Nanometrics

Centaur

User Guide

STRATEGIC INTELLIGENCE
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Nanometrics Inc.
250 Herzberg Road
Kanata, ON K2K 2A1
Canada

Toll free: +1 855-792-6776 (within North America)
Tel +1 613-592-6776
Fax +1 613-592-5929
Email sales_mktg@nanometrics.ca
www.nanometrics.ca

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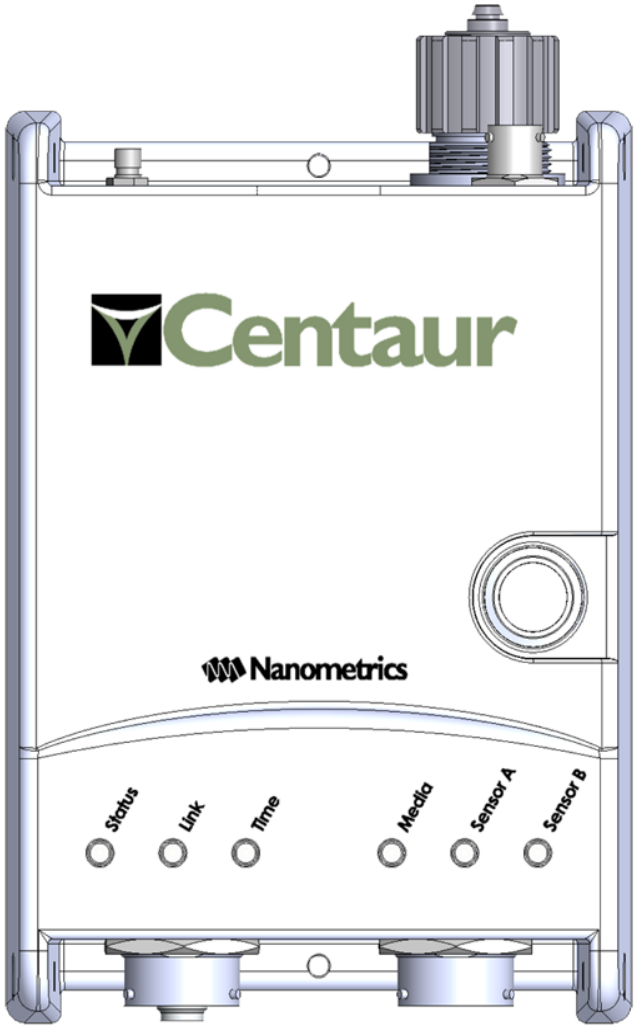
1.0 About the Centaur

The Centaur digital recorder is a portable seismic acquisition system that consists of a high-resolution 24-bit ADC, a precision GPS clock, and removable storage capabilities. Its ease of use simplifies high performance seismic deployments in both remote and networked environments.



1.1 Key Features

- Intuitive Web interface accessible via Wi-Fi or Ethernet connection
- Ultra-low noise floor for use with high performance broadband seismometers
- True 24-bit performance available in 3 or 6 channel configurations
- Sample rates of up to 5000 sps to support geothermal and/or passive seismic
- Advanced bandpassed triggering
- External State-of-Health (SOH) input (see applicable models below) that allows you to digitize up to 3 arbitrary, external analog signals for inputs such as temperature, barometric pressure, and similar slow moving signals
- Data retrieval via a removable SD[1]™ card or local Ethernet in MiniSEED file format
- Event peak ground motion statistics: acceleration, velocity, and displacement
- Acquisition and data management of high precision GPS data (BINEX)
- Comprehensive real-time communications options include SeedLink support

[1]Secure Digital

- Rugged field enclosure rated for continuous submersion
- Precision Time Protocol (PTP)*, which provides network-based timing to digital recorders that are placed in areas where GPS signals are weak or inaccessible.

  * Available if PTP is enabled in your firmware. Contact technical support for more information.

1.2 Applicable Models

The Centaur User Guide and WebHelp apply to the following models:

Product Name	Model Number	Part Number	Key Features
Centaur, 3 channel SOH	CTR2-3S-8	17954	◦ 3-channel differential inputs for seismic sensors and/or geophones ◦ External SOH input
Centaur, 6 channel SOH (pictured above)	CTR2-6S-8	17955	◦ 6-channel differential inputs for seismic sensors and/or geophones ◦ External SOH input
Centaur, 3 channel	CTR-3	17594	◦ 3-channel differential inputs inputs for seismic sensors and/or geo-phones
Centaur, 6 channel	CTR-6	17610	◦ 6-channel differential inputs for seismic sensors and/or geophones

All models listed above are available with SeedLink licensing pre-configured. Alternatively, you can purchase a license that allows you to access SeedLink and other licensed features after you acquire your Centaur.

Setup and operational instructions may vary by model.

1.3 About Data Storage

Understanding how and where Centaur stores data will help you plan and implement effective data access for your deployment.

1.3.1 Primary Media

Centaur continuously records seismic data, state-of-health (SOH) data, and configuration data in a proprietary database called the Store. The Store wraps when it is full and records over the oldest data. The frequency with which the Store wraps is shown in the Internal Storage section of the **Health** Page.

The Store is located on an internal flash media device.

Data is recorded to the Store in Nanometrics Protocol (NP) format, but seismic data can be streamed in SEEDLink and NP formats for networked deployments, and/or archived to removable media in MiniSEED format. In addition, selected SOH channels are available in Steim compressed formats. For networked deployments using continuous streaming, the Store is used to back fill any data lost during transmission downstream.

Regardless of whether you deploy Centaur as a networked or standalone device, the internal storage acts as your primary media. You can retrieve data from internal storage on the **Maintenance** page.

1.3.2 Secondary (or Removable) Media

The most effective backup for your data is to use an SD card as your secondary (removable) media, and configure continuous archiving. Use an SD card that is formatted as FAT32 or ext4.

The SD card serves two main functions:

1. Backup for the primary media for networked or standalone deployments.
2. Convenient data retrieval for standalone deployments.

When you enable continuous archiving, the Centaur continuously records data in MiniSEED format to the SD card. You can also configure Centaur to archive events and SOH data to the SD card.

When the SD card is full, the Centaur continues recording data to its internal storage media, but stops writing data to your SD card. Any configured streamers are unaffected when the SD card is

full. You can monitor the amount of space that data archiving consumes on your SD card from the **Removable Media** section of the **Maintenance** page.

For standalone deployments, swapping out removable media is a more convenient way of harvesting data than downloading data from internal storage using a laptop and Ethernet cable. Data retrieval via SD card swap or internal storage download is referred to as file transfer.

1.3.3 Data Backup

The Centaur reserves a small backup Store on the removable media (SD card), if one is present, or in RAM if no SD card is available. The backup Store is used in the rare event that internal storage fails. The backup Store does not grow over time, nor does the backup Store overwrite your data.

For networked deployments using continuous streaming, the backup Store can backfill a limited amount of data lost during transmission.

As mentioned above, the most effective way to back up your data is to archive data continuously to your SD card.

1.4 Cables and Accessories

Nanometrics offers optional equipment that can add convenience to the installation and use of your Centaur. The table below describes a number of these options.

Name	Part Number	Description
Cable - Ethernet	CAB0013	An Ethernet cable with RJ-45 connectors on both ends. Available in lengths from 1 m to 100 m.
Cable – Power	14983-3M 14983-5M 14983-6M 14983-8M 14983-10M	An unshielded 22 AWG power cable. Available in lengths of 3 m, 5 m, 6 m, 8 m, and 10 m.

Name	Part Number	Description
Cable - Centaur External SOH	17949-3M	Flexible cable that connects to Centaur models with Part Numbers 17954 and 17955. The cable provides three inputs for equipment (± 5 V range) with slow moving signals.
External SOH sealing plug	CON1904	External SOH sealing plug (used to protect the External SOH connector when not in use). Shipped with Centaur.
Ethernet cable sealing plug	CON0284	RJ-45 sealing plug (used to make the Ethernet cable connector waterproof). Shipped with Centaur.
GPS antenna cable LMR-400 low loss	12785	LMR-400 very low loss RF coaxial cable. Available in lengths up to 80 m.
GPS antenna cable RG-223 low loss	12030	RG-223 low loss RF coaxial cable. Available in lengths up to 25 m.
GPS bullet antenna	15699	A 3.3 V thread-mount GPS bullet antenna with a TNC connector.
GPS patch antenna	15808	A 3.3 V GPS patch antenna with a 5 m cable. Shipped with Centaur.
Power supply	17236	Power supply with mains to 24 VDC. FOR INDOOR USE ONLY.
*SD Card	18023-xxGB	Secure Digital Media Card, Industrial Multi-level cell (MLC), pre-formatted with FAT32.

Name	Part Number	Description
USB Wi-Fi Accessory Kit	17630	A kit containing a USB Wi-Fi dongle, O-ring, and Media Bay dome cover to connect Centaur over Wi-Fi

*See About SD cards.

2.0 Installation Tasks

At a high level, we recommend that you perform the following tasks to install a Centaur:

1. Insert an SD card (optional).
2. Choose a deployment option.
3. Perform the initial configuration.
4. Develop a grounding plan.
5. Connect and ground the device.

Before leaving the installation site (post-installation)

- Monitor the LEDs and troubleshoot any errors that occur.

2.1 About SD Cards

Nanometrics tests with industrial-quality SD cards that have proven to be very reliable. SD cards are available in 16 GB, 32 GB, and 64 GB capacities. If you prefer to supply your own SD cards, please contact technical support for information about SD cards that have been qualified by Nanometrics.

2.1.1 Insert SD Card

The Centaur can be configured to archive MiniSEED data, event data, and SOH data to an **SD**[1] card formatted as FAT32 or ext4. The event data can be archived in multiple industry-standard formats.

Before data archiving can be enabled, an SD card (formatted as FAT32 or ext4) should be inserted into the media slot on the Centaur. When properly inserted and ready for use, the Media LED will blink green and the Media Eject LED behind the media door will be solid red for 10 minutes (it will then turn off to save power).

2.1.2 Remove the SD Card

To safely remove the SD card, push and release the **Media Eject** button in the media bay. Wait for the Media Eject LED to turn solid green, which indicates that it is safe to remove the card.

[1] Secure Digital

To prevent data loss or corruption, the data cartridge and SD card should never be physically removed while the SD status LED is blinking in any colour.

2.1.3 SD Card Full or Corrupt

The status of the SD card in use is indicated by the Media LED on the instrument, and on these Web Interface pages:

- Health > Storage section
- Maintenance > Removable Media section

If your SD card is full or corrupt, the instrument continues recording data to its Store, but stops writing data to your SD card. Any configured streamers are unaffected when the SD card is full or corrupt.

SD Card Troubleshooting

- The most effective way to retrieve data directly from the Centaur's **internal storage**[1] is by downloading it from the **Maintenance** page to your computer.
- To ensure sufficient space on your SD card, you can remove older time series data from your continuous archive. The safest method for transferring data from the SD card is to connect it to your computer. Alternatively, you can use secure FTP and the client application of your choice to manage your continuous archive files.
- Individual archive files can also be downloaded from the **Download archive files** link from the **Maintenance** page.
- If your SD card is corrupt or damaged, you can try to repair it from the Maintenance page. You may also re-format the card. Repair and re-formatting of SD cards is performed in the **Removable Media** section of the **Maintenance** page.

2.2 Choose a Deployment Option

The Centaur can be deployed as a stand-alone device to record continuous data on removable media for extended periods of time or as a network device that allows data downloads, data

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

streaming, and remote configuration changes while also recording data to the storage media.

Regardless of whether data is streamed and/or archived to secondary, removable media (SD card), the Centaur continuously records data to internal storage. For more information, see About Data Storage.

2.2.1 Stand-alone Deployment

In a stand-alone deployment, a Centaur is deployed as a "do-it-all" device. The recorded time series data is written in NP format to the internal storage on a Linux ext4 formatted CF card.

A technician must visit the Centaur in the field to retrieve the data, which is done by replacing the removable media with empty media or by downloading data from the internal storage.

2.2.2 Networked Deployment

In a networked deployment, a Centaur is deployed as part of a network and the recorded time series data is written in NP format to the internal storage and then streamed over the network to a data acquisition server, such as Apollo Server. As an additional backup, the Centaur can be configured to continuously write the time series data in MiniSEED format to a FAT32 or ext4 formatted SD card.

The field technician does not typically visit the Centaur in the field after it has been installed, but instead uses a Web browser to make any necessary configuration changes and receive the streamed data.

2.2.3 Data Access Options

Typically, the data access method you choose is influenced by the remoteness and duration of the deployment.

The Centaur can be deployed as a:

- Network device that allows data downloads, continuous streaming to a data acquisition server (such as Apollo Server), and remote configuration changes.
- Stand-alone device to record continuous data on removable media for extended periods of time (accessed later via file transfer or retrieving the SD card when a technician is visiting the site).

Regardless of whether data is streamed and/or archived to a secondary removable media (SD card), the Centaur continuously records data to internal storage. For more information, see About Data Storage.

Continuous Streaming

Continuous data streaming is usually the preferred data access method for longer term deployments.

Continuous data streaming is enabled through the use of a cellular modem, Low Earth Orbit (LEO) modem, or VSAT communication system, such as Nanometrics' Libra II VSAT System.

File Transfer

File transfer is more common for short-to-medium term deployments when streaming is not possible or practical. You can remove the SD card from the media bay and swap in a new SD card without causing any data gaps between the records on the two cards. Alternatively, you can connect to the Centaur via Ethernet to download the data stored in its internal flash memory.

Data Formats

Each data access method provides specific data recording formats.

For a list of available data formats you can use for file transfer from SD card or internal storage, see Recording (Continuous) and Recording (Events) in the specifications.

To view the data formats available for data streaming, see Data Streaming in the specifications.

2.2.4 Use Cases: Deployment and Data Access

The table below illustrates the typical use cases for deployment and data access.

Deployment timeframe	Continuous data streaming required?	Data access option
Short-term (Temporary)	Yes	Streaming, using: • Cellular or Low Earth Orbit (LEO) modem/* VSAT
	No	File transfer: • Removable media (SD card) • Internal storage via Ethernet (retrieve unit and bring to lab)
Medium-term (Semi-permanent)	Yes	Streaming, using: • Cellular or LEO modem/VSAT
	No	File transfer: • Removable media (SD card)
Long-term (Permanent)	** Yes	Streaming, using: • Cellular or LEO modem/VSAT • Wired internet

* VSAT is not commonly used for temporary installations, but there are temporary stations that use VSAT.

** Streaming is normally required for permanent stations because file transfer is often impractical.

2.2.5 Perform the Initial Configuration

Each Centaur comes factory configured with several default configuration settings. The factory configuration addresses the most common use cases for the Centaur and means that most devices will require minimal pre-installation configuration.

To check the configuration, you must connect the GPS cable, Ethernet cable, and power cable and wait for the device to power up. Once started, you need to access the Web interface of the Centaur to verify or change the configuration.

You should ensure the following settings are configured to your needs prior to deploying the device in the field:

- Sample rate
- Sensor type
- Detector settings
- Ethernet settings
- Streamer settings (Networked deployment)

2.3 Develop a Grounding Plan

The power consumption of the Centaur varies with factors such as the GPS receiver duty cycle and the activity of the Ethernet. Typical consumption is listed in the Power Usage section of the technical specifications.

The most appropriate grounding plan will depend on your application and the installation environment. Following is some general information you can take into account when planning grounding for a Centaur installation.

2.3.1 General Considerations

- Power — The Centaur power connector has 3 pins to allow the Centaur 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. The recommended 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 Centaur provides primary power to attached peripheral devices via the Sensor connectors. This power is switched to allow devices to be controlled by the user through the Centaur. The Centaur monitors for over-current conditions and will automatically switch off power to a peripheral if excessive current or a short is detected. The voltage provided to the Centaur is passed on to the attached peripherals. The current demand of each attached peripheral and the consequent voltage drop through the Centaur and peripheral cables should be taken into consideration when designing the power system to ensure that sufficient voltage is supplied to each peripheral.

2.4 Connect and Ground the Centaur

You will need the following items to set up and configure your Centaur:

- Power supply and cable*
- Ethernet cable*
- GPS antenna and cable
- External SOH cable* if you want to record analog state-of-health (SOH) signals from other sensors
- Seismometer cable
- Computer, tablet, or smartphone with one of the following browsers installed: Chrome, Firefox or Safari

*Not included. See Cables and Accessories.

The External SOH cable is only applicable to Centaur models that have an external SOH input.

Connect the cables and ground the Centaur

1. Connect the following cables to the Centaur:
   - Seismometer cable
   - Ethernet cable (if used)
   - External SOH cable (if used)
   - Power cable (apply power last)

You can make the Ethernet cable connector on the Centaur waterproof by installing a sealing plug (shipped with the Centaur).

2. Ground the Centaur:

i. Your Centaur ships with the grounding wire attached. If you must attach a new grounding wire, strip one end of the grounding wire and crimp the grounding lug around the grounding wire.
ii. Attach the grounding lug to the grounding hole using the M4x5 screw and the M4 washer. See the Top View of the Centaur for the grounding hole locations.
iii. Connect the other end of the grounding wire to a grounding point at the site.

3. Apply power. When you connect the power cable to the power source, the Centaur will power up immediately. It will take approximately 4 to 5 minutes for the device to completely start up.

If the device fails to power up, the power supply voltage might be below the configured Power on threshold.

Next step: Log into the Web Interface.

2.5 GPS Antenna

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 antenna does not have to be isolated from ground. We recommend that it be independently earthed when using a long cable; otherwise, it can rely on the Centaur for its safety ground to earth.

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 Centaur grounding, the sensor grounding, power supply grounding, and local site grounding.

2.6 Power

The Centaur power connector has 3 pins to allow the instrument 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. The recommended 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.

2.7 Install the SOH sealing plug

If you are not using the SOH input on the Centaur, it is recommended that you install the External SOH sealing plug (part number CON1904) that ships with the Centaur. The sealing plug will protect

the Centaur from dust and moisture.

1. With a 19 mm socket, loosen the jam nut from the SOH connector on the Centaur.

When removing the jam nut, be careful not to push or knock the connector into the chassis. If the connector drops into the chassis, you will have to open the Centaur cover to retrieve the connector.

