

# DRAFT Telemetry Repeater User Guide



## Acknowledgments

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Telemetry Repeater User Guide  
Reorder Number 391-0094-001  
Revision 01  
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Printed in U.S.A.

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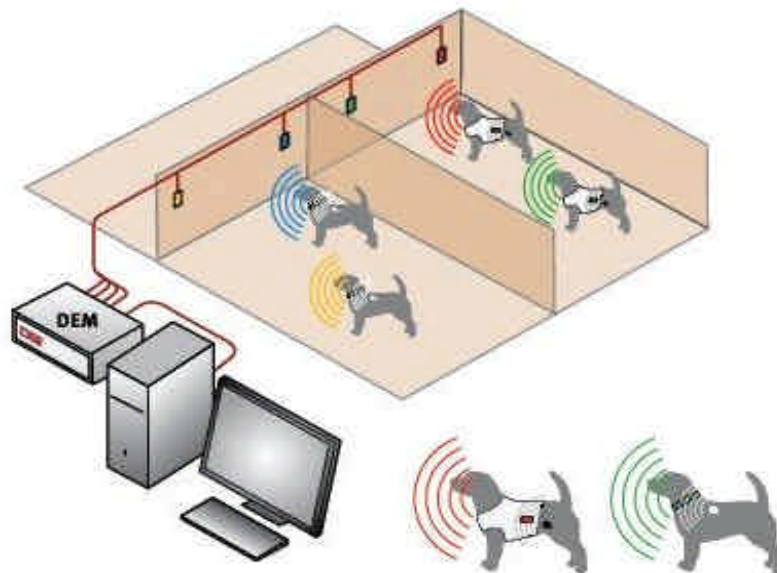
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## INTRODUCTION

The Multi-frequency Telemetry Repeater is a device that functions as a signal relay between a DSI Physiotel<sup>®</sup> transmitter and a Repeater Receiver and is used in large animal and primate telemetry applications. It offers greater flexibility and capabilities in cage design, housing and data acquisition than the standard DSI transmitter-receiver option.

There are several different frequency models of the Repeater available. The availability of these different frequency models allows the animals to be in closer proximity with one another or group housed. The Repeaters also have a larger transmission range than implanted transmitters, enabling greater separation between an animal and its receiver.

In a Repeater system, each animal is implanted with a Physiotel transmitter. Each animal is then outfitted with a Repeater and has at least one Repeater Receiver associated with it. The Physiotel transmitter transmits a localized signal that is detected by the animal's Repeater. The signal is then re-transmitted by the Repeater and recognized by the appropriate Repeater Receiver which brings the signal into the data acquisition system. There is no time delay introduced into the data acquisition process because of the Repeater's involvement in the signal relay.



The Multi-frequency Repeater being used in Group Housing Enclosures

Each Repeater has two modes of operation: short-range and long-range. The factory default setting for the Repeater is short-range mode (3m transmitting distance) but the long-range mode (8m transmitting distance) may be useful for some applications. These ranges indicate the shortest or minimum transmission distance that would be encountered in an environment without obstructions. Ranges will vary depending on the environment and based on the orientation of the Repeater with respect to its Repeater Receiver. Short-range mode is recommended when trying to use more than one repeater of the same frequency within the same environment. The long-range is recommended, however, to achieve greater area coverage when duplicate repeater frequencies are not being used. See the Maintenance section of this user guide for specific instructions of how to change the Repeater's mode of operation.

Each of the different frequency models of the Repeater is available in one of three physical designs or housings. The electronic components in each of these housings are the same, but the size and shape differences facilitate their use with different animal species. See the Specifications section of this user guide for additional details.



The Large Animal Telemetry Repeater's design allows it to be attached to an animal's collar, secured on a harness, or in a vest pocket.



The Primate Repeater Collar is designed to work with primate restraint systems and is available in small and large sizes.

Whenever a live battery is installed in the Repeater, it is operating. When operating, the Repeater is continuously “listening” for a signal from a transmitter. Regardless of its mode of operation (short or long-range), the battery life of the Large Animal Telemetry Repeater is 6 days. The battery life of the Primate Repeater Collar is 10 days. DSI recommends changing the battery on a regular basis within the battery life. Battery changing instructions can be found in the Maintenance section of this user guide.

