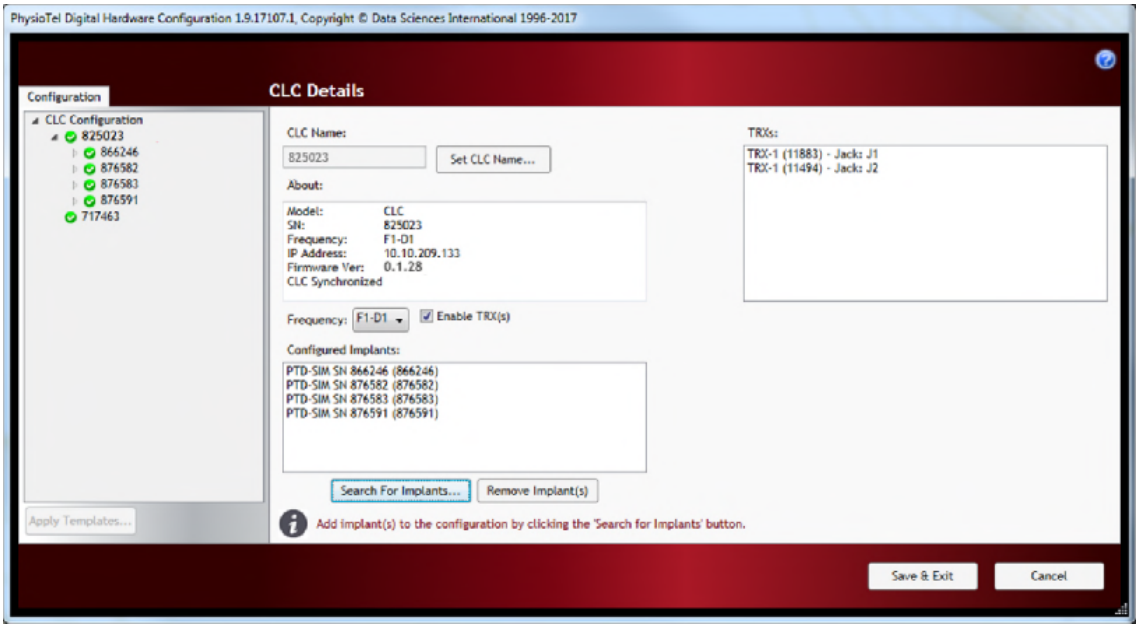
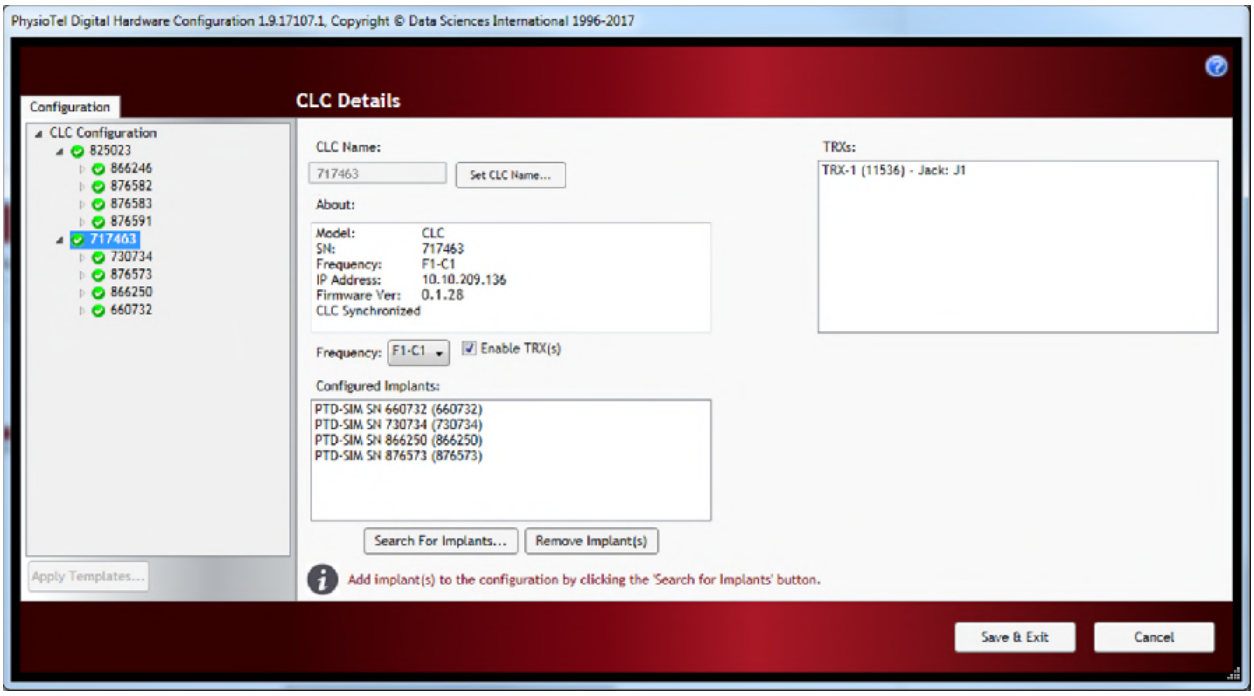
Note: The Frequency in the CLC Details page will display the last Frequency selected in the Search for Implants dialog (e.g. F1-B1). Once the implants change to their new frequency (e.g. F1-D1), the CLC Details Frequency will reflect its originally selected Frequency (F1-D1)

10. The **CLC Configuration** List View will update with the implants, along with the *Configured Implants* list within the *CLC Details*.



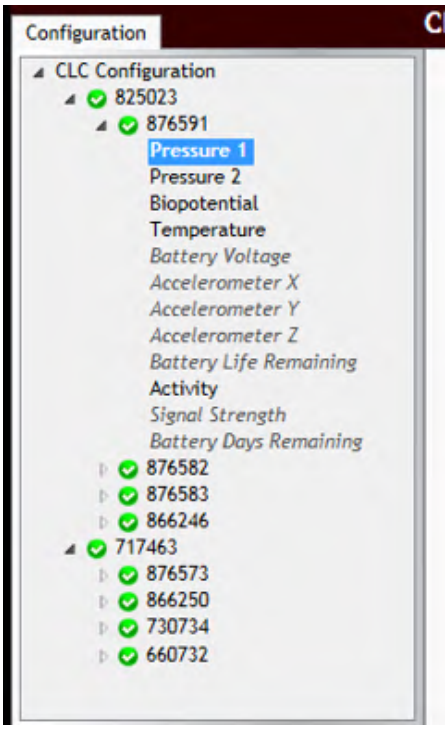
11. Repeat steps 6-10 for any additional CLCs/implants.



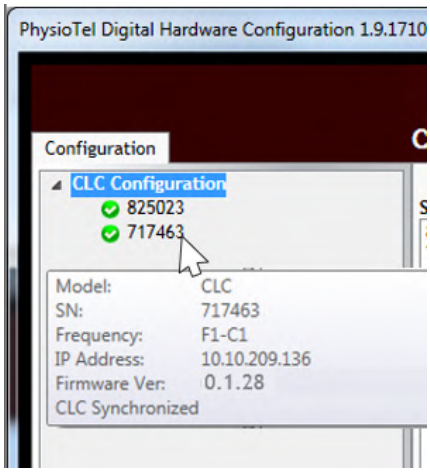
12. Once complete, click the **Save & Exit** button.

PhysioTel Digital Configuration Details

Multiple layers of information are contained in the *PhysioTel Digital Hardware Configuration* dialog, each accessed using the List View on the left side. The **CLC Configuration** column lists the entire setup in an expandable tree structure. The CLCs are listed with their assigned implants nested underneath.



Note: The tree structure can be expanded and contracted by clicking on the arrows immediately to the left of the individual line items. Hover the mouse cursor over any line item in the Configuration box to activate an information pop-up with that device's key status condition. The example below is the hover information for a CLC.



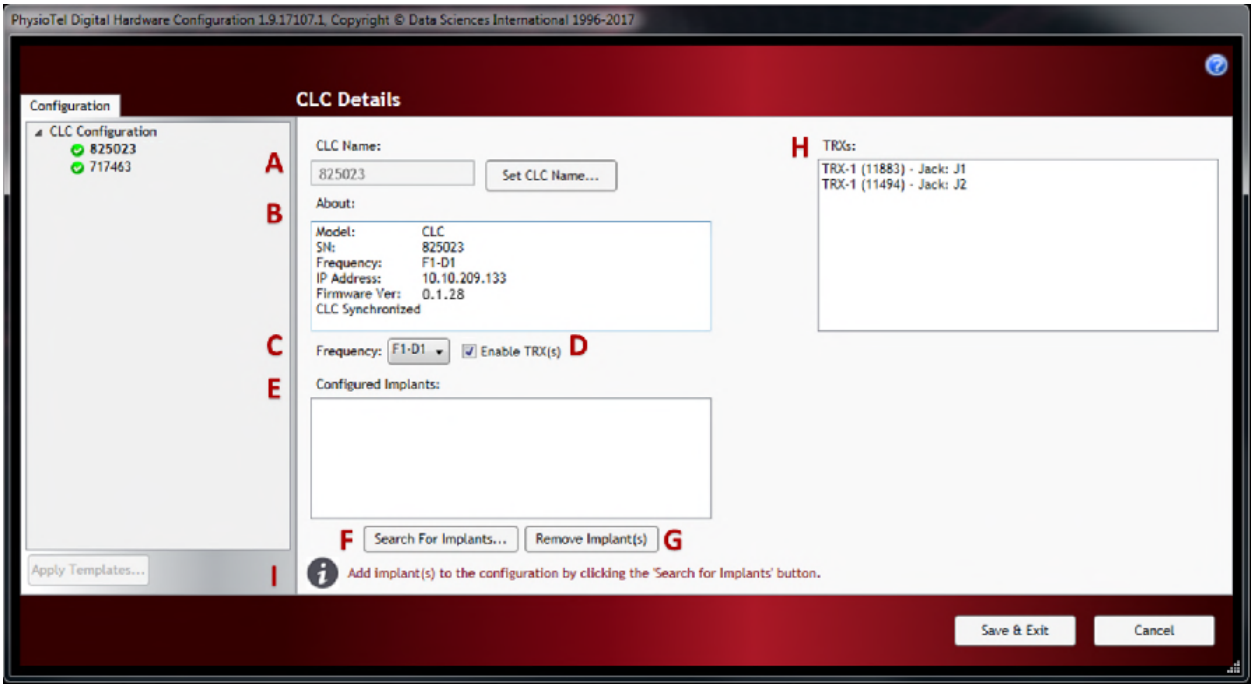
The **CLC Configuration** is the first line in the List View and displays the **Selected CLC** for the current configuration.

The List View can also be used to access the following information:

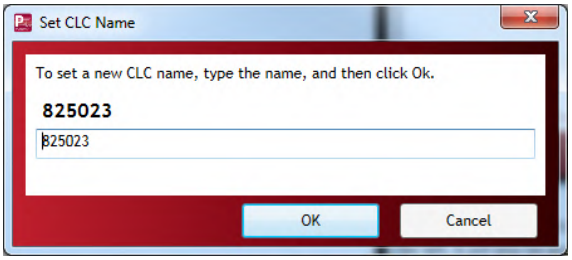
- CLC Details
- Implant Details
- Channel Details

CLC Details

The **CLC Details** view can be accessed by left-clicking on any of the CLC line items in the **List View**.



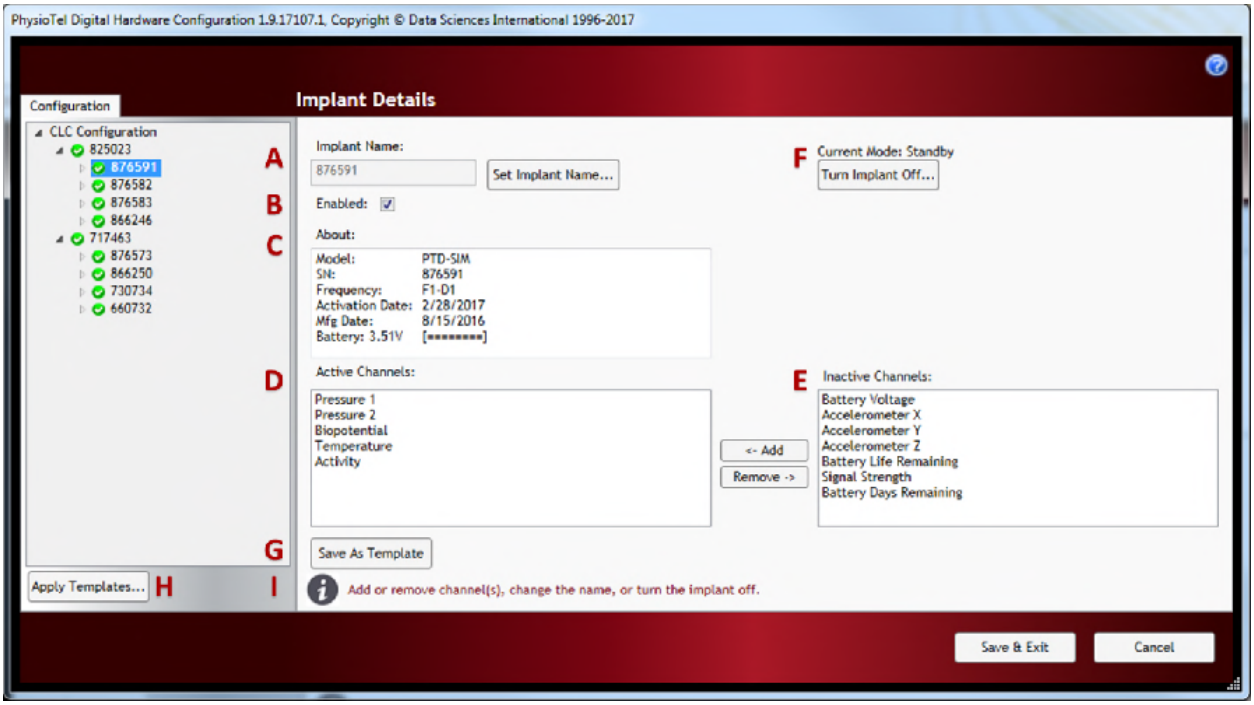
CLC Details include:

CLC Fields	Description
A. CLC Name:	Select the **Set CLC Name…** button to create or change the name of the CLC. This name is saved on the CLC and will be the name seen when searching the network for available CLCs to add to the configuration with the **PhysioTel Digital Configuration**. 
B. About:	Important information including CLC model and serial numbers, current frequency, IP Address, and Firmware. This same information is available by hovering the mouse cursor over the line item in the List View.
C. Frequency	Dropdown box used to select the frequency of the CLC.
D. Enable TRX(s)	Checkbox used to enable (checked) and disable (unchecked) the CLC broadcast frequency. Disabling the TRXs may be useful in preventing the CLC from interfering with the implant configuration process of another CLC in the configuration or on the network.
E. Configured Implants	Lists the implants currently configured to this CLC.
F. Search for Implants…	Allows the user to search for implants that are powered ON and in range for assignment to the CLC within this configuration.
G. Remove Implants	Allows the user to select the implants from the *Configured Implants* list and remove them from the configuration.
H. TRXs:	List of TRXs and serial numbers assigned to that CLC and the "Jack" number on the back panel of the CLC the TRX is plugged into.

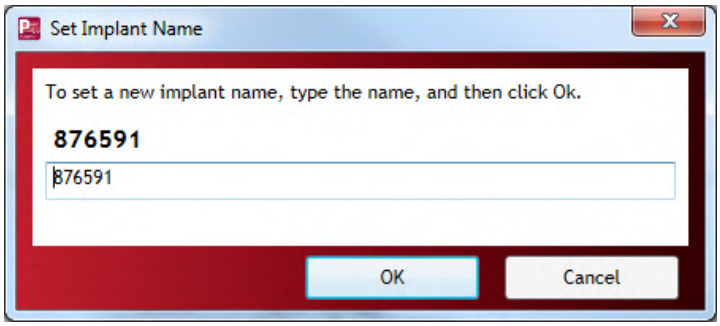
CLC Fields	Description
I. Information	Provides the user with instructions on actions to perform on that Details page.

Implant Details

The **Implant Details** can be accessed by left-clicking on any of the implant names in the **List View**. The Implant Details view contains implant information, as well as some important interactive features.

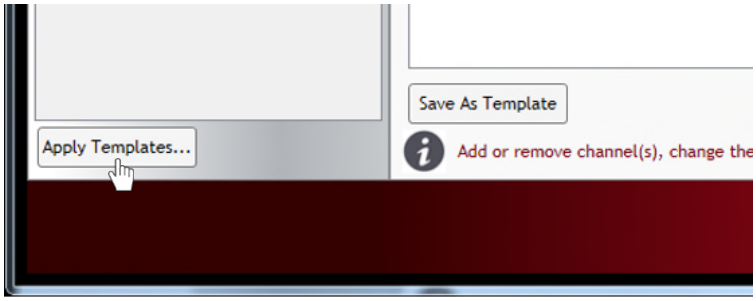


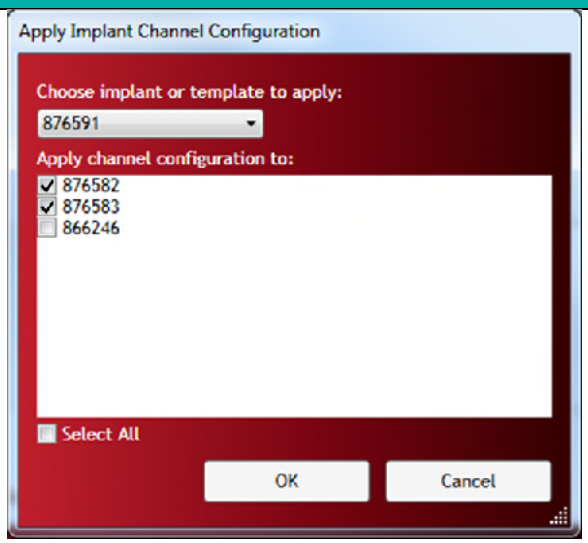
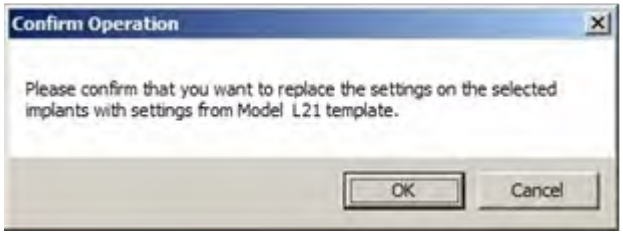
Implant Details contains the following information:

Implant Details Field	Description
A. Implant Name:	User may rename the implant by selecting the **Set Implant Name…** button. In the displayed dialog, enter the desired name in the text field and select **OK**.  Upon selecting OK, a  will display next to the existing implant name while the CLC communicates the name to the Implant. Once the implant is programmed with the name, the dialog will close. The name specified here is also used by Ponemah as the Subject Name when automatically creating the Subject upon clicking Save & Exit within this dialog.
B. Enabled:	This check box will toggle the implant between 'Enabled' and 'Disabled' modes. The Enabled mode allows the software system to record, store, and analyze data from the implant.  *WARNING: if the implant is not **Enabled**, the implant will still be powered ON and in communication with the system, but no data from the implant will be acquired.*
C. About:	Important information including model and serial numbers, activation and manufacture dates, as well as a battery level indicator. This same information is available by hovering the mouse cursor over the line item in the List View.

Implant Details Field	Description
D. Active Channels **E. Inactive Channels**	These columns allow the user to select which data collection channels are activated in the implant. **Active Implant Channels** collect physiologic data and transmit the data through the acquisition system to be stored in the data acquisition computer. **Inactive Channels** do not collect physiologic data as those channels are disabled. *Note*: In addition to avoiding the collection of unnecessary data, the in-activation of certain data channels has the potential to preserve battery resources.
F. Current Mode:	This displays the current implant operation mode. The **Turn Implant Off** button allows the user to remotely switch the implant to the **OFF** mode. See the PhysioTel Digital Implant Deactivation section of this manual for the process. *WARNING: Once in the implant is in OFF mode, it cannot be remotely returned to the ON mode. The implant can only be turned ON by physically passing a strong magnet close to the device for a few seconds. See the Implant Activation section of the manual for the process.*

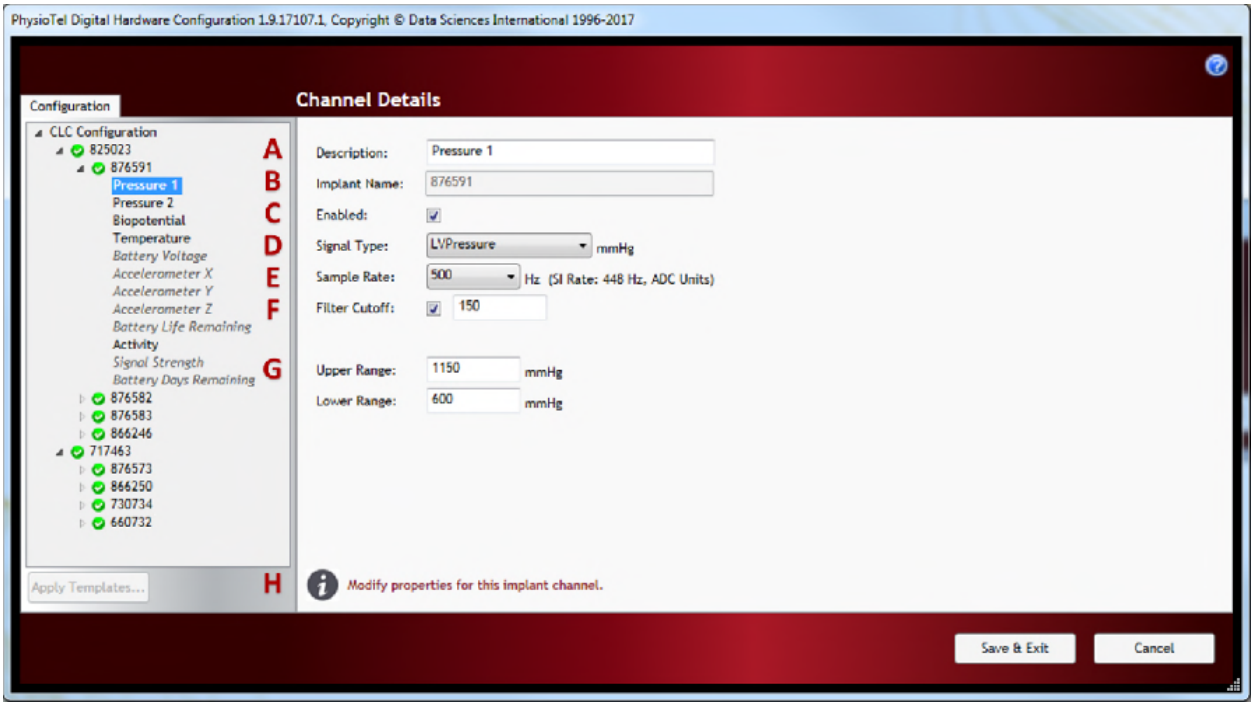
Implant Details Field	Description
G. Save As Template:	This allows the user to identically configure a group of implants with the same channel arrangement. Once the channel configuration is set for one of the implants, the user can save the implant configuration as a Template and apply that configuration template to all similar implants in the current configuration. *To create a Model Template*: 1. Select an implant from the **CLC Configuration** column on the left side of the screen. 2. Use the Active Channels dialog to configure the implant in the manner you wish to save as a Template. 3. Click the **Save As Template** button. 4. You will be offered a confirmation message "**Are you sure you want to replace the template …?**" 5. Click **Yes** to confirm. *Note*: Only one Model Template can be saved per implant model type.

