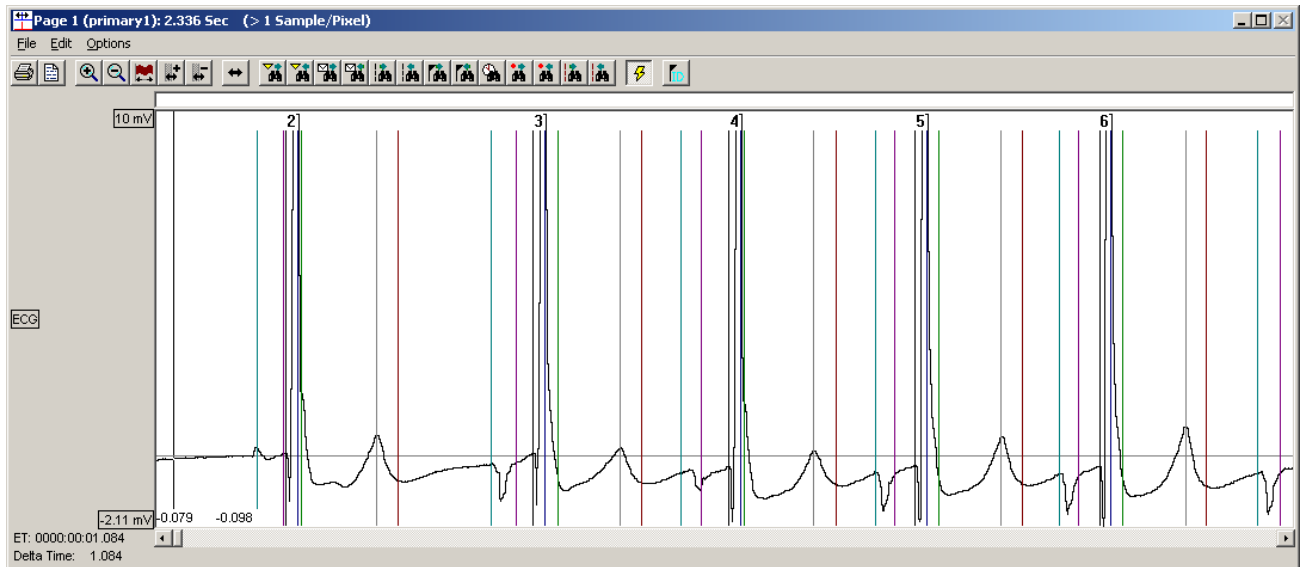


# Template Analysis Manual

Model: PNM-010-TMPLTE, PNM-110-TMPLTE, and PNM-210-TMPLTE  
Manual: MU00279-001  
Revision 52





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# Overview

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## Introduction

The purpose of **Template Analysis** is to allow users to accurately place the location of validation marks for a small number of cycles to create templates. Template analysis uses these templates to compare like regions of ECG signals within the data set and updates the marks on matched cycles. Template analysis is a **Review** only feature, and uses template enabled analysis modules.

The templates created are saved in the Template Library, a collection of templates specific to one type of signal from a test subject (e.g. a specific ECG lead).

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## Terminology

**Template enabled Analysis module:** An analysis module that supports Template analysis.

**Template:** A cycle with accurately placed marks that is stored in a Template Library.

**Template Library:** File in which Templates and Signatures are stored. Template Libraries may contain Templates from different RAW files.

**Match Region:** Regions of the Template that will be used to assess similarity between a Template and data cycles.

**Minimum Match:** User specified Degree of Match that must be attained for a match to be accepted.

**Template Graph Page:** A graph page that is used to display and manage Templates. The contents of a single template library are displayed.

**Template Enabled Graph Page:** This is the Primary graph page that contains one or more channels that are associated with the Template Library.

**Template Enabled Channel:** This is a Review Channel that is associated with a Template Enabled Analysis Module and a valid Template Library.

**Binding:** In order to use Templates, a Channel must be associated with (bound to) a Template Library. Additionally, the sample rate used to collect the data in the Template Library must match the sample rate of the data being analyzed by that library.

**Batch Template Analysis:** This will allow the user to perform analysis across all channels with a valid library binding.



# Template Setup

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## Template Setup

In order to use Template Analysis the user must have the appropriate analysis module to support Templates. The channels with Template enabled analysis modules may be viewed in the PPP3 Setup dialog as described below.

Each channel to be analyzed using Templates must be associated with a template library. Select **P3 Setup** from the **Setup** menu. Select the **Template Setup** configuration.

### Input

The input channel.

### Analysis

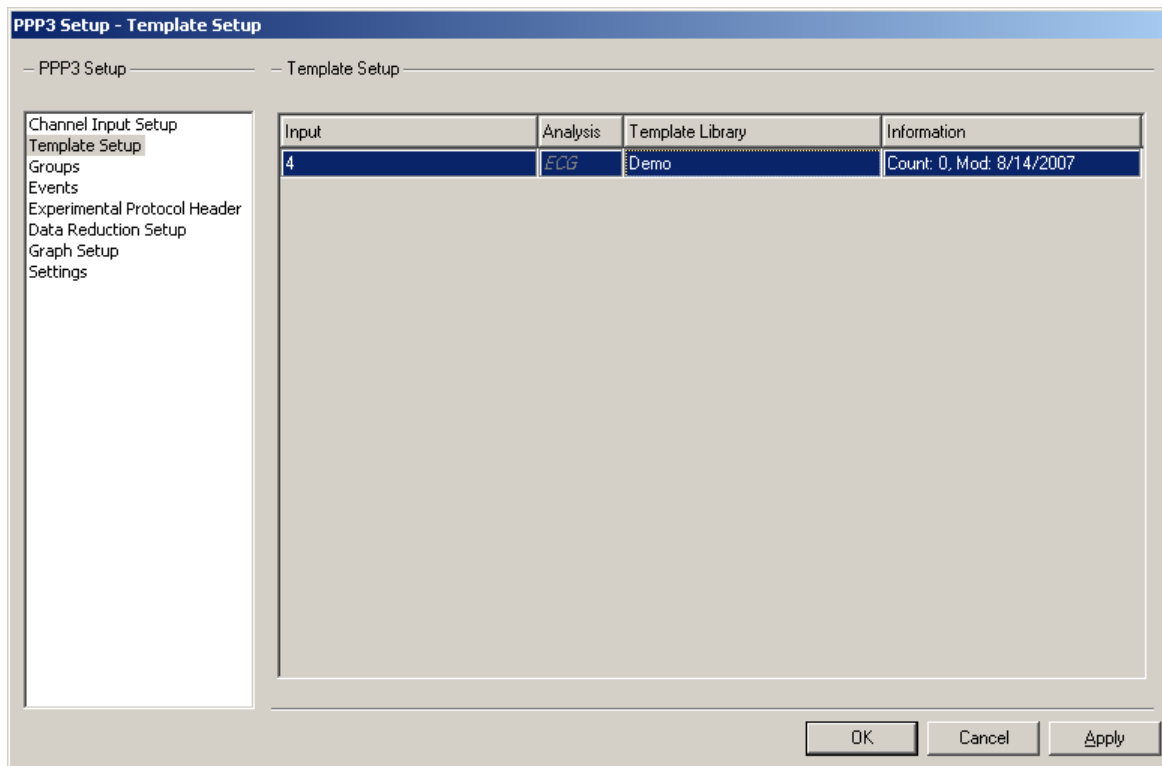
The analysis module associated with the channel.

### Template Library

Clicking on this field permits selection of a new or an existing Template Library.

### Information

This lists the number of Templates in the Template Library (Count) and the date it was last modified.

