

# Sensys Networks VDS240 Wireless Vehicle Detection System

## Repeater Installation Guide

P/N 152-240-020-001, Rev K

June 2015



## Document Properties

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

P/N 152-240-020-001 Rev K

Sensys Networks, Inc. makes no representation or warranties with respect to the contents hereof and specifically disclaims any implied warranties of merchantability or fitness for any particular purpose. Furthermore, Sensys Networks reserves the right to revise this publication and to make changes from time to time in the content hereof without obligation of Sensys Networks to notify any person or organization of such revisions or changes.

© 2007 - 2015 – All rights reserved.

Sensys Networks and the Sensys Networks logo are trademarks of Sensys Networks, Inc. All other products, names and services are trademarks or registered trademarks of their respective owners.

## Regulatory Statements

### 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: [www.ewtbattery.com/en/DownView.asp?ID=9](http://www.ewtbattery.com/en/DownView.asp?ID=9)

## Document Control

Sensys Networks continually reviews and revises its technical publications. Please address questions, suggestions, or corrections to [support@sensysnetworks.com](mailto:support@sensysnetworks.com).

## Sensys Networks Technical Publications

For additional information regarding Sensys Networks products and applications, design guides, configuration guides, and best practices, refer to the Sensys Networks technical documents library available at [http://www.sensysnetworks.com/resources#technical\\_documents](http://www.sensysnetworks.com/resources#technical_documents).

## **Contact Information**

**Sensys Networks, Inc.**

1608 Fourth Street, Suite 200  
Berkeley, CA 94710 USA  
+1 (510) 548-4620

[www.sensysnetworks.com](http://www.sensysnetworks.com)

---

# Contents

<b>Chapter 1: Introduction .....</b>	<b>1</b>
What's Inside .....	1
<b>Chapter 2: Overview .....</b>	<b>3</b>
Wireless Repeater .....	3
FLEX Repeaters .....	4
FLEX-RP-B-2 Repeater and FLEX-RP-B-LL-2 Repeater .....	4
FLEX-RP Solar Repeater .....	5
Antenna Options .....	5
Repeater Package Contents .....	6
Universal Mounting Kit Contents .....	6
<b>Chapter 3: Installation Considerations .....</b>	<b>9</b>
Determining the Location of the Repeater .....	9
Optimal Location Criteria .....	9
Height .....	9
Line of Sight .....	10
Recommended Distances Between Devices .....	10
Proximity to Wireless Sensors .....	10
Proximity to Access Points or SPPs .....	10
Stability .....	10
Accessibility .....	10
Determining the Orientation of the Repeater .....	11
Antenna Characteristics .....	11
Positioning the Repeater .....	12
Positioning the FLEX Repeater .....	13
FLEX Standard Antenna .....	13
FLEX Long Range Antenna .....	14
<b>Chapter 4: Installation Procedures .....</b>	<b>17</b>
Tools Required for Repeater Installation .....	17
Step-by-Step Procedures .....	17
Connecting the Repeater Battery .....	18
Connecting the FLEX Repeater Battery .....	18
External Antenna .....	19
Connecting the Solar Battery .....	20
External Antenna .....	21
Installing the Mounting Plate on Poles .....	21
Installing the Mounting Plate on Walls .....	23
Installing the Mounting Plate on Beams .....	23

---

<b>Chapter 5: Configuration .....</b>	<b>25</b>
Overview .....	25
Tandem Repeaters .....	25
Starting TrafficDOT and Connecting to a APCC or an Access Point .....	26
Working with the Repeater Configuration Window .....	27
Specifying the RF Channels .....	28
Specifying the Upstream Channel .....	28
Specifying the Downstream Channel .....	29
Adv Tab .....	29
Setting the Time Slot of a Repeater .....	31
Exiting TrafficDOT .....	32
<b>Appendix A: Clamp Band User Guide .....</b>	<b>33</b>
<b>Appendix B: Replacing the Repeater Battery .....</b>	<b>35</b>
De-install Repeater .....	35
Remove Battery .....	35
Replace Battery .....	36
Re-install Repeater .....	37

## Introduction

This guide provides information and procedures for installing Sensys Networks wireless repeaters 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*, describes a wireless repeater and the contents of a product shipment.
- *Chapter 3: Installation Considerations*, notes key points for installing repeaters.
- *Chapter 4: Installation Procedures*, provides step-by-step instructions for installation.
- *Chapter 5: Configuration*, provides step-by-step instructions for setting up a repeater at a particular site.
- *Appendix A: Clamp Band User Guide*, provides clamp band usage and specifications.



## Overview

This chapter provides an overview of a wireless repeater and describes the contents of a product shipment. Unless otherwise noted, the document uses the term *repeater* to apply equally to the following:

- Hinged Repeater (RP240-BH-2)
- Hinged Long Life Repeater (RP240-BH-LL-2)
- FLEX Repeater (FLEX-RP-B-2)
- FLEX Long Life Repeater (FLEX-RP-B-LL-2)
- FLEX Solar Repeater (FLEX-RP)

### Wireless Repeater

A wireless repeater is an optional system component that extends the range of an access point or SPP by receiving and forwarding RF communications between the access point or SPP and wireless sensors that would otherwise be out of signal range. Under optimal conditions, a repeater relays detection data over a distance of up to 1,000 feet (305 meters).

Repeaters are used wherever the locations of sensors and access points or SPPs are far enough apart so as to impede RF communications. Typically, these conditions occur at large intersections, in ramp management applications, or advance detection situations.

Additionally, the orientation of an access point or a SPP relative to the total population of wireless sensors in an installation may sometimes dictate the inclusion of a repeater.



Figure 2.1. Wireless Repeater

## FLEX Repeaters

FLEX Repeaters are second generation repeaters from Sensys Networks that provide antenna options that extends the range of the repeaters and eliminates the need for additional repeaters operating in tandem. Maximum single-hop range of ~2000 feet (610 meters) from supporting access point/SPP or repeater. Maximum single-hop range of ~300 feet (91 meters) from sensors with Long range External Antenna at height of 30 feet (9.14 meters).

### FLEX-RP-B-2 Repeater and FLEX-RP-B-LL-2 Repeater

The FLEX-RP-B-2 Repeater (FLEX Repeater) is powered with a replaceable battery pack located within the unit; however, the FLEX-RP-B-LL-2 Repeater (FLEX Long Life Repeater) does not have a replaceable battery. Both FLEX Repeaters utilize enhanced RF chipsets and circuitry that improves RF robustness and reduces energy consumption. FLEX Repeaters have an internal antenna and connect with the FLEX External Antenna.



Figure 2.2. FLEX Repeater

## FLEX-RP Solar Repeater

The FLEX-RP Solar Repeater (FLEX Solar Repeater) offers a power pack delivering a 15 year life. The solar repeater utilizes a hybrid power source: solar power which feeds into a super capacitor as its primary power source and lithium batteries to provide backup power if required. The FLEX Solar Repeater includes the enhanced RF chipsets and external antenna options of the FLEX family of second generation repeaters.



Figure 2.3. FLEX-RP (left) and FLEX-Solar (right)

## Antenna Options

The FLEX External Antenna connects to FLEX Repeater, FLEX Long Life Repeater, and FLEX Solar Repeater via a coaxial cable. The antenna, which works in conjunction with a repeater, allows the repeater to be aimed in two directions simultaneously utilizing a pole located between the sensor and access point or SPP.

