Sensys Networks VDS240 Wireless Vehicle Detection System

Access Point Controller Card Installation Guide

P/N 152-240-030-005 Rev A
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Sensys Networks
2560 Ninth Street, Suite 219
Berkeley, CA 94710
www.sensysnetworks.com

Contents

Document Properties

This document is reference material for the Sensys Networks VDS240 wireless vehicle detection system from Sensys Networks, Inc.

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

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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.

The users manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

To comply with FCC's RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter."

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)
- Repeaters (RP240-B, RP240-BH, RP240-B-LL, and RP240-BH-LL)

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 (batteries 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 battery cell: http://www.able-battery.com/msds/ABLE_MSDS_ER14505.pdf
- Repeater battery cell: http://www.able-battery.com/msds/ABLE_MSDS_ER34615.pdf

Document Control

Sensys Networks continually reviews and revises its technical publications Please address questions, suggestions or corrections to support@sensysnetworks.com.

Contact Information

Sensys Networks, Inc.
2560 Ninth Street, Suite 219
Berkeley, CA 94710 USA
+1 (510) 548-4620
www.sensysnetworks.com

CHAPTER 1
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 setting up an APCC for a particular site.

Other Documents

General and Reference Information

- *Sensys Networks VDS240 Wireless Vehicle Detection System – System Overview*
- *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide*

Freeway and Arterial Applications

- *Design Guidelines for Freeway & Arterial Applications*
- *Configuration Guidelines for Freeway & Arterial Applications*
- *Installation Guidelines for Freeway & Arterial Applications*

Intersection Applications

- *Design Guidelines for Intersection Applications*
- *Configuration Guidelines for Intersection Applications*
- *Installation Guidelines for Intersection Applications*

Installation and Removal Procedures

- *Wireless Sensor Installation Guide*
- *Access Point Installation Guide*
- *Repeater Installation Guide*

Application Notes

- *Installing Sensys Networks Sensors Beneath the Road Surface*

Sensys Management Server

- *SNAPS Server Set Up and Operating Guide*

Readers of this document are encouraged to contact Sensys Networks, Inc. for the latest technical information, design guides, and best practices.

CHAPTER 2
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 access points that collect and forward 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 CC cards and are daisy-chained to a CC card by front-panel RJ45 jacks or backplane connectors. Up to 63 EX cards can be used per CC 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, and an optional second serial port or built in cellular modem.

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.

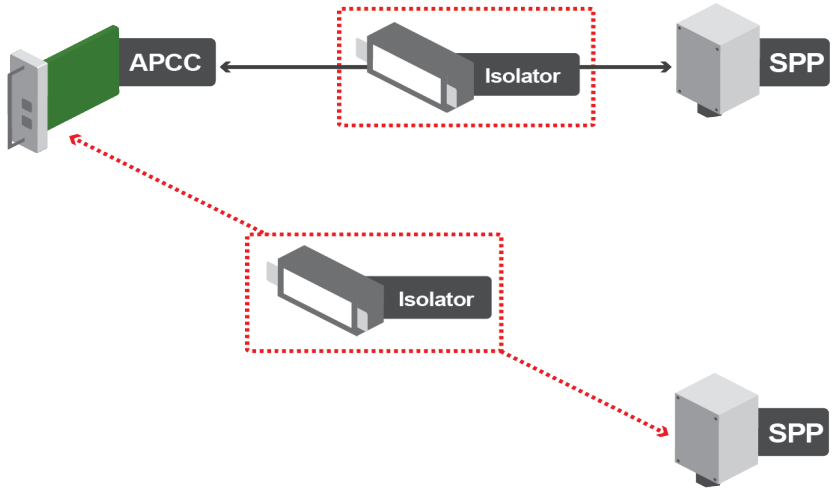

Figure 2-1: APPC system configuration

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.

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
- provides a wired port for IP network access (suitable for network configuration, management and data acquisition)

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-MP	APCC Module, Peripheral Support (I/O Board without modem)
APCC-MP-A	APCC Module, Peripheral Support (I/O Board with modem)
EX-170	Expansion Card for Type 170, Type 2070 (2/0 relay), or NEMA TS1 traffic controllers
EX-TS2	Expansion Card for Type 2070 or NEMA 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 (either Ethernet or serial port configuration)
- "Tool less" push/pull Ethernet bulkhead connector
- Power-over-Ethernet (PoE) injector
- 48V power supply
- Universal mounting kit
- Information sheet (one per device)

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, see Figure 2.2)

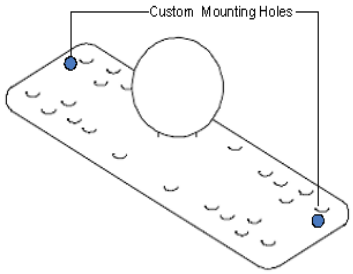

Figure 2-2: Factory installed ball plate (rectangular)

- Surface mounting ball plate (square, see Figure 2.3)

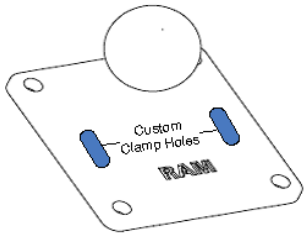

Figure 2-3: Surface (wall/beam/pole) mounting ball plate (square)

- Double socket arm (see Figure 2.4)

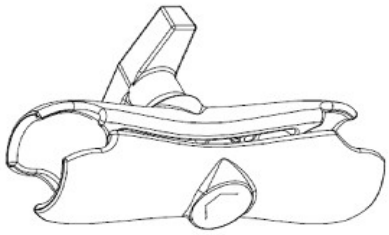

Figure 2-4: Double socket arm

- 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 (*see Notes below*)
- RJ45 jack kit and crimp tool
- Cable ties
- PC or laptop with Microsoft Windows (XP, Vista, 2007) and TrafficDot, the system management software tool from Sensys Networks.