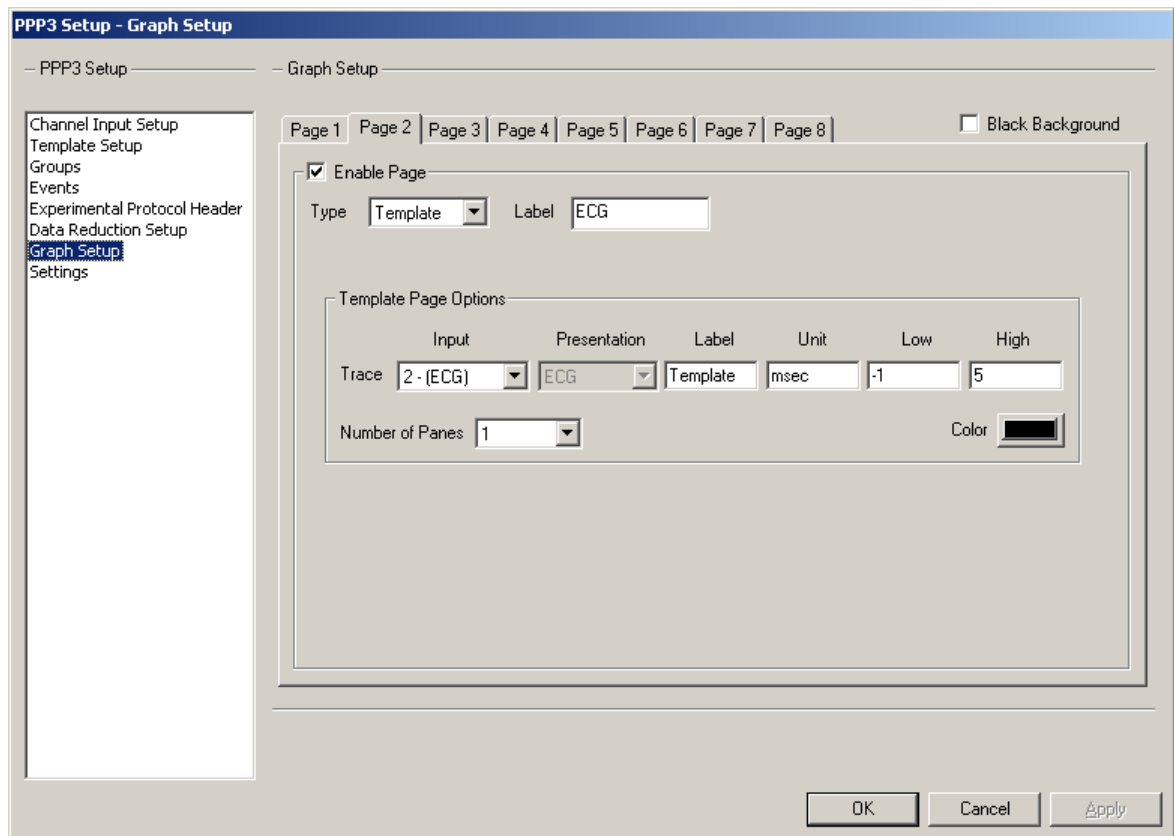




# Template Graph Page

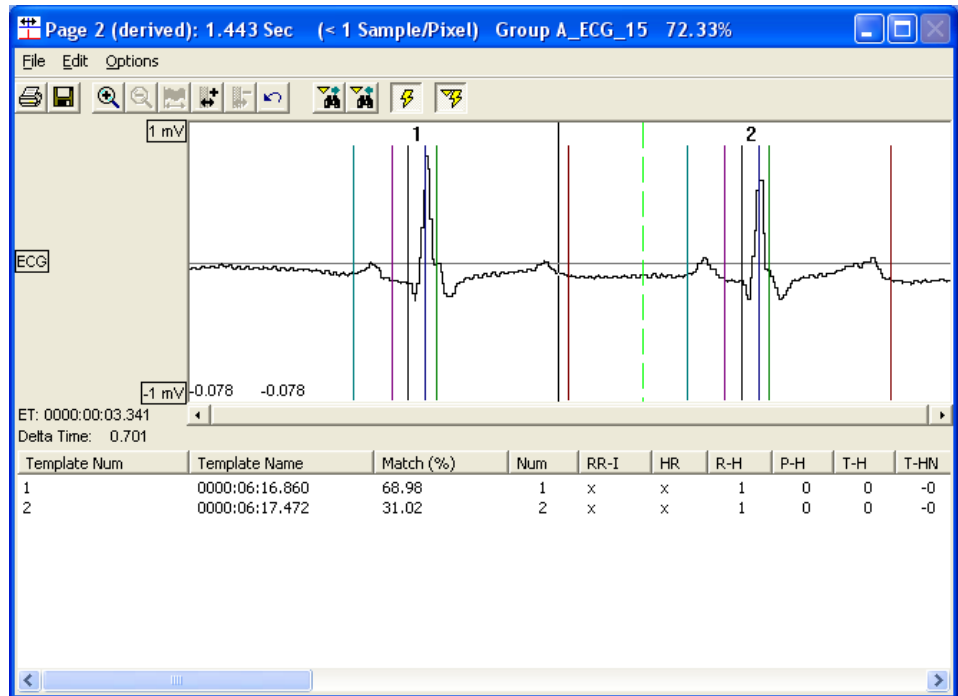
## Setup

In the **Setup** dialog select the **Graph Setup** configuration. Select an unused graph page and select **Template** as the **Type**. The **Input** drop down list box contains the Template enabled channels. Selecting an input will update the Label and Unit fields with the channels current settings. Type in a **Label**, and the **Low** and **High** values required for the graph page.



The following shows an example of a Template Graph Page. In the information list view, each Template has:

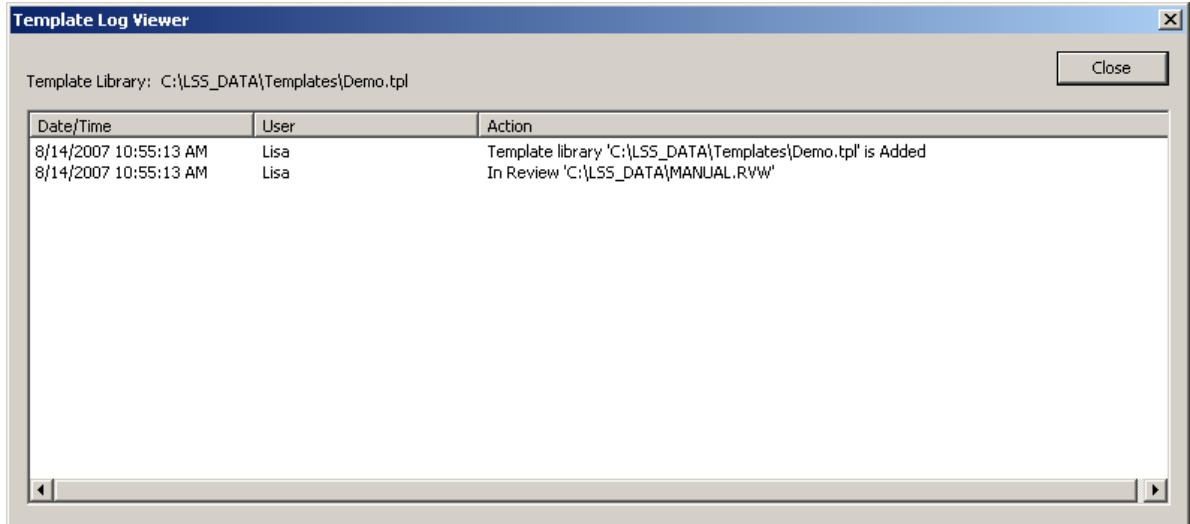
- Template Number
- Template Name (currently listed as the time acquired, can be changed by right clicking on the wave form and selecting **Rename**)
- Match (%)
- The remaining columns are for derived data specific to the associated analysis module



Note: When using Template Analysis, it is not necessary to assign a Template Graph Page (from Graph Setup) for each signal. A single page may be set up and used for multiple channels. After the Template page has been configured and saved for the first animal, access the Template Graph page from the Graph Setup menu and select the next Input channel. This will refresh the current Template Graph page and remove the previous waveforms. This will not remove the waveforms saved in the Template Library for the channel. Repeat this process for all signals. When analyzing data, the software will use the Templates stored in Template library which are associated with the channel that is being analyzed.

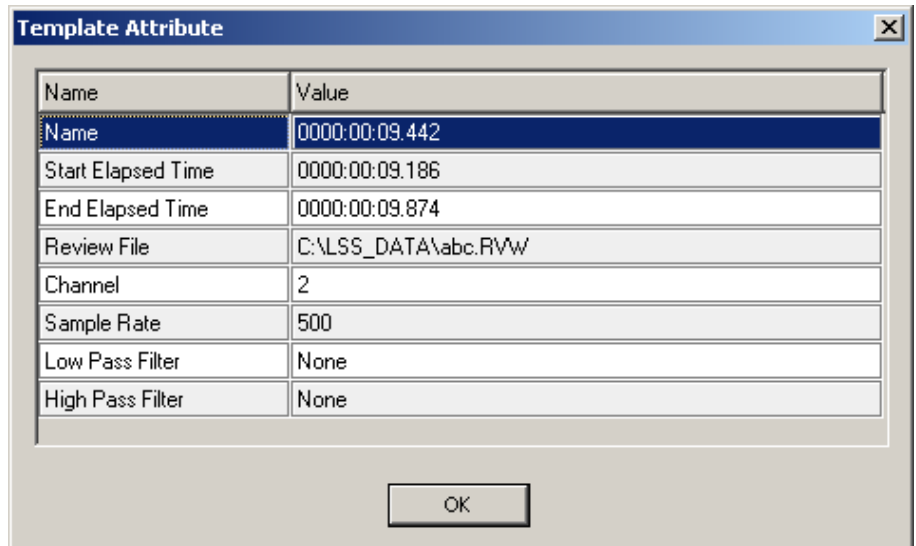
## Template Log Viewer

In the Template Page the user can view the Template Log by selecting **View Logs** from the **File** menu. This lists actions related to the current Template Library.



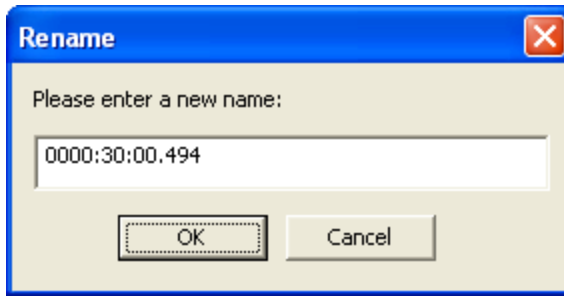
## Template Attributes

The Template Attributes window lists all attributes for a particular Template. This function is useful when using Templates on multiple analyses to view where the template originated from. To view Template Attributes select a Template, right click and select **Attributes**. A dialog similar to the one below will appear.



## Renaming Template

To Rename a Template select a template, right click and select **Rename**. A dialog similar to the one below will appear.



# Template Analysis

---

## Analysis Setup

Right mouse click on the **Primary Graph Page** and select **Analyze [Entire Library]**. The **Template Analysis** dialog will appear, shown below. In this example we have selected the T Wave as the match region for analysis with a Minimum Match of 85%. This means that if the T Region does not match with at least 85% confidence, the cycle will be marked as unmatched. Select a **Match Region, Data Range, Cycles to Analyze**, and **Match Method**. If needed, change the advanced settings for the desired match region.

If performing a Batch Template Analysis (analysis across multiple channels at once), select this option by accessing the Functions menu from the main Ponemah window (not the graph page).

**Template Analysis**

Match Region

Name	Minimum Match (%)	
<input type="checkbox"/> P Wave	85	Advanced...
<input type="checkbox"/> Q Wave	85	Advanced...
<input type="checkbox"/> S Wave	85	Advanced...
<input checked="" type="checkbox"/> T Wave	85	Advanced...

Data Range

Visible region in the graph page  
 Region from the left edge of the graph page to the end of the data  
 Data in Parser Segments  
 The entire channel

Cycles To Analyze

All  
 Unmatched

Match Method

Whole Cycle  
 Region

Species

Dog (Set in P3 Setup : Group)

OK Cancel

## Match Region

Regions of the Template that will be used to assess similarity between a Template and data cycles.