Each Repeater must be combined with the appropriate Repeater Receiver. Instructions for matching Repeaters with Repeater Receivers can be found in the Setup section of this user guide. The Repeater cannot be used with any other model of receiver manufactured by DSI.



Repeater Receiver

Please note that this user guide is not meant to function as a guide to animal care or handling. Appropriate animal handling and care measures must be determined by the laboratory before using these devices.

## Specifications

### Naming Convention

The Repeater model name, for example RPT-910-3, is defined by the following:

The first numerical digit indicates the geographical region of use: RPT-910-3

- 4 = European use only
- 9 = U.S. and Canada use only

The next two numerical digits represent a specific transmission frequency: RPT-910-3

Values are multiples of 10 where each different value indicates a unique transmission frequency. Please note that these values do not indicate the actual transmission frequency.

The final numerical digit indicates the reception frequency (collecting the signal from the implanted transmitter): RPT-910-3

- 1 = Frequency 1
  - 2 = Frequency 2
  - 3 = Frequency 3
- } Frequencies 1 and 2 are being reserved for future use

### Part Numbers

Currently, there are 36 unique Repeater part numbers available. Individual Repeater part numbers are identified by two characteristics: the model of Repeater Receiver that it will be used with and the Repeater housing. The table below provides the appropriate part numbers for the Repeaters based on these two characteristics.

		Housing Type			
		Large Animal	Primate		
			Small	Large	
<b>Repeater Receiver Model Number</b>	U.S. and Canada	RMC-910	272-0903-910	272-1903-910	272-2903-910
		RMC-920	272-0903-920	272-1903-920	272-2903-920
		RMC-930	272-0903-930	272-1903-930	272-2903-930
		RMC-940	272-0903-940	272-1903-940	272-2903-940
		RMC-950	272-0903-950	272-1903-950	272-2903-950
		RMC-960	272-0903-960	272-1903-960	272-2903-960
		RMC-970	272-0903-970	272-1903-970	272-2903-970
		RMC-980	272-0903-980	272-1903-980	272-2903-980
	Europe	RMC-410	272-0403-410	272-1403-410	272-2403-410
		RMC-420	272-0403-420	272-1403-420	272-2403-420
		RMC-430	272-0403-430	272-1403-430	272-2403-430
		RMC-440	272-0403-440	272-1403-440	272-2403-440

Part numbers for replacement batteries are provided in the table below.

Housing Type	Part Number
Large Animal Telemetry Repeater	276-0941-002 (quantity of 5)
Primate Repeater Collar (either size)	276-0942-002 (quantity of 5)

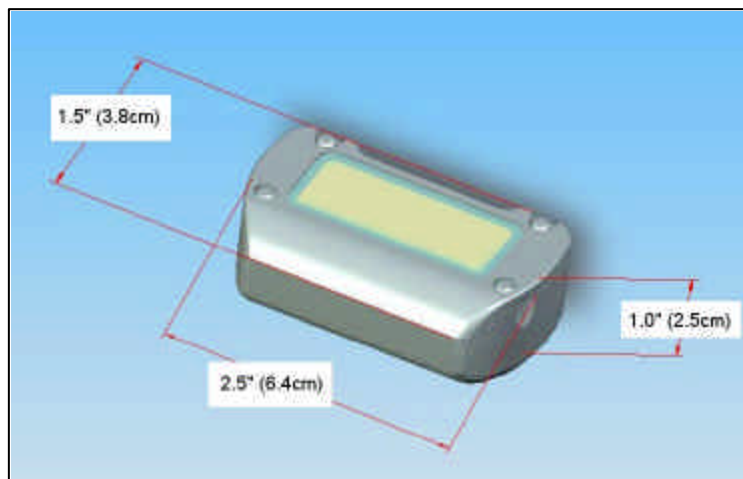
## General Specifications

The table below outlines the major specifications of the Repeater.