> **Note**: Access points are available with a range of options. Verify that the access point you are using with the contact closure card(s) is appropriate for that use.

Notes

1. Cabling – a minimum of two 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. APCC and EX cards may also be configured via the switches on their front panel obviating the need for a laptop PC and TrafficDot.

CHAPTER 3
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.
2. Determine the configuration of the APCC.
3. Determine the number of available slots in the traffic controller's detector shelf and which contact closures are required.
4. Develop the sensor-to-contact closure card mappings.

Identifying the SPP, Access Points and Sensors

SPP

Each APCC must connect to an SPP. This connection supplies power to the an SPP and passes command and configuration data to/from the APCC. There is a one-to-one relationship between access points 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 for RS422 communication .

Access Points

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

Determine the location of the access point relative to the cabinet that will hold the APCC. The cable that connects to the access point to the APCC must meet standard length limitations for Ethernet over CAT5 (or better) cable. (See the *Installation Procedures* chapter for more information.)

> **Note**: The APCC is are never directly connected to a access point. EX cards are daisy-chained together with the APCC at the head-end of the chain.

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.

> **Note**: Wireless sensor have a unique identifier know as the SensorID. 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 or LED with audible tone) used by each channel

Refer to the *Sensys Networks VDS240 Wireless Vehicle System Reference Guide* for more information of the topics above.

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*.)

Channel Configuration Worksheet

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
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)		
Access Point identifier	*(from Access Point)2 SNAPS 2.4 Online Help N/A Update Just-in-Time Help and provide new help for new application pages. M. Bunshaft 02-21-11 02-28-11 03-08-11 100% Online help is complete and integrated into the application.*	192.2.68.100
Distance from Access Point	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. (See the *Installation Procedures* chapter for more information on setting the Card ID.)

Mapping Wireless Sensors to Contact Closures

The final installation consideration for 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 with *TrafficDot*, the Sensys Networks system management application.

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

Sensor-to-Channel Mapping Worksheet

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.

Chapter 4
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
- Determining the Location of the SPP

Each consideration is discussed below. In addition, refer to the *Sensys 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 access point 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.

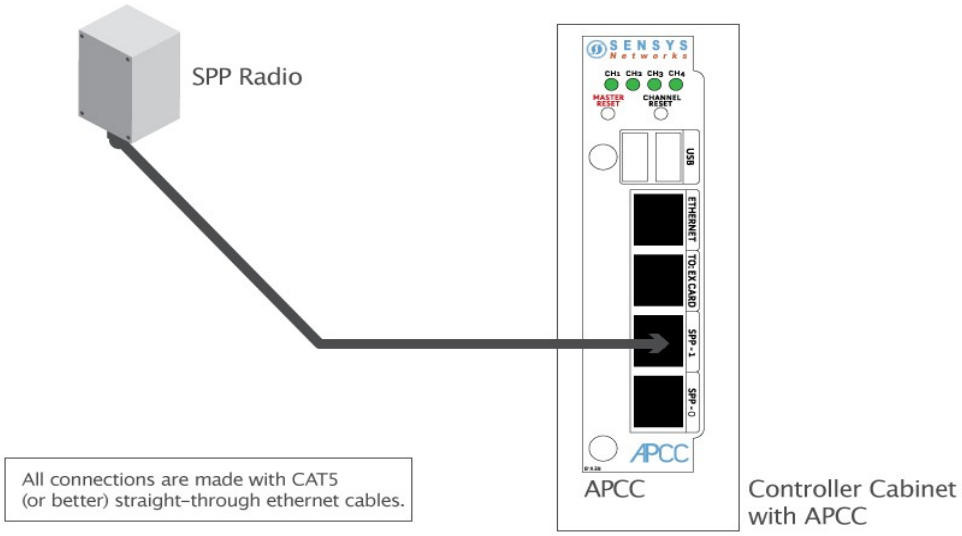

Figure 3.1 – SPP radio powered from a traffic controller

Acquiring Power Form Traffic Controller Using an Isolator

An optional isolator can be used when acquiring power from the traffic controller as shown in following figure.

