SENSYS networks

Sensys Networks VDS240 Wireless Vehicle Detection System

Access Point Controller Card (APCC) Installation Guide

P/N 152-240-030-005, Rev F

June 2015

Document Properties

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P/N 152-240-030-005 Rev F

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FCC Compliance Statement

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference.

(2) This device must accept any interference received, including interference that may cause undesired operation.

Any changes or modifications to this product not authorized by Sensys Networks could void the EMC compliance and negate the authority to operate the product.

RF Exposure Statement

This device has been tested and meets the FCC RF exposure guidelines. It should be installed and operated with a minimum distance of 20 cm between the radiator of RF energy and the body of users, operators, or others.

Improper use or tampering with the device is prohibited and may not ensure compliance with FCC exposure guidelines.

Warnings

No Safety Switching

Sensys Networks **does not** allow its equipment to be used for safety applications such as controlling a mechanical gate or switching a train to avoid a collision.

Lithium Thionyl Chloride Batteries

Sensys Networks uses Lithium Thionyl Chloride batteries in the following products:

- Sensors (VSN240-F, VSN240-T, VSN240-S, VSN240-M, VSN240-F-2, VSN240-T-2)
- Repeaters (RP240-BH-2, RP240-BH-LL-2, FLEX-RP-B-2, FLEX-RP-B-LL-2)

Lithium batteries are widely used in electronic products because they contain more energy per unit -weight than conventional batteries. However, the same properties that deliver high energy density also contribute to potential hazards if the batteries are damaged. Improper use or handling of the batteries may result in leakage or release of battery contents, explosion, or fire.

Following are the recommendations of the battery manufacturer for proper use and handling of batteries in the Sensys Networks devices mentioned above:

- **DO NOT** charge or attempt to recharge the batteries (they are NOT rechargeable)
- **DO NOT** crush or puncture batteries
- **DO NOT** short-circuit the batteries
- **DO NOT** force over-discharge of the batteries
- **DO NOT** incinerate or expose batteries to excessive heating
- **DO NOT** expose battery contents to water
- **DO** dispose of batteries and devices containing batteries in accordance with local regulations

NOTE:

Sensys Networks wireless sensors contain no serviceable parts and should never be disassembled. Installation and removal of sensors from pavement should only be done by trained personnel and care should be taken to insure that the sensor casing is not punctured or crushed.

Additional safety information is available from the battery's manufacturer:

- Sensor and repeater battery cell: http://www.ewtbattery.com/en/DownView.asp?ID=9

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Introduction

This guide provides information and procedures for installing Sensys Networks Access Point Controller Card (APCC) and the APCC Serial Port Protocol (SPP) digital radio in conjunction with the Sensys Networks VDS240 wireless vehicle detection system. This document is intended to be used by Sensys Networks customers, consultants, partners, dealers, and those who are interested in the application of wireless communication technology to the challenges of traffic detection, management, and control.

What's Inside

- This guide includes the following information:
- *Chapter 1: Introduction*, defines the purpose and scope of the guide.
- *Chapter 2: Overview*, provides an overview of the APCC and its additional components. It also describes the contents of a product shipment.
- *Chapter 3: APCC Installation Considerations*, provides the installation considerations for the APCC.
- *Chapter 4: SPP Installation Considerations*, provides the installation considerations for the SPP.
- *Chapter 5: APCC Installation Procedures*, provides instructions for installing and cabling the APCC.
- *Chapter 6: SPP Installation Procedures*, provides instructions for installing and mounting the SPP.
- *Chapter 7: Configuration*, provides instructions for configuring an APCC and expansion cards.
- *Appendix A: X Mode LED Displays for Slot Numbers*, depicts the channel LED displays when an APCC operates in X mode.

- *Appendix B: Circuit-board Dip Switch SW1 Settings*, depicts SW1 settings that identify the shelf number portion of the unique card address.

- *Appendix C: Circuit-board Dip Switch SW2 Settings*, depicts combinations of switch settings on the circuit-board dip switch SW2.

- *Appendix D: Pre-Installation Worksheets*, provides worksheets for capturing pre-installation information.

- *Appendix E: Contact Closure Card External Interfaces*, provides the connector pin assignments for the external interfaces of contact closure master and expansion cards.

Overview

This chapter provides an overview of the APCC and its additional components. The chapter also describes the contents of a product shipment.

Access Point Controller Card (APCC)

The Sensys Networks VDS240 Wireless Vehicle Detection System detects the presence and movement of vehicles with magneto-resistive sensors mounted in the pavement. Wireless sensors continuously transmit detection data to the APCC that collects and forwards data to remote traffic management systems or local traffic signal controllers such as the CalTrans Type 170, Type 2070 ATC and NEMA TS-1, and TS-2 controllers.

The Sensys Networks Access Point Controller Card (APCC), is a second generation controller card that maintains low power consumption, supports multiple radios, and allows for additional communication and processing power. The APCC, which is compatible with all of Sensys Networks VDS240 Wireless Vehicle Detection System products, receives and processes data from the sensors. The APCC then relays the sensor detection data to a roadside traffic controller or remote server traffic management system.

Contact Closure Expansion Card

Additional capacity (to handle more sensors or controller channels) is provided by a contact closure expansion card (EX card). EX cards use the same form factor as APCC cards and are daisy-chained to a CC interface on the APCC on the front-panel RJ45 jacks or backplane connectors. Up to 63 EX cards can be used per APCC card.

Types of APCC Configurations

The APCC single-slot configuration consists of dual APCC radio ports, Sensys Networks Expansion (EX) port, and contact closure interface via backplane to a traffic controller. It also has dual USB 2.0 full speed host ports and 10/100Base-T network access. The APCC dual-slot configuration adds an SD memory card, real-time battery-backed clock, dual serial (DB9) interface, or an optional built in cellular modem.

Figure 2.1. APCC configurations

APCC System

The minimum APCC system consists of an APCC and one SPP radio. The system can also consist of multiple SPP radios and an isolator that offers electrical isolation up to 1500V, surge protection up to 1500V, and AC power cross protection.
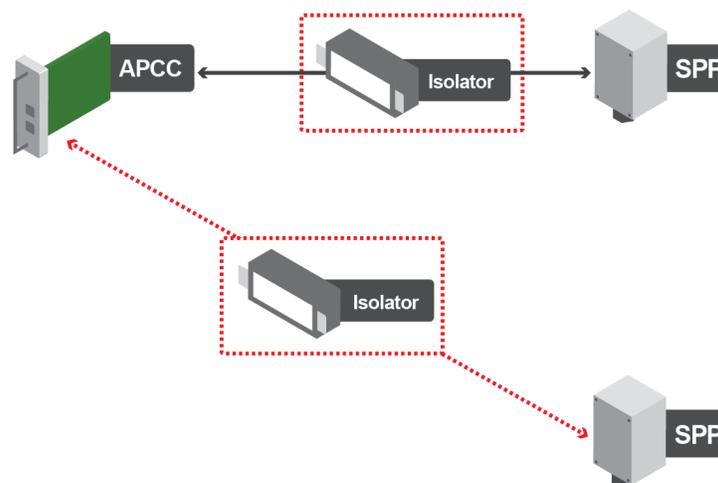
Figure 2.2. APPC system configuration

APCC Serial Port Protocol (SPP) Digital Radio

The APCC, along with the SPP, maintains two-way wireless links to an installation's sensors and repeaters, establishes overall time synchronization, and transmits configuration commands and message acknowledgements.

Figure 2.3. SPP digital radio

Isolator

The isolator is an optional component that provides the following services:

- connects an SPP to the APCC
- isolates and routes power from the controller backplane to the SPP
- extends the communication for the APCC to and from the SPP at RS422 distance.

Figure 2.4. Isolator

APCC Package Contents

Each APCC is shipped with the items listed below. Verify that you have received all of them. In the event that some items are missing, contact Sensys Networks or the party that supplied the equipment to you.

The items in a Sensys Networks APCC shipment include:

- An APCC
- *Access Point Controller Card Installation Guide* (this document)
- Information sheet

The Sensys Networks APCC is shipped with a factory default configuration suitable for bench-testing the device and typically require further configuration to meet the needs of specific applications. Hardware serial numbers are found on the information sheet.

The APCC and EX cards are available in the models as shown below. Verify that you have the correct model for your application.

Product	Description
APCC-M	APCC Module
APCC-M-E	APCC Module with Enhanced Ethernet
APCC-MP-E	APCC Module with Peripheral Support and Enhanced Ethernet
APCC-MP-EG	APCC Module with Peripheral Support and Enhanced Ethernet, GSM
APCC -MP-EV	APCC with Peripheral Support and Enhanced Ethernet, Verizon
EX240	Expansion Card for Type 170, Type 2070, or NEMA TS1 or TS2 traffic controllers

Table 1. APCC models

SPP Package Contents

Each SPP is shipped with the items listed below. Verify that you have received all of them. In the event that some items are missing, contact Sensys Networks or the party that supplied the equipment to you.

The items in an SPP shipment include:

- An SPP
- "Tool less" push/pull Ethernet bulkhead connector
- Information sheet (one per device)

Item that is shipped separately:

- Universal mounting kit (kit can be purchased from Sensys Networks)

SPP digital radios are shipped with a factory default configuration suitable for bench-testing the device and applicable to many field environments. The information sheet details the physical attributes of the SPP as well as key configuration elements.

