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TALENT User's Manual

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TALENT User's Manual

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Abstract

The Ground-Based Monitoring R&E Component Evaluation project performs testing on the hardware components that make up Seismic and Infrasound monitoring systems. The majority of the testing is focused on the Digital Waveform Recorder (DWR), Seismic Sensor, and Infrasound Sensor. The software tool used to capture and analyze the data collected from testing is called TALENT: Test and Analysis Evaluation Tool. This document is the manual for using TALENT. Other reports document the testing procedures that are in place (Kromer, 2007) and the algorithms employed in the test analysis (Merchant, 2011).

CONTENTS

NOMENCLATURE

dB	Decibel
DOE	Department of Energy
DFT	Discrete Fourier Transform
DUT	Device Under Test
DWR	Digital Waveform Recorder
FFT	Fast Fourier Transform
GNEMRE	Ground-based Nuclear Explosion Monitoring Research & Engineering (Program within NA22)
NA22	Office of Non-proliferation Research & Development (Office within NNSA)
NNSA	National Nuclear Security Administration (Office within DOE)
PDF	Probability Density Function
PSD	Power Spectral Density
RMS	Root Mean Square
SNL	Sandia National Laboratories
Tester	The individual responsible for performing a given test and the associated analysis

1 INTRODUCTION

1.1 Background

TALENT is designed to be a single, standard interface to all test configuration, metadata, parameters, waveforms, and results that are generated in the course of testing monitoring systems. It provides traceability by capturing everything about a test that is required to reproduce the results of that test. It consists of two basic components: A table of contents and a desktop. Users can browse to the devices and tests within the table of contents and display the associated device configurations and test interfaces within the desktop.

1.2 Development History

Development of TALENT began in mid-2007 with an initial investigation into understanding the algorithms that were in place in the existing software utilities used by the Component Evaluation project. It quickly developed into a basic architecture for capturing generic test metadata in a relational database and integrated user interfaces for reading data and analyzing test results. Over time, additional tests and functionality have been added to better capture the scope of testing that takes place.

1.3 Creators and Contributors

The design and development of TALENT was performed by John Merchant, Gary Huang, and Andre Encarnacao of Sandia National Laboratories.

1.4 Typographic Conventions

This manual uses (or tries to!) the following typographical conventions:

Italics	Book titles, names of sections in the manual, computer files and directories.
Bold	Key names, module names, menu names, button names, selectable items

When indicating an option of a pulldown menu, we use the notation:

Menu → Option

If there is an option within a submenu you may see:

Menu → Submenu → Suboption

Selection commands for displayed objects assume that the user has a standard 3-button mouse. “Left-click” , “Center-click”, or “Right-click” means a single click with the left, center, or right button, respectively. “Double-click” means two clicks in rapid succession. “Two-single- clicks” means two separate clicks, in moderate succession. If no left, center, or right is specified for a click, assume left.

2 SYSTEM SETUP

2.1 Platform Requirements

TALENT was developed primarily on a Windows XP and Windows 7 development environment. TALENT was written entirely in Java, a platform independent programming language, and should be able to run on any platform that has Java installed. There are no licensing requirements for running TALENT. The only software needed is a copy of the Java Virtual Machine version 1.5 or greater, which is freely available from Oracle.

2.2 Database Requirements

The contents of TALENT are stored in, and retrieved from, a relational database. Having a database is necessary for being able to retain changes in the TALENT contents between sessions. TALENT's database implementation should be able to support any SQL database for which there is a JDBC (Java Database Connection) driver available. TALENT is distributed with an Oracle and JavaDB driver. The JavaDB driver provides for a local database on the client computer, stored in binary files on disk, for the case when an external database is not available. No user setup of a JavaDB database is required, other than directing the program where to save the files to disk.

TALENT will automatically examine any database that it is directed to in order to identify the necessary database tables. If the tables exist, then the application will make use of those tables. If any of the tables do not exist or are missing necessary fields, then the application will make the necessary modification to the database tables.

2.3 Configuration

To run TALENT, the user must simply execute the file *talent.jar*, which contains all compiled code needed for the application, by double clicking the file. Note that the operating system file association must be configured appropriately for this to work. Alternatively, the following command may be typed at the command line:

java –jar talent.jar

Note that java by default only allocates 64 megabytes of memory for its applications. It may be necessary to increase that amount depending upon the volume of data that is to be loaded within TALENT. The following virtual machine setting may be specified to increase the allocated memory:

-Xmx???m

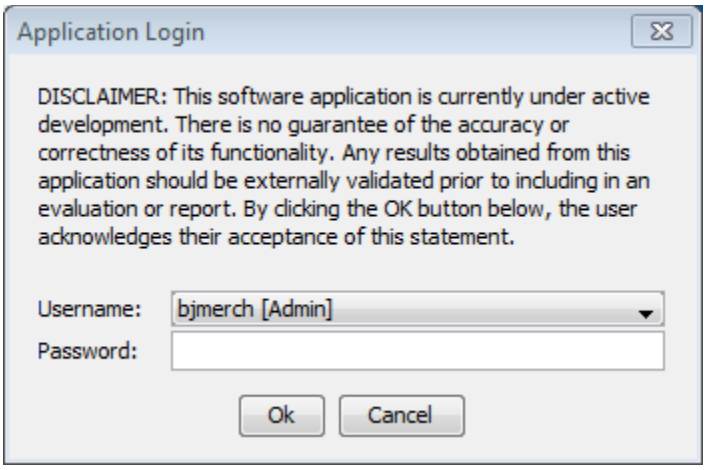
Where ??? is the amount of memory of megabytes. In typical use, an amount of 1000 megabytes has worked well. This virtual machine setting may either be included in the command line, by configuring the operating system's file type association, or added to the runtime operations using JVM Options within the Windows Control Panel.

The only other configuration change needed to run TALENT is to set it up to the appropriate database. This can be performed by starting the application and then adjusting the database settings from the **File → Database → Setup Database** menu item.

TALENT will automatically create a file called *talent.properties* within the user's current working directory upon startup. Any configuration changes made to TALENT will be automatically stored in this file and used whenever the application is run the next time.

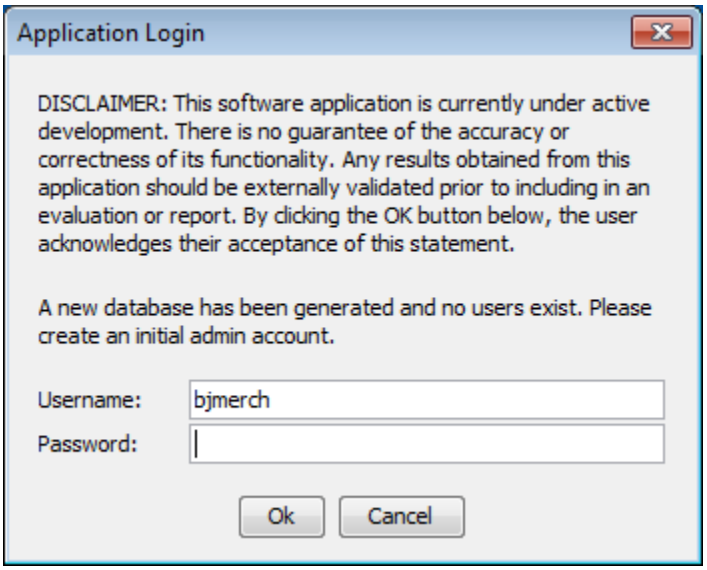
3 APPLICATION DESKTOP

When the user starts the TALENT application, they are prompted to log in to the database to which they are connecting to by entering the appropriate username and password into the dialog shown below.

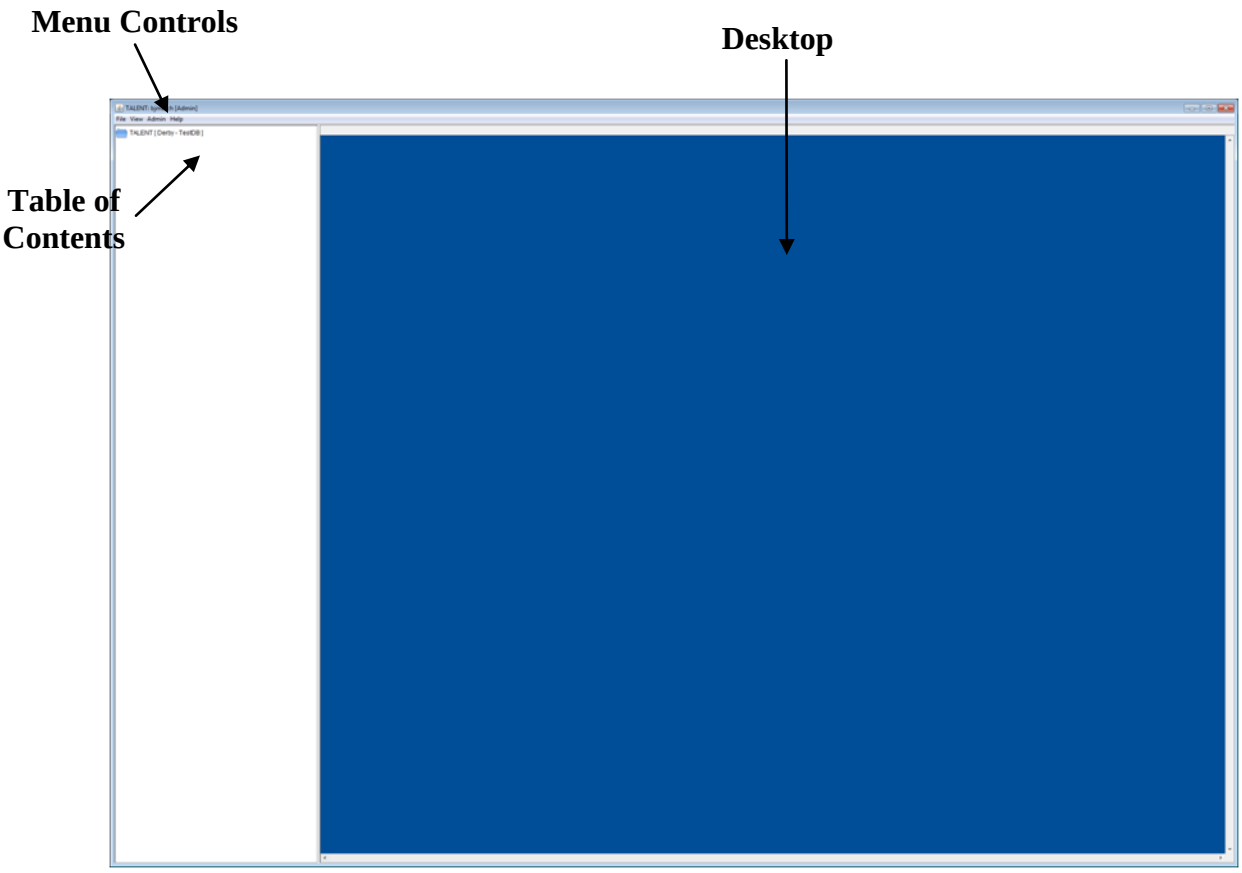


The username may be selected from a drop-down list of usernames that have been setup within the database. Until the user logs in with a valid username and password, they will be unable connect to the database or interact with any of the content of that database. There is very limited functionality within the TALENT application when it is not connected to a database.

The first time that TALENT connects to a newly created database, the application will prompt the user to create a special user login with administrative privileges, as shown in the dialog below. At all other times, the user must login with a username and password prior to finalizing the connection to the database.



Once the user is logged in, they are then presented with the main application desktop shown below. The primary components that make up the application are the **Menu Controls**, **Table of Contents**, and **Desktop**. The **Menu Controls** provide the user with access to additional menu items and controls for interacting with TALENT. The **Table of Contents** displays the hierarchical structure stored in the database of devices and tests that have been saved. The **Desktop** is the location where the various viewers for items stored within the database will be displayed. Additional information about each of these application components is provided in subsequent sections of this manual.



3.1 Menu Controls

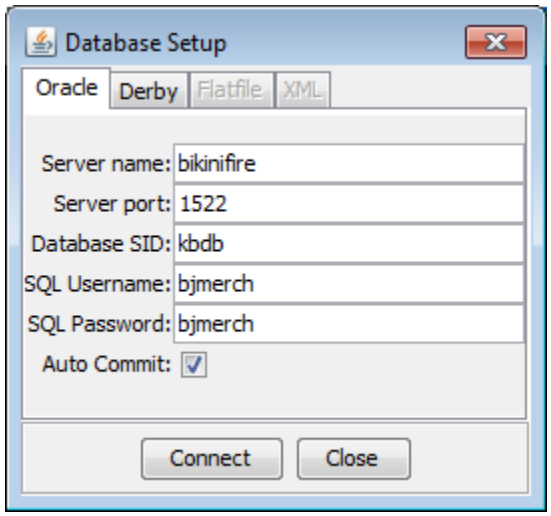
3.1.1 File

3.1.1.1 Database

The **Database** submenu provides menu items for configuring and managing the database connection.

3.1.1.1.1 Setup Database

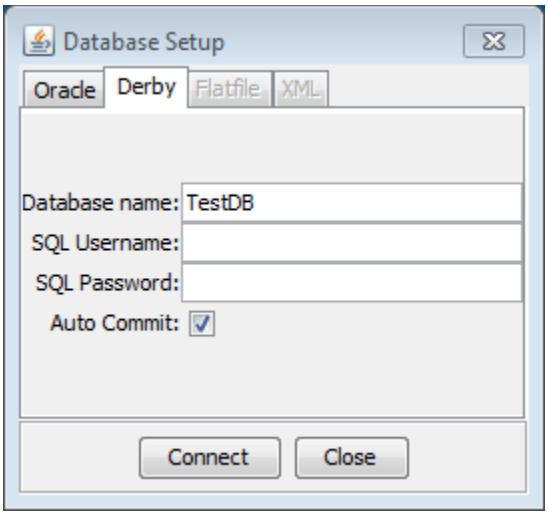
The connection to the database may be configured by selecting the **File → Database → Setup Database…** menu item. The user is presented with a dialog shown below. Different tabs across the top of the dialog may be selected to choose the various types of databases available. Currently, only two types of databases are supported: Oracle and Derby.



If an Oracle database is selected, then the necessary connection parameters must be entered for the desired database location:

Server Name	The hostname of the computer on which the Oracle server is running.
Server Port	The TCP/IP Port on which the Oracle server is running.
Database SID	The SID for the Oracle server.
SQL Username	The username of the database account.
SQL Password	The password of the database account.
Auto Commit	A flag indicating whether the database connection is in auto commit mode. If auto commit is enabled, then any changes made to the database content are automatically stored within the database. If auto commit is disabled, then any changes made are considered to be temporary until they are manually committed or undone. Note that if auto commit is disabled, any uncommitted changes will be lost in the event that the application aborts abnormally.

A Derby database is a local, within-application database that makes use of a set of binary files on disk to store the database content. No installation or setup is necessary to make use of a Derby database. Support for Apache Derby is built in to the TALENT application.



If a Derby database is selected, then the necessary connection parameters must be entered for the desired database location:

Database name The folder location in which the Derby database files are stored. The folder location may be relative or absolute. If relative, it is relative to the current working directory in which the application was launched. If absolute, the folder location must include the full path name (i.e. *c:\workfiles\TestDB*).

SQL Username The username of the database account. This field is typically empty for a Derby database.

SQL Password The password of the database account. This field is typically empty for a Derby database.

Auto Commit A flag indicating whether the database connection is in auto commit mode. If auto commit is enabled, then any changes made to the database content are automatically stored within the database. If auto commit is disabled, then any changes made are considered to be temporary until they are manually committed or undone.

Note that if auto commit is disabled, any uncommitted changes will be lost in the event that the application aborts abnormally.

3.1.1.1.2 Commit

The **File → Database → Commit** menu item is only enabled if the current database connection has the **Auto Commit** parameter within the Database Setup dialog disabled.

If selected, this menu item will store the most recent changes, since the connection was made or the most recent Commit or Undo, to the database.

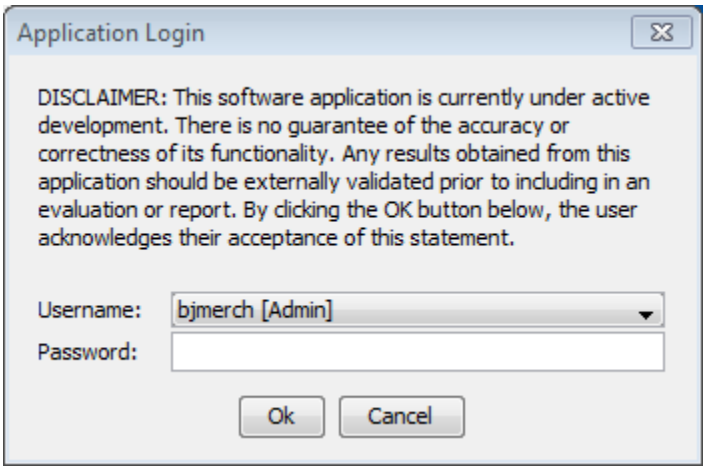
3.1.1.1.3 Undo

The **File → Database → Undo** menu item is only enabled if the current database connection has the **Auto Commit** parameter within the Database Setup dialog disabled.

If selected, this menu item will discard any recent changes made. The database content will be rolled back to the point at which the database connection was made or the most recent Commit or Undo operation was performed.

3.1.1.1.4 Switch User

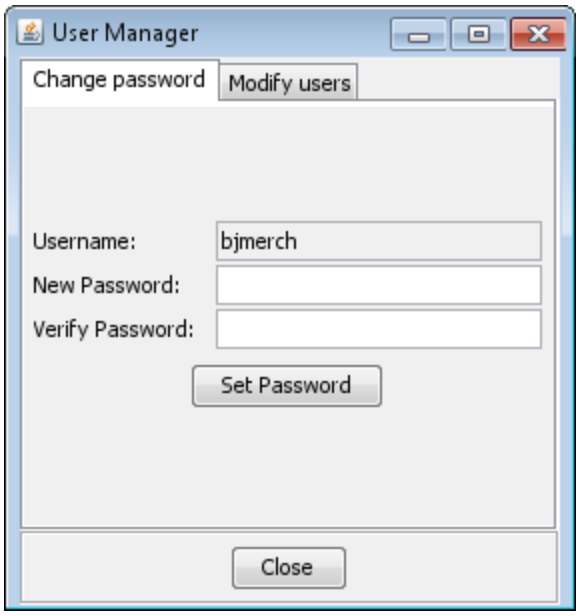
The **File → Database → Switch User** menu item allows a user to login to the existing database connection as a different user. The dialog below is shown.



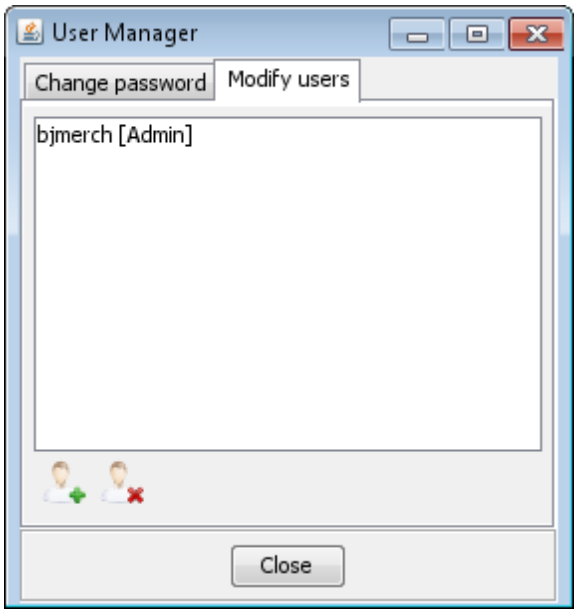
3.1.1.1.5 User Manager

The **File → Database → User Manager** menu item allows a user to make modifications to their own or other user accounts. Note that regular users are only allowed to change their passwords. Only administrative users are allowed to create users, delete users, or to make other users an administrator.

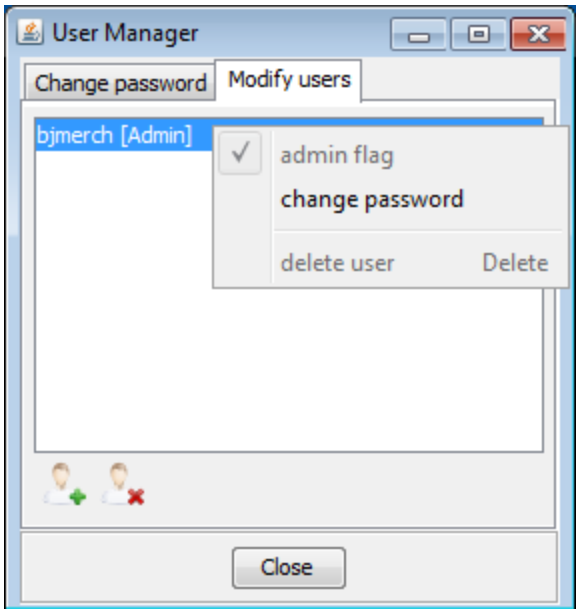
When the User Manager dialog first appears, as shown below, the user can change their password by entering a new password and clicking the **Set Password** button.



By switching to the **Modify Users** tab, shown below, an Administrator can create a new user by clicking on the icon. An Administrator can delete a user by selecting the user within the list and clicking on the icon.



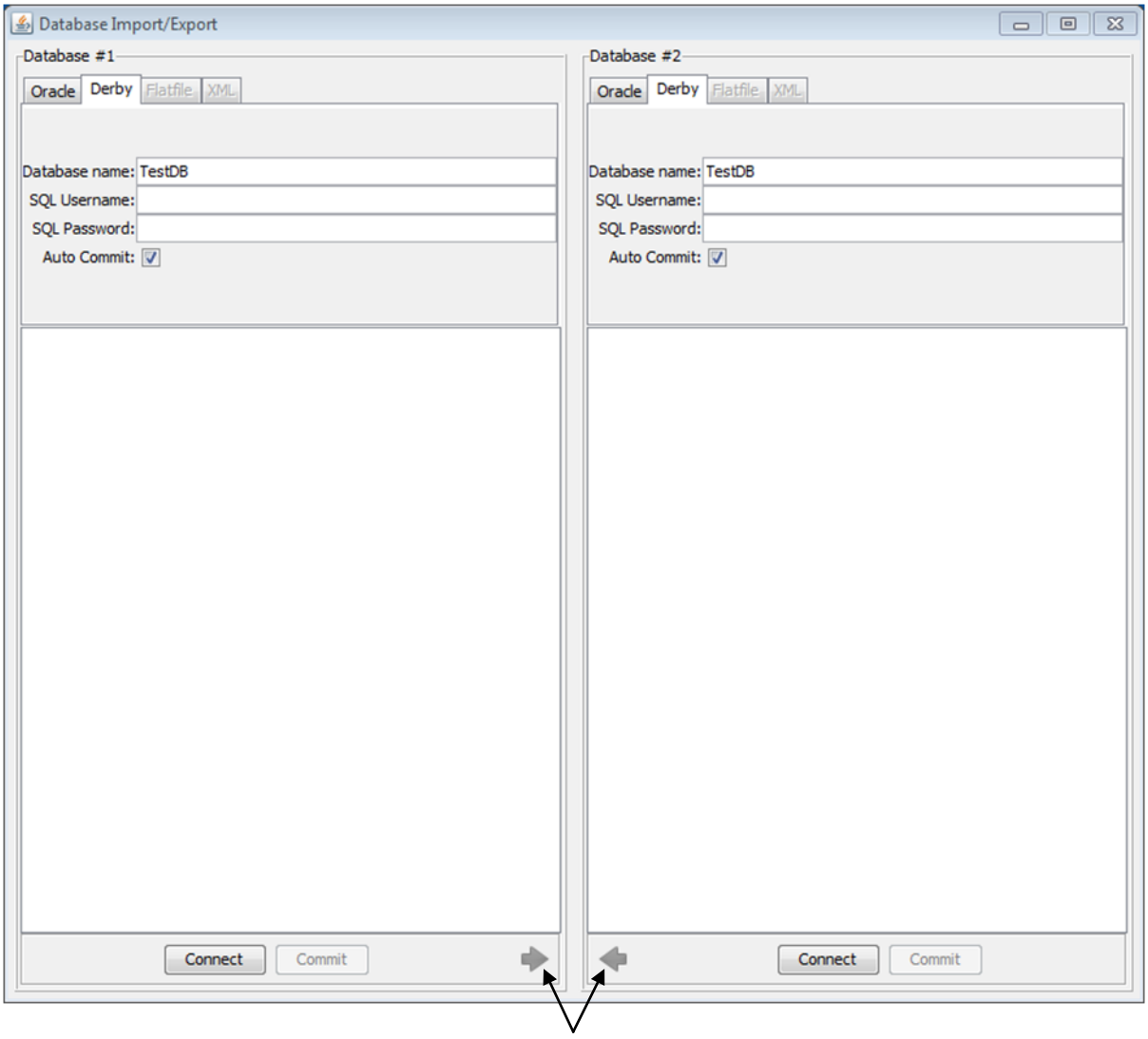
In addition, an Administrator may make additional changes to a user by right-clicking on a username and selecting the desired item from the popup menu. An Administrator may toggle another user's administrator setting, change a user's password, or delete a user.



Note that an Administrator is not allowed to delete their own user account or revoke administrative privileges from themselves. This constraint was implemented to ensure that there would always be at least one user account with administrative privileges.

3.1.1.1.6 Import / Export

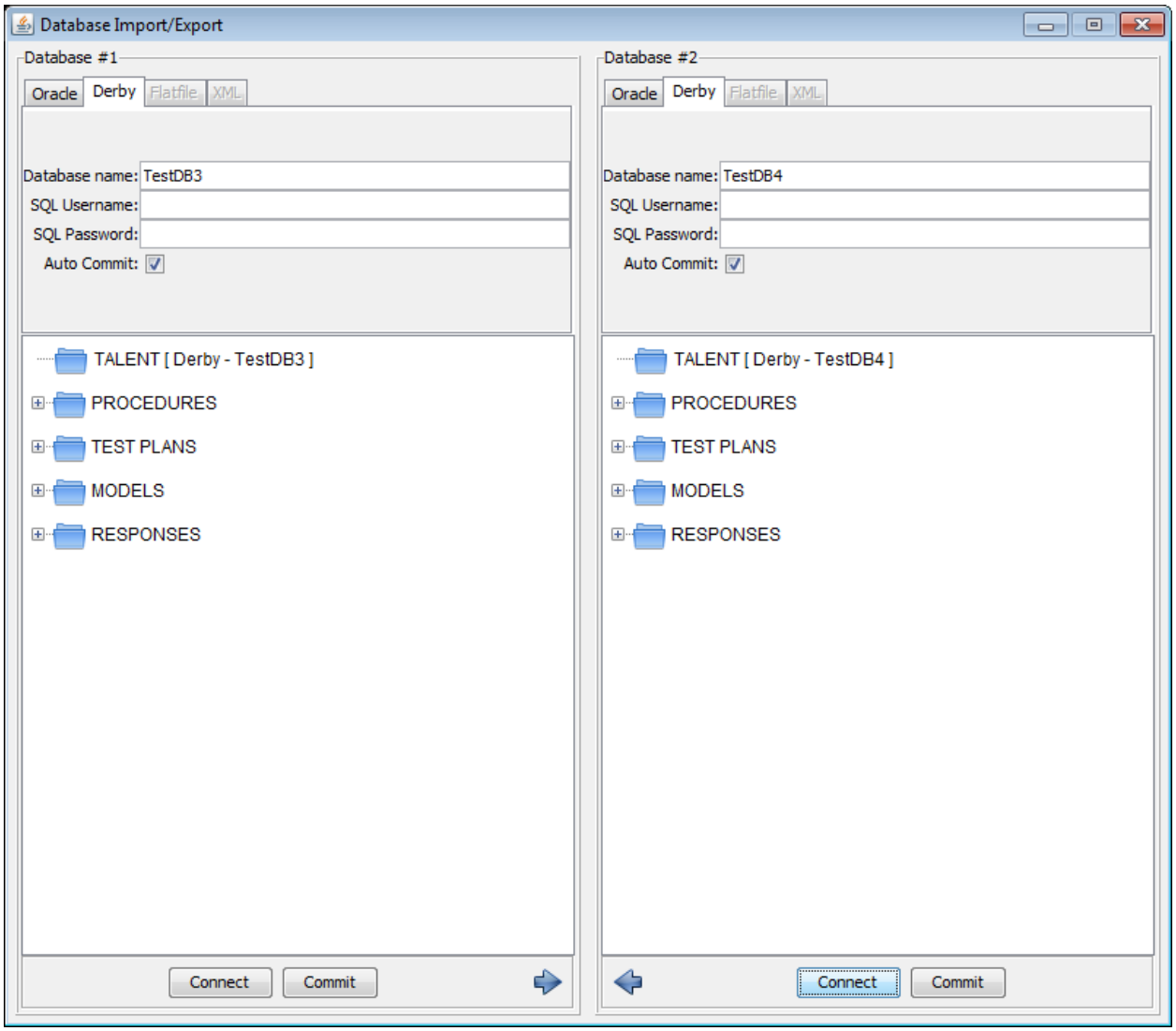
The **File → Database → Import/Export** menu item brings up a dialog, shown below, that allows the user to transfer the database contents from one database to another.



Transfer Content Arrows

The user must first enter the database connection details for Database #1 and Database #2 and click the **Connect** button within each of the panels to make the connections.

When connected to a database, each database panels contains entries for all of the types of information that TALENT can capture: Table of Contents, Procedures, Test Plans, Models, and Responses.



Once both of the database connections have been made, the user can transfer database contents between the two databases via a drag and drop operation. If the user wishes to copy the entire contents of one of the database into the other, they may do so simply by clicking on one of the transfer content arrows.

Note that if using a Derby database, do not attempt to connect either of the database import/export panels to the same Derby database that the main application table of contents is connected to. This will result in the application freezing for some amount of time before returning an error.

Once the user is finished with the Database Import/Export tool, they may close the dialog by click on the red X in the upper right corner of the window.

3.1.1.2 Properties

3.1.1.2.1 Edit

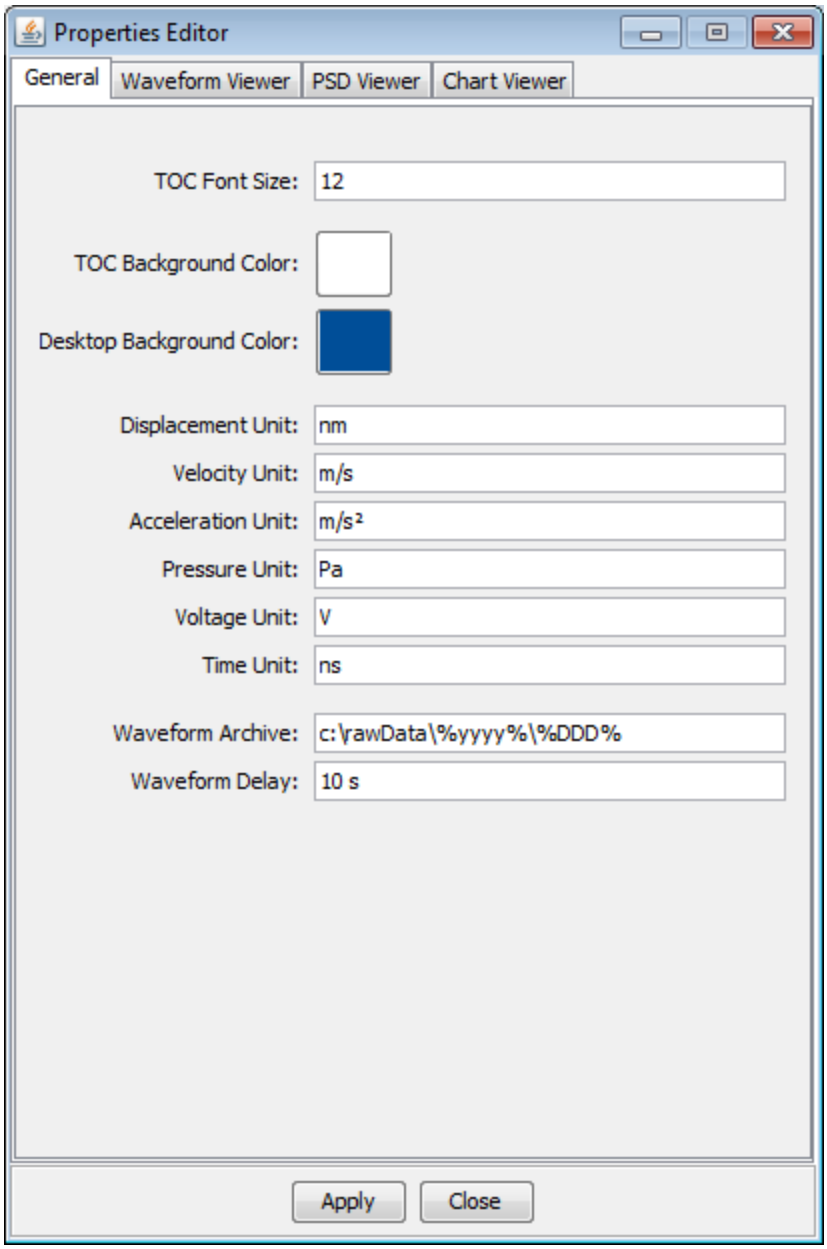
The **File → Properties → Edit** menu item brings up a dialog that allows the user to customize some of the behavior and appearance of the TALENT application by setting parameters. The parameters are divided into tabs according to their application. The following sections describe each of the tabs.

Note that any changes to these parameters are automatically saved in the *talent.properties* configured file located in the current working directory. The next time that the application is started, these parameters are automatically loaded from the parameter file. This allows a user to retain a specific set of customizations.

If there are any viewers currently open when a change is made to any of the parameters, then the viewers may need to be closed and re-opened in order for the changed properties to take effect.

3.1.1.2.1.1 General Properties

The **General** tab contains parameters that apply to the main application figure and all dialogs that are created.



TOC Font Size	Text font size in points for the table of contents.
TOC Background Color	Background color of the table of contents. Click on the color swatch to open a color chooser dialog and select a different color.
Desktop Background Color	Background color of the application desktop. Click on the color swatch to open a color chooser dialog and select a different color.
Displacement Unit	The preferred unit of displacement that will be used in representing all numeric values and plots.
Velocity Unit	The preferred unit of velocity that will be used in representing all

numeric values and plots.

Acceleration Unit The preferred unit of acceleration that will be used in representing all numeric values and plots.

Pressure Unit The preferred unit of pressure that will be used in representing all numeric values and plots.

Voltage Unit The preferred unit of voltage that will be used in representing all numeric values and plots.

Time Unit The preferred unit of time that will be used in representing all numeric values and plots.

Waveform Archive The location that TALENT will read from when acquiring data from digitizers during the automated execution of tests. The archive location may specify either an individual file or a folder. If a folder is designated, then TALENT will examine all files in the designated folder for waveforms. The files may be in any format that the application is able to read.

The folder location supports tags embedded within the path in order to support a dynamic set of files or directories. For numeric values, the number of pattern letters is the minimum number of digits, and shorter numbers are zero-padded to this amount. For text values, if the number of pattern letters is 4 or more, the full form is used; otherwise a short or abbreviated form is used if available.

TAG	Description	Example
%STA%	Station Code of the digitizer	
%CHAN%	Channel Code of the digitizer	
%G%	Era	AD
%yy% %yyyy% %yyyyy%	Year	11 2011 02011
%M% %MM% %MMM% %MMMM%	Month in year	7 07 Jul July
%w% %ww%	Week in year	29 09
%W% %WW%	Week in Month	2 02
%D% %DD% %DDD%	Day in year	189 08 008

%d% %dd%	Day in month	10 08
%F%	Day of week in month	2
%EEE% %EEEE%	Day in week	Tue Tuesday
%a%	AM/PM	AM
%H% %HH%	Hour in day (0-23)	0 00
%k% %kk%	Hour in day (1-24)	1 01
%K% %KK%	Hour in am/pm (0-11)	0 00
%h% %hh%	Hour in am/pm (1-12)	1 01
%m% %mm%	Minute in hour	30 08
%s% %ss%	Second in minute	55 06
%S% %SS% %SSS%	Millisecond	978 05 005
%z% %zzzz%	General Time zone	GMT Greenwich Mean Time
%Z%	RFC 822 time zone	-0800

For example, the folder location:

C:\rawData\%yyyy%\%DDD%

For reading waveform data from May 16, 2011 would be interpreted as:

C:\rawData\2011\136

Waveform Delay

The amount of time that TALENT will wait for the data to be available within the Waveform Archive. This delay is to allow for any latency inherent in the digitizer recording, communicating the data to a server, and storing the data in the archive location.

For example, if a test is being executed and needs to read 30 seconds of data from the waveform archive and there is a 10 second delay, then TALENT will wait for 40 seconds (30 + 10) before attempting to read the waveform data from the archive.

3.1.1.2.1.2 Waveform Viewer Properties

The **Waveform Viewer** tab contains parameters that apply to the waveform viewer panels within the Test Viewers.

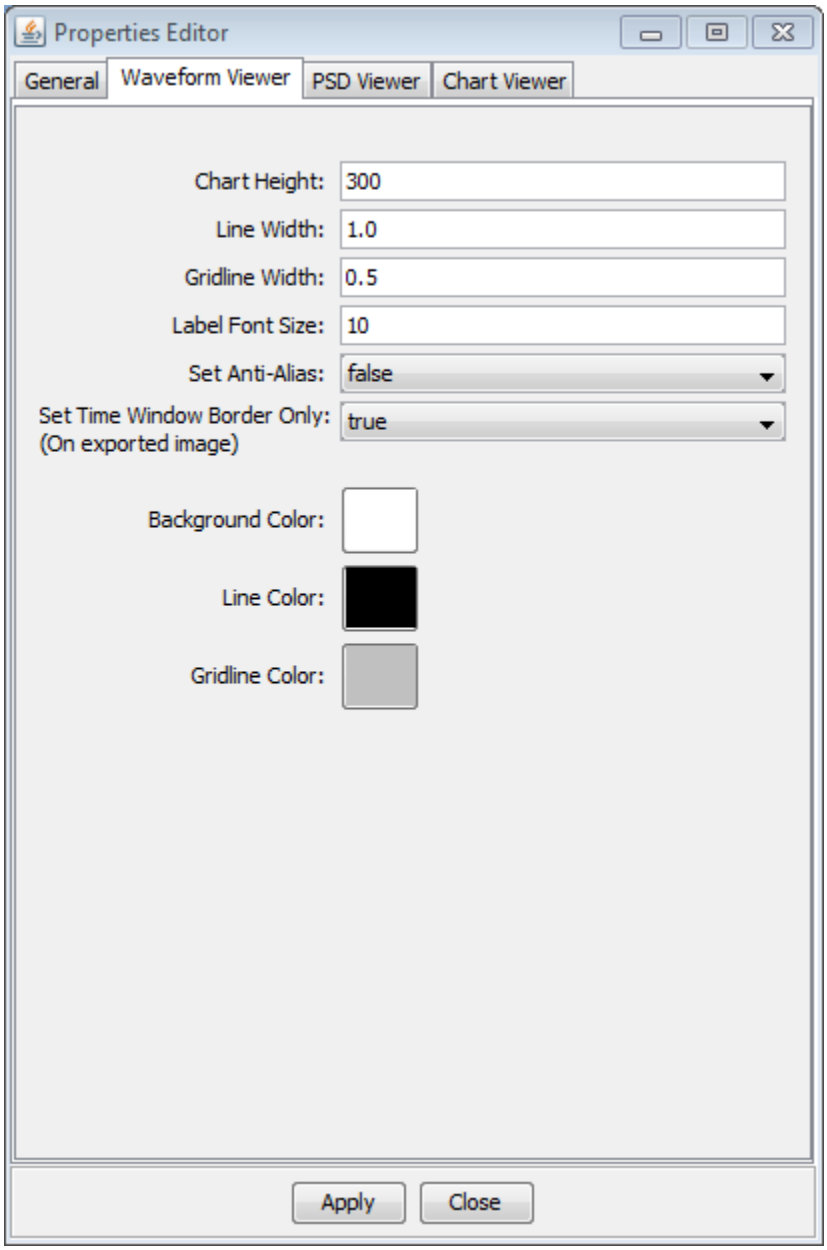


Chart Height	Height of the waveform viewer in pixels.
Line Width	Line width of the waveform time series line in points.
Gridline Width	Line width of the plot gridlines in points.
Label Font Size	Font size of the axes labels in points.

Set Anti-Alias	Flag to control whether the plotted lines are smoothed using an anti-alias filter.
Time Window Border Only	Flag to control whether the waveform time window markers are visible as a filled swatch or just a border line. This parameter only affects how the clipboard image, saved image, and generated report are displayed. It has no effect on the display of the waveform viewer within the application.
Background Color	Background color of the waveform viewer. Click on the color swatch to open a color chooser dialog and select a different color.
Line Color	Line color of the waveform time-series. Click on the color swatch to open a color chooser dialog and select a different color.
Gridline Color	Color of the plot gridlines. Click on the color swatch to open a color chooser dialog and select a different color.

3.1.1.2.1.3 PSD Viewer Properties

The **PSD Viewer** tab contains parameters that apply to the PSD viewer panel within the Test Viewers.

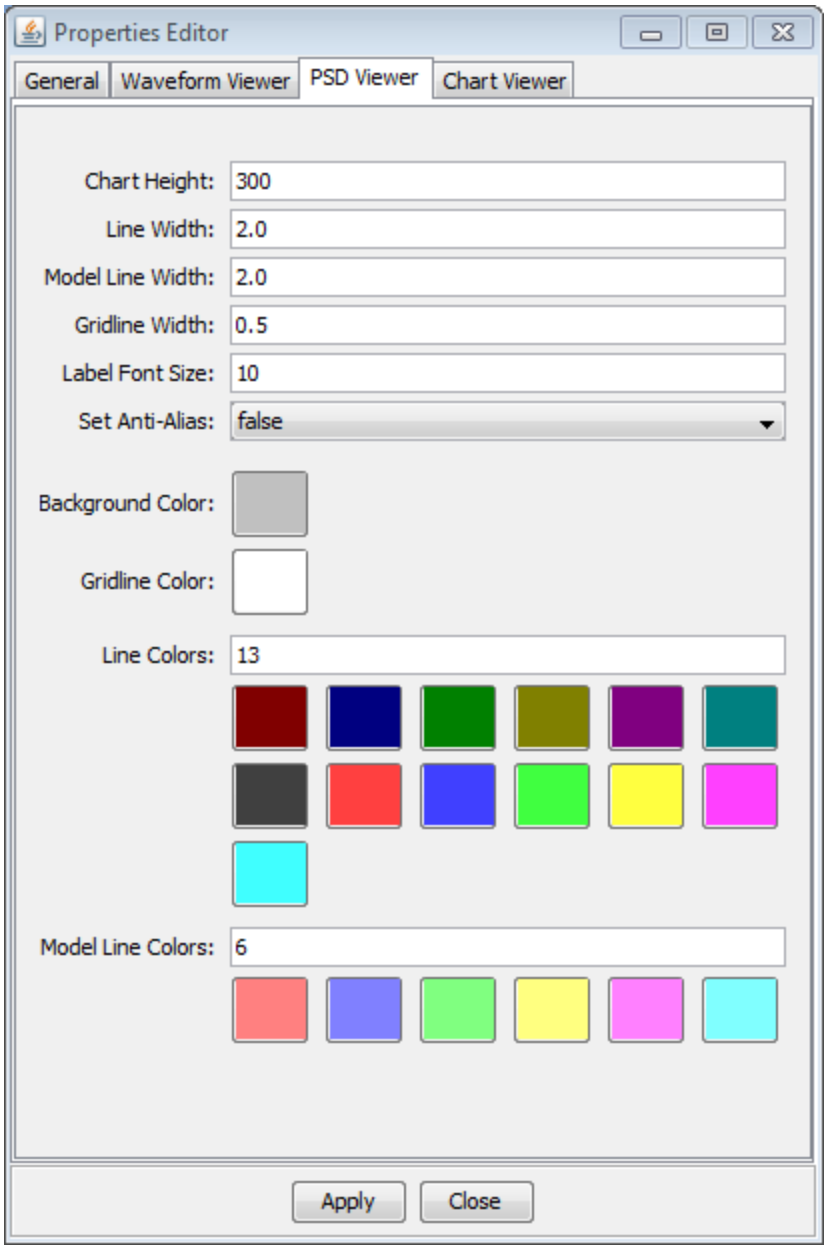


Chart Height	Height of the PSD Viewer in pixels.
Line Width	Line width of the PSD lines in points.
Model Line Width	Line width of the model lines in points.
Gridline Width	Line width of the plot gridlines in points
Label Font Size	Font size of the axes labels in points.
Set Anti-Alias	Flag to control whether the plotted lines are smoothed using an anti-alias filter.