2. Place the ring from the sealing plug over the connector.
3. Secure the jam nut over the ring sealing ring.
4. Close the sealing plug cap over the connector.

3.0 Accessing the Web Interface

The Web Interface is where you can assess the status and health of your instrument, configure your sensor, view the waveform, and perform maintenance tasks, such as backing up your configuration settings and upgrading your firmware.

You can create a direct connection to your Centaur using a link-local IP address or you can create a network connection to the device.

3.1 Direct Connection to the Web Interface

For a direct connection between your instrument and a computer (with Chrome, Firefox or Safari installed), use the link-local IP address.

For Centaur, use the link-local IP address of 169.254.33.33 (3 channel model) or 169.254.35.35 (6 channel model) with a subnet mask of 255.255.0.0.

You can access the Centaur user interface over Wi-Fi using the optional USB Wi-Fi Accessory Kit (Nanometrics part number 17630).

3.2 Network Connection to the Web Interface

1. Connect the Centaur to a DHCP-enabled network and allow it to automatically assign an IP address to the device.
2. Use Apollo Discovery, a Nanometrics application, to search the LAN for Nanometrics instruments and applications.

Contact Nanometrics Support at http://support.nanometrics.ca to get Apollo Discovery.

Apollo Discovery must be run on the same subnet as the devices you want to find.

3. Confirm that the serial number displayed on the Web interface matches your Centaur. If it does not, then you are connected to a different Centaur in your network.

After connecting to the Centaur, either through the link-local address or via a DHCP-enabled network, you can configure a static IP address for your deployment.

3.3 Logging on to the Centaur Web Interface

When you first connect to the Web Interface, you are in view only mode. This mode allows you to view information about your instrument such as the status and health of your instrument, the connected sensors, events and waveforms. To edit the configuration, download firmware, and perform maintenance tasks, you need to log on to your Web Interface.

1. From the upper right corner of the Web Interface, click **Log On**. The Log On dialog box will be displayed.
2. Enter the default admin user account (user name: admin, password: admin).
3. Click the **OK** button. On the Web Interface, **admin** will display in place of Log On.

We recommend that you change your password after you have logged on for the first time.

3.3.1 Changing the admin password

1. From the upper right corner of the Web Interface, click on **admin** and select **Change password** from the list. The change password dialog box will be displayed.
2. Enter your **User name**, your **Old password**, and your **New password**.
3. Confirm your new password by entering it in the **Confirm new password** field.
4. Click the **OK** button. The dialog will close and your password will be set to the new password.

3.3.2 Changing the Calibration Password

The calibration user account and password allows you to upload a custom calibration file to the instrument (see Upload Custom Calibration Signal File). To do this you will need to log in to the instrument using an **SSH**[1]-based file transfer protocol such as **SFTP**[2] or **SCP**[3].

1. Log into the instrument using the terminal application of your choice and start an SSH session. Use the IP address of the instrument as the host name and the default port number of 22.

[1]Secure Shell

[2]SSH File Transfer Protocol

[3]Secure Copy

2. Log in to the instrument as root (username: root, password: dolphin18).
3. Run the following command:
    - passwd calibration
4. Enter your new password. Paswords must be a minimum of 5 characters and a maximum of 8, and include a combination of upper and lower case letters and numbers.
5. Reenter your new password.
6. Close the SSH session.

4.0 Configuring Your Centaur

You can change the configuration settings for the Centaur by logging on using the admin user account, opening the Configuration menu, and selecting **Configuration**.

We recommend that you change your password after you have logged on for the first time. See Changing the admin password.

 Configuration menu icon

Reset, Apply, Commit

- Reset — Discard any unapplied changes and reload the current configuration settings.
- Apply — Implement changes before they are committed. The device will operate with the new settings but will discard them if it is restarted.
- Commit — Permanently save changes. The device will use these new configuration settings each time it restarts until new settings are committed.

4.1 Downloading/Uploading the Configuration

You can download the current configuration of the Centaur and save it as a backup in case you ever want to restore the settings of the Centaur to the current state or upload it to a different Centaur. The downloaded configuration file is in RDF Turtle format.

If you do upload a configuration file, keep in mind that you might have to use Apollo Discovery to find the new IP address assigned to the device if the Ethernet mode changes from Static IP or Link-Local to DHCP.

Apollo Discovery is a Nanometrics command-line application that searches the LAN and returns the model number, serial number, IP address, and other information about the Nanometrics devices and applications that it finds.You can download Apollo Discovery from our support Web site: http://support.nanometrics.ca.

4.2 Install a License File

A license is required to use some Centaur features, such as continuously streaming data in SeedLink format. If your Centaur isn't pre-configured with a license, contact

sales_mkt@nanometrics.ca to purchase a license file.

The license file is uploaded from the **About** page on the Web Interface.

From the upper right corner of the Web Interface, click the Configuration menu icon.

1. Click **About**.
2. Click the **Upload** link.
3. Click **Choose File**, browse to the license file location, and click **Upload**.
4. Click **OK**.

4.3 General Configuration Settings

Retrieval mark

The date and time the last data was retrieved by Apollo Project for a Field Archive project.

Apollo Project automatically stores this date in the Centaur after it retrieves data for a Field Archive project and uses it as the starting point for a future data download. The Retrieval Mark box is blank if Apollo Project has not been used to download data from a Centaur for a Field Archive project.

You can delete the date if you want Apollo Project to download all of the data from the start of the project the next time you run a Field Archive project. You can also change the date if you only want data downloaded from a specific point in time.

This setting is only used by Apollo Project for Field Archive projects. If you do not use Apollo Project or Field Archive projects, you can ignore this setting. For more information on data retrieval and Field Archive projects, see the Apollo Project User Guide.

System log verbosity

The level of detail of the system log:

- Info – All errors, warnings, and minimal system status information
- Verbose – All error, warnings, and more detailed system status information
- Debug - All errors, warnings, and extensive system status information

You should only select **Verbose** or **Debug** as the logging level if you were instructed to do so by Nanometrics Technical Support because it generates a large number of log messages that can slow down the system and shorten the amount of time in the log files.

This setting only applies to Centaur models that have an external SOH input. See applicable models.

4.4 Digitizer

The Centaur Digitizer has three or six time series data channels that are constantly digitizing data. The data from each of these channels is recorded and written to the internal storage.

You can capture data at two concurrent sample rates by enabling secondary output, and setting different sample rates on your primary and secondary channels. For example, you may wish to continually stream your data at a lower sample rate on primary channels and archive data to an SD card at a higher sample rate on secondary channels.

You can also configure general settings for the Centaur Digitizer such as frames per packet on primary and secondary channels, as well as front end, input filter, and detector configuration settings.

The settings for Digitizer A are for Sensor A, channels 1 to 3. The settings for Digitizer B are for Sensor B, channels 4 to 6.

Enable continuous data products

Select this option to enable the streaming of continuous data products, such as QSCD20 data (see also QSCD20 Streaming), and to summarize triggered events.

4.4.1 Front End — Input Range [V]

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 other peak, the differential input is –20 V for a peak-to-peak input range of 40 V. The input range to Digitizer sensitivity mappings are provided in the **Digitizer Performance** section of the specifications.

- If you want to accurately measure full-scale sensor activity, the input range of the digital recorder 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 want 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.

4.4.2 Primary Channels

You can configure your sampling rate, enable DC removal, and set your frames per packet for your primary data channels.

If you are using a six-channel Centaur, you will need to configure your primary channel settings for both Digitizer A and Digitizer B.

Output type

Output type allows you to apply a Linear Phase filter to the digital signal processing and recording on primary channels, which is the default selection, or to disable data recording altogether.

Primary sample rate [Hz]

The number of samples per second taken from the continuous analog sensor signal by the Centaur to make a discrete-time signal. The default is 100 Hz (100 samples per second).

Primary frames per packet

The number of standard Steim data frames per packet for transmission and storage of the primary time series data. Smaller packets reduce the streaming latency, but will greatly increase the requirements for streaming throughput and data storage.

4.4.3 Secondary Channels

If you want to capture data at two concurrent sample rates, you must enable the *Secondary output type*. You can also configure other settings for your secondary channels to reflect your data retrieval needs.

If you are using a six-channel Centaur, you might want to configure secondary channel settings for both Digitizer A and Digitizer B.

Secondary output type

By default, the Secondary output type is *Disabled*. To enable it, select *Linear Phase*.

Secondary Sample rate [Hz]

The number of samples per second taken from the continuous analog sensor signal by the Centaur to make a discrete-time signal. The default is 100 Hz (100 samples per second).

Secondary frames per packet

The number of standard Steim data frames per packet for transmission and storage of the primary time series data. Smaller packets reduce the streaming latency, but will greatly increase the requirements for streaming throughput and data storage.

4.4.4 Bandpass Filter

High pass order

The order of the high pass filter applied to output data. The sum of the high and low pass orders must not exceed 5.

High pass frequency [Hz]

The 3 dB corner frequency of the high pass filter applied to output data when the high pass order is non-zero. The ratio of this corner frequency to the sample rate must be between 0.000001 and 0.499999.

Low pass order

The order of the low pass filter applied to output data. The sum of the high and low pass orders must not exceed 5.

Low pass frequency [Hz]

The 3 dB corner frequency of the low pass filter applied to output data when the low pass order is non-zero. The ratio of this corner frequency to the sample rate must be between 0.000001 and 0.499999.

4.4.5 Trigger Input Filters

The trigger input filter is a common band pass filter applied to the channel data prior to being processed by the **trigger**[1] **detectors**[2].

High pass order

The order of the high pass trigger filter.

High pass frequency [Hz]

The 3 dB corner frequency, in hertz, of the high pass trigger filter.

Low pass order

The order of the low pass trigger filter.

Low pass frequency [Hz]

The 3 dB corner frequency, in hertz, of the low pass trigger filter.

[1] A message generated by the device when the STA/LTA ratio for a channel goes above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.

[2] Algorithms applied to channels and used to declare seismic signals of interest

4.4.6 Trigger Detectors

The Centaur uses detectors combined with a voting system to declare an event. A detector is an algorithm that is applied to a channel and is based on either a configured threshold value or a configured **STA**[1]/**LTA** [2] ratio. As soon as the channel detector detects that the threshold value or STA/LTA ratio has been exceeded, it generates a **trigger**[3] for that channel. When the Centaur sees this trigger, it counts how many **votes**[4] are assigned to the channel that generated that trigger:

- If the number of votes are equal to or higher than the configured number of required votes, an event is declared with the date and time from the trigger.
- If not enough votes were received from the trigger, then the Centaur waits for additional triggers for a configured period of time to allow for transmission latency.
- If not enough votes are received within the configured period of time, the triggers are discarded and no event is declared.
- If enough votes are received, an event is declared and written to the internal storage and posted on the **Events** page.

Event declaration can happen locally using only the channels of the Centaur or it can happen across a network between multiple devices if you enable the option to share triggers across a network.

Type *n*

Select the type of detector for the channel.

---

[1]Short Term Average

[2]Long Term Average

[3]A message generated by the device when the STA/LTA ratio for a channel goes above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.

[4]The number of votes assigned to each channel that it can cast towards getting an event declared. The higher the number of votes, the greater the impact that the channel has on event declaration. To ensure proper event declaration, you should give zero votes to a channel that you do not want to affect the event declaration at all and a lower number of votes to channels at noisy stations.

Votes *n*

The number of votes assigned to each channel that it can cast towards getting an event declared.

The higher the number of votes, the greater the impact that the channel has on event declaration. To ensure proper event declaration, you should give zero votes to a channel that you do not want to affect the event declaration at all and a lower number of votes to channels at noisy stations.

Trigger threshold *n* [counts]

The value that must be exceeded for the channel detector to generate a trigger for that channel.

You only have to configure this setting if you selected **Threshold** as the detector type.

Threshold hold off *n* [s]

The amount of time after a threshold has been exceeded that the channel detector will wait before it generates a trigger for that channel.

This setting can be used to ensure that multiple triggers are not generated if a threshold is exceeded several times in a very short period of time. Multiple triggers could result in the declaration of multiple events when really it is only one event.

You only have to configure this setting if you selected **Threshold** as the detector type.

STA time constant *n* [s]

The short term average time constant in seconds

The time constant τ is related to the cutoff frequency f_c by $\tau = 1/(2\pi f_c)$.

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.

You only have to configure this setting if you selected **STA/LTA ratio** as the detector type.

LTA time constant *n* [s]

The long term average time constant in seconds

The time constant τ is related to the cutoff frequency f_c by $\tau = 1/(2\pi f_c)$.

Choose a value long enough to encompass at least several cycles of typical non-seismic, irregular noise for the site.

You only have to configure this setting if you selected **STA/LTA ratio** as the detector type.

Trigger on ratio *n*

The STA/LTA ratio above which the associated channel is triggered.

Choose a value low enough to be sensitive to events of interest but high enough to minimize false triggers.

You only have to configure this setting if you selected **STA/LTA ratio** as the detector type.

Trigger off ratio *n*

The STA/LTA ratio below which the associated channel trigger ends.

Latch LTA *n*

If you select this option, the LTA is held at the value when the channel triggered and is not updated while the channel is triggered.

If you do not select this option, the LTA continues to be calculated and updated while the channel is triggered.

In both cases, the trigger terminates either when the trigger off ratio is achieved or when the **Maximum duration** has expired.

You only have to configure this setting if you selected **STA/LTA ratio** as the detector type.

Maximum duration n [s]

The maximum duration of a trigger in seconds.

After this time period has expired, the trigger is ended even if the **Trigger off ratio** has not been achieved.

4.5 Sensor Library

The Centaur ships with default sensor configurations that you can select as the configuration for Sensor A and Sensor B (6 channel model only). Each sensor configuration contains the mode, power, voltage, sensitivity, control line, calibration, and SOH settings for a sensor.

You cannot edit the settings of any of the default sensor configurations but you can click **Add** on the main **Sensor Library** page and create your own editable custom sensor configuration or you can click **Copy** at the bottom of any default sensor configuration page to make a copy of it and then edit it.

4.5.1 Sensor Settings

Sensor name

The name of the sensor configuration.

SP/LP mode

The default operating mode of the sensor.

XYZ/UVW mode

The default orientation of the sensor elements.

UVW is the orientation for a symmetric triaxial seismometer.

Needs power

Select this option if the sensor needs power (active sensors). Do not select it for passive sensors that do not require power.

Nanometrics smart sensor

Select this option if the sensor is a Nanometrics smart sensor (for example, Trillium Borehole, Trillium Posthole, or Trillium Compact).

Sensitivity units

Refer to your sensor manual for the appropriate value.

Sensitivity value

Refer to your sensor manual for this value.

Channel *n* orientation

Select the orientation of the each sensor channel.

4.5.2 Sensor Control Lines

Refer to your sensor manual for the appropriate sensor control line settings and values for your sensor. Specific control line settings are required to make some of the sensor controls available on the **Sensors** page.

4.6 Sensor SOH

Each sensor port on the Centaur has three mass position SOH inputs and, if enabled, the voltage levels of these inputs are recorded at the configured Internal SOH report interval and displayed on the **Sensors** page. The Sensor mass position SOH values are also included in the Environment SOH group, which you can download from the **Maintenance** page.

You can edit the Sensor mass position SOH settings for any custom sensor configurations that you create.

SOH enabled *n*

Select this check box to allow the Centaur to record the voltage level of the mass position SOH input and generate an SOH channel for this input.

SOH label *n*

Type a label for the mass position SOH input.

The name you enter here will appear on the **Sensors** page and in the CSV file you download from the **Maintenance** page (Environment group of the SOH groups).

SOH monitor *n*

Select this check box if you want the status of this mass position SOH input to impact the overall status of the device.

This means that if a warning or error condition is reported for this mass position SOH input, it will be indicated in red on the **Health** page, **Sensors** page, and in the status bar at the top of each page. It will also be indicated by the Sensor LED on the Centaur.

SOH high threshold

An error condition is reported for the mass position SOH input when the SOH input voltage rises above the SOH high threshold value. This error condition is indicated in red on the **Health** page, **Sensors** page, and in the status bar at the top of each page. The Sensor LED on the Centaur blinks red when this error condition occurs.

An warning condition is reported for the mass position SOH input when the SOH input voltage rises above the SOH low threshold value and stays below the SOH high threshold value. This warning condition is indicated on the **Health** page, **Sensors** page, in the status bar at the top of each page. The Sensor LED on the Centaur blinks yellow when this warning condition occurs.

SOH low threshold

No error or warning condition is detected for the mass position SOH input when the SOH input voltage is below the SOH low threshold.

4.7 Auto Mass Centring

You can configure the Auto Mass Centring options to initiate automatic mass centring when sensor mass positions reach off-centre thresholds.

You can set thresholds for delayed or immediate recentring (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 Centre and have at least one of the following thresholds enabled:

- Auto Centre on Yellow – The Centaur 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 Centre on Red – The Centaur will initiate mass centring 1 minute after any axis exceeds the Red Threshold. You can configure the number of retries, as well as the configured retry interval. Retries will be attempted until all axes are below the yellow threshold or until the number of retries per Auto Centre have been executed.

4.7.1 Auto Mass Centring Settings

Once configured, the **Control** section on the **Sensor** page will indicate that automatic mass centring is enabled.

Red Threshold [V]

The minimum voltage level used to indicate that the mass position is out of range. Mass centring is initiated one minute after this level is crossed for any sensing element.

The threshold range is from negative to positive, for example 1 indicates a threshold range of – 1 to +1.

Enter a number that is equal to or higher than 0.001 and greater than the yellow threshold (if used).

If you use 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).

Auto-Centre on Red

Select this option if you want the Centaur to initiate mass centring when the Red Threshold is crossed. By default, this option is not selected.

Yellow Threshold [V]

The minimum voltage level used to indicate that the mass position is marginal. Mass centring is initiated after the Yellow Holdoff Time has expired.

The threshold range is from negative to positive: for example, 1 indicates a threshold range of –1 to +1.

Enter a number that is equal to or higher than 0.001 and lower than the red threshold (if used).

Auto-Centre on Yellow

Select this option if you want the Centaur to initiate mass centring when the Yellow Holdoff Time expires.