SPP information sheets contain the following elements:

- *Serial number* – a globally unique identifier for the SPP
- *Default RF channel* – a critical configuration property
- *Default IP address*
- *Firmware release version*

NOTE:

RF channel is essential for communicating and further configuring the wireless sensor network. Save all information sheets for the party who will configure and use the network after it is installed. Refer to the *Configuration* chapter of the *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide* for more information about network operations and configuration.

Universal Mounting Kit Contents

The following parts are included in the SPP mounting kit:

- SPP ball plate (rectangular, attached to the SPP at the factory, refer to Figure 2.5)
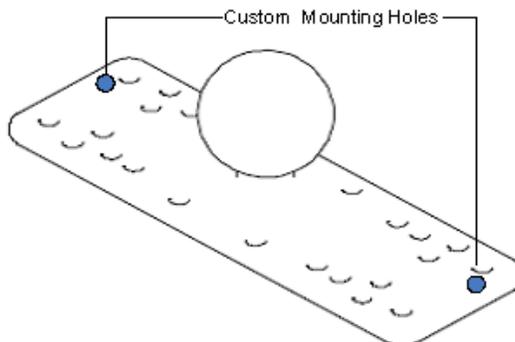
Figure 2.5. Factory installed ball plate (rectangular)

- Surface mounting ball plate (square, refer to Figure 2.6)
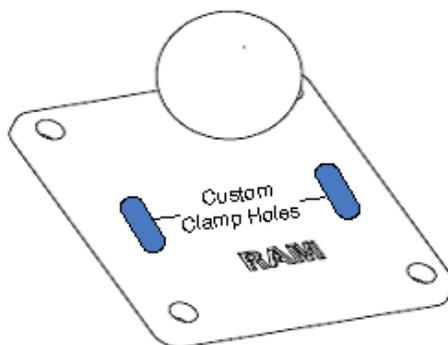
Figure 2.6. Surface (wall/beam/pole) mounting ball plate (square)

- Double socket arm (refer to Figure 2.7)
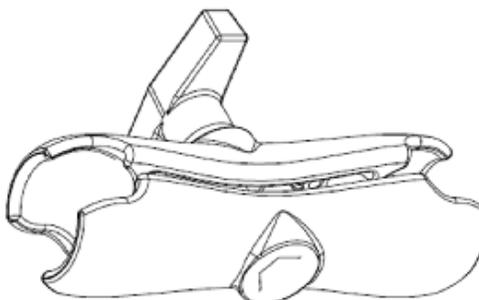
Figure 2.7. Double socket arm

- 5-foot clamp band
- Clamp fastener

Additional Parts and Equipment Required

Additional parts and equipment required for installation and configuration of a APCC include the following:

- Standard Ethernet compatible, outdoor rated, 4-pair CAT5 (or better) cable (*refer to Notes below*)
- RJ45 jack kit and crimp tool
- Cable ties
- PC or laptop with Microsoft® Windows® XP Professional or Windows 7 (including 64-bit editions) and TrafficDOT, the system management software tool from Sensys Networks.

NOTE:

The APCC is available with a range of options. Verify that the APCC you are using with the contact closure card(s) is appropriate for that use.

Notes

1. Cabling – a minimum of one straight-through Ethernet cables are required.

2. Laptop PC and TrafficDOT software – if contact closure cards will be configured via TrafficDOT's GUI, a suitable host is required.

3. Contact closure card functions can be configured from the switches on the front panel eliminating the need for a laptop PC and TrafficDOT.

APCC Installation Considerations

This chapter provides the installation considerations for the APCC. Prior to installing an APCC ensure that the following aspects have been considered in the site design.

1. Identify the devices that will be used with the APCC (refer to *Identifying the SPP and Sensors*).

2. Determine the configuration of the APCC (refer to *Determining the Device Configuration*).

3. Determine the number of available slots in the traffic controller's detector shelf and which contact closures are required (refer to *Determining Slots and Contact Closures*).

4. Develop the sensor-to-contact closure card mappings (refer to *Mapping Wireless Sensors to Contact Closures*).

Identifying the SPP and Sensors

SPP

Each APCC must connect to an SPP. This connection supplies power to the SPP and passes command and configuration data to/from the APCC. There is a one-to-one relationship between the APCC and master cards in a network.

Determine the location of the SPP relative to the cabinet that will hold the APCC card. The Cat5 cable that connects to the SPP to the APCC, via an isolator, must meet standard length limitations (2,000 ft with isolator) for RS422 communication.

Wireless Sensors

Each channel of an APCC interfaces a designated set of sensors to a designated contact closure. Ensure information describing which sensor (or sensors) will actuate a given APCC is available.

Wireless sensors have a unique identifier known as the Sensor ID. Use this identifier to refer to sensors in design notes and plans.

Determining the Device Configuration

Configuration of an APCC is based on the following design decisions:

- The number of APCC channels enabled
- The operating mode (pulse or presence) of each channel
- The use of and settings for any optional elements that modify the behavior of channels operating in presence mode
- The channel status communication method (LED-only) used by each channel

Configuration Worksheet

Each APCC supports up to four channels that are separately configured. Design decisions can be captured in a *Channel Configuration Worksheet* such as the one shown below.

NOTE:

Default values are shown in bold.

Configuration Element	Options	Example Data
1. Card identifier	(*Defined by the traffic controller or installer*)	
2. Channel	**1**, 2, 3, 4	1
3. Channel State	Enabled | **Disabled**	Enabled
4. Channel Mode	**Pulse** | Presence	Presence
4a. Presence Mode Modifier	(*applicable only to channels in presence mode*)	
4b. Modifier Type	**None** | Delay | Expansion	Delay
4c. Modifier Duration	**0** – 31 seconds in 1 sec increments (*Delay, Delay16+*) **0** – 7.5 seconds in 0.5 second increments (*Expansion*)	5

Configuration Element	Options	Example Data
5. Channel Holdover Setting	0 -.75 seconds in .05 second increments	0
6. Channel Status Communications	**LED-only**	LED and Tone	LED
Other Information (Optional)		
APCC identifier	(*from APCC*)	192.2.68.100
Distance from APCC (without Isolator)	328 feet (100 meters) – 10BaseT	6 feet
List of wireless sensor for the channel	(*use SensorIDs of each sensor*)	0707 AC15 020D

Table 2. Channel configuration worksheet with example data (default values shown in bold)

Notes

1. Contact closure cards are addressed by the *Card ID*, a value dictated by the controller or supplied by the installer.

2. Complete one worksheet for each channel.

3. *Channel Holdover Setting* should not be used; set it to zero.

4. The items listed in the section *Other Information* are not part of APCC configuration. They are relevant to other aspects of installing and operating the APCC.

Determining Slots and Contact Closures

Configuration of contact closure cards depends on (*i*) the availability of open slots on the controller backplane and (*ii*) the use of any predefined functions or phases for each slot – such as in the case of a standard CalTrans 322 shelf, where one contact closure card and three contact closure EX cards are required (one card per phase). Typically, a site survey of the traffic controller is required.

Shelf and slot information from the controller are used to create an identifier, known as the *Card ID*, that uniquely defines an APCC in the network.

IMPORTANT!

If using an APCC with an I/O board, it is essential that there is an empty slot directly to the left of the APCC.

Mapping Wireless Sensors to Contact Closures

The final installation consideration for contact closure cards are the assignment of sensors to specific channels.

The four channels represent independent contact closures which, in turn, are actuated by the vehicle detection events transmitted by a defined group of wireless sensors. Each sensor may be associated with zero or one *Card ID/Channel* combinations.

Up to 15 wireless sensors can be associated with the same card/channel, in which case the sensors are logically "OR-ed" together – meaning that if any sensor on the channel detects a vehicle, the corresponding contact closes.

The sensor-to-contact closure channel mappings are stored in a sensor database that resides in memory. The sensor-to-contact closure channel mappings are maintained within *TrafficDOT*.

Defining the channel mappings is aided by the use of a *Channel Mapping Worksheet* such as the one shown below.

Card ID	Channel (1 - 4)	Sensor ID	Channel Extension (opt.)	Location / Lane / Description (opt.)
3-02	1	06C2	0	East bound, lane 1
3-02	1	06C3	0	East bound, lane 2
3-05	2	14C7	0	Advance C.3
3-06	3	0404	0	Stop bar A1
3-15	1	05D7	0	West bound, lane 1

Table 3. Sensor-to-channel mapping worksheet with sample data

Notes

1. The worksheet assumes one sensor per row. Use as many rows as necessary to assign all necessary sensors to channels.

2. Do not duplicate *Sensor ID* values. (A wireless sensor may only be assigned once.)

3. The sample data above depicts representative *Card ID* values. Since these values are rarely known prior to field installation, substitute a place-holder value so that the installer will understand how the wireless sensors are allocated to the channels.

4. Values for *Channel Extension* and *Location* are optional.

SPP Installation Considerations

This chapter provides the installation considerations for the SPP. Prior to installing the SPP, ensure that the following aspects have been considered in the site design.

- *Powering the SPP*
- *Collecting Data From the APCC*
- *Determining the Location of the SPP*

Each consideration is discussed below. In addition, refer to the *Sensys Networks Wireless Vehicle Detection System Reference Guide*, *Design Guidelines for Freeway Applications*, and *Design Guidelines for Intersection Applications* for more information.