	Large Animal	Small Primate Collar	Large Primate Collar
<b>Physical</b>			
Size	See dimension drawings below	3 inch inner (neck) diameter	3 ½" inner (neck) diameter
Weight/mass (with battery)	50g	215g	240g
<b>Battery specifications</b>			
Battery Type	2/3 AA size, 3.6 Volt Lithium battery. <b>Do not use 'standard' 2/3 AA batteries</b>	3.6 Volt Lithium battery. <b>Do not use 'standard' AA batteries</b>	3.6 Volt Lithium battery. <b>Do not use 'standard' AA batteries</b>
Battery Life	6 days	10 days	10 days
<b>Environmental</b>			
Operating temperatures	0 to 40 degree C	0 to 40 degree C	0 to 40 degree C
Operating humidity	< 70% R.H non-condensing	< 70% R.H non-condensing	< 70% R.H non-condensing
Storage temperature	-20 to 55 degree C	-20 to 55 degree C	-20 to 55 degree C
Storage humidity	< 80% R.H non-condensing	< 80% R.H non-condensing	< 80% R.H non-condensing
<b>Other</b>			
Water Resistant	Yes	Yes	Yes
X-ray/Ultrasound Compatible	Yes	Yes	Yes
MRI compatible?	No	No	No

## Dimensions

Below is a drawing that indicates the gross dimensions of the Large Animal Telemetry Repeater.



## Setup

This section includes instructions for room configuration, device usage, as well as software setup.

### Matching Repeaters with Repeater Receivers

Each Repeater must be paired with a Repeater Receiver of the corresponding reception frequency. These transmission or reception frequencies are represented by the model name of the Repeater or Repeater Receiver. For example, the RPT-910-x Repeater transmits at a different frequency than the RPT-920-x. Similarly, the RMC-910 Repeater Receiver detects signals from an RPT-910-x, but not from an RPT-920-x. For an individual animal, its Repeater must be matched with a corresponding Repeater Receiver. This is accomplished by matching the first three numerical digits of the Repeater's model name (910) with the three numerical digits of the Repeater Receiver's model name (910).

When group housing animals or when animals will be in close proximity to one another, Repeaters with sequential model numbers should not be used together. This will eliminate the possibility of signal interference between two similar Repeater transmission frequencies. For example, place a Repeater RPT-410-x in the same cage with the RPT-440-x rather than placing the RPT-410-x in the same cage with the RPT-420-x.

### Use of Repeater with Implanted Transmitter

Careful consideration must be given to the implant site of the transmitter. When in use, the Repeater must be placed close enough to the implanted transmitter to adequately pick up the transmitter's signal. The maximum allowable distance between the implanted transmitter and the Repeater depends on the model of transmitter being used. The table below indicates this maximum recommended distance for each transmitter size. Exceeding this distance will increase the potential for communications failure.

Transmitter Size	Maximum recommended distance between implanted transmitter and Repeater
10/20	3 inches (7.6 cm)
40/50	4 inches (10.2 cm)
70	8 inches (20.3 cm)

Some examples of placement options are indicated in the drawings below. The ideal placement would have the Repeater placed directly over or very near the implanted transmitter. For example, a jacketed animal with a pocket strategically placed directly over the implantation site can have the repeater secured in the pocket. This would also help prevent the possibility of one animal's transmitter interfering with another animal's transmitter-Repeater link if both animals are housed in the same cage.





## Setting up a room for use with the Repeater

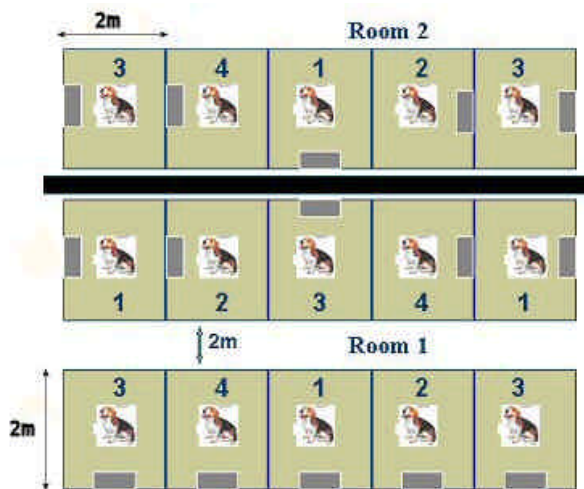
While the Repeater allows for greater flexibility in cage setup and housing designs, careful consideration must be taken when designing and setting up a room for use with the Repeater and associated telemetry.