By default, this option is not selected.

Yellow Holdoff Time [h]

The number of hours the Centaur waits when any mass position voltage is higher than the yellow threshold but lower than the red threshold before initiating mass centring.

Enter a number between 0.1 and 72.

Retries per Auto-Centre

The maximum number of re-attempts the Centaur makes to centre the masses.

Enter an integer between 0 and 20.

Retry Interval [min]

The number of minutes the Centaur waits before trying to automatically centre the masses again.

Enter an integer between 1 and 20.

4.8 Communications

You can configure a Centaur for network access via an IP connection over an Ethernet connection.

4.8.1 Discovery

Enable discovery

Select this check box to allow the Centaur to periodically send out small multicast identification messages to other Nanometrics devices and applications on the network.

IP address

A valid multicast IP address.

Port number

The UDP port number used by the Centaur for discovery broadcasts.

4.8.2 Ethernet

Ethernet mode

The method the Centaur uses to acquire an IP address for communications over the LAN.

By default, each Centaur ships in DHCP mode so it can automatically obtain an IP address in your network. If needed, you can also use the following Link-Local address: 169.254.33.33 (3 channel) or 169.254.35.35 (6 channel)

If you change this setting to another Ethernet mode (Static IP or Link-Local) and then change it back to DHCP, you can use Apollo Discovery to find the new IP address assigned to the device. You will need this new IP address to be able to commit the change you made to the Ethernet mode setting because the previous IP address will no longer work.

Apollo Discovery is a Nanometrics command-line application that searches the LAN and returns the model number, serial number, IP address, and other information about the Nanometrics devices and applications that it finds.

Ethernet static IP address

The IP address assigned to the Centaur for the LAN.

Configure this setting if the Ethernet mode is set to Static IP.

Ethernet static subnet mask

The subnet mask for the Ethernet Static IP Address.

Configure this setting if the Ethernet mode is set to Static IP.

Static default gateway

The default gateway address for the static IP address.

4.9 Data Streaming

You can configure the Centaur to **stream**[1] time-series data, SOH data, triggers, alerts, and raw data to one or more data acquisition servers, such as Apollo Server. The data is streamed in the NP format using a User Datagram Protocol (UDP) socket or Hypertext Transfer Protocol (HTTP).

NP UDP/HTTP Streaming

QSCD20 Streaming

Throttle

Fragmentation

4.9.1 NP UDP/HTTP Streaming

Name

The name of the streamer.

Enable

Select this option to enable the streaming of data.

Stream primary time series

Select this option to stream primary time series data.

Stream secondary time series

Select this option if you have enabled secondary output.

Stream environmental SOH

Select this option to stream environmental SOH data.

Environmental SOH for the Centaur includes the following data:

[1]The transfer of packets of data at a steady high-speed rate from the device to downstream devices and applications.

- Voltages
- Temperature
- Sensor SOH
- External SOH
- Timing information

Stream system SOH

Select this option to stream system SOH data to a downstream network management or monitoring tool, such as Antares Network Management.

Antares Network Management is a network management and diagnostic tool that allows you to assess the overall status of the network at a glance and to drill down into network issues in a wide range of areas including power, data availability, timing, latency, configuration, and firmware versions. Antares Network Management uses SOH data, log files, and configuration information available from the various assets in the network as well as data derived by monitoring data availability, latency, and error correction workload to provide you with this picture of network performance.

System SOH for the Centaur includes the following data:

- Internal storage statistics
- Data acquisition statistics

Stream triggers/events

Select this option to stream triggers and events. For **trigger**[1] settings, see also Trigger Detectors and Trigger Input Filters. For **event**[2] settings, see Events.

Stream alerts

Select this option to stream alerts generated by the Centaur for events such as start-ups, shut downs, and major errors.

---

[1]A message generated by the device when the STA/LTA ratio for a channel goes above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.
[2]Seismic activity that is detected and declared by the instrument using a voting system and threshold values or STA/LTA trigger algorithms.

Alert messages include a time stamp and a brief description. These messages are also displayed on the Health page.

Stream raw data

Select this option to stream raw data that came from an external source.

The raw data is inserted into an NP packet and streamed in the NP format.

Channel list

After you have selected the type of data you want the Centaur to stream, you have the option to use a filter to specify exactly which channels the Centaur streams.

The filter is a comma-separated list of the SCNL (Station, Channel, Network, and Location) names of the channels you want streamed. The network, station, location, and channel codes used in the SCNL list are defined in the Channel Naming settings and in the location and channel code settings of the raw TCP receivers.

You can use an asterisk (*) to represent one or more characters in a channel name and an exclamation point (!) to exclude a network, station, location, or channel. The exclamation point always has to be placed before the SCNL element that should be excluded.

The format for specifying SCNL elements in a filter is NN.SSSSS.LL.CCC, where NN is the network code, SSSSS is the station code, LL is the location code, and CCC is the channel code. The S, C, and N elements must be represented in the filter and each element must be separated by a dot (.). The L (Location) element is optional.

Examples:

a. Data is streamed for all of the channels in the XX network XX.*.*.*
b. Data is streamed for all of the Z channels in the XX network XX.*.*.*Z
c. Data is streamed for the specified channel XX.STN01.LO.HHZ
d. Data is not streamed for any of the channels in the XX network !XX.*.*.*
e. Data is streamed for all of the channels in the XX network and all of the channels from STN01 in the YY network XX.*.*.*,YY.STN01.*.*
f. All SOH data is streamed for the XX network (if all SOH channels are called SOH) XX.*.*.SOH

If you do not want to filter the data, type an asterisk (*) into the box. A single asterisk means that all available data will be streamed.

Destination

A valid unicast IP address of the streaming destination in dotted decimal format.

-OR-

A valid **multicast** [1] IP address.

Port number

The port number used by the Centaur to stream data in the NP format.

If you are streaming to Apollo Server, ensure that the Apollo Server UDP receiver is configured to listen to this port number.

ReTx strategy

Defines the manner in which requests to retransmit data are prioritized and processed.

- First-Come, First-Served – ReTx requests are processed in the order received.
- Oldest Data First, with Recent Data Threshold – ReTx requests are processed in chronological order based on the data time (oldest first) except for requests for data newer than the configured ReTx Recent Data Threshold, which are given highest priority.

ReTx recent data threshold [min]

The time in which recent requests should be processed before the oldest requests are processed.

You only have to configure this setting if you selected Oldest Data First, with Recent Data Threshold as the ReTx Strategy.

[1]The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.

Multicast TTL (NP UDP streaming only)

If the streaming destination address is multicast[1], you can increase the Time-To-Live (TTL[2]) of the packets by specifying the number of networks (routers) that the packet must cross to reach the destination.

For example, if the packets have to cross five networks to reach the destination, you should set the Multicast TTL to 5.

All of the routers must support the Time-To-Live feature. In some cases, this feature might be disabled for security reasons (Denial-of-Service attack).

4.9.2 QSCD20 Streaming

A QSCD20®[3] data stream sends QSCD20 encoded packets to destination software capable of consuming QSCD20 data. The data is produced using the primary sample rate(s) of the digital recorder(s), and this sample rate should be at least 100 sps for quality data. Data is streamed in one second packets with each packet timestamp containing the time of the last sample considered for that second of data. The timestamp is UTC[4] aligned.

QSCD20 is a region-specific streaming format. If your system requires QSCD20, contact customer support for more information.

Enable

Select this option to enable the streaming of QSCD20 data.

UDP source port

The port number on the streaming device used to stream QSCD20 data. The UDP source port is configurable to facilitate flexibility when passing packets through firewalls.

---

[1]The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.

[2]Time-To-Live

[3]Quick Seismic Characteristic Data (QSCD20®) from 20 sps data. QSCD20 is a region-specific streaming format. If your system requires QSCD20, contact customer support for more information.

[4]Coordinated Universal Time

QSCD20 destination 1-5

A valid unicast IP address, including the port number, of the data stream destination in dotted decimal format. The destination must be software capable of consuming QSCD20 data. Up to 5 destinations can be identified.

4.9.3 Throttle

If you have a low-throughput link, the throttle configuration settings allow you to configure the maximum data output of the streamer.

Enable throttle

Select this option to set the maximum data throughput of the NP streamer.

Maximum throughput [bps]

The maximum throughput in bits per second.

4.9.4 Fragmentation

This feature supports data paths with components that block packets larger than a particular threshold. For instance, if you are using a router that does not allow IP fragmentation, the fragmentation configuration settings allow you to configure the maximum packet size.

Enable fragmenting

Select this option to set the maximum allowable packet size. If enabled, packets larger than the configured threshold will be broken into smaller packets.

Fragment size [B]

The maximum packet size in bytes.

Include CRC

Select this option if you want a cyclic redundancy check performed on each fragment to verify that the data is not corrupted.

4.10 Raw TCP Receiving

You can configure the Centaur to acquire raw data from a TCP server using a TCP socket. For example, you can configure the Centaur to receive **BINEX**[1] data from a Trimble® NetR9 GNSS Reference Receiver.

You can create and configure raw data TCP receivers to acquire raw data. Once the raw data has been acquired, you can configure a streamer to stream the data to a data acquisition server. Before the raw data is streamed, it is inserted into an NP packet so that it can be streamed in the NP format.

Name

The name of the raw data TCP receiver.

Enable

Select this option to enable the raw data TCP receiver to receive data.

Server IP address

The unicast IP address of the TCP server.

Port number

The number of the port used by the TCP server to stream data. The raw data TCP receiver acts as a TCP client and connects to this port and then the external device streams data to the Centaur.

For example, you configure this port number in the I/O Configuration settings of a Trimble® NetR9.

TCP socket timeout [s]

The maximum amount of time in seconds that the modem will wait for data from the TCP socket before disconnecting from the socket.

After the modem has disconnected from the socket, it will reconnect and wait for a response again.

---

[1]BINEX is a binary exchange format for GPS and GNSS data. For more information on BINEX, see http://binex.unavco.org/binex.html.

Raw data type

Select the format of the raw data from the list.

The only available format is BINEX.

Make sure that the TCP server (for example, a Trimble® NetR9) is configured to stream data to the Centaur in the BINEX format.

Channel index

A number from 2001 to 2099 used to identify the raw data channel.

Each raw data TCP receiver should have a unique channel index number.

You only need to change this number if you are enabling more than one raw data TCP receiver on a single Centaur

Raw packets per NP packet

The number of packets the Centaur waits for before it creates an NP packet.

Location and channel code

A three character alphanumeric code for the channel name.

-OR-

A two character alphanumeric code for the location and a three character alphanumeric code for the channel name, separated by a dot.

Example: L0.RAW

These codes are used for filtering the data that is streamed to a downstream device and should be unique for each raw data TCP receiver. For more information on filtering, see the description of the Channel list setting of the NP UDP/HTTP streamer.

The station and network codes are defined by the Channel Naming settings.

4.11 Channel Naming

The channel names are used by the Centaur for two different purposes:

- Data Retrieval – The channel names are used in the file headings and default file names for all types of retrieved data. The names act as labels to help you identify the data. For more information, see Retrieve Data from the Internal Storage.
- Filtered Streaming – When you configure the Centaur to stream data, you have the option to define an SCNL-based filter to limit what channels are streamed. The Centaur refers to the channel names when it performs the filtering.

Centaur retains only the currently configured channel name. Historical naming information is not preserved.

When you make a query to retrieve data or to view a waveform from Centaur, make sure to use the channel name that is currently configured, not the channel name that was configured when the data was recorded.

Network code

A two character alphanumeric code (the alpha characters must be uppercase) that represents the network that the Centaur belongs to.

Station code

A five character alphanumeric code that represents the station where the Centaur is located.

Location code *(n-n)*

A two character alphanumeric code (the alpha characters must be uppercase) that represents the time series location of the Centaur.

This setting is optional.

Primary channel *n* code

A three character alphanumeric code (the alpha characters must be uppercase) that represents each of the time series data channels.

Secondary channel *n* code

A three character alphanumeric code (the alpha characters must be uppercase) that represents each of the secondary data channels.

SOH code

A two character alphanumeric code for the location and a three character alphanumeric code for the channel that represents the SOH for the Centaur.

The two codes have to be separated by a dot (.).

4.12 Continuous Data Archive

The Centaur Continuous Data Archive feature continuously archives MiniSEED data and SOH data (optional) to a removable SD card.

Before you enable this feature, make sure that you have inserted an SD card (formatted as FAT32 or ext4) into the SD card slot behind the media bay door of the Centaur.

In addition to streaming data from the Centaur to a network application or device and archiving data to a removable SD card, you can also retrieve time series and SOH data directly from the Centaur's **internal storage**[1] by downloading it from the Maintenance page to your computer.

Enable continuous data archive

Select this check box to allow the Centaur to continuously write MiniSEED data files to the SD card.

Each file contains multiple 512-byte MiniSEED records of waveform data for all live channels and is stored in a folder named for the day it was recorded. The location of this folder is **YYYY/MM/DD**.

The format of the name of each MiniSEED data file is as follows: **NE.STN.LO_YYYYMMDD_HHMMSS.miniseed**

The network, station, and location names are defined in the Channel Naming configuration settings.

Archive period [min]

Select the amount of data in minutes to be written to each file.

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

The number of 512-byte MiniSEED records contained in each file is determined by the duration you select here.

MiniSEED output files

Select the number of output files to be generated: one file per channel or one file per station.

The **per channel** option produces many small files, the **per station** option produces one large file.

Archive channel list

You can choose to filter the data you archive by channel.

The filter is a comma-separated list of the SCNL (Station, Channel, Network, and Location) names of the channels you want archived. The network, station, location, and channel codes used in the SCNL list are defined in the Channel Naming settings and in the location and channel code settings of the raw TCP receivers.

You can use an asterisk (*) to represent one or more characters in a channel name and an exclamation point (!) to exclude a network, station, location, or channel. The exclamation point always has to be placed before the SCNL element that should be excluded.

The format for specifying SCNL elements in a filter is NN.SSSSS.LL.CCC, where NN is the network code, SSSSS is the station code, LL is the location code, and CCC is the channel code. The S, C, and N elements must be represented in the filter and each element must be separated by a dot (.). The L (Location) element is optional.

Examples:

a. Data is archived for all of the channels in the XX network XX.*.*.*
b. Data is archived for all of the Z channels in the XX network XX.*.*.*Z
c. Data is archived for the specified channel XX.STN01.LO.HHZ
d. Data is not archived for any of the channels in the XX network !XX.*.*.*
e. Data is archived for all of the channels in the XX network and all of the channels from STN01 in the YY network XX.*.*.*,YY.STN01.*.*
f. All SOH data is archived for the XX network (if all SOH channels are called SOH) XX.*.*.SOH

If you do not want to filter the data, type an asterisk (*) into the box. A single asterisk means that all available data will be archived.

Archive filename pattern

You can specify a pattern for naming the archived MiniSEED files using the following parameters:

- ${N} is the network name
- ${S} is the station name
- ${L} is the location name
- ${C} is the channel name
- ${ID} is the instrumentID
- ${TIME} is the start time for the data archive in YYYYMMDD_hhmmss format

The default pattern includes all parameters and is in the following format:

- ${N}.${S}.${L}.${C}_${ID}_${TIME}

Example based on the default:

- XX.STN01.LO.HHZ_centaur-6_0345_20130912_073356

If the **MiniSEED output files** option is set to `Per channel`:

- ${C} is required if "Per channel" is selected

If the **MiniSEED output files** option is set to `Per station`:

- ${S} is required
- ${C} must be excluded

Include SOH archive

Select this check box if you also want SOH data files archived to the SD card.

The SOH data files are separate files and they are stored in a folder called **soh**. The location of this folder is **YYYY/MM/DD/soh**.

SOH archive format

If you selected the option to archive SOH data, select the format for archiving the SOH files.

Archiving SOH data in CSV format is time consuming and might impact the performance of the device.

4.13 Events

The Centaur uses detectors combined with a voting system to declare an event. A detector is an algorithm that is applied to a channel and is based on either a configured **STA**[1]/**LTA** [2] ratio. As soon as the channel detector detects that the threshold value or STA/LTA ratio has been exceeded, it generates a **trigger**[3] for that channel. When the Centaur sees this trigger, it counts how many **votes**[4] are assigned to the channel that generated that trigger. If the number of votes are equal to or higher than the configured number of required votes, an event is declared with the date and time of the trigger. If not enough votes were received from the trigger, then the Centaur waits for additional triggers for a configured period of time to allow for transmission latency. If not enough votes are received within the configured period of time, the triggers are discarded and no event is declared. If enough votes are received, an event is declared and written to the internal storage and posted on the **Events** page.

Event declaration can happen locally using only the channels of the Centaur or it can happen across a network between multiple devices if you enable the option to share triggers across a network.

Coincidence window [s]

The window of time into which the trigger on times of the channels must fall in order for those channels to be included in the same event.

Required votes

The minimum number of votes required for the Centaur to declare a group of triggers as an event.

---

[1]Short Term Average

[2]Long Term Average

[3]A message generated by the device when the STA/LTA ratio for a channel goes above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.

[4]The number of votes assigned to each channel that it can cast towards getting an event declared. The higher the number of votes, the greater the impact that the channel has on event declaration. To ensure proper event declaration, you should give zero votes to a channel that you do not want to affect the event declaration at all and a lower number of votes to channels at noisy stations.

Maximum event duration [s]

The amount of time, in seconds, the Centaur waits to see if the minimum number of required votes is met for event declaration. This wait time allows for transmission latency and any other delays that might occur.

The maximum event duration time should always be longer than the coincidence window duration.

Pre-event time [s]

The number of seconds of data archived before the event declaration time.

Post-event time [s]

The number of seconds of data archived after the event declaration time.

4.13.1 Events Data Archive

The Centaur Events Data Archive feature archives **event**[1] data and SOH data (optional) to a removable SD card. The event data can be archived in multiple industry-standard formats.

Before you enable this feature, make sure that you have inserted an SD card (formatted as FAT32 or ext4) into the SD card slot behind the media bay door of the Centaur.

In addition to archiving event data to a removable SD card, you can also manually declare an event on the **Events** page.

Enable events data archive

Select this check box to allow the Centaur to write event data to the SD card.