Powering the SPP

The overall network design determines how the SPP is powered; two general models are supported:

- Acquiring power directly from a traffic controller cabinet
- Acquiring power from a traffic controller using optional isolator

Acquiring Power From a Traffic Controller

An SPP can be directly interfaced to a traffic signal controller through an APCC. When this is the case, power to the SPP is drawn from the traffic controller as shown in the following figure.
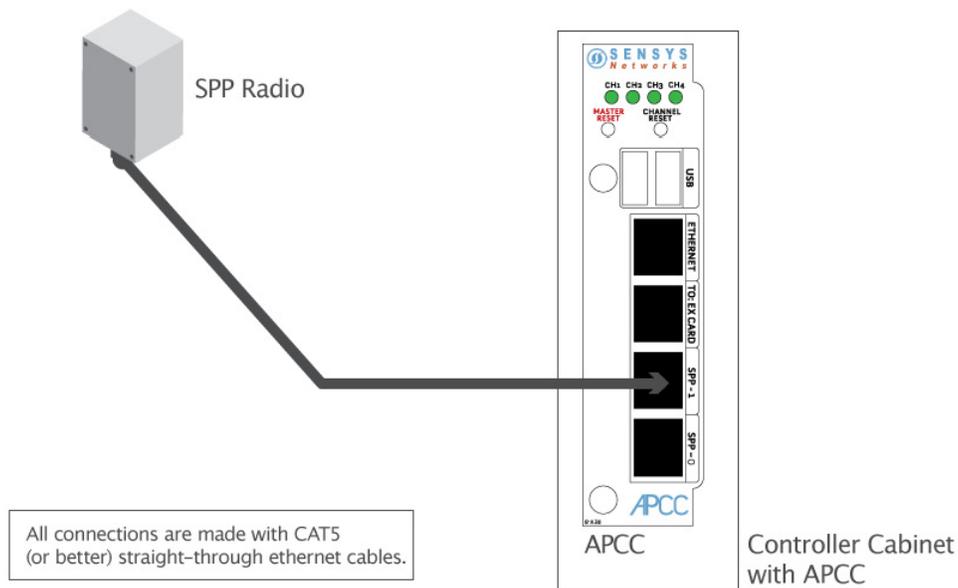
Figure 4.1. SPP radio powered from a traffic controller

Acquiring Power From Traffic Controller Using an Isolator

An optional isolator can be used when acquiring power from the traffic controller as shown in following figure.
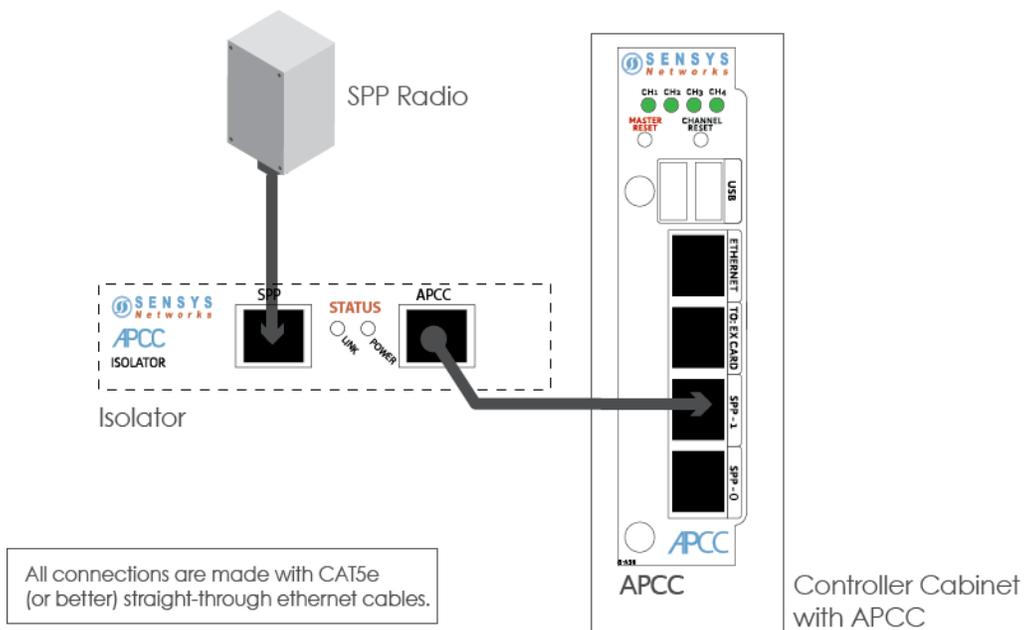
Figure 4.2. SPP radio powered from a traffic controller

Voltages

The APCC uses the following voltages drawn from one of the following sources:

- 20VDC – 28 VDC (24 VDC nominal) – typically supplied from a nearby traffic controller cabinet or power pole
- 10VDC – 16 VDC (12 VDC nominal) – typically supplied from a solar panel

Cabling

Standard Ethernet compatible, outdoor rated, 4-pair CAT5 or better cable is required. The maximum cable length is 328 feet (100 meters) or 2,000 ft (610 meters) with isolator. The cable should be terminated with RJ45 connectors according to the TIA/EIA 568-B specification when it is installed.

Collecting Data From the APCC

The APCC automatically collect detection events and, depending on the network design, forward them to upstream traffic information systems and management servers via an IP network connection. An on-board Ethernet network interface facilitates this. In situations where a wired network connection is not available, a modem supporting either GSM-based or CDMA-based cellular services may be added.

The following connection models are supported for IP communications:

- *Connection via a wired network path* – for example, bench configuration prior to installation, field access based on patching a technician's laptop to the APCC via an Ethernet cable, or an available wide area network connection.
- *Connection via a wireless network path* – for example, using GSM cellular networks (EDGE/GPRS data services) or CDMA cellular networks (1xRTT data services).

Additionally, event data may be forwarded to a local traffic signal controller via an APCC. This interface converts event data to the signal pattern required by the traffic controller.

Determining the Location of the SPP

The physical location of the SPP is the primary determinant of communications quality and, as such, the network's overall usefulness and reliability. Selecting a location involves several factors (including other local RF transmissions) that may make pre-assigned locations problematic.

Optimal Location Criteria

Optimal locations for SPP digital radios meet all of the following criteria:

- are high enough to promote high quality RF communications on a sustained basis
- allow a line-of-sight path to (optional) isolator, wireless sensors, and repeaters

- are within recommended distances for the APCC, (optional) isolator, and wireless sensors
- allow the SPP to be mounted with its bulkhead connector and cellular antenna (if applicable) pointed toward the ground
- are within specified cable length limits
- do not submit the SPP to avoidable vibration, shaking, or movement
- are reasonably accessible to field support personnel

APCC Installation Procedures

This chapter provides the instructions for installing and cabling an APCC.

Overview

Installation and setup of APCC occurs at the site of the traffic controller and consists of the following activities:

- *Determining the Card ID and Setting it via Circuit-board Dip Switches SW1 and SW2*
- *Determining the Controller Type and Setting it via Circuit-board Dip Switch SW1*
- *Connecting the Cables to Each Device*

Determining the Card ID and Setting it via Circuit-board Dip Switches SW1 and SW2

APCC and EX cards are addressed via a value known as the Card ID. A Card ID must be unique to the network and is required for communication between the APCC and the EX cards.

Card ID values are expressed as: `[ shelf number ] - [ slot number ]`.

Both *shelf-number* and *slot-number* must be determined to create a *Card ID*.

Some traffic controllers designate the card address, while others (typically older models) do not. In the latter case, the installer assigns the *Card ID* ensuring that it is unique to the network.

Follow the procedures in this section for each contact closure card to be installed.

Factory Default Card ID

Card IDs are implemented on Sensys Networks contact closure cards via two dip switches found on the side of the card. In this guide, the switches – named SW1 and SW2 respectively – are referred as *circuit-board* dip switches to differentiate them from other dip switches on the front-panel of contact closure cards.

A default Card ID of "03-15" is assigned at the factory and is shown in the following figure.

NOTE:

On the card, switches SW1 and SW2 are not as close to one another as shown in the figure.

SW1   **SW2**
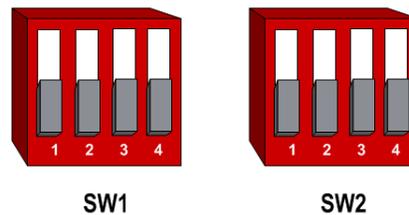
Figure 5.1. Default card ID (all dips down)

Before proceeding, ensure that switches SW1 and SW2 are set as in Figure 5.1 and, additionally, that all front-panel switches are in the right-hand position.

Querying the Backplane for an Assigned Address

The APCC support an operating mode (called *X mode*) that queries the traffic controller backplane for an address. Because it can be difficult to determine from visual inspection if the backplane dictates card addresses, the standard practice is to use *X mode* to see if this is the case.

X mode uses the four front-panel channel LEDs to visually indicate the backplane address assigned by the controller (if any). (Refer to *Appendix A: X Mode LED Displays for Slot Numbers* for a figure that depicts how the channel LEDs are used.)

Follow these steps to use X mode to query the controller for a card address:

1. Verify that the APCC is set to its default Card ID and that all front-panel switches are in the right-hand position.

2. Reset the APCC by pressing the master reset button (located on front-panel next to channel LEDs) or removing the unit from the cabinet and re-inserting it.

