KINEMETRICS Inc.

ROCK + Series

ETNA2 Accelerograph

User Manual

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Services available from Kinemetrics

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Declaration of Conformity

We

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hereby declare that the equipment specified conforms to the essential requirements of the following applicable European Directives and Standards and carries the CE mark accordingly:

Product Name:	**Kinemetrics ETNA 2**
Product Description:	Accelerograph
Model Number(s):	ETNA 2, iCOBI3
Equipment Class:	Electrical Equipment Measurement Control and Laboratory Use-Industrial
Directives:	Council Directive 2014/30/EU and 2014/35/EU
Standards:	Safety: EN 61010-1:2010 Class II
	EMC: EN 61326-1:2013 EN55011 Class A Group 1
	EN61000-4-2 EN61000-4-3 EN61000-4-4 EN61000-4-5 EN61000-4-6 EN61000-4-8 EN61000-4-11

Supplementary Information:

Pasadena, CA USA
July 12th 2016

Ian M. Standley
Vice President, Division Manager

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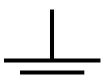
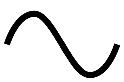
Safety

These symbols may appear on Kinemetrics equipment or in this manual

When you see this symbol, pay careful attention. Refer to the similarly marked, relevant part of this manual before servicing the instrument.

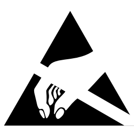
This symbol means a low-noise earth ground. The noted item should be grounded to ensure low-noise operation, and to serve as a ground return for EMI/RFI and transients. Such a ground does not work as a safety ground for protection against electrical shock!





This symbol means an alternating current (AC) power line.

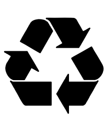
This symbol means a direct current (DC) power line derived from an AC power line.



This symbol indicates an electrostatic sensitive device (ESD), meaning that when handling the marked equipment you should observe all standard precautions for handling such devices.

This symbol indicates that a particular step/process or procedure is required to ensure the installation maintains conformity to European Community requirements.

This symbol indicates that this referenced equipment or material should be re-cycled and not thrown in the normal trash stream.



This symbol indicates that the step/process or equipment has an environmental consequence and steps such as recycling are required.

These safety-related terms appear in this manual

NOTE: Statements identify information that you should consider before moving to the next instruction or choice.

CAUTION: Statements identify conditions or practices that could result in damage to the equipment, the software, or other property.

WARNING: Statements identify conditions or practices that could result in personal injury or loss of life.

Follow the precautions below to ensure your personal safety and prevent damage to the accelerograph. The unit is powered by an 8-28 VDC source. The user may elect to supply the power using the local AC mains to run an AC/DC converter giving the required voltage. To ensure operation in the event of loss of AC the user may elect to use batteries that supply power to the unit when AC power is lost. When mains power is not available the user may provide a power system based on photovoltaic panels, a solar charge controller and suitable batteries.

Optional Power Supply and Charger Systems

If you plan to power the accelerograph from the mains supply Kinemetrics can supply a suitable power supply and battery back-up system. Similarly, if AC is not available, a solar charging system can be provided. As the required voltage, length of back-up time provided, and for solar systems, installation site location and orientation all vary the specific design recommended will depend on your application. The specific instructions supplied with the power system should be consulted but in no situation should the AC power system's power cord be plugged into AC outlets that will apply more than 260 VRMS between the supply conductors or between either supply conductor and ground. (This is for Universal AC supplies. For systems designed only to work on 110V AC systems this voltage will be lower please review the documentation provided with the supply.) A protective ground connection (provided through the grounding conductor in the power supply and its power cord) is essential for safe operation. Unless stated otherwise assume that the Power Supply and charger is designed for indoor use only; it must not be subject to immersion in water, high humidity, or temperatures above 50°C if batteries are being charged.

User-Supplied Batteries or Charging System

If you supply your own charging system, make sure the system provides the correct voltage and current required by the unit. If you derive power from the mains supply, make sure there is adequate grounding for all the equipment. If you supply your own batteries, follow the warnings below.

External Battery

Follow the precautions in this manual when handling and replacing external batteries. Metallic instruments of any kind could short the battery terminals, resulting in fire or explosion. Do not drop the battery or attempt to disassemble it. When charging the battery, use a properly rated charger and do not overcharge the battery. The only correct replacement battery is a sealed lead-acid battery with relief vents and ratings comparable to the original battery. Never try to use a non-rechargeable battery with a battery charging system.

Grounding the Accelerograph

When using an AC power supply remember that the unit is grounded through the power supply's power cord. To avoid electric shock, plug the power supply's cord into a properly wired receptacle where the protective earth ground has been verified. Do this verification before making any power connections to the unit.

Use the Proper Power Cord

Use the power cord and connector supplied with the power supply, or an equivalent IEC standard power cord. Be sure that it is in good condition.

Antenna, Phone & LAN Cabling

Never install antenna, telephone, or LAN wiring during electrical storms. Always ensure adequate separation between antenna cabling, telecom cabling, or LAN cabling and high voltage wiring. Always perform a safety check on telecom and LAN wiring to measure the voltage before working on the wiring. Remember telephone wiring carries fifty (50) to sixty (60) volts of DC and the ring signal at ninety (90) VAC can deliver a very uncomfortable shock. Power over Ethernet Cabling can carry DC voltages of up to 56VDC. To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. Ethernet LAN ports contain SELV circuits, and some WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables.

Do Not Operate in Explosive Atmospheres

The unit and the optional power supply systems provide no explosive protection from static discharges or arcing components. Do not operate the equipment in an atmosphere of explosive gases.

The Kinematics Etna2 Accelerograph is not To Be Used For Life Support or Life-Critical Systems

These products are not designed for operating life critical support systems and should not be used in applications where failure to perform can reasonably be expected to create a risk of harm to property or persons (including the risk of bodily injury and death).

Chapter 1

Introduction

This manual describes the basic operation of the Kinemetrics Etna2. The System Overview gives a brief overview of the unit. This is followed by the Installation & Setup instructions which will allow you to get the unit working. The Basic Operation section show how to use the unit for most simple operations, and is followed by specific instructions on various common tasks, the Advanced Operation section shows how to perform more complex tasks. The Detailed System Description describes in detail the various sub-systems, the various software components, and more. Finally, the Hardware Reference section explains items such as maintenance and wiring cables. It contains detailed information on the hardware, as well as operational information on the software. See Further Information for additional software and hardware references. The diagram below shows where you will find particular information.

1.1 System Overview

The Etna2 accelerograph consists of a chassis with three othogonally mounted EpiSensor force balance accelerometers. The signals from these sensors are routed to a circuit board and digitized by individual Analog to Digital Converters (ADCs). The digital output streams from the ADCs are then filtered and passed to the system's main processor. This consists of a low power highly integrated processor running Linux and Kinemetrics Rockhound software. The processor provides an Ethernet communication interface, USB 2.0 support, and the interface to internal fixed and external user provided storage.

The Etna2 is similar in some ways to the Kinemetrics Rock+ product families, and as such may be used in conjunction with those products.

The user interaction with the system is through the Rockhound software for set-up, control, and operation of the system, and through the Front Panel connectors for the physical connection of power, communication devices, and GNSS (GPS) signal to the system.

1.1.1 How is the Etna2 Series Different from the Rock+ Series?

There are many similarities between these instruments, including:

- They run Linux and Rockhound
- They have GNSS (GPS), Ethernet, and USB ports
- GNSS supporting Ground Based Augmentation
- Standard PTP (IEEE-1588)
- USB Host ports for data offload or communications interfaces
- 10/100 Ethernet
- Low latency packet support (0.1 seconds)
- Supports the ISTI RockToEW and RockToSLink extensions
- Uses the EXT4 filesystem

- Differences between them include:
  - Specific to the Etna2:
    - Includes two software controlled solid state relays
    - Input power 9-28VDC
    - Processor speed is selectable at 300, 600, 800Mhz
    - RAM is 512MB
    - Internal memory cards are 4GB SDHC System & 32GB SDHC Data cards
  - The Etna2 is a lower cost alternative to the Rock+ series, with some notable differences:
    - Runs a limited subset of Rockhound, including:
      - Recording formats of EVT, MiniSEED, and ASCII
      - No support for Altus Emulation
      - No support for FTP, SCP, or E-mail file senders
      - No support for E-mail or SMS messaging
      - No support for customer developed Rockhound modules
    - Maximum sample rate is 500sps supporting two simultaneous sample rates
    - No support for the DFS interface
    - No support for external sensors
    - No capability to charge and maintain VRLA batteries connected to the system
    - No supplied switchable COMM power
    - No available general use serial ports
    - No 1PPS input or output
    - No Power-Over-Ethernet support
    - Limited internal supercapacitor back up power
- And then the techy stuff:
    - A slightly later version of Linux (3.12.59 vs 3.12.36)

1.1.2 What is Rockhound?

Rockhound is the software system used to acquire, process, store, and transfer data. Rockhound is very flexible allowing processing and manipulation of data in a variety of ways.

By default, Rockhound is configured as a triggered event recorder with traditional Kinemetrics trigger methods, levels, and data formats. You are free to reconfigure software to not only change trigger settings, but triggering criteria, and output data formats. Further, the system can be set for applications such as continuous or timed recording or telemetry. This flexibility is achieved using software modules that exchange data in an output-neutral format. These modules may be combined in many ways.

See the section Further Information for additional software references.

1.1.3 Front Panel

The front panel consists of connectors allowing you to connect power, GNSS, and Ethernet connections as well as other functions. In this section we describe the connectors and the cables and accessories associated with them. Connectors are provided for:

- Power/Relays
- Ethernet port
- Console/USB Device or Host
- USB host
- GNSS Antenna

LEDs are provided for:

- Power
- Status
- Event
- Media
- Ethernet Link
- Ethernet Data

A magnetic switch is provided to force the unit on and off in abnormal situations. The location of this switch is described in the section Magnetic Switch

Figure 1: Etna2 Accelerograph

1.1.3.1 Interfaces

The Etna2 interfaces are:

Power: The unit is powered through this connector which also provides connections for the user to the two solid state relays in the unit.

The unit can be powered from a voltage between 9-28 VDC. The unit draws approximately 0.25 A at 12VDC, but the power supply should be capable of providing the equivalent of 1A at 12VDC to allow the unit to operate during periods of high activity and to provide the current required as a USB 2.0 host supplying multiple devices.

Typically the unit is operated with a 12-16 VDC supply that can also be used to charge a 12V Valve Regulated Lead Acid (VRLA) battery.

The relay outputs allow the unit to control other equipment depending on software configuration.

Kinemetrics supplies both cable assemblies and power systems with wide input AC to DC power supplies.

Cable Assemblies: PN 853764: Molded cable with Pigtails for user supplied DC power source and relay connections

Power Supply Systems: Contact Kinemetrics for information on other power supply options.

For more information on the power connection refer to the Power Connector section. See Power/Relay

Console/USB Device: This connector provides access to the RS-232 console port connection, and a USB connection that can be used either as an alternate console connection or to connect an additional USB device such as a thumb drive or cellular modem. The console port connection is used to provide access to an operating system console that is required in initial setup of the system (before network interfaces are defined) and in certain diagnostic and maintenance operations. The console port is not needed in normal operation. Typically, only a few console capable cables will be needed to support a large number of installed units.

The console is /dev/console. The default baud rate is 115200.

The cable to connect to the Console is P/N 853762

The USB device interface allows use of the unit as a USB device from a USB host (the host is typically something like a PC). This makes the USB device interface of the Etna2 appear as a virtual COM port on the PC. Compatible drivers will be required on the host end to utilize this interface.

From this port you can open a terminal session (using something like PuTTY) and log into the Etna2 without requiring a network connection or an actual serial port on your computer. Note that this USB connection is dual use. After booting, it can act as a device (connecting to a PC as above), or as a host for use with a USB device such as a thumb drive. Note that once the interface switches into host mode (e.g. by plugging in a thumb drive) then it will not operate in device mode again until the system is rebooted. The cable to connect as a USB Device on this port is P/N 853762

For a cable to connect to a USB device (thumb drive) on this port, use P/N 853774 with a P/N 853741 protective cap.

USB Host: This connector provides a USB connection that can be used to connect a USB device such as a thumb drive or cellular modem.

Note that this USB connection is single use. It acts as a USB host port only.

The cable to connect to a USB device (thumb drive) on this port is P/N 853610, or P/N 853740 if used with a P/N 853741 protective cap.

Ethernet: This connector provides a low power 10/100Mb Ethernet connection. The cable to connect to this port is P/N 853608

Ethernet is used for connection to other equipment, such as other digitizers and/or a hub or switch.

For additional information on the Ethernet Interface connections consult the Ethernet Connector section.

GNSS: This connector provides the connection to an active 3.3V GNSS antenna to allow reception of timing and position signals. These antennas contain low noise amplifiers which are powered by a DC current through the antenna cable. The standard antenna kit supplied with the Etna2 (P/N 880959) is a GNSS Mini-Mag Antenna with a 5 meter cable and a TNC Connector (note that the antenna is supplied with a SMA to TNC adapter). An optional external bullet style antenna with a 25 meter plenum rated cable can be ordered if a longer cable length is required. For additional information on antennas and cabling consult the 'GNSS Antenna Connections' section.

GNSS (Global Navigation Satellite Systems) – is the generic term for all such systems, four of which are available as of 2016: GPS (USA), GLONASS (Russian Federation), BeiDou (People's Republic of China), and Galileo (European Union); the GNSS system in the Etna2 supports any two of the four systems.

LEDs The LEDs on the front panel provide the following information:

Power:

- OFF - No power
- Flashing Green - Waiting to power up, Running off of external power
- Fast Green - Charging the supercapacitors
- Infrequent Green - System is powered up

Status:

- Flashing Red - No time source
- Infrequent Red - Time source detected, not locked
- Infrequent Green - Good time quality
- Flashing Green - The system is starting up
- Flashing Red/Green - Rockhound is shutting down or restarting

Event:

- OFF - No events
- Steady Green - Real time data stream
- Flashing Green - Storing an event
- Infrequent Green - Events stored

Media:

- OFF - Idle, OK to insert or remove
- Steady Green - Mounting
- Flashing Green - Transferring data

Ethernet Link (Green/Amber):

- Amber - Ethernet 10Mb link detected
- Green - Ethernet 100Mb link detected
- OFF - No Ethernet link detected

Ethernet Data (Amber):

- ON - Ethernet data transmission in progress
- OFF - Idle

Magnetic Switch The magnetic switch is located on the top of the unit between the mounting hole and the bubble level, where the seal test screw is located. The switch is used to start up and shut down the unit without use of a physical power switch.

The unit has no power switch. When power is connected, the unit's default behavior is to power up and begin operation. When power is removed, the applications and operating system will shut down and the unit will turn off.

Briefly touching a strong magnet near the magnetic switch location allows the user to start and stop the unit. This is useful if say a time window has been set incorrectly and the unit needs to be turned on to correct the problem.

> **CAUTION: Do not attempt to unscrew the seal test screw as this will destroy the seal and allow water to enter the unit.**

1.1.3.2 Internal Accelerometer Deck

The Etna2 Accelerograph unit contains a tri-axial EpiSensor deck connected to channels 1-3 of the ADC. The deck provides three orthogonal 1g/2g/4g selectable range sensors mounted internally to the unit. This unit is equipped with a single point mounting scheme and must be leveled and securely mounted to ensure high fidelity strong motion recording. The deck is configured for an XYZ axis orientation coordinate system, so channel 1 is X, channel 2 is Y, and channel 3 is Z. The coordinate system is shown on the cover of the unit.

1.2 Installation & Setup

To successfully deploy your Etna2, you will need to physically install the hardware in a suitable environment, provide your primary and backup power sources (if any), connect any communications links, install the GNSS antenna and connect the cable to the unit, and configure the software for correct operation if your requirements differ from the default factory configuration.

If you have not already done so, we recommend that you install the software from the Rock Support Software CD (300654-PL) now so that you will have the necessary utilities such as terminal emulation, telnet client, and secure file transfer programs. You are of course free to use other software that you are more familiar with that provides the same capabilities. The basic steps to install your Etna2 are as follows:

- Secure the unit physically in position, orientated in the appropriate direction
- Attach the grounding strap
- Mount the GNSS Antenna
- Connect the Ethernet LAN
- Connect the GNSS Antenna
- Connect other communication interfaces
- Connect the DC power source
- Connect a laptop or equivalent to the console port (See Software Installation)
- Change the default system passwords (See Passwords)

- Configure the software:
  - Configure the LAN (See Network Configuration)
  - Configure desired IP services (See IP Services)
  - Configure extended storage (See USB Thumb Drives)
  - Configure Rockhound (See Basic Setup)
  - Configure GPS (GNSS), or PTP (See Timing System)

At this point, the system should be functional. See the section on Basic Operation for further details on initial configuration of the system. Note that several of the configuration and update steps listed above can be tested in the lab before the unit is deployed.

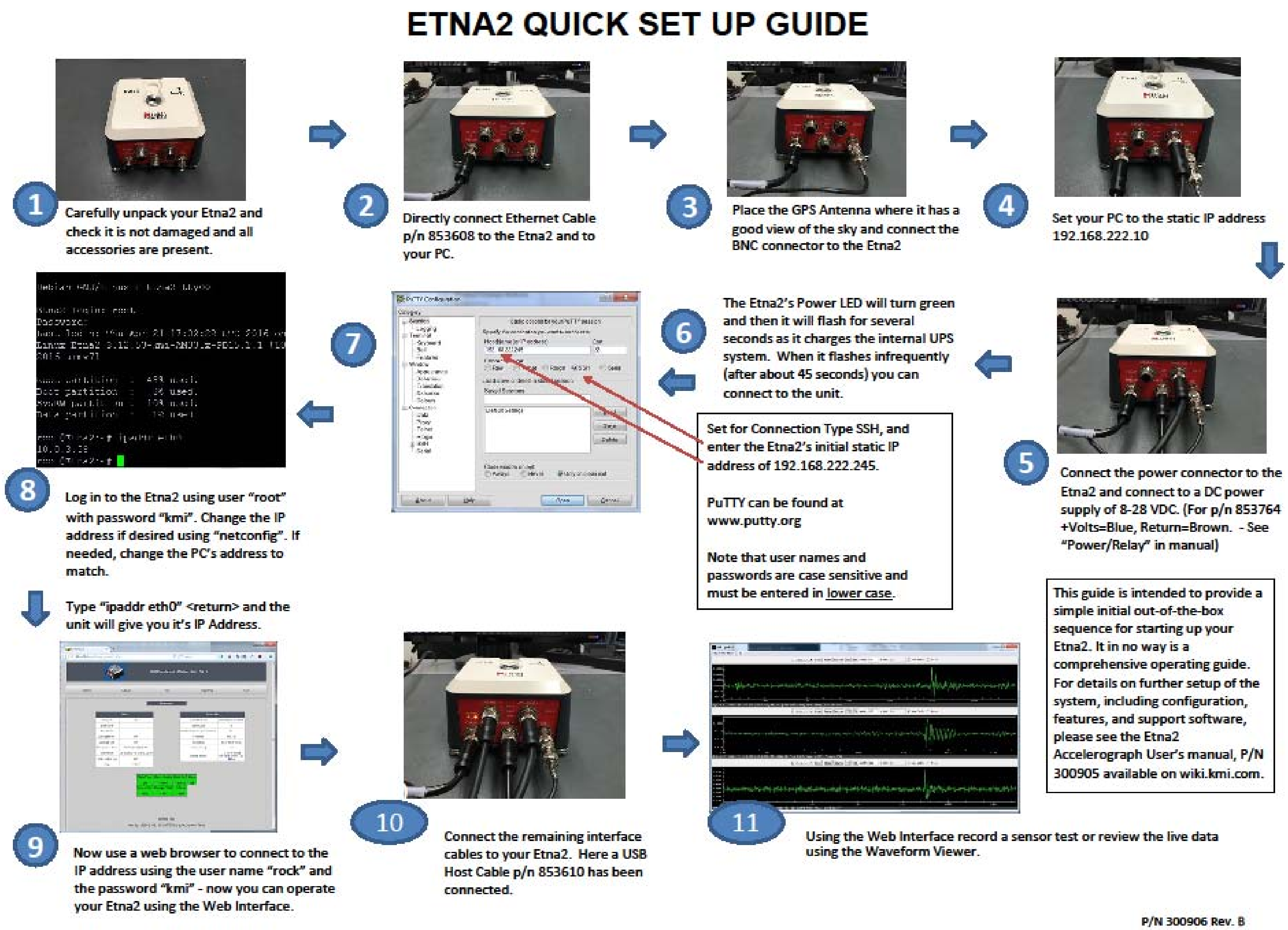


Figure 2: Etna2 Quick Setup Guide

1.2.1 Operating Environment

The Etna2 needs to be installed in a location that provides the following environmental conditions.

1.2.1.1 Operating Temperatures

The Etna2's operating temperature range is -20º to +70 ºC Operation. If you are charging a VRLA battery the operating temperature should be limited to 0º to +50 ºC. The Etna2's storage temperature range is -40º to +85 ºC.

This can be limited by user installed equipment. Replacing the storage cards with commodity cards can reduce the operating temperature range.

The unit should not be placed where it is exposed to direct sunlight and any user-supplied external battery should be located where the temperature is within the 0º to +50 ºC.

1.2.1.2 Operating Humidity

The case of the unit is designed to meet the requirements of a NEMA 6P enclosure (equivalent to IP67). The system can operate in humidity levels of up to 100% and withstand occasional temporary immersion in water up to 2 meters in depth. The system should not be continuously immersed, as galvanic corrosion of the connectors will occur, potentially destroying the system. To ensure operation in high humidity, the desiccant packet must be fresh and the case of the unit should be carefully re-sealed if it is opened.

1.2.1.3 Operating Altitude

The unit can operate at altitudes from -300 to +10,000 meters.

1.2.2 Unpacking & Inspecting the Unit

Before accepting the shipment the shipping carton should be examined for any obvious damage and this should be recorded by the freight carrier.

The Etna2 ships in a custom designed carton. This carton can be used to return the unit or to ship it to other destinations. It should be carefully opened at the top so it can be re-used. The Etna2 is packed in custom foam inserts. Carefully pull the unit and the inserts from the box. The unit should have no signs of external damage.

Underneath the unit is an additional compartment that contains the standard accessories. Please check the contents of this box against the packing list.

The unit is then ready for installation. See Practice Assembly

When the packaging is no longer required please recycle the cardboard cartons and foam insert appropriately.

1.2.3 Requirements for Installation

Below we provide lists of the tools, supplies and equipment required to install an Etna2 in a typical configuration.

Specialized installations may require additional tools, supplies or equipment, depending on specific sites and needs. This manual assumes that all civil engineering works (concrete pads, enclosures, conduit, mounting masts, etc.) are complete and ready before installation.

1.2.3.1 Required Tools

For a permanent installation the unit should be mounted to the floor, wall, or shelf in the structure.

The following tools are suggested:

- A drill capable of drilling into the attachment surface.
- Appropriate drill bits for the attachment surface.
- Suitable tools to install the screws/anchors into the attachment surface.

1.2.3.2 Optional Tools

Communication options, GNSS systems, and other advanced installations may require additional tools:

- Wrench or pliers to tighten the antenna connectors
- Tools for mounting the antenna
- A heat gun (electric or butane)
- Soldering iron (electric or butane)
- Small screwdriver
- Wire cutters

- Wire strippers
- Long-nose pliers
- Utility knife
- A drill (electric or battery powered)
- Cable tie wraps
- A crimping tool
- A short length of insulated braid
- An extension cord or a small generator for AC power, if butane-powered soldering irons and battery-powered drills are not available
- A special 2 pin socket used to open the Etna2 case lid (contact Kinemetrics for information)
    - (Note: There is generally no need to open the Etna2.)

1.2.3.3 Required Supplies

- Mounting hardware, screws, nuts, washers, concrete anchors studs etc (Dependent on selected mounting method)
- Material to make grounding straps for the unit
- Solder with rosin-core flux
- An assortment of heat-shrink tubing, cable tie-wraps, and electrical tape

1.2.3.4 Required Equipment

- A computer running Windows, Linux, or other suitable Operating System
- A serial port on the computer in order to access the system console. This may be an internal serial port or one provided through a USB to serial adapter. Alternatively:
    - A USB device cable can be used to provide a virtual COM port on the PC via USB
    - The unit may be reached through Ethernet at an initially predefined static IP address (See Initial Setup)
- An Ethernet network interface if you intend to use the networking capabilities
- Kinemetrics' Console cable (853762) to link a laptop to the unit

1.2.3.5 Optional Equipment

- A battery-powered digital volt meter (DVM) for system-checkout functions
- A digital camera, to photograph the completed installations

1.2.4 Practice Assembly

Once you have assembled the tools, supplies, and equipment listed above, we recommend that you run through a practice assembly following the installation instructions.

Why Practice in the Laboratory/Office?

The connections between all the components mentioned in this manual may appear a bit complex. They will be even more complex if your first installation attempt is in a remote field situation where you find that you lack the necessary tools, supplies, or equipment to make the connections work.

Practice in a well-supplied, well-lit laboratory or office when first connecting and setting up the unit and ancillary equipment. Follow these instructions carefully, step by step, to learn exactly which tools, supplies and equipment will be needed in the field. Murphy's Law provides a further reason for a practice installation:

If anything can go wrong, it will; and Isaac's Corollary: Murphy was an optimist!

See Unpacking & Inspecting the Unit

1.2.5 Planning your installation

This section discusses recording network setup and operating modes. Networking capabilities are an important part of this equipment, and should be considered carefully to make sure that adequate remote access and bandwidth are provided to utilize the real time capabilities of the Etna2.

1.2.5.1 Network Planning

Carefully consider the scientific objectives of the installation when planning the network, whether it includes one station or a hundred.

The station location, type and position of sensors, and instrument settings all affect the type of data recorded. Consider local seismic-noise conditions and the anticipated amplitude of events being recorded. This will help you correctly set trigger parameters, estimate the quantity of data expected, and decide how to retrieve the data.

It’s also necessary to plan how to analyze, combine, and archive data, as well as how to service and maintain the network. Finally, consider how the network will function after a large event, when mains power and telecommunications might not be available for a considerable time. Under such circumstances, how do you plan to retrieve and process the network’s data, as well as continue operating it?

1.2.5.2 Civil Engineering

Before installing the Etna2, plan and construct (if necessary) the housing that will provide a protective infrastructure for the unit. The exact details of the installation depend on local conditions, local regulations, and the purposes of the installation.

Except in cases of a rapid emergency deployment of seismic instruments, the Etna2 should be housed in a protective structure. Below are the two typical types of installation settings and related protective structures. They can be used as rough guidelines for an installation.

1.2.5.3 Free-Field Installations

In a free-field accelerograph installation, the Etna2 is installed some distance from buildings in a "free field" and sheltered by a small, lightweight structure that allows the sensors to sense acceleration as close as possible to the "true" accelerations of ambient ground motion. In softer ground sites, because of the soil-structure interactions during earthquakes, a heavier than-necessary protective structure could degrade data accuracy.

The structure should also protect the Etna2 from weather, direct sunlight, and theft or vandalism. A "transformer hut" made of fiberglass and stainless steel hardware is ideal as long as it, and the Etna2, are attached to a poured and reinforced concrete pad. If true hard-rock site response is desired, anchor this concrete pad to bedrock.

Provide the Etna2 with a good earth ground. Proper grounding depends greatly on the humidity of the soil at the site. For average-humidity soil, an effective earth ground can be made by wiring the case grounding lug to a 6’- to 8’-long copper rod embedded in the ground.

If no AC power is available, a solar charging system is required. Refer to the Advanced Installations section of this manual for more information.

If the Etna2 has a GNSS system, the GNSS antenna will need a suitable mounting mast. A cable connection, DSL line, fiber-optic link, cellular, or other communication link is required to communicate with the Etna2 remotely.

1.2.5.4 Structural-Monitoring Installations

In a structural-monitoring installation, you provide protection to the Etna2 by installing it within an existing building or structure (a bridge, a dam, a high-rise, etc.). The main purpose for installing the Etna2 in an existing structure is to measure and monitor the structure’s vibrations in response to ground motion. While some use such installations to calculate measurements of "free-field" seismic motions, the very nature of the structure’s size and foundation depth cause the acceleration measurements to deviate considerably from "true free-field" response.

For a structural-monitoring installation, make sure the space in the structure allows enough room to mount and service the Etna2, and that the space provides enough protection so the Etna2 will not be disturbed or vandalized. Powering the Etna2 requires a mains supply close to the installation point. A LAN connection should be provided to allow communication with the unit.

As for the Etna2’s optional GNSS antenna, carefully plan to locate the antenna close enough to the Etna2 so the supplied GNSS cable will reach between the two.

To use multiple Etna2s around the structure, make a detailed plan of the units' locations and plan how to run the LAN cables between them. To interconnect Etna2s, plan the layout of the interconnecting Ethernet cables. If it is not possible to provide a GNSS connection at each location the PTP capabilities of the Etna2 can be used to transmit time over a LAN network equipped with PTP switches see more details in the advanced installation section. All these elements of an installation should be in place before the Etna2s are installed.

1.2.6 Installing the Etna2

The unit should be installed preferably in a dry environment protected from direct sunlight and exposure to standing moisture. The temperature should be within the operating limits given earlier. The unit should also be protected from animals that may eat cabling and from vandalism. If an external battery is used it is important that the temperature limits for charging are. As you perform the installation pay particular attention to the warning below.

WARNING: Antenna, Phone, & LAN Cabling. Never install antenna, telephone, or LAN wiring during electrical storms. Always ensure adequate separation between antenna cabling, telecom cabling, or LAN cabling and high voltage wiring. Always perform a safety check on telecom and LAN wiring to measure the voltage before working on the wiring. Remember telephone wiring carries fifty (50) to sixty (60) volts of DC and the ring signal at ninety (90) VAC can deliver a very uncomfortable shock. Power over Ethernet Cabling can carry DC voltages of up to 56VDC. To avoid electric shock, do not connect safety extra-low voltage (SELV) circuits to telephone-network voltage (TNV) circuits. Ethernet LAN ports contain SELV circuits, and some WAN ports contain TNV circuits. Some LAN and WAN ports both use RJ-45 connectors. Use caution when connecting cables.

1.2.6.1 Mount the Unit

The unit can be mounted on the:

- Floor
- Shelf
- Wall

Floor-Mounting: The unit should be placed on a dry floor. It is recommended that the unit be anchored to the floor using the concrete anchor supplied.

Mounting the Etna2 Accelerograph The unit must be securely coupled to the ground to accurately record ground motion.

The unit has a single hole through the unit for a ¼-20 4” threaded bolt. To attach the Etna2 to the mounting surface, use the mounting kit shipped with the recorder. It includes a heavy-duty wedge type expansion anchor bolt with 1/4-20 thread, and a grounding lug. The following figures show the details of such an installation.

> **CAUTION: Invalid data. Etna2s with internal EpiSensor decks must be securely floor-mounted to ensure the acceleration levels of the actual structure are measured.**

Anchor the recorder unit to a concrete floor if possible. Be sure that each of the recorder’s leveling feet are screwed into place and extending less than ¼” from the bottom of the unit. The locking nuts should be loosened.

1. Move the recorder gently to one side.
2. Locate where you plan to put the recorder, keeping in mind necessary working space. With the recorder mounted with connectors facing forward, you should allow 10” (254mm) clearance around the unit.
3. Use a drill with a 3/8" (9.5 mm) bit, and drill into the concrete to a depth slightly deeper than the length of the anchor (1” or 25.4mm). A percussion or hammer drill will make this procedure much easier. You should follow all recommended safety precautions when using power tools and we recommend you wear safety glasses during the installation procedure. (Using an anchor set tool as a depth gage can make this easier. Mark the thick end with a piece of tape at the depth of the bolt – check the hole depth with this.)

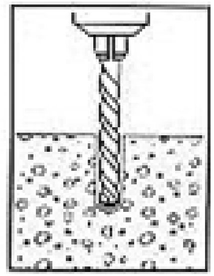


Figure 3: Drilling Mounting Hole

4. Make sure you clean out the hole after drilling it. (Using a flexible drinking straw works very well for this, but make sure you don't blow dust in your eyes!)
5. Set the anchor using an anchor set tool. Place the anchor in the hole. The top should be flush with the floor. Place the thin end of the anchor set vertically into the anchor. Strike with a hammer until the shoulder of the anchor set tool is flush with the top of the anchor.

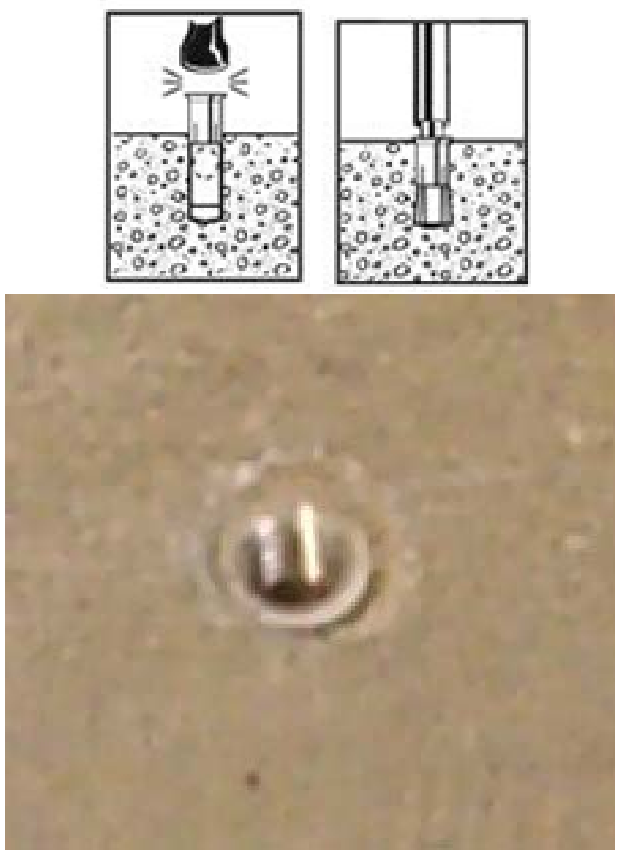


Figure 4: Installing Anchor

6. Center the Etna2 over the anchor, using a small diameter rod or tool to line up the hole.

7. Place the grounding lug onto the bolt. Then pass the bolt through the Etna and into the anchor without tightening.

8. Make sure the Etna2 is oriented in the correct direction before you proceed with Step 9.

9. Look at the bubble level window while you carefully adjust each of the Etna2's three leveling feet in or out. When you can see the air bubble centered in the bubble level window with all three leveling feet resting on the mounting pad, the recorder is level.

10. Tighten the locking nuts on the leveling feet.

11. Carefully maintain both the Etna2's level and its orientation as you tighten down the anchor bolt to hold the unit firmly in place. Use a torque of 80-100 inch-lbs (9.2-10.2 Nm) to tighten.

Figure 5: Mounted to the Floor

The unit is now firmly attached to the ground.

Grounding the Unit

CE All users should complete this procedure. You must provide the Etna2 with a good, low-impedance earth ground before operating it for the following reasons:

- To shunt ESD transients, lightning-induced transients and EMI/RFI transients to ground.
- To meet the requirements of the European Community's EMI/RFI directives.

Determine what earth ground you will connect the Etna2 to. A good earth ground includes the following:

- a metal plumbing pipe that is eventually buried in the ground
- a copper ground rod staked in soil
- a well engineered electrical grounding system, or
- steel reinforcing rods that protrude from a concrete foundation.

Prepare the conductor you plan to use to connect the unit to the earth ground. For the conductor, you should at least use a heavy-gauge wire or, better yet, a copper strap or copper braid.

Connect this conductor to the unit's grounding lug and then secure this to the top of the unit using the mounting stud and nut. Then connect the other end of the conductor/grounding strap to the selected earth ground.

> **NOTE: If the Etna2 is powered by an optional power supply, the third pin (earth connection) of the power supply's AC plug provides the safety ground. To ensure the unit's low noise performance, you may still connect the Etna2's grounding stud to a good earth ground as described above.**

Mount the GNSS Antenna The GNSS Antenna should be mounted following the directions below:

Mounting the MiniMag Antenna

The MiniMag Antenna (P/N 880959, GNSS 5 Meter, MiniMag) should ideally be mounted in a protected location. It can be used for long periods when protected in a fiberglass hut, when no external antenna mast is desired. Mount the antenna by placing it on a flat surface within 5 meters of the Etna2. Make sure the antenna has a good view of the sky, without any obstruction from large buildings or trees.