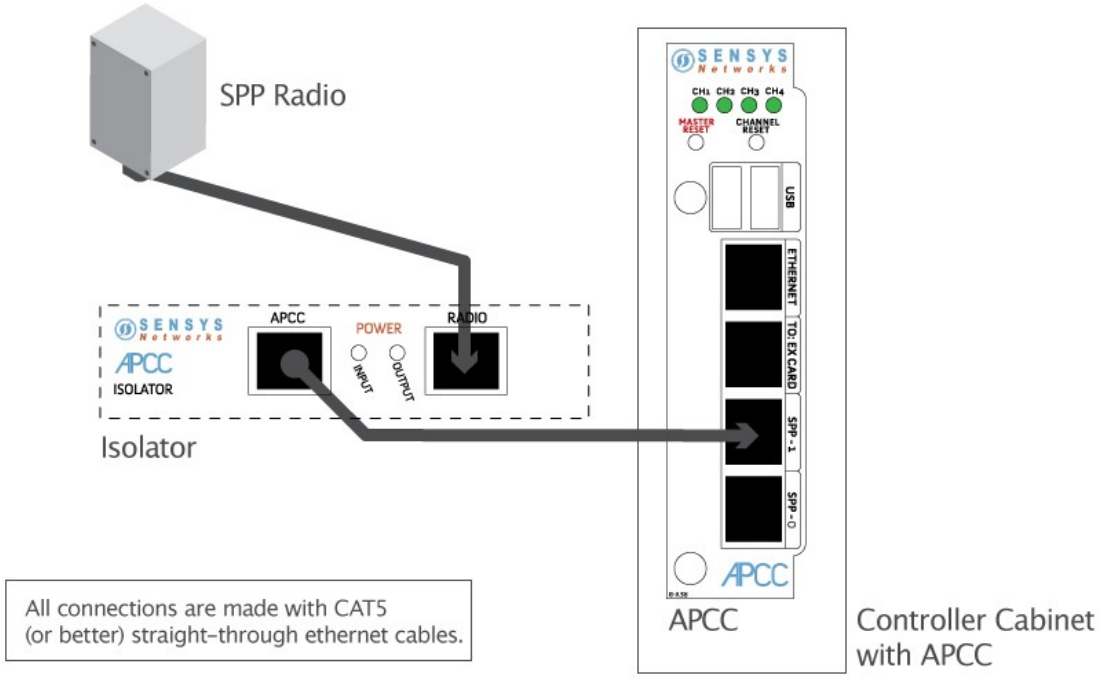

Figure 3.2 – SPP radio powered from a traffic controller

Voltages

Access points use the following voltages drawn from one of the following sources:

- 36VDC – 58VDC (48VDC nominal) - typically supplied from a nearby traffic controller cabinet or power pole
- 10VDC – 20 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 100 meters (328 feet). The cable should be terminated with RJ45 connectors according to the TIA/EIA 568-B specification when it is installed.

Note: The outside diameter of the cable is an important attribute. The cable's OD is used to select the proper bushing for the access point's bulk head connector on access points manufactured after May 2010.

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 access point 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 the APCC, (optional) isolator, and wireless sensors
- 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
- allow the SPP to face the APCC, (optional) isolator, and wireless sensors
- are within specified cable length limits
- do not submit the SPP to avoidable vibration, shaking or movement
- are reasonably accessible to field support personnel

CHAPTER 5
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 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 figure below. (Note that on the card, switches SW1 and SW2 are not as close to one another as shown in the figure.)

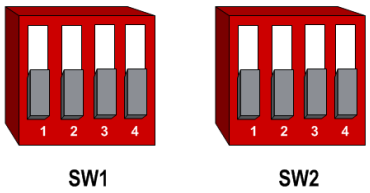

Figure 5.1 – Default Card ID (all dips down)

Before proceeding, ensure that switches SW1 and SW2 are set as in the figure above 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 1* 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 1*.

The address value that matches the LED display pattern (from *Appendix 1*) 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 1* 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 3* 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 2* 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 2* as a guide for setting switch 3 of SW1 to the proper value.

Connecting the Cables to Each Device

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

> **Note**: The steps below are for a system configuration that contains 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 “Radio” 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.

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.

Cabling Summary

The cabling to connect an APCC, SPP and laptop is shown in the following figure.

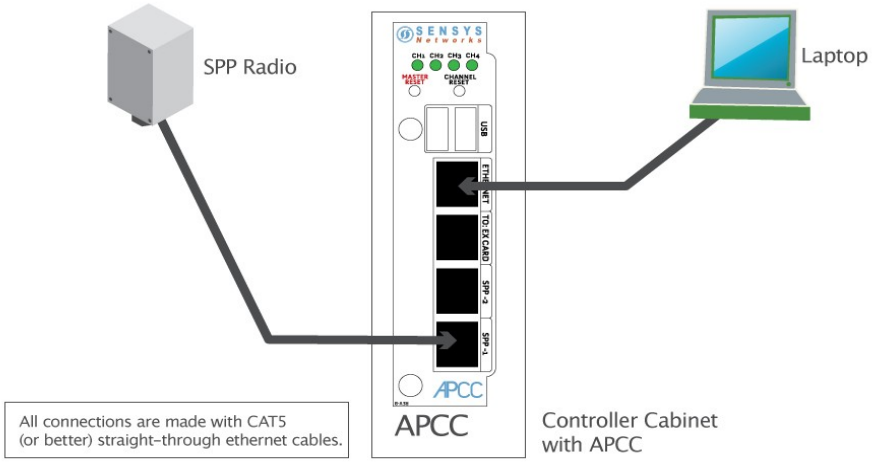

Figure 5.3 – Cabling a PC or Laptop

The cabling to connect an APCC, SPP, isolator, hub or switch, and laptop PC is shown in the following figure.