Background Color	Background color of the waveform viewer. Click on the color swatch to open a color chooser dialog and select a different color.
Gridline Color	Color of the plot gridlines. Click on the color swatch to open a color chooser dialog and select a different color.
Line Colors	Number of defined colors within the palette for plotting the PSD lines. Each line is plotted in its respective color according to the order. The first line is plotted in the first color, the second line in the second color, and so on. If there are more lines than defined colors, then the chosen color wraps back around to the beginning of the palette. Click on the color swatch to open a color chooser dialog and select a different color.
Model Line Colors	Number of defined colors within the palette for plotting the Model lines. Each line is plotted in its respective color according to the order. The first line is plotted in the first color, the second line in the second color, and so on. If there are more lines than defined colors, then the chosen color wraps back around to the beginning of the palette. Click on the color swatch to open a color chooser dialog and select a different color.

3.1.1.2.1.4 Chart Viewer Properties

The **Chart Viewer** tab contains parameters that apply to any other charts within the application.

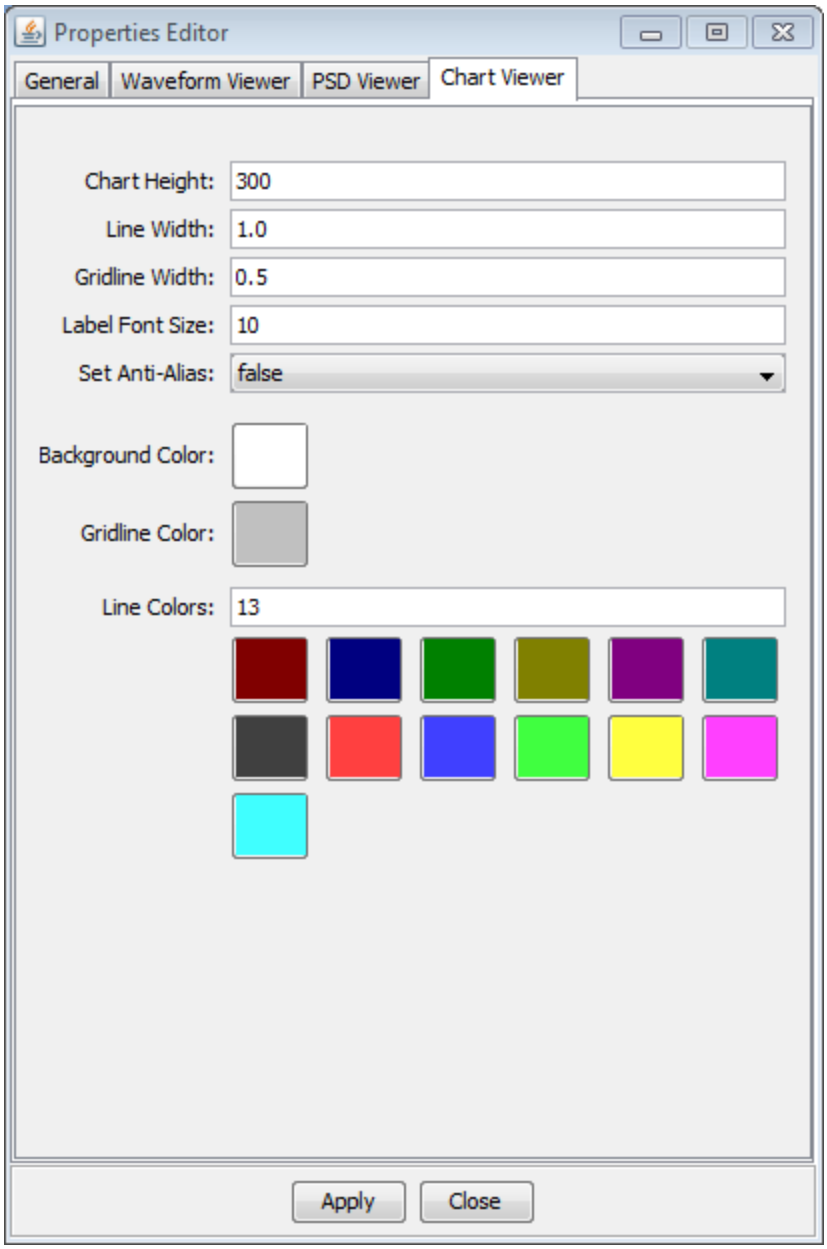
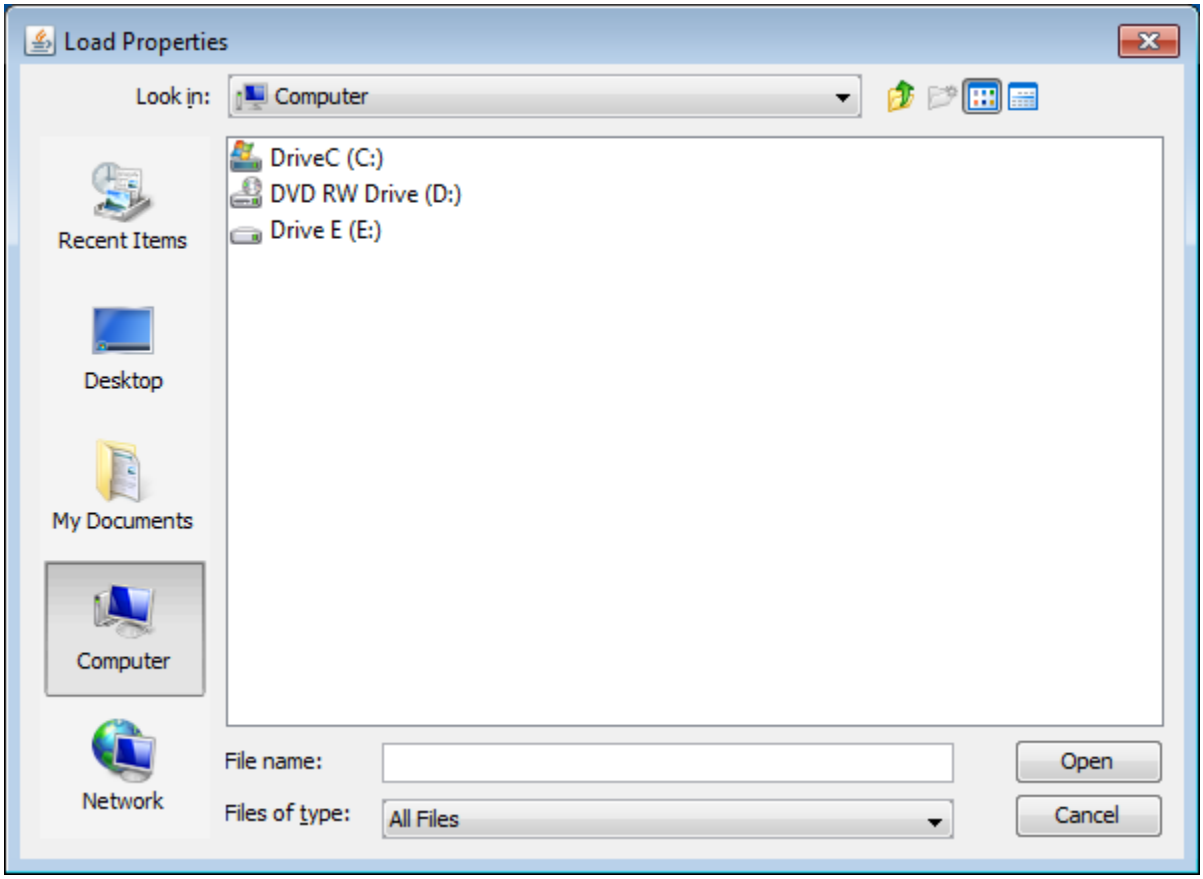


Chart Height	Height of the chart in pixels.
Line Width	Line width of the chart lines in points.
Gridline Width	Line width of the plot gridlines in points.
Label Font Size	Font size of the axes labels in points.
Set Anti-Alias	Flag to control whether the plotted lines are smoothed using an anti-alias filter.
Background Color	Background color of the waveform viewer. Click on the color swatch to open a color chooser dialog and select a different color.

Gridline Color	Color of the plot gridlines. Click on the color swatch to open a color chooser dialog and select a different color.
Line Colors	Number of defined colors within the palette for plotting the data lines. Each line is plotted in its respective color according to the order. The first line is plotted in the first color, the second line in the second color, and so on. If there are more lines than defined colors, then the chosen color wraps back around to the beginning of the palette. Click on the color swatch to open a color chooser dialog and select a different color.

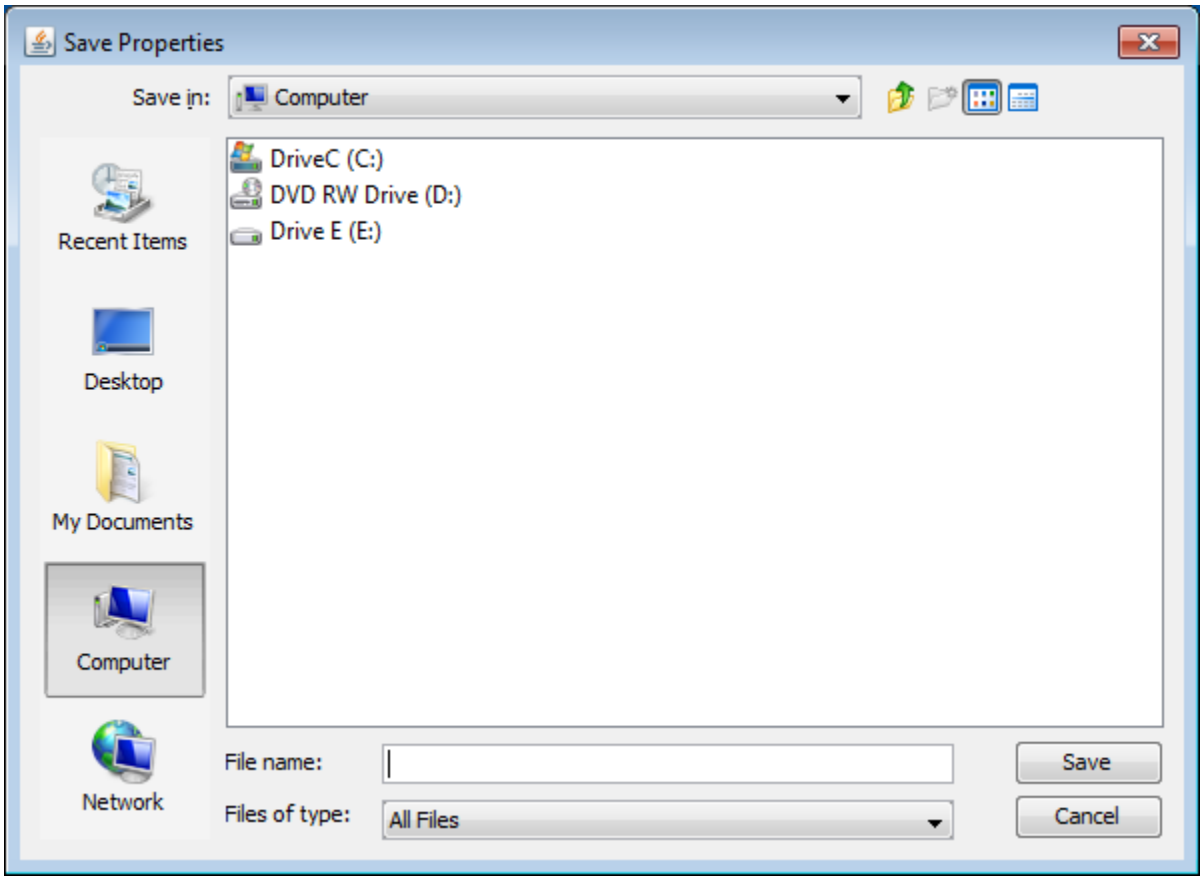
3.1.1.2.2 Load

The **File → Properties → Load** menu item allows a user to load the properties from an external file into the current application session using a file chooser similar to the one shown below.



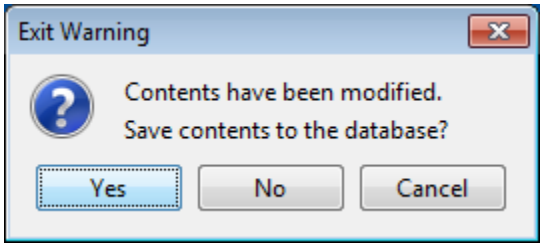
3.1.1.2.3 Save

The **File → Properties → Save** menu item allows a user to save the properties for the current application session to an external file using a file chooser similar to the one shown below.



3.1.1.3 Exit

The **File → Exit** menu item exits the application. Prior to exiting, the application checks to ensure that all of the viewers and the database changes have been committed to the database. If there are any uncommitted changes, the application will prompt the user for their desired course of action with the dialog shown below:



Click **Yes** to commit the changes to the database and then exit. Click **No** to exit without committing changes to the database. Click **Cancel** to abort the exit without committing any changes to the database.

3.1.2 View

3.1.2.1 Responses

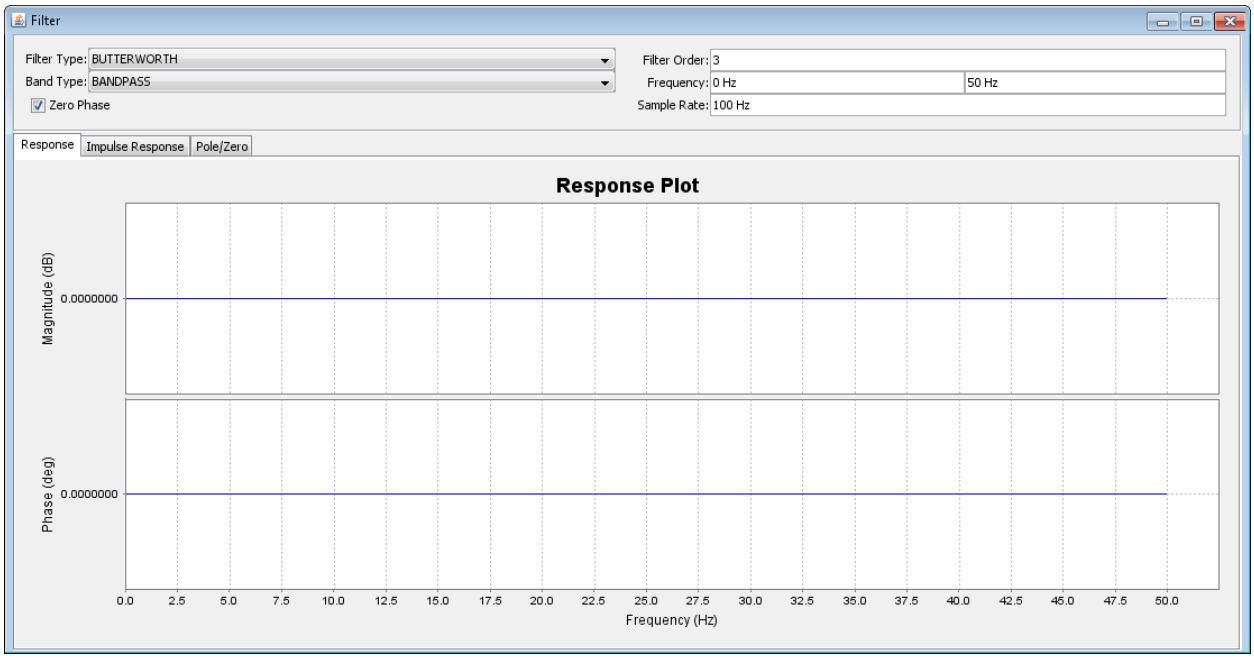
The **View → Responses** menu item opens a dialog for managing the responses stored in the database. See the section on responses for additional detail.

3.1.2.2 Models

The **View → Models** menu item opens a dialog for managing the models stored in the database. See the section on models for additional detail.

3.1.2.3 Filters

The **View → Filters** menu item opens a dialog that allows the user to design several types of filters and observe the magnitude and phase response, impulse response, and digital pole/zero locations of the filter.



Filter Type	Select the type of filter to design from the options in the provided pull down menu: Butterworth, Chebyshev 1, Chebyshev 2, and Bessel.
Band Type	Select the type of filter band from the options in the provided pull down menu: Low Pass, High Pass,

	Band Pass, and Band Stop.
Zero Phase	Flag to control whether the filter is zero-phase. This option is sometimes also referred to as non-causal.
Filter Order	The order of the filter which specifies the number of poles and zeros.
Frequency	The low and high frequency limits for the chosen **Band Type**.
Sample Rate	The sample rate of the digital filter.

3.1.2.4 Snapshot

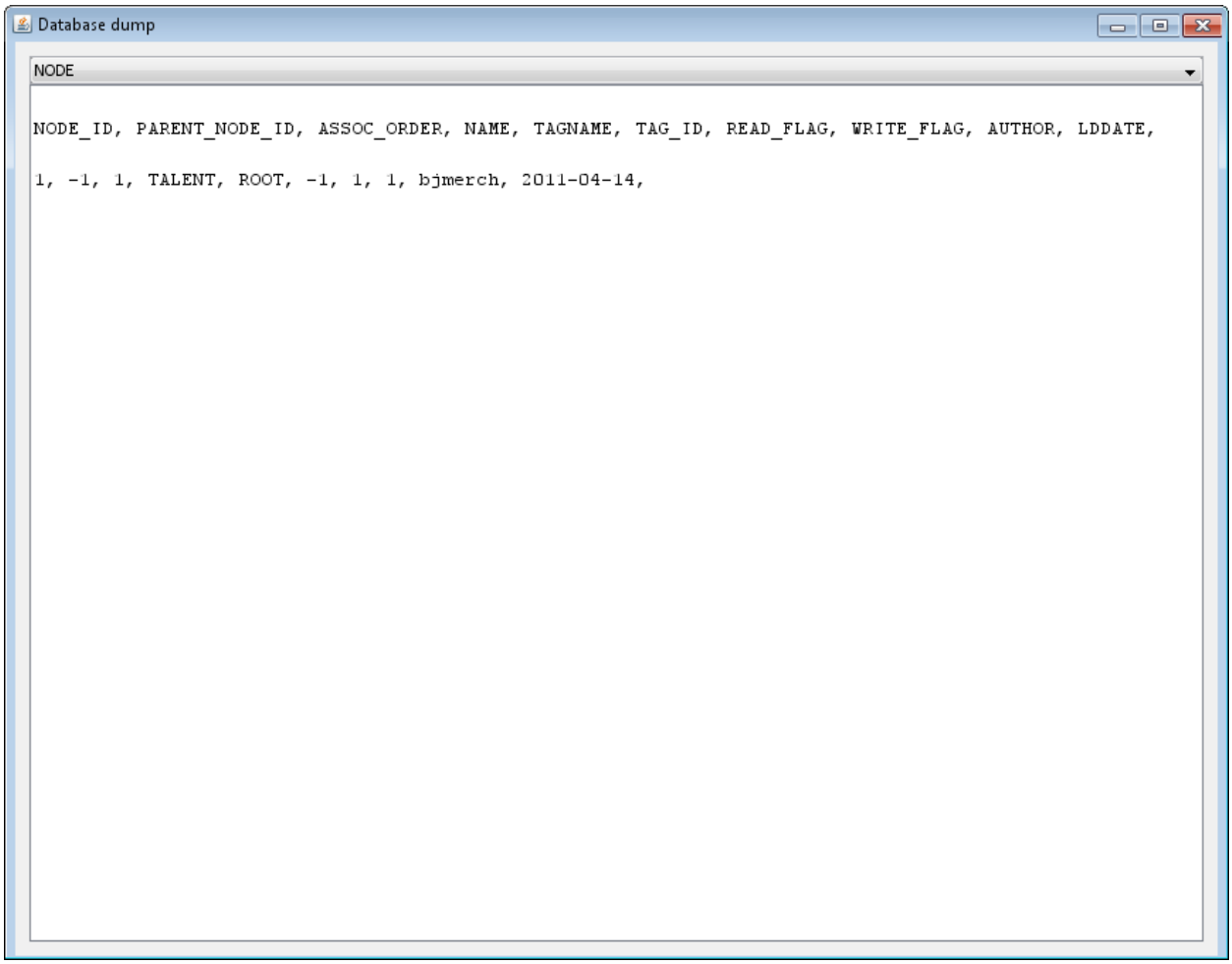
The **View → Snapshot** menu item creates an image of the currently selected viewer within the TALENT Desktop and copies that image to the clipboard. The image on the clipboard may then be pasted into a document.

3.1.3 Admin (Optional)

The **Admin** menu contains menu items that are only available for the Administrator to access. If the user is currently logged with a username and password that does not have the Administrator flag set, then the **Admin** menu will not be displayed or accessible.

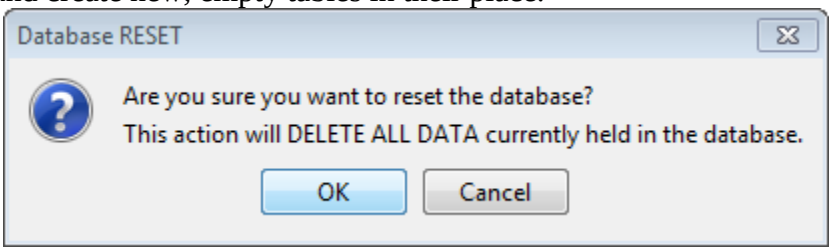
3.1.3.1 Database Dump

The **File → Admin → Database Dump** menu item allows an Administrator to display the dumped out contents of each of the database tables. The administrator can select the desired database table from the pull down list at the top of the dialog. The field names and all of the rows within the database are displayed within the dialog.



3.1.3.2 Database Reset

The **File → Admin → Database Reset** menu item allows an Administrator to drop all of the database tables and create new, empty tables in their place.



Obviously, this operation will delete all data currently held in the database. Please exercise caution when making use of this functionality.

3.1.3.3 Procedure Editor

See Test Procedures for a description of the Procedure Editor.

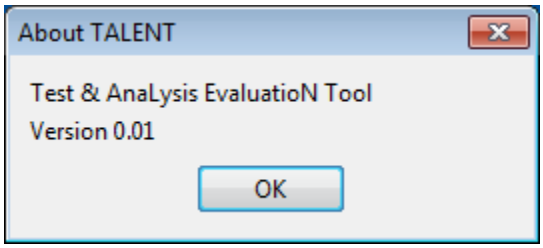
3.1.3.4 Test Plan Editor

See Test Plan for a description of the Test Plan Editor.

3.1.4 Help

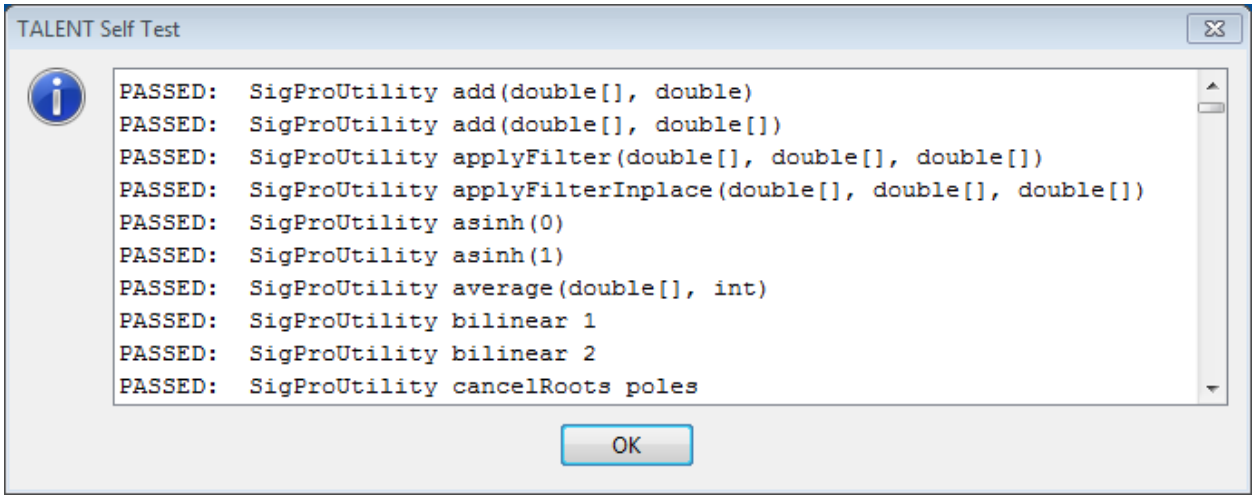
3.1.4.1 About

The **Help → About** menu item displays the version information for the currently running application.



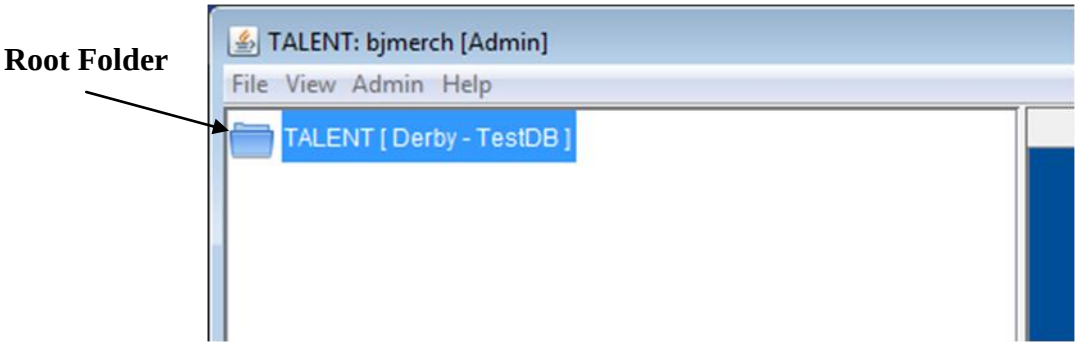
3.1.4.2 Test

The **Help → Test** menu item performs a set of self tests on the data analysis and signal processing routines. The pass/fail status for each routine is shown in the dialog



3.2 Table of Contents

The **Table of Contents** (TOC) displays the hierarchical tree structure of devices and tests. This tree structure is stored entirely within the database. At the top level of the tree is the **Root Folder** shown below:

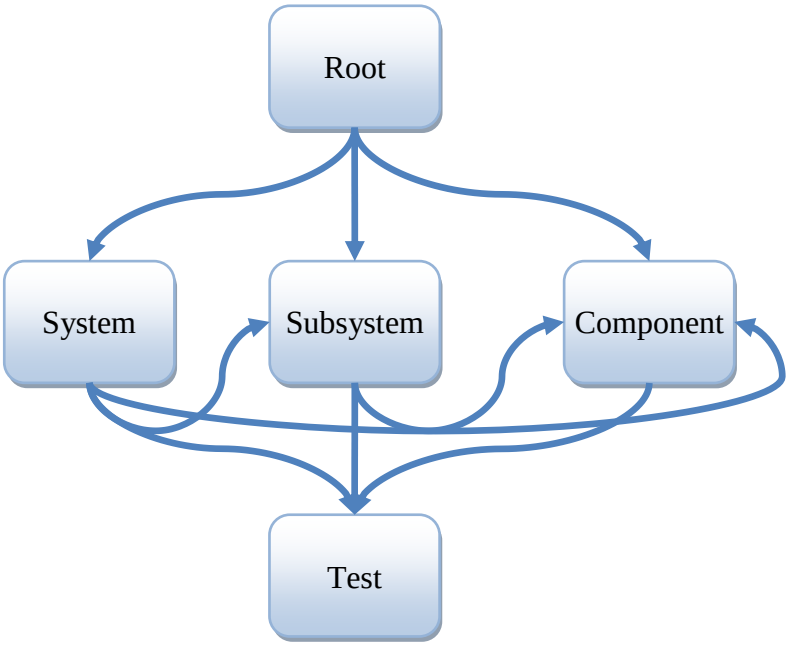


The TOC tree structure can contain several types of entries: Folders, Components, Subsystems, Systems, and Tests. There are specific rules that determine the allowable hierarchy of entries. These rules are summarized below:

Folders	Folders are used for organization within the TOC. They may be created at any level within the TOC.
Components	A Component represents a specific device that is in use either as a device under test, a portion of the Testbed, or as a portion of a Subsystem or System. There are several types of Components that may be created, such as a Digitizer or a Sensor. See the Components section for additional details Components may exist at the top level of the TOC, within a Subsystem, or within a System. Components may only contain Tests that are applied on that Component.
Subsystems	A Subsystem is a collection of Components that are grouped together as a unit for testing. Subsystems may exist at the top level of the TOC or within a System. Subsystems may contain Components and Tests that are applied to that Subsystem.
Systems	A System is a collection of Subsystems that are grouped together as a unit for testing. Systems may exist at the top level of the TOC. Subsystems may contain Subsystems, Components, and Tests that are applied to that System.
Tests	A Test represents a specific implementation of a type of test on a specific device. There are many types of tests.

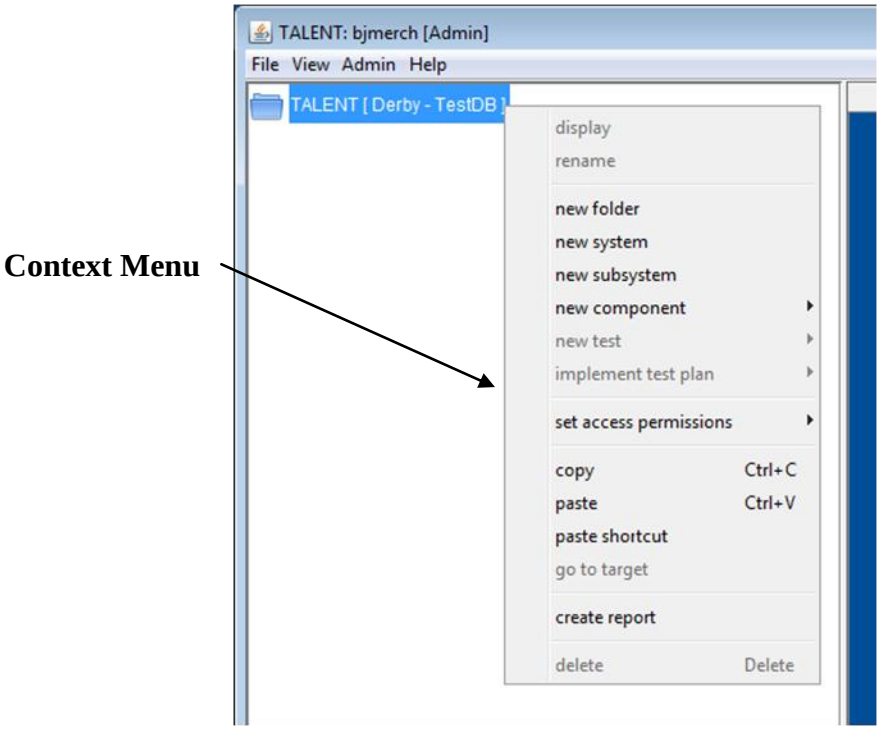
Tests may only exist below a Component, Subsystem, or System. Tests are the leaf entries within the tree and cannot contain any other entries below themselves.

A diagram of the allowable TOC hierarchy is shown below.



3.2.1 Context Menu

The user may bring up the **Context Menu** by selecting one or more entries in the **Table of Contents** and right-clicking with the mouse. The specific options that are enabled within the **Context Menu** depend upon the type of entries that are selected.



The following actions may be selected from the **Context Menu**:

Display Display the appropriate viewer within the Desktop for the selected Components, Subsystems, Systems, and Tests. Folders cannot be displayed. See the relevant section for the selected TOC entry for specific details on the viewer that will be displayed.

The user may also perform this action by double-clicking the TOC entry with the left mouse button.

Rename Change the name of the selected Component, Subsystem, System, Test, or Folder. Once this action has been selected, enter the desired name within the edit box that appears over the selected item. Press Enter to finalize the rename. Press Esc or change focus to another portion of the GUI to cancel the rename operation.

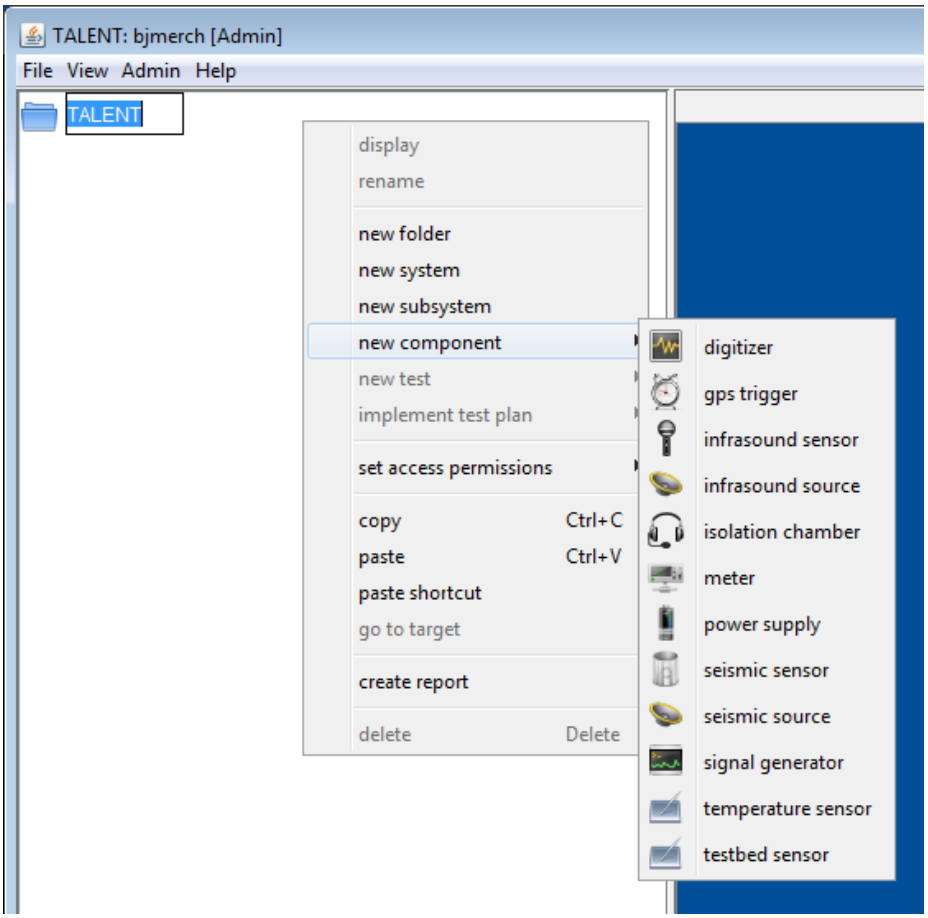
New Folder Create a new folder below the selected entry. Once the folder has been created, the user may type in a name for the folder in the edit box that appears.

New System Create a new System below the selected entry. Once the System has been created, the user may type in a name for the folder in the edit box that appears.

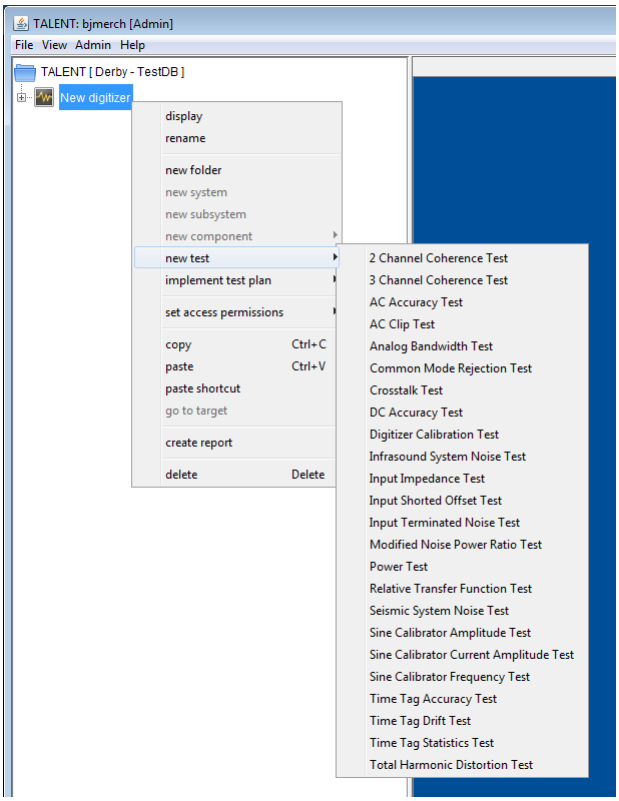
New Subsystem Create a new Subsystem below the selected entry. Once the Subsystem has been created, the user may type in a name for the folder in the edit

box that appears.

New Component Create a new Component below the selected entry. The user may select from a menu of the available components.

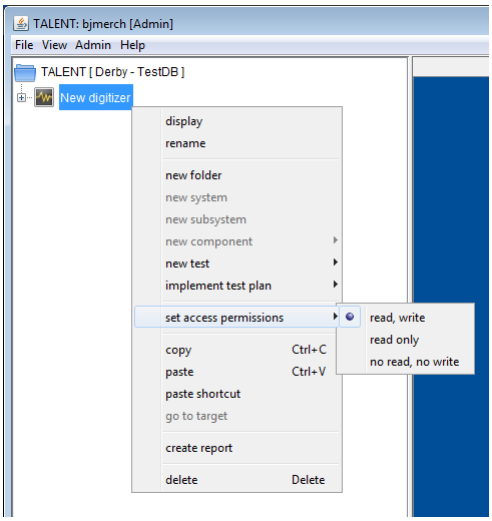


New Test Create a new Test below the selected Component, System, or Subsystem. The list of available tests that are displayed is dynamic depending upon the TOC entry that was selected. The list of tests shown below are the ones available for a digitizer:



Implement Test Plan Create the tests for a previously defined test plan. See the Test Plan section for a more detailed description.

Set Access Permissions Set the access permissions to allow other users to read and write, read only, or no read and write. See the section on User Access Permissions for more details.

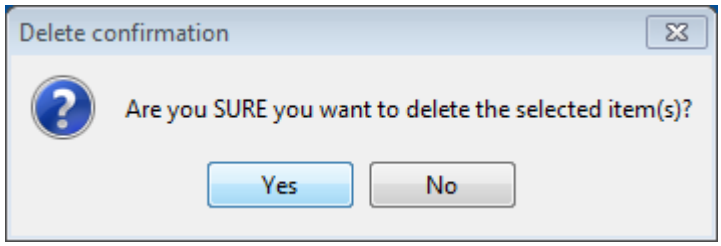


Copy Copy the selected TOC entries onto the clipboard.

Paste Paste the entries on the clipboard within the selected TOC entry.

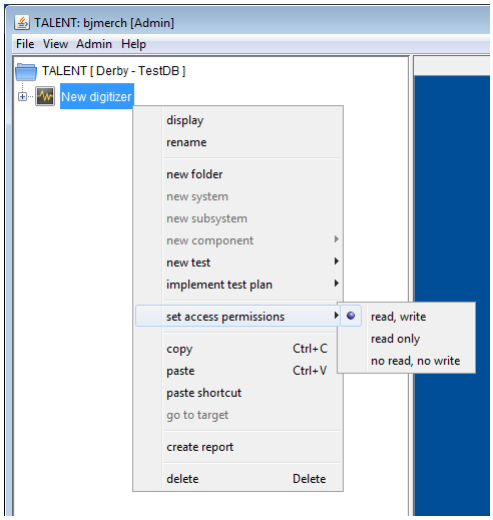
Paste Paste a shortcut to the entries on the clipboard within the selected TOC

Shortcut	entry.
Go to Target	If the selected TOC entry is a shortcut, open and select the TOC entry that the shortcut points to.
Create Report	Save a generated report to a file on disk of the selected TOC entries. The report is saved as an HTML file that may be opened in any web browser or a document editor such as Microsoft Word.
Delete	Delete the selected TOC entries. The user will be prompted to confirm the deletion:



3.2.2 User Access Permissions

Users can limit the access permissions to portions of the TOC for which they are the author. The access permissions of a TOC entry can be set by right-clicking on the selected entry and choosing from the available access permission options: read, write; read only; and no read, no write.

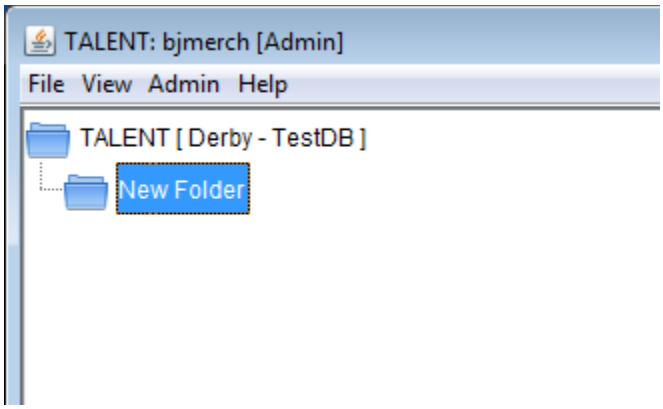


Setting the access permissions on a TOC entry automatically sets all its children within the tree to the same access permissions setting.

Note that these user access permissions only apply to non-administrator users. Administrator users are able to read and write any TOC content without restriction.

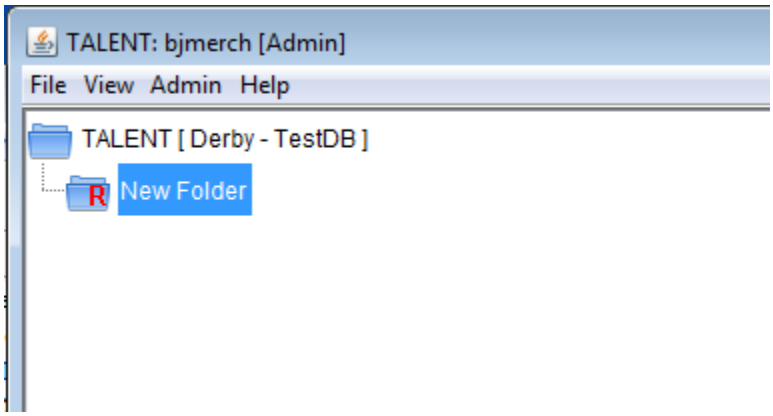
3.2.2.1 Read and Write

Setting the access permission to "read, write" allows all other users to read and make changes to the content with no restrictions. This setting is the default for all newly created TOC content.