H. Apply Templates…	*To apply a saved Model Template to other implants in the CLC Configuration List View:* 1. Click the **Apply Templates…** button in the lower left corner of the window to open the **Apply Implant Channel Configuration** screen.  2. Use the drop-down menu under **Choose implant or template to apply**: to select the saved template you wish to apply to the other implants. It is also possible to copy the channel configurations from one implant to another provided they are the same model type. 3. In the **Apply channel configuration to:** dialog box, select the individual implants to which the template should be applied. Select the implants using the check boxes next to the implant label. The **Select All** check box can be used to select/deselect all implants in the dialog box.

Implant Details Field	Description
	 4. The **Select All** check box can be used to select/deselect all implants in the dialog box. 5. Click **OK** to apply the saved template configuration.  6. A **Confirm Operation** dialog is offered as a precaution, click **OK** to accept.
I. Information	Provides the user with instructions on actions to perform on that Details page.

Channel Details

Implant **Channel Details** are accessed by selecting a **Channel** associated with an implant from the **CLC Configuration** List View. Click on the arrow icon to the left of implant name within the List View display the implant Channels. The current "active" channels are listed in **bold** text in the List View once the tree structure is fully expanded. The inactive channels are listed in *italic* text.



Channel Details contain the following information:

Channel Details Fields	Description
A. Description	Allows the user to change the name of the channel. Unlike the CLC and Implant name, the Channel name is not saved to the device and will revert to its default name in new configurations.
B. Implant Name	Displays the implant name.
C. Enabled	This check box will toggle the **Input** channel between '**Enabled'** and '**Disabled'** modes. The **Enabled** mode allows the software system to record, store, and analyze data from the **Input** channel.

Channel Details Fields	Description
D. Signal Type	Allows the user to define which signal type should be used for the particular implant channel. These will default to the most common signal types based on the implant model selected; e.g. **L21** Channel 1 pressure channel will default to the **LVPressure** signal type. This is important because the signal type defined here is used to automatically define the **Analysis Module** assigned to the channel when Ponemah automatically creating Subjects upon **Save & Exit** from this dialog.
E. Sample Rate	Allows the user to define a unique sampling rate to each implant channel.
F. Filter Cutoff	Filter cutoff defines the frequency in Hz at which the finite impulse response (FIR) low-pass digital filter attenuates the waveform by 3 decibels (dB). Contact DSI Technical Support prior to changing these values.
G. Upper/Lower Range	Used to determine the range of values that can be represented in a stored waveform. Data values outside this range will be marked as bad when they are saved.
H. Information	Provides the user with instructions on actions to perform on that Details page.

Edit SoHo Configuration

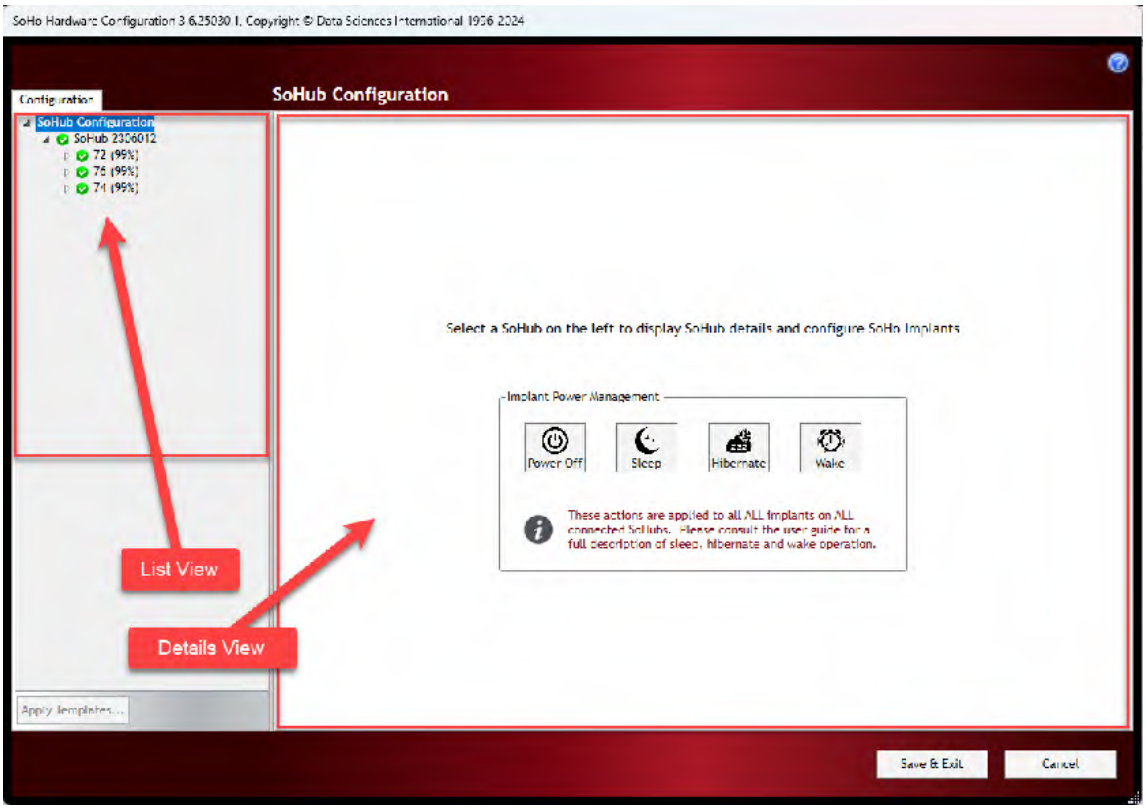
The SoHo telemetry platform automates the collection of physiologic data from freely moving research animals via wireless telemetry. The system consists of a sophisticated acquisition and analysis software platform and a family of advanced, state of the art implantable telemetry transmitters.

The SoHo Configuration allows a user to add SoHo implants to the system, associate implants with the appropriate SoHub for data collection and change implant mode (turn off, sleep, hibernate, wake up).

The SoHo Configuration dialog is launched from the **Hardware** menu.

There are two functional areas in the *SoHo Configuration* dialog:

- The "**List**" view on the left is a container which tracks the growing hardware configuration. When the dialog is opened all currently connected SoHubs will be displayed. As implants are added the individual items will be automatically arranged in a tree structure to represent their relationships.
- The "**Details**" view on the right provides the customizable options available for the hardware items when selected from the List dialog.



Configuration

The **SoHub Configuration** is the first line in the List View. When selected it will indicate in the Details Section to the right to select a SoHub for implant configuration, and it also introduces the **Implant Power Management** box which allows implants to be set to different power states to optimize and save battery life.

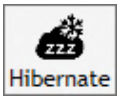
Implant Power Management

Note: The Implant Power Management is available at different levels and will affect either ALL IMPLANTS (SoHub Configuration level), ONLY IMPLANTS on a given SoHub (Sohub level) or just an individual implant (implant level).

Sends a command for implants to power off. See Implant Deactivation for details.

Warning: The Power Off button will send the command for implant to power off continuously for one minute. If the implant is turned back on with a magnet within the minute after clicking Power Off, it will shut off.

Sends implants to Sleep Mode. Implants can be taken out of Sleep Mode using the Wake function. See Implant Operation Modes for details.



Sends implants to Hibernate Mode. Implants can be taken out of Hibernate Mode using the Wake Function. See Implant Operation Modes for details.

Begins the process to Wake implants from either Sleep or Hibernate Mode. The time to wake can vary. See Implant Operation Modes for details.

Configuring Implants

The **SoHo Configuration** allows you to add SoHo implants to the system and associate them with the appropriate SoHub for data collection.

To begin your configuration process:

- Select an available **SoHub** from the **Configuration** tab's **List View**.

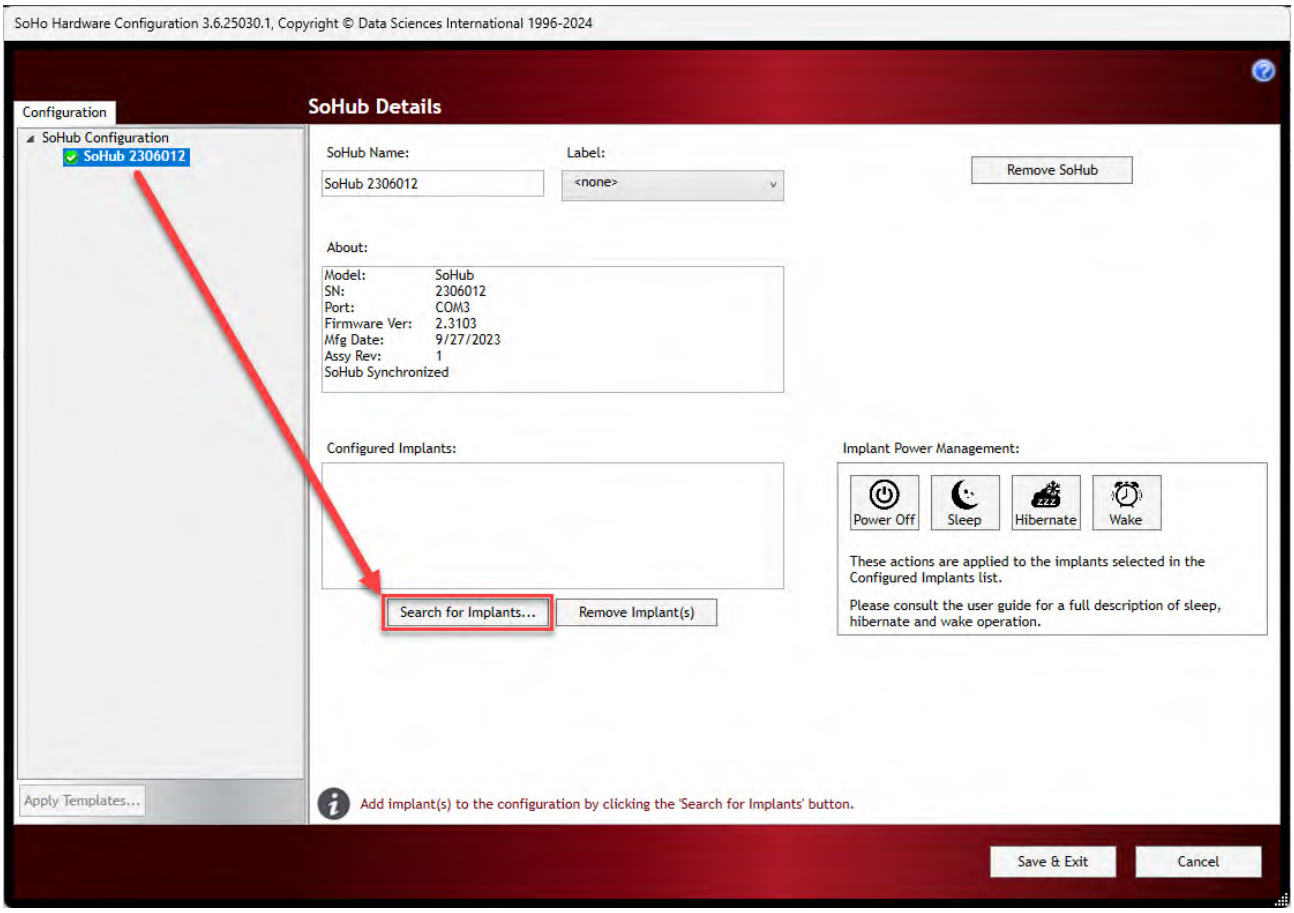
Each SoHub will have a circular icon indicating current status:

Connected – a green colored icon with checkmark indicates the SoHub is synchronized and ready.

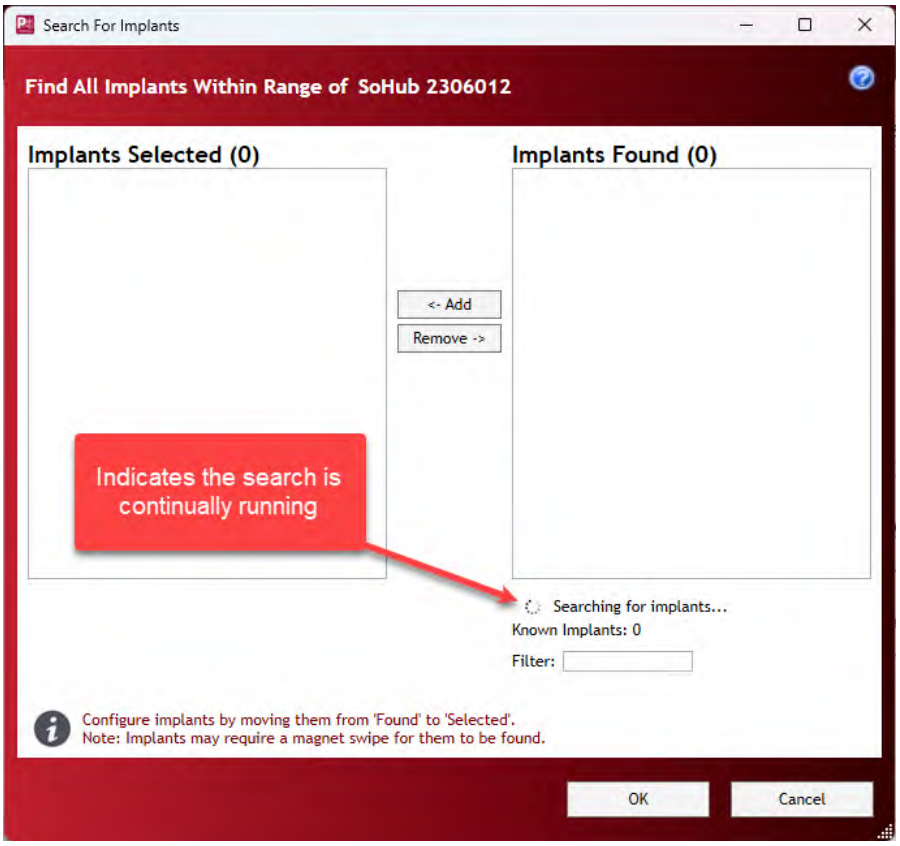
Not Connected – a red colored icon with exclamation mark indicates the SoHub was previously detected but is not currently available. It may have been unplugged.

Synchronizing – a yellow colored, time icon indicates the SoHub is attempting to synchronize to the computer. This is rare and may require a re-connect of the SoHub.

- Select the **Search for Implants…** button



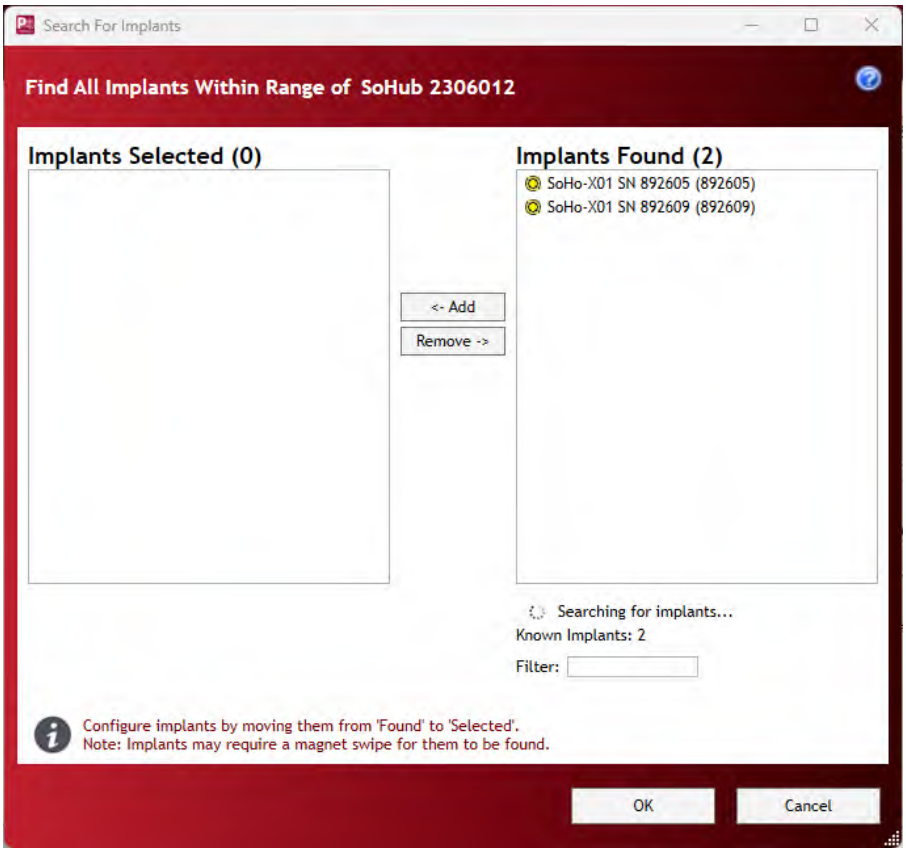
The *Search for Implants* dialog will open and automatically begin searching for implants that are powered ON and within range. The dialog displays the count of implants that are selected, found, and the total number of known implants.



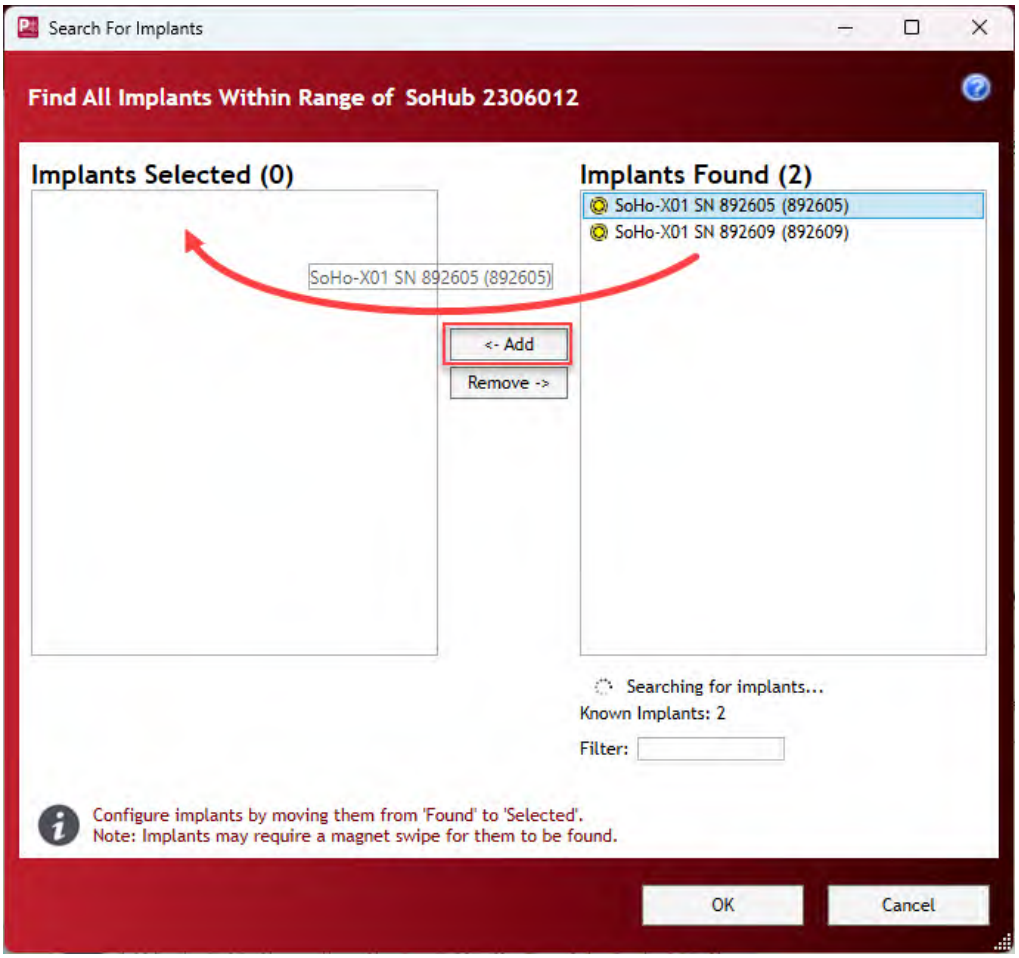
Known Implants: Lists the number of SoHo implants that have been found during this configuration session.

Filter: Implants Found can be filtered by any combination of model or SN

- Activate the implants to be added to this configuration per the procedure described in Implant Activation of the SoHo Telemetry Platform Section.
- Implants that are detected by the SoHub will be displayed in the **Implants Found** column.

