Taurus

Portable Seismograph

User Guide

Nanometrics Inc.
Kanata, Ontario
Canada

Taurus Portable Seismograph User Guide

The information in this document has been carefully reviewed and is believed to be reliable for Taurus running firmware version 2.05.*x*. Nanometrics Inc. reserves the right to make changes at any time without notice to improve the reliability and function of the product.

Nanometrics Inc.
250 Herzberg Road
Kanata, Ontario, Canada K2K 2A1
Tel +1 613-592-6776
Fax +1 613-592-5929
Email info@nanometrics.ca
www.nanometrics.ca

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Chapter 1 Introduction

1.1 About the Taurus

The Taurus Portable Seismograph is a compact, self-contained digitizer and data logger that combines exceptional performance with versatility and low power consumption. The Taurus can be used either as a stand-alone time-series data logger or as a component in a data acquisition network. Taurus incorporates a three-channel 24-bit Digitizer, GPS receiver and System Clock, removable data storage, and remote communication options. Taurus is configurable locally using the colour display screen and integrated browser or remotely using any web browser over a TCP/IP connection.

Taurus is equipped with three 24-bit data channels. Time-series data are stored in Steim (1) format, and can be extracted to MiniSEED, Seisan, or ASCII format, and streamed in Nanometrics NP format. Taurus supports 10/100Base-T Ethernet and serial interfaces. Communication protocols include UDP/IP, TCP/IP, SLIP, PPP, and HTTP.

As a portable unit, Taurus can be deployed to record continuous data for extended periods of time. For example, when recording 3 channels at 100 sps, up to 600 days of data can be recorded using a 40 GB 1.8" hard disk drive. A CompactFlash card may also be used as an alternative to a hard drive, for example to use at more extreme temperatures or altitudes, or to realize optimal power consumption. Media are removable for easy data retrieval from the field. The extensive storage combined with low power consumption make the Taurus ideal for long term unattended data acquisition.

1.2 About this User Guide

Note Please refer also to the release notes for the version of firmware you have installed on your Taurus.

This User Guide provides quick setup and installation information, procedures for operating and configuring the Taurus, and reference information:

Part 1 "Getting Started" provides an overview of setting up the Taurus, and general procedures for operating the Taurus:

- Chapter 1 "Introduction"
- Chapter 2 "Quick Start" – An overview of basic procedures and installation.
- Chapter 3 "Operating and Maintaining Taurus" – General instructions for operating the Taurus.

Part 2 “Using the Taurus” provides detailed procedures:

- Chapter 4 “Powering the Taurus” – Grounding considerations, and procedures for properly powering and shutting down the Taurus and for setting power manager parameters.
- Chapter 5 “Changing a Taurus Configuration” – An overview of how to work with the Taurus configuration, and procedures for changing a configuration.
- Chapter 6 “Configuring Taurus User Access” – An overview of user access models, and procedures for logging in to the Taurus.
- Chapter 7 “Configuring Taurus Communications” – Procedures for configuring the Taurus for Ethernet or serial networking.
- Chapter 8 “Configuring the Digitizer and Timing” – Overview information and procedures for configuring the Digitizer and system timing.
- Chapter 9 “Controlling and Configuring Sensors” – Procedures for sending commands to a sensor, and for configuring the Taurus to work with sensors either by manually editing settings or by uploading predefined configurations.
- Chapter 10 “Recording Data” – Overview information and procedures for working with the recording media (IDE hard drive or CompactFlash card) and with Taurus data Stores.
- Chapter 11 “Accessing Data” – Overview information and procedures for extracting data from Taurus Stores and for streaming data to a central server.

Part 3 “Appendices” contain reference information:

- Appendix A “Specifications” – Taurus specifications
- Appendix B “Connector Pinouts” – Connector pinouts diagrams and descriptions.
- Appendix C “Sensor-Digitizer Interconnection” – An overview of principles for connecting sensors and digitizers, and recommended wiring lists for various sensors.
- Appendix D “Filter Response” – Digitizer filter response.
- Appendix E “Open Source/Free Software Information” – Open Source/Freeware license information.
- Appendix F “Apollo Light Utility” – Procedures for using the Apollo Light utility to view and extract data from Stores on your file system.
- Appendix G “Taurus Firmware Upgrade Procedures” – Procedures for upgrading from Taurus software version 1.*x* to 2.*x*, and from 2.*x* to 2.*x* and higher.
- Appendix H “UI Pages and Parameters” – A listing of each UI page and brief descriptions of the parameters on each page, including valid value ranges.

1.3 Unpacking the shipment

Note The information in this section should be used in conjunction with product warranty information.

Open the shipment and check the contents for completeness against the packing slip. There is a configuration sheet containing specific configuration information for each Taurus Portable Seismograph included in the shipment. This configuration sheet lists information such as the serial numbers of the parts shipped.

Visually inspect the equipment for any damage that may have occurred in transit. If there are any problems with the shipment, please contact Nanometrics Support.

1.4 Technical support

Read the appropriate sections of this user guide and related documents such as firmware release notes before installing or operating the Taurus Portable Seismograph.

Taurus features as identified in this manual have been tested and are supported by Nanometrics. Use of other capabilities on the Taurus (for example, SSH, general Linux resources) is not supported by Nanometrics Technical Support or Warranty. Use such additional capabilities at your discretion.

If you need technical support, please submit your request via the Nanometrics customer support site, or by email or fax. Include a full explanation of the problem and supporting data (for example, relevant log and SOH files). Before returning a unit for repair, request an RMA number.

Customer support site:	http://support.nanometrics.ca/
Email:	techsupport@nanometrics.ca
Fax:	To: Support, at +1 613-592-5929

Chapter 2 Quick Start

This chapter provides an overview of basic setup procedures. Refer to the relevant chapters for more detailed information.

2.1 Taurus basic elements

Figure 2-1 shows the location and function of basic Taurus physical features, and Figure 2-2 gives an overview of the Taurus subsystems.

Figure 2-1 Taurus physical features

Connectors (see Appendix B “Connector Pinouts”)

Colour display screen (display)

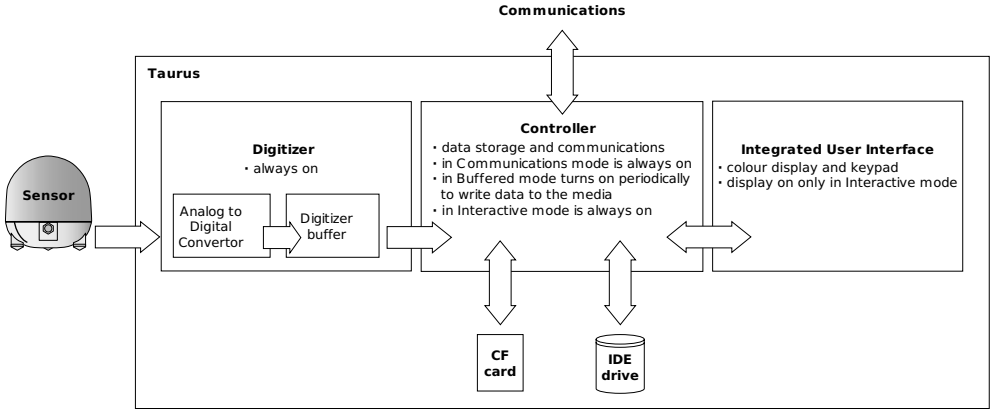
SuperLED (indicates Taurus unit status)

Keypad (see also Section 3.4 “Using the Taurus keypad” on page 22)

✧ Press and hold the centre key for about 1 second to start the Taurus (see also Section 3.3 “Starting up and shutting down the Taurus” on page 19)

Media door (see also Section 10.3.1 “Insert and remove recording media” on page 99)

Figure 2-2 Taurus subsystems block diagram*



* See also Section A.13 “Power” on page 127 for typical power consumption specifications, Section 3.1 “About the Taurus operating modes” on page 17, and Section 8.2.1 “GPS receiver duty cycle” on page 79.

2.2 Verify operation of a Taurus

To check basic operation of a Taurus:

1. Connect the GPS antenna.
   a) Place the GPS antenna where it has a good view of the sky (ideally, an unobstructed view of the sky above 30° elevation angle).
   b) Connect the cable to the Taurus GPS connector.
      ▸ If you have the optional metal dust caps installed (Nanometrics part number 15762), ensure that none of the dust caps are touching the GPS connector as this will create a ground loop.
2. If you wish to use a web browser on a PC to configure the Taurus, connect the Taurus to your LAN using the supplied Ethernet cable (15228) or equivalent.
3. Insert recording media (see Section 10.3.1 “Insert and remove recording media” on page 99).

   Recording media supplied with your order from Nanometrics is already formatted to Ext3. For Ext3 formatted media, the Taurus will automatically create a data Store on startup, using the current Store configuration. (The Store is the set of files that contains time-series and other types of data; see also Section 10.2 “Data Stores” on page 95.)

   ▸ For other formatting options, see Section 10.3.2 “Format recording media” on page 101.
4. Power up the Taurus:
   a) Build a power cable using a power connector from the optional Taurus Connector Kit (part number 15170) or equivalent (see also Appendix B “Connector Pinouts”).
   b) Connect the Taurus to an appropriate 9 to 36 V DC power supply (see also Chapter 4 “Powering the Taurus”). The Taurus will start booting up; it will take

2 to 3 minutes for the Taurus to finish booting. Progress is indicated by the LED colour and blink patterns (see Section 3.8.2 “Status LEDs” on page 26) and the boot progress screen (see Section 3.3.1 “Start the Taurus” on page 19).

c) About 2 minutes after connecting the power, you can start the Taurus display. Press and hold the centre key on the keypad for about 1 second to turn on the display (see Figure 3-2 “Taurus keypad functions” on page 22). It will take about 10 to 15 seconds for the display to start. It will open to the Status page.

5. View the Status page to check basic operation.

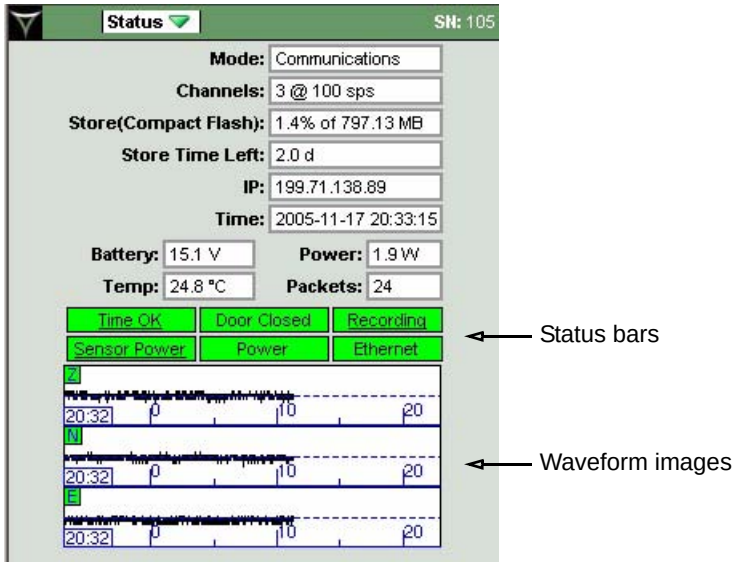
   a) Verify that the status bars are all green (Figure 2-3).
      - For an initial startup in a new location it may take the GPS receiver a few minutes to lock. Until then, the GPS/timing status bar will be red or yellow.
      - The Sensor status bar may be red, depending on the Sensor settings.

      See Table H-1 “Status page options” on page 177 for information on interpreting the status bars.

   b) Verify that waveform images are displayed and that the value for Packets is incrementing; this indicates that data are being recorded to the Store.

6. Note the Taurus current Ethernet IP address. Use this address to connect to the Taurus, for example if you will use a web browser for configuration (http://*TaurusIPAddress*/). (See Chapter 7 “Configuring Taurus Communications” for information on how the IP address is obtained.)

Figure 2-3 Taurus Status page



2.3 View or change configuration settings

You can view and change configuration settings via either the display and keypad, or via a browser over an IP connection.

2.3.1 Making configuration changes

The Configuration and Advanced Configuration pages are available from the Taurus UI main menu, on either the display or a browser. You must be logged in as `tech` or `central` to change the configuration. See also Section 3.6 “Navigating the Taurus UI pages” on page 23, Chapter 5 “Changing a Taurus Configuration”, and Chapter 6 “Configuring Taurus User Access”.

- Note the functions of the **Apply**, **Commit**, **Reset**, and **Previous** buttons:
  - **Apply** will save configuration changes to volatile memory until the next restart of the associated Taurus subsystem (see Section 5.1 “Configuration format and storage” on page 43). In most cases you can use **Apply** to test your changes before you commit the changes.
  - **Commit** will save the applied changes to non-volatile memory as the new configuration. The **Commit** function includes **Apply**. In most cases, configuration changes are active as soon as you commit them.
  - **Reset** will clear all changes that have not yet been applied. **Reset** has no effect once you have clicked either **Apply** or **Commit**.
  - **Apply**, **Commit**, and **Reset** work independently of the current UI page you are on. They always affect the entire configuration (the entire configuration is the collection of all Taurus parameters which you can modify). For example, if you make a change in one configuration page, go to another page and make a second change, and then click **Reset**, both changes are cleared from volatile memory.

    Some configuration changes require a **Restart** before they take effect (for example, changes to Communications and Security settings). The UI will provide a message when this is the case, instructing you that a commit followed by a restart is required. In these cases, you cannot use **Apply** to test the changes before committing them.
  - **Previous** returns you to a configuration page one up in the hierarchy without losing unapplied changes.
    - When using a browser, always use the **Previous** button, not the browser’s Back button, to preserve unapplied changes when navigating back through configuration pages.

2.3.2 Basic configuration settings

There are some basic settings you may want to check before proceeding to other configuration changes.

- You can make all of the configuration changes, then do a single **Apply** and **Commit**.

2.3.2.1 Running mode

There are two basic running modes—Buffered and Communications—as well as an Interactive mode, which is on only while the display is active. Once the display shuts down the Taurus operates in the configured running mode. Buffered mode is the most

power-efficient, whereas Communications mode allows continuous access via an IP connection. See also Section 3.1 “About the Taurus operating modes” on page 17.

- Choose the Running mode from either the Configuration page or the Advanced Configuration > General page. (The change will be permanent after a **Commit**.)

2.3.2.2 Number of channels

- Choose the number of channels from either the Configuration page or the Advanced Configuration > General page. (The change will be permanent after a **Commit**.)

2.3.2.3 Digitizer sample rate

- Choose the Digitizer sample rate from either the Configuration page or the Advanced Configuration > Digitizer > Main page. (The change will be permanent after a **Commit**.)

2.3.2.4 Playback settings

Downloaded data files will use the network and station definitions as entered on the Advanced Configuration > Playback page.

- Enter appropriate values on the Advanced Configuration > Playback page. (The change will be permanent after a **Commit**.)

2.4 Install recording media (IDE hard drive or CF card)

Taurus can record to a CompactFlash card (CF) or a 1.8" ATA hard drive (IDE hard drive) formatted to a Linux Ext3 file system. For recording media specifications, see Section A.6 on page 125.

See Chapter 10 “Recording Data”, in particular Section 10.3.1 “Insert and remove recording media” on page 99, for more detailed information.

Warning You could damage the Store or the recording media if you remove the media while the Controller is running. Do not remove or insert media if the MediaLED is red. Wait until the Controller has shut down and the MediaLED is green.

1. The Controller must be shut down before you remove or insert recording media. To shut down the Controller if it is running:
   - In the Shutdown page, choose **Shutdown**.
2. Open the media door (Figure 10-4 on page 100).
3. Do not remove or insert media if the MediaLED is red. Wait until the Controller has shut down and the MediaLED is green (Figure 10-5 on page 100).
4. Remove or insert recording media as required.

5. Close the media door. Closing the media door will start the Controller.
   ▸ If you want to start the display, press the centre key for about 1 second. The display will start up once the Controller has finished booting.

Once you have inserted media you may be prompted to choose setup options, depending on factors such as whether the media are already formatted. If you have inserted a formatted medium of the same type that previously contained the active Store, the Taurus will continue to record to that medium automatically. Two possibilities exist:

- If the medium does not yet contain a Store, the Taurus will create a new Store using the last configured Store size setting.
- If the medium already has a Store created by a Taurus, the Taurus will automatically start appending data to the existing Store (see also Section 10.2.1.1 “About appended Stores” on page 96).
  ▸ If you do not want to have the new data appended to an existing Store (for example, if it was created on a different Taurus), you can either reformat the medium or delete the existing Store. You can then create a new Store.

2.5 Format recording media

You can use the Taurus to format recording media to the Linux Ext3 file system. For a description of formatting options and procedures, see Section 10.3.2 “Format recording media” on page 101.

2.6 Retrieve data from a Taurus

Time-series data, state of health (SOH) data, log information, and system configuration information are recorded in the Nanometrics Store. There are various methods for accessing these data, listed below. Refer to the sections indicated for more information.

- ▸ Retrieve data from the Store to files on your network using options in an external web browser over an IP connection.
  - Time-series data may be extracted in any of MiniSEED, Seisan (version 8.0 or higher), or ASCII formats (Section 11.2 on page 109).
  - Other information, such as SOH data, logs, and configuration information can be downloaded as described in Section 11.3 on page 116.
- ▸ Access data on removed recording media (Section 11.1.4 on page 109).
- ▸ Stream time-series data from a Taurus to a Nanometrics acquisition system (for example, a server running NAQS) over an IP connection (Section 11.2.3 on page 115).

2.7 Install a Taurus

Taurus can be installed as a stand-alone unit to record continuous data on removable media for extended periods of time, or as a network component that allows data downloads, data streaming, and remote configuration changes while also recording to the storage medium.

2.7.1 Deployment options

The Taurus may be deployed as either a stand-alone data recorder or as a network component.

- For stand-alone recording where network access is not required, typically you would configure the Taurus to run in Buffered mode. It consumes less power in this mode as the Controller only runs when the Taurus is recording buffered data to the Store.
- For networked operation you must configure the Taurus to run in Communications mode and configure the appropriate network options. In this mode, the Controller is running continuously. It consumes more power than Buffered mode but allows continuous access via an IP connection.

In either case, installation requires these general steps:

1. Plan the physical installation (for example the power system, proper equipment grounding, and location of the GPS antenna).
2. Configure Taurus for your application. The as-shipped configuration of a Taurus includes various default settings, but setup of the Taurus will include changing some of these settings as appropriate (see Section 2.3 on page 9 for an overview, and relevant chapters in Part 2 for detailed information).

   Typically you would do most of the configuration before field deployment, using a web browser on a PC over a network connection. You can also use the Taurus display and keypad to change the configuration in the field.
3. Install the hardware at the site (power supply, sensor, GPS antenna, Taurus).

2.7.2 Powering and grounding considerations

- See Section A.13 “Power” on page 127 for power specifications and Chapter 4 “Powering the Taurus” for information on powering the Taurus.
- See Section 4.2 “Grounding a Taurus installation” on page 35 and Appendix C “Sensor-Digitizer Interconnection” for guidelines on equipment and signal grounding.
- It is recommended that you use **Shutdown** to power down the Controller before disconnecting the power from the Taurus. If you disconnect the power while the Controller is running, you may lose data presently cached in the buffer. This can be about 15 seconds of data if the Taurus is running in Communications mode, and up to several hours of data if the Taurus is running in Buffered mode, depending on the sample rate, seismic signal and noise, and number of channels configured (for example, typically about 30 minutes of data for 3 channels at 100 sps). Also, if the Store is not closed down properly, it may need to perform a lengthy reindexing on the next startup (see Section 10.2.3 “Reindex a Store” on page 98).
  - On the Shutdown page, choose **Shutdown**. Shutdown has completed when the SuperLED switches to a slow blinking pattern; note that this is about 10 seconds after the Taurus display has turned off. See also Section 3.3.3 “Shut down the Controller” on page 20 and Section 3.8.2 “Status LEDs” on page 26.
- Do not press and hold the centre key for more than 4 seconds as this will cause a hard shutdown of the Taurus Controller. A hard shutdown immediately terminates

various processes and may cause detrimental effects, such as causing the Store to require reindexing.

2.7.3 Sensor configuration considerations

2.7.3.1 Mass auto-centre and mass locks

- Disable the setting Advanced Configuration > Sensor Details > Mass Auto-Centering – Auto-Center on Red before you connect a sensor that has masses locked. Once you unlock the masses, you may enable Auto-Center on Red.

2.7.3.2 Calibration

Before a sensor can be calibrated, the Taurus must be properly configured for the installed sensor. Configure Taurus to operate with your sensor, and then calibrate the sensor. See Section H.13.7 “Sensor Details” on page 199 for descriptions of the configuration parameters.

1. Configure Taurus for the installed sensor, either by uploading a preset configuration file or by manually editing settings:
   - Some sensor configurations (Sensor Details, Sensor Control Lines, and Mass Auto-Centering settings) are included with this software release, in the `/sensors` directory. You may upload one of these configurations at a time to the Taurus using the Advanced Configuration page options (Section 9.2.2 “Using predefined sensor configurations” on page 90).
     - For passive sensor configurations, in the Sensor Details page you must also enter the appropriate sensitivity.

     Uploading a sensor configuration file will replace all existing sensor configurations on the Taurus with the uploaded configuration.
   - If you are entering the sensor configuration manually, in the Advanced Configuration > Sensor Details > Sensor Control Lines page, configure the control line parameters as appropriate for the installed sensor:
     - The assert and deassert levels.
     - The control pulse duration.
     - The default function of each line.
     - Which lines are to be asserted during the calibration.
2. In the Advanced Configuration > Calibration page, configure the type of calibration, the channels to calibrate, and the calibration waveform parameters.
3. To start the calibration, go to the Sensor page and click **Start**.

2.7.4 Environmental seals

Taurus can be sealed against dust and moisture. Before leaving a Taurus installation, confirm the following:

- The media door is closed, with the door knob locked and the black plastic lever in the down position.

- All Taurus connectors are either occupied by the appropriate cable connector or are sealed with the optional factory-installed dust caps (Nanometrics part number 15762) or equivalent.
- The self-sealing pressure relief screw is torqued to hand-tight (Figure 2-4). This screw is a slot head on older models and is a 2.5mm hex Allen key on newer models.

Figure 2-4 Pressure relief screw location

2.7.5 Installation

This example provides an overview of installing a Taurus. See the appropriate sections of the manual for more information.

1. Choose a deployment option appropriate for your project, for example:
   - Install Taurus as a stand-alone data recorder (you would likely use Buffered mode for this).
   - Install Taurus in a network, for example to stream data to a central acquisition server such as a Nanometrics NAQS Server, or if continuous IP access is required (requires the Taurus to be in Communications mode).
2. In the lab, configure the Taurus as appropriate (see also Section 2.3 “View or change configuration settings” on page 9). For example:
   - Running mode
   - Sample rate
   - Sensor configuration (see also Section 2.7.3 “Sensor configuration considerations” on page 14)
   - Playback settings
3. Install and level the sensor.
4. Mount the GPS antenna with a good view of the sky, and ensure that the antenna cable is installed with sufficient strain relief (for example, Figure 2-5).

Figure 2-5 Mount the GPS antenna (shows optional bullet antenna)

5. Ensure that the system is properly grounded.
6. Ensure that a supported recording medium is installed in the Taurus media slot.
7. Connect the sensor to the Taurus.
8. If you will be accessing the Taurus over a network, connect the Taurus Ethernet cable or a serial cable (see also Chapter 7 “Configuring Taurus Communications”).
9. Power up the Taurus:
   - Connect the power cable to start the Taurus up in the mode it was in before the last shutdown. It will take the Taurus a minute or two to boot. While the unit is booting, the display will be off, and the LEDs will indicate status (Section 3.8.2 “Status LEDs” on page 26). About 2 minutes after connecting power, you can start the display:
     - Press and hold the centre key for about 1 second. It may take a minute for the display to start up.
10. In the Sensor page, turn on the sensor power (for an active sensor), and unlock the masses if required. If you disabled Auto Mass Center on Red, you may now enable that option.
11. If the Taurus is to operate in Buffered mode, ensure that Running Mode is configured to Buffered before you leave the unit.
12. Ensure that the Taurus is sealed environmentally (Section 2.7.4 on page 14).
13. Ensure before you leave the Taurus installation that the SuperLED is blinking green. The SuperLED blinking green indicates that all systems are operating as configured and no problems are detected.
    - If the SuperLED is blinking yellow or red, use the Status page indicators to assist with finding the problem (step 5. on page 9). If the display is off, press the centre key for about 1 second and wait for the display to start up. It will open to the Status page.

Chapter 3 Operating and Maintaining Taurus

This chapter provides an overview of the Taurus operating modes and describes the basics of how to operate and maintain the Taurus.

3.1 About the Taurus operating modes

The Taurus has three operating modes, including an Interactive mode and two running modes.

- Interactive mode is a temporary state invoked automatically while the display is active. Use this mode for managing the Taurus via the display and keypad, and for allowing IP access while the Taurus is running in Buffered mode. (See Section 3.1.2.)
- The configured running mode (Buffered or Communications) determines how the Taurus will operate once Interactive mode is off. (See Section 3.1.3 and Section 3.1.4.)

3.1.1 Configure the running mode (Buffered or Communications)

1. Log in as `tech` or `central` (Section 6.1.1 “Logging in to the Taurus” on page 48).
2. Go to either the Configuration page or the Advanced Configuration > General page, and then choose an option from the Running Mode drop-down list. Options are Buffered and Communications. For a description of each of the running modes see Section 3.1.3 and Section 3.1.4.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

3.1.2 Interactive mode

Interactive mode is on only while the display is active (that is, until the configured UI timeout expires or you click **Turn Off Display** in the Shutdown page). The Controller is on continuously in this mode and allows access over an IP connection. Once Inter-

active mode ends, the Taurus operates in the configured running mode (Buffered or Communications). See also Section 3.3.5 “Set the UI timeout (display timeout)” on page 21.

Interactive mode will be on until the configured UI timeout expires, with these exceptions:

- Each time you make a selection (change a setting, click a button, choose a page from the main menu, or click a hyperlink), the UI timeout will start counting again from that operation. This applies to selections made either by pressing the centre key on the Taurus keypad or by using a browser.
- If you have started a data download in Buffered mode, the Controller will run long enough to complete the download and will override the configured UI timeout if necessary.
- If you click **Turn Off Display** in the Shutdown page, Interactive mode will end immediately. The Taurus will then operate in the configured running mode.
  - In Buffered mode, if a data download is in progress **Turn Off Display** will terminate the download.

3.1.3 Buffered mode

If the Taurus is configured to Buffered mode, Buffered mode starts automatically when Interactive mode ends. Buffered mode consumes the least power of the 3 operating modes (see Section A.13 “Power” on page 127 for specifications). Running in this mode, the Taurus continues to buffer data, and wakes the Controller only to write data to the Store when the buffer is full. The time it takes for the buffer to fill ranges from a few minutes to several hours, depending on the number of active channels, input signal activity, the sample rate, and the size of the buffer in your Taurus (2 MB on units with serial number 0353, 0375, 0379 and higher, 1 MB on all other units); for example, about 30 minutes for 3 channels at 100 sps and 2 MB RAM.

There is no IP access to the Taurus once it is running in Buffered mode.

If the Taurus is configured to Buffered mode, you can start a data download if it is operating in Interactive mode (see also Section 3.1.2).

You cannot stream data if the running mode is Buffered, whether or not the Taurus is currently in Interactive mode.

3.1.4 Communications mode

If the Taurus is configured to Communications mode, Communications mode starts automatically when Interactive mode ends. Running in Communications mode, the Controller is on continuously. This mode consumes more power than Buffered mode because the Controller is always on, but it allows you to communicate with the Taurus continuously via an IP connection.

You can download data and stream data in Communications mode. (Shutdown page options **Restart** and **Shutdown** will terminate a download in progress, and will interrupt data streaming until the Controller is restarted.)

3.2 About the Controller

The Taurus Controller manages operations such as communications and networking, the display and UI, and the recording media. The Taurus Digitizer operates continuously whether or not the Controller is running. Whether or not the Controller is running is determined by the operating mode you have selected (see Section 3.1). Options in the Shutdown page (such as **Restart**) and hard shutdown with the centre key apply only to the Controller, they do not affect the Digitizer.

While the Controller is running you have access to the Taurus over an IP connection, and applied configuration changes are held in volatile memory. Once the Controller shuts down, you no longer have IP access to the Taurus, and any uncommitted changes in the volatile memory for Controller-based functions will be lost.

The Taurus Digitizer runs as long as the Taurus has power connected. Therefore, there is a practical distinction between references to running the Controller, which may be running or not depending on the configuration, and powering the Taurus, which depends only on whether power is connected continuously.

3.3 Starting up and shutting down the Taurus

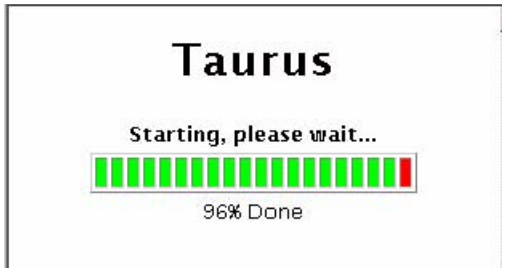
This section lists procedures for starting up and shutting down the Taurus.

3.3.1 Start the Taurus

The Taurus Digitizer, Controller, and timing are started up as soon as you connect power to the Taurus. Typically it takes about 3 minutes for these Taurus systems to finish booting when power is first connected. About 2 minutes after connecting power to the Taurus, you can start the display (press and hold the centre key for 1 second; the display will start in about 10 to 15 seconds). You may see the initial splash screen indicating boot progress (Figure 3-1).

If the supply voltage exceeds either of the configured voltage disconnect settings (that is, it is either lower than the Battery Low value or higher than the Battery High level), the Taurus will not power up. See Section 4.3.3.2 “Bypass the Battery Low/High voltage disconnect settings on startup” on page 39.

Figure 3-1 Taurus boot progress screen



3.3.2 Start the Controller

The Controller will start up following any of these actions:

- When you connect power to the Taurus (see also Section 3.3.1 on page 19)
- When you press the centre key for 1 second
- When you close the media door
- When the buffer fills in Buffered mode or when the buffer fills after a Shutdown in Communications mode, if the media door is closed and the configured media type is installed.

The Controller will run continuously while the Taurus is in either of Interactive or Communications mode (unless you shut down or restart the Controller). In Buffered mode the Controller runs only long enough to write data to the Store when the buffer is full. See also Section 3.1 “About the Taurus operating modes” on page 17.

If the Store is reindexing while the Taurus is in Buffered mode, you will see a yellow blinking SuperLED and the display may take a long time to start up after you press the centre key. This should be a very rare scenario. See Section 10.2.3 “Reindex a Store” on page 98.

3.3.3 Shut down the Controller

The **Shutdown** option powers down the Controller gracefully.

- Always ensure the Controller is shut down before removing or inserting recording media. (This does not turn off the Digitizer, which continues to collect and buffer data.) See also Section 10.3.1 “Insert and remove recording media” on page 99.

  The Controller will remain shut down if the media door is left open and you do not restart it by pressing the centre key. If the media door is left open for longer than it takes for the buffer to fill, data in the buffer will start to be overwritten starting with the oldest data. The time elapsed before the buffer fills depends on factors such as the number of active channels, sample rate, seismic signal and noise, and buffer size (2MB on units with serial number 0353, 0375, 0379 and higher, 1MB on all other units). This will range from a few minutes to several hours; for example, about 30 minutes for 3 channels at 100sps and a 2MB buffer.

- It is recommended that you use **Shutdown** to shut down the Controller before disconnecting the power. If you disconnect the power while the Controller is running, you may lose data presently cached in the buffer. This can be about 15 seconds of data if the Taurus is running in Communications mode, and up to several hours of data if the Taurus is running in Buffered mode, depending on factors such as the sample rate and number of channels configured. Also, if the Store is not closed down properly, it may need to perform a lengthy reindexing on the next startup (see Section 10.2.3 “Reindex a Store” on page 98).

To shut down the Controller:

- In the Shutdown page, choose **Shutdown**. The LEDs indicate when shutdown has completed (see also Section 3.8.2 “Status LEDs” on page 26):
  - The SuperLED has switched to a slow blinking pattern.
  - The MediaLED is green.

- The EtherLED is off.

This occurs about 10 seconds after the display has turned off.

If the Taurus is in Buffered mode the Controller will normally be shut down already. If the Controller is running, it is writing buffered data to the medium and will shut down automatically when it is finished writing the data.

- To use **Shutdown** in Buffered mode, wake the display first (press the centre key for 1 second and wait for the display to start) so that you can access the **Shutdown** option. (See also Section 3.4 “Using the Taurus keypad” on page 22.) You may wish to do this to ensure any remaining buffered data are written to the recording medium before you remove media or power down the Taurus.

- If you submit the **Shutdown** command from a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the shutdown command.

It is possible to do a hard shutdown of the Controller by pressing the centre key for about 5 seconds, but this is not recommended. A hard shutdown will interrupt various processes and may cause detrimental effects, such as causing the Store to require reindexing.

3.3.4 Restart the Controller

Use **Restart** to reboot the Taurus after committing configuration changes that require a Controller restart to become active (for example, Communications changes, Security changes). The Taurus continues to buffer data during a restart.

- In the Shutdown page, click **Restart**.

- If you submit the **Restart** command from a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the restart command.

3.3.5 Set the UI timeout (display timeout)

If you have not made a selection in the UI within a configured period of time, the display will turn off and the Taurus will revert from Interactive mode to the configured running mode, either Buffered or Communications. (A selection is any of these actions: change a setting, click a button, choose a page from the main menu, click a hyperlink, or have a download of data in progress. This applies for selections made either by pressing the centre key on the Taurus keypad or by using a browser.)

1. Log in, then choose the number of minutes for the UI timeout in the Advanced Configuration > General page (UI TimeOut [min]).
2. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

3.3.6 Turn off the display

You can turn off the display and end Interactive mode before the configured UI timeout expires. This immediately shuts down the display and switches the Taurus to its configured running mode (either Buffered or Communications).

- In the Shutdown page, click **Turn Off Display**.

  A browser will show the message “Turning off display... Please wait...”.

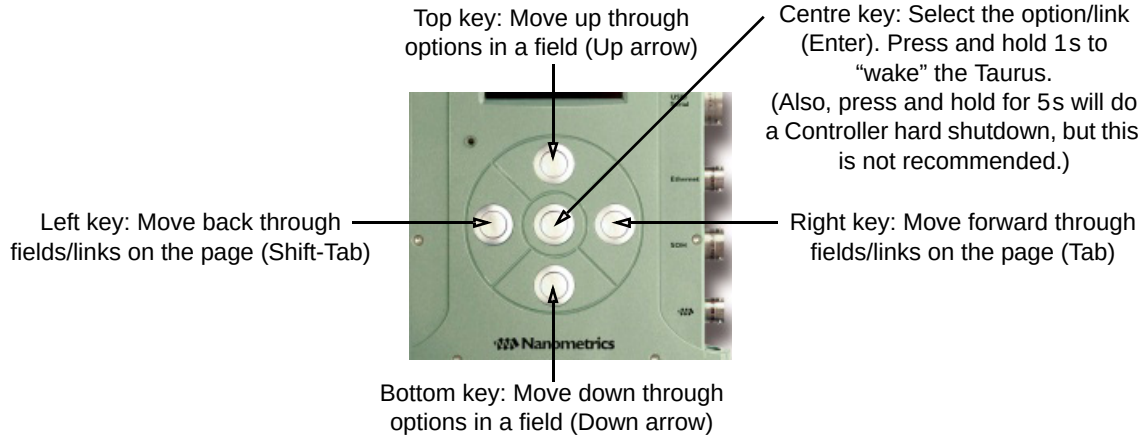
- If you submit the **Turn Off Display** command from a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the **Turn Off Display** command.

3.4 Using the Taurus keypad

Taurus has a 5-key keypad for Taurus startup and for navigating the UI pages on the display (Figure 3-2). The Taurus key functions equate to these standard keyboard functions:

- Centre key = Enter
- Top key = Up arrow
- Bottom key = Down arrow
- Left key = Shift-Tab
- Right key = Tab

Figure 3-2 Taurus keypad functions



3.5 Accessing the Taurus from a remote browser

You can access the Taurus from a browser over an IP connection. The Taurus must be in either Communications mode or Interactive mode, and the network cable must be connected before the Taurus is powered. See also Chapter 7 “Configuring Taurus Communications”.

1. Connect to the Taurus using any of these methods:
   - Use the Ethernet cable (15228) to connect the Taurus to your LAN, or to connect your computer directly to the Taurus.

- Connect to the Taurus via a serial (SLIP or PPP) connection.

2. Power up the Taurus.
3. If you do not know the IP address of the Taurus, start the display. The IP address of the unit is shown on the Status page.
4. Open a browser and go to a Taurus URL. For example, the Status page is http://*TaurusIPAddress*.

3.5.1 Using the web interface over slow links

The Taurus web interface normally refreshes every 5 seconds. Taurus will detect if a communications link is slow, and will reduce the interface refresh rate to attempt to compensate for the link speed.

3.6 Navigating the Taurus UI pages

The Taurus UI web pages show real-time status information, and provide configuration, data download, and firmware upgrade options. You can use the UI pages via the Taurus display and keypad, and on any web browser with IP access to the Taurus. (See Appendix H for a summary of the UI pages and options.) You must have cookies enabled in your browser.

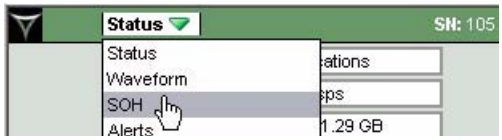
3.6.1 Choose a main page

Main pages are available from the drop-down menu in the title bar. Some main pages have hyperlinked sub-pages. From any page on the Taurus UI, you can choose a main page from the menu.

- In a browser, click to open the menu and then click to choose the highlighted page (Figure 3-3). You can bookmark the page (http://*TaurusIPAddress*/pages/taurus/*pagename*.page).
  - Optionally, you can use the Taurus icon  to return to the Status page.
- In the display, the menu is active when the text is white on a blue background. Press the centre key to open the menu and use the top or bottom key to scroll through the list of main pages. Press the centre key to open the highlighted page.

Do not use the main menu or Taurus icon if you want to preserve changes in the Advanced Configuration sub-pages and the Data Retrieval pages. If you want to preserve changes, use the page navigation options as described in Section 3.6.3.

Figure 3-3 Taurus main menu



3.6.2 Browser navigation

- On a browser you can use the Back and Forward buttons to navigate unless there are changes that you want to preserve. Navigating with the browser buttons will discard any unapplied changes in the Advanced Configuration sub-pages and any changes in the Data Retrieval pages. If you want to preserve changes, use the page navigation options as described in Section 3.6.3.

3.6.3 Preserve configuration changes or data retrieval settings

Use these methods for page navigation if you want to preserve changes to configuration and data retrieval settings during a session:

- On Advanced Configuration sub-pages, navigate with the **Previous** button and the sub-page hyperlinks to preserve changes that have not yet been applied. (See also Table H-12 “Advanced Configuration page options” on page 191).
- On Data Retrieval pages, use the **Next** button to preserve changes. (See also Section 11.1.3.1 “Navigate Data Retrieval pages” on page 106.)

3.6.4 Select an active field or a hyperlink

- In a browser, either use the mouse or the Tab and Enter keys to select a field or open a hyperlink.
- In the display, use the left and right keys to tab the focus through the active fields and links on a page. A link with focus will have a dotted outline. An active field with focus will have white text on a blue background (Figure 3-4).

  Once you have tabbed to a link or an active field, you can go to the linked page or choose an option in the active field (press the centre key).

Figure 3-4 Examples of link and field with focus

✧ The Main link has focus.

✧ The Running Mode field has focus.

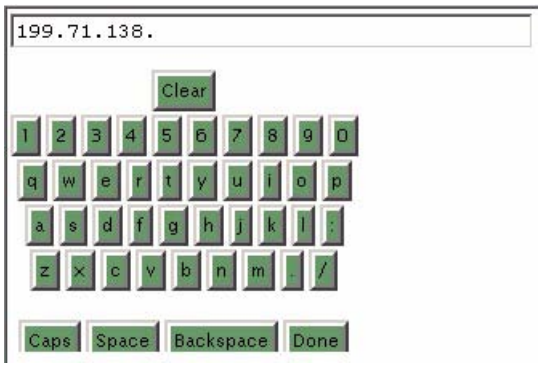
3.7 Using the virtual keyboard

Taurus provides a virtual keyboard that you can use to enter text in the display using the Taurus keypad (Figure 3-5).

1. Click the Keys link beside the text field into which you want to enter a value.
2. Navigate the virtual keyboard using the Taurus keypad left/right/top/bottom keys, and use the centre key to choose the currently-selected virtual key. Alphanumeric selections will be entered in the field at the top of the screen.

3. Once you have finished entering the value, click the **Done** button to exit the keys page. This enters the value in the original page.

Figure 3-5 Virtual keyboard for text field entries on the display



3.8 Monitoring Taurus operation

Taurus includes these methods for monitoring operation:

- The LEDs provide a quick view of current Taurus status (Section 3.8.2 on page 26).
- The Status page includes status bars to assist with interpreting the LEDs (Section 3.8.3 on page 29).
- Various pages show the current state of subsystems, such as SOH, Sensor, and Timing pages (Section 3.8.4 on page 29).
- SOH data are recorded for the external SOH channels and for internal SOH (Section 3.8.5 on page 30).
- The system logs provide detailed operation history (Section 3.8.6 on page 30).
- Alert messages can be used to narrow down a search through system logs (Section 3.8.7 on page 30).
- The Data Availability pages show a summary of data availability and any gaps (Section 3.8.8 on page 31).
- System configuration information includes current version information for Taurus hardware and software, and a configuration audit trail with a record of all configuration changes since the Store was created (Section 3.8.9 on page 31).

3.8.1 About the Taurus status colours

The Taurus LEDs and status bars use the same colour scheme (Table 3-1).

Table 3-1 Status colours

Colour	Status
Green	Indicates that everything is working properly.

Table 3-1 Status colours (Continued)

Colour	Status
Yellow	Indicates a temporary situation that will resolve either to ok (Green) or to an error state (Red). ▸ You should not leave a Taurus that is in a Yellow state, on the chance that it resolves to Red. You can check the relevant status and configuration pages to identify the problem, and the log files if more detail is required.
Red	Indicates that a problem exists that must be investigated and fixed. ▸ You can check the relevant status and configuration pages to identify the problem, and the log files if more detail is required.

3.8.2 Status LEDs

Taurus includes 4 status indicator LEDs:

- SuperLEDs to indicate overall unit status (two LEDs, one on the top panel and one on the connectors panel). They indicate the same thing. The top panel LED is visible when you are using the keypad, the side panel LED is useful for monitoring stacked Tauruses.
- An EtherLED to indicate Ethernet connection status.
- A MediaLED to indicate whether it is safe to remove or insert recording media.

3.8.2.1 About LED blink patterns

Immediately after you connect power to the Taurus, the SuperLED will be on solid for about 5 seconds. Depending on configuration and status, during operation the LEDs will either be off, or blinking with a status colour. There are two blink rates: slow (0.5s on, 5s off), and fast (0.5s on, 0.5s off).

3.8.2.2 Unit status LEDs (SuperLEDs)

The SuperLEDs—the LED on the top panel and the LED beside the power connector (Figure 3-6)—indicate overall unit status. The top LED is not visible when Tauruses are stacked (Figure 3-7); in that case, view the LED on the connectors panel. Table 3-2 describes the Taurus unit status indicated by the various SuperLED states.