Mounting a Bullet Antenna

The bullet antenna is the preferred antenna for most external applications as it supports a longer cable and is designed to better resist environmental exposure to sunlight and weather than the MiniMag.

The bullet antenna comes with an adapter to convert from its M18X1 mounting threads to 3/4" NTP, which threads onto standard 3/4" pipe fittings. The use of a pipe union on the lower end of the 3/4" nipple that screws into the adapter will simplify getting all of the pipe connections tight. It is advisable to use Teflon pipe tape on all of the pipe connections. Attach the half of the union with the captive nut to the nipple, and attach that to the adapter. Attach the other half of the union to the top of the pipe that will carry the cable.

Feed the GNSS antenna cable through the pipe up to the roof, and through all of the components: the disassembled union, the nipple, the adapter, the stainless steel flat washer, and the rubber flat washer. Screw the cable's TNC connector tightly to the GNSS antenna's connector. With the rubber washer centered over the lands on the base of the antenna, screw the adapter assembly tightly onto the antenna. Feed the cable slack back into the pipe until you can join the two halves of the union together, and tighten its nut securely.

Figure 6: GNSS bullet antenna with TNC jack and M18X1 mounting threads

CAUTION: If the GNSS system will operate in an area at high risk for lightning strikes, consider installing a lightning protector on the GNSS antenna. Kinematrics offers a lightning protector device (P/N 114225-PL). See Section Installing Optional GNSS Lightning Protection

Connect the GNSS Antenna The GNSS antenna Cable can now be connected to the Etna2 using the TNC adapter on the Front panel.

Configure the Timing Source The Timing Source of the Etna2 defaults to the internal GNSS.

After making the selection, remember to save and apply the changes.

Connect the Ethernet Connection The Etna2 can now be connected to the Local Area Network using the Ethernet Cable. The RJ45 plug from this cable should be inserted into a suitable Ethernet switch to make the connection. As the Etna2 is a 10/100 Base-T device it is better to connect to a switch than to a hub. The connection can also be made to a Router or other Ethernet based communication device. If directly connecting to a Laptop or PC a crossover adapter may be required.

Connecting the Optional Communication Interfaces The optional communication options can now be connected appropriately.

Functional Test Sequence The functional test feature sends a calibration sequence from the Etna2 to it’s internal sensor. The size, duration and shape of the resulting record depend on several factors, including the sensor sensitivity.

For example, an Etna2 with a 4g internal deck will produce the following calibration result:

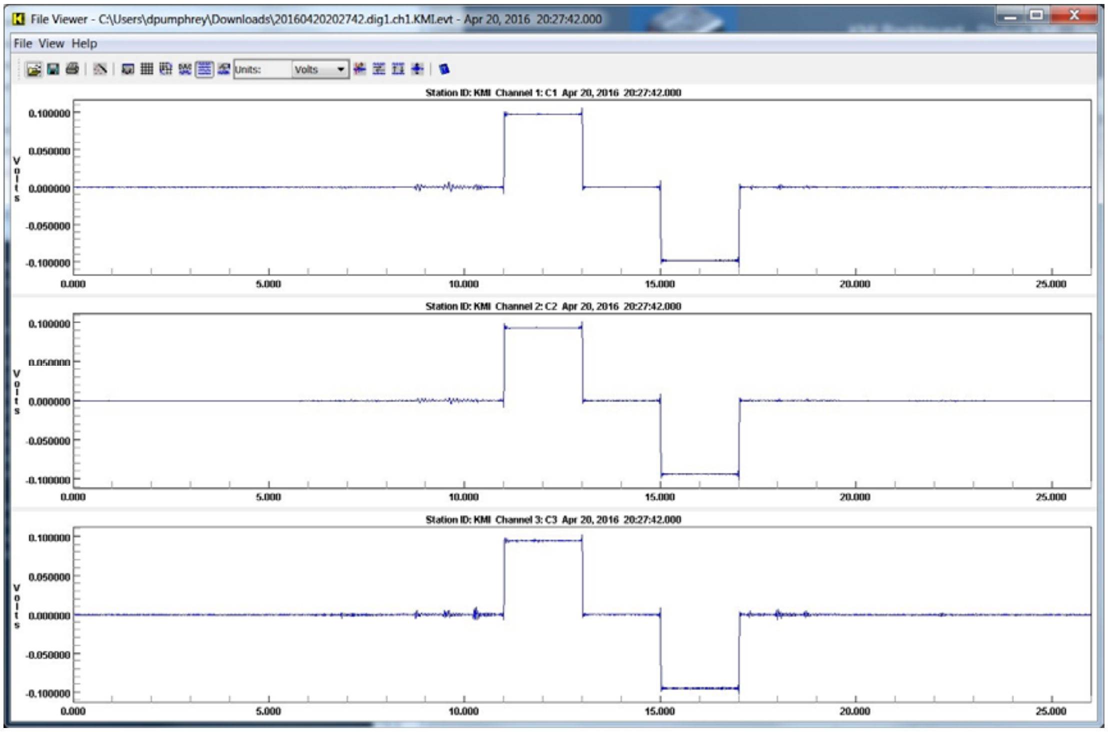


Figure 7: Basic Functional Test

The duration of the calibration sequence also depends on several factors. In this example, the duration of the test record will be set primarily by the software (12 seconds), plus the pre-event and post-event time (3 seconds and 10 seconds respectively in this example), plus one second. This gives a total expected record duration of 34 seconds (12+3+10+1).

Connecting a user-supplied External Battery with a charging system

> **WARNING: Fire or explosion hazard. Do not install a non-rechargeable battery to be charged by the unit. Only install a sealed lead acid battery with specifications compatible with the original unit. Other types of Lead Acid battery should not be used as the temperature corrected charging voltage is set for SLA batteries only. On no account install an alternative battery chemistry such as Lithium Ion or Nickel Metal Hydride!**

If you store a Sealed Lead Acid (SLA) battery, you should still charge it every six to nine months to prevent permanent loss of capacity. You can float-charge the battery at 13.5-13.8V or cycle-charge the battery, provided the current is limited appropriately and the voltage to less than 14.7V. When the voltage reaches 14.7V, the battery will be damaged unless you convert the cycle charging to float charging. Kinemetrics ships batteries fully charged; make sure a battery is still fully charged before installing it.

Battery Installation

Follow the instructions below to install the external battery.

WARNING: ⚠ **Burn or explosion hazard. Never place metallic objects (such as a screwdriver or your wristwatch strap) across the terminals of a battery. The metal terminals can get very hot. Handle batteries with care, and do not drop them or attempt to take them apart. Recycle used batteries, or dispose of them in accordance with local regulations. Do not throw used batteries onto a fire.**

CAUTION: Before installing the new battery make sure it is fully charged. If the battery is uncharged, the unit will charge it, but this can take some time — and if AC power is lost, the unit's power autonomy will be reduced.

To install an external battery:

1. Ensure the power cable is disconnected from all power sources and the unit.
2. Connect the negative terminal of the battery to the appropriate wire.
3. Connect the positive terminal of the battery to the correct wire.
4. Connect the power cable to the power connector on the unit and ensure the unit turns on under battery power.
5. Proceed to connect the power supply to the AC mains and check that the unit switches to this power source.

CAUTION: Using the wrong power supply with the unit can permanently damage its circuit boards. Do not attach any power supply assembly to the Etna2 other than the one supplied by Kinemetrics unless it exactly matches the voltage and current ratings required for the Etna2. Older Altus power supplies are not compatible with Etna2 or Rock+ digitizers.

Connect a laptop or equivalent to the console port The Etna2 should now be connected to a Laptop or PC using the console port. (A serial to USB connector may be required.) The initial set-up of the device can now be performed over this serial link as described in the Initial Setup in the next section. Alternatively:

- A USB device cable can be used to provide a virtual COM port on the PC via USB
- The unit may be reached through Ethernet at an initially predefined static IP address (See Initial Setup)

Chapter 2

System Overview

This manual gives an overview of the Etna2 and the various components that are included in the system. This explains some of the operational features and will give other information that will allow you to understand the many capabilities of the system. An Etna2 includes the following subsystems:

- Intelligent power supply
  - ◦ DC power input
  - ◦ Internal supercapacitor array
  - ◦ Temperature sensor
  - ◦ Power system control processor
- Main processor System
  - ◦ Processor
    - ? Linux Operating System
    - ? BootLoader
    - ? Java Virtual Machine
    - ? RockHound Software
  - ◦ On-board RAM
  - ◦ Console port
  - ◦ Ethernet Communications
  - ◦ USB Host and Device Interfaces
  - ◦ Primary SDHC card for firmware
  - ◦ Secondary SDHC card for data
  - ◦ GNSS Timing Module & Disciplined Oscillator

- High resolution analog to digital converters and supporting circuitry
    - ◦ DC/DC Power supply for Analog Section
    - ◦ Delta Sigma ADC Converters
    - ◦ Calibration and Control Processor
- Internal Sensor Deck
    - ◦ ±4g/2g/1g EpiSensor Deck
    - ◦ Powered from Unit Power
    - ◦ Configured for XYZ channel orientation

2.1 Power Supply

The power supply subsystem is an important part of the reliability and proper functionality of your system. The power supply subsystem provides the following features:

- Supercapacitor backup
- Reversed input and overvoltage protection
- Sequenced start up
- Sequenced shut down
- Communication with the user via status LEDs
- Magnetic switch
- Temperature monitoring
- Parameteric operation protection
- System watchdog

In general, the power supply subsystem takes input from system power sources and converts them into the supply voltages necessary to operate the system. In addition to this primary task, the power supply subsystem also monitors system current usage, voltage levels, temperature and other parameters to assure that the system is operating correctly and within operational limits. Under some circumstances, the power supply subsystem may inhibit start up of the system in order to protect the hardware. This system basically ensures the safety of the remainder of the Etna2.

2.1.1 Supercapacitor Backup

The power supply subsystem utilizes a supercapacitor array to provide backup power to the processor. This is important to assure proper shut down of the memory card in the event that external power is lost. The supercapacitor array will be charged when power is first applied and before the system is allowed to operate. The process of charging the supercapacitor array can take up to a few minutes depending on the capacity of the array and how much energy is already stored.

2.1.1.1 Reversed Input and Overvoltage/Undervoltage Protection

The system will protect against a reversed power connection, it will also not turn on if the voltage is below the low voltage turn-on threshold. The unit is protected against high voltage transients.

2.1.2 Sequenced Start Up

The system will perform a sequenced power up when power is applied to the system. The sequence is to assure proper start up of the processor. The system start up sequence is approximately as follows:

- Perform initial start up delays to avoid system "motorboating"
- Charge the supercapacitor array
- Assure that external power sources and other operating parameters are within limits
- Start the processor
- Load and start the analog to digital sections

2.1.3 Sequenced Shut Down

The system also controls sequenced power down when the system has been commanded off, or when all sources of external power have been lost. If external power has been lost, the power supply will perform the following steps after having automatically started running off of the supercapacitor power:

- Turn off the sensor and analog circuitry
- Notify processor that shut down is imminent, killing all processes
    - Main purpose here is to protect the memory cards. In the Etna2 the software sections are mostly read-only. This combined with the use of the EXT4 filesystems makes a

controlled shutdown unnecessary. The controlled shutdown is only intended to make sure the most recent memory card action is allowed to complete.

- Wait for the super capacitor to decay, processor to acknowledge shut down, or shut down timeout to expire
- Shut off the processor

When commanded to power down (not due to power loss), the power supply will perform the following steps:

- The processor will be notified that a "slow" shut down is required through the power supply status flags, and the processor will have up to 15 minutes to terminate applications. (For example, if the system is currently triggered)
- The power supply will monitor power loss, processor shut down acknowledge, or completion of the 15 minute timeout and may then transition to the sequenced shut down described above.

2.1.4 Communication with the User Via Status LEDs

The power supply indicates its state of operation to the user through its LEDs:

Power:

- OFF - No power
- Flashing Green - Waiting to power up, Running off of external power
- Fast Green - Charging the supercapacitors
- Infrequent Green - System is powered up

2.1.5 Magnetic Switch

The magnetic switch is located on the top of the unit between the mounting hole and the bubble level. The switch is used to start up and shut down the unit without use of a physical power switch.

The unit has no power switch. When power is connected, the unit’s default behavior is to power up and begin operation. When power is removed, the applications and operating system will shut down and the unit will turn off.

Briefly touching a strong magnet near the magnetic switch location allows the user to affect this default behavior as follows:

- When Running - The magnetic switch causes the unit to shut down and go into a 12 hour timed operation window. If power remains connected, the unit will restart operation in 12 hours.
- When not running (in a timed window) - The magnetic switch will terminate the window and will cause the unit to start operating.

There are other functions of the magnetic switch used in conjunction with diagnostic functions.

2.1.6 Temperature Monitoring

The power supply system monitors system temperature through use of a built-in temperature sensor. The temperature is reported to the main processor and is available to the user as a display or a state-of-health stream.

2.1.7 Parametric Operation Protection

Operating limits are imposed in order to protect the hardware, but to allow operation of the system as much as possible. Defined limits are:

- Supercapacitor array charged: Above 4.2VDC
- External voltage limits: Above 6.0VDC or 10.0VDC (selectable)

NOTE: To change the low voltage cut-off range from 10.0V to 6.0V, use the "pscutoff" command from Linux.

There is a 1.0V hysteresis. So if the low voltage cut-off is set for 10.0V, then the system will require 11.0V to turn on, but will turn off at 10.0V.

2.1.8 System Watchdog

The system includes an advanced power system that provides watchdog and power fail protection with power fail warning capabilities.

The watchdog provision is independent of the main processor, but does interact with it. The watchdog exists as part of the power supply subsystem, and requires that it be "pinged" by the main processor every 10 minutes. Failure to do so will be interpreted by the watchdog as a lockup of the main processor and the main processor will be shut down and restarted in an attempt to get the system back into operation. Exceptions:

- The watchdog is initially held off for 4 hours after processor power on, allowing for initial start up and worst case automatic filesystem repair on a large system disk.

2.1.8.1 Default Behavior

The watchdog is normally serviced by a Linux service in order to keep the system alive. By default, only a failure of Linux to boot or a crash of the operating system or of the watchdog service will cause the watchdog to trigger and restart the system.

2.1.9 Power Fail Protection

The system includes an internal power backup called a supercapacitor array which is charged with power at system turn on. This backup provides enough residual power to terminate any last commanded memory card action. Once power fail has been detected, the system begins to operate off of this residual power and issues a request to Linux to halt immediately. When the shutdown request has been acknowledged (or backup power has been exhausted) the processor will power off.

2.1.10 Power System Display

The psdisplay command displays power system information once:

```
root@Etna2:~# psdisplay
VER=1.07
TEMP=401
VOLTS=14.879
VLIM=10.000
SC=5.000
LDO=3.196
IO=00
```

The items displayed by psdisplay are as follows:

- VER: Power supply firmware version
- Temp: Current temperature in degrees C (x 10)
- Volts: System input voltage
- VLim: System start up and shut down minimum voltage (This is selectable. The factory default setting is 10.0V, which will protect an external battery from damaging discharge, an optional setting of 6.0V will allow unit operation down to approximately 6V but may damage a connected battery if used)
- SC: Internal supercapacitor voltage
- LDO: Internal LDO voltage
- IO: State of two input bits from the processor used for diagnosis

2.1.11 Updating the Power Supply

The intelligent power supply includes a microprocessor that holds some highly specialized firmware for controlling it. This firmware is updated (if needed) as part of Linux package updates and normally does not have to be updated separately.

2.2 Processor System

The Processor system provides the intelligence for the system and controls all the user interfaces, storage media, and system operation. The processor also is responsible for configuring and loading the code into the PRUs. It also handles updating the code in the other processors such as the Power Supply.

2.2.1 Processor

The Processor is a TI AM3359 Processor. This is a highly integrated low power processor that is based on the ARM architecture. It has 512MB of SDRAM Memory. The system boots Linux from the internal System SDHC Card.

2.2.2 Storage

The unit provides a two internal SDHC card slots:

- The System card is a 4GB card
- The Data card is a 32GB card

2.2.3 Communication Interfaces

The Processor supports multiple communication protocols.

2.2.3.1 Serial Connections

A console port is provided with every unit. There are no other serial ports.

2.2.3.2 Ethernet Connections

Etna2 Accelerographs provide a 10/100BaseT Ethernet connection. The system supports PTP Slave and Master Clock operation using hardware in the Ethernet PHY.

2.2.3.3 USB Connections

The unit provides a USB 2.0 Device Port and a USB 2.0 Host Port.

The USB Device Port is dynamically configurable and will automatically become a host port is a device (such as a USB drive) is plugged in. Once acting as a host, the USB device port will not become a device again until the next reboot.

2.2.3.4 GNSS System

A GNSS module is provided on the processor board that can work with the system to provide data time aligned to sub-microsecond accuracy. The GNSS can also provide the accurate location of the unit.

GNSS (Global Navigation Satellite Systems) – is the generic term for all such systems, four of which are available as of 2016: GPS (USA), GLONASS (Russian Federation), BeiDou (People’s Republic of China), and Galileo (European Union); the GNSS system in the Etna2 supports any two of the four systems.

2.2.3.5 Hardware Identification

The major Kinemetrics-built electronic components of your system include information that helps to identify them for maintenance, warranty, and repair purposes. The processor can interrogate this information.

Each system includes the following information:

- Part numbers
- Serial numbers
- Assembly dash numbers
- Assembly revisions
- Parts List revisions
- Build dates
- Test dates

In addition, a unit tag number is assigned to the system as a whole.

To list this identification information on your system, execute the owview command from the Linux command prompt. The display looks something like:

```
UnitType=Etna2
UnitTagNo=3
M0_Record=143311
M2_1/4gHorizontalSpan=9.9761
M0_SensorGain=2
M0_FinalCalCoilSens=0.0594
M1_Record=142902
M2_1/2gHorizontalSpan=4.9916
M0_1/4gVerticalSpan=-9.9288
M0_MechError=-0.0871
M2_4gHorizontalSpan=0.6251
M0_Damping=0.7
M2_SensorGain=2
M1_1/4gHorizontalSpan=9.9608
M0_Phase=-57.4
M2_Phase=-57.8
M1_Phase=-58.6
M2_2gHorizontalSpan=1.249
M2_Record=144744
M1_NatFreq=206.0
M2_1gHorizontalSpan=2.4947
M1_1/2gHorizontalSpan=4.9921
M0_SerialNumber=15361
M0_2gVerticalSpan=-1.2509
M0_SensorType=32
M0_Gain=-0.24
M2_NonLinearity=681
M2_Gain=-0.48
M2_SensorType=32
M1_MechError=-0.0463
M1_FinalCalCoilSens=0.061
M1_Damping=0.7
M1_SensorGain=2
M2_NatFreq=202.0
M0_1/2gVerticalSpan=-4.99
M1_4gHorizontalSpan=0.6252
M0_1gVerticalSpan=-2.4982
M2_SerialNumber=15362
M1_NonLinearity=598
M1_2gHorizontalSpan=1.2492
M0_NatFreq=210.0
M1_1gHorizontalSpan=2.4963
M0_4gVerticalSpan=-0.6265
```

```
M2_FinalCalCoilSens=0.0631
M2_MechError=-0.0136
M2_Damping=0.7
M1_Gain=-0.23
M1_SensorType=32
M1_SerialNumber=15360
M0_NonLinearity=371
FrontPanelSerialNo=101
FrontPanelPartNo=114250-PL
FrontPanelDashNo=101
FrontPanelTestDate=MAR 30, 2016
SDSerialNo=104
SDPartNo=114255-PL
SDBoardDashNo=104
SDBoardTestDate=MAR 30, 2016
CPUBoardSerialNo=103
CPUBoardPartNo=811473
CPUBoardDashNo=103
CPUBoardTestDate=MAR 30, 2016
CarrierBoardSerialNo=102
CarrierBoardPartNo=114260-PL
CarrierBoardDashNo=102
CarrierBoardTestDate=MAR 30, 2016
SensorInterface1SerialNo=105
SensorInterface1PartNo=114265-PL
SensorInterface1DashNo=105
SensorInterface1TestDate=MAR 30, 2016 S
ensorInterface2SerialNo=106
SensorInterface2PartNo=114265-PL
SensorInterface2DashNo=106
SensorInterface2TestDate=MAR 30, 2016
SensorInterface3SerialNo=107
SensorInterface3PartNo=114265-PL
SensorInterface3DashNo=107
SensorInterface3TestDate=MAR 30, 2016
KAUTH=9b99250d01f2ab10b758bf0c3d45d8c8
```

2.3 Performance vs Power Use

2.3.1 Setting Processor Speed

The clock speed of the Etna2's main processor is adjustable to 300, 600, or 800Mhz.

This speed is initially set to 600Mhz from the factory, which balances adequate performance for most applications with low power consumption.

You can adjust the CPU speed if you wish to decrease CPU speed to save a little more power or increase CPU speed at the expense of power consumption. The command is "cpuspeed":

```
cpuspeed
Usage: cpuspeed {low|medium|high|query} [-u update config]
```

The argument to the command is:

- low=300
  - Setting CPU speed to 300Mhz will save up to 200mW (vs 600Mhz), but will significantly impact system performance. The lower speed will also reduce the "head room" available to the system and may make the system less tolerant of denial-of-service attacks. It is best suited to basic recording and telemetry applications within a secured network.
- medium=600 (default)
- high=800
  - Maximum performance mode. This mode is recommended when using Low Latency telemetry features. See Low Latency Telemetry
- query=show current speed.

Speed changes are immediate, so you can experiment to determine what best fits your application.

The optional "-u" updates a config file so that the new speed is the default at boot.

2.3.2 Setting Network Speed

The Ethernet interface is configured to auto-negotiate speed to determine if it should operate at 10Mbps or 100Mbps

If however, you are running in an environment where 10Mhz would be adequate to support your telemetry or event transmission needs then you can save up to 120mW by setting the Ethernet interface to an un-negotiated 10Mbps.

Setting low speed or normal speed is done through netconfig with an additional question:

Force eth0 to low speed (10MBit) to save power at the cost of reduced performance? (Y/N)? >

2.4 ADC SYSTEM

Each Etna2 system contains a proprietary multi-channel ADC system that digitizes the signals from the sensor s and also provides calibration signals to verify the operation of the sensors and the performance of the ADC system itself.

2.4.1 DC/DC Analog Power Supplies

The ADC system contains low noise highly efficient power supplies to power the ADCs and their associated electronics and the sensors. The system monitors the voltage levels of these supplies and the values can be interrogated by the State of Health system.

2.4.2 Delta Sigma ADC Converters

Each channel is digitized by a primary Delta Sigma converter producing an 8 kSPS output. This raw data stream is then processed by various signal processing streams to filter and decimates the data to the user selected output data rates.

2.4.3 Anti-Alias Filtering

The recorder has a high-order anti-aliasing filter system that offers extremely steep ("brickwall") roll-off combined with decimation of data. You can select between the causal or non-causal versions of these filters depending on your application.

Use the final causal filter for precise seismic phase picking (this type of filter does not generate precursors that might interfere with determining the precise onset time). Use the non-causal final filter to avoid phase distortion of the signal.

The non-causal filter has a linear phase response that is equivalent to a pure time delay, and the phase of the seismic signal is undistorted. Therefore, there is no need for deconvolution of seismic signals when using these filters if you are primarily concerned with phase distortion. The degree to which their pass-band amplitude characteristics modify seismic signals is tolerable in most seismological applications.

ASCII files containing the coefficients of all these filters can be downloaded from the Kinemetrics Web site or at www.kinemetrics.com.

These filters are implemented as two to eight stage, multi-rate, Finite Impulse Response (FIR) filters. They offer extremely steep low pass amplitude response. The -3dB point is at 40% of the Sampling Frequency, while at the Nyquist Frequency (50% of the Sampling Frequency) the amplitude is -130dB. An 8K data stream from the A/D converter is decimated by the appropriate factors to get to an intermediate data stream at twice the final sampling rate. The final filter is a decimate by 2 brickwall filter, causal or non-causal. The table below lists the final sample rate, filter name, number of coefficients and decimation for the anti-alias filters used in the Etna2.

500 sps:

- coefA8_80 (197, /8)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

250 sps:

- coefA8_80 (197, /8)
- coefA2_20 (85, /2)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

200 sps:

- coefA8_80 (197, /8)
- coefB5_350 (350, /5) or coefB5C_350 (350, /5)

100 sps:

- coefA8_80 (197, /8)
- coefA5_50 (85, /5)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

50 sps:

- coefA8_80 (197, /8)
- coefA5_50 (85, /5)
- coefA2_20 (85, /2)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

20 sps:

- coefA8_80 (197, /8)
- coefA5_50 (85, /5)
- coefA5_50 (85, /5)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

10 sps:

- coefA8_80 (197, /8)
- coefA5_50 (85, /5)
- coefA5_50 (85, /5)
- coefA2_20 (85, /2)
- coefB2_80 (173, /2) or coefB2C_80 (173, /2)

1 sps:

- coefA8_80 (197, /8)
- coefA5_50 (85, /5)
- coefA5_50 (85, /5)
- coefA5_50 (85, /5)
- coefA2_20 (85, /2)
- coefA2_20 (85, /2)
- coefB2_80 (173, /2)) or coefB2C_80 (173, /2)

Group delay is automatically and transparently compensated by the recorder, so the time stamps are accurate for the first scan and the trigger scan.

SPS	Non-causal empirical (sec)	Causal empirical (sec)	Sample Period (mSec)
500	0.101	0.021	2
250	0.227	0.071	4
200	0.188	0.033	5
100	0.483	0.083	10
50	1.123	0.323	20
20	2.403	0.403	50
10	5.603	1.603	100
1	60.003	20.003	1000

2.5 EpiSensor Theory of Operation

This section describes the operating principles of the EpiSensor internal deck used in the Etna2.

The EpiSensor deck consists of three orthogonally mounted force balance accelerometers (FBAs) – X-axis, Y-axis and Z-axis. The figure below shows a simplified block diagram of the major components of each of the EpiSensors.

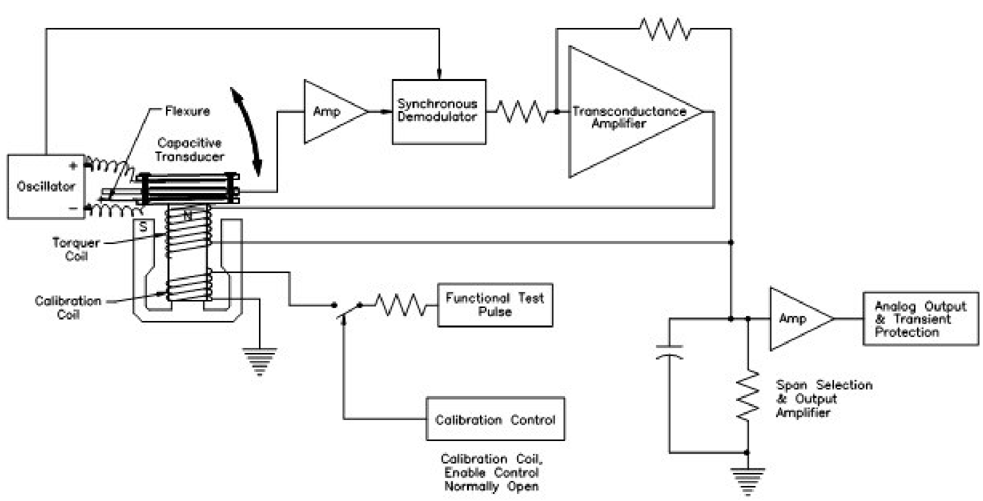


Figure 8: EpiSensor Simplified Block Diagram

2.5.1 Working Principle

The oscillator applies an AC signal of opposite polarity to the two moving capacitor plates (also referred to as "the moving mass"). When the accelerometer is "zeroed" and when no acceleration is applied, these plates are symmetrically positioned to the fixed central plate and no voltage is generated.

An acceleration causes the coil and capacitive sensor plates, which are a single assembly mounted on mechanical flexures (springs), to move with respect to the fixed central plate of the capacitive transducer.

This displacement results in a signal on the center plate of the capacitor becoming unbalanced, resulting in an AC signal of the same frequency as the oscillator being passed to the amplifier.

The amplifier amplifies this AC signal.

This error signal is then passed to the demodulator where it is synchronously demodulated and filtered, creating a "DC" error term in the feedback amplifier.

The feedback loop compensates for this error signal by passing current through the coil to create a magnetic restoring force to "balance" the capacitor plates back to their original null position.

The current traveling through the coil is thus directly proportional to the applied acceleration. By passing this current through a complex impedance consisting of a resistor and capacitor, it can be converted to a voltage output proportional to acceleration with a bandwidth of approximately 200 Hz. The internal deck can be set via software to provide a 1g,2g, or 4g output range.

2.5.2 Pole Zero Representation of the EpiSensor

EpiSensor accelerometers are closed-loop, force-feedback sensors measuring the relative displacement of a moving mass (plates) with respect to the sensor case. The sensor's transfer function (TF) depends almost entirely on the electronic components rather than on the mechanical components of the sensors. The influence on the transfer function of the mechanical damping, spring elements and internal RC low-pass filter in the trans-conductance amplifier stage within the closed-loop path of the sensor are negligible for most applications.

We have determined a good empirical model of the system, which uses two pairs of conjugate poles to represent the transfer function of the instrument. If this transfer function is corrected for the DC sensitivity of the sensor, the amplitude agreement is within +/-0.5 dB over the bandwidth of the sensor. The phase agreement is within +/- 2.5 in the 0-100 Hz band and within +/- 5º over the full bandwidth of the instrument. The phase response of the transfer function is fairly linear and equivalent to approximately 1.6 ms group delay for signals up to 200 Hz.

This model can be represented as:

$$\frac{V(s)}{A(s)} = \frac{k1 * k2}{(s-p_1)(s-p_2)(s-p_3)(s-p_4)}$$

where:

- k1 = 2.46 x 1013
- k2 = Sensitivity of sensor in V/g (1.25V/g for a 2g Range)
- s is the Laplace transform variable
- p1 = -981 + 1009i (Pole 1)
- p2 = -981 - 1009i (Pole 2)
- p3 = -3290 + 1263i (Pole 3)
- p4 = -3290 - 1263i (Pole 4)
- V (s) is the Laplace transform of the output voltage
- A (s) is the Laplace transform of the input acceleration

The figure below shows the amplitude, phase and step response of this pole zero representation.

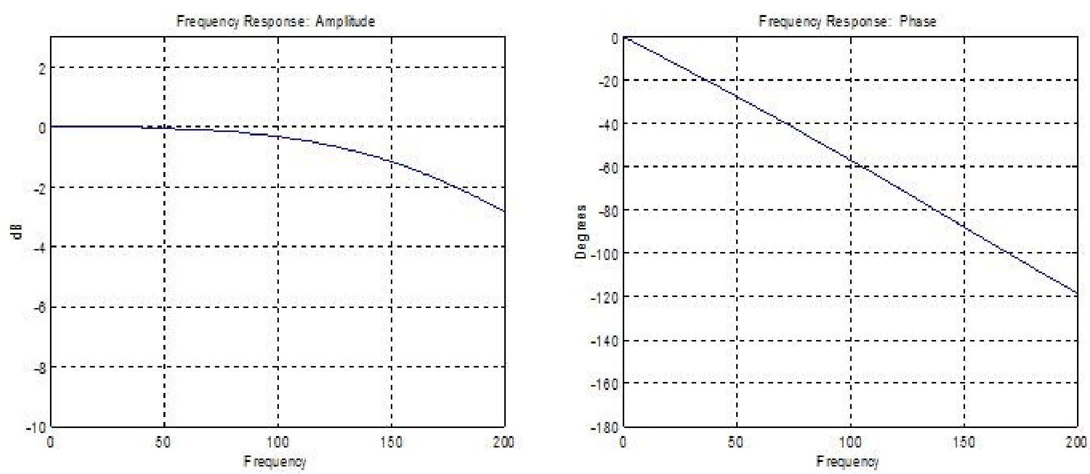


Figure 9: Amplitude and Phase Response

Additional references to pole zero responses and damping are available on the Kinematrics website.

2.5.3 Polarity Conventions

The internal EpiSensor deck uses an XYZ coordinate system with a positive output for acceleration along each axis. The direction of the axis is shown on the lid of the unit.

Chapter 3

Basic Operation

The Etna2 can operate stand-alone, requiring only power and its internal sensors to operate, in this case you have to visit the unit to retrieve data. Beyond this basic set up, if you provide a GNSS antenna connection for accurate timing and a network connection, then the Etna2 really is able to provide tremendous additional capabilities. The Etna2 is designed for use with a network, and will serve you best in that environment. (Network connections can be wired or wireless). This section describes how to set up the Etna2 and perform basic operations.

3.1 Initial Setup

Initial setup of the Etna2 is done using a console cable. This connects the Etna2's RS-232 console connection to your computer so that you can do preliminary setup. Once done, the console cable will rarely be used, so a single console cable is usually sufficient to maintain a large number of Etna2s.

If using a console cable you may need to use a USB to serial adapter if your PC does not have an available COM port. If so, install the software and then plug in the adapter, making note of the COM port assigned to the port.

> **NOTE: Alternatively, you can set up the Etna2 using a USB device cable or via Ethernet at a static IP address as described below.**

You'll also need a PC or equivalent running a terminal emulation program such as HyperTerminal or PuTTY on Windows or minicom on Linux.

Kinemetrics includes the PuTTY application as an alternative to using HyperTerminal on Windows, or if you are using an Operating System (such as Windows 7) that does not supply HyperTerminal. Please see the Software Utilities section that includes a basic description of PuTTY setup and operation.

You should set up your RS-232 communication software (such as HyperTerminal) for 115200 baud, no flow control, no parity, 1 stop bit. After power on, you should be able to get a login prompt from the Etna2. Initially log into the system with the username "root" and the password "kmi". You are now logged on to the Linux operating system on the Etna2.

Alternatively, the following initial setup methods can be used:

1. Using a USB device cable. This will present the Etna2 to your PC as a virtual COM port over USB. Thus way, you can simply connect to the Etna2 via PuTTY and log in. You may have to consult the device manager to determine the COM port assigned by Windows. Flow control and baud rates are meaningless and do not need to be set when using a virtual COM port.

2. Static IP. From the factory, the Etna2 is configured as a dynamic (DHCP) IP and simultaneously as the static IP of 192.168.222.245. Either may be used until you run "netconfig" to specifically set up your network. Since 192.168.222.245 is a static address, do not connect more than one "fresh" Etna2 to your network at one time. See Clearing the ARP Cache

3.1.1 Network Address

The first thing that you'll need to do is to set (or determine) the network address of the Etna2. You need to do this even if your Etna2 will not normally be connected to a network. Network access is needed to retrieve files even if you need to retrieve them manually and locally.

If you are unfamiliar with TCP/IP networking, we suggest you review the IP Primer section.

At this point the Ethernet connection should be connected to your network. If the Ethernet link lights do not appear, give the following commands to start the Ethernet interface:

```
[root@Etna2:~]# ifdown -a
[root@Etna2:~]# ifup -a
```

The Etna2 is configured at the factory for DHCP. This means that it expects to get its network address from a network server, which can be a local LAN or can be your Internal Service Provider. If you plan to use DHCP in regular operation, then you only need to know the IP address assigned by DHCP. You can find this out by typing:

```
[root@Etna2:~]# ipaddr eth0
10.0.1.153
```

The IP address is also shown in the sysinfo display as shown below.

If you need to specify an IP address, then once logged into the console, use the NETCONFIG script.

In either case, make a note of the current IP address. You will need it later.

The Etna2 can also act as a DHCP Server, which can be useful if you will occasionally connect to a standalone Etna2 with something like a laptop computer. See the section on Non-Networked Use

See the section Non-Networked Use if you don't intend your Etna2 to normally be connected to a network.

