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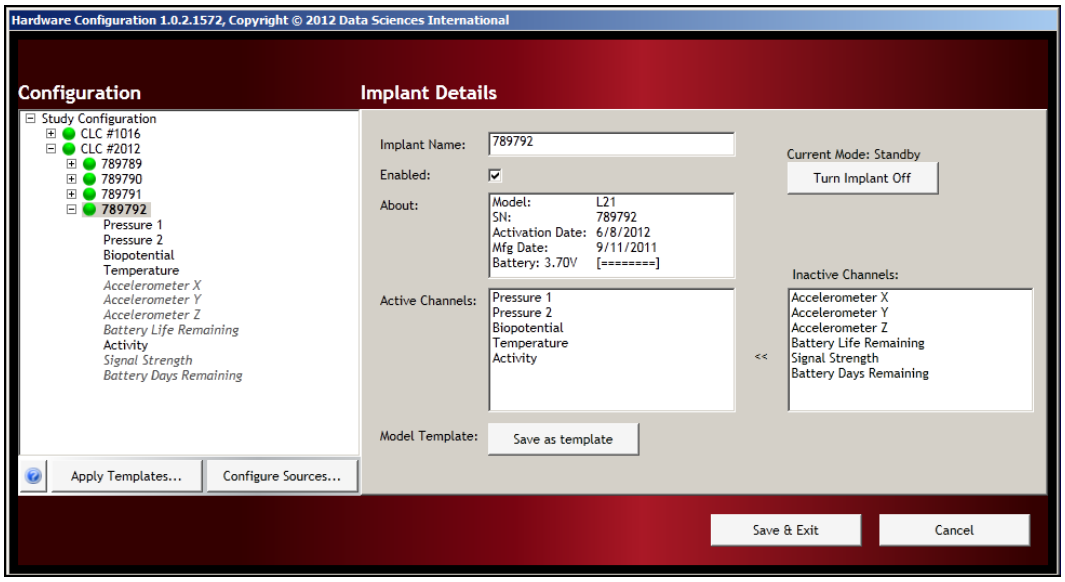
PhysioTel Digital Telemetry Platform

Model: PhysioTel Digital
Manual: MU00285
Revision: 1



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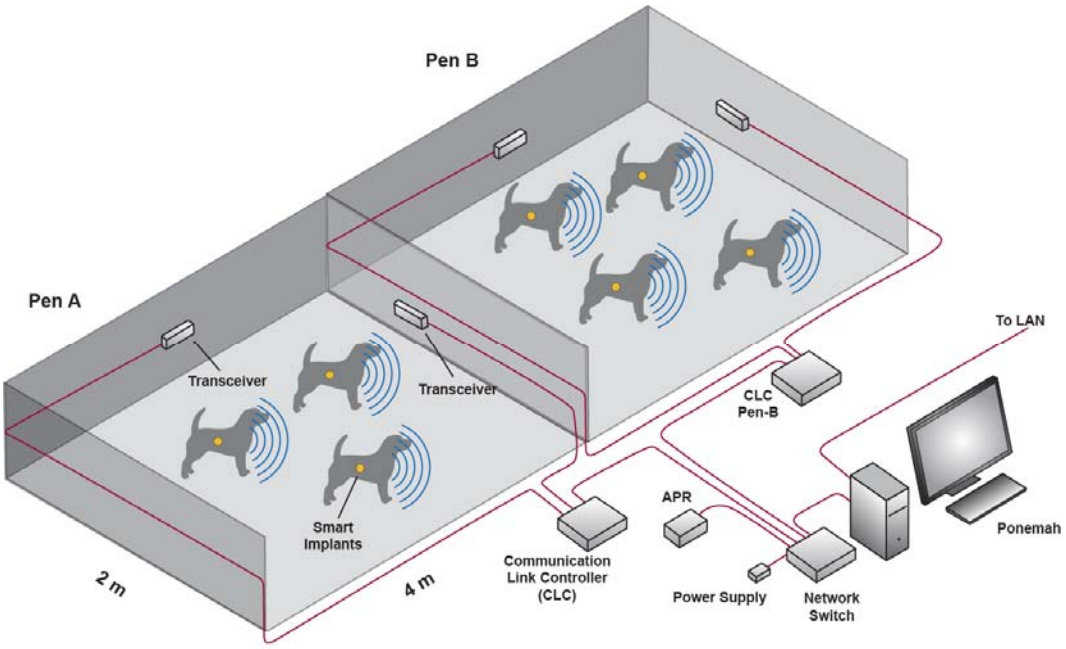
PhysioTel Digital Telemetry Platform

Theory of Operation

There are four main components of the PhysioTel Digital telemetry system; the data acquisition computer, the Communication Link Controller (CLC), the transceivers (TRX), and the smart implants. The CLC and the implants are the components that are actively communicating with one another; the TRX is the transmitting\receiving link between them. Using a hardware configuration wizard in the data acquisition software, the user chooses a set of implants and assigns them to a particular CLC; up to four implants can be assigned to one CLC. Each CLC operates on a separate communication frequency. During the configuration process the CLC instructs the implants to "Join" its unique frequency. Once joined, the implants are ready to collect physiologic data and transmit it back to the data acquisition computer.

System Diagram

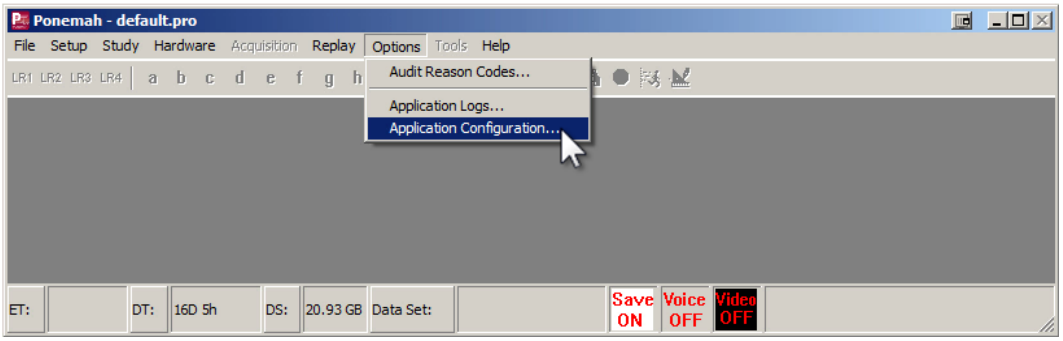


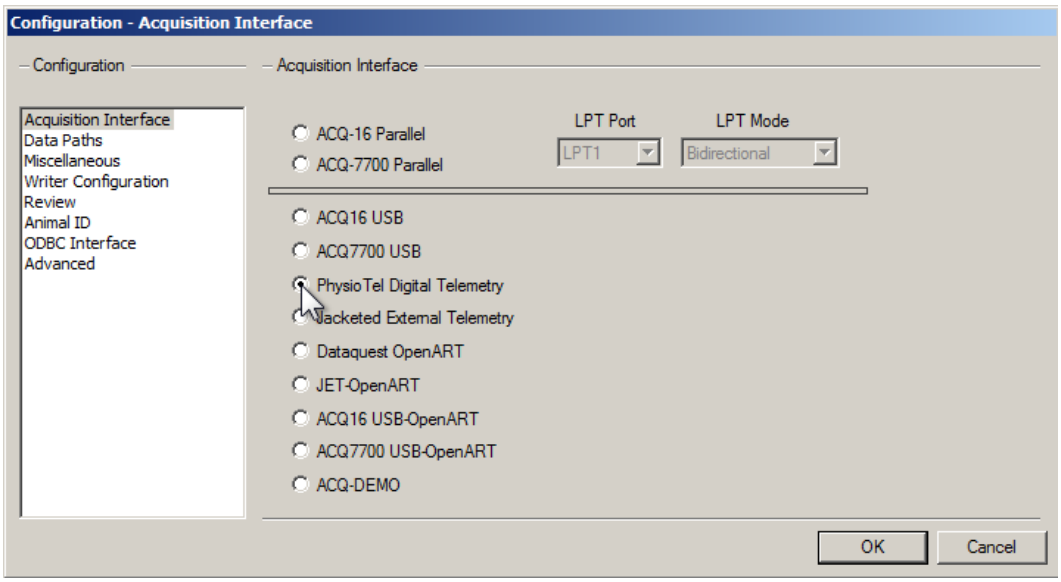
Software

Getting Started

Hardware Selection

The PhysioTel Digital Telemetry system is a specific Application Interface within the Ponemah software. Select the **Application Configuration** function from the **Options** menu. Select **PhysioTel Digital Telemetry** and click **OK**.

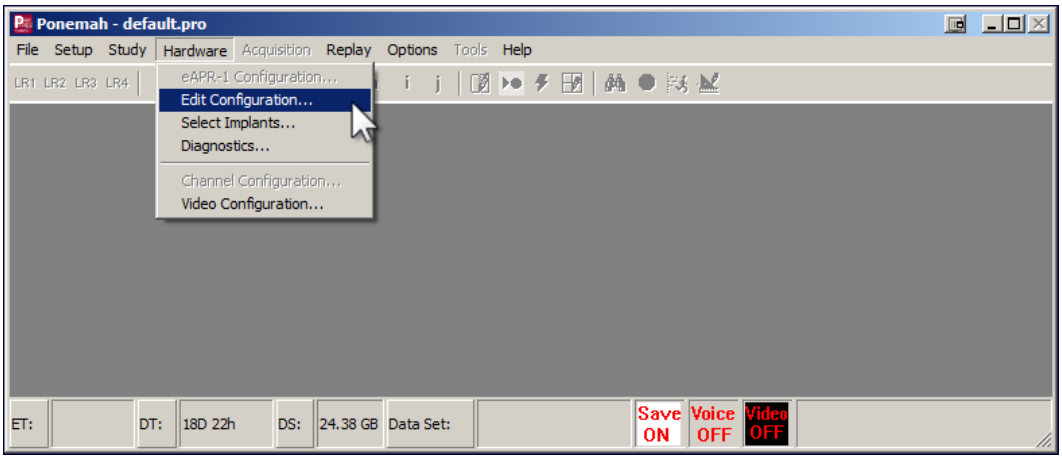




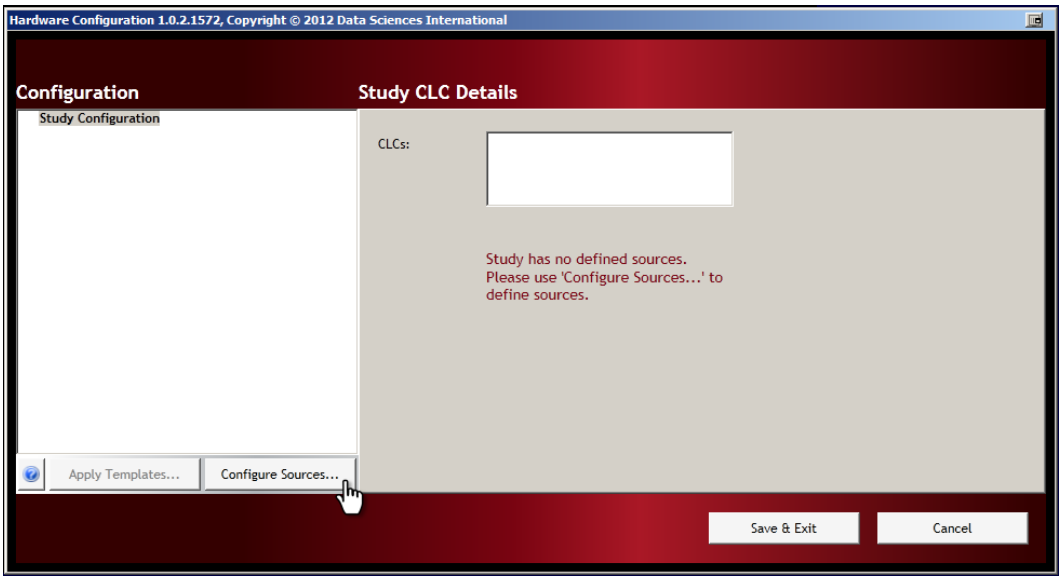
Hardware Configuration

The PhysioTel Digital system 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 communications link between these two components consists of wired and wireless components collectively referred to as the PhysioTel Digital Hardware.

Accessing Hardware Configuration through Ponemah

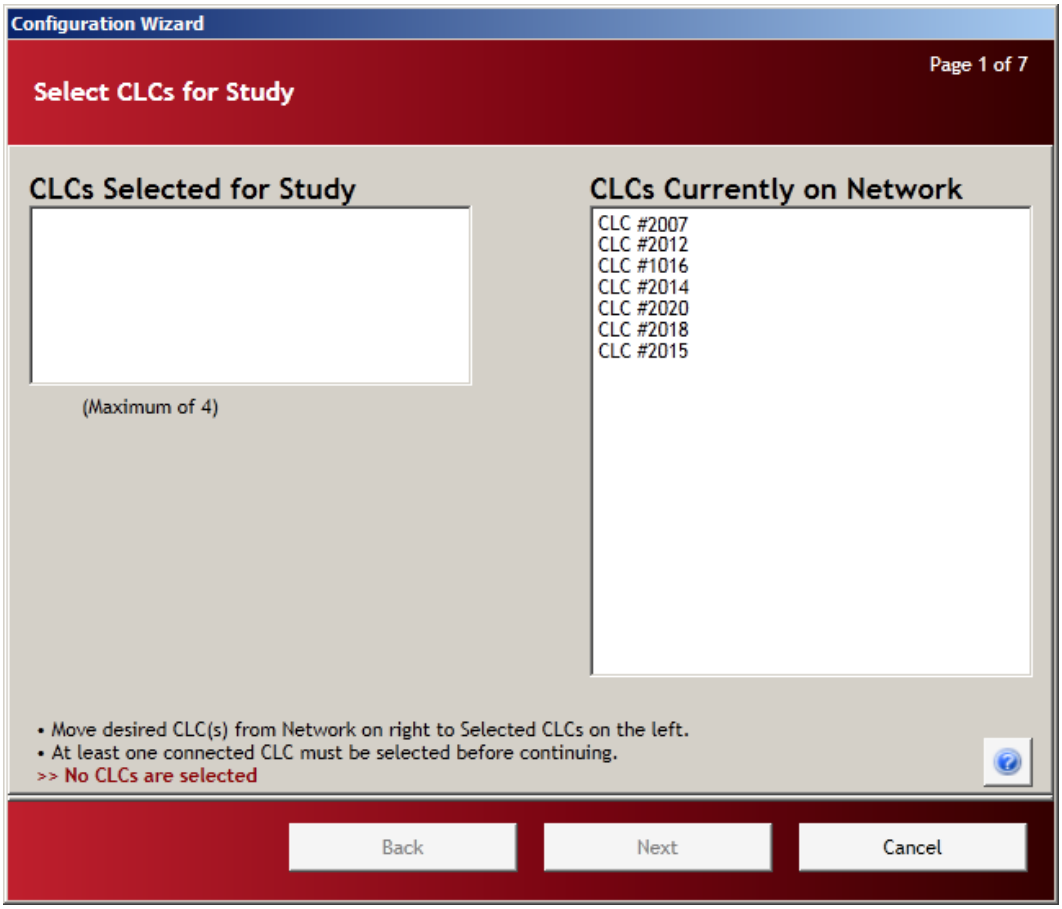


- From the menu bar click **Hardware,** and select **Edit Configuration…**
- This opens the **Hardware Configuration** window.