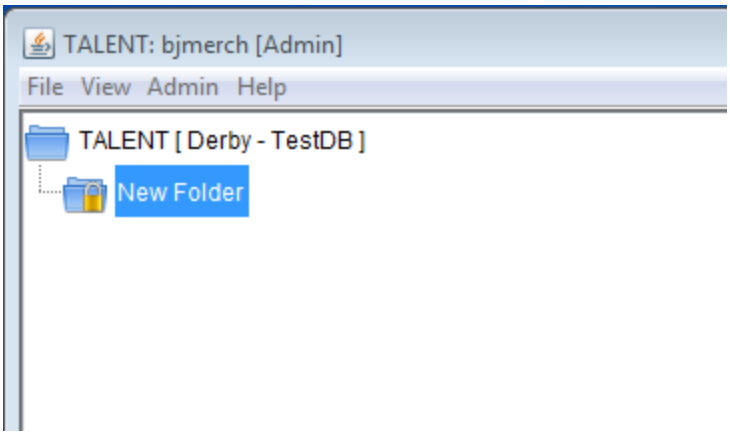
3.2.2.2 Read Only

Setting the access permission to "read only" allows all other users to read the content, but not make changes. TOC content that is read only is indicated with a red R overlaying the entries icon, as shown below:



3.2.2.3 No read, No write

Setting the access permission to "no read, no write" does not allow other users to read or make changes. TOC content that has been flagged as having no read and no write permissions is indicated with a lock overlaying the entries icon, as shown below:



Note that if a user does not have read access permission for a folder and they attempt to expand the folder, they will not be able to view any of the folder contents.

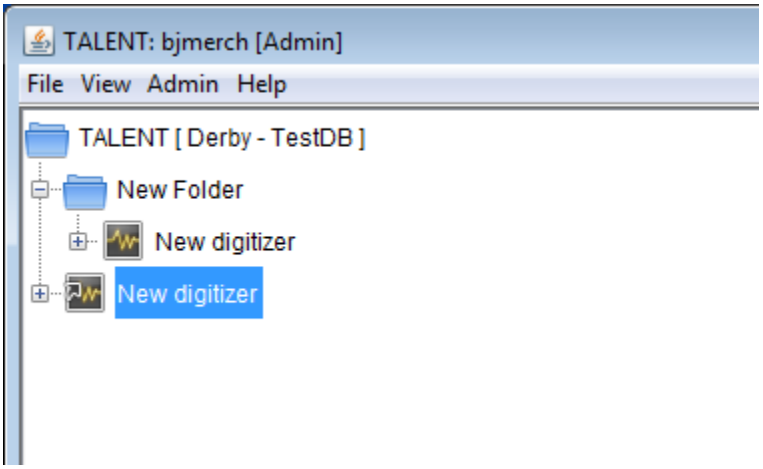
3.2.3 Drag and Drop

In addition to the copy and paste using the **Context Menu**, users can move content from one location to another within the TOC by performing a drag and drop operation.

The user may select one or more entries within the TOC and drag those entries to a new location within the TOC. Once the entries are dropped to a new location, TALENT will automatically move the entries from their prior location and add them to the drop location.

3.2.4 Shortcuts

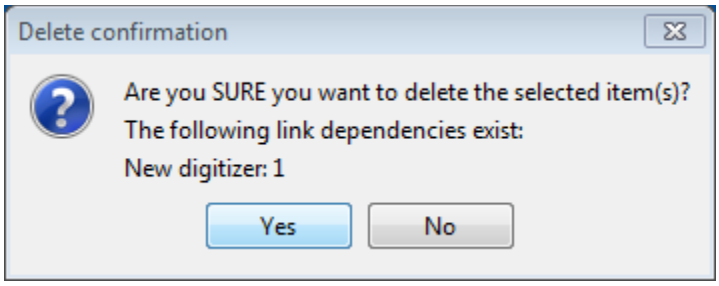
A user may create a shortcut, or link, to any entry within the TOC by using the **Copy** and **paste Shortcut** commands from within the TOC Context Menu. A shortcut is displayed within the TOC using the same icon as the original entry. However, the shortcut has a small arrow overlaying the icon as shown below:



The user may interact with the shortcut entry as if it were the original entry since the shortcut references the same content within the database. Any changes made in either location are reflected in both locations.

The user may delete the shortcut. However, deleting the shortcut deletes just the reference and not the original entry.

Deleting an original entry for which there are linked shortcuts results in the following warning message:

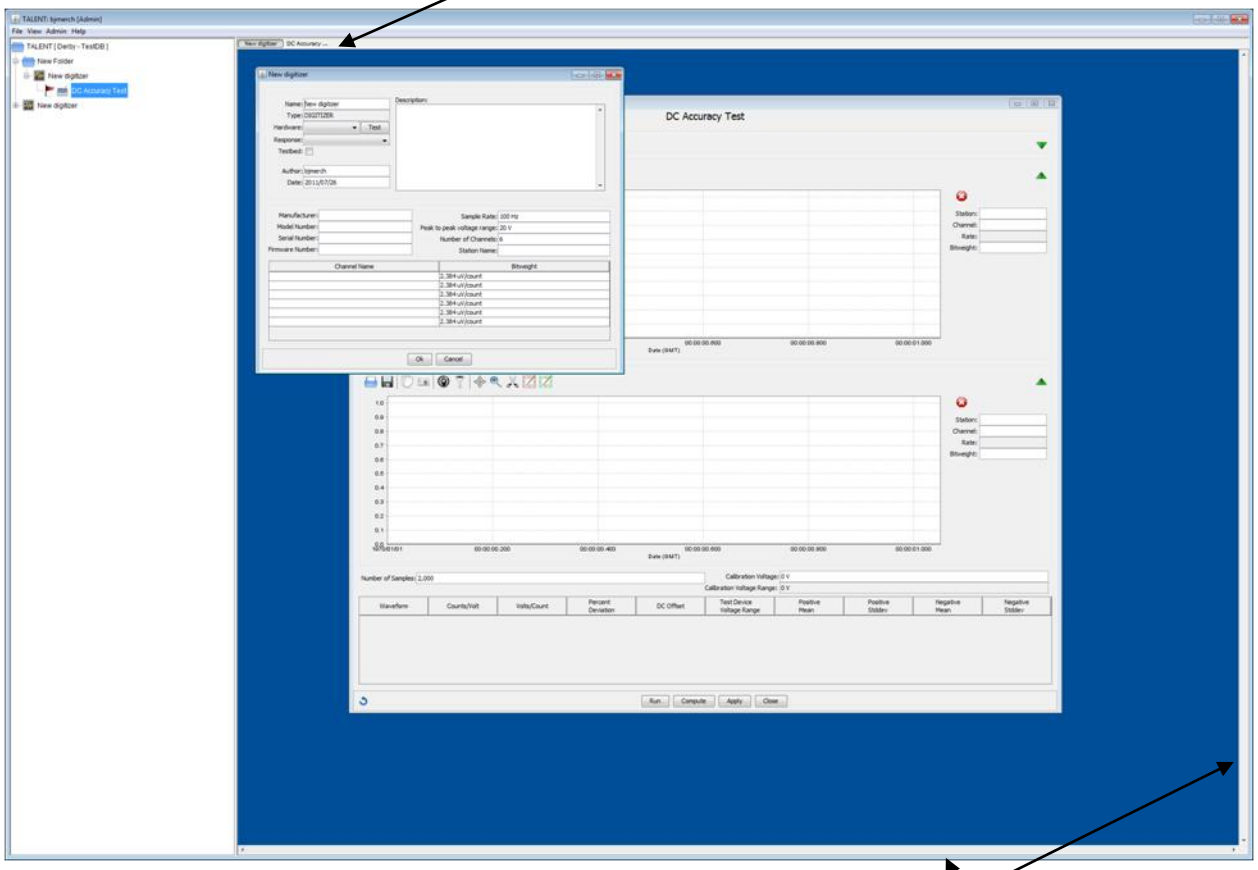


Shortcuts are intended as an easy way for the user to reference a device or set of tests in multiple locations without having to duplicate the information and worry about keeping the duplication synchronized. An example use case would be if the user were performing component levels tests on a piece of hardware that is also going to be a part of a subsystem for which there will be subsystem level tests. The user will be able to keep a reference to the same piece of hardware organized in multiple locations within the TOC.

3.3 Desktop

The TALENT **Desktop** provides an integrated workspace for managing any viewers that are created for displaying database content. In addition to the viewer dialog that is visible within the Desktop, each dialog window also has a corresponding button on the **Taskbar**. The user may bring a window to the front by clicking on its corresponding **Taskbar** button. Also, **Scrollbars** are provided on the bottom and right sides of the **Desktop**.

Taskbar



Scrollbars

4 RESPONSES

4.1 Overview

A response describes how a device transforms some input, represented by *x*, to an output, represented by *y*.

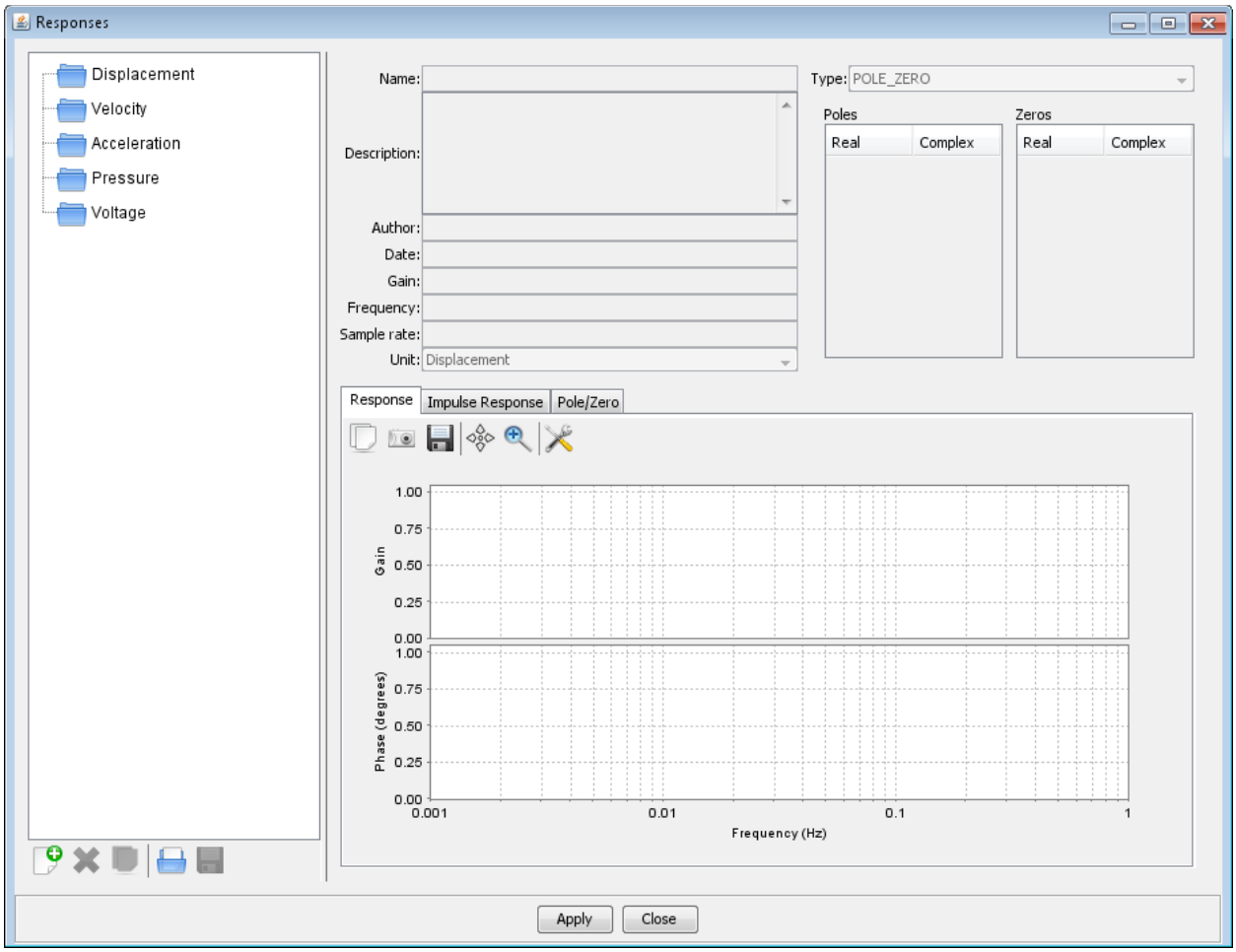
For the case of a seismometer that measures ground displacement, the input to the seismometer is ground motion measured in nanometers and the seismometer output is an electric potential measured in volts. So, the response, H, would have units of V/nm.

The TALENT application can store responses in its database. A user with administrative privileges will have to first setup the responses for other users to make use of. However, once the responses are setup, then any users will be able to view them and apply them within tests.

The purpose of including the responses within TALENT is to allow the user to take a waveform time series from a digitizer, measured in volts, and convert that voltage data to the original unit that was being measured by the device.

4.2 Managing

The responses stored within the database may be displayed by selecting the **View → Responses** menu item. Any user may view and change the responses. However, only an Administrator may save those changes to the database.



The available responses are listed along the left-hand side of the dialog. The responses are organized into folders based upon their input unit: Displacement, Velocity, Acceleration, Pressure, and Voltage.

Below the listed responses are several buttons for managing the responses:


Create a new response below the selected category folder.

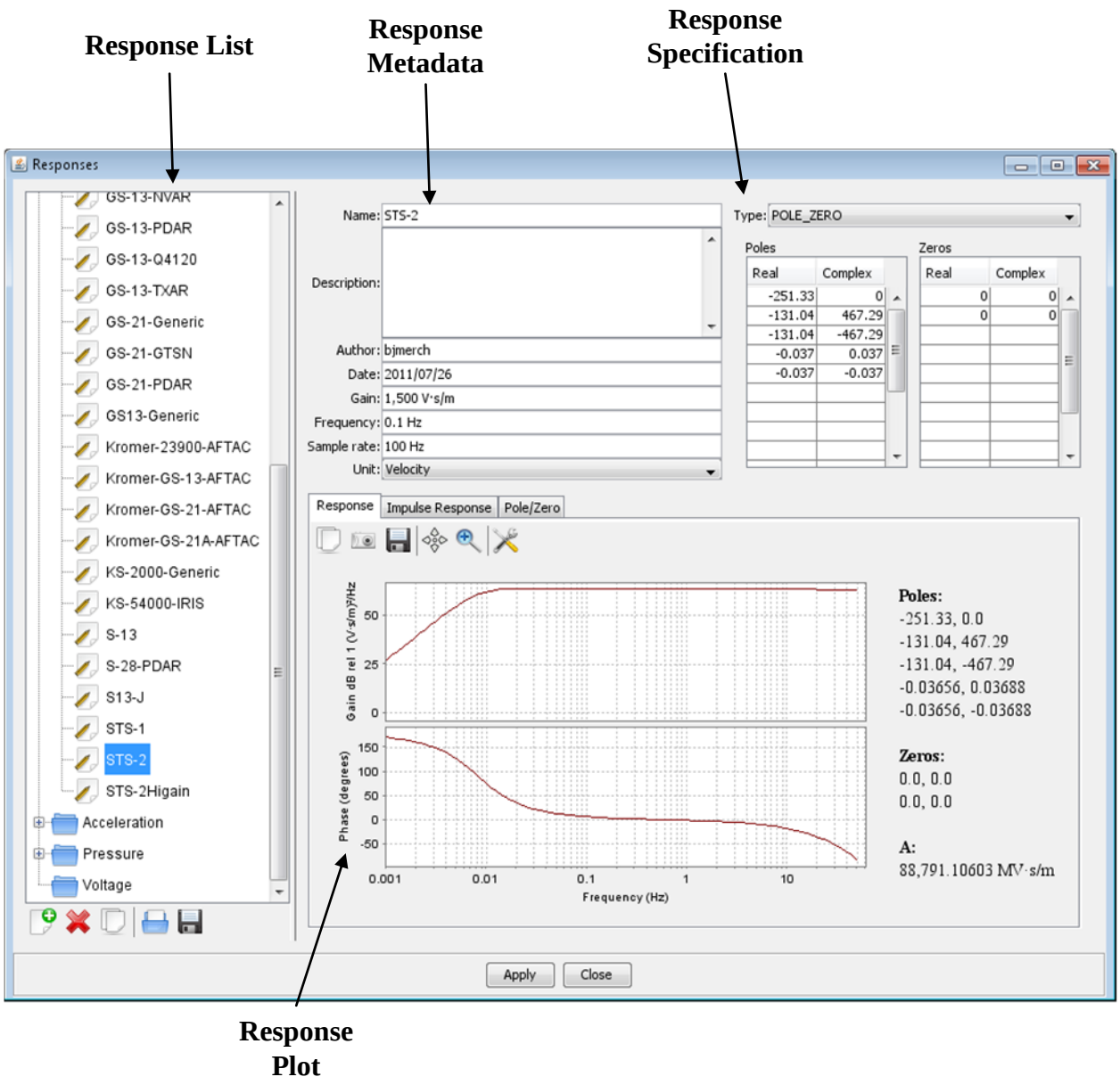

Delete the selected response.


Duplicate the selected response.


Import one or more responses from a text file.


Export the selected response to a text file.

The user may click on a response to display it within the response dialog.



At the top, the user may enter metadata about the response:

Name	The name used to label the response
Description	An arbitrary description of the response
Date	Date that the response was generated. Note that this date is not necessarily the date that it was entered into the TALENT database.
Gain	The gain, or sensitivity, of the response at some nominal frequency.
Frequency	The frequency at which the gain is specified.

Sample Rate	The presumed sample rate used for displaying the gain and phase plots.
Unit	The unit of the response input. Changing the unit will move the response to the appropriate folder within the list of responses.

To the right of the metadata, the user may specify the response in one of several methods by selecting the desired method from the pull down menu:

Pole/Zero	The user may enter the analog Poles and Zeros within the tables below the pull down menu.
FAP	The user may enter Frequency-Amplitude-Phase (FAP) values within the table below the pull down menu.
FIR	The user may enter Finite-Impulse-Response (FIR) coefficients within the table below the pull down menu.

Below the Metadata and Response Specification panes, there are several tabs that display information about the response that was entered. Each of the tabs contains a chart of the relevant information. The charts have several icons across the top:


Copy an image of the chart onto the clipboard.

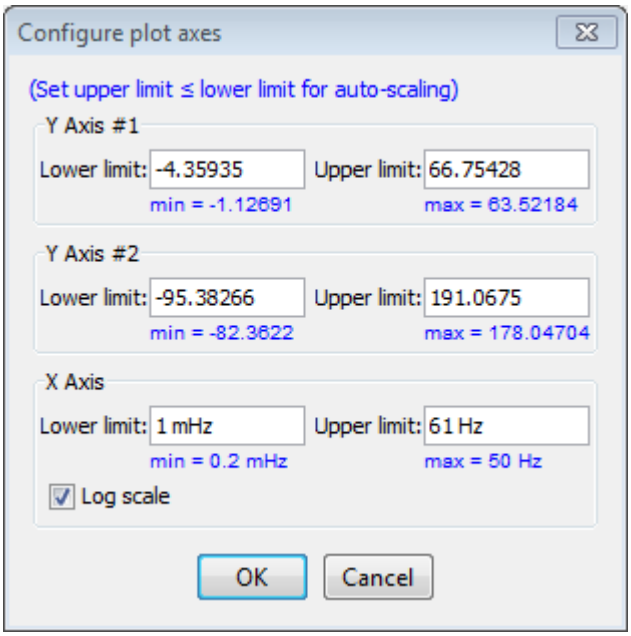

Save an image of the chart to a file on disk.


Export the data in the chart as a text file on disk.


Enable panning on the chart. Pan the chart display by dragging with the left mouse button.

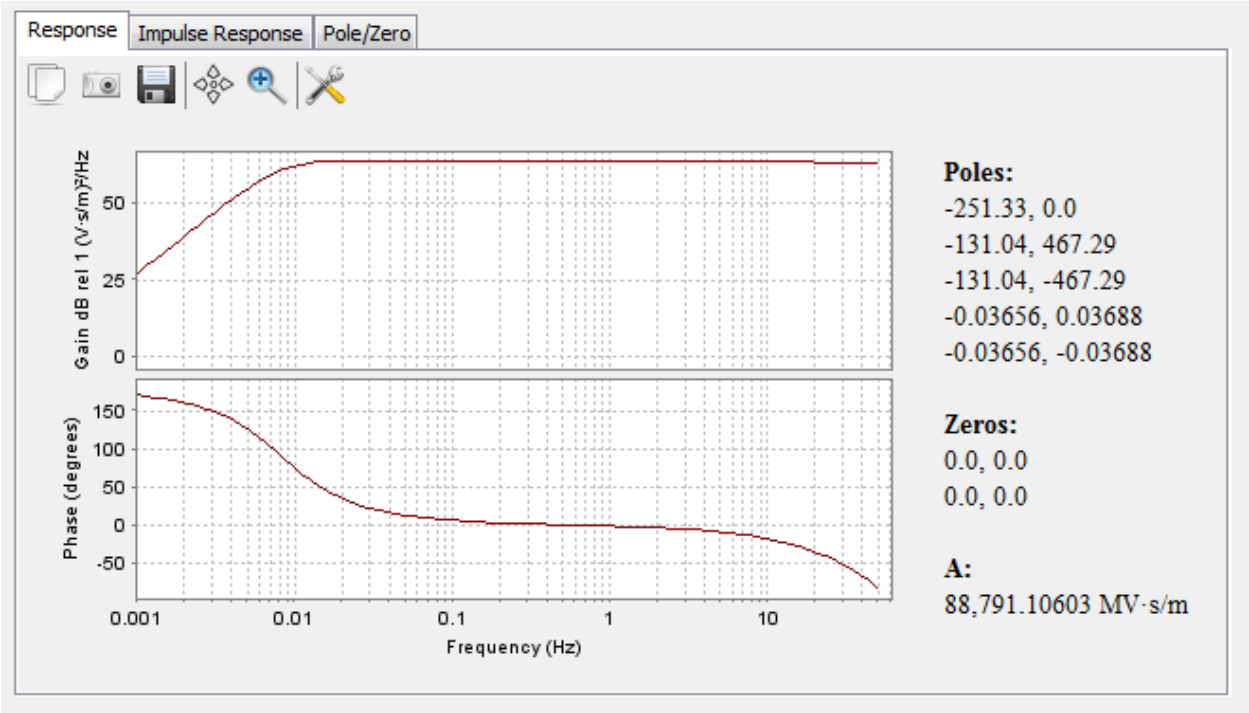

Enable zooming on the chart. The user may zoom in by using the left mouse button to draw a box around the desired zoom region or a single click to zoom in a fixed amount. The user may zoom out a fixed amount by clicking with the right mouse button.


Configure the plot axes. Use the dialog box, similar to the one shown below, to manually enter the axes limits.



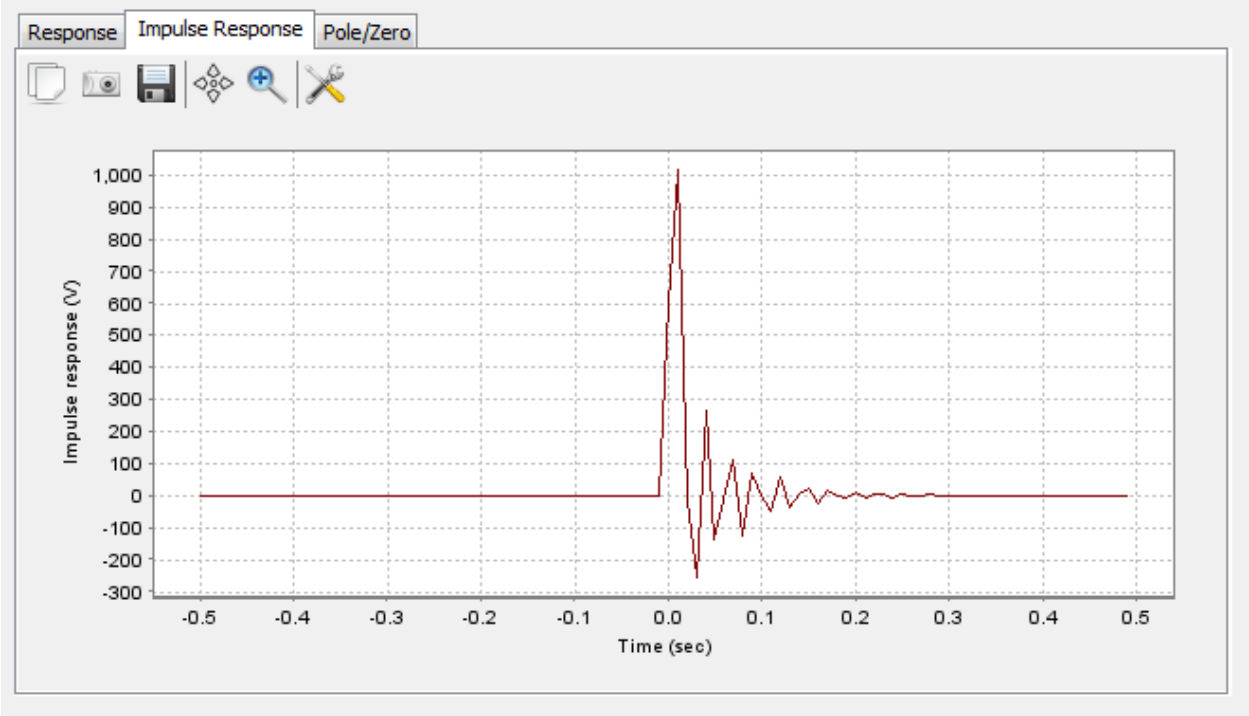
Magnitude and Phase Response

The magnitude and phase response plots display the amount of response gain in decibels and phase response in degrees versus frequency.



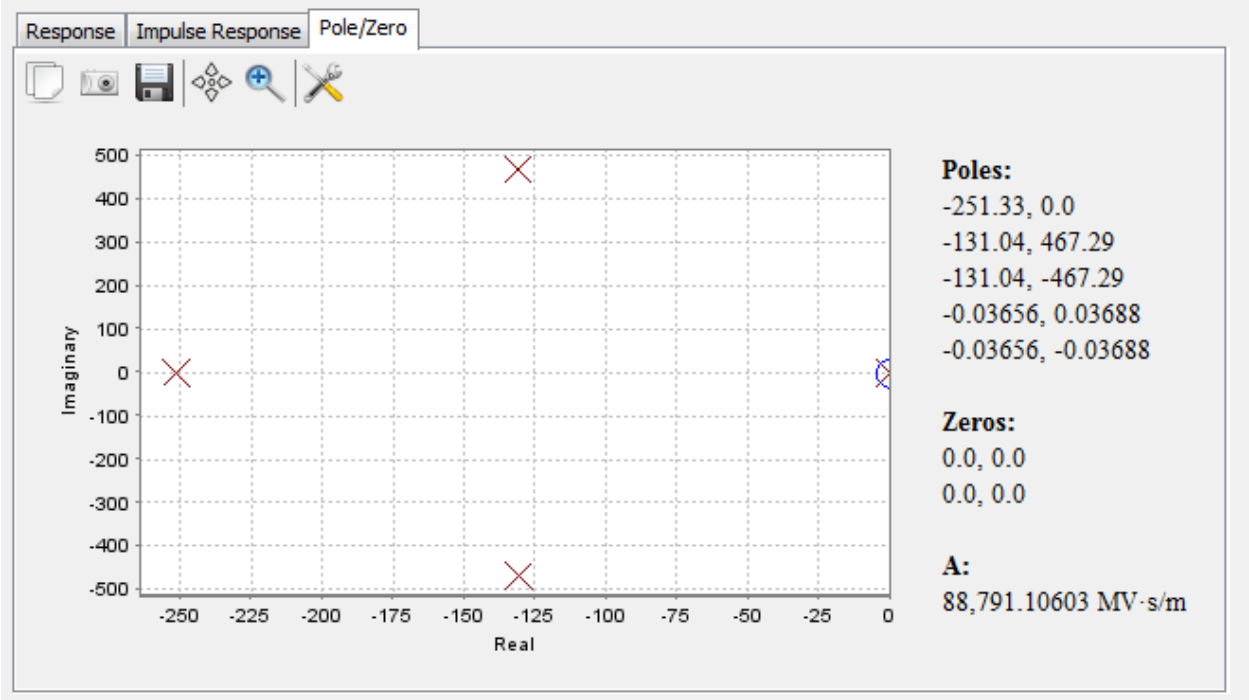
Impulse Response

The impulse response plot displays the resulting output of the response if a single impulse were provided as input to the response.



Pole/Zero

The pole/zero plot displays the locations of the poles and zeros of the response.



4.3 Applying Responses

Responses may be applied to the waveform time series within tests by selecting the desired response from within the Waveform Viewer. Once the response is selected, the time series will be displayed in the input unit of the response instead of in Volts. This conversion is a simple approximation made by dividing the time series in Volts by the response sensitivity at the calibration frequency (Volts/Input Unit) to obtain a time series. See the section on the Waveform Viewer for additional details.

If the test contains plots of Power Spectra versus frequency, then the selected waveform response will be used to perform frequency domain response removal in order to shape the power spectra.

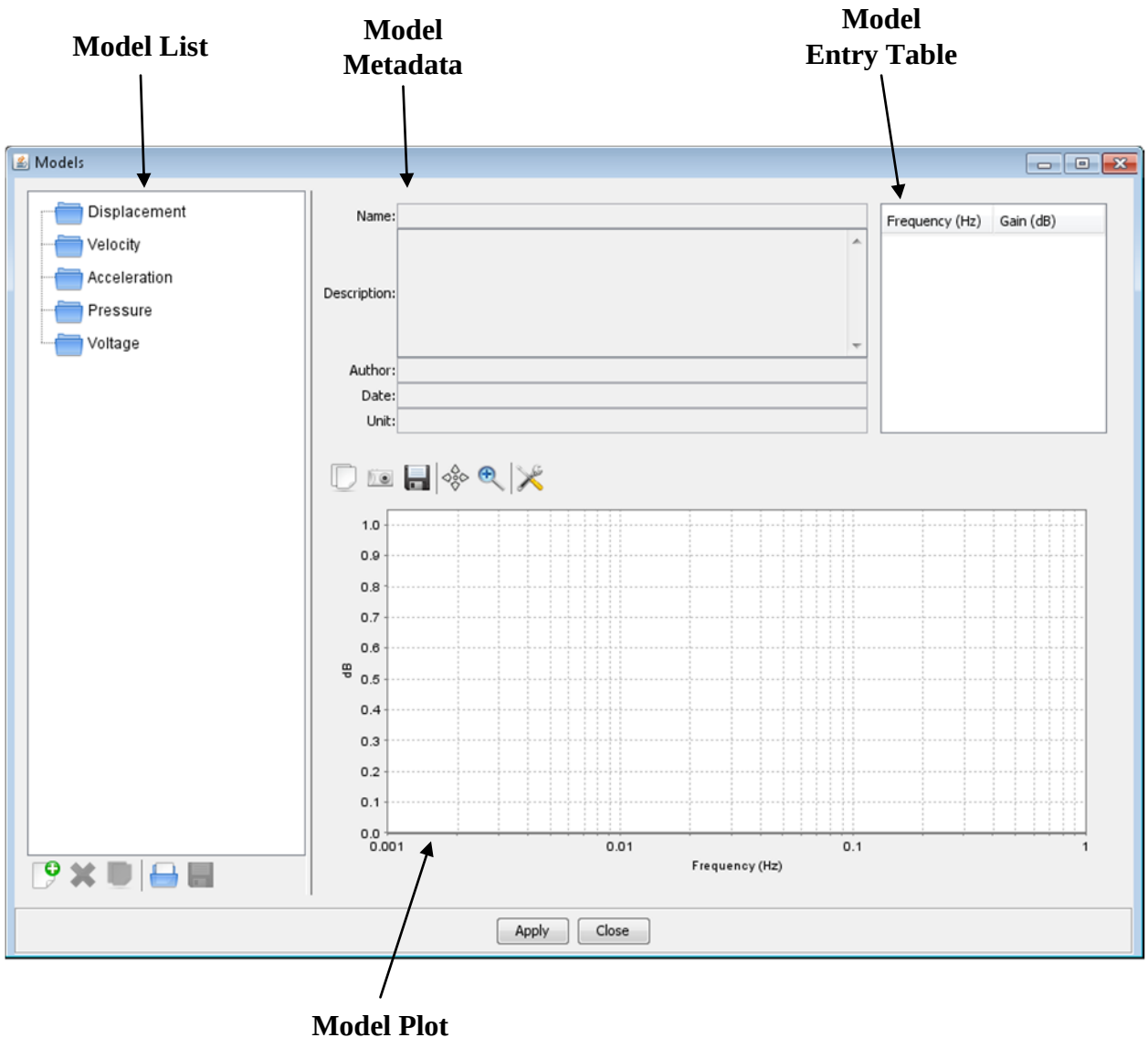
5 MODELS

5.1 Overview

A model describes a simplified representation of some quantity that varies with frequency. Examples of possible models include site background noise, device self noise, threshold requirements, etc. The purpose of including the models within TALENT is to allow the user to overlay the models on top of power spectra for comparison.

5.2 Managing

The models stored within the database may be displayed by selecting the **View → Models** menu item. Any user may view and change the models. However, only an Administrator may save those changes to the database.



The available models are listed along the left-hand side of the dialog. The models are organized into folders based upon their unit: Displacement, Velocity, Acceleration, Pressure, and Voltage.

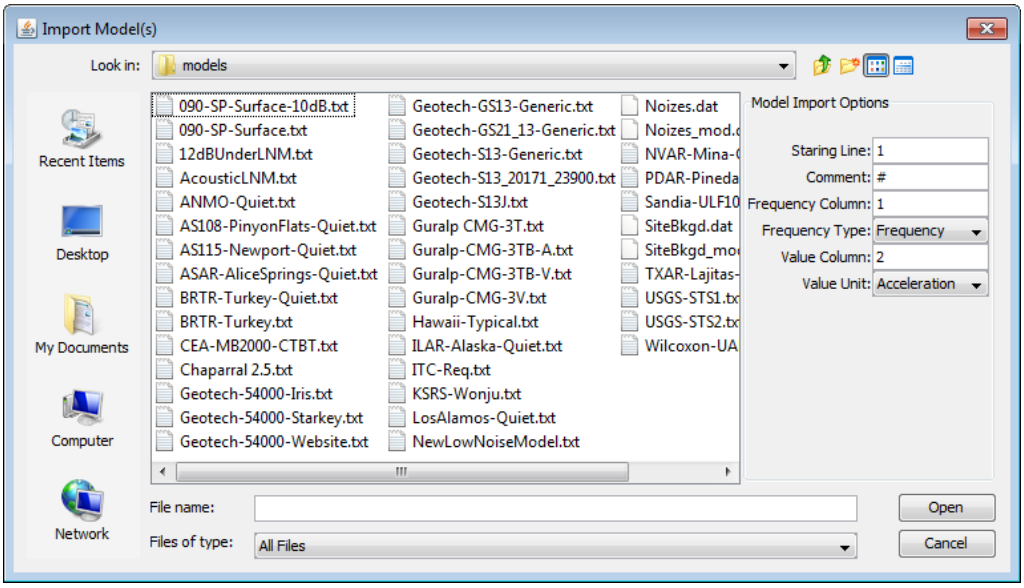
Below the listed responses are several buttons for managing the responses:

Create a new model below the selected category folder.

Delete the selected model

Duplicate the selected model.

Import one or more models from a text file.



The model import dialog shown above allows the user to select one or more ASCII text files that contain model definitions. The format must contain the model values in white space delimited columns with one row per frequency and value.

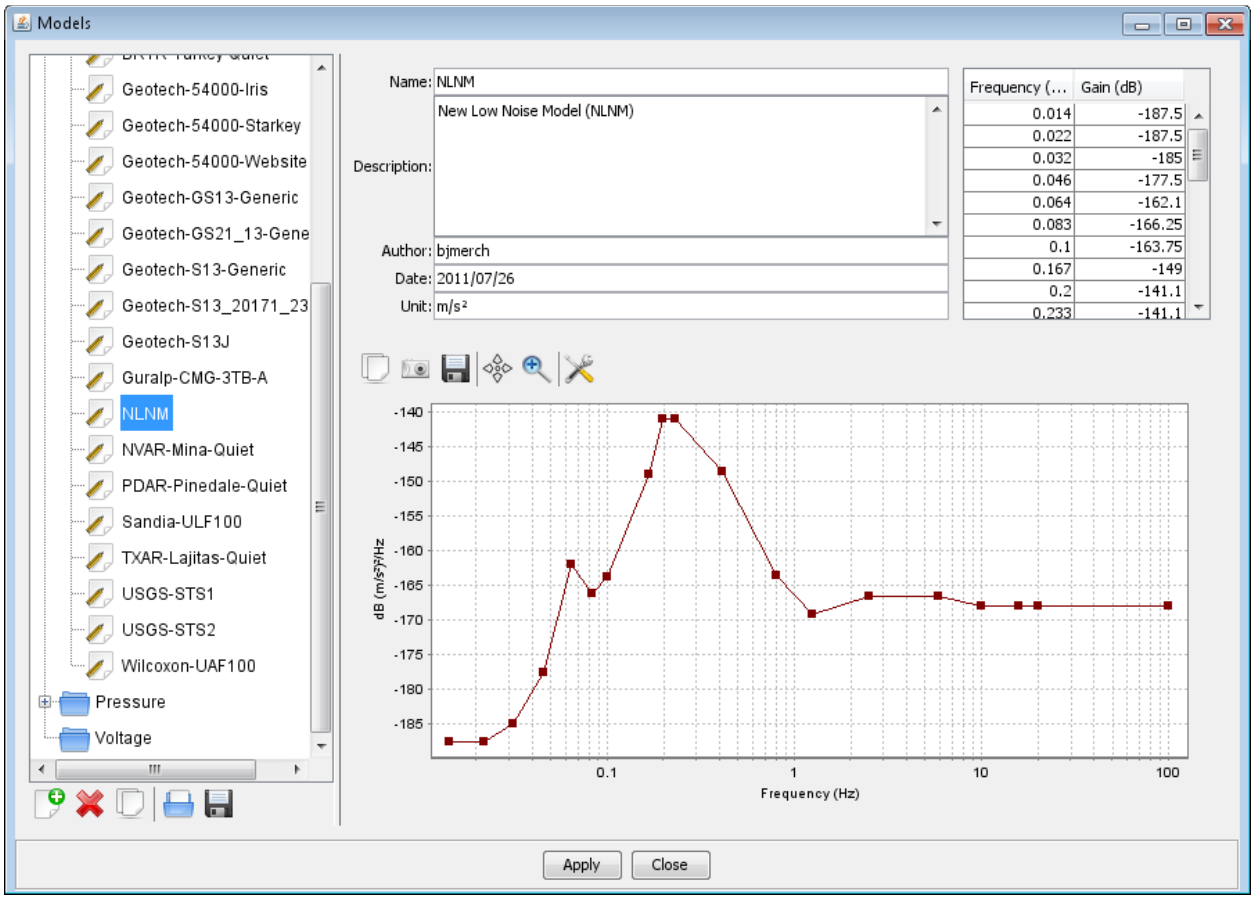
There are a number of model import options displayed on the right hand side of the import dialog:

Starting Line	The first line of the file to start parsing. All preceding lines will be skipped
Comment	The character used to

	identify a comment line. Any text on a comment line will be imported into the model description
Frequency Column	The column number, starting with 1, that contains the frequencies.
Frequency Type	Select whether the frequency is stored as frequency or period.
Value Column	The column number, starting with 1, that contains the values.
Value Unit	The unit of the values, selected from Displacement, Velocity, Acceleration, Pressure, or Voltage.

 Export the selected model to a text file.

The user may click on a model to display it within the model dialog.



At the top, the user may enter metadata about the model:

Name	The name used to label the model.
Description	An arbitrary description of the model.
Date	Date that the model was generated. Note that this date is not necessarily the date that it was entered into the TALENT database.
Unit	The unit of the model data that the decibel gain values are relative to.

To the right of the metadata, the user may specify the model by entering the frequency (Hz) and gain (decibel) values in the table. Any values entered will automatically be sorted in order of increasing frequency.

Below the Metadata and model entry panes, there is a chart displaying the model that has been entered. The chart has several icons across the top:

 Copy an image of the chart onto the clipboard.

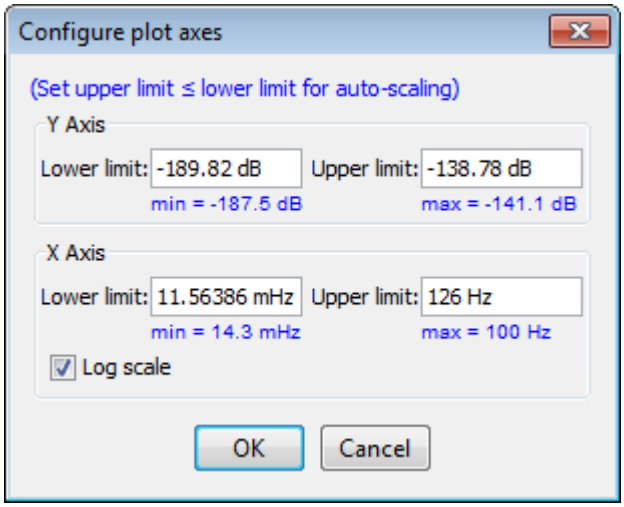
Save an image of the chart to a file on disk.

Export the data in the chart as a text file on disk.

Enable panning on the chart. Pan the chart display by dragging with the left mouse button.

Enable zooming on the chart. The user may zoom in by using the left mouse button to draw a box around the desired zoom region or a single click to zoom in a fixed amount. The user may zoom out a fixed amount by clicking with the right mouse button.

Configure the plot axes. Use the dialog box, similar to the one shown below, to manually enter the axes limits.



5.3 Applying

A model is applied within a test module simply by selecting it from a list within the PSD Viewer. The model will then be displayed within the PSD. See the section on the PSD Viewer for additional detail.

Note that for seismic applications including models specified in displacement, velocity, and acceleration, the models are dynamically transformed to the desired unit of ground motion.

6 COMPONENTS

6.1 Overview

Components within TALENT represent a single physical device that has some role in performing testing. Components may represent a device under test, a portion of the Testbed, a portion of a System or Subsystem, or a dependency within a test.

