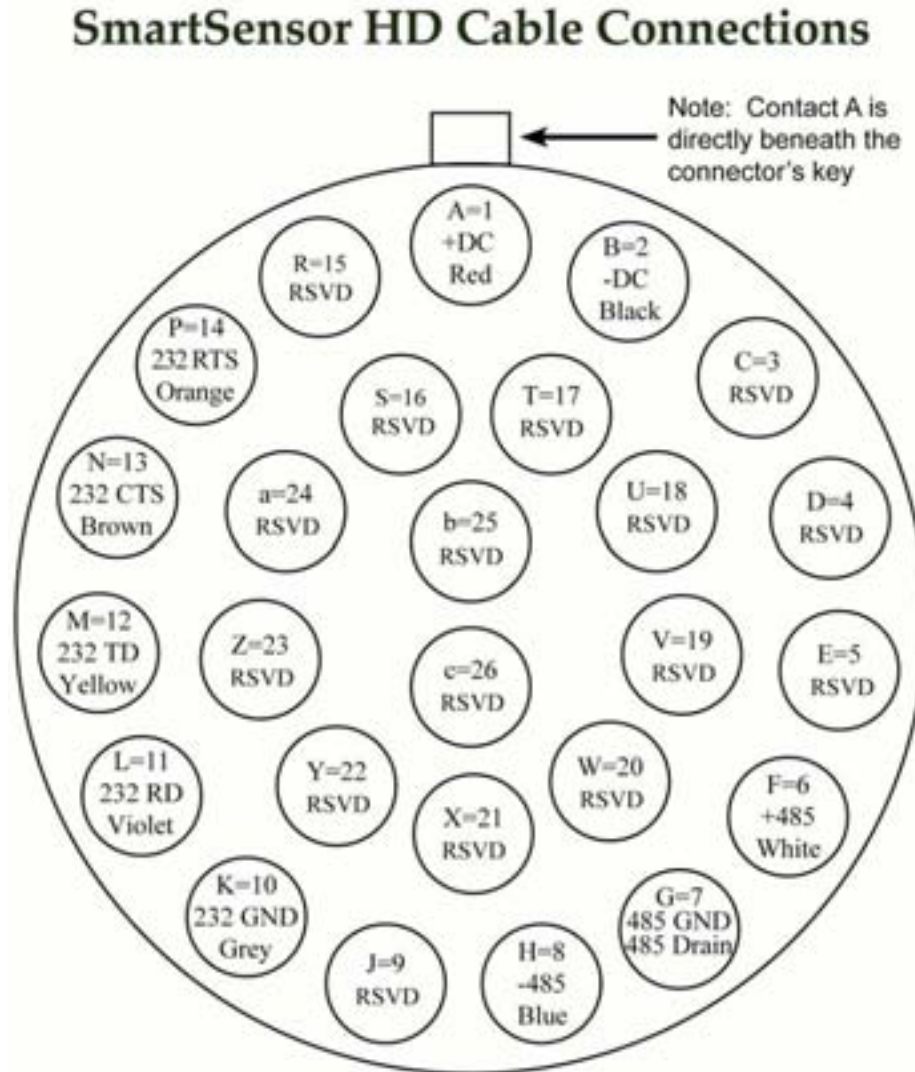


Figure 9 – SmartSensor HD SS125 Plug Connector Socket Assignment

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To connect a SmartSensor HD to a Click! 200 over a short cable run, wire the SmartSensor cable to the unprotected side of the Click! 200 according to Figure 7 and Table 2:

SmartSensor Cable	Click! 200 Protected Connection	Description
Black	GND Next to +DC	-DC (0 V, DC GND)
Red	+DC	+DC (12-24VDC Input)
Power Drain	GND	Power Shield
RS-232 Drain	GND	RS-232 Shield
Blue	-485	-485
White	+485	+485
RS-485 Drain	GND	RS-485 Shield & Signal GND
Grey	GND	RS-232 GND
Yellow	TD	TD (RS-232 Output from sensor)
Violet	RD	RD (RS-232 Input to sensor)
Brown	CTS	CTS (RS-232 Handshaking input to sensor)
Orange	RTS	RTS (RS-232 Handshaking output from sensor)

Table 2 – SmartSensor Cable Connections for a short cable run

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

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Connecting the SmartSensor Cable

The Click! 200 has 12 screw terminal connections on both the protected and unprotected sides of the module.

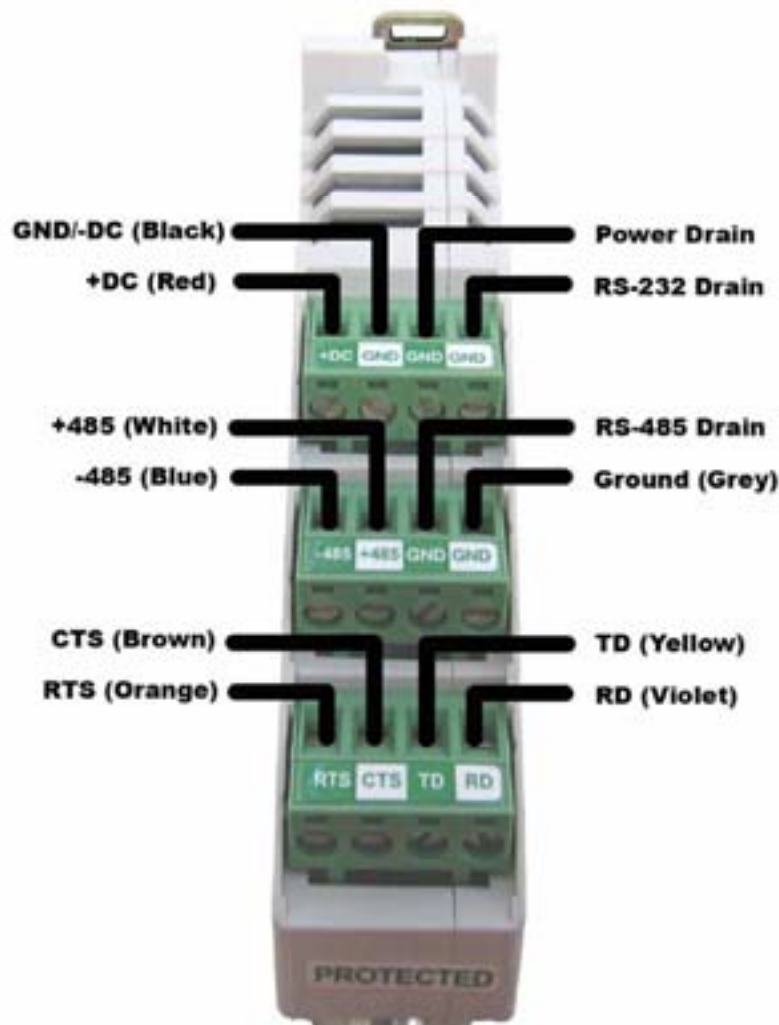


Figure 10 – Surge Protected Terminal Connections

Figure 10 above shows the protected side of the Click! 200. The unprotected side of the Click! 200 contains the same screw terminal connections, but in the opposite order.