Repeaters with the same transmission frequency may interfere with each other if there is not adequate spacing between them. To prevent this potential for communication failure, the room and cage setup should be designed to place as much distance as possible between cages with Repeaters operating at the same transmission frequency. The appropriate distance between cages with Repeaters of the same transmission frequency will vary depending on the mode of operation that each Repeater is set to (3m or 8m transmission range). Cage materials, room architecture and other factors from the surrounding environment may also affect the transmission distance. More than one Repeater can be used in a single cage as long as they operate at a unique transmission frequency.

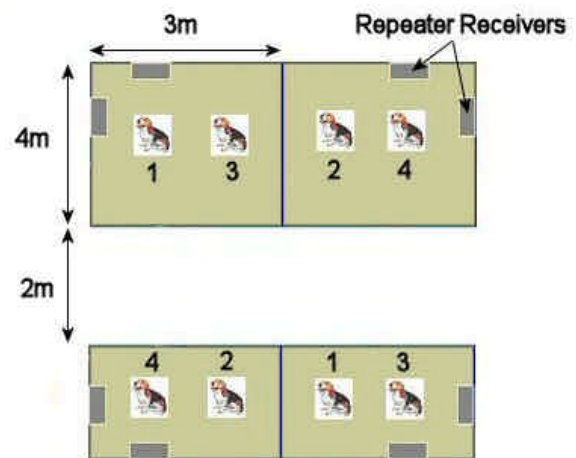
If a cage is too large, the Repeater's distance from its associated Repeater Receiver may exceed its transmission range. In this case, signal dropout or interference will occur. It is possible to combine the reception distance of several Repeater Receivers for one animal using a Distributed Receiver Array (DRA). See the Dataquest A.R.T. User Guide for additional information about the DRA configuration of receivers.

DSI recommends testing the Repeaters with Repeater Receivers in the telemetry room before initiating a study. This testing can help optimize the room setup by determining the best Repeater Receiver location as well as the proper mode of operation for the Repeater (short or long-range). Potential problems with cross talk and electromagnetic interference may be identified and solved during this testing as well.

The illustrations below provide examples of successful telemetry setups for Repeaters that are set to the short-range (3m) mode. Each cage number (1-4) represents a unique Repeater transmission frequency. These examples assume the Repeater Receivers are mounted on the cage walls at or near the height of the animal.



Repeater room setup example



Group housing setup example

## Software Setup

Follow these instructions to set up the Dataquest A.R.T. software when using the Repeater:

Note: The software automatically detects the Repeater Receiver, but the Repeater is invisible to the Dataquest A.R.T. software and does not need to be configured.

Note: The Repeaters and Repeater Receivers can be used with Dataquest A.R.T. versions 4.0 or later without modification. If using version 3.1 of the Dataquest A.R.T. software, contact DSI Technical services for the appropriate software compatibility update.

These devices are not compatible with versions of Dataquest A.R.T. prior to 3.1.

Note: Activity data is only available for a Repeater system in Dataquest A.R.T. 4.0 and later

1. Physically connect the Repeater Receiver(s) to a jack in the B or C row of the Data Exchange Matrix.
2. Open the Dataquest A.R.T. Acquisition program and click the Ignore button if any configuration errors appear.
3. From the main Acquisition window, select **Configuration - Hardware**. The Configuration module will open.
4. Select **Hardware - Verify**. The program will indicate which receivers are being added to the configuration and where they are located.
5. Choose **Accept** to allow these changes to be made.
6. Right click on one of the Repeater Receivers that will have a transmitter associated with it and choose **New Transmitter**.
7. Complete the New Transmitter Wizard.
8. Repeat steps 6 and 7 for each transmitter that needs to be configured.
9. Close the Configuration module. The main Acquisition window will update and reflect the changes by creating an icon for each newly configured animal.

Note: The Repeater Receivers may be configured as a Distributed Receiver Array (DRA). The DRA setting makes it possible to have more than one Repeater Receiver used with a single Repeater and transmitter combination. Information about the DRA configuration is available in the Dataquest A.R.T. User Guide.