> **NOTE: As described above, Etna2 units from the factory are configured for DHCP and for a simultaneous static address.**

3.1.2 Viewing System Information

Use the sysinfo command to view System Information:

```
[root@Etna2:~]# sysinfo
Hostname:         Etna2
Int Temp C:       40.5
Voltage:          14.849
MilliAmps:        222.41
MilliWatts:       3302.566
OS Time:          Wed Apr 20 18:14:02 UTC 2016
Up-Time:          18:14:02 up 2:52, 1 user, load average: 1.25, 1.39,
                  1.45
MemFree:          368900 kB
eth0 IP Addr:     10.0.3.58
Timing Mode:      gps
Important Services:
sshd is running.
KMI TCXO service is running.
runprus is running.
Rockhound is running.
Tomcat is running.

Filesystem Size Used Avail Use% Mounted on /dev/root
2.5G 1.1G 1.3G 48% /
/dev/mmcblk0p3 998M   92M 839M 10% /mnt/sysrw
/dev/mmcblk0p1 128M 9.4M 119M    8% /boot
/dev/mmcblk1p1  30G   49M   28G   1% /mnt/data1
```

Use the versions command to view the major software versions:

```
[root@Etna2:~]# versions
KMI GPS MOD NEO-M8N-0, ROM BASE 2.01 (75331) Oct 29 2013 13:28:17
KMI Etna2 Arm Filesystem 1.4
KMI Etna2 Kernel 3.12.59-kmi-AM335x-PD15.1.1 #214 SMP PREEMPT Wed Jun 8 13:12:33
PDT 201 KMI Rockhound 3.14
```

3.1.3 The Web Interface

The web interface to the Etna2 allows you to configure and operate your Etna2 using a web browser without installing any Kinemetrics-specific software. The web browser should be HTML 1.1 compliant (or later) and should support Java and Java applets.

See Web Interface Overview

3.2 Basic Setup

Although Kinematrics makes every effort to make the Etna2 useful out of the box, there are some items that must be set because they depend on how you will use your system.

The parameter configuration described here is done using the web interface. It can also be done using the RockTalk program through the network.

3.2.1 Sensor G Range and Calibration

Next, you must set up the sensor full scale range. The Etna2 is capable of supporting sensor ranges of 1g, 2g, or 4g. This selection is made system-wide, and is made near the top of the Hardware parameters section with a parameter called Sensor Range.

There are always 24 bits of ADC resolution, so it would break down like this:

Range	ADC Counts	µG/ct	cm/s^2/ct
1g	8388608	0.119209290	0.000116904378
2g	8388608	0.238418579	0.000233808756
4g	8388608	0.476837158	0.000467617512

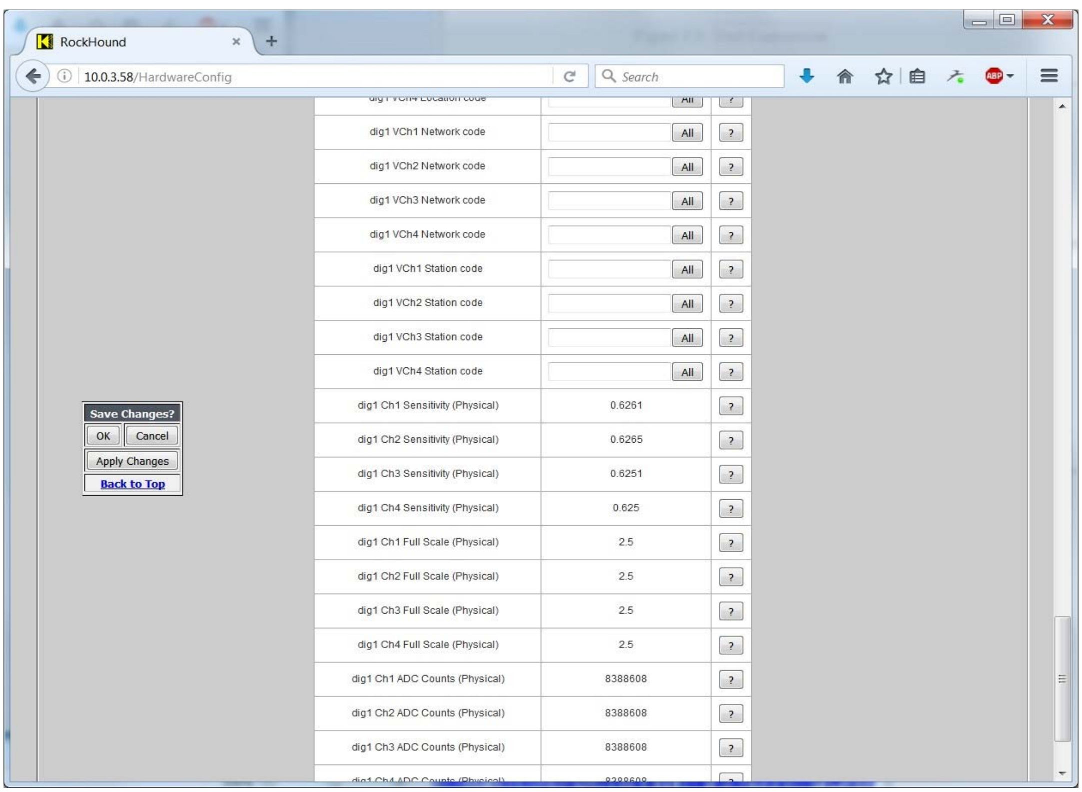


Figure 10: Unit Conversion

After completing your changes, be sure to press OK to save your changes.

3.2.2 Etna2 Sensor Zero Offset

Generally, as the sensors are zeroed at the factory, and if the unit has been leveled, digital zero offset will probably not be required. If required you can zero the accelerometer offset using the “sensorzero” command from the Rockhound Command Console.

If the offset without correction of any axis exceeds 200mg with the unit levelled you should contact the factory as this may indicate the sensor has been damaged.

3.2.3 Other Channel Parameters

Many other channel parameters listed in the Hardware parameters section are notational only, meaning that they are included in telemetry and output file information (depending on the formats used), but have no direct effect on the data itself. Notational parameters include Channel ID, Sensor Type, Sensor SN, Natural Frequency, Damping, Gain, Altitude, Azimuth, Offsets North, East, and Up, Location Code, Network Code, etc. Remember that these values are defined for each virtual channel.

After completing your changes, be sure to press OK to save your changes.

3.2.4 Physical vs. Virtual Channels

It is important to understand the difference between physical and virtual channels. There is a physical set of sensors in the Etna2, and virtual channels that represent a physical channel at a specified sample rate. The Etna2 can produce more virtual channels than it physically has as sensors. For example, a three channel unit could be configured in the following ways: Example 1. Produce a virtual channel corresponding to each physical channel:

Physical	Virtual
1	1 – Physical 1 at 100sps
2	2 – Physical 2 at 100sps
3	3 – Physical 3 at 100sps

Example 2. Produce data from two channels at multiple sample rates:

Physical	Virtual
1	1 – Physical 1 at 10sps
2	2 – Physical 2 at 10sps
1	3 – Physical 1 at 50sps
2	4 – Physical 2 at 50sps

Example 3. Produce data from each physical channel at multiple sample rates:

Physical	Virtual
1	1 – Physical 1 at 10sps
1	2 – Physical 1 at 100sps
2	3 – Physical 2 at 10sps
2	4 – Physical 2 at 100sps
3	5 – Physical 3 at 10sps
3	6 – Physical 3 at 100sps
4	7 – Physical 4 at 10sps
4	8 – Physical 4 at 100sps

You select the sample rates and the produced sample rates on the System Operation parameters for each channel, also called Channel Mapping:

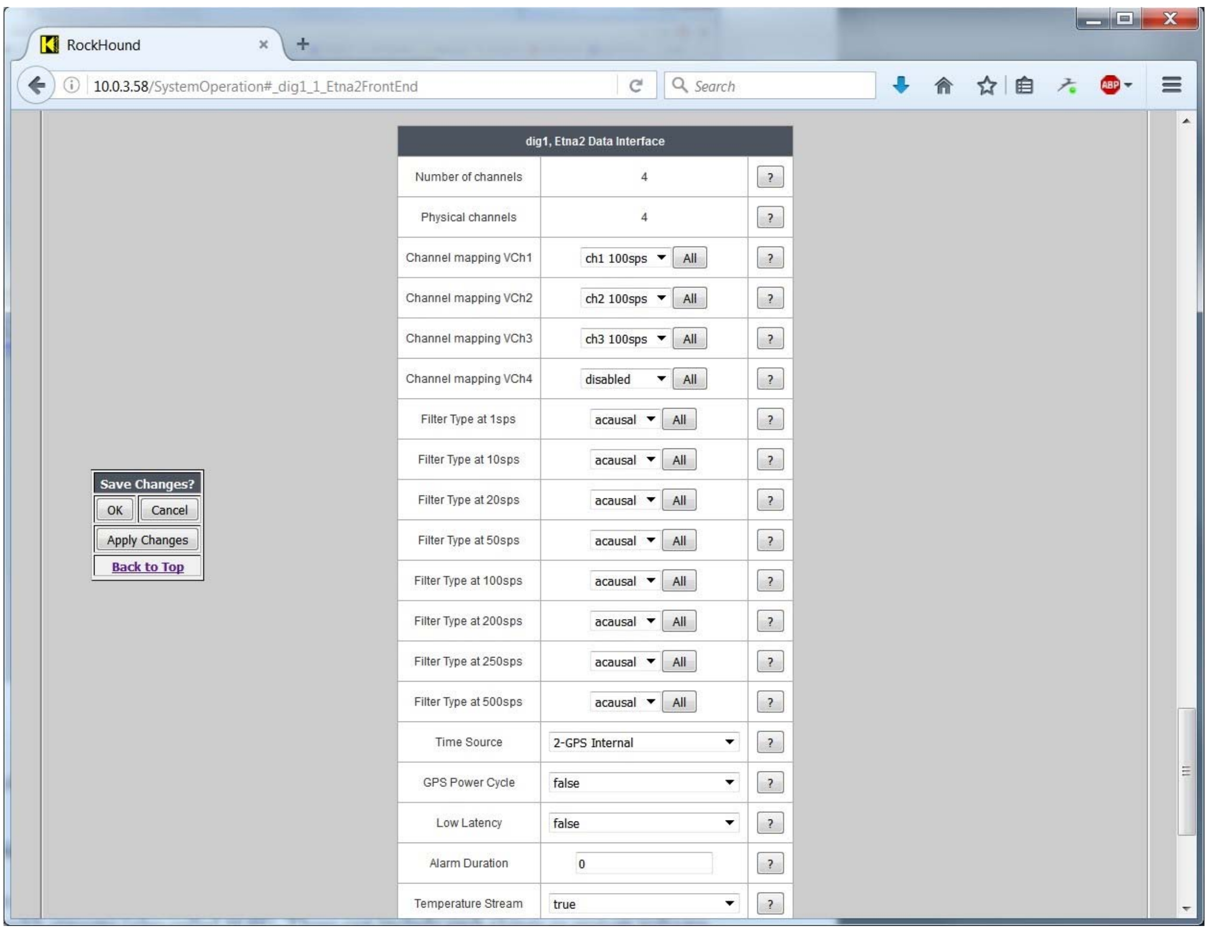


Figure 11: Channel Mapping

After completing your changes, be sure to press OK to save your changes.

3.2.5 State-of-Health Streams

In addition to the sensor input channels discussed above, the system can produce several State-of-Health streams (also called SOH). These can include such things as system voltages, temperature, and time quality. These streams are produced at 1sps, so to record them; you'll need a data format that can record data at 1sps. The SOH streams are selected in the System Operation parameters, just below the Channel Mapping.

After completing your changes, be sure to press OK to save your changes.

3.2.6 Trigger Levels

Trigger levels are the level at which the system will decide that a channel is triggered and that it should contribute that channel's votes toward triggering the entire system. By default, the system uses threshold triggers, which are set as a percentage of full scale. So if your full scale range is 2g and your threshold is set to 2%, then your trigger level is 2% of 2g, or 0.04g. Trigger levels are set in the System Operation parameters:

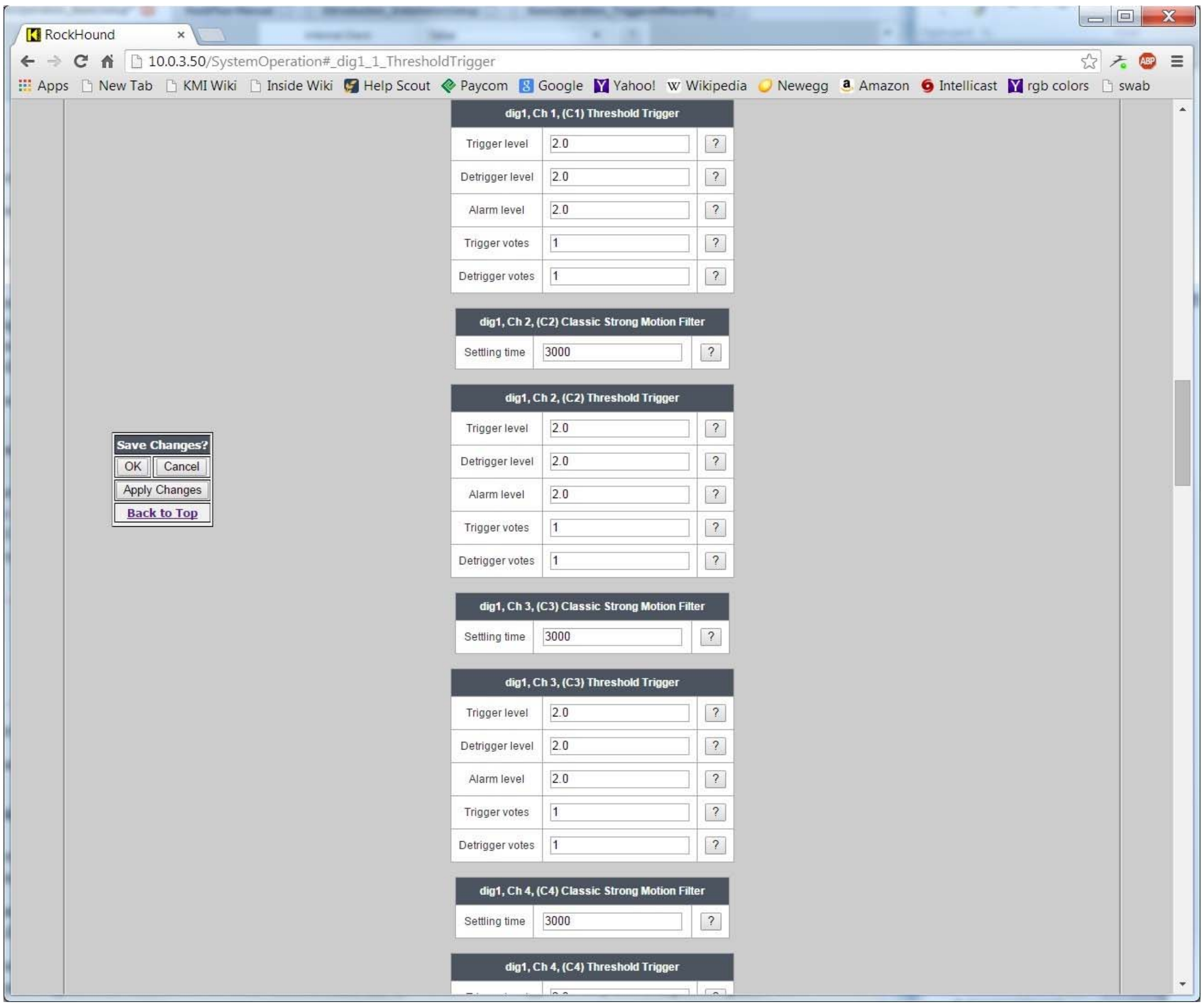


Figure 12: Trigger Levels

Please note that the trigger levels and votes apply to virtual channels.

After completing your changes, be sure to press OK to save your changes.

3.2.7 Voting Options

The Voter used in the Etna2 is the traditional Voter used in previous generation Altus, Rock, and Rock+ digitizers.

A channel is considered triggered if it has filtered data values that exceed the specified level specified for that channel. Correspondingly, a channel is considered detriggered if NO values exceed the specified level.

Note that the levels used change depending on whether the system as a whole is triggered or not. If the system is not triggered, the filtered data values are compared against the TRIGGER levels, whereas once the system has been triggered they are compared against the DETRIGGER levels.

- The Voter counts triggers and uses that count to determine detriggering by comparing votes with the detrigger voting threshold. If the number of votes of triggered channels do not exceed the detrigger threshold, then the system will detrigger. Exceeding the detrigger threshold will cause the system to remain triggered.
- The system detriggers when not enough channels exceed the trigger threshold (number of votes) to maintain the trigger.

3.2.8 Other Parameters

Other basic parameters that are worth reviewing are:

- Voter parameters
- Pre-event and post-event times
- Channel trigger and detrigger votes

After completing your changes, be sure to press OK to save your changes.

3.2.9 Activating Parameter Changes

Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes” from the Layout menu.

3.2.10 Passwords

All Etna2s are shipped with the same default passwords. Before deployment, Kinemetrics strongly recommends that you change all passwords to something meaningful to you and make a record of all passwords assigned for later reference. Default passwords are assigned as follows:

Linux:

- root : kmi
- kmi : kmi
- admin : kmi
- client : kmi

Rockhound:

- Console: kmi
- Web service: rock : kmi

You should also review the enabled IP services to make certain that the services are enabled that you need and want. For example, do you want FTP, TELNET, and other services enabled?

3.2.11 Locked File System

The Obsidian and Etna2 file systems are much more locked down than earlier systems such the Basalt. This is for additional protection of the files from accidental corruption.

To manually edit system files on these (including changing the passwords), you much first unlock the filesystem:

```
fsunlock
<make your edits>
fslock
```

The file system is automatically relocked on reboot if you forget.

Convenience scripts such as netconfig will automatically unlock and relock the file system.

3.2.11 Save Parameters

Once you've configured Rockhound for how you intend to operate your system, you should save your configuration. This saved copy of the parameters will be used to restore the Rockhound parameters in case they become corrupted. This is done in two ways:

- From a Linux login, use the command rhsave to save a copy of your parameters within the system that can be restored in case your parameters become corrupted. This is done as follows:
- cd /usr/rock/SMARTSDist/bin
- ./rhsave If the unit's configuration is destroyed, the system will revert to the copy of the configuration most recently saved by rhsave, or to the factory default if the configuration was never saved using rhsave.
- From the web interface use the Advanced Features function Administrative Details to download a copy of the parameters to your PC. At the top of the Administrative Details screen, there is a link "Click Here to Download Parameters", from the instrument.
- Kinemetrics recommends that you save a copy of your Rockhound parameters any time that you make significant changes to the parameters so that you can quickly restore them in the event of loss.
- See Save/Restore Parameters

3.3 Triggered Recording

3.3.1 Pre-Event Time

The setting allows you to determine how many seconds of data before the trigger criteria were met will be recorded in the event file. For strong motion applications this is normally set to a few seconds so you can determine the noise before the start of the event. The factory default is ten seconds.

For weak motion recording, especially if you expect the system to be triggered on the S-waves, the situation is more complex. In this case, the pre-event should be sufficiently long to allow any P-waves from an event within the region of interest to be recorded. This time can be estimated by the travel times of the P and S waves from the most distant point of interest. The difference between these times, with some allowance for a true pre-event time, gives the setting for the pre-event time.

3.3.2 Post Event Time

The post event time determines how many seconds after the system has de-triggered will be recorded in the file. It also determines how likely events are to be split into separate files. This is because if the system re-triggers during the post event the file will just be extended. If the post event is set too short, several files could be created from the same event. We set the factory default at ten seconds, which is a reasonable value for strong motion recording. For weak motion recording this time should be set according to the goals of the study. Generally, a time of 30 seconds or more should be considered.

3.3.3 Minimum Run Time

This is the minimum time the recorder will record once an event is triggered. Formerly, it was used to ensure a complete sequence of time code was recorded with the event, but this is not required anymore. Generally, the pre-event and post-event now give sufficient control over the event timing. For this reason we set the factory default to zero seconds.

3.3.4 Channel Triggering

Although you will need to read most sections to determine what is appropriate for your application, we have split the triggering system into two sections. If you are just interested in recording "strong motion" events when the ground or structure shakes significantly, you will find instructions on setting triggers in the Triggering for Strong Motion Recording section. If you are interested in recording weak events that are very close to the local seismic noise, you should read Triggering and Recording Weak Motion Applications. After you read the relevant section you will be able to set up each channel’s triggering appropriately for your application.

3.3.4.1 Triggering in Strong Motion Applications

For strong motion recording you will want to record the strongest motion from an earthquake that can be felt and possibly cause damage to buildings and other structures. Normally, a simple threshold trigger will be sufficient to reliably trigger the recorder. As these are sensitive instruments, it is also possible to record much weaker motions using the threshold trigger. The tradeoff to consider is how you will retrieve the data and how to ensure that there will be room for the "big one" if you have very sensitive threshold trigger levels.

The threshold trigger has two parameters for each channel. The first is the threshold trigger, which is the level in percent of full scale that causes the channel to trigger. The default value for this is 2%. The second parameter is the threshold de-trigger. This is the value in percent of full scale the signal must fall below after triggering for the channel to detrigger. The default value is 2%. The detrigger parameter can be used for extending the recording time by setting it to a smaller value than the threshold trigger value.

3.3.4.2 Alarms

The recorder has an additional set of thresholds called alarm threshold parameters. These are specified as a percentage of the full-scale input and can be set independently for each channel. They are set in the channel trigger parameters window. When a channel's triggered filtered data exceeds this threshold, the hardware alarm is activated.

3.3.4.3 Triggering in Weak Motion Applications

The recorder includes the following features for use in seismological applications:

- Three different trigger filters that allow the trigger band of interest to be optimized.
- STA/LTA triggering to support the recording of small amplitude events. The use of these specific features is discussed below.

3.3.4.4 Trigger Filters

Your selection of a pre-trigger filter is determined by your application, by seismic noise conditions at the site, and by the type of sensors installed with the recorder. The pretrigger filter pass-band should encompass the maximum energy of expected seismic events. The filter you select should have a pass-band that doesn't coincide with the peak frequency components of seismic noise at the site, thus discriminating against seismic noise.

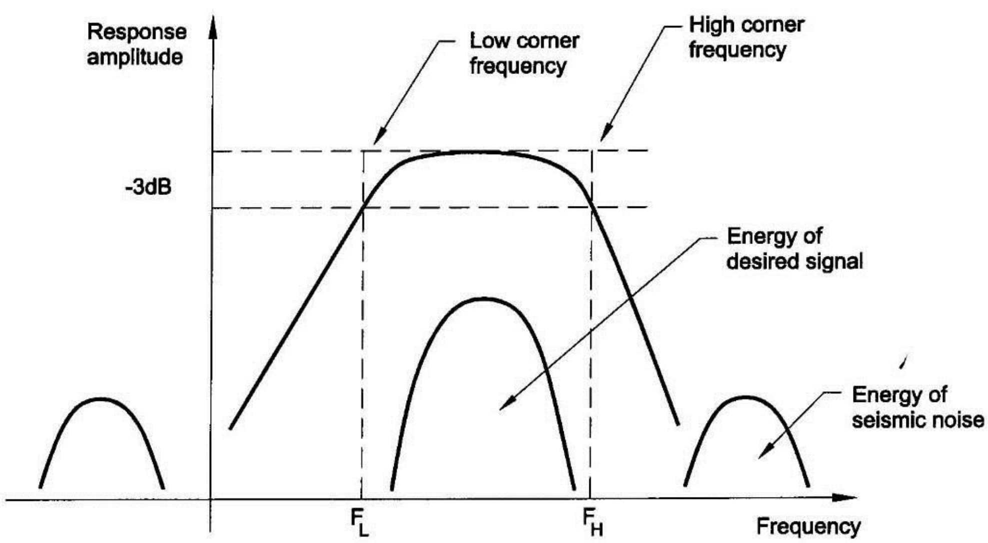


Figure 13: Typical trigger filter response

The frequency response function of the seismic sensor modifies event and noise signals and thus is an important factor in your choice. If the frequency content of events and of seismic noise occur in the same frequency band, the trigger filter will be inefficient.

The recorder has three band-pass filters with different low- and high-corner frequencies. Note that the corner frequencies scale according to the sampling rate. Some examples are as follows:

- An IIR-A filter with a sampling rate of 200 or 250 Hz can monitor local earthquakes with efficient protection against marine noise.
- The classic strong motion filter at a sampling rate of 200 Hz or 250 Hz is used in typical strong motion applications.
- The low-frequency corner of a classic strong motion filter at a sampling rate of 100 Hz can be used for far-regional and tele-seismic applications. It has good protection against 20 - 40 Hz man-made seismic noise in urban areas.
- An IIR-C filter at a 200 or 250 Hz sampling rate can monitor local earthquakes. However, there is no protection against high-frequency man-made noise because the frequency content of the events and the noise is approximately the same. The approximate band-pass of these filters is shown in the table below.

3.3.4.5 Trigger types and sampling rates

Trigger Type	**20 SPS**	**40 SPS**	**50 SPS**
IIR-A	~ 0.12-2 Hz	~ 0.24-4 Hz	~ 0.3-5 Hz
Classic Strong Motion	~ 0.01-1.25 Hz	~ 0.02-2.5 Hz	~ 0.025-3.125 Hz
IIR-C	~ 0.2-4 Hz	~ 0.4-8 Hz	~ 0.5-10 Hz
Trigger Type	**100 SPS**	**200 SPS**	**250 SPS**
IIR-A	~0.6-10Hz	~1.2-20Hz	~1.5-25Hz
Classic Strong Motion	~0.05-6.25Hz	~0.1-12.5Hz	~0.12-15Hz
IIR-C	~1-20Hz	~2-40Hz	~2.5-50Hz

3.3.4.6 STA/LTA Triggering

The short-time average/long-time average (STA/LTA) trigger algorithm generally increases the sensitivity of the Etna2 in comparison to the amplitude threshold trigger algorithm. It improves the earthquake triggers/false triggers ratio, and, to some extent allows discrimination among the different types of earthquakes.

This can minimize the work of analysts and allows more efficient use of the Etna2's data memory. Historically, STA/LTA triggering is used most often in weak motion applications that try to record as many seismic events as possible and so is not so relevant for a strong motion accelerograph. The STA/LTA trigger parameter settings are always a tradeoff among several seismological and instrumental considerations – the highest possible trigger sensitivity for a given type of earthquakes (including "all earthquakes") at a tolerable number of false triggers.

STA/LTA triggering is most beneficial at seismically quiet sites where natural seismic noise (marine noise) is the dominant type of seismic noise.

STA/LTA triggering is also effective in cases of suddenly changing man-made seismic noise (like the noise due to day/night variation of human activity in or close to an urban area). The STA/LTA algorithm is less effective in the presence of irregular, high amplitude man-made seismic noise that is often of the burst and/or spike type.

How STA/LTA Works The STA/LTA algorithm continuously follows the changes in seismic noise over time, and automatically adjusts recorder sensitivity to give you optimal sensitivity to the actual seismic noise level at a specific time. This results in significantly higher sensitivity during seismically quiet periods.

The STA/LTA algorithm calculates average absolute amplitude of a seismic signal in two time windows – a Short Time Average window (STA) and a Long Time Average window (LTA). The short time average window (STA) "watches" for earthquakes and measures the "instant" amplitude of the seismic signals. The long time average window (LTA) takes care of the average value of seismic noise during the same period of time. A ratio of both values – the STA/LTA ratio – is continuously calculated and, if it exceeds the preset STA/LTA trigger threshold level, a channel trigger is declared. The channel de-triggers if the STA/LTA ratio falls below another pre-set value – the STA/LTA de-trigger threshold level.

STA/LTA trigger ratio calculations are calculated according to the steps in the figure below. All calculations are made for every data sample in every channel in the recorder, assuring minimal time delay between the seismic event and the triggering.

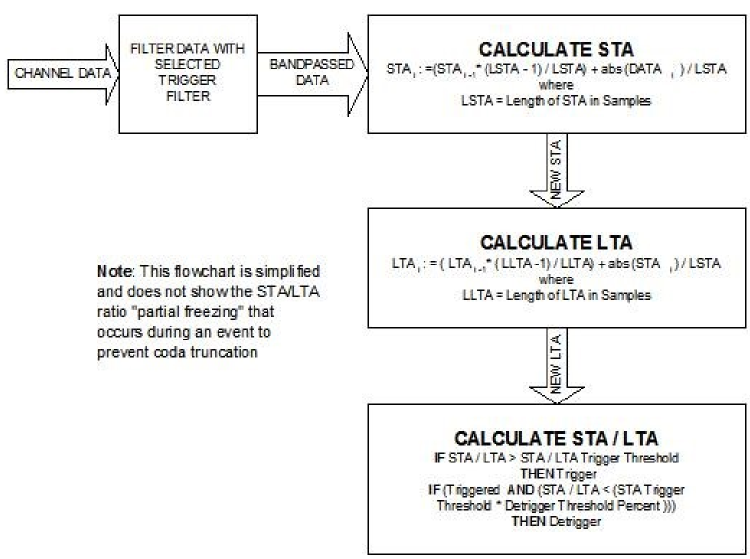


Figure 14: STA/LTA Simplified Flowchart

Simplified flowchart of STA/LTA calculations

STA/LTA Parameters To set the STA/LTA trigger algorithm, adjust the following parameters:

- STA window duration in seconds
- LTA window duration in seconds
- STA/LTA trigger threshold level
- STA/LTA de-trigger threshold level

Adjusting STA/LTA Trigger Parameters The STA/LTA trigger parameter settings depend on the goals of the application, seismic noise conditions, and the properties of earthquake signals at a given location. Each seismic site requires detailed study, and only experience will enable you to determine optimal trigger settings.

In general, by proper adjustments of the STA and LTA duration, you can make triggering more or less sensitive to certain type of earthquakes, and less sensitive to the type of seismic noise at a given site.

Short Time Average Window (STA) Duration The short time average window (STA) duration works as a kind of filter. The shorter it is, the more sensitive the STA/LTA trigger will be too short and high frequency signals of local earthquakes. It will also be less sensitive to distant earthquakes. The longer the STA duration, the less sensitive the trigger will be for short local earthquakes. By changing the STA duration you can prioritize to some extent between distant or local events.

On the other hand, by increasing the duration of the STA window, for example, triggering becomes less sensitive to the common spike-type of man-made seismic noise, and vice versa. For regional events, a typical initial value of STA duration is 1 second, for local events shorter values of around 0.3 s are most commonly used.

Long Time Average Window (LTA) Duration By setting the LTA window, you can make recording more or less sensitive to regional events with typically slowly emergent onset waves. In the case of a short LTA duration, you allow the LTA value to follow the slowly increasing amplitude of emergent seismic waves and this results in a decreased STA/LTA ratio at the moment when the S waves arrive, thus reducing trigger sensitivity. In the opposite case, using a longer LTA duration, the sensitivity to emergent earthquakes will increase because the STA/LTA ratio will not be influenced so rapidly by the emergent seismic signal. On the other hand, a short LTA will adjust recorder sensitivity to relatively fast changes in "continuous" man-made seismic noise during night-to-day transitions of activity in urban areas. Natural seismic noise (marine noise) changes much more slowly and therefore much longer LTA durations can be used.

An LTA duration of 60 seconds is a good initial value. A shorter LTA duration is needed to exclude emergent regional events or to reject changing man-made noise at the site.

The recorder has a modified version of a "frozen" long time average window (LTA) during events. The LTA value is, to the first approximation, not allowed to change (increase) during an event. This prevents truncation of coda waves due to the LTA increasing too rapidly during events (and thus decreasing STA/LTA ratio too rapidly). However, this "freezing" is not complete, allowing the trigger algorithm to prevent the unit from being permanently triggered by a rapid increase in seismic noise.

STA/LTA Trigger Threshold Level The optimal STA/LTA trigger threshold ratio depends mainly on seismic noise conditions at the site. Higher noise levels, particularly the man-made kind, require higher values. Higher values result in fewer false triggers but miss more earthquakes. Lower STA/LTA triggers make the station more sensitive but cause more false triggers to be recorded. False triggers and missed events are an unavoidable reality when recording seismic signals in event triggered mode.

An initial setting of 4 for the STA/LTA ratio is common for relatively quiet seismic sites. Higher values of 8 and above are required at less favorable sites where man-made seismic noise is present.

STA/LTA De-Trigger Threshold Level The STA/LTA de-trigger threshold level (along with the post-event time parameter) determines when the recording will terminate. The de-trigger threshold is determined through a selectable STA/LTA de-trigger threshold percentage parameter and the current STA/LTA trigger threshold value. For example, a STA/LTA de-trigger threshold level of 4 at an STA/LTA trigger threshold level of 8 is obtained by selecting the STA/LTA de-trigger threshold percentage of 50%.

The STA/LTA de-trigger threshold level determines how well the coda waves of recorded earthquakes will be captured. To preserve complete coda waves, low values are required. On the other hand, if one is not interested in coda waves, significant savings in memory are possible if high values of STA/LTA de-trigger threshold levels are used. An STA/LTA de-trigger threshold percentage of 100% is the highest value possible. It makes the STA/LTA trigger threshold level and the STA/LTA de-trigger threshold level equal.

In general, the noisier the site, the higher the value of the STA/LTA de-trigger threshold level that must be used to prevent continuous, repeated re-triggering. This danger is particularly high at sites heavily polluted by man-made seismic noise.

The recorder will always use an STA/LTA de-trigger threshold level of at least 1.2. For example, if you select a 10% de-trigger threshold with the STA/LTA trigger threshold level of 4, you would theoretically get 10% of 4 or 0.4 and the unit would be continuously triggered. However, the recorder automatically uses a minimum STA/LTA de-trigger threshold level of 1.2 to prevent this continuous triggering.

A typical initial value of the de-trigger threshold is 2 to 3. The percentage set must be calculated taking into account the current STA/LTA trigger threshold value. For example with an STA/LTA trigger threshold of 4, and a desired STA/LTA de-trigger threshold of 2 you would need to set an STA/LTA de-trigger threshold percentage of 50%.

Default Values STA/LTA trigger algorithm default parameters are:

- STA (short time average) window duration = 1 sec
- LTA (long time average) window duration = 60 sec
- STA/LTA trigger threshold level = 4
- STA/LTA de-trigger threshold percentage = 40%, resulting in an effective STA/LTA de-trigger threshold level 1.6

Trigger Voting Parameters Each channel can be assigned a number of votes that it may cast towards getting the system to trigger. This is called "voting." How the voting system is set up is dependent on which signals you are trying to record and which you are trying not to record. You may need some first-hand experience with the conditions at the site before you can optimize this triggering. The parameters used to set up the triggering are explained below.

Channel Weights (Trigger/Detrigger Votes) The mechanics of this are relatively simple. You select the number of votes each channel will contribute (when it is triggered) to the total number of votes required to trigger the system. Give zero votes to a channel that you do not want to affect the triggering. Give a positive number of votes to a channel you do want to contribute to the triggering. Give negative votes to a channel you wish to inhibit triggering.

Trigger Weight This is the total number of votes required to get the system to trigger.

Keyboard Votes If you want to trigger the unit from a keyboard for test purposes, give the keyboard trigger the same number of votes as the total trigger weight so that it will trigger the unit by itself (without any other channels being triggered).

External Votes This is the number of votes you assign to the external hardware trigger source. If you want all units in the network to trigger when one unit triggers, assign it the same number of votes as the trigger weight. If you want to use a combination of an external trigger with other internal criteria, set the votes appropriately.

Examples of Voting Schemes

Classic Free-Field Site: A single Etna2 with its three-channel internal EpiSensor with no other interconnected units is a classic free field installation. Each channel has 1 vote and requires only 1 vote to trigger. Any channel could trigger the system.

Interconnected System: For example: two Etna2s with internal EpiSensors in a building; one in the basement and one on the roof. The units are interconnected. Initially we set 1 vote for each channel and the external trigger and 1 vote to trigger. We find that the unit on the roof often triggers the system due to the building swaying in the wind. We can compensate for this by changing the voting of the roof unit so that its three accelerometer channels have 1 vote while the external trigger has 3 votes. We set the trigger weight to 3 in this unit. Now all of the channels on the roof must trigger simultaneously to record or the unit must be forced to record by the unit in the basement triggering.

In conclusion, from these examples we can see the flexibility of the triggering options and some of the ways this flexibility can be used in particular installations.

3.4 Timing System

Time keeping is an important part of the Etna2 and is performed at a number of levels:

- Etna2 data time is set at data acquisition start by sending current system time to the data collection software. This time is used to time stamp data until a better time source is available such as GNSS (GPS) or PTP (Precision Time Protocol). GNSS and PTP time sources are very accurate – typically much less than a microsecond – and are used to time-stamp acquired samples, telemetry and data files.

- Time is set and maintained in the main processor based on time received from an NTP server (network time protocol) by communicating with any of several default internet time servers. You can also specify the NTP server the Etna2 will use by using the Linux script timeconfig.