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6. Configuring SmartSensor HD Using SmartSensor Manager HD™

After the SmartSensor HD is installed, it must be configured to the roadway using SmartSensor Manager HD (SSM HD). 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 and is shipped with each sensor.

NOTE: Before installing SmartSensor Manager HD, you may need to install the .NET framework that is included in the setup CD. SmartSensor Manager HD has only been tested using the **Dell X51V** and **HP hX2495** Pocket PC's.

Installing the SSM HD Software

To install SmartSensor Manager HD, place the CD in the CDR drive and double click the icon labeled "Setup.exe" listed in the contents of the CD. This executes a setup program that will copy all the necessary files to the hard drive and create icons for the Start menu and desktop on the PC or laptop. If a Pocket PC is connected, the software will guide you through the installation process.

Connecting Your Computer to SmartSensor HD

To confirm the configuration of lanes (detection zones) in SmartSensor Manager HD, connect to the sensor through a serial, modem or Internet connection.

Serial Connection

The following are two serial options available for connecting to the SmartSensor HD:

1. Connect RS-232 communication using a 9-pin straight-through serial cable connected to the standard RS-232 serial port on your PC (see Figure 11).



Figure 11 – Straight-through cable connection

2. Connect RS-485 communication using a Universal Serial Bus (USB) cable connected from the USB port on your PC to the USB port on the front of the Click! 305 (see Figure 12).

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Figure 12 – USB cable connection

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.

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. **CDMA Modem** – Code Division Multiple Access (CDMA) is a wireless Internet service available in most metropolitan areas in the United States and coverage continues to expand. The SmartSensor HD can be equipped with an optional external CDMA modem and assigned an Internet address.
2. **Ethernet to Serial Converter** – The SmartSensor HD can be connected to a local area network (LAN) by using an Ethernet to Serial adapter. As an option, the SmartSensor HD can be shipped with a Click! 301 Serial to Ethernet adapter that is Internet addressable, which makes it possible to connect to the sensor from anywhere the adapter's address is accessible.
3. **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 $+74^{\circ}\text{C}$ temperature range.

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Establishing a Connection to the SmartSensor HD Using SSM HD

Once your computer is physically connected to the SmartSensor HD by one of the methods described above, use SmartSensor Manager HD to visually configure and interact with it.

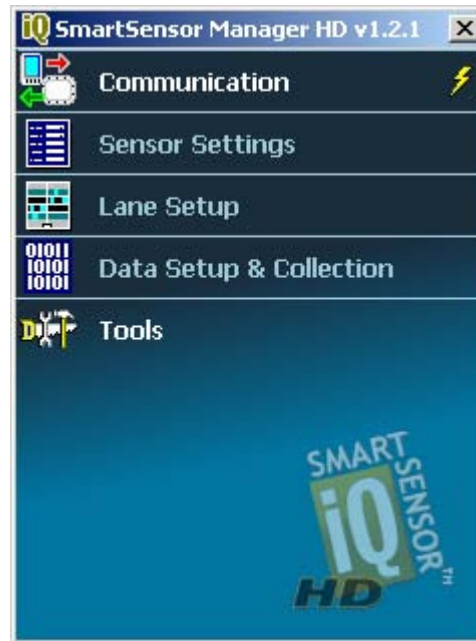


Figure 13 – SmartSensor Manager HD

To begin, either click on the icon that was placed on your desktop or click the icon found in the Start menu and the “SmartSensor Manager HD” homepage will appear (see Figure 13).

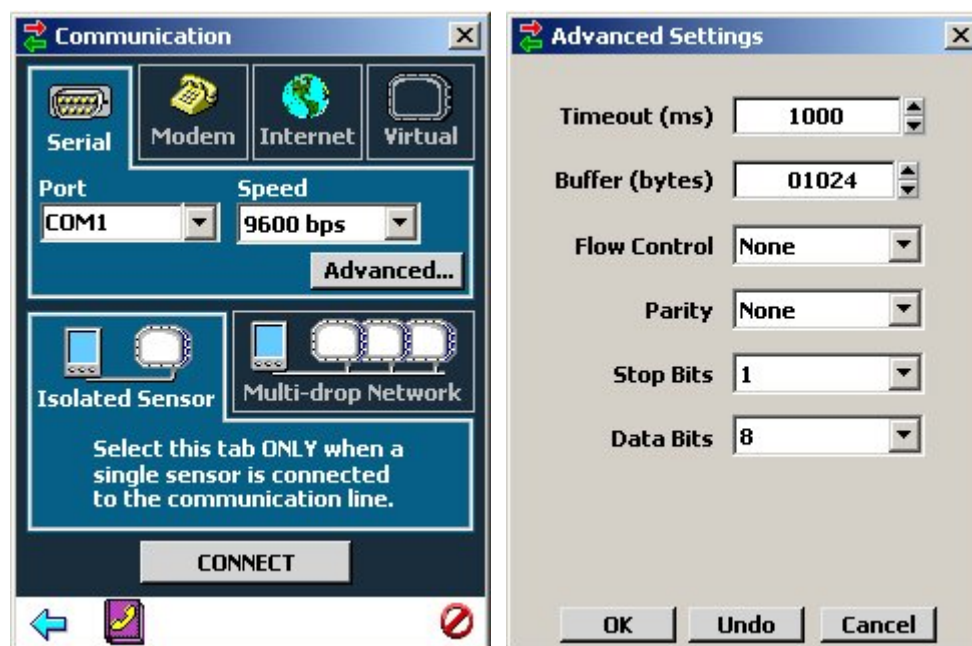


Figure 14 & 15 – Serial Connection and Advanced Settings

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Serial Connection

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

1. Click on **Communication** and the “Communication” window will appear (see Figure 14).
2. Select the **Serial** tab and the serial setting options will appear.
3. Set the “Port” and “Speed” to the desired settings. If you do not know the baud rate, set the baud to **auto-baud**.
4. Click the **Advanced...** button for additional settings (see Figure 15).
5. Click the **Connect** button.