Sampling can begin after the following conditions are met:

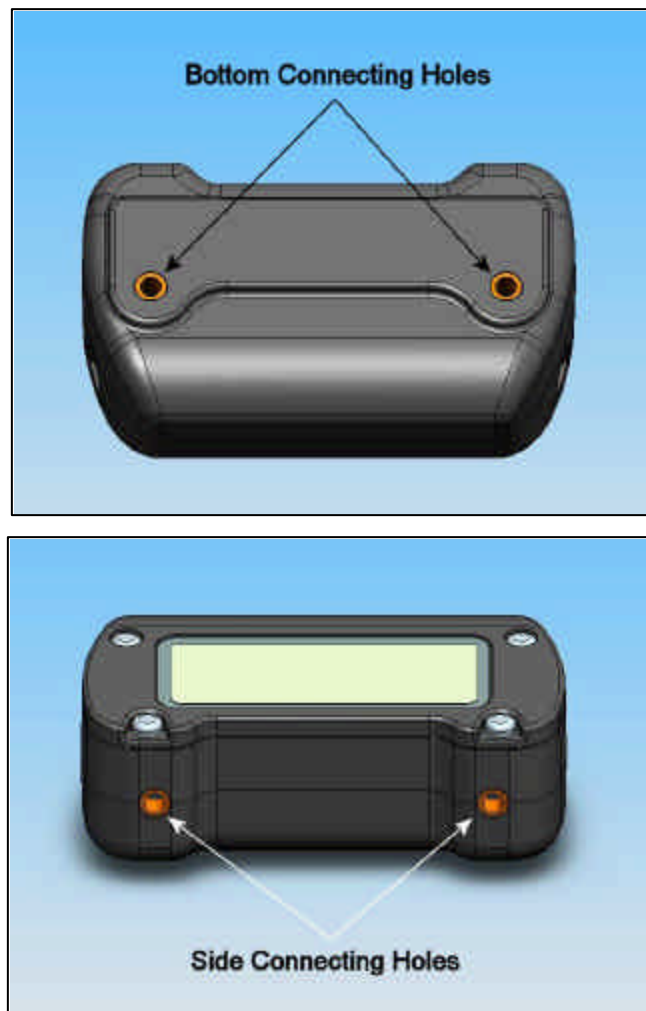
- The transmitter is turned ON
- The Repeater has a live battery installed
- The Repeater is within range of the implanted transmitter (see table on previous page)
- The Repeater is within range of its associated Repeater Receiver
- The transmitter and Repeater Receiver are configured correctly in the acquisition software

## Large Animal Telemetry Repeater Use and Maintenance

This section describes the recommended use and maintenance procedures for the Large Animal Telemetry Repeater. Similar information for the Primate Telemetry Repeater Collar can be found in the next section.

### Connecting the Repeater

While in use, the Repeater must remain near its associated implanted transmitter at all times. There are several methods available to ensure that the Repeater remains with the animal. The preferred approach is to place the Repeater in the pocket of a fitted jacket or vest. Alternatively, the Repeater can be directly connected to an animal's collar or harness using one of two available sets of Connecting Holes indicated in the drawings below.



The centers of the Connecting holes (both sets) are 1.8 inches (4.6 cm) apart. To connect the Repeater to a collar or similar device, DSI recommends using the 4-40x $\frac{1}{4}$ " Phillips truss head machine screws provided by DSI. Properly spaced holes can be punched in the collar or harness using a grommet kit.

## Cleaning/Decontamination

The Repeater Receiver can be cleaned/decontaminated using the method described in the hardware cleaning tech note on the DSI website <http://www.datasci.com>.

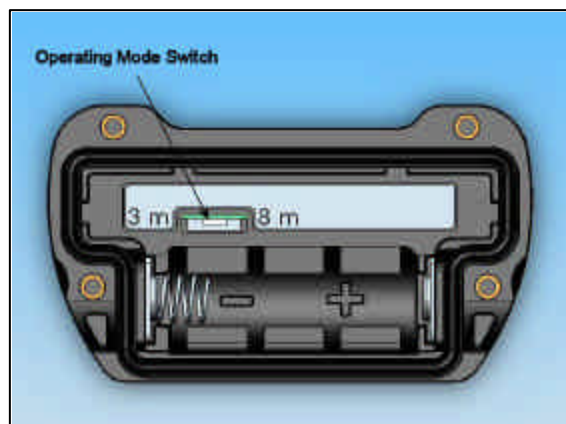
## Changing mode of operation

The Repeater can be set to function in one of two operating modes: short and long range. DSI recommends determining which setting is optimal before a study begins and setting the mode of operation before the Repeater is used on the animal. This will prevent the need for unnecessary access to the Repeater when it is in use. To change between the short range (3m transmitting distance) and long range (8m transmitting distance) modes, follow the instructions below.