  NOTE: The NTP protocol DOES NOT provide sufficient accuracy or determinism for precise data acquisition timing. It is generally used ONLY to set the Operating System time and to "pre-load" the time used by the data acquisition system until "good" time can be acquired by GNSS or PTP.

- Time is saved in the system's internal clock periodically and will maintain time without any external power for several days. This time will be restored at reboot in absence of any other time.

- Should the internal clock time source be lost, the time at boot will be the time of the last proper shutdown.

- Time can be set manually from the Linux date command

3.4.1 Data Time vs OS Time

It is important to clarify that Data Time (the time-stamps applied to the data samples) and OS (Operating System) Time are close to each other, but are not the same thing. OS Time is only required to be "reasonably close" to Data Time so that OS time stamps of created files and log entries are reasonably close to reality. How close OS Time is to Data Time varies depending on the timing source from a few milliseconds of error to a few seconds.

Data Time is as close as possible to absolute time. Again, this depends on the timing source. Accurate time sources such as GNSS or PTP will typically align Data Time to less than a microsecond from absolute time. Less accurate time sources such as undisciplined NTP may only be accurate to within a few tens of milliseconds.

NOTE: Kinemetrics *DOES NOT* recommend using NTP for data timing.

3.4.2 Disciplined Oscillator

Accurate time sources in the Etna2 basically operate by having a reported time value and an accurate 1Hz signal. For example, with GNSS a packet is received every few seconds that reports the current time. This is paired with a highly accurate 1Hz signal of typically +/-70 nanoseconds from absolute time.

The Etna2 uses this accurate time to control its internal 1Hz signal to follow the external 1Hz by adjusting the TCXO DAC. The values of the TCXO DAC and the "drift" (timing error) are available as SOH (State of Health) values or streams.

3.4.3 Time Quality

The Etna2 will use available information about the timing system to determining a Time Quality value. This value can be useful in determining the trustworthiness of the timing. This value varies from 0-100%. Values are as follows:

- 0 - No timing source used
- 10-60 - Time source lost. Degrades by 1% every 10 minutes.
- 80 - Time source identified, but not trusted yet.
- 90 - Time source producing time, but not locked.
- 100 - Time source locked.

3.4.4 Timing Options

The Etna2 has timing options that allow for "outstanding" timing accuracy for a range of applications.

The list below includes timing options that are functional and available now in the Etna2 generation of instruments. For each option we list description, application, infrastructure, maximum distance, and accuracy.

3.4.4.1 GNSS (GPS) Internal

Description: Uses internal GNSS (GPS) engine to supply accurate timing for an individual Etna2. This is the default timing selection since it is often the most accurate and most cost-efficient solution.

Application: Free field installations or installations where GNSS antennas can be run for each unit.

Infrastructure: GNSS engine is built into the Etna2. GNSS cable and antenna required.

Maximum distance: 50m antenna cable, longer with specialized extenders.

Accuracy: Typically 1us or less assuming antenna has good sky view.

3.4.4.2 PTP Slave

Description: Uses the PTP (IEEE-1588v2) protocol. Gets time from a provided (local) PTP master.

Application: PTP allows for accurate timing over local Ethernet networks where a PTP master is available. The PTP master can be a 3rd party commercial PTP time server or can be another Etna2 or an Obsidian acting as the PTP master.

Infrastructure: Requires a network connection to the PTP master, as well as the PTP master itself. Timing is significantly improved if the PTP master and any intermediate Ethernet switches are hardware PTP compliant (see note).

Maximum distance: 100m Ethernet segments, longer with repeaters or fiber-optics.

Accuracy: Using hardware PTP compliant servers and switches, typically less than 1us of the PTP master. When not using hardware compliant PTP hardware it can range from several microseconds to completely unusable.

3.4.4.3 PTP Master w/ GNSS

Description: Disciplines the local unit via GNSS and shares out this timing to one or more PTP slaves on the local network.

Application: Use in places where units can be network interconnected, and GNSS is available to the PTP master (such as the top floors of a tall building).

Infrastructure: Requires network connection to one or more PTP slaves. Use of hardware PTP compliant hardware recommended.

Maximum distance: 100m Ethernet segments, longer with repeaters or fiber-optics.

Accuracy: GNSS accuracy for master unit.

Notes:

- Maximum distance for Ethernet over CAT-5 or CAT-6 cable is 100m. This can be extended by adding Ethernet “repeaters” (such as switches) to add segments. Note that repeaters added should have back-up power.
- Fiber-optic converters may be used to significantly extend Ethernet distances. Note that there are several fiber-optic Ethernet standards ranging from about 400m to as much as 40km maximum distances.
- PTP infrastructure is available commercially (time servers, switches, etc.) These basically come in two variants:

  - Hardware based PTP and Software based PTP. Hardware based PTP is much more accurate, on the order of less than 1us.
  - Software based PTP is much less accurate and is more affected by network traffic and so may not be as deterministic. Software based PTP solutions are typically in the order of several to tens of microseconds of inaccuracy but can be worse.

- When using PTP, there should only be ***ONE*** PTP master on the local network.
- PTP hardware and software is built into the Etna2 and is hardware PTP compliant.

3.4.5 Using an NTP Server

The Etna2 defaults to using public NTP servers at pool.ntp.org. To use these servers, you must have DNS enabled in your network configuration.

To configure a different NTP Time server, use the "timeconfig" script from Linux:

The timeconfig script operates as follows:

```
# timeconfig
System time is: Thu Dec 11 15:37:06 UTC
2014 Do you want to set the system time
manually?
(Y/N)? > n
Do you want to configure NTP servers?
(Y/N)? > y
IP address or host name of the Primary NTP server
> www.myntp.com
IP address or host name of the Secondary NTP server
(optional) >
Settings to be saved:
Primary : www.myntp.com
Secondary :
Tertiary :
Quaternary :
Press [Enter] to Continue, or [Ctrl-c] to Quit.
```

3.4.6 Acting as an NTP Server

The Etna2 can act as an NTP server for your network. This is useful when you have other non-Kinematics equipment that needs a time reference and when NTP is good enough for that purpose.

Whenever the Etna2 is configured to get time from GNSS (whether configured as GNSS only or configured as PTP Master with GNSS) then the Etna2 will automatically act as an NTP server. No additional configuration is required - simply give your other equipment the IP address of the Etna2 as the NTP server's address.

Note that the NTP time provided by the Etna2 is only as good as the definition of the NTP protocol allows.

3.5 TCP/IP Primer

3.5.1 Terminology

IP Address – The address of a device that uniquely identifies it so it can be found on a network. Typically this is a four part numeric address such as 192.168.1.1. Each part ranges 0 to 255.

Network – A collection of devices which can communicate with each other by knowing each others' addresses.

Internal Network – An internal network (and the devices in it) cannot normally be directly accessed from the outside world, but they MAY be allowed to access the outside world. If you have one computer and a router, you have an internal network. Internal networks typically have the first three parts of the address the same – for example 192.168.1.x will be used for all devices in the network, with only the "x" part varying.

Router – Equipment that bridges between internal networks and the Internet. A router will view devices on the internal network with one range of addresses, and will present a single address to the Internet. A router also serves to restrict access to the internal network. This restriction/protection is known as a firewall.

Switch – Allows you to connect multiple networked devices together. Many routers include several open sockets allowing them to also act as a switch.

Hub – A "dumb" predecessor to the switch. Do not use a hub when the network includes different speed devices because it will bring all devices on the network down to the speed of the slowest device.

Crossover – When connecting two devices directly together without a switch (such as a Etna2 and your PC only), use a crossover cable or adapter to allow the direct connection. (Think null modem for Ethernet)

Gateway – This is the address where all external address requests are sent. In most internal networks, this will be the address of the router so that the device can access the Internet when needed.

Netmask – Defines which addresses are inside the network and which are outside the network. 255.255.255.0 (class C) is typical, meaning that only the last part of the address varies within the network. Everything else is outside.

Services or Ports – A single device may have one to several thousand different services running on it. Services can include things like web services, e-mail, and file transfers among many. Each service runs on a numbered port at an IP Address. These port numbers are somewhat standardized.

Client vs. Server – In communication over TCP/IP there is generally a Server (the one providing the service) and a Client (the one using the service). Devices can act as both. They may, for example be a Client for web services when opening a web browser and may at the same time be a Server providing services such as file storage.

DHCP – A Service that automatically assigns IP Addresses. Typically, your ISP assigns an Internet address to your router and your router assigns an internal address to your device.

DNS – A Domain Name Server is a service on the Internet that translates names, like www.kmi.com into a numeric address. Usually the DNS is provided by your ISP and the address of the DNS server is forwarded by DHCP.

DDNS - Dynamic DNS. This is a service that assigns your router a URL (like www.xxx.com) that “follows” your numeric IP address as it is dynamically changed. DDNS is usually handled completely by the router with the router “pinging” the DDNS servers to report the current address. DDNS services range from free to commercial services and have varying amounts of latency (the time between when your numeric IP address changes and when the URL is updated to match).

URL - Uniform Resource Locator. This is a name such as www.kmi.com that is equivalent to a numeric IP address.

3.5.2 Addresses

A device’s address may be static or dynamic. A dynamic address is the most common, with another device (a DHCP server) assigning the addresses on request.

Dynamic addresses are convenient because they are managed automatically and don’t require the involvement of System Administrators to assign them.

The problem with dynamic addresses though is that they are just that – dynamic. This means that their address is uncertain and can change from one day or one minute to the next.

The typical dynamic connection has a router that gets an IP Address from the ISP. The router translates the addresses within your internal network to the outside address from the ISP. When you surf the web or send e-mail this translation is unseen. However, if you wanted to access your computer from work or from a coffee shop it can be difficult because you cannot be sure of the IP Address assigned to your router (and thus your device) at the moment.

In order to access a device remotely, you need a well known or static address. Most companies and organizations have static addresses because they must be routinely accessed from the Internet. Static addresses cost more.

3.5.3 Clearing the ARP Cache

When you access a network device, your computer will internally associate the IP address used with the device's MAC address. Generally, this helps make network activity more efficient.

However, if you set up multiple Etna2 units using the default static IP address of 192.168.222.245, your computer may have problems when the MAC address "changes" as you talk to additional units (one at a time of course) that all have the same IP address.

The solution is to delete the entry from the ARP Cache (ARP is Address Resolution Protocol) before talking to the next unit. On a Windows PC this can be done by opening a command console with administrative privileges and typing the command:

```
arp -d 192.168.222.245
```

3.5.4 Some Guidelines

Typical internal addresses are 10.x.x.x, 192.168.x.x, or 172.16.x.x thru 172.31.x.x. These addresses should only be used within an internal network and should NEVER be exposed directly to the Internet.

Using 0 or 255 in the final part of an IP address has special meaning and should not be used for any normal address. So, for example do not use:

- 192.168.1.0
- 192.168.1.255
- 10.0.1.0
- 10.0.1.255

When using devices within an internal network, use dynamic addresses whenever possible. Assigning static addresses has the potential for conflict with other devices on the network and should only be done after consulting with the System Administrator.

Assigning the same static IP address to multiple units can cause problems as your network may remember the address as belonging to a previous unit and get confused (even if they're not connected to the network at the same time). Use unique addresses if possible. If you have configured a standalone Etna2 as DHCP server, you should disable this functionality before you connect the Etna2 to your internal LAN or you may cause yourself networking problems due to the conflict in address assignments.

3.5.5 Typical Configurations

- Etna2 products are configured as DHCP clients out-of-the-box. This means that they will try to get an IP Address from your network. To determine which address has been assigned, your best bet is to use the Etna2's Linux serial console connection and the Linux command "ipaddr eth0".

  Alternatively, the following initial setup methods can be used:

  1. Using a USB device cable. This will present the Etna2 to your PC as a virtual COM port over USB. Thus way, you can simply connect to the Etna2 via PuTTY and log in. You may have to consult the device manager to determine the COM port assigned by Windows. Flow control and baud rates are meaningless and do not need to be set when using a virtual COM port.
  2. Static IP. From the factory, the Etna2 is configured as a dynamic (DHCP) IP and simultaneously as the static IP of 192.168.222.245. Either may be used until you run "netconfig" to specifically set up your network. Since 192.168.222.245 is a static address, do not connect more than one "fresh" Etna2 to your network at one time.

  See Clearing the ARP Cache

- When the Etna2 will be deployed using a router (such as in a structure using a DSL connection), you may let the Etna2 obtain an address from the router or you may assign a static address within the internal network. The outside address of the router will either be statically assigned or dynamically assigned by the ISP depending on the service purchased. The Etna2 is accessed externally using the address of the router. It may be necessary to "poke holes" in the firewall to allow external access to some services.

- If the network is local only (no router used), use static addresses within the internal network.

- If the Etna2 is standalone and you will occasionally connect a computer (a laptop?) to configure the unit or obtain data, then configure the Etna2 to have a static address (usually 192.168.9.1) and to act as a DHCP server. This way, you need only connect your laptop to communicate with the Etna2. The Etna2 will assign the laptop an address and you will not have to manually configure your laptop.

The Etna2's IP address is configured using the "netconfig" script from Linux.

3.5.6 Etna2 Services

By default, the following services are enabled:

- PING
- SSH
- HTTP
- NTP
- POC

By default, the following services are disabled:

- FTP
- TELNET
- TFTP

3.5.7 Further

Distance limitations – Ethernet is limited to a standard distance of 100 meters. It is possible to push this limit a little bit, but there are no guarantees. To extend the limit, you need a powered Ethernet repeater, or a powered inline switch.

DSL connections are asymmetric – A typical DSL line has different speeds for upload than for download. These connections are designed for web surfing. They are typically 8X faster on download than upload. So you must understand that although the connections are cheap, your 3Mb connection is actually only a 375Kb connection when you upload, such as streaming real-time data or sending recorded data back to the data center.

Internet security is a complex topic. The gist of it though is this:

- SSH (which includes SFTP) allows secure logins and file transfers over the internet.
- TELNET is totally "in the clear" meaning that anyone watching can see exactly what you type, including passwords. It should generally NOT be used over the Internet.
- FTP or TFTP is also sent in the clear, but can be useful. For example, setting up an FTP Server at a data center can be a useful and easy way to upload the data from your equipment. Although not inherently secure, you can easily configure most FTP Servers so that data once uploaded cannot be seen or accessed from the internet. This causes your data center to lose its appeal to hackers who might be tempted to use your system for data storage.

- Enabling the Etna2 as an FTP Server over the Internet is generally discouraged because this exposes system passwords every time that you log into FTP over the Internet. It can be useful though under some conditions such as:
    - When the unit is not connected to the Internet (such as within your lab)
    - For a temporary connection where you are willing to take the risk – e.g. connect to the unit once a year to upload new firmware and then immediately disable FTP again.
    - Using a VPN or "tunnel" connection where all traffic to the unit is encrypted and protected by a wrapping layer provided by the router. This is an advanced subject and is not covered here.

An alternative to using a more expensive static IP Address is to use a Dynamic DNS (DDNS) service. This can be free, but even if you choose a commercial DDNS server that is a fee-forservice feature, it will usually be cheaper than obtaining a static IP Address if that is even possible. You can then connect to the units at their URL using the web interface, SFTP (for file transfers) or SSH for secure Linux login connections.

Additional network-centric capabilities are supported as well, including:

- Dropbox support for file uploads
- OpenVPN support
    - Includes "stealth" mode that blocks all but VPN and SSH ports
- SNMP support

For in-depth reading on TCP/IP, see RFC 2151 - A Primer On Internet and TCP/IP Tools and Utilities

Also good, but less formal is "Daryl's TCP/IP Primer", which can be found at www.ipprimer.com

3.6 File Management

Basic file access is done through the web interface. To see recorded files, select Recorded Files from the menu. You'll see:

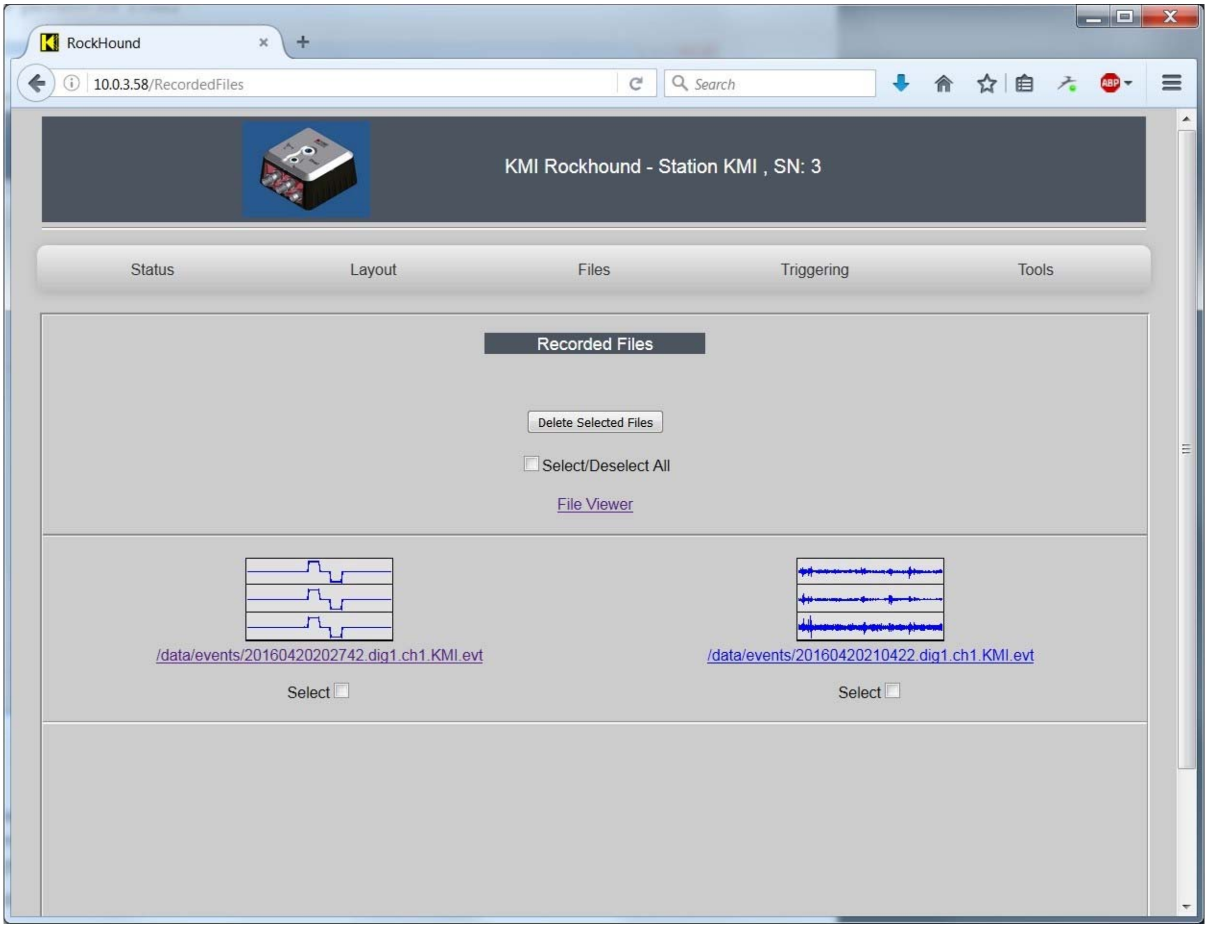


Figure 15: Recorded Files

Each of the thumbnail pictures shown on the right represents one recorded file. These pictures are small files for fast download and display. They show only enough detail to help you distinguish which files are sensor tests, meaningful triggers, or useless noise data.

To see a bit more detail, you can click on each picture to see an expanded – but still static – picture:

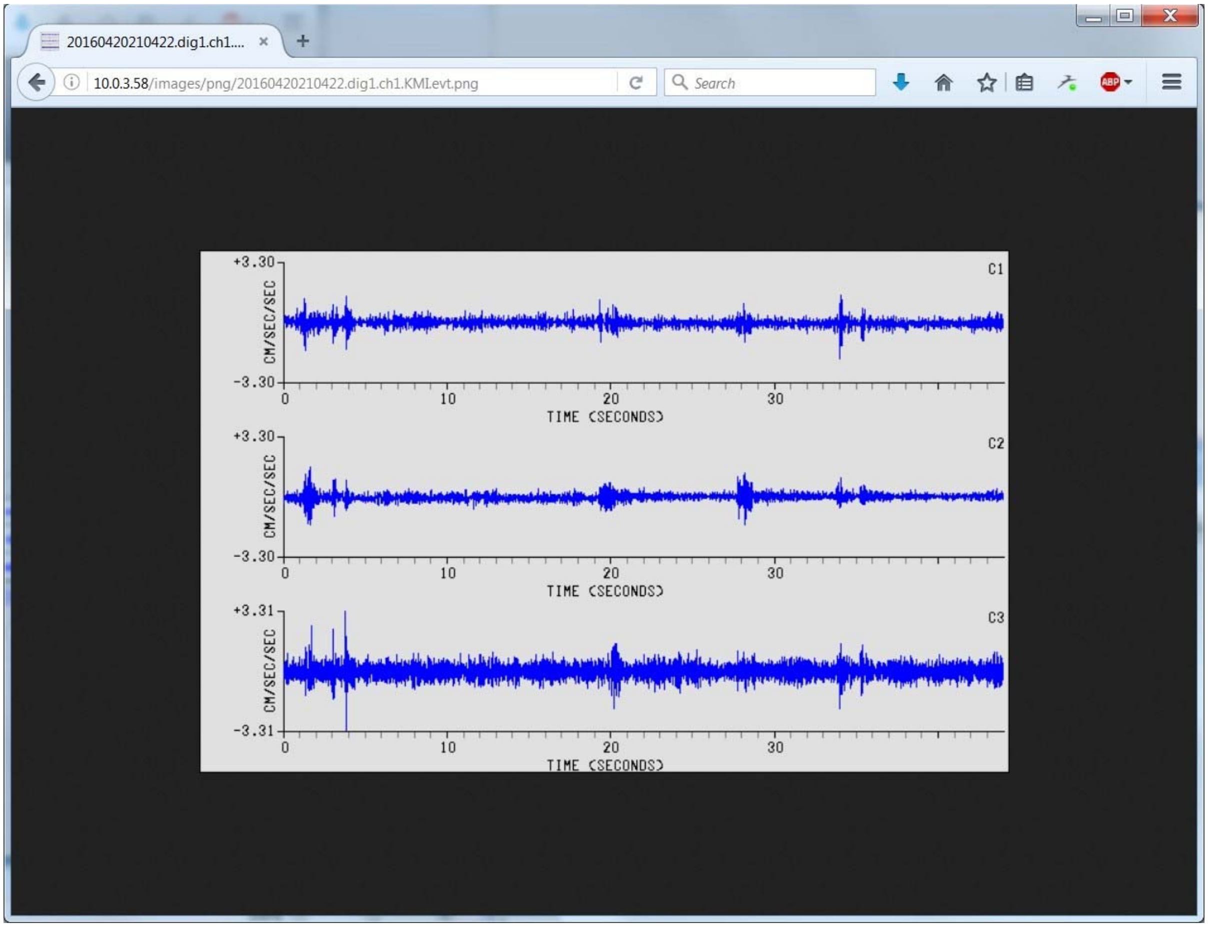


Figure 16: Recorded Files Detail

If needed, you can use your browser's zoom function (usually holding the CTRL key and scrolling the mouse wheel will zoom in and out).

Individual files can be downloaded by clicking the file name (like "aza001.evt") and selecting "save".

Files can be deleted by selecting it (or them) under the corresponding filename(s) and clicking "Delete Selected".

To manage large numbers of files (downloading and/or deleting them), you should use a program such as WinSCP, which is described later in this manual under Software Utilities Tools.

3.7 File Viewing

The Recorded Files screen described above allows you to overview your recorded files using static pictures. However, often you need to look a little closer. For this purpose, the Etna2 includes a File Viewer Application.

The File Viewer is an executable Java JAR file that can be downloaded to your computer by clicking the "File Viewer" link on the Recorded Files page. Save this file (usually FileViewer.jar) someplace convenient (like your Desktop, either directly or as a link). You only need to download the File Viewer once unless you need a fresh copy.

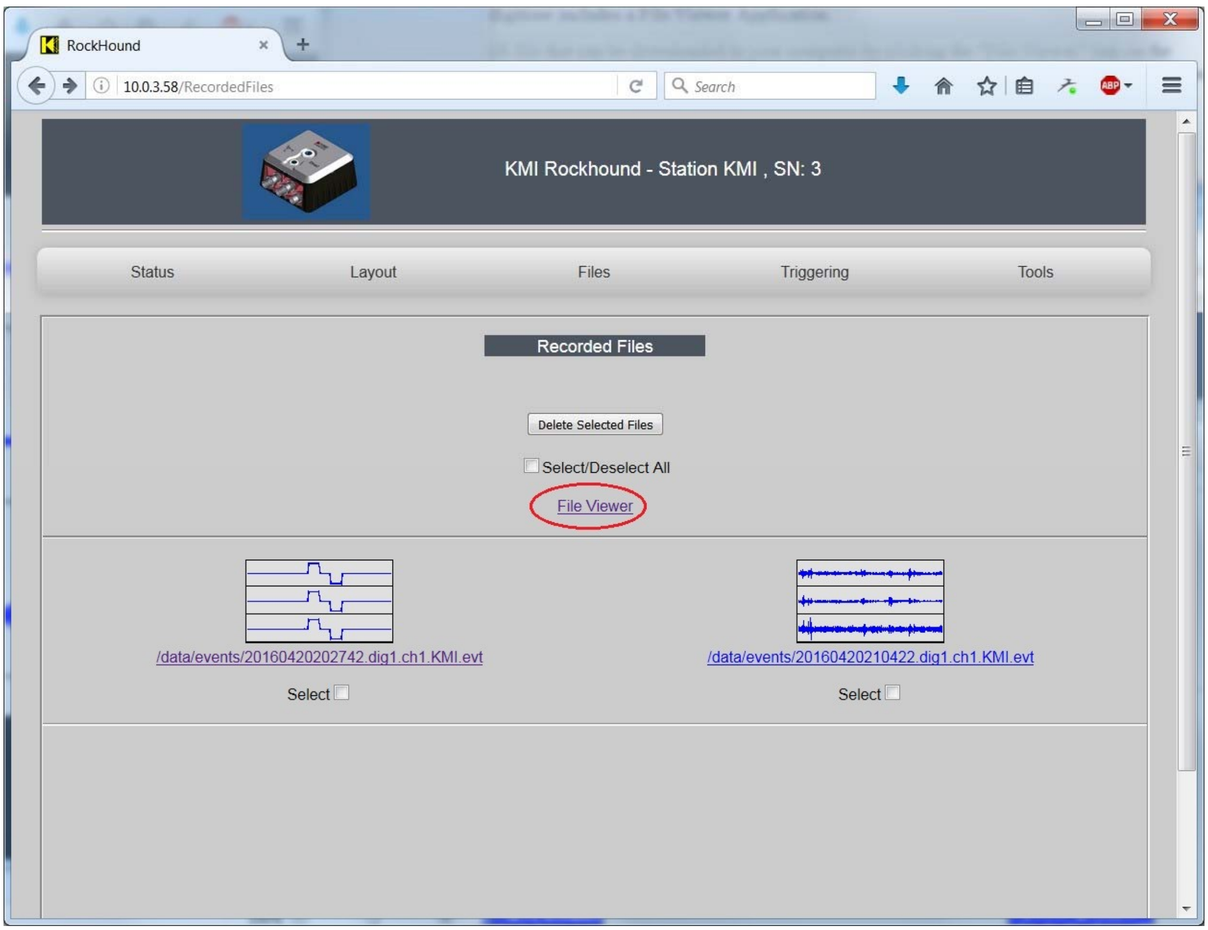


Figure 17: Downloading the File Viewer

To view a file, download it and then launch the File Viewer. From the File Viewer menu, select Open and locate and select your file.

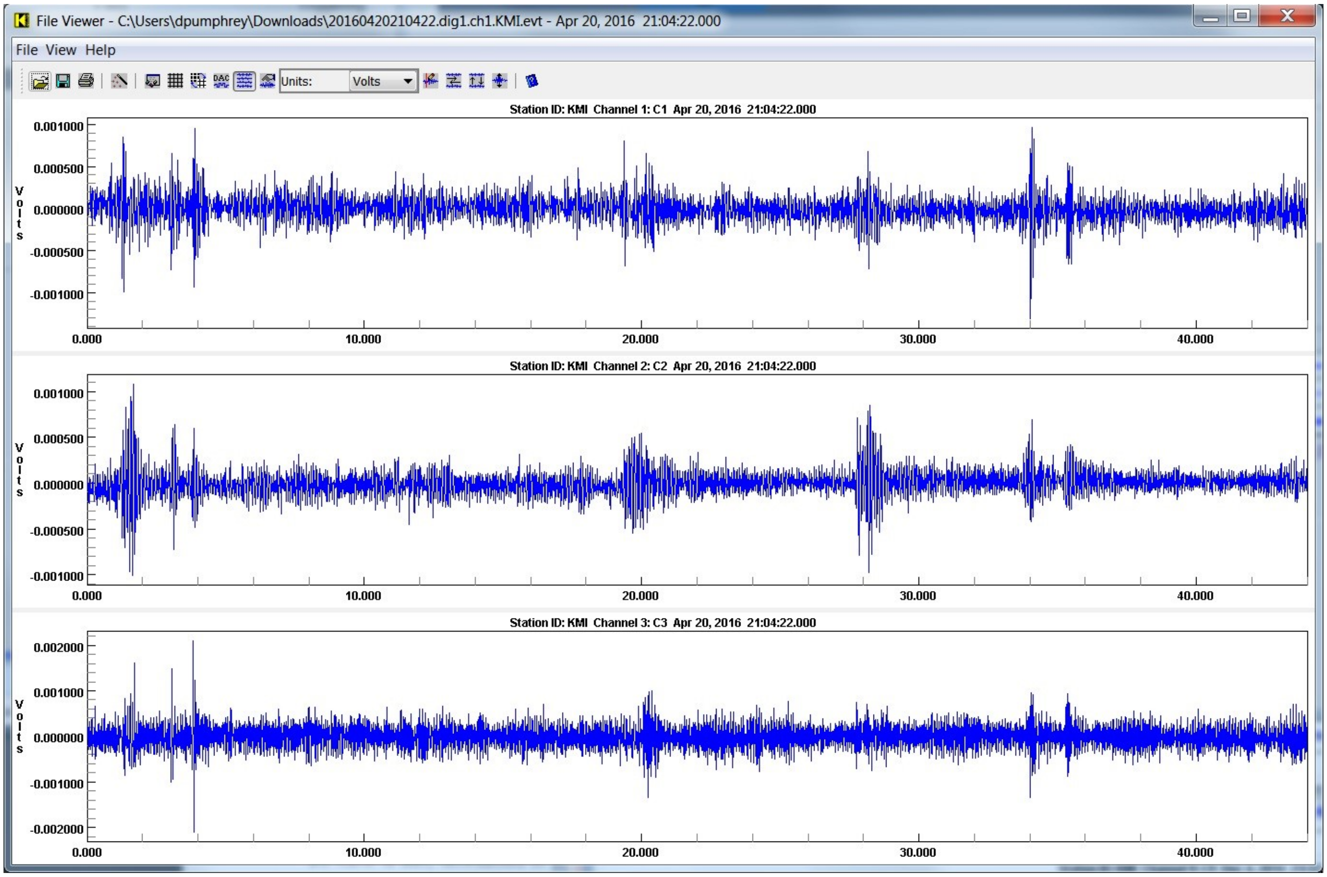


Figure 18: File Viewer

Though not covered in detail here, note that you can zoom, pan, change display units, apply grid lines, sync displays in the X and Y axes, and do many other things.

3.8 Waveform Viewing

In addition to being able to view recorded files after they've been recorded, you can also view live waveforms as the data is digitized. To do this, select Waveform Viewer:

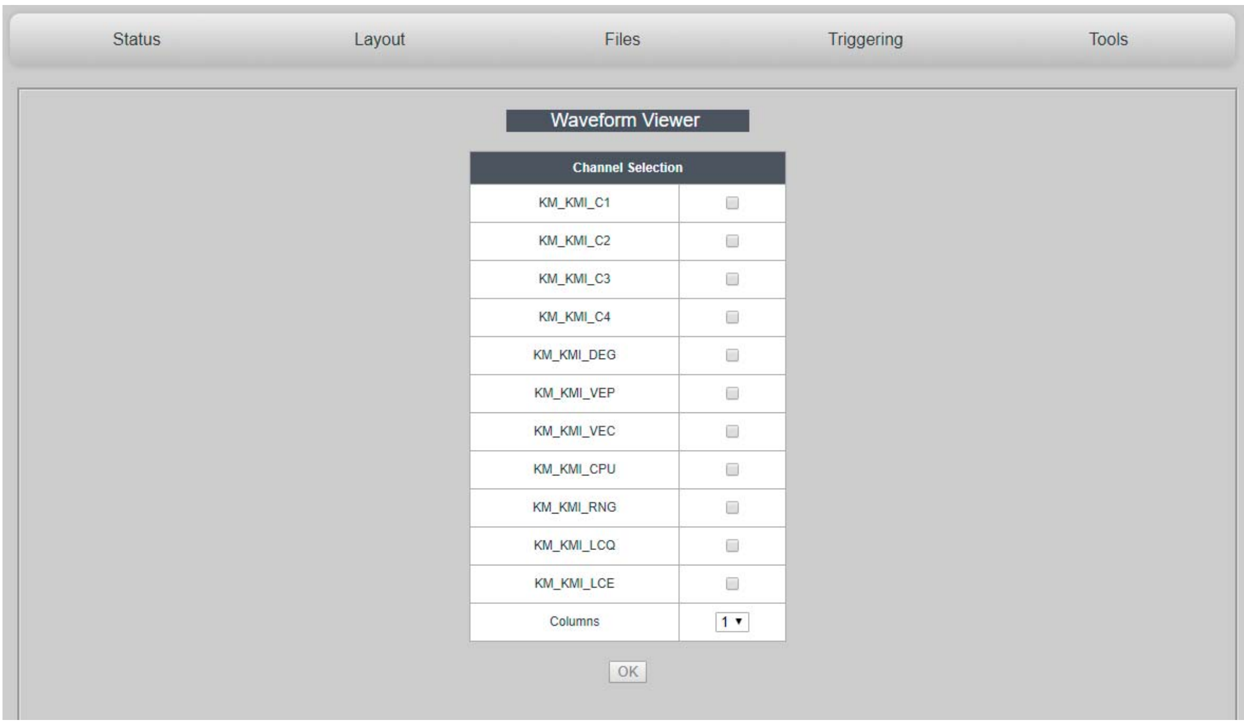


Figure 19: Waveform Viewer

Once the list is displayed, select one or more virtual channels from the list on the right (including SOH channels) and then press OK:

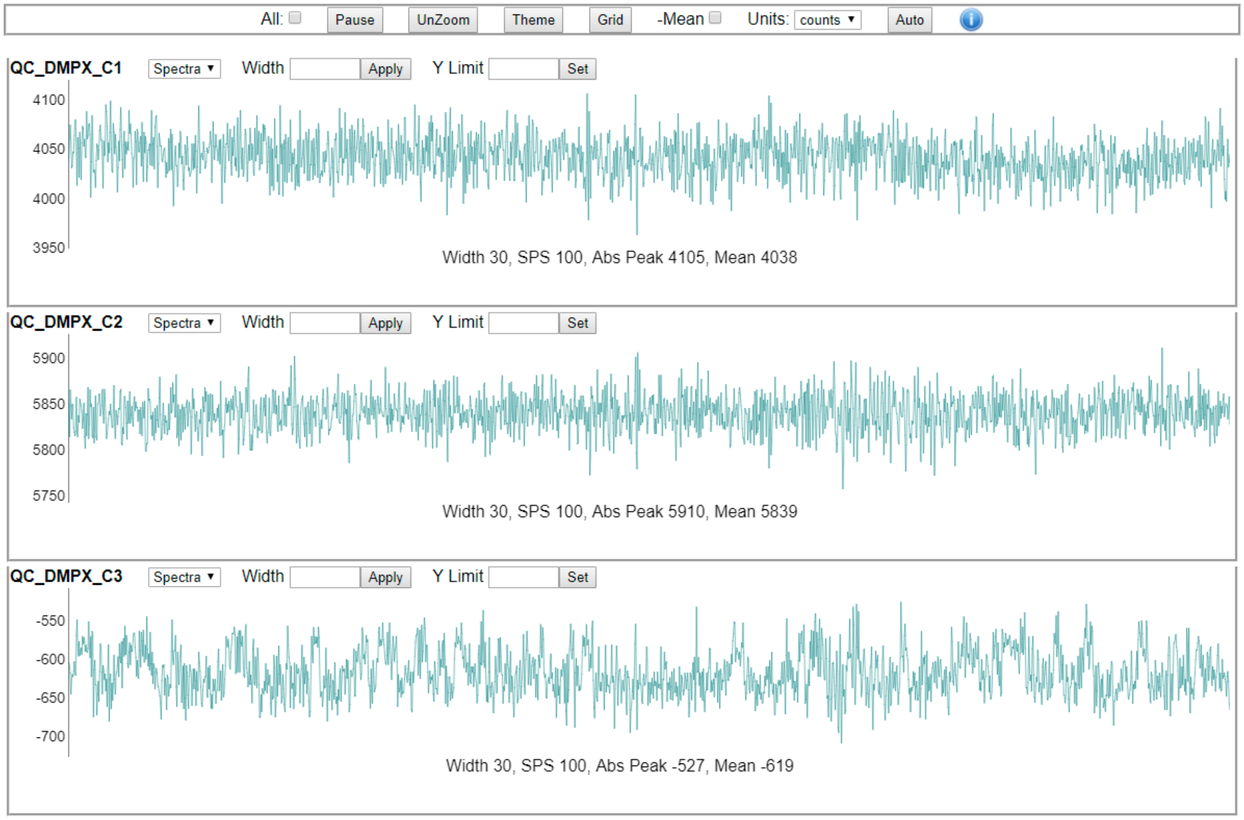


Figure 20: Waveform Display

Note that you can select the display units.