There are several types of components that are available within the application:

- Digitizers
- Seismic Sensor
- Infrasound Sensor
- Meter
- Signal Generator
- GPS Trigger
- Isolation Chamber
- Seismic Source
- Infrasound Source
- Temperature Sensor
- Power Supply
- Generic Testbed Sensor

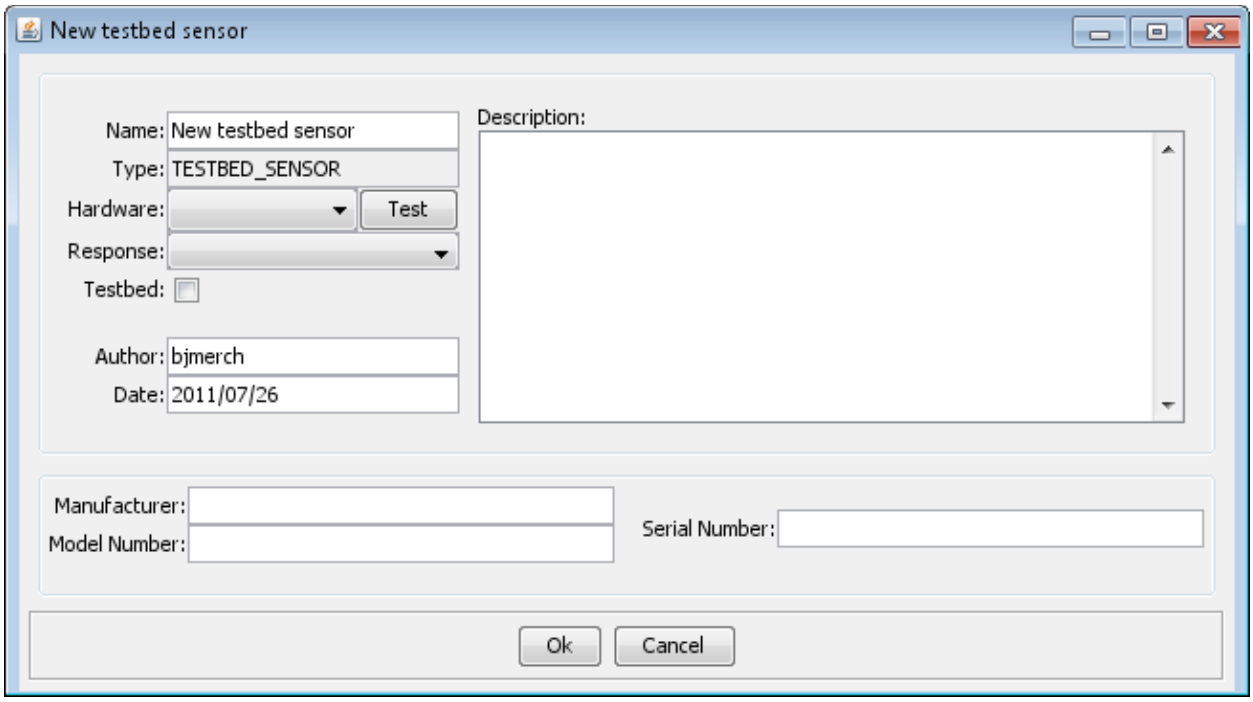
A component type is specified at the time of creation. Once a component has been created, its type cannot be changed.

6.2 Managing

The specific metadata about a component may be displayed and changed by selecting the TOC entry representing the desired Component, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A viewer specific to the component will then appear within the application desktop. All of the component viewers share a common layout and appearance. However, some of the components have additional attributes that may be defined.

The base Component Viewer is shown below:



The component metadata is contained within the upper portion of the component viewer:

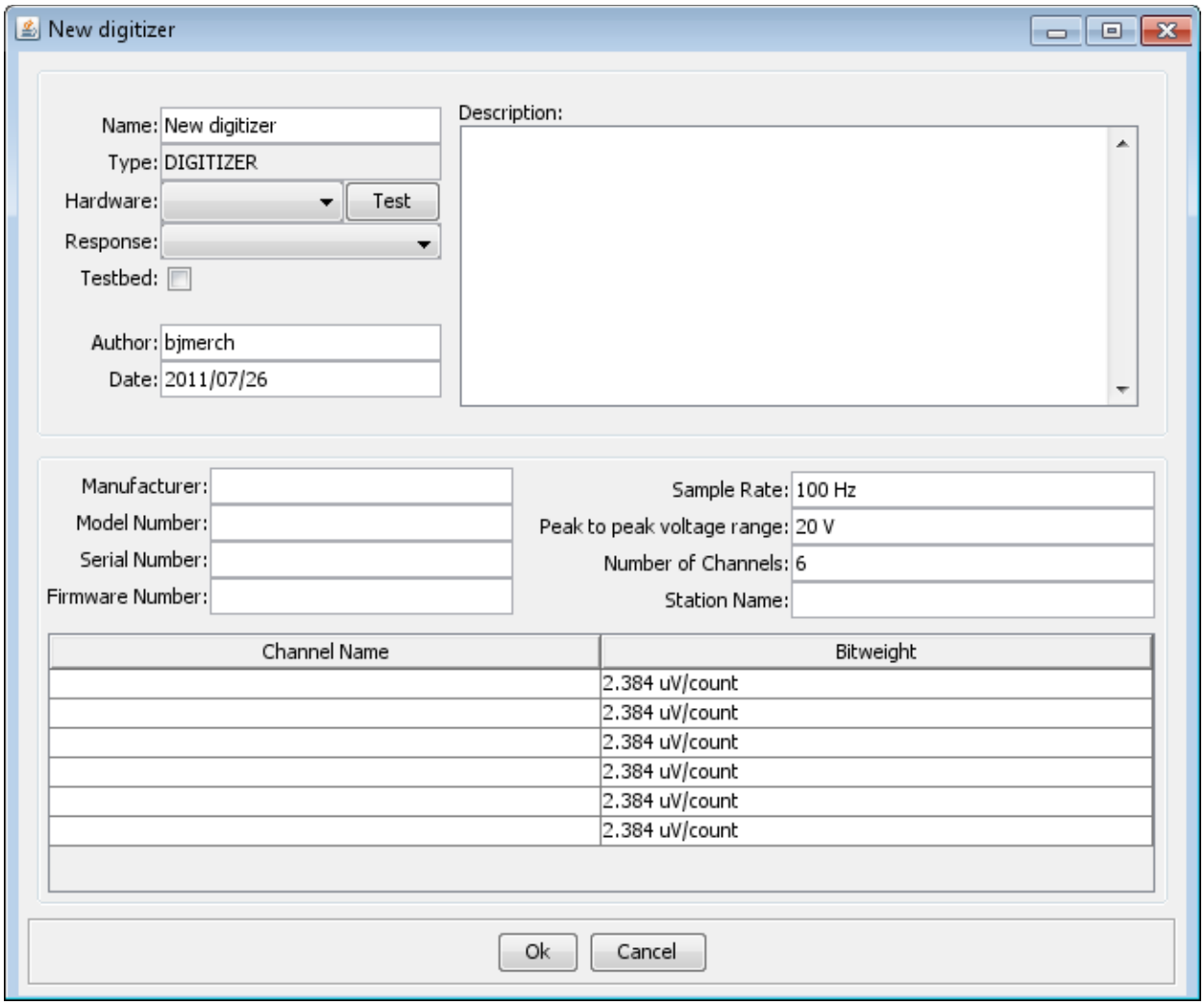
Name	The name used to label the component.
Type	The type code stored in the database to identify the type of component
Hardware	A selection of hardware interfaces used for automated test command and control. See the Command and Control section for a more detailed description. The **Test** button attempts to connect to the hardware interface. A dialog is displayed to inform the user whether the connection failed or was successful.
Response	The associated response, if available, for this component.
Testbed	A flag indicating whether this component is a part of the Testbed. Components that are a part of the testbed are included within selection lists for component dependencies within the Test Viewers.
Author	Author who entered the component into the database.
Date	Date that the component was entered into the database in YYYY/MM/DD format.
Description	An arbitrary description of the component.

Below the metadata are the attributes that are defined for each type of component. The attributes that all components share are:

Manufacturer	The name of the component manufacturer.
Model Number	The model of the component.
Serial Number	The serial number of the component.

For those components that have additional attributes, a brief overview of each component is provided below.

6.2.1 Digitizer



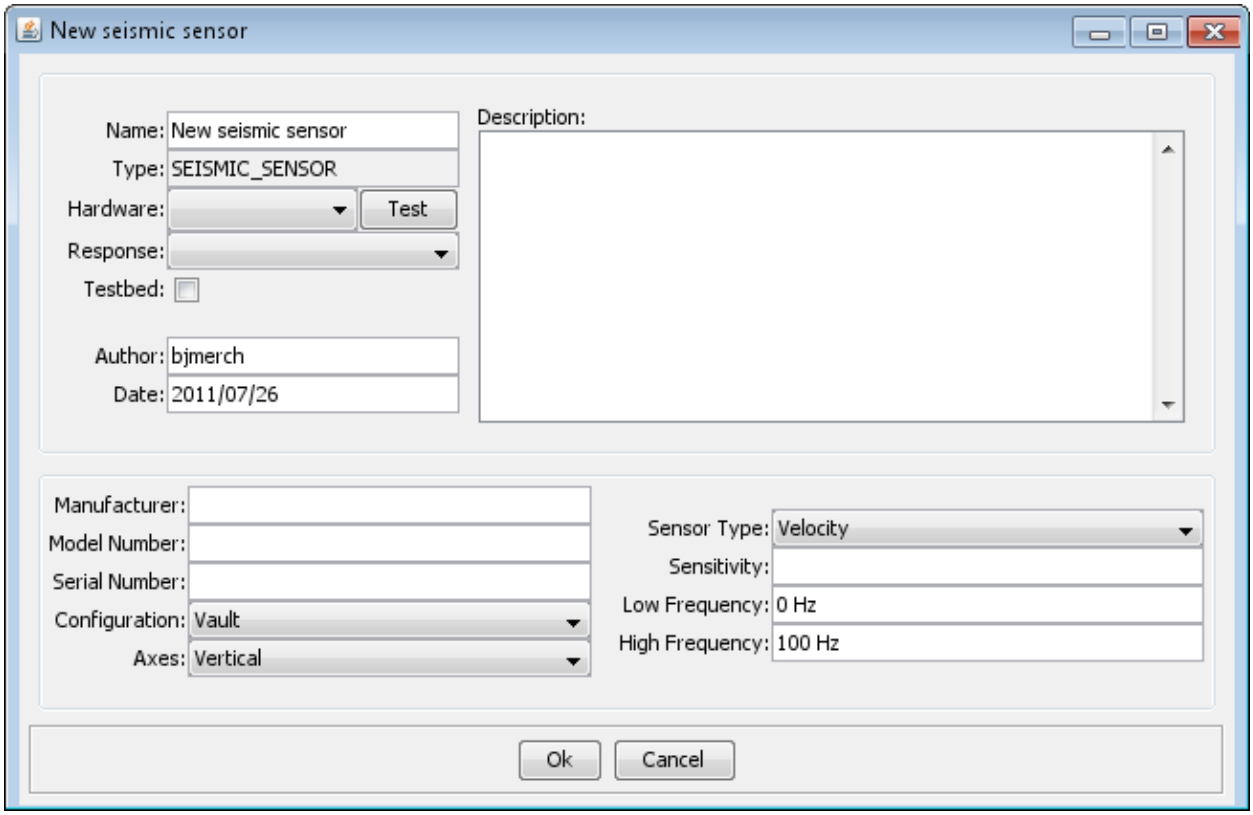
Firmware Number	The component firmware number
Sample Rate	The configured sample rate of the digitizer. This sample rate

	is used within the tests that are associated with this digitizer. For example, when controlling a Meter, the meter is automatically configured to sample at this rate.
Peak to peak voltage	The peak to peak voltage range.
Number of Channels	The number of channels that the digitizer can record. There is a no maximum to the number of channels.
Station Name	The preferred station name for this digitizer.

Below the specific digitizer attributes, there is a table of channel names and bitweight values. These bitweight values are the preferred bitweights for each of the digitizer channels. It is expected that these bitweights would be either the manufacturer's nominal bitweights or the experimentally derived bitweights from testing.

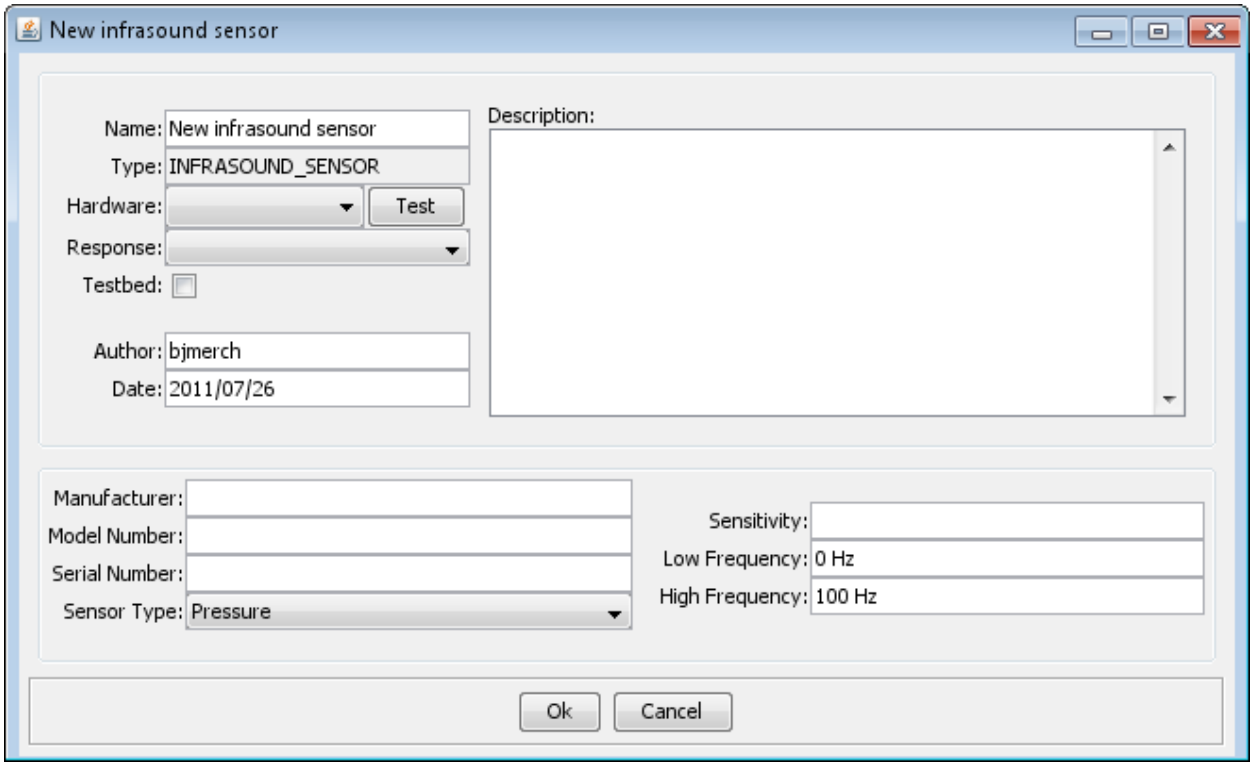
The channel names and bitweights within the table will be used when a waveform time-series is loaded within a test that references this digitizer. If the waveform time-series has a channel name that matches an entry in the table, then the corresponding bitweight will be automatically applied to the waveform.

6.2.2 Seismic Sensor



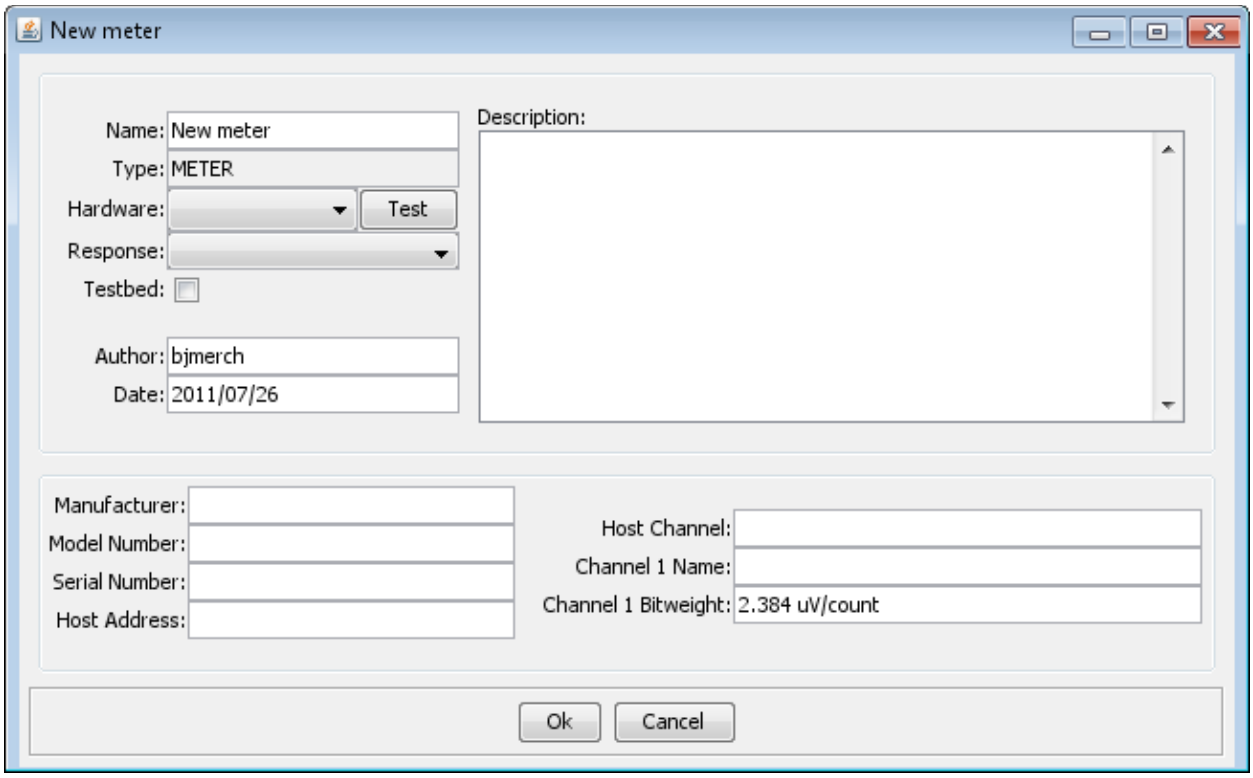
Configuration	The installation configuration of the sensor: Vault or Borehole.
Axes	The axes configuration of the sensor: Vertical, Horizontal, or 3-Axis.
Sensor Type	The type of ground motion that the sensor outputs: Displacement, Velocity, or Acceleration
Sensitivity	The nominal sensitivity of the sensor
Low Frequency	The low frequency cutoff of the sensor's bandpass.
High Frequency	The high frequency cutoff of the sensor's bandpass.

6.2.3 Infrasound Sensor



Sensor Type	The type of air motion that the sensor outputs: Pressure.
Sensitivity	The nominal sensitivity of the sensor
Low Frequency	The low frequency cutoff of the sensor's bandpass.
High Frequency	The high frequency cutoff of the sensor's bandpass.

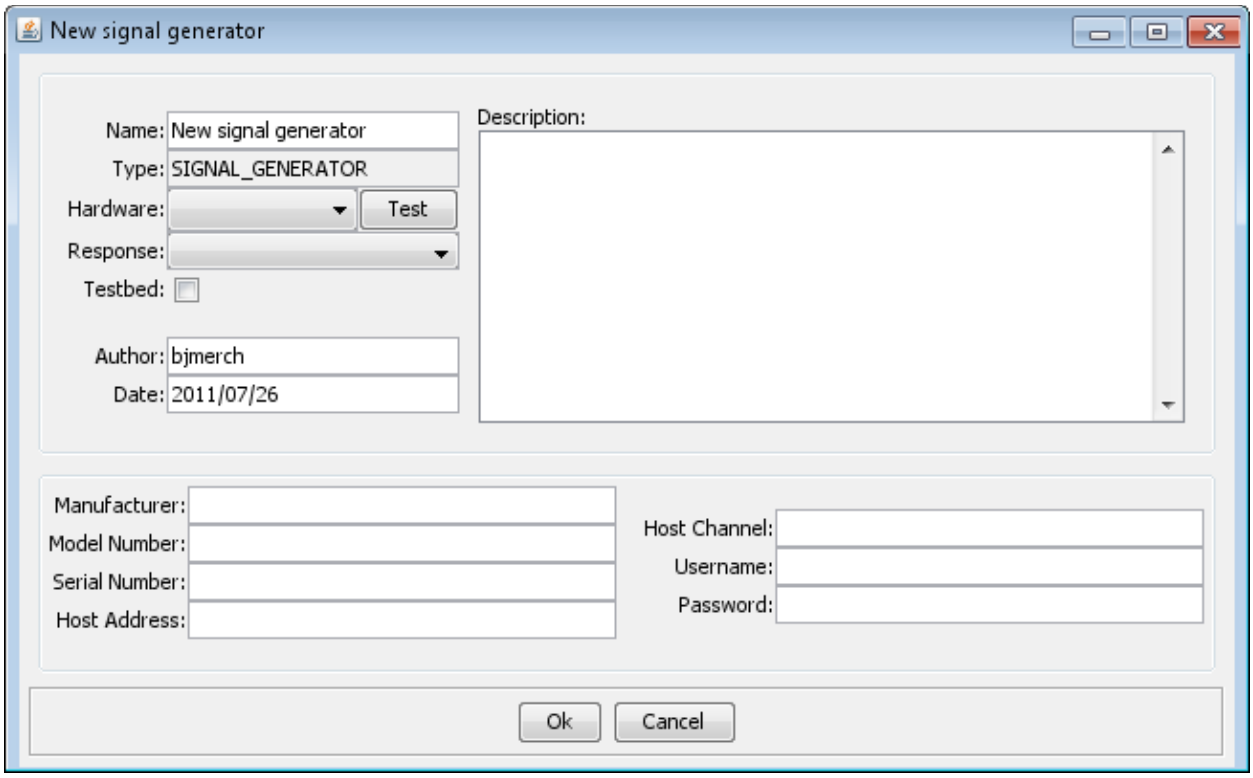
6.2.4 Meter



Host Address	The Host name or IP Address of the meter on the network
Host Channel	The channel number of the Meter.
Channel 1 Name	The preferred channel name for this meter.
Channel 1 Bitweight	The preferred bitweight for this meter. Note that most meters have a dynamic bitweight that changes depending its configuration. Setting a preferred bitweight in this field may incorrectly override the bitweight coming from the meter.

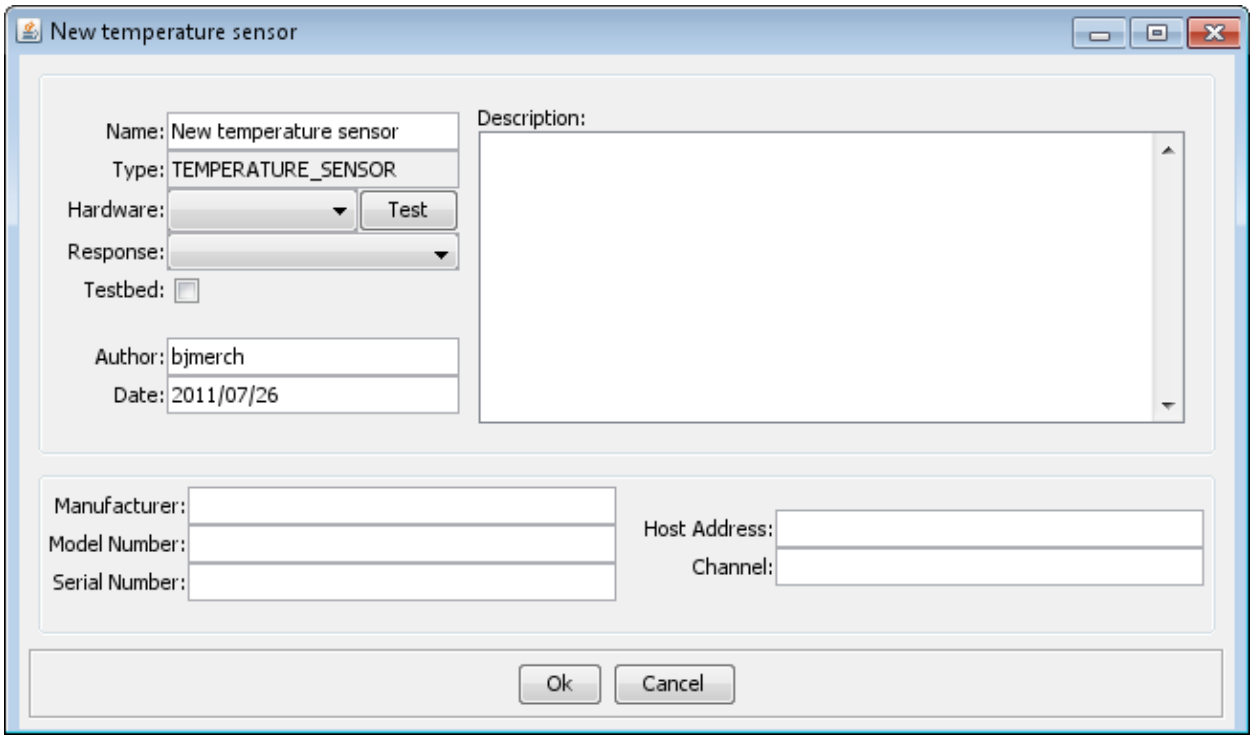
The Host Address and Host Channel attributes are intended to allow the Hardware interface to connect to the meter on an Ethernet network through an Ethernet to GPIB adapter. The Host Address is the Ethernet address of the adapter. The Host Channel is the GPIB Address of the meter. Typically, if there is only a single GPIB device on the adapter, then the address will default to 22.

6.2.5 Signal Generator



Host Address	The Host name or IP Address of the function generator on the network
Username	The username for connecting to the function generator
Password	The password for connecting to the function generator

6.2.6 Temperature Sensor



Host Address	The Host name or IP Address of the temperature sensor
Channel	The channel number on the temperature sensor, if the device has multiple channels of temperature sensing.

7 SUBSYSTEMS

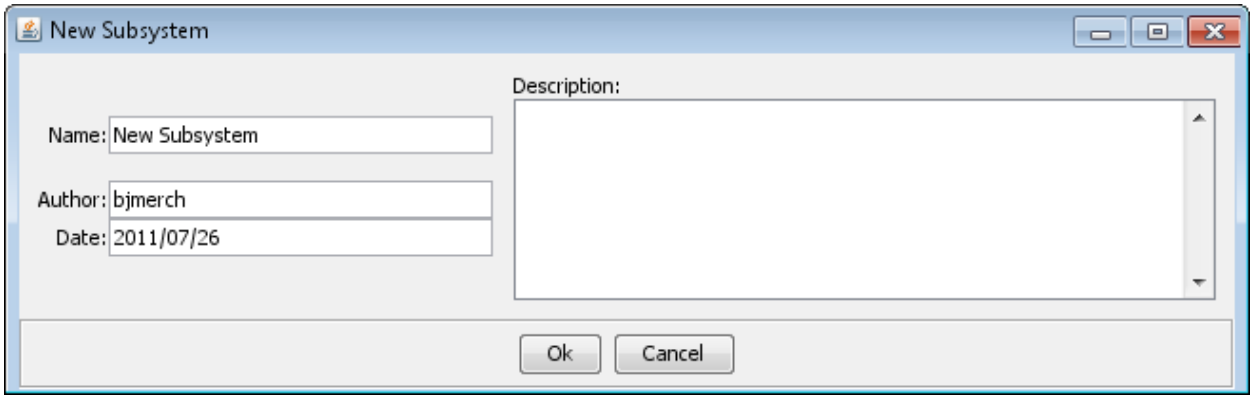
7.1 Overview

Subsystems within TALENT represent a collection of components that are intended to be operated together as a subsystem. Typically, a subsystem includes a digitizer and one or more sensors: seismic and/or infrasound. The components that make up a subsystem are either created or linked using a shortcut within the subsystem folder. The purpose of testing a subsystem is to test a specific digitizer and sensor pair together to determine if their performance is similar to the results from the component level testing.

7.2 Managing

The specific metadata for a subsystem may be displayed and changed by selecting the TOC entry representing the desired subsystem, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A subsystem viewer will then appear within the application desktop.



Name	The name used to label the subsystem.
Author	Author who entered the subsystem into the database.
Date	Date that the subsystem was entered into the database in YYYY/MM/DD format.
Description	An arbitrary description of the subsystem.

8 SYSTEMS

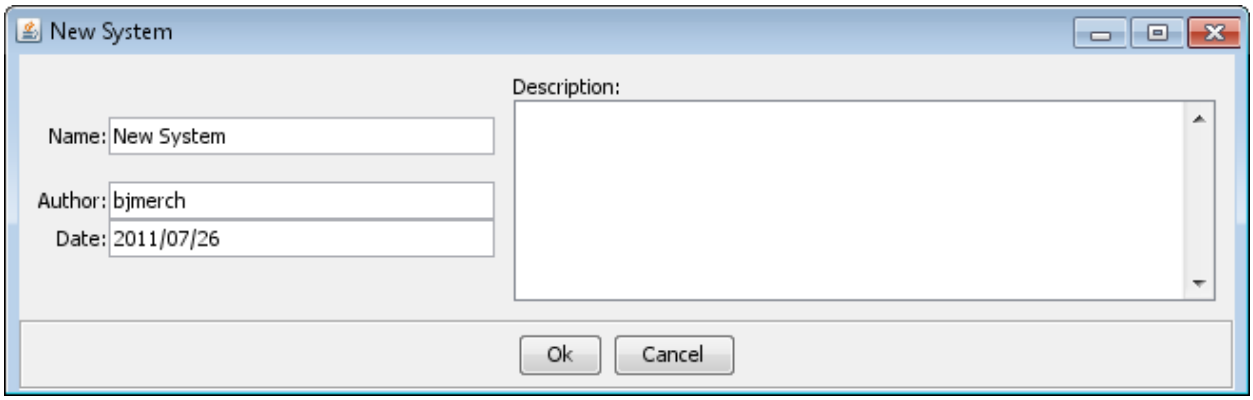
8.1 Overview

Systems within TALENT represent a collection of subsystems that are intended to be operated together. Typically, a system includes multiple subsystems and some number of components. The components and subsystems that make up a system are either created or linked using a shortcut within the subsystem folder.

8.2 Managing

The specific metadata for a system may be displayed and changed by selecting the TOC entry representing the desired system, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A system viewer will then appear within the application desktop.



Name	The name used to label the system.
Author	Author who entered the system into the database.
Date	Date that the system was entered into the database in YYYY/MM/DD format.
Description	An arbitrary description of the system.

9 TEST PROCEDURES

9.1 Overview

The test procedures are an abstracted level above the test modules. A test procedure defines a set of steps that must be performed in the course of a test. Each step contains a description that includes written directions of what must be performed. The procedure and its steps, along with a unique procedure type, are stored within the database. A given test procedure is tied to a single test module. However, there may be multiple procedures for a given test module.

As an example:

Test Procedure	**Test Module**
DC Accuracy	DC Accuracy
DC Full Scale	DC Accuracy
DC Over Scale	DC Accuracy

DC Accuracy, DC Full Scale, and DC Over Scale test procedures all use the DC Accuracy test module. However, they have slightly different procedures directing the test operator to apply voltage levels that are within, at, or above the digitizer's full scale range.

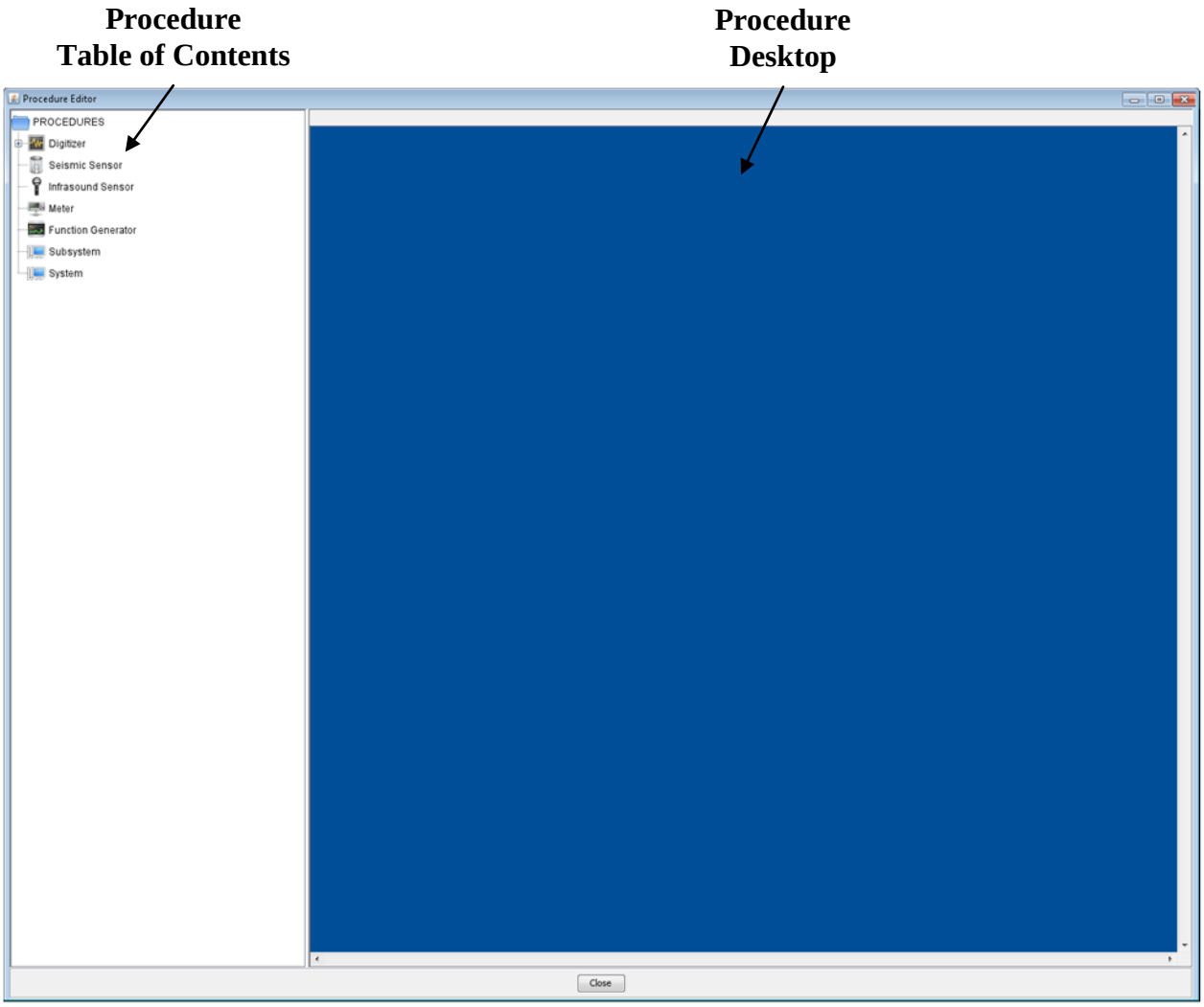
Each procedure is specific to a System, Subsystem, or Component test. In the case of Component tests, procedures are also specific to a particular type of Component (seismic sensor, digitizer, meter, etc). The parameters and results of procedures may be subject to certain allowable ranges of values for a given test. These requirements will be used to validate the results of a test.

Only an Administrator may make changes to the test procedures stored in the database.

9.2 Managing

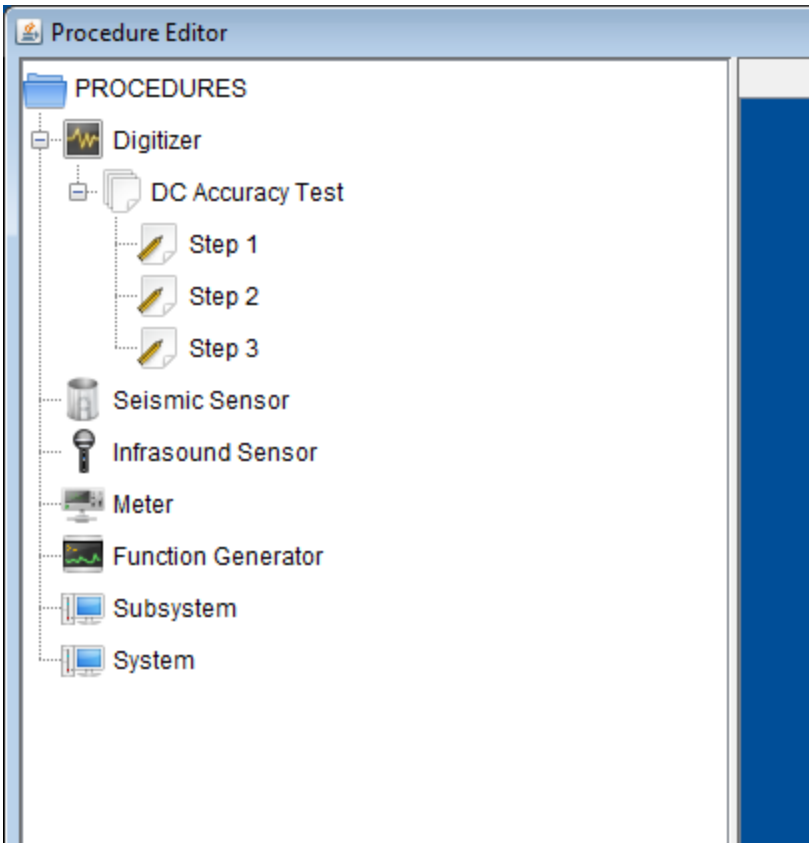
The test procedures stored within the database may be displayed by selecting the **Admin → Procedure Editor** menu item. Only an Administrator has access to the procedure editor.

The **Procedure Editor** will appear within the TALENT Desktop as shown below.

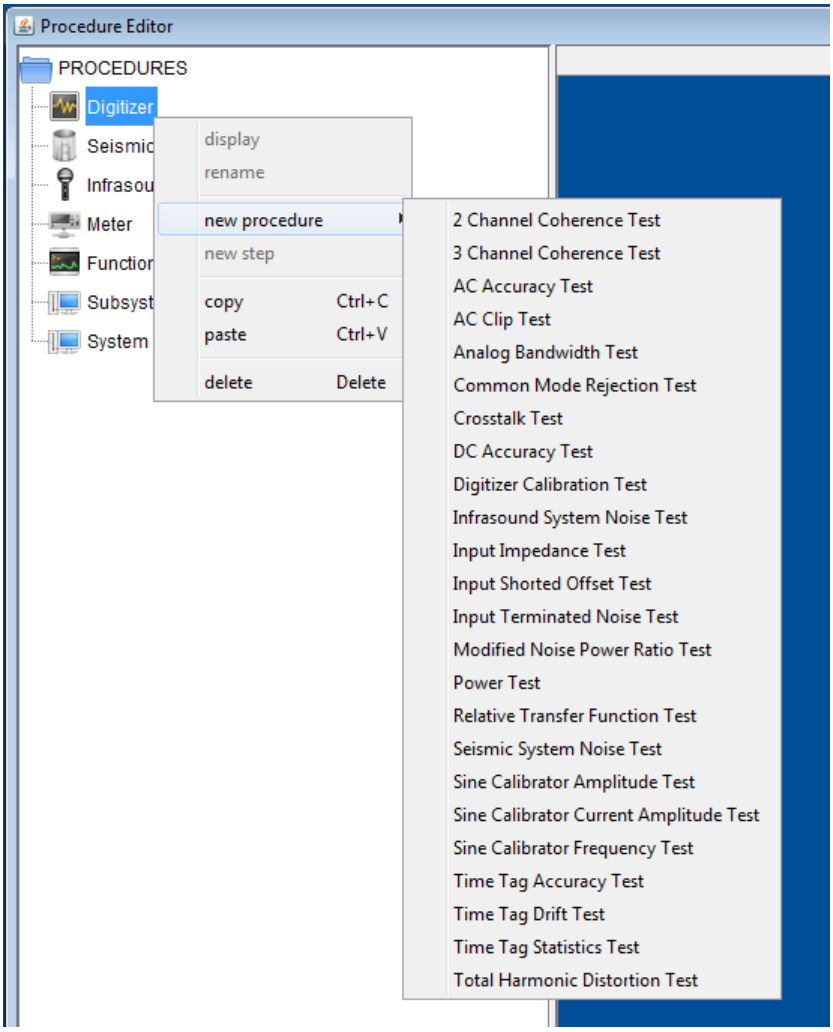


The **Procedure Editor** is comprised of a desktop and a table of contents. The procedure desktop, similar to the TALENT desktop, is where the viewers related to the procedures are displayed. The procedure table of contents contains entries for each of the component types, subsystems, and systems for which there are test modules.

The top level entries within the table of contents are the components, subsystems, and systems for which test procedures may be created. Below each top level entry are the test procedures. The administrator may arrange the order of these procedures however they may like. Below each procedure are the ordered steps for that procedure.

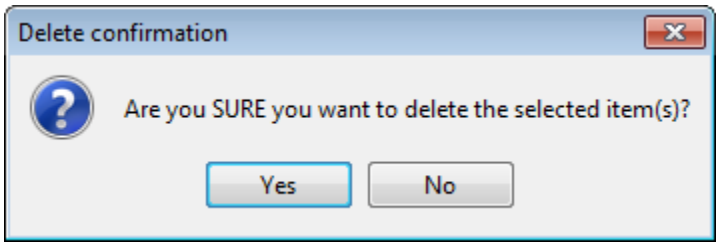


Select an entry in the table of contents and right-click with the mouse to display the context menu shown below:



Display	Display the appropriate viewer within the desktop for the selected procedure or step. The user may also perform this action by double-clicking the TOC entry with the left mouse button.
Rename	Change the name of the selected procedure or step.
New Procedure	Create a new procedure below the selected component, subsystem, or system. The menu of available procedures is dynamic depending upon the selected entry in the table of contents.
New Step	Create a new Step below the selected procedure.
Copy	Copy the selected TOC entries onto the clipboard.
Paste	Paste the entries on the clipboard within the selected TOC entry.
Delete	Delete the selected procedures and steps. The user will

be prompted to confirm the deletion:

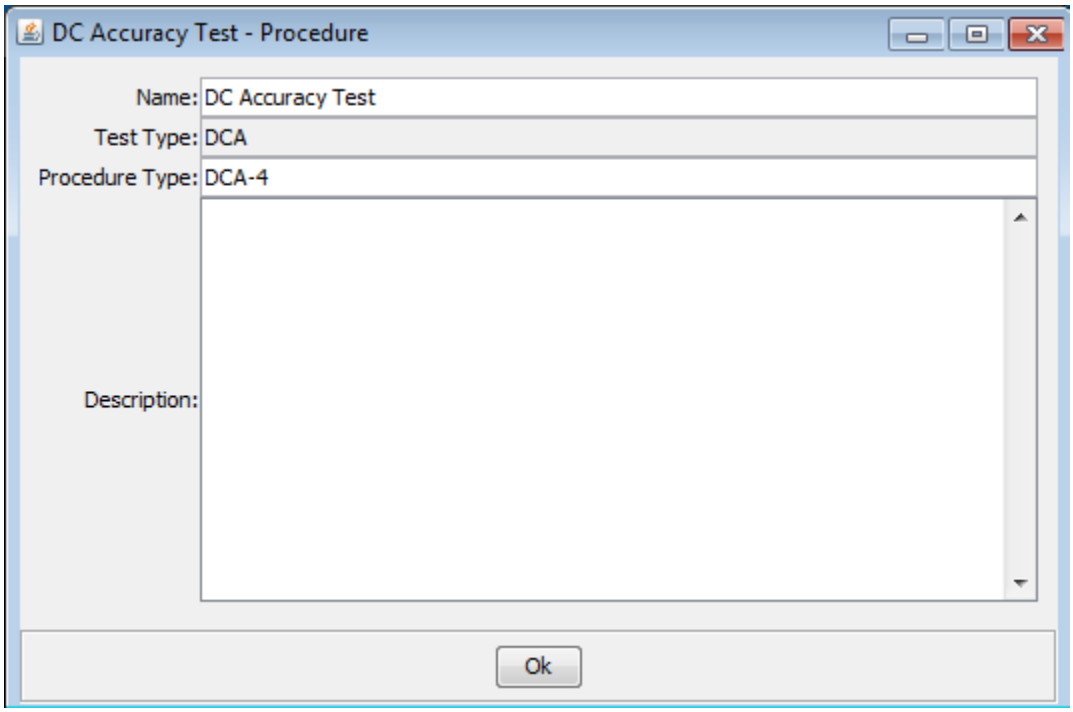


In addition to the context menu, the Administrator may also rearrange procedures and step using the drag and drop mouse operation. Procedures may not be dragged or copied to other devices under test as they are only valid for the device under which they were created. Steps, however, may be dragged or copied to any procedure without restriction.