## Data Range

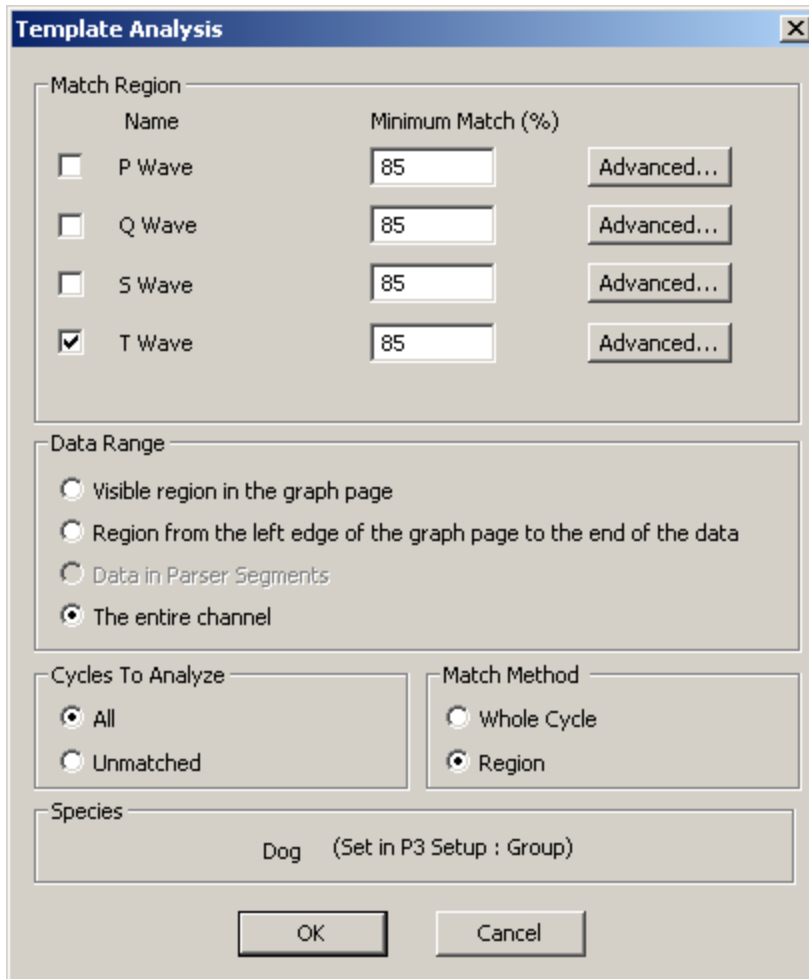
Specifies the data over which the analysis should be performed.

## Cycles to Analyze

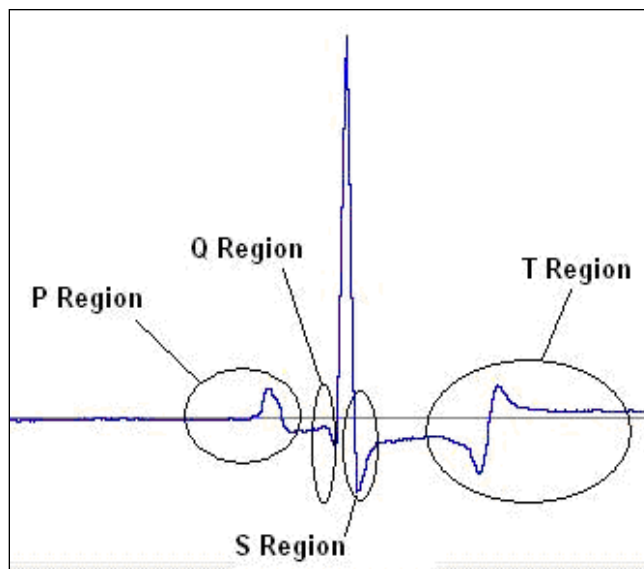
May either be all cycles or only Unmatched cycles.

## Match Method

When multiple Match Regions are selected, if Whole Cycle is chosen, the Template Cycle that, on average, matches the cycle best will be used. When Region is used, the best match for each match region will be used, possibly from different templates.

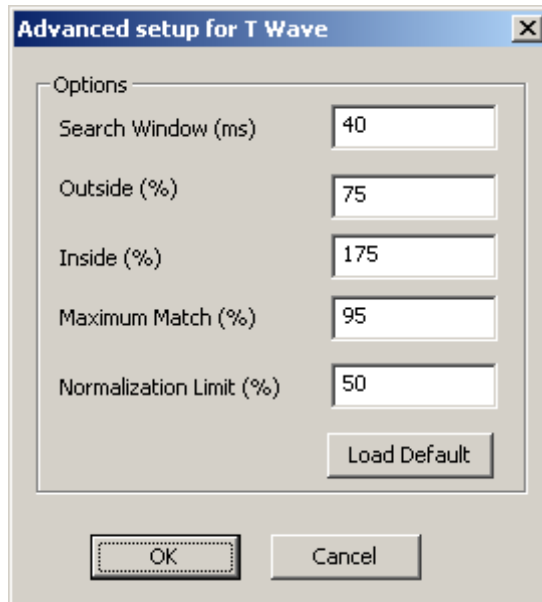


For the different match regions please refer to the image below:



## Advanced Setup

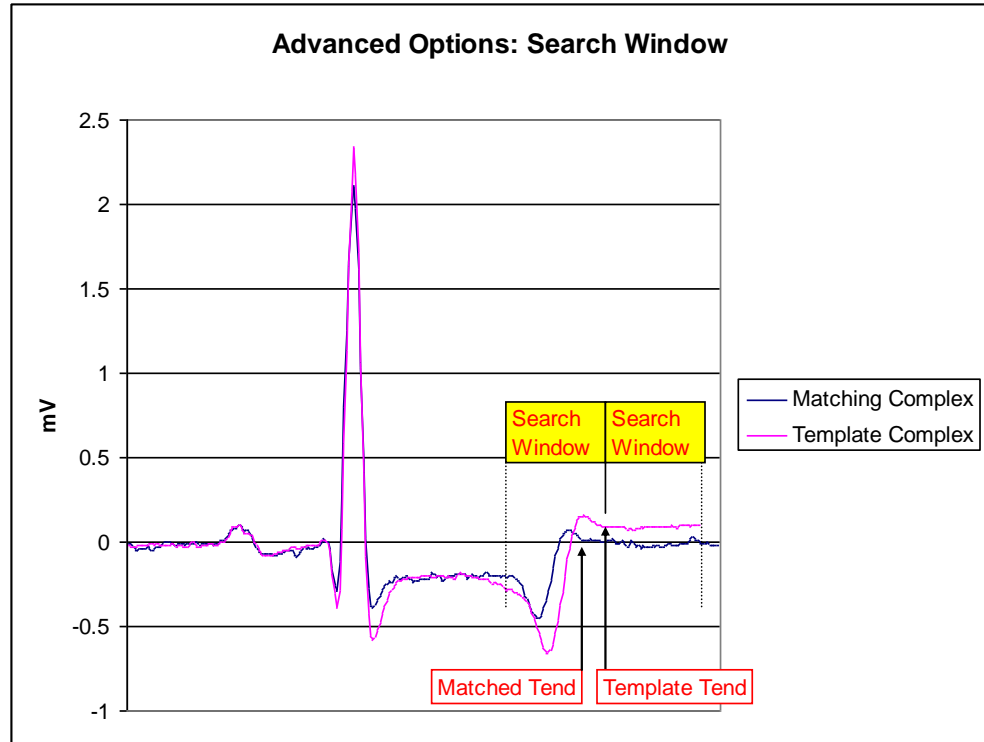
From the **Template Analysis** dialog select the **Advanced** button for a specific Match Region. The dialog is shown below. It is unlikely that users will need to modify the Advanced settings.



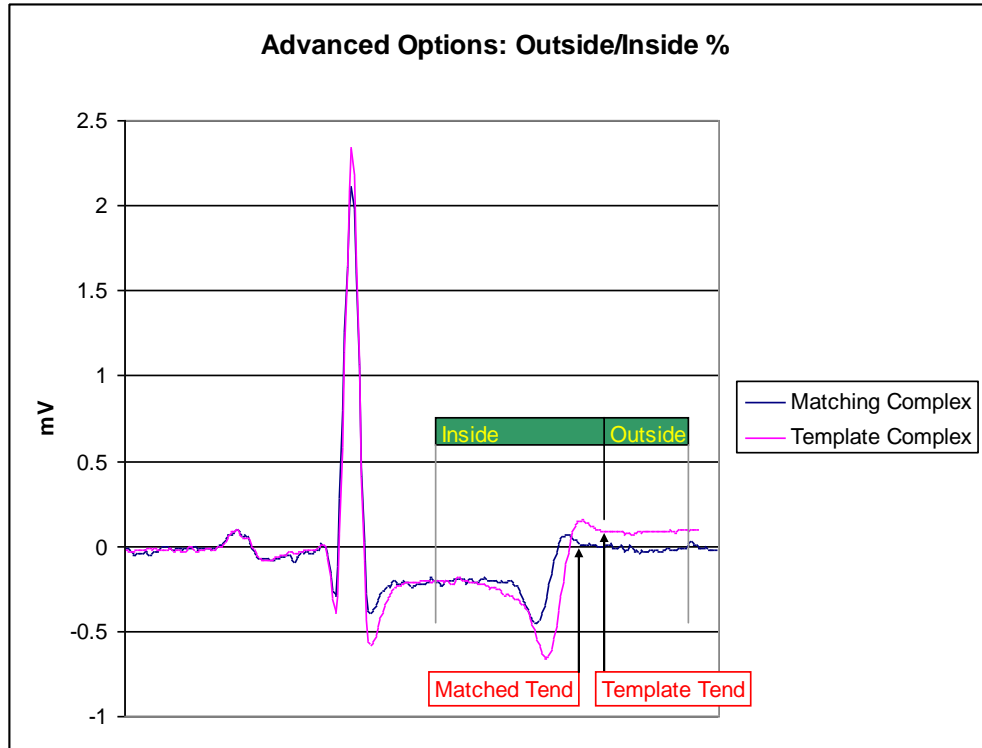
The available options are:

- **Search Window** - Template analysis will search for the best match for a Match Region, being P, Q, S, or T over the range of data specified by the Search Window. Each region has a specific mark that the search window is centered around. The example below displays the search window for Tend. The 40 millisecond window, displayed in yellow below, is applied to the Tend data from the template to locate a match within the unmatched data that is being analyzed. Below are graphical representations of a template and data that is being analyzed.





- Inside and Outside %** - Specifies the range of template data for the selected region used in the comparison. Once a candidate complex has been located, the template analysis will search the specified percentage on each side of the mark. In the case below the **Outside %** follows the mark and the **Inside %** precedes the mark. Displayed below is the range for the Tend windows.



**Further explanation of Inside and Outside percentages:**

The Inside and Outside percentages relate to how much data around a mark is used for matching purposes. The specifics for each mark follow:

**P Wave**

The percentages relate to the region between the **P Start** and **P End**.

When matching against the **P Start mark**, an inside % of 80% and outside % of 35% corresponds to:

**Inside time** = 80% of the time between P start and P end

**Outside time** = 35% of the time between P start and P end

**Inside time is to the right** of the P start mark

**Outside time to the left** of the P start mark

When matching against the **P End** mark, an inside % of 80% and outside % of 35% corresponds to:

**Inside time** = 80% of the time between P start and P end

**Outside time** = 35% of the time between P start and P end

**Inside time is to the left** of the P end mark

**Outside time to the right** of the P end mark

**Q Wave**

The percentages relate to the region between the **Q mark** and the **R mark**.