Notice the selections for live Spectra (FFT and PSD), which will produce something like this:

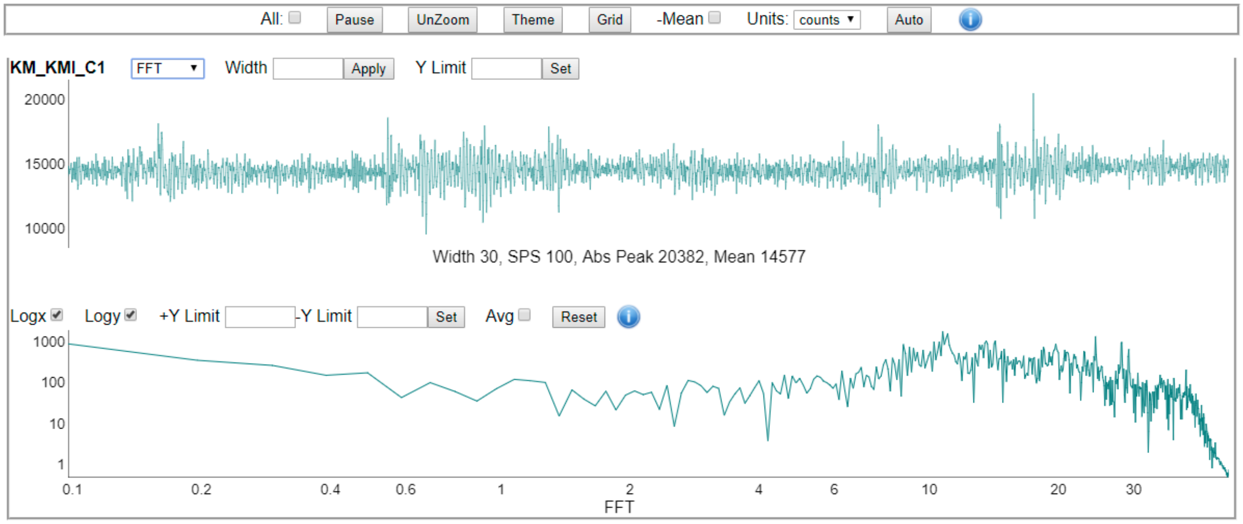


Figure 21: Real Time PSD

Chapter 4

Web Interface Overview

The web interface allows you to configure and operate your Etna2 using a web browser in many cases without installing any Kinemetrics-specific software. The web browser should be HTML 1.1 compliant (or later).

To access the Etna2 through the web interface:

Open a web browser on your PC. In the address bar of the browser, type the IP address of the Etna2 – for example 10.0.3.71. You'll be presented with a login prompt:

Figure 22: Login Prompt

Web logins use a relatively secure Digest Authentication login. Log into the unit using the username and password used by your unit. By default, the username is "rock" and the password is "kmi".

Two groups of accounts may be set up:

- Client level users can view things, but cannot make any changes.
- Admin level users have administrative access, meaning that configuration changes can be made.

Multiple web users from multiple IP addresses can log in at one time. But if more than one Admin level user tries to log in at one time, the first user gets Full Access (read/write), all others get Limited Access (read only).

Admin users who are given Limited Access can force the other Admin user to log off so that they can obtain Full Access. Client users are not affected since they only have Limited Access.

After 60 minutes of inactivity, any connected web user will be logged off. So if you forget to log out of the Web Interface, the system will log you out after this time automatically.

Type a user name and password in and press OK. This will display the Overview screen:

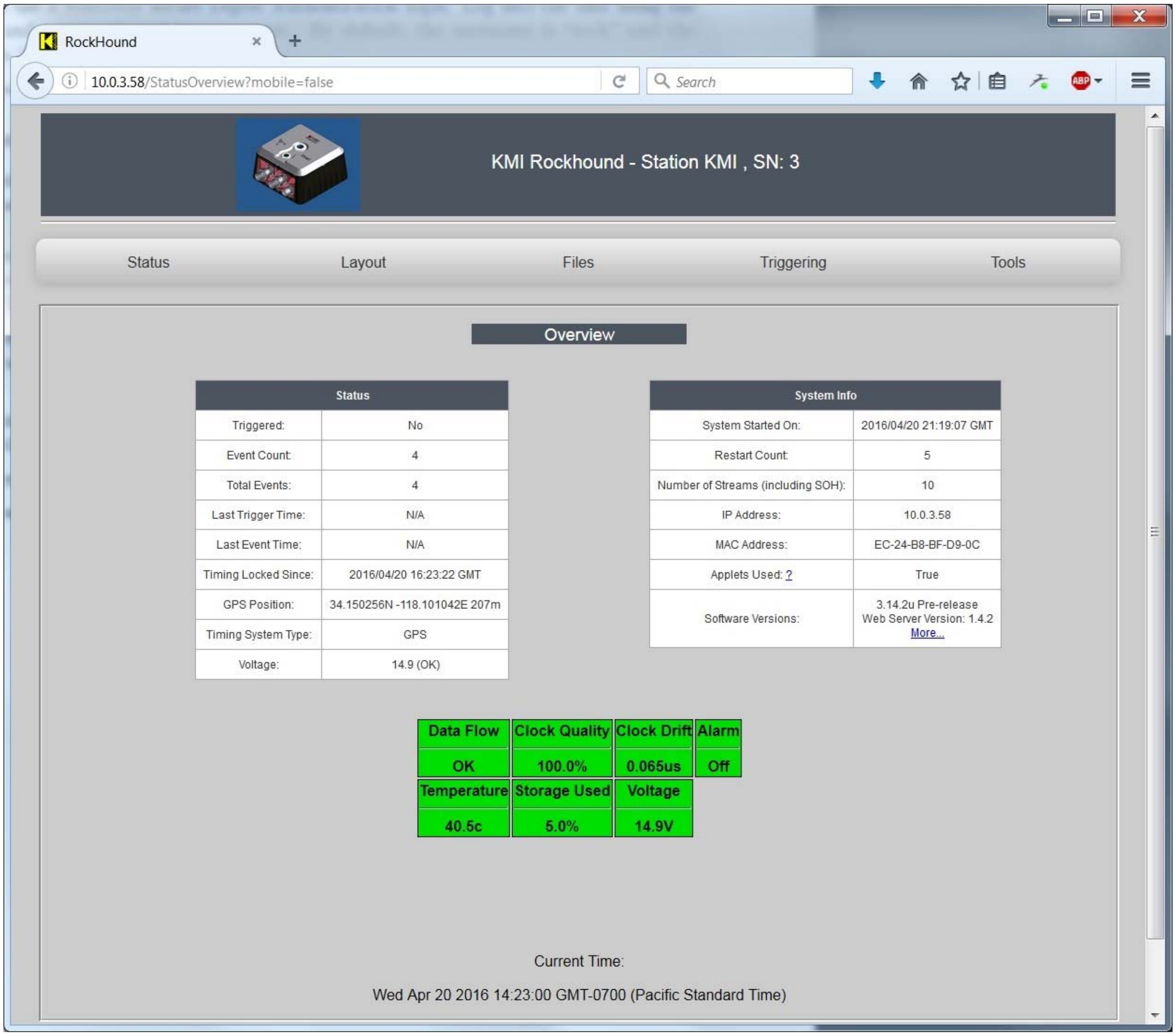


Figure 23: Overview Screen

The menu items listed across the top of the display (left to right) are:

- Status
  - Overview: The main status screen
  - Waveform Viewer: Display of real-time waveforms
  - State of Health: Access to State-of-Health displays
  - Logout: Log out of the web interface
- Layout
  - Hardware: Edit of hardware specific parameters
  - Configuration: Edit of application specific parameters

- ◦ Channel Summary: Displays a table of channel configurations
- ◦ Site Summary: Displays summary information for thr site (including network setup)
- ◦ Layout Display: Graphical display of the module layout
- ◦ Layout Wizard: Allows you to rebuild the module layout (downloaded)
- ◦ Download Config: Download the current configuration to your computer
- ◦ Apply Changes: Validate and restart with any changes made

- Files
  - ◦ Runtime Log: A display of the run time log file
  - ◦ Error Log: A display of the error log file
  - ◦ Maintenance Log: Make maintenance history changes
  - ◦ Recorded Files: A display of recorded file thumbnails
  - ◦ File Viewer: Display files interactively (downloaded)
- Triggering
  - ◦ Triggering and Sensors: Commanded triggers, sensor tests, and sensor control
- Tools
  - ◦ Help Tips: A list of built-in help topics
  - ◦ Rock Recovery: Recovery modes back to a saved configuration or factory default
  - ◦ Operation/Password: Edit operation parameters including passwords
  - ◦ Module Add: Add modules to the layout
  - ◦ Module Remove: Remove modules from the layout
  - ◦ Module Replace: Replace modules with a similar type
  - ◦ Advanced Toggles: Display for edit advanced or test modules and parameters
  - ◦ Debug Levels: Edit module debug levels (for diagnostics)
  - ◦ Edit Users: Edd/edit/delete web user names and passwords
  - ◦ Admin details: Upload and download firmware, configurations, and licenses

Hardware accesses hardware specific values such as specific IP addresses, number of channels, sensor types, voltage ranges, serial numbers, etc.

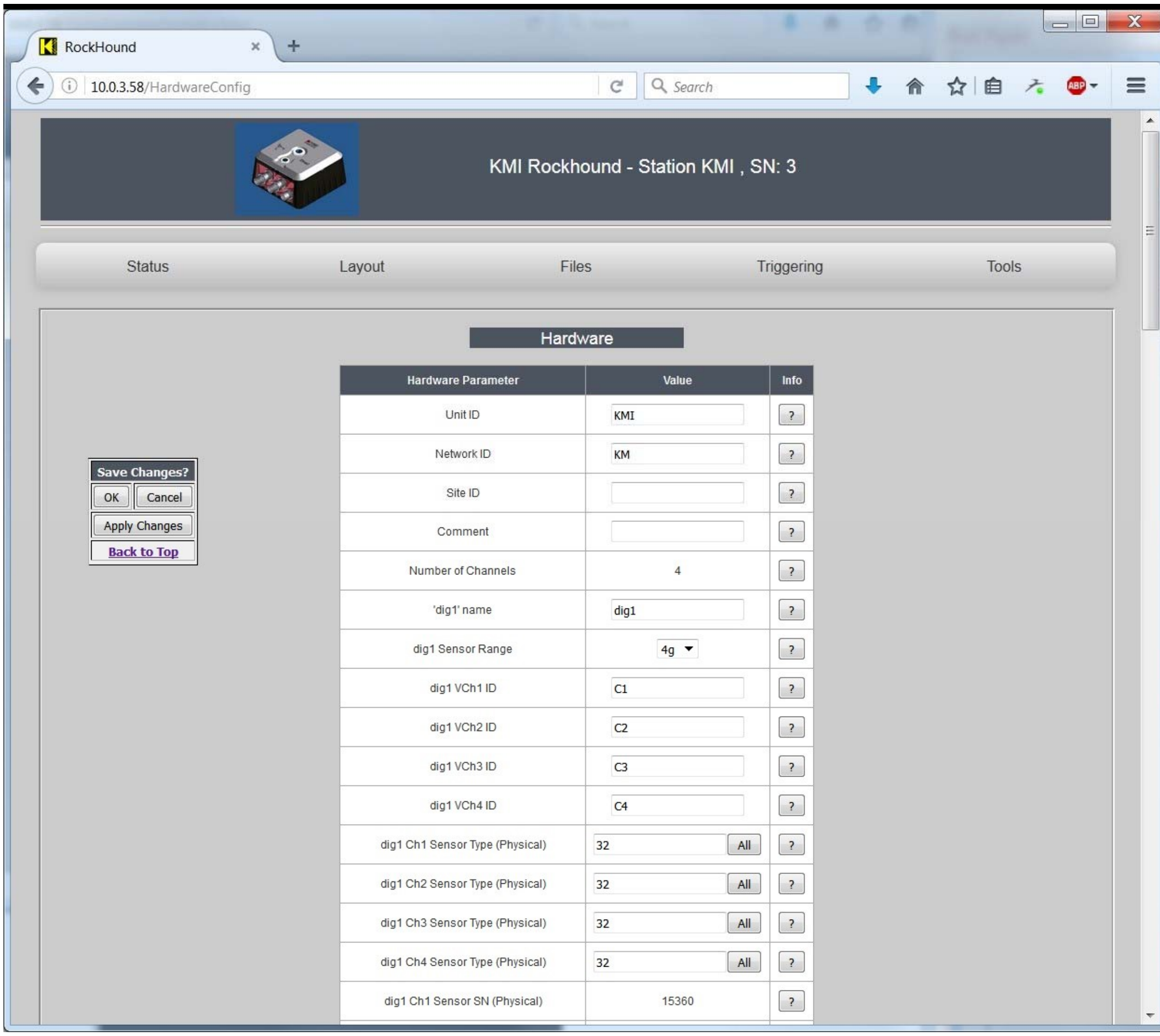


Figure 24: Hardware Configuration

Configuration accesses installation independent values such as pre-event time, post event time, sample rates, and other operational parameters.

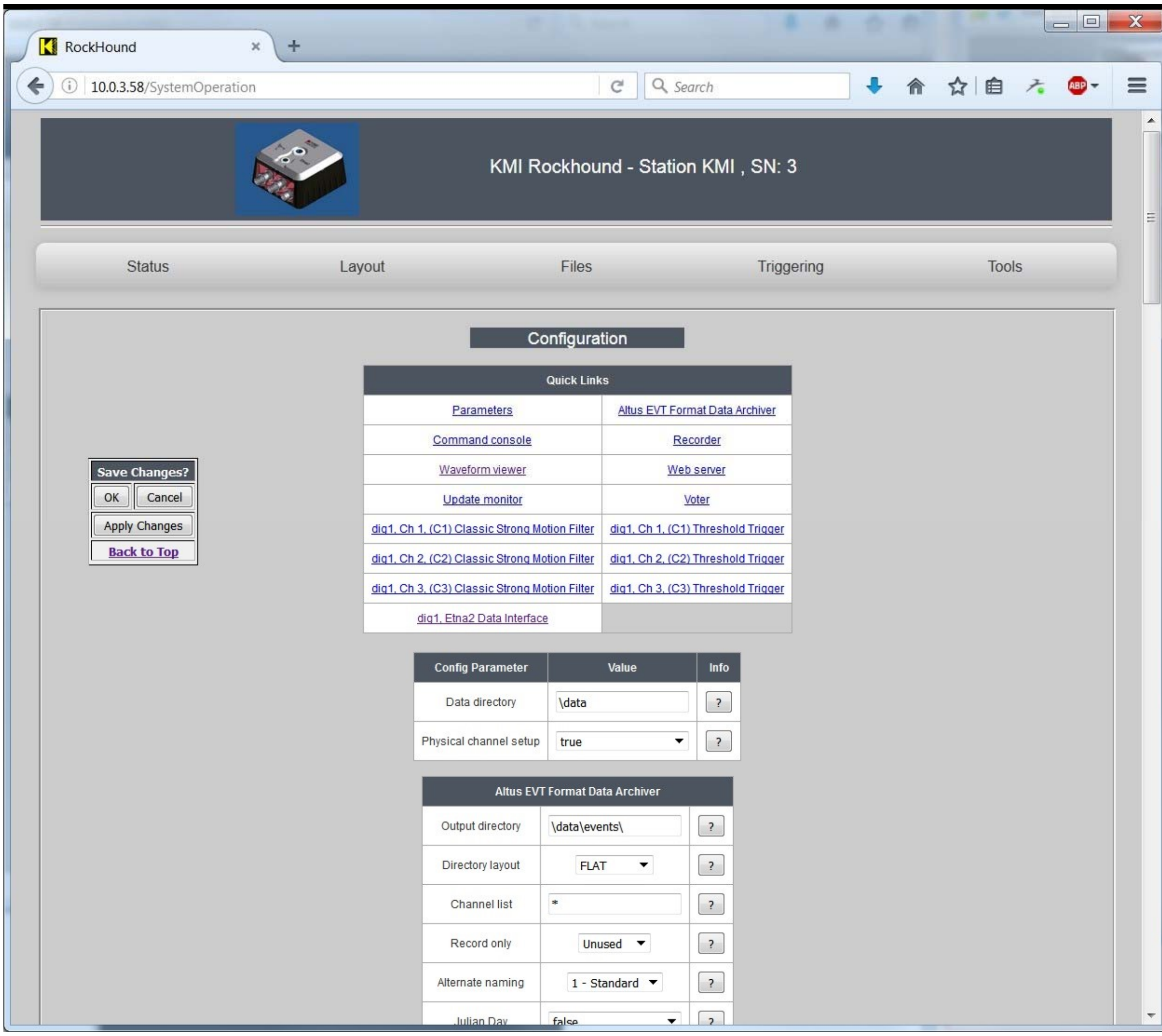


Figure 25: Configuration

The top of the Configuration page is a Parameter Map, which is a set of links to the individual parameter sets of each module. This can be faster than scrolling to find a parameter. For example, to access the Etna2 Data Interface, click on that link and you will get:

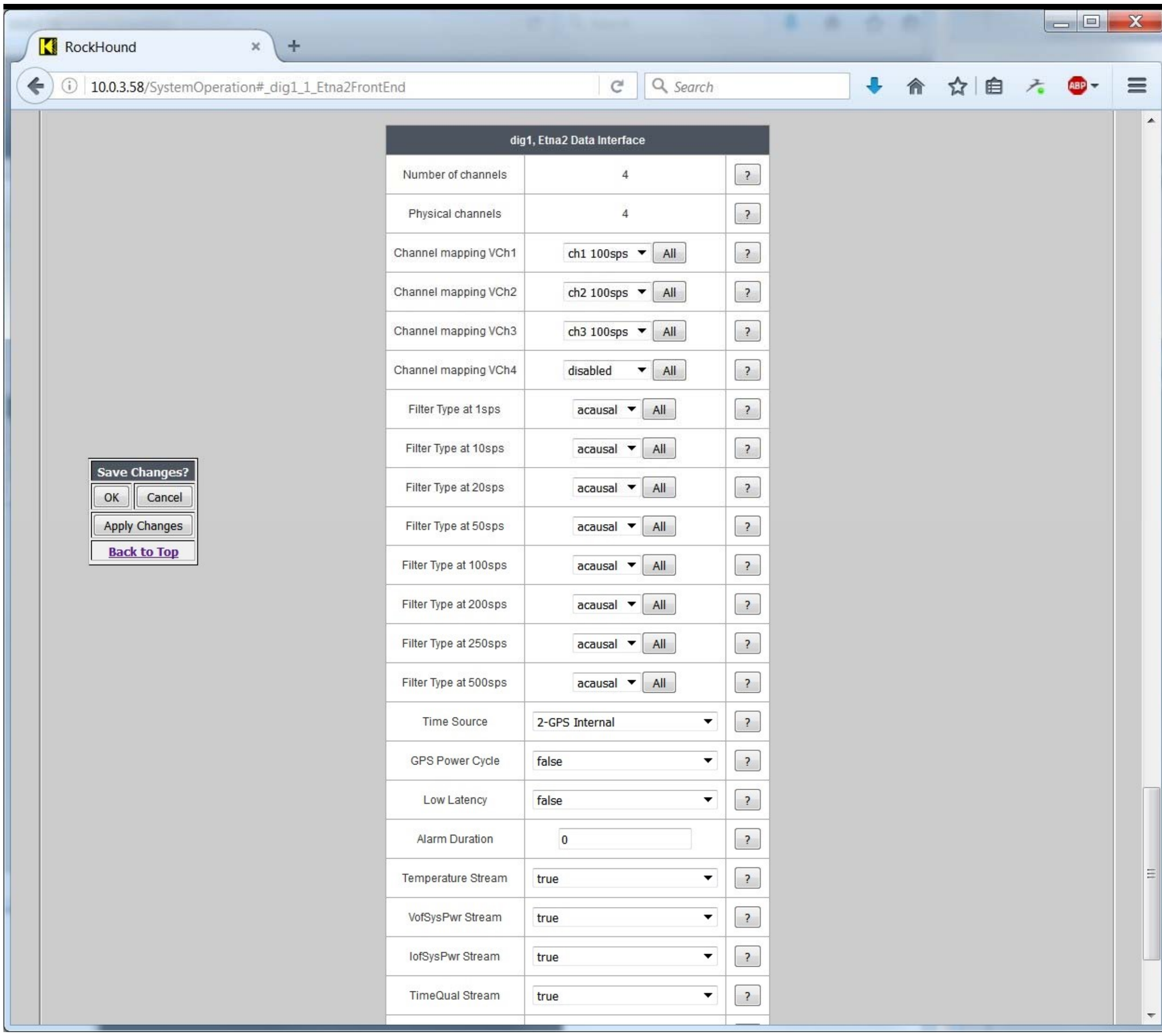


Figure 26: Module Parameter Example

Layout Display displays a picture of the current layout, along with a brief explanation of each module.

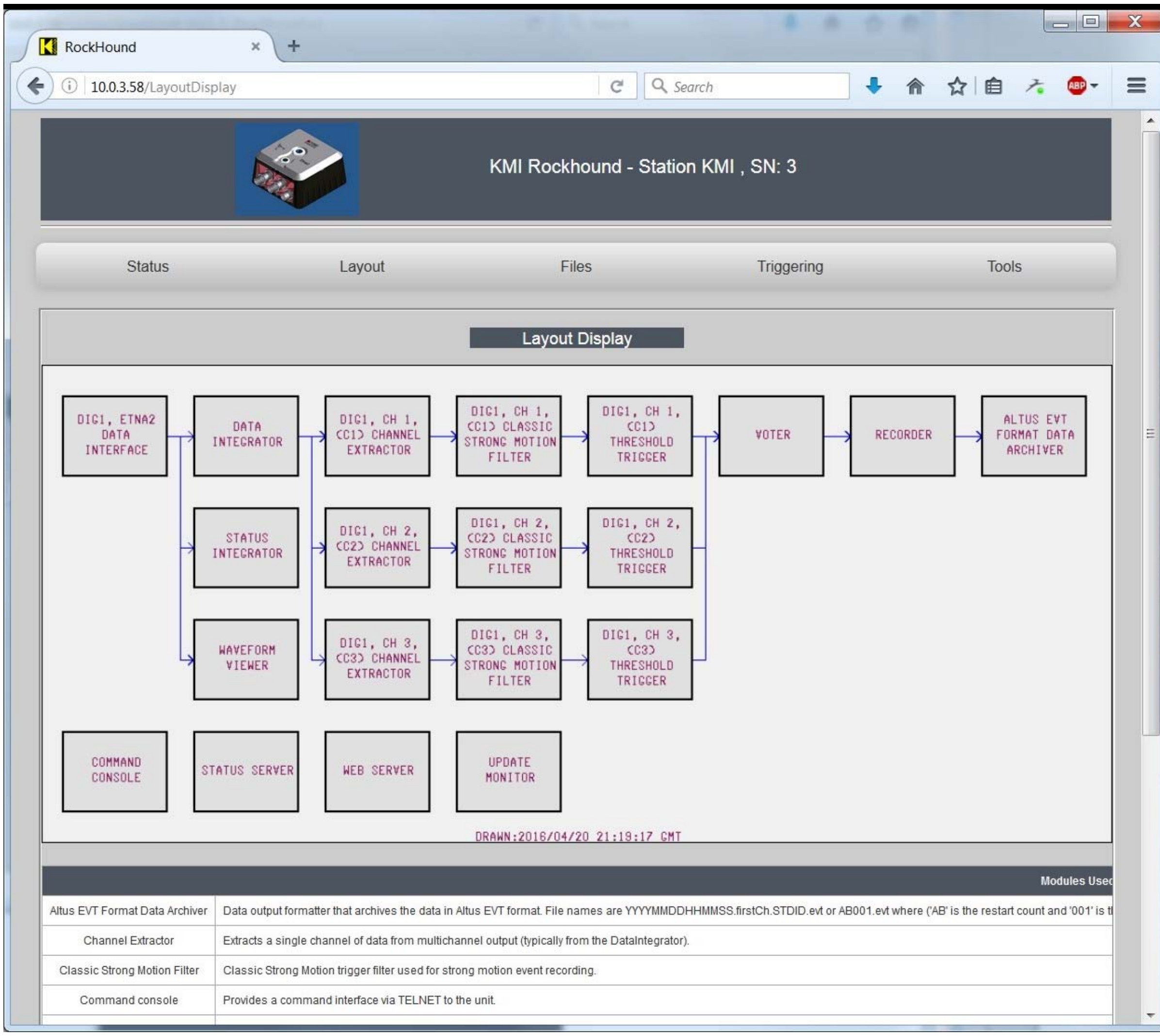


Figure 27: Layout Display

Apply Changes tells the Etna2 to make changes you've made permanent.

Channel Summary displays channel information:

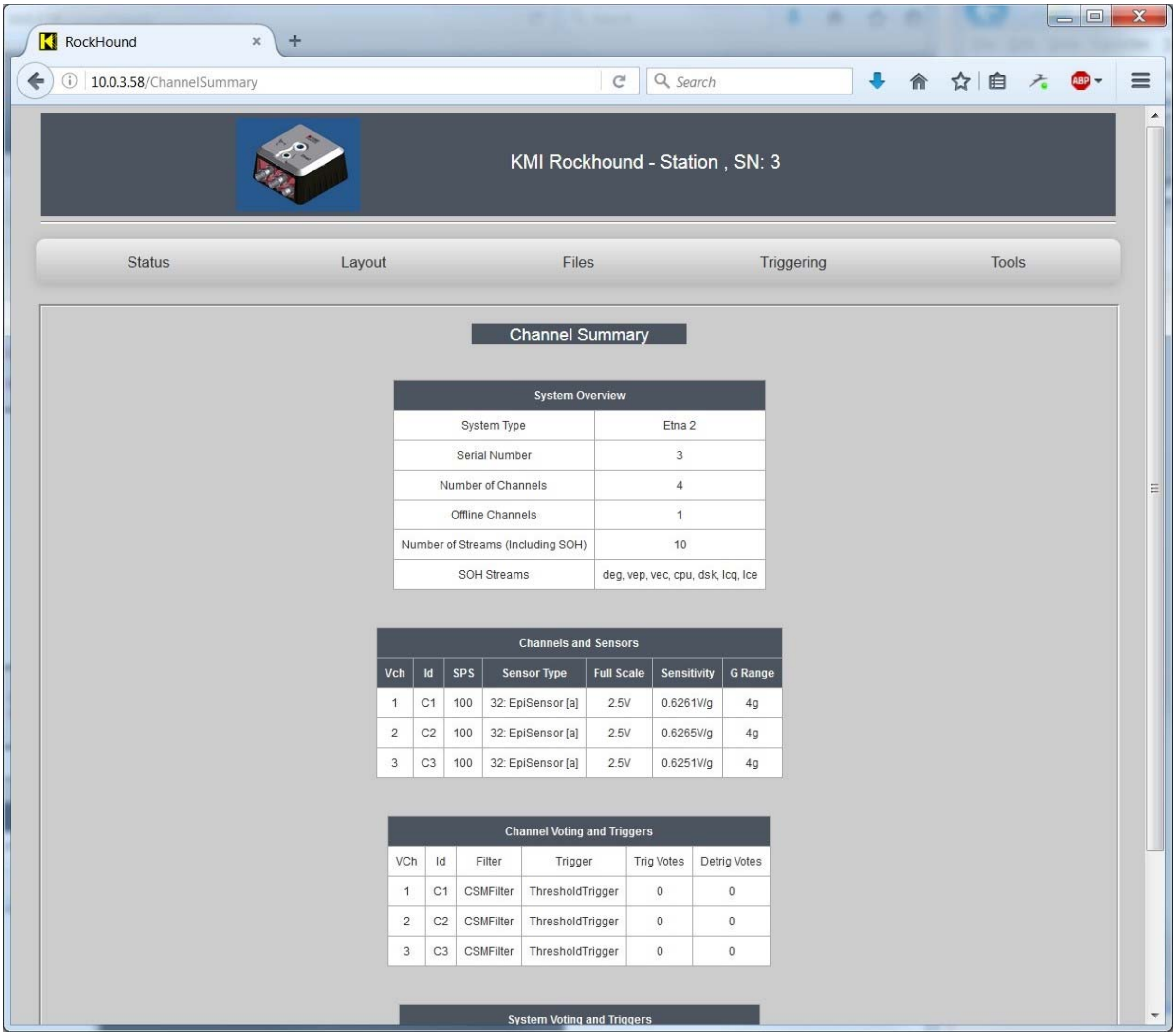


Figure 28: Channel Summary

Site Summary shows:

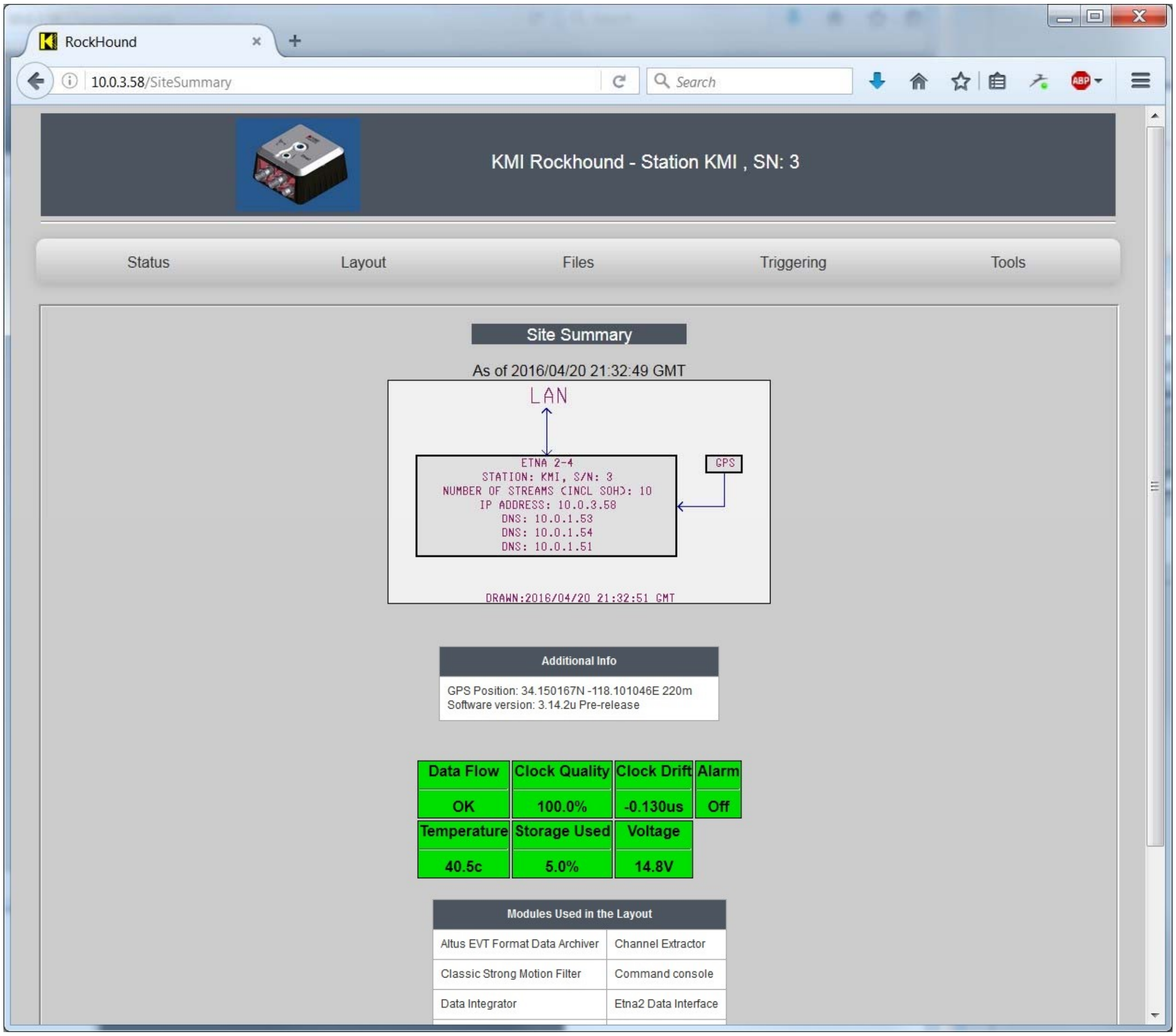


Figure 29: Site Summary

State of Health displays SOH information that is logged short term (24 hrs) and long term (one year):

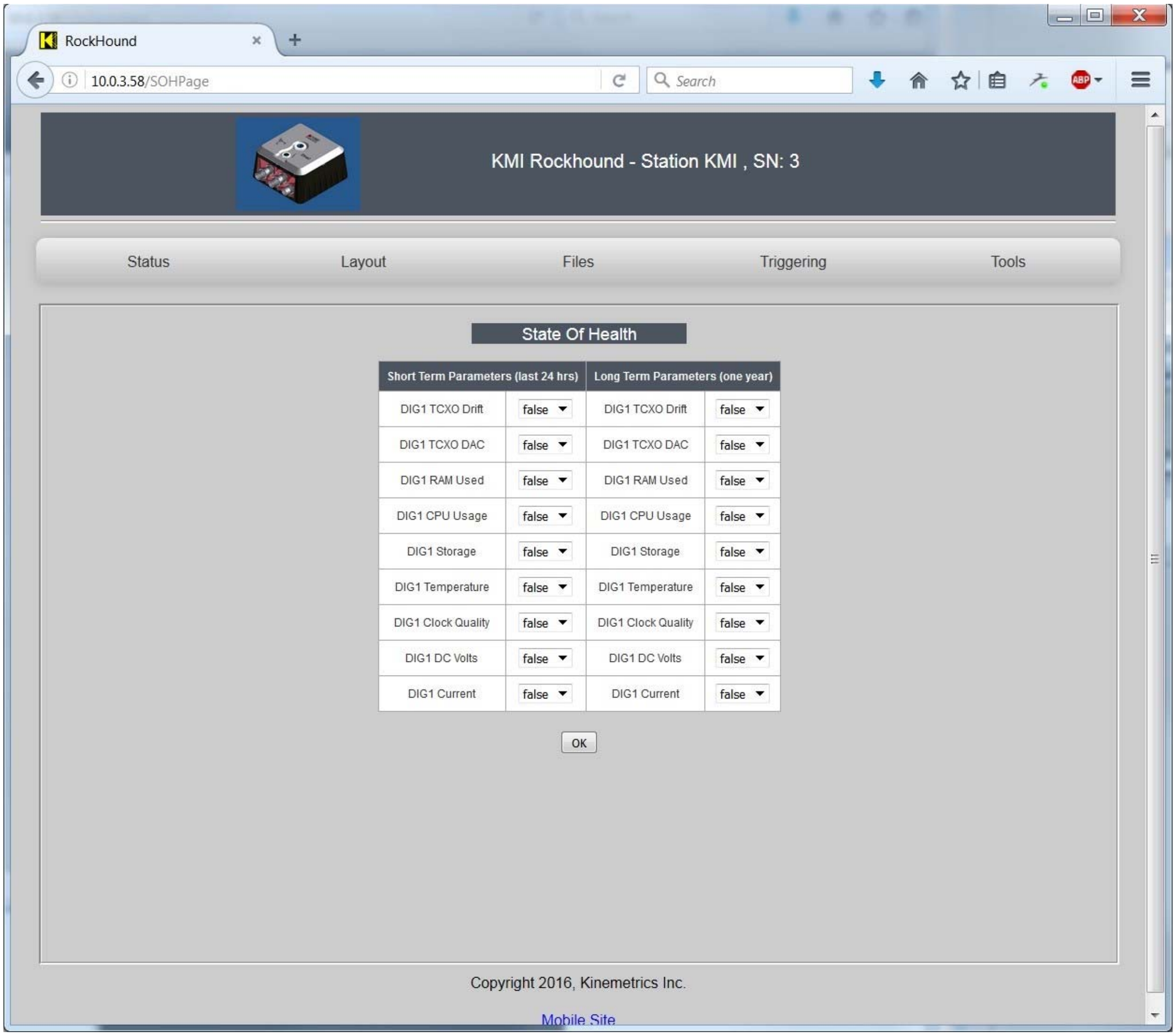


Figure 30: SOH Selection

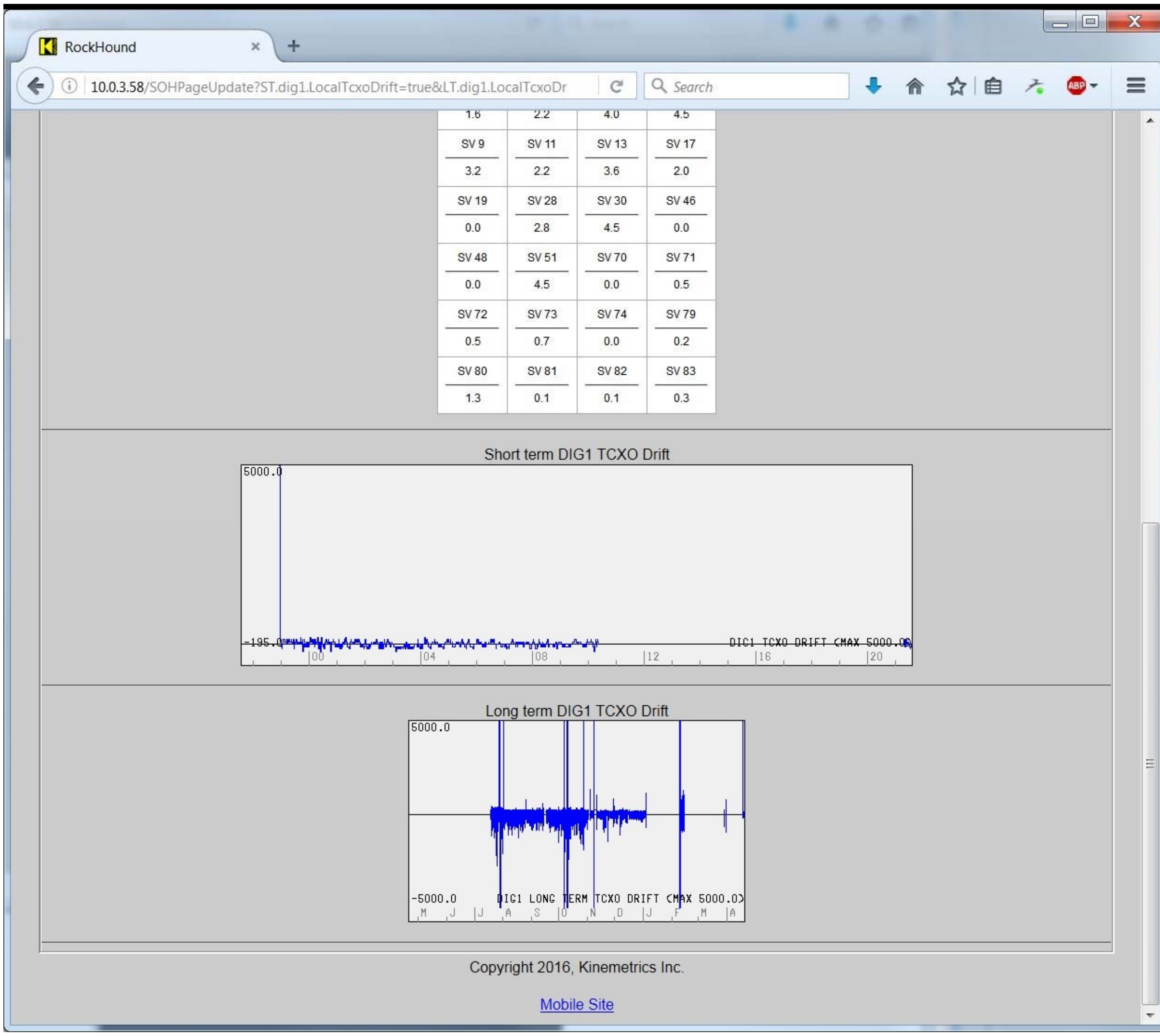


Figure 31: SOH Display

Waveform Viewer defaults to non-applet mode (using HTML and Javascript only). For the majority of users this will be the preferred mode, and also allows use on mobile devices. If for some reason you need to use the older applet mode, you will need to change the non-applet mode setting.