- If this is a new configuration, the red colored message text will inform you that you need to use **Configure Sources…** to define telemetry implant sources.
- Click on the **Configure Sources…** button to open the Configuration Wizard and begin the study configuration process.

Configuration Wizard

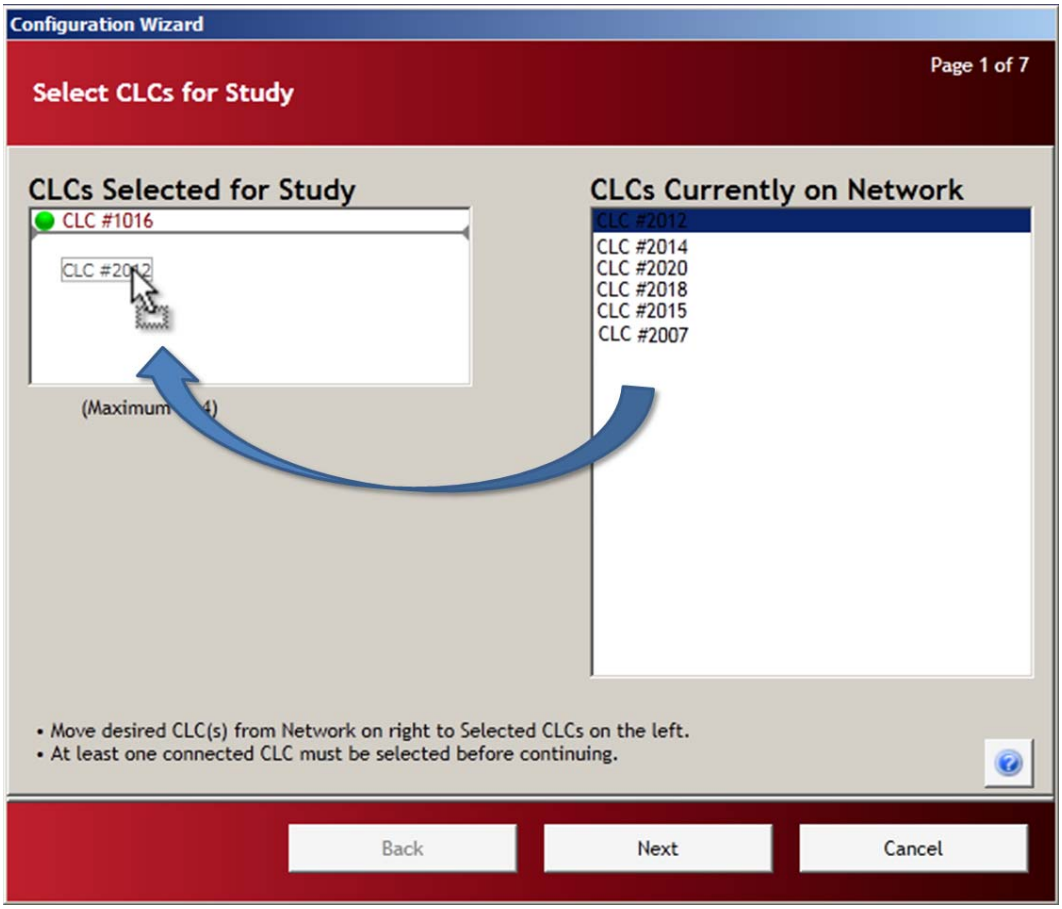


Page 1: Select CLCs for Study

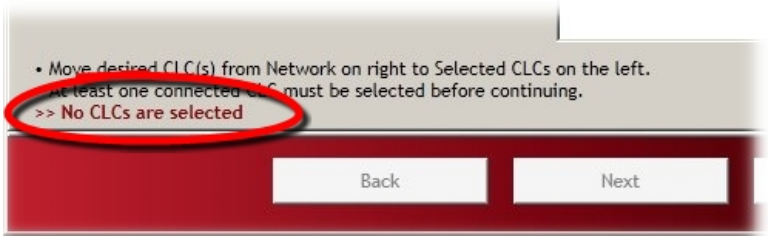
Page 1 of the Configuration Wizard is basic inventory. The wizard queries the network; it finds all of the active CLCs (Communication Link Controller) on the system and lists them in the right hand column titled **CLCs Currently on Network**. To configure a CLC for use in the system, select a CLC and move it from the right column, **CLCs Currently on Network** to the left column, **CLCs Selected for Study**.

- Select a CLC in the right column, click and hold the selection with the left mouse button and drag the selection to the left column. Release the mouse button and the CLC will be added to the list.

  NOTE: The Configuration Wizard will only a maximum of four CLCs to be configured during each run of the configuration process (4 CLCs for frequency F1, 3 CLCs for F2). If more than four CLCs are to be configured, the Configuration Wizard will have to be run again.

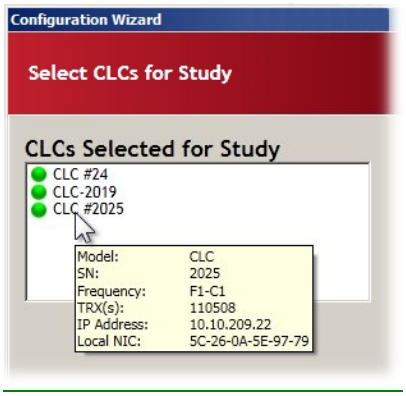


- The newly added CLC will be added to the list with a circular status indicator.
  - Green colored indicator: CLC enabled
  - Red colored indicator : CLC disabled
- If the colored status indicator does not change from red to green, an error message will be displayed in the lower left corner of the screen indicating the nature of the discrepancy
- An error message may also appear even though the indicator is green.



- At least one CLC must be selected and enabled (green indicator) before continuing.

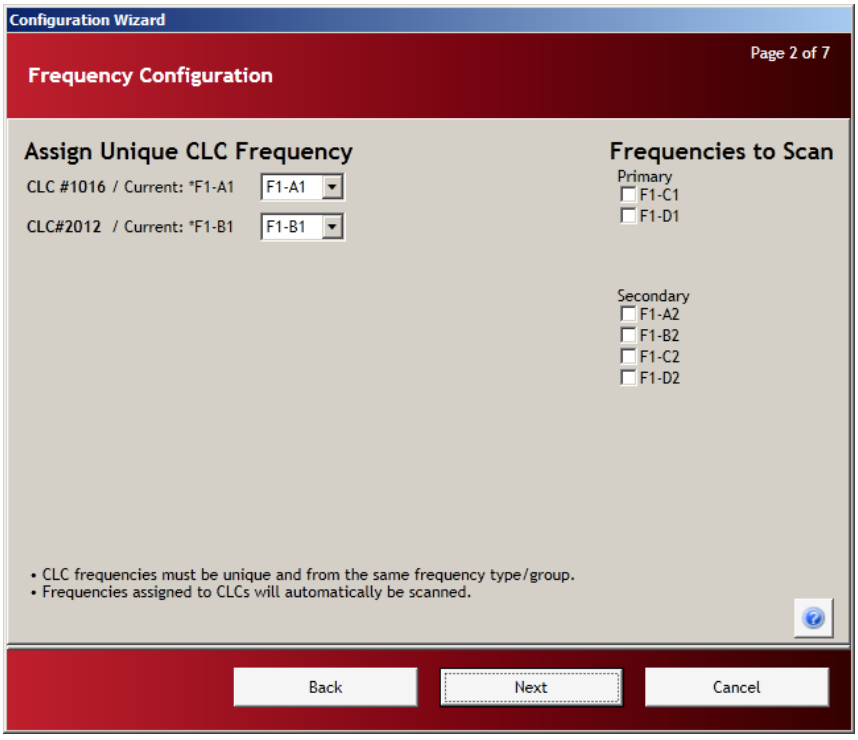
- All of the “Selected” CLCs (left column) must be enabled (green indicator) before continuing. Enabled status means that the CLC is “powered up” and not in use by another system.
- If everything is in order, you will be able to click the **Next** button to proceed to Page 2.
- If the **Next** button is not available, consult the error messages mentioned above.



NOTE: At any time a CLC information pop up is available by hovering your mouse cursor over any of the CLC labels on the page. Details concerning the content of this information pop-up can be found in the chapter titled “CLC Details”

Page 2: Frequency Configuration

Page 2 allows the user to select a separate frequency for each CLC. As many as four CLCs may be configured at one time, but each CLC must be assigned a unique operating frequency.

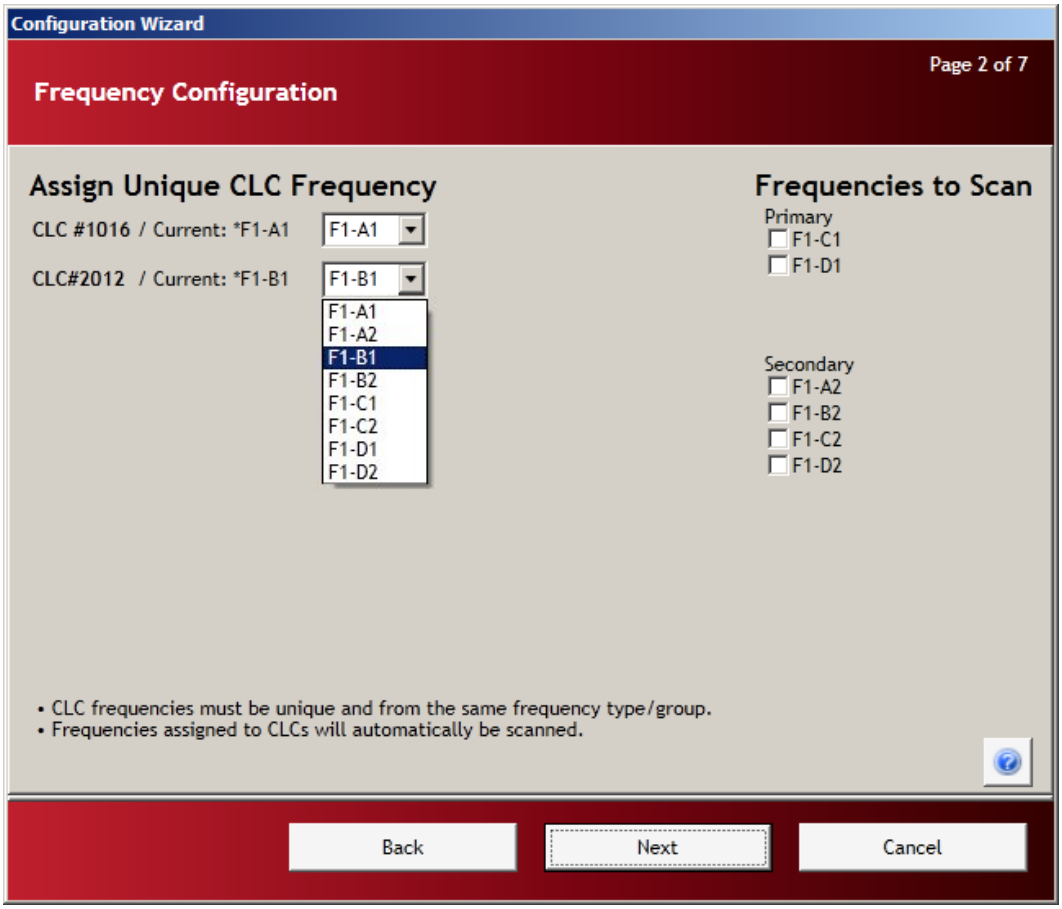


[Assign Unique CLC Frequency](#)

[Frequencies to Scan](#)

Assign Unique CLC Frequency

- The CLCs that are enabled in the previous step are listed in the left hand column labeled **Assign Unique CLC Frequency.**



- The left hand side of the page is arranged in a table.

Assign Unique CLC Frequency		
CLC label	Current CLC frequency	Select frequency
CLC#2012	Current: *F1-B1	F1-B1

  - CLC Label: The name that is assigned to the CLC
  - Current CLC frequency: The currently assigned frequency

- Select frequency: Drop-down with frequency options

- The current operating frequency of each CLC is listed in the center column.
- Use the drop-down menu to the right of the CLC to select an available communication frequency.
- The frequencies are designated by four alpha-numeric characters **XX – YZ (XX = region, Y = frequency, Z = group).**

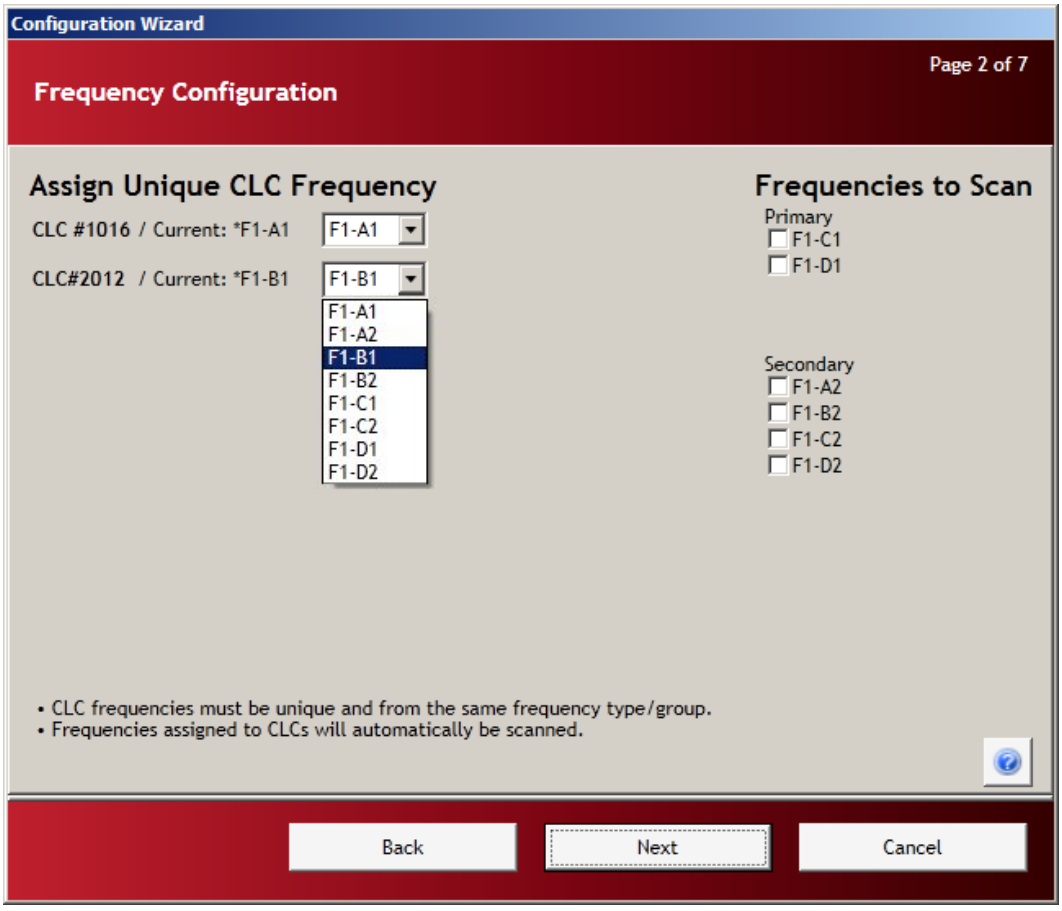
Region	Frequency	Group
F1 = USA	A	1
F2 = Europe	B	2
	C	
	D	

- The available frequencies are as listed below:

USA	Europe
F1-A1	F2-A1
F1-B1	F2-B1
F1-C1	F2-C1
F1-D1	
F1-A2	F2-A2
F1-B2	F2-B2
F1-C2	
F1-D2	

Guidelines for selecting frequencies

The frequency **Group** designation (above) is used to allocate certain frequencies as Primary or Secondary. **Group 1** (**A1, B1, C1, D1**) is the Primary frequency and **Group 2** (**A2, B2, C2, D2**) is the Secondary frequency. When setting up a system all of the CLCs must be assigned to the same frequency Group. For instance, assign all of the Primary frequencies first before using any of the frequencies from Secondary Group.