Two types of FLEX External Antennas are supported: (i) the FLEX-ANT-1 (FLEX Standard Antenna) with the same RF coverage as the internal antenna and (ii) the FLEX-ANT-2 (FLEX Long Range Antenna) with Long Range RF coverage.



Figure 2.4. FLEX Standard Antenna (left) and FLEX Long Range Antenna (right)

The FLEX family of repeaters work with the standard repeaters RP240-BH-2 and RP240-BH-LL-2. The FLEX Solar Repeater can also operate without an external antenna.

## Repeater Package Contents

Each repeater 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 repeater shipment include:

- A wireless repeater
- A repeater safety cable
- *Repeater Quick Start Guide*

Items that are shipped separately:

- Universal mounting kit (mounting kit can be purchased from Sensys Networks)
- External antenna (optional)
- Solar powered hybrid power pack (for FLEX-RP only)

Repeaters are shipped with a factory default configuration suitable for bench-testing the device and applicable to many field environments:

- *Default RF channel for wireless sensor communications* – a critical configuration property is set to 5.
- *Default RF channel for access point communications* – a critical configuration property is set to 4.

---

**NOTE:**

Repeaters use two RF channels for communications. Refer to section *Specifying the RF Channels* in Chapter 5 for more information about operation and configuration.

---

## Universal Mounting Kit Contents

The following parts are included in the repeater mounting kit:

- Surface mounting ball plate (square, refer to Figure 2.1)

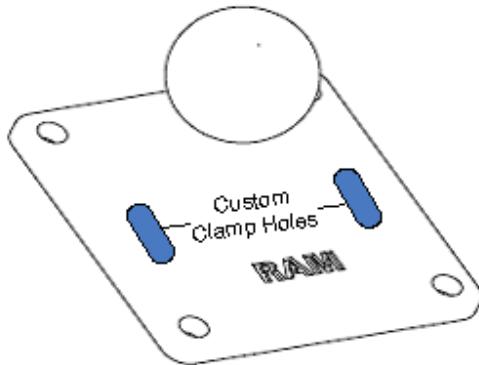


Figure 2.5. Surface (wall/beam/pole) mounting ball plate (square)

- Double socket arm (refer to Figure 2.2)

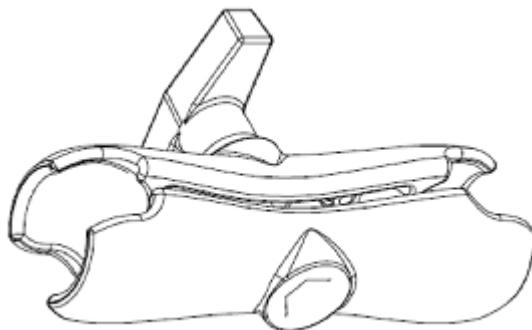


Figure 2.6. Double socket arm

- 5-foot clamp band
- Clamp fastener



# Installation Considerations

This chapter provides information to consider before installing repeaters.

## Determining the Location of the Repeater

The physical location of the repeater is one of the primary determinants of the quality of wireless radio communications and, as such, the network's overall usefulness and reliability. Selecting a location involves several factors (including other local RF transmissions) that may make preassigned locations problematic. Sensys Networks recommends that designers/installers specify a location that conforms to the requirements outlined in this section and then make adjustments based on field validation.

### Optimal Location Criteria

An optimal repeater location meets the following criteria:

- is high enough to promote high-quality RF communications on a sustained basis
- allows a line-of-sight path to all sensors and the access point or SPP
- is within recommended distances for sensors and the access point or SPP
- allows the repeater to face the sensors and the access point or SPP
- does not submit the repeater to avoidable vibration, shaking, or movement
- is accessible to field personnel to periodically change the battery pack or replace the unit

### Height

Height and distance from transmitting devices are primary determinants of RF quality. Mount the repeater well above the roadway surface, optimally at a height between 16 – 30 feet.

## Line of Sight

RF communications can be impeded by objects that block a direct line-of-sight between the access point or SPP, sensors, and repeaters. A clear path between the transmitting devices is always preferred.

## Recommended Distances Between Devices

Height and distance from transmitting devices are primary determinants of RF quality. Position the repeater so that it remains within the guidelines shown in the following table.

### Proximity to Wireless Sensors

In general, a maximum range of 175 feet (50 meters) can be obtained. Range expectations as a function of mounting height are summarized in the following table:

Height of Repeater Relative to Road Surface	Maximum Recommended Range to Sensor
16 feet (5 meters)	100 feet (30 meters)
20 feet (6 meters)	150 feet (45 meters)
30 feet (9 meters)	175 feet (50 meters)

Table 1. Recommended maximum repeater to wireless sensor ranges

#### NOTE:

Maximum recommended range to sensors using a FLEX Repeater with a Long Range Antenna (mounted at 30 feet (9 meters) height) pointing at MAG2 sensors is up to 300 feet (91 meters).

### Proximity to Access Points or SPPs

The maximum range between an access point or a SPP and a repeater – while depending on local terrain and the mounting height of each device – depends more critically on the orientation of the devices to each other. (Refer to the section *Determining the Orientation of the Repeater*.)

## Stability

Although a repeater contains no moving parts, ensure that the installed location does not submit the device to unnecessary movement, vibration, or force shock.

## Accessibility

Repeaters are powered by an multi-cell battery pack. Battery replacement requires removal of the device from the mounting location. Select a mounting location that provides field technicians clear access to the device.

## Determining the Orientation of the Repeater

The orientation of a repeater to its sensors and access point or SPP is one of the primary determinants of high-quality RF communications. Repeaters must be positioned such that (i) the sensors serviced by it are within its RF range, and (ii) the repeater is within the RF range of its access point or SPP.

### Antenna Characteristics

The beam pattern of a repeater's antenna is non-uniform as shown in the following diagram. The antenna's directional beam pattern provides a main lobe directed perpendicular to the top surface, with its maximum power radiated along this boresight and decreasing symmetrically as the elevation (vertical) or azimuth (horizontal) angle from boresight increases.

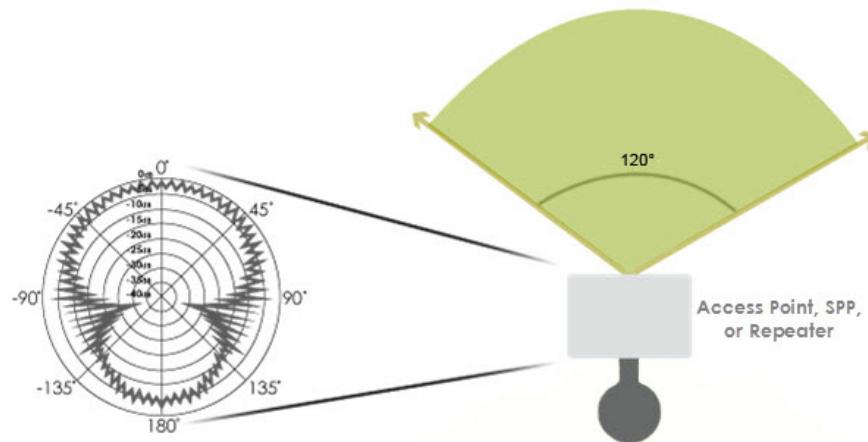


Figure 3.1. Antenna beam pattern

With repeaters, the strongest signal comes from the front of the device, in a pattern radiating approximately 120° from the front of the device as represented in Figure 3.1. With regard to installed sensors, the primary signal energy radiates straight upward. Signal strength radiating in the opposite direction is not useful. Antenna orientation is a direct contributor to the quality of RF signal reception in the field. The optimal orientation is where the devices face each other. When devices must be oriented differently, be certain to assess the impact on the RF signal strength.