9.3 Editing a Procedure

The specific metadata for a procedure may be displayed and changed by selecting the TOC entry representing the desired procedure, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A procedure viewer will then appear within the application desktop.



Name The name used to label the procedure.

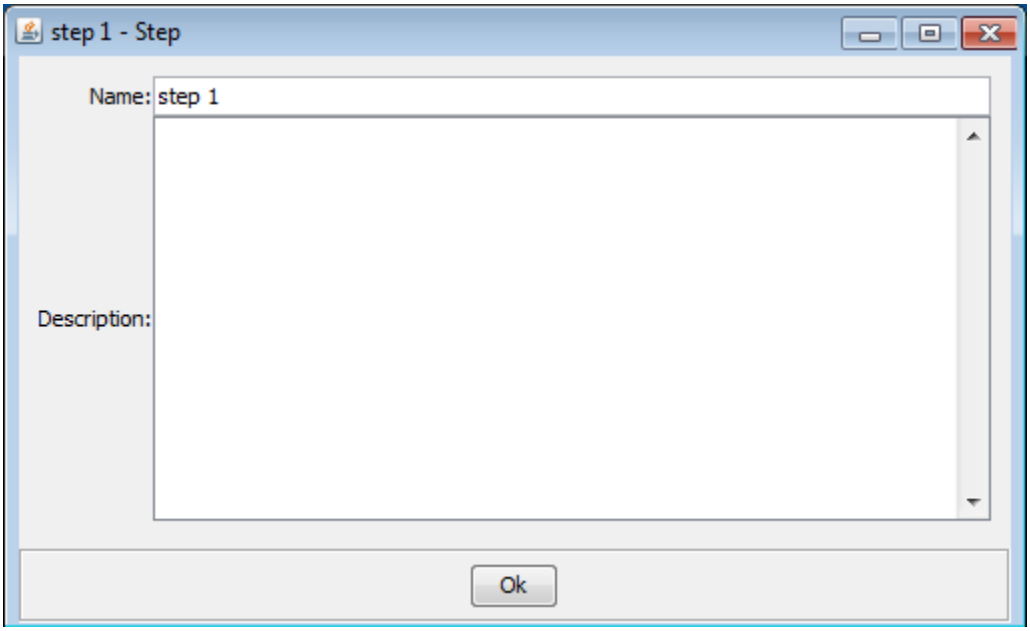
Test Type Unique identifier for the test module that this procedure is for.

	The Test Type cannot be modified.
Procedure Type	Unique Procedure identifier that is used to track this procedure. The Administrator is responsible for determining an appropriate identification code to be used.
Description	A description of the procedure

9.4 Editing a Step

The specific metadata for a step may be displayed and changed by selecting the TOC entry representing the desired step, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A step viewer will then appear within the application desktop.



Name	The name used to label the step.
Description	A description of the procedure

10 TEST PLAN

10.1 Overview

A test plan contains an organized set of tests that are to be applied to a given component, subsystem, or system. A test plan contains multiple test cases that are organized within a folder hierarchy. A given component may have multiple test plans to provide multiple levels of testing (research, qualification, production, etc).

The purpose of a test plan is to define a template of tests that can be instantiated at once. The test plan definition can include a hierarchy of test cases.

Only an Administrator may make changes to the test plans stored in the database

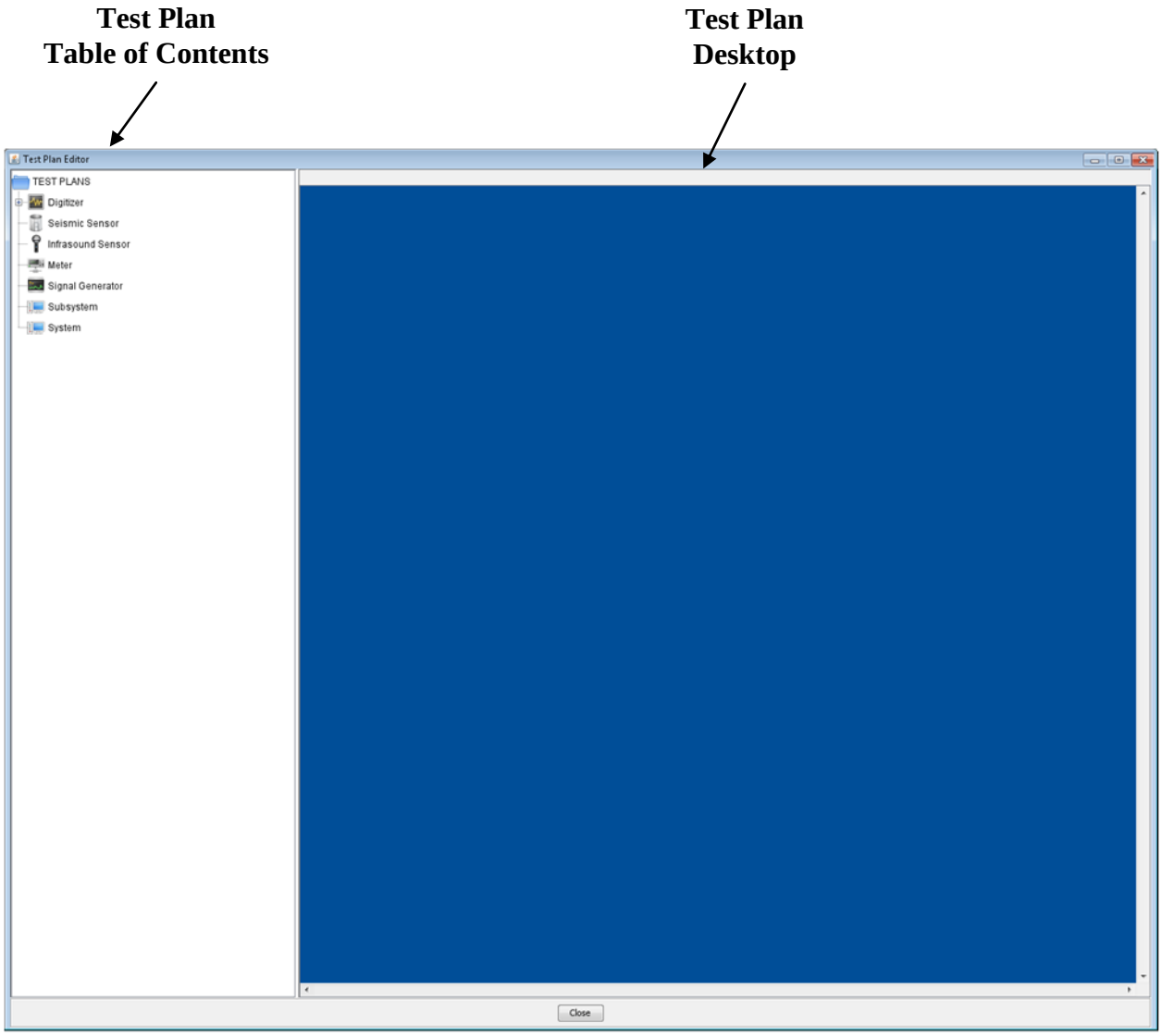
10.2 Test Case

A test case is a specific implementation of a test procedure within a test plan. A given test case is tied to a single test procedure. However, there may be multiple test cases for a given test procedure. Each test case defines the initial parameter values for a test module. These parameter values are an indication to the test operator what the operating conditions of the test are. In addition, a test case defines the pass criteria, expressed as a minimum and maximum value, that determine whether the results of a test module are acceptable.

10.3 Managing

The test procedures stored within the database may be displayed by selecting the **Admin → Test Plan Editor** menu item. Only an Administrator has access to the procedure editor.

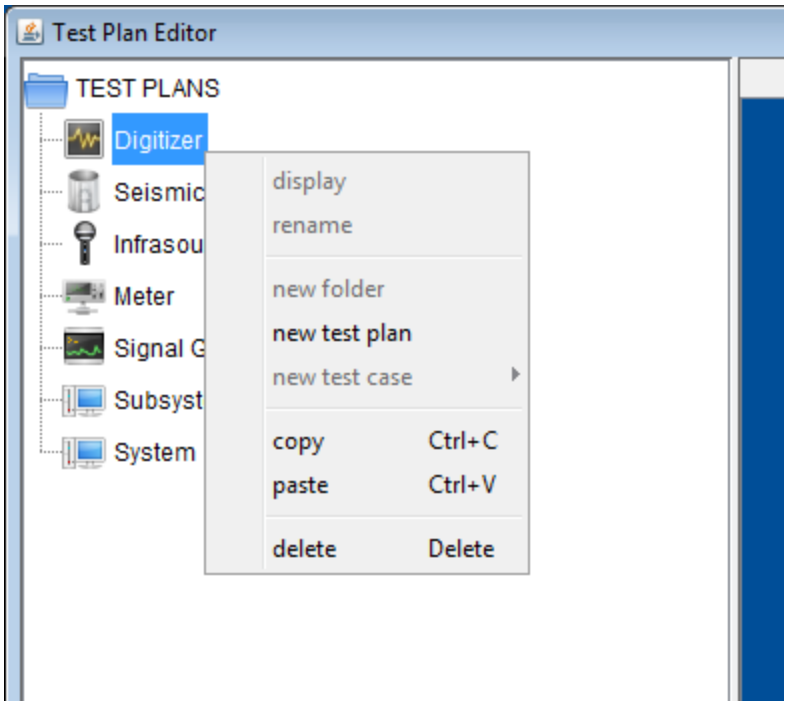
The **Test Plan Editor** will appear within the TALENT Desktop as shown below.



The **Test Plan Editor** is comprised of a desktop and a table of contents. The test plan desktop, similar to the TALENT desktop, is where the viewers related to the test plans are displayed. The test plan table of contents contains entries for each of the component types, subsystems, and systems for which there are test modules.

The top level entries within the table of contents are the components, subsystems, and systems for which test procedures may be created. Below each top level entry are the test procedures. The administrator may arrange the order of these procedures however they may like. Below each procedure are the ordered steps for that procedure.

Select an entry in the table of contents and right-click with the mouse to display the context menu shown below:



Display Display the appropriate viewer within the desktop for the selected test plan or test case.

The user may also perform this action by double-clicking the TOC entry with the left mouse button.

Rename Change the name of the selected folder, test plan, or test case.

New folder Create a new folder below the selected entry.

New test plan Create a new test plan below the selected component, subsystem, or system.

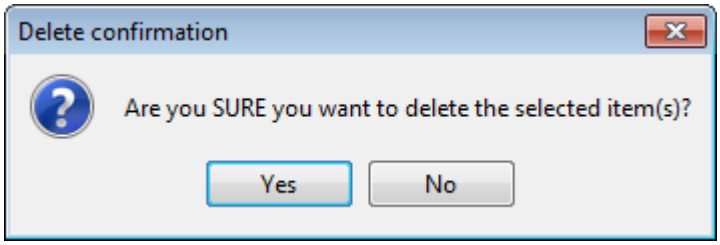
New test case Create a new test case below the selected entry. The available list of menu entries when creating a new test case changes depending upon the component, subsystem, or system that the test plan falls under.

Test cases can only be created for test modules which have defined procedures.

Copy Copy the selected TOC entries onto the clipboard.

Paste Paste the entries on the clipboard within the selected TOC entry.

Delete Delete the selected TOC entries. The user will be prompted to confirm the deletion:

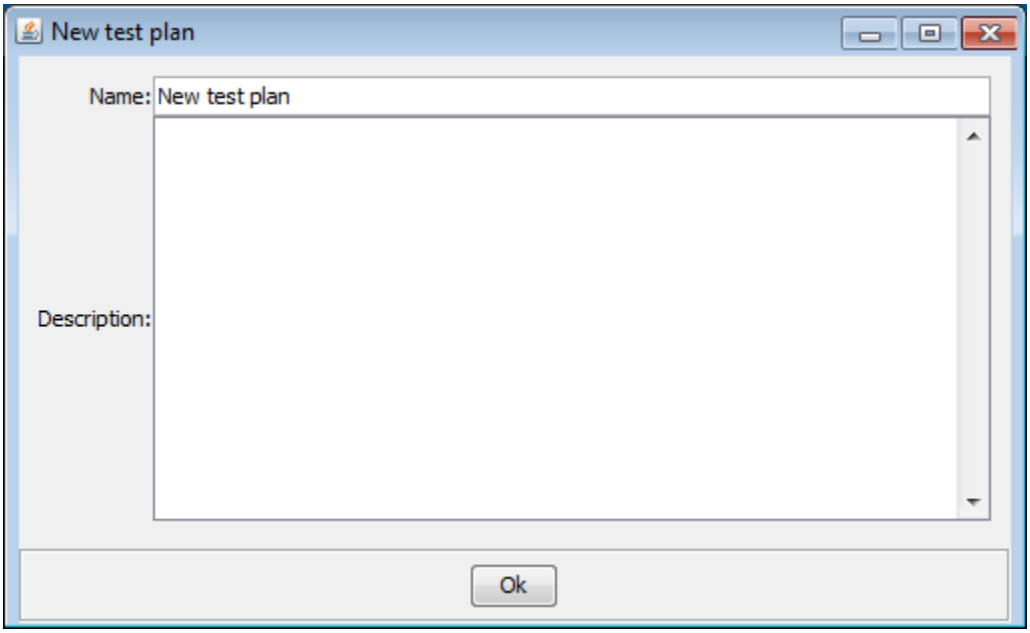


In addition to the context menu, the Administrator may also rearrange folders and test cases using the drag and drop mouse operation. Test plans and test cases may not be moved or copied to other devices under test as they are only valid for the device under which they were created. However, test cases may be moved or copied to other test plans within the same device under test.

10.4 Editing a Test Plan

The specific metadata for a test plan may be displayed and changed by selecting the TOC entry representing the desired procedure, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A test plan viewer will then appear within the application desktop.



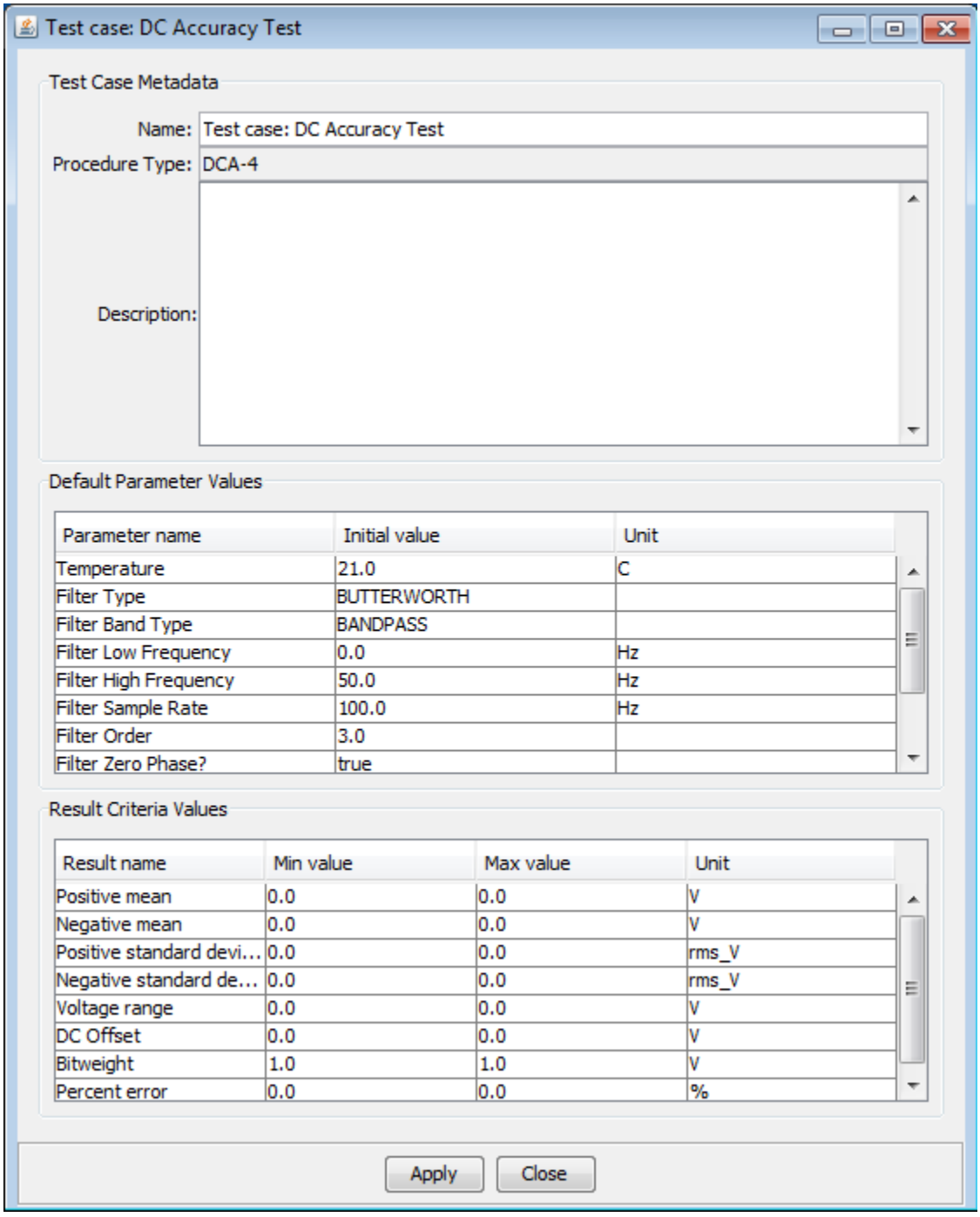
Name The name used to label the test plan.

Description A description of the procedure

10.5 Editing a Test Case

The specific metadata for a test case may be displayed and changed by selecting the TOC entry representing the desired test case, right-click on the selected entry, and choosing **Display** from the context menu that appears.

A test case viewer will then appear within the application desktop.



Name	The name used to label the step.
Procedure Type	The unique procedure identifier used to tie the test case to a procedure. The Procedure Type is displayed for informational purposes only and cannot be modified.
Description	A description of the procedure

The **Default Parameter Values** pane contains a table of the initial default values for this test case. The administrator may customize any of these values. When the test plan is implemented and tests are created for each of the defined test cases, the test parameters will be set to these initial default values. The set of parameters is unique to each test module. However, the parameters generally include things such as filter definitions, waveform time segments, power spectra parameters, etc.

The **Result Criteria Values** pane contains a table of the acceptable result values for this test. The administrator may customize any of these values by specifying a range of minimum and maximum acceptable values. For any test that is created from this test case definition, when the test results are computed, any values that fall outside of this acceptable range will be flagged as being outside of the acceptable range.

11 TEST VIEWERS

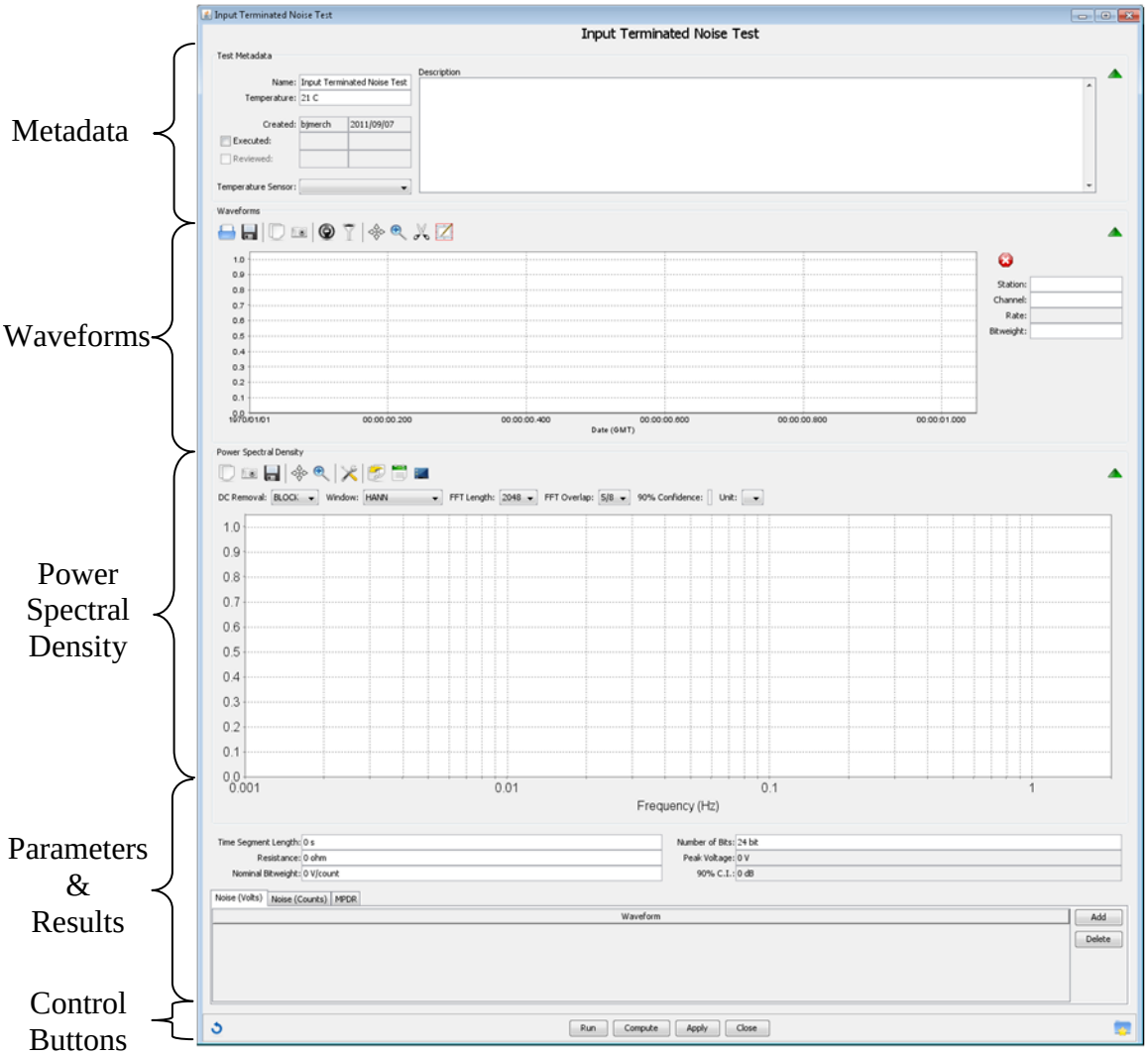
11.1 Overview

Each of the test modules within the TALENT application has a unique viewer associated with it that will allow the user to display and make changes to a test. The test viewers are customized for each test module to support the unique set of waveforms, parameters, and results that make up a test module. Also, the test viewers enforce any rules that are specific to the test such as ensuring that there are sufficient waveforms or that the time segments are all of the same lengths.

This manual will not attempt to cover every test viewer that has been developed. However, all of the test viewers have been designed to share a common look and to make use of similar components. These components and the general behaviors will be explained so that the user should be able to comfortably make use of any of the test viewers.

The general template for the Test Viewers is to have the test module name at the top of the window along with a number of panels that flow from the top of the window down to the bottom. These panels can include a **Test Metadata** section for entering common attributes about the test, a **Waveform** section for loading and selecting portions of the waveform data to be used in the test, a **Power Spectral Density** section for displaying the power spectra of any selected waveform data, a section for **Parameters & Results**, and **Control** buttons. Additional details on each of these panels can be found in the subsequent sections.

Many of these panels also support the ability to be expanded and collapsed by clicking on the green arrow in the upper right hand corner of the panel. Since the test viewers can become very large depending upon the number of waveforms that have been loaded, shrinking some of the panels allows the user to focus on just the sections of the test viewer that they are interested in at a given time.



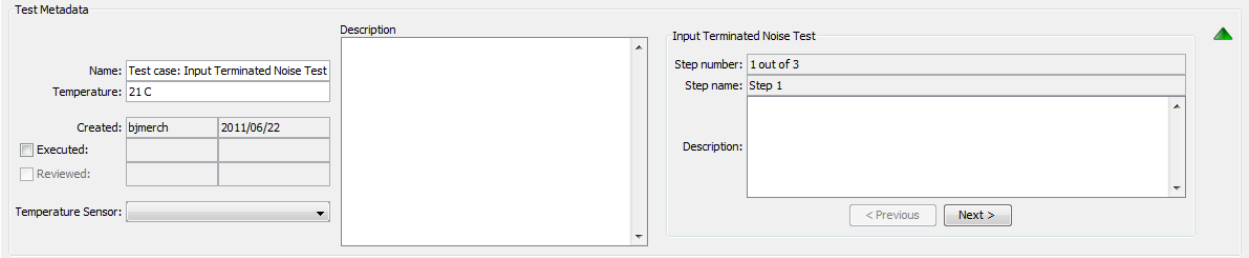
11.2 Test Metadata

The Test Metadata panel contains general attributes about a test. These attributes are common to all tests. This panel is present within all Test Viewers. The Test Metadata panel is always collapsed when the test viewer first appears. The user may toggle the panel between being collapsed and expanded by clicking on the green arrow in the upper right hand corner of the panel. The panel appears as shown below:

Name	The name used to label this test.
Temperature	The ambient temperature at the time
Created	The name of the user and the date on which this test was created.
Executed	A checkbox allowing a user to indicate that the test has been performed. If the test has been executed, then the current user name and date will inserted to stamp the test execution. Also, the flag indicator for this test within the TALENT Table of Contents will change from red to yellow.
Reviewed	A checkbox allowing a user to indicate that the test has been reviewed for quality assurance. This checkbox is not enabled until the test has been executed. If the test has been reviewed, then the current user name and date will be inserted to stamp the test review. Also, the flag indicator for this test within the TALENT Table of Contents will change from yellow to green. Once a test has been flagged as having been reviewed, all of the interface controls within the test viewer that would allow a user to make modifications to the test are disabled. This prevents a user from inadvertently modifying a test once it has been reviewed.
Temperature Sensor	Select the temperature sensor from the pull down menu of available Testbed components. The sensor will be used to directly acquire the ambient temperature when the test is run. Additional component dependencies may be available within the Metadata panel depending upon the specific test. These associations are captured in the database and used to provide traceability as well as for command and control when tests are run.
Description	A description of the test

11.2.1 Procedure Viewer

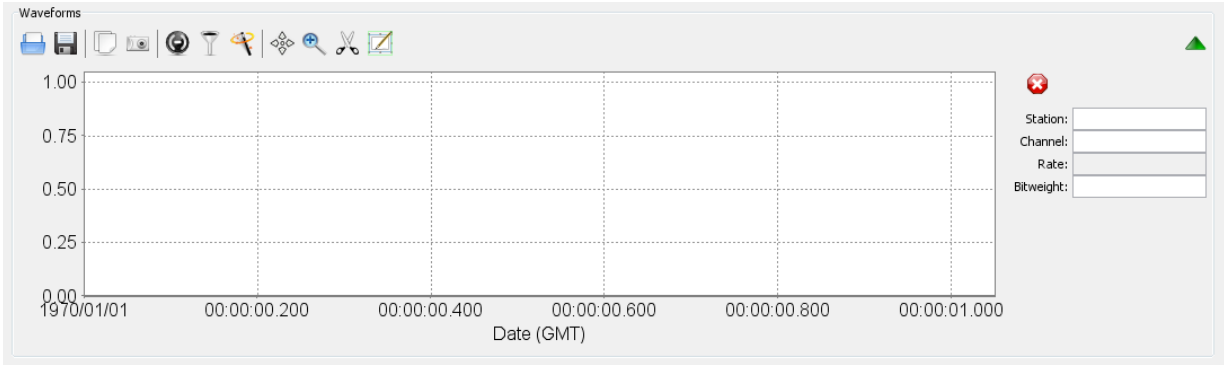
The Test Metadata panel may also include the Test Procedure steps. This portion of the Test Metadata panel is only visible if the test was created from a previously established Test Plan with a defined Test Procedure. The Test Procedure steps are displayed as shown below:



The step number, name, and description are shown. The user may cycle between the steps using the **Previous** and **Next** buttons. The current step is stored within the database so that if the user closes the test viewer or the TALENT application, when the Test Viewer resumes at the step at which the user had left off.

11.3 Waveform Viewer

The Waveform Viewer provides the user with the ability to load, manage, and select the waveforms that are to be used in a test. Most Tests Viewers contain a single Waveform Viewer that can contain one or more waveforms. However, some tests have two Waveforms Viewers. Having multiple Waveform Viewers allows a test to differentiate between the waveform based upon their use. Typically, the first Waveform Viewer will contain a single reference waveform (from a meter in the case of a digitizer test or a reference sensor in the case of a sensor test) and the second Waveform Viewer will contain the test waveforms.



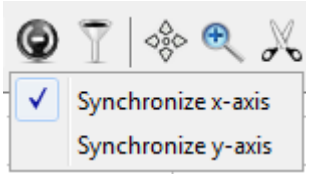
Across the top of the Waveform Viewer are several icons related to managing the waveform time series:

Load waveforms from one or more external files. Once the waveforms have been loaded into the test, the waveforms will be stored in the database and the external files will no longer be needed by the TALENT application.

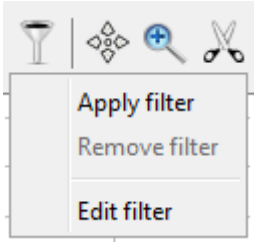
Save the waveforms to an external file. This external file is separate and distinct from the waveforms stored within the TALENT database. This functionality is only provided to allow for sharing waveform data between applications or users outside of the TALENT application.

Copy an image of the Waveform Viewer onto the clipboard.

Save an image of the Waveform Viewer to a file on disk.



Synchronize the X and/or Y Axes for all of the waveforms within the Waveform Viewer. With the axes synchronized, any changes made to zooming or panning of one waveform will be automatically reflected in the other waveforms.



Apply, Remove, or Edit the time-domain filter for the waveforms within the Waveform Viewer.

Details on the Edit filter dialog are covered in section 3.1.2.3 Filters.

Display a sine fit overlaid on the waveform time series. The sine time series is displayed in green and the error is displayed in red. Note that this button is only enabled for those tests that perform sine fits in their analysis. For all other tests, this button is disabled.

Enable panning on the chart. Pan the chart display by dragging with the left mouse button.

Enable zooming on the chart. The user may zoom in by using the left mouse button to draw a box around the desired zoom region or a single click to zoom in a fixed amount. The user may zoom out by clicking with the right mouse button.

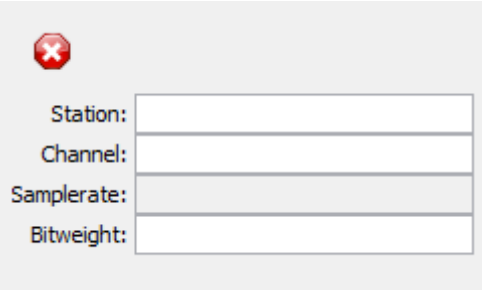
Enable waveform cutting on the chart. Cut a waveform by dragging a selection box on the desired waveform. Any portion of the waveform outside the time bounds of the selection box will be discarded. Warning, a waveform cut cannot be undone. To recover a waveform, the waveform must be reloaded from an external data file or the test reloaded from the database.

Enable the waveform time segment. A user may set a waveform time segment by dragging a segment with the left mouse button. An existing time segment may be moved by dragging on the middle portion of the segment or resized by dragging on either side of the segment. Note that some Test Viewers impose restrictions on position or duration of the time segments.

The Waveform Viewers in a particular test may contain additional time segment controls in order to select multiple

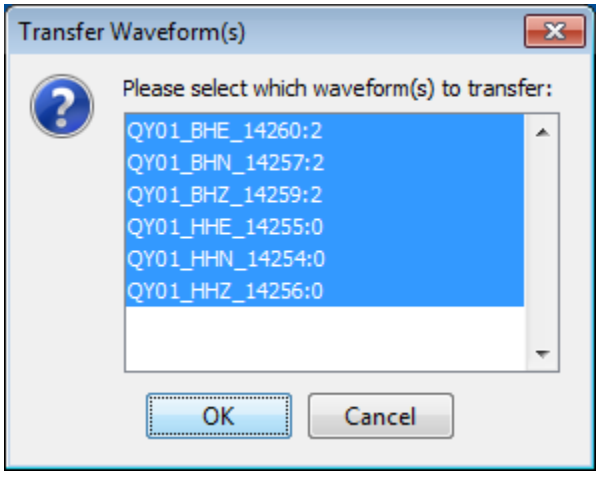
portions of the waveforms.

There are additional buttons and controls to the right of the waveform plot:



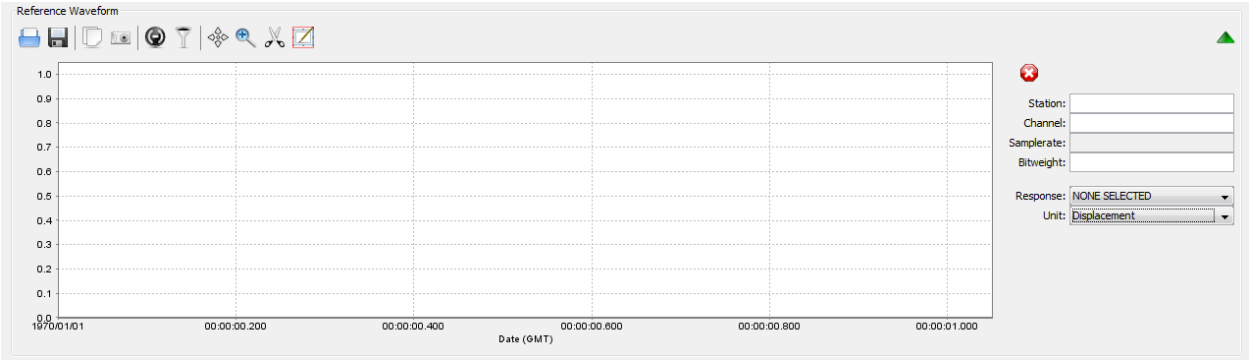
	Delete this waveform from the Waveform Viewer
Station	Display and/or modify the waveform station name
Channel	Display and/or modify the waveform channel name
Samplerate	Display the waveform sample rate in Hertz.
Bitweight	Display and/or modify the waveform bitweight in units of volts/count.

In addition to reading and writing waveforms from within the Waveform Viewer, waveforms can also be transferred between Waveform Viewers via a drag and drop operation. If the source Waveform Viewer contains only a single waveform, then a copy of that waveform will be added to the target Waveform Viewer. If the source Waveform Viewer contains multiple waveforms, then the user will be presented with a selection dialog allowing them to indicate which of the waveforms are to be copied, as shown in the figure below.



11.3.1 Responses

In the case of tests that are related to sensors, the Waveform Viewer contains two additional controls as shown below: Response and Unit



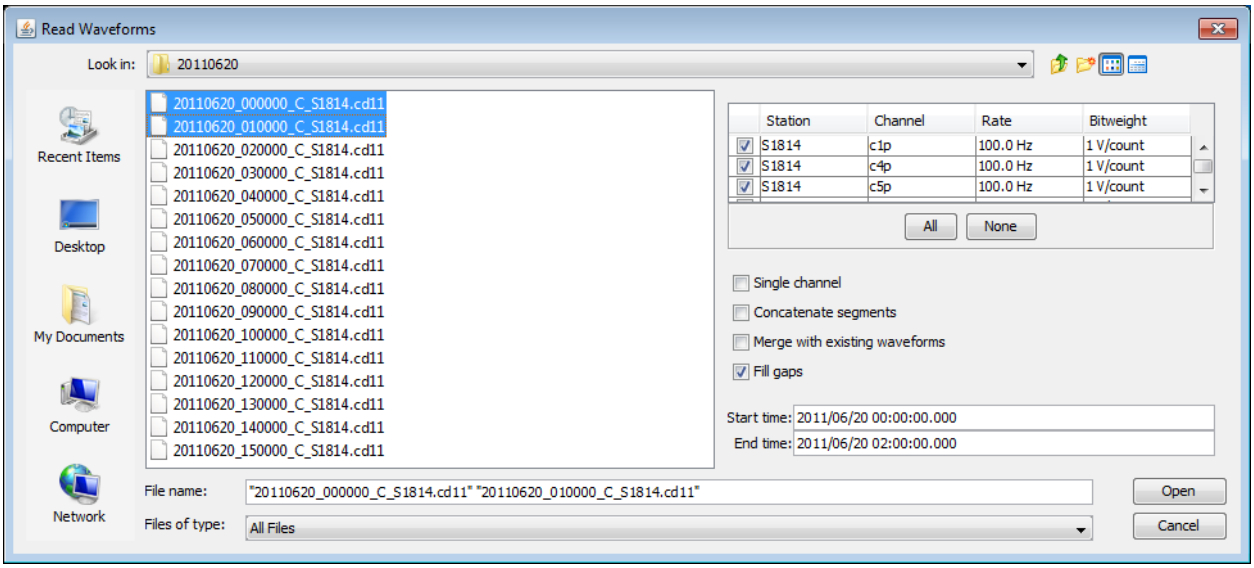
The user may select an instrument response from the **Response** pull down list. The list of available responses is populated from the responses stored in the database. If the test is for a seismic sensor, then the responses include displacement, velocity, and acceleration responses. If the test is for an infrasound sensor, then the responses include only pressure responses. Once selected, the response is associated with the waveform and is used to convert the waveform time series from a voltage to the appropriate earth unit.

For the case of seismic responses, the user may select a unit from the **Unit** pull down list. The selected unit defaults to the unit of the selected response: displacement, velocity, or acceleration. However, the user may override that selection and the waveform time series being displayed will be automatically integrated, differentiated, and/or scaled as necessary to perform the conversion.

11.3.2 Read Waveforms

The user may read waveform data from files on disk by clicking on the Load Waveforms icon in the Waveform Viewer. The dialog for reading waveforms will appear similar to the one shown below. The user may select one or more files that contain waveform time series data from the main file browser dialog. The following waveform formats are supported for reading:

ASCII integer counts with one value per line and a header in the format of:
"H <epoch seconds> <channel> <sample rate> <bitweight>"
CD1.1
CSS Flatfile
Geotech Smart24 binary
Guralp GCF
MiniSEED
RefTek
SAC



Once the user has selected one or more files, the panel to the right is updated to display the available channels of waveform data. The user simply needs to select the checkbox next to the waveform table entries that they wish to read. The fields in the **Bitweight** column of the table are editable if the user wishes to override the bitweight contained within the file.

The **Single channel** checkbox, if selected, directs the application to treat all of the waveform data being read as if it were from a single channel regardless of the designated station and channel name within the file. All of the waveform data will then be merged into a single waveform time series. This option is useful if the waveform data to be read in does not have a consistent station and channel naming convention.

The **Concatenate segments** checkbox, if selected, directs the application to not honor the time stamps on the waveform segments being read in. Instead, the waveform segments will simply be concatenated without any regard to their absolute timing. This option is useful if there are significant time errors in the data being read in or if the user desires to read in several short time segments that have a significant gap of time between them.

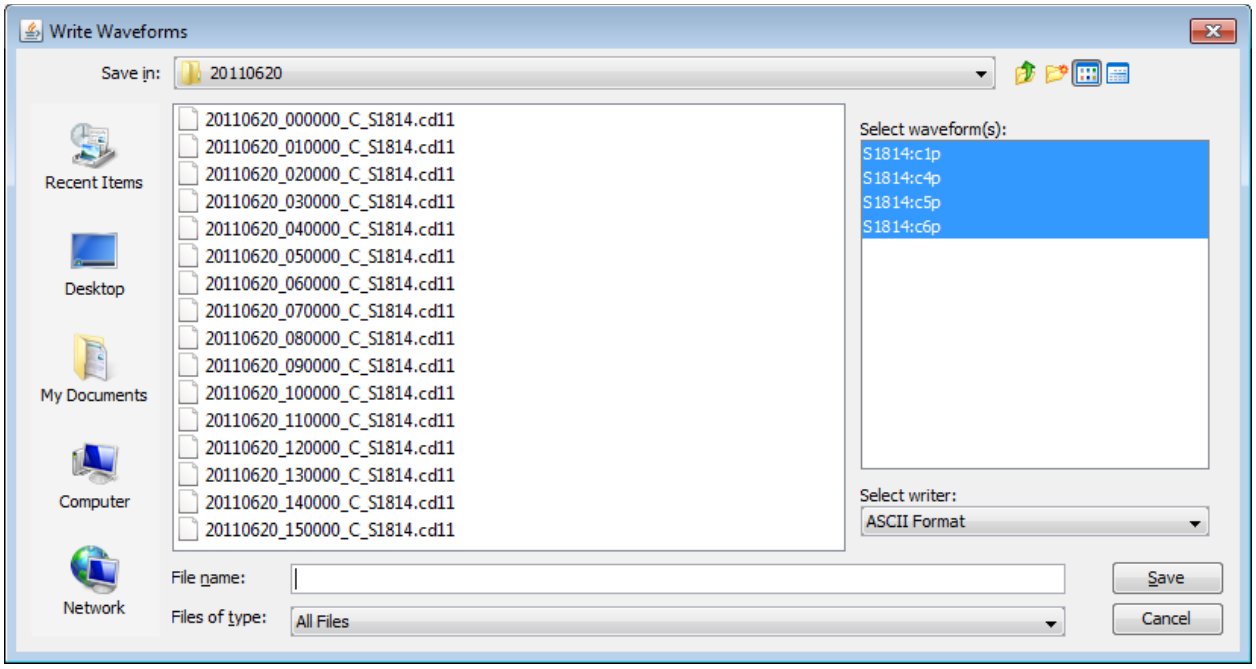
The **Merge with existing waveforms** checkbox, if selected, directs the application to combine the waveform segments being read in with any existing waveforms already in the Waveform Viewer. This option is useful if the user wishes to add additional data to existing waveforms. It may be necessary to use this option, for example, if there are several waveform data files that span multiple directories.

The **Fill gaps** checkbox, if selected, directs the application to fill any data gaps with the average of the values just before and after each gap. If this option is not selected, then any data gaps will be filled with zeros.

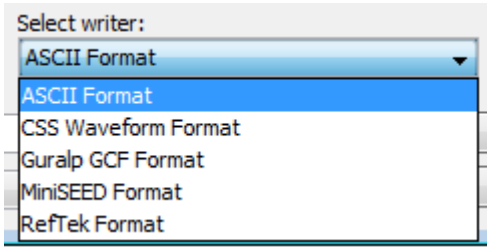
The start and end time default to the range for which there is available data. The user may optionally reduce the time range to down-select the amount of data to be read in. The start and end time are specified as *Year/Month/Day Hour:Minute:Second.Millisecond*.