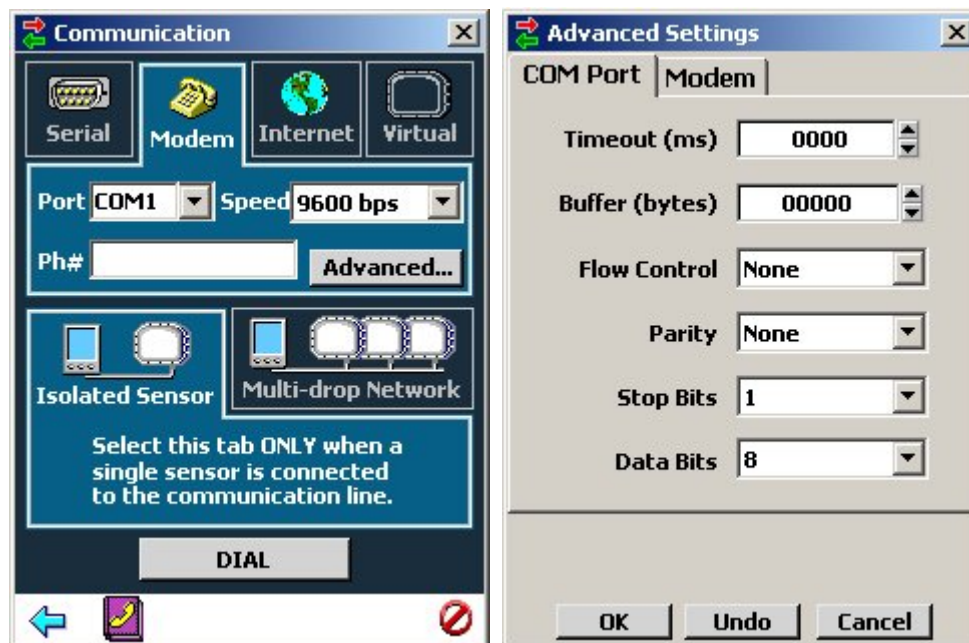


Figure 16 & 17 – Modem Connection and Advanced Settings

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 and the modem setting options will appear (see Figure 16).
3. Enter the phone number in the “Phone #” field.
4. Click the **Advanced...** button for additional modem settings (see Figure 17).
5. Click **Dial** to establish the connection.

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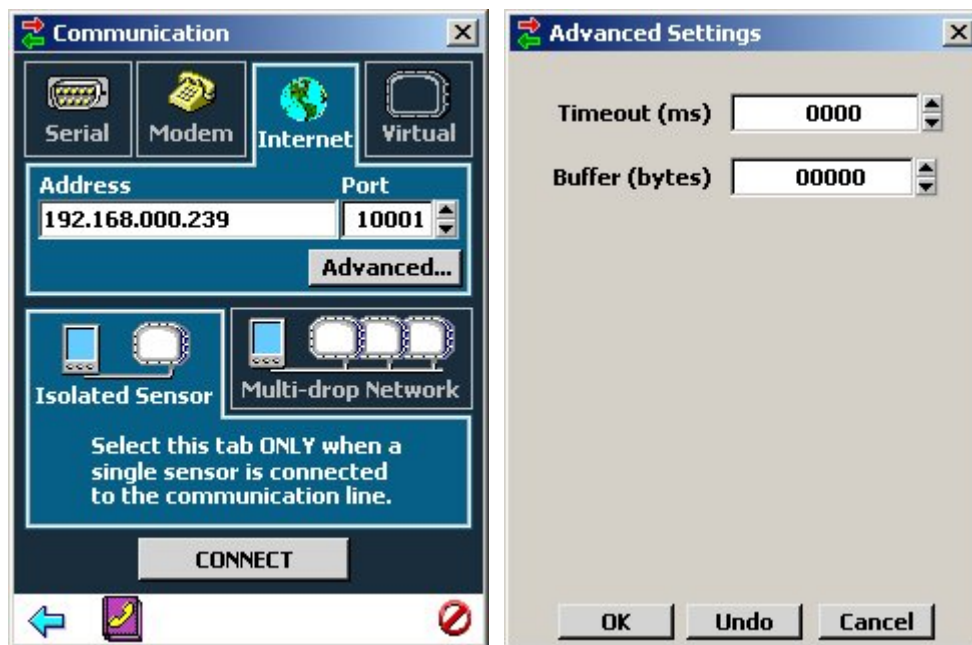


Figure 18 & 19 – Internet Connection and Advanced Settings

Internet Connection

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

1. Click on **Communication** and the “Communication” window will appear.
2. Click the **Internet** tab and the Internet setting options will appear (see Figure 18).
3. Enter the IP address 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 Ethernet to Serial adapter.
4. Enter the port number assigned to the CDMA modem or the Click! 301 Ethernet to Serial adapter 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 (see Figure 19).
6. Click the **Connect** button to connect to the sensor.

When a connection is made to the SmartSensor HD, the message “You are connected!” is displayed and **Disconnect** and **Continue** buttons will appear. Click **Continue** to view the current sensor configuration. Connection failure can occur for various reasons; if a failure occurs repeatedly, call Wavetronix Technical Support for assistance.

If you were unable to connect using SmartSensor Manager HD:

1. Make sure that all power and communication wiring is correct.
2. Check the Port settings (Baud rate, Port ID).
3. Check and make sure that the Sensor ID is correct.
4. Click the **Search** button to find a connection.

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Firmware Upload

After clicking the **Connect** button, the “Version Control” screen may appear asking you to install firmware upgrades (see Figure 20). The **Recheck** button will query the sensor to see if an upgrade is imperative to continue. Clicking the **Details** button will display the current sensor and software information. Click the **Install Upgrade** button to upgrade the software.