An inside % of 120% and outside % of 30% corresponds to:

**Inside time** = 120% of the time between Q and R

**Outside time** = 30% of the time between Q and R

**Inside time is to the right** of the Q mark (this will extend past the R mark)

**Outside time to the left** of the Q mark

Similarly for the S and T marks, where

For the S mark, the region is between the **S end and the R** mark

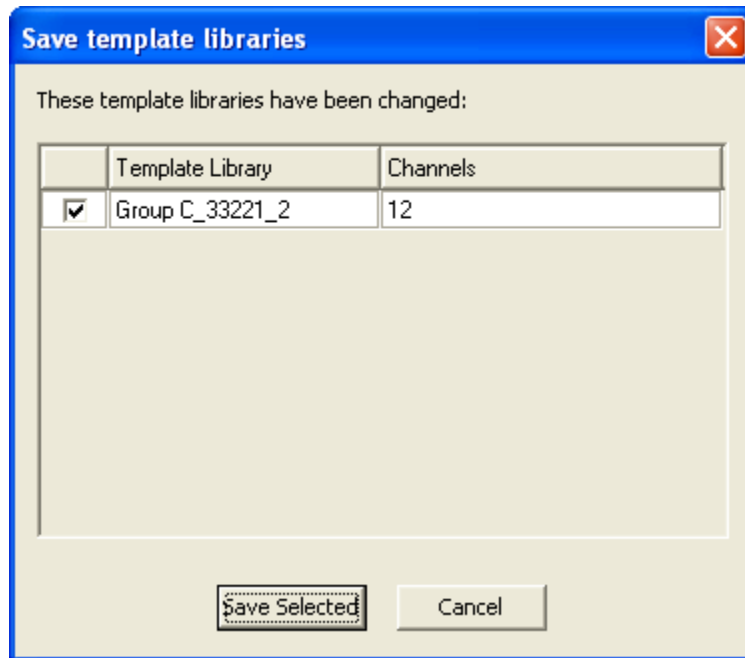
For T marks, the region is between the **T peak and T end** marks

- **Maximum Match (%)** - Once a template matches the data at or above the maximum match, no further match attempts are made for the cycle.
- **Normalization Limit (%)** - is used to control how much of a change in amplitude between a template and data will still be regarded as a match. If a user is interested in amplitude changes this parameter should be kept small.

The **Load Default** button will add the species specific default values.

## Saving Template Library

Template Libraries are saved through Templates: Save.



## Parser Segments

There may be value to setting up regular Parser Segments when working with large (24 hour or more) data sets. This can be used to focus on a representative subset of the data while setting up the Template Library. When the Template Library is complete the entire data set can be analyzed using the Template Library. This can speed up the Analysis process significantly.

## Batch Template Analysis

Batch Template Analysis can be applied to the entire data set or across the defined Parser Segments of the data set. From **Functions** within a review file select **Batch Template Analysis**. Once started, Batch Template analysis will analyze all valid channels without requiring any user interaction, and is capable of being started immediately after the Review file has been loaded. Prior to starting a Template Batch Analysis, the user has the option of using each individual channel's Match Range settings or overriding all settings with global Match Range settings. The Data Range, Cycles to Analyze and Match Method will be selectable and applied globally to each channel, these settings will not use the settings saved within each channel. The settings override option, along with the global settings themselves, will be saved within the Review file.

# Tutorial

---

## Introduction

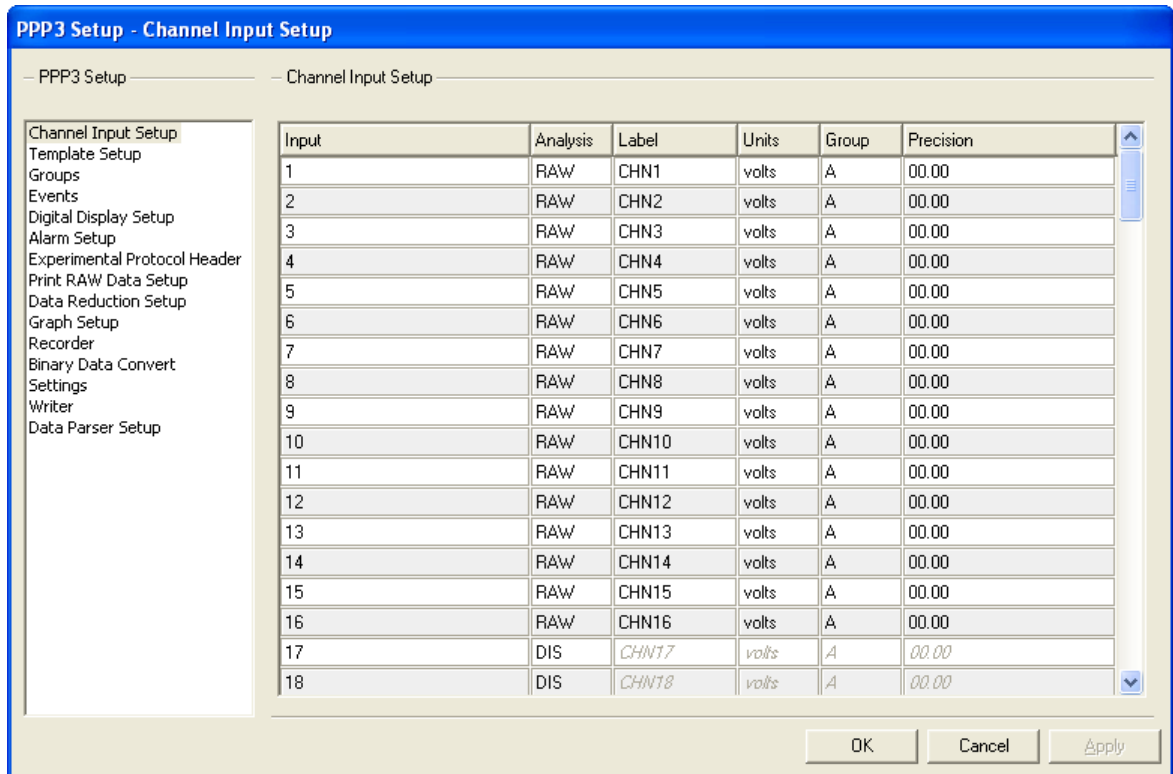
This tutorial will go through a general configuration and use of **Template Analysis**. Once P3 Plus is started, open the review file. In addition, the correct **Species** must be set in the **Groups** configuration. When opening older review files that do not have a species specified, the system will default to Dog.

### Parser Segments

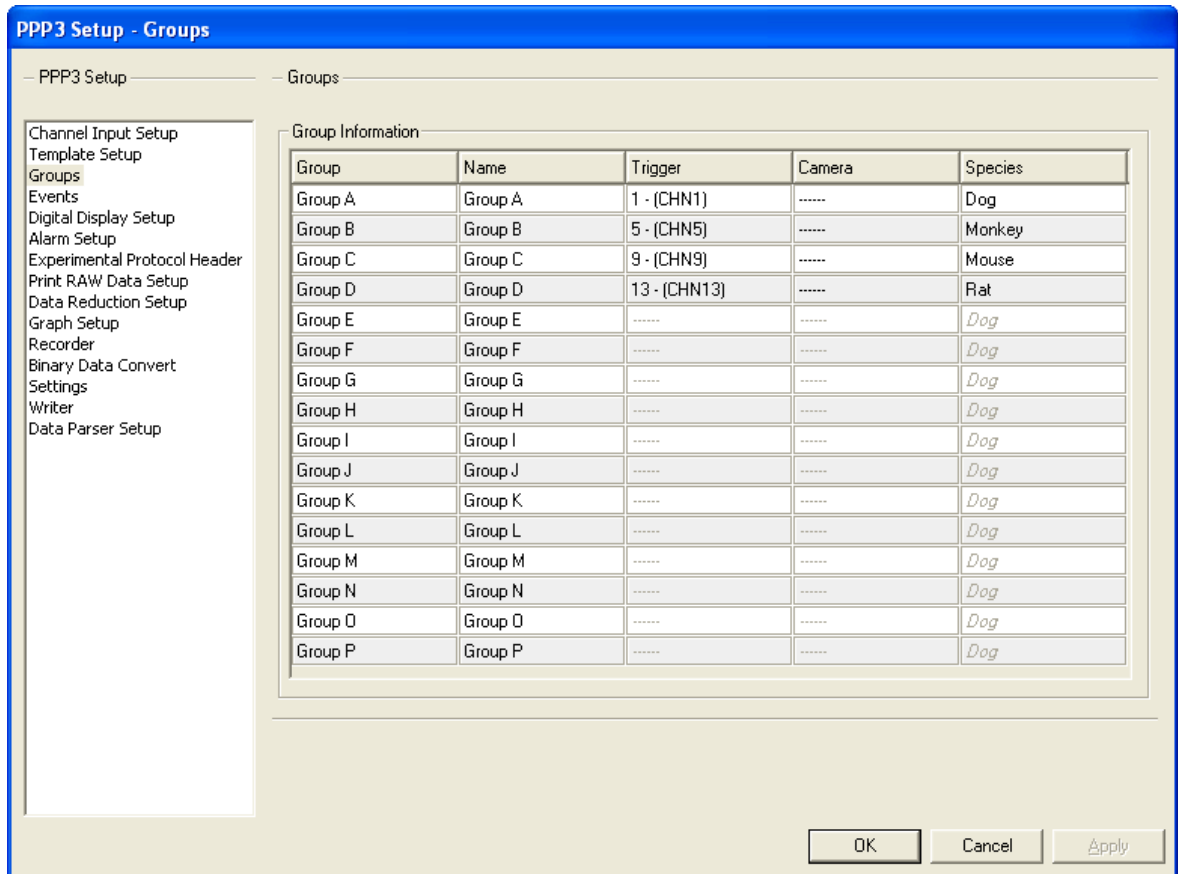
There may be value to setting up regular parser segments (i.e. 1 hour every 4 hours, when working with large 24 hour or more data sets). This can be used to focus on a representative subset of the data while setting up the Template Library. When the Template Library is complete, the entire data set can be analyzed using the Template Library. This can speed up the Analysis process significantly.

### Change Species

It is recommended to set the Species for each group. This will give the user typical values for some of the ECG attributes. Also, the default values for some of the attributes are set based on the Species used. To change the species, the user must open the **PPP3 Setup** dialog by selecting **P3 Setup** from the **Setup** menu. A dialog similar to the one below will be shown.