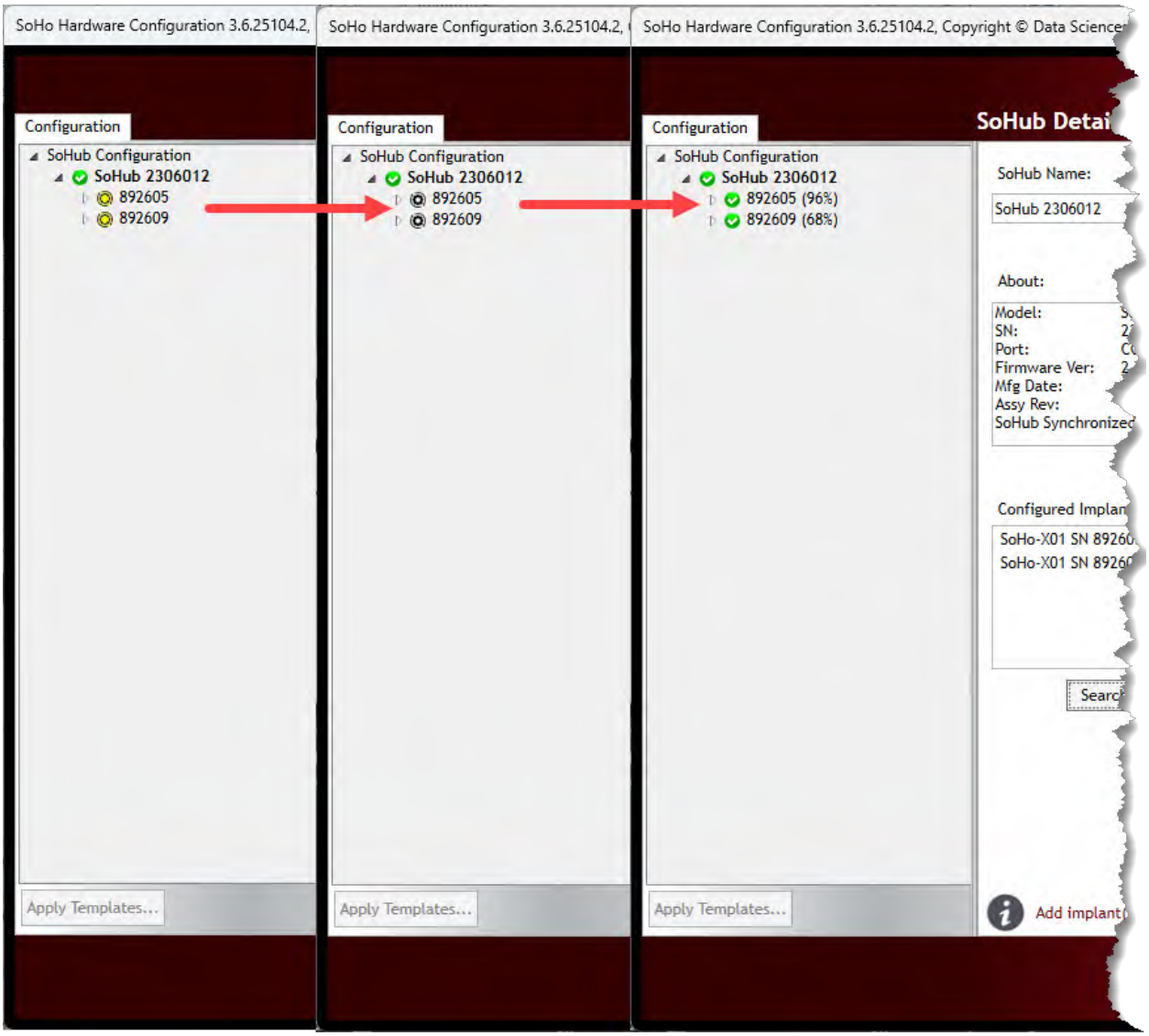


- Drag-and-drop the desired implants individually from the **Implants Found** column to the **Implants Selected** column to assign the implant to this SoHub. Implants may be multiselected and added all at once using the **Add** button.

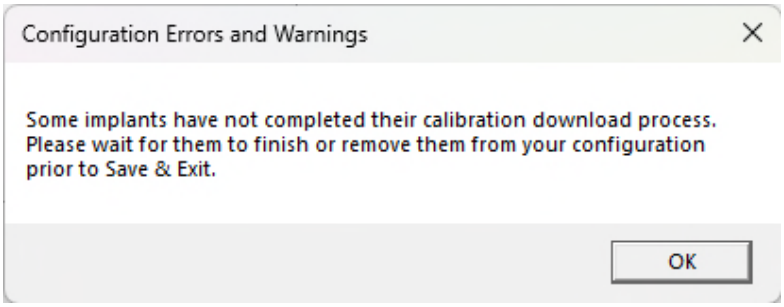


- Click OK after the desired SoHo implants have been added to the **Implants Selected** column (up to 16). The **Search For Implants** window will close and implants will be displayed with the associated SoHub in the **List View**.

  Implant calibrations are stored on the implants and must be transmitted to the Ponemah software. When implants are initially added, the implant status icon will indicate the calibration download process. Implants that are in queue and pending download will display a yellow gear icon. When implants are actively downloading calibrations the icon will change to a white gear icon, and when the process is completed the icon will turn green. The process can take up to two minutes for all implants.



The implant calibration download process MUST be completed before clicking Save and Exit. If calibration download is not complete, a warning will be displayed to prevent the user from closing the window.



Implants can have the following status:

Searching for Implant – a yellow colored icon with question mark indicates the SoHub was previously communicating with the implant but it has lost connection and is waiting to re-connect.

Pending Download of Calibration Data – a black and yellow gear icon with circling arrows. The implant is in queue and waiting to re-connect. Once connected the state will change to Downloading Calibration Data.

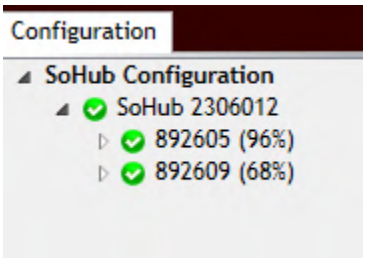
Downloading Calibration Data – a black and white gear icon with circling arrows. When a new implant is added, the pre-configured channel calibration data that is stored on the implant is uploaded to the system.

Standby – a green colored icon with checkmark indicates the implant is currently connected to the SoHub.

Powering Off – A purple colored power-button icon indicates the implant is currently powering off. This status is temporary for up to 8 seconds as an implant fully powers off.

OFF – A red colored icon indicates the implant is in the configuration but is in OFF mode.

Multiple layers of information are contained in the *SoHo Hardware Configuration* dialog, each accessed using the List View on the left side. The **SoHub Configuration** column lists the entire setup in an expandable tree structure. The SoHubs are listed with their assigned implants nested underneath. The number displayed next to the implant in the List View is the remaining battery percentage.



Note: The tree structure can be expanded and contracted by clicking on the arrows immediately to the left of the individual line items. Hover the mouse cursor over any line item in the Configuration box to activate an information pop-up with that device's key status condition.

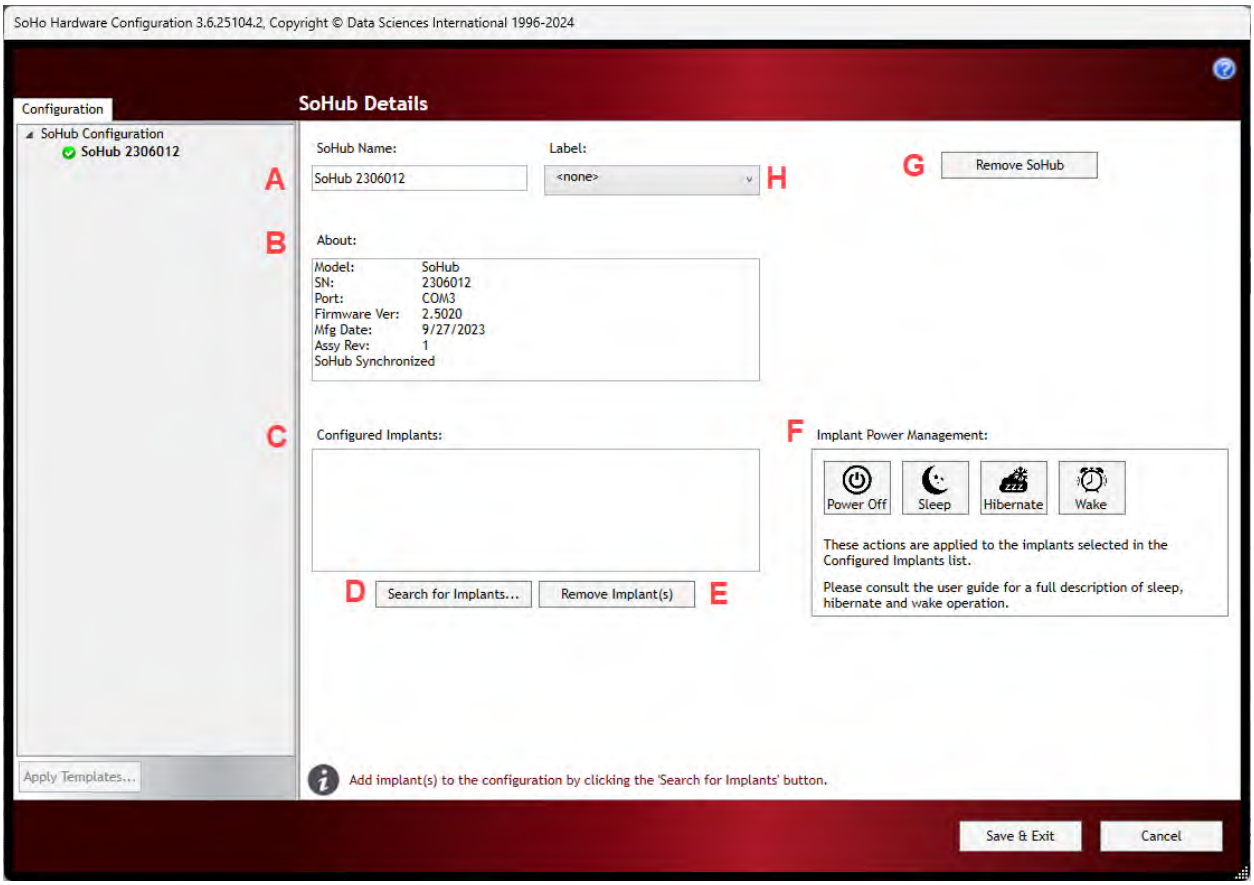
The List View can also be used to access the following information:

- SoHub Details

- Implant Details
- Channel Details

SoHub Details

The **SoHub Details** view can be accessed by left-clicking on any of the SoHubs in the **List View**.



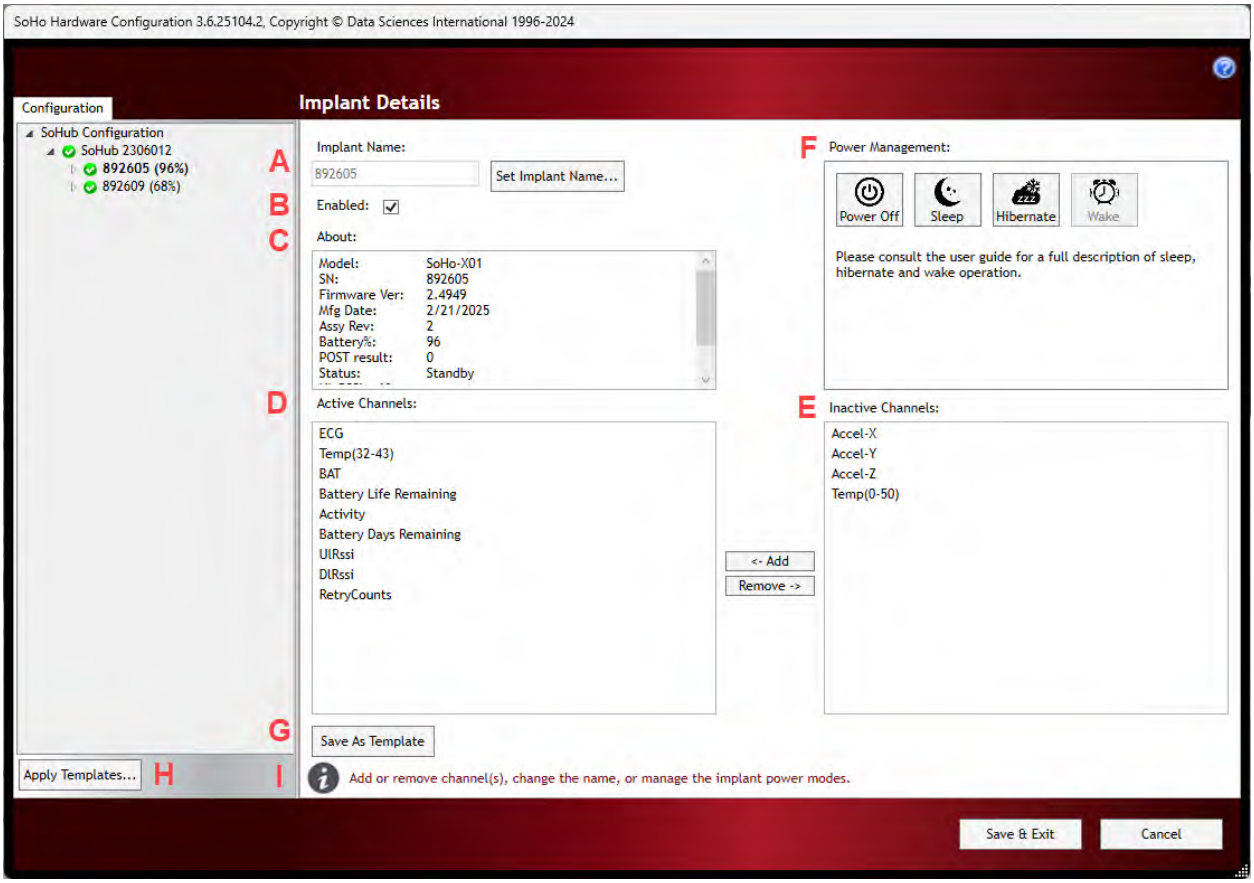
SoHub Details include:

SoHub Details Fields	Description
A. SoHub Name:	Click in the SoHub Name box to change the name of the SoHub. This name is saved in the current protocol but not on the SoHub itself.
B. About:	Shows important information including SoHub model, serial number, COM port and Firmware. This same information is available by hovering the mouse cursor over the line item in the List View.
C. Configured Implants:	Lists the current implants paired with the SoHub
D. Search for Implants…	Allows the user to search for implants that are powered ON and in range.
E. Remove Implant(s)	Allows the user to select the implants from the *Configured Implants* list and remove them from the configuration.

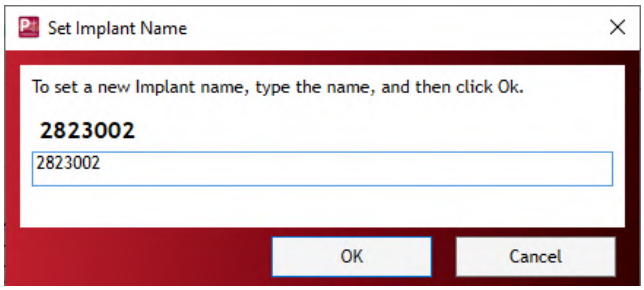
SoHub Details Fields	Description
F. Implant Power Management	Allows changing of the implant power state for any number of implants on the SoHub to preserve battery life. See the Implant Power Management section for details.
G. Remove SoHub	Removes the selected SoHub from the configuration. A new configuration will need to be started to add the SoHub back.
H. Label:	Allows selection of one of six number labels, which correspond to the circular numbered stickers that are provided in the SoHub packaging.

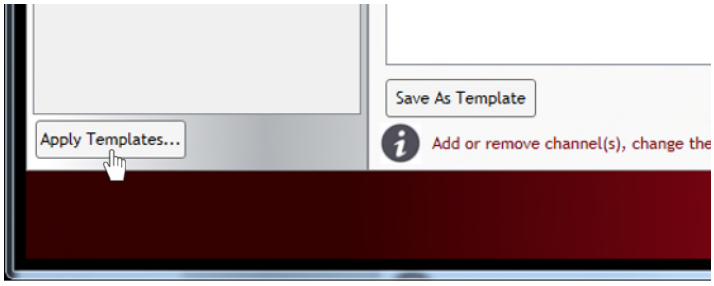
Implant Details

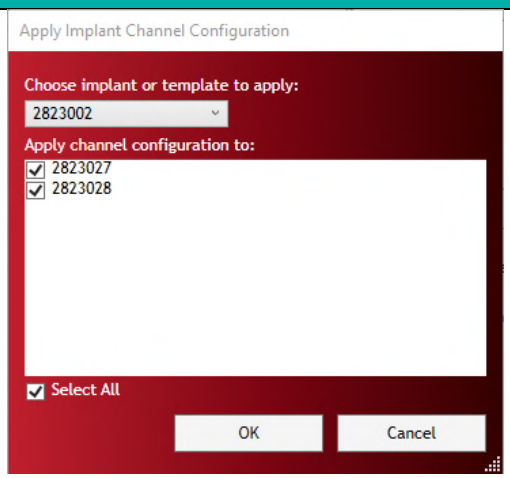
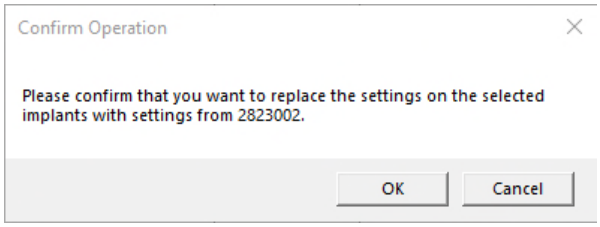
The **Implant Details** can be accessed by left-clicking on any of the implant names in the **List View**. The Implant Details view contains implant information, as well as some important interactive features.



Implant Details contains the following information:

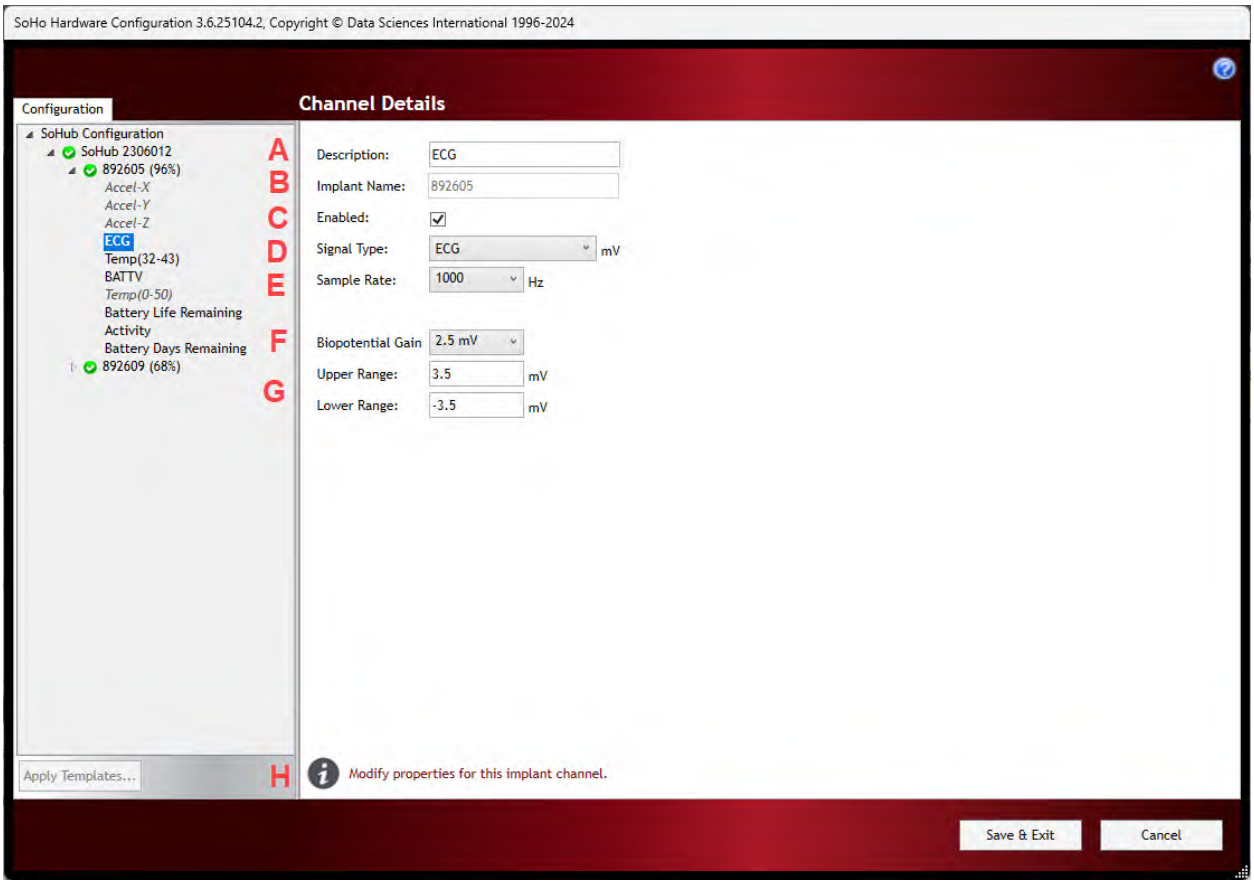
Implant Details Fields	Description
A. Implant Name:	User may rename the implant by selecting the **Set Implant Name…** button. In the displayed dialog, enter the desired name in the text field and select **OK**.  The name specified here is used by Ponemah as the Subject Name when automatically creating the Subject upon clicking Save & Exit within this dialog. If multiple implants are given the same name, they will be associated with the same subject automatically upon exiting the configuration.
B. Enabled:	This check box will toggle the implant between 'Enabled' and 'Disabled' modes. The Enabled mode allows the software system to record, store, and analyze data from the implant. *WARNING: if the implant is **not Enabled**, but it has not been turned off or put into sleep mode, the implant will still be powered ON and in standby mode which will use battery life.*
C. About:	Important information about the implant including model, serial number, firmware version, Manufacture Date, Assembly Revision, Battery percentage, POST result, implant status, Uplink (UL) RSSI, Downlink (DL) RSSI and Retries.. This same information is available by hovering the mouse cursor over the line item in the List View. *NOTE:* The RSSI values indicate signal strength. A more negative number indicates lower (worse) strength, while a less negative number (closer to zero) is a higher (better) strength. A value greater than -90 is preferred to prevent data loss. *NOTE:* The POST result of zero indicates no errors were detected when the implant powered up. See the POST result table in the Appendix for details.
D. Active Channels **E. Inactive Channels**	These columns allow the user to select which data collection channels are activated in the implant. **Active Implant Channels** collect physiologic and diagnostic data and transmit the data through the acquisition system to be stored in the data acquisition computer. **Inactive Channels** do not collect data as those channels are disabled.
F. Power Management:	Allows changing of the implant power state for the selected implant to preserve battery life. See the Implant Power Management section for details.

G. Save As Template **H. Apply Templates…**	This allows the user to identically configure a group of implants with the same channel arrangement. Once the channel configuration is set for one of the implants, the user can save the implant configuration as a Template and apply that configuration template to all similar implants in the current configuration. *To create a Model Template*: 1. Select an implant from the **SoHub Configuration** column on the left side of the screen. 2. Use the Active and Inactive Channels dialog to configure the implant in the manner you wish to save as a Template. 3. Click the **Save As Template** button. 4. You will be offered a confirmation message "**Are you sure you want to replace the template …?**" 5. Click **Yes** to confirm. *NOTE*: Only one Model Template can be saved per implant model type. *To apply a saved Model Template to other implants in the SoHub Configuration List View:* 1. Click the **Apply Templates…** button in the lower left corner of the window to open the **Apply Implant Channel Configuration** screen.  2. Use the drop-down menu under **Choose implant or template to apply**: to select the saved template you wish to apply to the other implants. It is also possible to copy the channel configurations from one implant to another provided they are the same model type. 3. In the **Apply channel configuration to:** dialog box, select the individual implants to which the template should be applied. Select the implants using the check boxes next to the implant label.