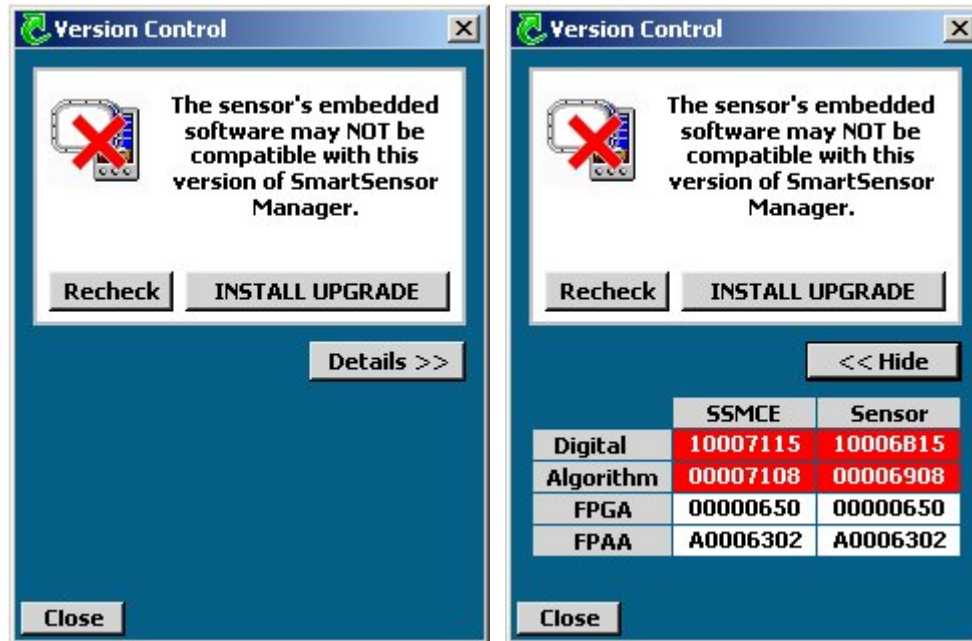


Figure 20 & 21 – Version Control and Firmware Upgrade details

NOTE: Do NOT upgrade if the Sensor number is bigger than the Firmware number (see Figure 21). The software will display a warning if the user tries to downgrade the sensor's firmware.

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Sensor Alignment

Once a connection is made, you can verify that the sensor is correctly aligned with the roadway. SmartSensor Manager HD has an aligning feature that gives visual and audio confirmation that the SmartSensor HD is aimed accurately.

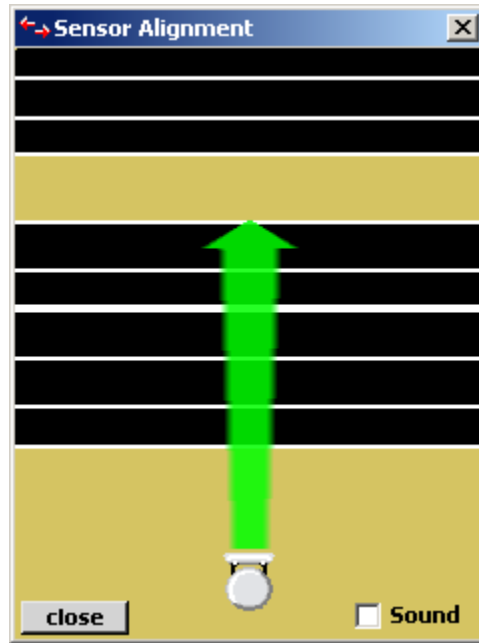


Figure 22 - Sensor Alignment

Follow the steps below to access the Sensor Alignment feature:

1. Visually align the SmartSensor HD parallel to the roadway.
2. Go to the “Lane Configuration” screen and make sure that most of the cars show valid speeds. If they do not show valid speeds, then you need to repeat step one until most of the cars show valid speeds. If too many cars don’t show valid speeds, then the sensor may be off alignment too far for the tool to work properly.
3. From the main screen, click the **Lane Setup** button.
4. Click the **Sensor Alignment** button.
5. Adjust the sensor according to the sensor displayed in the Sensor Alignment window (see Figure 22). A green arrow means the sensor is correctly positioned for optimal performance; a yellow arrow means the sensor is NOT correctly aligned with the roadway. For audio verification, check the **Sound** box.

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Automatic Configuration

Once a connection is made to the SmartSensor HD, all configuration options will become available (see Figure 23).

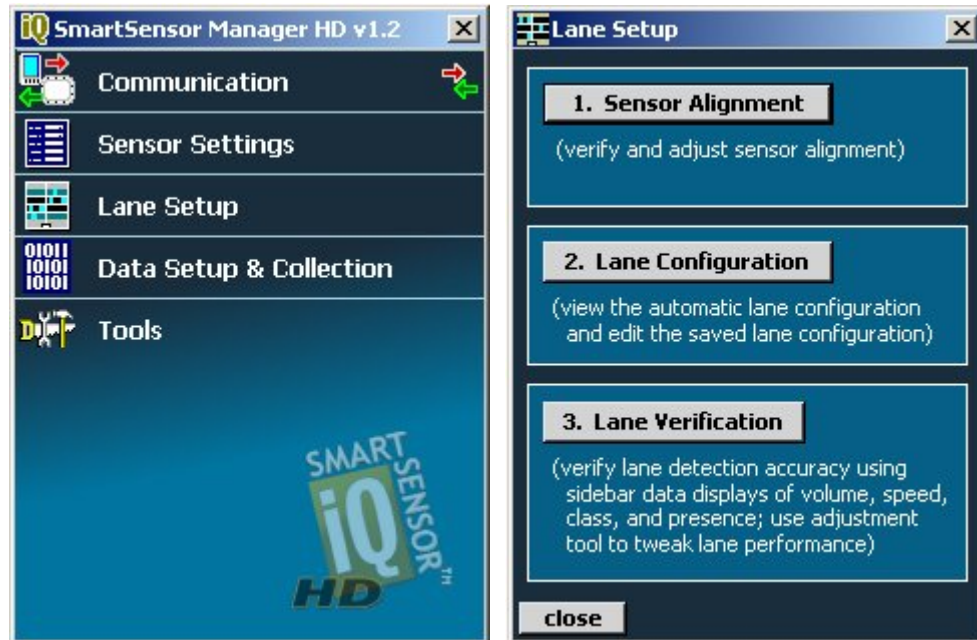


Figure 23 and 24 – Configuration Options and Lane Setup screen

Follow the steps below to automatically configure the SmartSensor HD:

