SmartSensor 105

Installation Guide

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Contents

Typographical Conventions

Before you start using this guide, it is important to understand the terms and typographical conventions used in the documentation.

Bold Text Bolded text represents items you must select, such as menu options, command buttons, or items in a list.

Product Notifications

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.

FCC Part 15 Compliance

This device complies with Part 15 of the Federal Communications Commission (FCC) rules which states that operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesirable operation. FCC compliance statements for applicable optional modules are to be found in the module specifications. Unauthorized changes or modifications not expressly approved by the party responsible for compliance with the FCC rules could void the user's authority to operate this equipment.

NOTE: Do not shorten supplied cable less than manufacturer's recommended length. Sensor cable must be at least 2 m long to maintain FCC compliance.

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. Wavetronix is not liable for any bodily harm or damage caused if service is attempted or if the back cover of the SmartSensor unit is opened. 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.

Introduction

The Wavetronix SmartSensor utilizes patented Digital Wave Radar™ technology to detect lane occupancy, traffic volume and average speed in up to eight lanes of traffic simultaneously. Classified as Frequency Modulated Continuous Wave (FMCW) radar, SmartSensor collects data using a 10.525 GHz (X-band) operating radio frequency.

The installation and configuration process is quick and easy. Once installed, SmartSensor configures automatically, requires little or no on-site maintenance and may be remotely reconfigured. This installation guide provides the step-by-step process for installing and configuring SmartSensor, including mounting and alignment guidelines and instructions for both automatic and manual sensor configurations. 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:

- 10.525 GHz SmartSensor Radar Traffic Sensor
- SmartSensor Mounting Kit
- Installation Guide
- SmartSensor Manager Software

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):

- SmartSensor Cable with Connector
- 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-802.11b Converter Module

Installing the SmartSensor

Installing the SmartSensor involves seven simple steps:

1. Attaching the mounting bracket to the pole;
2. Applying silicon dielectric compound;
3. Attaching the SmartSensor to the mounting bracket;
4. Aligning the SmartSensor;
5. Connecting SmartSensor cable to the SmartSensor;
6. Connecting SmartSensor to Power and Communication Devices;
7. Configuring the SmartSensor using SmartSensor Manager™.

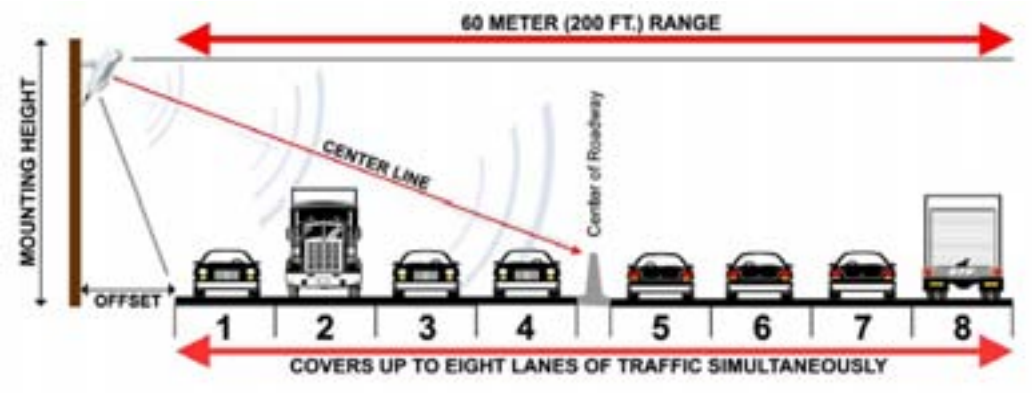

Figure 1 – Detection range of a properly mounted SmartSensor

1. Attaching the Mounting Bracket to the Pole

1. Measure the offset from the first detection lane to the pole as demonstrated in Figure 1 above.
2. Look up the recommended mounting height from Table 1 on the following page.

   NOTE: Depending on the site and type of traffic the sensor may tend to over- or undercount. If the sensor is over-counting, reduce the height of the sensor by 3 feet and reconfigure the sensor. If the sensor is under-counting, increase the height of the sensor by 3 feet and reconfigure. Normally, reducing the height of the sensor improves performance.
3. Strap the mounting bracket to the pole at the specified height using stainless steel straps.

SS105 Mounting Height Guidelines

Offset from 1st Detection Lane	Recommended Mounting Height	Minimum Mounting Height	Maximum Mounting Height
10	12	9	15
11	12	9	16
12	13	10	16
13	13	11	17
14	14	11	17
15	15	12	18
16	15	12	18
17	16	13	18
18	17	14	19
19	17	14	19
20	18	15	20
21	18	15	21
22	18	16	22
23	19	16	23
24	19	16	24
25	20	17	25
26	20	17	26
27	21	18	27
28	21	18	28
29	21	18	29
30	22	19	30
31	22	19	31
32	22	19	32
33	23	19	33
34	23	19	34
35	23	20	35
36	23	20	36
37	23	20	37
38	24	21	38
39	24	21	39
40	25	22	40
41	25	22	41
42	26	22	42
43	26	22	43
44	27	23	44
45	27	23	45
46	28	23	46
47	28	24	47
48	29	24	48
49	29	24	49
50 to 180	30	25	Must be < Offset

Recommended Offset

Table 1 – Mounting Height Guidelines

2. Applying 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 as shown in Figure 2. Be sure to wipe off any excess compound.

Figure 2 – Applying Silicon Dielectric Compound

3. Attaching the SmartSensor to the Mounting Bracket

1. Align the bolts on the back of the SmartSensor with the holes in the mounting bracket. The large 25-pin connector on the SmartSensor should be pointing towards the ground.
2. Place the lock washers onto the bolts after the bolts are in the mounting bracket holes.
3. Thread on the nuts and tighten.

4. Aligning the SmartSensor

Figure 3 – Aiming the SmartSensor

1. Aim the front of the sensor at the center of the detection area as shown in Figure 3. You may also refer to Figure 1 as an illustration of where to aim the sensor.

2. Adjust the side-to-side angle to within approximately ±2° of perpendicular to the flow of traffic.
3. Tighten mounting bracket bolts.

5. Connecting the SmartSensor Cable to SmartSensor

Figure 4 – Attached Cable

1. Attach the cable connector to the 25-pin connector at the base of the SmartSensor as shown in Figure 4. The SmartSensor connector is keyed to ensure proper connection; simply twist the connector clockwise until you hear it click into place.
2. Strap the cable to the pole, or run it through conduit to prevent cable strain.

6. Connecting SmartSensor to Power and Communication Devices

A typical sensor installation requires a pole-mount box containing surge protection and connections for power and communications. SmartSensor is compatible with all standard control cabinets; a table describing the SmartSensor cable's pin-out and appropriate connection points inside the control cabinet can be found in Appendix B of this document.