3. Observe the front-panel channel LEDs. Match the pattern of lighted LEDs with the figure in *Appendix A: X Mode LED Displays for Slot Numbers*.

The address value that matches the LED display pattern (from *Appendix A*) is the *slot number* component of the Card ID.

NOTE:

After the cabinet backplane is queried for an address, be sure to take the APCC card out of X-mode by setting front-panel dip switch 2 to the right, and resetting the card.

Setting the Slot-Number With Circuit-board Dip Switch SW2

Circuit-board dip switch SW2 implements the *slot number* component of the Card ID. Set switch SW2 to match the value derived from the figure in *Appendix A* subject to the exception noted below.

Exception

In cases where the controller does not assign an address, the installer will see a front-panel channel LED display pattern indicating an address of 15 (all LEDs lighted). This address can be used for the first contact closure card installed. However, subsequent cards must be given a different address – arbitrarily assigned by the installer. Any value between 0 and 15 may be used; remember that Card IDs must be unique for the network.

Refer to *Appendix C: Circuit-board Dip Switch SW2 Settings* for a figure that illustrates how to set switch SW2 to values between 0 and 15.

Setting the Shelf-Number With Circuit-board Dip Switch SW1

Circuit-board dip switch SW1 implements the *shelf number* component of the Card ID. Shelf numbers are assigned by the installer after visually inspecting the cabinet.

The convention is to consider the top-most shelf in the card rack as *shelf zero* and to increment the shelf number by one for each shelf below the top-most shelf. For example, the bottom shelf in a cabinet of four shelves would be considered shelf *three*.

Set circuit-board dip switch SW1 to the shelf number using the two left-most switches. Refer to *Appendix B: Circuit-board Dip Switch SW1 Settings* for a figure that illustrates how to set switch SW1 to values between 0 and 3.

Determining the Controller Type and Setting it via Circuit-board Dip Switch SW1

At the factory, contact closure cards are set for use with Type 170, Type 2070 (without status relays), or NEMA TS1 traffic controllers. This setting is made with switch three of circuit-board dip switch SW1.

Verify the controller type and set dip three of circuit-board dip switch SW1 as needed. Use the figure in *Appendix B: Circuit-board Dip Switch SW1 Settings* as a guide for setting switch three of SW1 to the proper value.

Connecting the Cables to Each Device

Cable the devices according to the steps below. Refer to the section *Cabling Summary* below for figures that depict the supported cabling schemes.

NOTE:

The steps below are for a system configuration that contain an optional isolator, and an EX card. A figure of a minimal cabling configuration is shown in the *Cabling Summary* section.

1. Connect a straight-through CAT5 (or better) cable, terminated with RJ45 connectors to the SPP and the port labeled "SPP" on the isolator.

2. Connect a straight-through CAT5 (or better) cable, terminated with RJ45 connectors to the jack labeled "APCC" on the isolator and the port labeled "SPP-1 or SPP-0" on the APCC.

    The green LED labeled "POWER" on the APCC should light.

    When communication is established between the SPP and the APCC, the LED labeled "LINK" blinks periodically. When data from the radios are being transmitted to the APCC, a periodic blinking occurs.

3. Connect a straight-through CAT5 (or better) cable, terminated with RJ45 connectors to the jack labeled "TO: EX CARD" on the APCC and the port labeled "IN" on the EX card.

4. To connect a laptop PC to the system, connect a straight-through CAT5 (or better) cable, terminated with RJ45 connectors from the laptop to the port labeled "ETHERNET" on the APCC.

5. To connect the APCC to a hub, bridge, switch, router or similar device, use a cross over Ethernet cable.

NOTE:

> Steps 4 and 5 are optional. Connect the laptop PC to the APCC to configure or manage the contact closure cards through TrafficDOT, the system management tool from Sensys Networks.
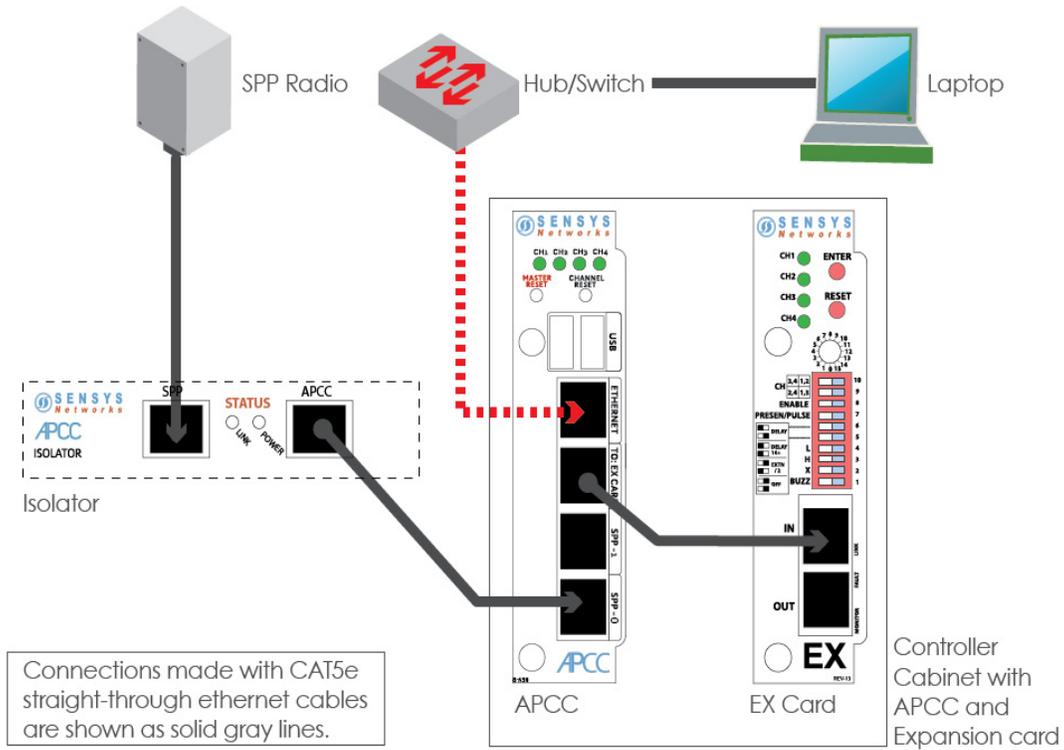
Figure 5.2. Cabling an isolator and hub or switch to an APCC

Cabling Summary

The cabling to connect an APCC, SPP, and laptop is shown in the following figure.
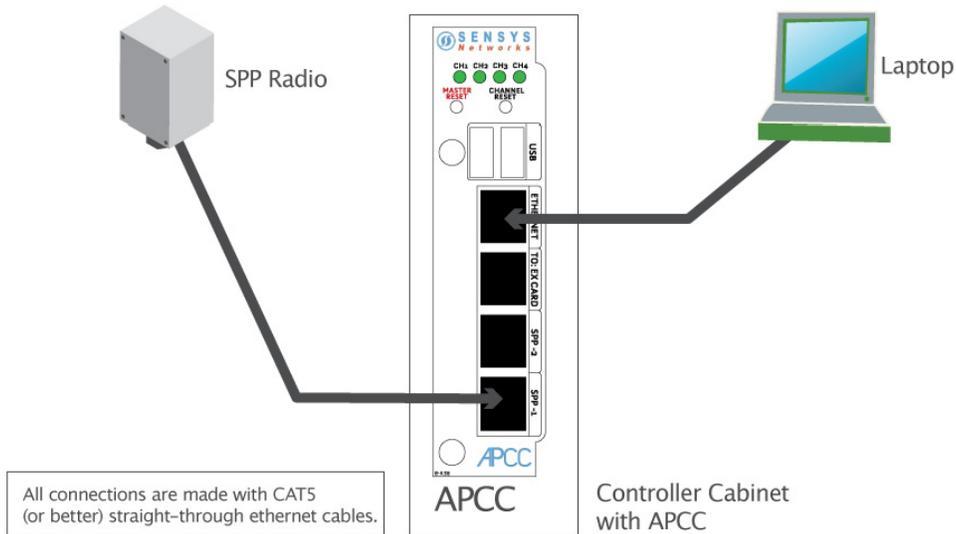
Figure 5.3. Cabling a PC or laptop

SPP Installation Procedures

This chapter provides the instructions for installing and mounting an SPP.

Installing an SPP consists of the following:

- Attaching the square surface mounting ball plate to an available vertical surface
- Attaching the SPP to the surface mounting ball plate via the double socket arm

Mounting hardware is included in the universal mounting kit provided with each SPP.

Tools Required for SPP Installation

The following tools are required for installing an SPP:

- *RJ45 crimp tool* – to terminate the SPP cable. (Sensys Networks recommends the EZ-RJPRO P/N 100044 from Platinum Tools.)