Implant Details Fields	Description
	 4. The **Select All** check box can be used to select/deselect all implants in the dialog box. 5. Click **OK** to apply the saved template configuration.  6. A **Confirm Operation** dialog is offered as a precaution, click **OK** to accept.
I. Information	Provides the user with instructions on actions to perform on that Details page.

Channel Details

Implant **Channel Details** are accessed by selecting a **Channel** associated with an implant from the **SoHub Configuration** List View. Click on the arrow icon to the left of implant name within the List View display the implant Channels. The current "active" channels are listed in **bold** text in the List View once the tree structure is fully expanded. The inactive channels are listed in *italic* text.



Channel Details contain the following information:

Channel Details Fields	Description
A. Description	Allows the user to change the name of the channel. Channel name is not saved to the device and will revert to its default name in new configurations.
B. Implant Name	Displays the implant name.

Channel Details Fields	Description
C. Enabled	This check box will toggle the **Input** channel between '**Enabled'** and '**Disabled'** modes. The **Enabled** mode allows the software system to record, store, and analyze data from the **Input** channel.
D. Signal Type	Allows the user to define which signal type should be used for the particular implant channel. These will default to the most common signal types based on the implant model selected. This is important because the signal type defined here is used to automatically define the **Analysis Module** assigned to the channel.
E. Sample Rate	Allows the user to define a unique sampling rate to each implant channel.
F. Biopotential Gain	Only displayed for biopotential channels. A default gain value and Upper/Lower range is automatically set for the Signal Type chosen (ECG, EEG, EMG, etc.) and it can be modified if needed. ⚠ *WARNING: If the recorded signal amplitude is outside of the upper or lower range the signal will be clipped.*
G. Upper/Lower Range	Used to determine the range of values that can be represented in a stored waveform. Data values outside this range will be marked as bad when they are saved.
H. Information	Provides the user with instructions on actions to perform on that Details page.

Temperature Channels: SoHo implants have two temperature channels. A more precise temperature channel labeled 'Temp(32-43)' is the standard which is functional between temperatures of 30 to 43 degrees C. A secondary temperature channel labeled 'Temp (0-50)' is functional for temperatures of 0 to 50 degrees C. The secondary channel can be enabled if desired, or for expanded temperature measure needs such as hibernation studies.

Appendices

This appendix provides information about DSI's implant exchange program, tells you how to manage a zero-pressure offset, and describes how to maintain an implant after it has been first implanted.

Implant Appendix

Exchange Program

The DSI Exchange program allows you to exchange your used telemetry implants for replacement implants at a fraction of the original purchase price. In addition, we ensure that each implant provided as part of DSI Exchange program will meet or exceed your design expectations for guaranteed performance and quality. By participating in the DSI Exchange program, the overall costs of your study should be considerably reduced. The three key elements to this program are construction, calibration, and certification.

CONSTRUCTION

All implants are hand assembled by DSI's highly skilled technicians, and before being shipped to you, each implant is rigorously inspected to ensure that all components meet the highest quality standards.

In addition, we take the following steps to ensure that you receive a biocompatible device that is guaranteed to perform to specifications *in vivo*.

- A new battery is installed, which guarantees the implant will function throughout the warranty period.
- All implants are sterilized and placed in a biocompatible housing before being shipped to you.
- Biopotential leads and catheters are provided to ensure signal fidelity.

CALIBRATION

Here's what we do to ensure that all our implants are properly calibrated.

1. Mechanical and electrical testing of all components to guarantee optimal functionality.
2. Full calibration of each physiologic signal, followed by testing to ensure accuracy specifications are met or exceeded, when used as intended. Signals include: temperature, pressure, biopotential, and respiratory impedance.

3. Each implant includes a calibrations label on the sterile package to document that the device has been calibrated for accuracy.

CERTIFICATION

Every implant shipped from DSI has the same warranty policy, and is guaranteed to operate in exactly the same every time. Implants that are received through the exchange program are like a new product. Exchanged implants are purchased for a fraction of the cost of new devices, which reduces ongoing study costs while maintaining data quality and accuracy.

Implant Maintenance After First Implantation

EXPLANTATION

For complete information on products and techniques approved for use with DSI implants, visit www.datasci.com or contact Technical Support (Support@datasci.com). When explanting DSI implants that are implanted intra-peritoneally or subcutaneously, consider the following.

- First carefully detach the implant body.
- Be careful not to drop the implant.
- *Never* cut a catheter, if the intention is to re-use the implant.
    - If cutting the catheter is necessary, use only a new scalpel blade to cut the catheter at a 45-degree angle away from the device body and approximately 3 cm from the implant body.
    - Do not use any instrument other than a scalpel blade to cut the catheter. Cutting the catheter with a pair of scissors or any other instrument could cause damage to the pressure sensor and *void the warranty*.
    - *If the catheter must be cut, the implant cannot be reused in another animal model*. Please send the device back to DSI for participation in the Exchange Program and the standard Exchange discount on a new device will apply.
- Leads can be cut as there are lead coupler kits available for purchase to extend the length of the leads. Lead coupler kits may make the leads less flexible over time so try to save as much length as possible during explantation.
- Clean and sterilize the implant with an approved enzyme detergent and sterilant before returning the implant to DSI or re-using in another animal.
- If the animal should die unexpectedly and the implant cannot be explanted immediately, the animal can be placed in a refrigerator until the explant can take place. The refrigerator will not damage the device, however; storage in a refrigerator will allow for an easier retrieval. Clots may be more difficult to remove from the catheter so it is recommended to heat the catheter to body temperature in a warm water bath to prevent the sensor from being blown. Never cut the tip of the catheter.

ON-SITE CLEANING AND RE-STERILIZATION

All new and exchanged implants shipped to an investigator are sterile and ready for implantation. In studies where implants are implanted for short periods at a time, significant battery life may remain at the end of the study allowing reuse of the implant. DSI has published specifications on the minimum guaranteed hours of battery life. Record the amount of time the device is on to track use and to calculate the battery life left. The PhysioTel HD

platform allows this tracking to be much easier as the battery voltage and approximate on time is transmitted from the implant when it is in the ON mode.

DSI has developed detailed procedures for cleaning and sterilizing telemetry implants. These procedures will increase the number of times you can use each implant before returning it to DSI via the Exchange Program, helping to reduce overall costs per study. Sterilization procedures are available online at www.datasci.com.

SHELF-LIFE AND STORAGE

The following sections tell you what to do when you receive a new implant, and how to store it.

- New Implants Direct from Manufacturing
  Here's what to do when you receive a new implant from DSI.
  - Carefully examine all implants when they arrive at your facility.
  - Remove the sterile packages containing the implants from the shipping boxes. All implants are sterile upon arrival.
  - Save the shipping boxes to use, when returning used implants for the Exchange Program.
  - Inspect each implant's sterile packaging for signs of damage. If the package remains undamaged, this sterility is warranted according to the information on the package label.
  - Confirm that each implant is turned off before storing.
    - Using the AM radio on the low frequency setting, turn each implant on and off by scanning a magnet across the implant to ensure that none of the implants were damaged during shipping.
    - Although each unit is checked just before shipping, the implant may have been exposed to stray magnetic fields during shipment. This can cause the unit to be turned on unintentionally.
    - Implants in the OFF mode may lose up to 10% of the battery life within 12 months after the manufacture date.
- Storage of Sterilized Implants
  Occasionally there may be a delay between the implant removal from the animal and the beginning of the next study. Proper storage of the on-site sterilized implant is necessary to ensure that the unit will perform normally during the next study.
  - Using the AM radio on the low frequency setting, check each implant to ensure that it is properly turned off.
  - Thoroughly clean and sterilize each implant according to DSI's On-Site Re-sterilization procedure at www.datasci.com/resources/technical-notes.
  - If the original implant sterile package was saved, place the implant into the plastic packaging. This will help to identify the implant and the calibration values associated with it. Do not store implants in saline or other liquid!
  - Sterilization before storage is necessary to prevent the spread of bacteria during handling.
  - Each implant will require sterilization again at the time of use, because there is no effective way of maintaining sterility after the sterile package has been opened.
- Storage Location Requirements
  The implants should be stored in a cool (between 10 and 25 degrees Celsius), dry area away from exposure to static discharge and magnetic fields. *Never* expose them to temperatures above 60 degrees Celsius, as this will

void all warranties. It is also important to store them in an area where they will not be accidentally dropped or have items placed on top of them, as the catheter could be crushed and the sensor blown. Battery life is *not* significantly increased by storing your implant in a refrigerator. By following the proper storage procedures, the implants should perform just as well as the day they were shipped.

PhysioTel Digital Hexadecimal Conversion

Hexadecimal is base 16. Base 16 is where the 'numbers' you can use are zero through to the letter F (0123456789ABCDEF). i.e. the decimal value for '1' is represented in hexadecimal as '1' but the hexadecimal value of '15' (decimal) is shown as 'F' (hexadecimal) and the value of '17' (decimal) is '11' in Hexadecimal.

DECIMAL	HEX	DECIMAL	HEX	DECIMAL	HEX
1	1	11	B	30	1E
2	2	12	C	40	28
3	3	13	D	50	32
4	4	14	E	60	3C
5	5	15	F	70	46
6	6	16	10	80	50
7	7	17	11	90	5A
8	8	18	12	100	64
9	9	19	13	500	1F4
10	A	20	14	1000	3E8

SoHo Implant POST Result

SoHo implants typically report a POST result of zero when powering up. Refer to the table provided for POST result error values.

```
//------------------------------------------------------------------------------
//
// Name: ImplantPostResults
//
// Description:
//     Enumeration for implant bit-mapped POST results.
//
// PostSuccess                          // 0x00000000 - No self check error encountered.
// PostClocks                           // 0x00000001 - LFCLK vs HFCLK speed compare failed.
// PostWdtReset                         // 0x00000002 - Reset due to watchdog timer.
// PostRfu2                             // 0x00000004 - Reserved for future use.
// PostRfu3                             // 0x00000008 - Reserved for future use.
// PostRfu4                             // 0x00000010 - Reserved for future use.
// PostSdVersion                        // 0x00000020 - Soft Device version is incorrect.
// PostRfu6                             // 0x00000040 - Reserved for future use.
// PostRfu7                             // 0x00000080 - Reserved for future use.
// PostFlashStatic                      // 0x00000100 - Static flash settings have failed CRC check.
// PostFlashDynamic                     // 0x00000200 - Dynamic flash settings have failed CRC check.
// PostRfu10                            // 0x00000400 - Reserved for future use.
// PostRfu11                            // 0x00000800 - Reserved for future use.
// PostRfu12                            // 0x00001000 - Reserved for future use.
// PostRfu13                            // 0x00002000 - Reserved for future use.
// PostRfu14                            // 0x00004000 - Reserved for future use.
// PostRfu15                            // 0x00008000 - Reserved for future use.
// PostSpiAsic                          // 0x00010000 - SPI communication to the AFE ASIC failed.
// PostSpiAccel                         // 0x00020000 - SPI communication to accelerometer failed.
// Posti2Ctemp                          // 0x00040000 - I2C communication to temp IC failed.
// PostRfu19                            // 0x00080000 - Reserved for future use.
// AfeAsicRam                           // 0x00100000 - RAM check failed for read write failure.
// PostRfu21                            // 0x00200000 - Reserved for future use.
// PostRfu22                            // 0x00400000 - Reserved for future use.
// PostRfu23                            // 0x00800000 - Reserved for future use.
// PostRfu24                            // 0x01000000 - Reserved for future use.
// PostRfu25                            // 0x02000000 - Reserved for future use.
// PostRfu26                            // 0x04000000 - Reserved for future use.
// PostRfu27                            // 0x08000000 - Reserved for future use.
// PostRfu28                            // 0x10000000 - Reserved for future use.
// PostRfu29                            // 0x20000000 - Reserved for future use.
// PostRfu30                            // 0x40000000 - Reserved for future use.
//
```

SoHo Implant Charge Counter

Battery Charge Counter

SoHo implants come with enhanced battery life monitoring capability. Each SoHo implant contains a charge counter that measures the amount of energy consumed by the implant circuit. The charge used is converted to **Battery Life Remaining (%)** and **Battery Days Remaining.** Days Remaining is simply the percent Battery Remaining multiplied by the model-specific implant Warranted Implant Life (in Days). For example, if an implant has 80% remaining life and the warranty is 30-days, Battery Days Remaining will read 24 days. Both Battery Life and Days Remaining are channels enabled by default when the implant is configured. Remaining life data is saved when acquisition is started and can be reviewed in analysis like other channel types.

Charge Counter Accuracy

Charger counter accuracy has been verified and found to be within 10% of independent measurements for SoHo-X01 and SoHo-X02 implants.

Scheduled Sampling

SoHo implants power down between scheduled sampling intervals. This allows the user to extend implant use for a given study or conduct a greater number of studies over a longer time.

For instance, a SoHo-X01 that is collecting data continuously is guaranteed to last 30-days, whereas when scheduled to sample 5 minutes every 15 minutes it will run for approximately 75 days, or 135 days if sampled 5 minutes every 30 minutes. The predicted SoHo implant life is conveniently displayed in the Ponemah software Sampling Control window and is updated as the user modifies the scheduled interval and duration values.

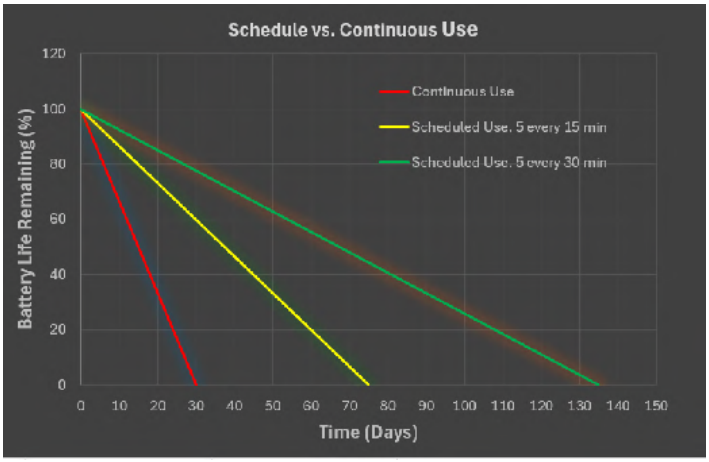


Figure 1, Comparison of Continuous and Schedule Life

Telemetry and Power Use.

SoHo Implants operate using Bluetooth® Low Energy wireless communication that is designed for low-power consumption and a robust telemetry link that minimizes data loss. One means of reducing data loss is use of an **RF Transmission Queue** where data is stored on an implant for a short period of time. If the telemetry link is lost the queue is retransmitted once the connection is reestablished. Ponemah logs every time the RF transmission queue becomes full and has to be flushed as well as any time implants become disconnected. This gives the user an indication of link integrity. If the link is burdened in some way such as taking implants out of range it will result in overflows and retransmissions. The system will attempt to maintain data at the cost of increased battery consumption. Even though SoHo implants allow transmission up to 5 meters or even greater, it is recommended to keep implants within ≤ 3 meters of the SoHub because it will reduce the likelihood of increased battery consumption due to a marginal RF link.

Inadvertent Magnetic Activation

Unlike all other DSI small animal implants, when a SoHo implant becomes inadvertently turned on during shipping, storage, or even post implantation, **if it is not configured to a SoHub,** it will stay in Sleep mode to conserve battery life. During Sleep the implant wakes every two minutes and advertises to allow for connection to a SoHub. If still in Sleep after 48 hours, the implant will fall into an even lower power Hibernate mode. In Hibernate the implant only advertises once every 20 minutes, reducing the impact on battery life even further.

Note: A SoHo-X01 or SoHo-X02 in Sleep consumes ≤ 2% of battery capacity per week and less than ≤ 0.1% of capacity per week when in Hibernate mode.

Caution! Sleep and Hibernate mode do not apply to non-ASIC based SoHo X00N implants. It is recommended to turn X00N implants OFF when not collecting data.

Standy Mode

An implant configured to a SoHub that is not acquiring data or placed in Sleep or Hibernate is in **Standby** mode. If there are no immediate plans to acquire data from an implant, whether scheduled or continuous, it is highly recommended to place the implants in Sleep or Hibernate mode to conserve power. Powering OFF implants is an option, but manual magnet activation would be required to power implant back on from the OFF state.

Note! Unlike Sleep and Hibernate modes, a SoHo-X01 or SoHo-X02 in Standby uses approximately 8% of the battery capacity per week.

Hardware Appendix

PhysioTel and PhysioTel HD Caging and Shielding Recommendations

DSI has experience using the typical shoe box sized cages but more and more customers are finding that lab space is difficult to come by. Many different configurations are possible depending on the animal model and space available. As a rule of thumb, always leave at a minimum the distance of one RPC-1 (~12 inches or 31cm) between cages. The best case situation would be placing each cage two receiver widths (18 inches or 45 cm) away from each other. Excluding pair housing studies, below is an example of the minimum recommended small animal configuration without any shielding:

As shown above, stagger the cages on a shelf to conserve the most space with this single frequency device. This illustration represents one implanted animal in each cage paired with another animal that is not implanted. With the HD-S11-F2 device, it is possible to pair two implanted animals with different frequency implants in the same cage and gather data simultaneously. The RPC-3 receiver is mandatory for pair housing studies and requires the same amount of distance between cages as that of the RSC-1 (~12 inches or 31cm).

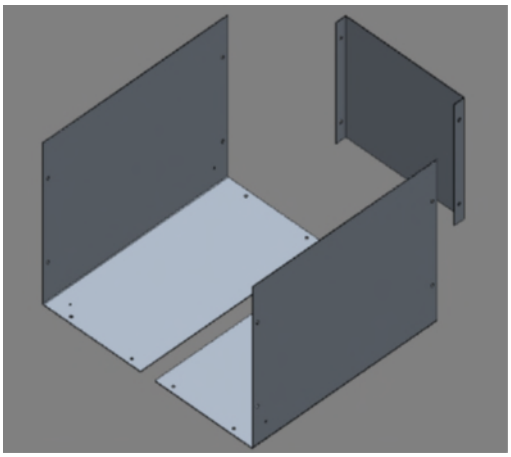
Shielding Recommendations

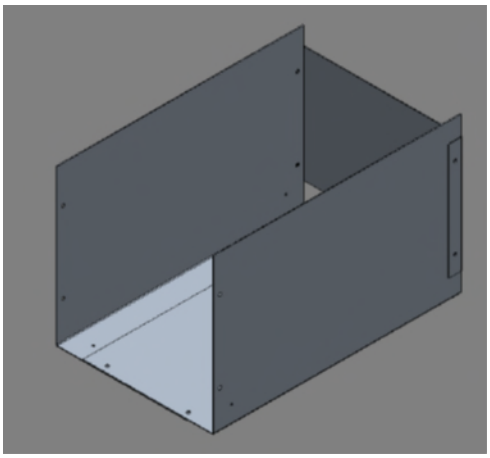
If the receivers need to be closer together and data loss is prevalent (>5%) implement electromagnetic shielding. Shielding comes in many forms from sheet metal and chicken wire to high tech clear specifically designed metal mesh. Locate the source of the noise and enclose that with shielding if possible. For example, the MX2 or another implant can be a source of noise if it is placed too close to the receivers. If problems arise or if you require a list of acceptable shielding options, technical support is equipped to help determine the best shielding method either remotely or onsite if necessary.

There are a number of ways to shield cages to prevent electromagnetic noise interference in the data. Shielding can be used around individual animal cages and/or MX2s. If possible, additional shielding should be used when configuring the animal room. Shielding is highly recommended when non-metal shelves are used. The shielding material should consist of conductive metal such as copper, stain-less steel, or aluminum. As shown below, shielding allows cages to be placed closer together.

Note: The shields can be constructed in such a manner that the following four configurations can be achieved (length x width x height):

- 18 x 12 x 10 inches
- 18 x 12 x 12 inches
- 18 x 18 x 10 inches
- 18 x 18 x 12 inches





Shield components

Shield assembled

Transceiver Placement Recommendations

This appendix is intended to provide recommendations for placing Transceivers (TRX) in animal cages to minimize any signal drop-out with PhysioTel Digital implants. In general, a single TRX can cover 3-5 meters; however, null points may exist. To be safe, DSI recommends one TRX for every 3 meters, and at least 2 for every CLC. When more than one TRX is used, DSI suggests placing them at right angles to one another to help protect against null points which are small areas of poor signal reception.

It is important to note that there are many different cage and room set-ups and the examples shown below are DSI's suggestions based on customer testing and assessment of the PTD product.

Please contact DSI Technical Support (support@datasci.com) for assistance and recommendations in setting up your specific animal room.

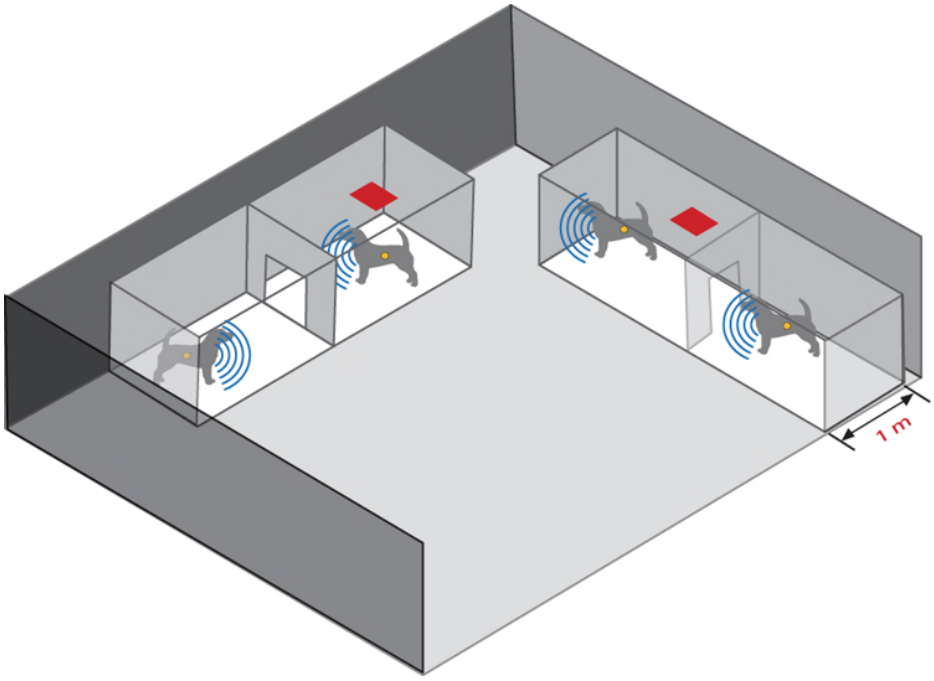
There are several factors that affect the transmission range of the implant.