However, 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); and a series of contact closure modules (Click! 100, 172, and 174). If you are connecting SmartSensor to any of the Click! devices, please refer to the installation guide for each product for instructions; if you are connecting SmartSensor to other manufacturer devices, please refer to the user manuals for those products.

Connecting SmartSensor to a Surge Protection Device

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

If using Click! 200 devices, 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 7' grounding rod.

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

Short Cable Run (40 feet or less)

A short cable run usually indicates any installation with a SmartSensor cable 40 feet or less. Follow the steps below to add surge protection on a short cable run (see Figure 5):

1. Connect the SmartSensor cable to the **UNPROTECTED** side of the Click! 200.
2. Connect power to the **PROTECTED** side of the Click! 200.
3. If a Click! 172 or 174 Input file card is being used for contact closure outputs, then the RS-485 cable and the 24 VDC power in the controller cabinet must be attached to the **PROTECTED** side of the Click! 200.

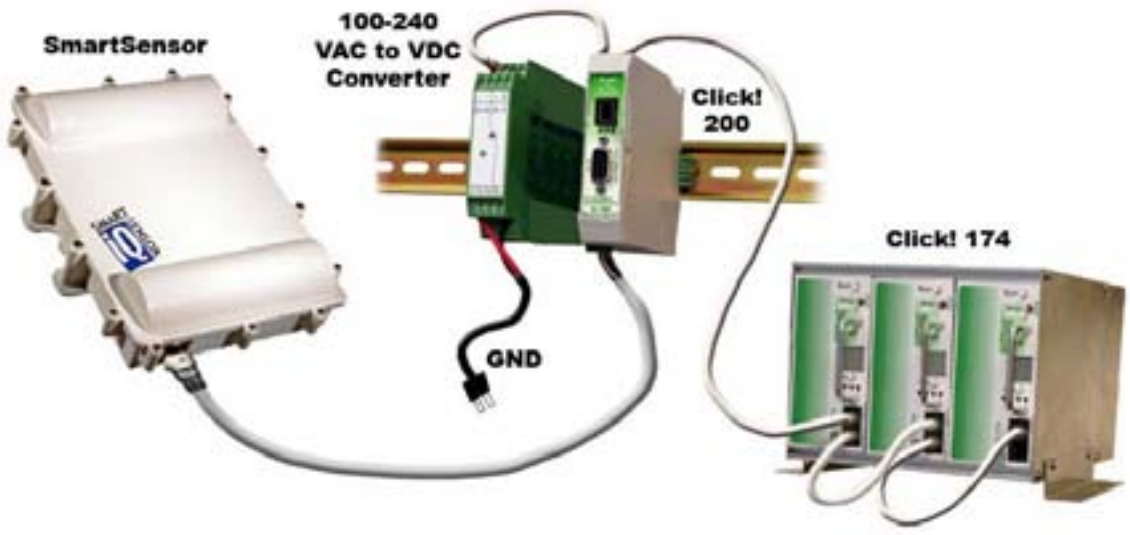

Figure 5 – Short Distance Cable Run

Long Cable Run (41-100 feet)

A long cable installation includes any installation with a SmartSensor cable longer than 40 feet. Follow the steps below to correctly add surge protection to a long cable run (see Figure 6):

1. Connect the SmartSensor cable from the SmartSensor to the **PROTECTED** side of the Click! 200.
2. Mount a Click! 200 (or equivalent) device on the same pole as the protected sensor, and mount another Click! 200 in the cabinet.
3. A single unspliced, shielded cable must be kept as short as possible and 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).
4. If a Click! 172 or 174 input file card is being used for contact closure outputs, then the RS-485 cable and the 24 VDC power in the controller cabinet must be attached to the **PROTECTED** side of the Click! 200.

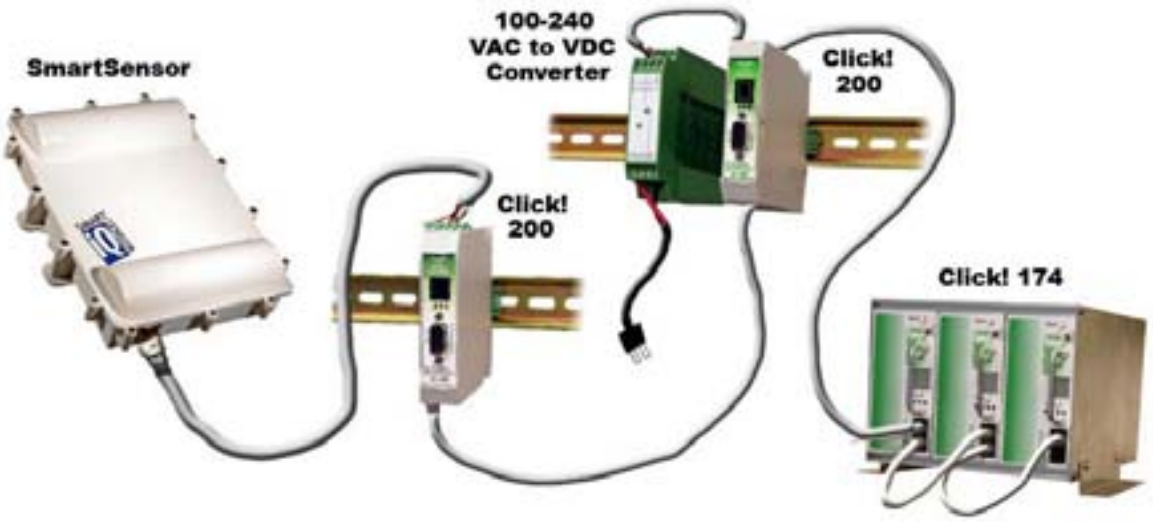

Figure 6 – Long Distance Cable Run

The Click! 200 has 12 screw terminal connections on both the top and the bottom (see Figure 7). The screw terminals on the top of the module are surge protected:

Back The back four terminals consist of one +DC power, -DC and two surge ground connections;

Middle 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-232 communication;

Front The front four terminals are for RS-232 communication and consist of TD, RD, CTS and RTS.