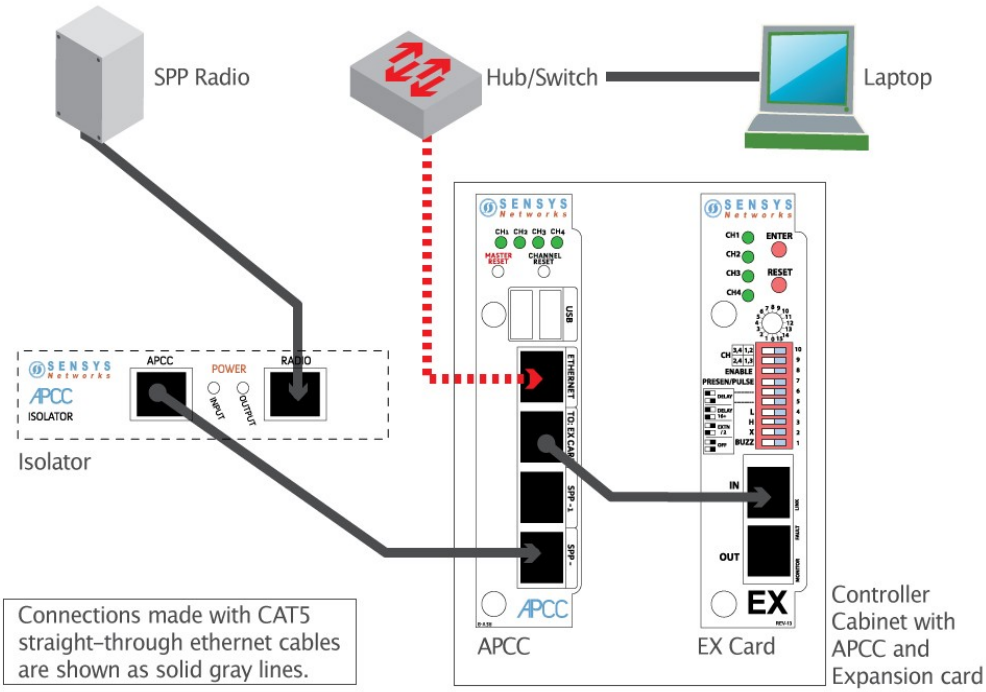

Figure 5.4 – Cabling an isolator and hub or switch to an APCC

CHAPTER 6
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.)

- *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.
- The cables connect the AccessBox to (*i*) field engineer's laptop (for SPP configuration) and

(*ii*) to the contact closure card in the 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.*
- *1 cross-over Cat5 Ethernet cable – optional*; approximately three feet in length; used to connect an AccessBox to an Ethernet switch/hub that is local to the controller cabinet. *Required only when a connection to a local hub/switch is specified.*
- *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 supplied by 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
- *Double-sided sticky tape* – attaches AccessBox to flat surface inside the controller cabinet

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. (See *Appendix 1* 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 (see figures below) 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 6-1: 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.

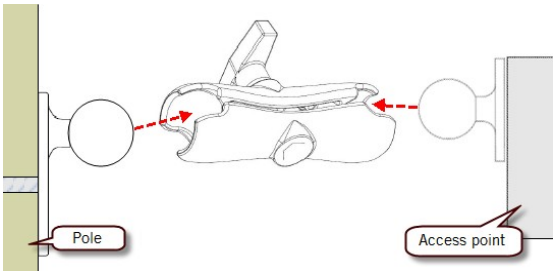

Figure 6-2: Double socket arm installation

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.

CHAPTER 7
Configuration

This chapter explains how to configure channels and 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 *Determining the Card ID* 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 the 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.

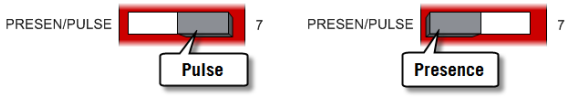

Figure 7.3 – Selecting the channel operating mode with front-panel switch 7

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.

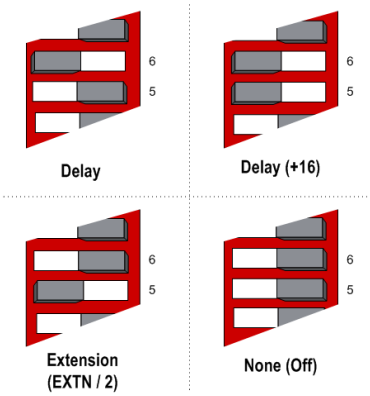

Figure 7.4 – Setting a delay or extension with front-panel dip switches 5 and 6 (Rotary switch not shown)

> **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.

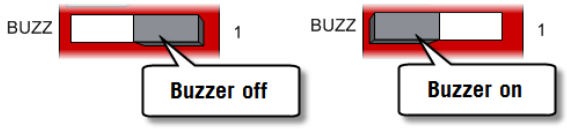

Figure 7.5 – Setting the channel monitor buzzer with front-panel dip switch 1

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 small, self-installing program that provides a graphical user interface (GUI) to the components of a Sensys Networks Wireless Vehicle Detection network. It is used to optionally configure contact closure cards and to define the sensor-to-channel mappings.