The SuperLED colour is synchronized with the status bar colours on the Status page (see also Table 3-1 on page 25, and Section H.2 “Status” on page 177). It uses information from these 6 subsystems as inputs:

- Timing status
- Media door status
- Store status
- Sensor status
- Power Manager status
- Ethernet networking status

Table 3-2 SuperLED states

LED state	Unit status
Off	The Taurus has no power.
Slow blink	The Controller is shut down (Buffered mode, or Communications mode after you choose **Shutdown** on the Shutdown page).
Fast blink	Any of these conditions: • The Taurus is booting (if the power was just connected). • The Controller is booting (for example, after a restart). • The Controller is running (Communications mode or Interactive mode). • The Controller is writing data to the media in Buffered mode. The LED colour will vary as Taurus initializes its status information during bootup.
Red (solid, ~5s)	The Taurus is starting to boot immediately after power is connected.
Blinking green	The unit meets all the conditions to capture data successfully. (For example, the Taurus is digitizing, has recording media, is able to record to media and/or transmit data if in Communications or Interactive mode, has good power, has good timing, and the media door is closed.)
Blinking yellow	The Taurus is initializing status of one or more subsystems. This is a temporary state that will resolve to either blinking green or blinking red. ▸ You should not leave a Taurus that is in a Yellow state, on the chance that it resolves to Red (an error state). You can check the relevant status and configuration pages to identify the problem, and the log files if more detail is required. If the Store is reindexing, the SuperLED will be blinking yellow and some UI pages will not be available until reindexing is complete. Reindexing may take a long time, depending on how much data are in the Store.
Blinking red	There is a fault or condition that prevents the unit from operating properly. (For example, GPS/Timing status is not good, missing recording media, a hardware or software problem, no Ethernet connection if in Interactive mode or Communications mode.) Investigate the problem, using the UI to check status if necessary and if possible.

Figure 3-6 SuperLED locations

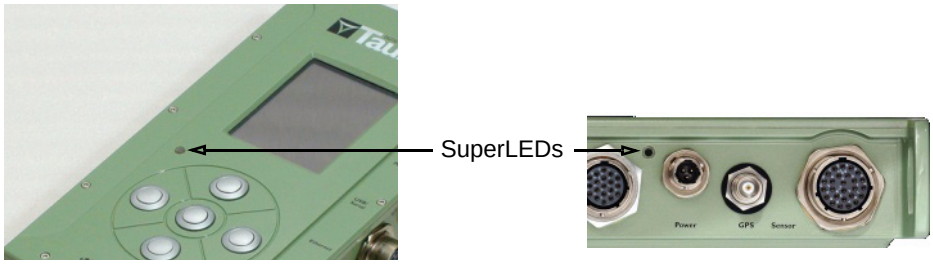


Figure 3-7 Stack of Tauruses

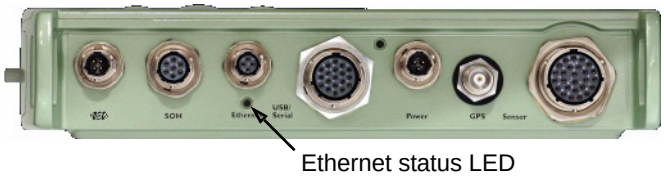
3.8.2.3 Ethernet status LED (EtherLED)

The EtherLED on the back panel (Figure 3-8) indicates the status of the Taurus Ethernet connection. Table 3-3 describes the status indicated by the various LED states.

Table 3-3 EtherLED states

LED state	Ethernet status
Off	• The Taurus has no power. • The Controller is shut down (Buffered mode, or Communications mode after you choose **Shutdown** on the Shutdown page).
Yellow (solid, ~8s)	The Taurus is starting to boot immediately after power is connected, or the Controller is starting.
Fast blinking green	Networking is enabled and a link is established.
Slow blinking green	Networking is not enabled.
Blinking yellow	Initial power up, diagnostics.
Blinking red	Networking is configured but there is no link.

Figure 3-8 EtherLED location



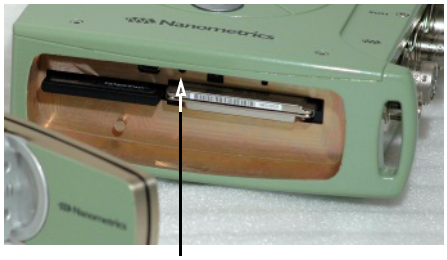
3.8.2.4 Media status LED (MediaLED)

The LED inside the media door (Figure 3-9) indicates whether it is safe to remove or insert recording media (either an IDE hard drive or a CF card; see also Section 10.3.1 “Insert and remove recording media” on page 99). Table 3-4 describes the status indicated by the various LED states.

Table 3-4 MediaLED states

LED state	Media status
Red	It is **not** safe to insert or remove recording media, as the Controller is running. ▸ Shut down the Controller before removing or inserting recording media. (This does not stop the Digitizer or cause data gaps.)
Green	It is safe to remove or insert recording media, as the Controller is shut down.

Figure 3-9 MediaLED location



3.8.3 Status bars

The status bars on the Status page are to help with interpreting the LEDs; the colour will match the relevant LED and a brief text label will summarize the problem. In general (see also the relevant entries in Table H-1 on page 177 for details on each status bar):

- A bar with a green background indicates good status.
- A bar with a yellow background and with text followed by a question mark indicates Taurus is acquiring status information.
- A status bar with a red background indicates an error condition.

Some of the status bars also have links to additional pages (such as Timing, Sensor, Store Tools) which show additional configuration or status information that may help with identifying any problems.

3.8.4 Pages showing current status information

Various pages show current status information. See these sections in Appendix H “UI Pages and Parameters” on page 175 for an overview of the information shown on each page:

- Section H.2 “Status” on page 177
- Section H.4 “SOH” on page 181
- Section H.8 “Timing” on page 187
- Section H.9 “Sensor” on page 189

The SOH information shown on these pages is updated every 5s, independent of the SOH sample rate setting (see also Section 3.8.5).

3.8.5 SOH data

SOH data are recorded to the Store for the 4 External SOH channels and for internal SOH.

- You can download SOH data to `.csv` files. See Section 11.3.1 on page 116 for information on downloading SOH information.

3.8.5.1 Set the SOH sample rate

You can set the SOH sample rate. This setting applies to the 4 External SOH channels and some of the internal SOH. The internal SOH using this setting include the types listed in Table 11-1 on page 117, except for the types in the row labelled PowerPC, which are not configurable.

1. Log in and go to the Advanced Configuration > General page.
2. Use the Soh Report Interval [s] parameter to set the SOH sample rate in seconds. Enter a number between 5 and 3600. Factory default is 60.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

The SOH information shown on the UI pages is updated every 5s, independent of the Soh Report Interval setting.

3.8.6 System logs

The Taurus system logs provide operation messages to the configured levels of detail. System logs are recorded to the Store.

- You can download the system logs to a file and then view the information in any text editor. See Section 11.3.2 on page 119 for information on downloading the system logs.

3.8.6.1 Set the log verbosity

You can set the level of detail for the Apollo and ARM system logs (the DSP log verbosity is not configurable).

1. Log in and go to the Advanced Configuration > General page.
2. Use the *logType* Log Verbosity parameters to set the level of detail in the Apollo and ARM logs. Options are Info, Verbose, and Debug. Factory default is Info.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

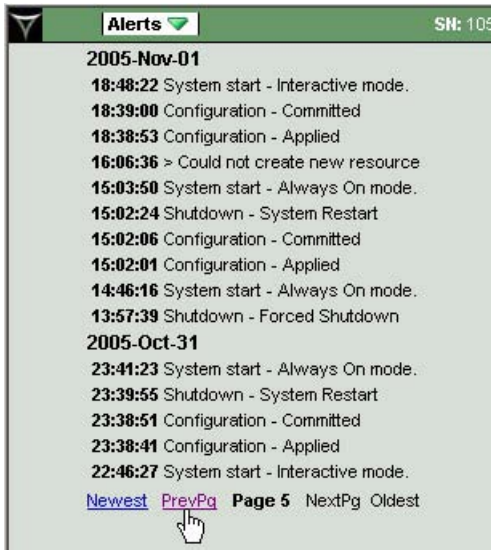
3.8.7 Alert messages

The Alerts pages show a list of occurrences such as startups, shutdowns, and major errors. Alert messages include the timestamp and a brief description (Figure 3-10). You

can use these message timestamps as reference points for searching through system logs for occurrences that generated an Alert.

- Use the links at the bottom of the page to navigate through the list of Alerts: Newest, PrevPg (previous page), NextPg (next page), and Oldest. (In a browser you can jump to a specific Alert page using its URL, for example http://*TaurusIPAddress*/pages/taurus/alerts.page?pageToShow=12 would open Page 11; page numbering starts at page 0, the Newest page.)

Figure 3-10 Alerts page example



3.8.8 Data availability information

The Data Availability pages provide an overview of availability including information about gaps. See Section H.6 “Data Availability” on page 181 for an overview of what information is shown, and Chapter 11 for the data download procedures.

3.8.9 System configuration information

The Taurus maintains an audit trail of configuration changes made since the Store was created. See also Section 5.3 “Configuration audit trail” on page 44.

- You can download the audit trail to a text file to view as a reference. See Section 11.3.3 on page 119.

Version information of Taurus hardware and software components is shown in the System Info page.

- You can download the version information to a text file. See Section 11.3.4 on page 120.

3.9 Maintaining the Taurus

The Taurus hardware does not require scheduled maintenance. Use the current status information and the system logs to assist with troubleshooting.

- If after troubleshooting it is determined that the Taurus requires repair, or if you have any questions, contact Nanometrics support (see Section 1.4 “Technical support” on page 5).
- Before returning a unit to Nanometrics for repair, contact Nanometrics Support to obtain an RMA number.

New firmware uploads may be available periodically. See also Appendix G “Taurus Firmware Upgrade Procedures”.

Part 2 Using the Taurus

- Powering the Taurus
- Changing a Taurus Configuration
- Configuring Taurus User Access
- Configuring Taurus Communications
- Configuring the Digitizer and Timing
- Controlling and Configuring Sensors
- Recording Data
- Accessing Data

Chapter 4 Powering the Taurus

This chapter provides overview information for planning Taurus grounding and power, and procedures for configuring power manager settings.

4.1 Taurus power consumption

Power consumption of the Taurus varies with factors such as the operating mode and GPS receiver duty cycle. (See also Section 3.1 “About the Taurus operating modes” on page 17, and Section A.13 “Power” on page 127 for specifications).

- In Buffered running mode, Taurus will write data to the Store on the recording media at approximately 30 minute intervals (for 3 channels at 100 sps). The average power consumption will typically be 750 mW when using CompactFlash and with the GPS Duty Cycle mode configured to Automatic. Instantaneous power consumption is higher than 750 mW for the minute or two when the data in the Digitizer buffer are being written to the Store. Power consumption will be higher with a higher sample rate since the buffer fills more frequently. Power consumption will be correspondingly lower for lower sample rates.
- In Communications running mode, the Controller is running continuously. This consumes more power (about 2.3 W when CompactFlash is used) than Buffered mode.
- In Interactive mode all systems are running, including the display, so this consumes the most power (about 3.3 W). This operating mode is not a running mode, it is on only temporarily while the display is on.

Power consumption as discussed above refers to the Taurus only. Power consumption of peripheral devices, such as the sensor, or devices connected to the NMXbus, serial port, or the External SOH, is in addition to these stated averages.

4.2 Grounding a Taurus installation

The most appropriate grounding plan will depend on your application and the installation environment. This section outlines some general information you may take into account when planning grounding for a Taurus installation. See also Appendix C “Sensor-Digitizer Interconnection”.

Figure 4-1 shows the Taurus ground architecture, and Figure 4-2 shows where to connect an earth lug to the Taurus (use an M4 x 5 screw).

Figure 4-1 Taurus ground distribution and architecture

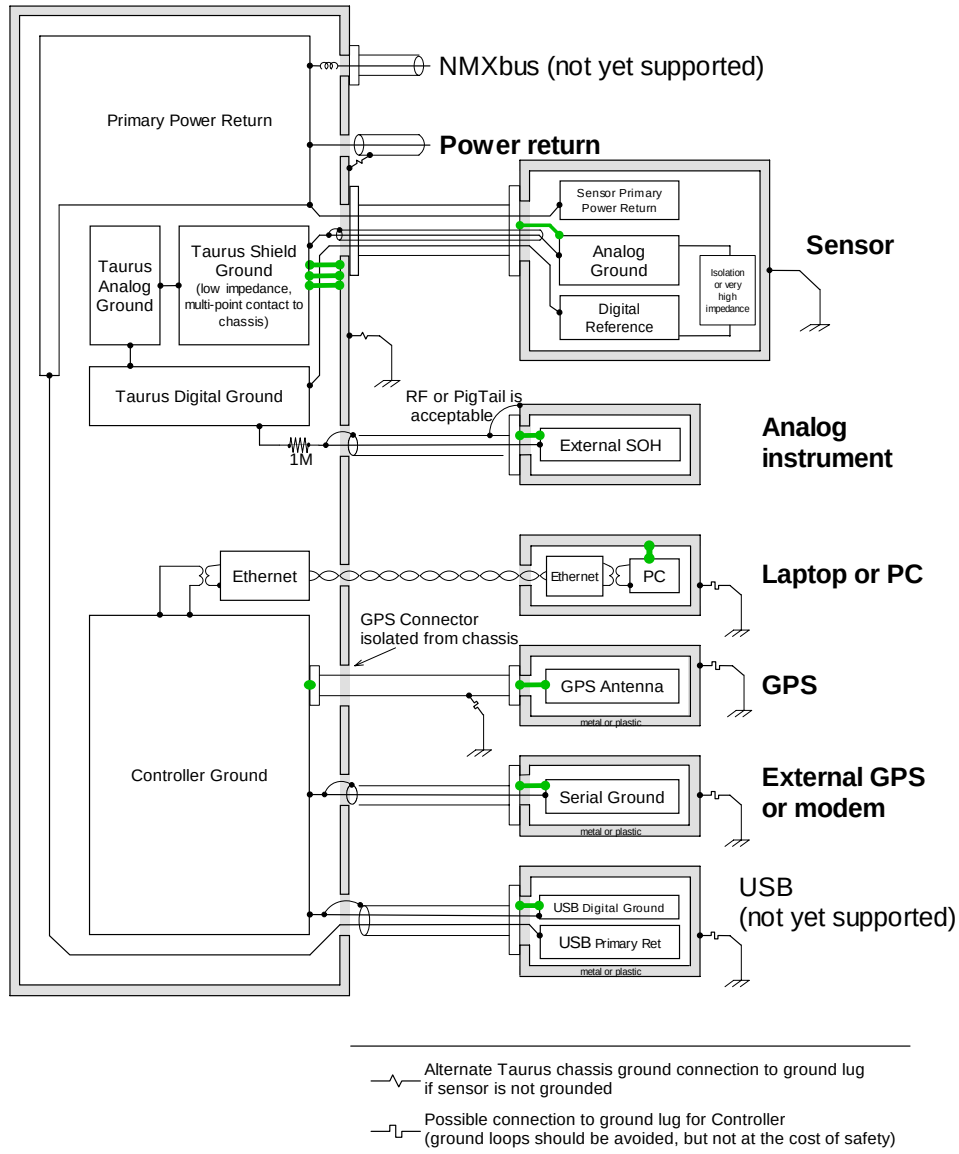
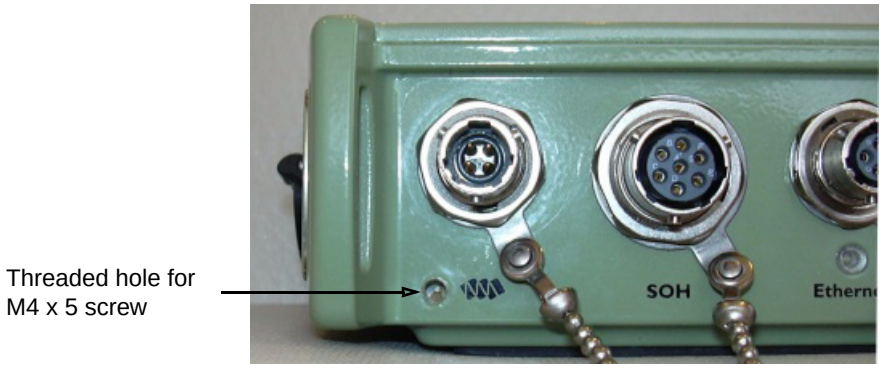


Figure 4-2 Hole for earth lug screw



The Taurus has chassis ground, analog ground, digital ground, and primary (input power) return. Primary power return is completely isolated from chassis, analog, and digital ground. Sensor power is connected directly to the input power and is thus isolated from digital and analog ground. Chassis (case) ground is connected to the analog ground of the Digitizer subsystem. There is a single point connection from analog ground to the Digitizer subsystem digital ground. The Taurus Controller subsystem is isolated from the Digitizer and has its own Controller ground, which is used for the Serial and USB interfaces. For sensor cables, the chassis ground should be connected to the outer shield of the cable which is connected to the chassis of the sensor. The channel grounds are connected to the channel twisted pair shield. The control lines use digital ground, and there must be a digital ground connection to the sensor. Sensor power return is connected to primary ground.

General considerations:

- Power – The Taurus power connector has 3 pins to allow the Taurus to conform to the site grounding system. You can connect the power return pin and ground, but combining grounding and power return in the same conductor limits the site grounding options. Our preferred practice is to establish a single ground point for the station and ground everything to that point, which minimizes the chances of ground loops and signal noise created by the power system.
- Peripheral power – The Taurus provides primary power to attached peripheral devices via the Sensor, Serial, and NMX Bus connectors. This power is switched to allow devices to be controlled by the user through the Taurus. The Taurus monitors for over-current conditions and will automatically switch off power to a peripheral if excessive current or a short is detected. See Section A.13 “Power” on page 127 for the typical current limit threshold of each peripheral power. Peripheral power is otherwise unregulated; the voltage provided to the Taurus is passed on to the attached peripherals. The current demand of each attached peripheral and the consequent voltage drop through the Taurus and peripheral cables should be taken into consideration when designing the power system to ensure that sufficient voltage is supplied to each peripheral.
  - Sensor – The voltage drop through the Taurus in a typical 12V system is (1.0 * *peak current draw of the sensor*) + 100 mV. Add to that the voltage drop in the Taurus power cable (*power cable resistance in ohms * peak current of the Taurus and all peripherals*) and the sensor cable (*sensor cable resistance in ohms * peak current of the sensor*) to ensure that the total voltage drop between the Taurus power supply and the sensor does not cause the voltage at the sensor to fall below its required operating voltage. Solutions to problems of excessive voltage drop include heavier gauge cables, shorter cables, and higher voltage power supplies (which lowers the current consumption).

    For example, a 12 V system designed to operate down to 10.8 V, with a short heavy gauge power cable and a 10 m 24 gauge sensor cable (1.75 Ω) operating a sensor with a peak current draw of 500 mA, could see a voltage drop of 1.0 * 0.500 + 0.100 + 1.75 * 0.500 = 1.425 V. When the battery dips to 10.8 V, peak current could cause the voltage at the sensor to drop to 10.8 – 1.425 = 9.375 V.
  - Serial – Similar considerations apply, except that the calculation for net voltage drop in the Taurus is (0.5 * *peak current draw of the peripheral*) + 100 mV.

  - NMXbus – Similar considerations apply, except that the calculation for net voltage drop in the Taurus is (0.5 * *peak current draw of the peripheral*) + 100 mV.
- External SOH – When there is a negative input voltage across External SOH values (pins A-G, for example), if ground is connected to negative on the voltage supply then an incorrect value appears for SOH. Ensure ground is floating from negative to prevent this error.
- GPS antenna – Do not short the GPS connector to the Taurus chassis as this may introduce a ground loop (for example, if the optional metal dust caps are installed, keep any loose caps away from the GPS connector).

  The GPS antenna is on digital ground which has a single point connection to analog ground, and analog ground is connected to chassis ground. The GPS TNC connector is fully isolated from the chassis and therefore is isolated from chassis ground. The purpose of this scheme is to avoid a ground loop from digital ground to chassis to analog ground. Accidental momentary connection to the chassis is not a problem, but a permanent connection may create ground loops. Ideally, the GPS antenna is isolated from ground and in most cases this is fine since the antenna cable is short.

  In configurations that have long GPS cables and lightning protection, an overall system design approach must be taken which balances the grounding requirements with the protection requirements. This approach requires an understanding of the Taurus grounding, the sensor grounding, power supply grounding, and local site grounding.

4.3 Powering the Taurus

See these sections for related information:

- Section A.13 on page 127 for Taurus power specifications.
- Section 4.2 and Appendix C for grounding information.
- Section 3.3 on page 19 for Taurus startup definitions and options.
- Section 4.4.1 on page 40 for power manager configuration options.
- Section 9.1.2 on page 84 for turning sensor power on and off via the Taurus UI.

Note It is recommended that you use **Shutdown** to power down the Controller before disconnecting the power. This will preserve data presently cached in the buffer and will allow the data Store to close gracefully. See also Section 3.3.3 “Shut down the Controller” on page 20.

4.3.1 Choose a power supply and cable

- Choose an appropriate power supply for your application. See Section A.13 on page 127 for the Taurus power specifications.
- Build a power cable using a power connector from the optional Taurus Connector Kit (part number 15170) or equivalent (see also Appendix B “Connector Pinouts”).

4.3.2 Power up the Taurus

1. Connect the Taurus to an appropriate power supply. The Taurus will start booting up in the currently configured running mode, either Buffered or Communications mode (Communications mode is the shipping default). It will take the Taurus a minute or two to boot.

   While the unit is booting, the display will be off, and the SuperLEDs and Ether-LED will indicate status (see Section 3.8.2 “Status LEDs” on page 26).

2. If you want to start the display, once the Taurus has finished booting press the centre key on the keypad for about 1 second. It may take a minute for the display to start.

Note If the Store is reindexing while the Taurus is in Buffered mode, the Taurus will not respond to a key press until the reindexing is complete. In this case you will see a yellow SuperLED, and the display may take a very long time to start up after you press the centre key. This should be a very rare scenario.

4.3.3 Specialized power-up procedures

There are two modified power-up procedures for specific purposes.

4.3.3.1 Power up the Taurus in factory test mode

When upgrading from version 1.*x* firmware to version 2.*x* or higher, you must start the Taurus in factory test mode.

1. Shut down the Taurus: Go to the Shutdown page and click **Shutdown**.
2. Once the LED below the Ethernet connector is off, disconnect the power cable.
3. Press and hold the centre key down while you connect the power cable and wait for the LED on the top of the Taurus to start blinking, then release the centre key.

4.3.3.2 Bypass the Battery Low/High voltage disconnect settings on startup

If the supply voltage exceeds either of the configured voltage disconnect settings (that is, it is either lower than the Battery Low value or higher than the Battery High level), the Taurus will not power up. You must use this method to power up the Taurus.

- Connect the power while the media door is open. Having the media door open when power is first applied disables the battery voltage level checks and forces the Taurus to start up.

  Once the Taurus has started, you can reconfigure the Battery Low/High disconnect to the appropriate values for your power supply (see also Section 4.4).

4.3.4 Power cycle the Taurus

Shutdown page options apply only to the Controller subsystem. If you need to power cycle other subsystems, for example to undo an applied configuration (Section 5.4.2 on page 45), use one of these methods:

If you have physical access to the Taurus:

1. In the Shutdown page, click **Shutdown**.
2. Wait until the SuperLED switches to a slow blink pattern (0.5s on, 5s off), then disconnect the power cable.
3. Reconnect the power cable.

If you must power cycle the Taurus remotely:

- Go to the URL http://*TaurusIPAddress*:8080/firmware/, and then click **Reboot**.

4.4 Configuring power manager settings

The Advanced Configuration > Power page provides options to configure power supply parameters such as disconnect levels and delays (Figure 4-3).

When the external supply voltage falls below the Battery Low threshold and remains below this threshold for Delay Low period, the Taurus powers off immediately. When the external supply voltage rises above the Hysteresis Low threshold (a low voltage reconnect value) the Taurus powers up, but not before 10 seconds has elapsed since the last shutdown. Set the low voltage disconnect values so as to properly protect the battery chemistry for your power supply, and set the reconnect value high enough to prevent the unit from prematurely turning on due to battery rebound. Voltage drops in long power supply cables should also be considered in determining these values.

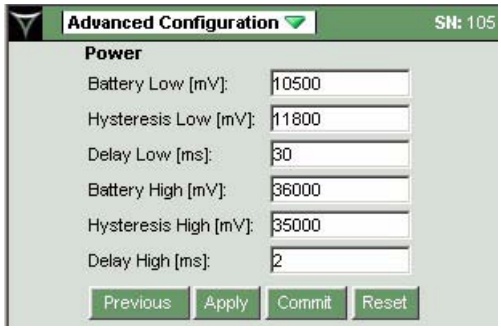
If the supply voltage is lower than the configured Battery Low value or higher than the Battery High value, the Taurus will not power up. You can bypass these voltage disconnect settings on power-up; see Section 4.3.3.2.

When the external supply voltage rises above the Battery High threshold and remains above this threshold for Delay High period, the Taurus powers off immediately. When the external supply voltage drops below the Hysteresis High threshold (a high voltage reconnect value), the Taurus powers up, but not before 10 seconds has elapsed since the last shutdown.

4.4.1 Configure power manager settings

1. Log in to the Taurus as `tech` or `central`.
2. Open the Advanced Configuration > Power page and enter the appropriate values for your system. See Table H-35 on page 206 for valid parameter values.
   - Factory default values are for 12V lead-acid batteries and assume short power cables. To protect your equipment, confirm the appropriate values for your power system and the maximum voltage tolerance of your sensor before setting these parameters.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 4-3 Power manager configuration page



Chapter 5 Changing a Taurus Configuration

This chapter provides overview information about Taurus configuration storage and management, and basic procedures for changing a configuration parameter.

5.1 Configuration format and storage

Configuration changes that have not yet been applied are stored in a temporary cache associated with the browser session. If the browser session is closed, any changes that are not yet applied are discarded. Use the **Previous** button to move back through configuration pages to preserve unapplied changes during a session (see also Table H-12 “Advanced Configuration page options” on page 191).

Applied changes to a configuration are stored in volatile memory on the Taurus. Restarting the subsystem where the changes have been applied will erase the applied changes. You must commit applied changes to make them permanent.

The committed configuration is stored in the internal non-volatile memory on the Taurus, as well as in the Store on the removable recording media. The internal non-volatile memory is used so that when the recording media are removed or the Taurus is power-cycled, the configuration is not lost. The Store also holds a configuration audit trail of all changes since that Store was created.

- The configuration may be downloaded from the Taurus, and uploaded to a different Taurus.
- The configuration audit trail may be downloaded for reference, but it is not a valid configuration for upload.

The downloaded Taurus configuration is in RDF Turtle format. For information on Turtle, see http://www.ilrt.bris.ac.uk/discovery/2004/01/turtle/. For information on RDF in general, see http://www.w3.org/RDF/.

5.2 Configuration pages

See Appendix H “UI Pages and Parameters” for a description of configuration parameters and permitted values on each configuration page. See also the specific configuration procedures in the appropriate chapters.

See Table H-12 “Advanced Configuration page options” for a description of configuration page controls (hyperlinks, and the **Apply**, **Commit**, **Reset**, **Previous**, **Browse**, **Upload**, and **Download** buttons).

5.3 Configuration audit trail

Taurus maintains an audit trail of all configuration changes since the Store was created. You can download this information to a text file (see Section 11.3.3 on page 119). You can view the text file to determine the exact state of the configuration for the Taurus at any point since the Store was created.

It contains the configuration data and metadata, and an audit trail event trigger. The audit trail event triggers that create an entry are:

- The Store is opened (which includes Taurus start up)
- Any change that is applied to the configuration
- The configuration is committed

5.4 Changing the configuration

The configuration parameters have default values as indicated in the relevant tables in Appendix H “UI Pages and Parameters”. You will likely need to change some of these values for your system. Basic options are in the Configuration page; all options are in the Advanced Configuration pages.

The **Apply**, **Reset**, and **Commit** functions affect all configuration pages, not just the page on which the **Apply**, **Reset**, or **Commit** was executed.

Note It is recommended that you have only one browser session at a time being used for configuration changes. For example, if you are running two browsers simultaneously (external and internal) and performing configuration changes via both, you must click the **Reset** button on the configuration page each time you switch from one browser to the other.

5.4.1 Change the configuration

1. Log in with the appropriate level of access. (See Chapter 6 for information on user permissions and logging in.)
2. Change the configuration parameter to the new value. You may make multiple changes in different configuration pages. These changes will be included in the same transaction (for example, if you click **Apply** in any page, all changes made in all pages will be applied).

   The Advanced Configuration sub-pages have a **Previous** button for moving back up the hierarchy of pages while caching any unapplied changes.

   ▸ In a browser use the **Previous** button, not the browser’s Back button, to ensure that unapplied changes are preserved.

3. Once you have changed the values you can test them, discard them, or make them permanent.
   - You can apply the changes to test the new configuration without making it permanent. Click **Apply**, and then wait for the message Changes Applied to be shown at the top of the page.
   - If you want to undo applied changes, see Section 5.4.2.
   - Once you are satisfied that you want to make the changes permanent, click **Commit** to save the new configuration. Wait for the message "Changes Applied. Successful Commit." (**Commit** includes **Apply**, so you may commit changes without having to apply them first.)
     - Some configuration changes require a Controller restart after **Commit**, to activate the saved changes. There will be a message shown in the UI if a restart is required. In the Shutdown page, click **Restart**.

5.4.2 Undo applied changes

To undo applied changes you must restart the subsystem where the applied changes are stored.

- Use Shutdown – **Restart** to undo applied changes made in these Advanced Configuration pages: Playback, Communications, Security, and the parameters UI TimeOut and Apollo Log Verbosity in the General page.
- You must power-cycle the Taurus to undo applied changes made in the Configuration page and in these Advanced Configuration pages: Timing, Calibration, Sensor Details, Digitizer, Power, and the last 4 parameters in the General page. See Section 4.3.4 "Power cycle the Taurus" on page 39.

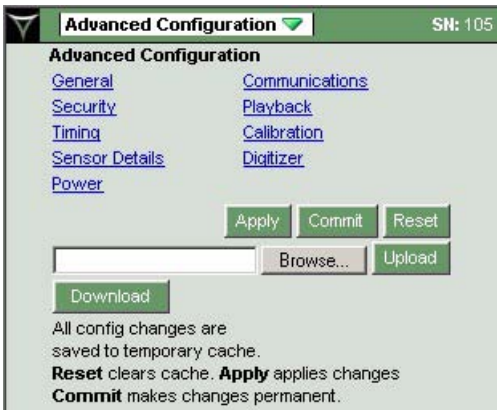
5.5 Downloading and uploading configurations

The complete configuration can be downloaded from the Taurus to an external file system. Valid configuration files can be uploaded to the Taurus to replace the existing configuration (for example, a configuration downloaded from another Taurus), or some part of the configuration (for example, a predefined seismometer configuration). The configuration is applied automatically on upload, so **Reset** will not have an effect. The configuration file is plain text in RDF Turtle format, so you can edit it with a text editor (ensure that you do not introduce errors).

Use the options on the Advanced Configuration main page to download and upload configurations (Figure 5-1; shows all options for a user logged in as `central`).

You must have the configured recording medium installed in the Taurus before you can upload a configuration.

Figure 5-1 Advanced Configuration main page options



5.5.1 Download a configuration from the Taurus

- Go to the Advanced Configuration page and click **Download**, then select a destination for the file.

5.5.2 Upload a configuration file to the Taurus

1. Go to the Advanced Configuration page and browse for a configuration file on an external file system, then click **Upload**. If you get an error during the upload no changes are made.
   - The configuration is applied automatically on upload. See Section 5.4.2 if you want to revert to the previous configuration.
2. If you want to make the uploaded configuration permanent, click **Commit**.
3. If the uploaded configuration contains changes to parameters that normally require a restart to become active, then restart the Taurus (Shutdown – **Restart**). (This would always be the case for a complete configuration.)

5.6 Saving default configurations

You can save whole or partial default configurations that you can later upload to any Taurus. (Partial default configurations are useful if you do not want to overwrite other parameters on upload.) For example:

- Download and save the entire factory default configuration from a new Taurus.
- Download and save an entire changed configuration as a customized default.
- Copy a predefined seismometer configuration file, edit, and save the file for a different seismometer configuration (see also Section 9.2.2 “Using predefined sensor configurations” on page 90).

Chapter 6 Configuring Taurus User Access

This chapter provides an overview and procedures for user access via the Taurus UI, and basic information for using other protocols such as SSH.

6.1 User access via the Taurus UI

To prevent unauthorized users from changing a Taurus configuration, there is a user authentication system (user name and password) and authorization model (the access level associated with the authenticated user). Access to configuration pages requires user authentication; which pages you can access depends on the authorization level of the user ID. HTTP requests must be via a browser. Authentication for browserless HTTP requests is planned for a future release.

The Taurus authorization model contains users, roles, and permissions, and their relationships as shown in Table 6-1. In this release, the authorization model is not editable. That is, you cannot reassign permissions or roles, and you cannot create or delete users. You can change the passwords.

Table 6-1 User permissions

User	Default password	Role	Permissions
`factory`			The `factory` account is not available for general use.
`central`	`central`	securityAdmin	Configure security Configure system Manage data Store and recording media Command sensor Download all data types Restart Shutdown Upgrade

Table 6-1 User permissions (Continued)

User	Default password	Role	Permissions
tech	tech	maintenance	Configure system Manage data Store and recording media Command sensor Download all data types Restart Shutdown
user	user	operator	Manage data Store and recording media Command sensor Download all data types Restart Shutdown
[not logged in]		[not defined]	If active medium unformatted, format active medium/switch media on startup Command sensor Download all data types Restart Shutdown

6.1.1 Logging in to the Taurus

Use the Log In/Log Off page to log in to one of the user accounts on the Taurus, to access the Change Password page, and to log out of the current session.

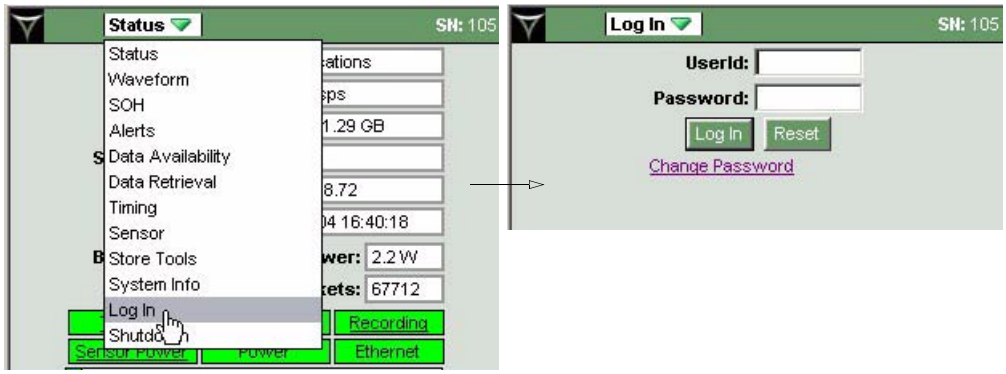
A logged-in session is specific to the browser session. That is, the session will log off automatically when you close the browser (for a browser session) or when the display shuts down (for a session on the Taurus display). If you encounter an error page in the browser session, you will still be logged in if you reopen the Taurus from a bookmark in the same browser session.

6.1.1.1 Standard login

1. Choose Log In from the Taurus menu.
2. Enter the UserID and Password. UserID and Password are both case-sensitive.
   - In a browser, type in the UserID and Password for the account you wish to use.
   - In the display, choose the UserID from the drop-down list and use the virtual keyboard to enter the Password (see Section 3.7 “Using the virtual keyboard” on page 24).
3. Click **Log In**.

   If authentication is successful, the Status page will open with the message Login Successful and the menu will now show items you are authorized to access. If authentication is not successful, the Status page message will be Login Failed. You can go back to the Log In page and try again. There is no limit on the number of login attempts.

Figure 6-1 Open the Log In page



6.1.1.2 Quick login

There are two ways to log in using the display: Standard, and Quick Login. You can configure Taurus to use Quick Login for local authentication. It allows logging in without having to enter or know the password for the account; for example, if a local user only needs to log in to swap media. Quick Login is available on the display only. Browser access to accounts always requires that you enter the UserID and Password, whether or not Quick Login is configured.

Once Quick Login is configured, the display Log In page will show an additional button, **Log In as** *configuredUserID*.

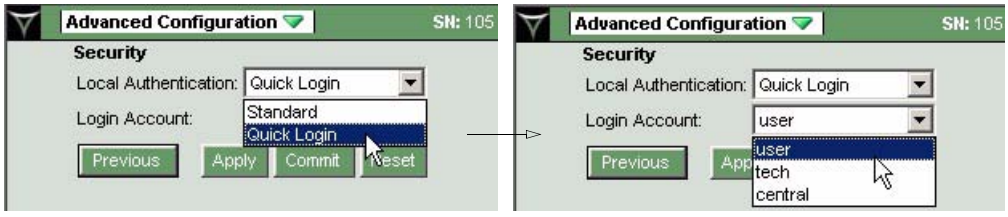
- Choose the correct UserID from the drop-down list if it is not already selected, then click the **Log In as** *configuredUserID* button.

To configure Quick Login (or change back to Standard login):

1. Log in as `central` and open the Advanced Configuration > Security page.
2. Choose Quick Login from the Local Authentication drop-down list, and then choose the appropriate account from the Login Account drop-down list (Figure 6-2)
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Similarly, you can change the configuration back to Standard, which will disable Quick Login access on the display.

Figure 6-2 Configure Quick Login



6.1.2 Logging off of the Taurus

If you are currently logged in to the Taurus, the page option in the main menu is Log Off. You will be prompted for confirmation before you are logged off.

- To exit this page without logging off, choose any other page option from the main menu. You can continue working in the current session.

A session will log off automatically when you close the browser (for a browser session) or when the display shuts down (for a session on the Taurus display).

6.1.3 Changing passwords

1. Log off if you are currently logged in, as the Change Password page is available from the Log In page.
2. Open the Log In page and click the Change Password page link.
3. Type in the current user ID and password, then type in the new password. It must be at least 4 alphanumeric characters long. It is case-sensitive.
4. Type the new password in the Verify New Password field.
5. If you want to clear all current field entries, for example to enter different values, click **Reset** (applicable only if you have not yet clicked Change Password).
6. To accept the new password, click Change Password. You will be logged in to that account automatically.

If you change and then forget your passwords, you can revert to the default set of passwords (listed in Table 6-1):

1. Access the Taurus via telnet or SSH and log in as root (user `root`, factory default password `dolphin18`).
2. Delete the file `/home/taurus_`*x*`/users.txt`.
3. In the UI, go to the Shutdown page and click **Restart**.

6.2 Other access protocols: FTP, telnet, and SSH

You can access the Taurus file system via File Transfer Protocol (FTP), telnet, and Secure Shell (SSH; Taurus supports SSH-1 and SSH-2). SSH is included as of Taurus firmware version 2.*x*. This section provides basic information for accessing the Taurus using these protocols. Nanometrics does not provide technical support for use of these protocols. Procedure details will depend on the operating system and client you are using, and your network setup.

FTP and telnet are both cleartext protocols, so it is risky to use them across an unsecure network. Where security is an issue it is better to use SSH, which encrypts the entire session. Most UNIX/Linux systems include an SSH client. On Windows, you can install a client such as PuTTY (http://www.chiark.greenend.org.uk/~sgtatham/putty/). PuTTY includes other utilities such as PSFTP (a secure FTP utility).

The Taurus server uses the standard port number for each protocol (FTP port 21, SSH port 22, and telnet port 23).

To log in as root, login or user is `root`. See Section 6.2.1 for information about the root password.

The Taurus SSH server does not support multiple login attempts if you enter the wrong user name. If you enter the user name incorrectly, close the current SSH session and try again with a new session.

6.2.1 Default passwords

This section lists Taurus default passwords by firmware version for access to the Taurus using protocols other than HTTP via a browser. (For user names and passwords to access the Taurus using HTTP via a browser, see Section 6.1 “User access via the Taurus UI” on page 47.)

During an upgrade of the Taurus firmware from version 1.*x* to version 2.*x* or higher, the default root password is changed automatically once the rootfs has uploaded.

Caution If you change the root password and then forget the password, there is no way to recover it. You will no longer be able to log in to the Taurus file system.

If you are logged in as user `root`, you can change the root password using the `passwd` command.

Table 6-2 Default root passwords

Taurus firmware version	Default root password
1.*x*	`root`
2.*x*	`dolphin18`

To connect to the Taurus via PPP, there is a fixed user name `pppuser` and password `beaver16`. This is planned to be configurable in a future release. (See Chapter 7 “Configuring Taurus Communications” for information on using serial protocols.)

Chapter 7 Configuring Taurus Communications

This chapter provides an overview of Taurus communications options, and procedures for changing network settings.

7.1 Taurus networking

You can configure Taurus for network access via an IP connection over either Ethernet or serial (SLIP or PPP). The Taurus will be accessible while it is in either Communications mode or Interactive mode (see Section 3.1 “About the Taurus operating modes” on page 17). The network configuration options are in the Advanced Configuration > Communications pages. (See Section H.13.2 on page 193 for a description of all Communications page parameters.)

You must be logged in as `tech` or `central` to change Communications settings (see Chapter 6). See also Chapter 5 “Changing a Taurus Configuration”.

7.1.1 Packet routing

When packets are destined to a location outside of the immediate subnet (more than a single hop) a routing gateway is required. The gateway is configured as an IP address of a machine. The Taurus may have multiple gateways configured, the Default Interface parameter specifies which gateway is in effect, and all packets not on an immediate subnet will be sent to that gateway:

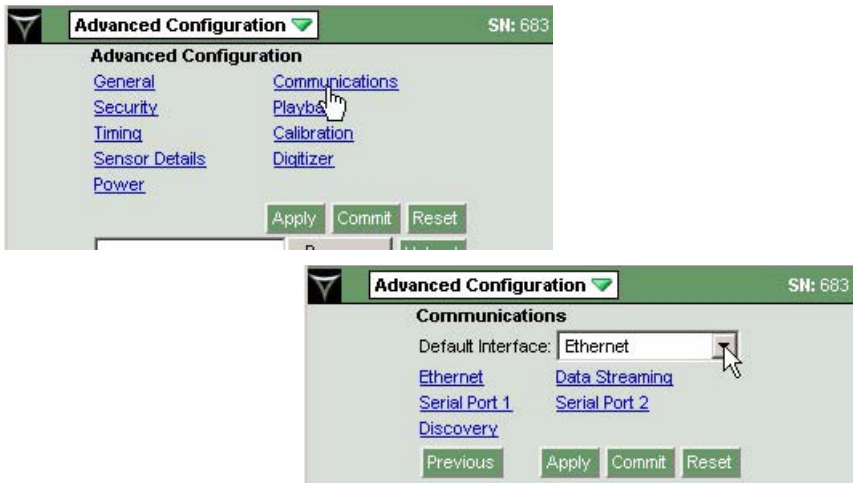
- Ethernet – The gateway used is the one obtained from the settings specified in the Advanced Configuration > Communications > Ethernet page.
- Serial Port 1 – The gateway used is the Remote IP Address configured in the Advanced Configuration > Communications > Serial Port 1 pages.

7.1.1.1 Set the packet routing default interface

1. Log in and go to the Advanced Configuration > Communications page (Figure 7-1).
2. Choose the Default Interface option from the drop-down list as appropriate to the type of network connection (Ethernet or serial).