- Each CLC in the system must be assigned a unique communication frequency.
  - CLC #1 – A1
  - CLC #2 – B1
  - CLC #3 – C1
  - CLC #4 – D1
- CLC frequencies must be unique and should be from the same frequency **Group.**
  - A1, B1, C1, D1
  - A2, B2, C2, D2

- The frequency options that are available to assign to CLCs are listed in the right hand column labeled **Frequencies to Scan.**
- The user must assign a unique frequency for each CLC before continuing to the next page.
- To assign a frequency, left-click the down arrow of the drop-down menu associated with each CLC listed.

Frequencies to Scan

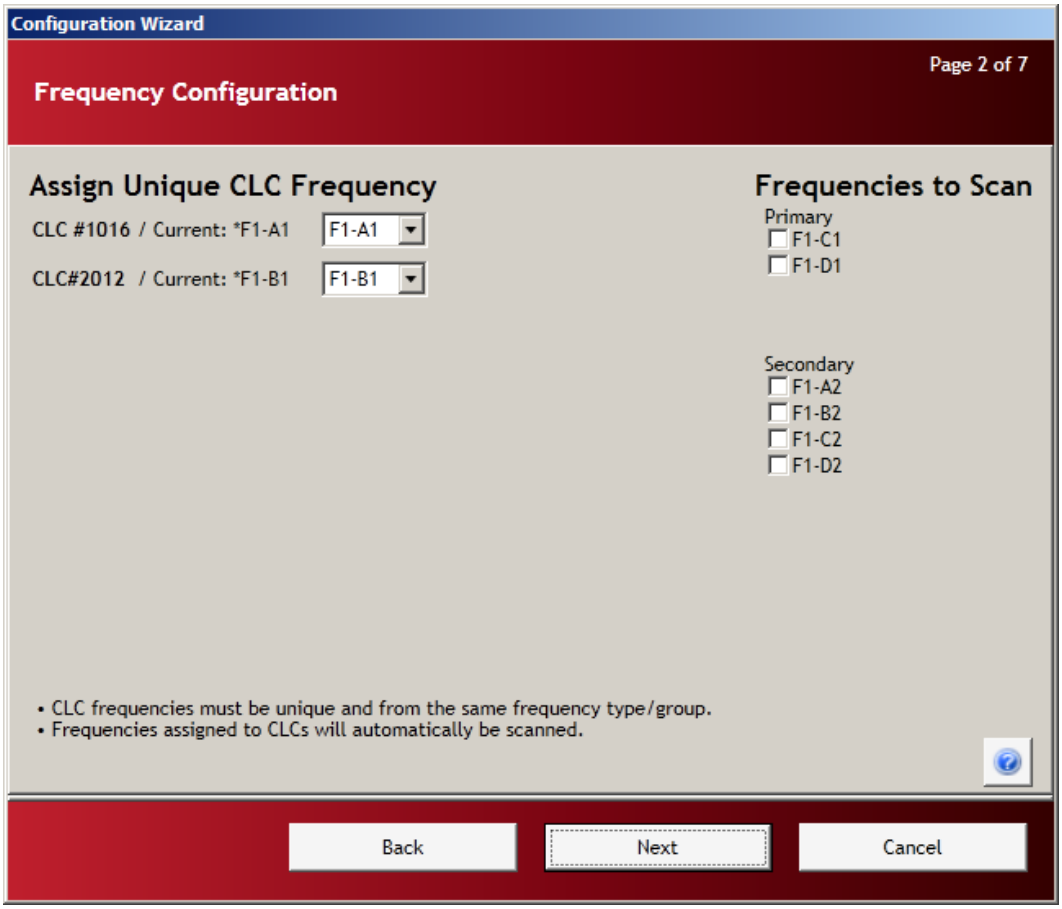
The PhysioTel Digital system consists of CLCs, TRXs, and telemetry implants. The proprietary communication protocols use several different radio frequencies to communicate with the implants. All individual implants are assigned to a particular frequency. New implants that have not been previously configured will be detectable using the default frequency (**B1**) assigned during manufacturing.

In the previous section, **Assign Unique CLC Frequency,** the user assigns a separate frequency to each CLC. In this section, the user selects which additional radio frequencies the system will scan in order to locate individual implants. If all of the implants are previously un-configured, the user must only insure that the default shipping frequency is assigned to a CLC in the left column – or is checked to be scanned in the right column.

- The frequencies are designated by four alpha-numeric characters **XX – YZ (XX = region, Y = frequency, Z = group)**

Region	Frequency	Group
F1 = USA	A	1
F2 = Europe	B	2
	C	
	D	

- The frequencies that are assigned to CLCs in the left column, **Assign Unique CLC Frequency,** will automatically be scanned for implants.
- Once a frequency is selected for a CLC, that frequency is no longer offered as an option in the **Frequencies to Scan** column.



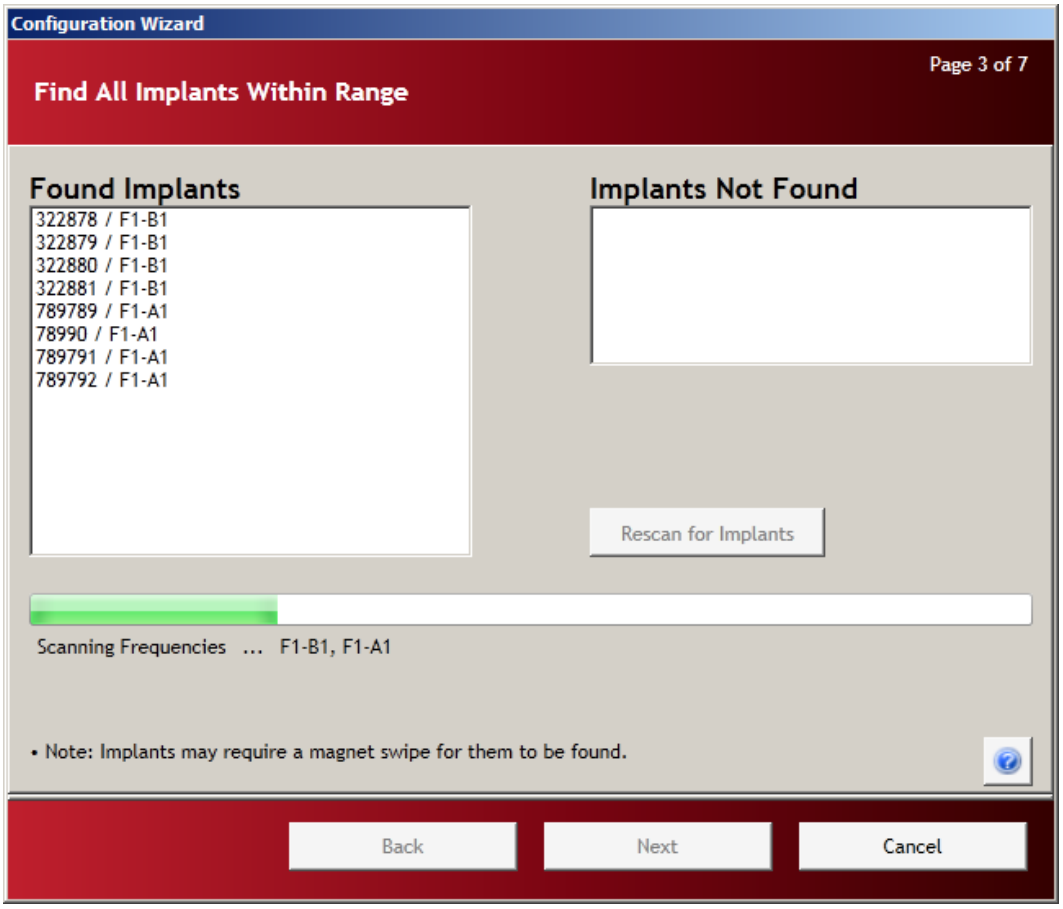
- The factory default frequencies for new implants are:
  - **F1-B1** for **North America**
  - **F2-B1** for **EU**

  NOTE: If the frequency of a previously configured implant cannot be determined, the user may choose to scan all of the available frequencies. The scanning of all available frequencies will take extra time.

- Click the **Next** button to progress to the next page – **Find All Implants Within Range.**

Page 3: Find All Implants Within Range

In this step of the configuration process the CLCs incrementally scan the frequencies selected in the previous screen. The "operational" telemetry implants, detectable in the network environment, will be listed in the left dialog box labeled **Found Implants.**



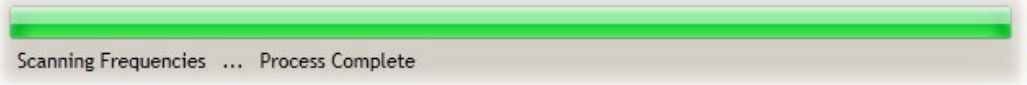
- The green progress bar tracks the status of the searching process and displays the frequencies currently being scanned.

  NOTE: It is normal for this process to take several minutes.

- Transmitters that are power **ON**, communicating, and within range will be listed in the **Found Implants** column once they are identified.
- Transmitters that were previously configured in a study, but not yet detected by this iteration of the Wizard, will be listed on the right in the **Implants Not Found** column.
- Implants will move from right to left as they are detected.

  NOTE: Implants that are powered OFF will require a magnetic swipe in order to place them in a communication mode.

- The Configuration Wizard can detect a maximum of eight implants per cycle, if the system will ultimately have more than eight implants; it is a good idea to power up and configure implants in groups of less than eight devices.
- Once the scanning process is complete and all of the implants are identified, the progress bar will be solid green and the message "**Scanning Frequencies … Process Complete"** will appear below the progress bar.

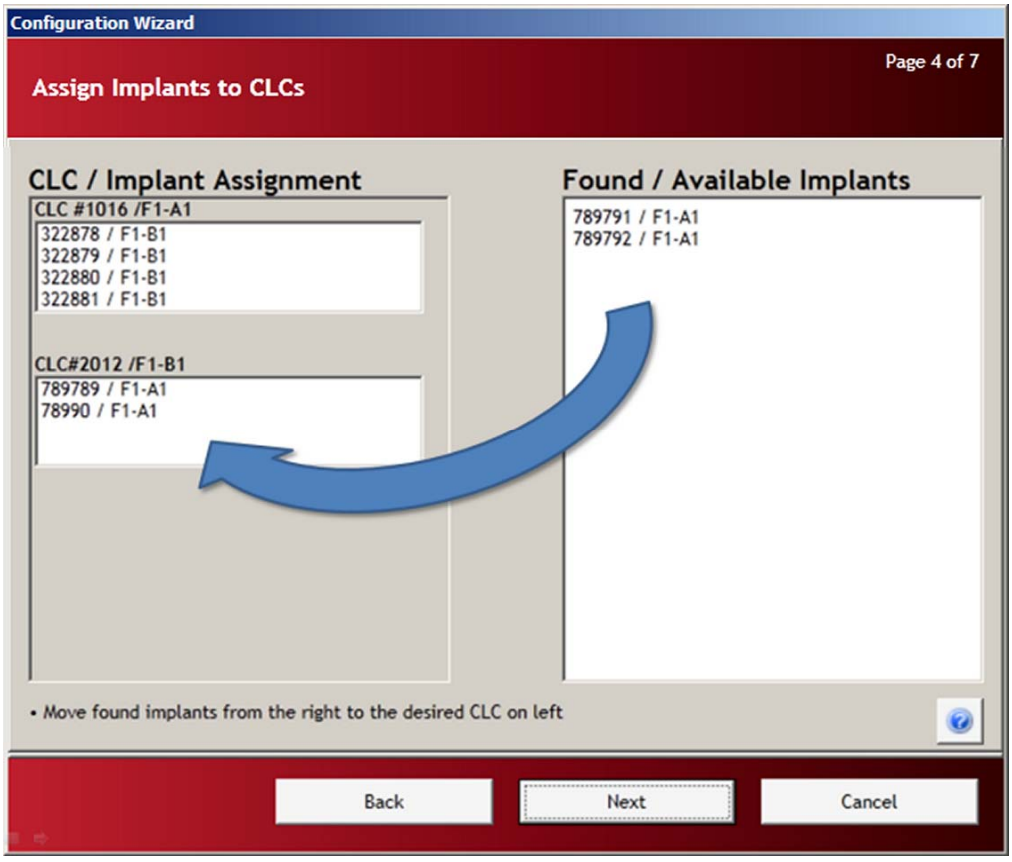


- Click **NEXT** to proceed to the next step – **Assign Implants to CLCs.**

Page 4: Assign Implants to CLCs

This stage of the process allows the user to custom configure the system to assign individual implants to specific CLCs: e.g. *"I would like implant A to be assigned to CLC #4, communicating on frequency F1-A1."*