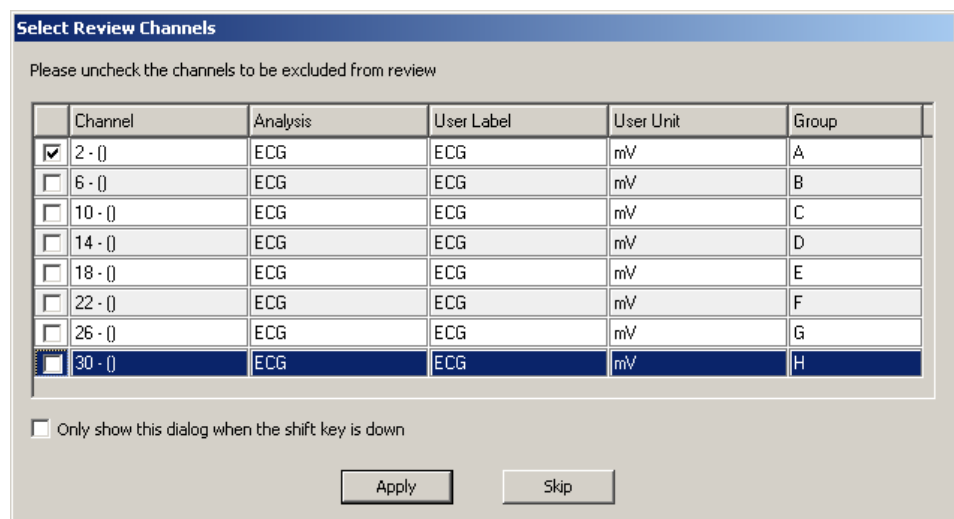
Then the user must configure the groups based on the channels that will be acquired. After that is done, select the **Groups** configuration. Each group can be configured for different species. The available species are: Dog, Monkey, Mouse, and Rat. The dialog below shows the species selections.



If the species that is being used is not listed, select one that has similar heart rate values.

## Initial Setup

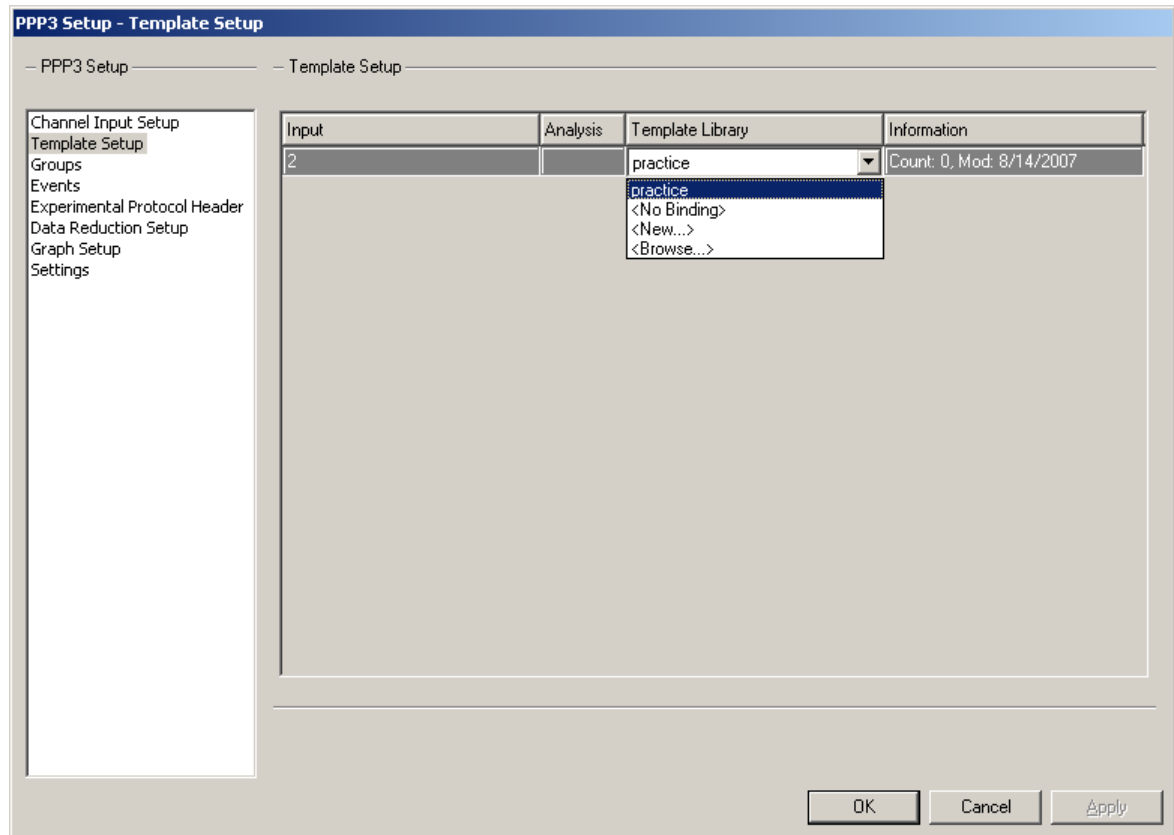
After opening the review file the **Select Review Channels** dialog box will automatically be displayed. Uncheck any channels to be excluded from review and then click on the **Apply** button.



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## Template Setup

From the **Setup** menu select **P3 Setup**. Select the **Template Setup** configuration and select a **Template Library**. The user can reselect the currently selected template library (if one was already configured), set it to **<No Binding>** which sets the review file to have no template library configured, create a new template library, or browse for an existing library.



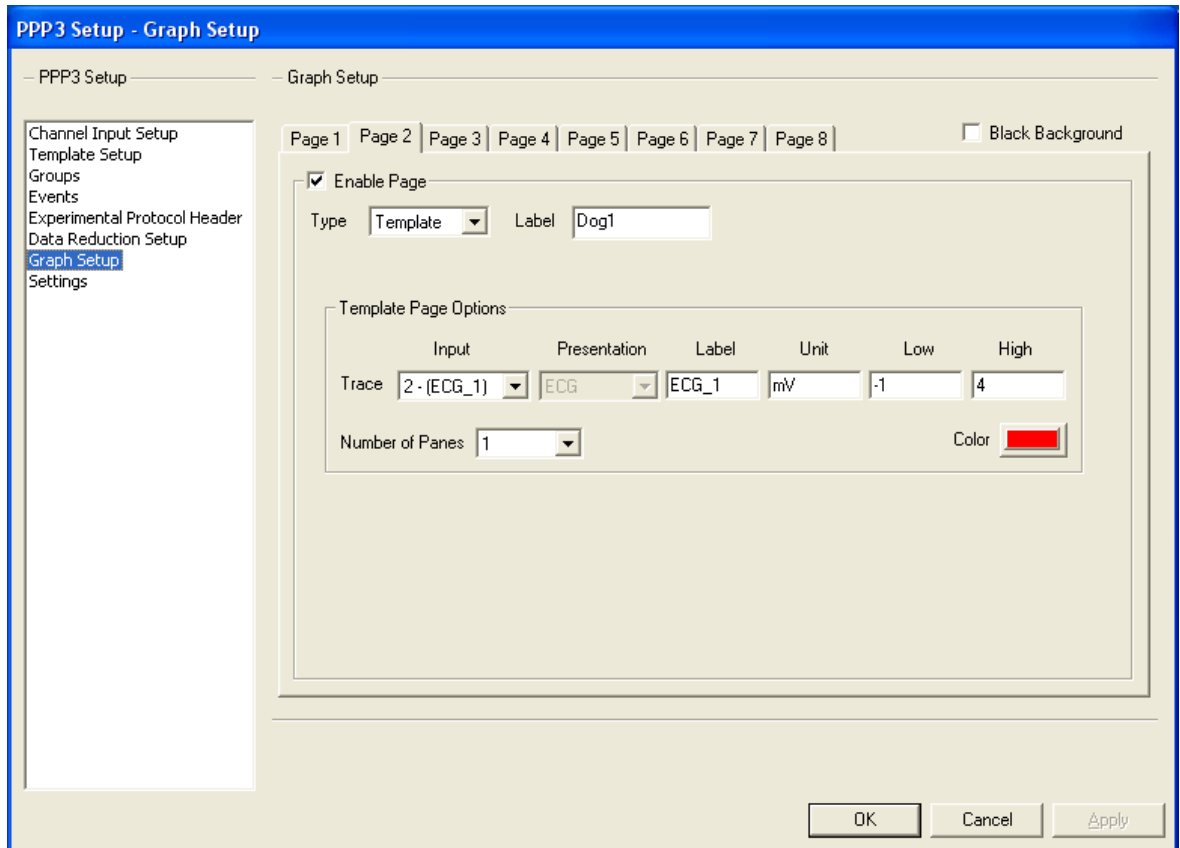
Note: The sample rate used to collect the data in the Template Library must match the sample rate of the data being analyzed by that library.

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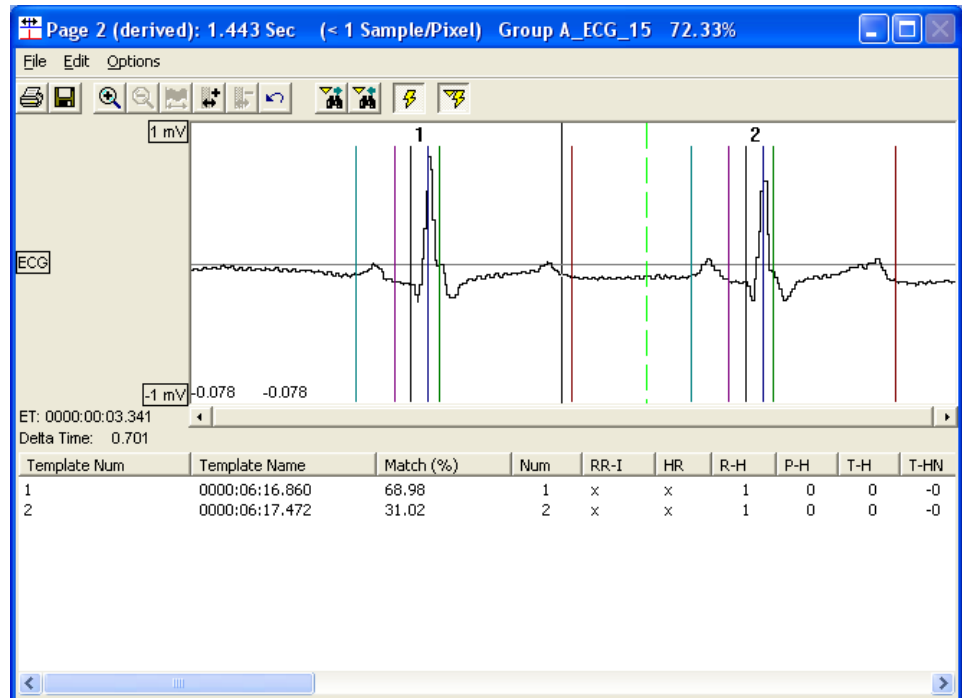
## Graph Setup

From the **Setup** menu select **P3 Setup**. Select the **Graph Setup** configuration. Select a page to use as a template graph page. Select the **Enable Page** check box. Select **Template** for the **Type**. **Input** should reflect the users channel selection. Type the appropriate information in the **Label**, **Unit**, **Low** and **High** text boxes. The user can also select a **Black Background** and trace **Color**. Select the **OK** button.