3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 7-1 Choose the packet routing default interface

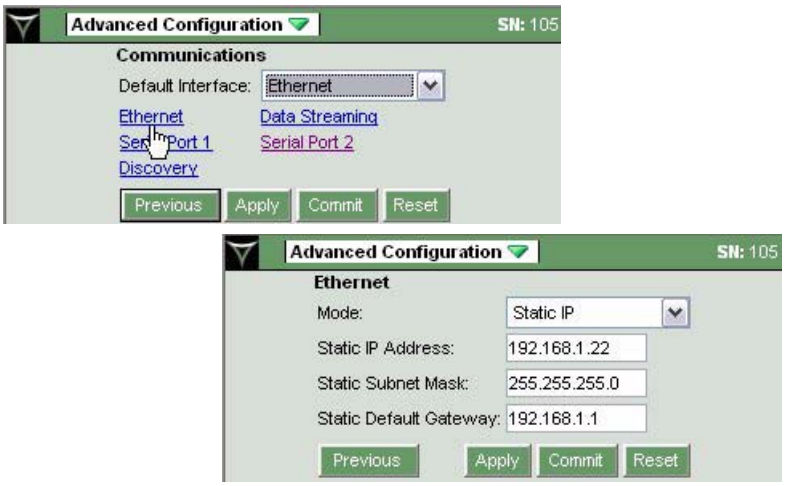


7.2 Communications over Ethernet

The Taurus provides standard modes for searching for an Ethernet LAN interface. These include DHCP, Link-Local, and Static IP. There is also an option for no Ethernet.

- Use the supplied Ethernet cable (15228) or equivalent to connect the Taurus to your LAN. Make sure the Taurus is connected to your LAN before you power up the Taurus.

Figure 7-2 Ethernet configuration pages



7.2.1 Configuring Ethernet settings

1. Log in and go to the Advanced Configuration > Communications page (Figure 7-2).

2. Ensure the Default Interface is set to Ethernet (Section 7.1.1.1 on page 53).
3. Click the Ethernet hyperlink.
4. Choose a Mode for the Taurus to define its Ethernet interface:
   - DHCP – The Taurus will search for a DHCP server to obtain a network address. If a DHCP server is not found, the Taurus will use Link-Local protocol to acquire an available IP address.
   - Link-Local – The Taurus will use trial-and-error testing of the LAN for address conflicts to acquire an available IP address in the Link-Local address space of 169.254/16.
   - Static IP– The Taurus will use the specified Static IP Address, Static Subnet Mask and Static Default Gateway settings to define its Ethernet interface. Therefore, for this mode also set these parameters:
     - Static IP Address – The IP address for the Taurus in the selected network.
     - Static Subnet Mask – Identifies which portion of the IP address is the network ID and which is the host ID.
     - Static Default Gateway – The IP address of the gateway device for remote network visibility.
   - None – The Ethernet interface will be disabled. This will conserve some small amount of power, but will restrict access to the Taurus to be via the display and keypad. (This parameter is not associated with serial configuration in any way.)
5. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

7.3 Communications over serial

Taurus provides two serial ports. Serial Port 1 can be configured to use SLIP or PPP for link control and establishment, with a further option to use TDMA on a SLIP link. Serial Port 2 does not support networking. The shipping default configuration for both ports is Raw, 9600 bps.

- Serial Port 1 (PPP/SLIP/Raw/TDMA) – A full 9-pin RS232 serial port designed for communication with a PC via dial-up modem or a direct connection. Configuration options are in the Advanced Configuration > Communications > Serial Port 1 pages.
- Serial Port 2 (Raw only) – A basic serial port that has transmit and receive lines for a character stream for connection to a serial device. Port speed is configured in the Advanced Configuration > Communications > Serial Port 2 page.

7.3.1 Protocols

- Serial Line IP (SLIP) – A simple IP over serial protocol with very little overhead. The Taurus uses a 1500 byte frame size.
- Compressed SLIP (CSLIP) – SLIP with TCP/IP header compression. This will decrease the TCP/IP header from 40 bytes to 7 bytes, but has no effect on the 28-byte UDP/IP headers.

- Point to Point Protocol (PPP) – A more advanced IP over serial protocol that is used in modem communications. The Taurus supports two connection methods:
  - Dial-in – The Taurus will accept dial-up connections from remote devices. This feature has been tested with USRobotics V.90 56K external Faxmodem.
  - Direct – This mode may be used to test streaming over PPP by connecting directly from a PC. However, Taurus is only listening for connect requests, it does not attempt to connect to a PPP server. Typically, you would use SLIP for a direct connection.

  The Taurus automatically provides a PPP client its local and remote IP addresses for the PPP connection, for both dial-in and direct.
- Time Division Multiple Access (TDMA) – Static channel allocation for multiple Tauruses to communicate with a Nanometrics comms device, such as a Janus Communications Controller, over SLIP links.

7.3.2 Flow control

For Data Streaming, the Taurus will automatically reduce the rate at which NP packets are transmitted based on the configured speed of Serial Port 1. The throttle rate is set to also allow for other TCP traffic to get across the link, and to account for PPP overhead.

7.3.2.1 Bandwidth requirement for data streaming over a serial link

Even with flow control the serial link will have bandwidth limits which, if exceeded, may affect data availability. When data streaming over a serial port, the following condition must be true. If it is momentarily violated, buffers will temporarily allow data streaming without data loss, but a data delay may be noticed:

$$Number\_bytes\_required\_to\_be\_sent < Maximum\_number\_bytes\_that\_can\_be\_sent$$

$$Maximum\_number\_bytes\_that\_can\_be\_sent = Serial\_Port\_Speed \cdot 0.90 / 10$$

$$Number\_bytes\_required\_to\_be\_sent = Output\_Channels \cdot Sample\_Rate\_Hz \cdot Bytes\_per\_sample \cdot Packet\_overhead$$

$$Packet\_overhead = (51 + 64 \cdot Frames\_per\_packet + 28) / (60 \cdot Frames\_per\_packet - 8)$$

The packet overhead is the combined overhead of the Steim (1), NP, and UDP/IP overheads.

If you are using TDMA over serial, take into account that the maximum number of bytes that can be sent will be limited additionally by the size of the Taurus TDMA slot.

7.3.3 Limitations

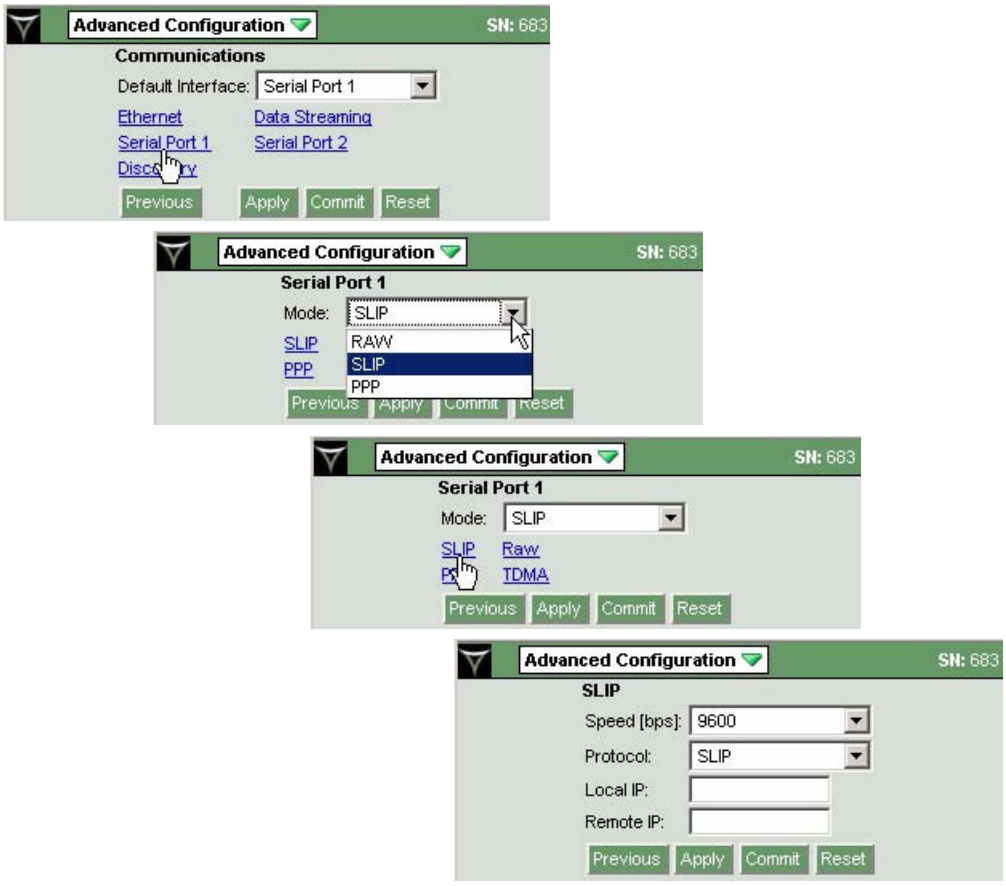
These limitations are planned to be addressed in a future release.

- After a client PC disconnects from the Taurus in PPP direct mode, another client PC cannot connect to the Taurus until after the Taurus has been rebooted.
- A normal disconnect works over PPP dial-up. However, when the link is physically disconnected the Taurus does not detect it, so a new connection cannot be started until after the Taurus has been rebooted.

7.3.4 Configuring a SLIP direct connection

The Taurus supports direct SLIP connection via a serial communication cable or transparent serial modem. This section provides the procedure for configuring the Taurus and an example configuration procedure for Windows XP.

Figure 7-3 SLIP configuration pages



7.3.4.1 Taurus configuration for SLIP connection

1. Log in and go to the Advanced Configuration > Communications page (Figure 7-3).
2. Ensure the Default Interface is set to Serial Port 1 (Section 7.1.1.1 on page 53).
3. Click the Serial Port 1 link.
4. Choose SLIP from the Mode drop-down list.
5. Click the SLIP hyperlink.
6. Choose a link speed from the Speed drop-down list.
7. Choose SLIP from the Protocol drop-down list.
8. Set the Local IP to the IP address of the local SLIP interface.
9. Set Remote IP to the IP address of the remote SLIP interface.

10. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

7.3.4.2 Windows XP configuration for SLIP connection

Note SLIP connections do not work on Windows XP Service Pack 1. In order to set serial direct connection on Windows XP you must upgrade to Window XP Version 5.1.2600 Service Pack 2 Build 2600, or higher.

This example procedure is for a direct cable connection.

1. Connect the hardware and remove potentially conflicting settings:
   a) Build a serial cable and connect to your PCs working COM port (normally COM1). For example, use a DB-9 connector and the connector from the optional Taurus Connector Kit (part number 15170). See also Appendix B "Connector Pinouts".
      - If your link drops frequently, use a serial cable having a PC serial connector (DB-9) with pins 7,8 (RTS, CTS) shorted and pins 1,4,6 (CD, DTR, DSR) shorted. Some motherboards (PC hardware) require a full loop back serial cable to maintain a connection.
   b) Close all serial port applications (such as Hyper terminal, Teraterm).
   c) Ensure all modems are removed from the Modems tab (Control Panel > Phone and Modem Options) before continuing. Other modem drivers may confuse XP enough to refuse connection.
2. Go to Start > Settings > Control Panel > Phone and Modem Options.
3. Click the Modems tab. If "Communications cable between two computers" is not in the list:
   a) Click **Add**.
   b) Choose "Don't detect my modem". Click **Next**.
   c) Choose "Communications cable between two computers". Click **Next**.
   d) Choose COM Port. Click Next.
   e) Click **Finish**.
4. Select "Communications cable between two computers". Click **Properties**.
5. Click the Modem tab and the set maximum port speed to 57600.
6. Click the Advanced tab.
7. Click "Change Default Preferences" and use these settings:
   a) Set port speed to 57600.
   b) Set Flow control to none.
   c) Click **OK**.
8. Click **OK** to return to the "Phone and Modem Options".
9. Click **OK** to return to Control Panel.

10. Create the new network connection:
    a) Go to Start > Connect to > Show all connections and choose Make new connection (or Control Panel > Network Connections > Make new connection.
    b) In the “Network Connection Wizard”, click **Next**.
    c) Choose “Set up an advanced connection”. Click **Next**.
    d) Choose “Connect directly to another computer”. Click **Next**.
    e) Choose “Guest”. Click **Next**.
    f) Type a name in the Computer Name box (for example, Taurus SLIP). Click **Next**.
    g) Choose “Communications cable between two computers (COM*x*)”. Click **Next**.
    h) Choose “Anyone’s use”. Click **Next**.
    i) Click **Finish**.
    j) In the “Connect *ComputerName*” dialog box, ignore User name and Password.
    k) Click **Properties**.
    l) For “Communications cable between two computers” click Configure and use these settings:
        i. Set maximum speed to 57600.
        ii. Ensure all check boxes are un-checked.
        iii. Click **OK**.
    m) Click the Options tab, and un-check “Prompt for name and password...”.
    n) Click the Networking tab and choose SLIP connection. Un-check all components except TCP/IP, QoS Packet Scheduler.
    o) Double-click TCP/IP and choose “Use the following IP address”. Set the IP address to the Remote IP configured in the Taurus.
    p) Click Advanced and use these settings:
        i. Un-check “Use IP header compression”.
        ii. Set frame size to 1500.
        iii. Click **OK**.
    q) Click **OK** on TCP/IP properties. Click **OK** on *ComputerName* Properties.
    r) Ensure the Taurus has been powered up and Serial 1 is connected to the COM port.

       If all is well, the message “All devices are connected” should appear briefly, and the connection icon will show up immediately in the task bar.
11. Test the connection by pinging the Local IP address configured on Taurus from a command prompt.

7.3.4.3 Using CSLIP

CSLIP provides minor amounts of compression to the link.

7.3.4.3.1 Taurus configuration for CSLIP connection

- To use CSLIP, follow the procedures for SLIP (Section 7.3.4.1 on page 57) with this change: For step 7, set protocol to CSLIP.

7.3.4.3.2 Windows XP configuration for CSLIP connection

1. Complete the procedure described in 7.3.4.2 on page 58.
2. Go to Control Panel > Network Connections and right-click on *ComputerName* connection.
3. Go to the Networking tab and double-click on “Internet Protocol (TCP/IP)” (or click on it and choose Properties).
4. Click **Advanced**.
5. Set “Use IP Header Compression” to enabled.
6. Click **OK** in each window until you exit.

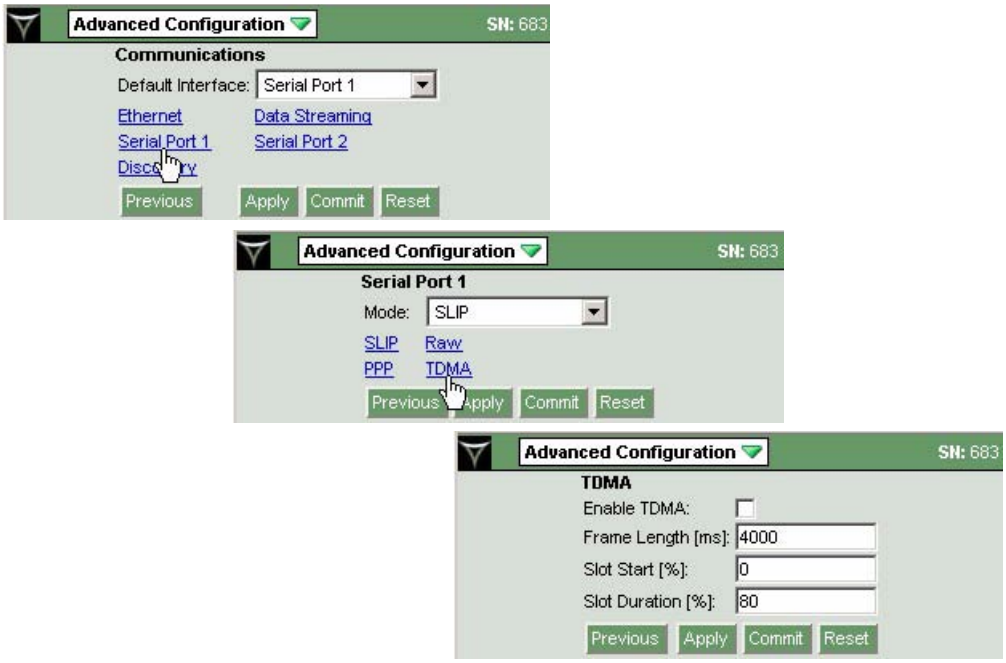
7.3.5 Configuring TDMA over SLIP

You can configure Serial Port 1 for TDMA over a SLIP link. The link typically would use a pair of transparent serial radio modems to communicate with a shared Nanometrics comms device, such as a Janus Communications Controller.

TDMA parameters are configured on both the Taurus and the Janus, therefore parameter values such as frame length must be set appropriately on both instruments for each Taurus-Janus link.

The Taurus and Janus use their GPS-derived system time to calculate TDMA slot timing. If the Taurus system timing status is not good (status is not Green), data streaming is disabled until timing status is good again. (See table row Timing status bar, on page 178, for a summary of timing statuses and indicators.) While data streaming is disabled, HTTP access to the Taurus is still available. HTTP access may be erratic, depending on the number of collisions on the link due to any significant shift of the Taurus time slot. If the Janus system timing status is not good, it will not transmit over the serial ports until its timing status is good again. While the Janus is not transmitting over the serial ports, it will continue to receive data from connected Tauruses and forward the data to the central site over Ethernet.

Figure 7-4 TDMA configuration pages



7.3.5.1 Taurus configuration for TDMA

Note For a network that uses a set of half-duplex links on different frequencies, it is recommended that you configure the radios for priority receive. In addition, for low bandwidth links you may balance transmission efficiency for data transmission and retransmission requests by setting the respective slot proportions to 90% and 10%.

1. Log in and go to the Advanced Configuration > Communications page (Figure 7-4).
2. Ensure the Taurus is configured for a SLIP connection (see Section 7.3.4.1 on page 57 for the procedure to configure Taurus for SLIP).
3. Go to the Advanced Configuration > Communications > Serial Port 1 > TDMA page.
4. Set Enable TDMA to enabled ☑, and set the TDMA parameter values as appropriate for your application:
   - Frame Length [ms] – Set the TDMA frame length in milliseconds. The frame length must be set to the same value for all devices sharing the link; for example, for each Janus Port *n*-Taurus pair. This value should be compatible with the minimum slot size for this connection (Section 7.3.5.1.1). Enter a number from 1000 to 10000. Factory default is 4000.
   - Slot Start [%] – Set the Taurus TDMA slot start position as a percentage of the entire frame. This value should be compatible with the corresponding Janus port setting. Slot Start plus Slot Duration must be less than or equal to 100. Enter a number from 0 to 99. Factory default is 0.

- Slot Duration [%] – Set the Taurus TDMA slot duration as a percentage of the entire frame. This value should be compatible with the corresponding Janus port setting, and the minimum slot size limit for this connection (Section 7.3.5.1.1). Slot Duration plus Slot Start must be less than or equal to 100. Enter a number from 1 to 99. Factory default is 80.

5. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

7.3.5.1.1 Minimum slot size

The minimum slot size is determined by the largest frame that may be transmitted over the serial link. The minimum slot size in milliseconds is defined as follows:

$$minSlotSize = guardTime + ((\ MTU \cdot bitsPerCharacter \cdot paddingMargin\ /\ dataRate\ )\ 1000\ )$$

For example, with 35 ms slot guard time (not configurable to other values in this release), a 530 byte Maximum Transmission Unit (MTU), 10 bits per character (8 data bits, 1 start, 1 stop, no parity), 10% byte stuffing margin, and 9600 bps, the minimum slot size would be:

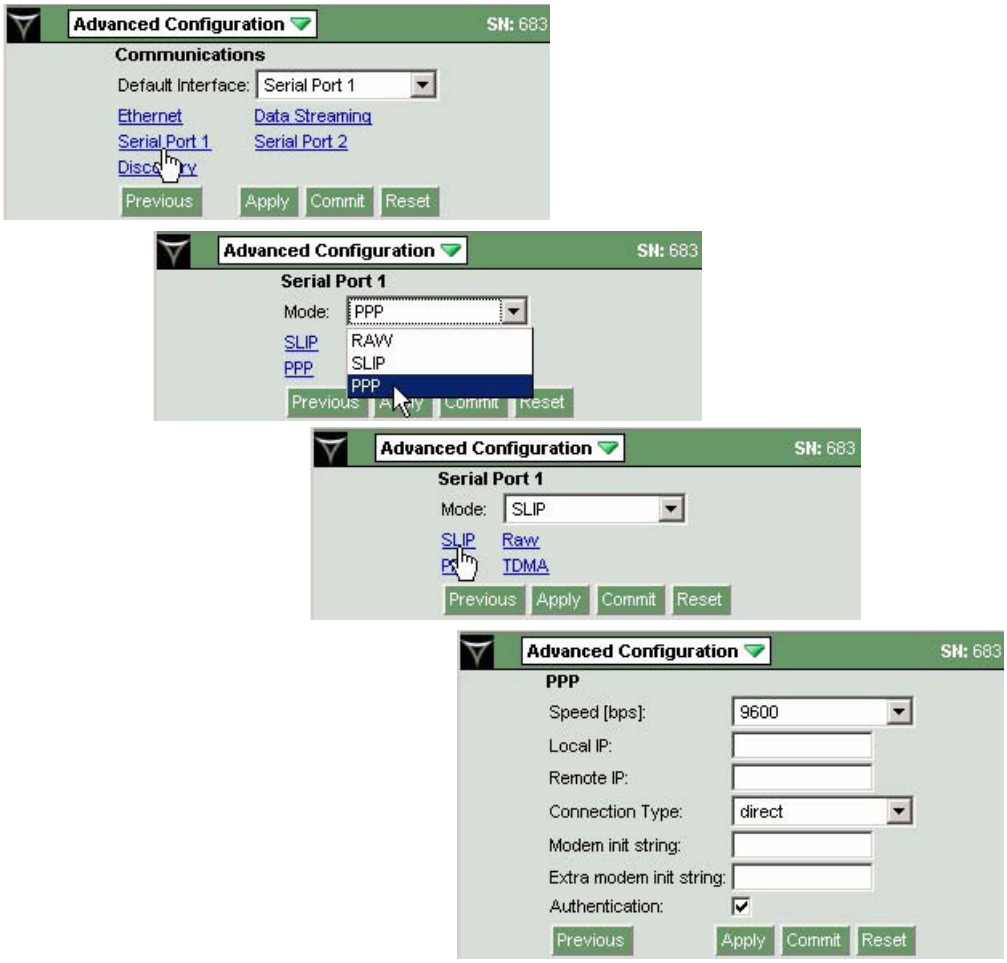
$$minimum\ slot\ size = 35 + 530 \cdot 10 \cdot 1.1 / 9600 \cdot 1000 = 642\ \text{ms}$$

7.3.6 Configuring a PPP dial-in connection via dial-up modem

The Taurus will accept a PPP initialization request from a client using a dial-up mode. This section provides the procedure for configuring the Taurus for PPP dial-in and an example configuration procedure for Windows XP.

To connect to the Taurus via PPP, a fixed user name `pppuser` and password `beaver16` is used to authenticate the PPP client, Taurus being the PPP server. This is planned to be configurable in a future release.

Figure 7-5 PPP configuration pages



7.3.6.1 Taurus configuration for PPP dial-in

1. Log in and go to the Advanced Configuration > Communications page (Figure 7-5).
2. Ensure the Default Interface is set to Serial Port 1 (Section 7.1.1.1 on page 53).
3. Click the Serial Port 1 hyperlink.
4. Choose PPP from the Mode drop-down list.
5. Click the PPP hyperlink.
6. Choose a link speed from the Speed drop-down list.
7. Set the Local IP to the IP address of the local PPP interface.
8. Set Remote IP to the IP address of the remote PPP interface.
9. Choose dial-in from the Connection Type drop-down list.

10. Set the modem initialization string (the entry is split into two parts to reduce clutter, but you may enter multiple commands in one field if you wish):
    a) Set Modem init string to an appropriate modem initialization command string (for example, AT&F1 OK).
    b) Set the Extra modem init string to an additional modem command string (for example, ATS0=0 OK).
11. Set Authentication to enabled ☑.
12. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

7.3.6.2 Windows XP configuration for Taurus PPP dial-in connection

This procedure shows example settings based on a USRobotics 56K Faxmodem.

1. Build a cable to connect Taurus to your modem. Use the connector from the optional Taurus Connector Kit (part number 15170), or equivalent. See also Appendix B “Connector Pinouts”.
2. Install the modem driver for USRobotics 56K Faxmodem (for example, find the driver `mdmusr01.inf`, right-click on the filename, and choose Install).
3. Create a cable connection modem:
    a) Go to Start > Control Panel > Phone and Modem Options.
    b) Click the Modems tab. If U.S. Robotics 56K FAX EXT is not in the list:
        i. Click **Add**.
        ii. Choose “Don't detect my modem”. Click **Next**.
        iii. Choose “3Com Corporation” in the Manufacturer list.
        iv. Choose “U.S. Robotics 56K FAX EXT”. Click **Next**.
        v. Choose COM port. Click **Next**.
        vi. In the Hardware Installation warning popup, click **Continue Anyway**.
        vii. Click **Finish** to close the Add Hardware Wizard dialog.
    c) Click **OK** to close the Phone and Modem Options dialog.
4. Create a PPP connection:
    a) Go to Start > Control Panel > Network Connections.
    b) Click **Create a new connection**.
    c) In the New Connection Wizard, click **Next**.
    d) Choose “Connect to the Internet”. Click **Next**.
    e) Choose “Set up my connection manually”. Click **Next**.
    f) Choose “Connect using a dial-up modem”. Click **Next**.
    g) Type a name in the “Computer Name” box (for example, Taurus PPP Dialup). Click **Next**.
    h) Type in the phone extension. Click **Next**.
    i) Choose “Anyone’s use”. Click **Next**.
    j) In the Internet Account Information page, enter these settings:

i. Type `pppuser` in the User name box.
ii. Type `beaver16` in the Password box.
iii. Type `beaver16` in the Password box.
iv. Set “Use this account name and password when...” to enabled.
v. Set “Make this the default Internet connection” to not enabled.
vi. Set “Turn on Internet connection Firewall...” to not enabled.
vii. Click **Next**.

k) Click **Finish**. A “Connect *ComputerName*” dialog box will pop up.
l) Click **Dial**. If it succeeds a connection icon will appear in the Windows notification area with the message “*ComputerName* is now connected”.
m) Test the connection by pinging the Local IP address configured on the Taurus from a command prompt.

7.3.6.3 Viewing modem logs on Windows XP

1. Go to Start > Control Panel > Phone and Modem Options.
2. Click on the Modems tab.
3. Click **Properties**.
4. Click on the Diagnostics tab.
5. Set Append to Log to enabled.
6. Click **View log** to see an updated log at any time.

7.3.6.4 Viewing modem logs on Linux

Note This does not take effect until after a reboot. View the log in `/var/log/ppp`.

This information is copied from http://axion.physics.ubc.ca/ppp-linux.html#Logging:

Message Logging

In order to figure out what is happening while you are trying to log on to your ISP, you must turn on debugging and log the debug messages to some file. The key programs are `pppd`, and a program it uses, called `chat`. We will store those debugging messages in a file called `/var/log/ppp`. (You can use any file you wish, including `/var/log/messages`. Some distributions are now installing a directory called `/var/log/ppp` (Eg, The Corel distribution does this). If yours does, you must use a different name, eg, `/var/log/ppplog`. Use that name instead everywhere this document talks about `/var/log/ppp`.)

In order that your system will record the debugging information from both these programs, do the following:

`cp /etc/syslog.conf /etc/syslog.conf.orig`

to make sure you have a copy of a good version in case you mess up the next command. If you have trouble, copy back the original version.

Edit `/etc/syslog.conf` and add the lines

```
local2.*        /var/log/ppp
daemon.*        /var/log/ppp
```

(Some versions of `syslogd` (eg on SunOS) demand that those be tabs not spaces between the two parts on each line. Some editors refuse to insert tabs and convert them to spaces. The `syslogd` shipped with most recent distributions of Linux do not seem to care, but Be warned.)

Then, to tell `syslogd` to actually log the information, do

```
killall -1 syslogd
```

7.3.7 Configuring a PPP direct cable connection

The Taurus supports a mode to test streaming over PPP by connecting directly from a PC. However, the Taurus is only listening for connect requests, it does not attempt to connect to a PPP server. This section provides the procedure for configuring the Taurus for PPP direct connection, and an example configuration procedure for Windows XP. Typically, you would use SLIP for a direct connection (Section 7.3.4 on page 57).

7.3.7.1 Taurus configuration for PPP direct connection

1. Connect the hardware and remove potentially conflicting settings:
   a) Build a serial cable and connect to your PCs working COM port (normally COM1). For example, use a DB-9 connector and the connector from the optional Taurus Connector Kit (part number 15170). See also Appendix B “Connector Pinouts”.
      - If your link drops frequently, use a serial cable having a PC serial connector (DB-9) with pins 7,8 (RTS, CTS) shorted and pins 1,4,6 (CD, DTR, DSR) shorted. Some motherboards (PC hardware) require a full loop back serial cable to maintain a connection.

   b) Close all serial port applications (such as Hyper terminal, Teraterm).
   c) Ensure all modems are removed from the Modems tab (Control Panel > Phone and Modem Options) before continuing. Other modem drivers may confuse XP enough to refuse connection.
2. Log in and go to the Advanced Configuration > Communications page (Figure 7-5 on page 63).
3. Ensure the Default Interface is set to Serial Port 1 (Section 7.1.1.1 on page 53).
4. Click the Serial Port 1 hyperlink.
5. Choose PPP from the Mode drop-down list.
6. Click the PPP hyperlink.
7. Choose a link speed from the Speed drop-down list.
8. Set the Local IP to the IP address of the local PPP interface.
9. Set Remote IP to the IP address of the remote PPP interface.
10. Choose direct from the Connection Type drop-down list.

11. Leave the Modem init string empty.
12. Leave the Extra modem init string empty.
13. Set Authentication to enabled ☑.
14. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

7.3.7.2 Windows XP configuration for Taurus PPP direct connection

1. Create cable connection modem
   a) Go to Start > Control Panel > Phone and Modem Options.
   b) Click the Modems tab. If “Communications cable between two computers” is not in the list:
      i. Click **Add**.
      ii. Choose “Don't detect my modem”. Click **Next**.
      iii. Choose “Communications cable between two computers”. Click **Next**.
      iv. Choose COM Port. Click **Next**.
      v. Click **Finish** to close the Add Hardware Wizard dialog.
   c) Choose “Communications cable between two computers and then click **Properties**.
   d) Click the Modem tab.
      ▸ Set Maximum Port Speed to 57600.
   e) Click the Advanced tab.
   f) Click Change Default Preferences and use these settings:
      i. Set Port speed to 57600.
      ii. Set Flow control to None.
      iii. Click **OK**.
   g) Click **OK** to close the “Communications cable between two computers Properties” dialog.
   h) Click **OK** to close the “Phone and Modem Options” dialog.
2. Create a PPP connection:
   a) Go to Start > Control Panel > Network Connections.
   b) Click **Create a new connection**.
   c) In the New Connection Wizard, click **Next**.
   d) Choose “Set up an advanced connection” Click **Next**.
   e) Choose “Connect directly to another computer. Click **Next**.
   f) Choose “Guest”. Click **Next**.
   g) Type a name in the “Computer Name” box (for example, Taurus PPP). Click **Next**.
   h) Choose “Communications cable between two computers (COM*x*)”. Click **Next**.
   i) Select “Anyone’s use”. Click **Next**.

j) Click **Finish**. A "Connect *ComputerName*" dialog box will pop up.
k) Click **Properties**.
l) Choose "Communications cable between two computers (COM*x*)".
m) Click **Configure** and use these settings:
   i. Set "Maximum speed (bps)" to 57600.
   ii. Ensure all check boxes are un-checked.
   iii. Click **OK** to close the Modem Configuration dialog.
n) Click the Networking tab.
   i. Choose "PPP: Windows 95/98/NT4/2000, Internet" connection (default).
   ii. Un-check all items except "Internet Protocol (TCP/IP)" and "QoS Packet Scheduler".
o) Choose "Internet Protocol (TCP/IP)" and then click **Properties**.
p) Choose "Use the following IP address" and set it to the Remote IP address configured on the Taurus.
q) Click **Advanced** and use these settings:
   i. Set "Use default gateway on remote network" to enabled.
   ii. Set "Use IP header compression" to not enabled.
   iii. Click **OK** to close the Advanced TCP/IP Settings dialog.
r) Click **OK** to close the Internet Protocol (TCP/IP) Properties dialog.
s) Click **OK** to close the *ComputerName* Properties dialog.

3. Connect using a PPP connection:
   a) Ensure the Taurus has been powered up and Serial Port 1 is connected to the appropriate Windows COM port.
   b) Open Start > Control Panel > Network Connections, and choose *ComputerName* (for example, Taurus PPP).
   c) In the Connect Taurus PPP dialog box use these settings:
      i. Type `pppuser` in the User name box.
      ii. Type `beaver16` in the Password box.
   d) Click **Connect**. If it succeeds a connection icon will appear in the Windows notification area with the message "Taurus PPP is now connected".
   e) Test the connection by pinging the Local IP address configured on Taurus from a command prompt.

7.4 Data Streaming

You can stream time-series data over either an Ethernet or Serial Port 1 (SLIP/PPP) connection to a destination such as a NAQS server. See Section 11.2.3 "Stream time-series data to a central acquisition server" on page 115.

7.5 Discovery

The Taurus can be configured to send out brief UDP messages that allow other programs, including Apollo, to discover other devices running Apollo on the local area network. This feature will have more application once Apollo Central is released.

The Taurus shipping default is to have Discovery enabled. You may wish to change this setting to disabled, for example to eliminate possible associated Alert messages:

1. In the Advanced Configuration > Discovery > page, disable the option Enable Discovery ☐.
2. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

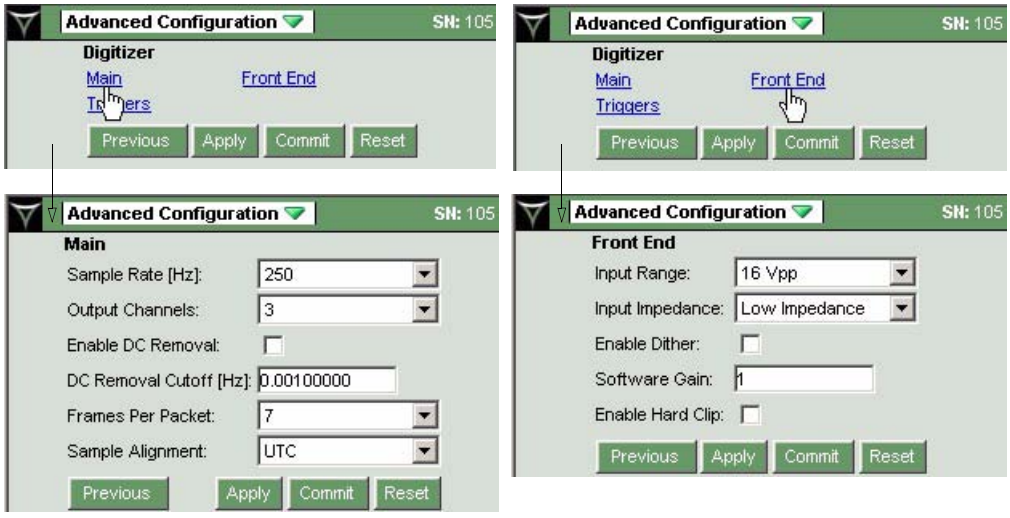
Chapter 8 Configuring the Digitizer and Timing

This chapter provides overviews of Digitizer and Timing system settings, and procedures for changing these settings.

8.1 Configuring the Digitizer

Digitizer settings are grouped on two pages under Advanced Configuration > Digitizer; (Main, and Front End; Figure 8-1). There is also a set of pages to define trigger detection (Triggers; Figure 8-2 on page 77).

Figure 8-1 Digitizer configuration pages



8.1.1 Main settings

1. Log in as `tech` or `central`.

2. In the Advanced Configuration > Digitizer > Main page, set parameter values as appropriate for your application:
   - Sample Rate – The sample rate in hertz (samples per second) on the sensor signal. Choose an option from the Sample Rate drop-down list. Options are 10, 20, 40, 50, 80, 100, 120, 200, 250, 500 (500 sps is not supported in Buffered mode). Factory default is 100.

     Note that valid value ranges for some of the trigger parameters depend on the sample rate, therefore some sample rates may be incompatible with your current trigger settings. See also Section 8.1.3 “Triggers settings” on page 75, Table H-33 “Input Filter page options” on page 204, and Table H-34 “Detector page options” on page 205.
   - Output Channels – The number of output channels. Choose an option from the Output Channels drop-down list. Options are 0, 1, 2, 3. Factory default is 3. If you choose 0 channels, no time-series data are written to the Store.
   - Enable DC Removal – Set whether the DC removal filter is used on data. This enables a high pass filter with a configurable low corner frequency. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
   - DC Removal Cutoff – The DC Removal cutoff refers to the corner frequency of the high pass filter in hertz used in the Enable DC Removal parameter. All signal frequencies below this are removed. Enter a number between 0.001 and 1.0. Factory default is 0.001.
   - Frames Per Packet – The number of standard SEED frames per packet for transmission of time-series data. Options are 3, 7. Factory default is 7.
   - Sample Alignment – Sample alignment after a time error correction (see also Section 8.2.2 “System time correction” on page 80). Choose an option from the Sample Alignment drop-down list:
     - UTC – After a time error correction, the next sample is aligned to 0 ns exactly. This is the factory default option.
     - None – After a time error correction, the next sample is aligned to some fraction of a second as determined by that correction.
     - HRD – After a time error correction, the next sample will have alignment based on the algorithm used in the HRD (a previous-generation Nanometrics digitizer). You can use this option if you have Nanometrics HRDs in your network, so output samples from both Taurus and HRD instruments are synchronized in the same way.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.1.2 Front End settings

To choose Digitizer Front End settings:

1. Log in as `tech` or `central`.

2. In the Advanced Configuration > Digitizer > Front End page, set parameter values as appropriate for your application (options are described briefly in the sections as indicated):
   - Input Range – Choose an option from the Input Range drop-down list; units are volts. Options are 40, 16, 8, 4, 2. Factory default is 40. (See also Section 8.1.2.1 “Input Range” on page 73.)
   - Input Impedance – Choose an option from the Input Impedance drop-down list. Options are Low Impedance (43.07 kΩ), High Impedance (>9 MΩ), with High Impedance options (low power) or (high power). Low Impedance is the factory default. (See also Section 8.1.2.2 “Input Impedance and common mode range” on page 74.)
   - Enable Dither – Set Enable Dither to enabled ☑ or not enabled ☐. Factory default is not enabled. (See also Section 8.1.2.3 “Enable Dither” on page 74.)
   - Software Gain – Type in a value for Software Gain. Float number from 0.001 to 100. Factory default is 1. (See also Section 8.1.2.4 “Software Gain” on page 75.)
   - Enable Hard Clip – Set Enable Hard Clip to enabled ☑ or not enabled ☐. Factory default is not enabled. (See also Section 8.1.2.5 “Enable Hard Clip” on page 75.)
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.1.2.1 Input Range

The input voltage ranges represent the differential between the sensor positive and negative signal inputs, in volts peak-to-peak. The maximum input range is 40 volts peak-to-peak. This represents the case of a differential input signal that at one peak has +10 V on the positive input and –10 V on the negative input (20 V peak). At the negative-going peak, the differential input is –20 V, for a peak-to-peak input range of 40 V.

Choose settings as appropriate for your application. For example:

- If you wish to accurately measure full-scale sensor activity, the Input Range of the sensor must be greater than the maximum output level of the sensor. However, if the sensor has a very large dynamic range and the Input Range is set to a large value (to capture full-scale movement), accuracy will be lost when measuring very weak seismic signals.
- If you wish to accurately measure very weak seismic signals, the Input Range of the sensor must be set to a small enough value to accurately digitize weak signals. If strong seismic events occur that exceed the configured range, these signals will be clipped. Increased sensitivity (lower input ranges) also tend to increase overall data volume. For example, a 3-channel 100 sps configuration might generate 3000 bps of sampled data. If the same system is reconfigured with much greater sensitivity, the increased signal activity may cause the average data throughput to rise to 6000 bps or more.

8.1.2.2 Input Impedance and common mode range

You may select between low and high input impedance:

- Low Impedance (43.07 kΩ) – This is the factory default.
- High Impedance (>9 MΩ)

Low impedance mode has the best immunity to noise pickup, and is the preferred mode when using active sensors. High impedance mode is provided for use with some passive sensors that require a damping load shunt resistor which is higher than the Taurus low input impedance. If the required load resistor is lower than the Taurus input impedance, you can use the Taurus in low impedance mode by choosing a shunt resistor that in parallel with the Taurus input impedance achieves the desired load shunt value. Alternatively, you can put the Taurus in high impedance mode to use the load shunt resistor value specified by the passive sensor directly.

Note that in low impedance mode the Taurus input impedance forms a voltage divider with the output impedance of the source signal, so that for example a 436 Ω source would result in a 1% decrease in signal amplitude at the digitizer. The exact signal amplitude is:

$$\textit{Taurus Input} = R_i / (R_s + R_i) \cdot \textit{Sensor Output}$$

where R_i is the Taurus input impedance and R_s is the total source impedance (both sides of the differential source output plus both conductors of the sensor-to-digitizer cable).

The voltage divider effect is negligible when using high impedance mode, where attenuation is less than 0.1% for source impedance up to 9 kΩ.

When using High Impedance mode you can choose between two common mode signal ranges:

- Low Power – The common mode rejection range is ±0.78 V and the clip level for ground-referenced single-ended signals is ±1.56 V. (Do not select the Low Power option with an Input Range of 40 V_{pp}.)
- High Power – The High Power mode increases the common mode rejection capability to ±1.8 V, and raises the clip level for ground-referenced single-ended signals to ±3.6 V. This is provided for use with sensors that have single-ended outputs referenced to ground, or where unusually high common mode signals must be rejected. This mode consumes approximately 40 mW additional power.

Either Low Power or High Power mode can be used with High Impedance mode for all input ranges except 40 V_{pp}, for which the Low Power setting is not applicable.

8.1.2.3 Enable Dither

Enable Dither adds a very small random signal to the input signal of the Digitizer, at an amplitude low enough so the dynamic range of the Digitizer is not reduced, to virtually eliminate so-called “idle tones”. Idle tones are a phenomenon which may occur only when the input is held to zero (or pure DC) so that the least significant bit of the Digitizer output can “flip” around in a quasi-periodic pattern. Idle tones seen on Taurus even when dither is turned off have virtually no energy, are not indicative of a malfunc-

tion, and are not present when recording real data. Setting Enable Dither to enabled costs an approximate 10 mW power.

8.1.2.4 Software Gain

You can set the Digitizer gain to attenuate or amplify the sensor input signal to a level that will optimize use of the Digitizer dynamic range. After the Taurus digitizes the signal, it multiplies the amplitude by the software gain value. The factory default value is 1.0 (that is, no change in amplitude).

This feature can be used to adjust the sensitivity of a station to match a desired value. For example, if a specific site has a sensitivity of 0.8 cnt/(nm/s/s) and you want all stations in the network to have a sensitivity of 1 cnt/(nm/s/s) you can set the Software Gain in this station to 1.25. You can "normalize" the sensitivity of each station by adjusting the Software Gain, or you can choose to create a different baseband response file (a `seed.rsp` file) for each station and use this file during data analysis at the central site.