## Positioning the Repeater

The gain of the repeater's built-in directional antenna is maximized when it is within  $60^{\circ}$  from the boresite of the face of the repeater, facing its sensors and the access point or SPP. When that is the case, the supported distance between the access point or SPP and repeater approaches 1,000 feet.

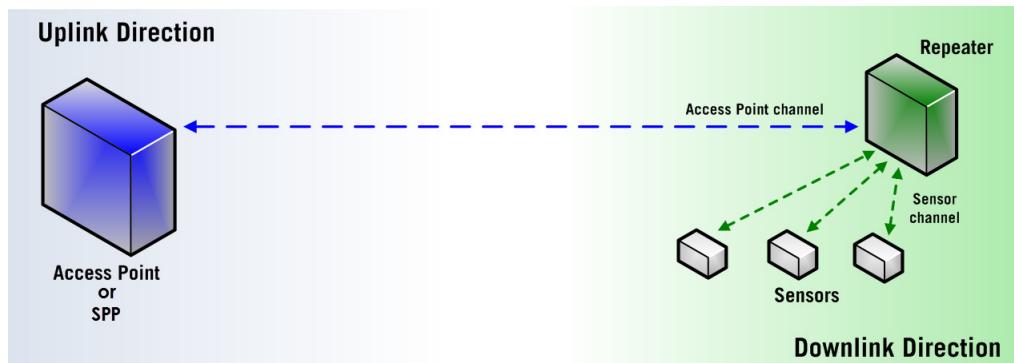


Figure 3.2. Repeater positioning

*Do not position the repeater between the access point or SPP and the sensors serviced by the repeater.* Doing so will likely result in poor sensor-to-repeater and repeater-to-access point/SPP communications. Strive to keep all sensors serviced by the repeater ***between the repeater and the access point or SPP*** as shown in Figure 3.3.

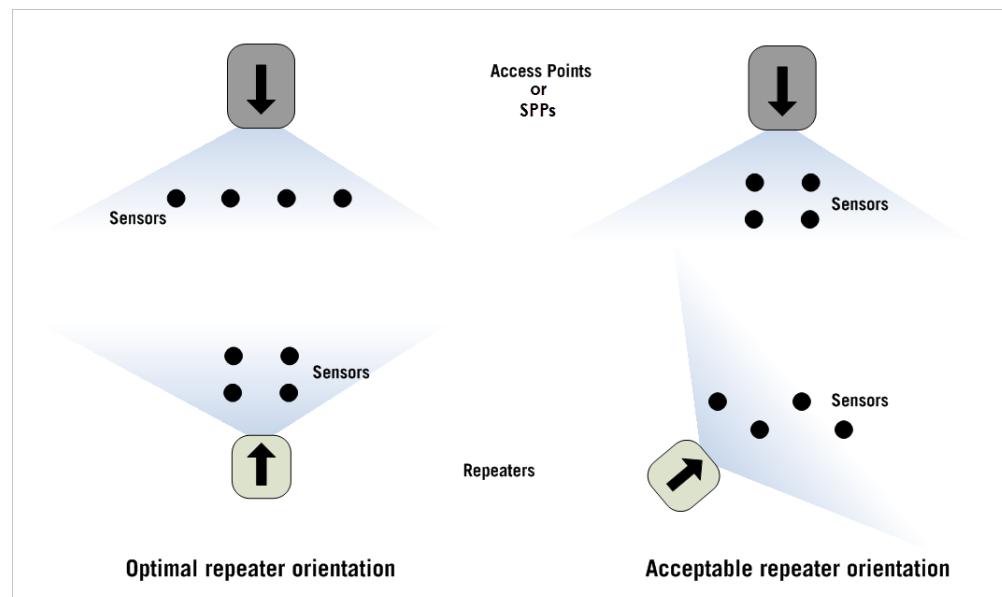


Figure 3.3. Repeater orientation

Figure 3.3 depicts repeater orientations relative to the access point or SPP. Acceptable RF communications between the access point or SPP and the repeater typically follow the estimates provided in the following table.

Repeater Orientation to Access Point or SPP	Maximum Recommended Range to Access Point or SPP
Optimal (head-on)	~ 1,000 feet (305 meters)
Acceptable (~ 60° angle)	Approximately 400 – 1,000 feet (122 – 305 meters)

Table 2. Approximate distance limits between access point or SPP and repeater

**NOTE:**

Maximum recommended range to an access point or a SPP using a FLEX Repeater with a Long Range Antenna facing the access point/SPP is up to 2,000 feet (610 meters).

The table values are approximations; the actual range may vary based on mounting heights of the devices and terrain.

## Positioning the FLEX Repeater

The following diagrams show the designs for various freeway situations and an intersection that showcases the benefits of the FLEX Repeater system.

### FLEX Standard Antenna

The Standard Antenna provides an additional RF node. Each RF link can be optimized for performance. Replaces the need for adjacent tandem repeaters. The antenna can communicate with sensors **or** an access point, SPP, or repeater in tandem.

Figure 3.4 displays a mounted FLEX Repeater on a pole located between the access point or SPP and the sensors. Enables maximum RF performance on each link.

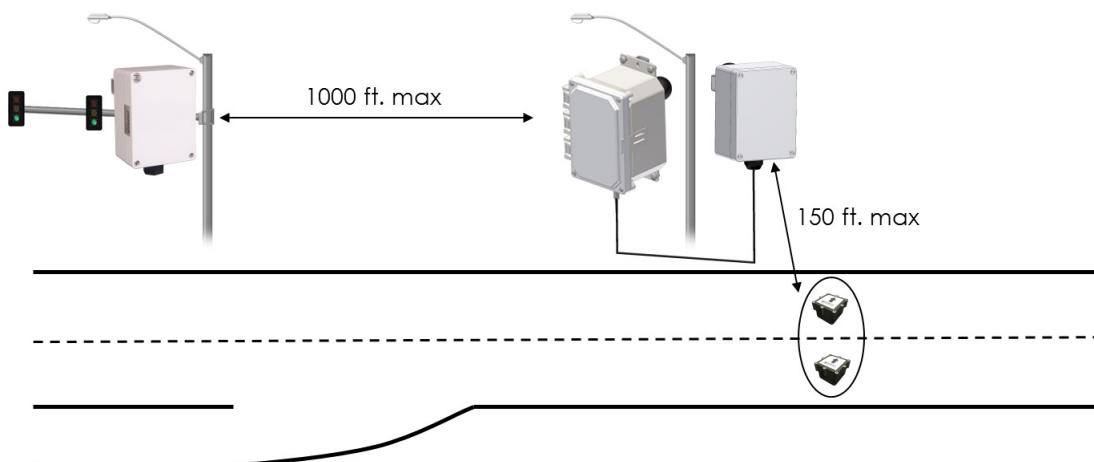


Figure 3.4. Repeater pole located between the access point/SPP and the sensors

## FLEX Long Range Antenna

The Long Range Antenna provides a longer RF range than the FLEX Standard Antenna. Up to 2,000 feet (610 meters) to access points, SPPs, and repeaters. Up to 300 feet (91 meters) to MAG2 sensors. It also provides a narrower RF node, 60° horizontal and vertical as shown in Figure 3.5. The antenna can communicate with sensors **or** an access point, SPP, or repeater in tandem.