1. Loosen the four captive Phillips screws that secure the cover to the Repeater housing and pull the cover away from the body of the Repeater as shown in the drawing below.



2. Locate the operating mode switch. Its position is indicated below.



3. The factory default setting of the Repeater's operating mode is the short range (3m) mode. When the Repeater is in the orientation shown in the illustration above, the switch can be moved to the right to set it to long range (8m) mode.
4. Set the switch to the preferred position using the tip of a tweezers or similar tool. **Do not use excessive force when manipulating the operating mode switch.**
5. Replace the cover on the Repeater and retighten the screws.

## Battery Replacement

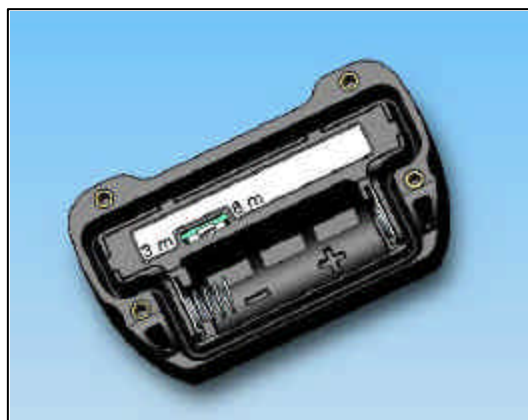
**Caution: Use only the DSI-supplied 3.6 Volt Lithium batteries with the Repeater. Do not use 'standard' AA batteries or the Repeater will not work correctly and may be damaged.**

The Repeater battery should be replaced on a regular basis to prevent data loss. Replacement batteries can be purchased from DSI. The Large Animal Telemetry Repeater replacement batteries are available as DSI part number 276-0941-002. To replace the battery, follow these steps:

1. Stop data sampling and remove the Repeater from the animal's collar, harness, vest, etc.
2. To access the battery compartment, loosen the four Phillips head machine screws that hold the Repeater cover in place, and pull the cover away from the body of the Repeater as shown in the drawing below.



3. Remove the old battery from its housing and note its original orientation in the battery compartment.
4. Replace the old battery with the new one using the old battery's orientation. The positive (+) end of the battery must match with the positive (+) sign printed on the inside of the battery compartment and the negative (-) end of the battery must match with the negative (-) sign printed on the inside of the battery compartment. **Improper installation of the battery may damage the Repeater.**



5. Replace the cover on the Repeater and retighten the screws.
6. Place the Repeater back on the animal and resume sampling. DSI recommends checking the signal after replacing the battery.

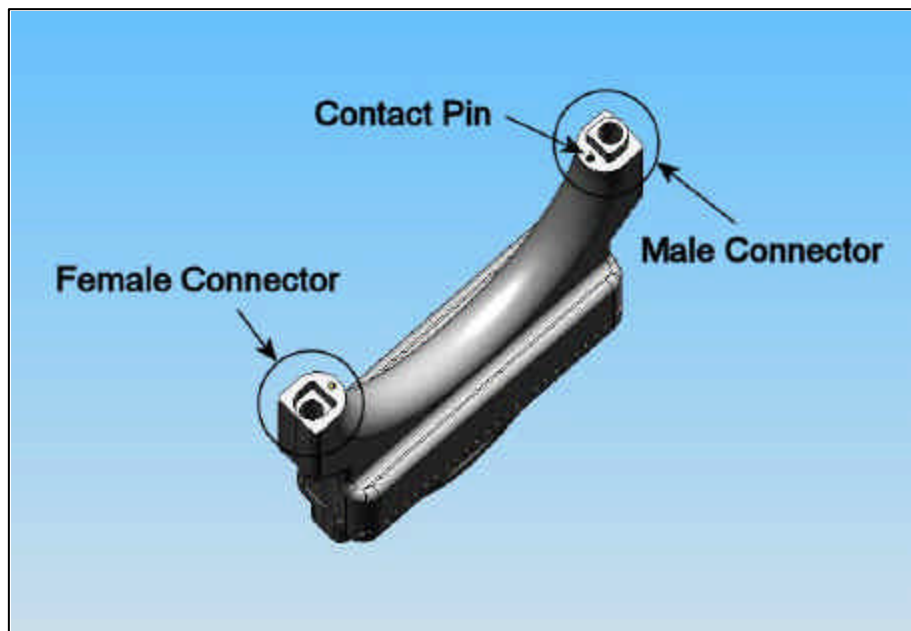
## Primate Telemetry Repeater Collar Use and Maintenance (Preliminary)