TrafficDot requires an IP network connection to the access point. Typically, when configuring contact closure cards, this connection is made by cabling a laptop to the "ACCESS" port of the AccessBox. (See the section *Cabling Summary* for additional information.)

See also the *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide* for a more discussion of using TrafficDot with the Sensys Networks Wireless Vehicle Detection System.

Connect to the access point 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.

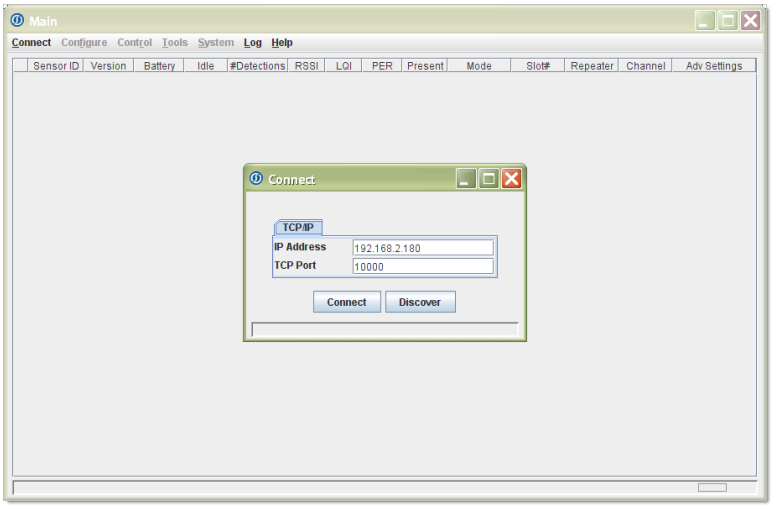

Figure 7.6 – TrafficDot Main and Connect windows

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

   If you do not know the address, click the *Discover* button.

Discovering Access Points

The *Discover* button queries the local network and opens a window that lists all access points on the network.

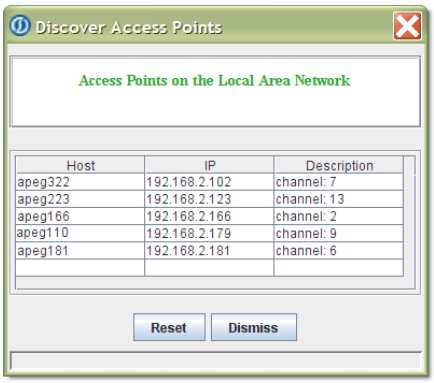

Figure 7.7 – Discover Access Points window

Make a note of the IP address of the access point you wish to connect to. Click *Dismiss* to close the window and return to the *Connect* window at Step 2.

> **Note**: It is not uncommon to see only one access point on the Discover Access Points window.

3. After clicking *Connect*, wait a moment for the *Main* window to populate with information about the network.

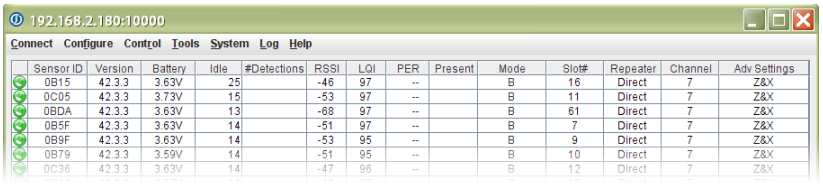

Figure 7.8 – Main window

Configuring Channels With TrafficDot

The general procedure for configuring APCC channels with TrafficDot is the same as for configuring other devices from Sensys Networks. (Refer to the *Sensys Networks VDS240 Wireless Vehicle Detection System Reference Guide* for information about configuring other devices from Sensys Networks)

Configuring devices with TrafficDot consists of the following activities:

- Opening the configuration windows
- Specifying the elements of the configuration
- Saving the configuration

Opening the Configuration Windows for Controller Cards

Configuration of contact closure cards is accomplished with the *Controller Card Configuration* window. Follow these steps to open it:

1. From the command menu on TrafficDot's main window, access the *Configure* menu and click *Controller Cards*.

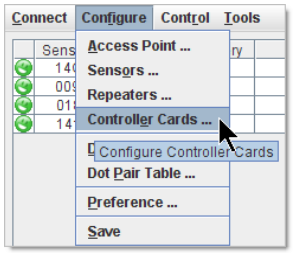

Figure 7.9 – Configure / Controller Cards menu

The *Controller Cards* window opens. The window lists all of the contact closure master and EX cards in the network.

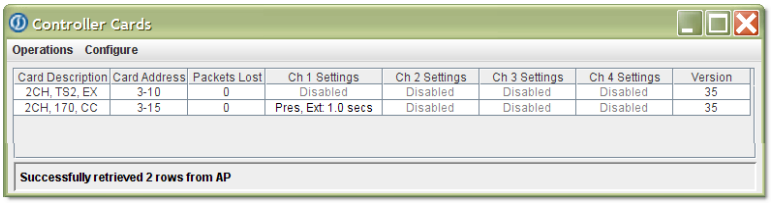

Figure 7.10 – Controller Cards window

2. From the command menu, select *Configure* and click *Controller Card Settings*.

Figure 7.11 – Configure / Controller Card Settings menu

The *Card Configuration* window opens.