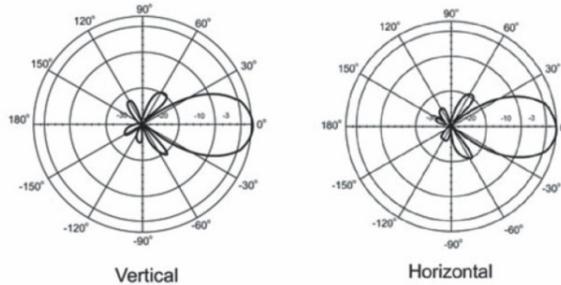


Figure 3.5. FLEX Long Range Antenna RF Node

Mount FLEX Repeater with Long Range Antenna on pole closest to sensors. Enables extended communication capability for long distances between poles. Tackles configurations that were previously impossible.

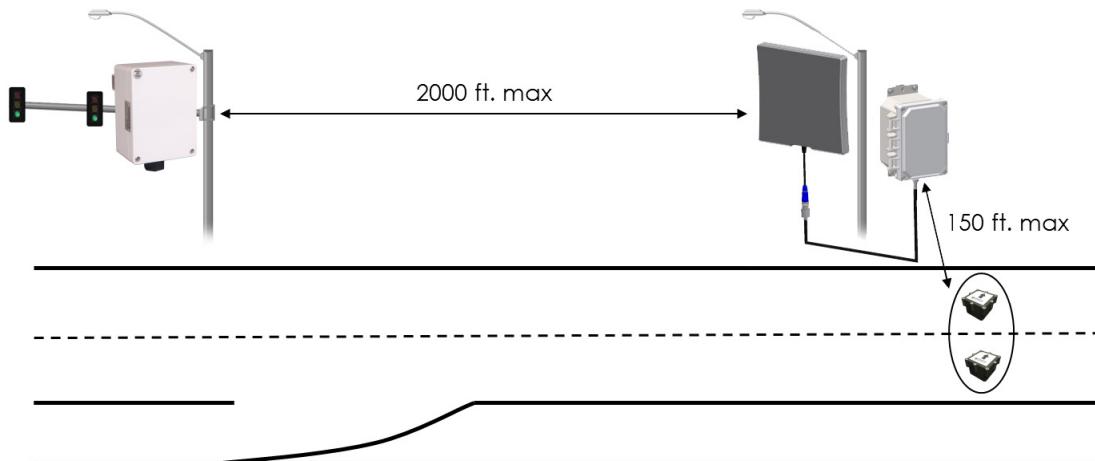


Figure 3.6. Mid-block detection with FLEX Repeater and FLEX Long Range Antenna

Mount FLEX Repeater with Long Range Antenna pointing directly at sensors. Enables extended communication capability for long distances between poles and sensors. Tackles configurations that were previously impossible.

**NOTE:**

The long range antenna to sensor 300 feet distance is only applicable in conjunction with the MAG2 sensor, which has the improved radio.

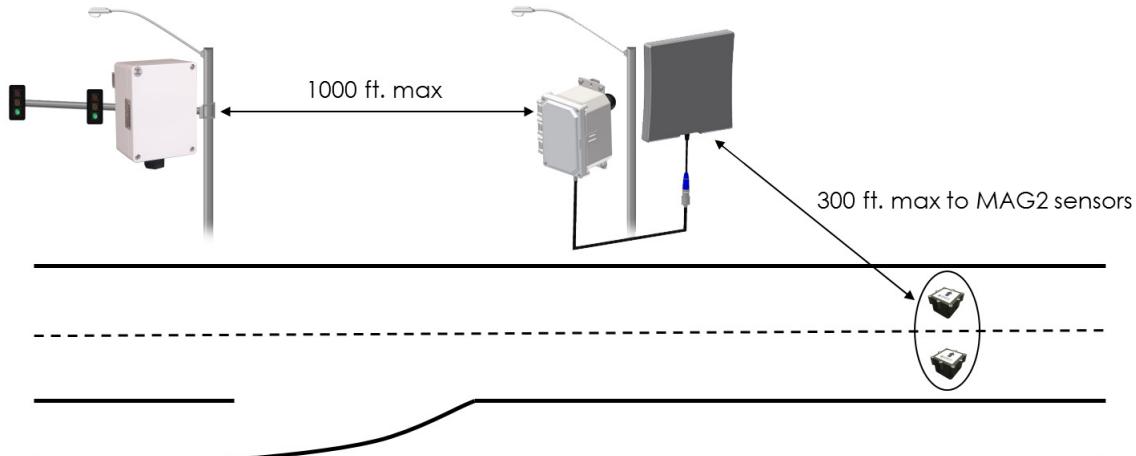


Figure 3.7. Mid-block detection with closest pole far from sensors

For intersections with the closest pole is far from the sensors, mount FLEX Repeater with Long Range Antenna pointing directly at sensors. Enables extended communication capability for long distances between poles and sensors. Enables communication to sensors without adding advance repeaters or poles.

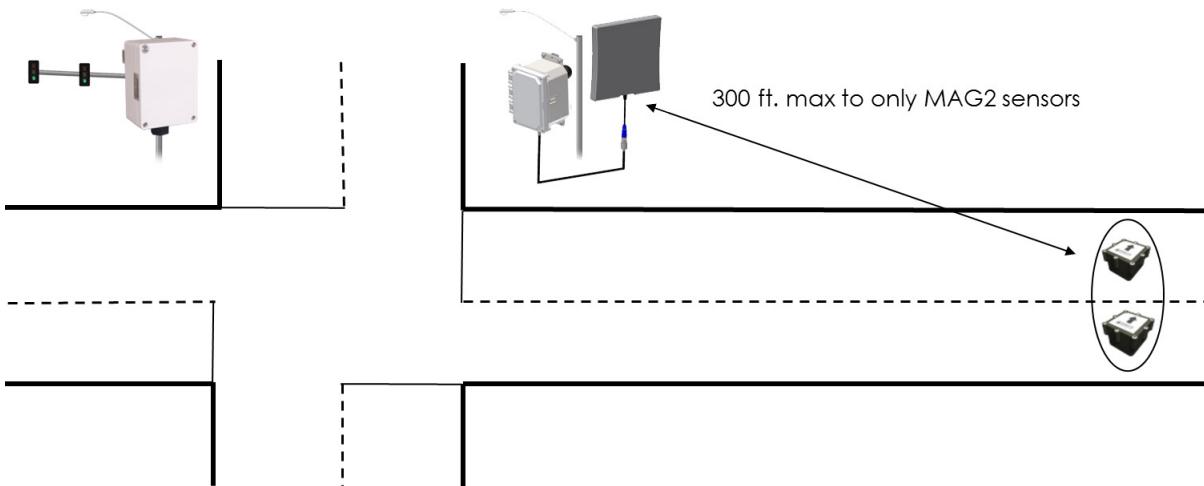


Figure 3.8. FLEX Repeater with FLEX Long Range Antenna in advanced detection for a intersection



# Installation Procedures

This chapter describes the tools required to install a repeater and provides step-by-step procedures.