This section describes the recommended use and maintenance procedures specific to the Primate Telemetry Repeater Collar. Similar information for the Large Animal Telemetry Repeater can be found in the previous section.

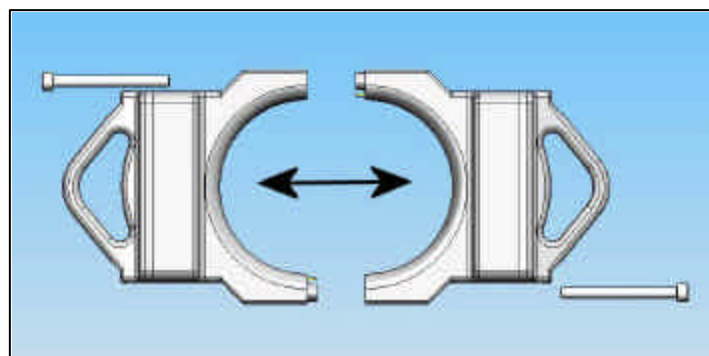
### Connecting the Repeater

The Repeater consists of two halves. Each half has one male connector and one female connector. The drawing below illustrates one of these halves and indicates the connector types.

**Warning: Take care not to damage the contact pins when connecting or removing the collar. Contact pins may be damaged if the Repeater halves are stressed abnormally. Unscrew and remove both Socket Head Cap Screws before disconnecting the collar halves.**



The two halves of the Repeater must be joined in order for it to function. Connect the two halves by aligning them and using the two 10-32 X 2" Socket Head Cap Screws supplied with the Repeater as shown in the drawing below. Use a 5/32 hex wrench (provided with the Repeater) to fasten or loosen the screws in the Primate Repeater Collar.



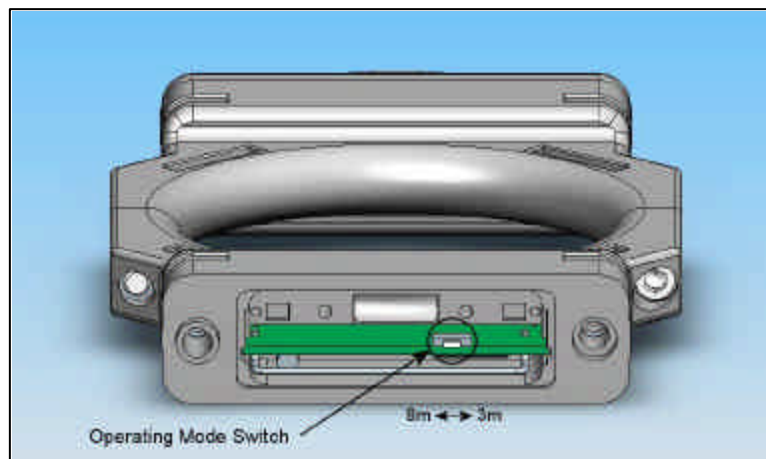
## Cleaning/Decontamination

The Repeater Receiver can be cleaned/decontaminated using the method described in the hardware cleaning tech note on the DSI website <http://www.datasci.com>.

## Changing mode of operation

The Repeater can be set to function in one of two operating modes: short and long range. DSI recommends determining which setting is optimal before a study begins and setting the mode of operation before the Repeater is used on the animal. This will prevent the need for unnecessary access to the Repeater when it is in use. To change between the short range (3m transmitting distance) and long range (8m transmitting distance) modes, follow the instructions below.