1. Click on **Lane Setup** and the “Lane Setup” window will appear (see Figure 24).
2. Click the **Lane Configuration** button.
3. Once the “Lane Configuration” window appears, click the **Tools** icon  and select **Clear Edit Area** (see Figure 25 on the next page).
4. Click the **Tools** icon again and then click **Restart Auto Cfg.**

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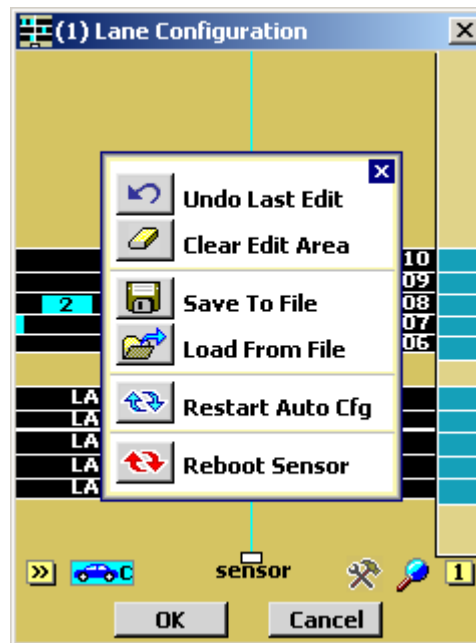


Figure 25 – Lane Configuration screen

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 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.

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

This completes the basic installation and automatic lane configuration process. The remainder of this document explains some of the additional features of the SmartSensor Manager HD software and how these features allow you to manually configure lanes, and monitor and record traffic data.

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Manual Configuration

If the sensor is unable to configure itself to your satisfaction, you can manually configure it.

Lane Configuration

The **Lane Configuration** button on the “Lane Setup” screen will take you to the “Lane Configuration” screen to manually configure the SmartSensor HD (see Figure 26).

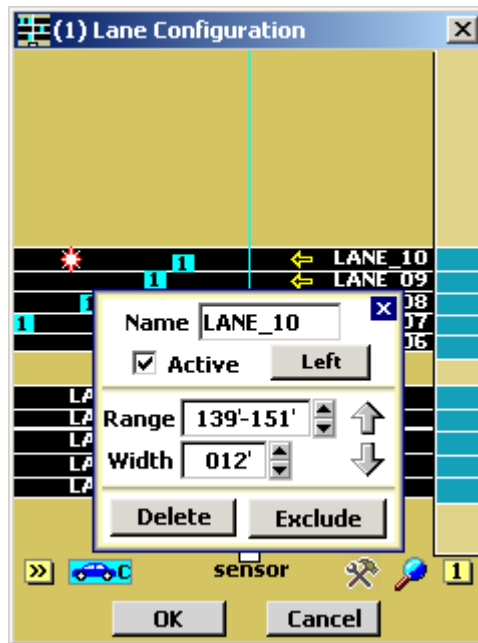


Figure 26 – Lane Configuration Options

The Lane Configuration screen allows the user to:

1. **Delete or exclude lanes** – To delete or exclude a lane, click anywhere inside a lane and click the **Delete** or **Exclude** buttons.
2. **Change lane names** – To change a lane name, click on the lane to be changed and type the desired name into the “Name” field.
3. **Change lane direction** – To change lane direction, click the **Left** button.
4. **Change lane activity** – To de-activate a lane, uncheck the “Active” box (only ten lanes can be active).
5. **Change the range and width** – To change the range and width of a lane, use the up and down toggle buttons.

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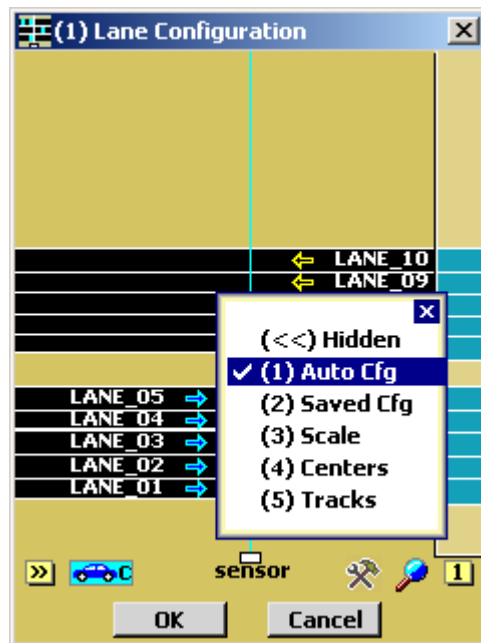


Figure 27 - Lane Configuration sidebars

The sidebars on either side of the “Lane Configuration” window have five different modes (see Figure 27). A list of modes can be seen by holding down the sidebar   buttons.

1. **Auto Cfg** – The “Auto Configuration” sidebar shows the lanes that were automatically configured by the sensor.
2. **Saved Cfg** – The “Saved Configuration” sidebar will show the lanes that are saved on the sensor.
3. **Scale** – The “Scale” sidebar shows the distance in feet from the SmartSensor HD to each lane.
4. **Centers** – The “Centers” sidebar shows the relative occurrence of events.
5. **Tracks** – The “Tracks” sidebar shows the vehicle paths for low-traffic lanes.

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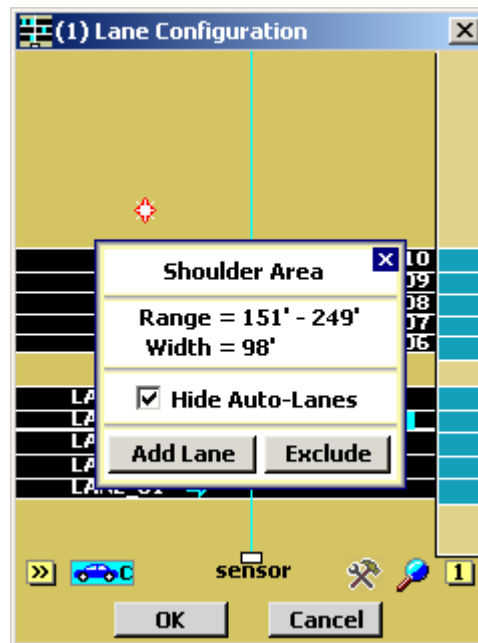


Figure 28 – Adding Lanes

To add a lane, click any area where a lane is desired and select **Add Lane** from the options in the pop-up box. An added lane can be deleted by first clicking anywhere inside the lane and then selecting **Delete Lane** from the options that appear (see Figure 28).