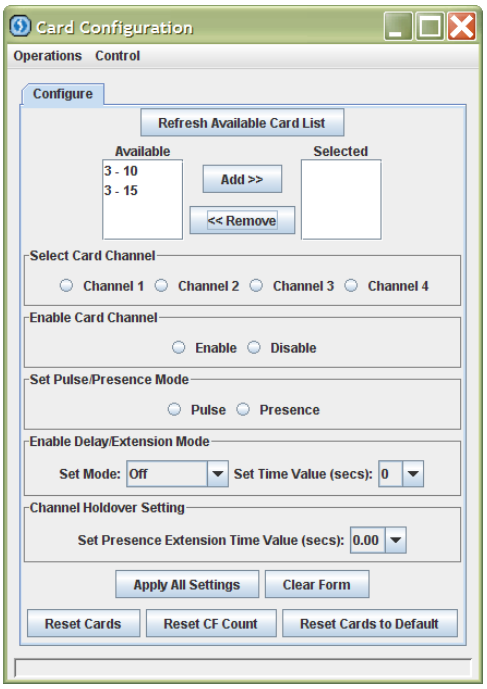

Figure 7.12 – Card Configuration window

Specifying the Elements of the Configuration

Specifying the elements of a contact closure card's configuration with TrafficDot involves the following:

- Selecting an APCC or EX card
- Selecting a channel
- Enabling (or disabling) a channel
- Specifying the channel mode
- Setting a presence mode modifier (optional)

Note: Enabling the audible channel status monitor is not supported with TrafficDot. Use front-panel dip switch 2 to select this option as described in the section Configuring Channels With the Front-Panel Interface above.

Selecting an APCC or EX Card to Configure

Before configuration can take place, a controller card must be selected. This is done by populating the scrolling list area labeled *Selected* with the Card ID of the target controller cards.

Available APCC or EX Card

The controller cards in the network appear in a scrolling list area labeled *Available*.

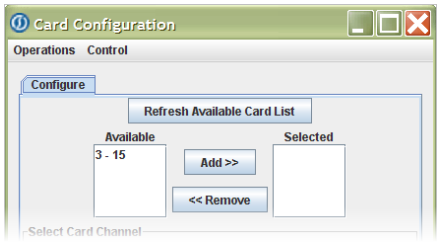

Figure 7.13 – Selecting a Controller Card to configure

Selecting and De-selecting APCC or EX Card

Controller cards are selected by moving their Card IDs from the *Available* list to the *Selected* list as follows:

1. From the *Available* list, click the Card ID of the target controller card.
2. Click the button labeled *Add* >>.

   The Card ID appears in the *Selected* list.

To remove Card IDs from the *Selected* list, do the following:

1. From the *Selected* list, click the Card ID of the target controller card.
2. Click << *Remove*.

   The Card ID is removed from the *Selected* list and appears in the *Available* list.

Selecting a Channel

The window area *Select Card Channel* displays radio buttons that correspond to the available channels on the controller card.

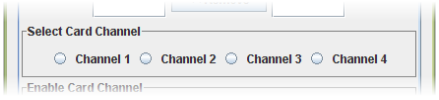

Figure 7.14 – Selecting a controller card channel

Select a channel to configure by clicking the radio button that appears to the left of the channel name. Only one channel may be selected.

Enabling and Disabling a Channel

The window area *Enable/Disable Card Channel* displays radio buttons that enable or disable the selected channel.

To enable the channel, click the radio button displayed to the left of the *Enable* label.

To disable the channel, click the radio button displayed to the left of the *Disable* label.

Specifying the Channel Mode

The window area *Set Pulse/Presence Mode* displays radio buttons that define the operating mode of the selected channel.

To select pulse mode, click the radio button displayed to the left of the *Pulse* label.

To select presence mode, click the radio button displayed to the left of the *Presence* label.

Setting a Presence Mode Modifier (Optional)

Channels operating in presence mode may be tuned through the use of a modifier. The window area *Enable Delay/Extension Mode* provides the following options:

- *Delay, Delay16+* – delays the onset of the contact closure by *n* seconds
- *Extension* – extends the length of a contact closure by *n* seconds

Delay

The implementation of delay uses two settings to maintain consistency with front-panel operations in regard to this setting. The first setting, *Delay*, allows the duration of the delay to be set between 0 and 15 seconds. The second, *Delay16+*, allows the duration to be set between 16 and 31 seconds.

Extension

Extension is implemented as a duration between 0 and 7.5 seconds, in .05 second increments.

To set a delay, select either *Delay* or *Delay16+* from the *Set Mode* drop-down list. To set an extension, select *Extension/2* from the *Set Mode* drop-down list.

The values of the *Set Time Value (secs)* automatically adjust based on the selection of either delay or extension.

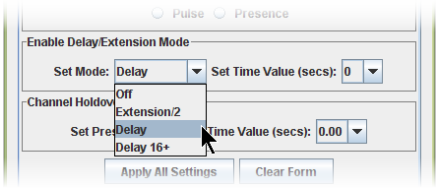

Figure 7.15 – Setting Delay or Extension for presence mode channels

Select an entry from both the *Set Mode* and *Set Time Value (secs)* drop-down lists.