Figure 6.1. EZ-RJPRO

- *RJ45 connectors* – rated Cat5e or better; to terminate the SPP cable
- *Cat5e cable continuity line tester* – to validate cable continuity
- *Outdoor rated Cat5e Ethernet cable* – to build the SPP cable; length is determined by the distance between the SPP mounting location and the source of power (typically a controller cabinet, solar panel or other available source)

- *2 straight-through Cat5 Ethernet cables* – each approximately three feet in length; used in installations where the SPP is connected to a contact closure card in a controller cabinet.
- *Additional straight-through Cat5 Ethernet cables* – optional; each approximately one foot in length; these cables are used to daisy chain multiple contact closure cards. Required only in the case of multiple CC/EX cards.
- *Lift truck* – to install the SPP 16 – 30 feet above the road surface
- *Screwdriver* – combination flat and Phillips head ends
- *Universal mounting kit* – double-socket arm holds the SPP. (Kit can be purchased from Sensys Networks.)
- *Clamp band kit* – for attaching double-socket arm to mounting pole. (Kit supplied by Sensys Networks.)
- *Pliers* – used to work the clamp band
- *Wire cutters* – used to cut the clamp band

Step-by-Step Procedures

The square surface mounting ball plate can be installed on any available vertical surface sufficient to support the SPP including poles, walls or beams. This section provides procedures for pole installation; considerations for wall or beam mounting follow this section.

Installing the Mounting Plate on Poles

When attaching the square surface mounting ball plate to a pole, the clamp band is used to secure the ball plate to the pole. (Refer to *Appendix A* for more information about working with the clamp band.)

Follow these steps to perform the installation:

1. Use the measuring tape to determine the circumference of the pole that will hold the ball plate.

2. Subtract four inches from the measured circumference and cut the band to that length. Cut the band through the center of the nearest round hole.

3. Feed the clamp band through the square ball plate using the custom clamp holes (refer to the following figures) until the square ball plate is at the center of the band. Attach the fastener to *one end* of the band by diagonally inserting the end.

Figure 6.2. Clamp band threading through surface mounting ball plate

4. Use the cloth to clean the area of the pole that will meet the ball plate. Remove the double stick tape cover from the back of the plate, wrap the clamp band around the pole, and attach the second (non-engaged) end of the fastener. Tighten the clamp to secure it.

5. Attach the double socket arm to the square ball plate.

6. Attach the SPP ball plate to the other end of the double socket arm.
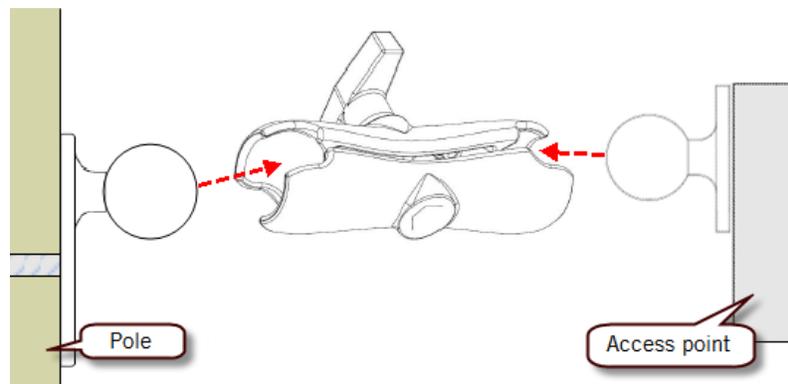
Figure 6.3. Double socket arm installation

7. Point the front of the SPP toward the wireless sensors and tighten the double socket arm to secure the SPP digital radio's position.

Installing the Mounting Plate on Walls

When attaching the square surface-mounting ball plate to a flat surface, the clamp band is not used. Instead, attach the ball plate to the surface with screws using each of the four corner holes.

Installing the Mounting Plate on Beams

When attaching the square surface-mounting ball plate to a beam, the clamp band is not used. Instead, attach the ball plate to the beam with beam clamps using two of the four corner holes. Beam clamps are available from Sensys Networks.

Determining the Type of SPP Radio Bulkhead Connector

The bulkhead connector mechanism used on SPPs from Sensys Networks is one type:

- *Hex-head type*

Refer to the following figure to determine the proper installation procedure.

SPP Radio Bulkhead Connector

Figure 6.4. SPP radio bulkhead connector type: hex-head

Figure 6.4 shows the SPP hex-head connector. Follow the procedures in the section *Connecting the Cable to an SPP Radio with the Hex-head Connector* to connect the Ethernet cable to SPPs using this connector type.

Connecting the Cable to an SPP Radio with the Hex-head Connector

Follow the steps in this section to properly connect the cable to the SPP via the hex-head bulkhead connector.

Components

Open the bulkhead connector kit and arrange the components as shown in the following figure. In the figure, the two principal connectors are labeled *A* and *B* respectively.

NOTE:

Two cable bushings are included; **choose one** to fit the outside diameter of the Ethernet cable being connected to the SPP. Additionally, a **spare gasket** is included; use the gasket **only** if the factory installed gasket is lost or visibly damaged.

NOTE:

Figures in this section depict only one of the bushings. The procedures apply equally to **either** bushing.

Figure 6.5. Components used with the hex-head bulkhead connector

Step-by-Step Procedures

1. Remove the factory installed hex-head cap from the bottom of the SPP and set it aside. The cap may be discarded after the cable has been completely connected.

Figure 6.6. Remove the factory-installed cap

2. Carefully inspect the factory installed gasket seated on the bulkhead connector. Ensure the gasket is seated smoothly and uniformly on the connector with the ridged edge of the gasket facing outward.

Figure 6.7. Inspect the factory-installed gasket

Replace the gasket if it does not uniformly seat or shows signs of fatigue or wear. (When replacing an SPP, always use a new gasket.)

NOTE:

Use gaskets from Sensys Networks only. Never substitute a different gasket; doing so exposes the device to environmental risk and voids the product warranty.

Figure 6.8. Replace damaged or used gaskets

3. Thread the cable through the *Connector* A as shown in the following figure.

Figure 6.9. Thread cable through connector A

4. Thread the cable through *Connector* B as shown in the following figure.

Figure 6.10. Thread cable through connector B

5. Inspect the outer diameter (OD) of the Ethernet cable. Use the following chart to select one of the provided bushings based on the cable OD.

NOTE:

Use only one bushing. Discard the other bushing after the job is complete.

OUTER DIMENSION OF ETHERNET CABLE
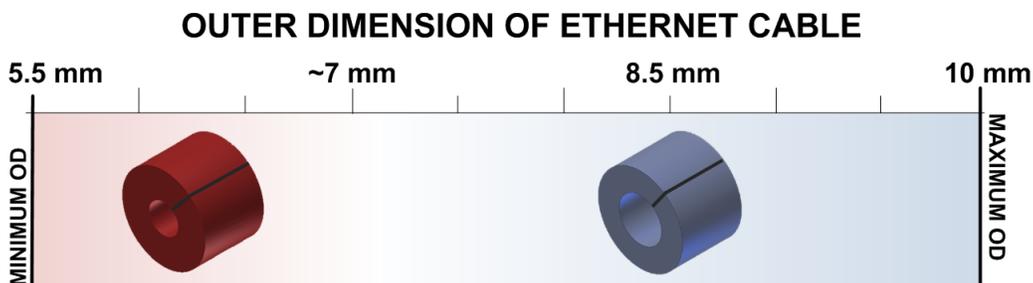
Figure 6.11. Ethernet cable bushing chart (not to scale)

6. Fit the bushing onto the cable between *Connectors A* and *B* as shown in the following figure. Proper fit is achieved when the bushing fully closes around the cable with no gap at the cut.

Figure 6.12. Fit bushing onto cable between connector A and connector B

Proper Fit (little to no gap between edges of cut)
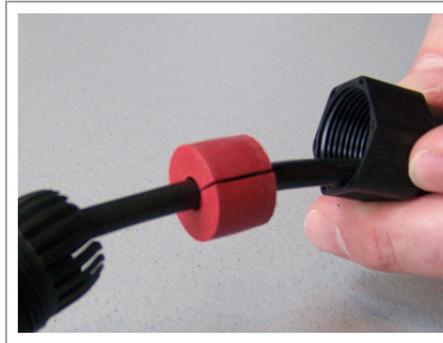
Figure 6.13. Correct fit: bushing closes fully around cable with little or no gap

Improper Fit (gap between edges of cut)
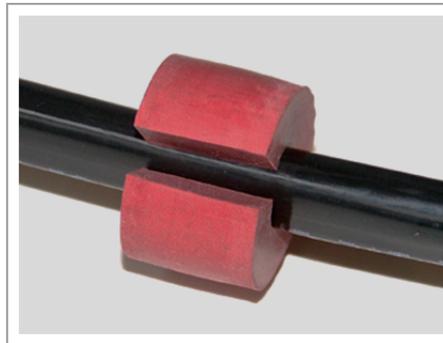
Figure 6.14. Incorrect fit: bushing does not close fully around cable leaving large gap

7. Connect the cable to the RJ45 input jack on the bottom of the SPP.

Figure 6.15. Connect cable to input jack

8. Thread *Connector B* onto the hex-head nut on the bottom of the SPP and tighten by hand until it no longer turns easily.

NOTE:

Snug *Connector A* down by hand. **Do not over-tighten or use tools.**

Figure 6.16. Thread connector B onto the SPP and hand tighten

9. Slide the cable bushing toward the SPP and fully insert it into the guide fingers on *Connector B* as shown in the following figure. Proper fit is achieved when the edge of the bushing is flush with the edge of the guide fingers.