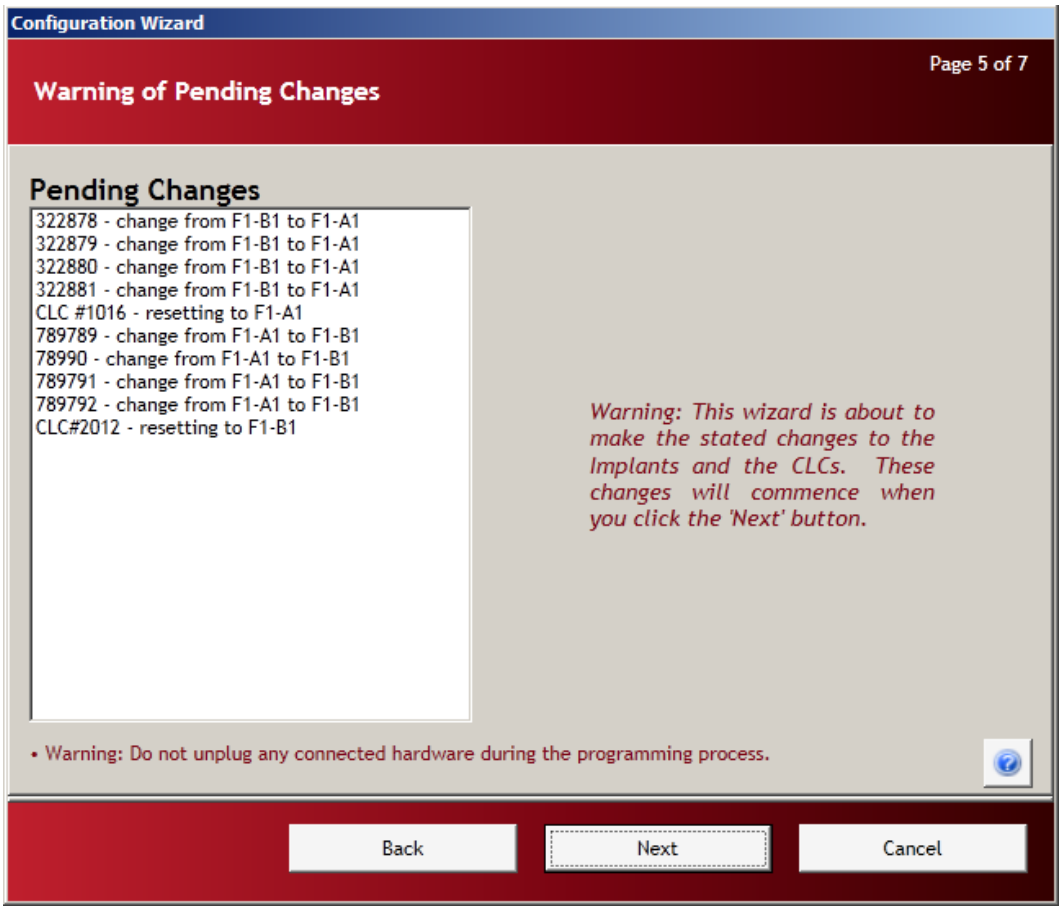
- The implants that have previously been assigned to CLCs will automatically be shown in the left column labeled **CLC / Implant Assignment.**
- The implants that have not been previously assigned to a CLC will appear in the right column labeled **Found / Available Implants.**
- To assign an available implant, click on the implant name in the right column and drag the implant into the box below the desired CLC on the left.
- Once all of the implants are assigned to the appropriate CLCs, Click **Next.**



Page 5: Warning of Pending Changes

Page 5 is a confirmation page that warns the user that the pending changes are about to be committed. The **Pending Changes** are listed in the dialog box on the left. There is no user interaction in this step of the Wizard, it merely warns the user that once the **Next** button is pressed, there is no "Undo" option.

△ *WARNING: Do not unplug any connected hardware during the programming process.*



Click **Next** to progress to Page 6: **Change Implant Frequencies.**

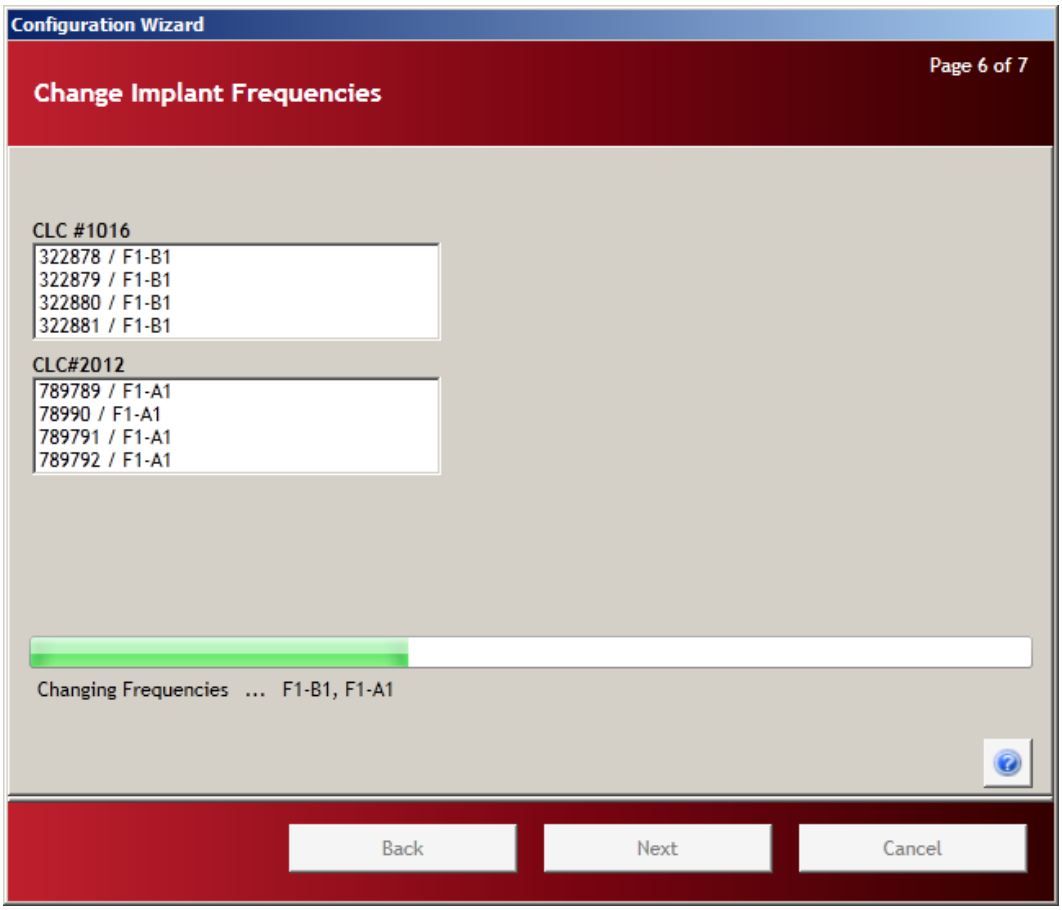
Page 6: Change Implant Frequencies

Page six is the re-assignment process. One by one, the CLCs instruct the implants to switch frequencies and the implants comply. Once an implant switches to a new frequency, it can no longer communicate with its previously assigned CLC. The implant must then wait until a CLC on its new frequency attempts to contact it.

- The green progress bar shows the status of the re-assignment process and displays the pertinent information.

  NOTE: This process may take several minutes.

- As the re-assignments progress, the information in the text box below the CLC listing will continuously update.
- Do not alter any components of the system until confirmation that the process is complete.
- Completion of the process is indicated by a completely green progress bar with the message "**Process Complete"** below.

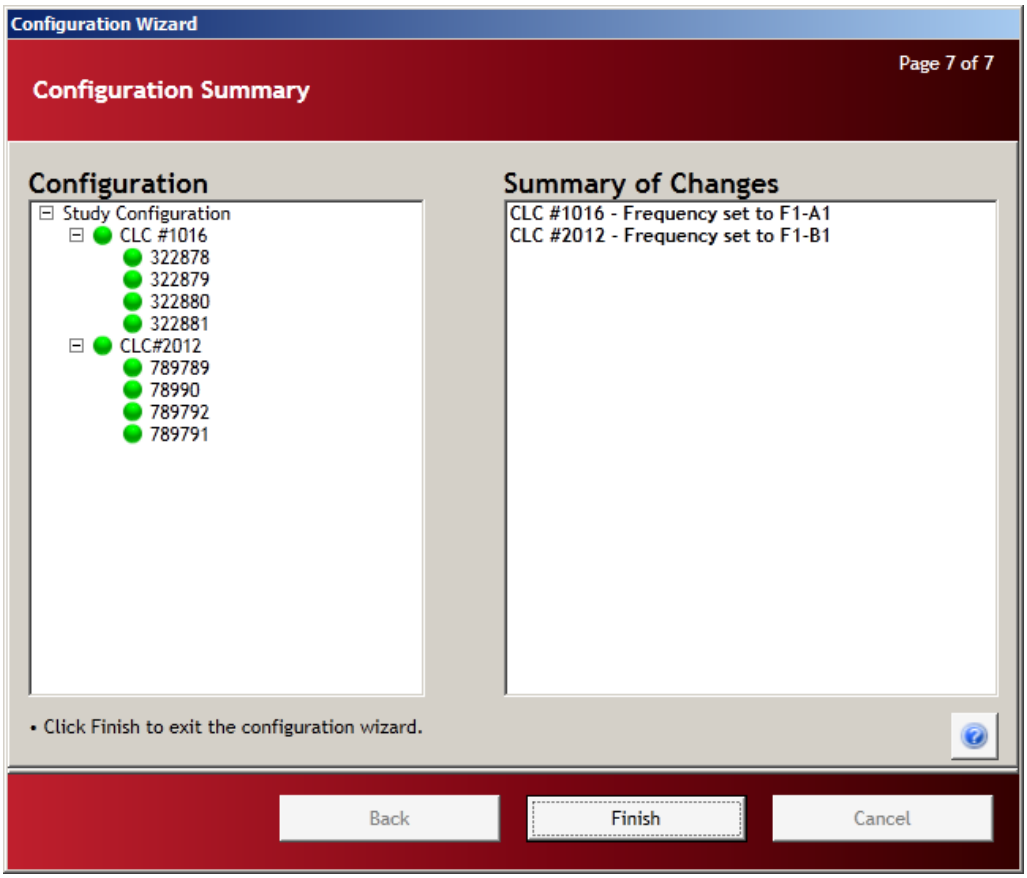


- Click **Next** to progress to Page 7: **Accept Configuration.**

Page 7: Accept Configuration

Page seven is the final step in the **Configuration Wizard**. The column on the left, **Configuration**, presents the newly configured tree structure of CLCs and implants. The column on the right, **Summary of Changes,** will indicate successes and failures in the configuration process. If the user wishes to alter or repair the final configuration listed in the **Configuration** dialog box, the wizard will have to be run again.

- The **Configuration** column on the left outlines the new hardware configuration.
    - **Study Configuration**
        - **CLC 1**
            - **Implant 1**
            - **Implant 2**
            - **Etc…**
        - **CLC 2**
            - **Implant 1**
            - **Implant 2**
            - **Etc…**
- To accept and save the study configuration as it is outlined in the **Configuration** dialog box, click the **Finish** button**.**

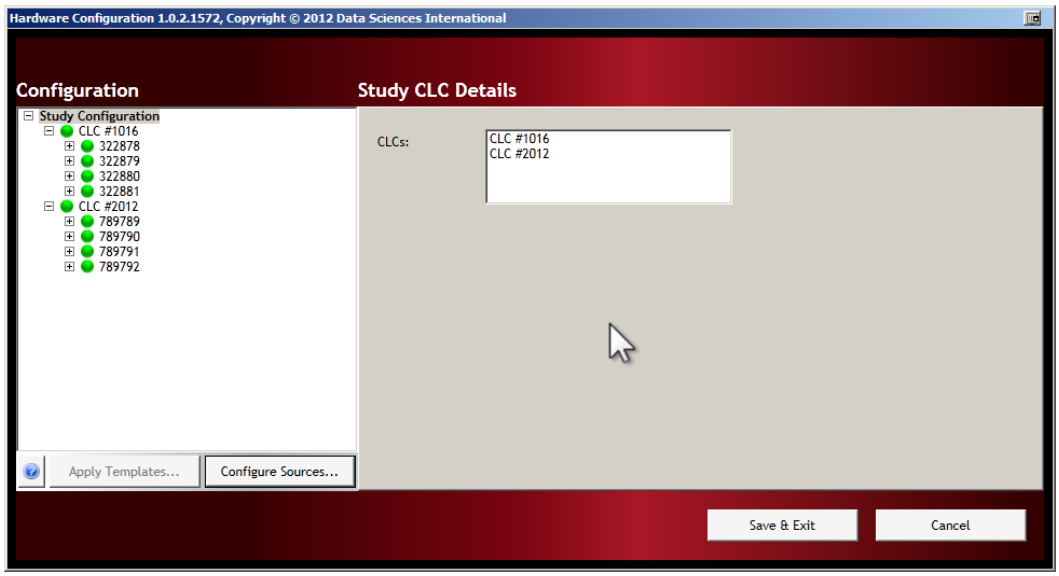


Hardware Configuration (Details)

Once the **Configuration Wizard** closes, the configuration process is complete. The **Hardware Configuration** screen is updated with the new **Study Configuration**.

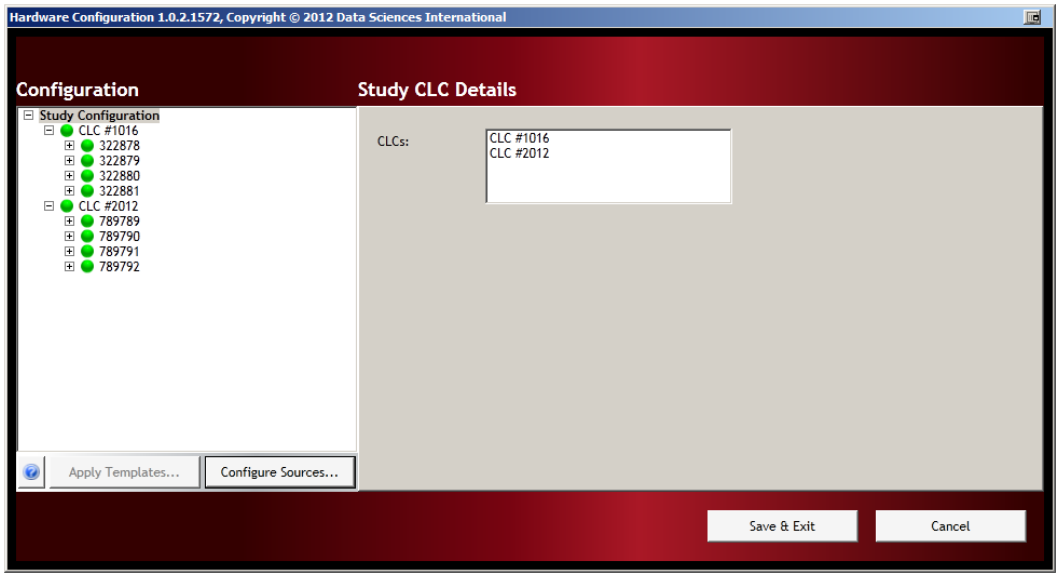
There are multiple layers of information contained in this window:

- **Study CLC Details**
- **CLC Details**
- **Implant Details**
- **Channel Details**