Note that Java applets are increasingly unsupported so if you are still using them you should be prepared for their demise.

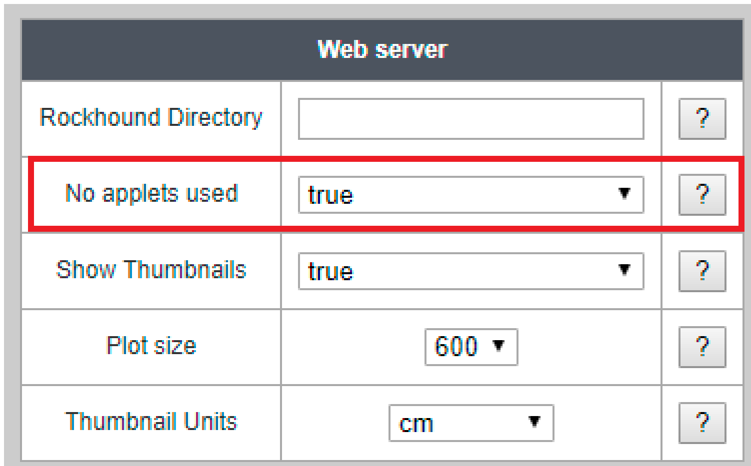


Figure 32: Applet Mode Selection

Click on Waveform Viewer to start the Viewer, you'll see this:

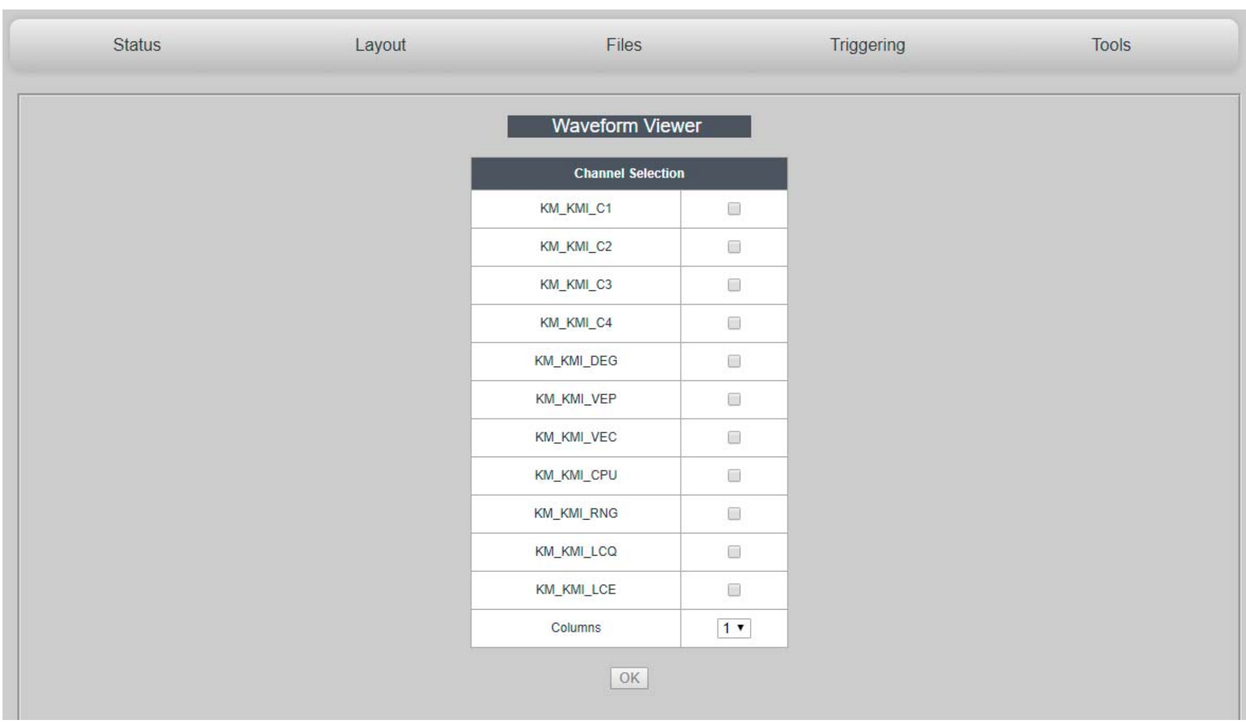


Figure 33: Waveform Viewer Selection

Select the channel(s) you want to see and press OK:

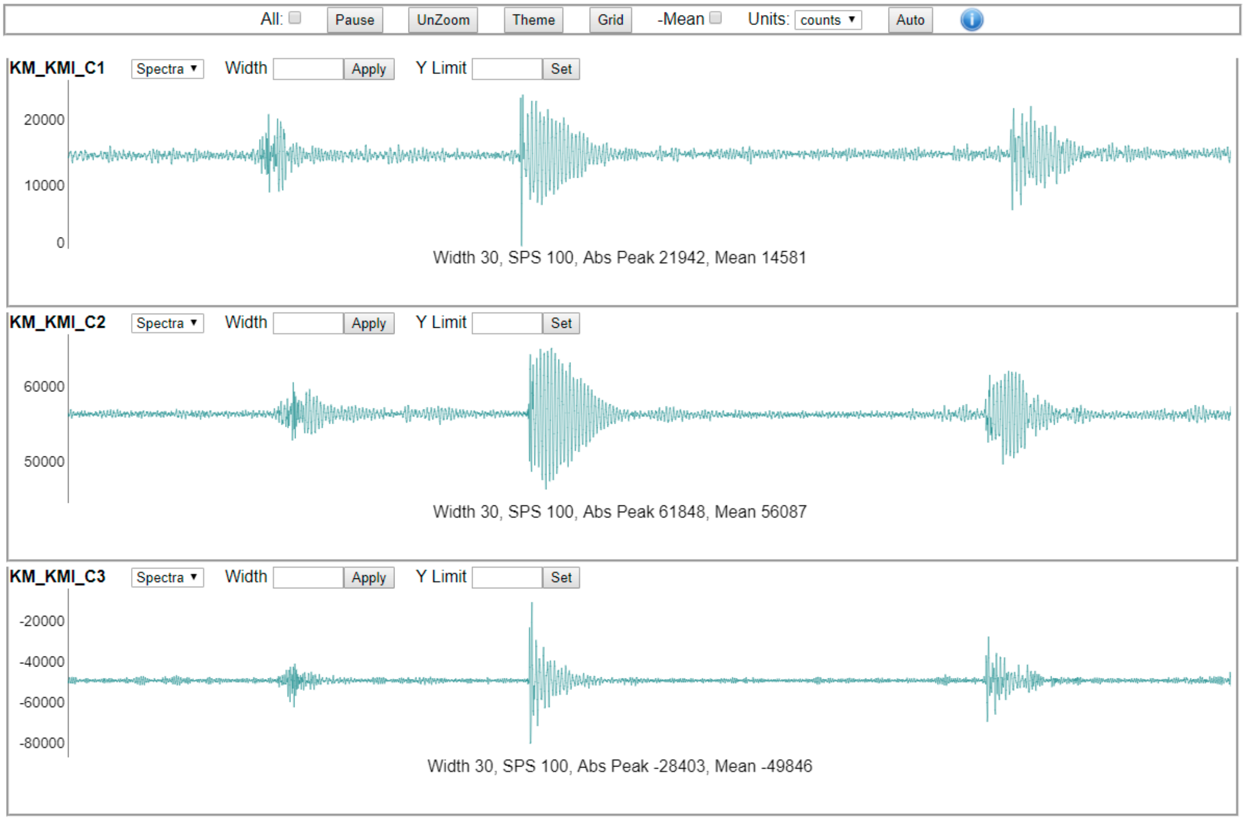


Figure 34: Waveform Display

Note the options for FFT and PSD display:

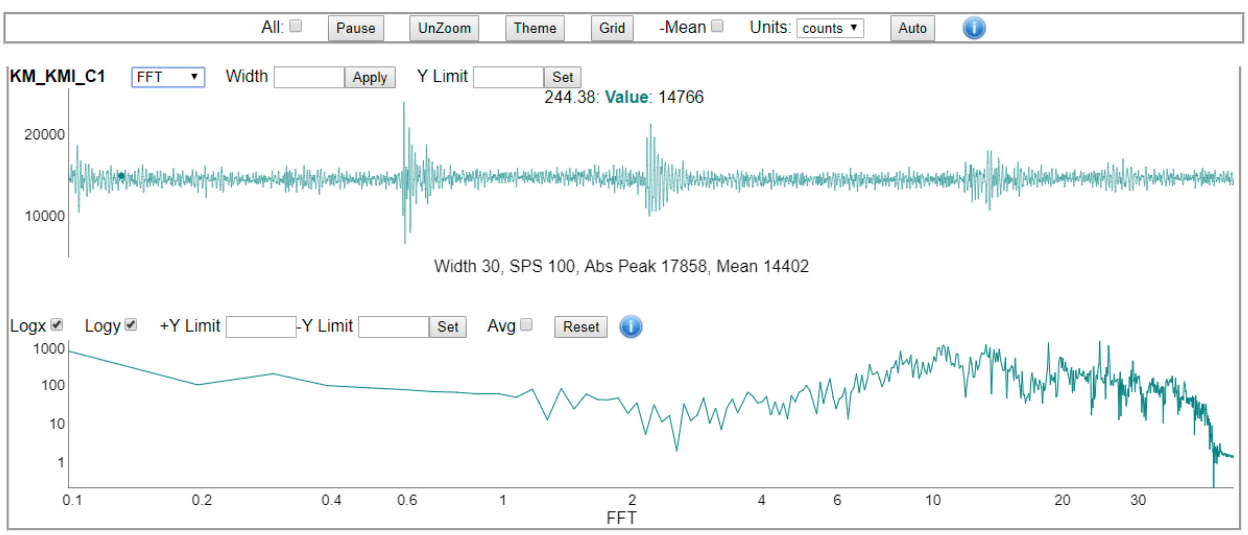


Figure 35: PSD Display

Next is Recorded Files. This shows small (1-2kb) thumbnails of recorded files:

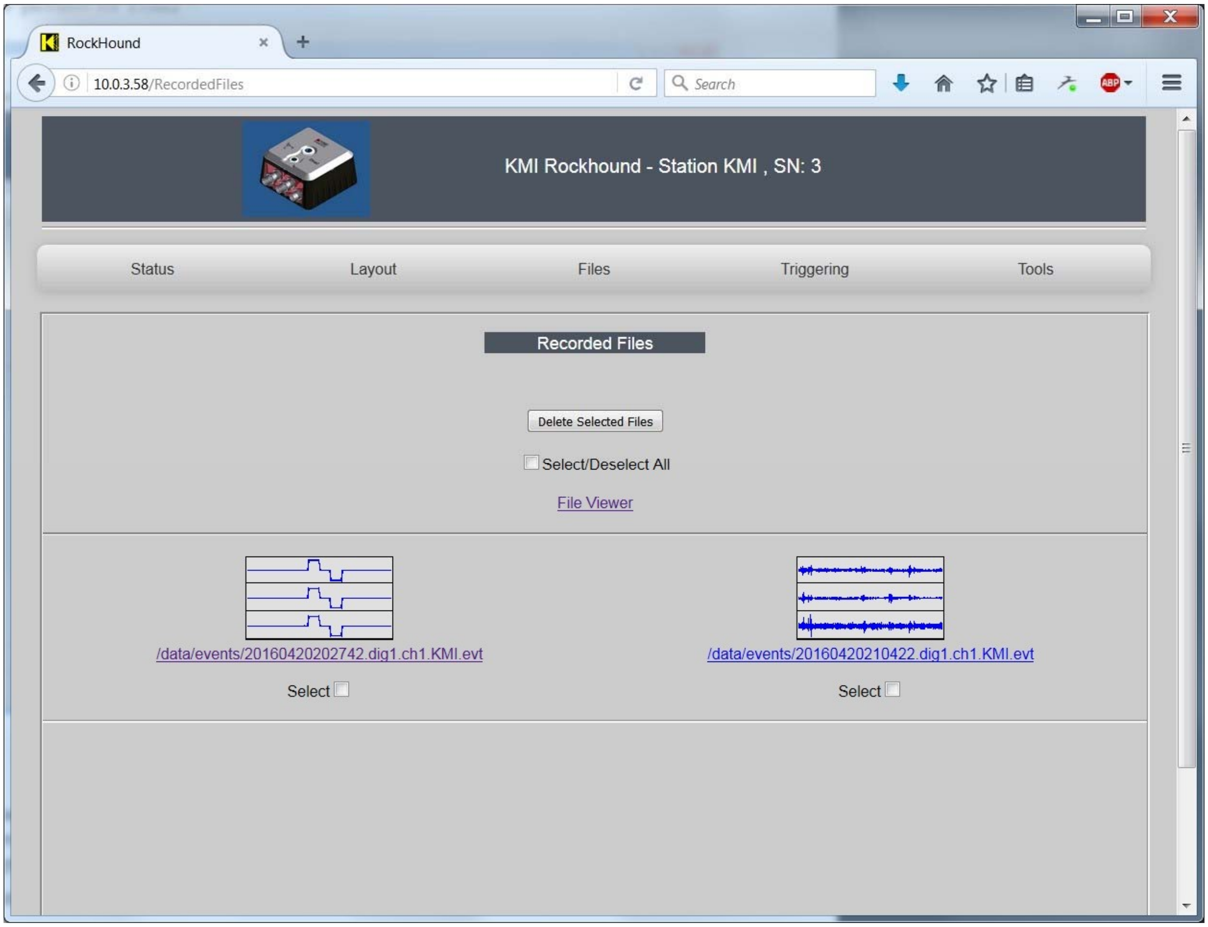


Figure 36: Recorded Files

If you click on a thumbnail, you can see a larger (6-10kb) thumbnail:

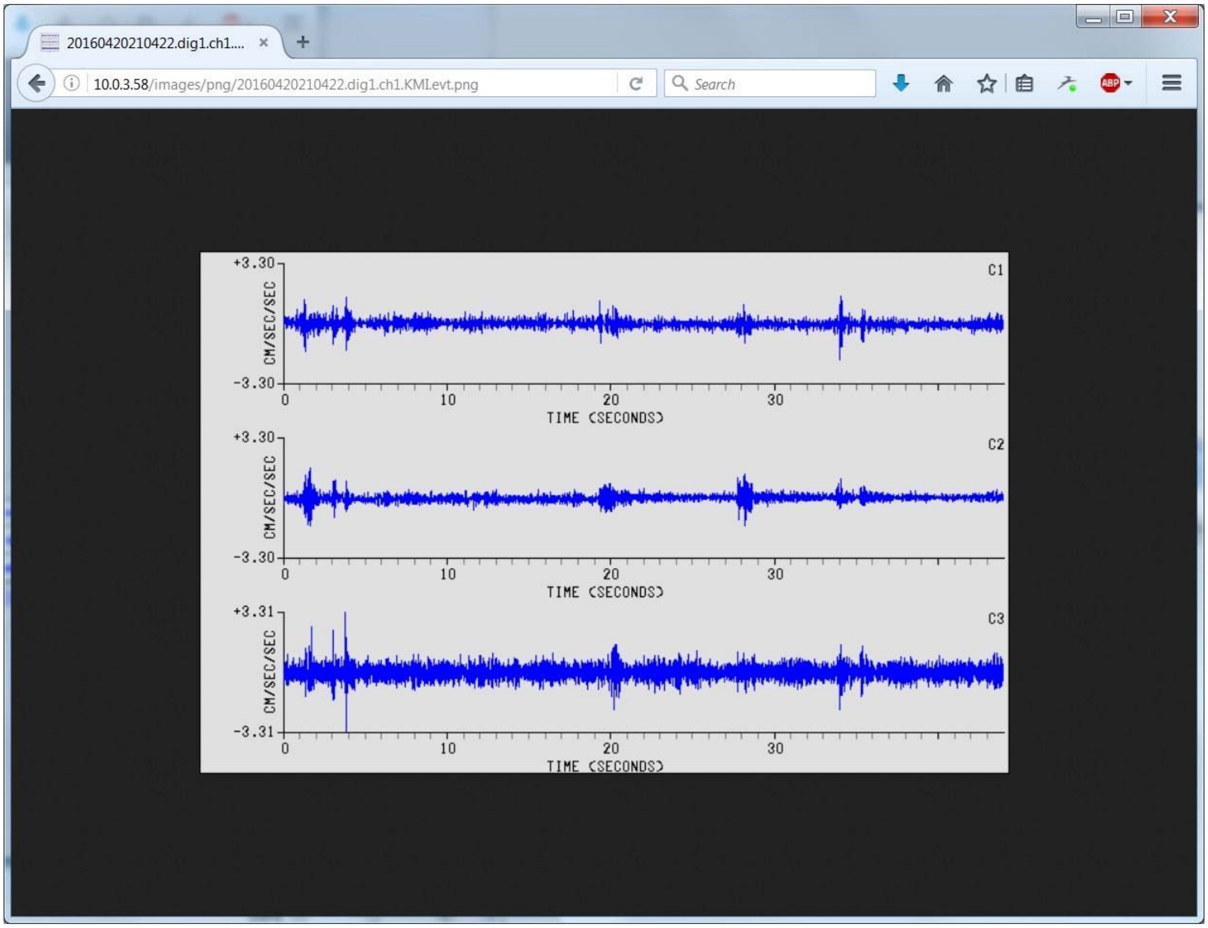


Figure 37: Recorded File Detail

The links and buttons below the small thumbnails allow you to download or delete the files (one at a time) via HTTP. Larger scale file maintenance is best done via SFTP or WinSCP.

Triggering & Sensors allows you to perform console or sensor test triggers:

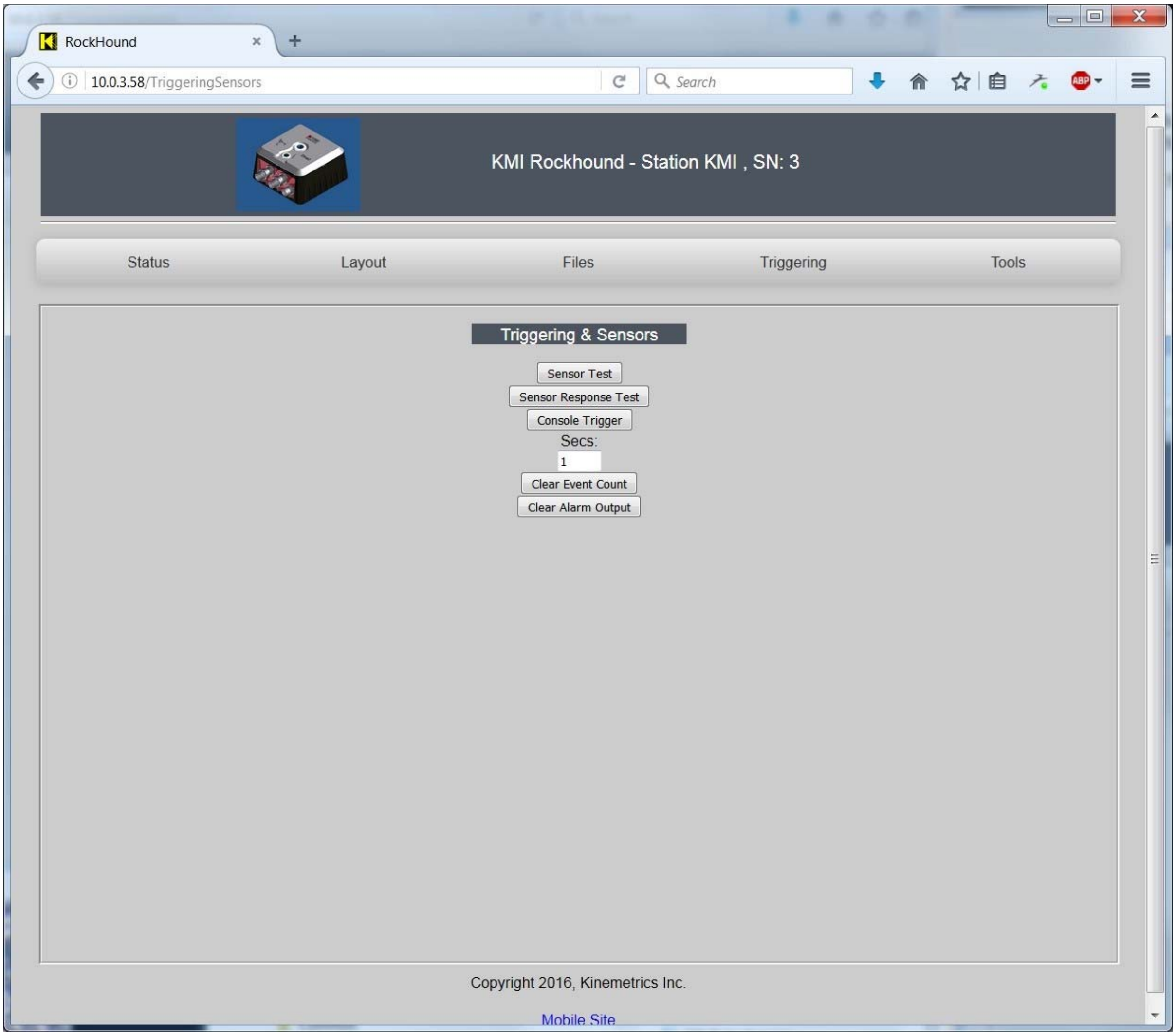


Figure 38: Triggering and Sensors

Back on the Overview, status information is displayed at the bottom:

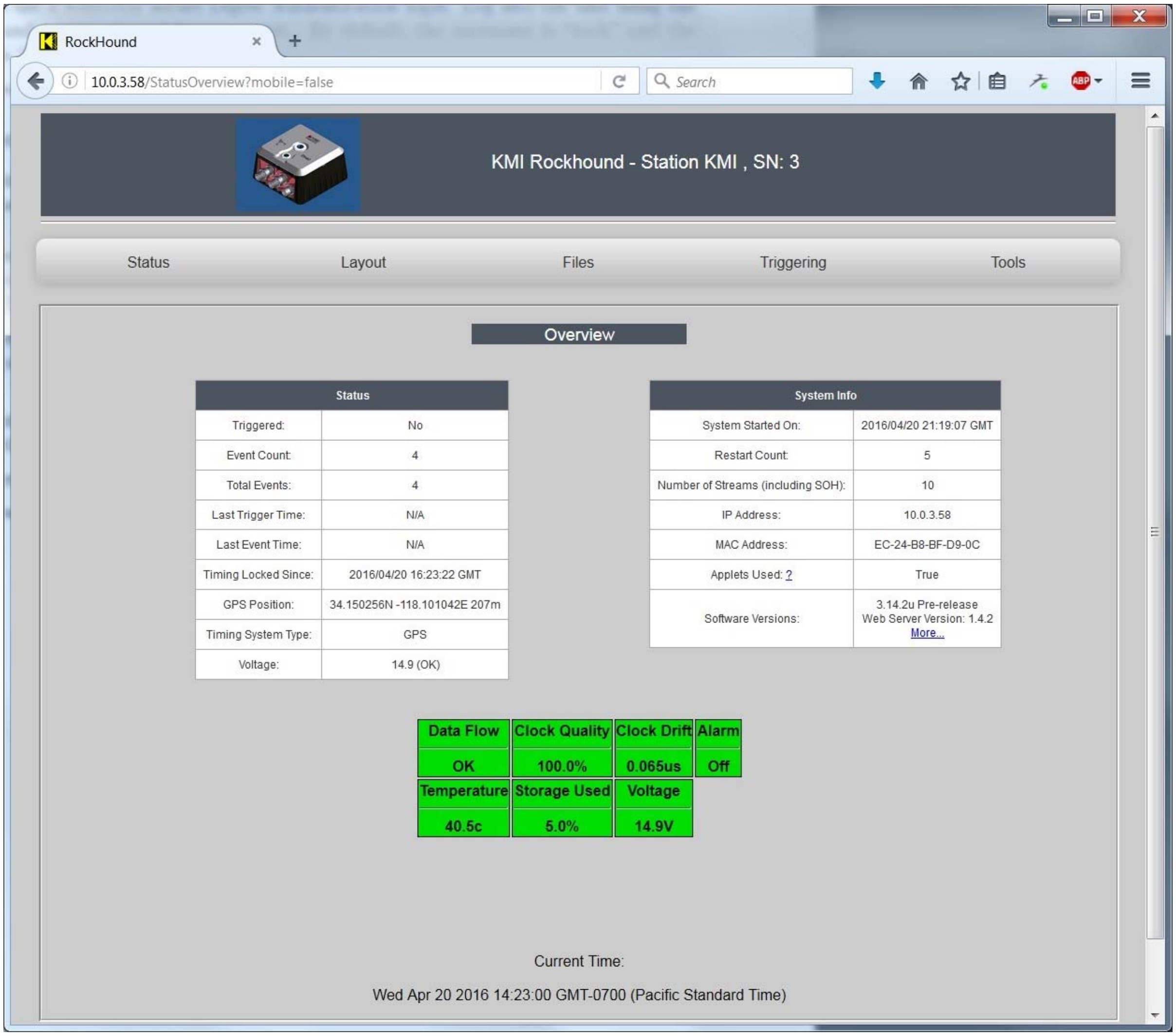


Figure 39: Overview

4.1 Editing Parameters

Parameters are divided into two main sections. Hardware parameters are those that are typically hardware related such as sensor and channel specifics. Configuration parameters are those that are mainly related to how the system operates – things like trigger levels, pre-event and post-event times, and so on.

To edit hardware parameters, select Hardware from the Layout menu and you'll see something like this:

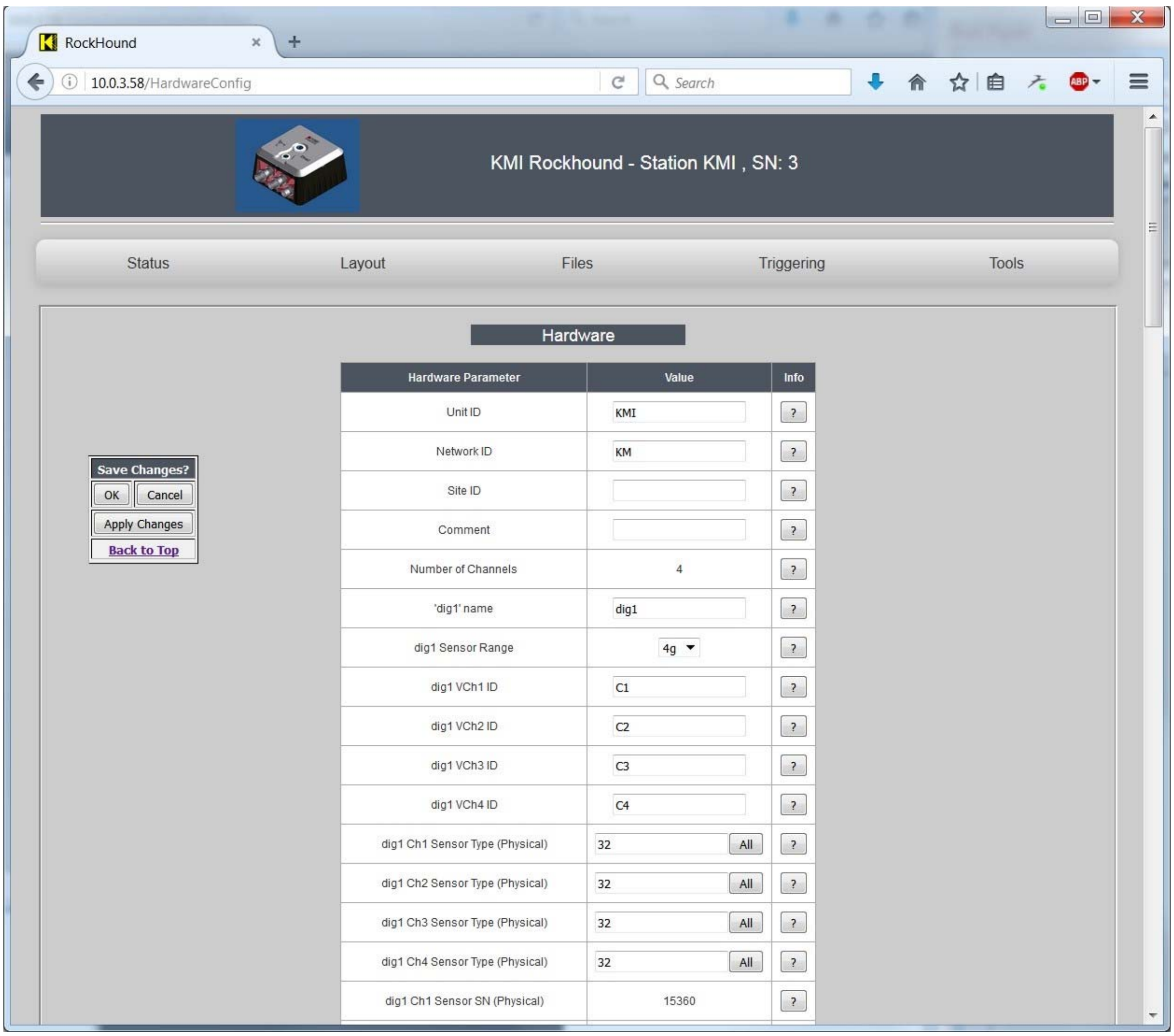


Figure 40: Hardware Parameters

Note that when you click the “?” next to the name of a parameter that you’ll be shown the help string that provides more detail about the purpose of the parameter:

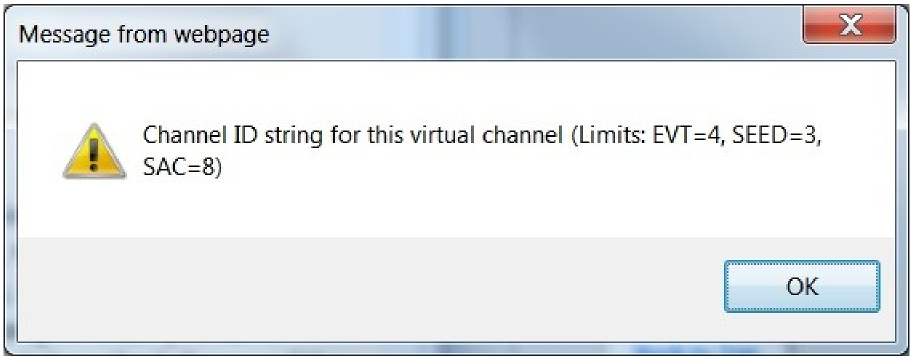


Figure 41: Help String

When you’ve finished editing the Hardware Parameters, click OK to save your changes. To edit Configuration Parameters, select Configuration from the Layout menu and you’ll see:

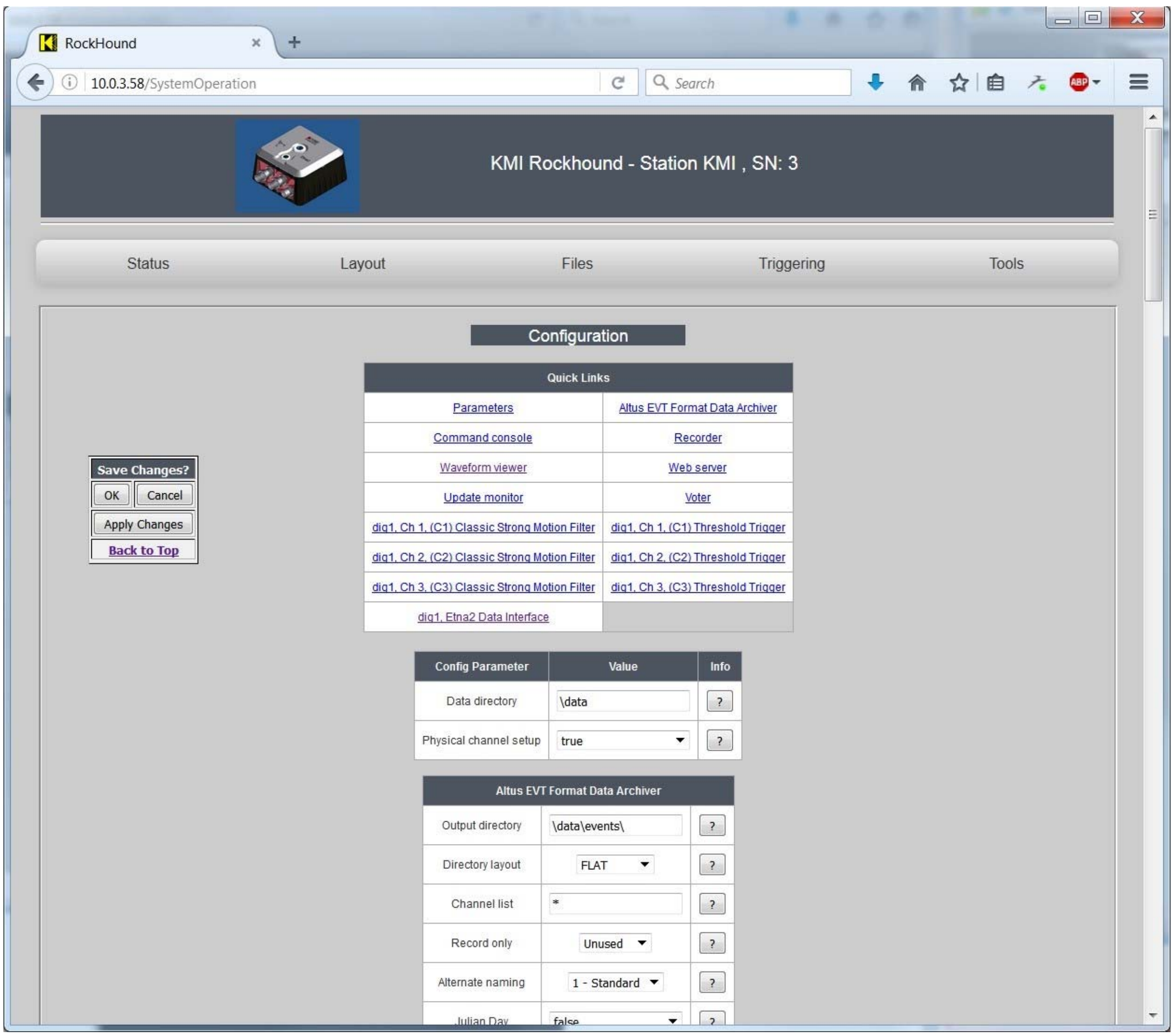


Figure 42: Configuration Parameters

The top of the Configuration page is a Parameter Map, which is a set of links to the individual parameter sets of each module. This can be faster than scrolling to find a parameter.