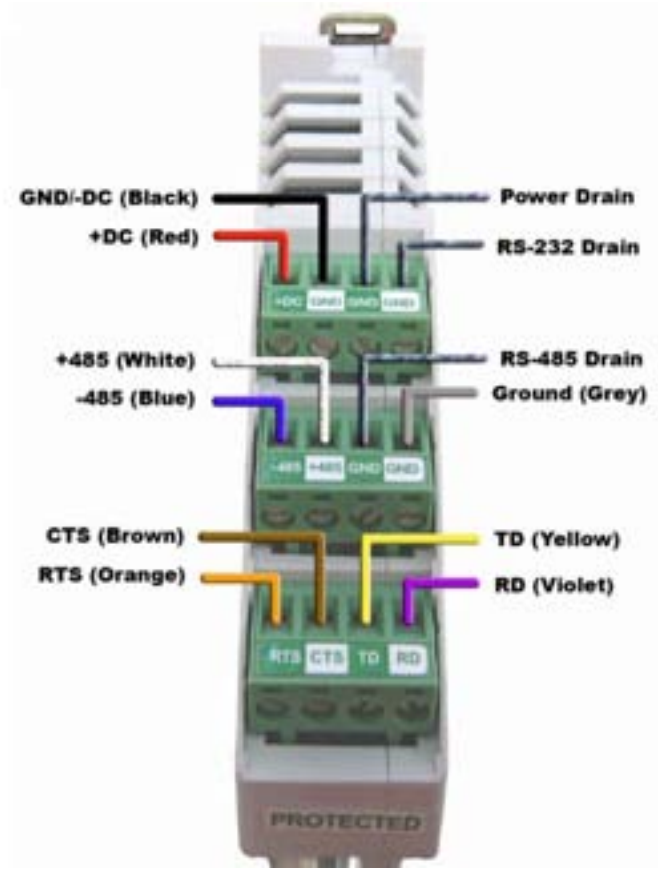

Figure 7 – Surge Protected Terminal Connections

Figure 7 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.

Wire the SmartSensor cable to the Click! 200 according to Table 2:

SmartSensor Cable	Click! 200 Connection	Description
Black	GND next to +DC	-DC (0 V)
Red	+DC	+DC (12-24 VDC Input)
Power Drain	GND	Earth GND
RS-232 Drain	GND	GND
Blue	-485	-485
White	+485	+485
RS-485 Drain	GND	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 – Click! 200 Connections

NOTE: See Appendix F 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.

7. Configuring SmartSensor with SmartSensor Manager™

After the SmartSensor is installed, it must be configured to the roadway for proper operation. The SmartSensor Manager software is used to perform this configuration.

Automatic Configuration

1. Connect SmartSensor to a Personal Computer. SmartSensor can be connected to a personal computer for on-site configuration; it can also be remotely configured via wired or wireless modems and Ethernet. These connection options are described in detail in the SmartSensor Manager manual.

   For on-site configuration, connect a 9-pin (DB9) null-modem serial cable from the RS-232 connector on the Click! 200 to the standard RS-232 serial port on your PC. Wiring diagrams which illustrate connections to a personal computer or to a modem can be found in Appendix C of this document.

2. Launch SmartSensor Manager by clicking on the shortcut that was placed on your Windows desktop.

3. When prompted, connect to the SmartSensor you are configuring by the appropriate method: Serial Connection (if connected via RS-232 or RS-485); Modem (requires

a telephone number); or Ethernet (requires a TCP/IP address). Select the radio button of the appropriate connection method and click **OK.**

If you select Serial Connection and SmartSensor Manager cannot find a SmartSensor connected to the serial port, then a "SmartSensor was not detected…" window will appear on your screen. Check the serial and power connections and click on **OK.**

4. When a successful connection is made, select **Lane Configuration** from the **Edit** menu.
5. Once the Lane Configuration page opens, click on the button labeled **Restart** and, when prompted, confirm the configuration "restart" by clicking **Yes.** SmartSensor Manager will automatically begin detecting and configuring lanes, and the screen will show a visual depiction of the lanes and the vehicle detections in real-time.

   NOTE: Free-flowing traffic is required for proper configuration.
6. After the lanes have been detected and configured correctly, save the configuration by clicking on the **Finished** button. The time required for configuration depends on the volume of traffic present in the lanes, but a typical configuration takes only a few minutes. Light or sporadic traffic may result in slower configurations.

Manual Configuration

If the sensor is unable to automatically configure itself to your satisfaction, you can manually configure it by adding, removing or adjusting lanes, lane dividers and lane centers.

Figure 8 – Automatic and Manual Modes

1. With the Lane Configuration page open, select the **Manual** button; the buttons in the toolbar on the right of the screen will change from gray to black (see Figure 8).
2. The newly activated buttons will remain pressed when you click them. To change the configuration, click the appropriate button, move your cursor over the window showing the roads, lanes and vehicles, and then make the changes:

Adjust Lanes

The **Adjust Lanes** button allows you to click your mouse cursor on any visible shoulder (gray line), lane divider (white line), or lane center (pink line) and drag it to the desired position.

The cursor will change from an arrow to a hand when it is positioned over a “draggable” line.

Lane centers (pink lines) only appear when the cursor is placed directly over them.

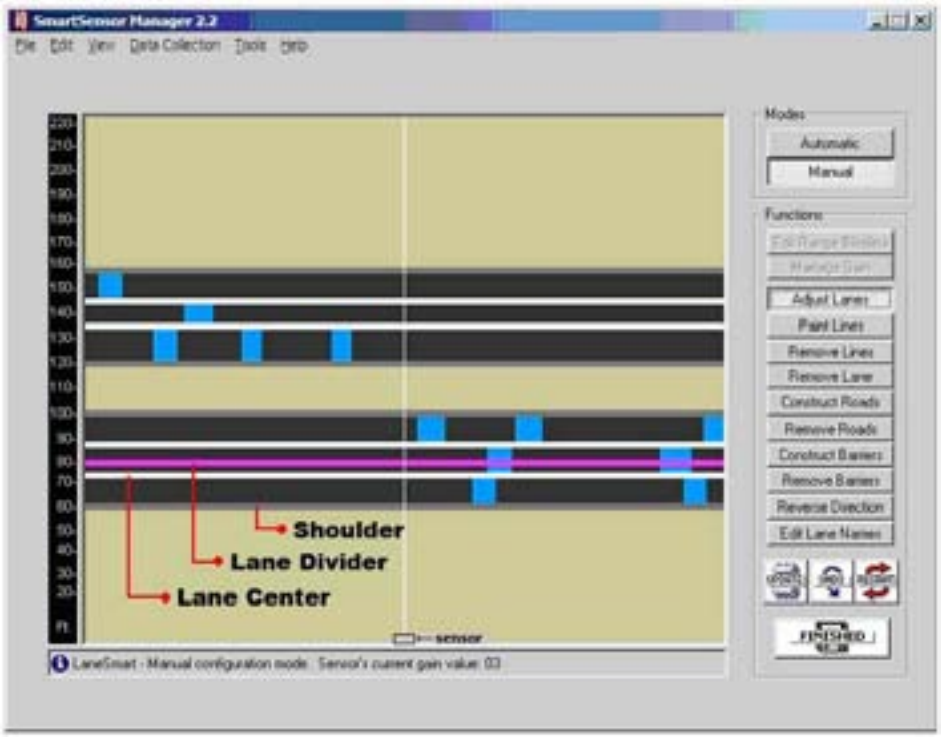

Figure 9 – Adjusting Lanes

Also, you will notice that shoulders, dividers, or centers cannot be dragged past each other. Figure 9 shows the pressed **Adjust Lanes** button, the hand cursor and the adjustable or draggable lines. To adjust this lane center, click and hold the left mouse button and move the line up or down on the screen, but only within the area between the shoulders.