Study CLC Details

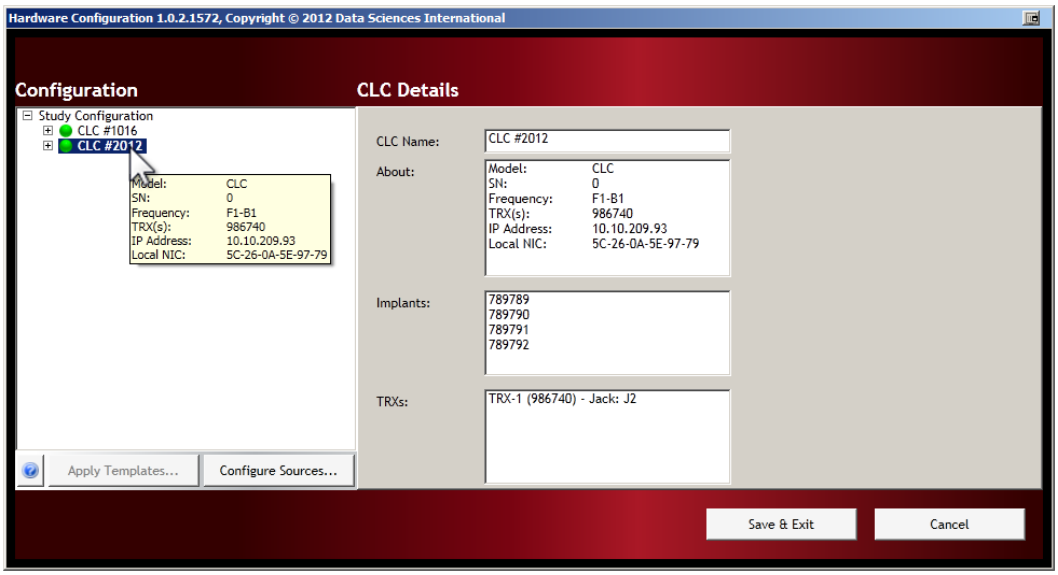
The **Study CLC Details** screen shows the overall configuration from the "Study" level. To view the **Study CLC Details** level, click on the **Study Configuration** line item in the left column labeled **Configuration.**



- The **Configuration** column lists the entire configuration in an expandable tree structure.
- The CLCs are listed with the assigned transmitters listed underneath.
- Click on the **Study Configuration** line item in the left column labeled **Configuration.**
- The right hand column **Study CLC Details**, lists the CLCs in the new configuration.
- 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 tree structure can be expanded and contracted by clicking on the [+] and [-] icons to the left of the individual line items.

CLC Details

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

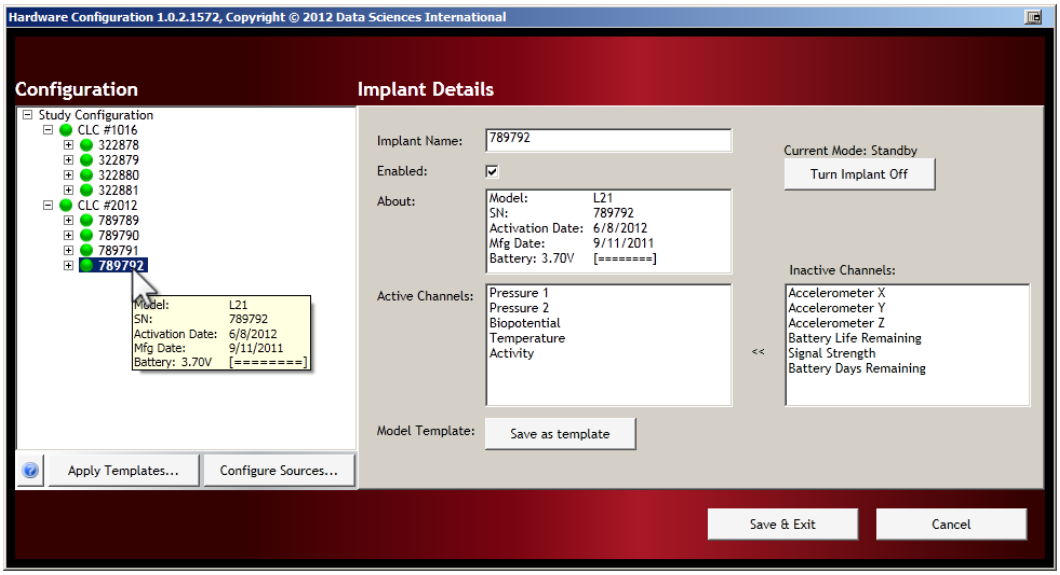


CLC Details include:

- **CLC Name**: User may rename the CLC by editing the text in this box
- **About**: Model
  Serial number
  Frequency
  TRX(s)
  IP Address
  Local NIC (Network Interface Card)
- **Implants**: List of the implant names assigned to that CLC
- **TRXs:** List of TRXs and serial numbers assigned to that CLC – the "Jack" number on the back panel of the CLC that the TRX is plugged into

Implant Details

The **Implant Details** view can be accessed by left-clicking on any of the implant names in the **Configuration** column. There is a lot of information available in this screen as well as some important interactive features.



Information:

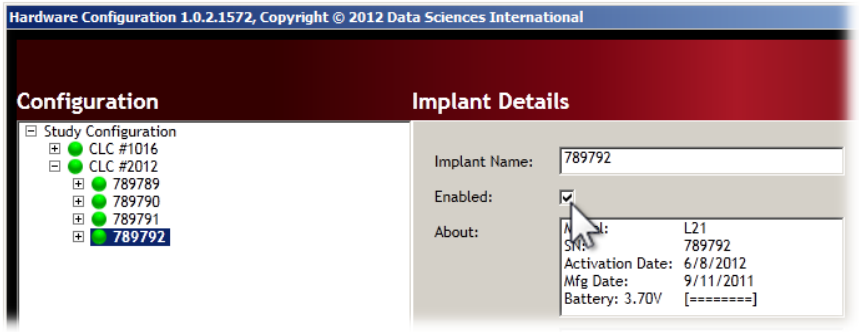
- **Implant Name:** User may rename the implant by editing the text in this box
- **About:** Important information including model and serial numbers, activation and manufacture dates, as well as a battery level indicator. (This same information is available by hovering the mouse cursor over the line item in the **Configuration** column.)

Interactive Features:

The **Implant Details** view can be accessed by left-clicking on any of the implant line items in the **Configuration** column on the left. There are several important implant configuration options available in the **Implant Details** portion of the hardware configuration screen.

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 device will still be in communication with the system but **no data from this implant will be visible to the analysis software**.*

Current Mode:

The **Turn Implant Off** button allows the user to remotely switch the implant to the OFF mode. Once in the OFF mode, the implant 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.

> ⚠ *WARNING: Once the implant is switched OFF, it cannot be remotely turned back ON.*

Procedure for switching the implant to the OFF mode:

1. Select the implant by clicking the line item in the **Configuration** column on the left of the screen.
2. Click the button labeled **Turn Implant Off.**

3. Confirm your intentions by clicking the button labeled **Turn Off.**
4. The progress bar will indicate the status of the operation. The completed process will be indicated by the statement "**Implant has been turned off successfully."**

5. Click the **Close** button to return to the **Implant Details** screen.

CAUTION: Once you turn off an implant it can only be returned to the ON state by physically passing a strong magnet close to the implant device for a few seconds.

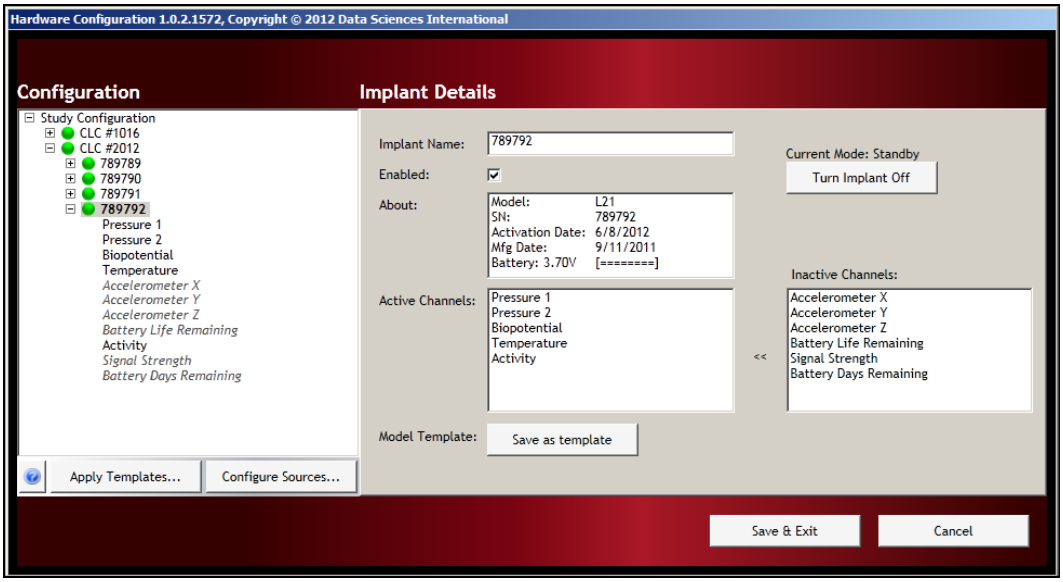
Active Channels:

The **Active Channels** dialog allows 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, those particular implant functions are turned off.

In addition to avoiding the collection of unnecessary data, the in-activation of certain data channels has the potential to preserve battery resources.

Channel Details

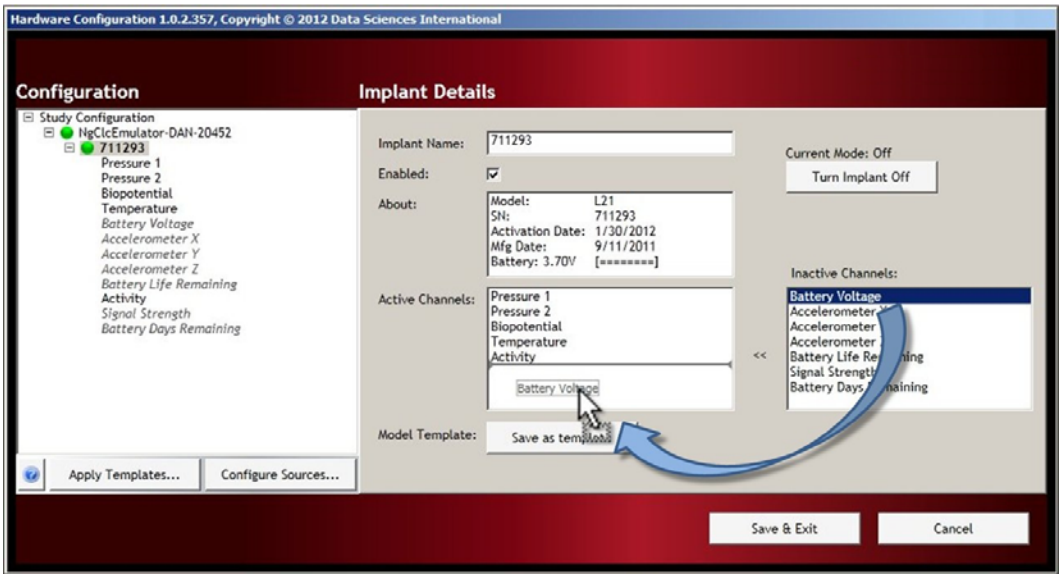
- Locate an implant by expanding the **Study Configuration** tree structure in the **Configuration** dialog box. The tree structure can be expanded and contracted by clicking on the [+] and [-] icons to the left of the individual line items.
- Click on the [+] icon to the left of implant name in the **Configuration** dialog box to view the implant details.
- The current "active" channels are listed in **bold** type in the **Configuration** box once the tree structure is fully expanded. The inactive channels are listed in *italic* text.



Activating Inactive Channels

- The default channels for the particular implant type are automatically listed in the **Active Channels** dialog box in the center of the **Implant Details** screen.

- To activate an inactive channel, click on the desired channel label in the **Inactive Channels:** dialog box, hold the mouse button, and drag the channel label to the **Active Channels:** dialog box. Release the mouse button.



- To render a channel inactive, click and drag an active channel from the **Active Channels:** dialog to the **Inactive Channels:** dialog.

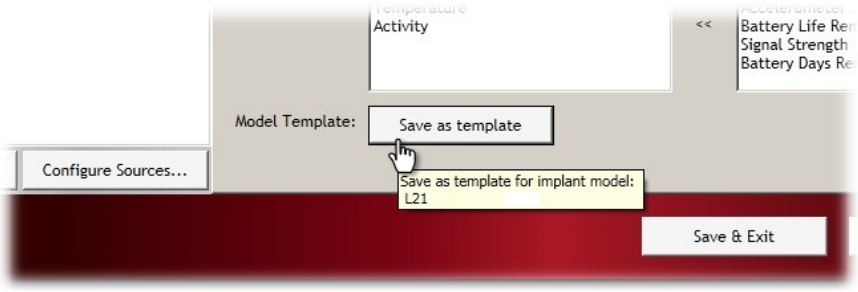
Model Template:

A **Model Template** can be created in order 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 channel configuration as a template and apply that configuration template to all of the similar implants in a particular study configuration.

1. Select an implant from the **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.

*NOTE: Only one **Model Template** can be saved per implant model type.*

3. Click the **Save as Template** button.



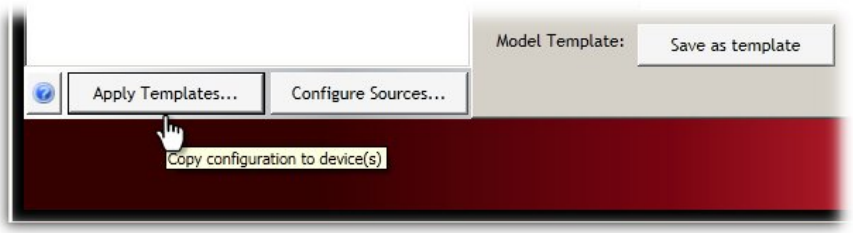
4. You will be offered a confirmation message "**Are you sure you want to replace the template …?**"
5. Click **Yes** to confirm.

Apply Templates:

Once an implant configuration is saved as a **Model Template**, that identical channel configuration can be applied to any of the implants in the **Study Configuration** (provided that the implants are the same model number).

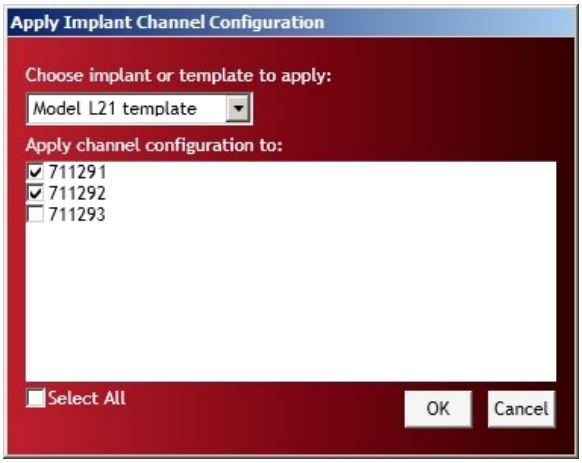
To apply the saved template to other implants in the **Configuration** list:

1. Click the **Apply Templates…** button in the lower left corner of the window to open the **Apply Implant Channel Configuration** screen.