Figure 6.17. Slide cable bushing fully into connector B

Proper Fit (bushing fully seated into guides)

Figure 6.18. Proper fit of cable bushing into connector B

Improper Fit (bushing poorly seated into guides)
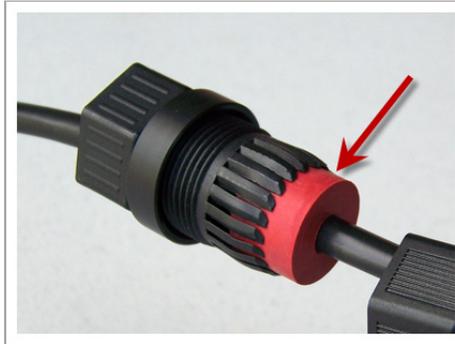
Figure 6.19. Improper fit of cable bushing into connector B

10. Thread *Connector A* onto *Connector B* and tighten by hand until it no longer turns easily.

NOTE:

Snug *Connector A* down by hand. *Do not over-tighten or use tools.*

Figure 6.20. Thread connector A onto connector B and hand tighten

11. Inspect the seating of the bushing by looking at it from the exposed cable end of *Connector A*. Proper fit is achieved when all of the following conditions are met:

 - bushing edge is recessed 1/8" to 1/4" below the lip of *Connector A*
 - bushing face is smooth - not puckered or pinched
 - bushing face does not protrude out of *Connector A*

Proper Fit (recessed bushing, smooth face)

Figure 6.21. Proper fit of the cable bushing inside connector A

Improper Fit (bushing not recessed, pinched edge, mushroomed face)
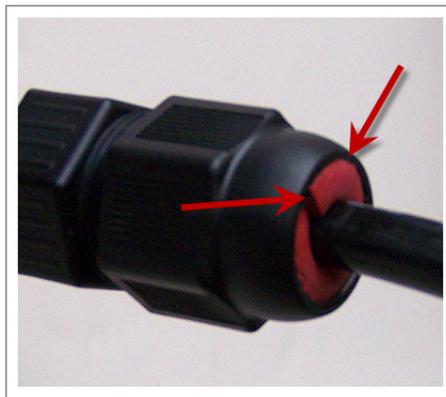
Figure 6.22. Improper fit of the cable bushing inside connector A

Figure 6.23.

Removing the Cable Connection

Perform procedure above in reverse to remove the cable from the SPP.

Configuration

This chapter explains how to configure channels and other operating elements of contact closure cards in the APCC and EX cards.

NOTE:

Prior to configuring channels, ensure that each contact closure card has been given a unique Card ID. Refer to the *Identifying the SPP and Sensors* section in the *Installation Considerations* chapter for more information.

Overview

Each channel of an APCC or EX card is configured separately. Configuring a channel consists of the following activities:

- Enabling (or disabling) the channel
- Specifying the channel mode
- Setting a presence mode modifier (optional)
- Specifying the type of communication used to disclose channel status

Additionally, after channel configuration is completed, TrafficDOT is used to define the sensor-to-channel mappings stored on the APCC.

After all configuration work is complete, including definition of sensor-to-channel mapping entries for all channels, Sensys Networks recommends verifying the operation of each channel using the front-panel channel LEDs.

Configuration Methods

Configuration occurs through two mutually exclusive choices: (*i*) the card's front-panel interface or (*ii*) with TrafficDOT, the system management application from Sensys Networks. This chapter includes the following sections:

- *Configuring Channels With the Front-Panel Interface*
- *Starting TrafficDOT and Connecting to an APCC*
- *Configuring Channels with TrafficDOT*
- *Defining Sensor-to-Channel Mappings*
- *Exiting TrafficDOT*

Configuring Channels With the Front-Panel Interface

After completing the configuration of all channels, continue setting up the APCC by starting the TrafficDOT software utility and defining the sensor-to-channel mappings.

NOTE:

If the APCC is configured with TrafficDOT, this section can be ignored.

General Procedure

The general procedure for configuring channels via the front-panel is provided below. Examples of specific configuration activities are included in the following sections. The steps are as follows:

1. Select a channel.

2. Move dip switches (as required) to represent the desired settings.

3. Press the **MASTER RESET** button on the card front-panel and hold it down for a minimum of five seconds.
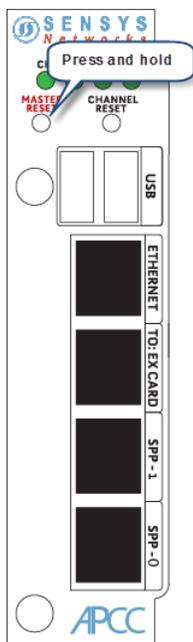
Figure 7.1. Configuration via the front-panel interface

Saving the Configuration

After the *MASTER RESET* button is pressed, the *LINK* LED flashes. When the flashing stops, the settings have been stored in flash memory.

The sections below give examples of setting specific configurations via the front-panel interface. The procedures may be performed in any order or combination.

Enabling / Disabling a Channel

APCC and EX cards ship with channels one and two enabled. Sensys Networks recommends explicitly disabling all unused channels.

Follow these steps to enable or disable a channel.

1. Position front-panel dip switch 8 to the left to enable (to the right to disable) the channel.

Figure 7.2. Enabling (disabling) a channel with front-panel dip switch 8

2. Press the **Enter** button for five seconds to save the configuration to flash memory or continue with other configuration activities described in this section.

Specifying the Channel Mode

Contact closure cards operate in either pulse or presence mode. (Refer to the *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide* for information about the operating modes.)

Follow these steps to specify the operating mode of the channel.

1. Position front-panel dip switch 7 to the left to select presence mode or to the right to select pulse mode.
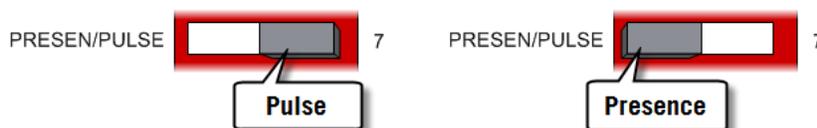
Figure 7.3. Selecting the channel operating mode with front-panel switch 7

2. Press the **Enter** button for five seconds to save the configuration to flash memory or continue with other configuration activities described in this section.

Setting a Presence Mode Modifier (Optional)

Channels operating in presence mode may use a modifier to delay the onset of or extend the duration of a contact closure. The modifier type and scope is specified using front-panel dip switches five and six together. (Refer to the *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide* for more information.)

Using Delay and Extension

When *Delay* or *Extension* are specified, the rotary dial is used to articulate the numeric value associated with the parameter.

When *Delay* is specified, the value set on the rotary dial is taken directly. This allows the 16-step rotary switch to represent values from 0 to 15.

When *Delay+16* is specified, the value set on the rotary dial is incremented by 16. This allows the 16-step rotary switch to represent values from 16 to 31.

When *Extension* (EXTN / 2) is specified, the value set on the rotary dial is divided by 2. This allows the 16-step rotary switch to represent values from 0 to 7.5 in ½ step increments.

Specify a contact closure delay or extension for channels operating in presence mode by following these steps:

1. Position front-panel dip switches 5 and 6 and the front-panel rotary switch to reflect the desired modifier and scope value. Use the figure below as a guide.
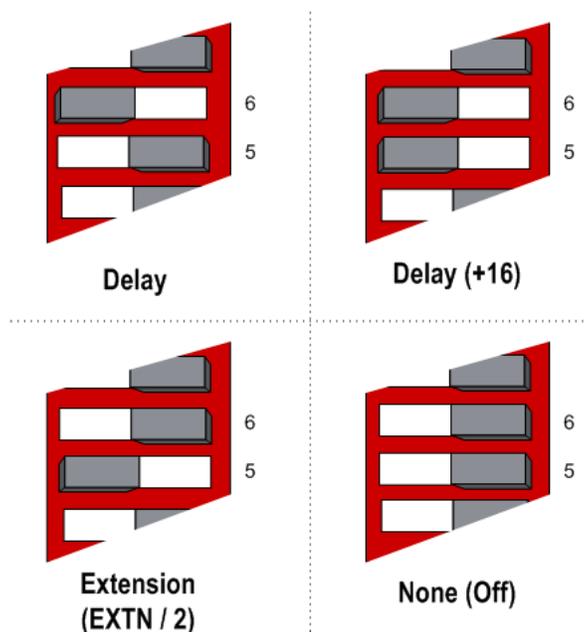
Figure 7.4. Setting a delay or extension with front-panel dip switches 5 and 6 (rotary switch not shown)

NOTE:

This step is optional; set both dips to right-hand position to disable the feature. Additionally, front-panel switches 5 and 6 are ignored for channels operating in pulse mode.

2. Press the **Enter** button for five seconds to save the configuration to flash memory or continue with other configuration activities described in this section.

Specifying the Type of Communication Used by the Channel Status Monitor

Contact closure cards indicate the status of each channel via the front-panel LEDs. The state of an LED corresponds directly to the channel state. When the LED is on, the channel relay is closed indicating a call. When the LED is not on, the channel relay is open.

Additionally, a contact closure card can be set such that closed channel relays activate an audible tone (buzzer) as well as the front-panel LED for the channel. The audible channel status tone is set via front-panel dip switch one as follows:

1. Position front-panel dip switch 1 to enable or disable the audible channel status monitor. Use the figure below as a guide.

Figure 7.5. Setting the channel monitor buzzer with front-panel dip switch 1

2. Press the **Enter** button for five seconds to save the configuration to flash memory or continue with other configuration activities described in this section.