Paint and Remove Lines

The **Paint Lines** button allows you to add new lanes by inserting lane dividers in paved (black) areas. SmartSensor Manager allows a maximum of eight lanes.

Again, the mouse cursor will change from an arrow to a hand when it is positioned directly over a location where it is possible to paint a lane divider. When the cursor appears as a hand, click the left mouse button and a white line will appear.

To remove a lane divider, click on the **Remove Lines** button, select the white line you want to remove, make sure the cursor appears as a hand and click the left mouse button.

Remove Lane

The **Remove Lane** button allows users to remove entire lanes by moving the mouse cursor arrow to the desired lane. When the arrow changes to a hand, click the left mouse button and the selected lane will disappear.

Construct and Remove Road

To insert a new road, click on the **Construct Roads** button and select a location anywhere in the background (khaki colored) area. Make sure the cursor appears as a hand and then click the left mouse button to draw the road.

Because new roads are initially drawn with an upper shoulder line, a centerline and a lower shoulder line, you will usually need to adjust your road to the desired width using the **Adjust Lanes** function.

To remove an entire road, including all lanes, click on the **Remove Roads** button, select the road you want to remove, and click the left mouse button.

Construct and Remove Barrier

Constructing a barrier or median is essentially the act of dividing a single road into two separate roads. SmartSensor Manager defines a barrier or median as two adjacent shoulder lines or two shoulder lines with only background (khaki colored) areas in between them.

To construct a barrier or median, click on the **Construct Barriers** button and move the cursor to the paved area where you want to insert the barrier. When the cursor changes from an arrow to a hand, click on the left mouse button and the barrier will appear.

Initially, the new barrier is only two shoulder lines wide. To widen the barrier, use the **Adjust Lanes** feature as explained earlier.

You may also remove a barrier, or convert two roads into a single road, by clicking on the **Remove Barrier** button and selecting the barrier you wish to delete.

Reverse Direction

Once the configuration process has been completed, you will notice that SmartSensor Manager shows all detected vehicles moving in the same direction. The **Reverse Direction** button enables you to change the direction of travel depicted in SmartSensor Manager so that each lane reflects the actual direction traveled by detected vehicles.

To do this, press the **Reverse Direction** button and move the cursor over the lane you wish to change. Once the cursor is in place, the cursor will again change from an arrow to a hand and a tiny arrow will appear below the hand to indicate the current direction of that lane.

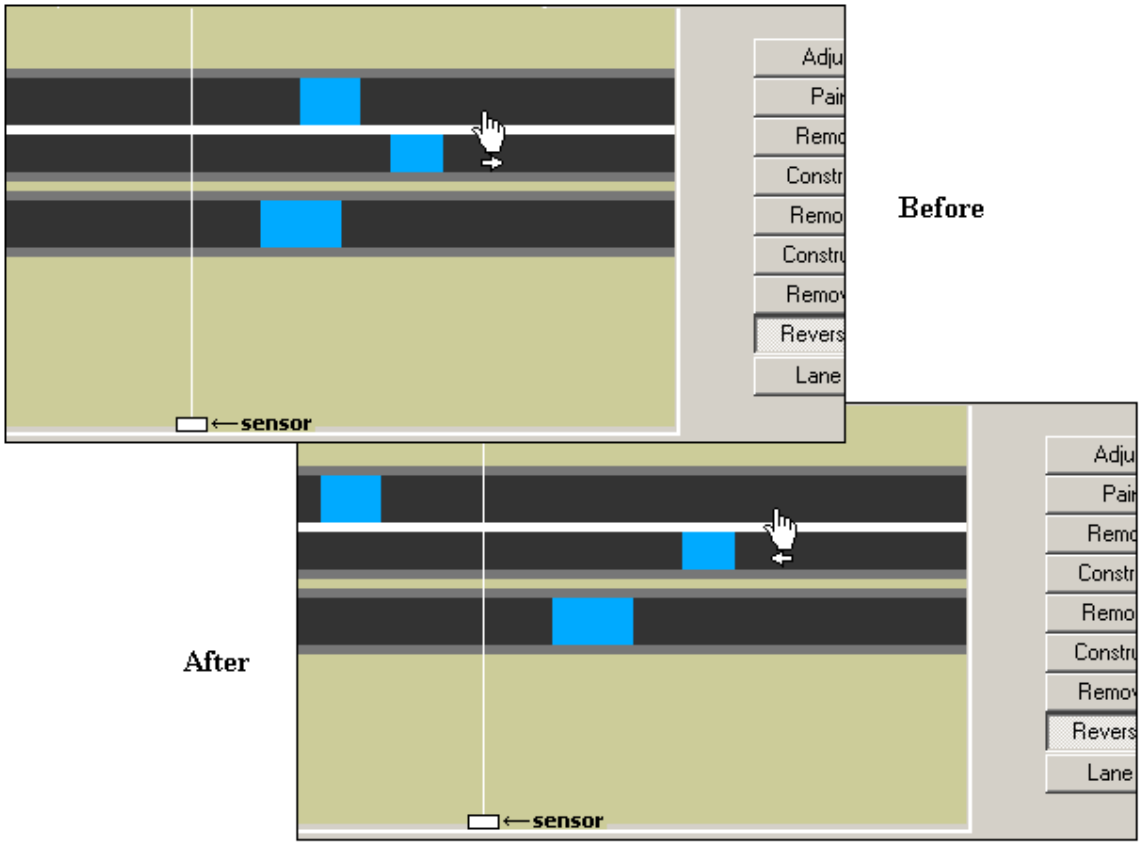

Figure 10 – Reversing Direction

Click the left mouse button, and the tiny arrow will reverse direction to verify the change has occurred (see Figure 10). Using the **Reverse Direction** button only affects the SmartSensor Manager display and is useful for verifying performance.

Edit Lane Names

By default, the SmartSensor identifies the lanes it configures as lane 1 up to lane 8, where lane 1 is the lane located closest to the sensor. However, you may wish to assign lane numbers differently.