Lane Verification

The sidebars on either side of the “Lane Verification” window have seven different modes (see Figure 29). A list of modes can be seen by holding down one of the sidebar   buttons.

1. **Presence** – The “Presence” sidebar displays buttons to the side of each lane that will light up after each vehicle is detected.
2. **Volume** – The “Volume” sidebar displays the number of events in each lane.
3. **Speed** – The “Speed” sidebar shows the speed of each individual lane in their respective lanes.
- 4-7. **Class** – The “Class” sidebars show vehicle classification, which can be created using the “Class Definitions” feature located in the “Data Setup & Collection” window.

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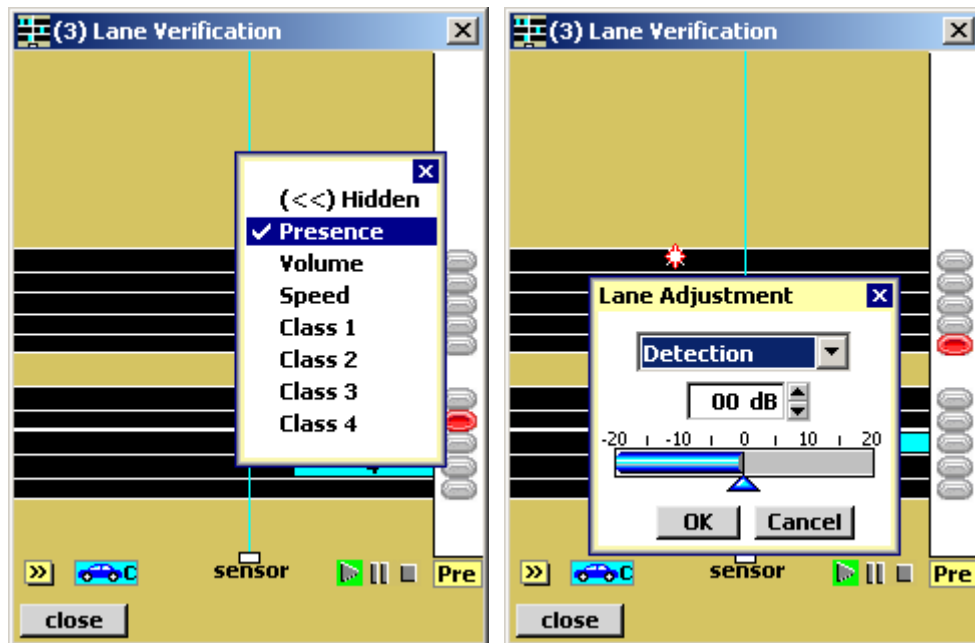


Figure 29 & 30 - Lane Verification sidebars and Lane Adjustment

Lanes can be adjusted by clicking anywhere inside a lane and using the Lane Adjustment tools (see Figure 30). The Lane Adjustment tools can be helpful when it is evident that some lanes are missing events. The drop-down list allows the user to change the thresholds for Detection, Speed, Length and Extension Time. To undo all lane adjustments, select the “Set Defaults” option in the drop-down list.

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Saving the Configuration

Click the **OK** button to save the configuration to the SmartSensor HD. Follow the steps below to save the configuration to a file:

1. Click on the **Tools**  icon on the bottom-right of the “Lane Configuration” screen.
2. Select **Save to File** (see Figure 31).

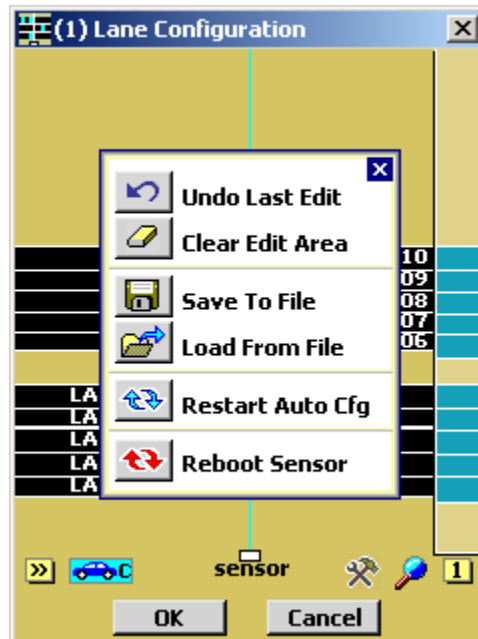


Figure 31 - Saving the Configuration

Undoing Manual Changes

To undo changes you have made to the configuration, click on the **Tools** menu 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 click **Clear Edit Area**.

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Appendix A - SmartSensor HD 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

Appendix B - Communications Connector Pin Outs

RS-232 Communication Port

The RS-232 communication port is configured in a 9-pin “D” male connector with the following pin out:

1. N/C
2. **232 RD (Violet)**
3. **232 TD (Yellow)**
4. N/C
5. **232 GND (Grey)**
6. N/C
7. **232 RTS (Orange)**
8. **232 CTS (Brown)**
9. N/C

RS-485 Communication Port

The RS-485 communication port is configured in a 25-pin “D” female connector with the following pin out:

- | | | |
|-----------------------|-------------------------|--------------------------|
| 1. N/C | 10. N/C | 19. N/C |
| 2. -485 (Blue) | 11. N/C | 20. N/C |
| 3. -485 (Blue) | 12. N/C | 21. N/C |
| 4. N/C | 13. N/C | 22. N/C |
| 5. N/C | 14. +485 (White) | 23. N/C |
| 6. N/C | 15. N/C | 24. N/C |
| 7. GND | 16. +485 (White) | 25. GND 485 Drain |
| 8. N/C | 17. N/C | |
| 9. N/C | 18. N/C | |

Appendix C - Old Cable Connector Information

The previously used SmartSensor cable is comprised of six twisted pairs of wire. Each pair consists 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. The following table details the pin out of the cable and the appropriate connection inside the cabinet for each wire (see Table 3):