11.3.3 Write Waveforms

The user may write waveform data to files on disk by clicking on the Save Waveforms icon in the Waveform Viewer. The dialog for writing waveforms will appear similar to the one shown below:

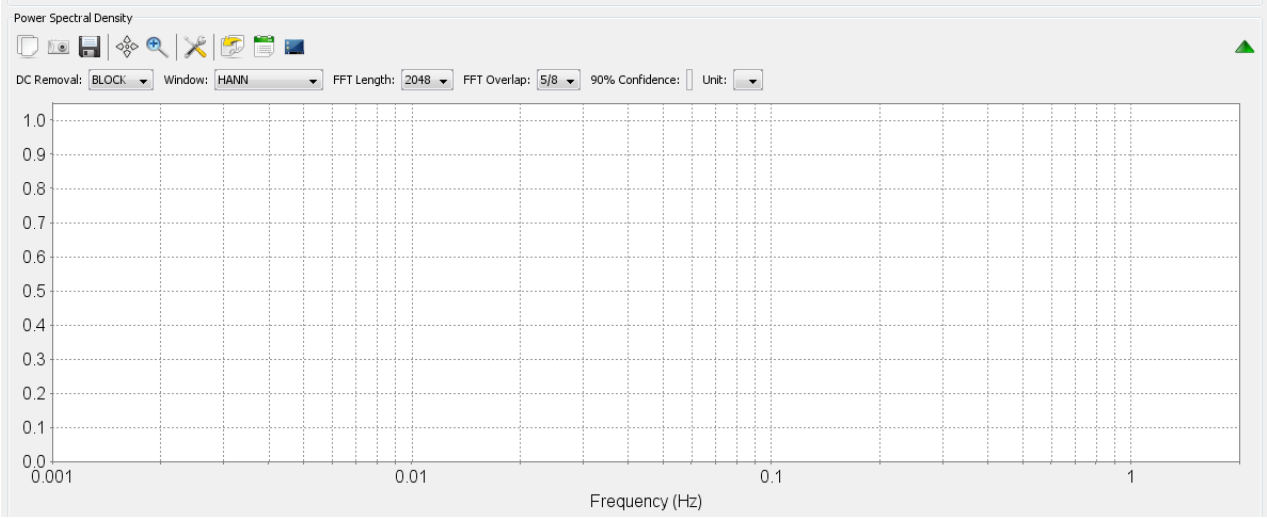


The user may select the file to be written to from the main file browser dialog. On the panel to the right, the user may selected the waveform within the Waveform Viewer that are to be written as well as the data format from the pulldown menu:



11.4 Power Spectral Density Viewer

The Power Spectral Density (PSD) Viewer displays the power spectra of the selected waveform segments from the Waveform Viewer.



At the top of the PSD Viewer is a toolbar with buttons for interacting with the Viewer:


Copy an image of the chart onto the clipboard.

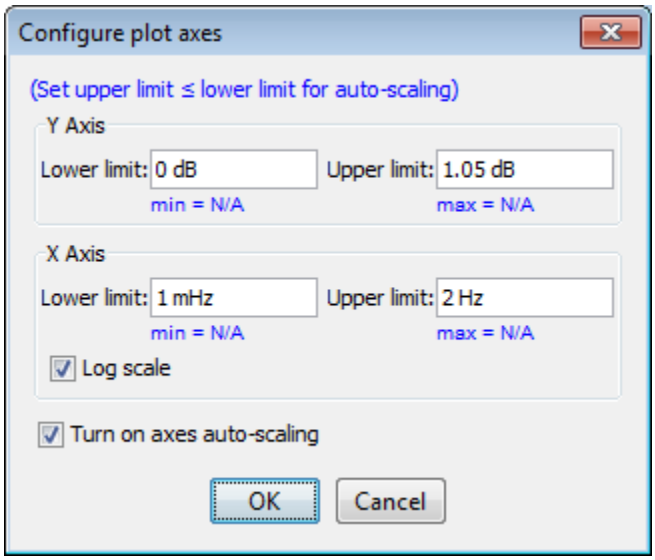

Save an image of the chart to a file on disk.


Export the data in the chart as a text file on disk.


Enable panning on the chart. Pan the chart display by dragging with the left mouse button.


Enable zooming on the chart. The user may zoom in by using the left mouse button to draw a box around the desired zoom region or a single click to zoom in a fixed amount. The user may zoom out amount by clicking with the right mouse button.


Configure the plot axes. Use the dialog box, similar to the one shown below, to manually enter the axes limits.



Select the PSD visibility for each of the waveforms that are being displayed.

Select the Models to overlay on the PSD Viewer

Toggle the visibility of any markers that have been overlaid on the PSD.

Below the PSD Toolbar are several controls for configuring how the power spectra are computed:

DC Removal	Specifies how the DC average of the waveform time series is removed from each window of data prior to computing the FFT and Power Spectra. The available options are: None, the average of the entire time series, and the average of the window.
Window	Specifies the windowing function that is used to shape each window of data. The available options are: Rectangular, Hann, Hamming, Kaiser Bessell, and Bartlett.
FFT Length	Specifies the length of the FFT (and Window) that are used in computing the PSD. The available options are: 128, 256, 512, 1024, 2048, 4096, 8192, 16K, 32K, 64K, 128K, and 256K. The large the FFT length, the finer frequency resolution in the PSD.
FFT Overlap	Specifies how much the subsequent windows overlap each other as a fraction of their length. The available options are: 0, 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, and 7/8. Overlapping the windows allows for a somewhat improved confidence interval without having to collect additional data.

90% Confidence Interval	The range, in decibels, that there is a 90% confidence that the estimated power spectra agrees with the underlying spectral content of the data. This range decreases as the amount of data being analyzed increases.
Unit	The unit in which the PSD data will be displayed. This parameter is only useable for seismic data. The user can select between displacement, acceleration, and velocity.

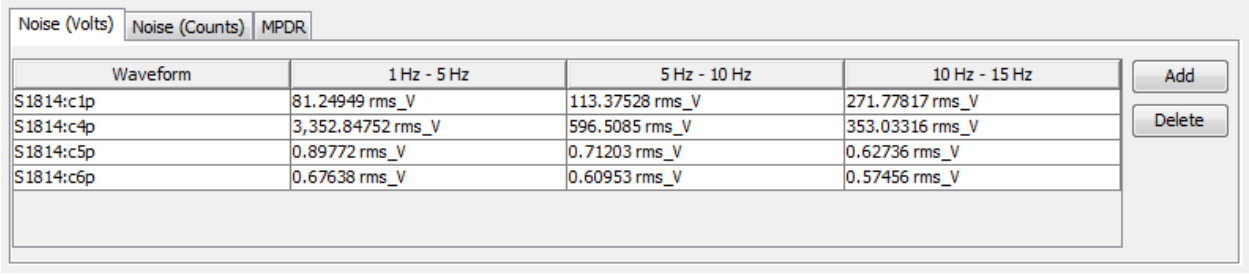
11.5 Parameters

Test Modules contain a variety of parameters that are unique to each test. The majority of these parameters are integrated into the existing panels within the Test Viewer. However, for those parameters that are not otherwise addressed, individual text fields and selection boxes are incorporated into the Test Viewer.

11.6 Results

Test Modules contain a variety of results that are unique to each test. The results for a given test will be displayed in a combination of non-editable text fields, tables of result values, and plots.

If there is a single result value that is generated, then that value will be displayed within a non-editable text field. However, it is more often the case that there are several computed values for multiple waveforms. In this case, the results are presented within a table, such as the one shown below for an Input Terminated Noise test:

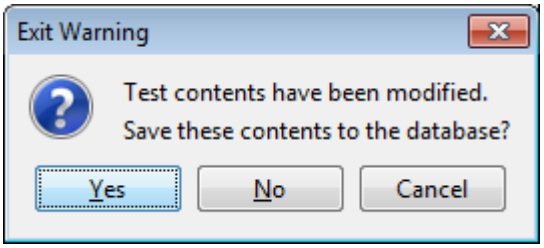


The results for each waveform are contained within a single row. The first column identifies the waveform for the row. For the remaining columns, some tests have a fixed definition of the results that are computed; however, other tests have a user defined set of columns. For the tests with variable columns, the user can typically add/delete columns and double-click on the column header to edit the value.

The result tables also support drag and drop of the table content. The column names are automatically included in the drop operation.

11.7 Control Buttons

There are several control buttons at the bottom of each of the Test Viewers:

	Refresh the Test Viewer. A viewer refresh may be necessary if the user has made any changes to the application outside of the test viewer such as modifying the display properties, responses, models, testbed components, or the device under test. All unsaved changes within the test will be lost when the viewer is refreshed.
Run	Run the test by connecting to any of the associated hardware components that support command and control. This capability automates some of the signal generation and acquisition.
Compute	Compute the test results based upon the waveforms and parameters within the test. Note that the computed results are not automatically saved to the database.
Apply	Save the waveforms, parameters, and results to the database.
Close	Close the Test Viewer. If the user has not saved any changes made to the database, they will be presented with a confirmation dialog: 
	Save the current test parameters as defaults. The next time that a test of this type is created, its parameters will be set to these default values. The test parameter defaults are stored in the same *talent.properties* file that the TALENT application properties are stored.

12 TEST MODULES

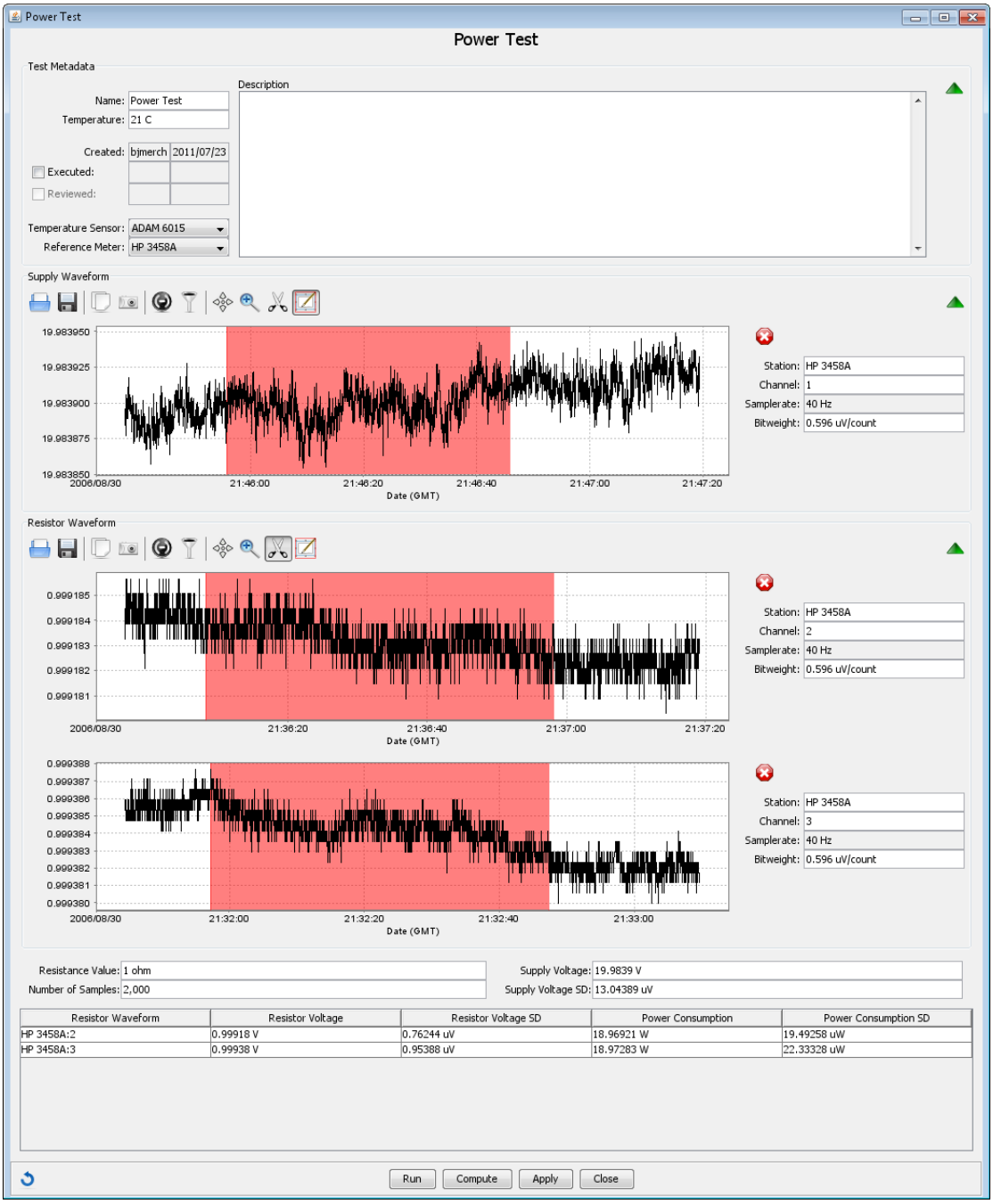
At the most fundamental level within the TALENT application is the test modules. The test modules are defined statically within the software application. Each test modules has a unique set of parameters, results, and waveforms that are captured within the database. In addition, each test module has a custom user interface to allow the user to interact with the test module. Each test module that has been defined applies only to a specific set of component types, subsystems, or system.

Below is a brief description of the tests, as well as some general directions for using the modules. For a more in-depth description of the test setup and how results are computed, see the appropriate reference section for that test (Kromer, 2007; Merchant, 2011)

12.1 General Test

12.1.1 Power Consumption Test

The Power Consumption Test is used to measure the amount of power that an actively powered electrical component consumes during its operation.



Procedure:

1. Select the desired **Temperature Sensor** and **Meter** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Resistance Value, Number of samples, Supply Voltage,** and **Supply Voltage SD** parameters. The resistance value is used to measure the current through a resistor. The specified number of samples and the waveform sample rate determine the length of the waveform time segment that may be selected. Changing either of these parameters will automatically update the time segment length. The supply voltage and its standard deviation are obtained from the power supply settings.

3. (Optional) Using the power supply and meter, record a reference waveform. Load that reference waveform into the **Reference Waveform Viewer** and select the desired waveform time segment to be used. If a reference waveform is present, then upon compute the **Supply Voltage** and **Supply Voltage** SD parameter will be updated with the computed average voltage of the selected reference waveform time segment. Otherwise, if no reference waveform is present, then the **Supply Voltage** and **Supply Voltage** SD parameters will simply be used as specified.

4. Connect the meter to the current sensing resistor and record a segment of data while the device is powered. Once the data has been recorded, load the waveform into the **Waveform Viewer**. Select the desired waveform time segments for the signal. The waveform time segments may be set independently of one another. However, their lengths are all fixed to be the same.

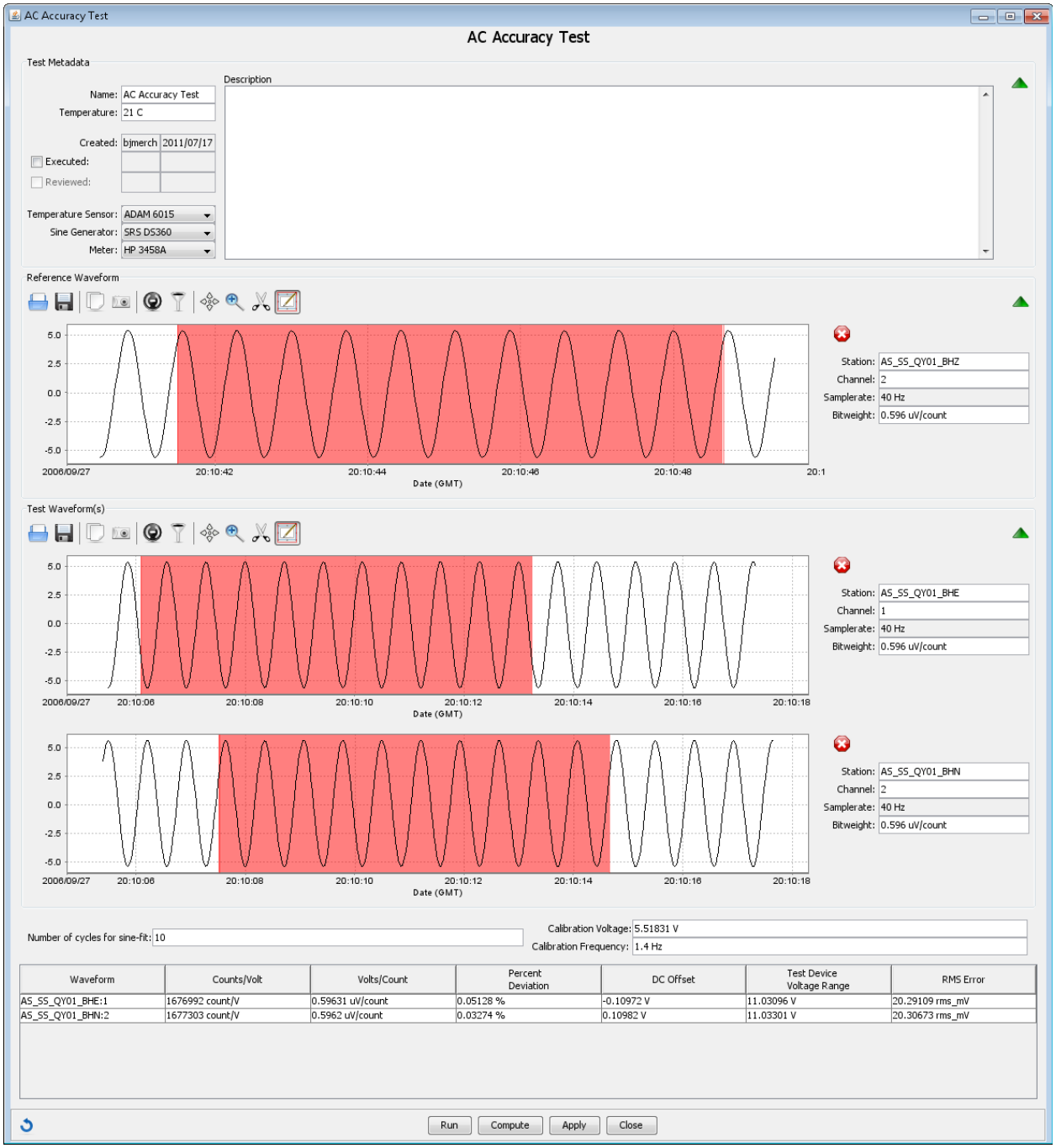
5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2 Digitizer Tests

12.2.1 AC Accuracy Test

The AC Accuracy Test is used to measure the DC offset and bitweight of a digitizer channel by recording a sinusoid with known frequency and amplitude.



Procedure:

1. Select the desired **Temperature Sensor**, **Sine Generator**, and **Meter** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Number of cycles for sine-fit**, **Calibration Voltage**, and **Calibration Frequency** parameters. The specified number of cycles and the calibration frequency determine the length of the waveform time segment that may be selected. Changing either of these parameters will automatically update the time segment length.

3. (Optional) Using the signal generator and meter, record a reference waveform. Load that reference waveform into the **Reference Waveform Viewer** and select the desired waveform time segment to be used. If a reference waveform is present, then upon compute the **Calibration Voltage** parameter will be updated with the computed peak voltage of the selected reference waveform time segment. Otherwise, if no reference waveform is present, then the **Calibration Voltage** parameter will simply be used as specified.

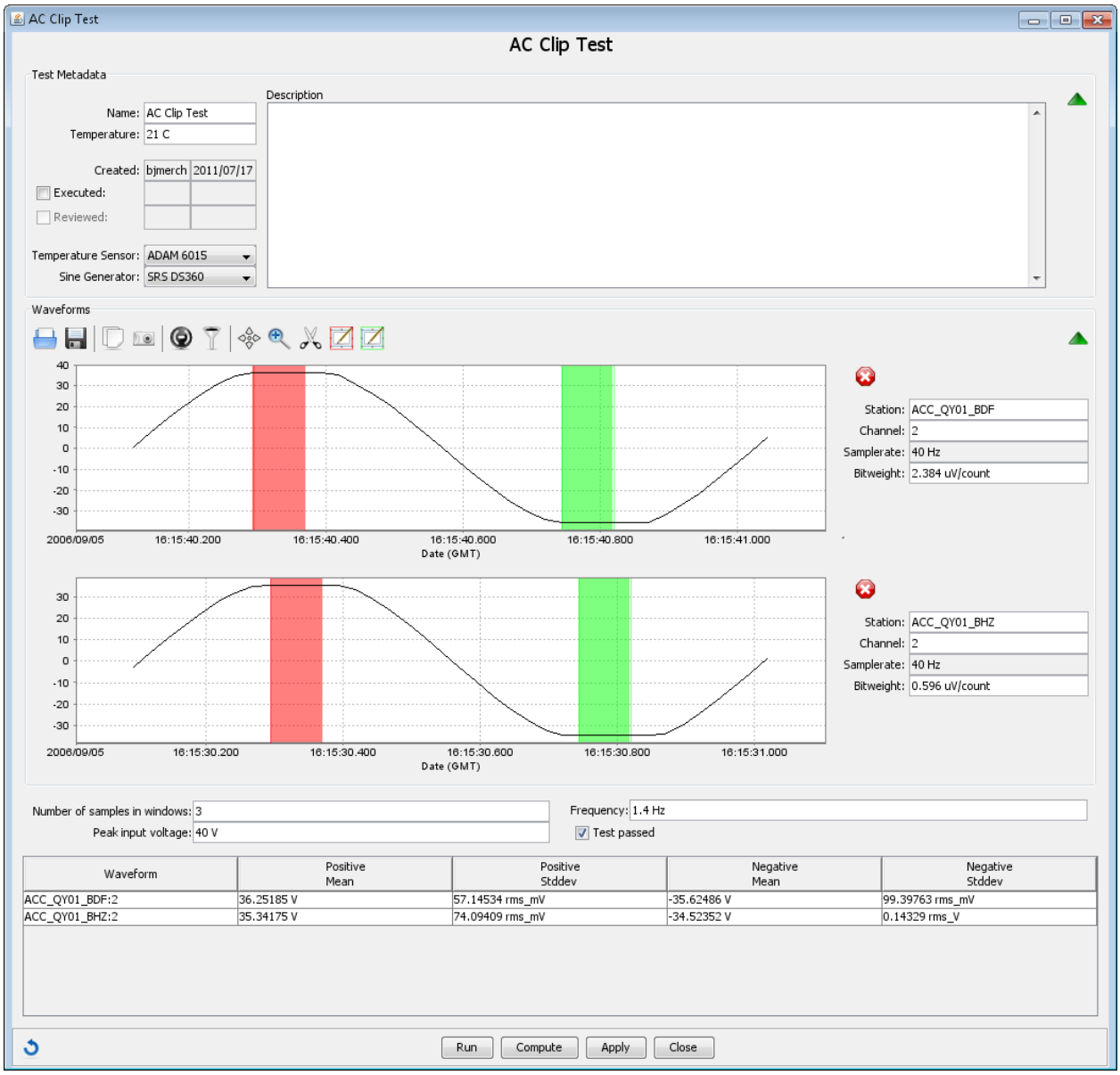
4. Record the signal generator output on each of the desired digitizer channels. Load the waveform for each of the channels into **Test Waveform(s) Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments may be set independently of one another. However, their lengths are all fixed to be the same.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.2 AC Clip Test

The AC Clip Test measures the digitizer clip level and behavior by feeding a sinusoid signal into a channel of the digitizer. When the digitizer input exceeds the maximum allowable input, the digitizer "clips" the waveform, and becomes flat at the peak and trough of the sine wave. This parameter is an important one to know in testing because clipping the digitizer for a prolonged period of time may cause permanent damage to the digitizer.



Procedure:

1. Select the desired **Temperature Sensor** and **Sine Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Number of samples in windows**, **Peak input voltage,** and **Frequency** parameters. The specified number of samples and the waveform sample rate determine the length of the waveform time segment that may be selected. Changing either of these parameters will automatically update the time segment length.

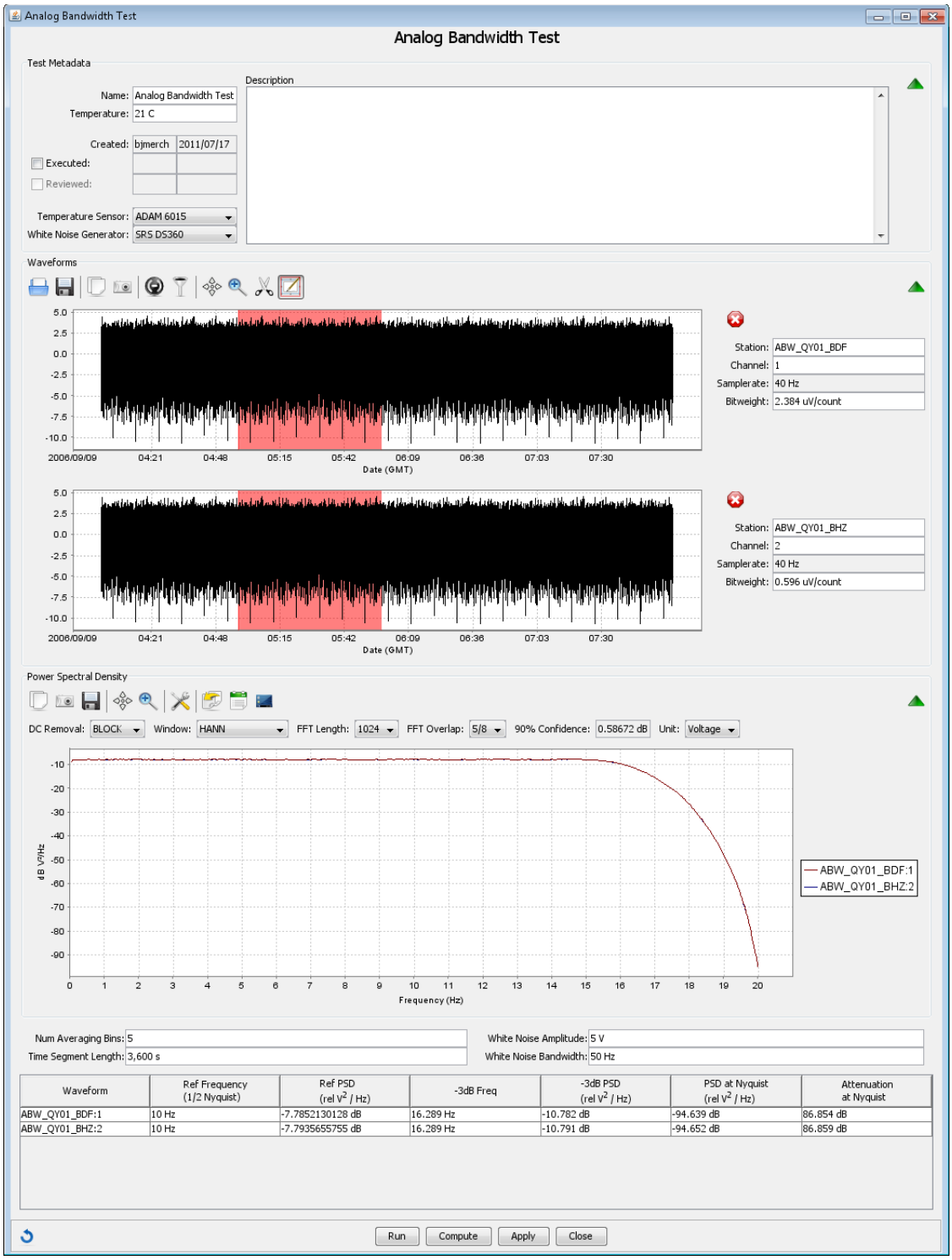
3. Connect the signal generator to each of the digitizer channels and obtain clipped data by slowly increasing the amplitude of the signal generator. Once the data has been recorded, disconnect the signal generator immediately and load the waveform into the **Waveform Viewer**. Select the desired waveform time segments for the positive (green) and negative (red) portions of the clipped sinusoid. The test module will attempt to select these regions automatically; however, the user may need to refine those selections. The waveform time segments may be set independently of one another. However, their lengths are all fixed to be the same.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. If the digitizer passed the expected clip behavior, then the user may check the **Test Passed** checkbox.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.3 Analog Bandwidth Test

The Analog Bandwidth Test measures the frequency bandwidth by feeding white noise from a signal generator into one or more of the digitizer channels.



Procedure:

1. Select the desired **Temperature Sensor** and **White Noise Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Number of averaging bins**, **Time Segment Length, White Noise Amplitude**, and **White Noise Bandwidth** parameters. The number of averaging bins specifies how the PSD will be smoothed. The time segment length specifies the length of the selected waveform time segment. The white noise amplitude and bandwidth capture the characteristics of the signal that is fed into the digitizer channels.

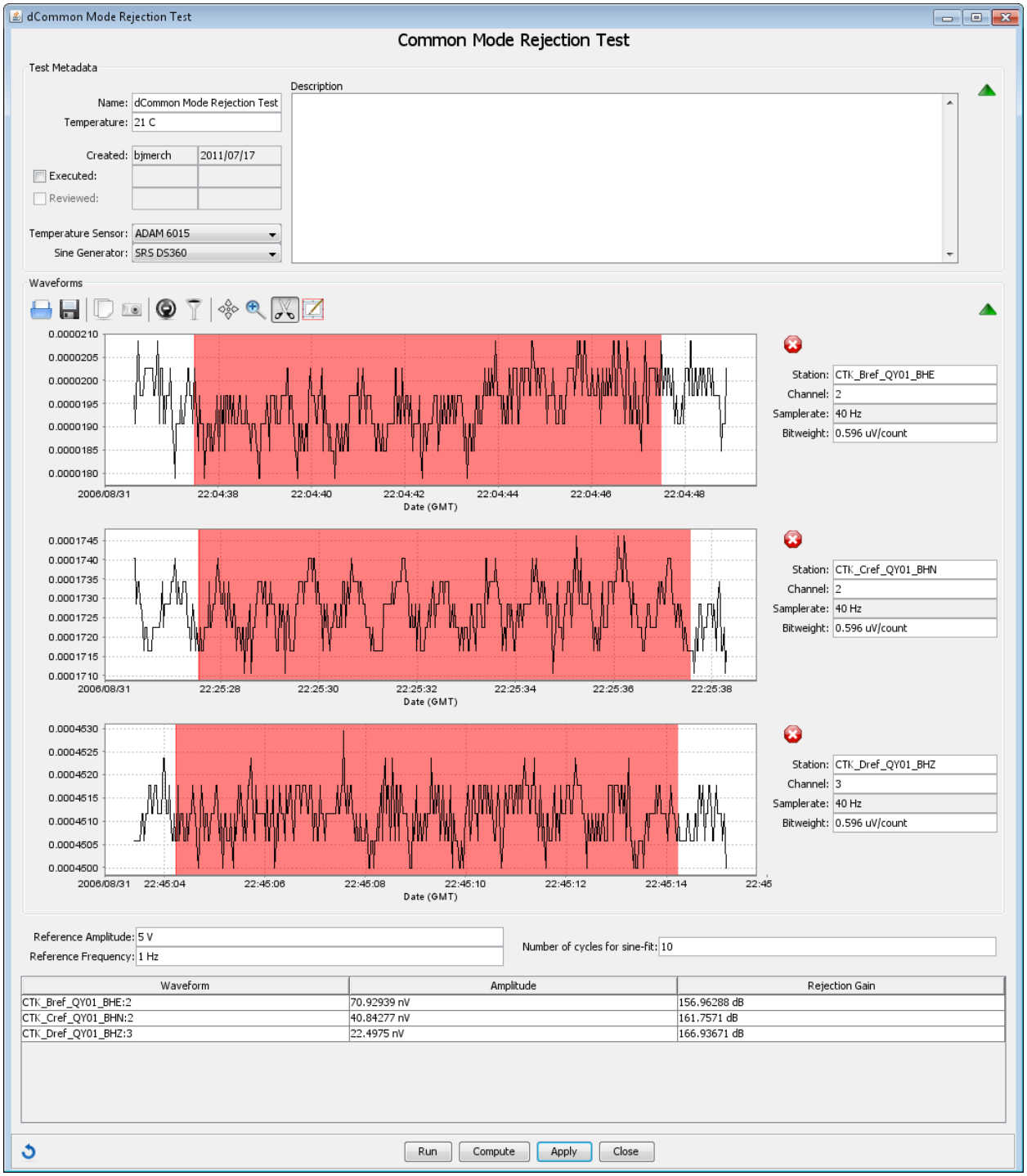
3. Record the signal generator output on each of the desired digitizer channels. Load the waveform for each of the channels into **Test Waveform(s) Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments are fixed across all of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.4 Common Mode Rejection Test

The Common Mode Rejection Test measures the ability of a digitizer to reject a common mode signal on a differential input channel. For this test, a signal generator is used to generate a sinusoid with known frequency and amplitude and this signal is applied to both of the differential input lines.



Procedure:

1. Select the desired **Temperature Sensor** and **Sine Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Amplitude**, **Reference Frequency**, and **Number of cycles for sine-fit** parameters. The reference amplitude and frequency describe the sinusoid signal that the signal generator is set to output. The number of sinusoid cycles specifies the length of the selected waveform time segment.

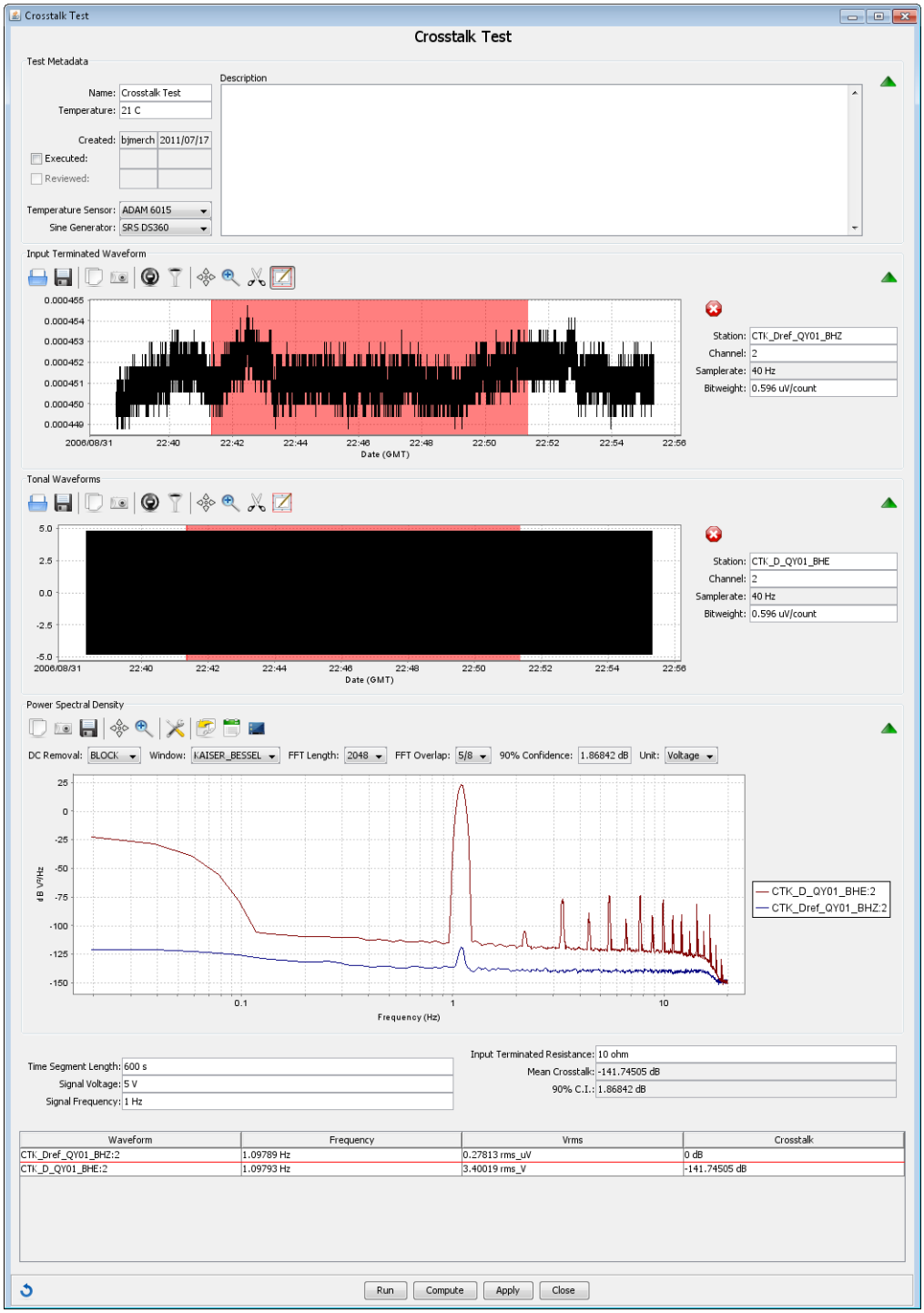
3. Record the signal generator output on each of the desired digitizer channels. Load the waveform for each of the channels into **Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments are independent across all of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.5 Crosstalk Test

The Crosstalk Test measures how much of a signal recorded on one channel of a digitizer is also present on another channel as noise. For this test, a signal generator is used to generate a sinusoid with known frequency and amplitude. One digitizer channel will be input terminated and the remaining channels will be connected to the signal generator.



Procedure:

1. Select the desired **Temperature Sensor** and **Sine Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length**, **Signal Voltage**, **Signal Frequency**, and **Input Terminated Resistance** parameters. The time segment length specifies the length of the waveform time segment. The signal voltage and frequency describe the sinusoid signal that the signal generator is set to output. The input terminated resistance specifies the value of the resistor that was used to terminate one of the digitizer channels.

3. Record the terminated digitizer channel and the tonal signal channels. Load the terminated waveform into the **Input Terminated Waveform Viewer**. Load the tonal waveforms into the **Tonal Waveforms Viewer.** Select the desired waveform time segment to be used for each of the waveforms. The waveform time segments are fixed to be identical.

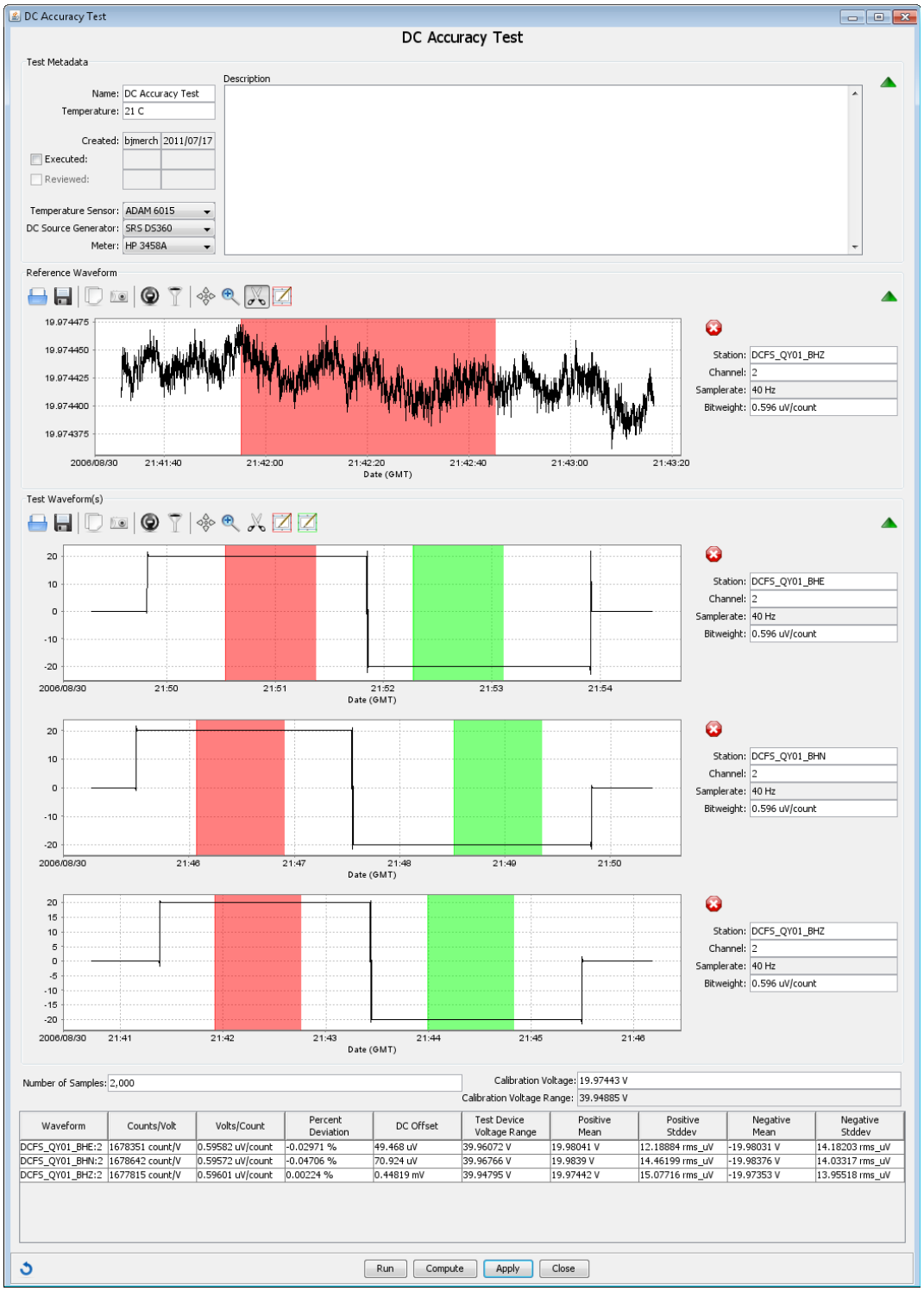
4. If necessary, adjust the PSD options to better resolve the peak of the sinusoidal tone: DC Removal, Window type, FFT Length, and FFT Overlap.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. The results should show crosstalk between the input terminated channel and each of the tonal channel. In addition, a mean crosstalk will be computed.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.6 DC Accuracy Test

The DC Accuracy Test is used to measure the DC offset and bitweight of a digitizer channel by recording a known positive and negative DC signal at a reference voltage from a precision voltage source.



Waveform	Counts/Volt	Volts/Count	Percent Deviation	DC Offset	Test Device Voltage Range	Positive Mean	Positive Stddev	Negative Mean	Negative Stddev
DCFS_QY01_BHE:2	1678351 count/V	0.59582 uV/count	-0.02971 %	49.468 uV	39.96072 V	19.98041 V	12.18884 rms_uV	-19.98031 V	14.18203 rms_uV
DCFS_QY01_BHN:2	1678642 count/V	0.59572 uV/count	-0.04706 %	70.924 uV	39.96766 V	19.9839 V	14.46199 rms_uV	-19.98376 V	14.03317 rms_uV
DCFS_QY01_BHZ:2	1677815 count/V	0.59601 uV/count	0.00224 %	0.44819 mV	39.94795 V	19.97442 V	15.07716 rms_uV	-19.97353 V	13.95518 rms_uV

Procedure:

1. Select the desired **Temperature Sensor**, **DC Source Generator,** and **Meter** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Number of samples** and **Calibration Voltage** parameters. The specified number of samples and the waveform sample rate determine the length of the waveform time segment that may be selected. Changing either of these parameters will automatically update the time segment length. The **Calibration Voltage** is the amplitude of the DC signal that is being used.

3. (Optional) Using the signal generator and meter, record a reference waveform. Load that reference waveform into the **Reference Waveform Viewer** and select the desired waveform time segment to be used. If a reference waveform is present, then upon compute the **Calibration Voltage** parameter will be updated with the computed average voltage of the selected reference waveform time segment. Otherwise, if no reference waveform is present, then the **Calibration Voltage** parameter will simply be used as specified.