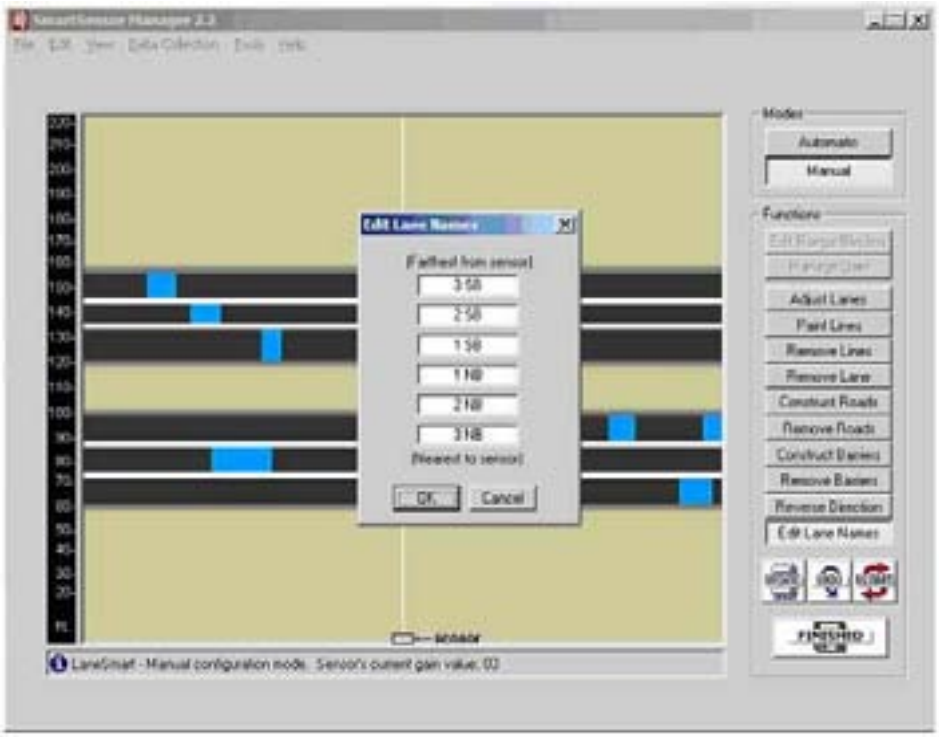

Figure 11 – Editing Lane Names

To do this, click on the **Edit Lane Name** button and an Edit Lane Names window will appear (see Figure 11). Highlight the current lane name by double clicking on it with the mouse, and then type in the lane's new alpha-numeric identification of up to eight characters. Lane names can also be changed by going to Sensor Settings and clicking on the **Data Collection** tab.

Saving the Configuration

Figure 12 – Update, Undo, and Restart Buttons

Once all manual configurations are completed, the changes must be updated in the SmartSensor's flash memory. Update all manual changes by clicking the **Update** button located below the manual tool buttons (see Figure 12). The process of updating the configuration takes only seconds and lane changes won't take effect until after the sensor has been updated. Once the process is completed, SmartSensor Manager will remain on the Lane Configuration page so that any manual changes made may be viewed and easily changed if needed.

Undoing Manual Changes

Unsaved changes may be undone without repeating the manual configuration process. Click on the **Undo** button found below the manual tool buttons (see Figure 12). This tool retrieves the last saved configuration from the SmartSensor, effectively undoing any unsaved changes that were made.

Restarting Lane Configurations

To completely erase the SmartSensor's current configuration and restart the Lane Configuration routine, change from Manual back to Automatic mode by clicking on the **Automatic** button and then clicking on the **Restart** button located near the **Update** and **Undo** buttons below the Manual toolbar (see Figure 12).

This erases all manual changes that have been made, and the SmartSensor Manager will automatically reconfigure the road for you.

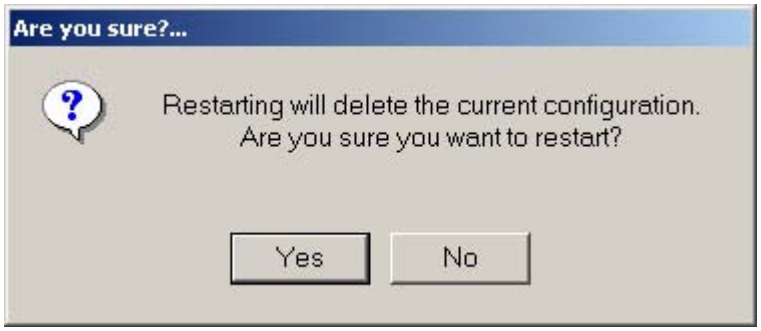

Figure 13 – Confirmation of Restart

After clicking on the **Restart** button, a window will be displayed asking whether you want to proceed (see Figure 13). Click on **Yes** to continue or on **No** to quit this procedure.

Exiting the Lane Configuration Page

Once all automatic and manual configurations have been completed, you may perform a final save and exit the Lane Configuration page by clicking on the **Finished** button located at the bottom right of the screen.