Each event data file is stored in a folder named for the day the event was recorded. The location of this folder is **events/YYYY/MM/DD**.

[1]Seismic activity that is detected and declared by the instrument using a voting system and threshold values or STA/LTA trigger algorithms.

The format of the name of each event data file is as follows: **NE.STN.LO_YYYYMMDD_HHMMSS.format**

If the **per channel** option is selected for the MiniSEED output files setting, then the channel name is also added to the name of the event data file before the YYYYMMDD_HHMMSS.

The network, station, and location names are defined in the Channel Naming configuration settings.

Enable MiniSEED

Select this check box to archive the event data in the MiniSEED format.

MiniSEED output files

Select the number of output files to be generated: one file per channel or one file for all instruments.

The **per channel** option produces many small files, the **per station** option produces one large file.

Other format

Select the desired file format from the list to archive event data in that format.

Archive channel list

You can choose to filter the data you archive by channel.

The filter is a comma-separated list of the SCNL (Station, Channel, Network, and Location) names of the channels you want archived. The network, station, location, and channel codes used in the SCNL list are defined in the Channel Naming settings and in the location and channel code settings of the raw TCP receivers.

You can use an asterisk (*) to represent one or more characters in a channel name and an exclamation point (!) to exclude a network, station, location, or channel. The exclamation point always has to be placed before the SCNL element that should be excluded.

The format for specifying SCNL elements in a filter is NN.SSSSS.LL.CCC, where NN is the network code, SSSSS is the station code, LL is the location code, and CCC is the channel code. The S, C, and N elements must be represented in the filter and each element must be separated by a dot (.). The L (Location) element is optional.

Examples:

a. Data is archived for all of the channels in the XX network XX.*.*.*
b. Data is archived for all of the Z channels in the XX network XX.*.*.*Z
c. Data is archived for the specified channel XX.STN01.LO.HHZ
d. Data is not archived for any of the channels in the XX network !XX.*.*.*
e. Data is archived for all of the channels in the XX network and all of the channels from STN01 in the YY network XX.*.*.*,YY.STN01.*.*
f. All SOH data is archived for the XX network (if all SOH channels are called SOH) XX.*.*.SOH

If you do not want to filter the data, type an asterisk (*) into the box. A single asterisk means that all available data will be archived.

Archive filename pattern

You can specify a pattern for naming the archived files using the following parameters:

- ${N} is the network name
- ${S} is the station name
- ${L} is the location name
- ${C} is the channel name
- ${ID} is the instrumentID
- ${TIME} is the event time in YYYYMMDD_hhmmss format

The default pattern includes all parameters and is in the following format:

- ${N}.${S}.${L}.${C}_${ID}_${TIME}

Example based on the default:

- XX.STN01.LO.HHZ_ centaur-6_0345_20130912_073356

If the **MiniSEED output files** option is set to `Per channel`:

${C} is required if "Per channel" is selected

If the **MiniSEED output files** option is set to `Per station`:

${S} is required

${C} must be excluded

Include SOH archive

Select this check box if you also want SOH data files archived to the SD card.

The SOH data files are separate files and they are stored in a folder called **soh**. The location of this folder is **YYYY/MM/DD/soh**.

SOH archive format

If you selected the option to archive SOH data, select the format for archiving the SOH files.

Archiving SOH data in the CSV format is time consuming and might impact the performance of the device.

4.13.2 Trigger/Event Sharing

The Centaur has the ability to send and receive **triggers**[1] and **events**[2] and from other devices via a multicast **UDP**[3]. The **votes**[4] associated with triggers received from other devices are used in the event detection and declaration process and the events received from other devices are displayed and downloadable on the **Events** page of the local device.

Share triggers

Select this option to enable trigger sharing.

---

[1]Messages generated by the instrument when the STA/LTA ratio for one or more channels go above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.

[2]Seismic activity that is detected and declared by the instrument using a voting system and threshold values or STA/LTA trigger algorithms.

[3]User Datagram Protocol

[4]The number of votes assigned to each channel that it can cast towards getting an event declared. The higher the number of votes, the greater the impact that the channel has on event declaration. To ensure proper event declaration, you should give zero votes to a channel that you do not want to affect the event declaration at all and a lower number of votes to channels at noisy stations.

If you enable this option, event declaration will happen both locally, using only the three channels of the local device, and across all of the devices in your network.

Share events

Select this option to enable events sharing.

If you enable this option, you can view and download the events received from other devices on the **Events** page of this device.

Multicast group

A valid **multicast** [1] IP address.

All devices that share triggers and/or events have to use the same multicast IP address and port number.

Port number

The port number used by the Centaur to share triggers and/or events with other devices (send and receive)

All devices that share triggers and/or events have to use the same multicast IP address and port number.

Multicast TTL

You can increase the Time-To-Live (TTL) of the trigger data packets by specifying the number of networks (routers) that the trigger data packets must cross to reach their destination.

For example, if the trigger data packets have to cross five networks to reach their destination, you should set the Multicast TTL to 5.

4.13.3 Data Products

You can configure the Centaur to calculate peak ground motion data products for any connected and configured accelerometer sensors. When this feature is enabled, the Centaur calculates the

[1]The first octet of a valid multicast IP address must be between 224 and 240, inclusive. Each of the last three octets can be any positive integer from 0 to 255.

PGA[1], **PGV**[2], and **PGD**[3] values for each declared event, writes the calculated values to the **internal storage**[4] with the event, and posts them on the **Events** page.

The PGA reported by the Centaur is based on measurements of the acceleration in the two horizontal directions (north-south and east-west).

Enable events data products

Select this check box to allow the Centaur to calculate peak ground motion data products for each event.

You can view the calculated PGA, PGV, and PGD values on the Events page.

Source sensor port

Select the sensor port used to calculate the data products.

This option is only applicable to a Centaur with 6 channels (two sensor ports).

Source data stream

Select the channels used to calculate the data products.

4.13.4 Configure Email Notifications for Declared Events

Centaur ships with three configuration template files that can be used to configure the automatic sending of email notifications when events are declared and completed. Once these files have been configured, two emails are sent automatically for each event. The first email is sent as soon as the event is declared and the second email is sent when the event has completed. The emails are sent to the email addresses specified in the configuration files.

---

[1]Peak Ground Acceleration

[2]Peak Ground Velocity

[3]Peak Ground Displacement

[4]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

Example email subject line: NX.PVEA1 Event 2013-05-10T18:09:19.015Z

Example email body:

Event complete 2013-05-10T18:09:19.015Z (titanEA-Master_0104)

Maximum PGA 1.40693125E-1 g @ NX.PVEA1 (titanEA-Master_0104)

See the Help for more information on event detection and declaration. You can access the help by clicking **Help** in the upper-left corner of the user interface of the device.

To configure the automatic sending of email notifications

1. Use the following commands to copy the three configuration template files that shipped with Centaur to /etc/nanometrics/config and remove the suffix (.template) from the copy:

   ```
   cp /usr/share/nanometrics/event-email/conf/event-email.conf.template
   /etc/nanometrics/config/event-email.conf

   cp /usr/share/nanometrics/event-email/conf/event-declared.-
   conf.template /etc/nanometrics/config/event-declared.conf

   cp /usr/share/nanometrics/event-email/conf/event-complete-email.-
   conf.template /etc/nanometrics/config/event-complete-email.conf
   ```

   The template files are called **event-email.conf.template**, **event-declared-email.conf.template**, and **event-complete-email.conf.template** and they are located in /usr/share/nanometrics/event-email/conf.

2. Modify the email server settings contained in **event-email.conf** so that they match the outgoing mail settings for your network and specify the email addresses of all intended recipients.
3. Modify the variables contained in **event-declared-email.conf** to determine the content of the event declared email notification (the first email that is sent).

   The first line of this file is the subject of the email and the other lines in the file are the body of the email. The available variables are as follows:

   - event_start — The time the event was declared
   - event_num_triggers — The number of triggers for the declared event

- stationName — The SCNL information for the local device (the SCNL information for a device is configured in the Channel Naming settings)
- instrumentID — The ID of the local device as shown at the top of the user interface of the device

4. Repeat step 3 for the variables in **event-complete-email.conf** to determine the content of the event completed email notification (the second email that is sent).

   The following variables are available for the event completed email notification in addition to the ones listed in step 3:

   - event_pga — The PGA of the local device, calculated after the post-event time has elapsed (see Configuration -> Events)
   - max_pga — The highest PGA value from the devices in a group, calculated after the post-event time has elapsed (see Configuration -> Events)
   - max_pga_instrumentID — The ID of the device with the highest PGA value
   - max_pga_stationName — The SCNL information for the device with the highest PGA (the SCNL information for a device is configured in the Channel Naming settings)

4.14 State of Health (SOH) Settings

Internal SOH report interval [s]

The SOH reporting rate of the SOH channels (for example, GPS, time, and storage). Default: 60 s.

External SOH report interval [s]

The SOH reporting rate of the three external SOH inputs. Default: 60 seconds. You can see voltage readings for connected equipment on the **Sensors** page, in the External SOH Inputs section.

This setting only applies to Centaur models that have an external SOH input. See applicable models.

Frames per packet

Number of frames used in each SOH packet. A smaller value means less latency, but more overhead.

4.15 Seedlink Server

Centaur can be configured to act as a SeedLink server for other SeedLink clients. Any time series data in the **internal storage**[1] of the Centaur can be converted into the 512-byte MiniSEED format and retrieved by SeedLink clients from the Centaur.

Channel names are used in the file headings and default file names of the data that is retrieved from the internal storage. These channel names act as labels and help the SeedLink clients identify the data. Before you enable a SeedLink server, ensure that you have configured the channel name settings.

The Seedlink Server feature requires a separate licence that has to be installed on the Centaur. Please contact Nanometrics at sales_mkt@nanometrics.ca for more information or to purchase a licence.

Name

The unique name of the SeedLink server.

Once you have configured the SeedLink server, its name will appear in the left pane of the Configuration dialog box, under the SeedLink server section of the tree. Select the name of the SeedLink server to edit its settings.

Enable

Select this check box to allow Centaur to stream data from this SeedLink server.

Clear this check box to disable this SeedLink server, stopping data acquisition from this source.

Port

The port number for the SeedLink server.

The SeedLink clients have to be configured to use this port number to acquire data from the Centaur SeedLink server.

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

Short term complete enable

Select this option to ensure that the SeedLink server sends data in chronological order.

If a packet is missed, the SeedLink server will wait up to the set threshold time (**Short term complete threshold [s]**) before sending any more packets. Once the threshold time is crossed, the SeedLink Server will send the next available packet and ignore the missed packet if it is received.

Short term complete should be used with Hydra and Earthworm slink2ew clients.

Short term complete threshold [s]

The number of seconds the SeedLink server will wait to receive a missed packet before continuing to send data.

This threshold value is only used if the Short term complete enable option is selected.

Enable one second packet

Produces only one second SeedLink packets by recompressing the data into new Data Records.

Real-time streaming is supported when this feature is turned on. When enabled, the SeedLink client should not send in any backfill requests, such as DATA command with sequence number, or TIME command with begin and/or end time.

Throttle

The throttle fields display under each SeedLink server added, allowing you to enable a throttle and to specify the maximum throughput bit rate:

- Enable throttle is selected by default. Uncheck this field if you do not want to limit the network transfer rate.
- Maximum throughput bit rate (bps) allows you to specify the maximum output bit rate. The default maximum is 2056000 bps.

4.16 Power

If the power supply voltage is below the configured **Power on** threshold, the Centaur will not power up. If this happens, you can bypass the power supply threshold settings and force the Centaur to power up by pressing the **Force Power On** button behind the media bay door to override this threshold.

The voltage reported at the sensor is lower than the voltage applied at the connector due to cable and connector losses, and small voltage drops in protective circuitry.

Power on [mV]

When the external power supply voltage rises above the Power on threshold, the Centaur powers up immediately.

If the current external power supply voltage is less than a newly committed **Power on** threshold, then the Centaur will not automatically power up the next time the power is disconnected and reconnected unless the **Force Power On** button behind the media bay door is pressed to override these thresholds.

Low voltage shutdown [mV]

When the external power supply voltage falls below the Low voltage shutdown threshold, the Centaur performs a safe shutdown.

If the current external power supply voltage is less than a newly applied **Low voltage shutdown** value, then the Centaur will automatically shut down. If not committed, the Centaur will revert to the previous Low voltage shutdown value.

Low voltage disconnect [mV]

When the external power supply voltage falls below the Low voltage disconnect threshold, the Centaur powers off immediately.

Set the disconnect to a value that will properly protect the battery for your power supply.

4.17 Timing

GPS configuration is not applicable when PTP is enabled as the timing source in your firmware. Contact technical support for more information.

GPS power mode

Select the power mode for the GPS.

- Duty cycled — The GPS is duty cycled automatically. The GPS receiver is switched on until the fine lock is reached in the system clock and then switched off until the estimated time uncertainty reaches a predefined limit such that the expected time error is less than the 100 µs specification. This is the most efficient setting for power consumption.

If the GPS is configured to **Duty cycled** the **Health** page will indicate a time error if the modelled uncertainty exceeds 100 µs.

- Always on — The GPS is always on. This mode uses more power, but provides the most accurate timing.

If the GPS is configured to **Always on** the **Health** page will indicate a time error if the modelled uncertainty exceeds 5 µs.

5.0 Using the Web Interface

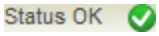
Once connected and your device is configured, you can use the Web interface to

- Monitor the status and health of your device.
- View and declare events.
- View the status of the sensor and perform several control functions.
- View waveform data and calibrate the sensor.
- Perform maintenance tasks.

5.1 Monitor the Status and Health of Your Instrument

In addition to monitoring the LEDs of your Centaur, you can also monitor the overall status and health of the device by viewing near real-time information on the **Health** page. Any problems are indicated in red. The last time the information was updated is shown in the lower-right corner of the page.

Each section on the **Health** page shows you the current state of health and status of your Centaur, grouped by component.

You can quickly check the health of the device from any page by looking at the status bar at the top of the page. The first section of the status bar displays both text and an icon to show the status of the device. 

5.1.1  Events

Most Recent

The date, and Peak Ground Acceleration (PGA), Peak Ground Velocity (PGV), and Peak Ground Displacement (PGD) of the most recent event.

 **Events Archive**

The status of the events archive and the SD card.

The possible statuses are as follows:

- Archive OK— The SD card is archiving event data or is ready to archive event data and the last event was archived successfully.
- No archive media— The SD card is missing. Insert an SD card or disable the archiving of event data.
- Archive error— The archive is corrupted or another error has occurred. Replace or reformat the current SD card.
- Archive full— The SD card is full and no more event data can be archived. Replace the current SD card or delete some of the archived events on the card.
- Disabled— The Centaur has not been configured to archive event data to a removable SD card.

Trigger Window

The window of time, in seconds, into which the Trigger on times of the channels must fall in order for those channels to be included in the same event.

Voting Threshold

Each channel of the Centaur can cast a specified number of votes towards getting an event declared and the voting threshold is the minimum number of total votes required for it to declare an event.

You can configure the number of votes each channel casts towards getting an event declared and you can also configure the voting threshold. To ensure proper event declaration, you should give zero votes to a channel that you do not want to affect the event declaration at all and a lower number of votes to channels in noisy locations.

Trigger Detectors

The trigger settings of Detector 1/Detector 2/Detector 3

The possible values are as follows:

- A hyphen (-) — This means that the detector is not enabled.
- A value in *g* — This is the configured threshold value.
- A value — This is the result of the configured STA/LTA ratio.

For more information on how to enable and configure detectors, see Trigger Detectors.

5.1.2 Device

System — Uptime

The time elapsed since the Centaur last powered up.

System — Streaming Rate

The combined streaming packet rate of all of the enabled streamers.

System — Enabled Streamers

The total number of enabled streamers.

System — Configuration

The status of the configuration settings.

If you have applied some changes to the configuration settings but not yet committed them, this value will be red. If you do not commit these outstanding changes before the next time the Centaur restarts, these changes will be lost.

System — Firmware

The version of the active firmware.

If you see **testcode** as the value, this means that you have upgraded the firmware but not yet made it permanent by committing it. Go to the **Maintenance** page and click **Commit** in the Firmware section to commit the new firmware.

Environment — Power Consumption

The amount of power consumed by the Centaur measured in watts.

The system current is shown in the tooltip.

Environment — Supply Voltage

The voltage level being supplied to the Centaur by the power source.

Environment — Temperature

The internal temperature of the Centaur.

The internal temperature may be several degrees higher than the ambient temperature.

5.1.3  Storage

Media Card — Status

The status of the removable media card.

The possible statuses are as follows:

- Media OK— The SD card is archiving data or is ready to archive data.
- Media not present— The SD card is missing. Please insert an SD card or disable the archiving of data (for more information, see Events Data Archive and Continuous Data Archive).
- Media error— The SD card is full, corrupted, or another error has occurred. Download files from your SD card to free memory, Repair, reformat, or replace the current SD card.

 **Media Card — Continuous Archive**

The status of the continuous data archive.

The possible statuses are as follows:

- Archive OK — The SD card is archiving MiniSEED data or is ready to archive MiniSEED data and the latest data was archived successfully.
- No archive media — The SD card is missing. Insert an SD card or disable the archiving of MiniSEED data.
- Archive error — The archive is corrupted or another error has occurred. Replace or reformat the current SD card.
- Archive full — The SD card is full and no more MiniSEED data can be archived. Replace the current SD card or delete some of the archived events on the card.
- Disabled — The Centaur has not been configured to archive MiniSEED data files to a SD card.

Media Card — Contains Events

Indicates if the removable SD card contains events.

Media Card — Percentage Used

The percentage of the total space used of the removable media card.

The total size of the removable media card is shown in the tooltip.

Internal Storage — Status

The status of the Centaur's **internal storage**[1].

The possible statuses are as follows:

- Temporary location — Internal storage has failed and data is being written to a backup Store.
- Recording — The internal storage is functioning correctly and recording data.
- Reindexing — The index within the internal storage is being recalculated and synchronized with the actual data that is available. Reindexing might take a long time depending on how much data is in the internal storage. Data will continue to be generated during reindexing and will not be lost. You will not be able to perform any other operations that involve the internal storage until it has finished reindexing.
- Not ready — The internal storage is not ready for recording because it is being resized, created, reformatted, or re-created.
- Not enough space — There is not enough free space in the internal memory to accommodate the intended full size of the internal storage. It will continue to operate normally with a reduced maximum capacity.
- No internal storage — The internal storage is corrupt or missing. Please contact Nanometrics Technical Support if you see this status.