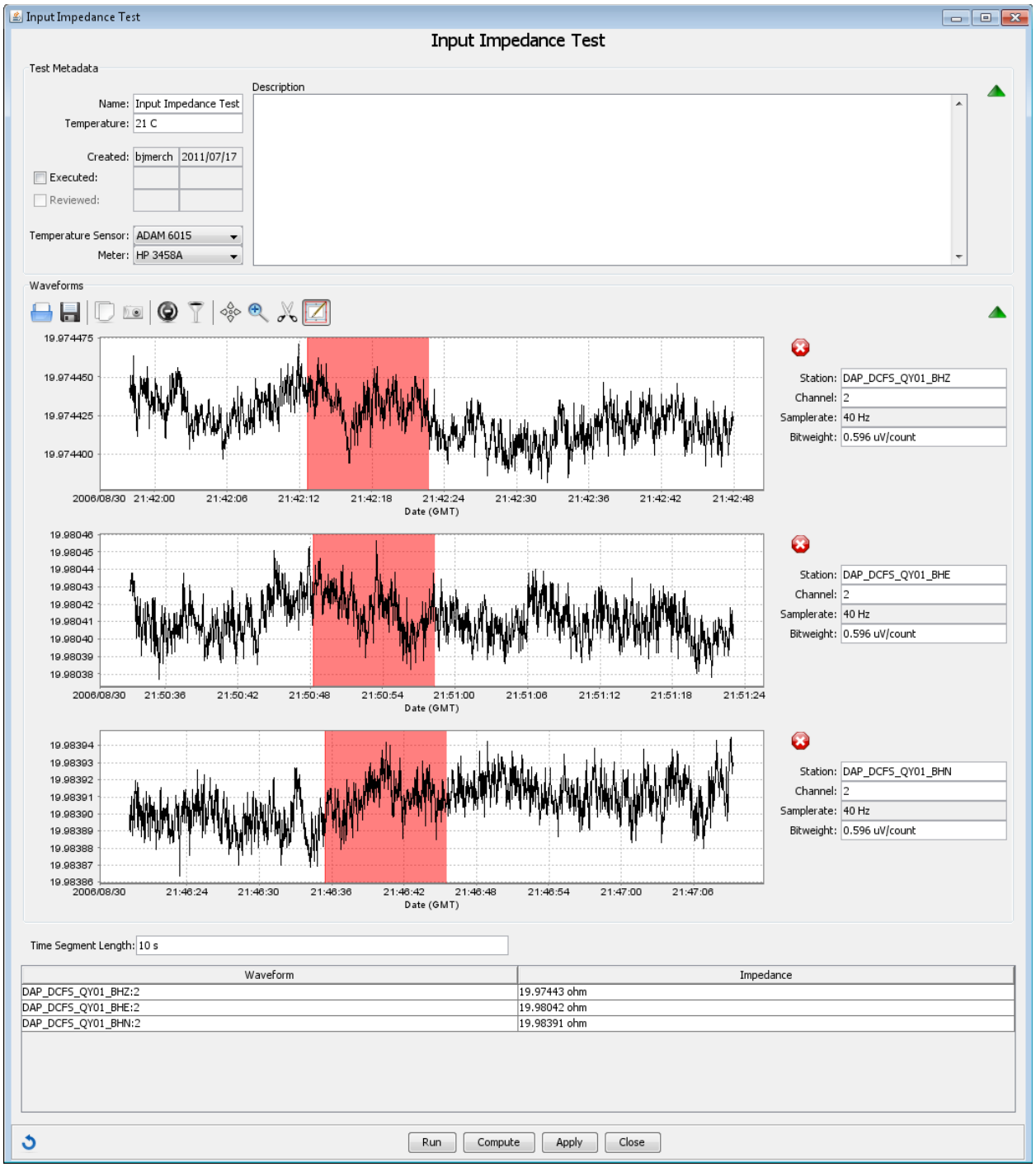
4. Connect the signal generator to each of the digitizer channels and obtain DC Accuracy data by recording positive and negative segments of data. Once the data has been recorded, load the waveform into the **Waveform Viewer**. Select the desired waveform time segments for the positive (green) and negative (red) portions of the DC signal. The test module will attempt to select these regions automatically; however, the user may need to refine those selections. The waveform time segments may be set independently of one another. However, their lengths are all fixed to be the same.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.7 Input Impedance Test

The Input Impedance Test measures the input impedance of a digitizer channel. A meter is configured to measure impedance and is connected to the digitizers input channel.



Procedure:

1. Select the desired **Temperature Sensor** and **Meter** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length** parameter. The time segment length specifies the length of the waveform time segment.

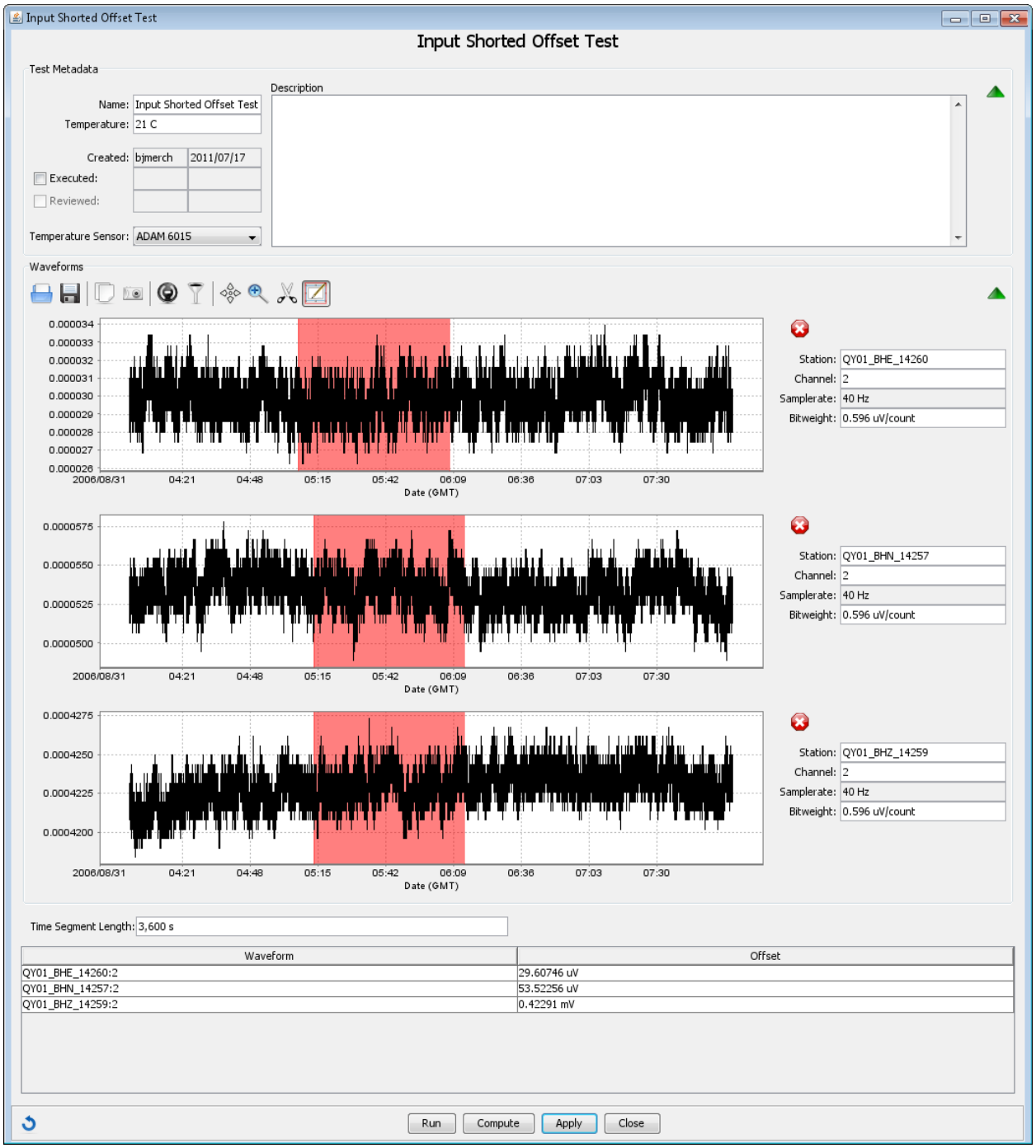
3. Record the input impedance for each of the desired digitizer channels. Load the waveform for each of the channels into **Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments are independent across all of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.8 Input Shorted Offset Test

The Input Shorted Offset Test measures the amount of DC offset present on a digitizer by collecting waveform data from an input channel that has been shorted. Thus, any signal present on the recorded waveform should be solely due to any internal offset of the digitizer.



Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length** parameter. The time segment length specifies the length of the waveform time segment.

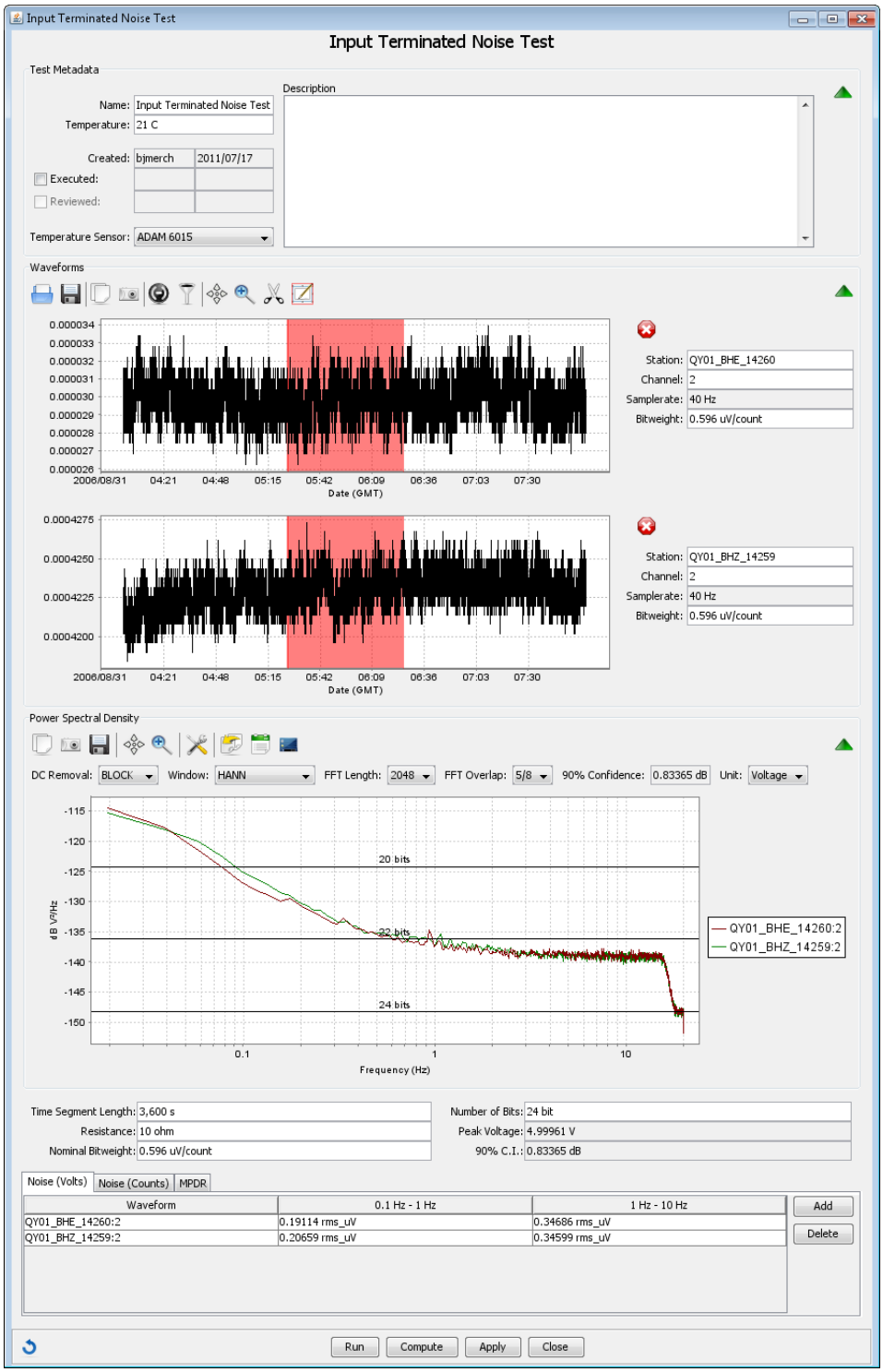
3. Record the waveform data for each of the desired digitizers whose inputs are shorted. Load the waveform for each of the channels into **Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments are independent across all of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.9 Input Terminated Noise Test and Maximum Potential Dynamic Range Test

The Input Terminated Noise Test and Maximum Potential Dynamic Range measures the amount of zero state noise present on a digitizer by collecting waveform data from an input channel that has been terminated with a resistor.



Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length, Resistance, Nominal Bitweight,** and **Number of bits** parameters. The time segment length specifies the length of the waveform time segment. The resistance is the value of the resistor that is used to terminate the digitizer channel. The nominal bitweight is the typical bitweight as supplied from the manufacturer. The number of bits is the bit resolution of the digitizer being tested.

3. Add frequency bands by clicking on the **Add** button next to the results table at the bottom of the Test Viewer. Double click on the table column header to modify the frequency band range. The range may be entered as two values in Hertz separated by a dash. The frequency bands are used for computing noise estimates within those bands.

4. Record the waveform data for each of the desired digitizers whose inputs are terminated. Load the waveform for each of the channels into **Waveform Viewer** and select the desired waveform time segment to be used for each waveform. The waveform time segments are independent across all of the digitizer channels.

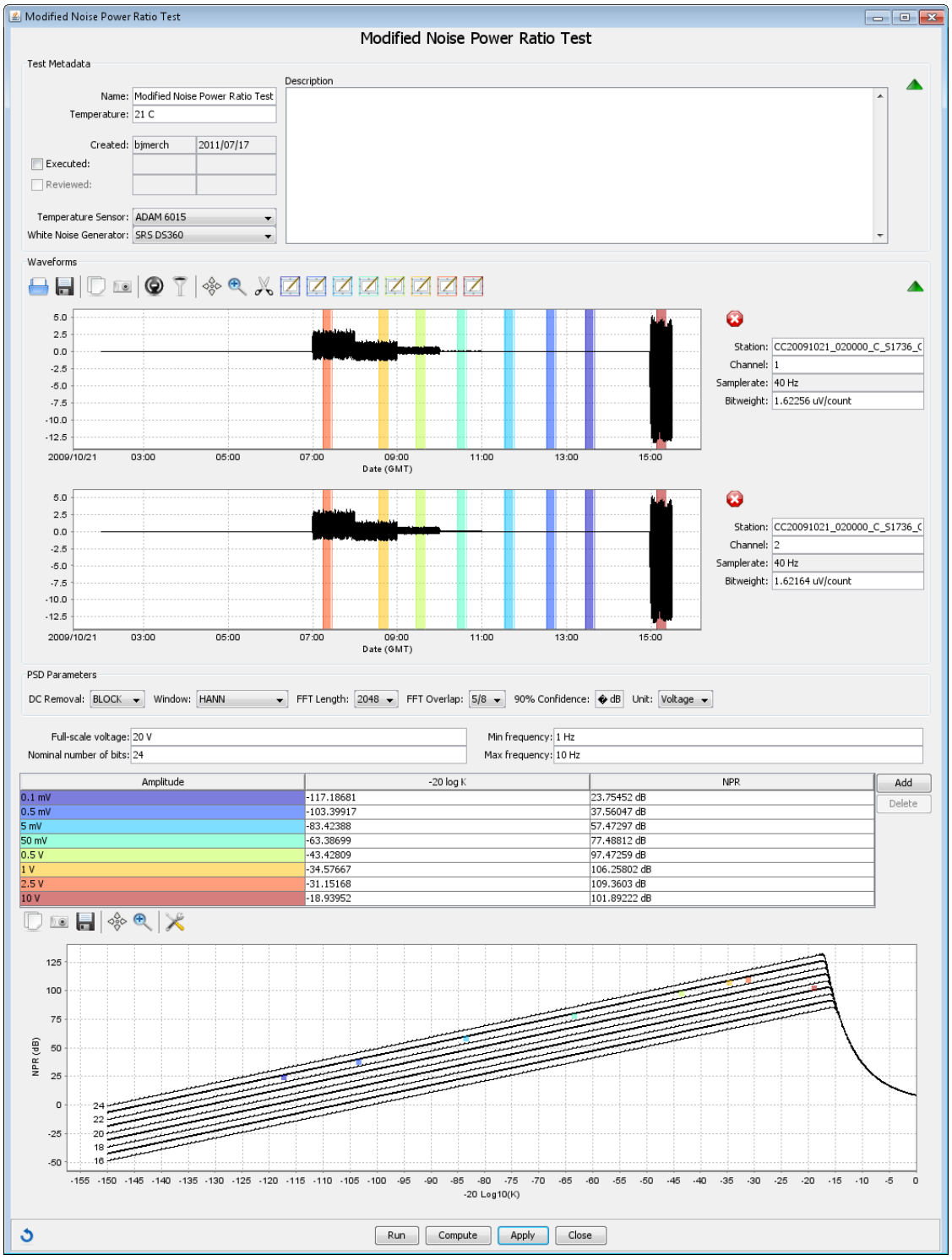
5. Make any desired changes to the **PSD Parameters** and overlay any desired models onto the spectra.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. Separate tables are provided for the noise in volts, the noise in counts, and the maximum potential dynamic range. In addition, horizontal theoretical bit-lines are overlaid on the PSD Viewer.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.10 Modified Noise Power Ratio Test

The Modified Noise Power Ratio Test compares the performance of a digitizer to the performance of an ideal digitizer at various bit lengths by calculating the SNR as a function of signal power. This test is able to demonstrate the linearity of a digitizer across a range of amplitudes.



Procedure:

1. Select the desired **Temperature Sensor** and **White Noise Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Full-scale voltage, nominal number of bits, Min. frequency,** and **Max. frequency** parameters. The full scale voltage is the peak-to-peak voltage range of the digitizer. The nominal number of bits is the number of bits of the digitizer, i.e. 24. The minimum and maximum frequency define the frequency band over which the MNPR is computed.

3. Add amplitudes by clicking on the **Add** button next to the MNPR table. Double click on color-coded amplitude table entry to enter the appropriate amplitude value.

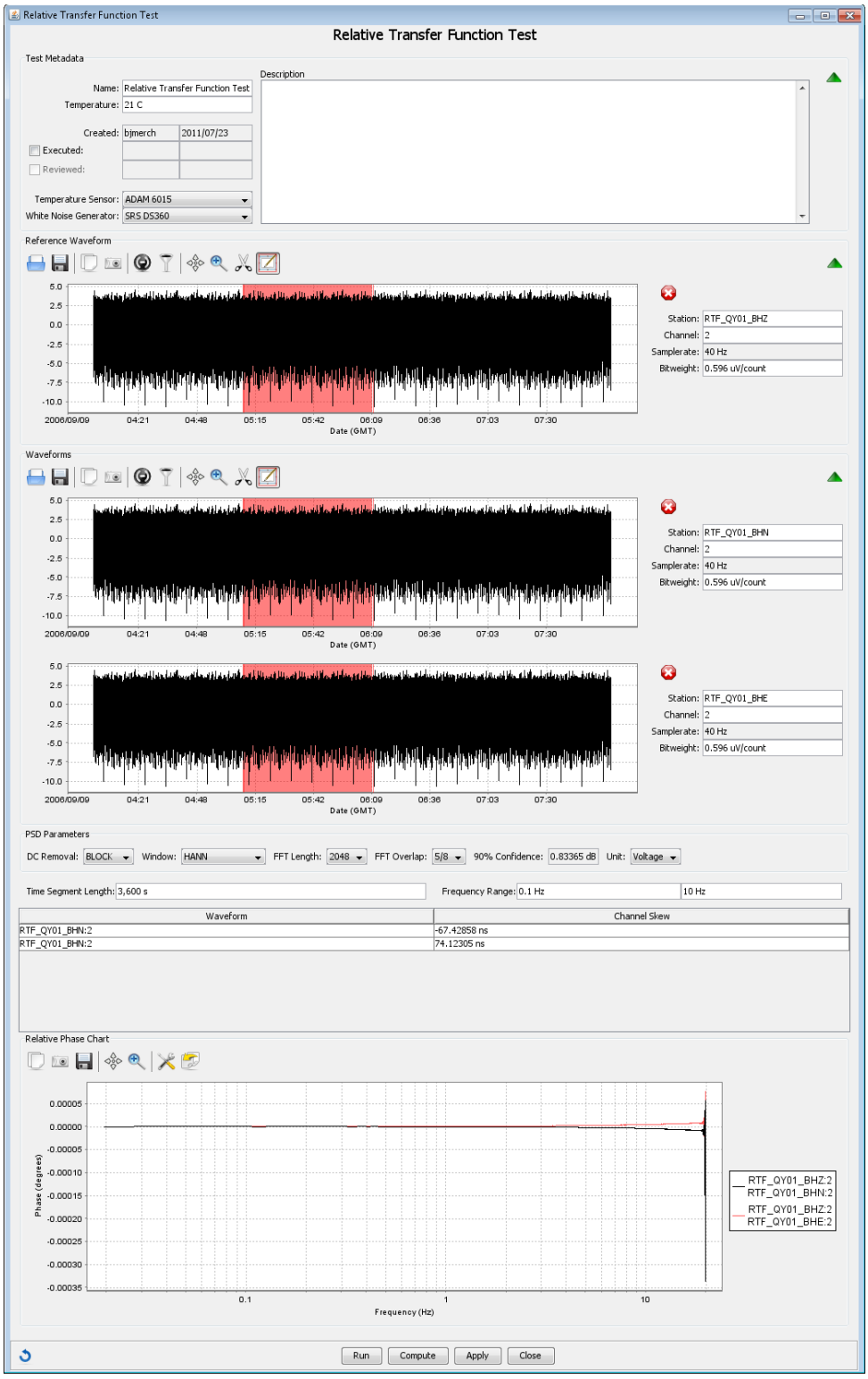
4. Record the waveform data for the pair of digitizer channels connected to the signal generator. Cycle the signal generator through each of the chosen amplitudes, allowing for a sufficient duration at each amplitude setting. Load the waveforms for each of the channels into **Waveform Viewer.** Select each amplitude section of the waveform data with the appropriate amplitude selection window.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table and plot below the waveforms. The NPR values should follow one of the bit-lines on the plot.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.11 Relative Transfer Function Test

The Relative Transfer Function Test measures the amount of channel-to-channel timing skew present on a digitizer. The test is performed by feeding white noise into the digitizer channels.



Procedure:

1. Select the desired **Temperature Sensor** and **White Noise Generator** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length** and **Frequency Range** parameters. The time segment length specifies the length of the selected waveform time segment. The frequency range specifies the bandpass over which the channel skew will be computed.

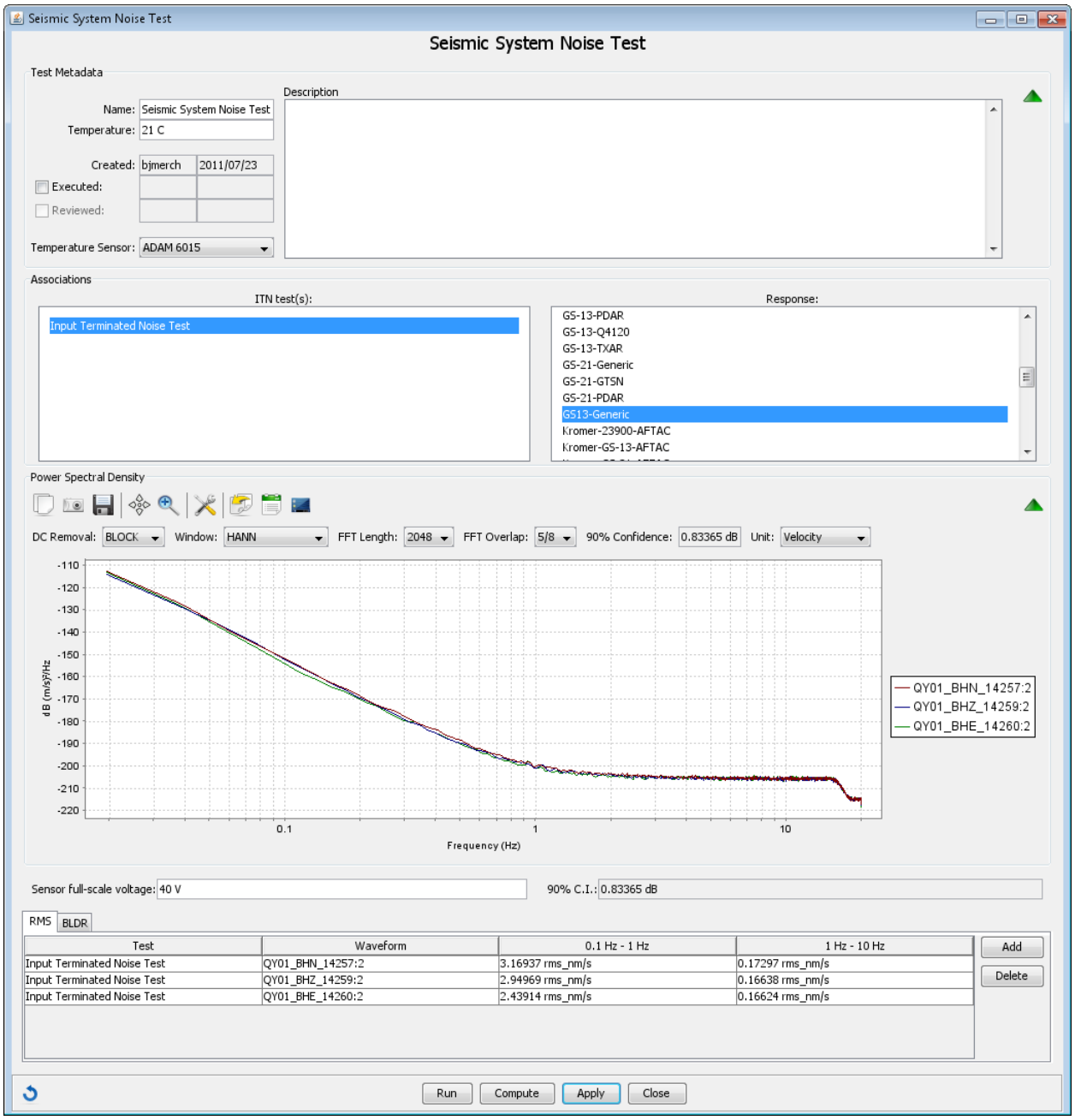
3. Record the signal generator output on all of the desired digitizer channels simultaneously. Load one of the waveforms into the **Reference Waveform Viewer**. Load the remaining waveforms into the **Waveforms Viewer**. Select the desired waveform time segment to be used for the waveforms. The waveform time segments are fixed across all of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.12 Seismic / Infrasound System Noise and Bandwidth Limited Dynamic Range Test

The Seismic / Infrasound System Noise and Bandwidth Limited Dynamic Range Test measures the digitizer's noise and dynamic range expressed in the units of a sensor.



Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.
2. Select one or more Input Terminated Noise Tests from the list of tests for this digitizer.
3. Select a single sensor response from the response list.
4. Enter the digitizer **Full Scale Voltage** parameter. The full scale voltage is the peak-to-peak voltage range of the digitizer and is is used in computing the dynamic ranges.
5. Add frequency bands by clicking on the **Add** button next to the results table at the bottom of the Test Viewer. Double click on the table column header to modify the frequency band range. The range may be entered as two values in Hertz separated by a dash. The frequency bands are used for computing noise estimates within those bands.
6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. Separate tables are provided for the noise in sensor units and the bandwidth limited dynamic range.
7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.13 Sine Calibrator Amplitude Test

The Sine Calibrator Amplitude Test measures the accuracy of the sinusoid amplitude that the digitizer's calibrator can output.

Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Frequency** and **Number of cycles for sine-fit** parameters. The reference frequency is the frequency of the sinusoid that the digitizer's calibrator will be outputting. The number of cycles for sine-fit determines the length of the waveform time segment.

3. Add amplitudes by clicking on the **Add** button next to the Amplitude table. Double click on the color-coded column header to enter the appropriate amplitude value. The voltage entered corresponds to the amplitude of the sinusoid that the digitizer's calibrator will output. A waveform time segment selection tool with matching color will appear within the waveform viewers for each frequency.

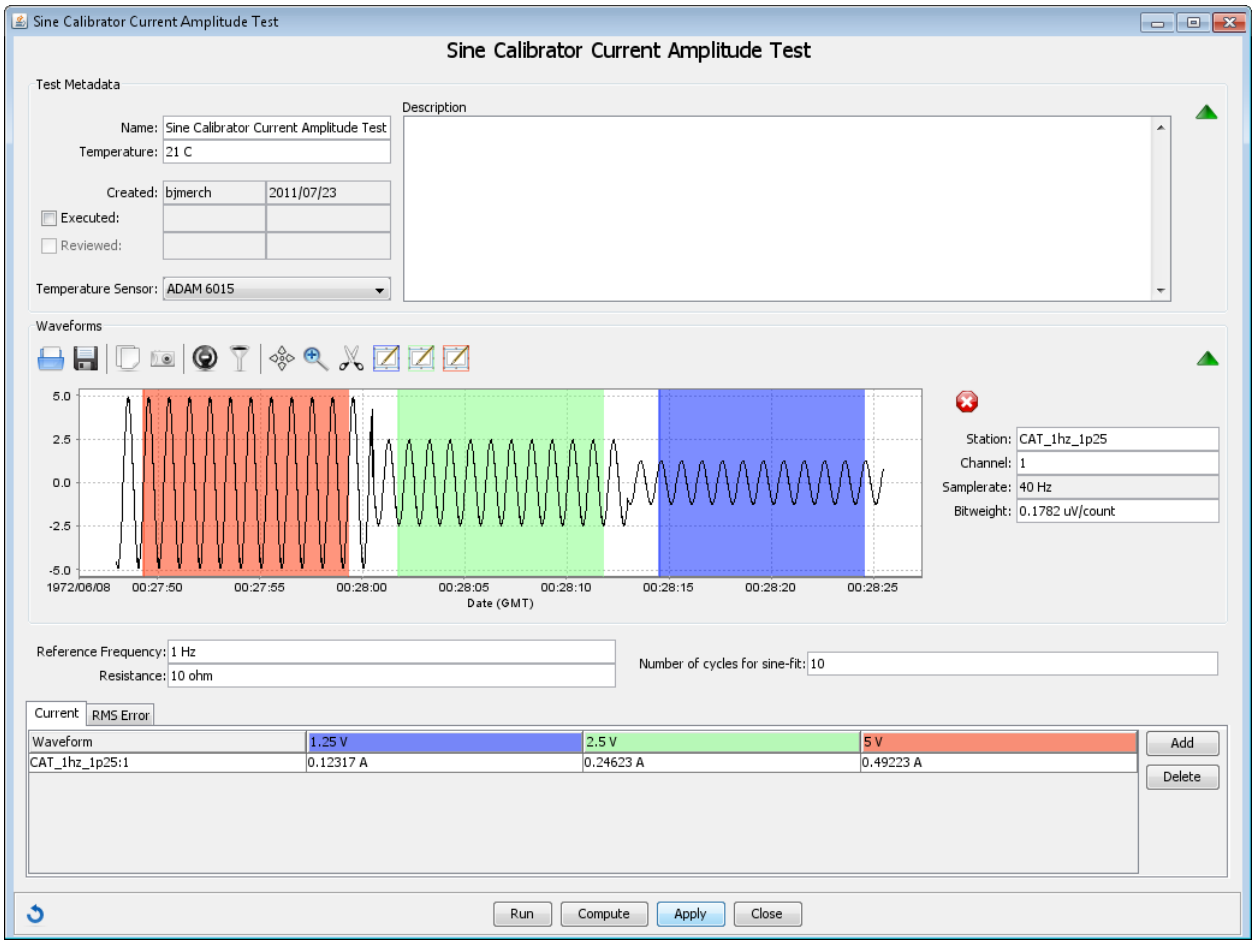
4. Record the waveform data for the digitizer's calibrator output. Cycle the calibrator through each of the chosen amplitudes, allowing for a sufficient duration at each amplitude setting. Load the waveforms for each of the channels into **Waveform Viewer.** Select each amplitude section of the waveform data with the appropriate amplitude selection window.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.14 Sine Calibrator Current Amplitude Test

The Sine Calibrator Current Amplitude Test measures the current output capacity of the digitizer's calibrator. The positive terminal of the calibrator output is connected to ground through a high precision resistor with a known resistance value. The negative terminal of the calibrator output is connected directly to ground. The voltage drop across the resistor is then measured in order to compute the current.



Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Frequency**, **Resistance**, and **Number of cycles for sine-fit** parameters. The reference frequency is the frequency of the sinusoid that the digitizer's calibrator will be outputting. The resistance is the value of the resistor and is used to compute currents from voltage. The number of cycles for sine-fit determines the length of the waveform time segment.

3. Add amplitudes by clicking on the **Add** button next to the Amplitude table. Double click on the color-coded column header to enter the appropriate amplitude value. The voltage entered corresponds to the amplitude of the sinusoid that the digitizer's calibrator will output. A waveform time segment selection tool with matching color will appear within the waveform viewer for each amplitude.

4. Record the waveform data for the digitizer's calibrator output. Cycle the calibrator through each of the chosen amplitudes, allowing for a sufficient duration at each amplitude setting. Load the waveforms for each of the channels into **Waveform Viewer.** Select each amplitude section of the waveform data with the appropriate amplitude selection window.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.15 Sine Calibrator Frequency Test

The Sine Calibrator Frequency Test measures the accuracy of the sinusoid frequency that the digitizer's calibrator can output.

Procedure:

1. Select the desired **Temperature Sensor** Testbed component that is to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Amplitude** and **Number of cycles for sine-fit** parameters. The reference amplitude is the amplitude of the sinusoid that the digitizer's calibrator will be outputting. The number of cycles for sine-fit determines the length of the waveform time segment.

3. Add frequencies by clicking on the **Add** button next to the Frequency table. Double click on color-coded frequency column header to enter the appropriate frequency value. The frequency entered corresponds to the frequency of the sinusoid that the digitizer's calibrator will output. A waveform time segment selection tool with matching color will appear within the waveform viewer for each frequency.

4. Record the waveform data for digitizer's calibrator output. Cycle the calibrator through each of the chosen frequencies, allowing for a sufficient duration at each frequency setting. Load the waveforms for each of the channels into **Waveform Viewer.** Select each frequency section of the waveform data with the appropriate frequency selection window.

5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

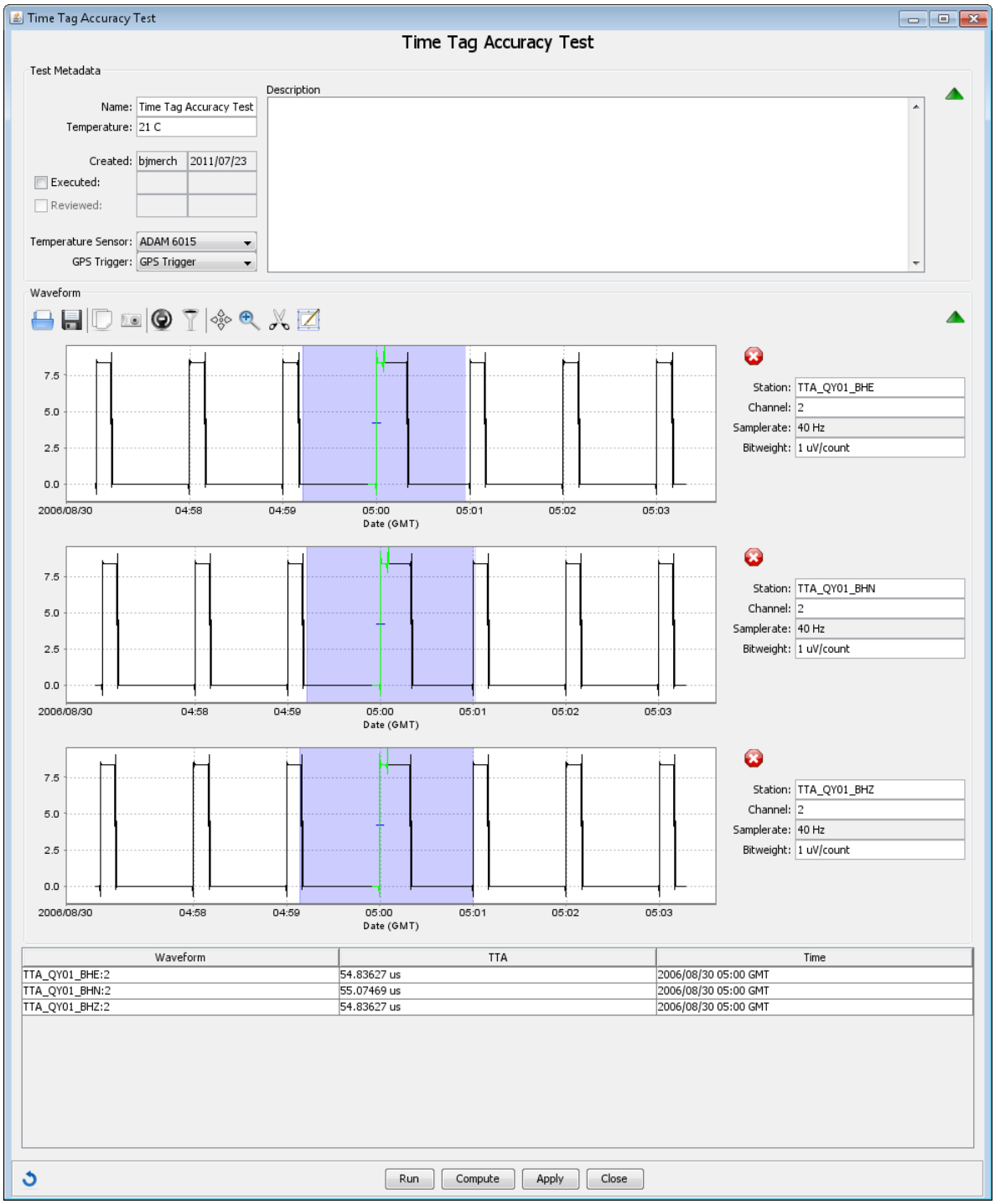
6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.16 Sine Calibrator Total Harmonic Distortion Test

The Sine Calibrator Total Harmonic Distortion is performed identically to the Total Harmonic Distortion Test. The only difference is that instead of using a low distortion oscillator, the digitizer is configured to generate its own sine wave from its calibrator and this signal is recorded by an independent calibrated meter. The reason for performing this test is to quantify the expected THD levels when using the digitizer's own calibrator. When a digitizer has been placed in the field, the digitizer's calibrator may be controlled remotely in order to reproduce this test without having to retrieve any equipment.

12.2.17 Time Tag Accuracy Test

The Time Tag Accuracy Test measures the digitizer's timing accuracy for the pulse per hour trigger output from an independent GPS Timing reference. The timing trigger output from a GPS receiver is connected to an input channel of the digitizer.



Procedure:

1. Select the desired **Temperature Sensor** and **GPS Trigger** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

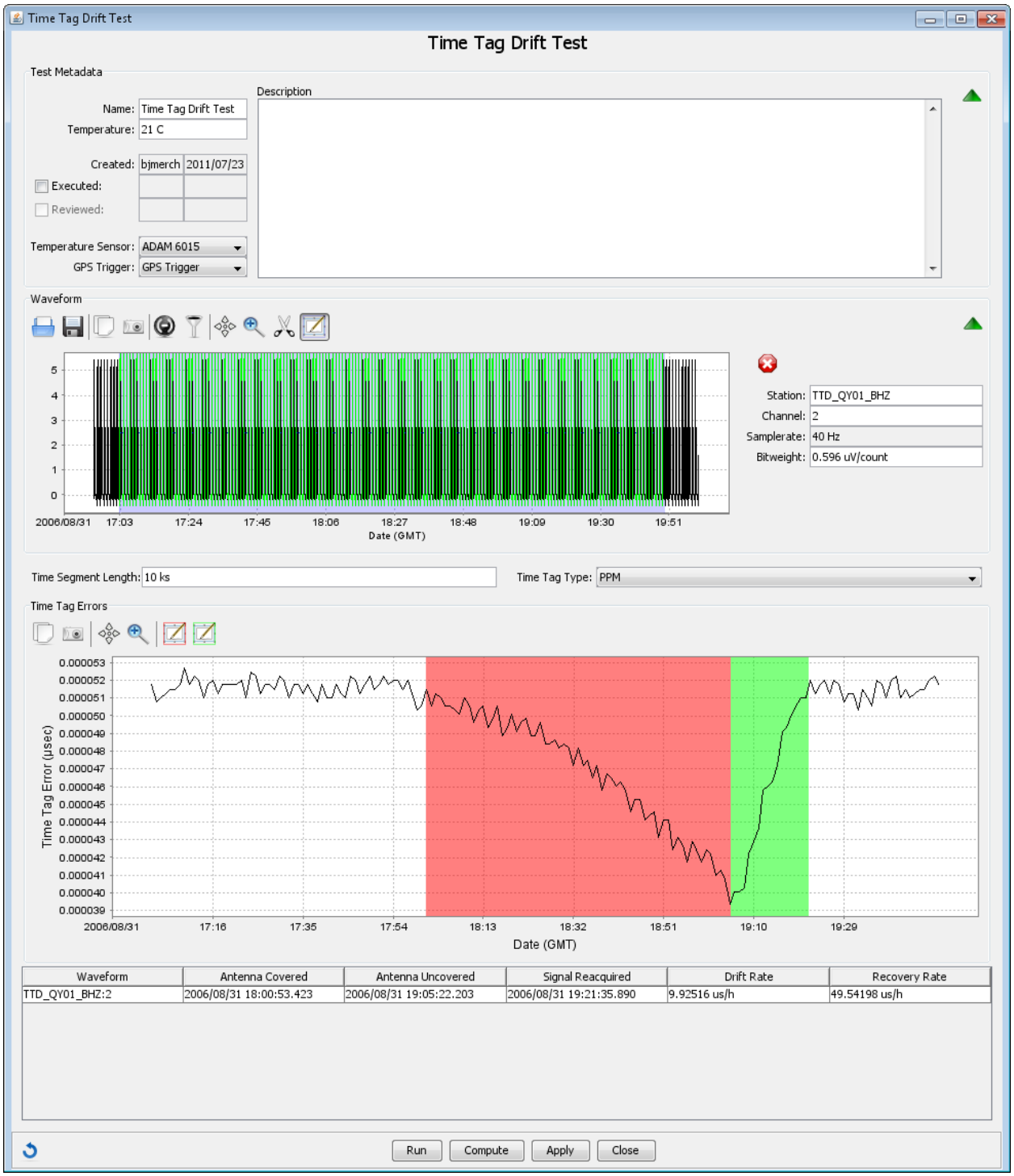
2. Record the GPS timing trigger on all of the desired digitizer channels simultaneously. Load the waveforms into the **Waveforms Viewer**. Select the desired waveform time segment to be used for the waveforms. The time segments should include trigger over an hour transition. The waveform time segments may be set independently for each of the digitizer channels.

3. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

4. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.18 Time Tag Drift Test

The Time Tag Drift Test examines the digitizers timing accuracy while it has a stable GPS lock, how the timing accuracy drifts once it has lost GPS lock, and how the timing accuracy recovers once the digitizer has re-acquired GPS lock.



Procedure:

1. Select the desired **Temperature Sensor** and **GPS Trigger** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Set the **Time Segment Length** and **Time Tag Type** parameters. The time segment length specifies the length of the selected waveform time segment. The time tag type specifies the type of triggers that are being analyzed.

3. Record the GPS timing trigger on the desired digitizer channels simultaneously. Load a single waveform into the **Waveform Viewer**. Select the desired waveform time segment to be used for the waveforms. The time segments should include trigger over an hour transition. The waveform time segments may be set independently for each of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The **Time Tag Errors** plot will be updated with the values computed from the selected waveform time segment.