A graph page similar to the one below will appear.



---

# Menus and Toolbar

## Menus and Toolbar

### *From the Primary Graph Page*



### *From the Template Graph Page*



#### ***File: Print***



Prints the current graph page based on the current Review Print Setup. See printing.

#### ***File: ASCII Output***



This option brings up a dialog for the user to create ASCII Output based on the options selected.

#### ***Edit: Expand***



Expands the time span (X axis).

#### ***Edit: Compress***



Compresses the time span (X axis).

#### ***Edit: View Entire Data Set***



Scales the X axis to display all available data.

#### ***Edit: Snap Zoom In***



Use to expand the X axis to display the selected region. (Select icon and drag mouse to zoom in selection). When this is used on an XY-Loop or Scatter graph, it changes both the X and Y scaling.

#### ***Edit: Snap Zoom Out***



Use to compress the X axis to display the current X axis range in the area selected. (Select icon and drag mouse to zoom out selection). When this is used on an XY-Loop or Scatter graph, it changes both the X and Y scaling.



Will perform an undo of the last scaling applied to the graph page.

***Edit: Sync with Derived Data***



Syncs derived and data reduction list views with the current cursor position.

***Edit: Change - Search Right***



Searches for the next change marker in the selected channel.

***Edit: Change - Search Left***



Searches for the previous change marker in the selected channel.

***Edit: Note - Search Right***



Searches for next Note in the selected channel.

***Edit: Note - Search Left***



Searches for previous Note in the selected channel.

***Edit: Event - Search Right***



Searches for next Event in the selected channel.

***Edit: Event - Search Left***



Searches for previous Event in the selected channel.

***Edit: Parser Segment - Search Right***



Searches for the next Parser Segment.

***Edit: Parser Segment - Search Left***



Searches for the previous Parser Segment.

***Edit: Time - Search***



Searches for a specific time in the selected channel.

***Edit: Unmatched-Search Right***



Searches for the next unmatched cycle.

### ***Edit: Unmatched-Search Left***



Searches for the previous unmatched cycle.

### ***Edit: Bad Data Mark-Search Right***



Searches for the next bad data mark.

### ***Edit: Bad Data Mark-Search Left***



Searches for the previous bad data mark.

### ***Options: Draw Validation Marks***



Toggles the Validation Marks for all channels in the graph page.

### ***Options: Mark Differences***



Toggles the Mark differences on and off for all channels in the graph page

### ***Options: Draw Parser Segment Watermarks***

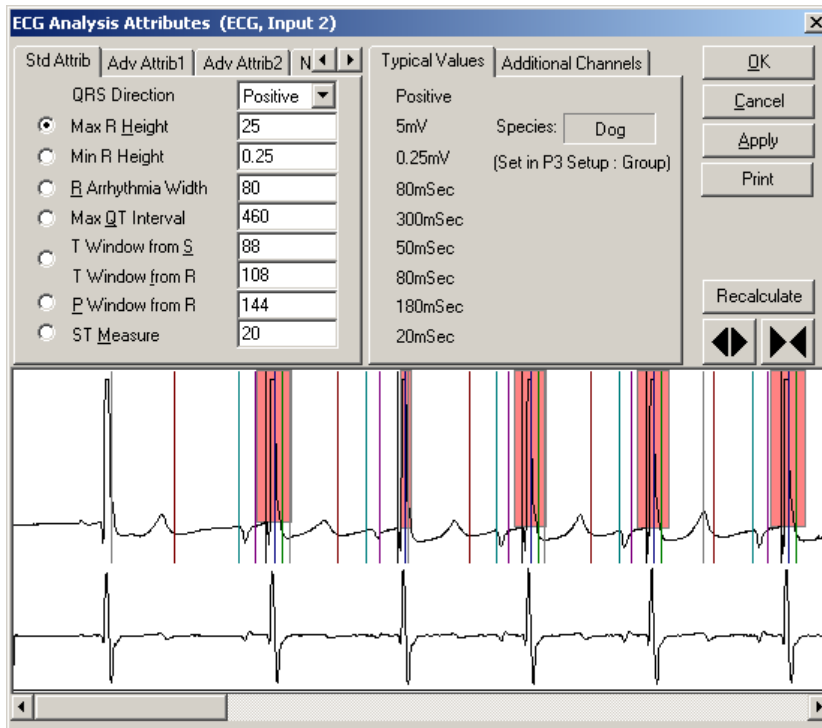


Toggles the Parser Segment Watermarks on the graph page.

---

## **Attribute Analysis**

Single click on the wave form within the primary graph, then right click, and select **Analyze [Attributes]**. Scroll through the tabs to view/change attributes.

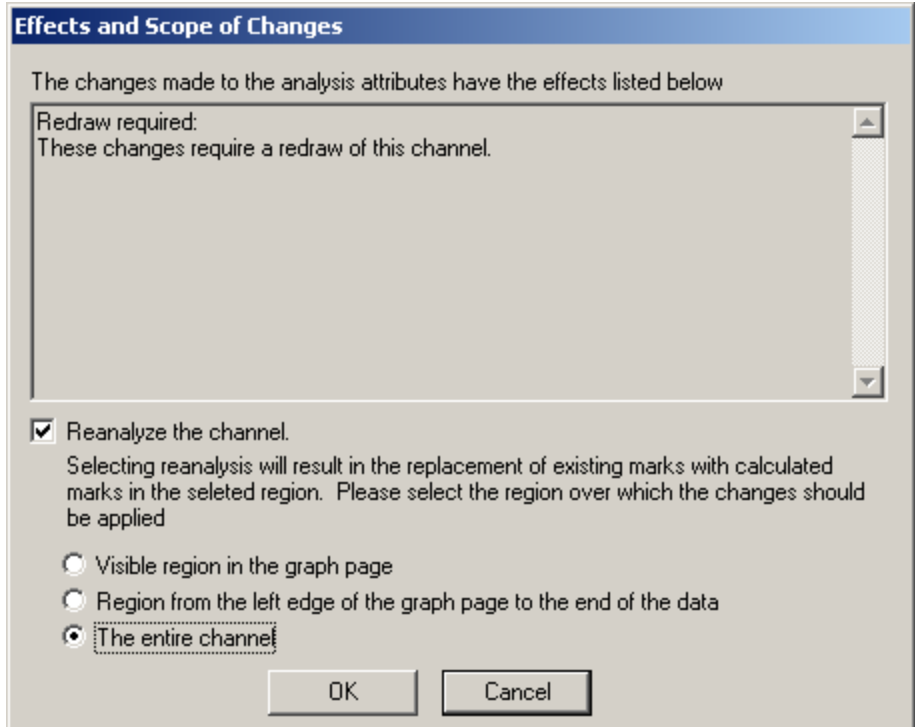


Configure the attributes required to analyze the regions of interest from the signal.

Note: In order for Template Analysis to be functional an **R Wave** must be identified via **Analysis Attributes**. Refer to the ECG section of the Analysis Modules Manual for guidance. The appropriate species must have been selected in the acquisition setup, prior to the data analysis.

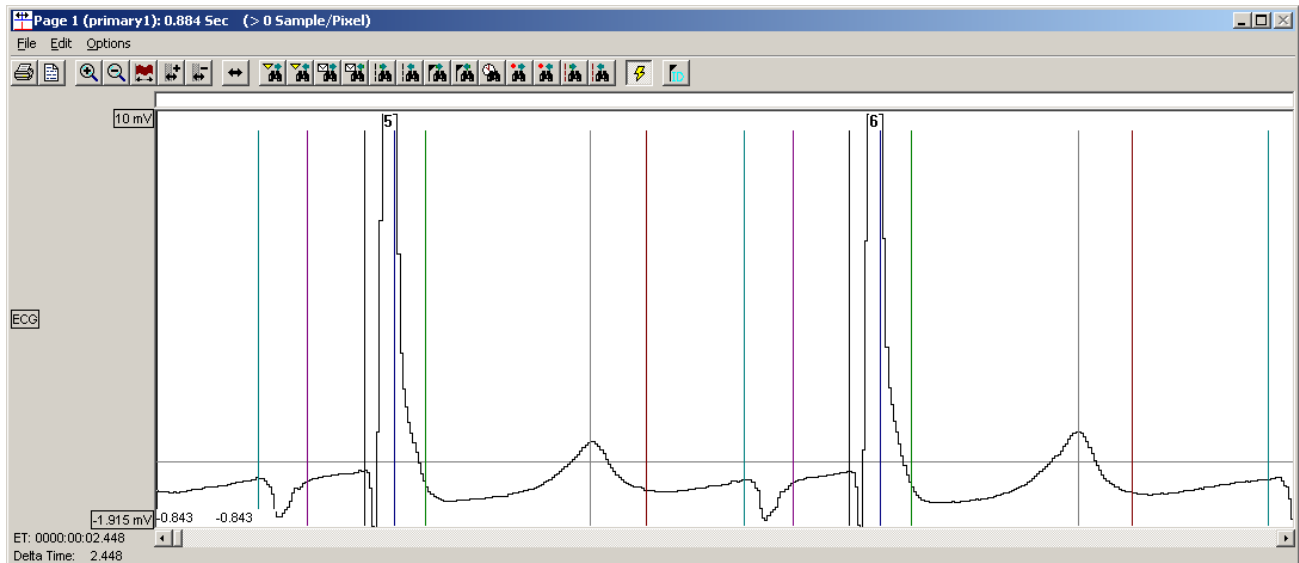
## Effect and Scope of Changes

After selecting **OK** the following dialog box will appear. Select **Reanalyze the channel** check box, select **The entire channel** and select the **OK** button. This will update the entire data set. This is only necessary if the data has not been previously analyzed. At a minimum, the R wave must be identified in order to utilize template analysis.