Internal Storage — Percentage Used

The percentage of the total space used of the internal storage.

The total size of the internal storage is shown in the tooltip.

---

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

Internal Storage — Wraps Every

The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data. This value is the estimated time, in days, that a packet stays in the internal storage.

Internal Storage — Recording Rate

The rate that packets are being written to the internal storage.

5.1.4 Data

Sample Rate

The number of samples acquired every second, in hertz, by the Centaur for the primary channels.

Secondary Sample Rate

The number of samples acquired every second, in hertz, by the Centaur for the secondary channels (if enabled).

Sensitivity

The overall sensitivity of the system, expressed in units of counts per velocity unit.

Status

The overall status of the connected sensor or sensors (6 channel model).

You can view more detailed information on the **Sensors** page.

Control

The status of the controls used to operate the sensors

A status of Unexpected means that one or more of the sensor control settings do not match the saved configuration settings for that sensor. For example, Unexpected is displayed if the XYZ/UVW Mode configuration setting for a sensor is set to **XYZ** but the sensor control is set to **UVW**.

You can view more detailed status information for the sensor controls on the **Sensors** page.

5.1.5 Time

Status

The status of the internal system clock used to timestamp the data produced by the instrument.

The possible statuses are as follows:

- Initializing— The instrument has just powered up and it is attempting to synchronize its time to the GPS receiver.
- Time OK— The timing quality of the internal system clock is accurate to within 100 µs.
- No antenna— The GPS receiver has detected that the antenna is not connected or not drawing a current.
- Antenna short— The GPS receiver has detected a short in the antenna.
- Time error—The GPS receiver is unlocked and it is past the initialization stage (the first 10 minutes after the instrument powers up).

  -OR-

  If the GPS is configured to **Always On**, the **Health** page will indicate a time error if the modelled uncertainty exceeds 5 µs, or 100 µs if the GPS is configured to **Automatic**. See also GPS settings.

When the instrument powers up for the first time or after it has been shut down for a long period of time, it will check to see if there has been a time step in UTC[1] (the introduction of a positive leap second). It takes approximately 13 minutes for the instrument to make this check and the Timing status will be red until this check has been completed.

The International Earth Rotation and Reference Systems Service makes announcements about leap seconds in bulletins.

[1] Coordinated Universal Time

- No PTP[1] Master— The PTP master[2] is not detected by the slave.

When PTP* is enabled as the timing source in your firmware:

The only applicable statuses are **Time OK** and **No PTP master**.

The **Uncertainty**, **GPS satellites**, and **Earth location** fields described in sections below are not applicable.

*Contact technical support for more information about PTP.

Uncertainty

Based on clock drift and temperature measurements, this is an estimation, in µs, of the timing uncertainty of the digital recorder clock. The longer the GPS receiver is unlocked, the higher the timing uncertainty.

GPS Satellites

The number of satellites used by the GPS receiver for position calculation.

When the instrument starts up, its GPS receiver needs to lock onto the signals from a minimum of four different satellites to calculate a three-dimensional positional fix, consisting of latitude, longitude, and altitude. If less than four are visible, reposition the antenna so that it has good visibility of the open sky.

Earth Location

The latitude and longitude of the instrument.

5.1.6 Alerts

The Alerts section provides you with a list of recent system-related events such as start-ups, shutdowns, and configuration changes.

---

[1]Precision Time Protocol: a protocol used to synchronize with nanosecond accuracy the real-time clocks of the devices in a network.

[2]The device in the PTP network with the most precise clock. All other PTP-enabled devices in the network synchronize their clocks with the master by constantly exchanging timing messages with it. The TitanEA Master is a PTP master.

5.2 Monitor the LEDs

The Centaur has the following LEDs that you can use to monitor the current status of the instrument and troubleshoot any problems that may occur. The LEDs are both external and internal.

External LEDs:

- Overall Status
- Link
- Time
- Media
- Sensor A/B

Internal LEDs:

- Media Eject
- USB Eject

5.2.1 Overall Status LED

Off

The Centaur is powered off.

Solid red

Initial power-on.

Blinking yellow

The Centaur is starting up and checking all of the internal systems.

Blinking green

The Centaur is operating properly.

Blinking red

There is a fault or condition that prevents the Centaur from operating properly. If none of the other LEDs indicate an error condition, check the Health page to determine the possible cause.

Possible problems could include the following:

- The GPS receiver is not locked or the GPS antenna is disconnected or shorted.
- The Data Archiving feature is enabled but the SD card is missing, full, corrupt, or could not be prepared for use.
- Configuration changes have not been committed.
- The firmware status is not okay.
- The status of the **internal storage**[1] is not okay.
- The sensor input voltages or control settings are not okay.
- The internal storage failed and data is being written to either the SD card, if present, or the instrument's RAM, if no SD card is present. You will also see the Internal Storage Status listed as **Temporary Location** on the **Health** page.

  -OR-

  The Force Power On button was pressed to force the Centaur to bypass the power supply threshold settings and power up. Once the **Force Power On** button is pressed, the Power LED will change from solid red to blinking yellow and then to blinking red.

5.2.2 Link LED

Off

No Ethernet cable is connected.

-OR-

The unit is powered off.

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

Solid green

Link established over the Ethernet cable.

Flickering green / orange

Data is being transmitted or received over the Ethernet link.

Flickering green

Link established over the Ethernet cable.

5.2.3 Time LED

Off

The Centaur is powered off.

Blinking yellow

The GPS receiver is initializing and attempting to acquire a lock. It will attempt to acquire a lock after the Centaur powers up.

Blinking green

The Centaur has synchronized to an accurate time.

Blinking red

The GPS receiver is unlocked, the time uncertainty is >100 µs, and the GPS initialization stage is past.

-OR-

No GPS antenna is connected, the GPS antenna is not drawing a current, or the antenna has poor visibility of the open sky.

5.2.4 Media LED

Off

For more information, see Events Data Archive and Continuous Data Archive.

Blinking yellow

Checking the status of the SD card.

Blinking green

The SD card is archiving data/ready to archive data.

Blinking red

The SD card is missing, full, or corrupt or it could not be prepared for use.

5.2.5 Sensor LEDs

The 3 channel model of the Centaur has one Sensor LED and the 6 channel model has two. In addition to the Sensor LEDs, you can also view information about the sensors on the **Health** and **Sensors** pages of the user interface.

Off

The unit is powered off.

Blinking yellow

Blinking green

All three mass position values are between the high and low configurable threshold values.

Blinking red

There is an error condition that could prevent the sensor from operating properly.

Possible problems could include the following:

- At least one mass position value is above 2.5 V or below -2.5 V.
- One or more of the sensor control settings do not match the saved configuration settings for that sensor.

5.2.6 USB Eject LED

The USB port is not currently supported for the Centaur for data archiving.

Off

No USB device is detected.

Blinking red

The USB device has been inserted and it is being prepared for use.

-OR-

The button next to the USB device has been pushed and the device is being prepared for safe removal.

The buttons next to the SD card and the USB device have been pressed and held for more than 6 seconds and then released to initiate a safe shutdown of the Centaur. Both LEDs will blink red while the Centaur is shutting down and then go off.

Solid red

The USB device is ready to use or is being used and it is not safe to remove it.

It will turn from solid red to off after 10 minutes to save power.

Solid green

The button next to the USB device has been pushed, the device has been prepared for safe removal, and it is safe to remove the USB device.

If the USB device is not removed within 10 minutes after it has been prepared for safe removal and the LED turns solid green, the device will be prepared for use again and the LED will turn to blinking red.

5.2.7 Media LED

Off

For more information, see Events Data Archive and Continuous Data Archive.

Blinking yellow

Checking the status of the SD card.

Blinking green

The SD card is archiving data/ready to archive data.

Blinking red

The SD card is missing, full, or corrupt or it could not be prepared for use.

5.3 Monitor Sensor Operation

Use the **Sensor** page to view the mass positions for each connected seismometer, as well as voltage levels for external SOH inputs (if your Centaur has an external SOH input). See Applicable Models.

Additionally, you can manage some aspects of seismometer operation, and access the Web interface of a Nanometrics smart sensor on the **Sensors** page.

5.3.1 Seismometer Mass Position SOH

Each sensor port on the Centaur has three mass position seismometer SOH inputs and, if enabled, the voltage levels of these inputs are recorded at the configured SOH report interval and displayed on the **Sensors** page. The seismometer mass position SOH values are also included in the Environment SOH group, which you can download from the **Maintenance** page.

You can edit the Sensor SOH settings for any custom sensor configurations that you create and view the Sensor SOH settings for any of the default sensor configurations.

5.3.2 External SOH Inputs

If your Centaur has an External SOH input and you have connected sensors to record analog SOH signals (± 5V), you can see the external SOH values displayed on the **Sensors** page. The SOH input provides three external SOH channels that record voltage levels at the configured External SOH report interval.

External SOH values are included in the Environment SOH group, which you can download from the **Maintenance** page.

This only applies to Centaur models that have an external SOH input. See applicable models.

5.3.3 Control

Mass centring is a key function in the control section of the Sensor page. You can also temporarily toggle the axis mode from UVX to XYZ for debugging purposes.

You can control some aspects of sensor operation using the controls on the **Sensors** page. Specific control line settings are required to make some of the controls available and not all controls are available for all sensor types.

If one or more of the sensor control settings do not match the saved configuration settings for that sensor, the status of Unexpected will be displayed in the Data section of the **Health** page. For example, Unexpected is displayed if the XYZ/UVW Mode configuration setting for the sensor is set to **XYZ** but the sensor control is set to **UVW**.

Sensor mode (XYZ or UVW) is configured in **Configuration > Sensor Library**

See Calibrate Sensor for information on how to calibrate a sensor.

Displays the model and serial number of the attached sensor.

Accessing the Web interface of a Nanometrics smart sensor through the Centaur can cause low levels of noise on the output signals of the sensor. When serial communication with the sensor is enabled, the Web Interface generates a status error due to the generated noise. Disable serial communications when you have completed debugging activities.

Axis

The orientation of the sensor elements.

Control line settings:

- XYZ/UVW On=UVW

  -OR-

  XYZ/UVW Off=XYZ

UVW is the orientation for a symmetric triaxial seismometer.

Period

The operating mode of the sensor.

The lower corner of the seismometer response can be changed from the normal long-period (LP) operating mode to a short-period (SP) response.

Changing to SP mode is useful when levelling the seismometer, allowing you to see the mass positions quickly respond to changes in tilt, or once the seismometer is levelled, to allow the mass positions to quickly settle. Be sure to leave the seismometer in long-period (LP) mode when recording seismic signals.

Control line setting:

- SP/LP On=SP

  -OR-

  SP/LP Off=LP

This option may not be available for all sensors.

Mass centre

Initiates automatic motorized re-levelling of the internal seismometer, and the re-centring of the masses.

Centres the masses.

Control line setting:

- Mass Centre

This option may not be available for all sensors.

Mass lock

Locks or unlocks all masses.

Control line settings (one control line for each setting):

- Mass Lock

  -OR-

  Mass Unlock

This option may not be available for all sensors.

Automatic mass centring

Indicates whether automatic mass centring is enabled or disabled. Automatic mass centring is disabled by default. You enable automatic mass centring in Configuration settings. For more information, see Auto Mass Centring.

The **Automatic mass centring** field is visible only if you have configured a control line for mass centring.

5.3.4 Discovery

After you connect a Nanometrics smart sensor (such as a Trillium Compact or a Trillium Posthole) to the Centaur and select it in the Sensor Library for Sensor A or B (6 channel model only), click the **Discover** button on the **Sensors** page to detect it and load the smart sensor details.

After it has been detected, you can access the Web interface of the Nanometrics smart sensor by changing the Serial setting to **A** or **B** and clicking the hyperlink in the name of the sensor.

Accessing the Web interface of a Nanometrics smart sensor through the Centaur can cause low levels of noise on the output signals of the sensor. When serial communication with the sensor is enabled, the Web Interface generates of status error due to the generated noise. Disable serial communications when you have completed debugging activities.

5.4 Event Detection and Declaration

The channels of the Centaur continuously digitize time series data, which is recorded to the **internal storage**[1]. You can configure the Centaur to stream this time series data to another device or application and/or archive it on a removable media card. You can also download it from the device using the options on the **Maintenance** page.

If you want the Centaur to detect and declare seismic events in addition to continuously recording time series data, you have to enable a detector for one or more of the time series channels and assign a number of votes to all channels with enabled detectors. The Centaur uses the detectors combined with a voting system to declare an event. A detector is an algorithm that is applied to a channel and is based on either a configured threshold value or a configured STA/LTA ratio. As soon as the channel detector detects that the threshold value or STA/LTA ratio has been exceeded, it generates a trigger for that channel. When the Centaur sees this trigger, it counts how many votes are assigned to the channel that generated that trigger. If the number of votes are equal to or higher than the configured number of required votes, an event is declared with the date and time of the trigger. If not enough votes were received from the trigger, then the Centaur waits for additional triggers for a configured period of time to allow for transmission latency. If not enough votes are received within the configured period of time, the triggers are discarded and no event is declared. If enough votes are received, an event is declared and written to the internal storage

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

and posted on the **Events** page. If configured, the time series data for the event is also written to a removable media card.

Event declaration can happen locally using only the channels of the Centaur or it can happen across a network between multiple devices if you enable the option to share triggers across a network.

You can view information about the declared events on the **Events** page, download them locally from devices in the network, and, if required, you can also manually declare an event. The information on this page is updated each time you access the page or each time you manually declare an event. You can check the **Last updated** information in the lower-right corner to see the age of the data.

5.4.1 View and Manage Events

The **Events** page shows you the date and time of each **event**[1] recorded in the **internal storage**[2] as well as the peak ground motion data products, cause and source, and the number of **triggers**[3] for that event. It also shows whether the event has been archived to the removable media or not. If the Centaur has been configured to automatically archive events to an SD card, then all declared events will be on the SD card as well as in the internal storage.

Download Archived Events

You can download locally to your computer any event that has been archived to the removable SD card. The available formats depend on the configuration for the events data archive. To download archived events, select the checkboxes next to the events you want to download and then click **Download**

[1]Seismic activity that is detected and declared by the instrument using a voting system and threshold values or STA/LTA trigger algorithms.

[2]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

[3]Messages generated by the instrument when the STA/LTA ratio for one or more channels go above the configured trigger on ratio or when the configured threshold value is exceeded. Each trigger is assigned a number of votes (on the source device) that it casts towards getting an event declared.

The archived events are downloaded locally in a compressed file (.zip) that contains all available formats.

You cannot download events that are only stored in the internal storage on the **Events** page but you can retrieve data from the internal storage on the **Maintenance** page.

Download Events Using Secure FTP

You can log into the instrument with read-only access and download MiniSEED event data from the SD card using a secure **FTP**[1] connection and the FTP client application of your choice.

Once you have logged on to the instrument, you can locate MiniSEED event data in the following location on the SD card:

- /var/archive/events

The instrument must have an SD card installed and the instrument must be configured to archive data (see Events Data Archive and Continuous Data Archive) to use this feature.

You have to log on to the instrument using the calibration user account (user name: calibration, password: calibrate) to download events via secure FTP.

We recommend that you change your password after you have logged on for the first time. See Changing the Calibration Password.

Delete Archived Events

You cannot delete events that are only stored in the internal storage but you can delete any events that have been archived to the removable SD card. You have two options for deleting events:

- You can select the checkboxes next to the events you want to delete and then click **Delete**.

  -OR-

  You can click the **Delete all event archives** button to delete all existing content on the SD card.

[1] File Transfer Protocol

You have to be logged on using the admin user account to delete all of the event archives on the SD card and you have to confirm that you want to do it since this action cannot be undone.

We recommend that you change your password after you have logged on for the first time. See Changing the admin password.

5.4.2 Manually Declare Events

If you know that an **event**[1] occurred but for some reason it was not declared as an event (for example, not enough votes were cast to get an event declared or the voting threshold was set too high), you can manually declare an event on the **Events** page. The manual declaration is based on the historical data stored in the **internal storage** [2].

You have to log on using the admin user account before you can declare an event.

We recommend that you change your password after you have logged on for the first time. See Changing the admin password.

The event will appear in the list of Events on the **Events** page as soon as you click **Declare Event**. You will be able to download it and view the peak ground motion products for the event as soon as it has been successfully retrieved from the internal storage. The **Source** column will help you distinguish automatically declared events from any that have been declared manually (user).

5.5 View Seismic Waveforms in Near Real Time

You can see the ground vibrations recorded by the Centaur in near real time by viewing the seismic waveforms on the **Waveform** page. One horizontal signal line is displayed for each channel of the Centaur on a data plot with a time scale.

If the sensor needs to be calibrated, you can also perform a sensor calibration on this page using a calibration signal file format.

---

[1]Seismic activity that is detected and declared by the instrument using a voting system and threshold values or STA/LTA trigger algorithms.

[2]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

5.5.1 View Waveform Data

The **Waveform** page shows a horizontal signal line, or trace, in near-real time for each channel of the Centaur.

The trace represents the amplitude of the signal received by the Centaur after **DC offset**[1] correction has been performed. The traces all begin and end at the same time and the starting time is shown in the lower-left corner of the data plot with time increasing to the right. The current time scale is shown at the bottom of the data plots between the current time and the plus and minus buttons. You can click the plus and minus buttons to increase or decrease the time scale.

- Click the pause button at the bottom of the data plot or click any of the traces to pause the traces. The colour of the traces changes to blue when paused.
- Click the rewind or fast forward button or click and drag the cursor on a trace to move back and forward in time. The amount of data buffered will limit how far back in time you can go.
- The **SCNL**[2] and sample rate is shown in the upper-left corner of each trace plot as well as the mean, **RMS**, minimum, and maximum. You can use the mean value to configure the Channel offset setting.