- Monitoring environment
- Placement of the implant antenna
- Size of the animal

	**Regulatory Note**: China: Tested to MIIT[2005]423 for short range devices' technical characteristics and test methods (Report No. C170417Z08, C170417Z09, C170417Z10).

Dog Cage Example 1

The diagram below illustrates the cage setup with Group Housing and two TRXs. Cage Dimensions are 1 Meter x 1 Meter x 1 Meter. The red square indicates a TRX.



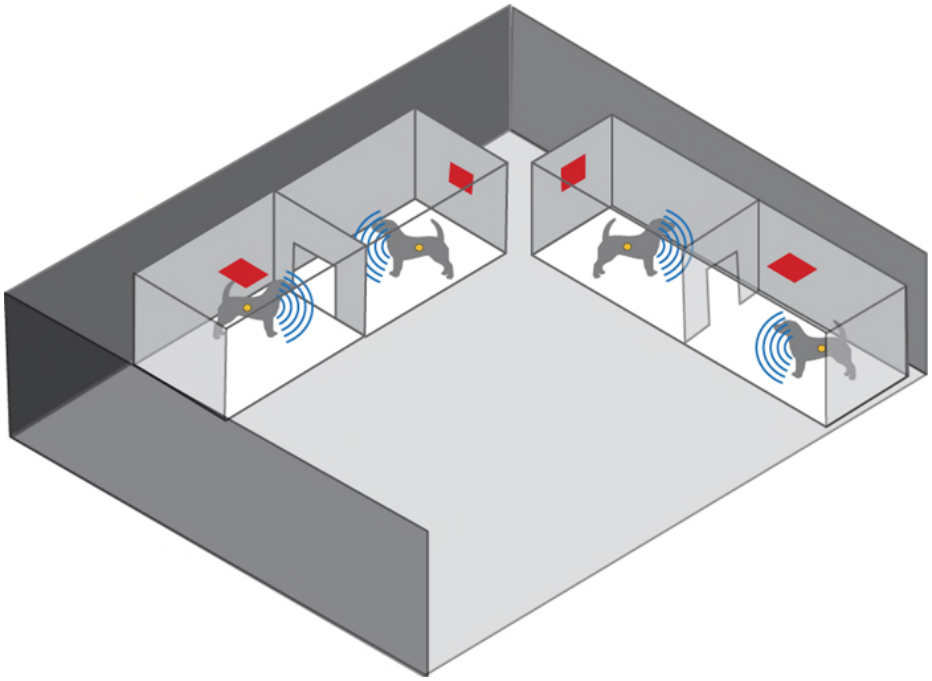
The set-up shown above includes one (1) TRX to cover the two cages on either side of the room. In this scenario the door between the cages is open and animals are able to freely move between cages.

If the door between the cages is closed, an additional TRX may be needed to provide supplemental coverage. DSI suggests testing this scenario to ensure that no drop-out occurs. If drop-out does occur, a second TRX should be used.

The following example illustrates a more ideal setup using four TRXs for increased coverage

Dog Cage Example 2

The diagram below illustrates the cage setup with Group Housing and four TRXs. Cage Dimensions are 1 Meter x 1 Meter x 1 Meter. The red square indicates a TRX.



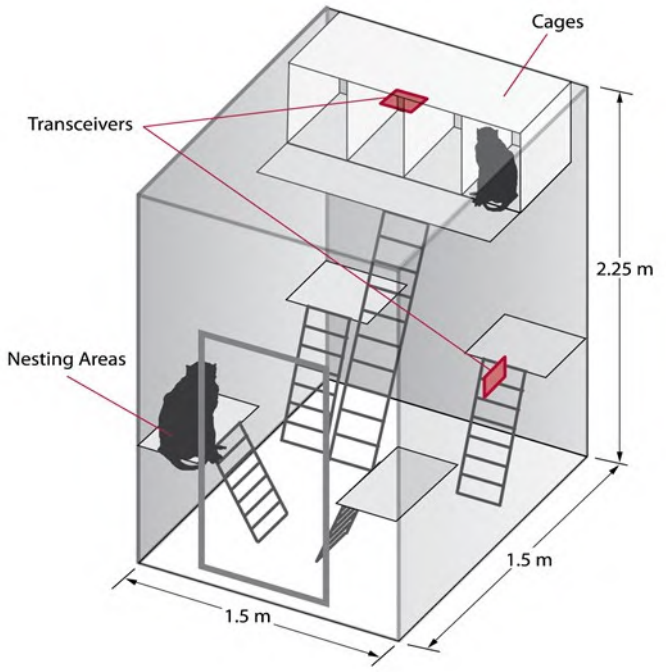
The set-up shown above includes two (2) TRXs to cover the two cages on either side of the room. In this scenario the door between the cages is open and animals are able to freely move between cages.

The TRXs are placed at right angles to one another to provide better coverage of the telemetry signal (having TRXs on different 'planes' helps avoid null areas and reduce the possibility of signal drop-out).

The set-up shown above would work either for the pair-housed or single-housed recordings without modification.

Primate Cage Example

The diagram below illustrates a primate cage setup with Group Housing and two TRXs.



The set-up shown above includes two (2) TRXs to cover the larger communal primate cage. In the example above, this type of cage can co-house up to four primates at the same time.

Placing the TRXs at right angles to one another will provide better coverage.

Ambient Pressure Reference

Maintaining Pressure Accuracy

Maintaining accuracy of the APR-2/APR-3 is a critical element of pressure measurements throughout the DSI telemetry system. A 1-mmHg error in the measurement of barometric pressure at the APR will result in a 1-mmHg error in pressure measurements recorded by your system. The same level of error will appear on all pressure measurements obtained with the system using the APR.

Extensive qualification testing and calibration prior to shipment assures that under normal use the APR will not drift as a result of temperature changes or shock from shipment. Therefore, the most important part of assuring accuracy is to determine if the APR has drifted over time. The following are three suggestions on how this can be accomplished.

- Comparison with the Weather Service or other barometer
  Compare your APR-2/APR-3 with the weather, radio or TV station, or another reliable barometer reading at regular intervals (e.g. every 3 months) and when you first receive your APR. Perform these comparisons when the weather is relatively calm and avoid comparisons during thunderstorms or when strong weather fronts are moving through your area. To obtain the APR measurement, initiate acquisition from a Subject with a pressure (BP or LVP) input channel. Ambient pressure values will be listed in the Derived List View as NPMN, within the main Ponemah window.

Keep a record of the comparison measurements you have taken. Keep in mind that it is important to obtain a local reading at the same elevation above sea level as your telemetry system. The APR measures the absolute pressure of the room it is placed in, and does not correct for elevation differences. For further information, contact DSI for the Technical Note 'A Consideration When Comparing DSI's Ambient Pressure Monitor Readings to Other Barometers and the Weather Service.' Any noted difference over time should be constant. If you find that the difference is increasing, then it is likely that the APR has drifted. Contact DSI Technical Services to discuss further action. You can also perform this procedure by comparing the APR with a highly accurate barometer (one with an accuracy of better than 1 mmHg) at your facility or by purchasing a second APR.

- Checking the offset of pressure transmitters
  If you are checking the offset of several DSI transmitters that have a manufacture date within the last month, they will provide a good indication of whether your APR has drifted. Check the offset of these transmitters using the procedure outlined in the Implant Appendix section of this manual. If you find that all transmitters have an offset that is excessively and consistently biased in one direction (above or below zero mmHg), this may indicate that the APR has drifted. Contact DSI Technical Services to discuss whether you should take further action.

Recalibration by DSI

DSI recommends that investigators working under GLP conditions send their APR back to DSI for recalibration every year. For those not working under GLP conditions, DSI recommends recalibration every 3-5 years. The drift specification indicates that, barring failure of the device, it will drift less than 1.0 mmHg per year. Therefore, if you return it for recalibration every year, accuracy will likely remain within +/- 1 mmHg. Contact DSI Technical Services for information regarding recalibration of your APR.

APR Specifications

See latest information on the DSI Support Center: https://support.datasci.com/hc/en-us/articles/360007512234

APR-3 Specifications

Barometric Pressure Range	263 - 975 mmHg
Initial Accuracy	+/- 0.25 mmHg
Stability Over Time	0.25 mmHg/year
Physical Dimensions	9.8 cm x 4.0 cm x 3.8cm
Weight	182g
Data Output Connector	USB-C
Power Connector	USB-C
Standard Cable Length	3 meters
Maximum Cable Length	3 meters (can be extended with a USB - Ethernet extender)
Operating and Storage Temperature Range	-40ºC to 85º C
Operating and Storage Humidity	<85% R.H. non-condensing

APR-2 Specifications

Barometric Pressure Range	0-1000 mmHg (torr)
Initial Accuracy	+/- 1 mmHg
Stability Over Time	Better than 1.0 mmHg/year at 20ºC to 30ºC
Physical Dimensions	12.5 x 10.5 x 4 cm
Weight	570 g
Data Output Connector	RJ45 (8 pin non-keyed)
Power Connector	9VDC

Power Input	9VDC or 12W PoE (IEEE 802.3af compliant)
Current	60mA
Standard Cable Length	1 meter
Maximum Cable Length	10 meters
Operating Temperature Range	0º to 45º C
Operating Humidity	<70% R.H. non-condensing
Storage Temperature	-20º to 65º C
Storage Humidity	<85% R.H. non-condensing

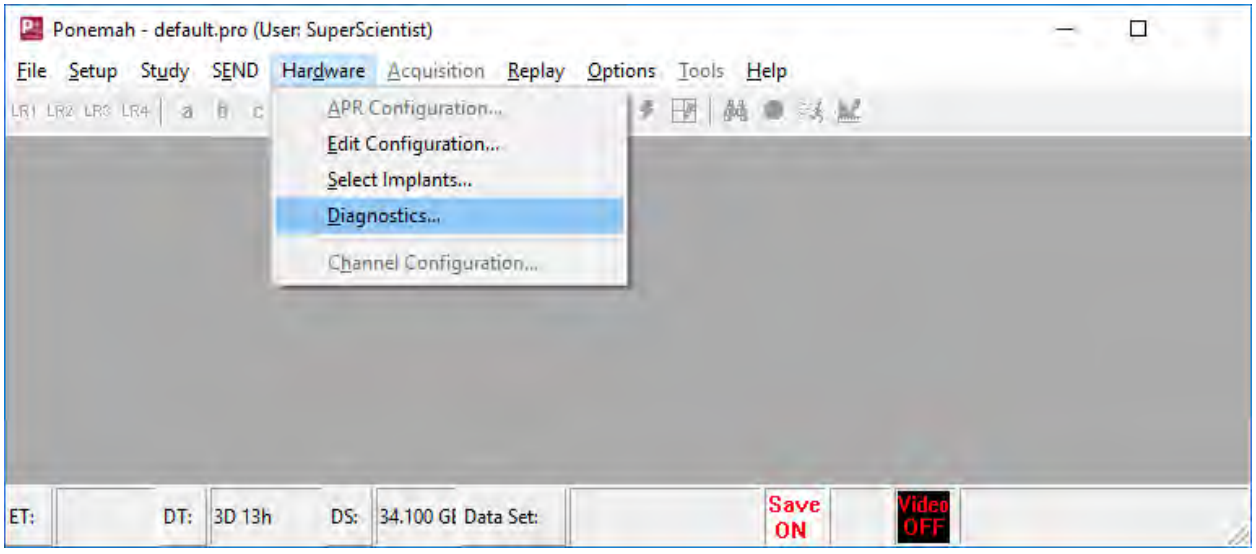
Software Appendix

PhysioTel Digital Diagnostics

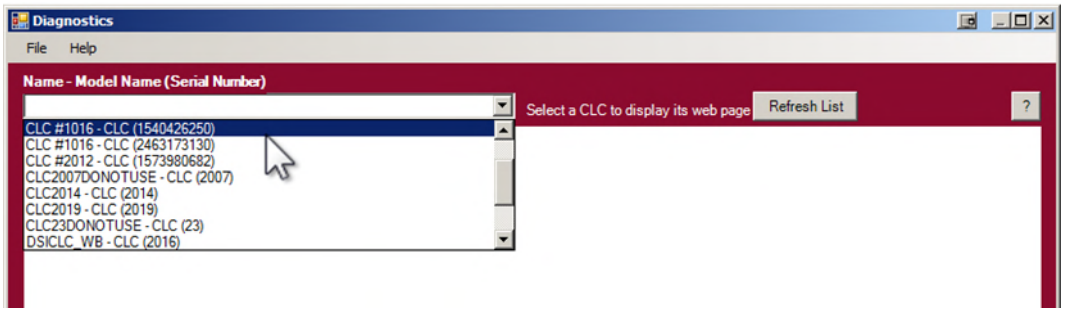
The Diagnostics user interface is a browser-based webpage that allows the user to check the status of the PhysioTel Digital hardware components, update firmware, and perform diagnostic tests to optimize the performance of the system components.

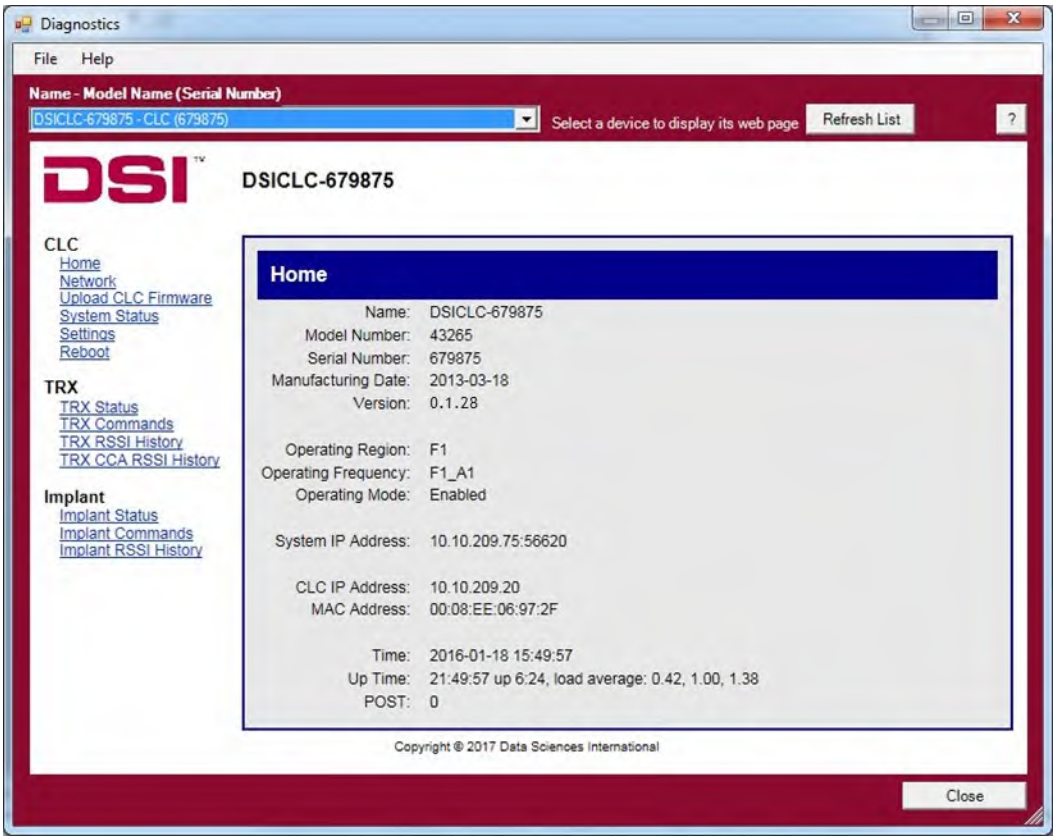
The Diagnostic user interface is accessed from the Ponemah Hardware menu.

Launching PhysioTel Digital Diagnostics in Ponemah v5.x:



To select a specific CLC click on the drop-down menu located in the top left corner of the diagnostics window. All of the configured CLCs that are connected to the system will appear in this list.



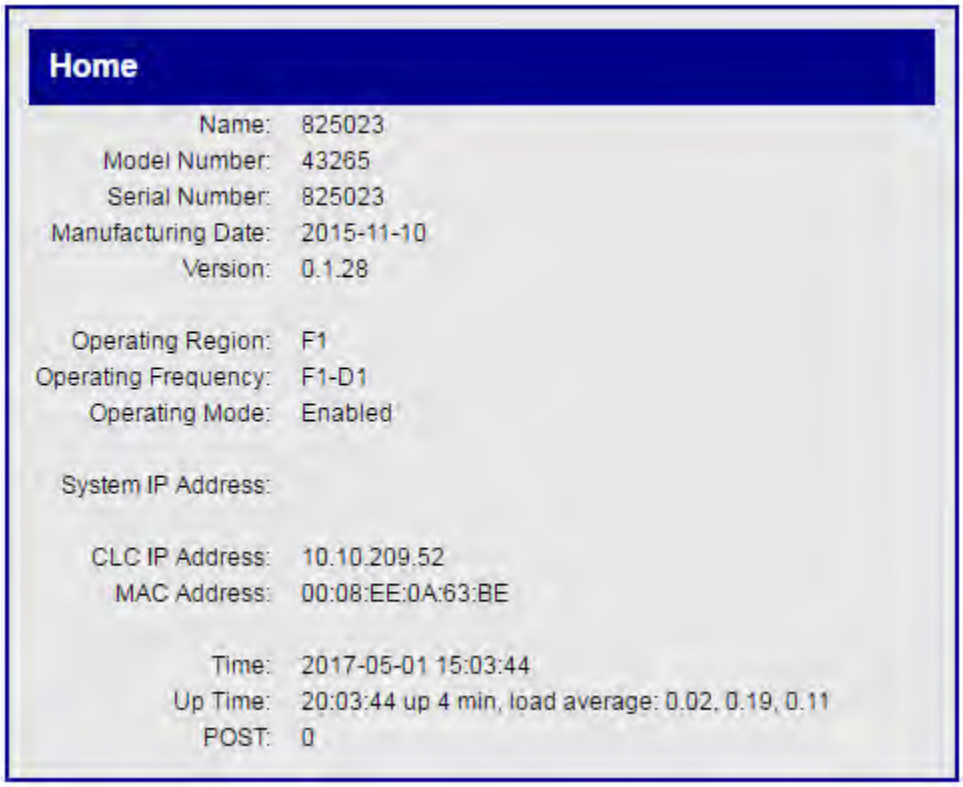


CLC Options

The CLC section of the Diagnostics webpage options are described below.

Home

The Home page lists general information about the select CLC.



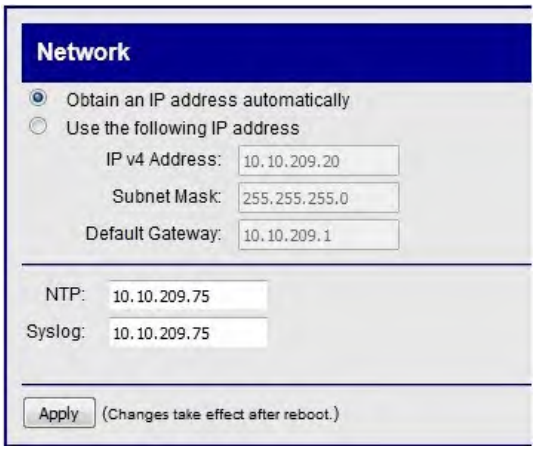
Field Information	Description
Name	Displays the user defined name assigned to the CLC.
Model Number	Displays a numeric value representing the CLC model.
Serial Number	Displays the CLC serial number.
Manufacturing Date	Displays the date the CLC was manufactured at DSI. Format is YYYY-MM-DD.
Version	Displays the firmware version the CLC is currently running.

<table>
<tr><th>Field Information</th><th>Description</th></tr>
<tr><td>Operating Region</td><td>Displays the current Operating Region of the CLC.
<table><tr><th>Frequency</th><th>Region</th></tr><tr><td>F1</td><td>US</td></tr><tr><td>F2</td><td>Europe</td></tr><tr><td>F3</td><td>Japan</td></tr><tr><td>F4</td><td>China</td></tr></table></td></tr>
<tr><td>Operating Frequency</td><td>Displays the currently assigned Operating Frequency, based on TRX connection.

Note: the Operating Frequency will read “Unknown” if CLC is powered up without a TRX connected.</td></tr>
<tr><td>Operating Mode</td><td>Enabled: Normal operational mode.
Disabled: The CLC sends and receives no RF data.
Assessment: The CLC monitors the RF field and collects RSSI data from attached TRXs.</td></tr>
<tr><td>System IP Address</td><td>IP address of the data acquisition computer.</td></tr>
<tr><td>CLC IP Address</td><td>IP address of this particular CLC.</td></tr>
<tr><td>MAC Address</td><td>Unique identifier for the CLC network interface.</td></tr>
<tr><td>Time</td><td>Current Date & Time (Format = YYYY-MM-DD HR:MN:SC).</td></tr>
<tr><td>Up Time</td><td>Status information since last reboot</td></tr>
<tr><td>POST</td><td>Power On Self-Test (0 = Passed, OK …)</td></tr>
</table>

Network

The Network section allows the user to define how IP addresses are assigned to the CLC.



- **Obtain an IP address automatically**

  This is the normal operating mode for the CLC. With this option selected the CLC is queried and the values that it reports back are displayed in the appropriate text boxes:
  - IP v4 Address:
  - Subnet Mask:
  - Default Gateway:

	**Important**: A new IP address can be generated by performing an "extended" reset: push and hold the reset button on the back of the CLC for 5-15 seconds.

- **Use the following IP address**

  If the user wishes to manually assign a specific IP address to the CLC, click this radio button and type a new IP address in the text box.

  If you wish to perform this operation, follow this procedure:

  1. Click the radio button for Use the following IP address
  2. Enter the desired values in the text boxes labeled:
     - IP v4 Address:
     - Subnet Mask:
     - Default Gateway:
  3. Click Apply.

  Note: A reboot of the system will have to be performed in order for the new IP Address to activate.

 *Caution*: In the event that the user-assigned IP address is not accessible, this diagnostics tool will lose contact with the CLC. To generate a new IP address, the user will have to perform an "extended" reset: push and hold the reset button on the back of the CLC for 5-15 seconds.

- **NTP**

  The CLC keeps synchronization with the PC using Network Time Protocol (NTP). By default Ponemah will set the NTP IP address to be the IP address of the PC. If it is desired, the NTP IP address can be set manually.

- **Syslog**

  This is an IP address that can be set by DSI personal for on-site troubleshooting. It is not needed for normal operation.

Upload CLC Firmware

This page allows the user to update the CLC firmware. From time to time it may be advantageous to upgrade the internal read-only program instructions through a firmware upgrade. This often results in improved performance.