Starting TrafficDOT and Connecting to an APCC

TrafficDOT is a configuration manager and monitoring tool for an access point and all its associated devices (sensors, repeaters, and contact closure cards). TrafficDOT provides a graphical user interface (GUI) to the network's devices, settings, and operations. The GUI simplifies both configuration and management of installations.

TrafficDOT requires an IP network connection to the APCC. When configuring contact closure cards, the connection is made by cabling a laptop to an APCC or EX card. (Refer to the section *Cabling Summary* in Chapter 5 for additional information.)

NOTE:

Refer to the *TrafficDOT Set Up and Operating Guide* for a more information on using TrafficDOT with the Sensys Networks Wireless Vehicle Detection System.

Connect to the APCC with TrafficDOT by following these steps:

1. On a Windows laptop or PC, start TrafficDOT by clicking its icon. TrafficDOT's *Main* window opens with the *Connect* window open in front of it.
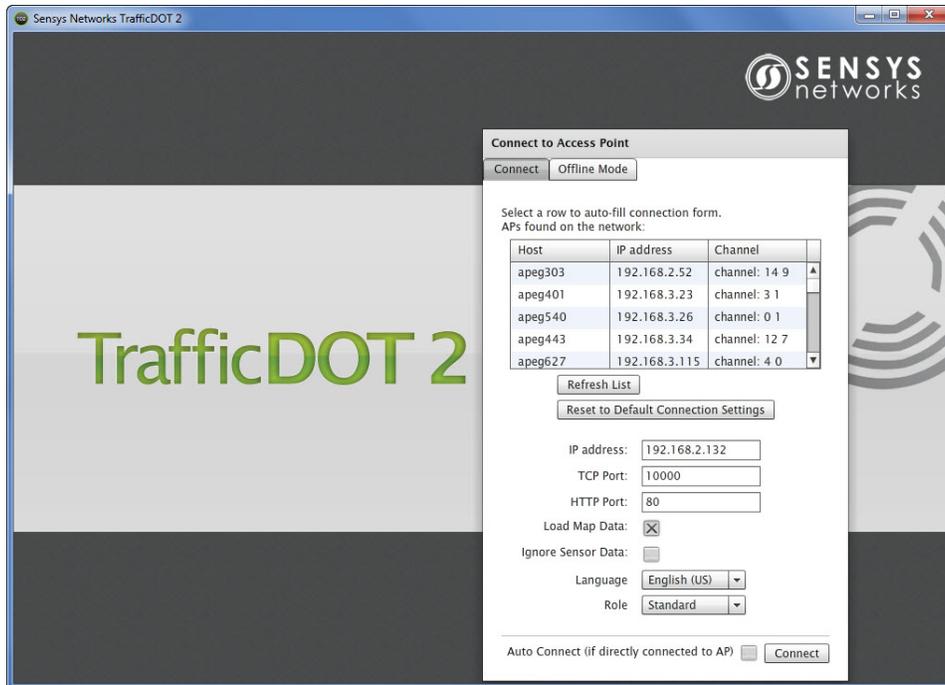
Figure 7.6. TrafficDOT Main and Connect windows

2.   Type the IP address of the APCC into the *IP Address* field and accept the default value in the *TCP Port* field. Click **Connect**.

3.   After clicking **Connect**, wait a moment for the *Main* window.
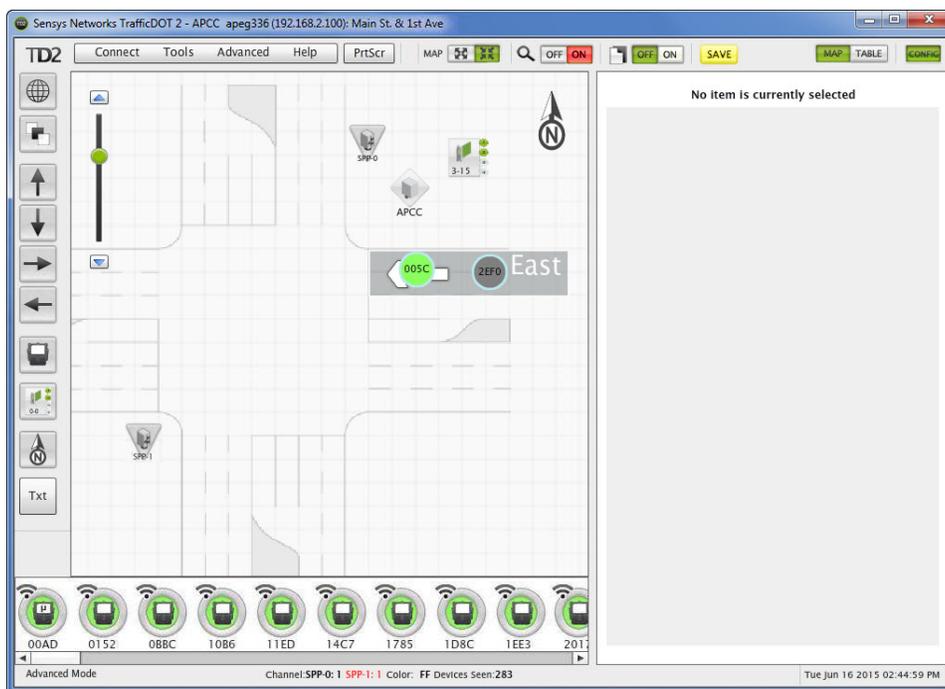
Figure 7.7. Map view

Configuring Channels with TrafficDOT

To select an controller card for configuration, click a controller card on your image map. The *Controller Card Configuration* window displays.

Figure 7.8. Controller Card Configuration window

Entering controller card information

To enter controller card information, select the controller card image on the map and enter the information into the *Configuration Panel*, or drag and drop a sensor onto the controller card icon, and then enter the information.

Figure 7.9. Controller Card Channels tab

Configuring Channel State

Contact closure card channels are independent of one another and are individually configured. Each channel occupies one of the following states:

- *Enabled* – the channel is operational; Sensor event data collected by the access point is transmitted to the contact closure card.

- *Disabled* – the channel is not operational. (When a channel is disabled, its contact closure relay and status relay are continuously open.)

The factory default configuration enable channels one and two. Ensure that any unused or unavailable channels are disabled.

Configuring Channel Mode

Enabled channels operate in one of the following modes:

- *Pulse* – the contact closure relay pulses for 0.125 seconds each time the leading edge of a vehicle is detected.

- *Presence* – the contact closure relay remains closed while a vehicle is detected.

The factory default setting is *pulse* mode.

Configuring Presence Mode Modifier

The behavior of a channel operating in presence mode may adjusted by applying one of the following modifiers:

- *Delay* – defers the onset of the contact closure by a specified duration. If a vehicle moves off of the sensor before the specified delay expires, the contact does not close. Delay is expressed in seconds from zero to 31.

- *Extension* – increases the duration of the contact closure by a specified increment. Extension is expressed in half-seconds from zero to 7.5.

The modifiers do not apply to channels operating in *pulse* mode.

Configuring Channel Holdover Duration

The *Channel Holderover* parameter allows an extension to the channel holdover duration when it is activated by the events from a particular sensor. Values from 0.0 to 0.75 are available for selection.

Defining Sensor-to-Channel Mappings

To map sensors to an APCC or EX card, perform the following steps:

1. Select a sensor from the image map.

2. Open the *Card Addresses* window by clicking the **Card Addresses** tab.

The *Extension* entry extends the duration of an APCC or EX card on a per-sensor basis. The *Delay* entry delays the duration of an APCC or EX card on a per-sensor basis; these entries are optional.

The *shelf number-slot number* is a card address associated with an APCC or EX card, and *channel* is between 1 and 4.

Figure 7.10. Card Addresses window

3. Select a *Shelf* number, a *Slot* number, and a *Channel* from the drop-down lists.

NOTE:

The **C** button clears the data in that row.

4. Click **Apply** to save configuration.

NOTE:

To assign a sensor to multiple controller channels, supply entries to the additional *Card Addresses* areas.

Exiting TrafficDOT

End the TrafficDOT session by selecting *Disconnect* from the *Connect* menu.

X Mode LED Displays for Slot Numbers

This appendix depicts the channel LED displays when an APCC operates in X mode.

When a card is configured in X mode, the front-panel channel LEDs display one of the patterns shown in the figure below. Match the pattern of the front-panel channel LEDs to a pattern in the figure. Use the corresponding value found under the heading Address as the slot-number portion of the Card ID. (Refer to *Examples* after the figure.)

Figure A.1. Channel LED display / slot number combinations

Examples

1. All fours channel LEDs lighted indicates *slot number* 15.
2. Single lighted LED on channel 2 indicates *slot number* 4.

Circuit-board Dip Switch SW1 Settings

This appendix depicts combinations of switch settings on the circuit-board dip switch SW1.

Settings for Shelf Number

The figure below depicts SW1 settings that identify the shelf number portion of the unique card address.