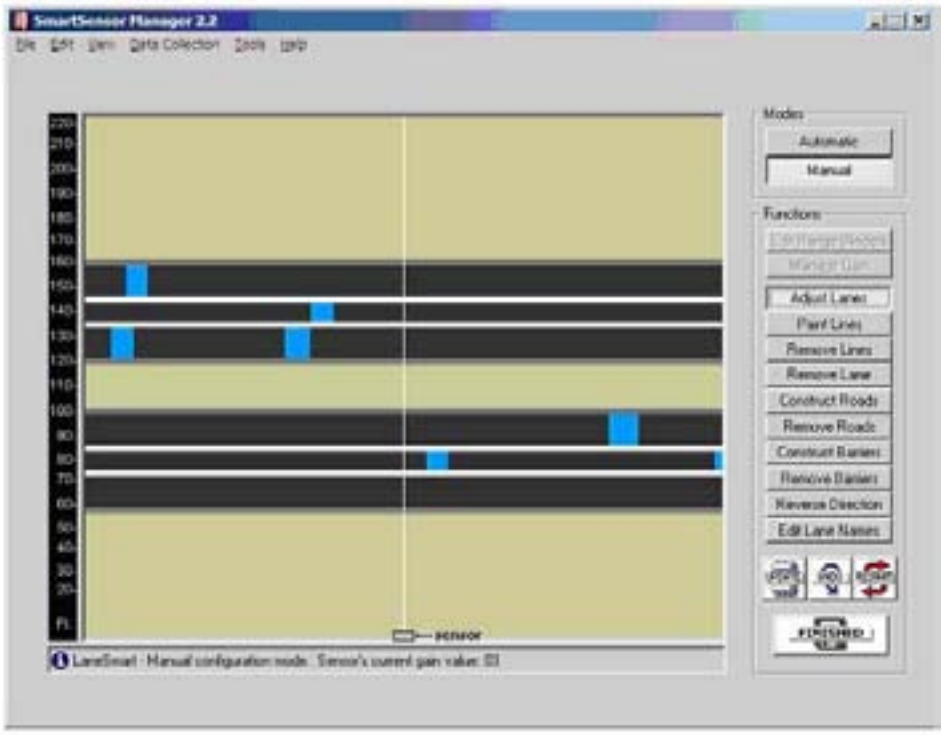

Figure 14 – Lane Configuration Page in Manual Mode

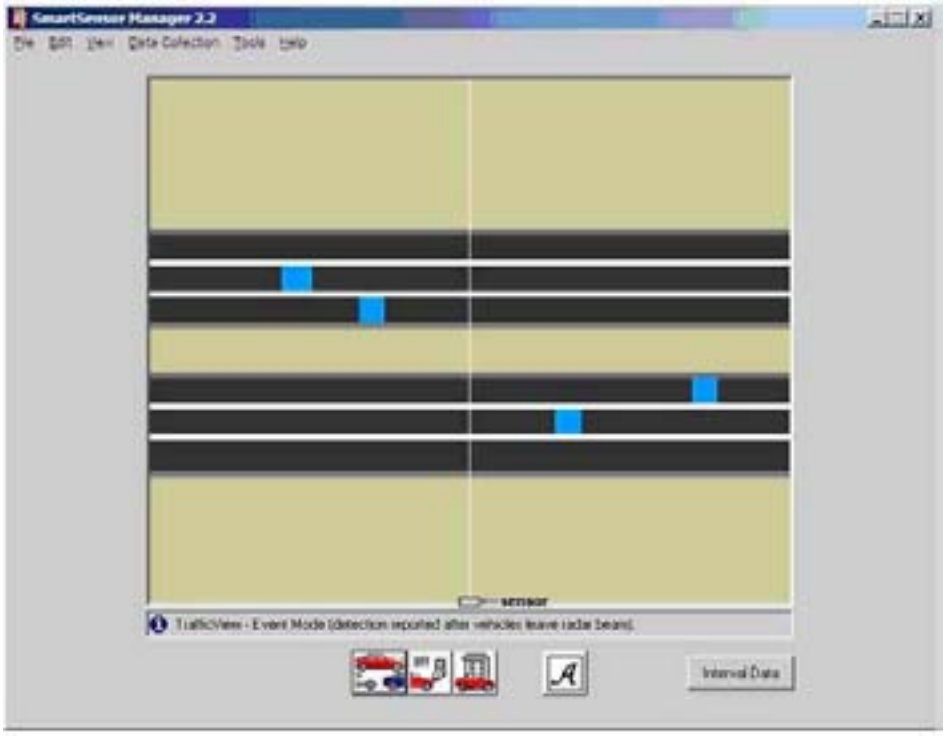

Figure 15 – Traffic/Event Data View Mode

A window will appear indicating that the changes are being saved to the SmartSensor. After the changes have been saved, SmartSensor Manager will automatically change from Lane Configuration to Traffic/Event Data View mode. Figures 14 and 15 illustrate the differences between these two modes.

Configuration Summary

After completing the steps listed above and having read over some of the configuration basics, the SmartSensor should now be installed and configured correctly.

SmartSensor will immediately begin detecting vehicles and providing speed, volume and occupancy data in real-time. For more detailed information regarding the configuration of the SmartSensor, refer to the SmartSensor Manager User's Manual. Your SmartSensor distributor can also provide additional assistance.

Appendix A – SmartSensor Specifications

Operating Frequency:	10.525 GHz (X-band)
Detection Zones:	Up to 8 traffic lanes simultaneously
Detection Range:	60 m (197 ft.)
Measured Quantities:	Speed, occupancy, volume, presence
Communications:	RS-232 and RS-485 connection
Power:	7.5 watts @ 10-30 VDC
Weight:	Less than 5 lbs. Or 2.27 kg
Physical Dimensions:	32 cm x 23 cm x 7.6 cm (H x W x D)
Zone Resolution:	3 m
Ambient Operating Temp:	-34C to +74C
Humidity:	Up to 95% RH
Shock:	10 g 10ms half sine wave
Transmitted Power at 3m:	Less than 2 mW @ 10.525Ghz

Appendix B – Cable Connector Definitions

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

SmartSensor Cable	Description	Cabinet Connections
Red	+DC	Positive terminal of 10-30 VDC power supply
Black	-DC	Negative terminal of 10-30 VDC power supply, which should also be connected to Earth Ground
Drain	GND	Earth Ground
Blue	-485	Negative RS-485 of a 2-wire RS-485 bus
White	+485	Positive RS-485 of a 2-wire RS-485 bus
Drain	485 GND	Earth Ground
Yellow	232 (TD)	Pin 3 of standard RS-232 DB9 connector
Violet	232 (RD)	Pin 2 of standard RS-232 DB9 connector if sensor connector is wired as a DTE device
Drain	GND	Earth Ground
Orange	RTS	Needed for RS-232 hardware handshaking
Brown	CTS	Needed for RS-232 hardware handshaking
Grey	232 GND	GND or pin 10 of DB25 connector

Table 3 – SmartSensor Cable and Cabinet Connection

See Figure 16 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.