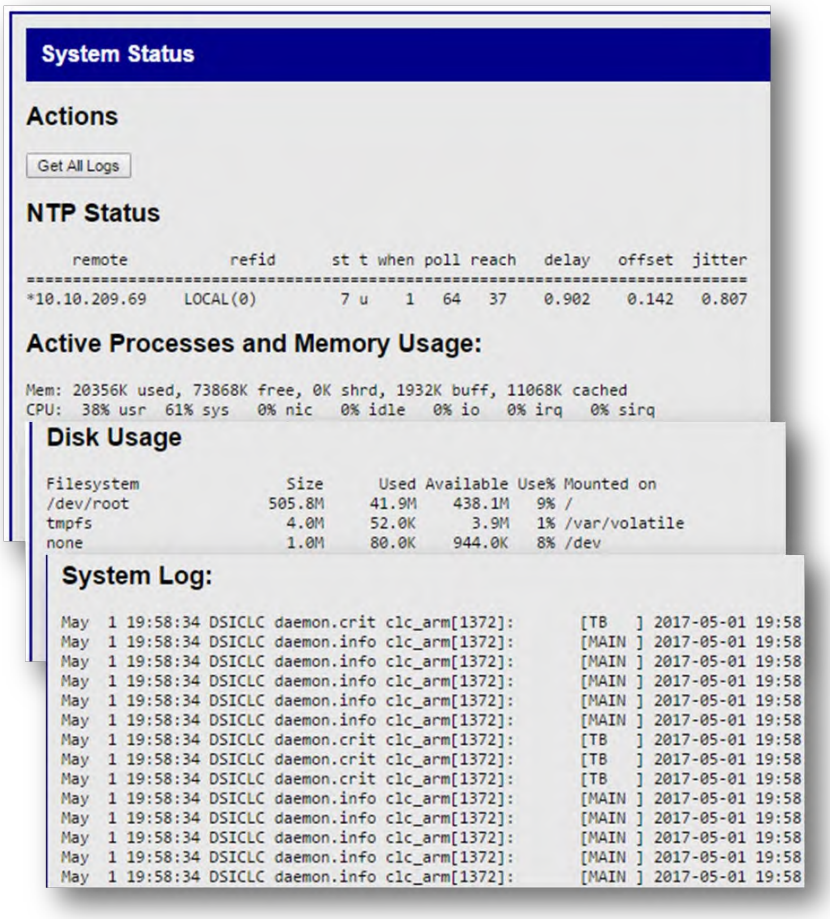
To update or change the firmware version in the CLC, follow this procedure:

1. Click on the Browse button and use the file upload window to locate the firmware file.
2. Navigate to the specific filename and click Open
3. Message 1: Uploaded, Validating
4. Message 2: Validated. Upgrade will be applied during reboot.

Note: A reboot of the system will have to be performed in order for the update to activate.

System Status

The System Status is a continuously updating “log” file of the CLC’s communication activity. It can be used to monitor communication issues in the event of discontinuities.

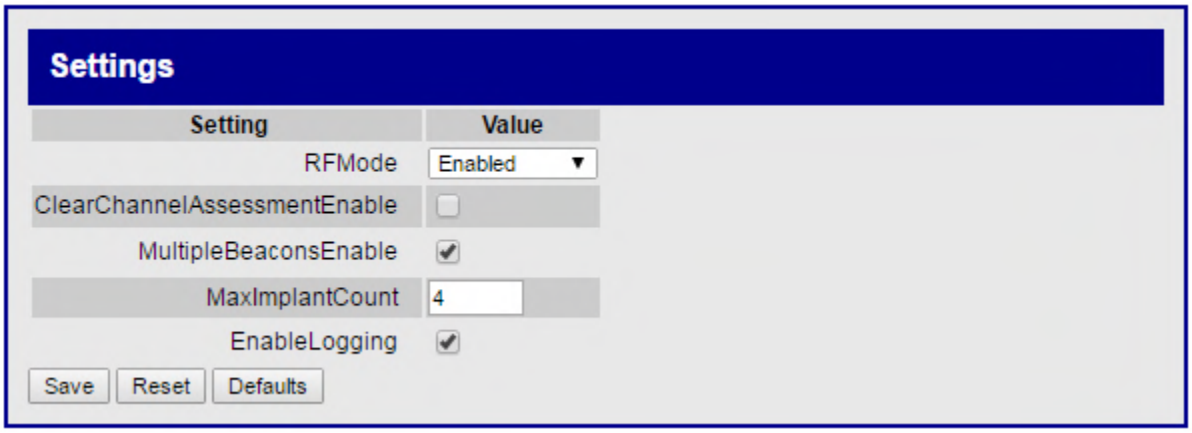


Contents:

- Get All Logs – downloads the CLC log file.
- NTP Status – Reports the last time the CLC received an update from the NTP Server
- Active Processes and Memory Usage
- System Log

Settings

The Settings page allows the user to set the RF Mode, Clear Channel Assessment, Enable Multiple Beacons, set the Maximum Implant Count per CLCs, and Enable Logging.



RF Mode

- **Enabled** – Normal operating mode
- **Disabled** – Halts communication between the TRXs and the implants
- **Assessment** – Allows the user to sample individual frequencies to assess the level of background RF interference. The Assessment mode is used for the TRX RSSI History function

Clear Channel Assessment

- For European and Japan customers this function is enabled by default and cannot be changed.
- For North American customers this function is not enabled by default, but can be with no effect on performance. This will allow the user the ability to detect if there are competing RF devices that have the potential of interfering with the Digital system. Reference the TRX CCA RSSI History section below for more detail.
- For customers in China, Clear Channel Assessment is not enabled by default and is not needed.

Multiple Beacons

- Multiple Beacons was an enhancement made to the system to maximize the number of attempts in communicating with the PhysioTel Digital implants. It is enabled by default.

Max Implant Count

- Defines the maximum number of Implants that may be assigned to a CLC. Default is 4. With certain combinations of Implant and CLC firmware, the maximum may be set to 6.
- The default maximum implant count for China is 5, which is also the maximum number of implants that may be assigned to CLCs in China.

- See the PhysioTel Digital Telemetry Platform Broadcasting Frequencies section of this manual for more details on supported frequencies.

Reboot

This function allows the user to perform a complete reboot of the CLC. A Reboot of the system is required to:

- Activate a firmware upgrade
- Change the IP settings
- To reboot the CLC left click the Reboot button

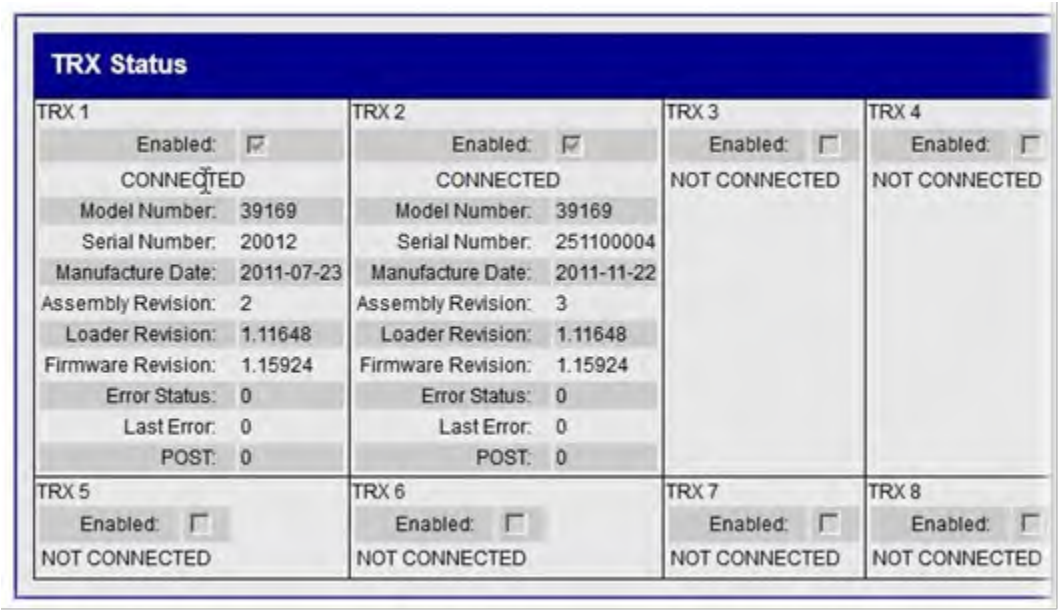
Note: the Reboot process may take several minutes to complete. There are no progress indicators that appear on this page, However there are indicator lights on the back of the CLC box itself.

TRX Options

The TRX is the three letter designation for a Transceiver: the component in the system that receives Radio-Frequency (RF) signals and converts it into digital form that is sent, via cable, to the Communication Link Controller.

TRX Status

The TRX Status screen is a non-interactive snapshot of the current status of the TRXs that are connected to the CLC. Each CLC is capable of interfacing with eight TRXs. This arrangement follows the layout on the rear panel of the CLC unit. The following is the TRX Status screen indicating that two TRX units are connected and enabled.



The line items are as follows:

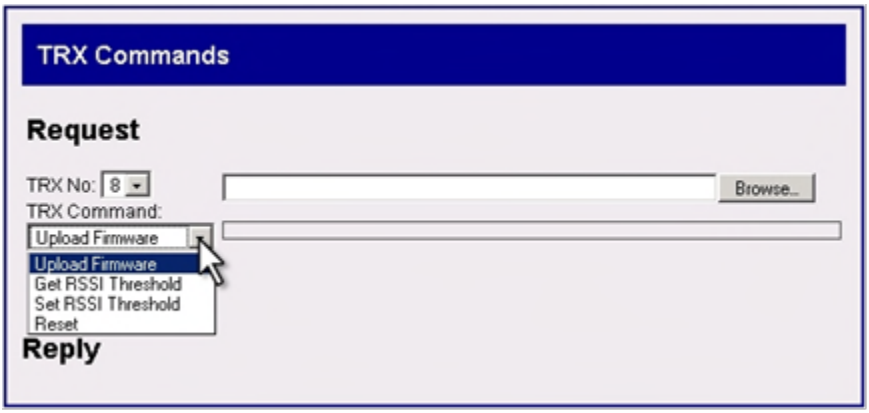
Field Name	Description
TRX (#):	Number 1-8.
Enabled:	A check mark in the box indicates that the TRX is connected and available to communicate with the implants
Connected:	Indicates whether the TRX is physically CONNECTED or NOT CONNECTED to the CLC
Model Number:	Displays a numeric value representing the TRX model.
Serial number:	Displays the TRX serial number.
Manufacture Date:	Displays the date the CLC was manufactured at DSI. Format is YYYY-MM-DD.
Assembly Revision:	Displays the current Assembly revision.
Loader Revision:	Displays the current Loader revision.

Field Name	Description
Firmware Revision:	Displays the firmware version the TRX is currently running.
Error Status:	Indicates that at least one error has occurred.
Last error:	Displays the most recent error encountered.
POST:	Power On Self-Test (0 =Passed, OK)

TRX Command

This dialog screen allows the user to perform two functions that affect the performance of the TRX. The user can upload a different version of the on-board read-only software (firmware). Additionally the user can adjust the telemetry receiver thresholds to optimize RF communications.

There are four commands available in this window.



Upload Firmware

To update or change the firmware version in the TRX, follow these steps:

1. Select the **TRX No**: drop-down menu and select the **TRX number** you wish to communicate with.
2. Select the **TRX Command**: drop-down menu and select **Upload Firmware**.
3. Select **Browse…** button and use the file upload window to locate the firmware file.
4. Navigate to the specific filename and click **Open**
5. Message 1: Uploaded.
6. Message 2: Validating
7. Message 3: Updating TRX Firmware...
8. Message 4: Command Completed

Get RSSI Threshold

RSSI stands for Received Signal Strength Indicator. It is a quantitative measure of the strength of the RF signal that the TRX is receiving from the implants. The Get RSSI Threshold command retrieves the current threshold value from the TRX. The default value = 12.

1. Select **Get RSSI Threshold** from the **TRX Command:** drop-down menu.
2. Select **Send**.
3. A successful operation is indicated by a blue colored Command Completed banner at the top of the screen and a text string below the word Reply at the bottom of the screen.
4. The reported text value **OK "xx"** is the Hexadecimal value of the **RSSI Threshold**.

Set RSSI Threshold

The Set RSSI Threshold command allows the user to adjust the lower limit of signal strength that the TRX will accept as viable information from the implants. The default value = 12.

Note: Anytime the TRX is unplugged, or the CLC is rebooted, or the CLC goes through the Configuration Wizard, the RSSI threshold value will revert back to the hexadecimal default value of 0x12.

1. Select **Set RSSI Threshold** from the **TRX Command**: drop-down menu.
2. Select the **TRX #** from the **TRX No**: drop-down menu.
3. Enter a **hexadecimal** value in the small text box above the **Send** button.
4. Select the **Send** button.
5. A successful operation is indicated by a blue colored Command Completed banner at the top of the screen and a text string "**OK**" below the word Reply at the bottom of the screen.

Reset

The Reset function returns the TRX settings to the factory default values.

1. Select **Reset** from the **TRX Command**: drop-down menu.
2. Select the **TRX #** from the **TRX No**: drop-down menu.
3. Change the value in the dialog box below the letters TRX from **"ff"** to **"02".**
4. Click the **Send** button.
5. A successful operation is indicated by a blue colored Command Completed banner at the top of the screen and a text string **"OK"** below the word Reply at the bottom of the screen.

RFMode (not pictured above)

The RFMode command is only available to EU users. It can be used to change the transmission power of the TRX. By default the TRX leaves the DSI factory with the maximum allowable transmission power. In some cases, that power is too much and it should be decrease to improve RF performance where multiple PhysioTel Digital systems are located in close proximity. The power can be changed from any value of 00 to 08, with the default value of 08. The default value in the United States, Japan, and China is 00.

1. Select **RFMode** from the **TRX Command**: drop-down menu.
2. Select the **TRX #** from the **TRX No**: drop-down menu.
3. Enter a **hexadecimal** value in the small text box above the **Send** button.
4. Select the **Send** button.
5. A successful operation is indicated by a blue colored Command Completed banner at the top of the screen and a text string "**OK**" below the word Reply at the bottom of the screen.

TRX RSSI History

This option allows the user to sample how well the TRXs are receiving RF signals from the implants, or as a tool to detect the amount of RF noise that may be present near the PTD system. In an actively running system (**Enabled**) these graphs continually update according to a user prescribed auto refresh rate.

There will be one RSSI graph displayed for each of the enabled TRXs connected to the CLC. The TRXs will display the received signals from all of the implants it is communicating with.

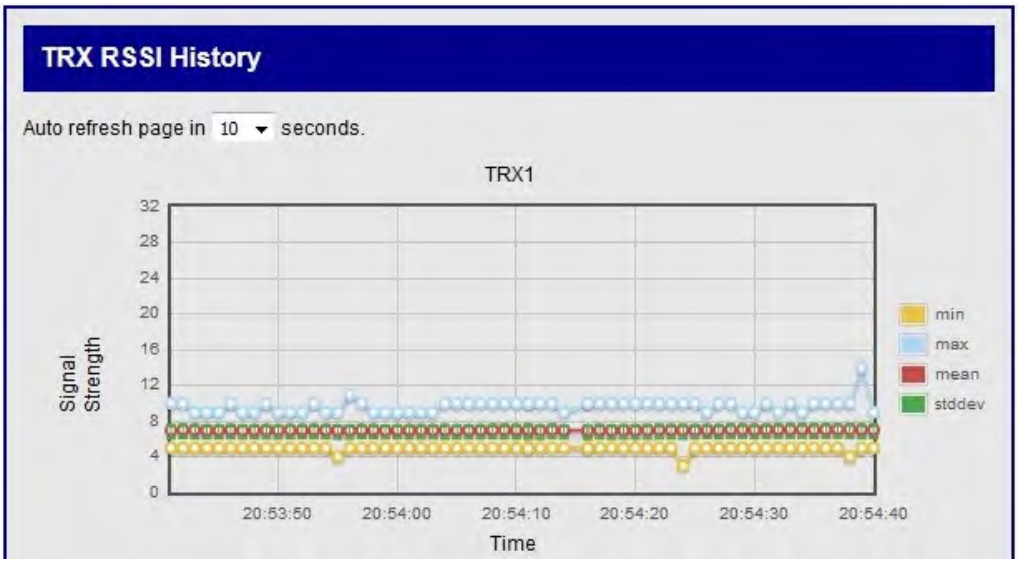
Follow this procedure to utilize the **TRX RSSI History** option:

1. Click on the Settings link under the **CLC Options** heading.
2. In the dropdown box to the right of the words **RF Mode**, select the word "**Assessment** "and click the **Save** button below.
3. Using the mouse cursor, click on the link marked **TRX RSSI History**.
4. This will open the RSSI graph screen.

   Warning! When you are finished with the TRX RSSI History function you MUST return the CLC to the "Enabled" mode!

5. Select the **Settings** link under the **CLC Options** heading.
6. Return to the dropdown box and select "**Enabled**", and click on the **Save** button below.
7. Verify the **CLC status** by **Home** link under the under the **CLC options** heading.
8. The **Operating Mode**: line item in the center of the screen should read **Enabled**, if it does not, refresh the internet page, or repeat steps 6-7 above.

The following is a graphical representation of the ability of the TRX to detect RF noise. To set the auto refresh rate of the graph click on the drop-down menu at the top of the screen and select a new value.



TRX CCA RSSI History

CCA is an acronym for Clear Channel Assessment. According to certain RF regulation environments, it is necessary to invoke a "listen before you talk" policy. The Clear Channel Assessment operation determines whether the wireless medium is busy or idle. The CLC can then make a decision on whether to attempt communication.

The CLC will display the RSSI value of what the TRX is receiving. If the TRX picks up a significant signal from a competing device the CLC delays the transmission of a command to the implant. If the interfering signal persists, communication with the implants may be disrupted.

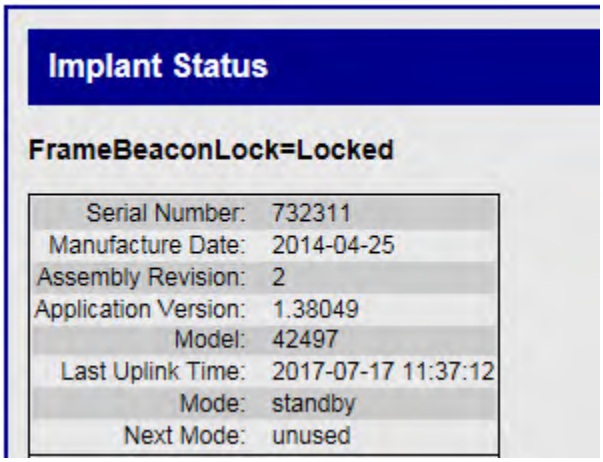
- The CLC will try to avoid talking in a noisy RF environment.

- The CLC will display an RSSI value of what the TRX is picking up in the Listening window.
- In Europe and Japan the “Listen Before Talk” function is enabled by default.
- In the United States the “Listen Before Talk” function is disabled by default.
- There will be one plot for each of the TRXs assigned to the CLC.
- To set the auto refresh rate of the graph click on the drop-down menu at the top of the screen and select a new value.

Implant Options

Implant Status

Implant Status is a non-interactive table which reports the operational status of all implants communicating with a CLC.



Frame Beacon Lock is a new feature that will prevent implants from being “stolen” by a configured system. Once a CLC with firmware v0.1.28 is configured, the Accept List of that CLC will become “Locked” and that is indicated on the Implant Status page. If an implant with firmware v1.62816 or later hears a beacon from a locked CLC (that isn’t its intended CLC) it will disregard that beacon/CLC, and continue to listen for its intended beacon/CLC.

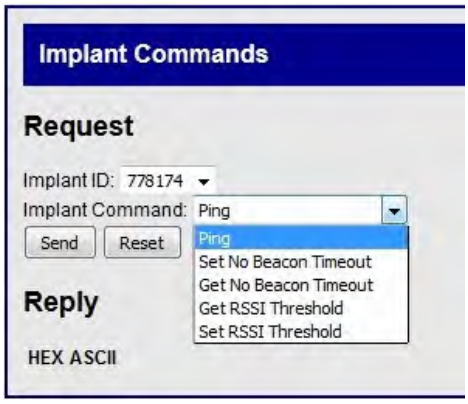
Previous versions of the CLC would allow implants that were not configured onto its Accept List if the implant heard the beacon and attempted to join (assuming there was room on the list). If the Accept List was already full, the implant would continuously attempt to become a part of that Accept List until it either a.) it timed out and eventually turned off, or b.) started to hear its intended beacon again. With the new version of the implant firmware, the implant will attempt to hears its intended beacon right away.

A table will be displayed for each implant with the following content:

Field Name	Description
Serial Number	Displays the serial number of the implant.
Manufacture Date	Displays the date the implant was manufactured at DSI. Format is YYYY-MM-DD.
Assembly Revision	Displays the assembly revision.
Application Version	Displays the application version.
Model	Displays the implant model.
Last Uplink Time	The latest time that the CLC received an uplink from the implant.
Mode	Displays the current mode of the implant: • Standby – On, but not actively transmitting data. • Active – On and actively transmitting data. • Unused – Configured but either out or range or off.
Next Mode	Will only update when using scheduled sampling in Ponemah.

Implant Commands

There are three commands with which the user can communicate with individual implants. They are **Ping**, **Get/Set RSSI Threshold**, **Get/No Beacon Timeout**.

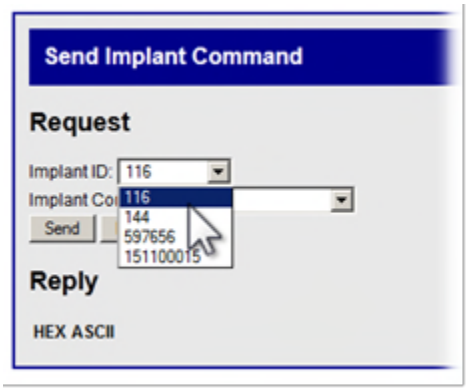


- The **Ping** command allows the user to select an individual implant and request a confirmation message that the implant is operating within range.
- The **Get RSSI Threshold** command retrieves the current threshold value from the implant.

- The **Set RSSI Threshold** command allows the user to adjust the lower limit of signal strength that the implant will accept as viable information from any of the TRXs.

Ping Command

The **Ping** command allows the user to send a request to an individual implant to reply with a confirmation message that the implant is operating within range.