For example, to access the Etna2 Data Interface, click on the link and you will get:

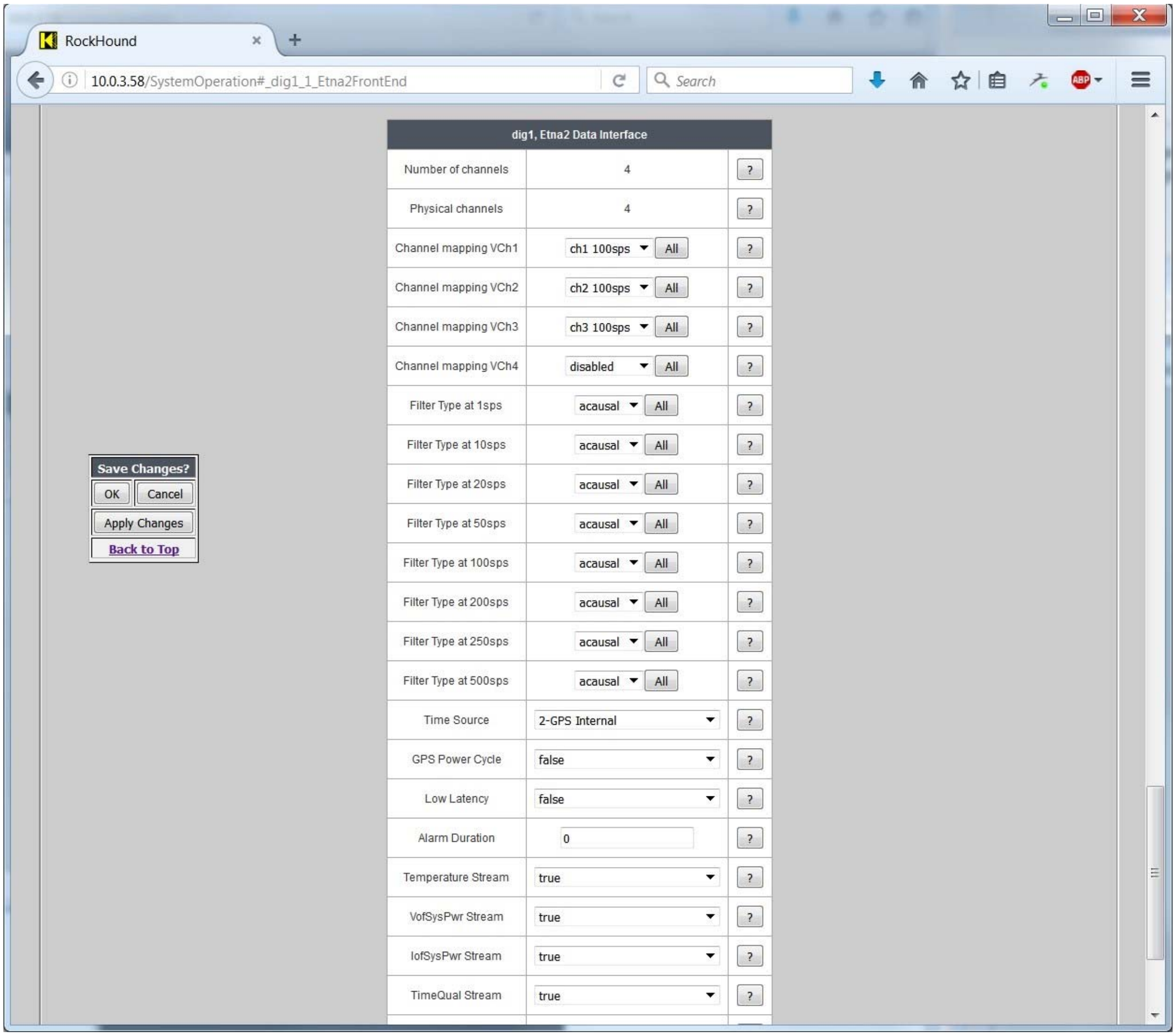


Figure 43: Module Parameters

After completing your changes, be sure to press OK to save your changes.

Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes” from the Layout menu of the display. The system will restart and reconfigure itself to make your changes. This may take a few minutes until the system is restarted and operational with your changes.

4.2 Adding Modules

You can add capabilities to your system by adding additional modules. The process is the same for adding modules of any type. For example, to add a module to the system to provide an Antelope compatible ring buffer, you will need to add a Ring Buffer Server module. To accomplish this, select Module Add from the Tools menu, and scroll down to locate the Ring Buffer Server, then click “Add”.

In this particular case, you’ll be asked where it should get data from, the “recorder” (to provide only recorded data to the Ring Buffer) or the Etna2 Data Interface (to provide all data to the Ring Buffer). Select the Etna2 Data Interface when the choices are presented.

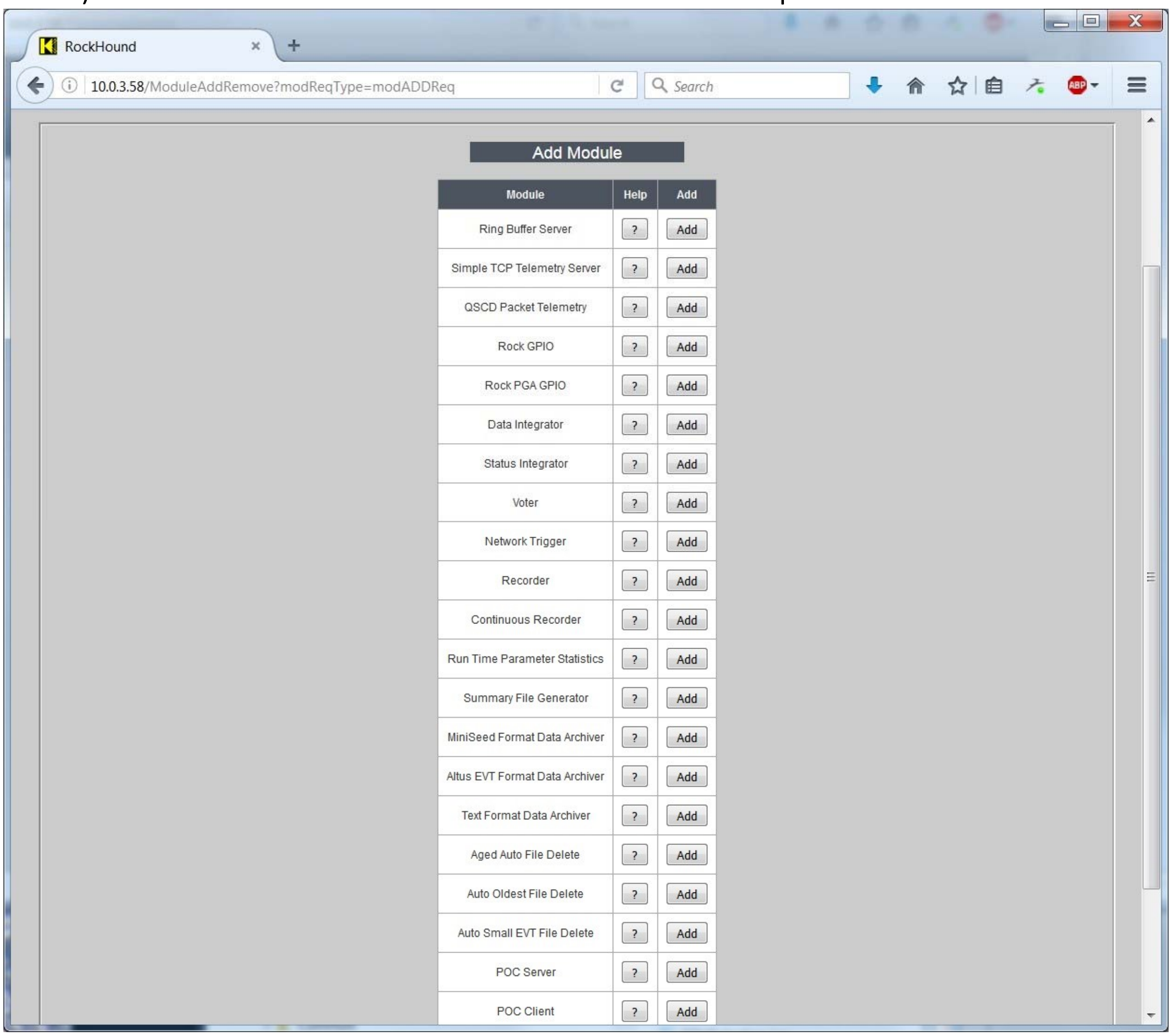


Figure 44: Module Add

Click “OK” once you’ve selected the choice to add the module.

Next, click Configuration from the Layout menu and select “Ring Buffer Server” from the parameter map. The Ring Buffer Server parameters will now appear at the top of the window as shown:

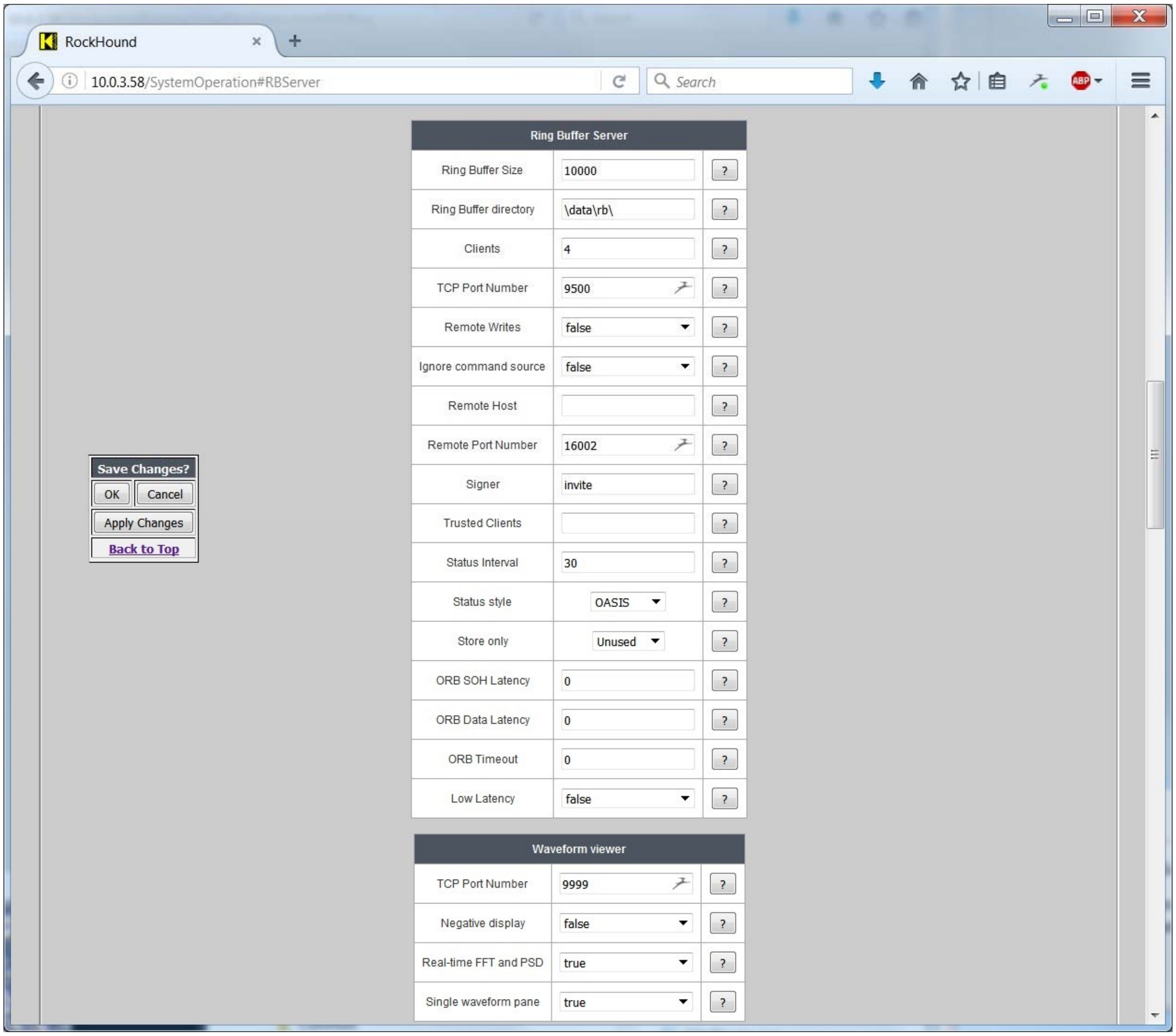


Figure 45: Ring Buffer Server Parameters

Configure the parameters for your new module as needed, then click OK to save your changes. Next, click “Apply Changes” from the Layout menu. The system will restart and reconfigure itself to add the Ring Buffer Server module. This may take a few minutes until the system is restarted and operational with your new module.

Please note than for most modules (including the Ring Buffer Server module used as an example here) that you can usually add multiple modules of the same type.

4.3 Removing Modules

You can further alter the capabilities of your system by removing modules. The process is the same for removing modules of any type. For example, to remove a Ring Buffer Server module from the system, select Module Remove from the Tools menu and scroll down to locate the Ring Buffer Server:

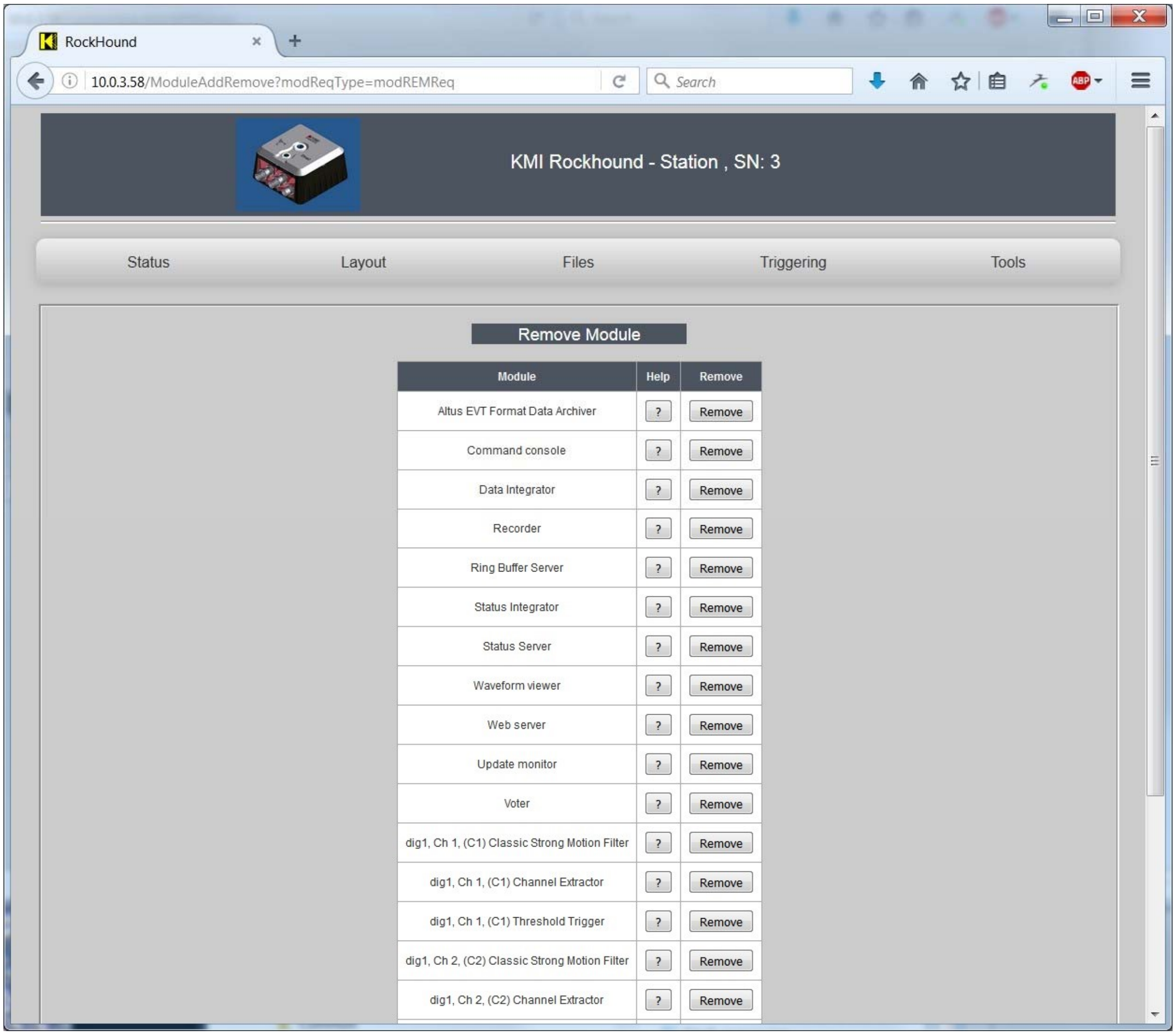


Figure 46: Module Remove

Click “Remove”.

Next, click “Apply Changes” in the Layout menu. The system will restart and reconfigure itself to remove the Ring Buffer Server module. This may take a few minutes until the system is restarted and operational with your changes.

4.4 Replacing Modules

Sometimes what you need to do is replace a module in the system with another that has the same basic functionality. For example, you may want to replace a data archiver that produces EVT files with one that produces MiniSEED files, or you may want to replace a Threshold Trigger with an STA/LTA Trigger. For example, to change the data format from Kinemetrics EVT file format to MiniSEED, use the web interface. Choose Module Replace from the Tools menu and you'll see:

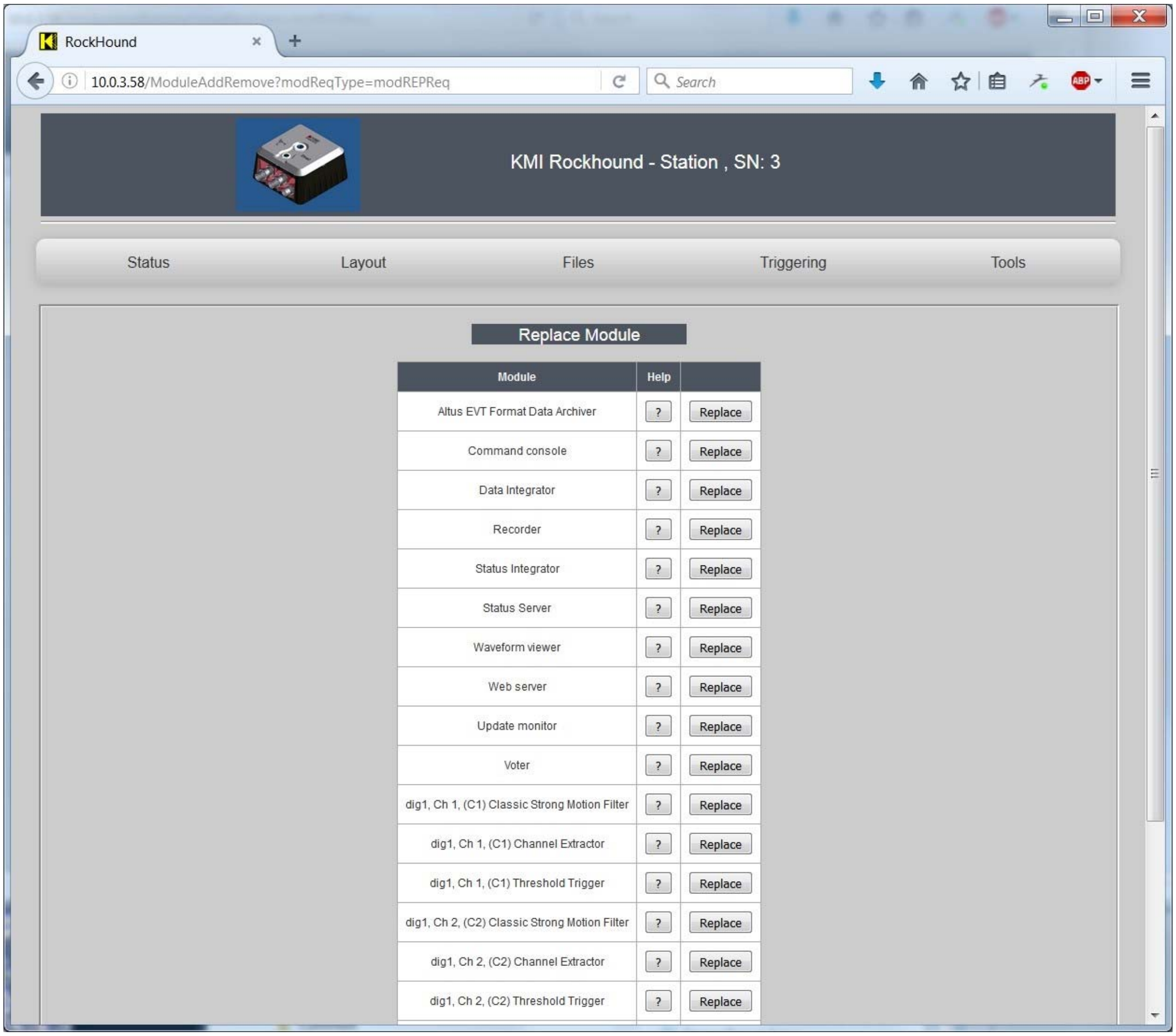


Figure 47: Module Replace

Click “Replace” for the Altus EVT Format Data Archiver and you’ll see your choices:

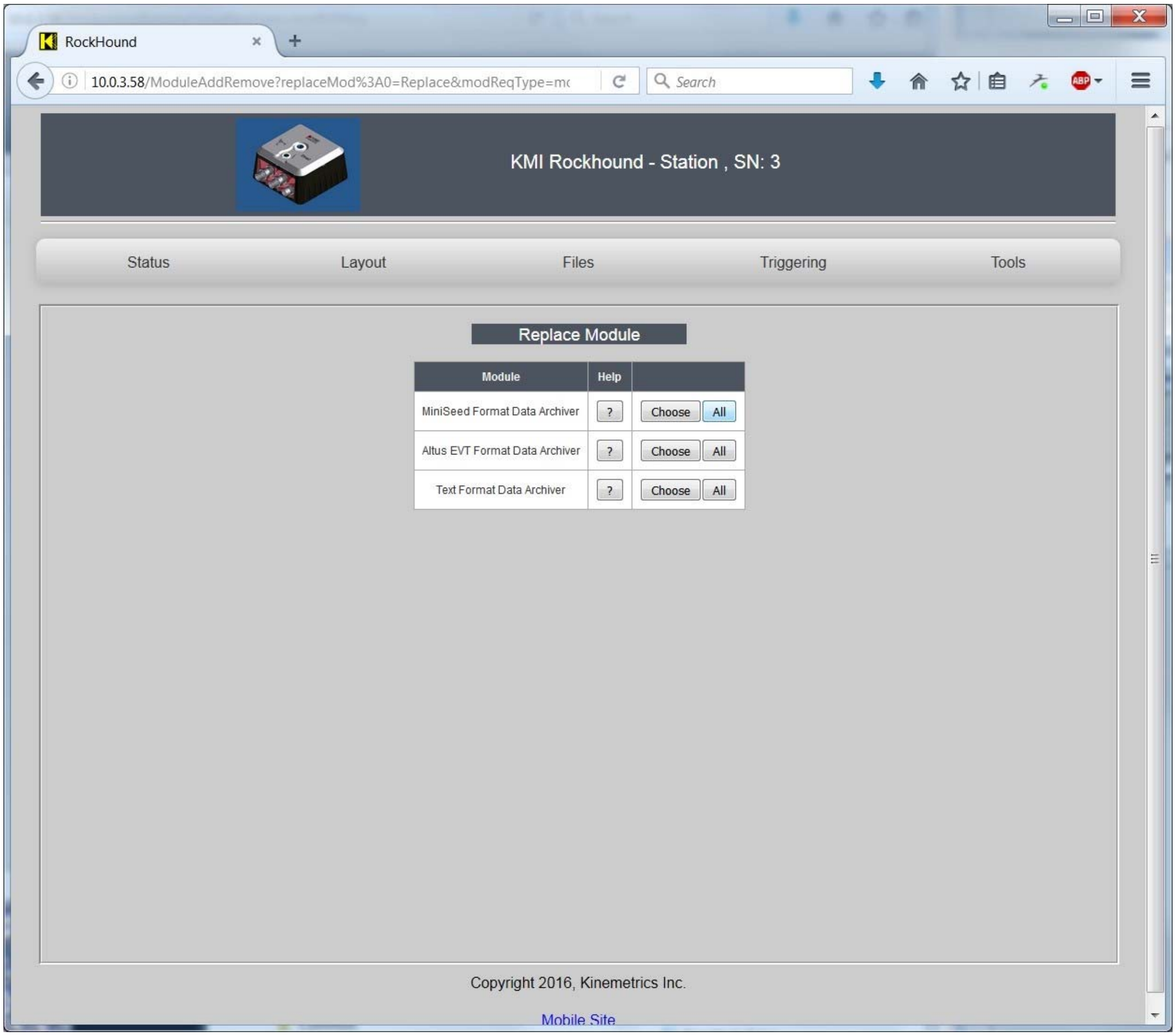


Figure 48: Module Replacement Options

If you select “Choose” next to MiniSEED Format Data Archiver, then you’ll replace the Altus EVT Format Data Archiver with MiniSEED. The Module Replacement screen will now look like this:

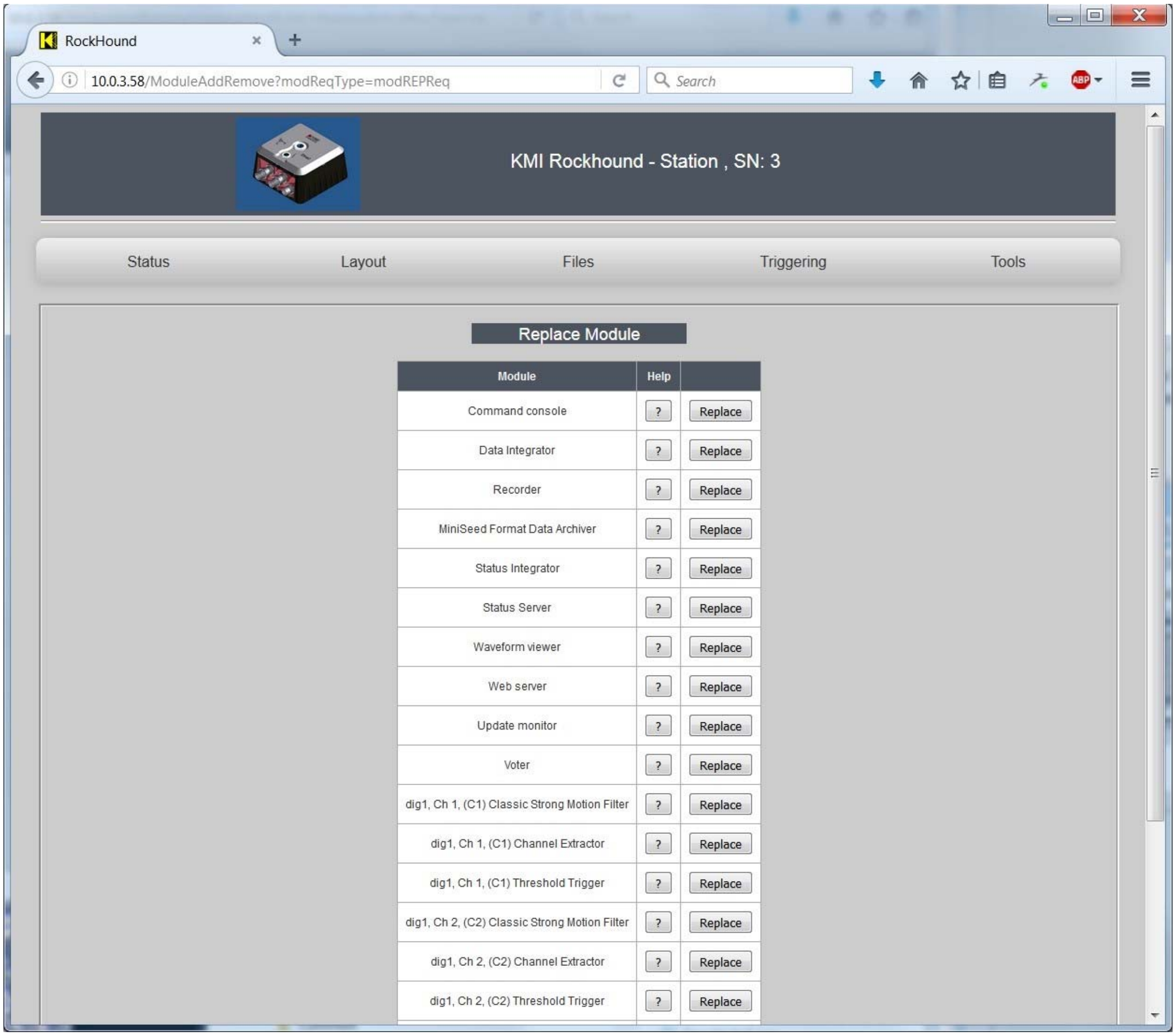


Figure 49: Module Replacement Complete

In this example, it was pretty simple because there was only one EVT Archiver module in the system. But if you needed to replace the Threshold Triggers with STA/LTA Triggers and you have a more complex system you can imagine that the process could become a bit tedious. To make this a little better, you can select “All” instead of “Choose” when you are shown the Compatible Modules list. You can then replace all modules of one type with another.

Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes” from the Layout menu.

4.5 Continuous Recording

Adding Continuous Recording to the existing layout typically requires you to add three modules:

1. The Continuous recording module itself
2. The data format that the continuous data will be stored as (MiniSEED is most common)
3. An auto-file delete module to stop the data storage from overfilling

If you choose not to add the auto-file delete module, then recording will continue until the storage fills up and then recording will stop

If you do not add a data archiver to store the data, then no recording will take place because a data format is not specified If you want to record continuous ONLY (without triggered recording), you can accomplish this one of two ways:

1. Disable triggering by setting the “votes to trigger” parameter to an impossibly high value
2. Rebuild the configuration entirely as a “simple continuous recorder” using the Layout Wizard

Here is the process to set up Continuous Recording, in the most common way - as MiniSEED: Select Module Add from the Tools menu, and scroll down to locate the Continuous Recorder, then click “Add”.

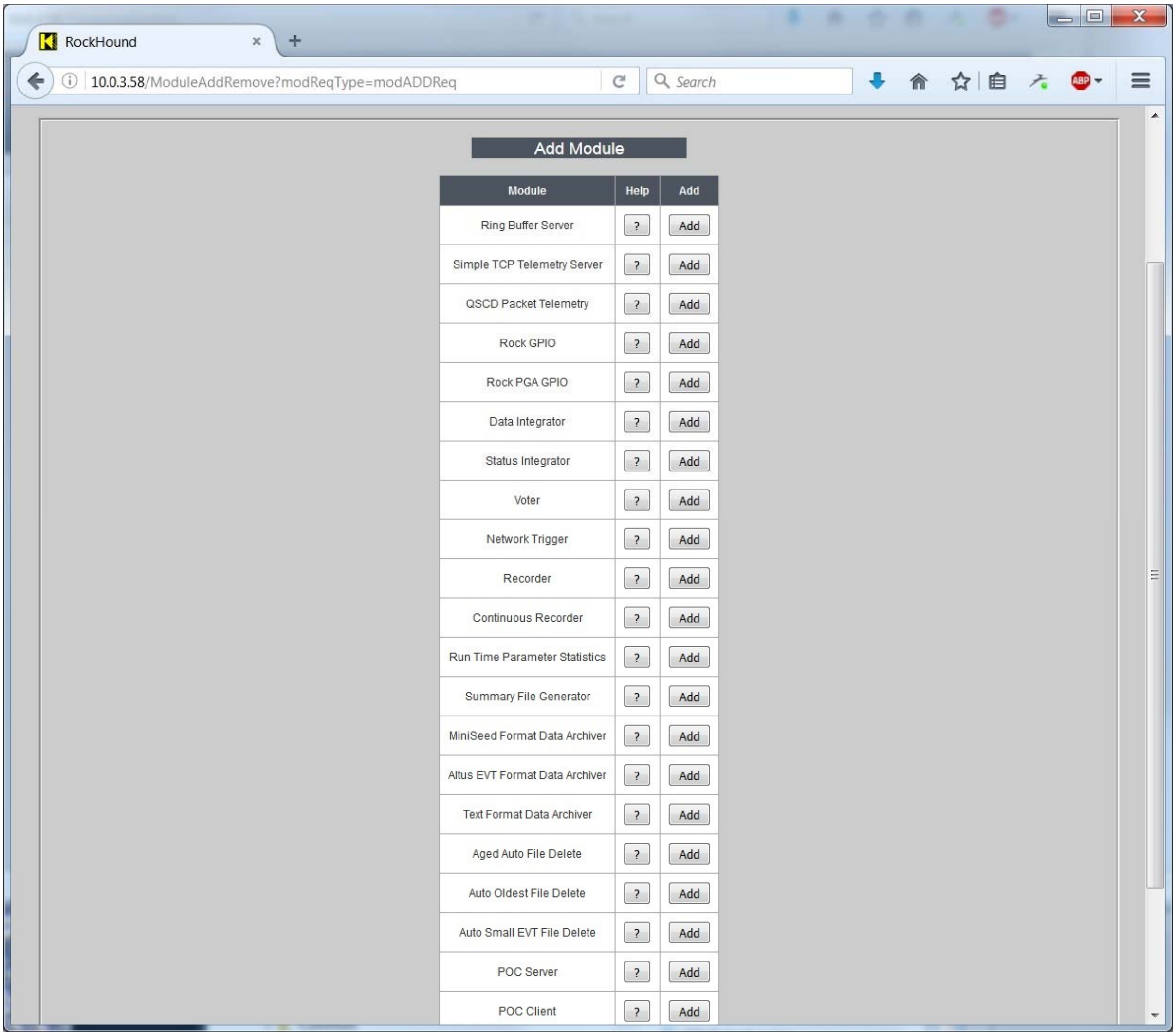


Figure 50: Module Add

Next, from the same screen select the MiniSEED Module then click “Add”.