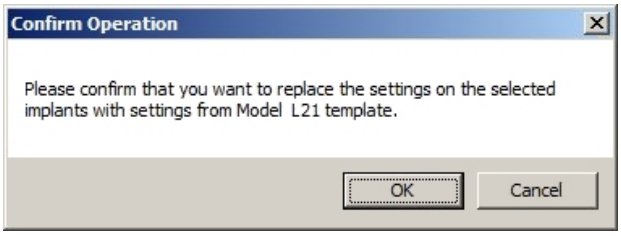


2. Use the drop-down menu under **Choose implant or template to apply:** to select the saved template you wish to apply to the other implants. It is also possible to copy the channel configurations from one implant to another provided they are the same model type.

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 of the implants in the dialog box.



4. The **Select All** check box can be used to select/deselect all of the implants in the dialog box.
5. Click **OK** to apply the saved template configuration.

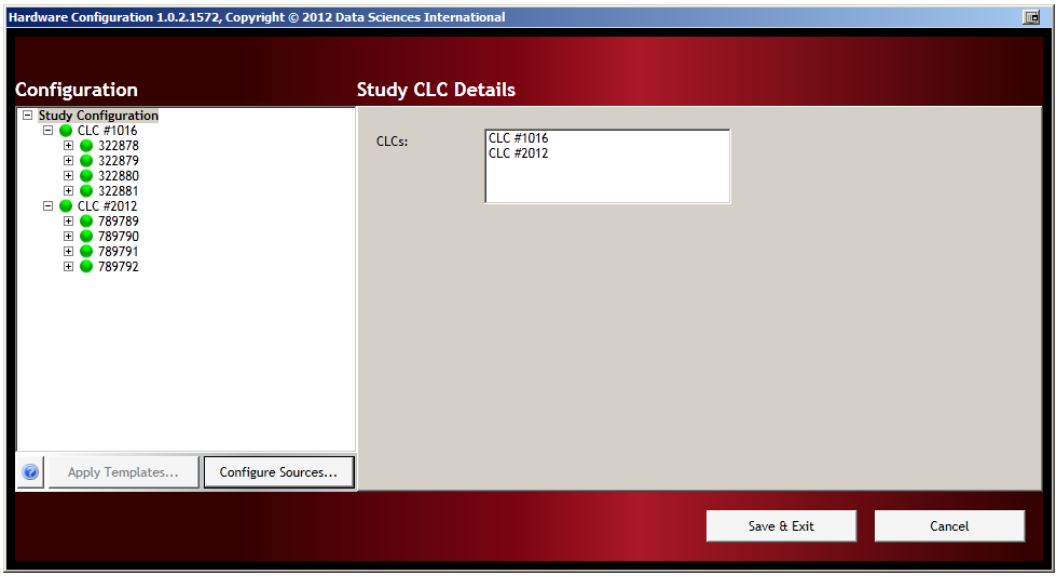


6. A **Confirm Operation** dialog is offered as a precaution, click **OK** to accept.

Save and Exit

This completes the **Hardware Configuration**.

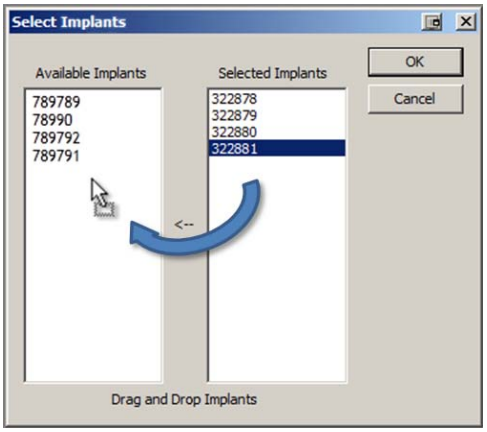
To save the configuration file and exit the configuration wizard, click the **Save & Exit** button.



Selecting Implants

Once the implants are configured in the **Hardware Configuration** they will be available for data collection. If the user does not wish to use all of the implants that are configured, the **Select Implants** option may be used to select which implants will be available in the **P3 Setup**. The implants that are placed in the **Selected Implants** column (right) will be passed through into the P3 Setup and will be available for acquisition. The implants that are placed in the **Available Implants** column (left) will remain configured in the system but will not be visible in the **P3 Setup**.

1. From the main Ponemah menu bar select **Hardware\Select Implants…**
2. The configured implants will appear in the **Selected Implants** column (right).
3. To de-select an implant for acquisition, click on the implant number in the right column and drag the item into the left column titled **Available Implants**. Repeat this step for each implant number to be moved.



4. Once all of the desired implants are moved, Click **OK**.

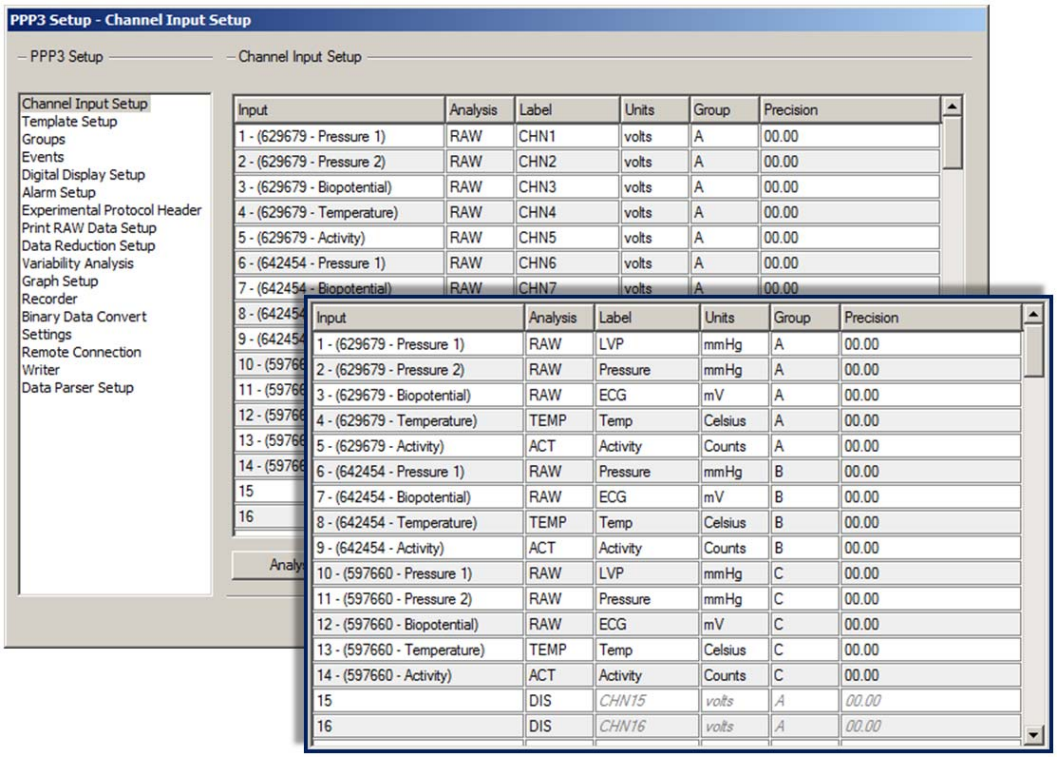
5. This closes the Hardware configuration process and return to the main Ponemah program.

Protocol Setup

P3 Setup allows the user to define the various acquisition settings for the sampling protocol. A default Channel Input Setup is available for each of the PhysioTel Digital implants which automatically configures the input channels for the most common PhysioTel Digital applications.

Model	Pressure 1	Pressure 2	Biopotential	Temperature	Activity
L11	✓		✓	✓	✓
L21	✓	✓	✓	✓	✓

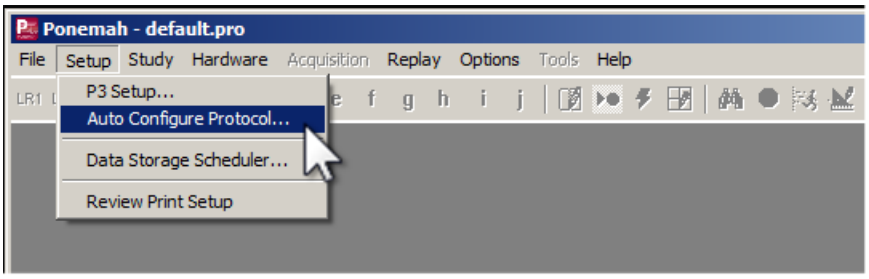
Without the Auto Configuration option the Channel Input Setup in Ponemah would have to be manually configured item by item. The Auto Configure Protocol automatically labels and configures all of the implant channels to their optimal settings.



The results of the Auto Configure Protocol option are shown in the insert frame on the right.

To apply the automatic configuration option:

1. Select **Setup\Auto Configure Protocol…**



2. A cautionary message will be offered concerning overwriting of previous protocol files, to accept and continue click **Yes**.

> *NOTE: For a more detailed description on the settings affected by the Auto Configure Protocol feature or the acquisition settings defined within P3 Setup, please see the P3Plus Manual.*

Start Acquisition

The Start Acquisition command performs the following functions:

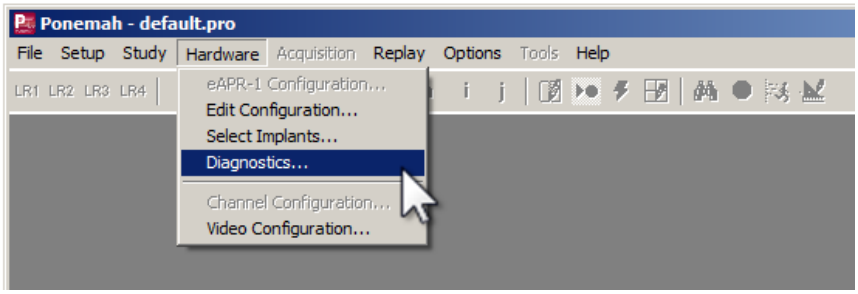
1. The data acquisition computer sends an implant **Mode Change** command to the CLC.
2. Ponemah starts displaying a countdown in the Implant Status screen.
3. The CLC configures the implants and sets the implant mode to Active.
4. The computer updates the implant status to Acquiring.
5. The implants start sending data packets to the CLC.
6. The CLC starts sending data packets to the computer.
7. The computer sends the data to Ponemah.
8. Ponemah begins displaying waveform data in P3P graphs.

Diagnostics

Accessing 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.

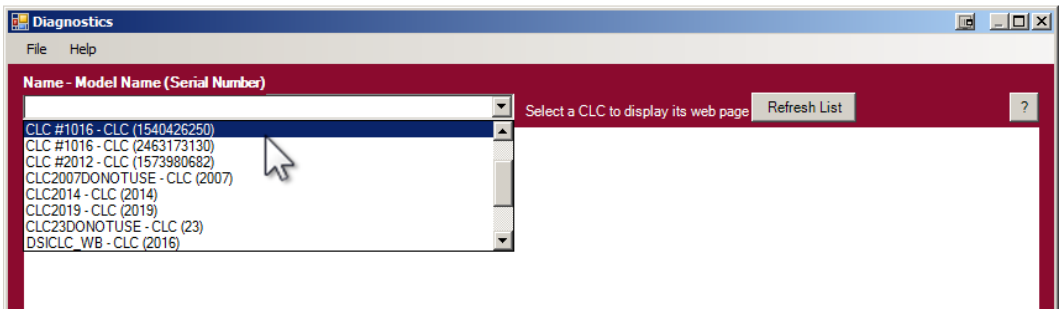


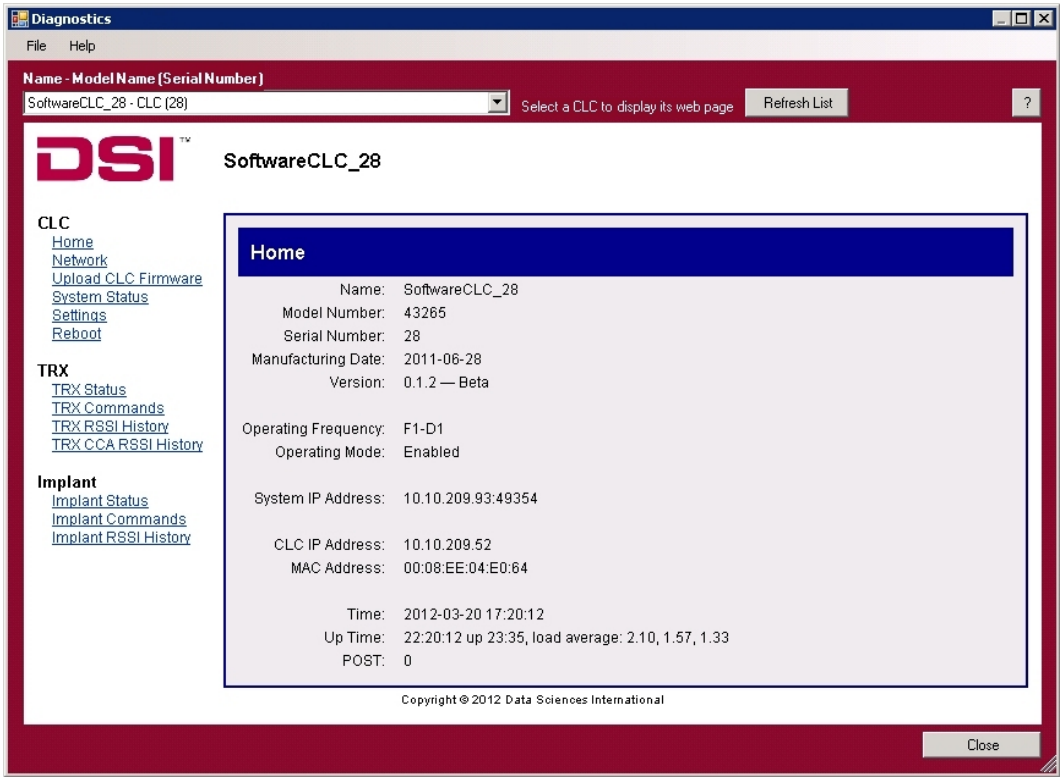
- From the menu bar click **Hardware,** and select **Diagnostics.**
- This opens the **Diagnostics Webpage** in a dedicated browser window.

Diagnostics Webpage

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.

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.