SmartSensor Cable	Description	Cabinet Connection
Black 1	-DC	Negative terminal of 10-30 VDC power supply which should also be connected to Earth Ground
Red 1	+DC	Positive terminal of 10-30 VDC power supply
Drain of Pair 1	GND	Earth Ground
Black 2	-DC	Negative terminal of 10-30 VDC power supply which should also be connected to Earth Ground
Red 2	+DC	Positive terminal of 10-30 VDC power supply
Drain of Pair 2	GND	Earth Ground
Black 3	-485	Negative RS-485 of a 2-wire RS-485 bus (or pins 2 and 3 of DB25 connector to connect SeaLink 485 or USB to 485 connector)
Red 3	+485	Positive RS-485 of a 2-wire RS-485 bus or pins 14 and 16 of DB25 connector
Drain of Pair 3	485 GND	Earth Ground or pin 7 of DB25 connector
Red 4	232 (TD) output from sensor	Pin 3 of standard RS-232 DB9 connector
Black 4	232 (RD) input to sensor	Pin 2 of standard RS-232 DB9 connector if sensor connector is wired as a DTE device
Drain of Pair 4	232 GND	Earth Ground
Pair 5	Reserved for future use	Leave unconnected
Pair 6	CTS/RTS Flow for 232	Contact Wavetronix for connection information

Table 3 – Cabinet Connection

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The table below shows the individual wiring of both the new and old SmartSensor cables and how they correspond (see Table 4).

Color-Coded Cable Bundle	Color-Coded Cable Wires	Belden 9331 (Old Cable) Wires
Power	Red	Red 1, Red 2
	Black	Black 1, Black 2
	Drain	None
RS-485	White	Red 3
	Blue	Black 3
	Drain	Drain 3
RS-232	Yellow	Red 4
	Violet	Black 4
	Orange	Black 6
	Brown	Red 6
	Grey	Drain 4
	Drain	Drain 4
None	None	Red 5, Black 5, Drain 5, Drain 6

Table 4 – Belden 9331 (Old Cable) Conversions

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Appendix C-1 - Click! 200/204 Wiring

Use the illustration below if you are using the old SmartSensor cable (see Figure 32):

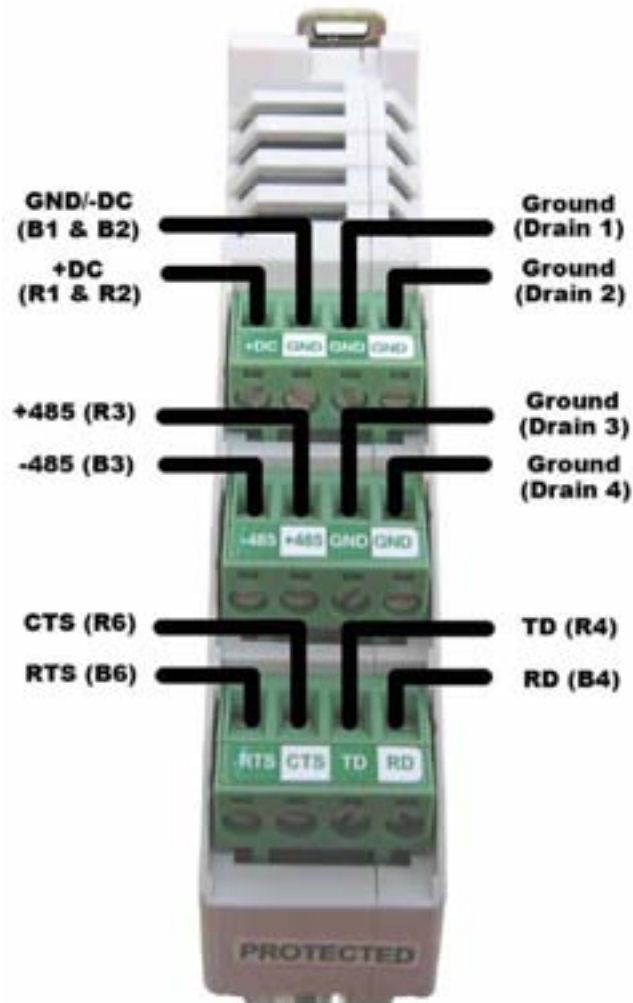


Figure 32 - Click! 200 Wiring (Old)

Figure 32 above shows the protected side of the Click! 200. The unprotected side of the Click! 200 contains the same screw terminal connections, but in the opposite order.

Appendix C-2 - SmartSensor Cable Pin Socket Assignments

Figure 33 below illustrates 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.

Legend

R = Red (e.g. R1 is 1- Red)
B = Black (e.g. B1 is 1- Black)
*** = Drain (e.g. *1 is 1- Drain)**