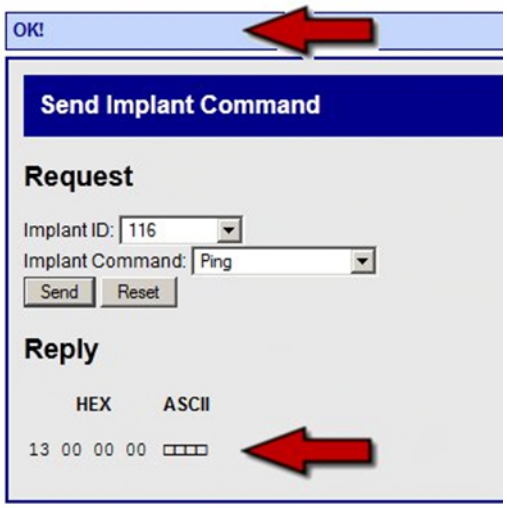


To **Ping** the implant:

1. Click on the drop-down menu labeled Implant ID:
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled Implant Command.
4. Left click the Ping command
5. Click the Send button

If the Ping dialog is successful:

- A blue colored banner with the word **OK!** will appear at the top of the screen.
- The implant will report back with a Hexadecimal value which is displayed in the Reply table at the bottom of the screen.

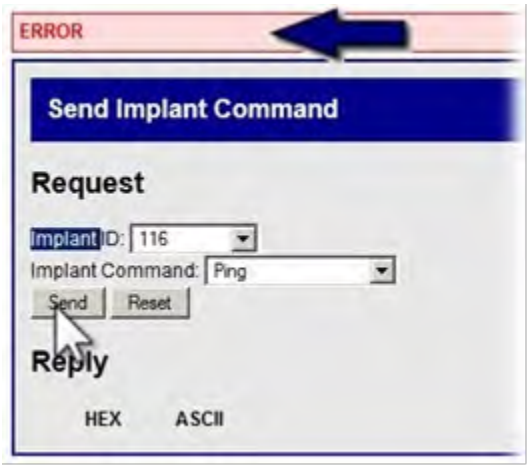


If the Ping dialog is unsuccessful:

The Ping will be automatically repeated several times.

- A red colored banner with the word ERROR will appear at the top of the screen.
- The more common error codes are listed at the end of this section.
- The implant will not report with a Hex value at the bottom of the screen.

Note: It may take several seconds for an unsuccessful Ping command to generate an error message.



Get RSSI Threshold

The Get RSSI Threshold command retrieves the current threshold value from the implant. Get RSSI Threshold reads the signal strength value that allows the implant to hear commands from the CLC/TRX.

To **Get RSSI Threshold**:

1. Click on the drop-down menu labeled **Implant ID**:
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled **Implant Command**.
4. Left click the **Get RSSI Threshold** command.
5. Click the **Send** button
6. A successful operation is indicated by a blue colored **OK** banner at the top of the screen.
7. A Hexadecimal value will also be reported in a table below the word **Reply**.
8. If the command cannot be successfully completed an error code may be displayed. Refer to the common error codes below.

Set RSSI Threshold

RSSI stands for Received Signal Strength Indicator. It is a quantitative measure of the strength of the RF signal that the implant is receiving from the TRXs. The Set RSSI Threshold command allows the user to adjust the lower limit of signal strength that the implant will accept as viable information from the CLC/TRX.

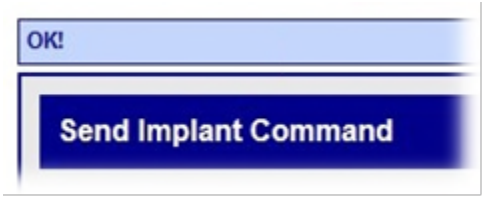
1. Click on the drop-down menu labeled **Implant ID**:
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled **Implant Command**.
4. Left click the **Set RSSI Threshold** command.
5. A small text-entry box will appear below the **Implant Command**: line.
6. Allowable values for **RSSI Threshold** are between 12 and 28 (values must be entered in Hexadecimal format).

Decimal	Hexadecimal
12	0C
28	1C

7. Adjusting the **RSSI Threshold** value will affect the implant performance in the following manner.

RSSI value	Sensitivity	Range	Susceptibility to RF Noise
Increase	Decrease	Decrease	Decrease
Decrease	Increase	Increase	Increase

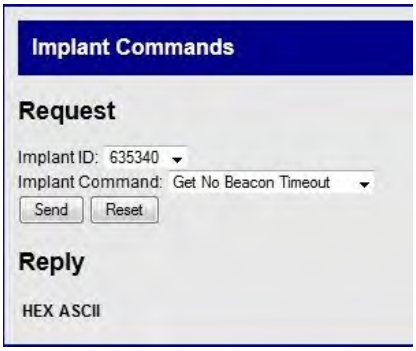
8. Enter a new value for the **RSSI Threshold** and click the **Send** button (values must be entered in Hexadecimal format).
9. A blue colored banner with the word **OK!** will appear at the top of the screen.



10. Repeat the **Get RSSI Threshold** procedure for verification.
11. If the command cannot be successfully completed an error code may be displayed. Refer to the common error codes below.
12. The RSSI Threshold value will revert to the default value anytime the implant turns off, or if it is assigned a new frequency.

Get No Beacon Timeout

The Get No Beacon Timeout command retrieves the amount of time that the implant can be out of RF range of the TRXs before it turns off. The returned value is in hexadecimal format and corresponds to minutes. The default value is set in the factory by DSI at a value of 60 minutes



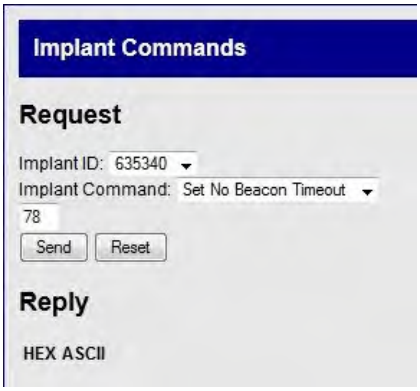
To **Get No Beacon Timeout**:

1. Click on the drop-down menu labeled **Implant ID**:
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled **Implant Command**.
4. Left click the **Get No Beacon Timeout** command.
5. Click the **Send** button
6. A successful operation is indicated by a blue colored **OK** banner at the top of the screen.
7. A Hexadecimal value will also be reported in a table below the word **Reply**.
8. If the command cannot be successfully completed an error code may be displayed. Refer to the common error codes below.

Set No Beacon Timeout

The Set No Beacon Timeout command sets the amount of time that the implant can be out of RF range of the TRXs before it turns off. The table below outlines some common values that could be entered with the hexadecimal conversion.

Minutes	Hexadecimal
60	3C
120	78
180	B4
240	F0
480	FF
Infinite (Doesn't Turn Off)	00



To **Set No Beacon Timeout**:

1. Click on the drop-down menu labeled **Implant ID**:
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled **Implant Command**.
4. Left click the **Set No Beacon Timeout** command.
5. Click the **Send** button
6. A successful operation is indicated by a blue colored **OK** banner at the top of the screen.
7. A Hexadecimal value will also be reported in a table below the word **Reply**.
8. If the command cannot be successfully completed an error code may be displayed. Refer to the common error codes below.

Common Error Codes

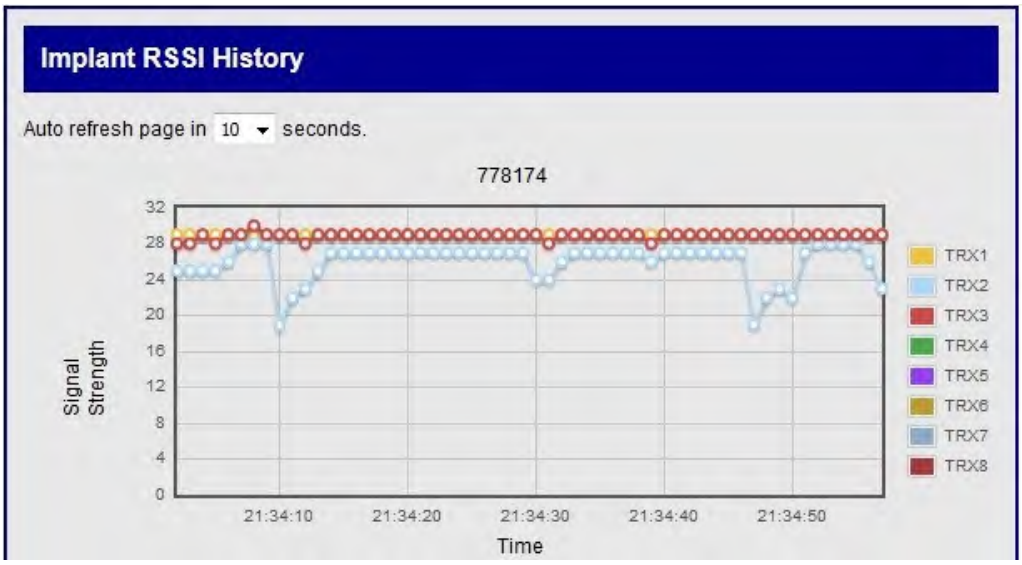
The implant commands in this section are capable of generating an error code if the command cannot be successfully executed. Below is a list of the more common error codes.

Error code	Description	Solution
900	Unknown Error	
901	Implant Not Found	Make sure implant in range
902	Timeout	Make sure implant in range
903	Send Fail	Make sure implant in range, in standby mode, Ponemah is not trying to send a lot of commands to the implant
905	Implant in Active Mode	Make sure the implant is in standby mode
906	Queue Full	Make sure implant is in range, Ponemah is not trying to send a lot of commands to the implant

Implant RSSI History

Similar to the TRX RSSI History, the Implant RSSI History generates graphs in which the received signal strength from each of the TRXs is plotted for each implant. These graphs allow the user to track how well the implants are being received by each of the TRXs. In an actively running system these graphs continually update according to a user prescribed auto refresh rate.

- There will be one RSSI graph for each of the recognized implants in the system.
- Each TRX will report the received signal strength from each of the implants it is communicating with. The RSSI graph will display one data set for each of the implants.
- To Set the Auto refresh rate of the graph, click on the drop-down menu at the top of the screen and select a new value.

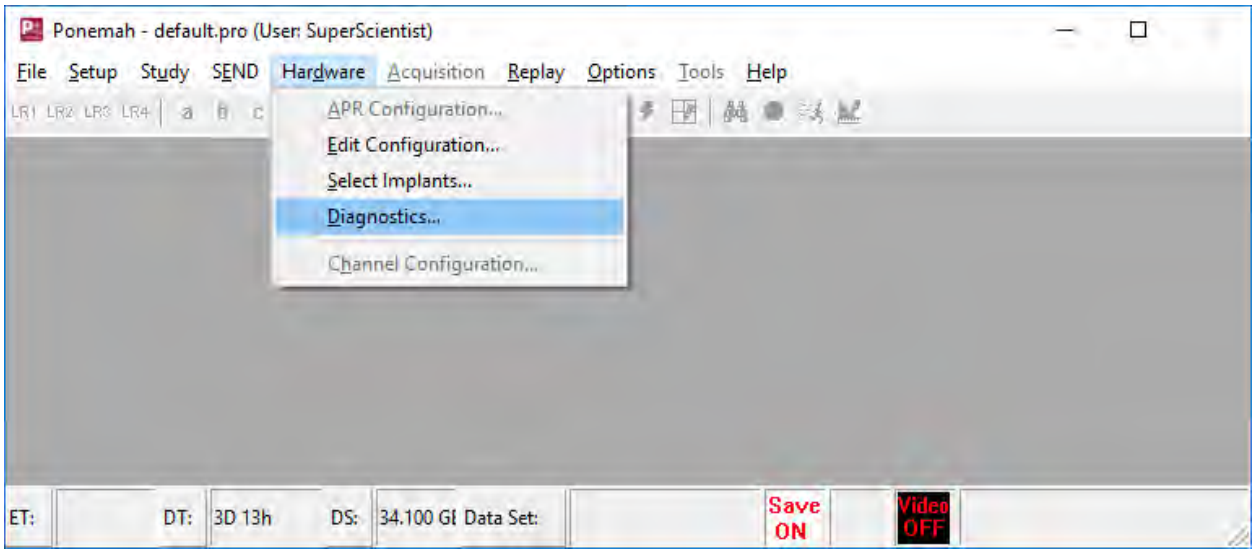


MX2 Diagnostics

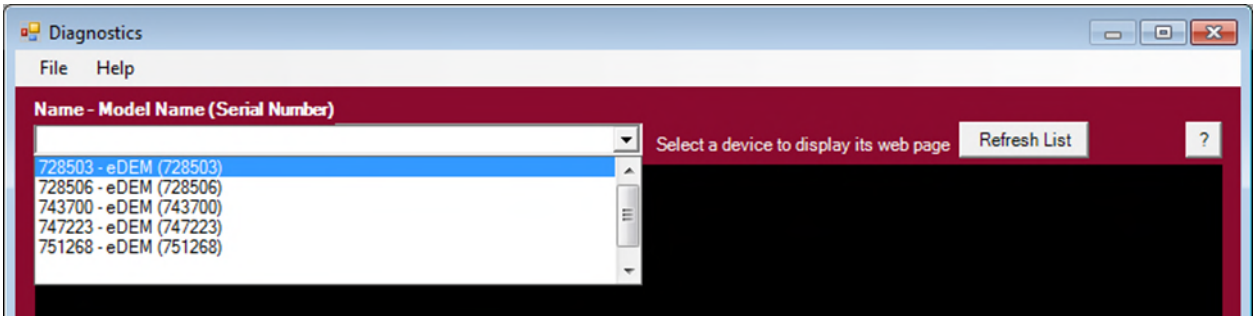
The **MX2 Diagnostics** user interface is a browser based webpage that allows the user to check the status of the MX2, Check network connections, update firmware, and perform diagnostic tests to optimize the performance of the system components.

The Diagnostic user interface is accessed from the Ponemah Hardware menu.

Launching MX2 Diagnostics in Ponemah v5.x:



To select a specific MX2 click on the drop-down menu located in the top left corner of the diagnostics window. All of the configured MX2s that are connected to the system will appear in this list.

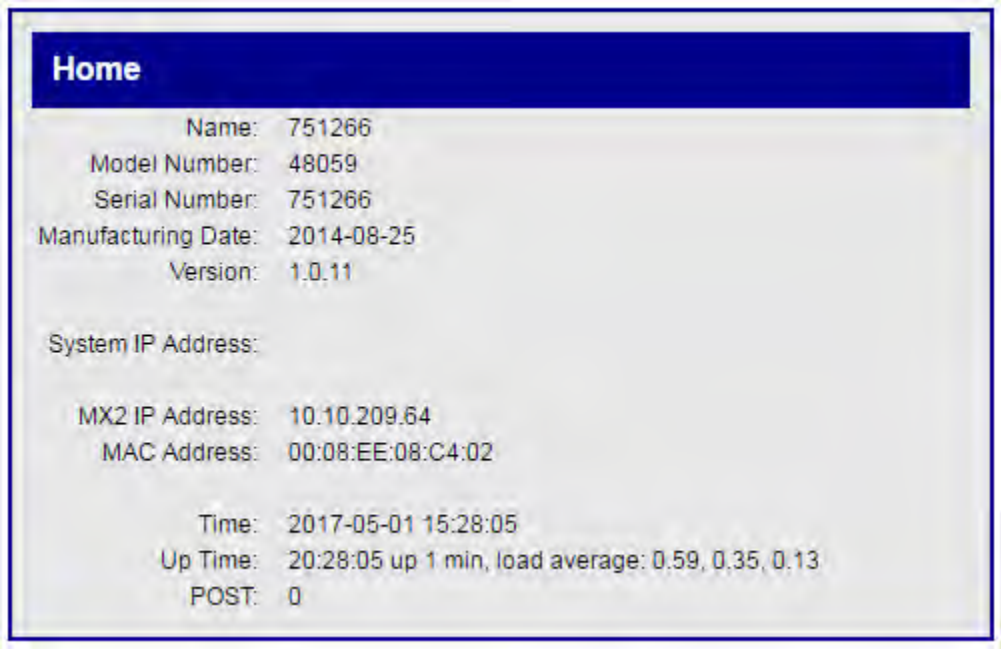


MX2 Options

The MX2 section of the Diagnostics webpage options are describe below.

Home

The **Home** section lists the general information pertinent to the selected MX2.

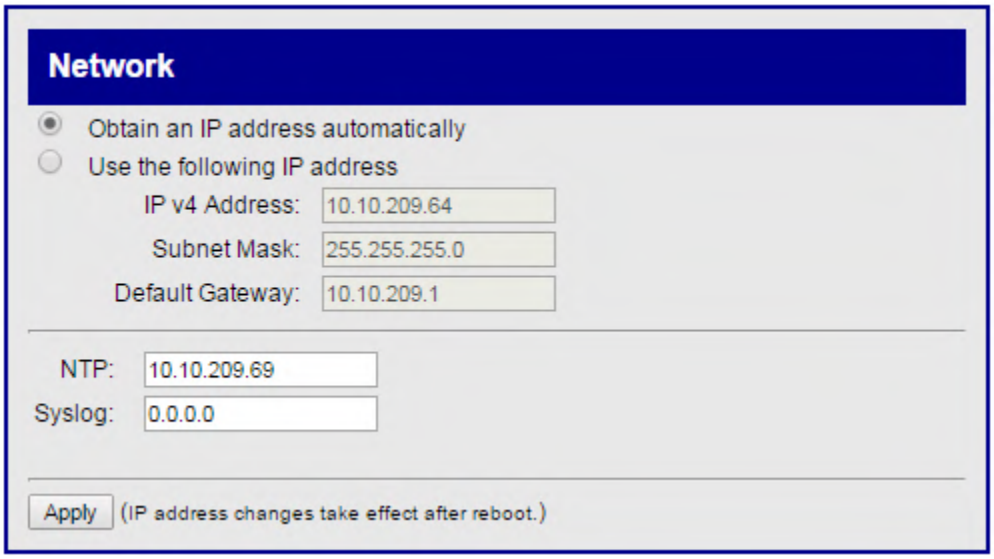


The information listed on the Home page is as follows:

Field Name	Description
Name:	Displays the user defined name assigned to the MX2.
Model Number:	Displays the MX2 model number.
Serial Number:	Displays the MX2 serial number.
Manufacturing Date:	Displays the date the MX2 was manufactured at DSI. Format is YYYY-MM-DD.
Version:	Displays the firmware version the MX2 is currently running.
System IP Address:	Displays the IP address of the acquisition computer.
MX2 IP Address	Displays the IP address of the MX2.
MAC Address	Displays the unique identifier for the MX2 network interface
Time:	Current Date & Time (Format = YYYY-MM-DD HR:MN:SC)
Up Time:	Status information since last reboot.
POST:	Power On Self-Test (0 = Passed, OK …)

Network

The **Network** page allows the User to adjust the network communication settings.



- **Obtain an IP address automatically**

  This is the normal operating mode for the MX2. With this option selected the MX2 is queried and the values that it reports back are displayed in the appropriate text boxes:
  - IP v4 Address:
  - Subnet Mask:
  - Default Gateway:

  Note: A new IP address can be generated by performing an "extended" reset: push and hold the reset button on the back of the MX2 for 5-15 seconds.

- **Use the following IP address**

  If the user wishes to manually assign a specific IP address to the MX2, click this radio button and type a new IP address in the text box.

If you wish to perform this operation, follow this procedure:

4. Click the radio button for Use the following IP address
5. Enter the desired values in the text boxes labeled:
    - IP v4 Address:
    - Subnet Mask:
    - Default Gateway:
6. Click Apply.

Note: A reboot of the system will have to be performed in order for the new IP Address to activate.

 *Caution*: If the user-assigned IP address is not accessible, this diagnostics tool will lose contact with the MX2. To generate a new IP address, the user must perform an "extended" reset: push and hold the reset button on the back of the MX2 for 5-15 seconds.

- **NTP**

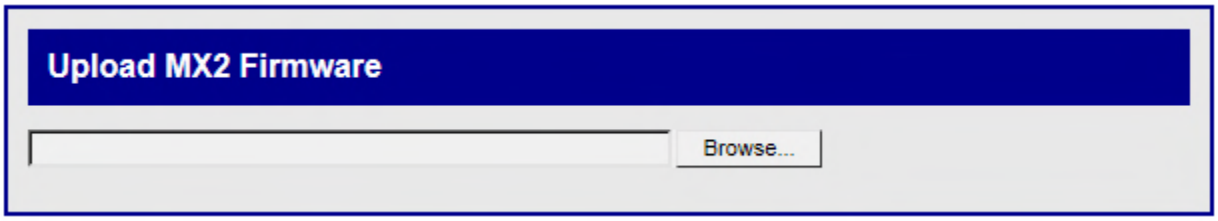
The MX2 keeps synchronization with the PC using Network Time Protocol (NTP). By default, Ponemah will set the NTP IP address to be the IP address of the PC. If it is desired, the NTP IP address can be set manually.

- **Syslog**

This is an IP address that can be set by DSI personal for on-site troubleshooting. It is not needed for normal operation.

Upload MX2 Firmware

This page allows the user to update the MX2 firmware. From time to time it may be advantageous to upgrade the internal read-only program instructions through a firmware upgrade. This often results in improved performance.



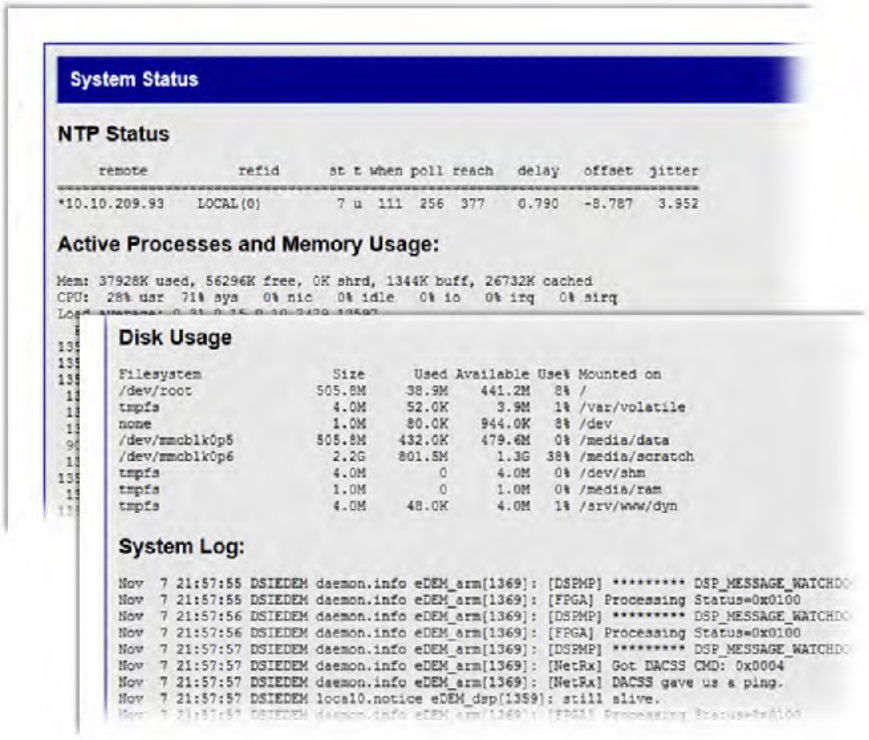
To update or change the firmware version in the MX2, follow this procedure:

1. Click on the **Browse** button and use the file upload window to locate the firmware file.
2. Navigate to the specific filename and click **Open**
3. Message 1: Uploaded, Validating
4. Message 2: Validated. Upgrade will be applied during reboot.