1. The Repeater circuit board must be accessed to change the operating mode. The circuit board compartment is located on the side of the Repeater with the DSI label and other device identification markings. Locate the circuit board compartment.
2. Remove the two 10-24 X 1.0" Socket Head Cap screws that hold the circuit board compartment in place and use the handle to pull the circuit board compartment cover apart from the Repeater.
3. Locate the operating mode switch on the circuit board. Its position is indicated in the drawing below.



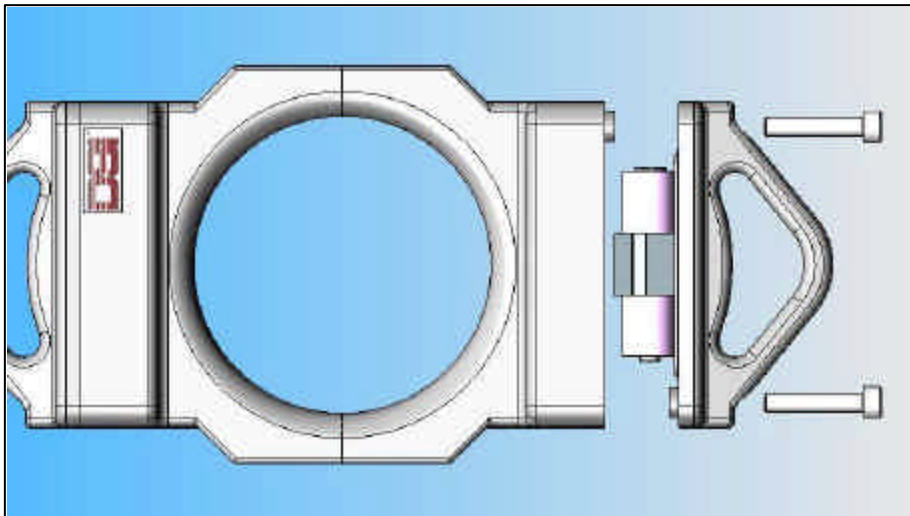
4. The factory default setting of the Repeater's operating mode is the short range (3m) mode. When the Repeater is in the orientation shown in the illustration above, the switch can be moved to the left to set it to long range (8m) mode. When the switch is set to the right, it is in the short range mode.
5. Set the switch to the preferred position using the tip of a tweezers or similar tool. **Do not use excessive force when manipulating the operating mode switch.**
6. Reconnect the circuit board compartment cover to the Repeater and secure it with the same screws that were removed in step 2.

## Battery Replacement

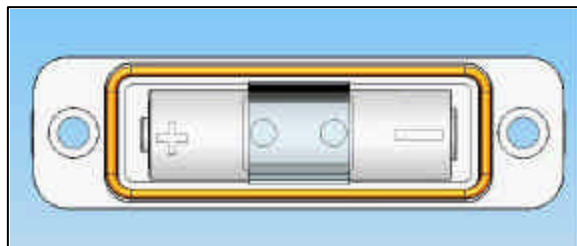
**Caution: Use only the DSI-supplied 3.6 Volt Lithium batteries with the Repeater. Do not use 'standard' AA batteries or the Repeater will not work correctly and may be damaged.**

The Repeater battery should be replaced on a regular basis to prevent data loss. The Primate Telemetry Repeater Collar replacement batteries are available as DSI part number 276-0942-002. To replace the battery, follow these steps:

1. Stop data sampling and secure the animal in an appropriate restraint system.
2. The battery compartment is located on the side of the Repeater *without* the DSI logo as shown in the image below. Locate the battery compartment.
3. Remove the two 10-24 X 1.0" Socket Head Cap screws that hold the battery compartment in place and use the handle to pull the battery compartment apart from the Repeater.



4. Remove the old battery from its housing and note its original orientation in the battery compartment.
5. Replace the old battery with the new one using the old battery's orientation. The positive (+) end of the battery must match with the positive (+) sign embossed on the end cap feature and the negative (-) end of the battery must match with the negative (-) sign embossed on the end cap feature. **Improper installation of the battery may damage the Repeater.**



6. Reconnect the battery compartment to the Repeater and secure it with the same screws that were removed in step 3.
7. Place the Repeater back on the animal and resume sampling. DSI recommends checking the signal after replacing the battery.



### Regulatory Compliance Statements

This device complies with part 15 of the FCC rules and RSS 210 of the Canadian Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference that may cause undesired operation.