## Creating and adding a Template

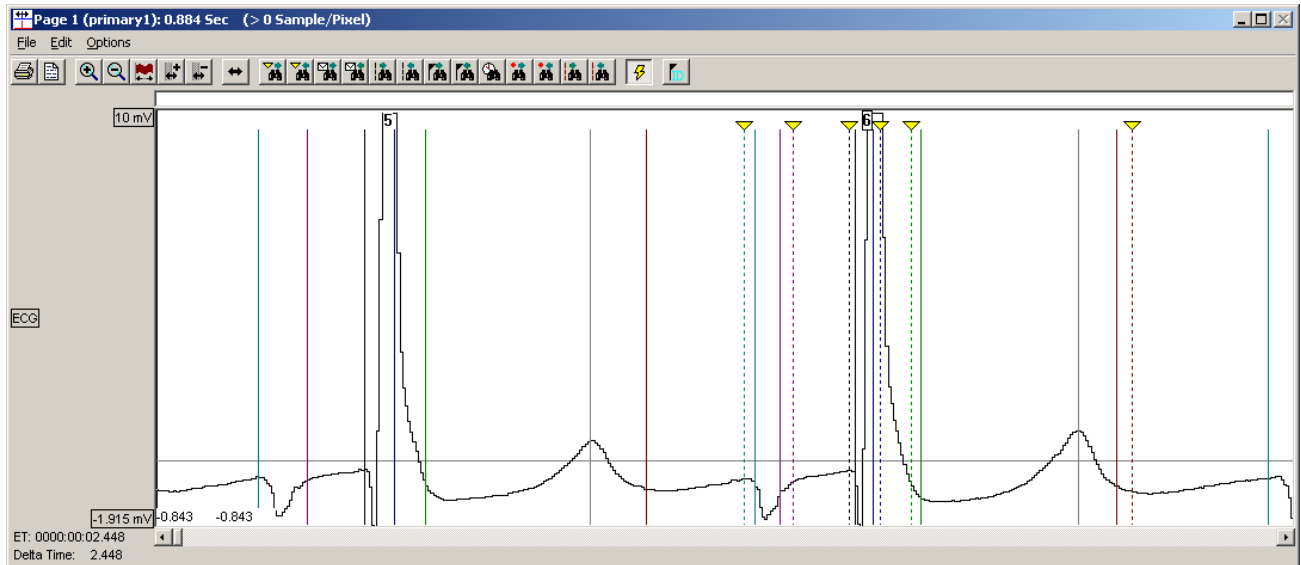
Select a wave form on the Primary Graph by left clicking the mouse to place the cursor on the desired complex. Solid vertical lines (Validation Marks) are the marks set up in the ECG Analysis Attributes. Hovering over the line will indicate what the line depicts (displayed in the lower left corner after Delta Time).



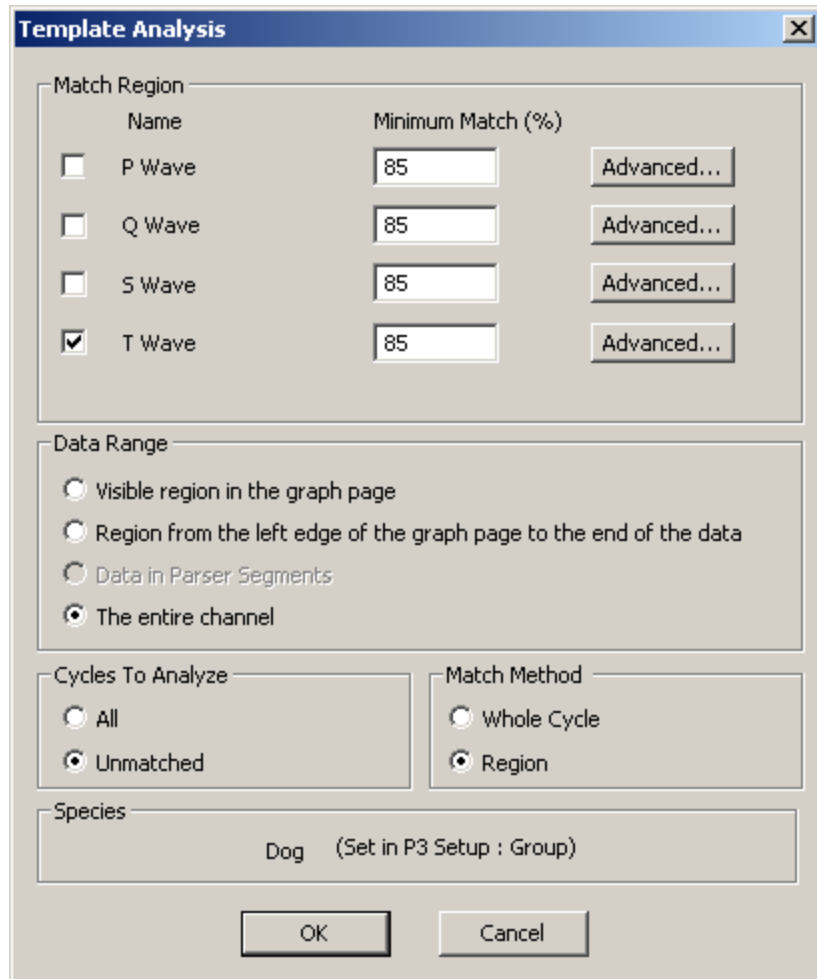
Adjust marks by clicking and dragging any marks to the appropriate locations. After the adjustments, the solid marks depict the new marks position and the dotted marks with yellow triangles represent the original marks position (See the Review Manual

for additional information on moving validation marks). Additionally, marks may be moved in the Template Graph page. Right mouse click on the cycle to be added to the template library and select **Add Template Cycle**.

Right mouse click again and select **Analyze [Entire Library]**.



Select the **Match Region** (for example, **T Wave**), select a **Data Range**, select a **Cycles To Analyze** option (suggest **Unmatched** for the first template, this will function the same as **All**), and select the desired **Match Method**. Click on the **OK** button.

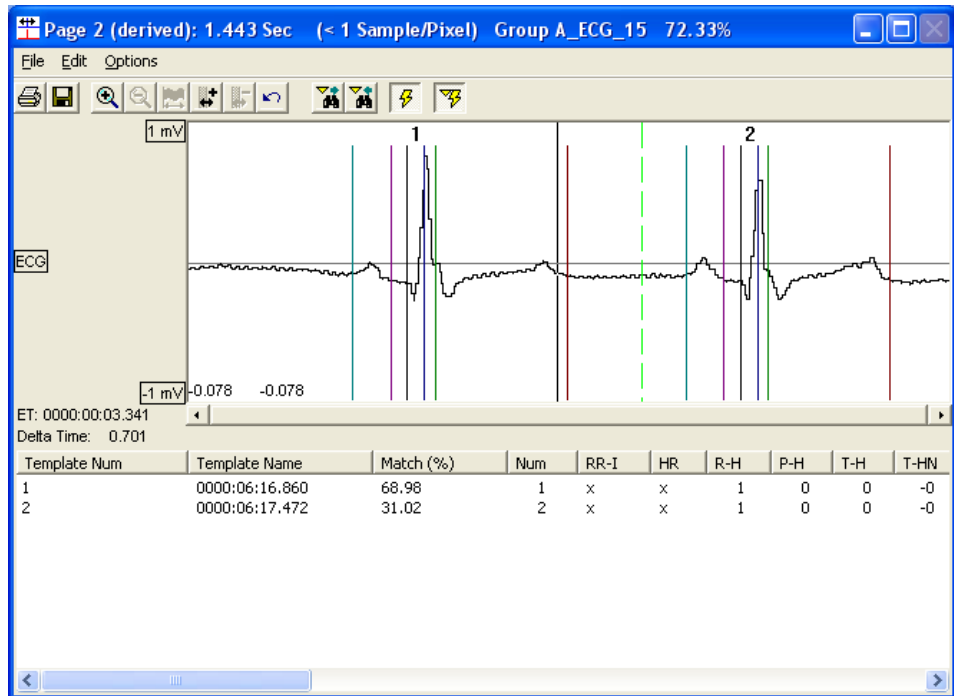


After the analysis is complete a percentage will appear in the Template Graph Page after the title (in the title bar). This indicates the percentage of wave forms that the template matched within the data set. Below the match was 70.38%. The *Match (%)* next to the Template Name in the Template Graph Page is the percent match of the Template within the matched cycles. The *Match %* will always add up to 100%. Both of these percentages will be updated as Templates are added and analyzed.

Note: When building a Template Library to match multiple regions.

- Focus on the T wave and build a library to match the desired percentage of T waves.
- Next use the Library to Analyze the other regions of interest P, Q, and S individually.





## Searching for the Next Template Cycle

Enabling the **Match** derived parameter is recommended to allow the user to search for sections of data where the next template cycle will be pulled from by clicking on the column header for the **Match** derived parameter (sorts values in ascending or descending order). If the **Match** derived parameter is used, set a logging rate of 20 seconds to 5 minutes, sort on the **Match** parameter and double click on the lowest **Match**. This will display the associated data in the primary graph page.

When using smaller data sets, the user can click on the **Search for next unmatched cycle** to search for the next unmatched cycle. The next unmatched cycle can then be used in the Template Library.

When hovering over the buttons the user will get a dialog box stating what each function does. These buttons are also defined in the Menus and Toolbar portion of this manual. The next unmatched cycle with marks will come up in the primary graph page as shown below.