8.1.2.5 Enable Hard Clip

A sigma-delta convertor output can transition sharply overscale if the input signal is near or exceeds the full scale input range, creating spikes in the output (that may also transition down into the range). The Enable Hard Clip feature cuts off the spikes that exceed the expected full scale limit, by replacing samples that are over-scale with the specified limit. The effect of the Digitizer output spiking at full scale may still be evident even with hard clipping on, as these spikes can also transition down within the normal operating range of the Digitizer even though the input is at or above full scale.

8.1.3 Triggers settings

The Taurus can be configured to detect events using a LTA/STA trigger algorithm on one or more of the 3 time-series data channels. You can define a trigger algorithm for each channel, and enable or disable trigger detection for any channel. Each time-series channel is associated with the same detector type identifier; that is, (channel 1, detector 1), (channel 2, detector 2), (channel 3, detector 3). Each channel before passing data to the detector will band-pass the data using the trigger input filter.

You may enable triggers for inactive channels (as defined under Advanced Configuration > Digitizer > Output Channels) although of course there will not be any associated data for any triggers that are detected. This could be used to define event information for a Time Series By Event retrieval on a different Taurus.

Set the detector and filter parameters as appropriate to your site and application, using options in the Advanced Configuration > Triggers pages (Figure 8-2). There are various external sources of information on defining trigger parameters in general; for example the New Manual of Seismological Observatory Practice (IASPEI 2002) provides an excellent discussion of this topic (see the publisher's site http://www.gfz-potsdam.de/pb2/pb21/ for information on the NMSOP).

- Ensure that DC is filtered out for trigger detection. If you do not have the DC Removal filter enabled for your seismic channels (Advanced Configuration > Dig-

itizer > Main page), you must include a high pass filter in the trigger input filter (Advanced Configuration > Digitizer > Triggers > Input Filter page).

- Note that valid value ranges for some of the parameters depend on the sample rate (see Table H-33 “Input Filter page options” on page 204 and Table H-34 “Detector page options” on page 205).
- Ensure that the Trigger On Ratio and channel gain are configured to values that are not so high that they will prevent events from ever triggering. (Trigger On Ratio is in the Advanced Configuration > Digitizer > Triggers > Detector *n* page, and channel gain is determined by the settings Input Range and Software Gain in the Advanced Configuration > Digitizer > Front End page.)
- If you wish to simulate an amplitude threshold trigger, you can use a short STA time constant and a long LTA time constant.

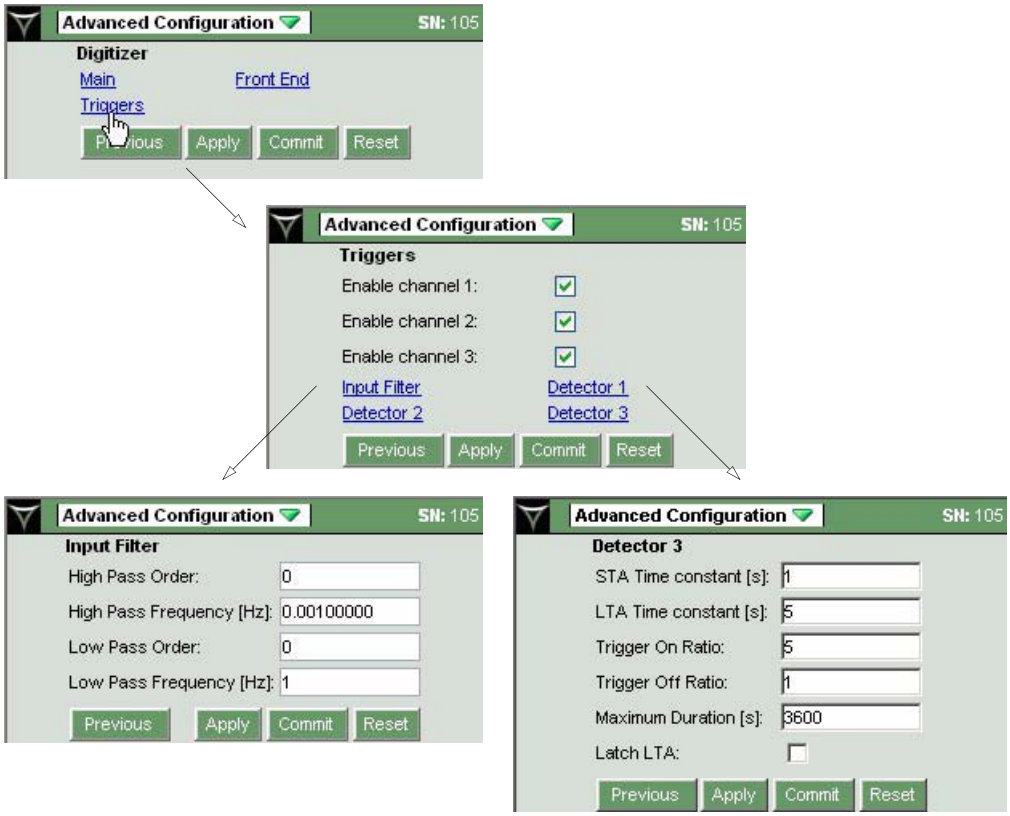
To enable trigger detection:

1. Log in as `tech` or `central`.
2. In the Advanced Configuration > Digitizer > Triggers page, set one or more channels to use the configured trigger algorithm for that channel. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

The Taurus will create a trigger channel with a data packet for each trigger. You can extract the trigger data as SOH information to a `.csv` file (Section 11.3.1.1 on page 118). A trigger packet contains the following information:

- Trigger start time
- Trigger duration
- Channel and detector identification
- STA at trigger detection
- LTA at trigger detection

Figure 8-2 Trigger configuration pages



8.1.3.1 Input filter parameters

See Table H-33 “Input Filter page options” on page 204 for parameter value ranges.

1. Log in as `tech` or `central`.
2. In the Advanced Configuration > Digitizer > Triggers > Input Filter page, choose input filter parameters as appropriate to your application (in general, to pass frequencies of expected seismic events of interest while blocking seismic noise peak frequencies as much as possible):
   - High Pass Order – The order of the high pass filter. Factory default is 0.
   - High Pass Frequency [Hz] – The 3dB corner frequency in hertz of the high pass filter. Factory default is 0.001.
   - Low Pass Order – The order of the low pass filter. Factory default is 0.
   - Low Pass Frequency [Hz] – The 3dB corner frequency in hertz of the low pass filter. Factory default is 1.0.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.1.3.2 Detector algorithm parameters

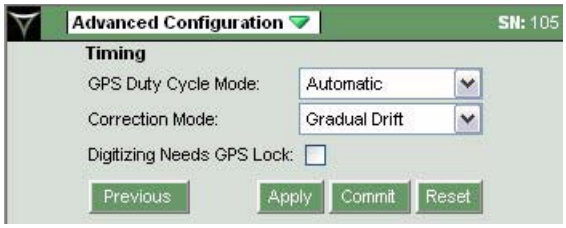
See Table H-34 “Detector page options” on page 205 for parameter value ranges.

1. Log in as `tech` or `central`.
2. In the Advanced Configuration > Digitizer > Triggers > Detector *n* page, choose detector algorithm parameters as appropriate to your application:
   - STA Time constant [s] – The short term time constant in seconds. (In general, choose a value longer than a few periods of a typical expected seismic signal of interest, shorter than expected durations of events of interest, and not so short that excessive false triggers are generated by non-seismic noise spikes near the site.) Factory default is 1 second.
   - LTA Time constant [s] – The long term time constant in seconds. (In general, choose a value long enough to encompass at least several cycles of typical non-seismic, irregular noise for the site.) Factory default is 5 seconds.
   - Trigger On Ratio – The STA/LTA threshold above which the associated channel is triggered. (In general, choose a value low enough to be sensitive to events of interest, but high enough to minimize false triggers.) Factory default is 5.
   - Trigger Off Ratio – The STA/LTA threshold below which the associated channel trigger is switched off. (In general, choose a value low enough to encompass the coda waves for events of interest, but high enough to terminate the trigger reasonably. The trigger will terminate either when the Trigger Off Ratio is achieved or when the Maximum Duration has expired.) Factory default is 1.
   - Maximum Duration [s] – You can set the maximum duration of triggers for that channel, after which the trigger is ended even if the Trigger Off Ratio has not been achieved. Factory default is 3600 seconds.
   - Latch LTA – If you set Latch LTA to enabled, the LTA is held at the value when the channel triggered, and therefore is not updated while the channel is triggered. If you set the Latch LTA to not enabled, LTA continues to be calculated and updated while the channel is triggered. In either case, the trigger will terminate either when the Trigger Off Ratio is achieved or when the Maximum Duration has expired. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.2 Configuring Taurus timing

The Taurus provides options for setting the GPS receiver duty cycle, for system clock corrections, and to set a requirement for GPS lock on startup before digitizing (Figure 8-3).

Figure 8-3 Timing configuration page



The Taurus derives its time frames from GPS time, as described in Table 8-1. The times shown on the various pages are updated whenever those page views refresh (typically every 5 seconds, unless the refresh rate is reduced to compensate for a slow network link when using a browser).

Table 8-1 Taurus time definitions

Type	Description	Shown on Taurus UI
GPS Time	The GPS time provided by the GPS receiver. The Taurus has an algorithm that attempts to correct any time errors that the GPS receiver may have under certain conditions.	Not shown; used as the basis for the derived times described below.
System Time	The current time according to the Taurus Digitizer subsystem. System Time is resynchronized to GPS Time when the GPS receiver is turned on. The timing module is sometimes referred to as the System Clock.	• Timing tab (Timing page) “System Time”
Controller Time	The current time according to the Controller (see Section 3.2 on page 19 for a description of the Controller). The Controller resynchronizes its time to System Time once per minute when it is running.	• Status page “Time” • SOH page “Time”
GPS Last Update Time	The System Time when the GPS data (including the GPS time) was last updated.	• GPS Map tab (Timing page) “Update Time”
Satellite Last Update Time	The System Time when the GPS receiver last updated the information for a specific satellite.	• GPS Satellites tab (Timing page) “Last Updated”

8.2.1 GPS receiver duty cycle

The Taurus has options to set when the GPS receiver switches on.

1. Log in and go to the Advanced Configuration > Timing page.

Caution The Always Off mode is used only for factory testing. Do not set the GPS Duty Cycle Mode to Always Off.

2. Choose a valid option from the GPS Duty Cycle Mode drop-down list:
   - Automatic – Automatic is the most efficient setting for Taurus power consumption. The duty cycling strategy is that the GPS receiver is switched on until fine lock is reached in the System Clock then switched off until the estimated time uncertainty reaches a predefined limit, such that the expected time error is still

less than the 100 µs specification. The uncertainty estimate is based on clock drift and temperature measurements. This is the default setting.

- Every 10 minutes | Every 30 minutes – You can use a constant duty cycle, either Every 10 minutes or Every 30 minutes. It is recommended to verify that the time error does not exceed your requirements when the GPS receiver is switched back on after these time intervals. Use the GPS Time SOH file to inspect the time error.
- Always On – Always On will use approximately an additional 200 mW, but will provide the most accurate timing. Since in this mode GPS time is always available, System Time can always be kept close to UTC such that the time error of the Taurus is typically not more than a few microseconds.

3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.2.2 System time correction

The System Time is kept close to GPS Time when GPS is available. Even when the GPS receiver is duty cycled and the System Clock is free-running for a while, the time error is regularly small enough so that it can be smoothly reduced to near-zero levels by running the clock slightly off-frequency until perfectly resynchronized. The time module is in Fine Lock if the time error (which is the difference between System Time and GPS Time) remains small. If a time error develops that is larger than a pre-set limit, the time module goes into Coarse Lock which steers the clock back faster.

Large time errors may develop if the System Clock is left free-running without the GPS receiver active for a prolonged period of time. The magnitude of the error is dependent on the length of time the GPS was unlocked (or otherwise unavailable) and the stability of the ambient temperature of the Taurus. In these cases the clock steering described above would take too long and a Time Error Reset is necessary. This eliminates a large part of the error instantly, after which the error can be driven small using the steering mechanism. The Time Error Reset introduces a discontinuity in the Taurus time frame because time appears to be “jumping” by a predefined amount.

8.2.2.1 Time error reset options

There are two modes for configuring how the Taurus will execute the Time Error Reset: Gradual Drift, and No Alignment. When Gradual Drift is selected, only time errors that are larger than 6.67 ms are eliminated by a time jump that is a multiple of 10 ms. After the reset the remaining time error is eliminated by the steering mechanism described above. This may take a while hence the name “Gradual Drift”. When No Alignment is selected, time errors as small as 66.6 µs are corrected by the Time Error Reset with a size of a multiple of 100 µs. The advantage of this is that the amount of error left for gradual steering is small and Fine Lock is achieved sooner. The disadvantage is that the time “jump” may cause the digitized samples to fall out of UTC alignment and re-alignment may be necessary, hence the name “No Alignment”.

To choose the time error reset method:

1. Log in as `tech` or `central`.

2. In the Advanced Configuration > Timing page, choose an option from the Correction Mode drop-down list (options are discussed above):
   - Gradual Drift
   - No Alignment
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

8.2.3 Digitizing on startup with GPS lock

In order to correctly time stamp the digitized data, GPS lock is required on startup. It may be important that Taurus does not even start digitizing until good time quality (that is, GPS lock) is reached. However, there may be situations when digitized data are desired even if GPS reception is not available or not sufficient (for example, testing, setup, demonstration). Taurus has the ability to accommodate both situations. The "Digitizing Needs GPS Lock" option can be used to select one of these two modes. Note that once the Taurus has started digitizing it will continue to do so even if GPS loses lock later, regardless of this setting.

The factory default is to not require GPS lock on startup before digitizing. If you wish to change this setting:

1. Log in as `tech` or `central`.
2. Open the Advanced Configuration > Timing page.
3. Set Digitizing Needs GPS Lock to enabled ☑.
4. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Chapter 9 Controlling and Configuring Sensors

This chapter provides overviews of sensor control options and configuration settings, and procedures for changing the sensor configuration.

9.1 Sensor monitoring and control

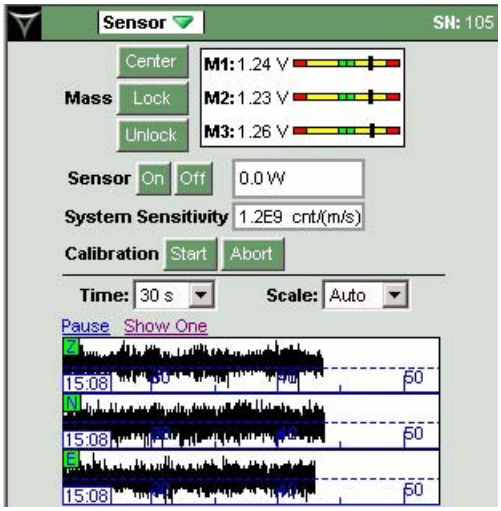
The Sensor page provides options for you to monitor and control the operation of the sensor.

9.1.1 Monitoring sensor operation

The Sensor page shows the following near real-time information about your sensor (Figure 9-1):

- The mass position of each component and the mass auto-centre voltage thresholds as configured in the Advanced Configuration > Sensor Details > Mass Auto-Centering page. (This information can also be extracted to an Environment SOH file; see Section 11.3.1 “Extract State of Health data to a `.csv` file” on page 116).
- For active sensors, an estimate of the sensor power consumption is shown beside the Sensor **On** | **Off** buttons. It is accurate to about ±15% for sensors drawing more than about 8mA. (Related items on the main Status page are the Sensor status bar and the Power status bar; see the relevant entries in Table H-1 “Status page options” on page 177.)
- System sensitivity, calculated using the sensor Sensitivity Value from the Advanced Configuration > Sensor Details page, and the Digitizer Input Range and Software Gain from the Advanced Configuration > Digitizer > Front End page. It is expressed in counts per unit of velocity or acceleration, based on the selected Sensitivity Units from the Advanced Configuration > Sensor Details page.
- A waveform of the sensor output for each channel, with scaling options and waveform selection options as described in Table H-2 “Waveform page options” on page 180.

Figure 9-1 Sensor page



9.1.2 Sending commands to the sensor

You can control some aspects of the sensor operation interactively with options in the Sensor page. You can configure the Taurus to perform mass auto-centring.

9.1.2.1 Manual sensor control

You can send commands to the sensor using these options in the Sensor page:

- Mass **Center** – You can send a mass centre command for sensors that support remote (automatic) mass centring. It will centre all masses.
- Mass **Lock** | **Unlock** – You can send mass lock and mass unlock commands.
  - It is recommended that you disable the mass auto-centring setting Auto-Center on Red before you connect a sensor that has masses locked. Once you unlock the masses, you may enable Auto-Center on Red. (See step 4. on page 87 in Section 9.2.1.1 “Edit an existing sensor configuration”.)
- Sensor **On** | **Off** – Sensor **On** will pass the Taurus supply voltage through to the sensor power pin (see Appendix B “Connector Pinouts”).

Note For sensors that require regulated power, an appropriate DC/DC converter must be built into the sensor cable.

- Calibration **Start** | **Abort** – You can start a sensor calibration, and abort a sensor calibration that is in progress. The process will use settings from the Calibration page (see Section 9.3 “Configuring calibration” on page 91).
  - It is recommended that you disable mass auto-centring during calibrations. Once the calibration has finished, you may enable mass auto-centring. (See step 4. on page 87 in Section 9.2.1.1 “Edit an existing sensor configuration”.)

9.1.2.2 Mass auto-centring

You can configure the Mass Auto-Centering feature (Figure 9-2 on page 86) to initiate mass centring attempts when sensor mass positions reach off-centre thresholds. You can set thresholds for a delayed or an immediate recentring attempt (Yellow and Red thresholds respectively), and set the number of retries and retry intervals to achieve centred masses. You must have a control line configured for Mass Center, and have at least one of these thresholds enabled.

- Auto-Center on Yellow – The Taurus will initiate mass centring when any axis has been above the Yellow Threshold for more than the Yellow Holdoff Time. If all axes drop below the Yellow threshold during holdoff time, then the holdoff time is cancelled.
- Auto-Center on Red – The Taurus will initiate mass centring 1 minute after any axis exceeds the Red Threshold.

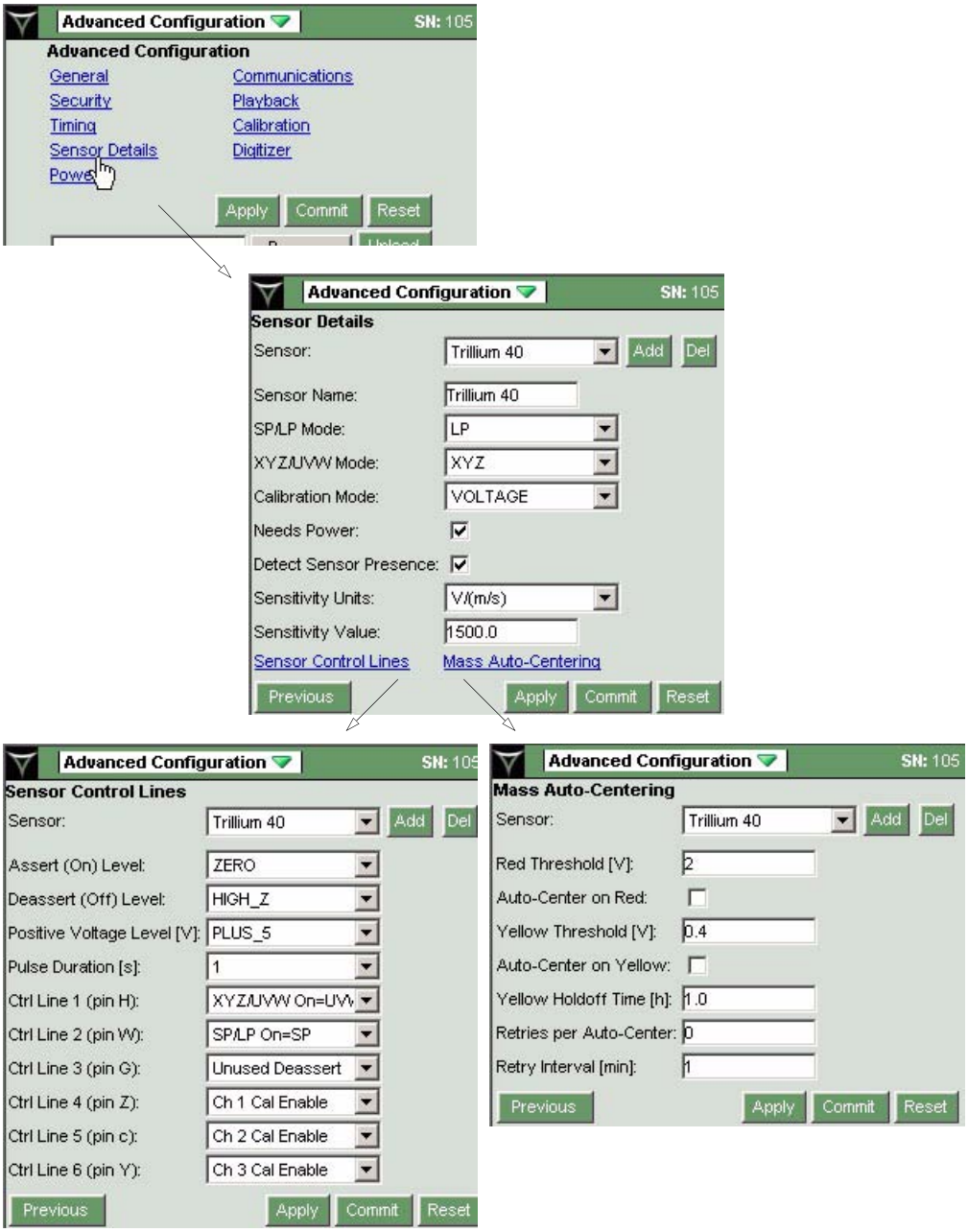
Each mass centring attempt is comprised of the configured number of retries at the configured retry interval. That is, retries will be attempted until all axes are below the Yellow threshold, or until the number of Retries per Auto-Center have been executed.

9.2 Sensor configuration

Sensor configuration options are in the Advanced Configuration > Sensor Details pages (Figure 9-2).

- You can edit, add, and delete sensor configurations manually (Section 9.2.1).
- You can upload predefined sensor configurations using options in the Advanced Configuration page, and you can create new sensor configuration files by copying and editing existing files (Section 9.2.2 on page 90).

Figure 9-2 Sensor configuration pages



9.2.1 Setting sensor configurations interactively

You can edit an existing sensor configuration, add a new configuration, or delete a configuration.

9.2.1.1 Edit an existing sensor configuration

1. Log in as `tech` or `central` and go to the Advanced Configuration > Sensor Details page.

2. Choose the sensor from the Sensor drop-down list and configure the settings as appropriate for the sensor (factory defaults are for the Nanometrics Trillium 40).
   - If the sensor has configurable operating modes, these two settings can be used to control the sensor operating mode(s). These mode selections will only take effect if the sensor control lines have been configured properly (see step 3).
     - SP/LP Mode – Choose the operating mode of the sensor, either short period (SP) or long period (LP). Factory default is LP.
     - XYZ/UVW Mode – The orientation of the sensor elements. Choose Set to UVW to indicate a triaxial seismometer (this will run the calibration on each channel separately). Options are XYZ, UVW. Factory default is XYZ.
   - Calibration Mode – The calibration signal mode; refer to your sensor manual. Options are VOLTAGE, CURRENT. Factory default is VOLTAGE.
   - Needs Power – Indicate whether your sensor needs power (active sensors) or not (passive sensors). It is used as an input for sensor status. (See Table H-1 “Status page options” on page 177.) Options are enabled ☑, not enabled ☐.
   - Detect Sensor Presence – When this feature is enabled, the Taurus will detect whether the sensor is drawing current (this feature works only for sensors drawing more than about 8 mA). It is used as an input for sensor status. (See Table H-1 “Status page options” on page 177. This information is also available as Instrument SOH; see Section 11.3.1 “Extract State of Health data to a `.csv` file” on page 116.) Options are enabled ☑, not enabled ☐.
   - Sensitivity Units – Refer to your sensor manual for the appropriate value. Options are V/(m/s), V/(m/s/s).
   - Sensitivity Value – Refer to your sensor manual for this value.
3. Click the Sensor Control Lines link and configure the settings as appropriate for the sensor (factory defaults are for the Trillium 40):
   - Assert (On) Level – Assert line level; HIGH_Z, ZERO, POSITIVE.
   - Deassert (Off) Level – Deassert line level; HIGH_Z, ZERO, POSITIVE.
   - Positive Voltage Level – Positive voltage level; PLUS_5, PLUS_12.
   - Pulse Duration [s] – Control pulse duration in seconds; 1, 3, 5, 7, 10, 15, 20.
   - Ctrl Line *n* – Options for control line functionality include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock.

     If you have configured calibration for current mode (Calibration Mode on the Sensor Details page), control lines 4, 5, and 6 will not be available for any other configuration option. They will be reserved for calibration current return.
4. Optionally, configure mass auto-centring (Section 9.1.2.2 on page 85). On the Sensor Details page, click the Mass Auto-Center link. Choose settings as appropriate to your application.
   - Red Threshold [V] – The minimum mass position voltage level to indicate that the mass position is out of range. Mass centring is initiated one minute after this level is crossed for any channel. Threshold range is ±*configured value*. Minimum value is 0.001 and must be greater than Yellow Threshold (if used). Factory default is 1.000000.

- Auto-Center on Red – Initiate mass centring if the Red Threshold is crossed. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
- Yellow Threshold [V] – The minimum mass position voltage level to indicate that the mass position is marginal. After the Yellow Holdoff Time has expired, mass centring is initiated. Threshold range is ±*configured value*. Minimum value is 0.001 and must be lower than Red Threshold (if used). Factory default is 1.000000.
- Auto-Center on Yellow – Initiate mass centring when the Yellow Holdoff Time has expired. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
- Yellow Holdoff Time [h] – The number of hours to wait before initiating mass centring, while any mass position voltage is higher than the Yellow Threshold but lower than the Red Threshold. Value range is from 0.1 to 72.
- Retries per Auto-Center – The maximum number of attempts to make to center the masses. Integer from 0 to 20. Factory default is 0.
- Retry Interval [min] – The number of minutes to wait between auto-center retries. Integer from 1 to 20. Factory default is 1.

If you are using both the Red and the Yellow thresholds, ensure that you set the Yellow threshold as the lower mass position limit and the Red threshold as the higher mass position limit (Red >= Yellow).

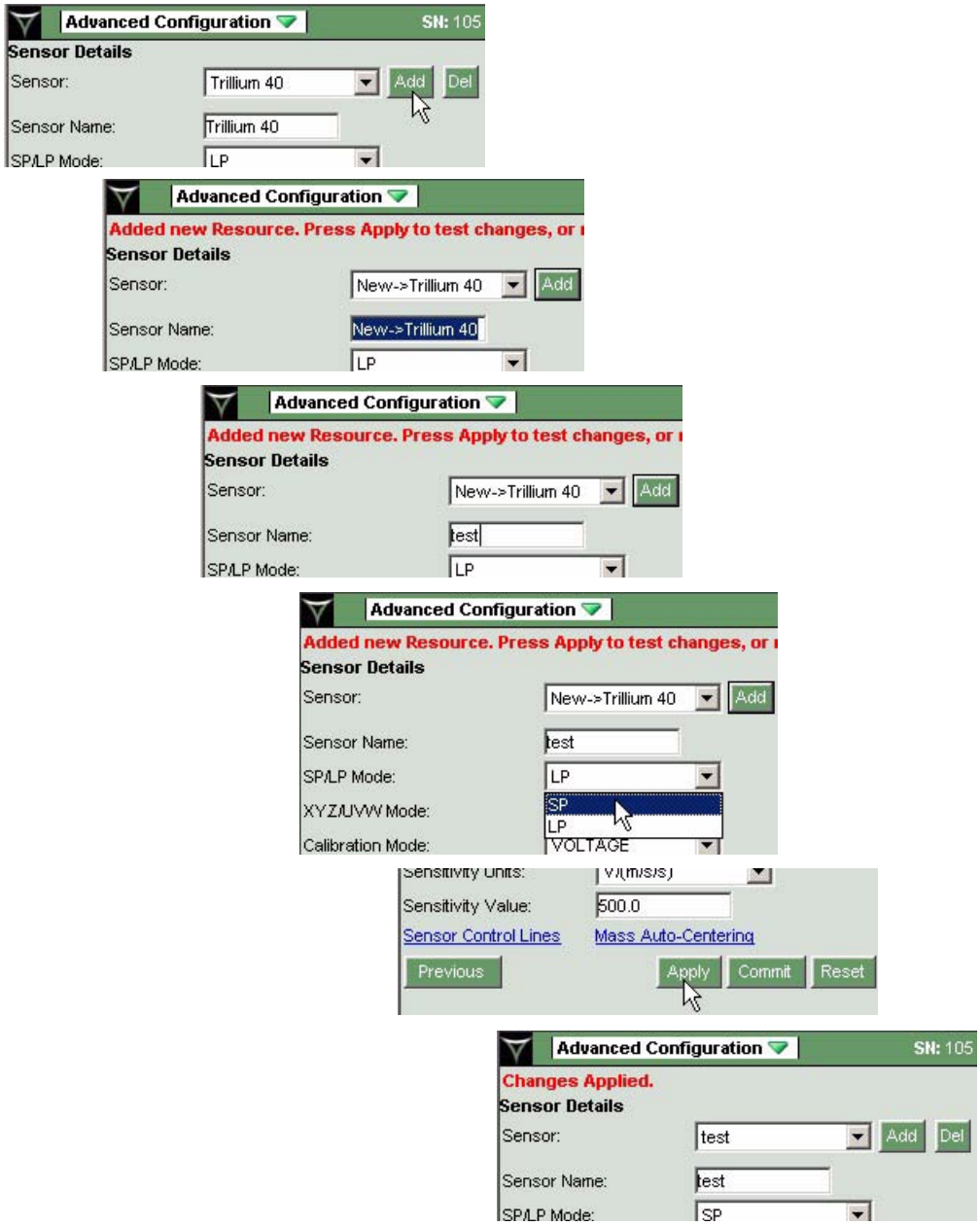
5. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

9.2.1.2 Add a new sensor configuration

You can save up to four sensor configurations on the Taurus. If you add them manually, in general it is easier to use the Sensor Details page, rather than the **Add** button on either of the sub-pages, as the sub-pages do not provide the option to edit the sensor name.

1. Log in as `tech` or `central` and go to the Advanced Configuration > Sensor Details page.
2. Click **Add**. This will create a new entry in the list and will create a temporary label using an existing sensor configuration New -> *Existing Name* (Figure 9-3).
3. Type a name for the sensor in the Sensor Name box to replace the temporary label.
4. Edit the configuration values for the new sensor configuration as appropriate (see Section 9.2.1.1 “Edit an existing sensor configuration”). If you want to clear all changes at this point, click **Reset**.
5. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 9-3 Add a sensor configuration manually



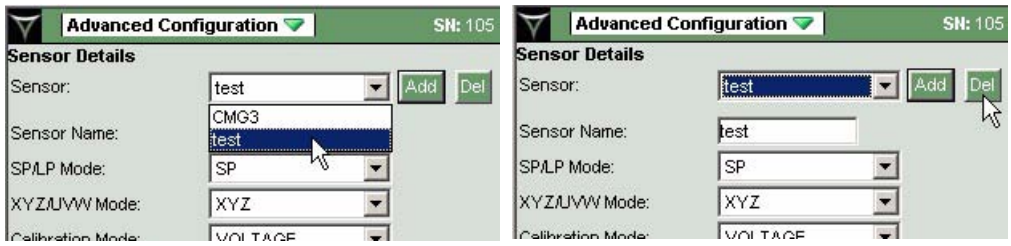
9.2.1.3 Delete a sensor configuration

You can delete a sensor configuration if there are more than one saved on the Taurus.

1. Log in as `tech` or `central` and go to the Advanced Configuration > Sensor Details page.
2. In the Sensor drop-down list, choose the sensor configuration that you want to delete (Figure 9-4).
3. Click **Del** to delete the configuration. If you want to restore the configuration at this point, click **Reset**.

4. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 9-4 Delete a sensor configuration



- You can delete all saved sensor configurations at once by uploading a sensor configuration file (see Section 9.2.2 on page 90).

9.2.2 Using predefined sensor configurations

You can upload predefined sensor configurations using the Advanced Configuration page, and you can create new sensor configuration files by copying and editing existing files. See also Chapter 5 “Changing a Taurus Configuration” for a general discussion of these options.

The Taurus software CD has a set of predefined sensor configurations as `.cfg` files in the `/sensors` directory. Configurations with the current release include:

- `Trillium40.cfg` (this applies to the Nanometrics Trillium 40)
- `Trillium120.cfg` (this applies to the Nanometrics Trillium 120P)
- `Trillium240.cfg` (this applies to the Nanometrics Trillium 240 and Trillium 240 OBS)
- `CMG-3.cfg` (except for the sensitivity, this applies to the Guralp CMG-3ESP, CMG-3T, CMG-T3E, and CMG-V3E)
- `STS-2.cfg` (this applies to the Streckeisen STS-2)
- `Passive.cfg` (except for the sensitivity, this applies to all passive sensors)

9.2.2.1 Upload a predefined sensor configuration

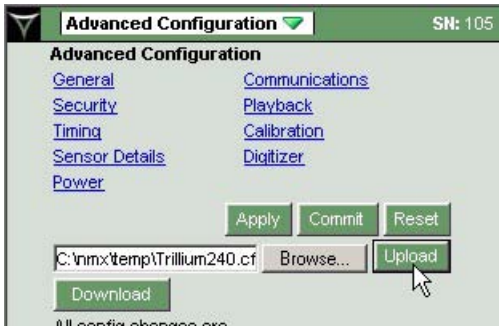
An uploaded sensor configuration file will replace all sensor configurations in the Taurus with the configurations in the uploaded file. For example, if the uploaded file contains only one sensor configuration and the Taurus currently has four configurations, that one configuration will replace the entire list of four.

The new sensor configuration is applied automatically on upload, so **Reset** will not have an effect. You can undo the uploaded sensor configuration if you have not committed it yet; see Section 5.4.2 “Undo applied changes” on page 45.

Note The predefined configuration files set the control lines based on assumed sensor cable wiring for the sensor type. Before you use the configuration, check your sensor cable wiring and the control line assignments (in the Advanced Configuration > Sensor Details > Sensor Control Lines page).

1. Log in as `tech` or `central`.
2. In the Advanced Configuration page, browse for a sensor configuration file and then click **Upload** (Figure 9-5).
   - If required, edit the Sensitivity Value (for example, for passive sensors) or operating modes in the Advanced Configuration > Sensor Details page, and then click **Apply**.
3. You can test the changes (the configuration is applied automatically). To save the changes, click **Commit**. If indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 9-5 Upload a sensor configuration



9.2.2.2 Create a new sensor configuration from an existing file

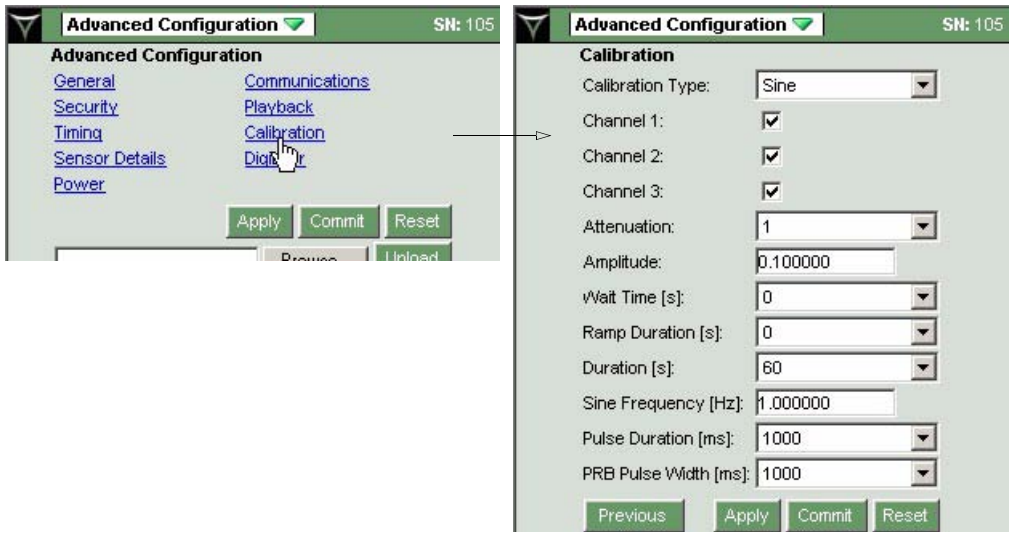
The predefined sensor configuration files are plain text in RDF format on the Taurus software CD, as `/sensors/*.cfg`.

- To make a new file, copy an existing sensor configuration file and edit it with a text editor. You may include up to four sensor configurations in one file. (If errors are introduced as a result of the editing, on upload the configuration will be rejected in whole or in part.)

9.3 Configuring calibration

Calibration configuration options are in the Advanced Configuration > Calibration page (Figure 9-6).

Figure 9-6 Calibration page



Notes:

1) If you have configured your sensor for current mode calibration, control lines 4, 5, and 6 will not be available for any other configuration option. They will be reserved for calibration current return.

2) If a sensor has one calibration enable line and multiple calibration signal inputs (for example, STS-2), to calibrate a different channel you must reconfigure the calibration channel each time.

1. Log in as `tech` or `central`.
2. In the Advanced Configuration > Calibration page, set parameter values as appropriate for your application:
   - Calibration Type – The type of calibration signal to use, either sine wave, pulse signal, or pseudo-random binary. Options are Sine, Pulse, PRB. Factory default is Sine.
   - Channel *n* – Choose whether to enable this channel for calibration. Options are enabled ☑, not enabled ☐. Factory default is enabled.
   - Attenuation – Use attenuation to select the range when lower amplitude signals are desired. A more accurate 5 mV signal is generated when using attenuation of 1000 and amplitude 5 V rather than attenuation of 1 and amplitude 0.005 V. Options are 1, 10, 100, 1000. Factory default is 1.
   - Amplitude – Set the calibration signal amplitude in the appropriate Calibration Mode units, volts or amperes. Float number. Factory default is 0.1. The Calibration page will accept calibration signal amplitudes up to 5.0 V or 60 mA, depending on the Calibration Mode (VOLTAGE or CURRENT). If taken as a single-ended output (for example, between pin N (SEN_CAL1+) and pin V (DGND), the calibration circuit can provide a signal with a maximum amplitude of 4.5 V.

     Ensure that you choose a value low enough that the signal will not clip. If you have configured calibration for voltage mode, ensure that you know the calibration coil resistance.

- Wait Time – The length of time in seconds after the calibration coil has been enabled before sending the calibration signal. Options are 0, 15, 30, 60, 120, 300, 600, 1200. Factory default is 0.
- Ramp Duration – The length of time in seconds to bring the signal amplitude up to the configured amplitude and then down from the configured amplitude. Typically, only Sine calibrations are ramped. Options are 0, 10, 30, 60, 120, 600, 1800, 3600. Factory default is 0.
- Duration – The length of time in seconds to generate the calibration signal at the configured amplitude between ramps. Options are 10, 60, 300, 600, 1800, 3600, 7200, 18000, 36000, 72000. Factory default is 60.
- Sine Frequency [Hz] – The sine signal frequency in hertz. Float number from 0.01000 to 50.0000. Factory default is 1.0.
- Pulse Duration – The pulse signal segment width in milliseconds. Options are 100, 1000, 10000. Factory default is 1000.
- PRB Pulse Width – The PRB signal unit pulse width in milliseconds. Options are 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000. Factory default is 1000.

3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).
4. To start a calibration, go to the Sensor page and click **Start**. To stop a calibration in progress, click **Abort**. Ensure you have disabled mass auto-centring before you start a calibration (see step 4. on page 87 in Section 9.2.1.1 “Edit an existing sensor configuration”).

Chapter 10 Recording Data

This chapter provides an overview of Taurus data storage, and procedures for working with data Stores and the recording media. See also Chapter 11 “Accessing Data”.

10.1 Data flow

Data are put into Nanometrics Protocol packets (NP packets). The Taurus buffers the NP packets for all data types and writes them into the Store on the removable media (a CompactFlash card or an IDE hard drive). Time-series data are available for streaming to an external system if the Taurus is running in Communications mode.

10.2 Data Stores

The Store contains the time-series, state of health (SOH), and log data. The data are organized into “bands”, which are groups of data that may contain one or more channels. Bands contain data packets in multiple data blocks with a default size of 1MB.

The Store works as a ringbuffer. It will wrap around when it is full and record over the oldest data that may be overwritten while preserving all data types. That is, the Taurus will select the oldest data block to overwrite as long as that is not the only data block for that band. If it is the only data block for that band, it will search for the next available data block to overwrite.

A single Store may encompass many files, each being up to 1GB in size. This is transparent when using the Store on the Taurus, but is relevant if you are planning to copy a Store to your PC because you must copy all files for that Store if you want to extract data later on.

A single recording medium may contain multiple Stores, although this is not recommended; see Section 10.2.1.1 on page 96.

10.2.1 Create a Store

Creating a Store is not a separate option. The Taurus will either create a Store automatically, or will prompt you to create a Store.

- The Taurus will create a Store automatically after formatting a new medium in the active media slot (Section 10.3.2.1 on page 101).

- The Taurus will prompt you to create a new Store under either of these conditions:
  - After deleting the currently active Store (Section 10.2.2 on page 97)
  - On switching to the medium in the other media slot after formatting that medium (Section 10.3.3 on page 104)

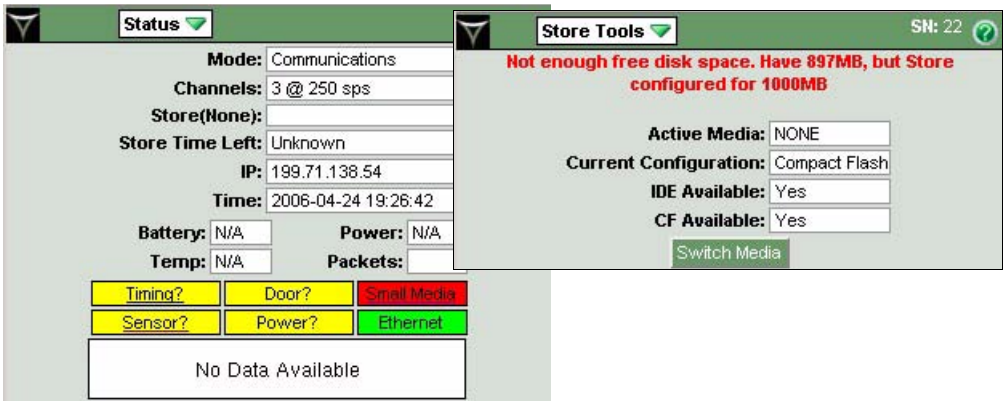
If you insert a used medium that is already formatted to Ext3 but does not contain a Store, the Taurus will need at least 200 MB of free space on the medium to create a Store. If the Taurus is creating a Store automatically, it will use the last Store capacity setting from the Taurus configuration when creating the new Store. It will set the Store capacity to the available space on the medium if the last Store configuration was set to Full (for example, Figure 10-2 on page 98). If the last Store configuration was for a specific capacity (for example, 800 MB), the Taurus will create a Store of that capacity if there is sufficient space on the medium.

If the last configured Store size was 1 GB (1000 MB) on CF and the current medium is a 1 GB CF, there still will not be sufficient space after deleting all files or formatting the medium, as the Taurus will require some of the space for other operations.