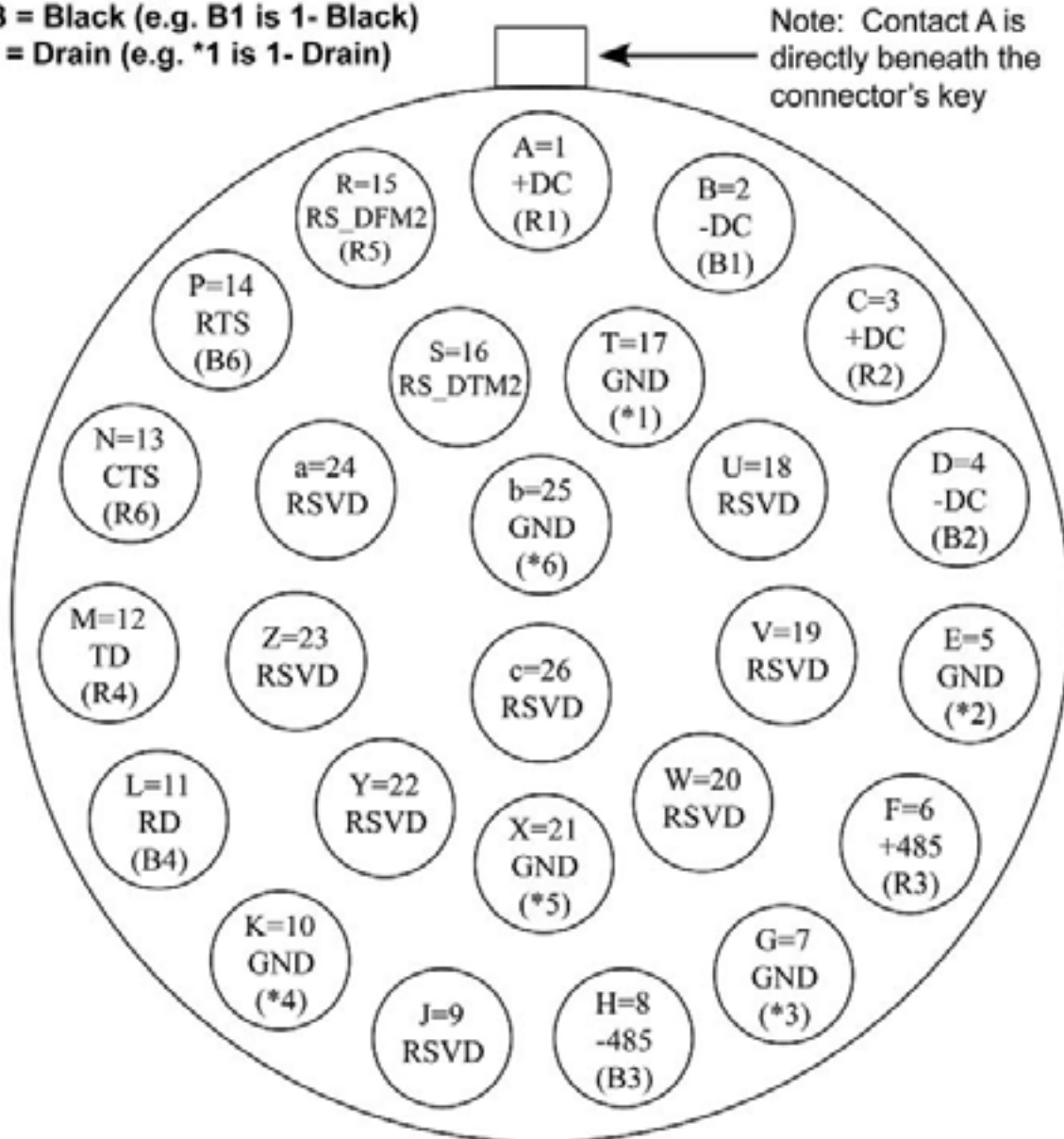


Figure 33 – Old SmartSensor SS105 Plug Connector Socket Assignment as seen from the solder cup side of the connector.

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Appendix C-3 - PC and Modem Connections

Communication between the SmartSensor and PC can be established using the RS-232 DTE specifications, along with the use of a null modem cable and the standard 9-pin “D” male connector. Please use the following guidelines for connecting the SmartSensor cable to the serial connection on a PC or modem when not using a Click! 200.

NOTE: The RS-232 pin outs remain the same on the SmartSensor cable regardless of connecting to a PC or a modem. If connecting to a PC, a null modem cable is required (see Figure 34). If connecting to a modem or other DCE device, then a straight-through serial cable is used (see Figure 35).

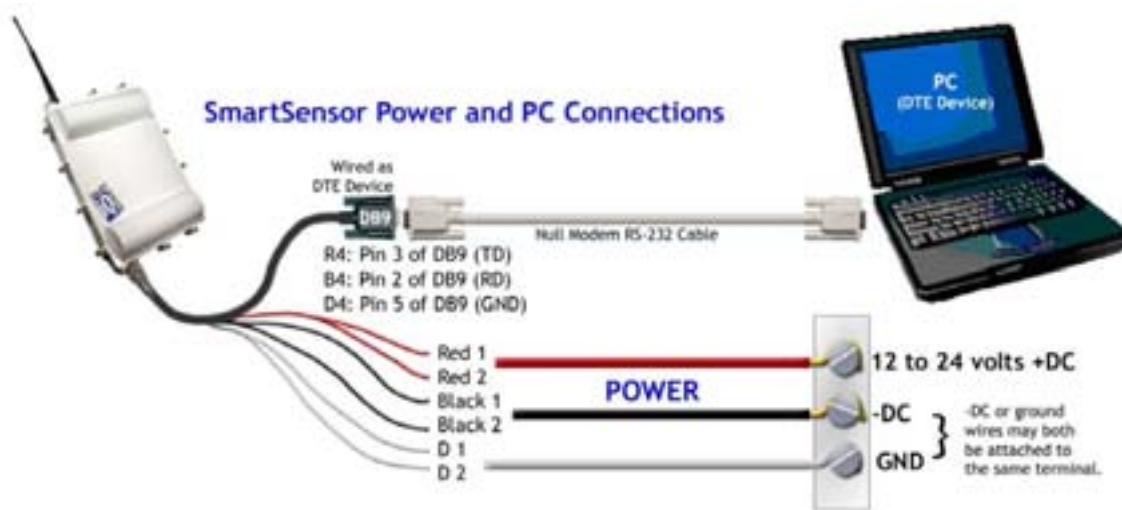


Figure 34 – Connecting a PC to the SmartSensor HD

SmartSensor RS-232 Connections	
SMARTSENSOR CABLE	DB9 SERIAL CONNECTOR
Red 4 (OUT FROM SENSOR)	Pin 3 (TD)
Black 4 (IN TO SENSOR)	Pin 2 (RD)
Drain 4	Pin 5

Table 5 – RS-232 Connections (Old Cable)

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Figure 35 - Connecting a Modem to the SmartSensor

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.

	Cable		Power	
	Gauge	Pairs	24 V	12 V
SmartSensor Cable	20 AWG	1-Pair	600 ft	110 ft
	Additional 22 AWG	Each Pair	Add 400 ft	Add 75 ft
Old SmartSensor Cable	22 AWG	1st Pair	400 ft	75 ft
	Additional 22 AWG	Each Pair	Add 400 ft	Add 75 ft
Alternate Power Cables	14 AWG	1-Pair	2500 ft	450 ft
	12 AWG	1-Pair	3900 ft	700 ft
	10 AWG	1-Pair	6000 ft	1050 ft
	8 AWG	1-Pair	9900 ft	1750 ft
	6 AWG	1-Pair	14,000 ft	2500 ft

Table 6 - 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.

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 8 (see the SmartSensor bid specification document for more information about cable requirements).

To achieve reliable wired communications, the selected baud rate must be compatible with the length of the cable run. The table below shows the cable length recommendations for wired communications (see Table 7):

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

Table 7 - Maximum Cable Length for Wired Communications (ft)

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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.