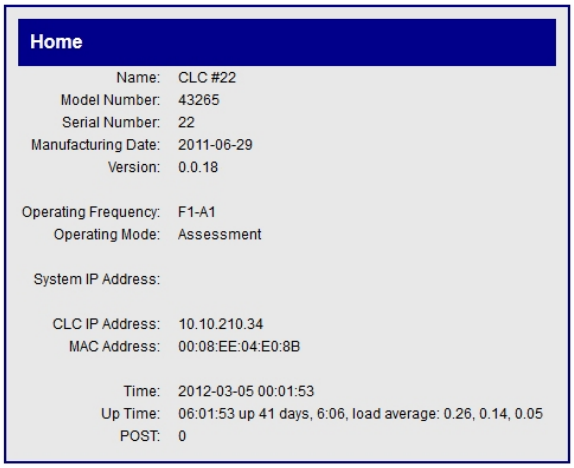
CLC Options

The CLC Section of the Diagnostics webpage has the following sections:

- Home
- Network
- Upload CLC Firmware
- System Status
- Settings
- Reboot

Each of these will be described in a separate section below.

Home



- Name : User-selected name
- Model Number:
- Serial Number:
- Manufacturing Date: (Format = YYYY-MM-DD)
- Version:
- Operating Frequency: (Format = XX-YZ)

Region	Frequency	Group
F1 = US	A	1
F2 = EU	B	2
	C	
	D	

The frequencies are designated by four alpha-numeric characters XX-YZ (XX = region, Y = freq., Z = group).

NOTE: the Operating Frequency will read "Unknown" if CLC is powered up without a TRX connected.

- Operating Mode: 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
- System IP Address: IP address of the data acquisition computer
- CLC IP Address: The IP address of this particular CLC
- MAC Address: Unique identifier for the CLC 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 …)

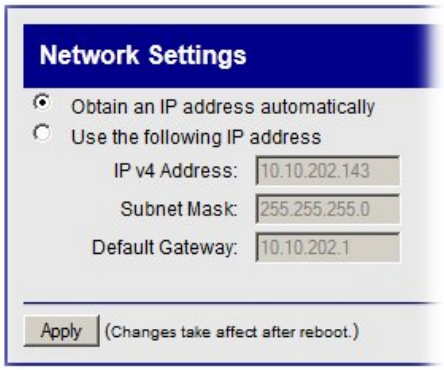
Network (Settings)

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:

NOTE: 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.



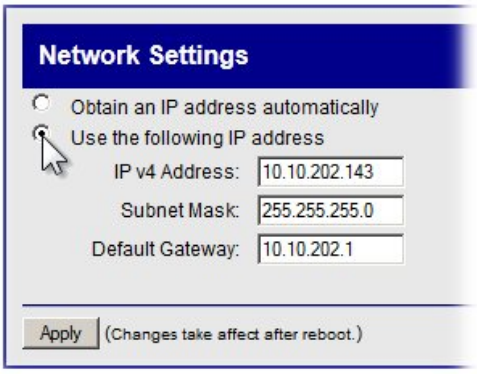
Use the following IP address

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.

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.

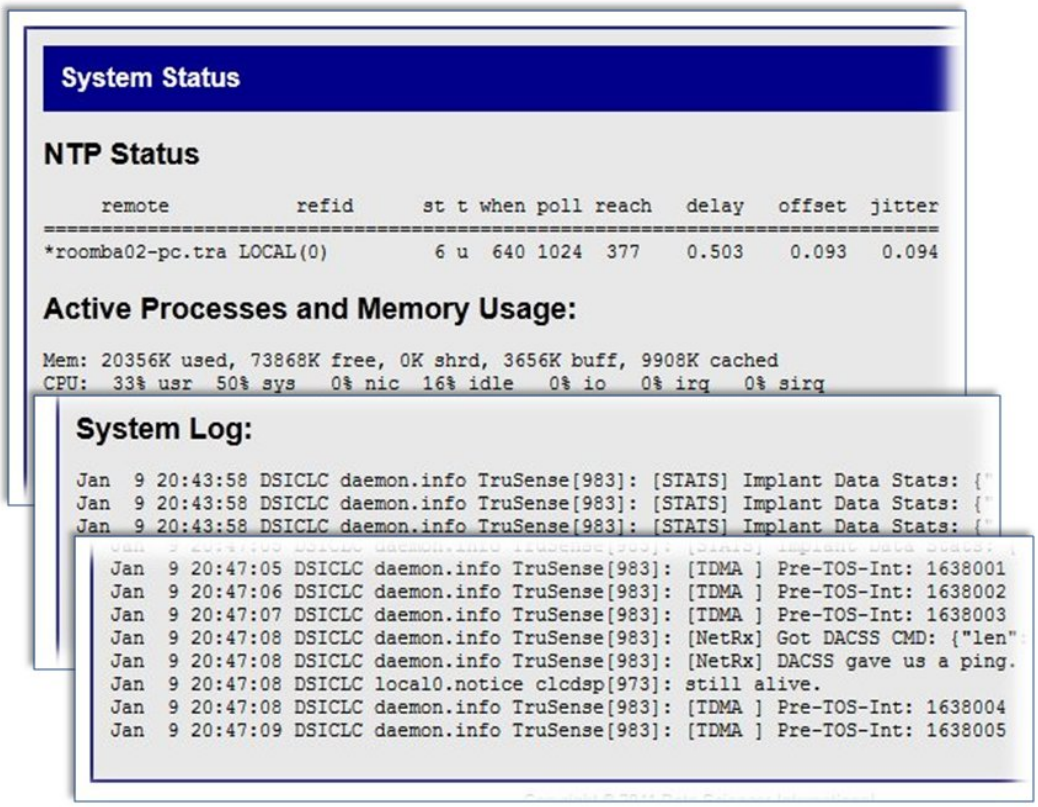
To update or change the firmware version in the CLC, follow this procedure:

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.

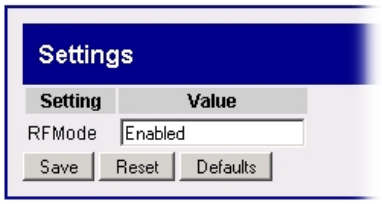


Contents:

- 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 monitor the 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

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

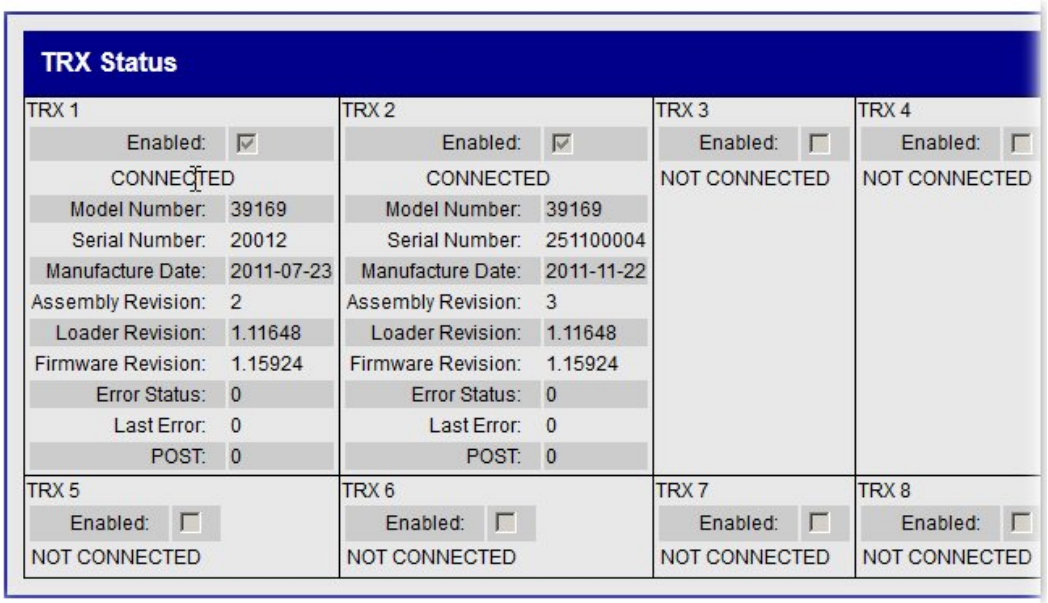
NOTE: the Reboot process may take several minutes to complete. There are no progress indicators that appear on this page, However there are indicator lights on the back of the CLC box itself.

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; additionally, the component that transmits Radio-Frequency signals converted from digital form sent via cable, from 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.



TRX Status screen indicating that two TRX units are connected and enabled.

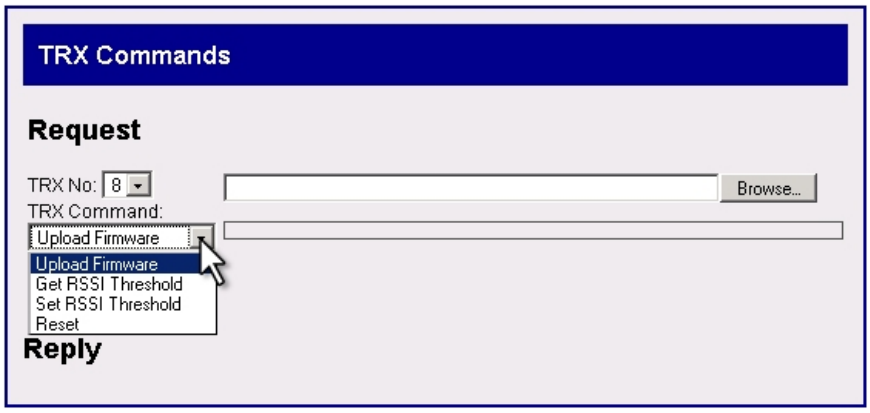
The line items are as follows:

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:	
Serial number:	
Manufacture Date:	YYYY-MM-DD
Assembly Revision:	
Loader Revision:	
Firmware Revision:	
Error Status:	Indicates that at least one error has occurred
Last error:	The most recent error encountered
POST:	Power On Self Test (0 =Passed, OK)

TRX Commands

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.

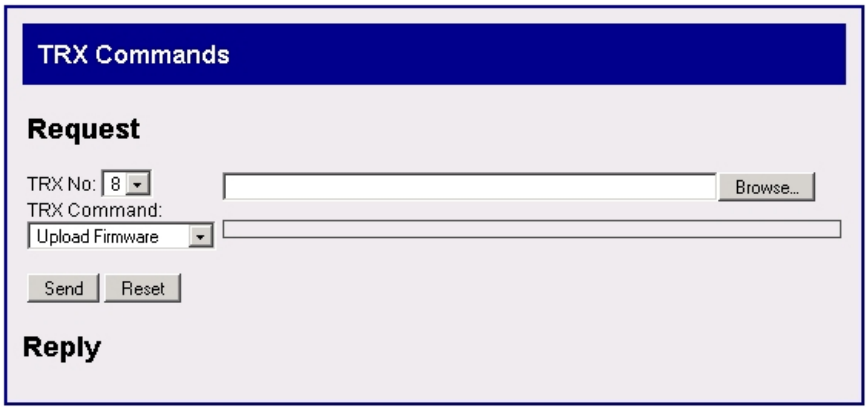
There are four commands available in this window.



Upload Firmware

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

1. Click on the TRX No: drop-down menu and select the TRX number you wish to communicate with.
2. Click on the TRX Command: drop-down menu and select Upload Firmware.
3. Click on the 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

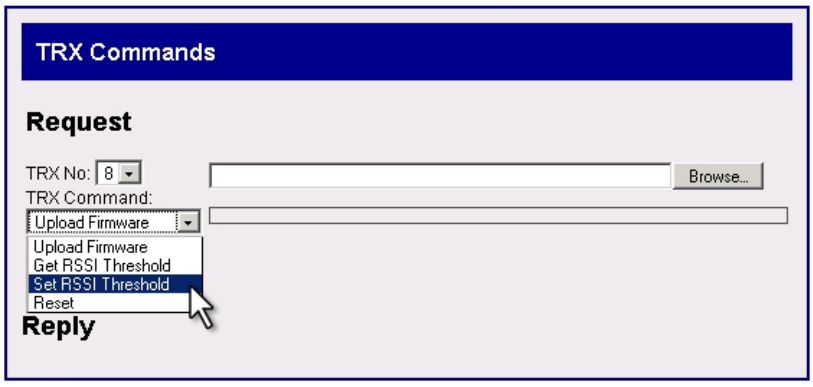
1. Select Get RSSI Threshold from the TRX Command: drop-down menu.
2. Click Send.

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

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 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, the RSSI threshold value will revert back to the hexadecimal default value of 0x12.

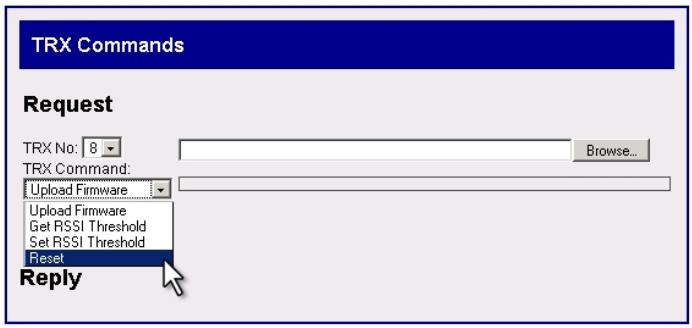


1. Select **Set RSSI Threshold** from the **TRX Command**: drop-down menu.
2. Select the **TRX #** from the **TRX No:** drop-down menu.
3. Enter a hexadecimal value in the small text box above the Send button.
4. Click the **Send** button.

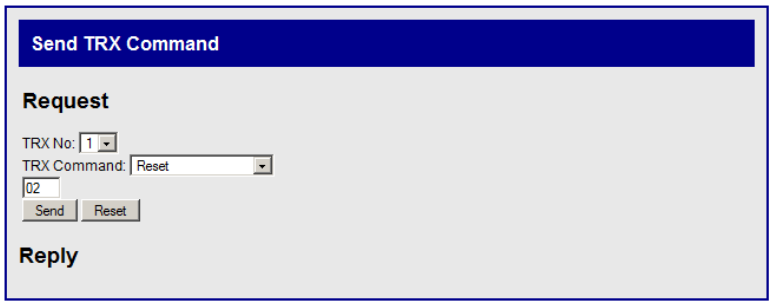
5. A successful operation is indicated by a blue colored **Command Completed** banner at the top of the screen and a text string "**OK**" below the word **Reply** at the bottom of the screen.

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.

TRX RSSI History

This option allows the user to sample how well the TRXs 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 enabled TRXs connected to the CLC. The TRXs will average the received signals from all of the implants it is communicating with. It will then average the implant signals and report an average value for each graph.