Off

Select the *Off* value from the *Set Mode* drop-down list for channels in pulse mode, or for channels in presence mode that do not require a modification to their default behavior.

Channel Holdover Setting

This feature is not intended for customer use; set this value to zero.

Saving the Configuration

After configuration settings have been specified, save the configuration to device memory. Click *Apply All Settings* to save the configuration.

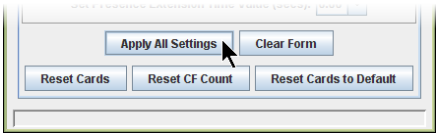

Figure 7.16 – Saving the configuration

Other Card Configuration Operations

The *Card Configuration* window provides other useful operations related to contact closure cards.

Command buttons at the bottom of the window perform the following:

- *Reset Cards* – sends a hardware reset command to each of the cards in the *Selected* list
- *Reset CF Count* – zeros the checksum failure counter on each of the cards in the *Selected* list.
- *Reset Cards to Default* – resets all cards in the Selected list to the factory default settings.

The *Control* menu includes an *Identify Card* option that when clicked causes a card's Link LED to blink rapidly for five seconds. This allows field service staff to easily match a card from the *Selected* list to the actual (physical) cards in a cabinet.

Defining Sensor-to-Channel Mappings

A database stored on the access point describes the associations between sensors and channels on the contact closure cards. This database – known as the *Dot Table* – is maintained with TrafficDot, Sensys Network's system management tool.

Enter the sensor-to-channel mappings by following these steps:

1. From the command menu on TrafficDot's main window, access *Configure* and click *Dot Table*.

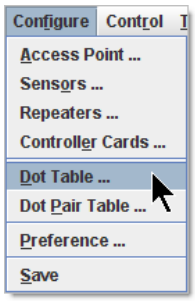

Figure 7.17– Configure / Dot Table menu

The *Dots Configuration* window opens. Depending on the status of your network the window may or may not contain information.

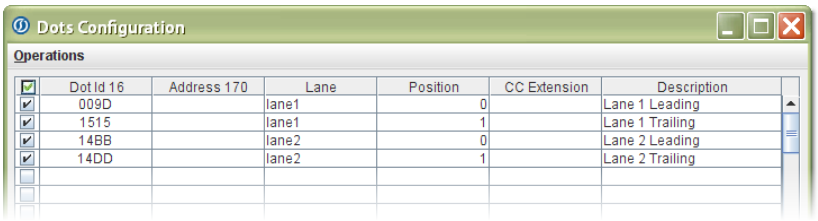

Figure 7.18 – Dots Configuration window

2. From the *Operations* menu, select *Populate*.

   The access point discovers all sensors in the network and add new entries to the table as needed. New entries require completion by the end-user as shown in the figure below (see sensors 14C7, 009C, 0180 and 1415).

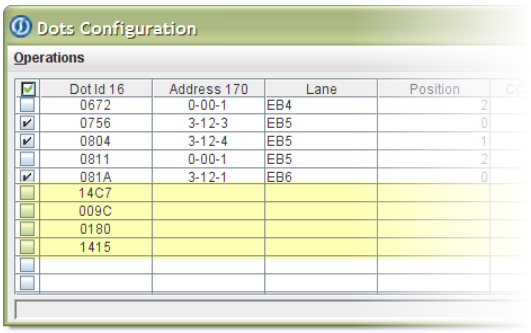

Figure 7.19 – Dot Configuration entries added by Populate process

3. Using information from the channel mapping worksheet(s), complete an entry for each sensor using the table and notes below as a guide.

Column	Description
(Checkbox)	Makes a sensor table entry active in the dot configuration. (*Required*)
DotId 16	Sensor ID (*Required*)
Address 170	Maps a sensor table entry to a contact closure card channel. (*Required*)
CC Extension	Specifies a channel extension duration in 1/1024 seconds for this sensor only. (*Optional)*

Table 4: Dot Configuration Elements

Notes

- Fill the checkbox to indicate that the dot table entry is active for the configuration. (*Note*: this element has no effect on the actual detection behavior of a sensor.)
- Sensor IDs may be added via the *populate* menu command or manually typed into the table.
- *Address 170* entries are required and must adhere to the following form:

  `shelf number – slot number – channel`

  where *shelf number – slot number* is a Card ID associated with a contact closure master or extension card and *channel* is between 1 and 4.

- *Lane, Position,* and *Description* are not required to map sensors to channels.

4. After completing the mapping entries, save the dot configuration to the access point. From the *Operations* menu, click *Apply*.

   A progress window appears as the configuration is saved. When the progress window closes, the dot configuration table has been saved to the access point.

Exiting TrafficDot

End the TrafficDot session by disconnecting from the access point as follows:

1. From the *Connect* menu, click *Disconnect*.
2. From the *Connect* menu, click *Exit*.

Appendixes

Appendix 1 – 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. (See examples beneath the figure.)

Figure A1 – 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*.

Appendix 2 – 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*.)