5.5.2 Calibrate Sensor

The Centaur ships with the following calibration signal files:

- A 1 Hz sine wave with a 5 V peak for 30 s
- A step function that is 0 V for 15 s and then 5 V for 15 s
- A pseudo random binary (PRB) file

To use one of these signal files for calibration

1. Log on using the admin user account. See Logging on to the Web Interface.
2. Select a sensor from the **Sensor** list on the **Waveform** page (6 channel model only).

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[1]The deviation from zero of the signal average over time. A signal should have a middle point at zero to allow maximum dynamic range.

[2]Station Channel Network Location

3. Select a file from the **Signal File** list.
4. Select the **Attenuation** from the list.

   The **Attenuation** is the value used to attenuate the calibration signal You can use attenuation to select the range when lower amplitude signals are desired. For example, a more accurate 5 mV signal is generated by selecting attenuation of 1000 and amplitude 5 V, rather than attenuation of 1 and amplitude of 0.005 V.

5. Select **Create event** if you want the Centaur to create an event during the calibration. The duration of this generated calibration event is based on the duration of the signal file plus the pre- and post-event times. This event will be available for download on the Events page when the calibration has finished.

6. Click the Start calibration button  .

When calibration starts, a small signal offset might be generated for between 1-2 s, and then the first sample of the calibration signal file is driven at the top of a second. That second is at least 5 s after the Start calibration button has been clicked.

If you would prefer to create your own calibration signal file, you can do so using a raw (headerless) file format and then you can use an SSH[1]-based file transfer protocol to upload it to your Centaur so that it will be available for selection in the signal file list on the Waveform page.

5.5.3 Calibration Signal File Format for the External Sensor

Use the file format information below to create a custom calibration signal file in an uncompressed raw sample format and when you are done upload it to your Centaur. You can use any software that can export raw (headerless) audio files, such as Audacity®, to create the custom calibration signal file.

If you do not want to manually create a calibration signal file, we have provided you with a Ruby script that you can use to create a raw signal file. You can download it by typing the following path into the location bar of your browser: **http://*IPaddressofyourCentaur*/calibration/create_externalsensor_calibration_signal.rb**

[1]Secure Shell

When you run the script using Ruby, you have to specify the signal type (sine or step), the duration in seconds, the amplitude in V, and a name for the output file. Once the file has been created, upload it to your Centaur and then select it from the **Signal File** list on the **Waveform** page to perform a calibration.

File Format Information

Format	Uncompressed raw
Header	None
Encoding	Signed 16-bit integer
Byte order	Little-endian[1]
Channels	
Start offset	0 bytes
Sample rate	30 000 Hz
Output signal	The maximum output signal (+5 V) corresponds to the maximum value (32 767)

Value (2's complement)	Output signal
-32768 (0x8000)	+5V
0 (0x0000)	0 V
32767 (0x7FFF)	-5 V

5.5.4 Upload Custom Calibration Signal File

After you have created a custom calibration signal file, you can upload it to your Centaur using an SSH[2]-based file transfer protocol such as SFTP[3] or SCP[4].

[1] In this order, the bytes of a multibyte value are ordered from least significant to most significant.
[2] Secure Shell
[3] SSH File Transfer Protocol
[4] Secure Copy

File Transfer Protocol Information	
Protocol	SFTP or SCP
Host name	IP address of your Centaur
Port number	22
User name	calibration
Password	calibrate
Upload location	/usr/share/nanometrics/calibration

You will have to re-upload your custom calibration signal file after you upgrade the firmware of your Centaur because it will be overwritten during the upgrade process.

5.6 Perform Maintenance Tasks

From time to time, you might have to perform simple maintenance tasks to ensure that your Centaur continues to operate correctly. These tasks include upgrading the firmware, and retrieving time series, SOH, or response files from the Centaur's **internal storage**[1] or archives on the SD card. You can perform these tasks on the **Maintenance** page as well as download log files; formatting or repairing the SD card, restart/shut down the Centaur; and reindex or re-create the Centaur's internal storage.

You have to be logged in with the admin user account to perform any of the tasks on the **Maintenance** page.

We recommend that you change your password after you have logged on for the first time. See Changing the admin password.

You should only click **Shutdown** on the Maintenance page if you are in the same location as the Centaur because it is not possible to power it up remotely.

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

5.6.1 Upgrade Firmware

Before you upgrade the firmware on your Centaur, refer to the release notes for the specific firmware version for recommendations and special considerations.

The **Delete** button on the **Maintenance** page is used to delete the firmware installation package. The actual firmware will not be deleted. If a firmware installation package does not exist on internal storage, then the **Delete** button is disabled.

To upgrade or install your firmware, follow the procedure below:

1. Contact Nanometrics Technical Support to obtain the latest firmware upgrade package (.tgz file) and download it to your computer.
2. Access the Web Interface for your Centaur and navigate to the Firmware section on the **Maintenance** page.
3. If required, click the **Commit** button to make the active firmware permanent.

   If the currently loaded firmware has already been committed the **Commit** button is disabled. You can also verify if the firmware is committed from the Device section on the **Health** page.

4. If the **Available Firmware** field displays the version number of a previously uploaded installation package, click the **Delete** button to remove the installation package from your Centaur. If no installation package is present, the **Available Firmware** list is disabled.

   Only one installation package can be present on the Centaur. The previous version must be deleted before you can upload the latest firmware installation package.

   Deleting a previously uploaded firmware installation package will not affect the operation of your Centaur.

5. Upload and commit the latest firmware to your Centaur:
   a. Click the **Choose file** button to select the new firmware installation package to upload to the Centaur.
   b. Click the **Upload** button. A message will be displayed if the upload is successful.
   c. Click the **OK** button to confirm the upload and select the release from the **Available firmware** list.

d. Click the **Apply** button to temporarily install the firmware. Your upgrade must be applied before it can be committed. The progress of the installation is shown in the installation log.

This operation will take several minutes. The Centaur will restart automatically after it has completed installing the firmware. You should not navigate away from the **Maintenance** page until the Centaur has completed installing the firmware and the device has restarted.

e. After the Centaur has restarted, navigate to the Firmware section on the **Maintenance** page and click the **Commit** button to ensure the newly upgraded firmware is installed.

6. The installation package is no longer required once the firmware has been committed to the Centaur. Click the **Delete** button to remove the firmware installation package from your Centaur.

Deleting the firmware installation package will not affect the operation of your Centaur.

5.6.2 Retrieve Data from the Internal Storage

In addition to streaming data from the Centaur to a network device and archiving data to the removable SD card, you can also retrieve time series and SOH data directly from the Centaur's **internal storage**[1] by downloading it from the **Maintenance** page to your computer.

When you specify the date and time range of the retrieval, remember that the internal storage wraps around when it is full and records over the oldest data. The frequency with which the internal storage wraps is shown in the Internal Storage section on the **Health** Page.

Only one data retrieval request can be run from one Centaur at any time. Any subsequent retrieval requests will be processed when the current download has finished.

[1]The device writes all of the data it receives to an internal storage. The internal storage works like a ring buffer and it wraps around when it is full and records over the oldest data.

5.6.3 Download Log Files

If required for troubleshooting purposes, you can view and save the system logs for your Centaur by clicking **Log files** in the **Download files** section on the **Maintenance** page.

5.6.4 Download Archive Files

If an SD card is present and configured to archive continuous and/or event data, and SOH data, you can periodically download archive files.

From the **Maintenance** page, in the **Download Files** section, click **Archive files**.

The archive opens in a separate tab in your browser where you can select the files you wish to download.

The **.store** directory on the SD card is the file system reserved by the Centaur for backup storage. Do not delete the .store directory or modify files within the directory. The best way to protect your data is to configure continuous archiving to your SD card. For more information, see About Data Storage.

Continuous data are stored in directories labelled by date. Event data are contained in the **events** directory. If you have enabled SOH in either or both continuous and event archives, you will see an **soh** subdirectory in these archives.

Archive files can only be downloaded one file at a time using this method. As an alternative, you can download multiple files using secure FTP and an FTP client of your choice.

Downloading archived files from the SD card while it is in the SIU is very slow due to data bus speed limitations. It is recommended that you retrieve data from the internal media (Store) via the Maintenance page if it has not wrapped already, or by physically removing the SD card and copying data directly onto a computer.

5.6.5 Download Channel Response Files

You can download channel response data directly from the instrument in IRIS RESP or dataless SEED format. The response is based on the current instrument configuration.

1. From the **Maintenance** page, in the **Channel Response** section, select the desired file format from the **Choose response file format** drop down list.

2. Click the **Download** button.

A zip file containing one response file for each channel will be downloaded to your browser's download location.

5.6.6 Removable Media

The **Removable Media** section on the **Maintenance** page provides:

- information about the status and the percentage of memory used on your SD card.
- the ability to remotely re-format your SD card in FAT32 or ext4 format.
- a repair function that runs a file system check on your SD card.

Format SD Card

Format your SD card by selecting either FAT32 or ext4 and clicking **Format** on the **Maintenance** page. Any data on your SD card is permanently deleted and a new file system is set up for reading and writing data.

It will take significantly longer to format SD cards as ext4.

Repair SD Card

When you repair your SD card by clicking the **Repair** button on the **Maintenance** page, Centaur runs a file system check on your SD card and repairs the file system, if possible.

5.6.7 Perform Maintenance on the Internal Storage

Typically, you only need to perform internal storage maintenance tasks when instructed to do so by Nanometrics Technical Support for troubleshooting purposes. These tasks involve using Internal Storage Tools on the **Maintenance** page to reindex or re-create the data Store, which is located in internal storage media. For more information about internal storage, see About Data Storage.

Reindexing the Store

To reindex the Store, which is located on the internal storage media, click **Reindex** on the **Maintenance** page. The index within the Store is recalculated and synchronized with the actual

data that is available. Reindexing might take a long time depending on how much data is in the Store. Data will continue to be generated during reindexing and will not be lost.

Re-creating the Store

To re-create the Store, click **Re-create** on the **Maintenance** page. All data in the Store is permanently deleted and a new Store is created.

In the event of internal storage failure

In the event of internal storage failure, the Status LED flashes red on the instrument and there will be a warning message on the **Health** page indicating that data is being written to a temporary location. In this case the temporary location is either the SD card, if present, or RAM if no SD card is present.

The instrument reserves 500 MB of space on the SD card for backup storage. When backup storage on the SD card reaches capacity, the Centaur overwrites the oldest data in the pre-allocated backup file system. The backup storage does not overwrite data in the SD card's continuous or event archive(s).

A smaller store in RAM is reserved for backup storage. The backup Store in RAM is primarily used to backfill a limited amount of data lost during network outages for deployments using continuous streaming.

Any configured streamers are unaffected by internal storage failure.

What should I do?

- Download files from your SD card to minimize data loss.
- Contact Nanometrics Technical Support. Support staff will instruct you about your next steps, which may involve re-indexing or re-creating the Store, or replacing your flash storage media.

5.6.8 Restart/Shut Down a Centaur

Read the information in this topic carefully before you shut down or restart your Centaur from the **Maintenance** page.

Shut Down a Centaur

You should only click **Shutdown** on the Maintenance page if you are in the same location as the Centaur because it is not possible to power it up remotely.

You have to shut down a Centaur before you disconnect the power to avoid potential data corruption and the possibility of a lengthy reindexing of the internal storage on restart.

When you click **Shutdown**, all data files are closed and saved and the Web server is shut down so that no data is lost when the power is disconnected. You can disconnect the power to the Centaur when all of the LEDs on the case have turned off.

Restart a Centaur

In general, you should only click **Restart** on the Maintenance page if instructed to do so by a Nanometrics representative for troubleshooting purposes. Some data loss will occur while the Centaur is restarting.

6.0 Application Program Interfaces (APIs)

The following HTTP-based APIs are available for the Centaur.

- Data Availability API
- FDSN-WS Data Retrieval API
- Nanometrics Data Retrieval API
- State of Health API
- Instrument Response API

Syntax

- Unless indicated otherwise, all parameters are optional. Optional values are given in the format {a|b}. The curly braces and vertical bar indicate the options and are not part of the API request.
- Note that APIs where all parameters are optional require the use of at least one parameter to return data.
- The use of ***bold-italics*** indicates the default value of an optional parameter.

6.1 Data Availability API

The Data Availability API provides the means for custom scripts and applications to retrieve data availability information from Centaur. Requested data is defined by selecting a base URI to determine the data source (band or channel). The data is further defined by selecting data source, data type and time option parameters. The response data is provided in JSON format and indicates ranges of time for which contiguous data is available on the instrument's primary, internal media.

BASE URIs

Use the following URI to return data from a device using the bandId/instrumentID parameter.

```
/api/v1/bands/availability.json
```

Use the following URI to return data from a device using the channels parameter.

```
/api/v1/channels/availability.json
```

`.json` is part of the base URIs. If you specify any parameters, you must remove `.json` from the API request.

Parameters

type

Use this parameter to specify data type.

Format: `type={`***`all`***`|timeSeries}`

Select

- `all` to return all data types.
- `timeSeries` to return only timeSeries data.

Example snippet: `type=all`

bandId/instrumentID

Use this parameter to specify a band or instrument data source.

Format1: `bandId=instrumentId_SN/band/timeSeries1`

Example snippet: `/api/v1/bands/availability?bandId=mc-ph1_0107/band/timeSeries...`

Format2:`dataSource={instrumentId_SN|NX.STN}`

Example snippet: `/api/v1/bands/availability?dataSource=centaur-3_0007&type=timeseries...`

Notes:

- Network.Station format only works with SEEDLink bands.
- Binder lookups are not performed.
- Multiple bandId parameters or instrumentID parameters are permitted.

channels

Use this parameter to specify a channel data source. Note that a binder is required.

Format: `channels={NX.STN.*}`

Example snippet:
`/api/v1/channels/availability?channels=XX.*.*.*&type=timeseries...`

Notes:

- Uses channel naming configuration in internal Binder.
- If this parameter is omitted, information for all available channels is returned .
- SOH channels return a modifier on the end of the channel name to differentiate between potentially different data that is available for different SOH types.
- Refer to “Channel list” in the Apollo Server User Guide for the format for specifying SCNL elements in a filter.

view

Use this parameter to trim returned data.

Format: `view=trimmed`

Example snippet: `view=trimmed`

Notes:

- Time ranges are trimmed to the time defined by the Time parameter.
- Sequence numbers are removed.

Time

Use this parameter to specify the ISO8601 time option.

Format: `{start|end}Time=yyyy-MM-ddTHH:mm:ss.sssZ`

Select:

- `start` to define the start time for retrieving data using the ISO8601 standard.
- `end` to define the end time for retrieving data using the ISO8601 standard.

Example snippet: `startTime=yyyy-MM-ddTHH:mm:ss.sssZ`

Notes:

- Milliseconds (.sss) are optional.
- Time is expressed in accordance with the ISO8601 standard.
- The Z indicates UTC (Zulu) time zone, non-UTC time zones are not supported.
- If you do not specify an end time, then it is assumed that the end time is the current time.

Millis

Use this parameter to specify the Milliseconds time option.

Format: `{start|end}Millis=#############`

Select:

- `start` to define the start time for retrieving data in Milliseconds.
- `end` to define the end time for retrieving data in Milliseconds.

Example snippet: `startMillis=1371686400000&endMillis=1371772800000`

Notes:

- Since 1970
- If you do not specify an end time, then it is assumed that the end time is the current time.

Nanos

Use this parameter to specify the Nanoseconds time option.

Format: `{start|end}Nanos=###################`

Select:

- `start` to define the start time for retrieving data in Nanoseconds.
- `end` to define the end time for retrieving data in Nanoseconds.

Example snippet: `startNanos=1371686400000000000&endNanos=1371772800000000000`

Notes:

- Since 1970
- If you do not specify an end time, then it is assumed that the end time is the current time.

Examples

This section provides examples of requests. Availability information for the requested data source and time period (or all if unspecified) is returned. The date and time in the returned data is in ISO8601 format, including nanoseconds. For instance, the combined date and time format is 2013-06-25T10:32.26.000000000Z.

Note that "ranges" in output indicate gaps in the data. Several ranges in an output could indicate a problem.

bandId/instrumentId

http://10.10.10.10/api/v1/bands/availability?type=timeseries&startTime=2013-06-21T12:00:00.000Z

http://10.10.10.10/api/v1/bands/availability?dataSource=centaur-3_0007&type=timeseries&startTime=2013-06-21T00:00:00Z

http://10.10.10.10/api/v1/bands/availability?dataSource=centaur-3_0007&type=timeseries&startMillis=1371686400000&endMillis=1371772800000

Trimmed example of the JSON data returned for bandId/instrumentId (... indicates where the data would continue)


```
{
        “availability”: [
                {
                        “id”: “titanSMA_0069/band/timeSeries1”, “ranges”: [
                                {
                                        “startTime”: “2013-06-18T17:03:31.180000000Z”,
                                        “endTime”: “2013-06-19T15:01:44.035000000Z”
                                },
                                {
                                        “startTime”: “2013-06-19T15:01:59.350000000Z”,
                                        “endTime”: “2013-06-19T22:27:50.760000000Z”
                                }
                        ]
                },
                {
                        “id”: “titanSMA_0069/band/timeSeries2”, “ranges”: [
                        ...
```

channels

http://10.10.10.10/api/v1/channels/availability?type=timeseries&startTime=2013-06-21T12:00:00.000Z

http://10.10.10.10/api/v1/channels/availability?channels=XX.*.*.*&type=timeseries&startTime=2013-06-21T00:00:00Z

http://10.10.10.10/api/v1/channels/availability?channels=!XX.*.*.*&type=timeseries&startMillis=1371686400000&endMillis=1371772800000

Trimmed example of the JSON data returned for channels (... indicates where the data would continue


```
{
        “availability”: [
                {
                        “id”: “CI.ADO/BHZ”, “ranges”: [
                                {
                                        “startTime”: “2013-06-18T17:03:31.180000000Z”,
                                        “endTime”: “2013-06-19T15:01:44.035000000Z”
                                },
                                {
                                        “startTime”: “2013-06-19T15:01:59.350000000Z”,
                                        “endTime”: “2013-06-19T22:27:50.760000000Z”
                                }
                        ]
                },
                {
                        “id”: “CI.ADO/BHN”, “ranges”: [
                        ...
```

6.2 Web Service data download interface (FDSN-WS)

This web service interface allows you to download time series seismic data and SOH data in MiniSEED format. The API is compliant with FDSN-WS Specifications version 1.1. See www.fdsn.org/webservices/FDSN-WS-Specifications-1.1.pdf for complete details.