NOTE:

The small, slide switches are referred to by number [1-4] starting with the left-most switch. Switches three and four of SW1 are not used in setting the *shelf* number.
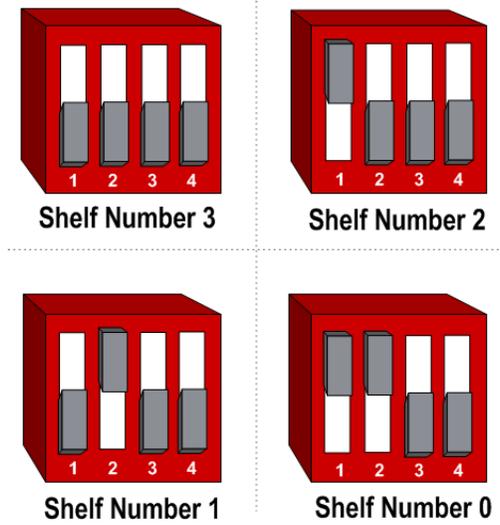
Figure B.1. SW1 settings for shelf number (switches 1 and 2 only)

Settings for TS1 and TS2 Controllers

The following figure depicts SW1 settings that identify the type of traffic controller. Type 170 and TS1 controllers are set the same way.
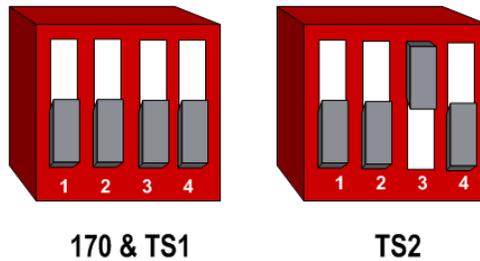
Figure B.2. SW1 settings for TS controller types (switch 3 only)

NOTE:

Slide switches one, two, and four are not used in setting the controller type.

Circuit-board Dip Switch SW2 Settings

This appendix depicts combinations of switch settings on the circuit-board dip switch SW2.

Settings for Slot Number

Circuit-board switch SW2 is used to designate the *slot number* portion of a contact closure card's Card ID. The switch combinations and the slot number values they represent are shown in the following figure. (Slot number values appear beneath the switches.)
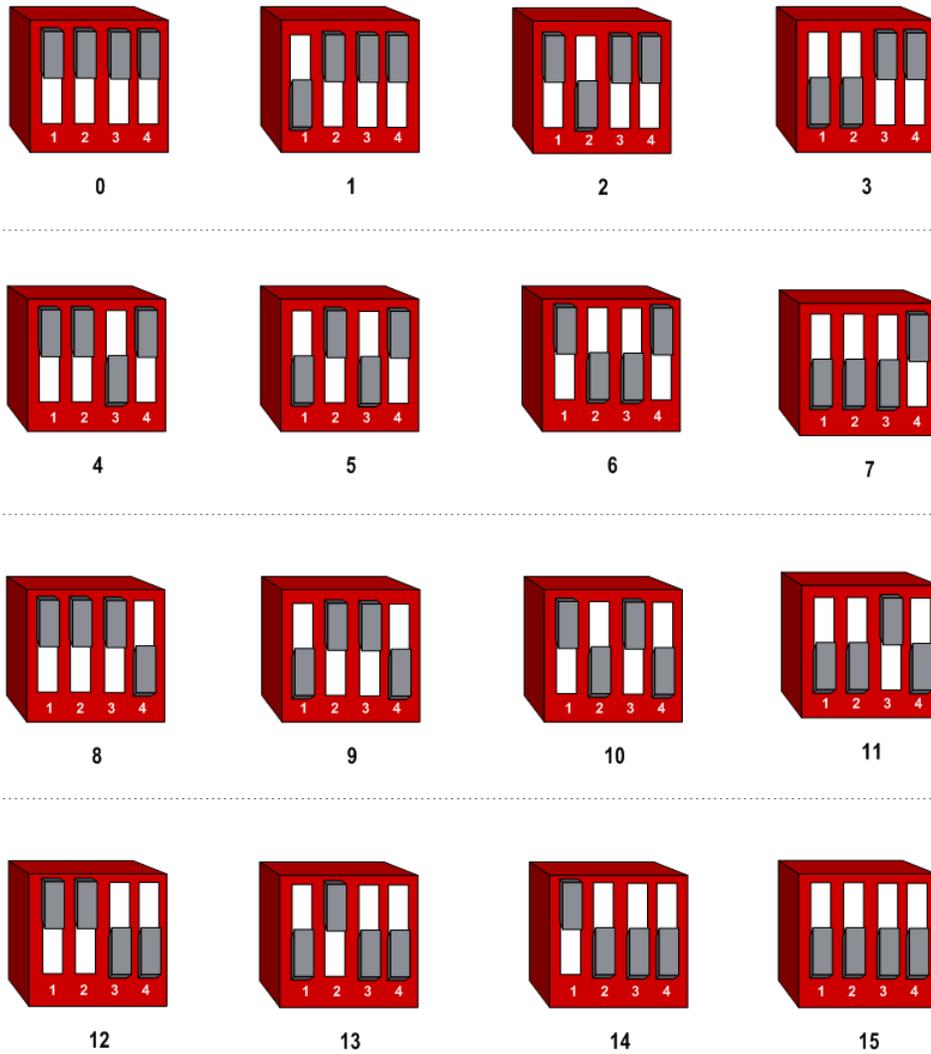
Figure C.1. SW2 settings for slot number

Pre-Installation Worksheets

This appendix provides worksheets for capturing pre-installation information. Refer to the chapter *APCC Installation Considerations* for more information.

Configuration Element	Options	Value
1. Card identifier	(*Defined by the traffic controller or installer*)	
2. Channel	**1**, 2, 3, 4	
3. Channel State	Enabled | **Disabled**	
4. Channel Mode	**Pulse** | Presence	
4a. Presence Mode Modifier	(*applicable only to channels in presence mode*)	
4b. Modifier Type	**None** | Delay | Expansion	
4c. Modifier Duration	0 – 31 seconds in 1 sec increments (Delay) 0 – 7.5 seconds in 0.5 second increments (Expansion)	
5. Channel Holdover Setting	0 -.75 seconds in .05 second increments	
6. Channel Status Communications	**LED-only** | LED and Tone	
Other Information (Optional)		
APCC identifier	(from APCC)	

Configuration Element	Options	Value
Distance from Sensys APCC (without Isolator)	328 feet (100 meters) - 10BaseT	
List of Wireless Sensor for the Channel	(*use SensorIDs of each sensor*)	

Table 4. Channel configuration worksheet

Card ID	Channel (1 - 4)	Sensor ID	Channel Extension (opt.)	Location / Lane / Description (opt.)

Table 5. Sensor-to-channel mapping worksheet

Contact Closure Card External Interfaces

This appendix shows the connector pin assignments for the external interfaces of contact closure master and expansion cards.

Sensys Networks, Inc.

Backplane Edge Connections

Pin	Function (TS1 mode)	Function (TS2 mode)
1	Not connected	Channel 1 Delay enable
2	Not connected	Channel 2 Delay enable
3	Address 3	Address 3
4	Daisy chain RS485 Uplink +	Daisy chain RS485 Uplink +
5	Daisy chain RS485 Uplink -	Daisy chain RS485 Uplink -
6	Address 0	Address 0
7	Not connected	Channel 1 status
8	Daisy chain RS485 Downlink +	Daisy chain RS485 Downlink +
9	Daisy chain RS485 Downlink -	Daisy chain RS485 Downlink -
10	Address 1	Address 1
11	AC power neutral	AC power neutral
12	AC power line	AC power line
13	Not connected	Not connected
14	Not connected	Not connected
15	Address 2	Address 2
16	Not connected	Channel 3 status
17	Not connected	Not connected
18	Not connected	Not connected
19	Not connected	Not connected
20	Not connected	Channel 2 status
21	Not connected	Not connected
22	Not connected	Channel 4 status
A	GND	GND
B	24V	24V
C	Reset input	Reset input
D	Not connected	Not connected
E	Not connected	Not connected
F	Channel 1 collector	Channel 1 collector

Pin	Function (TS1 mode)	Function (TS2 mode)
H	Channel 1 emitter	Channel 1 emitter
J	Not connected	Not connected
K	Not connected	Not connected
L	Chassis Ground	Chassis Ground
M	AC power neutral	AC power neutral
N	AC power line	AC power line
P	Not connected	Not connected
R	Not connected	Not connected
S	Channel 3 collector	Channel 3 collector
T	Channel 3 emitter	Channel 3 emitter
U	Not connected	Not connected
V	Not connected	Not connected
W	Channel 2 collector	Channel 2 collector
X	Channel 2 emitter	Channel 2 emitter
Y	Channel 4 collector	Channel 4 collector
Z	Channel 4 emitter	Channel 4 emitter

Table 1.(continued from prior page) Backplane edge connections

Notes

1. Pins G, I, O, and Q are not implemented.

IN RJ45 Connector Pin Assignments

Pin	Function on CC Card	Function on EX Card
1	Not connected	Daisy Chain RS485 Downlink +
2	Not connected	Daisy Chain RS485 Downlink -
3	Not connected	Daisy Chain Uplink +
4	RS485+	Not connected
5	RS485-	Not connected
6	Not connected	Daisy Chain RS485 Uplink -
7	+48V	Not connected
8	48V Return	Not connected

Table 2. IN RJ45 connector pin assignments

OUT RJ45 Connector Pin Assignments

Pin	Function on CC and EX Cards
1	Daisy Chain RS485 Downlink +
2	Daisy Chain RS485 Downlink -
3	Daisy Chain RS485 Uplink +
4	Not connected
5	Not connected
6	Daisy Chain RS485 Uplink +
7	Not connected
8	Not connected

Table 3. OUT RJ45 connector pin assignments