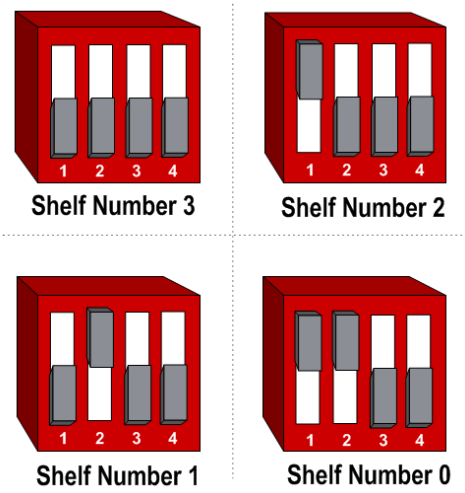

Figure A2.1 – SW1 settings for Shelf Number (switches 1 and 2 only)

Settings for TS1 and TS2 Controllers

The figure below depicts SW1 settings that identify the type of traffic controller. Type 170 and TS1 controllers are set the same way.

Figure A2.2 – SW1 settings for TS controller types (switch 3 only)

(*Note*: slide switches one, two and four are not used in setting the controller type.)

Appendix 3 – 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 below. (Slot number values appear beneath the switches.)

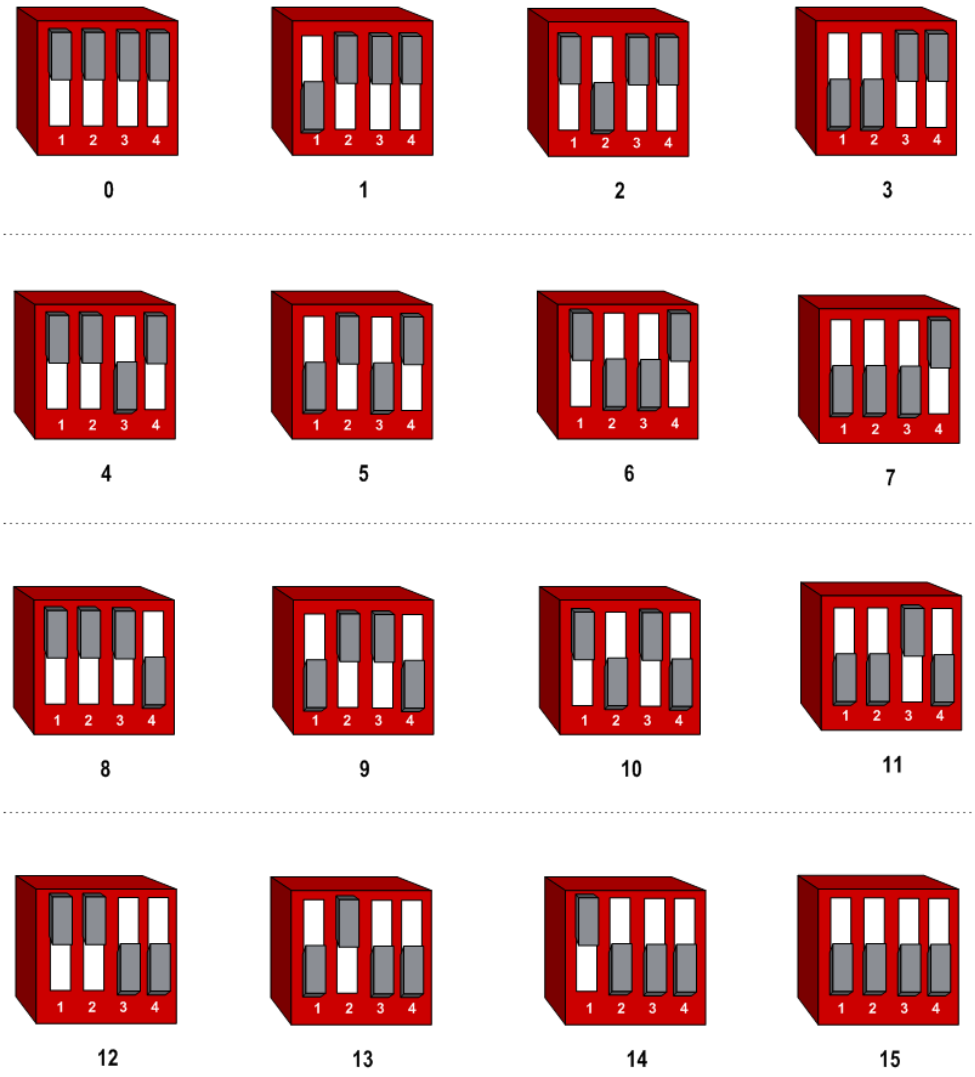

Figure A3.1 – SW2 Settings for Slot Number

Appendix 4 – Pre-Installation Worksheets

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

Channel Configuration Worksheet

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)		
Access Point identifier	*(from Access Point)*	
Distance from Sensys Access Point	328 feet (100 meters) - 10BaseT	
List of Wireless Sensor for the Channel	*(use SensorIDs of each sensor)*	

Table 5: Channel Configuration Worksheet

Sensor-to-Channel Mapping Worksheet

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

Table 6: Sensor-to-Channel Mapping Worksheet