The *fdsnws-dataselect* service currently supports the following methods:

- *query*
- *version*
- *application.wadl*

The following required parameters of *fdsnws-dataselect* service are supported:

- *starttime*
- *endtime*
- *network*
- *station*
- *location*
- *channel*

The following optional parameters are not supported at this time.

- *quality*
- *minimumlength*
- *longestonly*
- *format*
- *nodata*

Example snippet:

```
/fdsnws/dataselect/1/query?network=XX&station=S0001&location=*&channel=ZZ
Z&starttime=2015-05-20T18:21:00.000&endtime=2015-05-20T18:22:00.000
```

6.3 Nanometrics data retrieval API

This API allows you to download seismic data or SOH data from a Centaur.

This API has been deprecated. We recommend that you use the FDSN-WS Data Retrieval API.

BASE URI

`/retrieval`

Parameters

Group

Use this parameter to select either seismic data or SOH data to download.

Format: `Group={TIME_SERIES|SOH}`

Select:

- `TIME_SERIES` to download seismic data.
- `SOH` to download State-of-Health data.

Example snippet: `Group=TIME_SERIES`

Notes:

- The `TIME_SERIES` option is required if you wish to use the `TIME_SERIES_[n]` parameter.
- The `SOH` option is required if you wish to use the `ENVIRONMENT`, `TIMING`, or `TRIGGER` parameters.

TIME_SERIES_*[n]*

Use this sub-parameter to select time series data if you have specified the TIME_SERIES group.

Format: `TIME_SERIES_[n]=true`; where n=the channel number

Select `true` to download time series data for the defined channel.

Example snippet: `TIME_SERIES_1=true&TIME_SERIES_2=true&TIME_SERIES_3=true`

Notes:

- You can only use this parameter if you have specified the TIME_SERIES group.
- At least one channel must be defined. If you do not define a channel an HTTP 500 error stating that "no channels were selected" will result.
- One or more channels may be included in each request.

- The available channels are as follows:
  - Centaur3: TimeSeries1/2/3, 1/2/3/101/102/103 with secondary channels enabled.
  - Centaur6: TimeSeries1/2/3/4/5/6, 1/2/3/4/5/6/101/102/103/104/105/106 with secondary channels enabled.
- The number of channels available depends on the Centaur model and configuration.
- The SCNL information included in the MiniSEED file is defined in the Channel Naming section.

ENVIRONMENT

Use this sub-parameter to retrieve environment SOH data if you have specified the SOH group.

Format: `ENVIRONMENT=true`

Select `true` to download environment SOH data for the defined time range.

Example snippet: `ENVIRONMENT=true`

Notes:

- You can only use this parameter if you have specified the SOH group.
- This parameter can be called with the TIMING and TRIGGER parameters.
- Several SOH groups may be selected and multiple groups can be downloaded in a single request.
- Refer to SOH Groups for a listing of the data available for each SOH group.

TIMING

Use this sub-parameter to retrieve timing SOH data if you have specified the SOH group.

Format: `TIMING=true`

Select `true` to download timing SOH data for the defined time range.

Example snippet: `TIMING=true`

Notes:

- You can only use this parameter if you have specified the SOH group.
- This parameter can be called with the ENVIRONMENT and TRIGGER parameters.
- Several SOH groups may be selected and multiple groups can be downloaded in a single

request.

- Refer to SOH Groups for a listing of the data available for each SOH group.

TRIGGER

Use this sub-parameter to retrieve environment SOH data if you have specified the SOH group.

Format: `TRIGGER=true`

Select `true` to download trigger SOH data for the defined time range.

Example snippet: `TRIGGER=true`

Notes:

- You can only use this parameter if you have specified the SOH group.
- This parameter can be called with the ENVIRONMENT and TIMING parameters.
- Several SOH groups may be selected and multiple groups can be downloaded in a single request.
- Refer to SOH Groups for a listing of the data available for each SOH group.

Millis

Use this parameter to define the start and end time for the seismic or SOH data.

Format: `{start|end}Millis=<{start|end} time in milliseconds since epoch>`

Select:

- `start` to define the start time for retrieving data in Milliseconds.
- `end` to define the end time for retrieving data in Milliseconds.

Example snippet: `startMillis=<start time in milliseconds since epoch>`

SOH Groups

Environment SOH	Timing SOH	Triggers SOH
Supply voltage	Location	Start time
Total current	GPS receiver status	Duration

Environment SOH	Timing SOH	Triggers SOH
Temperature	GPS satellites used	Channel
	Timing status	Votes
	Timing phase lock	
	Timing uncertainty	

6.4 State of Health API

Use this API to retrieve the current status of all SOH channels on the specified instrument in JSON format. This API also allows you to share the information with other applications such as external reporting tools.

BASE URI

`/api/v1/instruments/soh`

Parameters

instrumentId

Use this parameter to specify the target instrument.

Format: `instrumentId=[instrumentId]`

Example snippet: `instrumentId=centaur-6_0242`

Notes:

- If you do not specify an instrument, the instrument will report its own SOH.

pretty

Use this parameter to retrieve the data in human-readable format.

Format: `pretty={true|false}`

Select:

- `true` to output the requested data in human-readable format.
- `false` to output the requested data in machine language.

Example snippet: `pretty=true`

6.5 Instrument response API

Use this API to download overall instrument response. The response is based on the current instrument configuration. For Centaur the sensor library contains response information for all Nanometrics and some third party sensors. Nanometrics can include sensor response for additional third party sensors. Contact techsupport@nanometrics.ca for more details.

BASE URIs

Use the following URI to return a dataless SEED file.

`/api/v1/responses/channels.dataless`

Use the following URI to return an IRIS RESP file.

`/api/v1/responses/channels.resp`

Use the following URI to return a JSON file.

`/api/v1/responses/channels.JSON`

Parameters

allInOne

Use this parameter to gather all of the channel response files into one file for downloading.

Format: `allInOne={true|`**`false`**`}`

Select:

- `true` to return a zip file of all channel response files.
- `false` to return a separate response file for each channel.

Example snippet: `allInOne=true`

7.0 Reference Information

This section contains information on everything from technical specifications to physical features and dimensions.

7.1 Technical Specifications

The Centaur provides one or two three-channel banks of high performance 24-bit digital recorders, each model designated as a three- or six-channel Centaur. The two types of digital recorder banks available are the Standard digital recorder model with inputs designed for active-output instruments such as broadband seismometers, and the High-Gain digital recorder model designed to record signals from passive output sensors such as geophones. A six-channel Centaur may have one bank of each type or both banks of the same type.

The specifications for the Centaur are listed in the following tables:

Sensor Inputs
Sensor Compatibility
Digitizer Performance
Calibration
External SOH Inputs
Recording (Continuous)
Recording (Events)
Data Retrieval
Data Streaming
Timing
Communications
Local User Interface
Connectors
Power
Power Usage
Physical Characteristics

7.1.1 Sensor Inputs

Channels

One or two banks of 3-channel high-performance 24-bit digital recorders:

- standard digital recorder option: 3 or 6 channels optimized for active-output broadband seismometers
- high-gain digital recorder option: 3 or 6 channels designed for passive-output sensors such as geophones

A 6-channel Centaur may have one 3-channel bank of each type (standard and high-gain) or both banks of the same type.

Sampling

Simultaneous on all 3 or 6 channels

Resolution

24 bits per channel, full 24-bit range to clip level

Input Impedance

40 kΩ (Standard digital recorder model)

1.8 MΩ (High-Gain digital recorder model)

Input Voltage Range

Standard digital recorder model:

- 40 V, 20 V, 10 V, 4 V, 2 V, 1 V peak-to-peak differential, software selectable

High-Gain digital recorder model:

- 10V, 5V, 2.5V, 1V, 0.5V, 0.25V peak-to-peak differential, software selectable

7.1.2 Sensor Compatibility

Sensor Types

Broadband active seismometers for Standard digital recorder model

Short period passive seismometers and geophones for High-Gain digital recorder model

Control Lines

6 per sensor input - typically used for Cal enable, mass centre, mass lock/unlock, and selecting XYZ/UVW

Configurable logic level:

- High: 5 V, 12 V, open drain
- Low: 0, open drain

Configurable assert and de-assert behaviour is consistent across all control lines

Sensor Power

Supply power pass-through to sensor (9-36 VDC, 1A). Over-current and surge protected

Serial Interface

Supports digital management of Nanometrics sensors

7.1.3 Digitizer Performance

Type

True 24-bit ADC per channel

Preamp Gain

Standard digital recorder model:				
Gain	**Gain (dB)**	**Input voltage range**	**Clip**	**Sensitivity**
1x	0 dB	40 Vpp	±20.97 V	0.4 counts/µV
2x	6 dB	20 Vpp	±10.48 V	0.8 counts/µV
4x	12 dB	10 Vpp	±5.24 V	1.6 counts/µV
10x	20 dB	4 Vpp	±2.10 V	4 counts/µV
20x	26 dB	2 Vpp	±1.05 V	8 counts/µV
40x	32 dB	1 Vpp	±0.524 V	16 counts/µV

High-gain digital recorder model:				
Gain	**Gain (dB)**	**Input voltage range**	**Clip**	**Sensitivity**
4x	12 dB	10 Vpp	±5.24 V	1.6 counts/µV
8x	18 dB	5 Vpp	±2.62 V	3.2 counts/µV
16x	24 dB	2.5 Vpp	±1.31 V	6.4 counts/µV
40x	32 dB	1 Vpp	±0.524 V	16 counts/µV
80x	38 dB	0.5 Vpp	±0.262 V	32 counts/µV
160x	44 dB	0.25 Vpp	±0.131 V	64 counts/µV

Sample Rates

1, 2, 5, 10, 20, 40, 50, 80, 100, 200, 250, 500, 1000, 2000, and 5000 sps

Dual Sample Rates

A second sample rate can be selected from the sample rates above

Low-pass Filter

Filter type: Linear phase (contact Nanometrics for other options)

Attenuation: 140 dB at output Nyquist, 0 dB at 80% Nyquist frequency

Digital Filters

Low-pass and high-pass high-quality digital filters, independently user configurable from first to fifth order with corner frequencies from 0.1 mHz to 50% of sample rate.

Different filters may be independently configured for primary and secondary sample rates and for the Sensor A and Sensor B channel banks on 6-channel Centaurs.

Accuracy

Sensitivity accurate to ±0.5%

Dynamic Range

Standard digital recorder model:

142 dB @ 100 sps, 135 dB @ 500 sps (40 Vpp range)

High-Gain digital recorder model:

142 dB @ 100 sps, 135 dB @ 500 sps (10 Vpp range)

Noise Floor (typical) — Shorted Input (RMS)

Standard digital recorder model:		
Sample rate (sps)	**@ 40 Vpp input range (µV)**	**@ 2 Vpp input range (µV)**
10	0.71	0.28
100	1.7	0.45
200	2.4	0.55
500	3.7	0.83
1000	5.2	1.2

High-Gain digital recorder model:		
Sample rate (sps)	**@ 10 Vpp input range (µV)**	**@ 0.5 Vpp input range (µV)**
10	150	20
100	430	46

High-Gain digital recorder model:		
Sample rate (sps)	**@ 10 Vpp input range (µV)**	**@ 0.5 Vpp input range (µV)**
200	600	63
500	930	100
1000	1310	140

7.1.4 Calibration

Signal Source

16-bit DAC with 30 ksps output

Attenuation

Attenuate the calibration signal by the specified value. Options are 1, 10, 100, 1000. Factory default is 1.

Waveforms

Playback audio files created in standard .wav file editors

- Step and 1 Hz sine provided
- User installed custom waveforms
- Pseudo random binary (PRB)

7.1.5 External State-Of-Health (SOH) Inputs

This only applies to Centaur models that have an external SOH input. See applicable models.

Channels

3 single-ended ±5V inputs, 50 kΩ input impedance

Sampling

Configurable from 60 to 3600 seconds, non-simultaneous

Resolution

18 bits effective resolution

7.1.6 Recording (Continuous)

Formats

MiniSEED[1], Nanometrics NP[2]

Internal Storage

8 GB flash memory (other capacities available upon request)

Removable Media

SD card up to 64 GB

7.1.7 Recording (Events)

Triggers

Bandpassed STA/LTA or threshold

Captured Data

Recorded on SD card: MiniSEED[3], ASCII[4] (COSMOS, SMC, Text)

---

[1]A version of SEED data which only contains waveform data. No station or channel metadata is included.

[2]A packet format developed by Nanometrics that is used for the transmission of data.

[3]A version of SEED data which only contains waveform data. No station or channel metadata is included.

[4]American Standard Code for Information Interchange

Data Products

Peak Ground Motion (PGA, PGD, PGV) statistics available on instrument for connected accelerometers

7.1.8 Data Retrieval

File Transfer

via Ethernet, Wi-Fi, or Ethernet-connected DSL, cellular, VSAT, radio

Media Exchange

SD card field-swappable during continuous recording with no loss of data

7.1.9 Data Streaming

Continuous

Seismic data and State-of-Heath data

Data Formats

SEEDLink (optional) or **NP**[1] (standard)

Events

Triggered event data: email, secure file transfer, other options available

7.1.10 Timing

Timing System

Internal DCXO clock disciplined to GPS

External PTP v1 (IEEE 1588-2002) timing source (optional firmware, please contact Nanometrics.)

[1] A packet format developed by Nanometrics that is used for the transmission of data.

Timing Accuracy

<100 µs (with **GPS power mode** set to **Duty cycled**)

<5 µs (with **GPS power mode** set to **Always on**)

<500 µs (using external PTP v1 (IEEE 1588-2002) timing source on local LAN)

GPS Receiver

Internal 12-channel receiver

GPS Power

Selectable: Always on or Duty cycled

PTP (optional)

High-precision network timing via Nanometrics PTP Master on same LAN (IEEE 1588-2002)

7.1.11 Communications

Web-based UI

Supports standard PC, tablet, and mobile platforms

Provided via onboard Web server

Use Web Interface for:

- State-of-health, waveform, and sensor monitoring
- Viewing event information and downloading events
- Calibration, configuration, and maintenance

Interfaces

10/100 Base-T Ethernet, WiFi (optional)

IP Addressing

Static IP, dynamic (DHCP), or link-local IP address

Protocols

UDP/IP (unicast/multicast) or HTTP-based streaming

7.1.12 Local User Interface

Removable Media

SD card protected in waterproof media bay. Media eject button and LED ensures gap-free swapping

External Status LEDs

System status, Ethernet link, Time quality, Media card status, and Sensor A & B state-of-health

Buttons

Wi-Fi wake-up, media eject, system shutdown

7.1.13 Connectors

Sensor

26-pin, shell size 16, female

MIL-C-26482 Series 1

Recommended mate: Souriau 851-06A16-26P

Power

3-pin, shell size 8, male

MIL-C-26482G Series 1

Recommended mate: Souriau 851-06JC8-3AS

Ethernet

Watertight RJ-45 connector

USB

USB 2.0 type A receptacle behind media bay door

Recommended mate: USB 2.0 type A, male

GPS Antenna

TNC [1] female with 3.3 V supply for active antenna

External State-Of-Health (SOH)

4-pin, shell size 8, female

MIL-C-26482 Series 1

Recommended mate: Souriau 851-06JC8-4PW

This only applies to Centaur models that have an external SOH input. See applicable models.

7.1.14 Power

Power Supply

9-36 V DC isolated input

Protection

Electronic resettable fuse design

Reverse battery and short circuit protection

Battery Manager

User-configurable low voltage shutdown and restart thresholds

Grounding

Grounding lug screw and wire included

7.1.15 Power Usage

GPS duty-cycled, recording to internal media.

[1] Threaded Neill-Concelman

Standard power usage for each digital recorder type

- 3-channel standard digital recorder: 1.0 W
- 6-channel standard digital recorder: 1.6 W
- 3-channel high-gain digital recorder: 1.2 W
- 6-channel high-gain digital recorder: 2.0 W
- 3-channel standard & 3-channel high-gain combined digital recorder: 1.8 W

If you have:

- Ethernet connected, add 300 mW to the above numbers.
- GPS always on, add 400 mW to the above numbers.
- For each set of 3 high-gain channels, add 200 mW to the above numbers.

7.1.16 Physical Characteristics

Housing

Aluminum

Surface resistant to corrosion, scratches, and chips

Weather Resistance

Rated to IP-68 with connectors mated or capped (48 hours immersion at 2 m depth)

Humidity

0 to 100%

Operating Temperature

-20°C to +60°C

Storage Temperature

-40°C to +70°C

Weight

1.9 kg (3-channel), 2.0 kg (6-channel)

Size

Length: 196 mm

Width: 137 mm

Height: 88 mm

7.2 SOH channels in Steim compressed formats

The Centaur stores selected SOH channels in Steim compressed formats. This data can be retrieved from the internal storage, streamed via SEEDLink or downloaded in MiniSEED format via the **Maintenance** page.

Code	Description	Units	Notes
EX1 EX2 EX3	External SOH channels 1 to 3	microvolts	
LCE	Absolute clock phase error	microseconds	The difference between the digitizer clock and the GPS receiver. When GPS value is off or unlocked, as indicated by GST, the LCE value will be 0.

Code	Description	Units	Notes
LCQ	Clock quality		A heuristic time quality value that can be defined as follows: • 100% means that the system locked to GPS with time error < 5 µs • 90% signifies an estimated time error of < 100 µs (GPS duty cycling, or coarse locked) • 70% signifies an estimated time error of < 200 µs (GPS coarse locked or system free running) • <70% decrements from 70% by 1% for each hour free running • 0% means that the system has never locked or been free running for more than 70 hours
VCO	VCO control voltage (for timing oscillator)	raw DAC counts	
VEC	Digitizer system current	milliamps	
VM1 VM2 VM3 VM4 VM5 VM6	Sensor SOH channels 1 to 6	microvolts	This value typically represents mass position. • VM1 to 3 for Sensor A SOH 1 to 3 • VM4 to 6 for Sensor B SOH 1 to 3 For Nanometrics seismometers: • VM1/VM4 = W axis • VM2/VM5 = V axis • VM3/VM6 = U axis Note that SOH channels 4 to 6 are only available on 6-channel Centaur models.