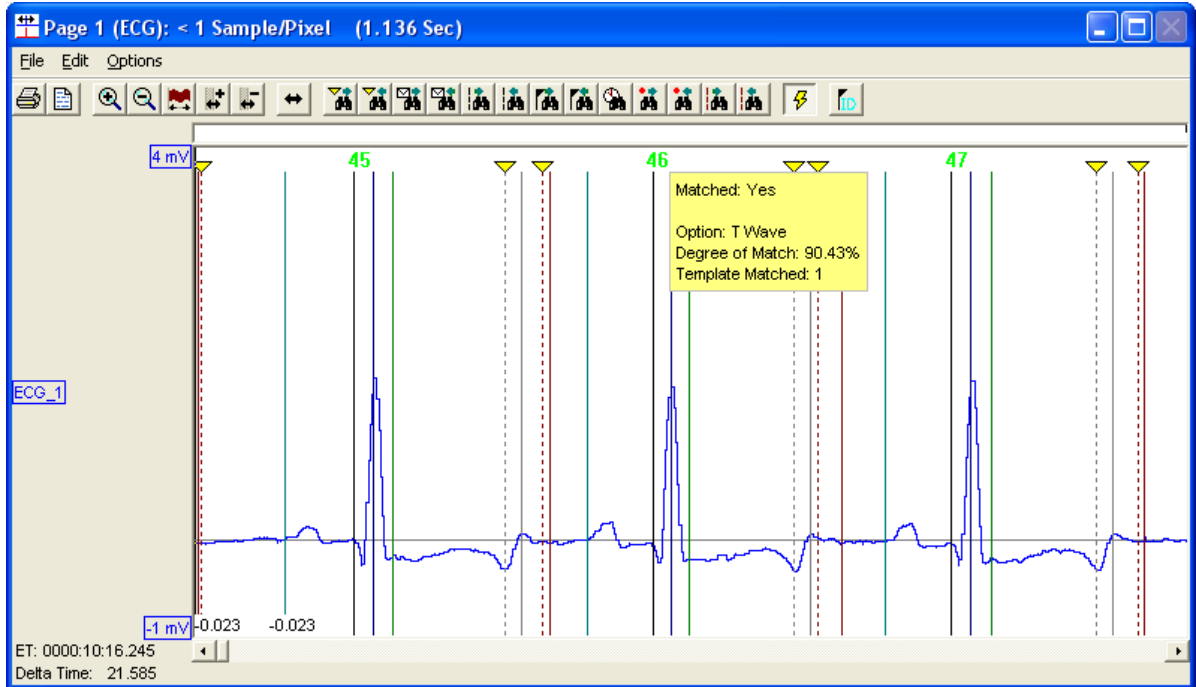
**Ctrl A** is a hot key that does the following:

- Adds the cycle that the cursor is on to the Template Library
- Analyzes using the current analysis settings using only the newest addition to the Template Library
- Searches for the next Unmatched Cycle

Right mouse click on the cycle to be added to the template library and select the **Add Cycle and Analyze [Single Template]** option. Matched cycles will not be re-analyzed, only unmatched cycles will (analysis should be faster).

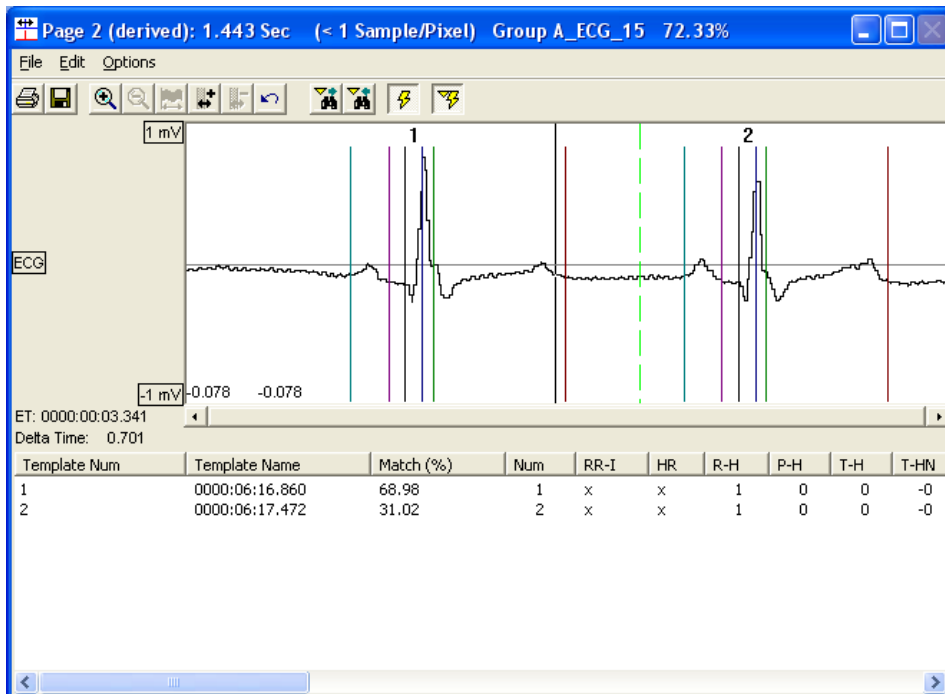
Note: If the P region is included in the desired Matches, the Match Percentage will not rise above the percentage of data that has discernable P waves (i.e. if only 60% of the cycles have discernable P waves, the max Match % that can be achieved when including the P region with other regions is 60% or less. Plotting a Trend Graph of

Match, P Match, T Match, Q Match or S Match will provide the user an indication of whether the unmatched cycles are concentrated at a specific time point or distributed throughout the data.



After the analysis, the green cycle numbers represent a match to the template cycle and the black cycle numbers are unmatched. When the cursor is placed over the cycle number of a match the match details will be displayed.

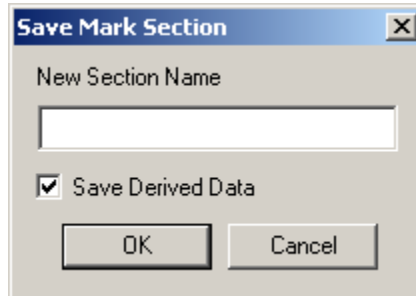
Continue this process until the percentage that appears in the dialog box after the title is the desired match percentage. Below, the Template Graph Page shows an 72.33% match using the 2 Templates.



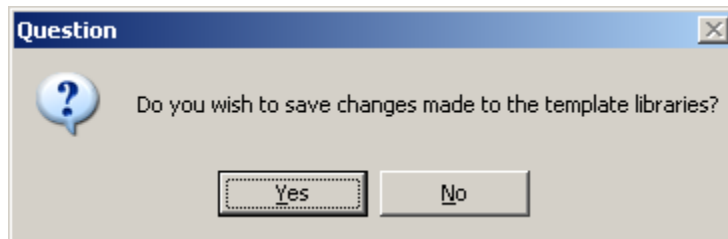
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## Saving Template Based Information

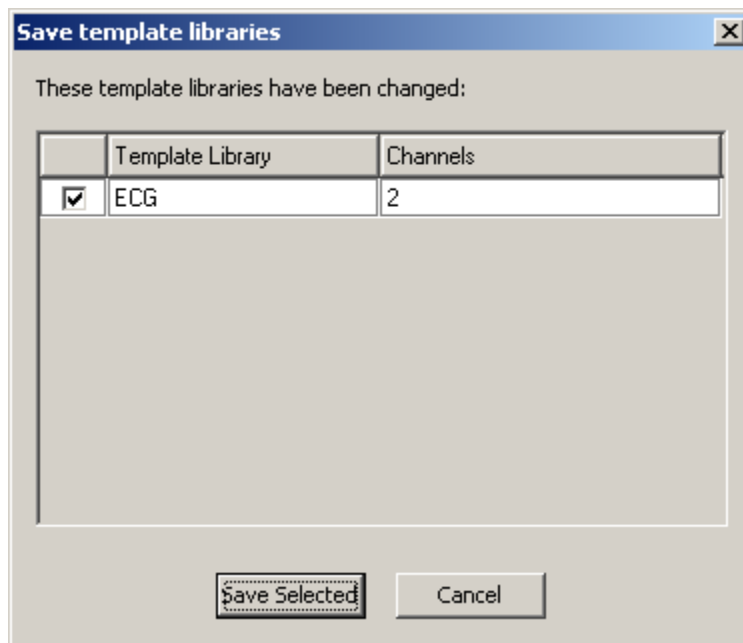
After achieving the desired Match using Templates, select **Save Marks Section** from the **Functions** menu. A dialog box as shown below will be displayed and a user defined name can be added.



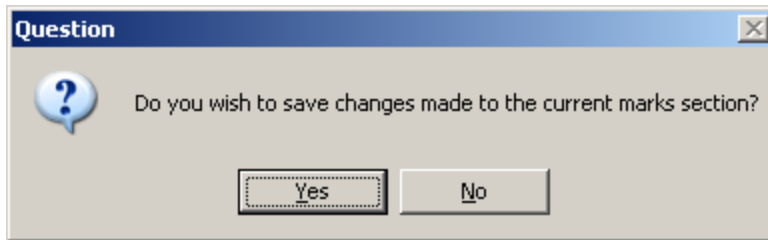
To exit the review session, select **Close Review Session** from the **Functions** menu in the main P3 Plus window. The following dialog box will appear. Select **Yes** to save the **Template Library**.



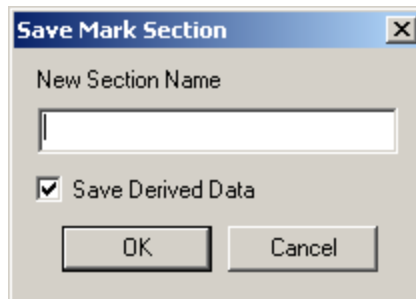
A **Save template libraries** dialog will appear asking which libraries will appear. For this tutorial only one is shown.



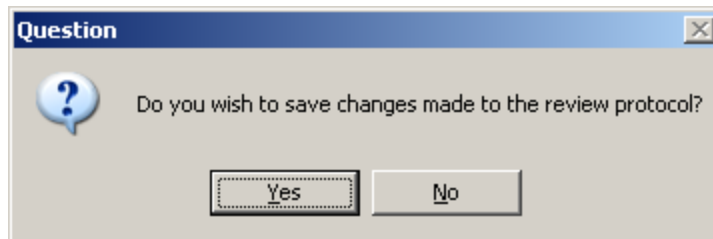
The following dialog box will appear, select **Yes** to save current marks section if not already saved in the graph page window already.



The following dialog box will appear, type in a **New Section Name** and click on the **OK** button.



The following dialog box will appear. Select **Yes** to save changes made to the review protocol.





# Feature Request

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## Feature Request Form

Sales Person: \_\_\_\_\_  
Customer Name: \_\_\_\_\_  
Company: \_\_\_\_\_  
Address: \_\_\_\_\_

Phone Number: \_\_\_\_\_  
Email Address: \_\_\_\_\_

P3 Plus Version (including Service Pack): \_\_\_\_\_  
Serial Number: \_\_\_\_\_  
Priority: \_\_\_\_\_  
Date: \_\_\_\_\_  
Hardware: \_\_\_\_\_

Feature (check one)  
 Unevaluated       Pending  
 Implement         Already Exists

Description: \_\_\_\_\_  
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