If there is insufficient space on the medium, the Status page will indicate Small Media and a Store Tools page message will provide some details (for example, Figure 10-1). In this case you have these options:

- Switch to the other medium if it is available. You may then log in and **Switch Media** again, at which time you can create a Store with a capacity from the list of available options.
- Delete files from the small medium to free up sufficient space.
- Format the small medium. Formatting will destroy all data and partition information on the medium.

Figure 10-1 Small Media example



10.2.1.1 About appended Stores

If you insert media containing a Store previously created on the same Taurus (the Store ID contains the Taurus serial number), the Taurus will append data to the existing Store. If there is more than one Store on the medium, the Taurus will append to the Store identified by its own serial number if it exists. Otherwise, it will append to any one of the existing Stores.

If you insert media containing one or more Stores created on different Tauruses, the current Taurus will start appending data to one of the existing Stores.

- It is recommended that you do not use existing Stores created on other Tauruses. You can insert media with existing Stores. You may then either delete the existing Store(s) or format the medium, and create a new Store to record data from the current Taurus (Section 10.2.2 “Delete a Store” on page 97, Section 10.3.2.2 “Format previously formatted media” on page 102).

If you do use a combined Store, note the following:

- A Store incorporates the serial number of the Taurus on which it was created, as a means of identifying that Store. The filenames will use the original Taurus serial number.
- The original data channels in that Store remain intact until the Store wraps. When the Store wraps, oldest data are always removed first, regardless of which Taurus created those data.
- All channels ever created in the Store will always have at least 2 MB of data in the Store.
- Apollo Light can be used to see what is actually in each Store, since the filename may not indicate the source of all data in that Store. See also Appendix F “Apollo Light Utility”.
- The Data Availability pages behave as follows:
  - The Month view will always calculate percentage of data available based on the (up to) 3 time-series channels of the current Taurus, ignoring other data in the Store. This is true both on the display and browsers.
  - The Week and Day views have these characteristics:
    - On the display, it will show only (up to) 3 columns of data for the current Taurus Time Series channels.
    - On a browser, it will show a column for all time-series channels in the Store (numbered 1-3, with the corresponding Taurus serial number printed above the columns).
    - Text views behave as for a single-Taurus Store, showing all channels in the Store.

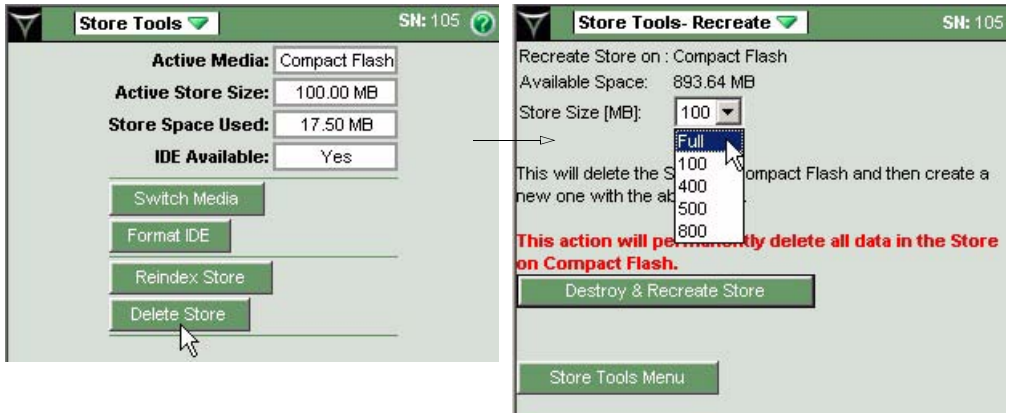
10.2.2 Delete a Store

You can delete the active Store (the Store that is currently in use) and create a new, empty Store. This will permanently delete all data in the old Store.

1. Log in and choose Store Tools from the menu.
2. Click **Delete Store**. This will open a page with options to set the new Store capacity (Figure 10-2).
   - To exit the page without deleting the Store, either click the **Store Tools Menu** button or choose another page from the main menu.
3. Choose a Store capacity from the Store Size drop-down list. The list of options is based on the available space on the medium. The option Full will use all available space on the medium.

4. Click **Destroy & Recreate Store** to delete the current Store and create a new one of the configured capacity.

Figure 10-2 Delete the Store and create a new one



10.2.3 Reindex a Store

If the Store is not closed down properly, for example if **Shutdown** is not used before the power is disconnected, it may need to be reindexed. Generally the Taurus will initiate reindexing on startup if it is required.

You should not have to invoke reindexing manually. You may choose to reindex if, for example, you believe that the Store has recorded data but it does not appear in the Data Availability lists. It will recalculate the index within the Store, synchronizing the index with the actual data that are available.

Reindexing may take a long time, depending on how much data are in the Store. Data will continue to be generated during this task and will not be lost. You will not be able to do other operations that involve the Store at the same time.

1. Log in and go to the Store Tools page.
2. Click **Reindex Store**. You will be prompted for confirmation.
   - To exit the page without reindexing the Store, either click the **Store Tools Menu** button or choose another page from the main menu.
3. To proceed, click **Yes, Reindex Store**.

10.3 Recording media

Warning Hard drives may be damaged permanently if they are operated at altitudes or temperatures beyond specified high and low limits. Do not operate the Taurus if it is at an altitude or unit temperature outside the specified ranges for the installed media type. (SanDisk Extreme CompactFlash cards can be used across the full operating environmental range of the Taurus.) See Section A.14 “Environmental” on page 127 for the operating range specifications.

Taurus removable recording media options include a 1.8” ATA hard disk drive (IDE hard drive) and a CompactFlash card (CF). (See Section A.6 “Internal data storage” on page 125 for specifications.) These are accessible via the media door (Figure 10-5 on page 100).

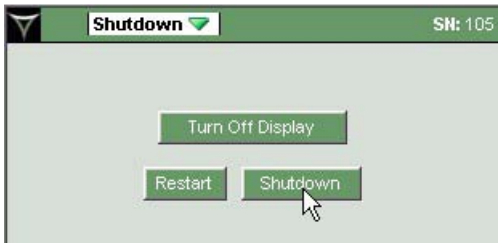
10.3.1 Insert and remove recording media

Warning You may lose data or damage the media if you remove the IDE/CF while the Controller is running. Shut down the Controller and wait for the MediaLED to turn green before removing the IDE/CF (Figure 10-5 on page 100).

The Taurus continues to collect and buffer data while the Controller is shut down. The Controller starts up again when you close the media door. If you want to preserve all of the buffered data, complete the procedure and close the media door before the data buffer fills. The time elapsed before the buffer fills will range from a few minutes to several hours, depending on factors including the number of active channels, sample rate, seismic signal and noise, and buffer size (2 MB on units with serial number 0353, 0375, 0379 and higher, 1 MB on all other units). For example, for 3 channels at 100 sps and 2 MB RAM, typically you would have approximately 30 minutes to remove the current medium, insert the new medium, and close the media door before the buffer wraps and begins to overwrite the oldest data in the buffer.

1. Power down the Controller, using the **Shutdown** option on the Shutdown page (Figure 10-3).

Figure 10-3 Shut down the Controller



2. Open the media door (Figure 10-4):
   a) Lift the black plastic lever on the media door knob and twist the door knob counter-clockwise to the unlocked position (vertical).
   b) The plastic lever has tabs that help remove the door. Push the lever flat against the door so these tabs push against the Taurus chassis. This will cause the door to pop free of the Taurus.

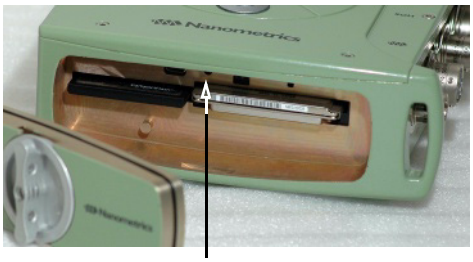
      Air pressure differential inside versus outside the Taurus case (for example, if the Taurus was transported by air) may make the media door difficult to remove.

      - If this occurs, loosen (but do not remove) the pressure relief screw (Figure 2-4 on page 15), allowing the pressure to equalize. Remove the media door, and then gently tighten the pressure relief screw (hand-tight is sufficient).

Figure 10-4 Open the media door

3. Check the MediaLED status to ensure it is safe to remove the IDE/CF—that is, ensure that the MediaLED is green (or off if the Taurus is not powered).
   - Do not remove the IDE/CF if the MediaLED is red.

Figure 10-5 Replacing the recording media



✧ Ensure that the MediaLED is green (or off), indicating that it is safe to remove or insert media.

4. Gently pull on the end of the IDE/CF to remove it.
5. Gently insert the replacement IDE/CF.

Note The media door is keyed such that it can be closed only if it is positioned correctly. Ensure the door is inserted right-side up before you try to close it.

6. Close the media door before the data buffer fills: Push the media door in place and twist the door knob clockwise to the locked position (horizontal). Rotate the black plastic lever down so that it lies flat against the door.

   Closing the media door will start the Controller.
   - If you want to start the display, press the centre key for about 1 second. The display will start up once the Controller has finished booting.

The Store options for the replacement medium generally include the following:

- If the active medium contains a Store, the Taurus will append data to that Store automatically. If the Store was created on a different Taurus, is recommended that you delete the existing Store and create a new one (Section 10.2.2 on page 97).
- If the medium is not formatted to Ext3, you can format it and create a new Store (Section 10.3.2).
- If the active medium is formatted to Ext3 but does not yet contain a Store, the Taurus will create one automatically using the last Store configuration settings (see also Section 10.2.1 on page 95).

10.3.2 Format recording media

Formatting is not necessary for media shipped from Nanometrics; these are preformatted to Linux Ext3.

You can use the Taurus to format media from a different filesystem format to Ext3, and to reformat used media that are already formatted to Ext3. Which procedure you can use depends on whether one or both media types are inserted in the Taurus, which medium is the active one, and whether the media are already formatted to Ext3 (Table 10-1). The active medium is the one the Taurus is currently configured to use for recording data.

Formatting will destroy all existing data and partition information on the medium. (The Taurus will create two directories on the medium immediately after completing the formatting: `/mnt/`*mediaType*`/logs` and `/mnt/`*mediaType*`/store`.)

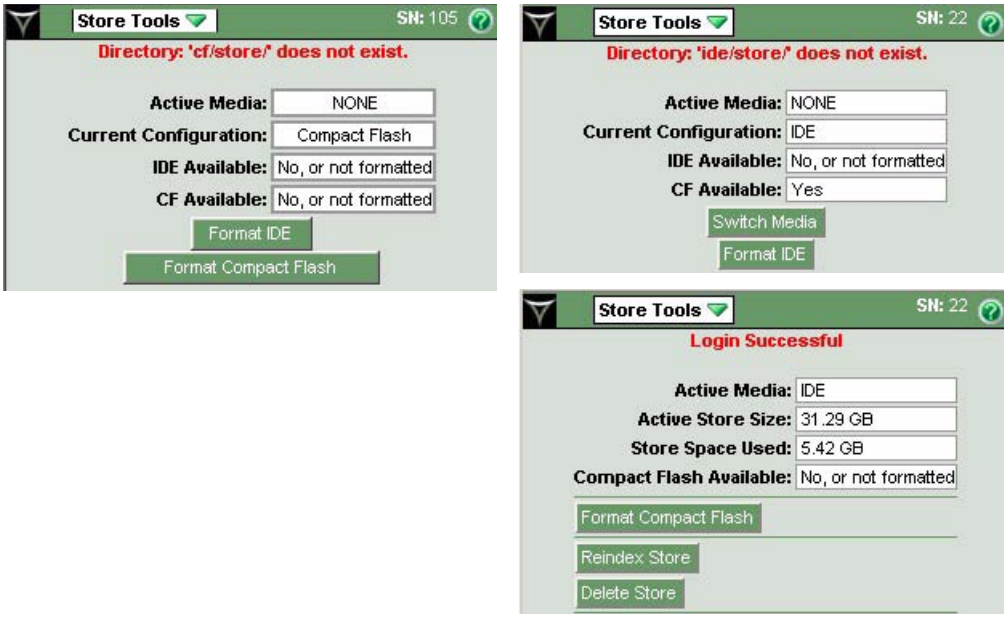
Table 10-1 Media formatting options

Media installed	Options for formatting media on the Taurus
One formatted, active medium	You cannot format the active medium if it is already formatted. (Optionally, delete the active Store and create a new one if you want to reuse the medium; see Section 10-2 on page 98.)
One formatted, inactive medium	You can format the inactive medium whether or not it is already formatted.
Two formatted (one active, one inactive)	You can format the inactive medium whether or not it is already formatted. You cannot format the active medium if it is already formatted. Therefore, to format the currently active medium, first **Switch Media** to the other medium (Section 10.3.3 on page 104).
Unformatted media	If you click **Format** ***MediaType*** for an inserted medium, the Taurus will detect and then format it. If there are media inserted in both slots, the Taurus will format the *MediaType* you selected and leave the other medium unformatted.

10.3.2.1 Format unformatted media

For unformatted media, the Taurus will indicate that media are either not available or are not formatted, and will provide different options depending on media status (Figure 10-6).

Figure 10-6 Unformatted media options



1. Shut down the Controller (Shutdown – **Shutdown**) and insert the media you want to format. See Section 10.3.1 “Insert and remove recording media” on page 99 for procedure details.

   ▸ Do not remove or insert media if the MediaLED is red. Wait until the Controller has shut down and the MediaLED is green.

   After you have closed the media door the Controller will boot automatically.

2. Go to the Store Tools page and log in if required. The Taurus will indicate that unformatted media are either not available or are not formatted.

   (Store tools to format and to switch media are available without logging in if the currently active media type is not present or not formatted—that is, Active Media is None. Once you have formatted or switched media, you will have to log in to access Store tools.)

3. Click **Format *MediaType*** for the medium you want to format.
   - If this is the currently active media type, the Taurus will format the medium and create a Store using the last Store configuration settings (see also Section 10.2.1 on page 95). The Taurus will start recording to it automatically.
   - If this is the currently inactive media type, the Taurus leaves it as the inactive medium after formatting it.
     ▸ If you want to record to the currently inactive medium, after formatting is complete click **Switch Media** and choose a Store Size.

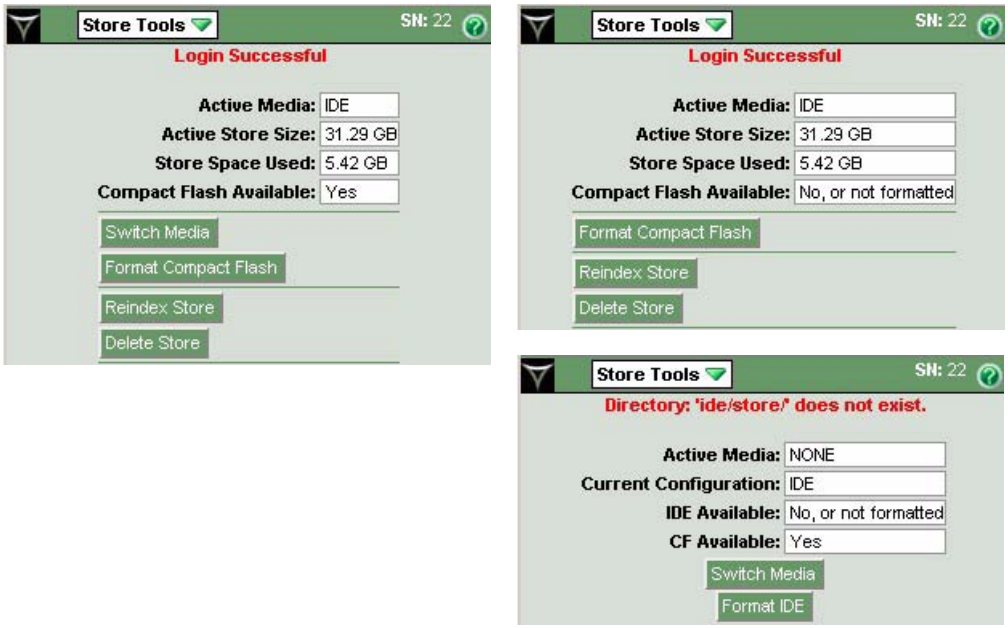
10.3.2.2 Format previously formatted media

For formatted media in the active slot, the Taurus will show Store information. For formatted media in the inactive slot, the Taurus will indicate that the media are available. Different options will be available depending on media status (Figure 10-7).

For media that are already formatted to Ext3, you can format the inactive medium only, If you want to reformat the active medium, you can install both media types, switch to the other medium, then format.

If you just want to reuse a medium with an old Store and do not need to reformat it, you can delete the Store and create a new one; see Section 10-2 on page 98.

Figure 10-7 Formatted media options



1. If you need to insert the medium you want to format, first shut down the Controller (Shutdown – **Shutdown**). See Section 10.3.1 “Insert and remove recording media” on page 99 for procedure details.
   - Do not remove or insert media if the MediaLED is red. Wait until the Controller has shut down and the MediaLED is green.

   After you have closed the media door the Controller will boot automatically.
2. Log in and go to the Store Tools page.
   - If you want to reformat the currently active medium, first choose **Switch Media**.
3. Click **Format *MediaType***. You will be prompted for confirmation.
   - To exit the page without formatting the medium, either click the **Store Tools Menu** button or choose another page from the main menu.
4. To format the medium, click **Proceed**.

If you choose **Switch Media** after formatting is completed (Section 10.3.3), you will be prompted to choose the new Store capacity from the list of available options.

10.3.3 Switch recording to the other medium

If you have media installed in both slots, you have the option to switch to the inactive medium if it is already formatted.

Note **Switch Media** will commit the new Store configuration (size, media type) and will also commit any other applied changes made in the Configuration or Advanced Configuration pages.

1. Log in and go to the Store Tools page.
2. Click **Switch Media**. (To exit the page without switching to the inactive medium, either click the **Store Tools Menu** button or choose another page from the main menu.)

   There will be two options, depending on whether there is a Store on the medium:

   - If there is no Store on the formatted inactive medium, you will be prompted to create one.
     - Choose a capacity for the new Store from the Store Size drop-down list.
   - If a Store already exists on the inactive medium, you will be prompted to confirm whether you want to use that Store. The Taurus will append data to that Store (see also Section 10.2.1.1 “About appended Stores” on page 96).
     - If you do not want to append data to the existing Store you can either delete the Store after you have switched media, or format the inactive medium before you choose **Switch Media**. Formatting will destroy all data and partition information on the medium.
3. Click **Proceed**.

Figure 10-8 Switch media and create a new Store

Chapter 11 Accessing Data

This chapter provides an overview of general methods for accessing data from Taurus Stores, and procedures for retrieving specific types of data.

11.1 General options for accessing data

Time-series data, and SOH, system configuration, and log information are stored in the Nanometrics Store. You can extract data from the Store to various standard formats using the data retrieval options. Data can be extracted over an IP connection from the Taurus. With the Apollo Light utility, you can extract data from a Store copied to your PC or directly off media inserted in a media reader. Time-series data may also be streamed to an acquisition server while the Taurus is in Communications mode.

One data retrieval request can be run at a time. Any subsequent retrieval requests will be processed when the current download is finished. You can run a data retrieval request concurrent with data streaming to an acquisition server.

11.1.1 Viewing data in near-real time

If the Taurus is in Communications or Interactive mode, you can view time-series waveforms and some SOH information in near-real time. The lag is the page refresh rate (usually 5s) plus the Post Data Interval (factory default 2s).

- Viewing waveforms – Waveforms in near-real time are shown on the Status page, Waveform page, and Sensor page.

  You can select waveform scaling options on the Waveform and Sensor pages (see Table H-2 on page 180 for a description). On the Waveform page only, the scaling presently in use is shown on the upper right of the waveform. After about 1 minute from startup of the Controller or following a change in the sample rate, the waveform will show AC RMS and DC average. On a single-waveform display, the minimum and maximum values of the visible data are also shown as a numeric value.

  - S = vertical scale of the channel window
  - MIN = smallest sample value of the samples
  - MAX = largest sample value of the samples
- Viewing SOH status – Current state of health (SOH) information is shown in several locations. See Section 3.8.4 “Pages showing current status information” on page 29.

11.1.2 Checking availability of data

The Data Availability pages provide options for viewing summaries and details of availability ranges and any gaps.

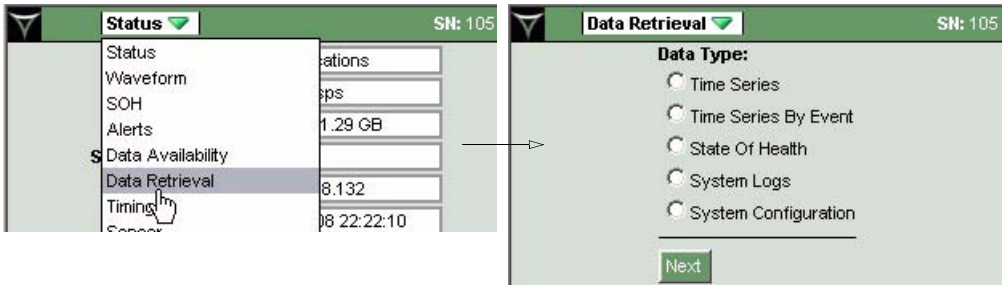
- See Section H.6 on page 181 for a description of the Data Availability page options.

11.1.3 Extracting data to files with the Data Retrieval pages

You can extract data from the Taurus via a browser over an IP connection. Use the Data Retrieval pages to set the data extraction options, described in the sections listed:

- Time-series data to MiniSEED, Seisan, or ASCII, delimited by time selections (Section 11.2.1 on page 109).
- Time-series data to MiniSEED, Seisan, or ASCII, delimited automatically using uploaded event information (Section 11.2.2 on page 111).
- SOH data and triggers to `.csv` files (Section 11.3.1 on page 116).
- System logs to a `.log` file (Section 11.3.2 on page 119).
- Configuration audit trail to a `.cfg` file (Section 11.3.3 on page 119).

Figure 11-1 Data Retrieval main page

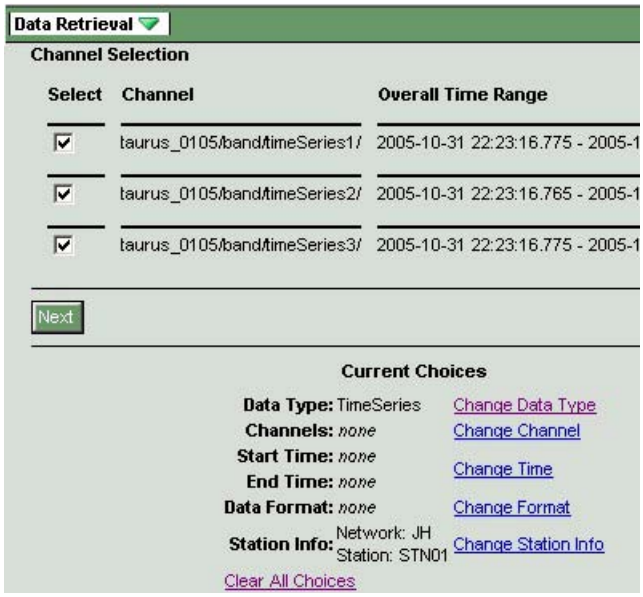


11.1.3.1 Navigate Data Retrieval pages

Options you have chosen on data retrieval pages are stored in a temporary cache. If you use browser options or main menu selections to navigate, your changes will be discarded. Use these navigation options to preserve your changes:

- Use the **Next** button to navigate away from a Data Retrieval page within a session. This is comparable to the **Previous** button for configuration sessions (see Table H-12 “Advanced Configuration page options” on page 191).
- The Current Choices hyperlinks will open other pages within a session, for example if you want to go back to a page and edit a setting. If you make changes to the page always use the **Next** button to continue, not another Current Choices link, to ensure the new changes are preserved.

Figure 11-2 Data Retrieval page navigation



✧ Use the **Next** button and the Current Choices links to navigate in a session.

11.1.3.2 Confirm Playback settings

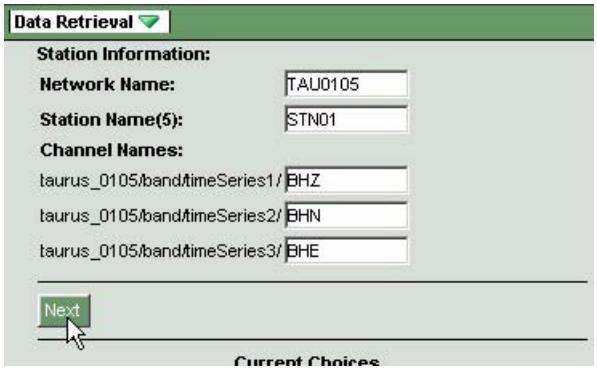
Ensure that the network, station, and channel information is correct for the data you want to extract. Playback information is used in extracted time-series data file headings, and in the default file names for all types of extracted data.

You can change the Playback information temporarily for the current data retrieval session, or change the default for all downloads as a change to the Taurus configuration.

11.1.3.2.1 Change the Playback settings for the current data extraction

- In a data retrieval page, click the Current Choices – Change Station Info link and edit the settings for downloads in the current session (Figure 11-4). Click **Next**.

Figure 11-3 Edit Station Info for the current download session



11.1.3.2.2 Change the Playback configuration for the Taurus

1. Log in as `tech` or `central`.

2. In the Advanced Configuration > Playback page (Figure 11-4), you can edit the default Playback settings for all data extract sessions.
3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

Figure 11-4 Playback configuration page

11.1.3.3 Initial setup for extracting to Seisan format

The first time you extract data using the Seisan format option on the Data Retrieval download page, you must install the `storeDataToSeisan` conversion program on your PC.

1. Ensure that you have Seisan installed on your PC, with these settings:
   - The environment variable `SEISAN_TOP` must be set.
   - For each station you will be decoding you must add to the `DAT/SEISAN.DEF` file two lines, a `WAVEFORM_BASE` and `CONT_BASE`. For example, for STN01:

     ```
     WAVEFORM_BASE     Waveform base name   STN01
     CONT_BASE         REA continuous base  STN01
     ```

2. On the Data Retrieval download page for Seisan format, click the "Download it" link and then save the file `storeDataToSeisan.zip` to your PC. It includes installation and usage instructions in the file `install_storeDataToSeisan.txt`.
3. Unzip the files to `c:\nmx\bin` or `/nmx/bin` (depending on platform).
4. The first time you download a Seisan file, in the browser download window choose Open, and choose the program to open it with as `storeDataToSeisan.bat` or `storeDataToSeisan.sh` (depending on platform).
   - If running under Linux/Unix, you will have to use `chmod` to change the permissions of the `.sh` file to make it executable.

Subsequent downloads to Seisan format will run the conversion automatically if you choose **Open it with the default application** (or equivalent) in the browser download window. (**Save** will save the file with the extension `.ms2seisan`; you can run the conversion program on this file; for example, double-click on the file.)

The conversion logs are written to the file `StoreDataToSeisan_`*yyyymmdd*`.log` in `C:\nmx\user` or `/nmx/user` (depending on platform).

11.1.4 Accessing Store files on the recording media with your PC

The Taurus media are formatted to use the Linux Ext3 file system. You can copy the files to your PC from the Taurus via a means such as FTP. You can access and copy the files on removed media with a media reader such as a Nanometrics Hard Drive Reader or a third-party CompactFlash reader.

- All of the Store files must be present in the same directory if you want to view or extract data. (For example, on the Taurus media in a media reader connected to your PC, or copied to a directory on your PC).
  - If you want to extract data from a copied Store or from a Store on removed media, use Apollo Light (see Appendix F).
- You can transfer the files from the Taurus to your PC via a means such as FTP. Ensure FTP is set to binary transfer.
- If you are using a media reader on Linux, note that some Linux versions will not detect a removable hard drive or CompactFlash card if the PC was not booted with the device attached. After booting with the removable HD or CF, they can be removed and exchanged for other media which will be detected.
- If you are using a media reader on Windows there are various third-party utilities available for you to access the files directly; for example, Ext2IFS and Explore2fs.
  - Ext2 Installable File System For Windows (Ext2IFS) provides a file system driver to include Ext3 volumes as fully accessible drives on Windows filesystems, and a control panel item for assigning drive letters to Ext3 volumes (http://www.fs-driver.org/index.html).
  - Explore2fs provides an Explorer-type graphical user interface for reading files and for copying files from an Ext3 file system (http://uranus.it.swin.edu.au/~jn/linux/explore2fs-old.htm for general information, and http://www.chrysocome.net/explore2fs for software updates).

Caution As of Explore2fs version 1.07 do not drag and drop a 1 GB file from the medium as this will allocate 1 GB of shared memory on the PC. Use the File > Save As menu option instead. The Save As option supports saving of multiple files.

11.2 Retrieving time-series data

You can retrieve time-series data from a Store (either from the Taurus directly or from removed media) by extracting it to a file in MiniSEED, Seisan, or ASCII format. You can also stream time-series data from the Taurus to a central acquisition server, for example to write the data to NAQS ringbuffers.

Note Trigger information is available as an SOH download (Section 11.3.1.1 on page 118).

11.2.1 Extract time-series data to a file

You can extract time-series data from a Store to various formats. This procedure describes data extraction using the Data Retrieval > Time Series page options.

1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose Time Series, then click **Next**. Available channels are listed with the data time ranges.
3. Click to select one or more channels, then click **Next**. This opens a page with options to select the start date and time, and duration of the data to download.
4. Set the time parameters, then click **Next**. This opens a page with options to select the data format.
5. You can extract the data to a file in any of 3 formats:
   - MiniSEED – The extracted file uses a 512 byte Data Record Length.
     - The current version cannot download more than 488 MB of data in Mini-SEED format. Use multiple downloads for quantities of data that exceed 488 MB.
   - Seisan – Extracted files have been tested with Seisan 8.0.
     - The current version cannot download more than 488 MB of data in Seisan format. Use multiple downloads for quantities of data that exceed 488 MB.
     - Seisan downloads use a conversion tool that you install on your PC from the Taurus on the initial download (see Section 11.1.3.3 “Initial setup for extracting to Seisan format” on page 108).

       Subsequent downloads to Seisan format will run the conversion automatically if you choose “Open it with the default application” (or equivalent) in the browser download window. (Save will save the file with the extension `.ms2seisan`; you can run the conversion program on this file; for example, double-click on the file.)
   - ASCII
6. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the data to a file using the current settings:
     - For MiniSEED and ASCII formats, save the file to your PC.
     - For Seisan, open the file. This will run the conversion program and save the file to a Seisan REA subdirectory for that station (for example, `C:\Seismo\REA\STN01\2005\10`).
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the Download page. For time-series data, settings pages and the corresponding links include:
     - Change Data Type – Choose a different data type to download.
     - Change Channel – Choose one or more time-series channels.
     - Change Time – Choose a different start date, time, and duration. You can see available times under Show Available Times.
     - Change Format – Choose ASCII, Seisan, or MiniSEED format for the downloaded data.
     - Change Station Info – Edit station information that will be used in the downloaded data file headers. You can change Network Name, Station Name, and Channel Names.

- Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page.

11.2.2 Extract seismic data to a file by event from an event list

You can retrieve seismic data from a Taurus using information from an event list. This procedure describes data extraction using the Data Retrieval > Time Series By Event page options. The event list may be a file that you upload to the Taurus—for example, a list of events from third-party Internet sites—or information for a single event that you enter into a form.

The Taurus calculates arrival times for various phases that are applicable to the event selected. Supported phases include P, S, Pn, Sn, PKiKP, SKiKS, PcP, ScS, PKP, SKS, Pdiff, and Sdiff. Travel time tables are used to calculate the estimated time it takes a seismic wave to travel distance from a seismic event to a specified location. This is used to determine what data to download for a known teleseismic event. The travel time tables used in Taurus and Apollo are calculated using the Tau algorithm, using the TauP Java Package (http://www.seis.sc.edu). TauP outputs files for any velocity model the user wants. Taurus and Apollo use the IASPEI91 Default Model, which is commonly used for teleseismic events.

Note There are two potential issues with uploading NEIC Epic Search - Compressed event files.

1) If you try to upload a very large file (containing hundreds of events) the browser may either take a very long time to load the file or may crash.
2) If the file contains any events that do not use the required date and time syntax, this will prevent the file from loading. (Only a small number of historic events might not use the required syntax.) Valid syntax options include the following, where the blocks of data are each separated by a single space:
   YYYY
   YYYY MM
   YYYY MMDD
   YYYY MMDD HH
   YYYY MMDD HHmm

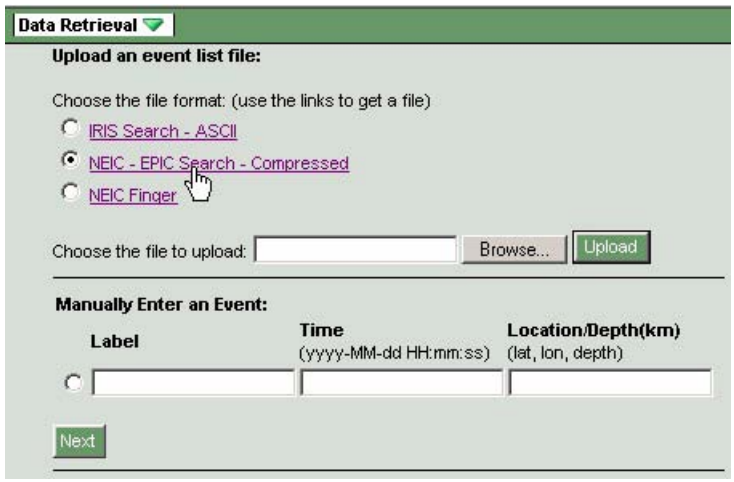
   If you choose to edit the file, be careful to maintain the data column structure as validity is checked only for the date and time syntax.

1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose Time Series By Event, then click **Next**. Available channels are listed with the data time ranges.
3. Click to select one or more channels, then click **Next**. This opens a page with options to either upload an event list or enter information for an event manually into a form.
4. To upload an event list (Figure 11-5):
   a) Choose the type of event list file to upload (click the radio button).

b) Download the event list from the linked site and save it to your file system. Each link opens the relevant site search page in a new window. Options include:
   - IRIS Search - ASCII – The link opens http://www.iris.edu/quakes/event-srch.htm. Do a search, then save using the ASCII Version link. Upload the ASCII version to Taurus.
   - NEIC Epic Search - Compressed – The link opens http://neic.usgs.gov/neis/epic/. Choose a search type (Global, Rectangular, or Circular), then choose option "2. Compressed File Format" for the output file type. Save and then upload the search to the Taurus as `.html`.
   - NEIC Finger – The link opens http://neic.usgs.gov/neis/finger/quake.asc. Save the document `quake.asc` and upload it to the Taurus.

c) **Browse** for the saved file and then click **Upload** to upload it to the Taurus.

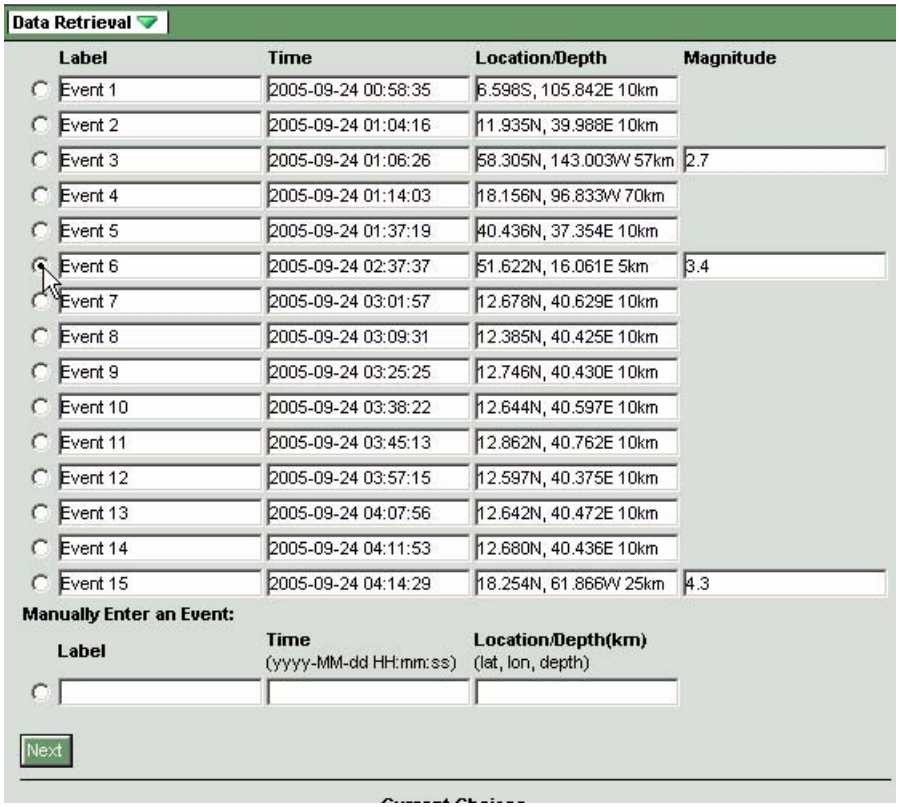
Figure 11-5 Download an event list file then Upload it to the Taurus



d) Click **Next** to open the event list.

e) Choose an event of interest from the list (click the associated radio button), then click **Next** (Figure 11-6).

Figure 11-6 Choose an event from an uploaded list

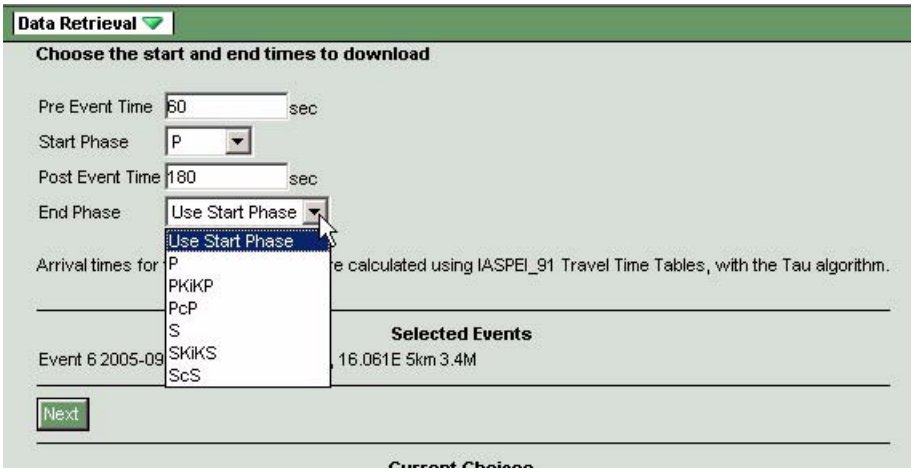


5. To enter event information into the form:
   a) Type the event information in the text fields:
      - Label – A name for the event, as an ASCII string of any length.
      - Time – Event time as an ASCII string of the format *yyyy-MM-dd HH:mm:ss*
      - Location/Depth(km) – The location of the event as a comma-separated list of the latitude, longitude, depth.

   b) Click the radio button to select the event once you have filled in the event form fields, then click **Next**.

6. Select time by phase and related options (Figure 11-7):
   - Pre Event Time – Number of seconds of data to download preceding the calculated start time.
   - Start Phase – Available phases that you may choose to set a start time automatically. Phase options are loaded according to what would be available for an event at that location relative to the Taurus location at the time the data were recorded.
   - Post Event Time – Number of seconds of data to download following the calculated end time.
   - End Phase – Available phases that you may choose to set an end time automatically. Phase options are loaded according to what would be available for an event at that location relative to the Taurus location at the time the data were recorded.

Figure 11-7 Options to select time by phase for Taurus to search for the event



7. Click **Next** to search the Taurus data for the event.
   - If there are no data for the selected event, you may choose to search for another event using the currently uploaded list. Under Current Choices, click the Change Event link to reopen the list.
8. If there are data for the event, you can extract it to a file of any of 3 formats:
   - MiniSEED – The extracted file uses a 512 byte Data Record Length.
     - The current version cannot download more than 488 MB of data in Mini-SEED format. Use multiple downloads for quantities of data that exceed 488 MB.
   - Seisan – Extracted files have been tested with Seisan 8.0.
     - The current version cannot download more than 488 MB of data in Seisan format. Use multiple downloads for quantities of data that exceed 488 MB.
     - Seisan downloads use a conversion tool that you install on your PC from the Taurus on the initial download (see Section 11.1.3.3 “Initial setup for extracting to Seisan format” on page 108).

       Subsequent downloads to Seisan format will run the conversion automatically if you choose “Open it with the default application” (or equivalent) in the browser download window. (Save will save the file with the extension `.ms2seisan`; you can run the conversion program on this file; for example, double-click on the file.)
   - ASCII
9. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the data to a file using the current settings:
     - For MiniSEED and ASCII formats, save the file to your PC.
     - For Seisan, open the file. This will run the conversion program and save the file to a Seisan REA subdirectory for that station (for example, `C:\Seismo\REA\STN01\2005\10`).
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the

Download page. For time series by event data, settings pages and the corresponding links include:

- Change Data Type – Choose a different data type to download.
- Change Channel – Choose one or more time-series channels.
- Change Time – Choose a different start date, time, and duration. (The initial time is set automatically on the Change Time By Phase page.) You can see available times under Show Available Times.
- Change Time By Phase – Choose a start time and duration automatically using the available phase data uploaded with the event.
- Change Format – Choose ASCII, Seisan, or MiniSEED format for the downloaded data.
- Change Station Info – Edit station information that will be used in the downloaded data file headers. You can change Network Name, Station Name, and Channel Names.
- Change Event – Choose a different event from the event list. (The page may take a minute to load if there is a large list of events.)

▸ Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page. This will also delete the currently uploaded event file and event list.

11.2.3 Stream time-series data to a central acquisition server

You can stream time-series data from a Taurus to a central acquisition server, for example to write the data to NAQS ringbuffers. To stream Taurus data to NAQS, the NpToNmxp utility must be running on the NAQS server.

Note If you have restarted NpToNmxp and you wish to ensure timely start of data packets from a Taurus running firmware version 2.*x*, then disable and enable streaming in the Taurus. (In the Advanced Configuration > Communications > Data Streaming page, disable Stream NP Packets ☐, **Apply** the setting, enable Stream NP Packets ☑, and **Apply** again.) Otherwise it may take some time before the data begin streaming to NAQS, depending on how busy the Taurus Controller is processing queued requests.

1. Ensure that the Taurus is running in Communications mode (Section 3.1 on page 17) and that the communications options are set as appropriate (Chapter 7 “Configuring Taurus Communications”).
2. In the Advanced Configuration > Communications Data Streaming page, change these settings as appropriate:
   - Stream NP Packets – Set Taurus to stream data to the specified destination; enabled ☑, not enabled ☐. Factory default is not enabled.
   - IP Address – The address of the streaming destination (for example, a NAQS server); a valid IP address in dotted decimal format.
     ▸ If you are streaming to NAQS you must have NpToNmxp running on the NAQS server. (See also the NpToNmxp User Guide, Nanometrics document number 15648.)
   - Port # – The port number used for NpToNmxp if the destination is a NAQS server. Factory default is 32004.

3. To test the changes, click **Apply**. To make the changes permanent, click **Commit**. If so indicated by a UI message, activate the new configuration with a restart (Shutdown – **Restart**).

11.3 Retrieving other data

There are various other types of information besides time-series data that you can retrieve from the Taurus or a Store. Data that you can extract from the Store includes SOH, system logs, and configuration history. You can download additional information from the Taurus, including system profile information and the current configuration.