Note: A reboot of the system will have to be performed in order for the update to activate.

System Status

The System Status is a continuously updating “log” file of the MX2’s communication activity. It can be used to monitor communication issues in the event of discontinuities.



Contents:

- NTP Status – Reports the last time the MX2 received an update from the NTP Server
- Active Processes and Memory Usage
- Disk Usage
- System Log

Reboot

This function allows the user to perform a complete reboot of the MX2. A Reboot of the system is required to:

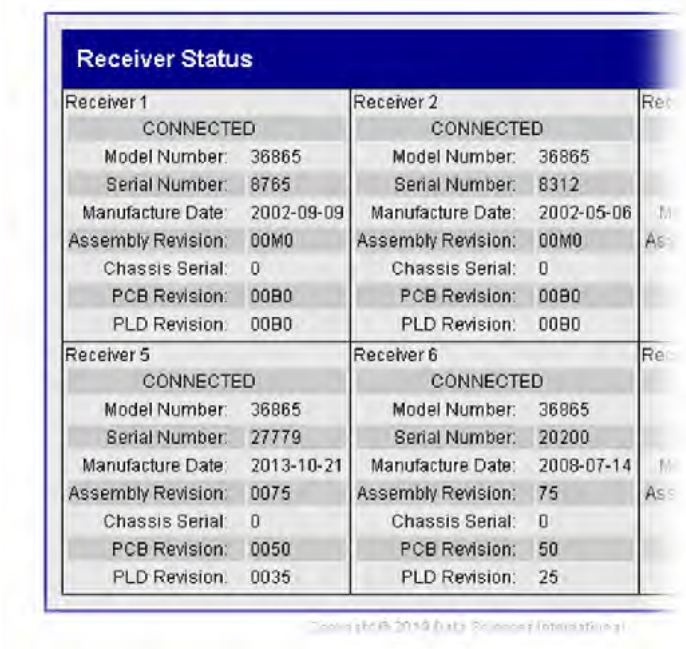
- Activate a firmware upgrade.
- Change the IP settings.
- To reboot the MX2 left click the Reboot button

	**Important**: The Reboot process may take several minutes to complete. There are no progress indicators that appear on this page, However, there are indicator lights on the back of the MX2 box itself

Receiver Options

Receiver Status

The Receiver Status screen is a non-interactive snapshot of the current status of the receivers that are connected to the MX2. Each MX2 is capable of interfacing with eight receivers. This arrangement follows the layout on the rear panel of the MX2 unit.



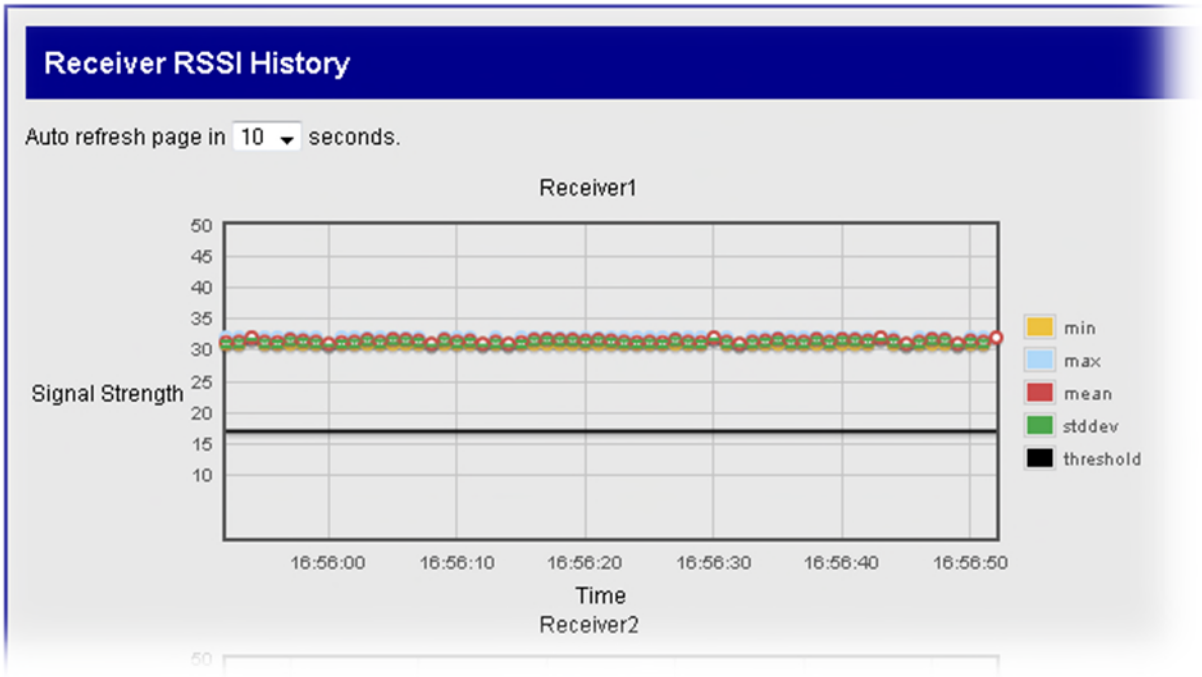
The line items are as follows:

Field Name	Description
Receiver (#):	Number 1-8.
CONNECTED:	Indicates whether the receiver is physically CONNECTED or NOT CONNECTED to the MX2.
Model Number:	Displays the Receiver model number.
Serial number:	Displays the Receiver serial number.
Manufacture Date:	Displays the date the Receiver was manufactured at DSI. Format is YYYY-MM-DD.
Assembly Revision:	Displays the Assembly revision.
Chassis Serial:	Not implemented.
PCB Revision:	Displays the Printed Circuit Board revision.
PLD Revision:	Displays the Programmable Logic Device revision.

Receiver RSSI History

This option allows the user to view how well the receivers are receiving RF signals from the implants. In an actively running system these graphs continually update according to a user prescribed auto refresh rate.

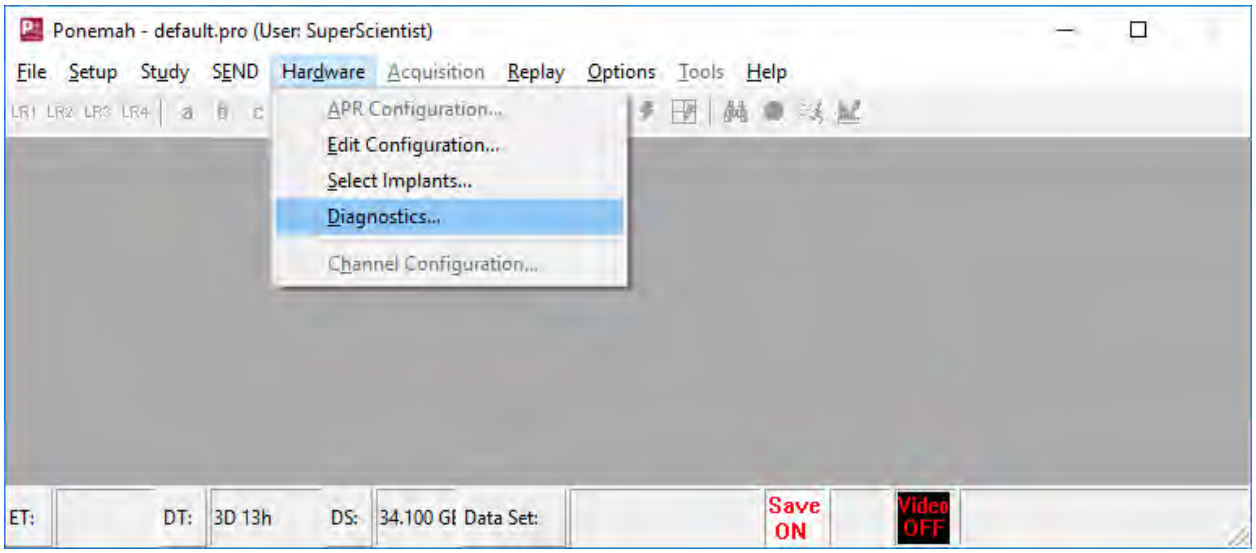
There will be one RSSI graph displayed for each of the receivers connected to the MX2.



SoHo Diagnostics

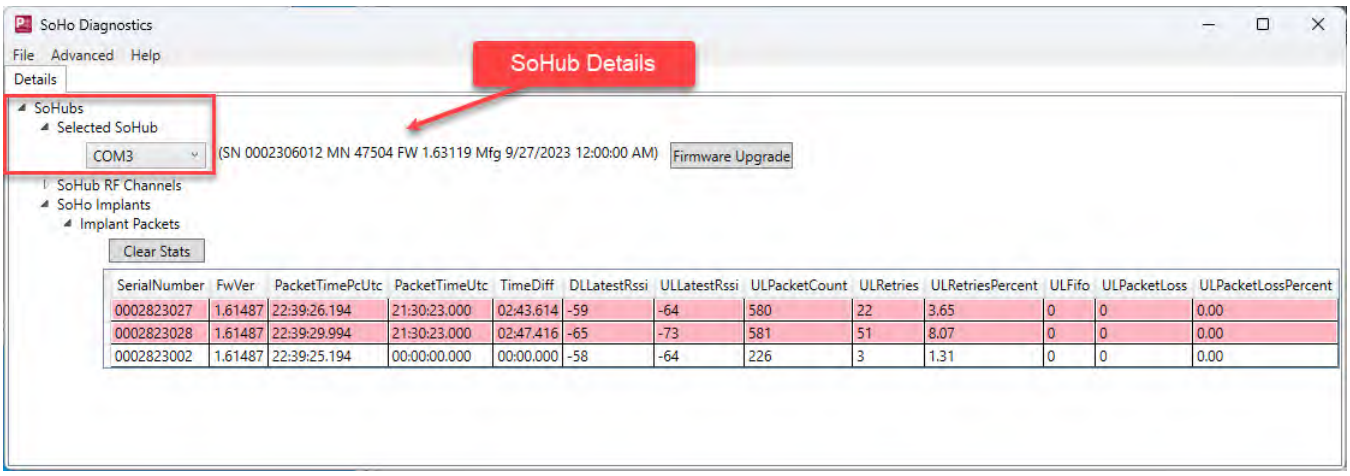
The **SoHo Diagnostics** user interface launches a new window that allows the user to check the status of the SoHub and SoHo implants, update firmware, and perform diagnostic tests to optimize the performance of the system components.

The Diagnostic user interface is accessed from the Ponemah Hardware menu.



SoHub Selection

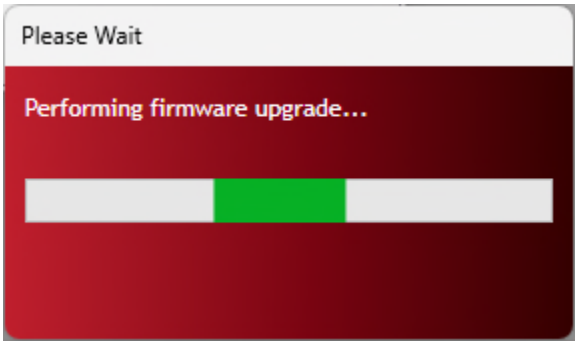
In the Details tab of the SoHo Diagnostics there is one main heading called SoHubs. A SoHub can be selected under the Selected SoHub heading by clicking on the drop-down menu. All the SoHubs that are connected to the system will appear in this list and are designated with a specific COM port. To the right of the COM port selection the SoHub Serial Number, Model Number, Firmware and Manufacture date are displayed.



Firmware Upgrade

Select the Firmware Upgrade button to upgrade the SoHub Firmware version. The latest SoHub Firmware is included with the installation and located in the C:\Ponemah\Firmware\SoHo folder. Select the SoHub firmware .zip file and select Open.

The firmware update process will begin and display a status window.



The window will close when completed and the SoHub will briefly disconnect and then re-connect.

SoHub RF Channels

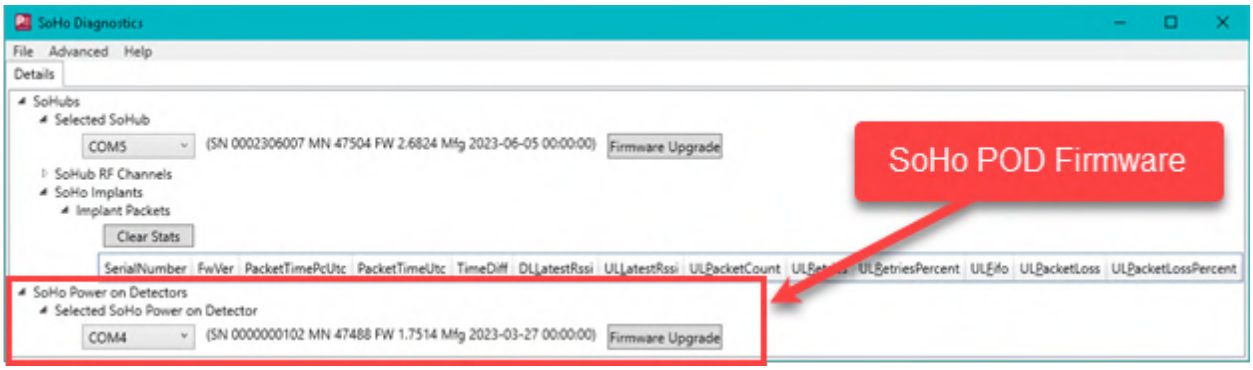
Displays real time information on the RF channels being used. This information may be needed for Technical Support troubleshooting.

SoHo Implants

Under the Implant Packets heading a table is displayed showing the currently connected implants. This table contains signal strength and data packet statistics that may be needed for Technical Support troubleshooting.

SoHo Power On Detectors

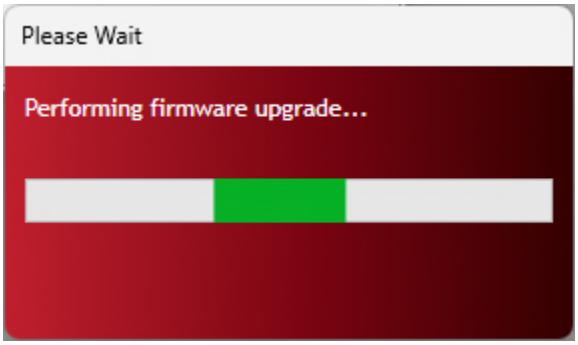
Any SoHo PODs that are connected will be displayed.



Firmware Upgrade

Select the Firmware Upgrade button to upgrade the SoHoPOD Firmware version. The latest SoHoPOD Firmware is included with the installation and located in the C:\Ponemah\Firmware\SoHo folder. Select the SoHoPOD firmware .zip file and select Open.

The firmware update process will begin and display a status window.

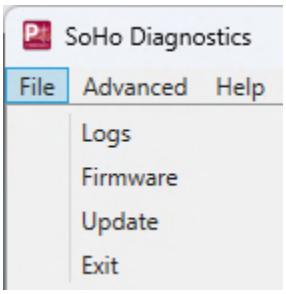


The window will close when completed and the SoHoPOD will briefly disconnect and then re-connect.

SoHo Diagnostics menus

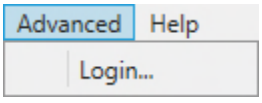
File

The file menu options will be implemented in a future Ponemah update.



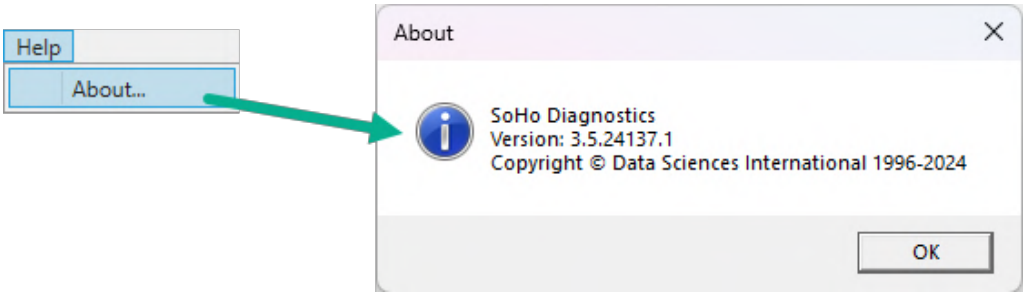
Advanced

The advanced menu contains a login that is only used by DSI Technical Services.



Help

The Help menu contains the version information.



Network Time Protocol (NTP) & Process Utilities Application

When connected to a CLC or MX2, Ponemah uses a **Network Time Protocol** as a time source instead of **Windows Time** for the sampling of data.

During the installation of Ponemah the needed Network Time Protocol software is installed as a service that will start up and run automatically when Windows is booted. The specifics of the service are:

- **Service Name**: NTP
- **Display Name**: Network Time Protocol Daemon
- **Startup Type**: Automatic

The installation will also turn off Windows Time by setting the startup type to disable. This is needed so there is only a single time source in the system to accurately collect data.

The installation will also add an entry in the Windows Firewall to allow the NTP service to communicate with the connected CLC/MX2 hardware devices. The specifics of the Windows Firewall settings are:

- **Type**: Inbound Rule
- **Name**: NTP UDP Datagram
- **Protocol type**: UDP
- **Local port**: 123
- **Profile**: Domain, Private and Public

Messages

During the startup of Ponemah, the application will check that certain services are in the correct state in order for the application to collect data correctly.

If Windows Time is started and NTP is not, the application will try to change this to Windows Time disabled and NTP enabled. If those states cannot be achieve a message will be posted notify the user of the issue.

Troubleshooting NTP

During the startup the application if the needed service states cannot be set an error message will be displayed for the user.

If the user starts an acquisition and the system displays all of the signals with a flat line this can also point to a problem with the NTP time source.

Typically the user can verify that there is an issue by going to the Diagnostic Web page and viewing the Home Page Time. If this time is in the range of 1/30/2012 the hardware device is not synchronized to the NTP time. Try rebooting the hardware device by power cycling the device.

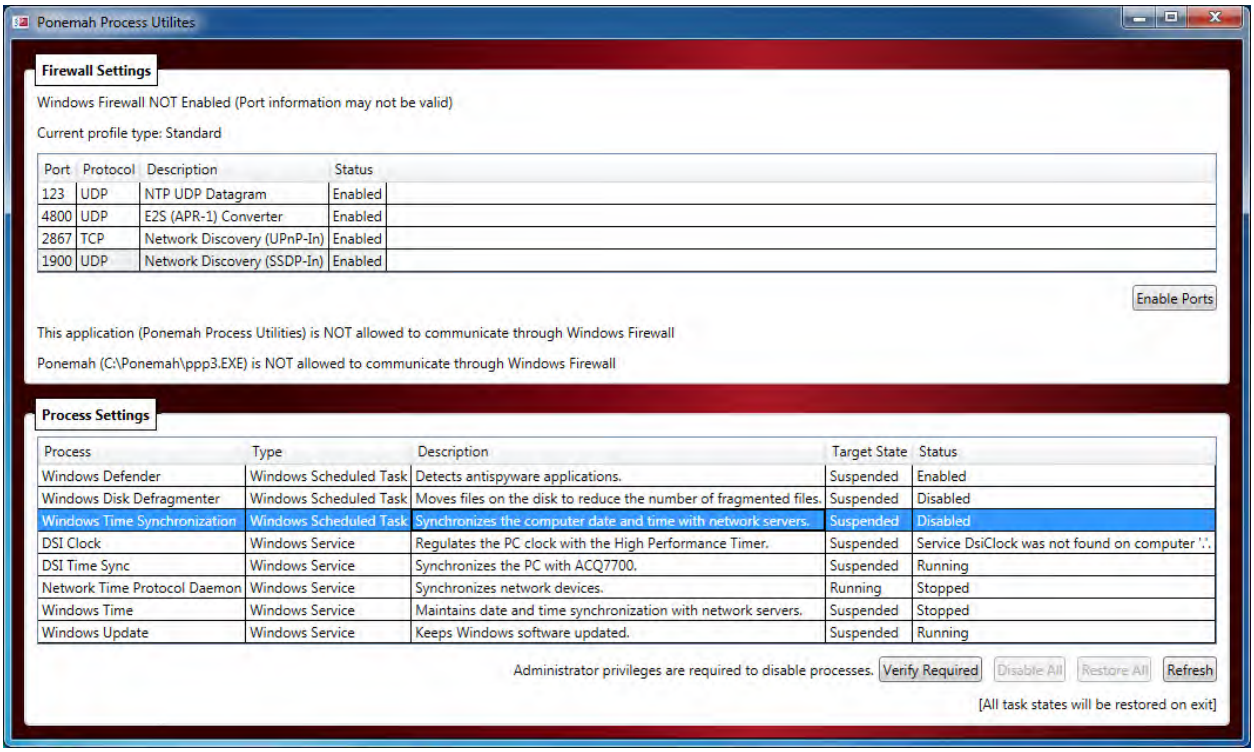
If that does not work exit the application and run a system check by running the Ponemah Process Utilities application which is available in the Ponemah folder under All Applications.

Ponemah Process Utilities Application

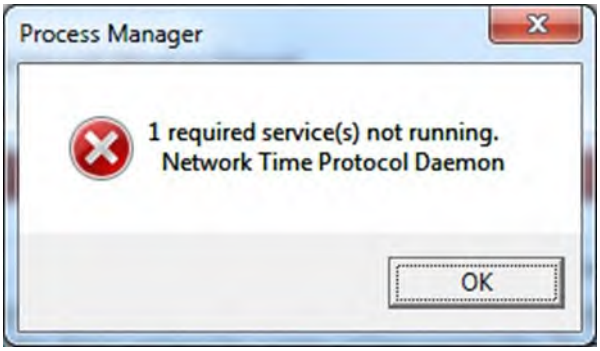
To aid in troubleshooting the user can run the application to view the needed system settings in order to have a valid configuration.

The **Ponemah Process Utilities** application will display the current state of the system settings and the user can select **Verify Required** to see if any of the system setting are not correct and then take appropriate action.

A typical display of a system is shown below.



After selecting **Verify Required** in the above condition, the application responded with:



At this time the user can try to change certain settings to resolve the issue. This can be accomplished by contacting the IT group that supports the computer.

For more information, contact DSI Technical Support by seeing the Getting Technical Support section of this manual.

Contact Information

We are available to help you with your questions and concerns. Should you hit a roadblock or need some additional training, please feel free to visit the DSI Support Center at https://support.datasci.com to find articles and helpful information in our knowledge base, Chat with an agent, or send a support request. We are happy to help!

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