## Tools Required for Repeater Installation

The following tools are required for installing the repeater:

- *Lift truck* – to install repeater 16 – 30 feet above the road surface
- *Screwdriver* – combination flat and Phillips head ends
- *Universal mounting kit* – double-socket arm holds the repeater.  
(*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
- *Measuring tape*

## Step-by-Step Procedures

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

## Connecting the Repeater Battery

Before installing the mounting plate, perform the following steps to connect the repeater battery:

1. Unscrew all four screws on the lid.
2. Open the repeater cover.
3. Connect the battery cable to the circuit board connector.

**NOTE:**

Wait approximately five seconds for the LED light to blink.

4. Close the repeater cover; ensure that the wires are not caught in the edges.
5. Tighten all four screws securely to 10 in-lbs.

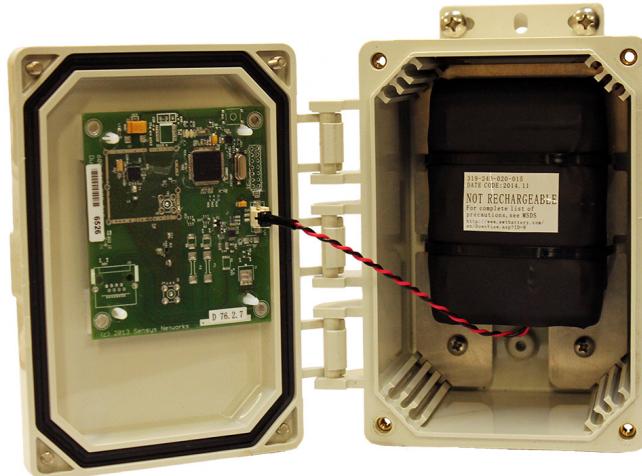


Figure 4.1. Connect repeater battery

## Connecting the FLEX Repeater Battery

Before installing the mounting plate, perform the following steps to connect the FLEX Repeater battery:

1. Unscrew all four screws on the lid.
2. Open the FLEX Repeater cover.
3. Connect the battery cable to the circuit board connector.

**NOTE:**

Wait approximately five seconds for the LED light to blink.

4. Close the FLEX Repeater cover; ensure that the wires are not caught in the edges.
5. Tighten all four screws securely to 10 in-lbs.

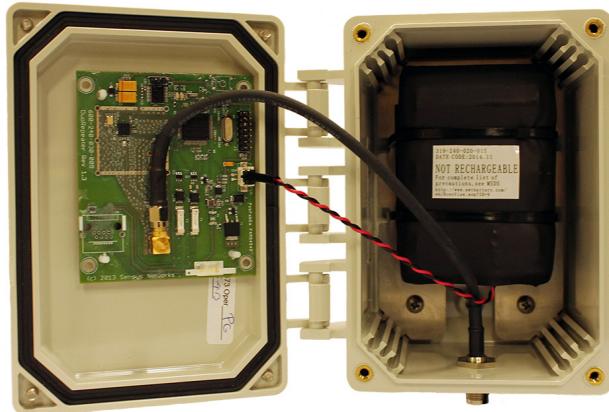


Figure 4.2. Connect FLEX Repeater battery

### External Antenna

Connect to one of the FLEX External Antenna options with a coax cable. Be sure to tighten coax cable all the way or external antenna may not function properly.

**NOTE:**

Maximum cable length from FLEX Repeater to antenna is three feet.



Figure 4.3. Connect FLEX Repeater with FLEX Standard Antenna

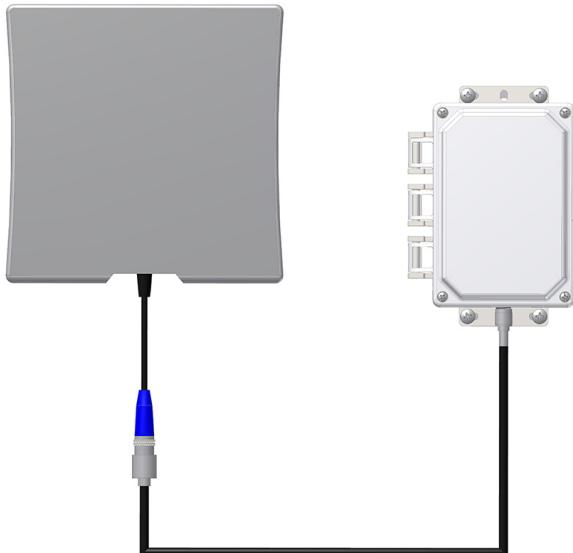


Figure 4.4. Connect FLEX Repeater with FLEX Long Range Antenna

## Connecting the Solar Battery

Attach FLEX-RP to FLEX Solar battery by:

1. Cable devices together with Cat5 cables.
2. Plug into the solar battery power source.

**NOTE:**

Maximum cable length from FLEX Repeater to solar battery is three feet.

---



Figure 4.5. Connect Solar battery

## External Antenna

Connect to one of the FLEX External Antenna options with a coax cable.

**NOTE:**

Maximum cable length from FLEX Repeater to antenna is three feet.

**NOTE:**

The FLEX Solar Repeater can also operate without an external antenna.

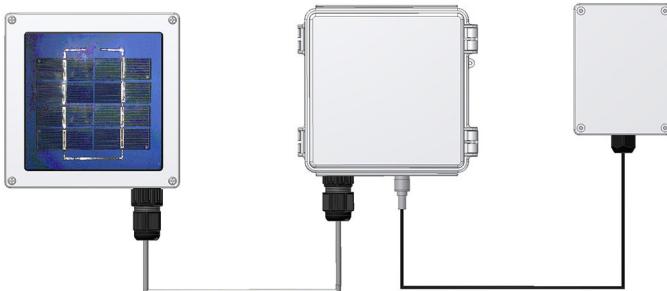


Figure 4.6. Connect FLEX Solar Repeater with FLEX Standard Antenna



Figure 4.7. Connect FLEX Solar Repeater with FLEX Long Range Antenna

## 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 figure) 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 4.8. 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. Slip the safety cable through one of the holes on the mounting ball plate of the repeater.
7. Feed the clip through the loop on the end of the safety cable (as shown in Figure 4.2).
8. Clip safety cable to the pole or mounting bracket.
9. Attach the repeater ball plate to the other end of the double socket arm as shown in the following figure.

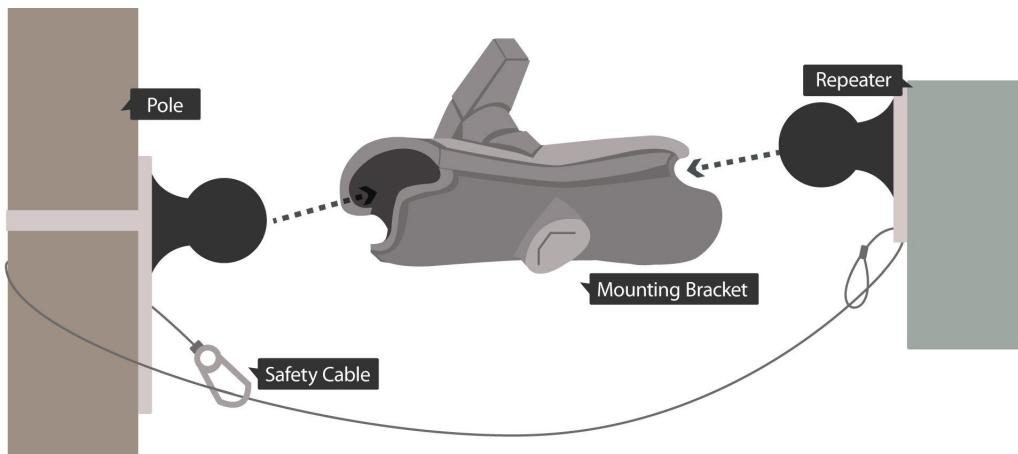


Figure 4.9. Double socket arm installation

10. Point the front of the repeater toward the sensors and tighten the double socket arm to secure the repeater'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.