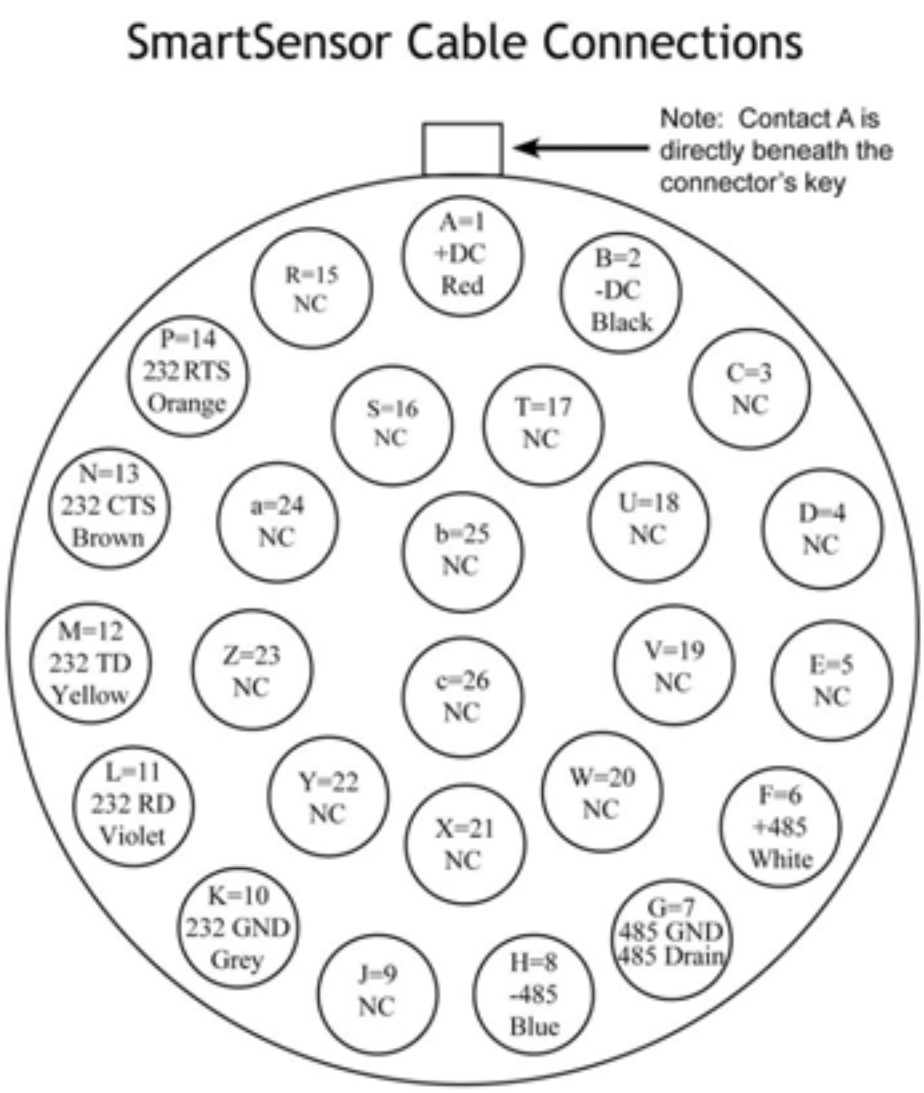

Figure 16 - SmartSensor SS105 Plug Connector Socket Assignment as seen from the solder cup side of the connector.

Appendix C – RS-232 Communication

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 17). If connecting to a modem or other DCE device then a straight through serial cable is used (see Figure 18).

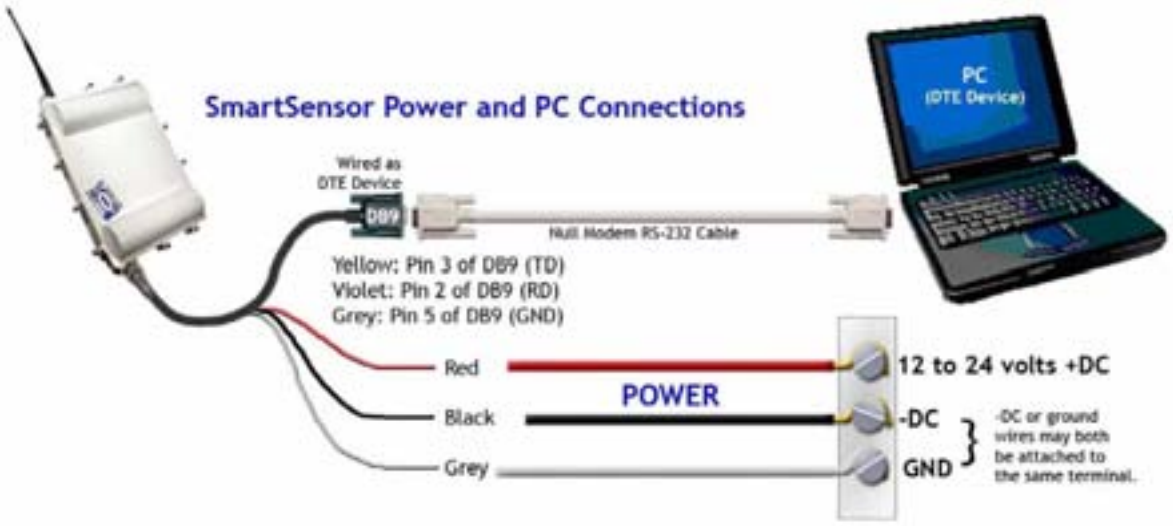

Figure 17 – Connecting a PC to the SmartSensor

SmartSensor Cable	DB9 Serial Connector
Yellow (Out from sensor)	Pin 3 (TD)
Violet (In to sensor)	Pin 2 (RD)
Grey	Pin 5

Table 4 – RS-232 Connections

Figure 18 – Connecting a Modem to the SmartSensor

Figure 19 – Rear view of RS-232 DB9 serial connector

Appendix D – RS-485 Communication

RS-485 communication between the SmartSensor and PC may be established by using the SeaLink +485 model #2102 RS-485 to USB converter by SeaLevel, along with the standard 25-pin "D" female connector with the following pin out:

1: No Connection (N/C)	10: N/C	18: N/C
2: -485	11: N/C	19: N/C
3: -485	12: N/C	20: N/C
4: N/C	13: N/C	21: N/C
5: N/C	14: +485	22: N/C
6: N/C	15: N/C	23: N/C
7: GND	16: +485	24: N/C
8: N/C	17: N/C	25: N/C
9: N/C		

Appendix E – Labeling

The following label, visible to all persons exposed to the transmitter, is provided on the product unless SAR compliance can be demonstrated:

Warning: All persons must beat least 20 cm from antenna when transmitter is operating to meet FCC RF exposure requirements.

Appendix F – Old Cable Connector Definitions

The previously used SmartSensor cable is comprised 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. The following table details the pin out of the cable and the appropriate connection inside the cabinet for each wire:

SmartSensor Cable	Description	Cabinet Connections
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 5 – Cabinet Connection

Use the illustration below if you are using the old SmartSensor cable:

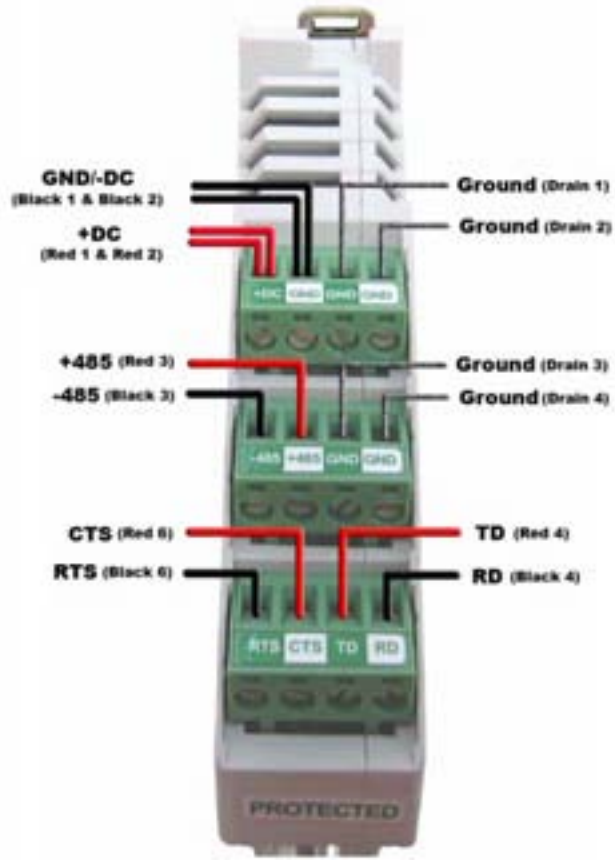

Figure 20 - Click! 200 Wiring (Old)

See Figure 21 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.