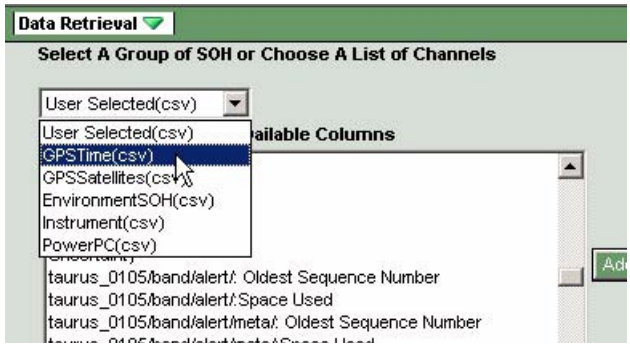
11.3.1 Extract State of Health data to a `.csv` file

You can extract various types of SOH data from a Store to `.csv` files. This procedure describes data extraction using the Data Retrieval page options.

Predefined sets of SOH data are provided in the drop-down list on the SOH Data page (Table 11-1 on page 117). Using the predefined SOH options rather than User Selected individual columns is the preferred method for those applicable SOH, as the predefined options in the list extract the relevant columns in context (for example, GPSTime parameters associated with Last update time). If you want to download an individual SOH data column, for example media door status, use the procedure as for Trigger data (Section 11.3.1.1 on page 118).

1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose State Of Health, then click **Next**.
3. Choose the SOH data set that you want to extract (Figure 11-8), then click **Next**.

Figure 11-8 Choose an SOH data set



4. Select the start date and time, and duration of the data to download, then click **Next**.
5. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the data to a `.csv` file using the current settings.
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the

Download page. For SOH data, settings pages and the corresponding links include:

- Change Data Type – Choose a different data type to download.
- Change Time – Choose a different start date, time, and duration. You can see available times under Show Available Times.
- Change SOH Data – Choose a different set of SOH data to download.

- Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page.

Table 11-1 Predefined SOH downloads to `.csv` files

Predefined SOH download option	SOH data
GPSTime	• GPS receiver status • Number of usable satellites • PDOP • TDOP • System clock phase lock • Time uncertainty • DAC count • Time error • Last update time The values for the 3 parameters *Number of usable satellites*, *PDOP*, and *TDOP* are provided by the GPS receiver at the *Last update time*. In order to see what time these 3 parameters correspond to, look at the *Last update time*. When GPS is off, these 3 parameters and *Last update time* are not updated. They show the last value continuously until the next update arrives (after the GPS is back on again).
GPSSatellites	For each channel: • Acquisition type • Azimuth • Elevation • PRN • Signal level • Last update time
EnvironmentSOH	• External SOH 1 (12-bit, voltage input) • External SOH 2 (12-bit, voltage input) • External SOH 3 (12-bit, voltage input) • External SOH 4 (12-bit, voltage input) • Sensor mass position channel 1 • Sensor mass position channel 2 • Sensor mass position channel 2
Instrument	• Supply voltage • Temperature • NMXbus current (external connector) • Sensor current • Serial port current • Controller current • Digitizer current
PowerPC	For each data band: • Packet oldest sequence number • Store space used

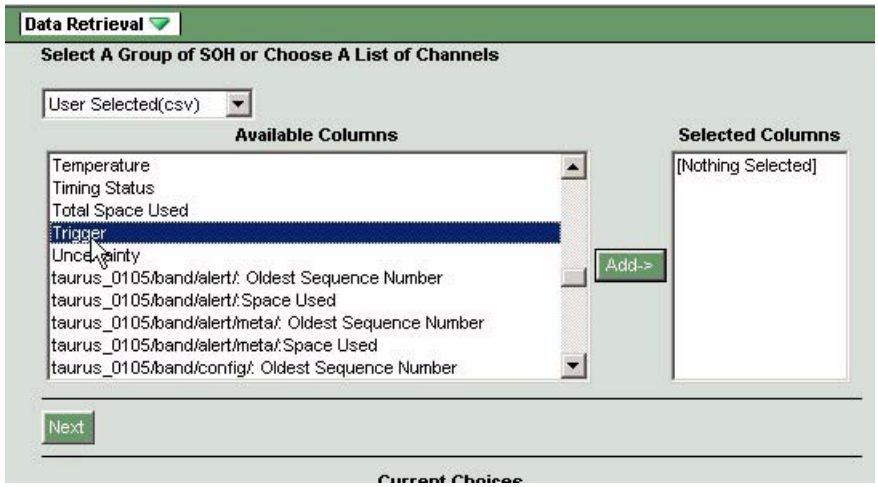
11.3.1.1 Extract trigger data to a `.csv` file

Triggers are included as SOH data, which you can extract to a `.csv` file.

This procedure also applies to download of any individual columns of user-selected SOH, for example media door status. It is recommended that you use predefined downloads to extract certain SOH data in context as described in Section 11.3.1 on page 116.

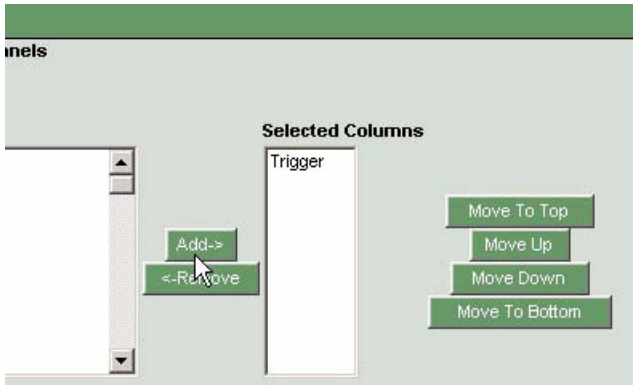
1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose State Of Health, then click **Next**.
3. Leave the SOH type to download as User Selected(csv), and then choose Trigger from the Available Columns list (Figure 11-9). The Trigger option will be included in the SOH Available Columns list only if triggers have already been generated.

Figure 11-9 Choose Trigger as an individual SOH column



4. Click **Add** to add Trigger to the Selected Columns list (Figure 11-10). (Once an Available Column has been added to Selected Columns, additional options for moving selections is included.)

Figure 11-10 Selected Columns options



5. Click **Next**.

6. Select the start date and time, and duration of the data to download, then click **Next**.
7. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the data to a `.csv` file using the current settings.
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the Download page. For SOH data, settings pages and the corresponding links include:
     - Change Data Type – Choose a different data type to download.
     - Change Time – Choose a different start date, time, and duration. You can see available times under Show Available Times.
     - Change SOH Data – Choose a different set of SOH data to download.
   - Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page.

11.3.2 Extract system logs to a `.log` file

You can extract the system logs from a Store to a file in text format. The Apollo, DSP, and ARM logs are downloaded to one combined file. This procedure describes data extraction using the Data Retrieval page options.

1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose System Logs, then click **Next**. This opens a page with options to select the start date and time, and duration of the log information to download.
3. Set the time period parameters, then click **Next**. This opens a page listing the settings you have chosen for this download.
4. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the log information to a text file using the current settings.
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the Download page. For system log information, settings pages and the corresponding links include:
     - Change Data Type – Choose a different data type to download.
     - Change Time – Choose a different start date, time, and duration. You can see available times under Show Available Times.
   - Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page.

11.3.3 Download the configuration audit trail to a `.cfg` file

You can download the system configuration audit trail from a Store to a file in text format. The downloaded file is not a valid configuration for upload. This procedure describes data extraction using the Data Retrieval page options.

1. On a browser over an IP connection, choose Data Retrieval from the menu.
2. Choose System Configuration, then click **Next**. This opens a page with options to select the start date and time, and duration of the log information to download.
3. Set the time period parameters, then click **Next**. This opens a page listing the settings you have chosen for this download.
4. Review the settings you have chosen and either download using these settings or change the settings:
   - Click **Download** to save the log information to a text file using the current settings.
   - To change the settings, click the link to return to the appropriate settings page, change the settings, then click **Next** to proceed through the settings pages to the Download page. For system configuration audit trail information, settings pages and the corresponding links include:
     - Change Data Type – Choose a different data type to download.
     - Change Time – Choose a different start date, time, and duration. You can see available times under Show Available Times.
   - Use Clear All Choices if you want to deselect all of the current settings delimiting the data, and return to the Data Retrieval main page.

11.3.4 Download Taurus system information to a `.id` file

You can download system information, such as firmware and hardware version information, from the Taurus to a text `.id` file.

- In the System Info > Firmware page click the Download link, then select a destination and save the file.

11.3.5 Download the current configuration to a `.cfg` file

You can download the current configuration from the Taurus. The downloaded file is a valid configuration that can be uploaded to a Taurus. See Chapter 5 for general information on working with the Taurus configuration.

- Go to the Advanced Configuration page and click **Download**, then select a destination and save the file.

Part 3 Appendices

- Specifications
- Connector Pinouts
- Sensor-Digitizer Interconnection
- Filter Response
- Open Source/Free Software Information
- Apollo Light Utility
- Taurus Firmware Upgrade Procedures
- UI Pages and Parameters

Appendix A Specifications

A.1 Sensor inputs

Channels	3 standard (selectable 0, 1, 2, or 3 active)
Sampling	Simultaneous
Hardware gain selection	Software configurable 0.4, 1, 2, 4, 8 (peak-to-peak input range 40 V, 16 V, 8 V, 4 V, 2 V)
Maximum input voltage range	40 V_{pp} differential (at hardware gain = 0.4)
Maximum single-ended voltage	±1.56 V, 3.12 V_{pp} or ±3.6 V, 7.2 V_{pp} (selectable) These limits apply to all gain settings.
Maximum common mode signal	±0.78 V, 1.56 V_{pp} or ±1.8 V, 3.6 V_{pp} (selectable) These limits apply to all gain settings.
Nominal sensitivity	1 count/µV (at hardware gain = 1)
Input impedance	Selectable low impedance (43.07 kΩ ±0.2%) or high impedance (>9 MΩ)

A.2 Digitizer performance

Type	Proprietary high order sigma-delta
Digital filter	140 dB attenuation at output Nyquist
Filter type	Linear phase (consult factory for other options)
Dynamic range	>141 dB (maximum sine wave above shorted input level) at 100 sps
Shorted input noise	<1 counts RMS (of 24 bits) at 100 sps
Sample rates	10, 20, 40, 50, 80, 100, 120, 200, 250, 500 sps
Software gain	User configurable 0.001 to 100
High pass filter	User configurable 0.001 to 1.0 Hz

A.3 Sensor support

Sensor types	Broadband active and short period passive
Control lines	6; typically used for Cal enable, mass centre, and mass lock/unlock. Logic level configurable: • High: 5V, 12V, high impedance • Low: 0V, high impedance
Mass position	Mass position monitoring, ±10V range
Sensor power	• Supply power pass-through to sensor (9V to 36V DC) • Protected against short circuit • Sensor power can be switched on/off from the user interface
Calibration signal	• Ramped sine wave • Pseudo-random binary • Pulse signal
Calibration control	User interface (local or remote)
Calibration mode	Voltage or current
Serial interface	Digital serial sensor managment interface for Nanometrics Trillium seismometers (feature planned for a future Taurus firmware release)

A.4 Timing subsystem

Timing system	Internal VCXO clock disciplined to GPS
Timing accuracy	<100µs
GPS receiver	Internal 8 channel or 12 channel
GPS antenna	External active antenna; 3.3V, 100mW
Duty cycle	Software configurable

A.5 State-Of-Health (SOH)

Continuously recorded SOH	See also Table 11-1 on page 117 • Instrument • Environment • GPS and timing • PowerPC
External SOH	4 analog SOH channels (12-bit, digitized), available for user-defined purposes
Configuration	Configuration audit trail
Log file	All software-generated log messages are stored with the data

A.6 Internal data storage

Standard	Removable, accessed via the media door • CompactFlash – SanDisk Extreme Series; tested up to 4 GB capacity with Taurus • 1.8” IDE disk drive – 20 GB to 60 GB
Duration	>600 days continuous recording, 3 channels @ 100 sps on 40 GB IDE drive (~30 days on 2 GB CompactFlash)
Recording modes	Continuous ringbuffer (overwrites oldest data)
File system	Linux Ext3
Storage format	Nanometrics Store. Streaming data output in Nanometrics NP format; extraction to MiniSEED, ASCII, Seisan

A.7 Data retrieval

Media exchange	Removable IDE hard drive or CompactFlash card
Download interfaces	10/100Base-T Ethernet, serial (SLIP or PPP)

A.8 Real-time data communication

Interfaces	• 10/100Base-T Ethernet • RS-232 serial. Port 1 has all RS-232 signals; Port 2 has Rx, Tx, RTS, CTS
Protocols	• UDP/IP unicast/multicast • HTTP (POST and GET) • RS-232 serial with IP drivers

A.9 Integrated UI

LEDs	System status (tri-colour), Ethernet communication status, media write status
Colour display	240*320 colour graphics LCD display with backlight 3.5” diagonal
Input device	5-key navigation control for web interface

A.10 Software

Operating system	Embedded Linux
Applications software	Nanometrics Apollo acquisition server with web interface

A.11 Connectors

This section lists Taurus connector receptacle specifications and indicates appropriate mating plugs. See Appendix B for connector diagrams and pinout descriptions.

Sensor	26-socket, shell size 16, MIL-C-26482 Series 1 Mating connector MS3116J16-26P
GPS	TNC female Mating connector TNC male
Power	3-pin, shell size 8, MIL-C-26482 Series 1 Mating connector MS3116J8-3S
USB/Serial	19-socket, shell size 14, insert position W, MIL-C-26482 Series 1 Mating connector MS3116J14-19PW
Ethernet	4-socket, shell size 8, insert position W, MIL-C-26482 Series 1 Mating connector MS3116J8-4PW
SOH	7-socket, shell size 10, MIL-C-26482 Series 1 Mating connector MS3116J10-7P
NMXbus	4-pin, shell size 8, MIL-C-26482 Series 1 Mating connector MS3116J8-4S
USB	Mini USB Type AB socket Mating connector mini USB Type A or Type B plug

A.12 Ports

Ethernet	10/100Base-T port for remote configuration and IP packet forwarding
Serial	• Serial Port 1: Rx, Tx, RTS, CTS, DTR, DSR, CD, RI • Serial Port 2: Rx, Tx, RTS, CTS (data collection from serial devices) • Serial device power (pass through supply voltage)
External state-of-health	• 4 user-defined 12-bit channels • Data rate: Configurable, options up to 1 sample per 5 seconds • Input range for each channel: ±2.0V DC • Uncalibrated accuracy: (Maximum offset error ±0.07V, maximum gain error 2%) or (Maximum error ±0.11V from –2V DC to +2V DC) • SOH power: 3.3V DC regulated, 10mA maximum

A.13 Power

Supply input voltage	9V to 36V DC

Power consumption (average typical)	Typical configurations:
	• Buffered mode; 12V, 3-channel @ 100sps, <100µsec timing precision:
	  • ~750mW recording to CF card
	  • ~800mW recording to IDE hard drive
	• Communications mode; 12V, 3-channel @ 100sps, <100µsec timing precision, real-time Ethernet or serial communication:
	  • ~2.3W typical continuous recording to CF card
	• Interactive mode; all systems operational including colour graphics display, continuous recording to hard drive
	  • ~3.3W
	In any mode:
	• For Input Impedance configured to High Impedance (high power), add 40mW
	• For GPS configured to Always On, add 200mW

Protection	Fuseless design with configurable low and high voltage disconnect, reverse protection, and short circuit protection
Isolation	Supply power is isolated from signal ground
Earth	Pre-drilled hole for M4 x 5 earth lug screw
Low/high voltage disconnect	Software configurable
Peripheral power output	Typical over-current limit threshold • Sensor (SEN_V+, SEN_RTN): 1000mA • NMX Bus (NMXBUS, NMXBUS_RTN): 1000mA • Serial (S_PWR+, S_PWR–): 750mA

A.14 Environmental

Operating temperature	For CompactFlash recording option: • –20°C to 60°C For IDE disk drive recording option: • 5°C to 55°C
Storage temperature	–40°C to 70°C
Humidity	0 to 100% non-condensing with media door closed, under 90% with media door open
Operating altitude	For IDE hard drive, –60m to 3000m (–200 feet to 10000 feet). No limit for operating with CompactFlash card
Dimensions	Width 147mm, Length 264mm, Depth 60mm
Weight	1.8kg
Construction	Machined aluminum case
Weather resistance	IP67 with media door closed, connectors occupied by the appropriate cable connector or sealed with the optional factory-installed dust caps (Nanometrics part number 15762) or equivalent, and the self-sealing pressure relief screw torqued to hand-tight

A.15 Regulatory compliance

Emissions	EN55022:1998 / CISPR22:1997 (modified); FCC Part 15:2004, Subpart B, Class A
Immunity	EN55024:1998 / CISPR24:1997 (modified)

Appendix B Connector Pinouts

This appendix includes front face views of the Taurus connector receptacles and connector pinout descriptions. See Section A.11 “Connectors” on page 126 for connector specifications.

Note The 4-pin connector above the IDE drive slot is for factory use only.

B.1 Sensor

Figure B-1 Sensor connector receptacle

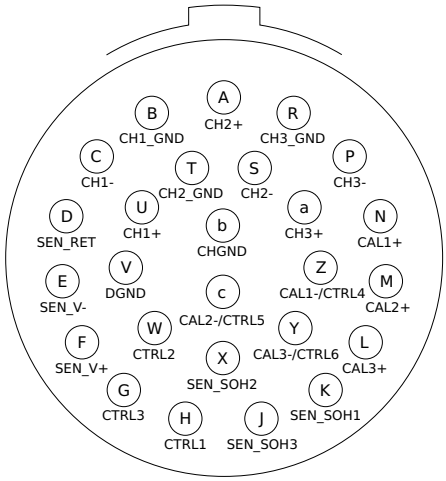


Table B-1 Sensor connector pinout

Pin	Name	Function	Details
U	CH1+	Channel 1 input	±20 V, differential
C	CH1–		
B	CH1_GND	Channel 1 ground/shield	Connected to shield ground
A	CH2+	Channel 2 input	±20 V, differential
S	CH2–		
T	CH2_GND	Channel 2 ground/shield	Connected to shield ground
a	CH3+	Channel 3 input	±20 V, differential
P	CH3–		
R	CH3_GND	Channel 3 ground/shield	Connected to shield ground
K	SEN_SOH1	Sensor state of health input signals	±10 V, single-ended Referenced to DGND
X	SEN_SOH2		
J	SEN_SOH3		
H	SEN_CTRL1	Sensor control signal outputs	0 V / 5 V / 12 V / high impedance Referenced to DGND
W	SEN_CTRL2		
G	SEN_CTRL3		
N	SEN_CAL1+	Sensor calibration signal outputs	±4.5 V single ended Referenced to DGND in voltage mode, and to CAL*n*– in current mode
M	SEN_CAL2+		
L	SEN_CAL3+		
Z	CAL1–/CTRL4	Sensor calibration signal return/ Sensor control signal outputs	Calibration signal return, or 0 V / 5 V / 12 V / high impedance Referenced to DGND
c	CAL2–/CTRL5		
Y	CAL3–/CTRL6		
V	DGND	Digital ground	Digital ground
F	SEN_V+	Sensor power supply	Filtered, unregulated voltage
E	SEN_V–	Reserved for future use	N/C
D	SEN_RTN	Sensor power return	Switched, overcurrent protected
b	CHGND	Chassis	

B.2 GPS Antenna

Figure B-2 GPS antenna connector receptacle

Table B-2 GPS antenna connector pinout

Pin	Function
A	GPS antenna signal and power
Shell	GPS ground, isolated from Taurus chassis

B.3 Power

Figure B-3 Power connector receptacle

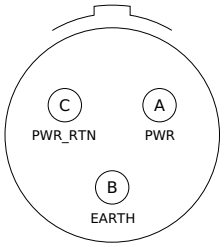


Table B-3 Power connector pinout

Pin	Function
A	Raw (battery) power in (9V to 36V DC)
B	Raw power supply earth
C	Raw power return

B.4 Serial/USB

Figure B-4 Serial/USB connector receptacle

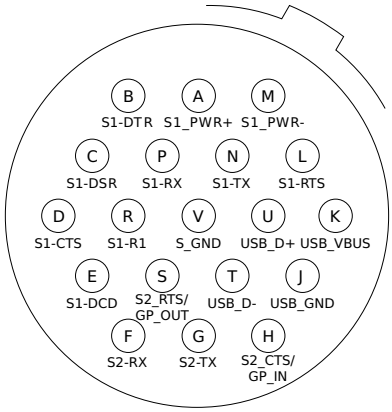


Table B-4 Serial/USB connector pinout

Pin	Name	Function	Details
P	S1-RX	Serial Port 1 receive	RS-232
N	S1-TX	Serial Port 1 transmit	RS-232
L	S1-RTS	Serial Port 1 RTS	RS-232
D	S1-CTS	Serial Port 1 CTS	RS-232
B	S1-DTR	Serial Port 1 DTR	RS-232
C	S1-DSR	Serial Port 1 DSR	RS-232
E	S1-DCD	Serial Port 1 carrier detect	RS-232
R	S1-RI	Serial Port 1 ring indicator	RS-232
V	S_GND	Serial Port ground	
F	S2-RX	Serial Port 2 receive	RS-232
G	S2-TX	Serial Port 2 transmit	RS-232
H	S2-CTS/GP_IN	Serial Port 2 CTS /General purpose input	RS-232
S	S2-RTS/GP_OUT	Serial Port 2 RTS /General purpose output	RS-232
U	USB_D+	Host USB data+	
T	USB_D-	Host USB data –	
K	USB_VBUS	USB power	5V, 100mA
J	USB_GND	USB ground	
A	S_PWR+	Power for serial devices	Filtered, unregulated voltage, referenced to S_PWR–
M	S_PWR–	Power return	Switched, overcurrent protected

B.5 Ethernet

Figure B-5 Ethernet connector receptacle

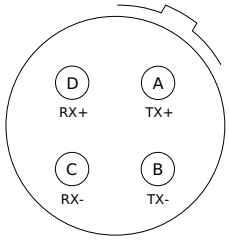


Table B-5 Ethernet connector pinout

Pin	Function
A	Ethernet MTL-3 Transmit +
B	Ethernet MTL-3 Transmit –
C	Ethernet MTL-3 Receive –
D	Ethernet MTL-3 Receive +

B.6 External SOH

Figure B-6 External SOH connector receptacle

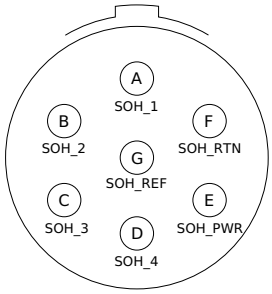


Table B-6 External SOH connector pinout

Pin	Function	Details
A	External SOH Port 1	±2.5V DC, referenced to pin G (SOH_REF)
B	External SOH Port 2	
C	External SOH Port 3	
D	External SOH Port 4	
G	External SOH reference	Do not ground
E	External SOH power	3.3V, 10mA
F	External SOH power return	

B.7 NMXbus

Figure B-7 NMXbus connector receptacle

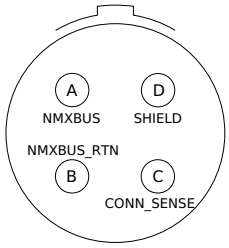


Table B-7 NMXbus connector pinout

Pin	Function
A	NMXbus power and signal; filtered, unregulated voltage
B	NMXbus power and signal return, switched, overcurrent protected
C	NMXbus cable connection sense, referenced to NMXBUS_RTN
D	NMXbus cable shield

B.8 USB

This refers to the mini USB connector socket in the media bay.

Figure B-8 USB connector receptacle

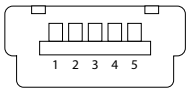


Table B-8 USB connector pinout

Pin	Function	Details
1	Standard USB power	+5V DC, 100mA
2	Data –	
3	Data +	
4	On-The-Go Sense	
5	USB ground	

Appendix C Sensor-Digitizer Interconnection

This appendix describes considerations and requirements for connecting the Taurus to a seismometer, using the Nanometrics Trillium seismometers as an example. The principles apply in general to connecting high-performance sensors to high-resolution digitizers. Recommended sensor cable wiring for connecting the Taurus to various sensors is provided in Table C-3 on page 143.

Note The Taurus is designed for best dynamic range performance when used with sensors having differential outputs. See Section C.5 on page 142 for information on Digitizer operation with single-ended inputs.

C.1 Circuit description

C.1.1 Digitizer

High-resolution digitizers will always have differential input circuits, however they will differ in their input impedance, RF suppression and common-mode rejection. It is also important to determine whether or not the power supply is isolated.

The Nanometrics Taurus Digitizer input stage has an input impedance of 43.07 kΩ (low impedance mode) or 9.4 MΩ (high impedance mode). It has a typical common-mode range of approximately ±0.78 V (low impedance mode) or ±1.8 V (high impedance, high power mode) with respect to the case. The front end is designed with excellent RF suppression so that with properly designed cables, the Taurus can be operated in the presence of radios and cell phones. The Digitizer power supply is completely isolated from the rest of the electronics and the case.

The Digitizer also provides state-of-health inputs and control, calibration, and sensor power outputs.

C.1.2 Sensor

High-performance active seismometers will always have differential output stages. Other active sensors will sometimes have single-ended output stages. Passive seis-

mometers have an isolated output coil. Active sensor power supplies may or may not be isolated.

The Trillium 240 output is a balanced differential output with a clip level of 16 V peak-to-peak and an output impedance of 300 Ω (150 Ω each output). The Trillium power supply is completely isolated from the rest of the electronics and the case.

The Trillium also provides mass position outputs and a calibration input. For the Trillium 40, active-low control inputs serve as calibration enables and to configure the output signals and short or long period frequency response. For the Trillium 120P and Trillium 240/240OBS models, these inputs are active-high.

C.2 Shielding

Sensor cables must be designed for good EMI shielding. This is most easily accomplished using double-shielded twisted-pair cable as shown in Figure C-1 and Figure C-2.

The twisted pairs provide magnetic shielding, an inner shield grounded at the digitizer provides good electric field shielding, and a continuous outer shield provides good high-frequency RF shielding. The outer shield must be earthed for safety.

C.3 Grounding

C.3.1 General considerations

The digitizer and sensor cases must always have a low-resistance path to ground for safety. However, directly earthing both instruments will result in a ground loop. When the digitizer and sensor are far apart differences in ground potential will cause spurious signals to appear unless the loop is broken. The solution is therefore to either earth the digitizer case and isolate the sensor case or vice versa.

Usually the simplest solution is to earth the digitizer as shown in Figure C-1 and Figure C-2. A hole pre-drilled for an M4 x 5 screw is provided on the side of the Taurus case for this purpose (Figure 4-2 on page 36). Trillium has stainless steel adjustable feet which when mounted directly onto dry rock or concrete provide a high resistance to ground. In wet environments it may be necessary to mount the sensor on a plate of glass embedded in sand, or to choose to earth the sensor and isolate the digitizer case.

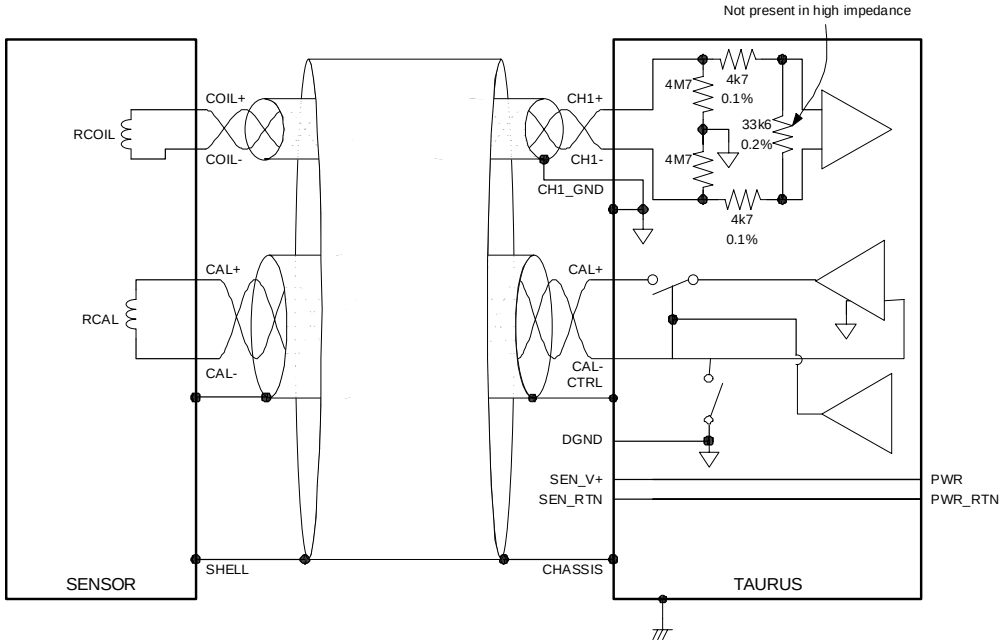
Some sensors may have no chassis connection at the connector. In this case the sensor and digitizer must be separately earthed.

In the wiring lists in this Appendix, P1 is the sensor connector and P2 is the digitizer connector. The “run” and “colour” columns are used to indicate which signals are paired together and how the shields are connected. In particular, “drain” means the drain wire of the shield of the twisted pair indicated in the run column and “braid” means the overall braided shield of the cable.

C.3.2 Passive sensors

For a passive sensor connect the output and calibration coils as shown in Figure C-1 and Table C-1.

Figure C-1 Typical passive sensor cable design



Note that the 4.7 MΩ input resistors at the input of the Digitizer ensure that the common-mode voltage will be negligible.

Table C-1 Typical passive sensor wiring list

From			To			Colour	Run
Conn	Pin*	Name	Conn	Pin	Name		
P1		COIL+	P2	U	CH1+	RED	1
P1		COIL–	P2	C	CH1–	BLK	1
			P2	B	CH1_GND	DRAIN	1
P1		CAL+	P2	N	SEN_CAL1+	WHT	2
P1		CAL–	P2	Z	CAL1–/CTRL4	BLK	2
P1		SHELL	P2	b	CHGND	DRAIN	2
P1		SHELL	P2	b	CHGND	BRAID	

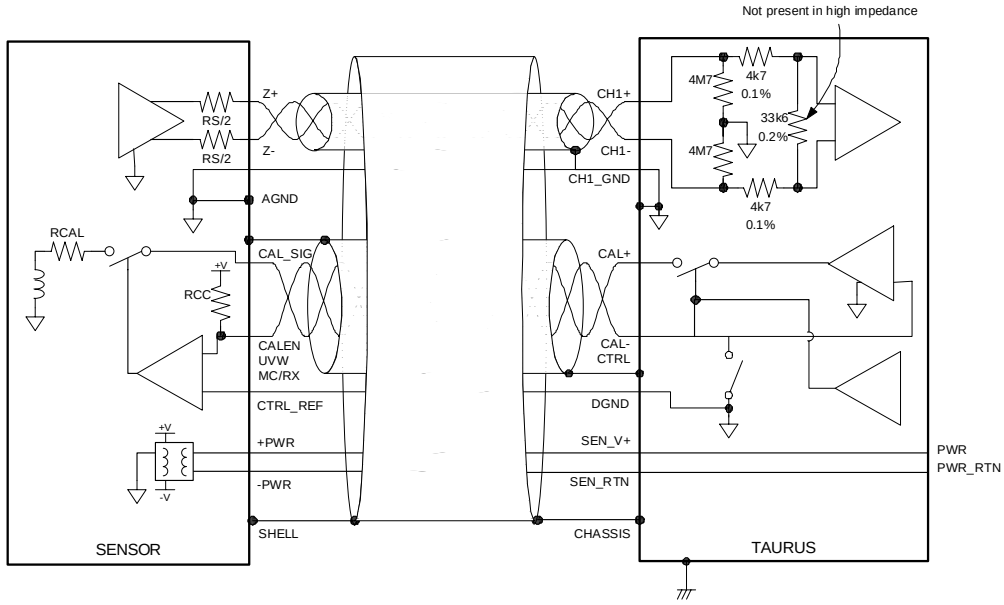
* Pinout will depend on the passive sensor that is selected.

C.3.3 Active sensors

For an active sensor with a differential output a typical cable design is shown in Figure C-2. Note that, for simplicity, one channel only is shown and the mass position state-of-health connections have been omitted.

A typical wiring list is given in Table C-2. Pinouts given are for the Trillium and the Taurus.

Figure C-2 Typical active sensor cable design



When either of the sensor or digitizer power supplies are isolated, there is nothing to constrain the common-mode voltage of the sensor outputs with respect to the digitizer ground. For optimal shielding performance the digitizer channel grounds are connected to the drain wires of the inner shields at one end of the cable only. Therefore it is of critical importance that the analog ground of the sensor (AGND) be separately connected to the analog ground of the digitizer (CH1_GND). The other two digitizer channel grounds (CH2_GND and CH3_GND) should only be connected to their respective shield drain wires and not to AGND.

The control signal reference (CTRL_REF) serves as the reference voltage for all of the Trillium control signals (U_CALEN, V_CALEN, W_CALEN, UVW and MC). This should be connected to the appropriate ground for the control signal outputs on the digitizer. In the case of the digitizer this is the digital ground (DGND).

Table C-2 Typical active sensor wiring list

From			To			Colour*	Run
Conn	Pin	Name	Conn	Pin	Name		
P1	L	Z+/W+	P2	U	CH1+	RED	1
P1	M	Z–/W–	P2	C	CH1–	BLK	1
			P2	B	CH1_GND	DRAIN	1
P1	N	Y+/V+	P2	A	CH2+	WHT	2
P1	A	Y–/V–	P2	S	CH2–	BLK	2
			P2	T	CH2_GND	DRAIN	2
P1	P	X+/U+	P2	a	CH3+	GRN	3
P1	B	X–/U–	P2	P	CH3–	BLK	3
			P2	R	CH3_GND	DRAIN	3
P1	T	CAL_SIG	P2	N	CAL1+	BLU	4
P1	U	W_CALEN	P2	Z	CAL1–/CTRL4	BLK	4
P1		SHELL	P2		SHELL	DRAIN	4
P1	J	V_CALEN	P2	c	CAL2–/CTRL5	YEL	5
P1	K	U_CALEN	P2	Y	CAL3–/CTRL6	BLK	5
P1		SHELL	P2		SHELL	DRAIN	5
P1	S	W_MP	P2	K	SEN_SOH1	BRN	6
P1	F	V_MP	P2	X	SEN_SOH2	BLK	6
P1		SHELL	P2		SHELL	DRAIN	6
P1	E	U_MP	P2	J	SEN_SOH3	ORG	7
P1	V	AGND	P2	B	CH1 GND	BLK	7
P1		SHELL	P2		SHELL	DRAIN	7
P1	H	+PWR	P2	F	SEN_V+	RED	8
P1	G	–PWR	P2	D	SEN_RTN	WHT	8
P1		SHELL	P2		SHELL	DRAIN	8
P1	D	UVW/TX	P2	H	CTRL1	RED	9
P1	C	MC/RX	P2	W	CTRL2	GRN	9
P1	R	CTRL_REF	P2	V	DGND	DRAIN	9
P1		SHELL	P2	b	CHGND	BRAID	
P2	N	CAL1+	P2	M	CAL2+		
P2	M	CAL2+	P2	L	CAL3+		

* Depends on cable type; this example shows Nanometrics cable 13050-*x*

C.4 Other considerations

Some other factors to consider when designing sensor cables:

- Ensure that the cable length does not exceed sensor requirements for capacitive loading.
- Ensure that the peak current requirement of the sensor does not result in a voltage drop along the cable which takes the power supply voltage below the minimum required at the sensor.
- Ensure the cable is watertight.
- Check the cable electrically after assembly. In particular, ensure that the individual and overall shields are not shorted together unless so specified.
- Make sure cables are labelled with correct drawing numbers and revisions.
- Make sure the digitizer is configured so that the default states of the control lines put the sensor in the state you want it to be in.

C.5 Digitizer operation with single-ended inputs

The Taurus is designed for best dynamic range performance when used with sensors having differential outputs. Over a limited voltage range common-mode signal components, such as unwanted noise induced into the input cable are rejected. However, common-mode signals greater than ±0.78 V with respect to chassis ground cause distortion. Maximum single-ended signal before distortion is:
2*maximum common-mode signal = 2*0.78 = 1.56 V.

Common mode range can be extended by using high impedance, high power mode.

C.5.1 Input range and gain for a single-ended signal

A single-ended signal can be considered as the sum of differential and common-mode signals.

Assume V_{cm} is the common-mode input (to both +ve and –ve terminals) and $+V_{dif}/2$ and $-V_{dif}/2$ are the differential inputs. If these are the components to a single-ended signal, and the –ve terminal is connected to GND return, then $V_{cm} + (-V_{dif}/2) = 0$. Therefore, $V_{cm} = V_{dif}/2$.
At the +ve terminal, with $V_{cm} + V_{dif}/2$ referred to GND, the differential input is $(V_{cm} + V_{dif}/2) - (V_{cm} + (-V_{dif}/2)) = V_{dif}$.

Therefore, gain to a single-ended signal is the same for differential and the common-mode component is half of the single-ended input.

C.6 Sensor cable wiring lists

Table C-3 provides guidelines for sensor cable wiring for connecting Taurus to various sensor types. Confirm the pinout for your sensor using information from the sensor manufacturer before building your cable.

Table C-3 Sensor cable wiring lists

Taurus		Trillium			STS-2			CMG			Lennartz			FBA-23			Episensor			L-4		
Pin	Signal	Pin	Signal	Pair	Pin	Signal	Pair	Pin	Signal	Pair	Pin	Signal	Pair	Pin	Signal	Pair	Pin	Signal	Pair	Pin	Signal	Pair
U	CH1+	L	Z+/W+	1	B	Z+	1	A	VERT+	1	A	Z+	1	C	V OUT	1	C	Z+	1	E	VERT+	1
C	CH1–	M	Z–/W–	1	G	Z–	1	B	VERT–	1	B	Z–	1	D	V COM	1	D	Z–	1	F	VERT–	1
B	CH1_GND			1D			1D			1D			1D			1D			1D			1D
A	CH2+	N	Y+/V+	2	C	Y+	2	C	N/S+	2	C	N+	2	A	L OUT	2	A	Y+	2	C	LONG+	2
S	CH2–	A	Y–//V–	2	H	Y–	2	D	N/S–	2	D	N–	2	B	L COM	2	B	Y–	2	D	LONG–	2
T	CH2_GND			2D			2D			2D			2D			2D			2D			2D
a	CH3+	P	X+/U+	3	D	X+	3	E	E/W+	3	E	E+	3	E	T OUT	3	L	X+	3	G	TRANS+	3
P	CH3–	B	X–/U–	3	J	X–	3	F	E/W–	3	F	E–	3	F	T COM	3	M	X–	3	H	TRANS–	3
R	CH3_GND			3D			3D			3D			3D			3D			3D			3D
N	SEN_CAL1+	T	CAL_SIG	4	Q	UCAL	4	P	CAL_SIG	4							E	CAL	4	A	CAL+	4
M	SEN_CAL1–	[N]	[CAL1+]		N	VCAL	4	[N]	[CAL1+]													
Z	CAL1–/CTRL4	U	W_CALEN	4	M	CCOM		R	VER_CALEN	4							F	CCE	4	B	CAL–	4
	SHELL			4D			4D			4D												
L	SEN_CAL3+	[M]	[CAL2+]		P	WCAL	5	[M]	[CAL2+]													
c	CAL2–/CTRL5	J	V_CALEN	5	[Z]	[CAL1–/CTRL4]		S	N/W_CALEN	5												
Y	CAL3–/CTRL6	K	U_CALEN	5	[c]	[CAL2–/CTRL5]		T	E/W_CALEN	5												
	SHELL			5D			5D			5D												
K	SEN_SOH1	S	W_MP	6	T	UPOS/U+	6	G	VER_MPOS	6												
X	SEN_SOH2	F	v_MP	6	V	VPOS/V+	6	J	N/S_MPOS	6												
	SHELL			6D			6D			6D												
J	SEN_SOH3	E	U_MP	7	U	WPOS/W+	7	L	E/W_MPOS	7												
B	CH1_GND	V	AGND	7	F	GNDS	7	N	SIGNAL_GND	7							G	GND	4D			
	SHELL			7D			7D			7D												
H	SEN_CTRL1	D	UVW/TX	8	E	AUTZ	8	U	CENTER	8				L	UNDAMP	4						
W	SEN_CTRL2	C	MC/RX/SP	8	K	CALSW	8	W	UNLOCK	8	H	–CAL	4									
	SHELL			8D			8D			8D												
G	SEN_CTRL3			9	R	PERSW	9	X	LOCK	9												
V	DGND	R	DGND	9	S	RET	9			9			4D			4D						4D
	SHELL			9D			9D			9D												
F	SEN_V+	H	+PWR	10	W	+VIN	10	c	POWER_+V	10	G	+12V [2]	5	S	+12V	5	J	+12V	5			
D	SEN_RTN	G	–PWR	10	X	–VIN	10	b	POWER_GND	10	H	0V	5	R	PWR_COM	5	K	PWR_COM	5			
	SHELL		SHELL	10D			10D			10D			5D			5D			5D			
b	CHGND		SHELL			SHELL					J	SHIELD		T	CH_GND		U	PGP_GND				
[K]	[CALSW]				L	SIGSW																
[N]	[–12V]													K	CAL		H	–12V [3]				
E	N/C																					

Notes:

1) Logic ground is internally connected to signal ground in both the CMG-series sensors and inside the Taurus and so if both are connected through the cable that will create a ground loop.

2) Lennartz sensors, and the Kinematics FBA-23 and some EpiSensor models require regulated power, so in those cases an appropriate DC/DC convertor must be built into the sensor cable.

Appendix D Filter Response

D.1 Response overview

Analog signals connected to the Digitizer module are filtered using a first order low pass antialias filter before being sampled at 30 kHz. This data is later low pass filtered and decimated, using a 3 to 4 stage FIR filter, to the output sample rate. Depending on the requested sample rate, different filters are used and a different number of filter stages are required. The output bandwidth will always be 0.4 times the output sample rate.

The low frequency response is also configurable using the DC removal IIR filter. With the DC removal filter enabled it can be set to a number of predetermined frequencies. With no DC removal filter DC signals are preserved.

D.2 System filter values

This section describes the transfer functions of the Digitizer module components.

D.2.1 Analog low pass antialias filter

The analog antialias filter is a first order low pass filter, with a corner frequency that is dependent on whether the Taurus input impedance is set to low impedance (Low-Z) or high impedance (High-Z).

D.2.1.1 Transfer function

$$F_{(j\omega)} = \frac{1}{R \cdot C \cdot j\omega + 1} \qquad \text{(EQ 1)}$$

where $C = 1.0 \times 10^{-8}$ F

and $R = \dfrac{1}{\dfrac{1}{33600} + \dfrac{1}{9600 + Z}} \Omega$ for low impedance mode

and $R = 9600 + Z\Omega$ for high impedance mode

where *Z* is the sensor's output impedance.

The corner frequency f_0 is therefore

$$f_0 = \frac{1}{2\pi RC} \text{ Hz} \quad \text{(EQ 2)}$$

If the sensor output impedance is negligible,

f_0 = 2132 Hz in low impedance mode

f_0 = 1659 Hz in high impedance mode

D.2.2 Digital IIR high pass filter

The digital IIR high pass filter is used for the optional DC removal feature. DC removal, if used, is applied after the digital FIR filtering.