Figure 4.10. Repeater



# Configuration

This chapter provides information on configuring repeaters in TrafficDOT.

---

**NOTE:**

Prior to configuring repeaters, ensure the battery cable in the repeater has been connected to the circuit board. Refer to the *Connecting the Repeater Battery* section in the *Installation Procedures* chapter for more information.

---

## Overview

Repeaters ship with a factory-installed default configuration. Configuring a repeater with TrafficDOT consists of the following activities:

- Starting TrafficDOT and connecting to an APCC or access point
- Specifying the RF channels
- Setting the time slot of a repeater

### Tandem Repeaters

Repeaters used to forward the signals of other repeaters (tandem repeaters) are configured in the same way as repeaters communicating directly with a APCC or an access point. Tandem repeater topologies are implied by the RF channel assignments made to separate repeaters.

## Starting TrafficDOT and Connecting to a APCC or an Access Point

TrafficDOT is a configuration manager and monitoring tool for a APCC or 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 or access point. Typically, when configuring contact closure cards, this connection is made by cabling a laptop to the “ACCESS” port of the AccessBox. (Refer to the section *Cabling Summary* 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 or 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.

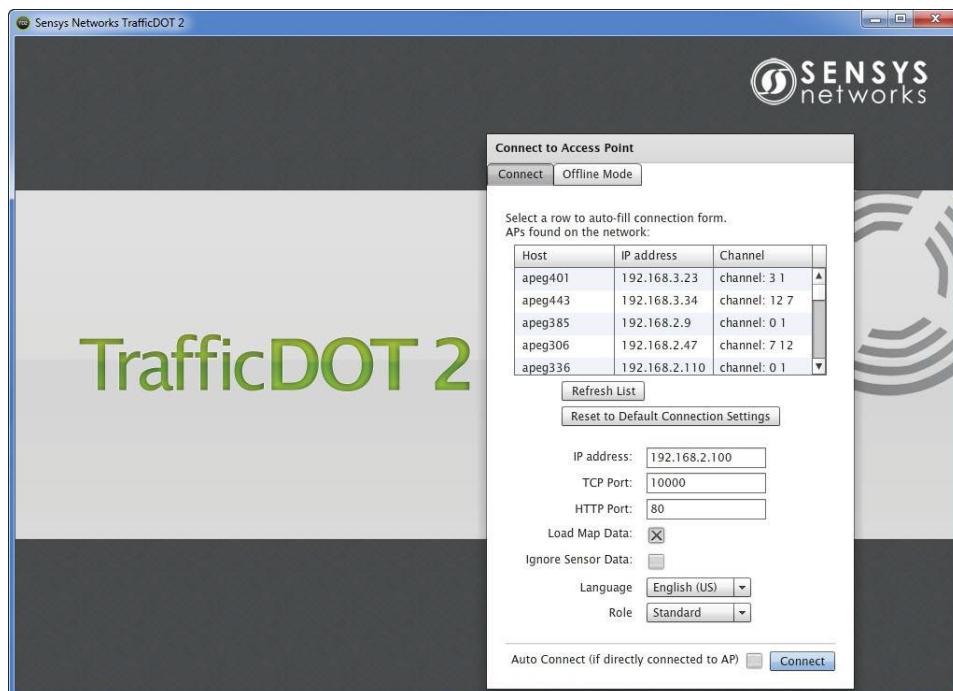


Figure 5.1. TrafficDOT Main and Connect windows

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

**NOTE:**

Ensure the box for *Load map data* is checked before clicking **Connect**.

3. Click **Connect**.

After clicking **Connect**, wait a moment for the The *Main* window.

## Working with the Repeater Configuration Window

To select a repeater for configuration, click a repeater on your image map. The *Repeater Configuration* window displays.

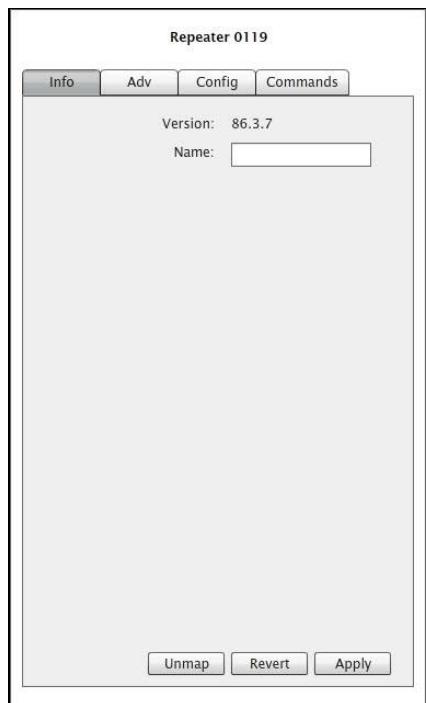


Figure 5.2. Repeater Configuration Window

**NOTE:**

Before configuring or reconfiguring a repeater, ensure the correct repeater is displayed on the map by hovering over the repeater icon with the mouse to view repeater information.

## Specifying the RF Channels

Repeaters are configured with two RF channels. The first channel, which is known as the upstream channel, is used to communicate with a SPP radio or an access point. This channel is set in the SPP radio's or access point's configuration. The second channel, which is known as the downstream channel, is used to communicate with sensors.

### Notes

- The default radio channel for SPP radio or access point to repeater communications 4 (four).
- The default radio channel for repeater to sensor communications is 5 (five).
- Never use the same channel for both SPP radio or access point and sensor communications.

## Specifying the Upstream Channel

To specify the RF channel for SPP radio or access point transmissions, perform the following steps:

1. Select an entry for the *Current Upstream Ch* field by clicking on the *Change to* drop-down list.  
The selected channel must be the same RF channel that the target SPP radio or access point is configured to use.
2. Click **Set Channel(s)** to accept configuration changes. To save the changes to the APCC or access point, click the **SAVE** button at the top of the window.

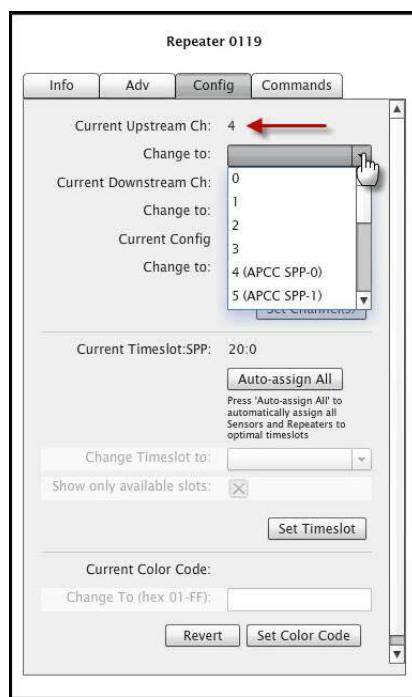


Figure 5.3. Repeater Upstream Channel

## Specifying the Downstream Channel

To specify the RF channel for transmissions in the direction of sensors, do the following:

1. Select an entry for the *Current Downstream Ch* field by clicking on the *Change to* drop-down list.  
The selected channel must not be the same than the channel selected as the upstream channel. In addition, all sensors serviced by the repeater must be configured to use the repeater's downstream channel.
2. Click **Set Channel(s)** to accept configuration changes. To save the changes to the APCC or access point, click the **SAVE** button at the top of the window.