SmartSensor Cable Connection Rev 1.4

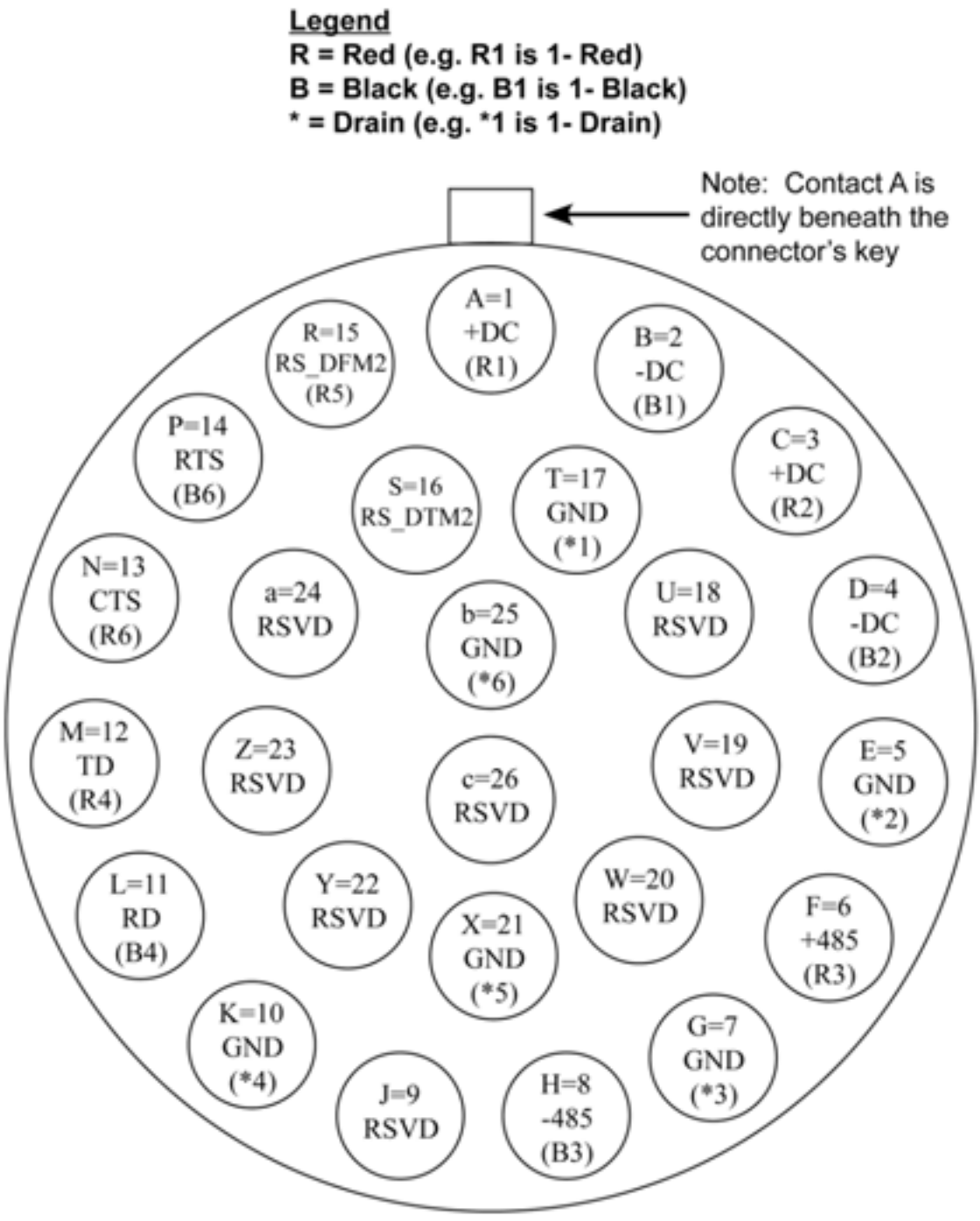

Figure 21 – Old SmartSensor SS105 Plug Connector Socket Assignment as seen from the solder cup side of the connector.

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 22). If connecting to a modem or other DCE device then a straight through serial cable is used (see Figure 23).

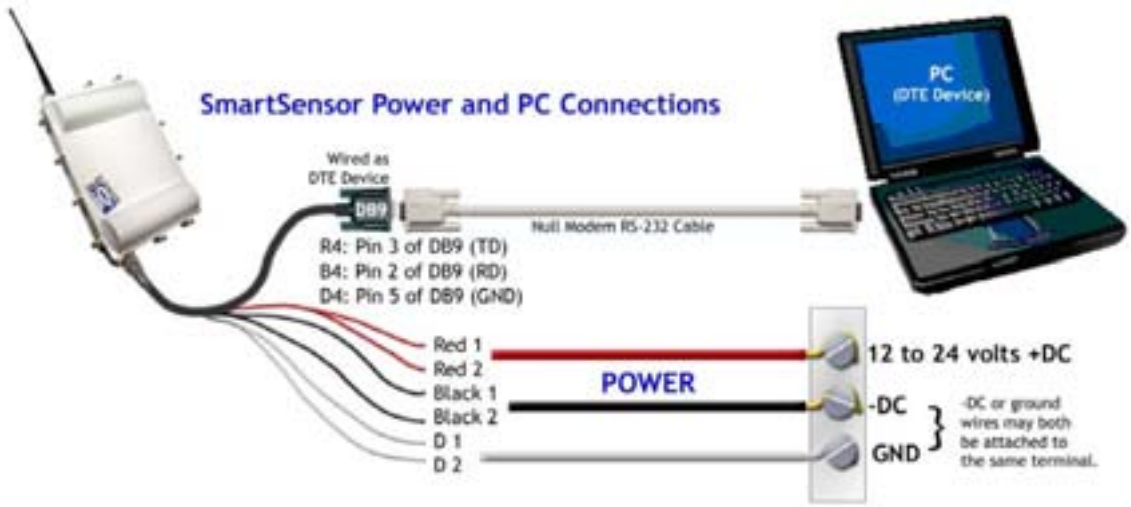

Figure 22 – Connecting a PC to the SmartSensor (OLD)

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 6 – RS-232 Connections (Old Cable)

Figure 23 - Connecting a Modem to the SmartSensor

The table below shows the individual wiring of both the new and old SmartSensor cables and how they correspond.

	Orion Color-Coded Cable	Beldin 9331 Cable
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 7 – Belden 9331 (Old Cable) Conversions

Appendix G – 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 8 - 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.

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 9):

	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 9 - 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. Some options include the Belden 3105A (Paired – EIA Industrial RS-485 PLTC/CM) or Alpha Wire 6010C 3PR 22 AWG.

There are many reliable options available for wired power and communications connections (see Table 10).

Length (ft)	Cable	Communication	
		Channel 1	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
1000 – 2000	Alternate power and communications cable	Native RS-485	Click! conversion of RS-232 to RS-485

Table 10 – Cable Length Options