Code	Description	Units	Notes
VPB	Digitizer buffer percent used		This value is typically 100% once the buffer is full.
GNS	GPS number of satellites used		The number of satellites used by the timing solution. If the GPS receiver status is off as indicated by GST, the last known value is preserved.
GLA	GPS latitude	microdegrees	
GLO	GPS longitude	microdegrees	
GEL	GPS elevation	micrometres	
GST	GPS status		0=off, 1=unlocked, 2=locked
GPL	GPS PLL status		0=no lock, 1=coarse lock, 2=fine lock, 3=free running
VDT	Digitizer system temperature	millidegrees Celsius	
VEI	Input system voltage	millivolts	
GAN	GPS antenna status		0=ok, 1=no antenna, 2=antenna short

7.3 Wi-Fi Access to the Centaur

If you need to access the Web interface of a Centaur that is not connected via Ethernet to the Internet or a laptop, you can create a Wi-Fi connection to the device using the optional USB Wi-Fi Accessory Kit and access it using a Wi-Fi device.

The kit contains a USB Wi-Fi dongle that you can install permanently (using the O-ring and Media Bay dome cover supplied in the kit) or use temporarily depending on your needs. The Wi-Fi connection is only activated when the Wake button on the Centaur is pressed. Wi-Fi access to the Centaur is automatically disabled after the Wi-Fi connection has been idle for more than 5 minutes

or when the device is shut down or restarted. It is also disabled when the USB eject button is pressed (used for safe removal of the dongle).

1. Accessing the Web interface of the Centaur over Wi-Fi can cause low levels of noise in the digitized data.
2. Ensure your Wi-Fi device is at least one metre from the Centaur to achieve reliable communications.

At a high level, you have to perform the following steps to access the Centaur over Wi-Fi:

1. Remove the Media Bay cover.
2. Insert the USB Wi-Fi dongle and then press the Wake button to activate the Wi-Fi.

   You can also press the Wake button before you insert the USB Wi-Fi dongle but you have to insert the dongle within 4 minutes of pressing the button.

3. Select the Centaur wireless network on your Wi-Fi device and type the password **w1f1admin** to connect to it.

   We recommend that you change your password after you have logged on for the first time. See Changing the admin password.

   The name of the wireless network is centaur-3_XXXX or centaur-6_XXXX, where XXXX is the serial number of the device.

4. Type **http://centaur** or **http://192.168.77.1** into your browser to access the Web interface of the Centaur.

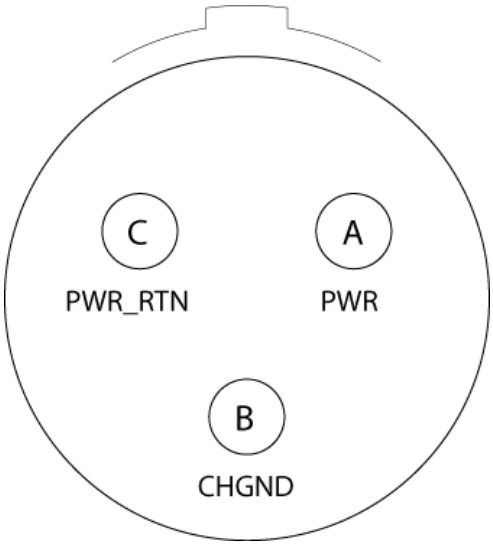
When you have finished accessing the Web interface, press the USB eject button and wait until the USB eject LED turns solid green before you remove the USB Wi-Fi dongle and replace the Media Bay cover. If you are installing the dongle permanently, you do not need to press the USB eject button but you do need to place the O-ring onto the Media Bay dome cover (both supplied in the USB Wi-Fi Accessory Kit) and screw the dome into the Media Bay slot to protect the Media Bay from the elements.

7.4 Connectors and Pinouts

This section does not include pinouts for industry standard connectors. See the Technical Specifications Technical Specifications for the full list of connectors.

- Power connector
- Sensor connector
- External SOH Input Pinout

7.4.1 Power Connector Receptacle and Pinout



Connector type:

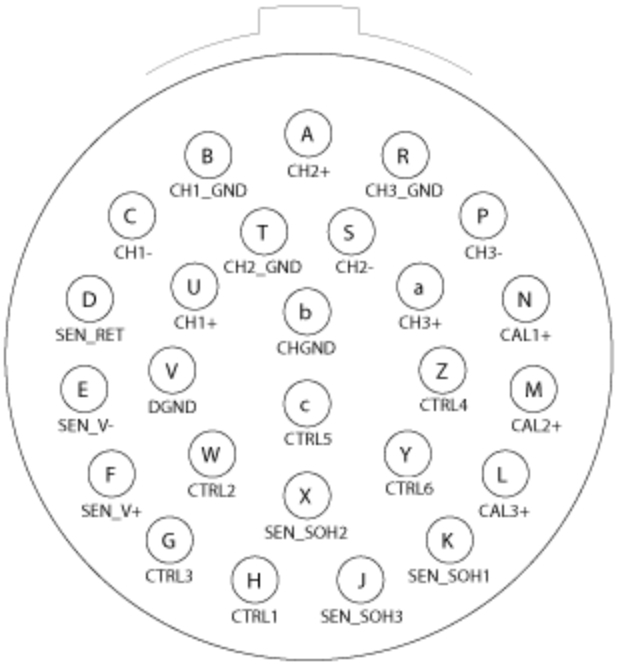
- 3-pin, shell size 8
- MIL-C-26482G Series 1

Recommended mating connector:

- Souriau 851-06JC8-3AS

Pin	Name	Function
A	PWR	Raw (battery) power in (9 V to 36 V DC)
B	CHGND	Internal connection to chassis ground
C	PWR_RTN	Raw power return

7.4.2 Sensor Connector and Pinout



Connector type:

- 26-pin, shell size 16, female
- MIL-C-26482 Series 1

Recommended mating connector:

- Souriau 851-06A16-26P

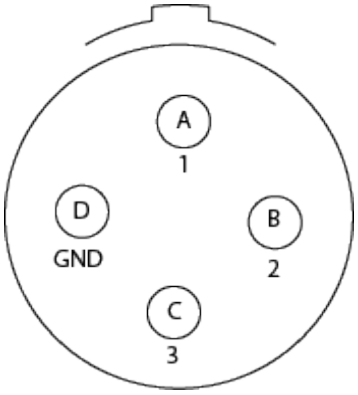
Pin	Name	Function	Details
U	CH1+	Channel 1 input	±20 V, differential
C	CH1-		
B	CH1_GND	Channel 1 ground/shield	Connected to shield ground
A	CH2+	Channel 2 input	±20 V, differential
S	CH2-		

Pin	Name	Function	Details
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		
Z	SEN_CTRL4		
c	SEN_CTRL5		
Y	SEN_CTRL6		
N	SEN_CAL1	Sensor calibration signal outputs	±5 V single ended Referenced to DGND in voltage mode
M	SEN_CAL2		
L	SEN_CAL3		
V	DGND	Digital ground	Digital ground

Pin	Name	Function	Details
F	SEN_V+	Sensor power supply	Filtered, unregulated voltage
E	SEN_V-	Reserved for future use	
D	SEN_RTN	Sensor power return	Switched, overcurrent protected
b	CHGND	Chassis	

7.4.3 External SOH Input Pinout

This only applies to Centaur models that have an external SOH input. See applicable models.



Connector type (on chassis):

- 4-pin, shell size 8, female
- MIL-C-26482 Series 1

Required mating connector:

- MIL-C connector, 4-pin, shell size 8, male
- Souriau 851-06JC8-4PW

Pin	Name	Function
A	Channel 1	Channel 1 input

Pin	Name	Function
B	Channel 2	Channel 2 input
C	Channel 3	Channel 3 input
D	GND	Ground reference for SOH input

7.4.4 Making the Ethernet Cable Connector Waterproof

If required for your application, you can make the Ethernet cable connector on the Centaur waterproof by installing a sealing plug onto the end of the Ethernet cable.

To perform this task, you need

- The Ethernet cable sealing plug that was shipped in the box with the Centaur
- A crimping tool
- A wire cutter/stripper tool
- An Ethernet cable
- An Ethernet cable connector (RJ45)

To complete this task

1. Cut the RJ45 connector off of the end of the Ethernet cable and dispose of it.
2. Thread all three parts of the Ethernet cable sealing plug separately onto the Ethernet cable in the following order: sealing nut, coupling nut, body.

3. Crimp a new RJ45 connector onto the end of the Ethernet cable in accordance with the EIA/TIA T568B wiring diagram for a Cat 5 cable.
4. Press the tab down into the groove on the RJ45 connector and slide the body of the Ethernet cable sealing plug down onto it.
5. Fit the coupling nut onto the body and move it to the end near the RJ45 connector.
6. Thread the sealing nut onto the other end of the body and tighten it.

After you have tightened the sealing nut, it should not be possible to slide the cable through the Ethernet cable sealing plug: there should be no movement at all.

7. Plug the Ethernet cable into the Ethernet connector on the Centaur, thread the coupling nut on to the Ethernet connector, and tighten it to seal the entire connection.

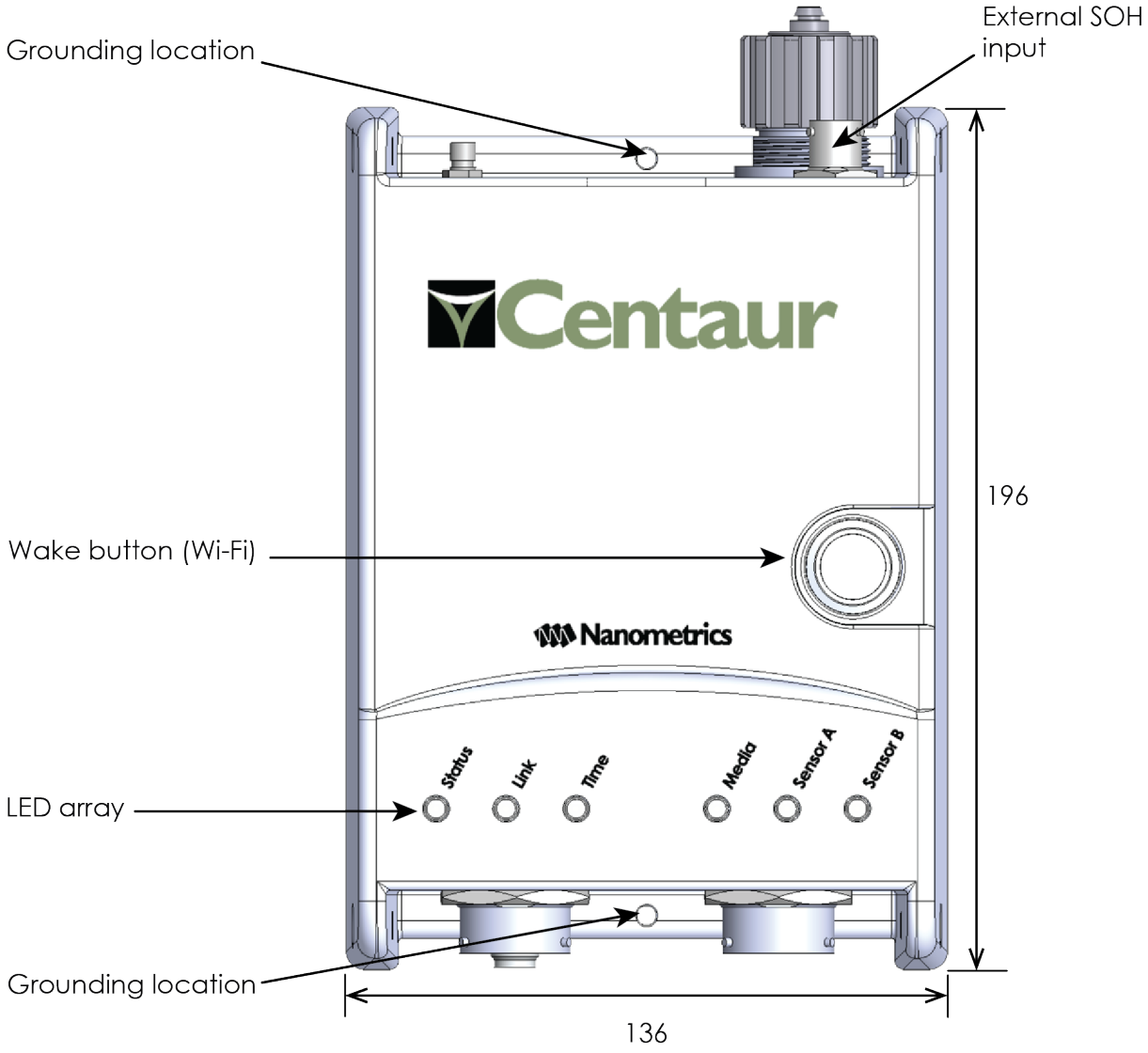
7.5 Physical Features and Dimensions

Refer to the following figures to view the features and dimensions. All dimensions in the figures are in millimetres unless otherwise stated.

- Top View
- Side View
- View of External Connectors
- View of Open Media Bay Door

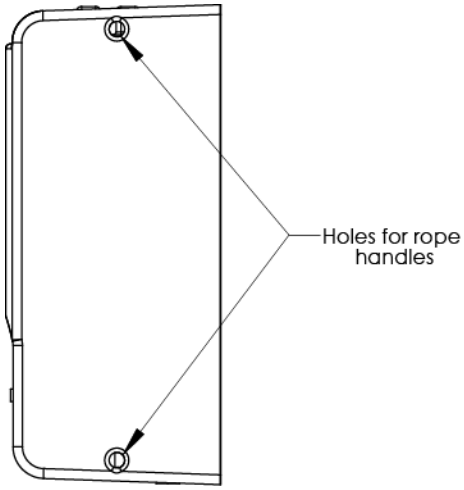
7.5.1 Top View of the Centaur

Dimensions are in millimetres unless otherwise stated.



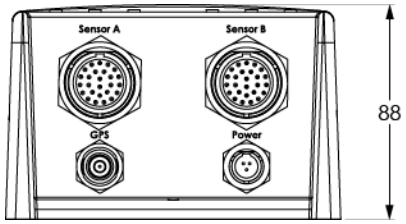
The external SOH input is not available on all Centaur models. See applicable models.

7.5.2 Side View of the Centaur

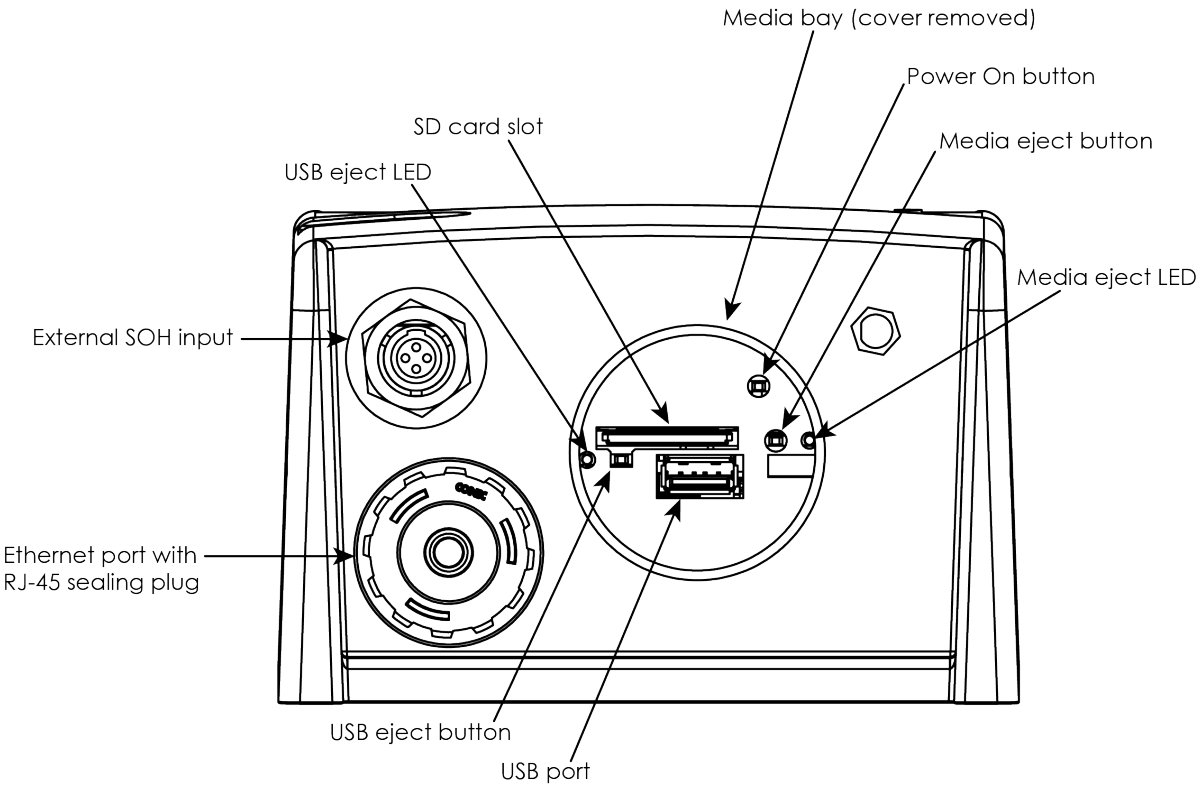


7.5.3 View of the External Connectors

Dimensions are in millimetres unless otherwise stated.



7.5.4 View of Open Media Bay



The external SOH input is not available on all Centaur models. See applicable models.

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Contact Us

Nanometrics Inc.

250 Herzberg Road
Kanata, ON K2K 2A1
Canada

Phone: +1 613-592-6776
Toll free: +1 855-792-6776 (within North America)
Fax: +1 613-592-5929
Email: sales_mktg@nanometrics.ca
Web: www.nanometrics.ca

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