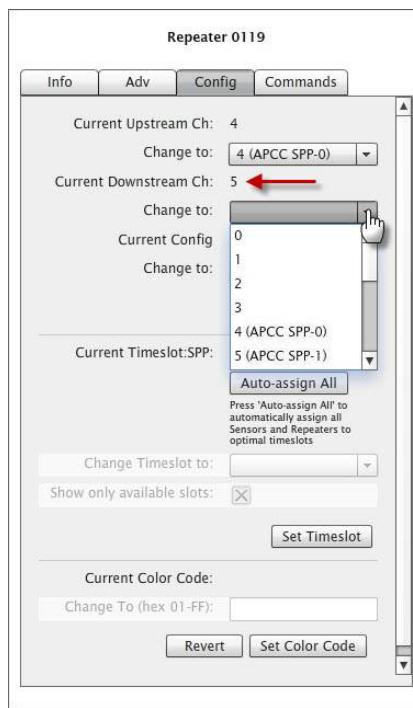


Figure 5.4. Repeater Downstream Channel

### Notes

- When an installation contains multiple repeaters with more than ten sensors, changing one or more repeaters from *Current Config 0* to *Current Config 1* allows the repeater to communicate with up to 20 sensors.

### Adv Tab

For FLEX and Solar Repeaters an additional *Adv* tab is available for external antenna configuration and to view *Solar Supply Status*.

### Antenna

The *Adv* tab provides the ability to choose an antenna for an external upstream connection to the APCC or access point or an external downstream connection to

the sensors. From the *Antenna* window, select either *Upstream (to AP)* or *Downstream (to sensors)* to configure the external antenna.

Click **Apply** to accept configuration changes. To save the changes to the APCC or access point, click the **SAVE** button at the top of the window.

**NOTE:**

Recommended setting for external antenna is *Downstream (to sensors)*.

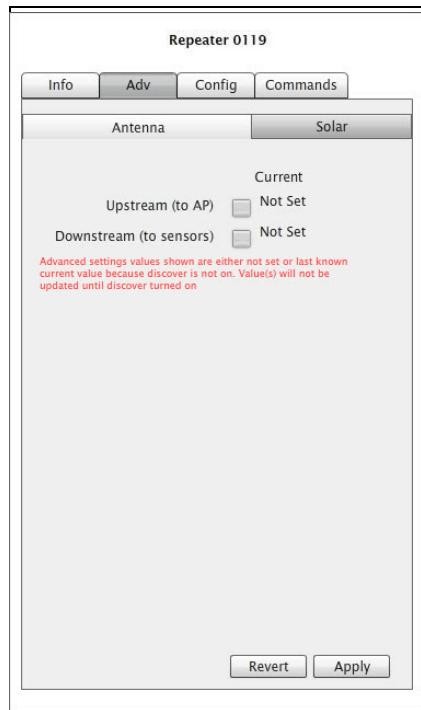


Figure 5.5. Antenna tab

### Notes

- Internal antenna is not listed on the panel, but will automatically be assigned to the unchecked option.
- A failsafe error message will occur should you choose both options.
- If *FLEX Solar Repeater* is installed with or without the external antenna and the *Adv* tab options are left unchecked, the internal antenna will be used for both *Upstream* and *Downstream* channels.
- If *Discover Mode* is not on the following warning will display: *Advanced setting values are either not set or last known current value because discover not on. Value(s) will not be updated until discover on.*
- If *Discover Mode* is off at connection time for TrafficDOT the *Adv* tab will display *Not Set* values. Turn on *Discover Mode* for true values to display.

## Solar

Click on **Solar** tab to view the *Solar Supply Status*.

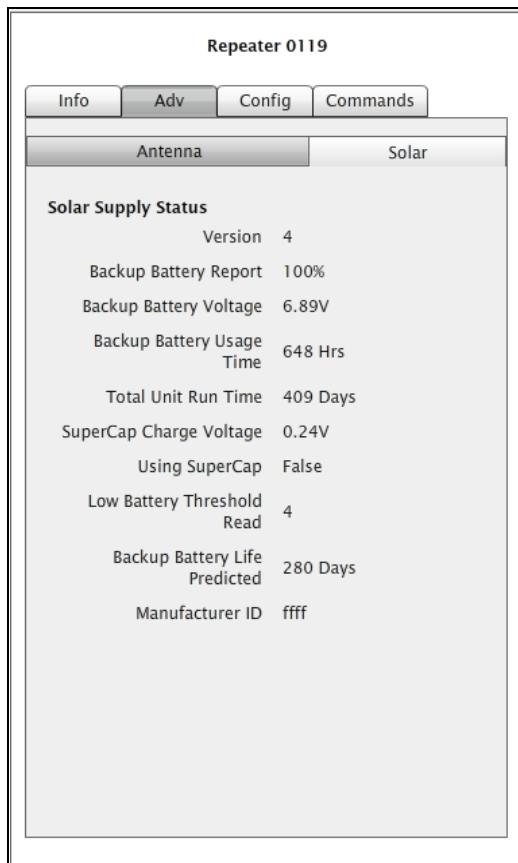


Figure 5.6. Solar tab

## Setting the Time Slot of a Repeater

In addition to forwarding event data packets to the SPP radio or access point and management packets to the sensors it services, repeaters originate packets of their own. Normally, repeaters transmit repeater packets via a sensor time slot when the repeater detects that a sensor is not transmitting.

In some instances, however, it may be beneficial to restrict the repeater's use to a defined time slot as a means to eliminate competition to transmit. To set the time slot, do the following:

- Click an entry from the *Change Timeslot to* drop-down list.

By default, TrafficDOT filters the contents of the drop-down list so that only available time slots (time slots that are consistent with the network's transmit interval and not already assigned) are displayed.

To change the drop-down list to include all time slots in the network (both assigned and unassigned), remove the check in the *Show only available slots*.

**NOTE:**

The list does not include time slots that are, by definition, reserved for use by SPP radios or access points.

- Click **Set Timeslot** to accept configuration changes. To save the changes to the APCC or access point, click the **SAVE** button at the top of the window.

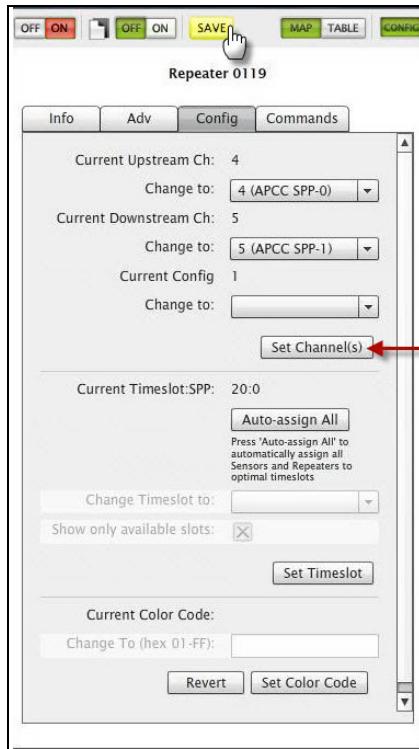


Figure 5.7. Save

**Note**

- The grayed out options can be made accessible by enabling *Advanced Mode* using the *Advanced* drop-down menu.