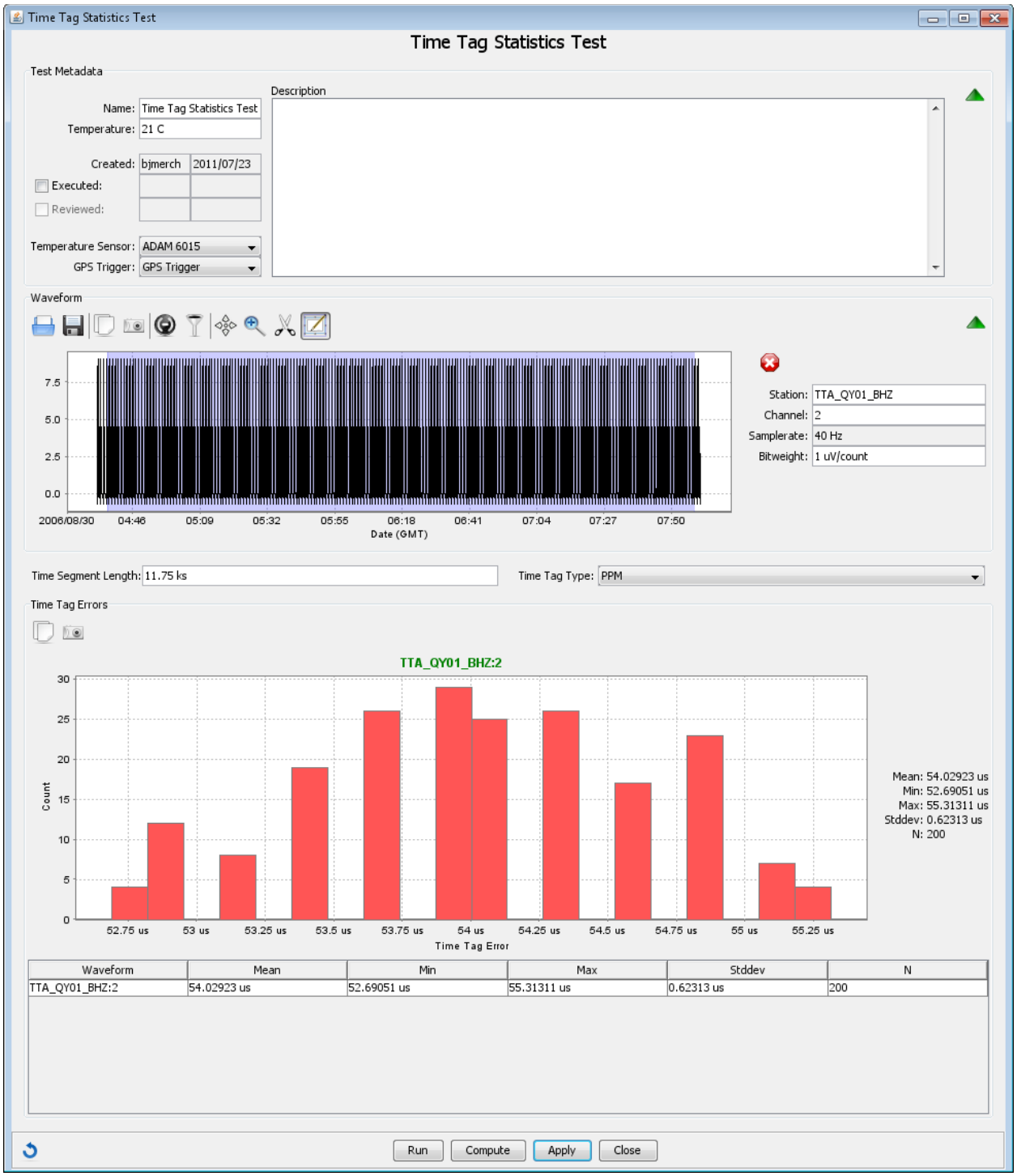
5. Select the Drift Period (red) and Recovery Period (green) using the appropriate time segment selection tools on the **Time Tag Errors** plot.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.19 Time Tag Statistics Test

The Time Tag Statistics Test measures the time tag error for many timing triggers, displays a histogram of the errors, and computes statistics of the errors.



Procedure:

1. Select the desired **Temperature Sensor** and **GPS Trigger** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Set the **Time Segment Length** and **Time Tag Type** parameters. The time segment length specifies the length of the selected waveform time segment. The time tag type specifies the type of triggers that are being analyzed.

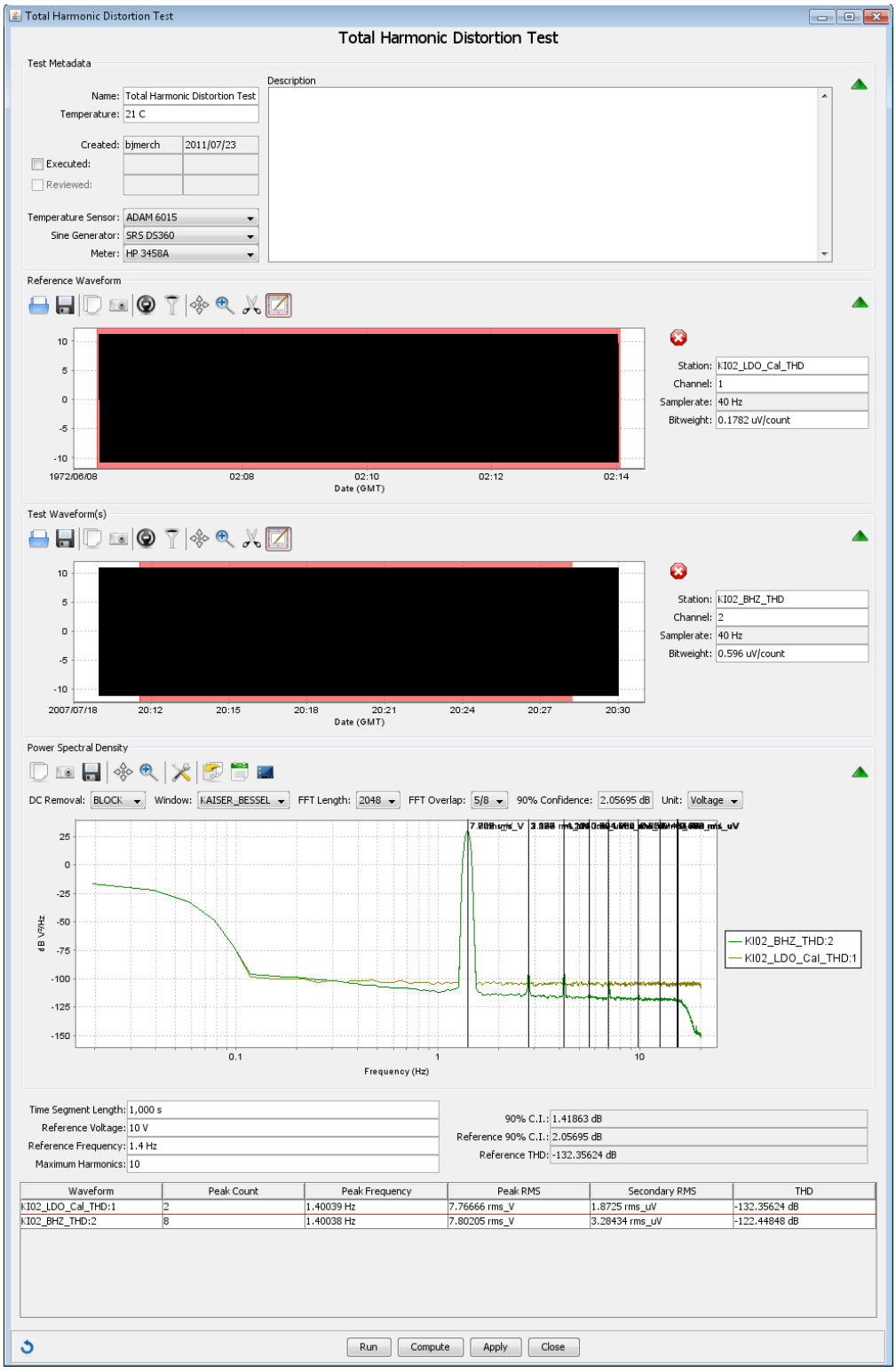
3. Record the GPS timing trigger on all of the desired digitizer channels simultaneously. Load the waveforms into the **Waveforms Viewer**. Select the desired waveform time segment to be used for the waveforms. The waveform time segments may be set independently for each of the digitizer channels.

4. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms.

5. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.2.20 Total Harmonic Distortion Test

The Total Harmonic Distortion Test measures the amount of distortion present in a pure sine wave from an ultra-low distortion oscillator that is fed into an input channel of a digitizer.



Procedure:

1. Select the desired **Temperature Sensor**, **Sine Generator,** and **Meter** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length**, **Reference Voltage**, **Reference Frequency**, and **Maximum Harmonics** parameters. The time segment length specifies the length of the selected waveform time segment. The reference voltage and frequency specify the voltage and frequency of the sinusoid from the sine generator. The maximum harmonics limits the number of harmonics that will be examined in the power spectra when computing the total harmonic distortion.

3. (Optional) Using the signal generator and meter, record a reference waveform. Load that reference waveform into the **Reference Waveform Viewer** and select the desired waveform time segment to be used.

4. Connect the signal generator to each of the digitizer channels and obtain the data by recording the sinusoid. Once the data has been recorded, load the waveform into the **Waveform Viewer**. Select the desired waveform time segments for sinusoid portions of the signal. The waveform time segments may be set independently of one another. However, their lengths are all fixed to be the same.

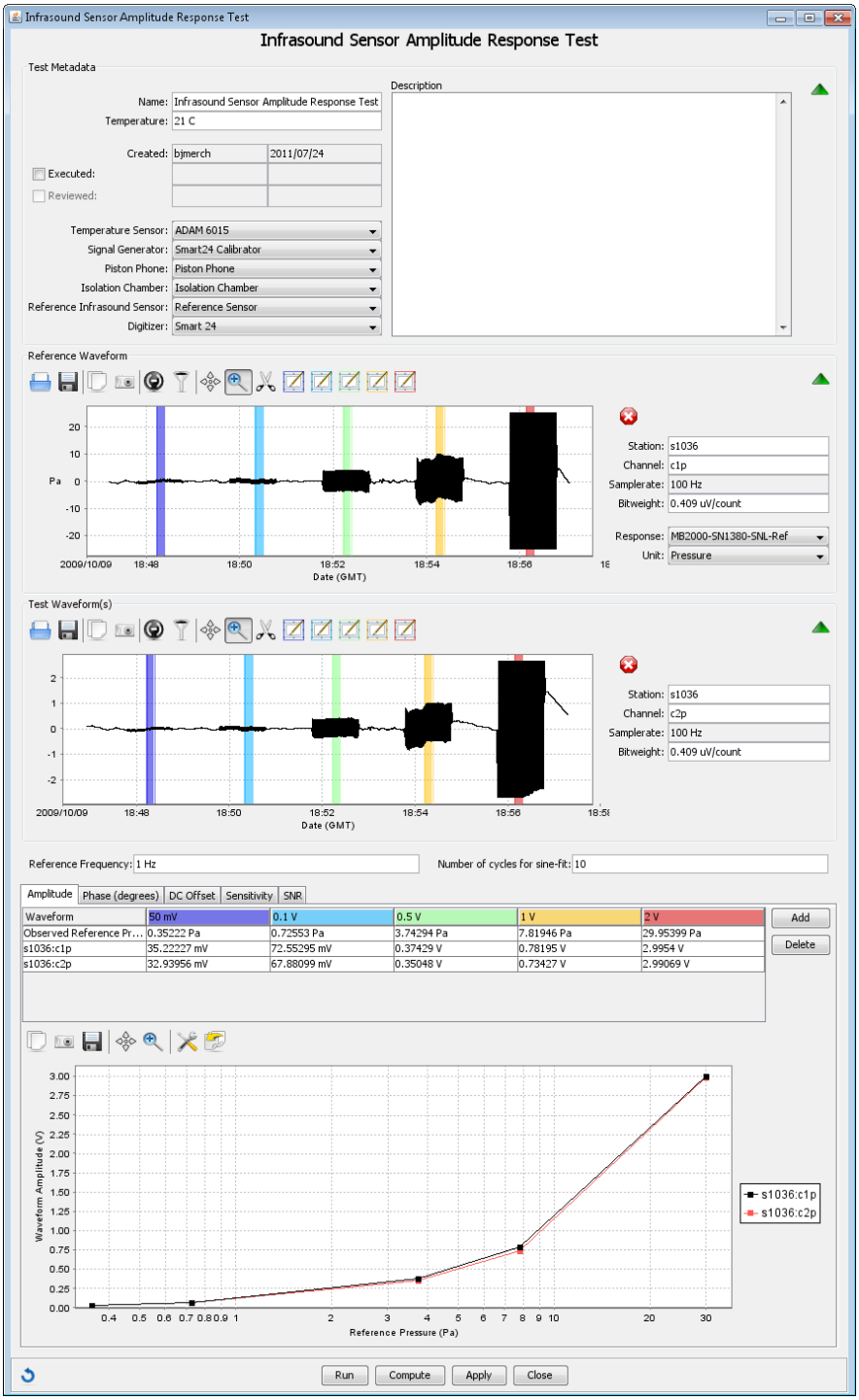
5. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. Also, the power spectra plot will be updated with vertical markers identifying the harmonic peaks.

6. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3 Infrasound and Seismic Sensor Tests

12.3.1 Infrasound Sensor Amplitude Response Test

The Infrasound Sensor Amplitude Response Test measures the sensitivity of an infrasound sensor under test at multiple discrete amplitude values at a fixed tonal frequency.



Procedure:

1. Select the desired **Temperature Sensor**, **Signal Generator, Piston Phone, Isolation Chamber, Reference Infrasound Sensor,** and **Digitizer** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Frequency** and **Number of cycles for sine-fit** parameters. The reference frequency is the frequency of the sinusoid that the signal generator will be outputting. The number of cycles for sine-fit and the sinusoid frequency are used in determining the length of the waveform time segment.

3. Add amplitudes by clicking on the **Add** button next to the Amplitude table. Double click on the color-coded column header to enter the appropriate amplitude voltage value. The voltage values correspond to the amplitude of the sinusoids that the signal generator will be outputting. A waveform time segment selection tool with matching color will appear within the waveform viewers for each amplitude.

4. Record the waveform data for the reference infrasound sensor and the infrasound sensor under test. Cycle the signal generator through each of the chosen amplitudes, allowing for a sufficient duration at each amplitude setting. Load the waveform for the reference infrasound sensor into the **Reference Waveform Viewer** and select the appropriate sensor response. Load the waveform for the infrasound sensor under test into the **Test Waveform Viewer.**

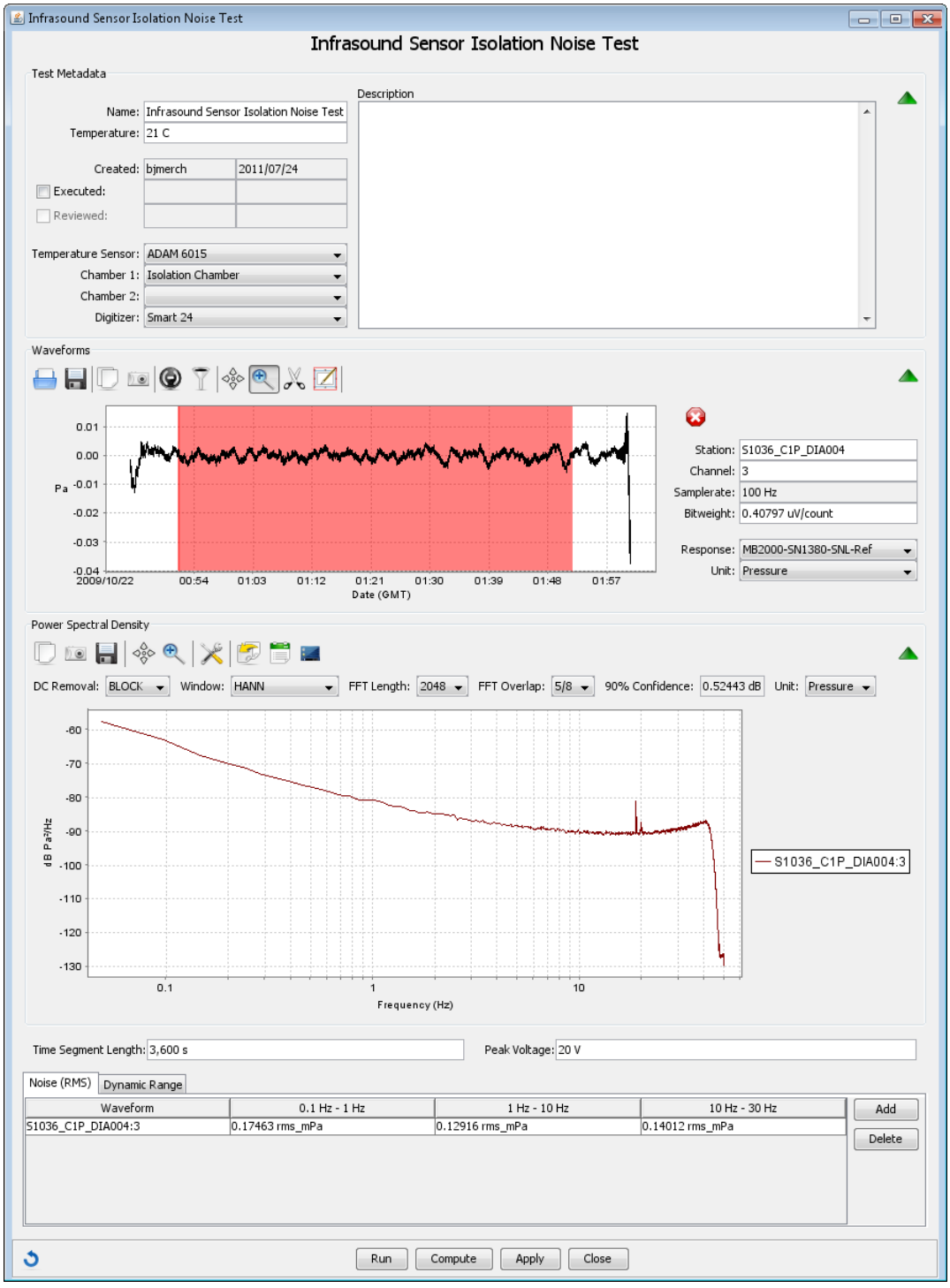
5. Select each amplitude section of the waveform data with the appropriate amplitude selection window. The window lengths are fixed based upon the signal frequency and number cycles for sine fit. The positions of each window are the same between the reference and test waveforms.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the tables and plots below the waveforms. There are tabs for each result types: Amplitude, Phase, DC Offset, Sensitivity, and SNR.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.2 Infrasound Sensor Isolation Noise Test

The Infrasound Sensor Isolation Noise Test measures the internal noise of an infrasound sensor under test when the ambient infrasound signals present are below the sensor noise. The infrasound sensor is placed inside of a pressure isolation chamber. The isolation chamber serves to attenuate any external ambient variations in pressure that would otherwise be recorded.



Procedure:

1. Select the desired **Temperature Sensor, Isolation Chamber(s),** and **Digitizer** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length,** and **Peak Voltage** parameters. The time segment length specifies the length of the waveform time segment. The peak voltage is the maximum signal output from the sensor under test. This value should be obtained from the manufacturer's datasheet.

3. Add frequency bands by clicking on the **Add** button next to the results table at the bottom of the Test Viewer. Double click on the table column header to modify the frequency band range. The range may be entered as two values in Hertz separated by a dash. The frequency bands are used for computing noise estimates within those bands.

4. Record the waveform data for sensor under test. Load the waveform for each of the channels into **Waveform Viewer** and select the appropriate sensor response. Select the desired waveform time segment to be used.

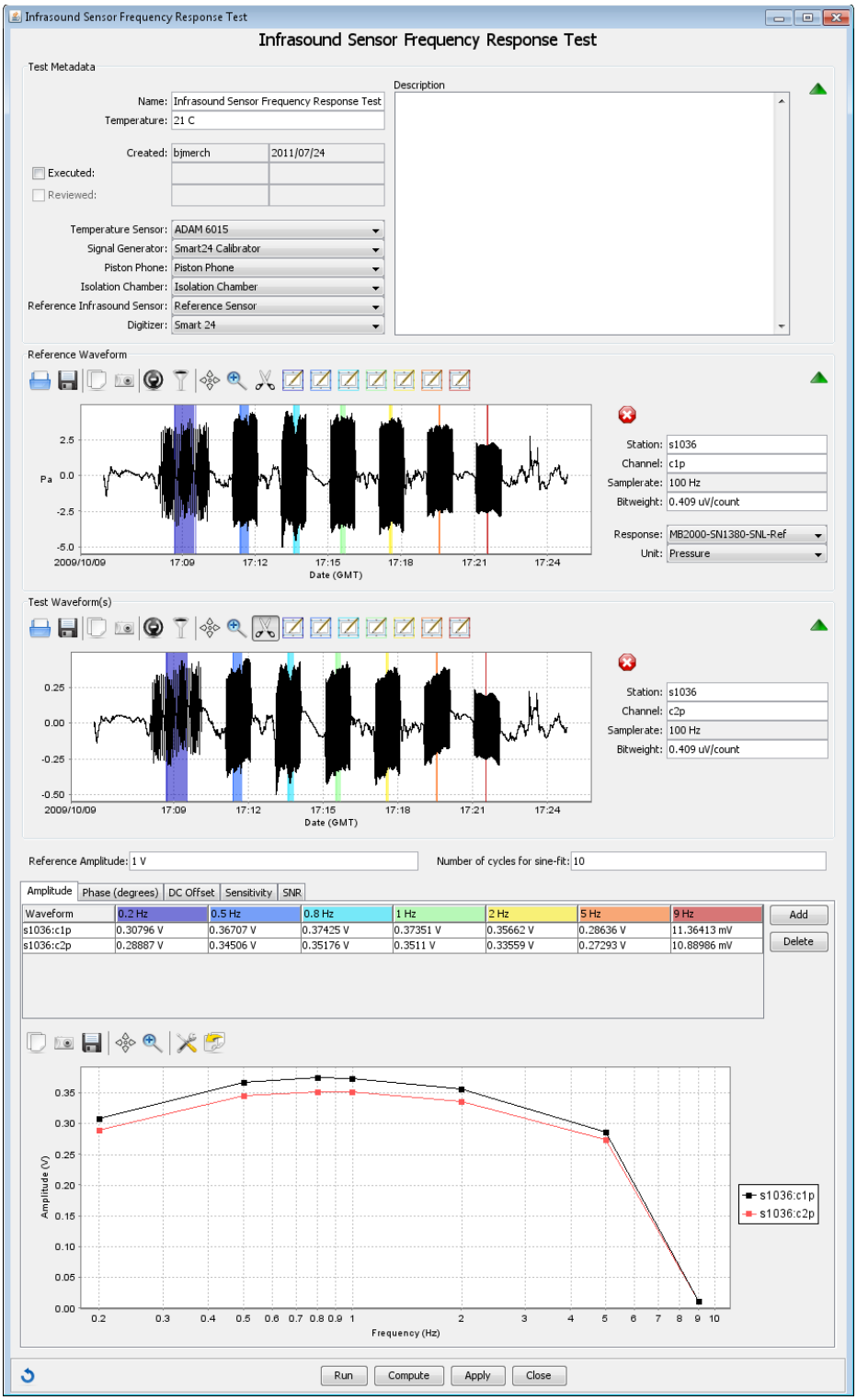
5. Make any desired changes to the **PSD Parameters** and overlay any desired models onto the spectra.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the table below the waveforms. Separate tables are provided for the noise and the dynamic range.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.3 Infrasound Sensor Frequency Response Test

The Infrasound Sensor Frequency Response Test measures the sensitivity of an infrasound sensor under test at multiple discrete frequency values.



Procedure:

1. Select the desired **Temperature Sensor**, **Signal Generator, Piston Phone, Isolation Chamber, Reference Infrasound Sensor,** and **Digitizer** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Reference Amplitude** and **Number of cycles for sine-fit** parameters. The reference amplitude is the amplitude voltage of the sinusoid that the signal generator will be outputting. The number of cycles for sine-fit and the sinusoid frequencies are used in determining the length of the waveform time segment.

3. Add frequencies by clicking on the **Add** button next to the Amplitude table. Double click on the color-coded column header to enter the appropriate frequency value in Hertz. The frequencies correspond to the frequencies of the sinusoids that the signal generator will be outputting. A waveform time segment selection tool with matching color will appear within the waveform viewers for each frequency.

4. Record the waveform data for the reference infrasound sensor and the infrasound sensor under test. Cycle the signal generator through each of the chosen frequencies, allowing for a sufficient duration at each frequency setting. Load the waveform for the reference infrasound sensor into the **Reference Waveform Viewer** and select the appropriate sensor response. Load the waveform for the infrasound sensor under test into the **Test Waveform Viewer.**

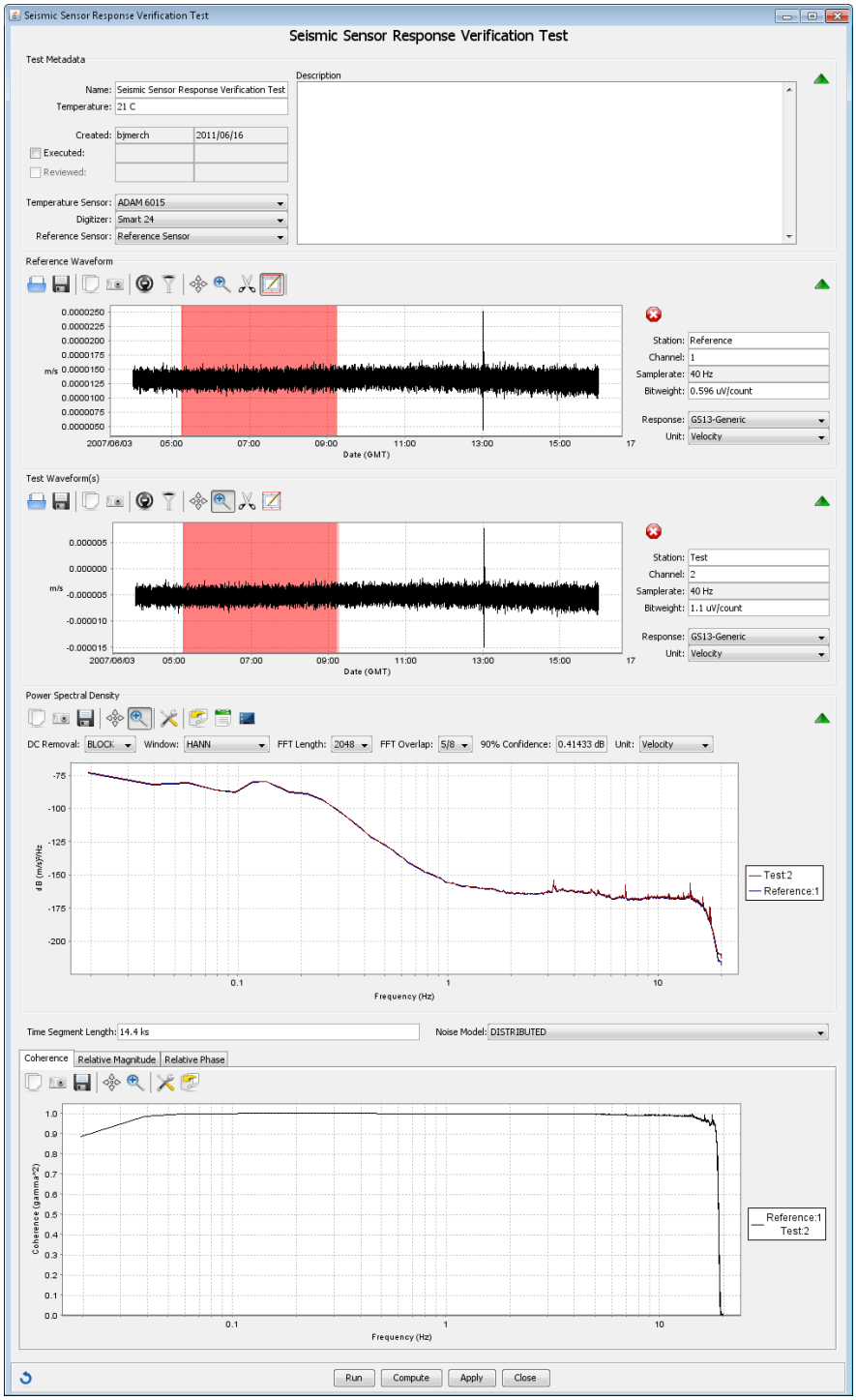
5. Select each frequency section of the waveform data with the appropriate frequency selection window. The window lengths are fixed based upon the signal frequency and number cycles for sine fit. The positions of each window are the same between the reference and test waveforms.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the tables and plots below the waveforms. There are tabs for each result types: Amplitude, Phase, DC Offset, Sensitivity, and SNR.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.4 Seismic / Infrasound Sensor Response Verification Test

The Seismic / Infrasound Sensor Response Verification Test measures the response of a seismic or infrasound sensor under test relative to a reference sensor. The sensor under test and the reference sensor with known response characteristics are co-located so that they are both measuring a common signal.



Procedure:

1. Select the desired **Temperature Sensor, Digitizer,** and **Reference Sensor** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length** and **Noise Model** parameters. The time segment length specifies the length of the waveform time segment. The noise model specifies whether noise is distributed between the two sensors or lumped into the test sensor for coherence analysis.

3. Record the waveform data for the reference and test sensors. Load the waveform for the reference sensor into the **Reference Waveform Viewer** and select the appropriate sensor response. Load the waveform for the sensor under test into the **Test Waveform Viewer** and select the appropriate sensor response**.**

4. Select the desired waveform time segment to be used for each of the waveforms. The waveform time segments are fixed to be identical between the reference and test waveforms.

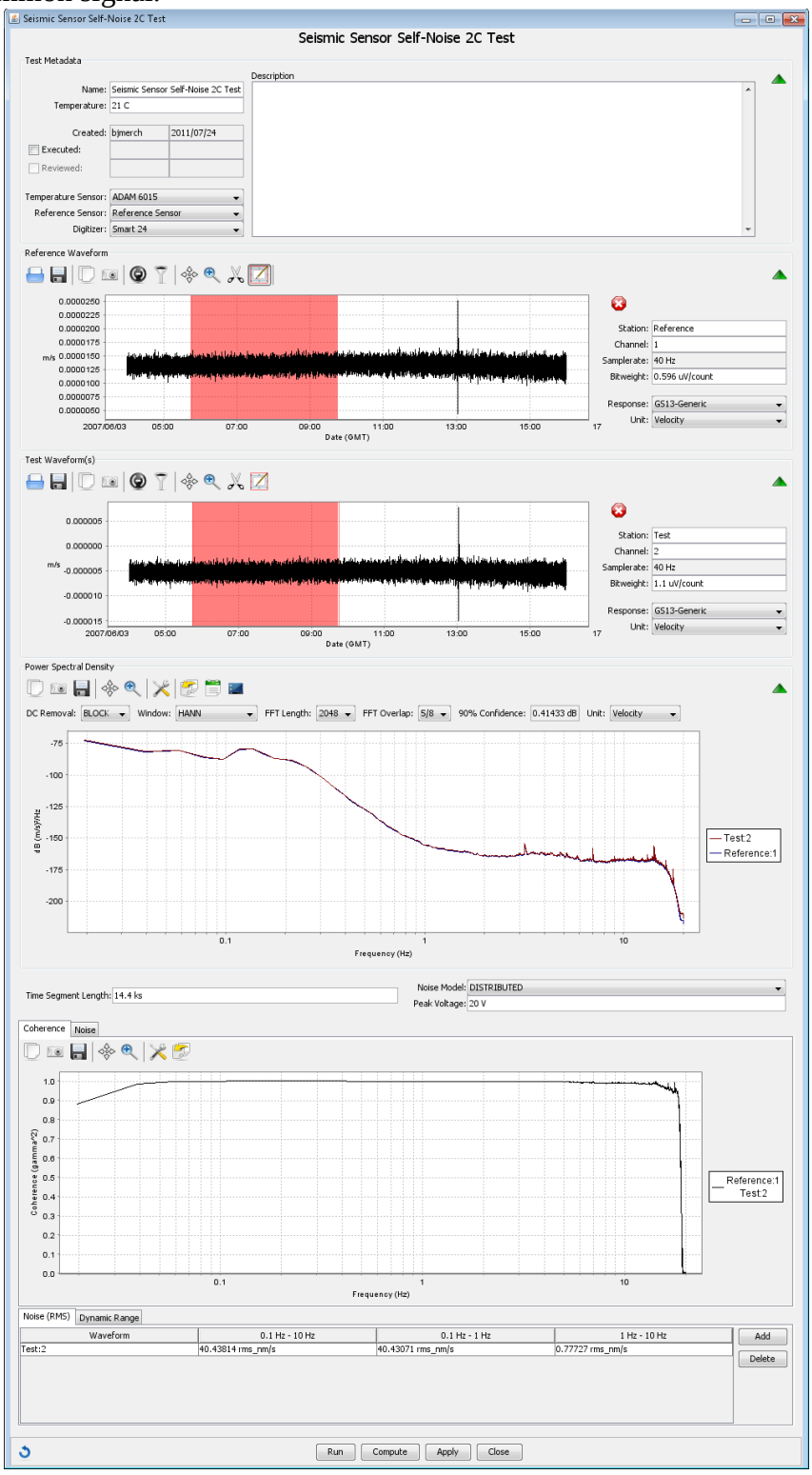
5. Make any desired changes to the **PSD Parameters** and overlay any desired models onto the spectra.

6. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the plots of coherence, relative magnitude, and relative phase.

7. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.5 Seismic / Infrasound Sensor Self-Noise 2C Test

The Seismic / Infrasound Sensor Self-Noise 2C Test measures the noise level of a seismic sensor under test relative to one reference sensors. The sensors are all co-located so that they are measuring a common signal.



Procedure:

1. Select the desired **Temperature Sensor, Digitizer,** and **Reference Sensor** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length, Noise Model,** and **Peak Voltage** parameters. The time segment length specifies the length of the waveform time segment. The noise model specifies whether noise is distributed between the two sensors or lumped into the test sensor for coherence analysis. The peak voltage is the maximum signal output from the sensor under test. This value should be obtained from the manufacturer's datasheet.

3. Add frequency bands by clicking on the **Add** button next to the results table at the bottom of the Test Viewer. Double click on the table column header to modify the frequency band range. The range may be entered as two values in Hertz separated by a dash. The frequency bands are used for computing noise estimates within those bands.

4. Record the waveform data for the reference and test sensors. Load the waveform for the reference sensor into the **Reference Waveform Viewer** and select the appropriate sensor response. Load the waveform for the sensor under test into the **Test Waveform Viewer** and select the appropriate sensor response**.**

5. Select the desired waveform time segment to be used for each of the waveforms. The waveform time segments are fixed to be identical between the reference and test waveforms.

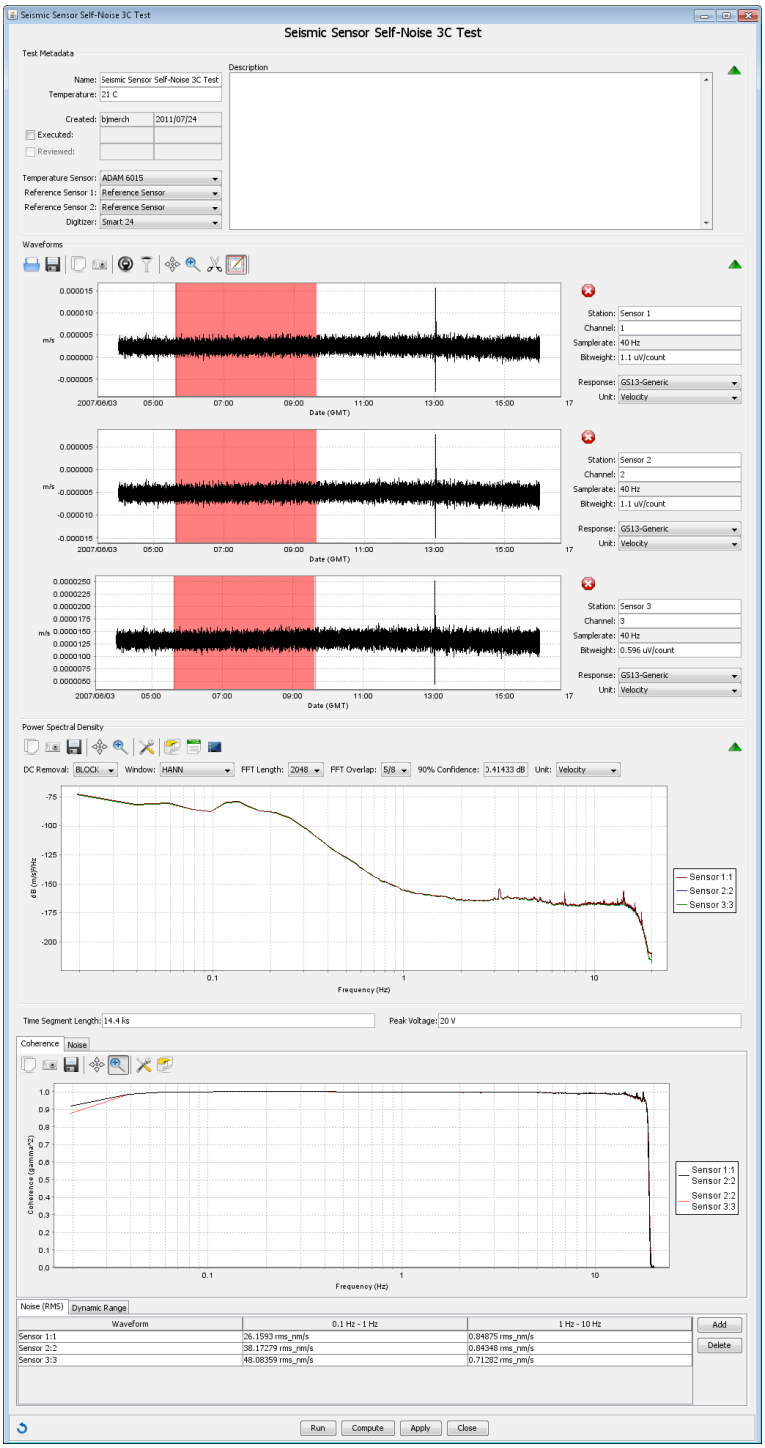
6. Make any desired changes to the **PSD Parameters** and overlay any desired models onto the spectra.

7. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the plots of coherence and noise. A table of noises and dynamic ranges for each of the defined frequency bands will also be generated.

8. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.6 Seismic / Infrasound Sensor Self-Noise 3C Test

The Seismic / Infrasound Sensor Self-Noise 3C Test measures the noise level of a seismic sensor under test relative to two reference sensors. The sensors are all co-located so that they are measuring a common signal.



Procedure:

1. Select the desired **Temperature Sensor, Digitizer, Reference Sensor 1** and **Reference Sensor 2** Testbed components that are to be used in this test from within the appropriate pull-down list in the Test Metadata section.

2. Enter the **Time Segment Length** and **Peak Voltage** parameters. The time segment length specifies the length of the waveform time segment. The peak voltage is the maximum signal output from the sensor under test. This value should be obtained from the manufacturer's datasheet.

3. Add frequency bands by clicking on the **Add** button next to the results table at the bottom of the Test Viewer. Double click on the table column header to modify the frequency band range. The range may be entered as two values in Hertz separated by a dash. The frequency bands are used for computing noise estimates within those bands.

4. Record the waveform data for the reference and test sensors. Load all three waveforms into the **Test Waveform Viewer** and select the appropriate sensor responses**.**

5. Select the desired waveform time segment to be used for each of the waveforms. The waveform time segments are fixed to be identical across all of the waveforms.

6. Make any desired changes to the **PSD Parameters** and overlay any desired models onto the spectra.

7. Click the **Compute** button at the bottom of the test window. The results of the analysis will appear in the plots of coherence and noise. A table of noises and dynamic ranges for each of the defined frequency bands will also be generated.

8. Click the **Apply** button at the bottom of the test window. The entirety of the test will be saved to the database.

12.3.7 Seismic / Infrasound Sensor Total Harmonic Distortion Test

The Seismic / Infrasound Sensor Total Harmonic Distortion Test is performed identically to the Total Harmonic Distortion Test. The only difference is that an additional source generator, such as a piston phone or shake table, is used to supply a sinusoidal signal to the sensor under test.

12.4 Subsystem Tests

12.4.1 Sensor Subsystem DC Accuracy Test

The Sensor Subsystem DC Accuracy Test is the same as the Digitizer DC Accuracy Test. However, it has an additional component association to select a Digitizer component. The contents of the Digitizer pull-down list in the Test Metadata section are obtained from the subsystem for this test.

12.4.2 Sensor Subsystem Input Terminated Noise / Maximum Potential Dynamic Range Test

The Sensor Subsystem Input Terminated Noise / Maximum Potential Dynamic Range Test is the same as the Digitizer Input Terminated Noise Test and Maximum Potential Dynamic Range Test. However, it has an additional component association to select a Digitizer component. The contents of the Digitizer pull-down list in the Test Metadata section are obtained from the subsystem for this test.

12.4.3 Sensor Subsystem Time Tag Accuracy Test

The Sensor Subsystem Time Tag Accuracy Test is the same as the Digitizer Time Tag Accuracy Test. However, it has an additional component association to select a Digitizer component. The contents of the Digitizer pull-down list in the Test Metadata section are obtained from the subsystem for this test.

12.4.4 Sensor Subsystem Time Tag Drift Test

The Sensor Subsystem Time Tag Drift Test is the same as the Digitizer Time Tag Drift Test. However, it has an additional component association to select a Digitizer component. The contents of the Digitizer pull-down list in the Test Metadata section are obtained from the subsystem for this test.

12.4.5 Sensor Subsystem Seismic / Infrasound System Noise and Bandwidth Limited Dynamic Range Test

The Sensor Subsystem Seismic / Infrasound System Noise and Bandwidth Limited Dynamic Range Test is the same as the Seismic / Infrasound System Noise and Bandwidth Limited Dynamic Range Test. However, it has an additional component association to select a Digitizer component. The contents of the Digitizer pull-down list in the Test Metadata section are obtained from the subsystem for this test.

12.4.6 Sensor Subsystem Seismic/Infrasound Self Noise 2-Channel Test

The Sensor Subsystem Seismic/Infrasound Self Noise 2-Channel Test is the same as the Seismic / Infrasound Sensor Self-Noise 2C Test. However, it has additional component associations to

select a Digitizer component and a Sensor components. The contents of the digitizer and sensor pull-down lists in the Test Metadata section are obtained from the subsystem for this test.

12.4.7 Sensor Subsystem Seismic/Infrasound Self Noise 3-Channel Test

The Sensor Subsystem Seismic/Infrasound Self Noise 3-Channel Test is the same as the Seismic / Infrasound Sensor Self-Noise 3C Test. However, it has additional component associations to select a Digitizer component and a Sensor component. The contents of the digitizer and sensor pull-down lists in the Test Metadata section are obtained from the subsystem for this test.

12.4.8 Sensor Subsystem Seismic/Infrasound Response Verification Test

The Sensor Subsystem Seismic/Infrasound Response Verification Test is the same as the Seismic / Infrasound Sensor Response Verification Test. However, it has additional component associations to select a Digitizer component and a Sensor component. The contents of the digitizer and sensor pull-down lists in the Test Metadata section are obtained from the subsystem for this test.

13 REFERENCES

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