D.2.2.1 Transfer function

$$y(n) = K \cdot [x(n) - x(n-1)] + F_1 \cdot y(n-1) \quad \text{(EQ 3)}$$

where

- *y(n)* is the current output sample
- *K* is the filter gain
- *x(n)* is the current input sample
- *x(n-1)* is the previous input sample
- F_1 is the filter coefficient
- *y(n-1)* is the previous output sample

D.2.2.2 Coefficients

The IIR filter is implemented as a first order IIR filter using the following coefficients calculated at runtime:

$$F_1 = \frac{1 - \left(\frac{\pi \cdot f}{F_S}\right)}{1 + \left(\frac{\pi \cdot f}{F_S}\right)} \quad \text{(EQ 4)}$$

$$K = \frac{1}{1 + \left(\frac{\pi \cdot f}{F_S}\right)} \quad \text{(EQ 5)}$$

where:

- F_S is the output sample rate
- f is the 3 dB corner frequency of the filter

The time constant (*TC*) of the filter can be calculated as follows:

$$TC = \frac{1}{2\pi \cdot f} \quad \text{(EQ 6)}$$

D.2.3 Digital FIR low pass filters

The 3 to 4 stage digital FIR filter low pass-filters and decimates the data to the output sample rate.

D.2.3.1 Transfer function

$$y(n) = \sum_{i=0}^{N-1} c(i) \cdot x(n-i) \quad \text{(EQ 7)}$$

where:

- *y(n)* is the output sample
- *x(n-i)* is an input sample
- *c(i)* is a FIR coefficient
- *N* is the number of coefficients

D.2.3.2 Coefficients

Table D-1 on page 148 shows the individual digital filter stages and associated decimation for each output sample rate, and the cumulative filter delay. You may obtain the filter coefficient sets from the file `Taurus_FIR_filter_coefficients.txt` included with the Taurus software. You may also obtain these values by running the utility `Tresponse` (see the Data Playback manual, Nanometrics document number 14548).

Table D-1 Digital filter stages and associated decimation for each output sample rate

Output Sample Rate	Filter Parameter	Stage				Cumulative Filter Delay (seconds)
		1	2	3	4	
10	# of Coefficients	213	177	113	223	6.172200
	Decimation	20	15	5	2	
20	# of Coefficients	165	187	113	223	3.104233
	Decimation	15	10	5	2	
40	# of Coefficients	177	71	113	223	1.547933
	Decimation	15	5	5	2	
50	# of Coefficients	203	245	223	—	1.194700
	Decimation	20	15	2	—	
80	# of Coefficients	165	63	497	—	0.638233
	Decimation	15	5	5	—	
100	# of Coefficients	165	187	223	—	0.604233
	Decimation	15	10	2	—	
120	# of Coefficients	59	69	113	223	0.515800
	Decimation	5	5	5	2	
200	# of Coefficients	173	95	223	—	0.303867
	Decimation	15	5	2	—	
250	# of Coefficients	187	73	223	—	0.243100
	Decimation	15	4	2	—	
500	# of Coefficients	123	65	223	—	0.123700
	Decimation	10	3	2	—	

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The Taurus software includes open source/free software components (see Table E-1). License information for each such component is included in the sections as indicated. You may request from Nanometrics the source code for derived components (see Chapter 1 “Introduction” for contact information); the remaining open source code may be obtained from the original developers.

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Table E-1 List of open source/free software components

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Epson video driver	yes	Section E.4 “GNU-GPL” on page 152
JFFS2 driver	yes	Section E.4 “GNU-GPL” on page 152
Konqueror Embedded	yes	Section E.4 “GNU-GPL” on page 152
Linux Kernel	yes	Section E.4 “GNU-GPL” on page 152
Qt Embedded Free	yes	Section E.4 “GNU-GPL” on page 152
Apache Commons FileUpload	no	Section E.2 “Apache License”
Bouncy Castle	no	Section E.3 “Bouncy Castle License” on page 152
Jetty	no	Section E.2 “Apache License”
lwIP	no	Section E.6 “Modified BSD License” on page 157
md5.js	no	Section E.5 “md5.js License (BSD License)” on page 157
OpenSSH	no	Section E.7 “OpenBSD License” on page 158

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Version 2.0, January 2004

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- RSA is no longer included, found in the OpenSSL library

- IDEA is no longer included, its use is deprecated

- DES is now external, in the OpenSSL library

- GMP is no longer used, and instead we call BN code from OpenSSL

- Zlib is now external, in a library

- The make-ssh-known-hosts script is no longer included

- TSS has been removed

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@version 3.0 (December 2000)

Optimised ANSI C code for the Rijndael cipher (now AES)

@author Vincent Rijmen <vincent.rijmen@esat.kuleuven.ac.be>

@author Antoon Bosselaers <antoon.bosselaers@esat.kuleuven.ac.be>

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Appendix F Apollo Light Utility

Apollo Light is a utility for extracting data from Nanometrics Store files on your PC. It provides a web interface with the same options to view data availability and to download data that are provided in the Taurus UI.

Note Apollo Light is used for Stores created with Taurus firmware V2.*xx*, indicated by file names of the form `taurus_0123_001.store`. For Stores created with Taurus firmware V1.*xx*, indicated by file names of the form `NmxVolume_001`, use the `TaurusExtract` utility.

Apollo Light is supported on Windows and Linux/Unix. It has been tested on Microsoft Windows XP using Java2RE 1.4.2.

F.1 Installing Apollo Light

- To install Apollo Light, extract the files from `apollo-2_`*xx_yy*`.zip` on the Taurus CD to your PC. The files will unzip to a directory named `apollo`.
  - Additionally, on Linux/Unix, set the `apollo.sh` file to be executable: Change to the `/apollo` directory and then enter the command `chmod +x apollo.sh`

F.2 Running Apollo Light

Apollo Light requires Java.

Note Apollo Light must always be started from the command line. That is, you must run the batch or script file before you can navigate to Apollo Light in your web browser.

1. Open a command window and start Apollo Light from the `apollo` directory.
   - On Windows, enter `apollo [port=`*value*`]`
   - On Linux/Unix, enter `./apollo [port=`*value*`]`

   where the default is `port=80`. Use the optional parameter to indicate an alternative port greater than `1024` (for example, `8080`) in either of these cases:
   - If there is a web server running on the machine, port 80 will already be in use.

- On Linux/Unix, root login may be required to run the web server at the default port (port 80).

Example 1: `apollo`

Example 2: `apollo port=8080`

2. Open a web browser and go to the "root" page of the machine on which Apollo is running (for example, http://localhost/). If the port is a value other than the default, you must include the port number (for example, http://localhost:8080/).

F.2.1 Initialize the Store location

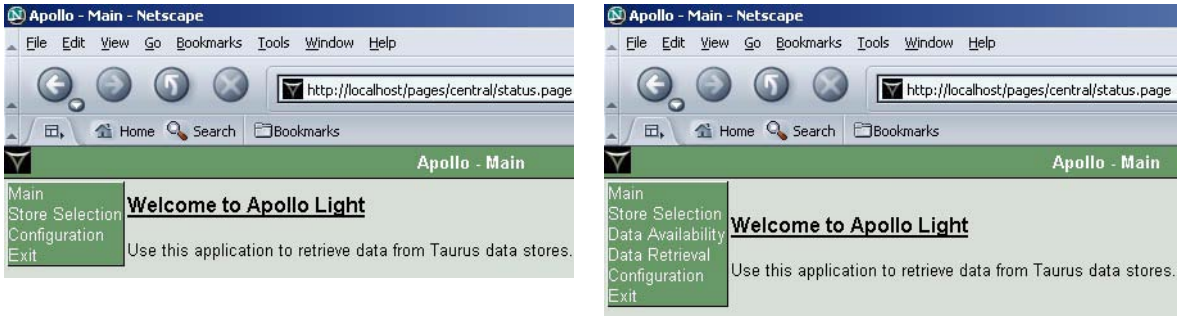
The first time you start Apollo Light from a new installation, or if the last-used Store directory has been deleted, the command window will indicate "Got error while opening store" followed by java exceptions as shown (example on Windows):

```
->    Got error while opening store: : ca.nanometrics.store.excep
tion.StoreException: Directory: 'C:\nmx\store/' does not exist. &
at ca.nanometrics.store.NPStore.createStoreFile(NPStore.java:345) &
at ca.nanometrics.store.NPStore.init(NPStore.java:262) & at
ca.nanometrics.store.NPStore.<init>(NPStore.java:226) & at ca.nano
metrics.store.NPStore.instance(NPStore.java:206) & at ca.nanomet
rics.apollo.MissionControl.openStore(MissionControl.java:304) & at
ca.nanometrics.apollo.MissionControlCentral.body(MissionControlCen
tral.java:82) & at ca.nanometrics.apollo.MissionControl.run(Mis
sionControl.java:823) & at ca.nanometrics.apollo.MissionCon
trol.main(MissionControl.java:891) &
```

This is normal. It indicates that a Store directory has not yet been identified.

Until you point to a Store, the menu will not include the Data Availability or Data Retrieval options. Once you have selected a Store (Section F.3.3), all of the menu options will be shown (Figure F-1). (If the Store you selected is corrupted, the menu still will not show the Data Availability or Data Retrieval options, and the startup window may show additional exceptions.)

Figure F-1 Apollo Light options without a Store location, and after a Store has been opened



F.2.2 Exit Apollo Light

- To exit Apollo Light, choose Exit from the menu.

F.3 Using Apollo Light

You can use Apollo Light to view what data are available in a Store on your file system, and to extract the data.

F.3.1 Working with data from multiple Tauruses

You can have Stores from different Tauruses in the same directory. Apollo Light will use the Store ID in the file name to access the correct files. The Store ID uses the serial number of the Taurus that recorded data into the Store.

In rare cases, a single Store may contain data from multiple Tauruses (see Section 10.2.1.1 “About appended Stores” on page 96). In that case, the Store ID in the filename uses the serial number of the last Taurus that recorded data into the Store. Each set of log and SOH data in a multi-Taurus Store is associated with the Taurus that originally recorded those data. Therefore, you must also specify the Instrument ID of the Taurus before retrieving log or SOH data for that Taurus data set. All time-series data can always be retrieved, regardless of the Instrument ID setting.

F.3.2 Requirements for accessing Store files

- The Store files must be in a directory that is accessible from your machine.
- All of the files for the Store you are accessing must be present in the same directory (for example, for a Store containing 5 files, all of the files from `taurus_`*`serialNumber`*`_001.store` to `taurus_`*`serialNumber`*`_005.store` must be present in the directory).
- The Store files must be set to read/write:
  - On Windows, right-click on the file name, choose Properties, and deselect the attribute Read-only.
  - On Linux/Unix, in the Store files directory enter the command `ls -al` to check read/write status (`w` indicates write permission; the files should already show read permission `r`).
    - To set a selected file for write permission, enter `chmod +w` *filename*.
    - To set all files in the directory to write permission, enter `chmod +w *`.

F.3.3 Select a Store

1. Choose Store Selection from the menu.
2. Click **Browse** to search for a Store on your file system.
3. Select any one of the files for that Store.
4. Click **Change Store** to point Apollo to the selected Store (Figure F-2).
5. If the Store contains data from more than one Taurus, choose the correct Taurus before working with logs or SOH data (Figure F-3). In the Instrument ID list, choose the appropriate Taurus Instrument ID, and then click **Change Instrument**.
6. Ensure you have configured the Playback options as appropriate for the data source (Section F.3.4).

The next time you start Apollo Light, it will by default point to the last Store used if it is still available. (See also Section F.2.1 “Initialize the Store location” on page 164.)

Figure F-2 Choose a Store

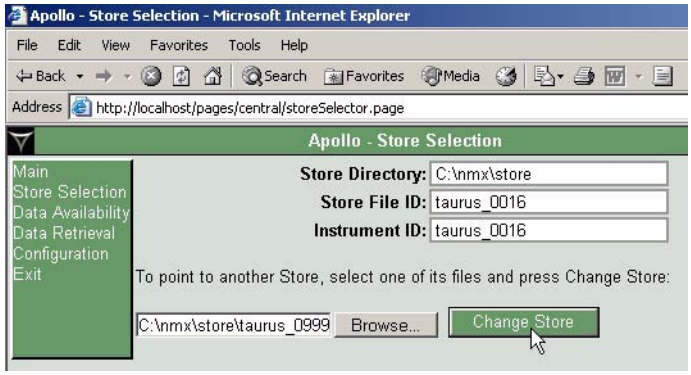


Figure F-3 Specify a Taurus from a multi-Taurus Store for retrieving log and SOH data

F.3.4 Configure extracted file headings (Playback)

Each time you open a different Store you must configure the headings to apply to time-series files extracted with the Data Retrieval options. Configure these file headings as appropriate to the data source. Use the options in the Playback configuration page. The options are identical to those included in the Taurus UI Playback page (Section 11.1.3.2 “Confirm Playback settings” on page 107 and Table H-23 “Playback page options” on page 197).

- To open the Playback configuration page, choose Configuration from the menu and then click the Playback link.

F.3.5 Check data availability and extract data

The Data Availability and Data Retrieval options are identical to those included in the Taurus UI (see Chapter 11 “Accessing Data”).

F.4 Using the log files

Apollo Light creates two log text files, a startup log and a main log. A new log file is opened each day that Apollo Light is run. The date is encoded in the log file name (for example, `Apollo_20050823.log`).

- The startup log is written to `Apollo_`*`yyyymmdd`*`.log` on the same disk on which the current Store files directory exists, one level above the Store files directory. It contains startup messages only.
- The main log is written to `Apollo_`*`yyyymmdd`*`.log` in the `\apollo\logs` directory. It contains operation messages generated by Apollo.

  The main log can be configured to show only messages at or above a specified level of detail (or verbosity). The default is Info (the minimum amount of detail); Debug is the most detailed level.

  - To configure the log verbosity to a different level of detail, choose an option from the drop-down list in Configuration > General > Log verbosity, then **Apply** and **Commit** the change.

Appendix G Taurus Firmware Upgrade Procedures

Use the scripts upgrade procedure (Section G.1) for firmware upgrades from Taurus Version 1.*xx* to Version 2.*xx* or higher. Use the web upgrade procedure (Section G.2) for firmware upgrades after a Version 2.*xx* or higher has been installed.

G.1 Upgrading Taurus from Version 1.*xx* to Version 2.*xx* or higher

The scripts procedure described in this section is applicable only to upgrades from Version 1.*xx* to Version 2.*xx* (or higher) and will not be supported for future releases. For future releases, use the Web upgrade procedure described in Section G.2 on page 172.

Warning Taurus Version 1.*xx* uses a data Store that is incompatible with Version 2.*xx* and higher. Ensure that you download or back up your Version 1.*xx* data before installing the 2.*xx* or higher upgrade, as the upgrade will delete the old Store.

This procedure requires that the Taurus be connected to a local network (LAN) using the supplied Ethernet cable (15228) or equivalent. You will require a Windows or Linux PC to establish a telnet session with the Taurus to upload the new firmware and install it.

1. Obtain the Taurus firmware upgrade package (a `taurus-release_`*releaseNumber*`.tgz` file) and place it in a convenient folder on the Windows or Linux PC you will use to connect to the Taurus.
2. Power up the Taurus in factory test mode:
   a) Shut down the Taurus: Go to the Shutdown page and click **Shutdown**.
   b) Once the LED below the Ethernet connector is off, disconnect the power cable.
   c) Press and hold the centre key down while you connect the power cable and wait for the LED on the top of the Taurus to start blinking, then release the centre key.
3. Check the IP address of your Taurus if you are not sure what it is: Once the Ethernet LED is blinking green, press the centre key for about 1 second to start the dis-

play. Wait for the display to come up (if the display has not started after several minutes, press the centre key again for about 1 second and wait). The IP address of the Taurus is shown on the Current Status page.

4. Telnet to the Taurus. Use `root` for both the login and the password.

Note The installation files will require about 50 MB of space on the recording medium.

5. Create an upgrade directory on either of the available recording media (either an IDE drive or a CF card):
   `mkdir /mnt/`*media*`/upgrade`
   where *media* is `ide` if you are using an IDE harddrive, and `cf` if you are using a CompactFlash card; for example, `mkdir /mnt/cf/upgrade`.
   - If the `/mnt/`*media* directory does not exist, it is because the media is not installed properly. Do NOT make that directory manually using `mkdir`. Instead, power down the unit, ensure the media is installed properly, and power the unit back on.
6. Keep the telnet session running.
7. FTP to the appropriate directory on the Taurus IDE or CF. Use `root` for both the login and the password. For example:
   `ftp://root:root@`*ip_address_of_your_taurus*`/../mnt/`*media*`/upgrade`
8. Locate your `taurus-release-2.`*xx*`.`*yy*`.tgz` file. Upload the file, with FTP set for binary transfer, to the appropriate upgrade directory on the Taurus (either `/mnt/ide/upgrade` or `/mnt/cf/upgrade`).
9. From the telnet session, go to the upgrade directory and untar the files (you can press Tab to auto-complete directory and file names):
   ```
   cd /mnt/media/upgrade
   tar zxvf taurus-release-2.xx.yy.tgz
   ```
   The files should finish untarring within 5 minutes.
10. Change directories to the release files directory, and then run the installation scripts:
    ```
    cd release-2.xx.yy
    ./taurus_install.sh
    ```

    The files should finish installing within about 15 to 20 minutes.
    - Make sure there are no errors during installation (these would be indicated by error messages on the screen). If there are errors, wait until the installation scripts have completed and then run them again.
    - If there is a power failure while the installation scripts are running, the media might unmount. If this occurs, you must mount the media before you can run the installation scripts. If the upgrade process is interrupted after the rootfs was successfully uploaded, the root password will have changed to `dolphin18`.
      - For the CF card, enter the command
        `mount -t ext3 dev/hdc1 mnt/cf`
      - For the IDE drive, enter the command
        `mount dev/hda1 mnt/ide`

Note In some browsers you may get an HTTP 404 error (page not found) when attempting to access the Taurus after the new software is installed. If this occurs, clear your browser cache.

11. Once the files have installed successfully (you will see a message saying so), start a browser on your PC and check the firmware version numbers. (The corresponding files are `tdp-`*component*`-`*versionNumber*`.nbf`.)
    a) Go to http://*ip_address_of_your_taurus*:8080/firmware/
    b) Confirm that the files have been uploaded correctly, by comparing the version numbers on the page with the versions in the `release-2.`*xx*`.`*yy* directory.
    c) Go to http://*ip_address_of_your_taurus*:8080/pwm/
    d) Confirm that the file has been uploaded correctly, by comparing the version number on the page with the version in the `release-2.`*xx*`.`*yy* directory.
12. From the telnet session, run the testcode script to set the installed files to Active and to force creation of a Version 2.*xx* data Store (this will delete the Version 1.*xx* data Store):
    ```
    ./testcode.sh -force
    ```
    The unit will reboot automatically.

Note The Taurus will try to use IDE as the recording medium on this reboot as that is the initial default with the new firmware. If you had CF as the configured recording medium prior to the upgrade, the Status page will indicate that no data are available. To select CF, log in either as `tech` (password is `tech`) or `central` (password is `central`). Choose Store Tools from the menu, then click **Switch Media** and follow the instructions shown in the UI.

13. After the Taurus has finished booting, indicated by the Ethernet LED blinking green, press the centre key for about 1 second to start the display. It will take the display a few minutes to start up. Check the Status page for normal operation (for example, you should see packets increasing for either recording medium, and waveforms moving on the Status page if your unit was previously configured to use IDE as the recording medium. See also the Note above this step).
14. To check if the upgrade was successful, go to the System Info page and confirm that versions are the same as those in the Taurus directory `/mnt/`*media*`/upgrade/release-2.`*xx*`.`*yy*. The items should map as follows, where `*` is the version number:

Taurus Firmware V:	*directory_name*	`(release-*)`
Digital Processor V:	`tdp-arm-*.nbf`	(ignore the A/B)
Signal Processor V:	`tdp-dsp-*.nbf`	
Power Manager V:	`tdp-pwm-*.nbf`	(ignore the A/B)
Filter Coefficients V:	`tdp-coeff-*.nbf`	
Fpga V:	`tdp-fpga-*.nbf`	
Flash Boot System V:	`tcp-uboot-*.bin`	(starts with `0.4.8 NMX *`)
Root File System V:	`tcp-rootfs-update-*.sh`	(starts with `NMX-*`)
Kernel V:	`tcp-uimage-.*`	(starts with `2.4.24-NMX-*`)
Apollo V:	`apollo-taurus-*.tgz`	

15. Go to the Taurus Log In page and log in as `central` (password `central`) and then set the Active firmware to Default: Click the **Commit** button.
16. In a browser window, confirm that the Active firmware is now also the Default firmware:
    a) Go to http://*ip_address_of_your_taurus*:8080/firmware/ and confirm that the new firmware is both Default and Active.
    b) Go to http://*ip_address_of_your_taurus*:8080/pwm/ and confirm that the new firmware is both Default and Active.
17. The upgrade is now complete. Optionally, you may remove the installation files from the Taurus: In the Upgrade page, select the installation filename from the drop-down list and then click **Delete**.

G.2 Upgrading Taurus from Version 2.00.*xx* or higher

Use the Taurus Web upgrade procedure for Taurus firmware upgrades after a Version 2.*xx* or higher has been installed. The scripts procedure described in Section G.1 is applicable only to upgrades from Version 1.*xx* to Version 2.*xx* (or higher) and will not be supported for future releases.

- Do not boot the Taurus in factory test mode for Web upgrades, boot it in normal mode. Factory test mode is required only for the scripts upgrade procedure described in Section G.1.
- Ensure that the Taurus is configured to Communications Mode before upgrading with the Web upgrade procedure (Section 3.1 “About the Taurus operating modes” on page 17).
- Uploading the file over your LAN using the Web upgrade may time out if you are using a proxy server. If this happens, you can change network settings to bypass the proxy server for local addresses. For example:
  - In Firefox, go to Tools > Options (General) > Connection Settings > No Proxy for: [use the address and mask width for a range of addresses, for example *w.x.y.*0/24].
  - In Netscape, go to Edit > Preferences > Advanced > Proxies > No Proxy for: [use the address and mask width for a range of addresses, for example *w.x.y.*0/24].
  - In Internet Explorer, go to Tools > Internet Options > Connections > LAN Settings [enable Bypass proxy server for local addresses] > Advanced > Exceptions [use the address and an asterisk wildcard for a range of addresses, for example *w.x.y.**].

G.2.1 Using the Taurus Upgrade page

This procedure requires that the Taurus be connected to a local network (LAN) using the supplied Ethernet cable (15228) or equivalent. You will require a Windows or Linux PC with an Internet browser to upload the new firmware and install it.

Taurus Versions 2.*xx* and higher provide an Upgrade page for firmware updates and upgrade file management. Follow this general procedure to use the Upgrade page:

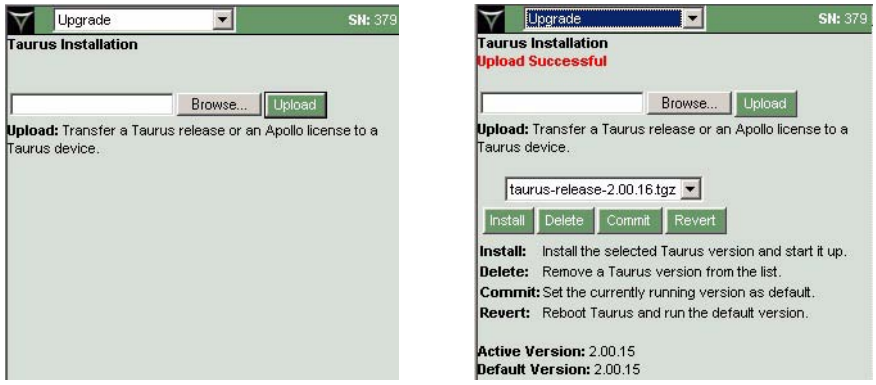
Warning Taurus Versions 2.00.16 and earlier use a data Store that is incompatible with versions higher than 2.00.16. Ensure that you download or back up your Store before upgrading to a version higher than 2.00.16, as the upgrade will delete the old Store.

Note The installation files will require about 50MB of space on the recording medium.

1. Obtain the Taurus firmware upgrade package (a `taurus-release_`*releaseNumber*`.tgz` file) and place it in a convenient folder on the Windows or Linux PC you will use to connect to the Taurus.
2. Boot the Taurus in normal mode.
3. Log in under the `central` account:
   a) On the Taurus menu, choose Log In.
   b) Enter the UserID `central` and the account Password (the initial default password is `central`), then click **Log In**.
4. Ensure the Taurus is set to Communications mode (see Section 3.1 “About the Taurus operating modes” on page 17).
5. In a browser on the Windows or Linux PC, choose Upgrade from the Taurus menu.

   If there are no `.tgz` files currently uploaded to the Taurus, the Upgrade page on a browser will show only the option to browse for an upgrade file (Figure G-1). The display will not have any options showing.
6. In a browser, click **Browse** and locate the Taurus upgrade package you want to use (a `taurus-release_*.tgz` file). Click **Upload** to upload the `taurus-release_`*releaseNumber*`.tgz` file to the Taurus.
7. The Upgrade page will now show the remaining upgrade management options. These options are also available on the Taurus display:
   - **Install** – Install the selected firmware package and start it up as the active version.
   - **Delete** – Remove the selected firmware upgrade file from the Taurus.
   - **Commit** – Set the currently running version of the firmware as default.
   - **Revert** – Reboot Taurus and run the default version of the firmware.

Figure G-1 Upgrade options before and after uploading a `.tgz` file to the Taurus



8. Ensure that the version you want to install is selected in the drop-down list.
9. Click **Install** to install the selected firmware. The unit will install the firmware (the files should finish installing within about 15 to 20 minutes) and then reboot automatically. The Taurus will take 2 or 3 minutes to finish rebooting.

   Once the firmware is installed and the unit has rebooted, the new firmware is active but it is not yet default. (You can run the unit with the active firmware but it will revert to the default firmware after a reboot.)
10. To set the new firmware as Default, log in as `centralt`, go to the Upgrade page, and click **Commit**.
11. The upgrade is now complete. Optionally, you may remove the installation files from the Taurus recording medium: In the drop-down list on the Upgrade page, choose the version you want to delete, then click **Delete**.

Appendix H UI Pages and Parameters

This appendix shows a map of the Taurus UI page hierarchy (Section H.1 “Taurus UI page map” with links to page descriptions), and provides a summary of the options available on each UI page.

Access to some options depends on the level of user access (for example, you can upgrade the Taurus firmware only if you are logged in as `centra l`; see also Table 6-1 “User permissions” on page 47). Availability of some options also depends on whether you are using a browser or the display (for example, data retrieval is available only via a browser).

H.1 Taurus UI page map

Go to the page number indicated for a description of the UI page and its parameters.

Status (p. 177)			
Waveform (p. 180)			
SOH (p. 181)			
Alerts (p. 181)			
Data Availability (p. 181)	Month (p. 182)		
	Week (p. 182)		
	Day (p. 182)		
	Text (p. 182)	Time Series (p. 182)	Time Series band (p. 183)
		Other (p. 183)	Other band (p. 183)
Data Retrieval (p. 183) [Browser only]	Time Series (p. 184)		
	Time Series By Event (p. 185)		
	State of Health (p. 186)		
	System Logs (p. 187)		
	System Configuration (p. 187)		
Timing (p. 187)	Timing (p. 187)		
	GPS Satellites (p. 188)		
	GPS Map (p. 189)		
Sensor (p. 189)			
Store Tools (p. 190)			
Configuration (p. 190) [Log in to access]			
System Info (p. 191)			
Advanced Configuration (p. 191) [Log in to access]	General (p. 192)		
	Communications (p. 193)	Ethernet (p. 193)	
		Data Streaming (p. 194)	
		Serial Port 1 (p. 194)	SLIP (p. 195)
			Raw (p. 195)
			PPP (p. 195)
			TDMA (p. 196)
		Serial Port 2 (p. 196)	
		Discovery (p. 196)	
	Security (p. 197)		
	Playback (p. 197)		
	Timing configuration (p. 198)		
	Calibration (p. 198)		
	Sensor Details (p. 199)	Sensor Control Lines (p. 200)	
		Mass Auto-Centering (p. 201)	
	Digitizer (p. 202)	Main (p. 202)	
		Front End (p. 203)	
		Triggers (p. 204)	Input Filter (p. 204)
			Detectors (p. 205)
	Power (p. 205)		
Upgrade (p. 206) [Log in to access]			
Log In/Log Off (p. 207)	Change Password (p. 207)		
Shutdown (p. 208)			

H.2 Status

The Status page shows basic unit and system status information in read-only fields, and widgets such as status bars and waveform images (Table H-1).

Status bars indicate subsystem status using a colour code and a text message; some of these also provide a link to the relevant SOH or configuration page. The status colour codes correspond to the status LED states. That is, red indicates an error state that must be investigated and fixed, green indicates that everything is working properly, and yellow indicates a temporary situation that will resolve either to a red or a green state.

Table H-1 Status page options

Parameter/Widget	Description
Mode	The running mode for collecting data (Buffered | Communications). (Configured in either Advanced Configuration > General – Running Mode, or in Configuration – Running Mode.)
Channels	*Number of channels @ Sample rate*. (Options are configured in Advanced Configuration > Digitizer > Main – Output Channels and Sample Rate [Hz], or in Configuration – Output Channels and Sample Rate [Hz].)
Store(*Type*)	The space used as percentage of configured Store size on the active recording medium. (The recording media type is configured with options on the Store Tools page.)
Store Time Left | Avg Time in Store	Store Time Left is the estimated number of days of recording space remaining in the active Store at the current sample rate. Once the Store has wrapped (that is, it has recorded data to the configured Store capacity and started to record over old data), it changes to a continuously recalculated average quantity of data in the Store, expressed as the number of days or hours of data.
IP	The current IP address of the Taurus, in dotted decimal format. (The assignment method for the IP address is configured in Advanced Configuration > Communications > Ethernet – Mode.)
Time	Shows the current time as *yyyy-mm-dd HH:mm:ss* (uses Controller time; see Table 8-1 “Taurus time definitions” on page 79). GPS options are configured in Advanced Configuration > Timing.
Battery	The power supply level in volts. (Battery options are configured in Advanced Configuration > Power.)
Power	The average power consumption of the Taurus in watts. This will include power consumption of any externally connected devices such as a seismometer, serial device, or a device connected to the External SOH.
Temp	The temperature inside the Taurus in degrees Celsius.
Packets	The number of data packets recorded to the Store since the Controller was started.

Table H-1 Status page options (Continued)

Parameter/Widget	Description
Timing status bar	The timing status bar indicates the status of the system time and its inputs with a status colour and a text message, and provides a link to the Timing page. Timing configuration options are on the Advanced Configuration > Timing page. (See Table 8-1 “Taurus time definitions” on page 79 for definitions of Taurus derived times.) Note that: • System time starts from zero on power-on, and has not been set properly until Time status has been Green at least once since power-on. • PLL state < Coarse Lock = either Free Running or No Lock.

Colour	Text	Indicates...
Red	No Antenna	Antenna open is detected. This is a hardware fault condition even if Taurus time is OK. The Lassen iQ GPS receiver can detect an antenna open condition, but the Lassen SQ GPS receiver cannot. If your Taurus uses the SQ, this status report option is not available.
	Antenna Short	Antenna short is detected. This is a hardware fault condition even if Taurus time is OK.
	GPS Off	Either of these conditions: • System Time has not been set yet after power-on, GPS is off. • Timing status was Green at least once, Time Uncertainty >= 100µs, GPS is off.
	GPS Failed	Either of these conditions: • System Time has not been set yet after power-on, PLL state has not reached Coarse Lock, GPS has been switched on for longer than the initialization time limit. • Timing Status was Green at least once, Time Uncertainty >= 100µs, GPS is on.
	Bad Time	Either of these conditions: • System Time has not been set yet after power-on, GPS is on, PLL state has reached Coarse Lock or better, Time Error >= 100µs. • Timing Status was Green at least once, PLL state >= Coarse Lock, Time Error >= 100µs.
Yellow	GPS Init	System Time has not been set yet after power-on, GPS is on, PLL state has not reached Coarse Lock, GPS is on for shorter than the initialization time limit.
Green	Time OK	Either of these conditions: • PLL state has not reached Coarse Lock and Time Uncertainty < 100µs. • PLL state has reached Coarse Lock or better and Time Error < 100µs.

Table H-1 Status page options (Continued)

Parameter/Widget	Description
Media door status bar	The media door status bar indicates the status of the media door, with a status colour and a text message. • Red, with text “Door Open”. • Green, with text “Door Closed”. The media door should be closed while the Taurus is operating at an installation.
Store status bar	The Store status bar indicates the status of the Store and the active recording medium, with a status colour and a text message, and provides a link to the Store Tools page. • Red, with various messages indicating that a Store is not available (for example, during reindexing, or if no media are installed). • Green, indicates data are being recorded to the currently active Store.
Sensor power status bar	The sensor power status bar indicates the sensor power status, with a status colour and a text message, and provides a link to the Sensor page. Sensor configuration options are on the Advanced Configuration > Sensor Details page, and control options are on the Sensor page. It uses these inputs: • Advanced Configuration > Sensor Details – Needs Power • Advanced Configuration > Sensor Details – Detect Sensor Presence • Sensor – Sensor [**On** | **Off**]

Colour	Text	Indicates...
Red	Sensor No Power	The sensor is configured as Needs Power enabled ☑ and Sensor **Off**.
	Sensor Powered	The sensor is configured as Needs Power not enabled ☐ and Sensor **On**.
	Sensor No Current*	The sensor is configured as Needs Power enabled ☑, Detect Sensor Presence enabled ☑, Sensor **On**, but it is not consuming any power. (Detect sensor presence works only for sensors drawing more than about 8 mA.)
Green	Sensor Power	Either of these conditions: • The sensor is configured as Needs Power enabled ☑, Detect Sensor Presence enabled ☑, Sensor **On**, and it is consuming power. • The sensor is configured as Needs Power not enabled ☐ and Sensor **Off**.

* If there is a No Current error for a sensor that normally draws more than 8 mA, it probably means either that the sensor is not connected, or the power manager has cut off power to the sensor. In the latter case, the Status Page will show red for both the sensor status and for the power status.

Table H-1 Status page options (Continued)

Parameter/Widget	Description
Power manager status bar	The power manager status bar indicates the status of external device current draw, with a status colour and a text message. • Red status, with text Power OverCurrent: An external device (on either the serial or the sensor connector) has drawn too much current and has been shut off. Sensor power can be turned back on (assuming the fault condition has been fixed) in the Sensor page (see Section H.9 “Sensor” on page 189). The Taurus must be power-cycled to restore serial power once it has been tripped. • Green status, with text Power: Power usage of external devices is within tolerance.
Ethernet status bar	The Ethernet status bar indicates the status of Ethernet networking, with a status colour and a text message. (Some status conditions, such as Ethernet Off, can only be viewed on the display.) • Red status, with text Ethernet: Ethernet networking is enabled, but there is no link. • Green status, with text Ethernet: Ethernet networking is enabled and a link is established. • Green status, with text Ethernet Off: Ethernet networking is not enabled. Ethernet configuration options are in the Advanced Configuration > Communications page and the Advanced Configuration > Communications > Ethernet page.
Waveform images	One waveform image for each channel shows the time-series data in near-real time.

H.3 Waveform

The Waveform page shows a waveform in near-real time for each channel, with DC offset correction. There are options to view a single channel at a time or all three channels, pause the waveform display, and adjust the scale (Table H-2).

Table H-2 Waveform page options

Parameter/Widget	Description
Time scale	Choose the time scale width in seconds. • Options: 5, 10, 15, 30, 60, 120. Factory default is 30.
Vertical scale	Choose the amplitude scale in counts. The setting presently in use is shown on the upper right of the waveform. After about 1 minute from startup of the Controller, the waveform will show AC RMS and DC average. On a single-waveform display, the minimum and maximum values of the visible data are also shown as a numeric value. • Options: Auto (for automatic scaling of each channel independently), 20e6, 10e6, 1e6, 100e3, 10e3, 1e3, 100, 10, 5, 2). Factory default is Auto.
Pause/Resume	Pause the waveform display, or resume a paused waveform. You cannot adjust the scale on a paused waveform.
Show One/Show Three	View one waveform at a time, or view all channel waveforms simultaneously.
Next Channel	View the next channel waveform, if Show One is selected.

Table H-2 Waveform page options (Continued)

Parameter/Widget	Description
Waveform images	One waveform image for each channel displays data in near-real time.

H.4 SOH

The SOH page shows a summary of the Taurus state of health as of the time shown (Table H-3). You can download detailed SOH information as `.csv` files (see Section H.6 “Data Availability” on page 181 and Section 11.3.1 “Extract State of Health data to a `.csv` file” on page 116).

Table H-3 SOH page options

Parameter	Description
Temperature	Internal temperature of the Taurus in degrees Celsius. Read only.
Battery Voltage	The power supply voltage, accurate to ±0.2V. Read only. Battery power cutoff options are on the Advanced Configuration > Power page.
Serial Current	An estimate of the current drawn by a connected serial device. It is accurate to about ±15% for currents over 100mA. Read only.
NMXbus Current	An estimate of the current at the external NMXbus connector. (External NMXbus is not yet supported.) Read only.
Sensor Current	An estimate of the current drawn by the connected sensor (for sensors that draw more than about 8mA). It is accurate to about ±15%. Read only.
Controller Current	An estimate of the current drawn by the Taurus controller board. It is accurate to about ±15%. Read only.
Digitizer Current	An estimate of the current drawn by the Taurus Digitizer board. It is accurate to about ±15%. Read only.
External 1 / 2 / 3 / 4	Voltage on the specified External SOH connector. Read only.
Time	Last update time of the SOH information. (Controller Time; see Table 8-1 “Taurus time definitions” on page 79). Read only.

H.5 Alerts

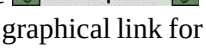
The Alerts pages show a list of occurrences such as startups, shutdowns, and major errors. Alert messages include the timestamp and a brief description. You can use these message timestamps as reference points for searching through log files for events that generated an Alert. See also Section 3.8.7 “Alert messages” on page 30.

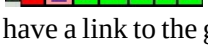
H.6 Data Availability

The Data Availability pages show graphical and text summaries of data availability. There is a graphical summary of the time-series data availability under the appropriate tab for a selected month, week, or day. Under the Text tab are text summaries with links

to detailed availability information for each channel (band) of data. Text summaries are available for both time-series and the other data types (such as SOH).

H.6.1 Month

The Data Availability > Month page shows a calendar-view summary of time-series data availability for the selected 6-week period. The graphical links at the top of the page 

scroll the calendar view in 2-week increments back or forward. The graphical link for each week 

opens the selected Week view. Any day for which there are data gaps have a link to the graphical summary for that day. The default view shows the current or most recently selected week at the bottom of the calendar. A legend for the colour-coding for Percent Data Available is shown at the bottom of the page. The Refresh link updates the page.

H.6.2 Week

The Data Availability > Week page shows a graphical summary of the time-series data availability for each channel for the selected week. The graphical links at the top of the page 

open the previous and next Week pages. The date links open the graphical summary for that day. It defaults to either the current or the most recently-selected week, or the last week on the Month calendar view, depending on your previous selections. The Refresh link updates the page.

H.6.3 Day

The Data Availability > Day page shows a graphical summary of the time-series data availability for each channel for the selected day. The graphical links at the top of the page 

open the previous and next Day pages. It defaults to either the current or the most recently-selected day, or the last day on the Month calendar view, depending on your previous selections. The Refresh link updates the page.

H.6.4 Text

There is a Data Availability > Text page for each of Time Series data and Other data. These pages show data availability and gap information. A gap can be either a data gap (data packets are missing), or a time tear (a time jump with no missing packets; for example, caused by a time adjustment after an extended GPS reception outage), or both (for example, after the power has been disconnected for an extended period).

H.6.4.1 Time Series

The Data Availability > Text > Time Series page shows a text summary of the available time ranges of data for each time series channel (band), the number of data gaps and time tears, and the quantity of data as both units of time and as the percentage of space used in the Store. The band name links to a page showing details about all gaps for that band. The Refresh link updates the page.

H.6.4.1.1 Time Series band

Each Data Availability > Text > Time Series > *band* page shows details about availability for that band. The page shows the quantity of data as the percentage of space used in the Store, the available time range of data, the number of gaps (includes both data gaps and time tears), and a list of all gaps that exceed the gap tolerance, with the number of packets missing (if that information is available), and the gap duration. You can select a gap tolerance for this band from the Gap Tolerance drop-down list (options are 5 min, 1 min, 30 s, 1 s, 500 ms, none). The Refresh link updates the page, and the All Channels link opens the main Time Series page.

H.6.4.2 Other

Other data types include alert, config, log (apollo, DSP, ARM), SOH (ARM, controller), and triggers. The Data Availability > Text > Other page provides a text summary of the available time ranges of data for each band of data, the number of data gaps and time tears, and the quantity of data as both units of time and as the percentage of space used in the Store. The band name links to a page showing details about all gaps for that band. The Refresh link updates the page.

H.6.4.2.1 Other band

Each Data Availability > Text > Other > *band* page shows details about availability for that band. The page shows the quantity of data as the percentage of space used in the Store, the available time range of data, the number of gaps (includes both data gaps and time tears), and a list of all gaps that exceed the gap tolerance, with the number of packets missing (if that information is available), and the gap duration. You can select a gap tolerance for this band from the Gap Tolerance drop-down list (options are 5 min, 1 min, 30 s, 1 s, 500 ms, none). The Refresh link updates the page, and the All Channels link opens the main Time Series page.

H.7 Data Retrieval

The Data Retrieval pages provide options to extract data from the Store to a file. This section provides a brief overview of the Data Retrieval pages. See Chapter 11 “Accessing Data” for detailed information and procedures.

One data download can be run at a time. Any subsequent download requests are processed pending completion of the download in progress. Use the **Next** button to navigate within a download session, to ensure that your choices are preserved.

For all data types, the data retrieved are all of the samples from the specified start time up to but not including the sample at the specified end time.

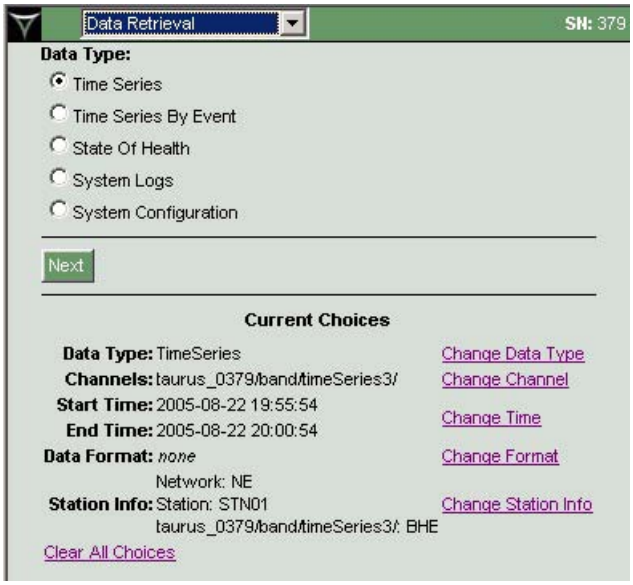
The main Data Retrieval page provides options to choose the type of data to extract to a file. Data types include:

- Time Series
- Time Series By Event
- State Of Health
- System Logs

- System Configuration

To set options for the download for a new session or new data type, click **Next**. If any data download selections have already been made, a summary of the current choices is shown at the bottom of the page (for example, Figure H-1). To set options for a subsequent session with the same data type, you may use either the **Next** button or a Current Choices link.

Figure H-1 Data Retrieval page showing time-series current choices



H.7.1 Time Series

The Time Series pages provide options to download recorded data to a file. Options to delimit the data are grouped on the corresponding linked pages listed below. See Section 11.2.1 “Extract time-series data to a file” on page 109.