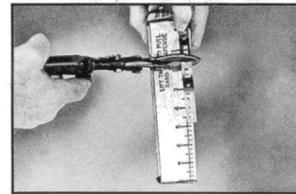
## Exiting TrafficDOT

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

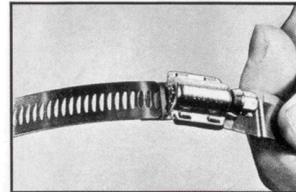
## Clamp Band User Guide

### Make Any Size Clamp Easily 1 *MakeAclamp*

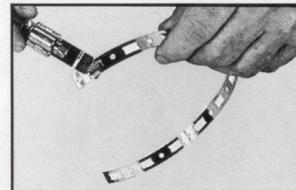
Determine proper band length one of two ways: (A) if diameter is known, refer to band length table below, or (B) if diameter is not known, measure circumference with string, twine, etc. and subtract 4" (to allow for length of fastener ends) to determine proper band length.



**2** Measure band to proper length and cut through center of nearest round hole with shears, snips, hacksaw, etc.



**3** Engage one screw housing end to one perforated end by turning screw three or four times.



**4** Complete the clamp by diagonally inserting the ends of the engaged fastener assembly to the band through the tops of the square holes at each end of the band.



**5** Tighten your finished clamp.

#### BAND LENGTH TABLE

Use this convenient table for cutting band to proper length.

Make-A-Clamp tightens and clamps around any shape rectangular or round. Band should always be cut midway on small round hole for smooth fastener-fit. This table is accurate for the diameters indicated. (Allows for insertion of Fasteners)

Diameter	Length to Cut on Mark	Diameter	Length to Cut on Mark	Diameter	Length to Cut on Mark
2"	2-1/2"	22"	65-7/8"	60"	184-13/16"
3"	5-1/16"	24"	72-1/8"	62"	191-1/8"
4"	8-7/8"	26"	77-1/4"	64"	197-7/16"
5"	11-7/16"	28"	83-5/8"	66"	203-5/8"
6"	15-3/16"	30"	89-7/8"	68"	209-15/16"
7"	17-3/4"	32"	96-3/8"	70"	216-1/4"
8"	21-1/2"	34"	102-5/8"	72"	222-9/16"
9"	24-1/8"	36"	108-7/8"	74"	228-7/8"
10"	27-7/8"	38"	115-1/4"	76"	235-13/16"
11"	30-3/8"	40"	121-9/16"	78"	241-1/2"
12"	34-3/16"	42"	128"	80"	247-13/16"
13"	36-3/4"	44"	134-5/16"	82"	254-1/8"
14"	40-1/2"	46"	140-5/8"	84"	260-7/16"
15"	43-1/16"	48"	146-15/16"	86"	266-5/8"
16"	46-7/8"	50"	153-1/4"	88"	272-15/16"
17"	49-7/16"	52"	159-9/16"	90"	279-1/4"
18"	53-1/8"	54"	165-7/8"	92"	285-9/16"
19"	55-3/4"	56"	172-3/16"	94"	291-7/8"
20"	59-1/2"	58"	178-1/2"	96"	298-3/16"

To determine longer lengths of Make-A-Clamp band material, multiply diameter in inches  $\times \pi$  (3.1416), minus 4.5" for the adjustable fastener end, or determine circumference by measurement, less 4.5" for adjustable fastener end.

**BREEZE CLAMP PRODUCTS**

3582 Tunnelton Road, Saltsburg, Pennsylvania 15681 • (724) 639-3571 • Fax: (724) 639-3020



# Replacing the Repeater Battery

This appendix contains instructions on how to replace the two year battery for repeaters.

## De-install Repeater

Perform the following steps to de-install the repeater:

1. Locate device.
2. Mark height on pole.
3. Document how repeater is oriented to SPP radio or Access Point.
4. Deinstall device. Save all mounting hardware.
5. Return to ground.

## Remove Battery

Perform the following steps to remove the battery from the repeater:

1. Unscrew the four screws.
2. Open the repeater cover. Do not stress cable.
3. Grasp connector.
4. Pull away from connector. Use little force.
5. Unscrew the two plate screws on the mounting plate.
6. Pull battery out of the housing.

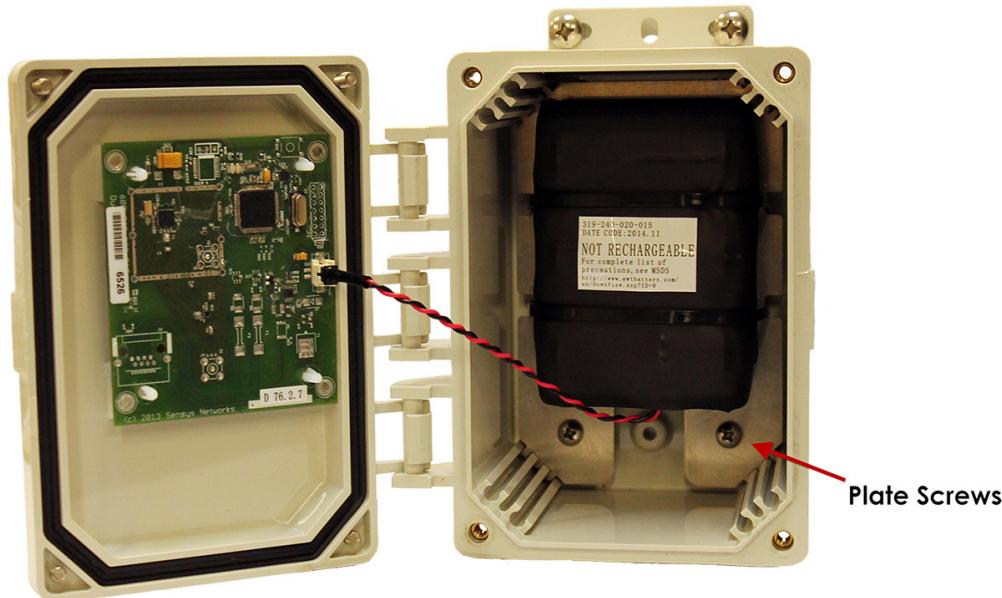


Figure B.1. Open repeater

## Replace Battery

Perform the following steps to replace the battery of the repeater:

1. Check desiccant color.

**NOTE:**

Do not use when pink (spent). Replace spent packages.

2. Place battery back in housing in same orientation as the previous pack.
3. Tighten the two plate screws into the mounting plate.
4. Connect battery cable to circuit board.
5. After connecting battery wait approximately five seconds for LED lights to blink.
6. Close cover; ensure wires are not caught in the edges.
7. Tighten all four screws securely.



Figure B.2. Closed repeater

## Re-install Repeater

Perform the following steps to re-install the repeater:

1. Re-install device.

---

**NOTE:**

Handle device with care. Observe safety precautions.

---

2. Orient repeater to SPP radio or Access Point exactly as it was before procedure.
3. Use TrafficDOT to verify RSSI and LQI measures are within acceptable ranges.

---

**IMPORTANT!**

RSSI or LQI values outside of acceptable range will impede system operation.

---