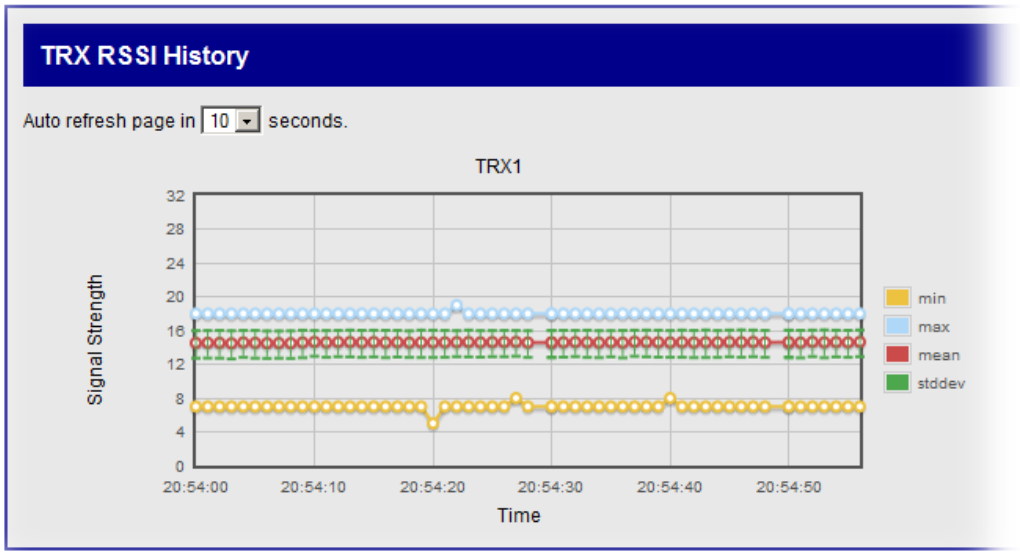
Follow this procedure to utilize the **TRX RSSI History** option:

1. Click on the **Settings** link under the **CLC Options** heading.
2. In the text box to the right of the words **RF Mode**, delete the word “**Enabled**”
3. Type the word “**Assessment**” in the text box and press click the **Save** button below.
4. Using the mouse cursor, click on the link marked **TRX RSSI History**.

5. This will open the RSSI graph screen.

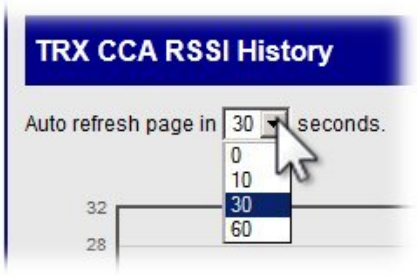
   Warning! When you are finished with the TRX RSSI History function you MUST return the CLC to the "Enabled" mode!

6. Click on the **Settings** link under the **CLC Options** heading.
7. Return to the text box delete the word "**Assessment**"
8. Type the word "**Enabled**" in the text box and press click the **Save** button below.
9. Verify the CLC status by Home link under the under the CLC options heading.
10. The **Operating Mode:** line item in the center of the screen should read **Enabled**, if it does not, repeat steps 6-9 above.



Graphical representation of the average strength of the signals received from 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.

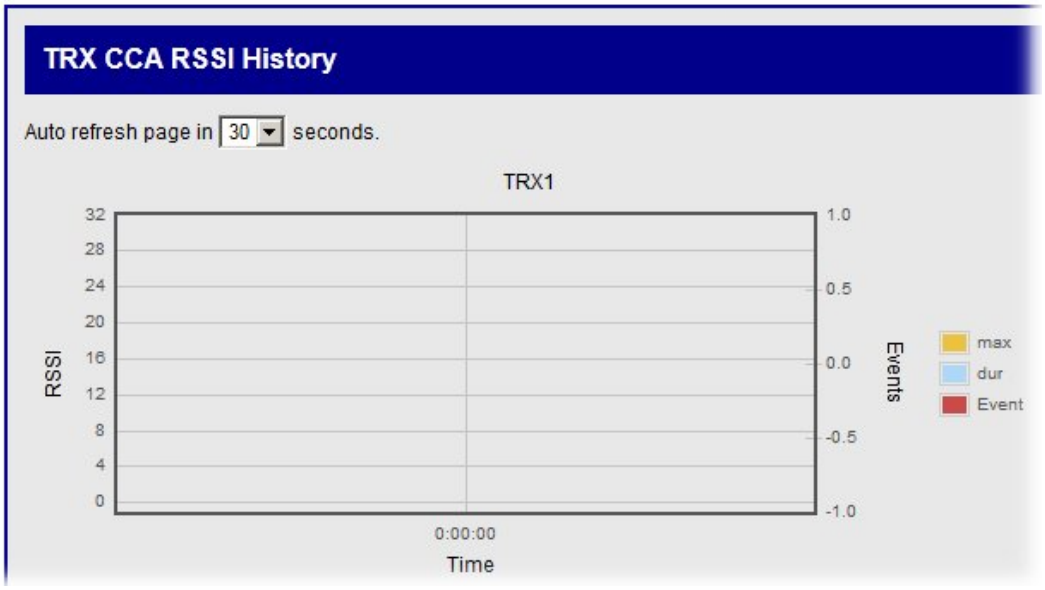


TRX CCA RSSI History

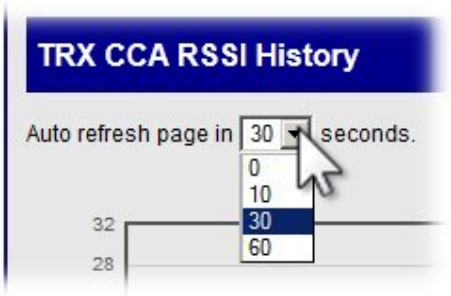
CCA is an acronym for Clear Channel Assessment. According to certain RF regulation environments, it is necessary to invoke a "listen before you talk" policy. The Clear Channel Assessment operation determines whether the wireless medium is busy or idle. The CLC can then make a decision on whether to attempt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

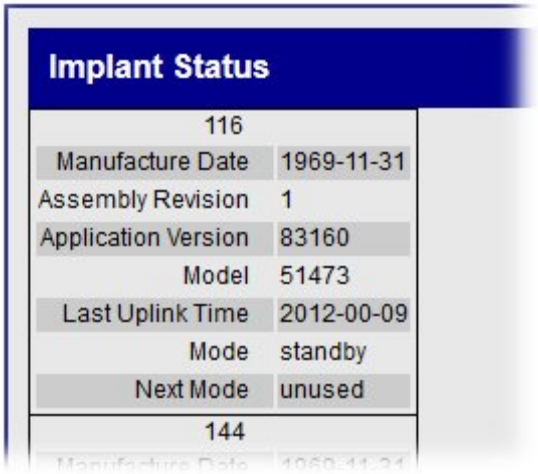


Implant Options

In this document the term “implant” refers to a PhysioTel Digital Telemetry Transmitter.

Implant Status

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



There will be one eight-row table for each implant. The content of the rows is as follows:

Serial Number	
Manufacture Date	YYYY-MM-DD
Assembly Revision	
Application Version	
Model	
Last Uplink Time	YYYY-MM-DD
Mode	standby active unused
Next Mode	

Definitions:

- Last Uplink Time – The latest time that the CLC received an uplink from the implant.
- Mode Options:

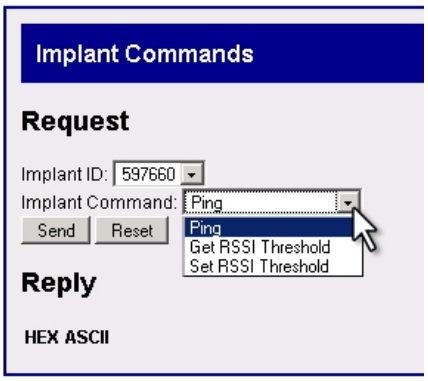
- Standby – not actively transmitting data
- Active – actively transmitting data
- Unused – configured but probably out of range

- Next Mode: (This feature is not yet implemented).

Implant Commands

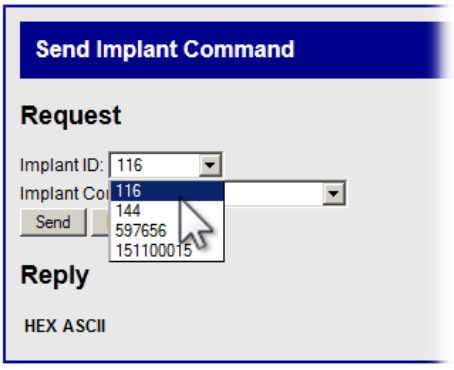
There are three commands with which the user can communicate with individual implants. They are Ping; Get RSSI Threshold; and Set RSSI Threshold.

- 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.



The "Ping" Command

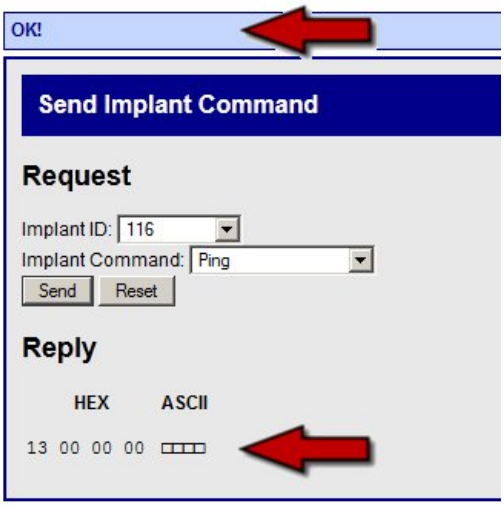
The Ping command allows the user to send a request to an individual implant to reply with a confirmation message that the implant is operating within range.



- Click on the drop-down menu labeled **Implant ID:**
- Select a device by left clicking on an implant serial number.

- Click on the drop-down menu labeled **Implant Command**.
- Left click the **Ping** command
- Click the **Send** button

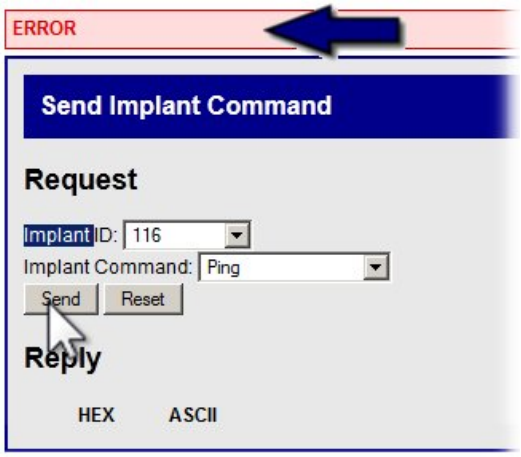
If the Ping dialog is successful:



- 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.

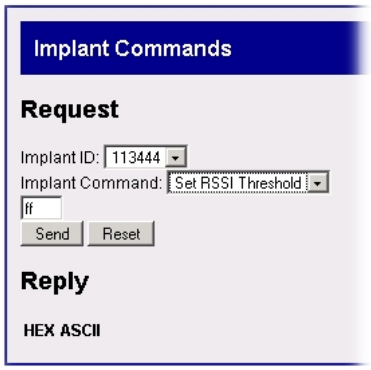
1. Click on the drop-down menu labeled **Implant ID:**
2. Select a device by left clicking on an implant serial number.
3. Click on the drop-down menu labeled **Implant Command**.
4. Left click the **Get RSSI Threshold** command.
5. Click the **Send** button
6. A successful operation is indicated by 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 TRX is receiving from the implants. 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 (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	RF performance
Increase	Decrease	Decrease	Increase
Decrease	Increase	Increase	Decrease

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.

Common Error Codes

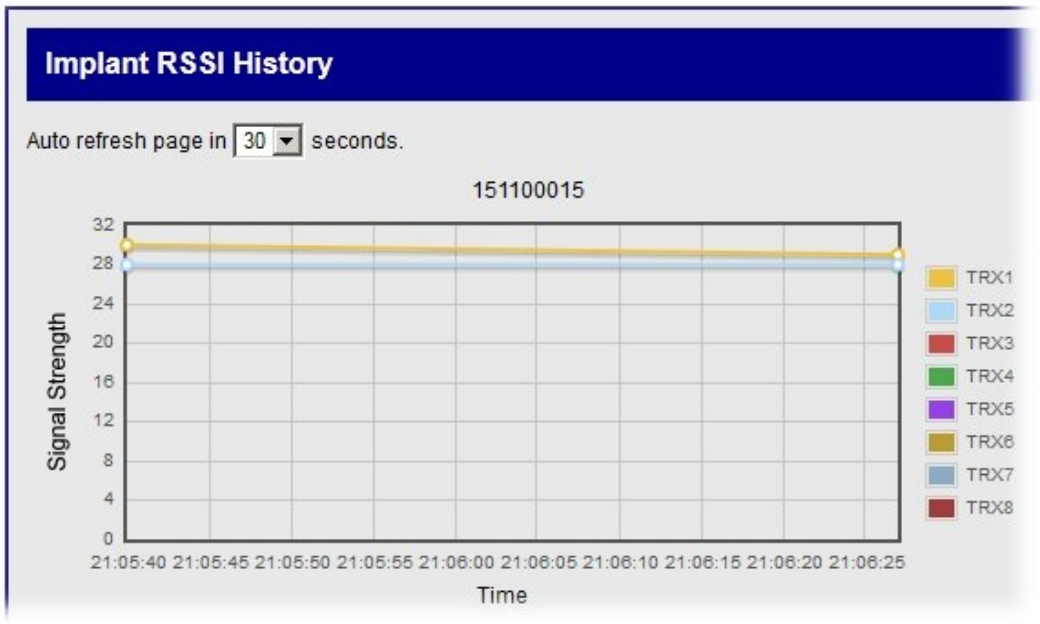
The implant commands in this section are capable of generating an error code if the command cannot be successfully executed. Below is a list of the more common error codes.

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

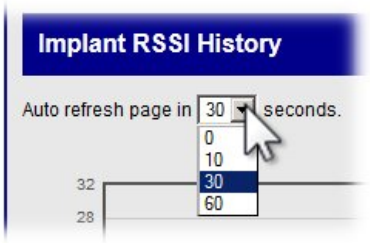
Implant RSSI History

Similar to the TRX RSSI History, the Implant RSSI History generates graphs in which the received signal strength from each of the implants 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 implant will report the received signal strength from each of the TRXs it is communicating with. The RSSI graph will display one data set for each of the TRXs.



- 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.



Glossary

1. CCA = Clear Channel Assessment: The clear channel assessment operation determines whether the wireless medium is busy or idle. The MAC layer can then make a decision on whether to send a frame.
2. CLC = Communication Link Controller: Processes telemetered data to/from the TRX for communications over the Ethernet connection.
3. Firmware: The combination of a hardware device and computer instructions and data that reside as read-only software on that device.
4. IP Address = Internet Protocol address is a numerical label assigned to each device participating in a computer network that uses the Internet Protocol for communication.
5. Listen Before Talk (LBT), or sometimes called Listen Before Transmit: A technique used in radio communications whereby a radio transmitter first senses, or surveys, the radio environment before it starts a transmission.
6. MAC Address = Media Access Control Address: A unique identifier assigned to network interfaces for communications on the physical network segment.
7. RSSI = Received Signal Strength Indicator (or Indication): A signal or circuit that indicates the strength of the incoming (received) signal in a receiver.
8. TRX = Transceiver: Component that receives Radio-Frequency signals and converts it into digital form that is sent, via cable, to the Communication Link Controller; additionally, the component that transmits Radio-Frequency signals converted from digital form sent via cable, from the Communication Link Controller.

Appendices

Appendix A: 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