- Change Data Type: Choose a data type to download.
- Change Channel: Choose one or more time-series channels.
- Change Time: Choose a start date and time, and a duration.
  - Show Available Times: Shows time and gap information for each data band.
- Change Format: Choose ASCII, Seisan, or MiniSEED format. The current version cannot download more than 488 MB of data in MiniSEED format or Seisan format. Use multiple downloads for quantities of data that exceed 488 MB. MiniSEED files use a 512 byte Data Record Length. Seisan downloads use a conversion tool (Section 11.1.3.3 “Initial setup for extracting to Seisan format” on page 108).
- Change Station Info: Edit station information for the downloaded data file headers. You can change Network Name, Station Name, and Channel Names.
- Clear All Choices: Reset all options to the defaults.

H.7.2 Time Series By Event

The Time Series By Event pages provide options to retrieve data from a Taurus using information from an event list. The event list may be a file that you upload to the Taurus, or information for a single event that you enter into a text form. The Taurus calculates arrival times for various phases that are applicable to the event selected. You may then download the data for available events. See Section 11.2.2 “Extract seismic data to a file by event from an event list” on page 111.

Options to delimit the data are grouped on the corresponding linked pages listed below.

- Change Data Type: Choose a data type to download.
- Change Channel: Choose one or more time-series channels.
- Change Time: Choose a different start date, time, and duration. (The initial time is set automatically on the Change Time By Phase page.)
  - Show Available Times: Shows time and gap information for each data band.
- Change Time By Phase: Choose a start time and duration automatically using the available phase data uploaded with the event.
- Change Format: Choose ASCII, Seisan, or MiniSEED format. The current version cannot download more than 488 MB of data in MiniSEED format or Seisan format. Use multiple downloads for quantities of data that exceed 488 MB. MiniSEED files use a 512 byte Data Record Length. Seisan downloads use a conversion tool (Section 11.1.3.3 “Initial setup for extracting to Seisan format” on page 108).
- Change Station Info: Edit station information that will be used in the downloaded data file headers. You can change Network Name, Station Name, and Channel Names.
- Change Event: Choose a different event from the event list. (The page may take a minute to load if there is a large list of events.)
- Clear All Choices: Reset all options to the defaults, including deleting the uploaded event file.

Table H-4 Time Series by Event file upload options

Parameter/Widget	Description

File format	Choose the type of event list file to upload (click the radio button). Each link opens the relevant site search page in a new window.
	Options include:
	• IRIS Search - ASCII
	  • http://www.iris.edu/quakes/eventsrch.htm. Do a search, then save using the ASCII Version link. Upload the ASCII version to Taurus.
	• NEIC Epic Search - Compressed
	  • http://neic.usgs.gov/neis/epic/. Choose a search type (Global, Rectangular, or Circular), then choose '2. Compressed File Format' for the output file type. Save then upload the search to the Taurus (as `.html`).
	• NEIC Finger http://neic.usgs.gov/neis/finger/quake.asc. Save the document (`quake.asc`) and upload it to the Taurus.

File upload	Browse for or enter the file path and name of the file to upload, then click **Upload** to upload the file.

Table H-4 Time Series by Event file upload options (Continued)

Parameter/Widget	Description
Event list	The list of all events from the uploaded file. You may choose an event to search for in the Store (click the radio button).

Event form	▸ Click the radio button to select the event once you have filled in the event form fields.
	Text fields are provided for you to enter an event manually:
	• Label: The event name, as an ASCII string of any length.
	• Time: An ASCII string of the format *yyyy-MM-dd HH:mm:ss*
	• Location/Depth(km):
	  • lat: Latitude, –90 to +90 degrees.
	  • lon: Longitude, –180 to +180 degrees.
	  • depth: Depth in kilometres, integer from 0 to $2^{31} – 1$.

Table H-5 Time Series by Event time selection by phase options

Parameter/Widget	Description
Pre Event Time	Number of seconds of data to download preceding the calculated start time.
Start Phase	Available phases that you may choose to set a start time automatically. Phase options are loaded according to what would be available for an event at that location relative to the Taurus location at the time the data were recorded.
Post Event Time	Number of seconds of data to download following the calculated end time.
End Phase	Available phases that you may choose to set an end time automatically. Phase options are loaded according to what would be available for an event at that location relative to the Taurus location at the time the data were recorded.
Selected Events	Read-only information identifying the selected event.

H.7.3 State of Health

The State of Health pages provide options to download SOH information from a Store to a `.csv` file. Options to delimit the data are grouped on the corresponding linked pages listed below. See also Section 11.3.1 “Extract State of Health data to a `.csv` file” on page 116.

- Change Data Type: Choose a data type to download.
- Change Time: Choose a start date and time, and a duration.
  - Show Available Times: Shows time and gap information for each data band.
- Change SOH Data: Choose a different set of SOH data to download.

Predefined sets of some SOH data (Table 11-1 on page 117) are provided in the drop-down list on the SOH Data page. This is the recommended method for SOH data types that are included in a predefined download, as the predefined options include those SOH columns in context.

For other SOH data you can download individual columns. The default option (User Selected) shown in the drop-down list is used only for selecting individual SOH columns for download. Use the **Add**/**Remove** and **Move** *x* buttons to populate and sort the selected columns. Use this option to download trigger information.

H.7.4 System Logs

The System Logs pages provide options to download all system log data (Apollo, ARM, DSP) for the selected time period to a text file. Options to delimit the data are grouped on the corresponding linked pages listed below. See also Section 11.3.2 "Extract system logs to a `.log` file" on page 119.

- Change Data Type: Choose a data type to download.
- Change Time: Choose a start date and time, and a duration.
  - Show Available Times: Shows time and gap information for each data band.
- Clear All Choices: Reset all options to the current defaults.

H.7.5 System Configuration

The System Configuration pages provide options to download the current system configuration information to a text file. This information is an audit trail of all configuration changes, it is not a valid configuration file (see Section 5.5 on page 45 for information on downloading and uploading valid configurations). Options to delimit the data are grouped on the corresponding linked pages listed below. See also Section 11.3.3 "Download the configuration audit trail to a `.cfg` file" on page 119.

- Change Data Type: Choose a data type to download.
- Change Time: Choose a start date and time, and a duration.
  - Show Available Times: Shows time and gap information for this data band.

H.8 Timing

The Timing page includes pages showing the status of the system clock, GPS satellites, and a GPS satellites map. You can download timing SOH information as `.csv` files (see Section H.7 "Data Retrieval" on page 183 and Section 11.3.1 "Extract State of Health data to a `.csv` file" on page 116). There is a corresponding Timing status bar on the Status page (see the relevant entry in Table H-1 "Status page options" on page 177). GPS and timing configuration options are in the Advanced Configuration > Timing page (Section H.13.5 on page 198).

H.8.1 Timing

The Timing page shows information about the system clock and GPS receiver status (Table H-6).

Table H-6 Timing status page options

Parameter group	Parameter	Description
System Clock	System Time	System time (see Table 8-1 “Taurus time definitions” on page 79).
	PLL State	Phase lock to GPS.
	Uncertainty	Uncertainty of System Time.
	Time Error	The amount of time by which System Time differs from GPS Time (see also Table 8-1 “Taurus time definitions” on page 79).
	DAC Count	The value used to calculate the time base. Read only.
GPS Engine	State	The current activity of the GPS receiver (for example, searching for usable satellites).
	# Satellites	The number of usable satellites.
	PDOP	Position dilution-of-precision. A standard estimate of the GPS position precision, based on the geometry of the visible satellites. A lower value indicates a more precise solution. The GPS receiver will not generate a solution if the PDOP is too high.
	TDOP	Time dilution-of-precision. A standard estimate of the GPS time precision, based on the geometry of the visible satellites. A lower value indicates a more precise solution.
Location	Latitude	The current latitude of the Taurus.
	Longitude	The current longitude of the Taurus.
	Altitude	The current altitude of the Taurus in metres.

H.8.2 GPS Satellites

The GPS Satellites page shows information about each usable GPS satellite (Table H-7).

Table H-7 GPS Satellites page options

Parameter	Description
PRN	The PRN (pseudo-random noise) code used to identify each satellite.
Status	The tracking status for this satellite.
Elevation	The elevation angle of the satellite in degrees. It ranges from 0° to 90° (0° is parallel to the surface of the Earth).
Azimuth	The azimuth of the satellite in degrees, measured clockwise from true North.
Signal	The strength of the signal in AMUs (antenna measurement unit, a measure of signal to noise ratio; to convert, $C/N_0 = 27 + 20\log10(SNR[AMUs])$.
Last Updated	The System Time when the GPS receiver last updated the information for a specific satellite (see also Table 8-1 “Taurus time definitions” on page 79).

H.8.3 GPS Map

The GPS Map page provides a visual summary of GPS satellite status and related information (Table H-8).

Table H-8 GPS Map page options

Parameter/Widget	Description
PDOP	Position dilution-of-precision (see Table H-6).
TDOP	Time dilution-of-precision (see Table H-6)
GPS satellite skyplot	A skyplot showing positions of the usable GPS satellites, labelled with the PRN codes, and a graph of the received signal strength of each satellite in AMUs.
Update Time	The System Time when the GPS data (including the GPS time) was last updated (see also Table 8-1 “Taurus time definitions” on page 79).
GPS State	Tracking status of the GPS receiver.
Location	The latitude and longitude of the Taurus, and the altitude of the Taurus in metres.

H.9 Sensor

The Sensor page provides sensor control and calibration command options, and status indicators (Table H-9). See also Chapter 9 “Controlling and Configuring Sensors”.

Table H-9 Sensor page options

Parameter/Widget	Description
Mass Center	A function button to send a mass centre command.
Mass – Lock, Unlock	Function buttons to lock and unlock sensor masses.
Mass centre images	A graphic showing mass centring of each component, with auto-centre voltage thresholds as configured in the Advanced Configuration > Sensor Details > Mass Auto Centering page.
Sensor – On, Off	Function buttons to turn power to the sensor on and off.
Sensor power field	An estimate of the sensor power consumption in watts, accurate to about ±15% for sensors drawing more than about 8mA.
Calibration – Start, Abort	Function buttons to send a calibration command, and to abort a calibration in progress. Configuration options are in the Advanced Configuration > Calibration page.
System Sensitivity	System sensitivity in cnt/(m/s) or cnt/(m/s/s). It is calculated using the sensor Sensitivity Value from the Advanced Configuration > Sensor Details page, and the Digitizer Input Range and Software Gain from the Advanced Configuration > Digitizer > Front End page. It is expressed in counts per unit of velocity or acceleration as appropriate using the selected Sensitivity Units on the Advanced Configuration > Sensor Details page.

Table H-9 Sensor page options (Continued)

Parameter/Widget	Description
Waveform images	A waveform in near-real time for each channel, with scaling options and waveform selection options as on the Waveform page (see Table H-2 on page 180).

H.10 Store Tools

The Store Tools page shows information about the active recording medium (IDE drive or CF card) and the availability of other media. If you are logged in, it also provides media and Store management options (Table H-10). See also Chapter 10 “Recording Data”.

Table H-10 Store Tools page options

Parameter/Widget	Description
Active Media	A read-only identifier of the active media type, either IDE (IDE hard drive) or CF (CompactFlash card).
Active Store Size	The capacity of the active Store. This is configured at the time the Store is created.
Store Space Used	A read-only field showing the amount of space used in the active Store.
other medium Available	A read-only field that indicates whether an Ext3-formatted recording medium is available in the other slot. Options are Yes, and “No, or not formatted”.
Switch Media	A wizard to switch recording of data onto a Store in the other media slot (if available). This does not move existing data between these Stores.
Format *media*	A wizard to format the recording medium in the other slot. All data and partition information on the medium will be erased.
Reindex Store	A wizard to reindex the entire Store on the active medium.
Delete Store	A wizard to replace the current Store on the active medium with a new Store. All data in the old Store will be erased.

H.11 Configuration

The Configuration page provides configuration options that are assumed to be accessed more frequently (Table H-11). You must log in as `tech` or `centra`l to use this page. Each of the options is also available in the Advanced Configuration pages.

Table H-11 Configuration page options

Parameter/Widget	Description
Running Mode	The operating mode of the Taurus, either Buffered or Communications. This option is also in the Advanced Configuration > General page (Section H.13.1 on page 192).

Table H-11 Configuration page options (Continued)

Parameter/Widget	Description
Output Channels	The number of channels, 0 to 3. This option is also in the Advanced Configuration > Digitizer > Main page (Section H.13.8.1 on page 202).
Sample Rate	The sample rate in samples per second. This option is also in the Advanced Configuration > Digitizer > Main page (Section H.13.8.1 on page 202).

H.12 System Info

The System Info pages show the revision information for this Taurus. Click the appropriate page link (Firmware or Hardware) to view the information.

- Firmware page – Indicates the version of Taurus software that is installed, and the version information for each of the firmware components.

  In a browser this page also has a link to download the revision information, for both the hardware and firmware, as a text file (Section 11.3.4 on page 120).
- Hardware page – Shows the serial number and revision information for each of the Taurus sub-assemblies.

H.13 Advanced Configuration

The Advanced Configuration page provides links to various configuration sub-pages, and options to manage the configuration (Table H-12). Availability of pages depends on the level of user access (see Chapter 6 “Configuring Taurus User Access”).

- All of the General, Communications, Security, Playback, Timing, Calibration, Sensor Details, Digitizer, and Power configuration pages are accessible if you are logged in as `central`.
- All configuration pages except the Security page are accessible if you are logged in as `tech`.
- No configuration pages are available if you are logged in as `user` (`user` access does allow access to the Store Tools options).

Table H-12 Advanced Configuration page options

Parameter/Widget	Description
Hyperlinks	Save all changes in a temporary cache and open the linked configuration page.
Previous	Save all changes in a temporary cache and open the configuration page that is at the previous level in the hierarchy. ▸ In a browser always use the **Previous** button, not the browser’s Back button, to preserve unapplied changes when navigating back through configuration pages.

Table H-12 Advanced Configuration page options (Continued)

Parameter/Widget	Description
Apply	Apply all changes that have accumulated in the temporary cache, for example if you have applied changes from several configuration pages. Nothing is applied if an invalid parameter is found. Applied changes that have not yet been committed are discarded when you restart the associated Taurus subsystem (Controller only, or any other component; see Section 5.1 “Configuration format and storage” on page 43). See Section 5.4.2 “Undo applied changes” on page 45 for discarding complex transactions (those that contain many applied changes). Some changes require a commit and restart before they become active. If a restart is required, a message will be displayed.
Commit	Commit all applied changes, and any subsequent new changes that have accumulated in the temporary cache. Committed changes are permanent. **Commit** includes **Apply**. Nothing is committed if an invalid parameter is found. Some committed changes require a restart before they become active. If a restart is required, a message will be displayed.
Reset	Discard all unapplied changes from the temporary cache.
Browse	This option is available in a browser. Browse for a Taurus configuration file on your file system.
Upload	This option is available in a browser. Upload and apply the selected configuration file to your Taurus. You can upload a partial configuration without affecting the rest of the configuration; for example, predefined sensor configurations from the `/sensors` directory. See also see Section 5.5.2 “Upload a configuration file to the Taurus” on page 46.
Download	This option is available in a browser. Download the configuration from your Taurus to your file system. You can upload this configuration to other Tauruses.

H.13.1 General

The Advanced Configuration > General page provides options to change miscellaneous settings (Table H-13).

Table H-13 General page settings

Parameter/Widget	Description
UI TimeOut [min]	The time delay in minutes before Taurus shuts down the display and Interactive mode, and reverts to the configured Running Mode. Options are 10, 20, 30, 60, 120. Factory default is 10. This parameter is overridden by UI activity and data downloads as described in Section 3.1.2 “Interactive mode” on page 17.
Apollo Log Verbosity	The level of detail of the Apollo log. Options are Info, Verbose, Debug (Info is normal operation messages, Debug is all messages). Factory default is Info.
Running Mode	The operating mode of the Taurus after Interactive mode ends. Options are Buffered, and Communications. This option is also in the Configuration page.

Table H-13 General page settings (Continued)

Parameter/Widget	Description
Soh Report Interval [s]	The SOH sampling rate in seconds, including some internal SOH and the 4 External SOH channels (see also Section 3.8.5.1 on page 30). Integer from 5 to 3600. Factory default is 60.
Post Data Interval [ms]	Do not change this setting from the factory default (2000 ms.)
ARM Log Verbosity	The level of detail of the ARM log. Options are Info, Verbose, Debug (Info is normal operation messages, Debug is all messages). Factory default is Info.

H.13.2 Communications

The Advanced Configuration > Communications page provides an option to set the Taurus default networking interface, and links to related sub-pages (Table H-14).

Table H-14 Communications page options

Parameter/Widget	Description
Default Interface	Specify on which interface the routing gateway is located (Ethernet or Serial Port 1). All packets not on an immediate subnet (more than a single hop) will be sent to a gateway determined by that interface. The gateway is configured as an IP address of a machine. The Taurus may have multiple gateways configured, and the Default Interface specifies which gateway is in effect; only one is allowed. • Ethernet – The gateway used is the one obtained from the settings specified from the Ethernet settings page. • Serial Port 1 – The gateway used is the Remote IP Address configured in Serial Port 1. The serial port must be in either SLIP or PPP mode for this setting.
Hyperlinks	Links to sub-pages Ethernet, Data Streaming, Serial Port 1, Serial Port 2, and Discovery. (See Table H-12 on page 191 for a description of hyperlink behaviour on configuration pages.)
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.1 Ethernet

The Advanced Configuration > Communications > Ethernet page provides options to set Ethernet networking parameters (Table H-15). See also Section 7.2 “Communications over Ethernet” on page 54.

Table H-15 Ethernet page options

Parameter/Widget	Description
Mode	The method Taurus will use to acquire an IP address. Options include DHCP, Link-Local, Static IP, and None (disable Ethernet). Factory default is DHCP.
Static IP Address	The IP address assigned to the Taurus, applicable only if Mode is set to Static IP. Factory default is 127.0.0.1.

Table H-15 Ethernet page options (Continued)

Parameter/Widget	Description
Static Subnet Mask	The network mask for the Taurus Static IP Address. Factory default is 255.255.255.0.
Static Default Gateway	The default gateway address for Static IP.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.2 Data Streaming

The Advanced Configuration > Communications > Data Streaming page provides options for streaming data from Taurus (Table H-16). See also Section 11.2.3 “Stream time-series data to a central acquisition server” on page 115.

Table H-16 Data Streaming page options

Parameter/Widget	Description
Stream NP Packets	Set Taurus to stream data to a specified data acquisition server (NAQS, Apollo) at the specified IP address and Port number. Options are enabled ☑, not enabled ☐. Factory default is not enabled. It is not enabled if Running Mode is set to Buffered (set in either the Configuration page or the Advanced Configuration > General page).
IP Address	The address of the destination server; a valid IP address in dotted decimal format. The destination IP address can be either a multicast address or a unicast address.
Port #	The port number used for NpToNmxp. Factory default is 32004.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.3 Serial Port 1

The Advanced Configuration > Communications > Serial Port 1 page provides options to set the serial communication protocol and has links to related sub-pages (Table H-17). See also Section 7.3 “Communications over serial” on page 55.

Table H-17 Serial Port 1 page options

Parameter/Widget	Description
Mode	Choose the serial port protocol. Options are Raw, SLIP, PPP. Factory default is Raw.
Hyperlinks	Links to sub-pages SLIP, Raw, PPP, and TDMA. (See Table H-12 on page 191 for a description of hyperlink behaviour on configuration pages.)
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.3.1 SLIP

The Advanced Configuration > Communications > Serial Port 1 > SLIP page provides options to set up a SLIP connection for streaming data (Table H-18).

Table H-18 SLIP page options

Parameter/Widget	Description
Speed [bps]	The data rate for SLIP mode. Options are 9600, 14400, 19200, 38400, 57600. Factory default is 9600.
Protocol	Protocol options include SLIP, and CSLIP (compressed for lower bandwidth usage).
Local IP	The IP address of the local (Taurus) SLIP interface.
Remote IP	The IP address of the remote SLIP interface.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.3.2 Raw

The Advanced Configuration > Communications > Serial Port 1 > Raw page provides the option to choose the transmission rate between Taurus and a connected serial device. Options are 9600, 14400, 19200, 38400, 57600; factory default is 9600. See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.3.3 PPP

The Advanced Configuration > Communications > Serial Port 1 > PPP page provides options to set up a PPP connection for streaming data (Table H-19).

Table H-19 PPP page options

Parameter/Widget	Description
Speed [bps]	The date rate for PPP mode. 9600, 14400, 19200, 38400, 57600. Factory default is 9600.
Local IP	IP address for the local PPP interface in dotted decimal format (for example, 10.0.0.1).
Remote IP	IP address for the remote PPP interface in dotted decimal format (for example, 10.0.0.1).
Connection Type	Specifies the nature of the connection. Options are direct, and dial-in. Direct is a direct connection to the Taurus via a serial cable or a transparent serial modem line. For dial-in, the Taurus accepts a PPP connection request from a client using a dial-up modem.
Modem init string	The modem initialization string for dial-in (for example, AT&F1 OK). Factory default is empty.
Extra modem init string	An additional modem initialization string for dial-in (for example, ATS0=0 OK). Factory default is empty.
Authentication	Indicates if authentication is required from the PPP client. Factory default is enabled (authentication required).

Table H-19 PPP page options (Continued)

Parameter/Widget	Description
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.3.4 TDMA

The Advanced Configuration > Communications > Serial Port 1 > TDMA page provides options to set up time slot access for this Taurus to a SLIP link (Table H-20).

Table H-20 TDMA page options

Parameter/Widget	Description
Enable TDMA	Set whether to use TDMA. When TDMA is enabled, Taurus will send data to Serial Port 1 only during the defined time slot. When TDMA is not enabled, data are sent immediately when the line is idle. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Frame Length [ms]	The TDMA frame length in milliseconds. Frame length must be set to the same value for the devices sharing the link (for example, a Janus Port *n*-Taurus pair). Integer from 1000 to 10000. Factory default is 4000.
Slot Start [%]	The Taurus TDMA slot start position as a percentage of the entire frame. Integer from 0 to 99. Factory default is 0. Slot Start plus Slot Duration must be less than or equal to 100.
Slot Duration [%]	The Taurus TDMA slot duration as a percentage of the entire frame. Integer from 1 to 99. Factory default is 80. Slot Duration plus Slot Start must be less than or equal to 100. The minimum slot size is determined by the largest frame that can be transmitted over the serial link (Section 7.3.5.1.1 on page 62).
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.4 Serial Port 2

The Advanced Configuration > Communications > Serial Port 2 page provides the option to choose the transmission rate between Taurus and a connected serial device. Options are 9600, 14400, 19200, 38400, 57600; factory default is 9600. See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.2.5 Discovery

The Advanced Configuration > Communications > Discovery page provides options to set Taurus to broadcast its presence to other devices on the network that are running Apollo (Table H-21; see also Section 7.5 on page 69).

Table H-21 Discovery page options

Parameter/Widget	Description
Enable Discovery	Set Taurus to send out identification messages to other devices on the network that are running Apollo. Options are enabled ☑, not enabled ☐. Factory default is enabled.
IP Address	A valid multicast IP address (the first octet must be between 224 and 240, inclusive; each of the last three octets can be any positive integer from 0 to 255). Factory default is 224.199.71.138.
Port #	The port number to listen on for Discovery broadcasts from Taurus. Factory default is 6776.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.3 Security

The Advanced Configuration > Security page provides two authentication options for logging in via the display (Table H-22). You can access this page only if you are logged in as `central`. See also Chapter 6 “Configuring Taurus User Access”.

Table H-22 Security page options

Parameter/Widget	Description
Local Authentication	Determines the type of authentication that can be used for logging in via the display. Options are Standard, Quick Login. Factory default is Standard. See also Section 6.1.1.2 “Quick login” on page 49.
Login Account	Indicates which account will be used for Quick Login. Options are `user`, `tech`, `central`. Factory default is `user`.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.4 Playback

The Advanced Configuration > Playback page provides options to identifying information about this Taurus to be used in downloaded data files (Table H-23). See also Section 11.1.3.2 “Confirm Playback settings” on page 107.

Table H-23 Playback page options

Parameter/Widget	Description
Network Name	The network name or code. Alphanumeric value.
Station Name	The station name for this Taurus. Alphanumeric value (for example, TAU0105 for Taurus serial number 0105).
Channel *n* Name	The channel name for each of the time-series data channels. Alphanumeric value (for example, BHZ, BHN, BHE).
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.5 Timing configuration

The Advanced Configuration > Timing page provides options to set basic timing parameters (Table H-24). See also Section 8.2 “Configuring Taurus timing” on page 78.

Table H-24 Timing configuration page options

Parameter/Widget	Description
GPS Duty Cycle Mode	The GPS receiver duty cycle. Options are Always On, Automatic, Every 10 minutes, Every 30 minutes, Always Off. Factory default is Automatic. Automatic is the most efficient setting for Taurus power consumption. ▸ Do not use the Always Off setting.
Correction Mode	Sample timing correction method. Options include Gradual Drift, No Alignment. Factory default is No Alignment.
Digitizing Needs GPS Lock	Defines whether GPS lock is required before the Taurus starts digitizing on startup. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.6 Calibration

The Advanced Configuration > Calibration page provides the sensor calibration configuration options listed in Table H-25. See also Section 9.3 “Configuring calibration” on page 91.

Table H-25 Calibration page options

Parameter/Widget	Description
Calibration Type	The type of calibration signal to use. Options are Sine, Pulse, PRB. Factory default is Sine.
Channel *n*	Choose whether to enable this channel for calibration. Options are enabled ☑, not enabled ☐. Factory default is enabled.
Attenuation	Attenuate the calibration signal by the specified value. Options are 1, 10, 100, 1000. Factory default is 1.
Amplitude	Set the calibration signal amplitude (in the appropriate Calibration Mode units, volts or amperes, as set in the Advanced Configuration > Sensor Details page). Float number. Factory default is 0.1. This parameter will accept calibration signal amplitudes up to 5.0 V or 60 mA, depending on the Calibration Mode (VOLTAGE or CURRENT). If taken as a single-ended output (for example, between pin N (SEN_CAL1+) and pin V (DGND), the calibration circuit can provide a signal with a maximum amplitude of 4.5 V.
Wait Time	The length of time in seconds after the calibration coil has been enabled before sending the calibration signal. Options are 0, 15, 30, 60, 120, 300, 600, 1200. Factory default is 0.

Table H-25 Calibration page options (Continued)

Parameter/Widget	Description
Ramp Duration	The length of time in seconds to bring the signal amplitude up to the configured amplitude and down from the configured amplitude. Options are 0, 10, 30, 60, 120, 600, 1800, 3600. Factory default is 0.
Duration	The length of time in seconds to generate the calibration signal at the configured amplitude between ramps. Options are 10, 60, 300, 600, 1800, 3600, 7200, 18000, 36000, 72000. Factory default is 60.
Sine Frequency [Hz]	The sine signal frequency in hertz. Float number from 0.01000 to 50.0000. Factory default is 1.0.
Pulse Duration	The pulse signal segment width in milliseconds. Options are 100, 1000, 10000. Factory default is 1000.
PRB Pulse Width	The PRB signal unit pulse width in milliseconds. Options are 10, 20, 50, 100, 200, 500, 1000, 2000, 5000, 10000. Factory default is 1000.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.7 Sensor Details

The Advanced Configuration > Sensor Details page provides options to edit and save basic sensor settings, and provides links to related pages (Table H-26). See also Section 9.2 “Sensor configuration” on page 85.

Table H-26 Sensor Details page options

Parameter/Widget	Description
Sensor	Lists the types of sensors and their associated configurations currently saved to the Taurus. Factory default is Nanometrics Trillium 40.
Add	Add a sensor type to the list. You can store up to 4 sensor configurations.
Del	Delete a sensor type and its associated configuration from the Taurus. You cannot delete an item if it is the only item in the list.
Sensor Name	The label for this configuration used in the Sensor drop-down list. Alphanumeric value.
SP/LP Mode	Choose the operating mode of the sensor, either short period (SP) or long period (LP). Factory default is LP.
XYZ/UVW Mode	The orientation of the sensor elements. Choose Set to UVW to indicate a triaxial seismometer (this will run the calibration on each channel separately). Options are XYZ, UVW. Factory default is XYZ.
Calibration Mode	The calibration signal mode; refer to your sensor manual. Options are VOLTAGE, CURRENT. Factory default is VOLTAGE.
Needs Power	Indicates whether the sensor needs power (active sensors) or not (passive sensors). Options are enabled ☑, not enabled ☐.
Detect Sensor Presence	This feature works only for sensors drawing more than about 8mA.

Table H-26 Sensor Details page options (Continued)

Parameter/Widget	Description
Sensitivity Units	Refer to your sensor manual for the appropriate value. Options are V/(m/s), V/(m/s/s).
Sensitivity Value	Refer to your sensor manual for this value.
Hyperlinks	Links to sub-pages Sensor Control Lines, and Mass Auto-Centering. (See Table H-12 on page 191 for a description of hyperlink behaviour on configuration pages.)
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.7.1 Sensor Control Lines

The Advanced Configuration > Sensor Details > Sensor Control Lines page provides options to set control line parameters for your sensor. Factory default values are for a Trillium 40 seismometer. Refer to your sensor manual for appropriate values.

Table H-27 Sensor Control Lines page options

Parameter/Widget	Description
Sensor	Lists the types of sensors and their associated configurations currently saved to the Taurus.
Add	Add a sensor type to the list. You can store up to 4 sensor configurations.
Del	Delete a sensor type and its associated configuration from the Taurus. You cannot delete an item if it is the only item in the list.
Assert (On) Level	Assert line level; HIGH_Z, ZERO, POSITIVE. Factory default is ZERO.
Deassert (Off) Level	Deassert line level; HIGH_Z, ZERO, POSITIVE. Factory default is ZERO.
Positive Voltage Level	Positive voltage level; PLUS_5, PLUS_12. Factory default is PLUS_5.
Pulse Duration [s]	Control pulse duration in seconds; 1, 3, 5, 7, 10, 15, 20. Factory default is 1.
Ctrl Line 1 (pin H)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is XYZ/UVW On=UVW.
Ctrl Line 2 (pin W)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is SP/LP On=SP.
Ctrl Line 3 (pin G)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is Unused Deassert.

Table H-27 Sensor Control Lines page options (Continued)

Parameter/Widget	Description
Ctrl Line 4 (pin Z)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is Ch 1 Cal Enable. • If you have configured calibration for current mode (Calibration Mode on the Sensor Details page), this control line will not be available for any other configuration option. It will be reserved for calibration current return.
Ctrl Line 5 (pin c)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is Ch 2 Cal Enable. • If you have configured calibration for current mode (Calibration Mode on the Sensor Details page), this control line will not be available for any other configuration option. It will be reserved for calibration current return.
Ctrl Line 6 (pin Y)	Control line options include Unused Assert, Unused Deassert, Ch 1 Cal Enable, Ch 2 Cal Enable, Ch 3 Cal Enable, SP/LP On=SP, SP/LP On=LP, XYZ/UVW On=XYZ, XYZ/UVW On=UVW, Mass Center, Mass Lock, Mass Unlock. Factory default is Ch 3 Cal Enable. • If you have configured calibration for current mode (Calibration Mode on the Sensor Details page), this control line will not be available for any other configuration option. It will be reserved for calibration current return.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.7.2 Mass Auto-Centering

The Advanced Configuration > Sensor Details > Mass Auto-Centering page provides options to initiate mass centring automatically when the mass positions exceed configurable thresholds for sensors with that capability (Table H-28). The Sensor page shows mass position status (Section H.9 on page 189).

Table H-28 Mass Auto-Centering page options

Parameter/Widget	Description
Sensor	Lists the types of sensors and their associated configurations currently saved to the Taurus. Factory default is Trillium 40.
Add	Add a sensor type to the list. You can store up to 4 sensor configurations.
Del	Delete a sensor type and its associated configuration from the Taurus. You cannot delete an item if it is the only item in the list.

Table H-28 Mass Auto-Centering page options (Continued)

Parameter/Widget	Description
Red Threshold [V]	The minimum voltage level to indicate that the mass position is out of range. One minute after this level is crossed for any sensing element, mass centring is initiated. Threshold range is from negative to positive, for example 1 indicates –1 to +1. Float number 0.001 or higher, and greater than Yellow Threshold (if used). Factory default is 1.000000.
Auto-Center on Red	Initiate mass centring if the Red Threshold is crossed. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Yellow Threshold [V]	The minimum voltage level to indicate that the mass position is marginal. After Yellow Holdoff Time has expired, mass centring is initiated. Threshold range is from negative to positive, for example 1 indicates –1 to +1. Float number 0.001 or higher, and lower than Red Threshold (if used). Factory default is 1.000000.
Auto-Center on Yellow	Initiate mass centring if the Yellow Holdoff Time has expired. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Yellow Holdoff Time [h]	The number of hours to wait while any mass position voltage is higher than the Yellow Threshold (but lower than the Red Threshold) before initiating mass centring. Float number from 0.1 to 72.
Retries per Auto-Center	The maximum number of attempts to make to center the masses. Integer from 0 to 20. Factory default is 0.
Retry Interval [min]	The number of minutes to wait between auto-center retries. Integer from 1 to 20. Factory default is 1.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8 Digitizer

The Advanced Configuration > Digitizer page provides links to the relevant sub-pages (Table H-29). See also Chapter 8 “Configuring the Digitizer and Timing”.

Table H-29 Digitizer page options

Widget	Description
Hyperlinks	Links to sub-pages Main, Front End, and Triggers. (See Table H-12 on page 191 for a description of hyperlink behaviour on configuration pages.)
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8.1 Main

The Advanced Configuration > Digitizer > Main page provides options to set the main parameters for the Digitizer (Table H-30). See also Section 8.1.1 “Main settings” on page 71.

Table H-30 Main page options

Parameter/Widget	Description
Sample Rate [Hz]	The sample rate in hertz on the sensor signal. Options are 10, 20, 40, 50, 80, 100, 120, 200, 250, 500. 500sps is not supported in Buffered mode. Factory default is 100. Note that valid value ranges for some of the trigger parameters depend on the sample rate, therefore some sample rates may be incompatible with your current trigger settings. See also Section 8.1.3 “Triggers settings” on page 75, Table H-33 “Input Filter page options” on page 204, and Table H-34 “Detector page options” on page 205.
Output Channels	The number of output channels. Options are 0, 1, 2, 3. Factory default is 3.
Enable DC Removal	Set whether the DC removal filter is used on data. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
DC Removal Cutoff [Hz]	The corner frequency of the DC removal filter in hertz. Float number between 0.001 and 1.0. Factory default is 0.001.
Frames Per Packet	The number of standard SEED frames per packet for transmission of time-series data. Options are 3, 7. Factory default is 7.
Sample Alignment	Sample alignment after a time error correction. Options are UTC, None, HRD. Factory default is UTC.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8.2 Front End

The Advanced Configuration > Digitizer > Main page provides options to set the front end parameters for the Digitizer (Table H-31). See also Section 8.1.2 “Front End settings” on page 72.

Table H-31 Front End page options

Parameter/Widget	Description
Input Range	The voltage range for the sensor input in volts peak-to-peak. The input voltage ranges represent the differential between the positive and negative signal inputs. Options are 40, 16, 8, 4, 2. Factory default is 40.
Input Impedance	Options are Low Impedance, High Impedance (low power), High Impedance (high power). Low impedance is 43.07kΩ ± 0.2%, high impedance is >9MΩ. Factory default is Low Impedance. Either Low Power or High Power mode can be used with High Impedance mode for all values of Input Range except 40Vpp, for which the Low Power setting is not applicable. See also Section 8.1.2.2 “Input Impedance and common mode range” on page 74.

Table H-31 Front End page options (Continued)

Parameter/Widget	Description
Enable Dither	Adds a very small random signal to the input signal of the Digitizer to eliminate idle tones. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Software Gain	Set the Digitizer gain, to attenuate or amplify the sensor input signal to a level that will optimize use of the Digitizer dynamic range. Float number 0.001 to 100. Factory default is 1.
Enable Hard Clip	Limits the output samples of the Digitizer to the specified limits. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8.3 Triggers

The Advanced Configuration > Digitizer > Triggers page provides options to select channels to use triggers, and links to the relevant sub-pages (Table H-32). Trigger information can be extracted to a `.csv` file (Section 11.3.1.1 on page 118). See also Section 8.1.3 “Triggers settings” on page 75.

Table H-32 Triggers page options

Widget	Description
Enable channel *n*	Select one or more channels to use triggers. Configure the triggers in the related sub-pages. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Hyperlinks	Links to sub-pages Input Filter, Detector 1, Detector 2, and Detector 3. (See Table H-12 on page 191 for a description of hyperlink behaviour on configuration pages.)
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8.3.1 Input Filter

The Advanced Configuration > Digitizer > Triggers > Input Filter page provides options to set the filter (Table H-33). This is used for all detectors.

Table H-33 Input Filter page options

Parameter/Widget	Description
High Pass Order	The order of the high pass filter. Integer from 0 to 5. Factory default is 0.
High Pass Frequency [Hz]	The 3dB corner frequency in hertz of the high pass filter. Float number where $0.000001 < \frac{f}{sampleRate} < 0.499999$. Factory default is 0.001.

Table H-33 Input Filter page options (Continued)

Parameter/Widget	Description
Low Pass Order	The order of the low pass filter. Integer from 0 to 5. Factory default is 0.
Low Pass Frequency [Hz]	The 3dB corner frequency of the low pass filter. Float number where $0.000001 < \frac{f}{sampleRate} < 0.499999$. Factory default is 1.0.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.8.3.2 Detectors

The Advanced Configuration > Digitizer > Triggers > Detector *n* page provides options to set the detector for the corresponding channel (Table H-34).

Table H-34 Detector page options

Parameter/Widget	Description
STA Time constant [s]	The short term time constant (TC) in seconds. Float number where $0.000001 < \frac{\left(\frac{1}{2\pi \cdot TC}\right)}{sampleRate} < 0.499999$. Factory default is 1.
LTA Time constant [s]	The long term time constant (TC) in seconds. Float number where $0.000001 < \frac{\left(\frac{1}{2\pi \cdot TC}\right)}{sampleRate} < 0.499999$. Factory default is 5.
Trigger On Ratio	The STA/LTA at which a trigger is written to the Store. Float number, where 0 < *Trigger Off ratio* < *Trigger On ratio*. Factory default is 5.
Trigger Off Ratio	The STA/LTA at which a trigger ends. Float number, where 0 < *Trigger Off ratio* < *Trigger On ratio*. Factory default is 1.
Maximum Duration [s]	A duration in seconds at which to end a trigger that has not yet reached the Trigger Off Ratio. Float number from 0.001 to 3600. Factory default is 3600.
Latch LTA	Freeze the LTA at the value it had when the trigger started. Options are enabled ☑, not enabled ☐. Factory default is not enabled.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.13.9 Power

The Advanced Configuration > Power page provides options to configure power supply parameters such as voltage disconnect levels (Table H-35). See also Section 4.4 “Configuring power manager settings” on page 40.

- Factory default values are for 12 V lead-acid batteries. To protect your equipment, confirm the appropriate values for your power system and the maximum voltage tolerance of your sensor before setting these parameters.

Table H-35 Power page options

Parameter/Widget	Description
Battery Low [mV]	Battery low voltage threshold in millivolts. Integer from 9000 to 36000. Factory default is 10500. See also Section 4.3.3.2 “Bypass the Battery Low/High voltage disconnect settings on startup” on page 39. This field will accept values slightly outside the recommended range. ▸ Ensure that the value you have entered is between 9000 and 36000.
Hysteresis Low [mV]	Battery Low turn-on level in millivolts. Integer within the range Battery High and Battery Low. Factory default is 11800.
Delay Low [ms]	Battery low reaction delay factor in milliseconds. Integer from 0 to 300. Factory default is 30.
Battery High [mV]	Battery high voltage threshold in millivolts. Integer from 9000 to 36000. Factory default is 36000. This field will accept values slightly outside the recommended range. ▸ Ensure that the value you have entered is between 9000 and 36000.
Hysteresis High [mV]	Battery High turn-on level in millivolts. Integer within the range Battery High and Battery Low. Factory default is 35000.
Delay High [ms]	Battery high reaction delay factor in milliseconds. Integer from 0 to 300. Factory default is 2.
Function buttons	See Table H-12 on page 191 for a description of the **Apply**, **Commit**, **Reset**, and **Previous** buttons.

H.14 Upgrade

For Taurus firmware version 2.x and higher, there is a firmware Upgrade page that provides options as listed in Table H-36. See also Section G.2 “Upgrading Taurus from Version 2.00.xx or higher” on page 172. You must be logged in as `centra`l to use this page.

Table H-36 Upgrade page options

Parameter/Widget	Description
Browse	This option is only available from a browser. Browse your file system for a Taurus upgrade file (`taurus-release-`*x*`.tgz`).
Upload	This option is only available from a browser. Transfer the selected `taurus-release-`*x*`.tgz` to the Taurus.
Install	Install the selected Taurus version and run it in test mode.
Delete	Delete the installation files for the selected Taurus version.
Commit	Set the currently running firmware as default.
Revert	Reboot the Taurus and run the default version of the firmware.
Active Version	A read-only indicator of the currently running version of the firmware.
Default Version	A read-only indicator of the default version of the firmware.

H.15 Log In/Log Off

The Log In/Log Off pages provide options for you to log in to the Taurus with different levels of user access, and to change passwords (Table H-37 and Table H-38). See also Chapter 6 “Configuring Taurus User Access”.

Table H-37 Log In page options

Parameter/Widget	Description
UserId	User account to log in under. Options are `user`, `tech`, `centralt`.
Password	The password for the specified UserID. Factory defaults are `user`, `tech`, and `centralt`.
Log In as *account*	Log in using the display without having to enter the Password (but choose the correct UserID from the drop-down list first). It is available if the Taurus has been configured for Quick Login.
Log In	Log in using the specified UserId and Password.
Reset	Clears all existing entries on the current page.
Change Password	This link opens the Change Password page (see Section H.15.1).

Table H-38 Log Off page options

Parameter/Widget	Description
Log Off	Click Log Off to exit the current session. To exit this page without logging off, choose any other page option from the main menu. You can continue working in the current session.

H.15.1 Change Password

The Log In > Change Password page provides options for you to set a new password for any of the user accounts (Table H-39).

Table H-39 Change Password page options

Parameter/Widget	Description
UserId	A text field to enter the UserID for which to change password.
Current Password	A text field to enter the current password for the specified UserId.
New Password	A text field to enter the new password. The password must be at least 4 alphanumeric characters long. It is case-sensitive.
Verify New Password	A text field to retype New Password, as confirmation.
Change Password	Saves the New Password and logs you in to that account.
Reset	Click to clear all field entries (applicable only if you have not yet clicked Change Password).

H.16 Shutdown

The Shutdown page provides options for you to safely shut down the Taurus Controller (Table H-40). See also Section 3.3 “Starting up and shutting down the Taurus” on page 19.

Table H-40 Shutdown page options

Widget	Description
Turn Off Display	Use this option to turn off Interactive mode without waiting for the UI timeout, for example to conserve power once you have finished using the display. The Taurus continues to record data in its configured running mode (either Buffered or Communications). ▸ If you use **Turn Off Display** in a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the turn off display command.
Restart	Use this option to restart the Controller (referred to as the PPC on the Shutdown page), for example to activate any committed configuration changes that require a reboot to take effect. The Digitizer continues to run and buffer data during a restart so no data are lost. ▸ If you use **Restart** in a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the restart command.
Shutdown	Use this option before you remove or insert recording media, or before you disconnect the power. It powers down the Controller gracefully while the Taurus continues to buffer data. ▸ If you use **Shutdown** in a browser, do not refresh the old browser window after the Controller has been restarted as this will resubmit the shutdown command.