In this particular case, you’ll be asked where it should get data from, the “Recorder” (to record only triggered data) or the “Continuous Recorder” (to provide all data to the Ring Buffer). Select the Continuous Recorder when the choices are presented.

Finally, from the same screen add an auto-file delete module. There are several choices available, but in this example we’ll select the “Aged Auto File Delete” to delete files based only on age (in our example, to delete files over 90 days old).

Finally, configure the modules as needed by selecting Configuration from the Layout menu. The important parameters we will change are noted here. You can change others as well depending on your application:

For the Continuous Recorder:

- Set the Recording Duration to 600 seconds and the Starting Second to 0. This will cause the system to write data to the one hour MiniSEED files in 10 minute (600 second) chunks. This is a good balance of efficiency and constant CPU load.

For the MiniSEED Archiver:

- Set Cimarron Format and Cimarron Naming both true. This will produce data in a comparible format and data structure for use with the Quanterra Cimarron program which is useful for viewing large amounts of continuous data.

For the Auto File Delete:

- Set File Extensions to “*” (all files) and set “Age Limit” to 90 (90 days).

The Directories parameter specified for the auto-file delete module should match the Output Directory parameter of the MiniSEED archiver so that the continuously recorded data is managed. If you choose to change these directories, try to keep them properly related and remember to keep them under /data so that files are recorded to the data card. Recording under the root directory (“/xxx”) will write to the system card, causing you to fill the system card with perhaps unexpected results. When your parameters are set as you want them, click OK to save your changes.

Next, click “Apply Changes” from the Layout menu. The system will restart and reconfigure itself to add the selected modules.

Chapter 5

File Viewer

The File Viewer is a downloaded Java application that is loaded into your PC from the unit's web page when you click the File Viewer link. It will be downloaded as an executable .jar file that you can run by directly if you have Java installed on your computer.

A brief summary of capabilities follows. Upon launch, the initial File Viewer display looks like this:

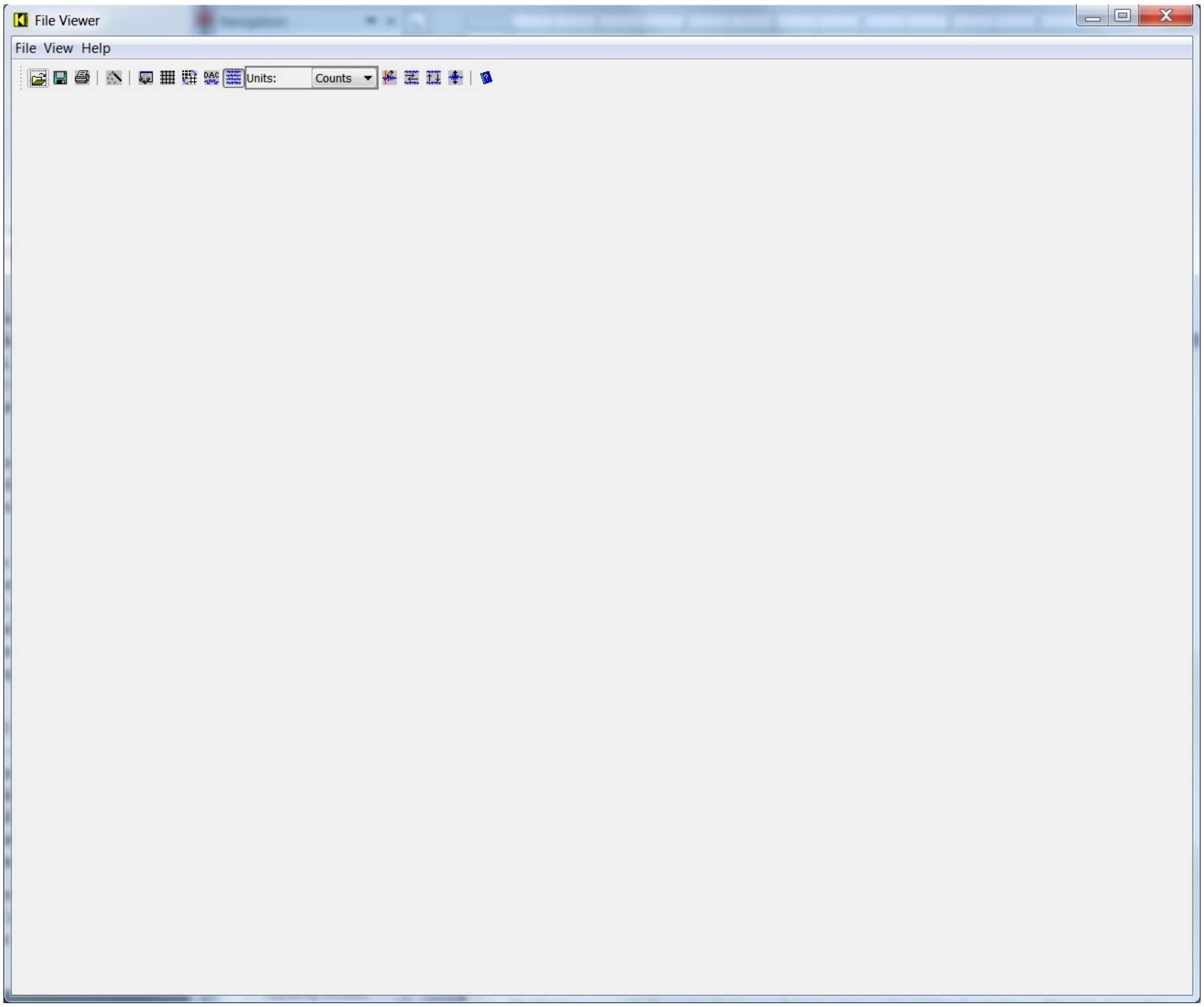


Figure 51: File Viewer Main

The File Viewer consists of a graphic display area (below), a menu, and a set of toolbar buttons. Left to right, the toolbar buttons are as follows:

Open – Opens a file for display. Once the program has been started, it can be used to open other files. As of this writing, the File Viewer supports Kinemetrics EVT files and MiniSEED files (with some restrictions) when used with a ".m" extension. In the case of MiniSEED, multiple files for the same time period may be opened at once.

Save As – Allows saving of the current file in another directory or under another name.

Print – Prints the current time series.

Setup – Allows configuration of additional File Viewer features. The Setup dialog looks like:

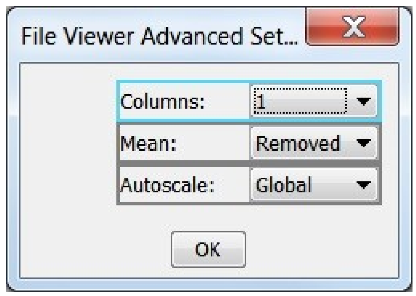


Figure 52: File Viewer Setup

Setup selections include:

- Columns – Select the number of columns of graphic displays. You could for example, organize an 18 channel record into 1 column of 18 plots, two columns of 9 plots, or three columns of 6 plots.
- Mean – Allows mean removal from the data, or "As Read" display.
- Autoscale – Allows autoscale as "Global" (all channels scaled to largest signal), "Individual" (channels scaled individually), or "None"

Header Display – Displays header information as is available from the file:

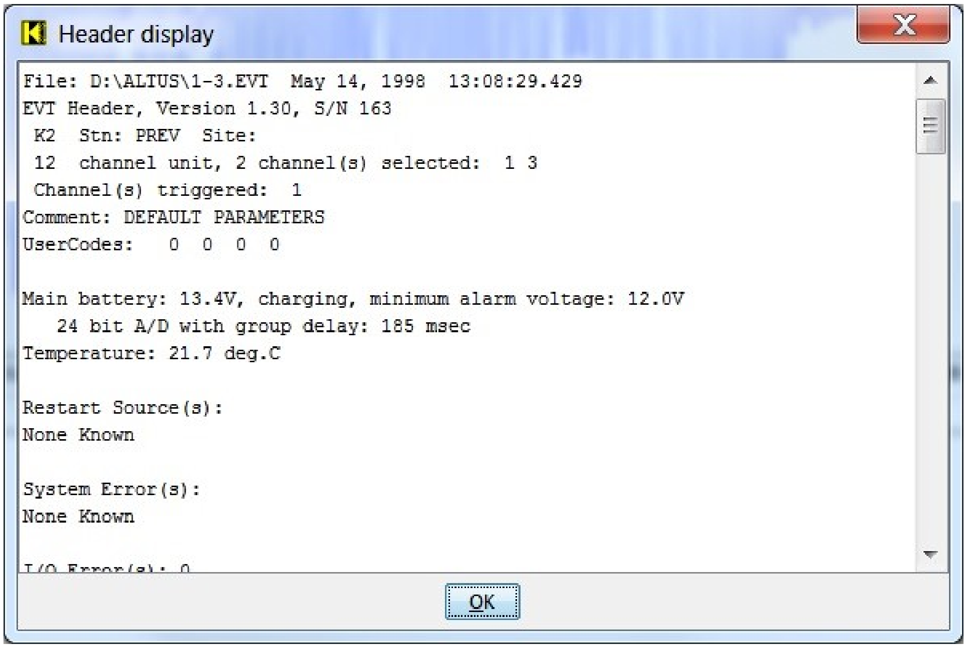


Figure 53: Header Display

Grid Mode – Displays grid lines on the plots if requested.

Negative Display – Displays plots as green on black or blue on white.

DAC Mode – Displays data points as point-to-point, or showing individual signal levels for each sample. This is usually only discernable when zoomed in closely.

Multi-channel Mode – Displays all channels or only one channel at a time. In single channel mode, channels can be selected with the Page Up / Page Down keys.

Units – Allows selection of display units. Choices include counts, volts, g, cm/s2, or gal. Note that correct bit weight and sensitivity settings are required for proper scaling of the data.

Cursor – Enables cursor mode so that you can click to display exact time and amplitude of individual sample values. Note that the cursor can be moved with another mouse click or by using the left and right arrow keys:

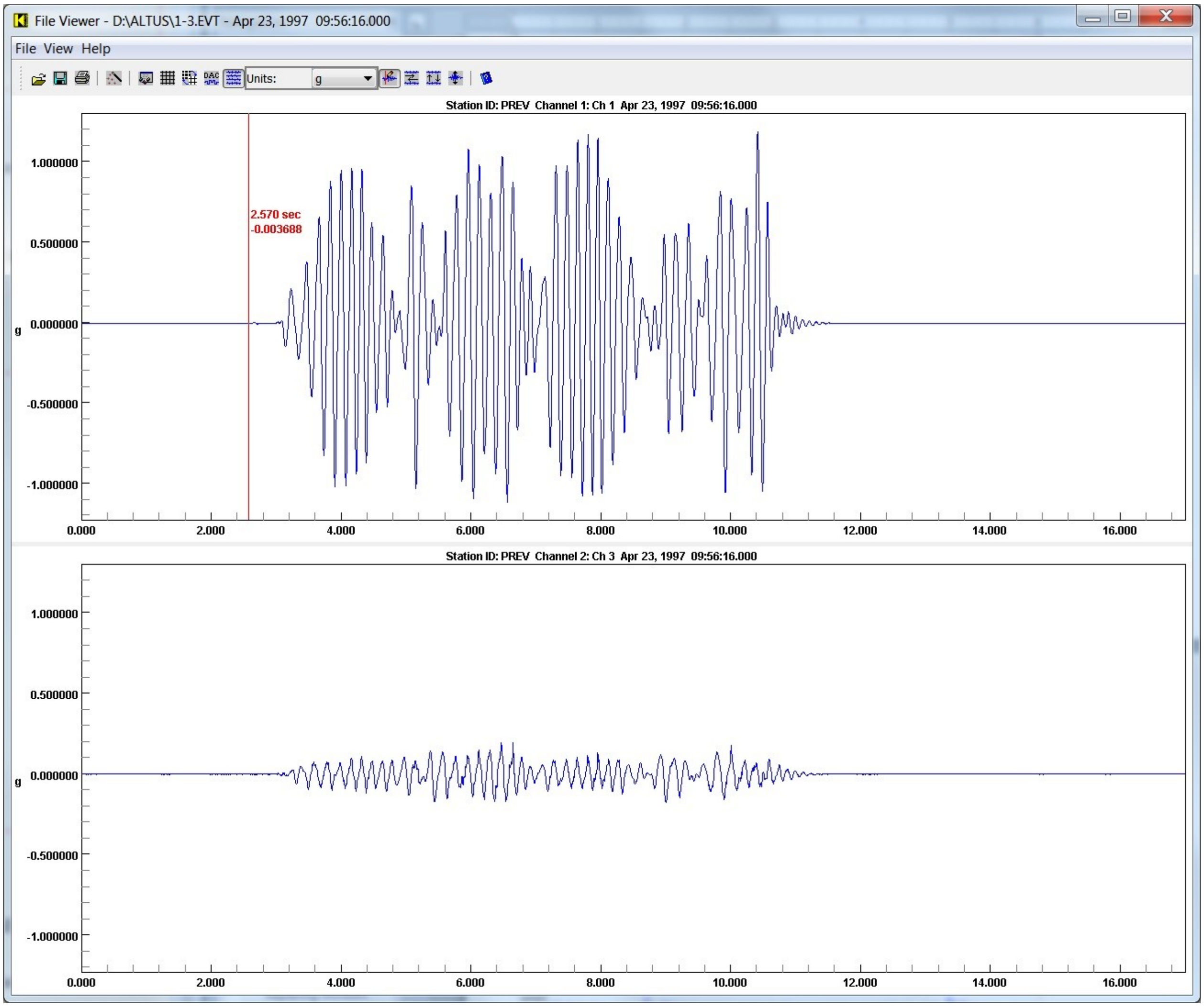


Figure 54: Cursor Display

Re-Sync X-Axes – Allows you to synchronize the display of all channels in the X-axis to show the same time period. You could, for example zoom in on an area of one channel, and then re-sync the other channels to show the same time period.

Re-Sync Y Axes – Allows you to synchronize the display of all channels in the Y-axis to show the same amplitude range. You could, for example zoom in on an area of one channel, and then re-sync the other channels to show the same amplitude range.

Zoom Out – Zooms out to the original full scale range or autoscale setting. About –

Shows the current version of the program.

5.1 File Viewer Dynamic Operation

The File Viewer contains some dynamic display manipulation features as follows:

Zooming: When NOT in Cursor mode, you can zoom on any channel by using the mouse to draw a “box” around the area of interest:

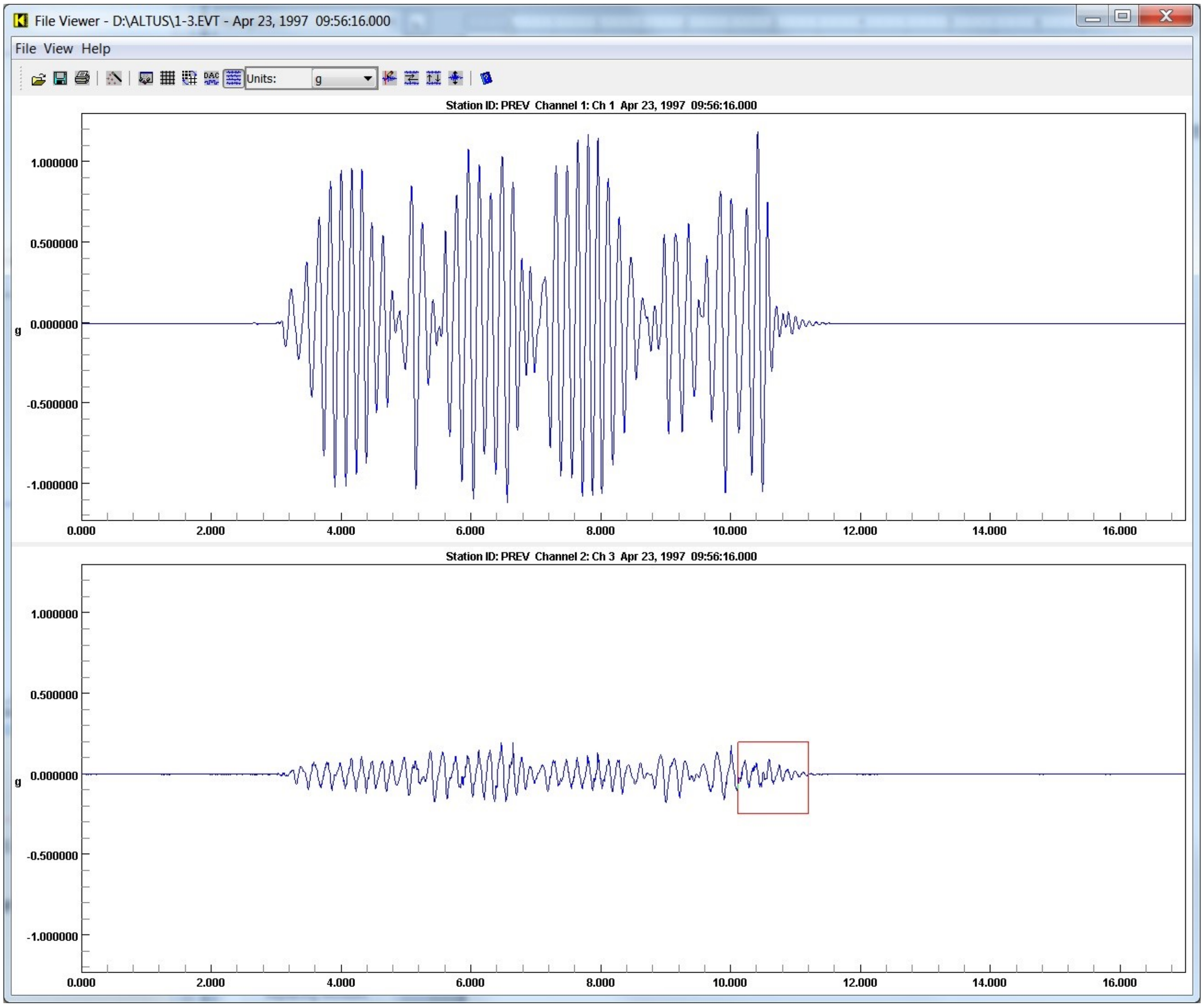


Figure 55: Zooming in

Once zoomed, the display will look like this:

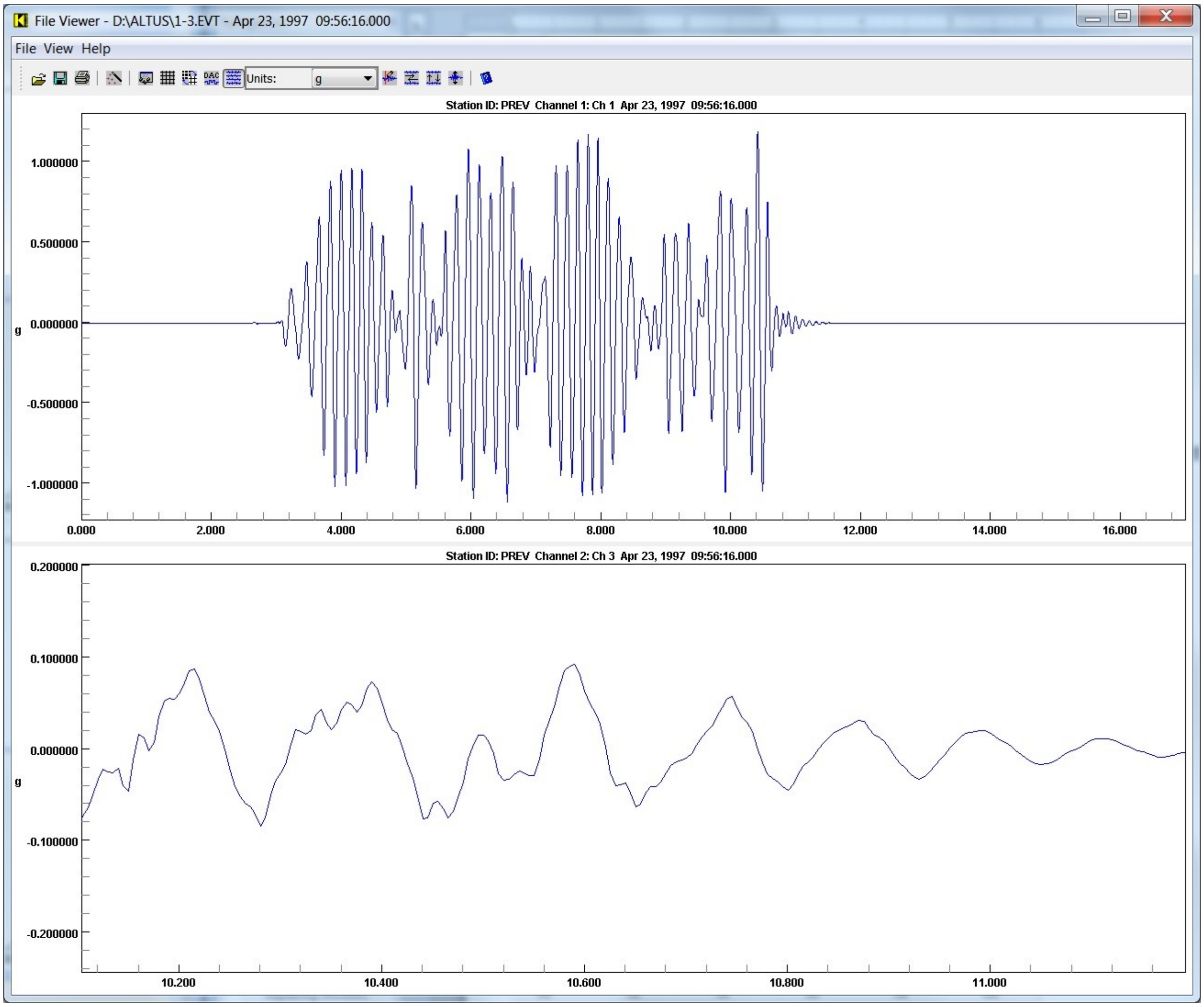


Figure 56: Zoomed in

Note that the zoomed data will show a different amplitude and/or time period. You can zoom in multiple times, and un-zoom one level at a time using a right click of the mouse. Zooming will remember five levels of zoom for each plot.

Panning of the selected plot is also supported regardless of zoom level. The arrow keys allow panning left, right, up, or down.

Chapter 6

Rockhound Command Console

The Rockhound Command Console can be opened in any of a number of ways:

- If you are using RockTalk, then you can open the Command Console using the “Terminal Window” feature of RockTalk.
- You can also open the Command Console using a telnet or PuTTY connection at port 9900
- You can also connect to the system using SSH and then use telnet within the SSH session to open the Command Console on a telnet connection on localhost (127.0.0.1) at port 9900.
    - When opening the Command Console from a Linux terminal window, you can use the shortcut command “rhconsole”

Once open, you will need to know the console password in order to log in.

Command Console parameters are available under System Operation parameters as shown here:

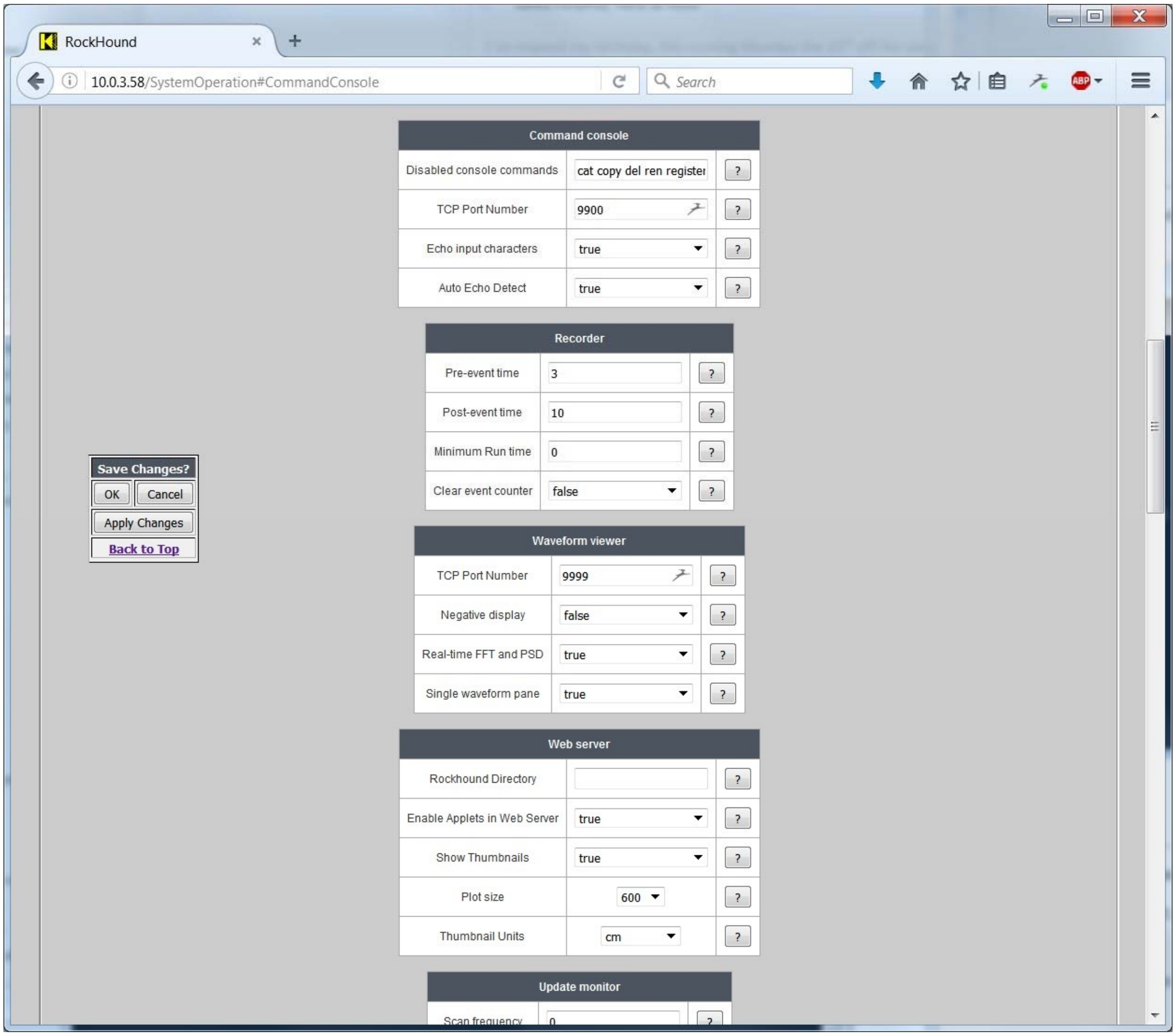


Figure 57: Console Parameters

The Command Console once open will look like this:

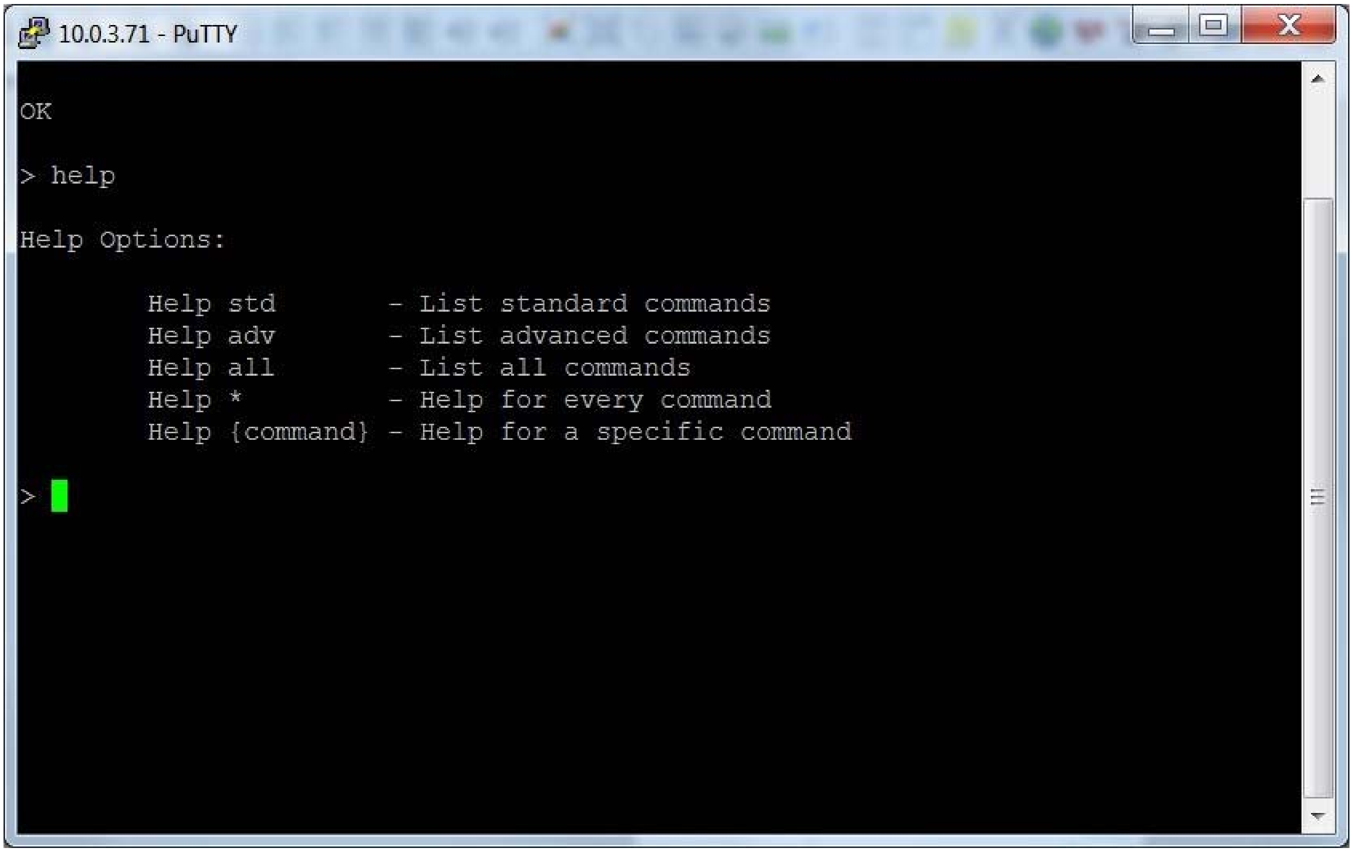


Figure 58: Console Open

The "help" command can be used as shown to list standard, advanced, or all commands. The list of available commands is as follows:

ALARM - Set the state of the Alarm bit.
Usage: ALARM on|off

BASEDIR - Report the base installation directory.
Usage: BASEDIR

BROADCAST - Send a message to all modules.
Usage: BROADCAST {command} [optional argv1] [optional argv2] [...]

CLREVT - Clear event counter.
Usage: CLREVT

CLS - Clears the screen.
Usage: CLS

CRFLUSH - Request an early flush of continuously recorded data files.
Usage: CRFLUSH

CTIME - Display the current time.
Usage: CTIME

DATAFLOW - Display current Data Flow stats.
Usage: DATAFLOW

DEFDECK - Defaults channels 1 to 3 by reading parameters from an internal Episensor deck.
Usage: DEFDECK

DIR - Display a complete directory listing.
Usage: DIR {path}

ECHO - Turns character echo on/off.
Usage: ECHO {on|off}

EEPROM - Display status of board ID EEPROMs.
Usage: EEPROM

EXIT - Exits the console session.
Usage: EXIT

EXTCHARGERTEST - Command a power supply external charger test.
Usage: EXTCHARGERTEST mins

GPS - GPS and Timing control functions.
Usage: GPS STAT: Timing system status
GPS ID: Timing system type and version
GPS RUN: Enable timing system
GPS STOP: Disable timing system
GPS ON: Turn on GPS power
GPS OFF: Turn off GPS power
GPS DIAG on|off|val: Timing system diagnostics vals:
1=Time reports 2=Time verifies vals: 4=Time quality
8=Time syncs vals: 10=Position reports 20=State of health
vals: 40=Satellites & SNRs
GPS DAC on|off: Timing system TCXO reports

Help Options:
Help std - List standard commands
Help adv - List advanced commands
Help all - List all commands
Help * - Help for every command
Help {command} - Help for a specific command

HOSTSERVICES - Report current services and associated port numbers.

HWID - Display the hardware ID string.
Usage: HWID

KBTRI - Keyboard trigger.
Usage: KBTRI (secs)

LS - Display a brief directory listing.
Usage: LS {path}

MINFO - Display info about currently loaded modules.
Usage: MINFO

MKBATCH - Creates a batch file by typing in lines of commands.
Usage: MKBATCH file

MSGLEVEL - Set the level of messages sent to this session.
Usage: MSGLEVEL {level, 0=None, 1=Critical, 2=All}

MSTIME - Display the system time in milliseconds since Epoch.
Usage: MSTIME

NEWSPSATE - Changes sample rate for ATE testing by rebooting.
(intended for factory use only)
Usage: NEWSPSATE sps

NWDEFER - Defers network triggering temporarily.
Usage: NWDEFER secs

PAUSE - Pause and wait for user input.
Usage: PAUSE

PING - Request a PONG reply.
Usage: PING [optional reply text]

PLLCHECK - Checks clock drift and VCO range.
(intended for factory use only)
Usage: PLLCHECK lcerange vcorange

RECONFIG - Command re-read of the configuration files.

RSVERIFY - Verify that unit has not restarted under stress test conditions.
Arg=0 saves current restart for later comparison.
Arg!=0 checks restart count against saved.
(intended for factory use only)
Usage: RSVERIFY rsflag

RTPARAMS - Display current system runtime parameters.
Usage: RTPARAMS [optional key-match]

RUN - Run a batch file by executing commands in it as if they were typed.
Usage: RUN file

SENSORZERO - Removes sensor offset based on 30 seconds of data.
Usage: SENSORZERO

SETDEBUGMASK - Set the debug mask for a given module.
Usage: SETDEBUGMASK {module} [value (default=0)]

SLEEP - Sleep the specified number of seconds.
Usage: SLEEP seconds

SNSCAL - Do sensor calibration.
Usage: SNSCAL (type)

SOHFLUSH - Request a flush of SOH data files when using the optional web server interface.
Usage: SOHFLUSH

STAID - Set station ID and restart.
Usage: STAID auto or STAID name

STEP - Apply the sensor step voltage.
Usage: STEP

STIME - Display the system start time.
Usage: STIME

UNSTEP - Remove the sensor step voltage.
Usage: UNSTEP

USERSTAT - Write numeric parameter to user status stream.
Usage: USERSTAT num

VALIDATE - Validates firmware or config update. If valid may cause restart.
Usage: To validate and restart: VALIDATE UPDATE
To validate and dynamically reconfigure: VALIDATE RECONFIG

VCOCHECK - Check the VCO response by offsetting and monitoring drift.
(intended for factory use only)
Usage: VCOCHECK secs vcodelta mindrift maxdrift

VCOSTABLE - Sets VCO initial value for stable temperature and GPS locked.
(intended for factory use only)
Usage: VCOSTABLE

VCOVERIFY - Verify that VCO has not changed.
Arg=0 saves current VCO for later comparison. Arg!=0 checks VCO against saved.
(intended for factory use only)
Usage: VCOVERIFY vcorange

VER - Display the software and hardware version numbers.
Usage: VER

VMBYTES - Display the total bytes available, and bytes free in the VM.
Usage: VMBYTES

VMERROR - Exits the VM with error 99 (for testing).
Usage: VMERROR

VMEXIT - Exits the VM.
Usage: VMEXIT

VMGC - Force Garbage Collection in the VM.
Usage: VMGC

VMCRASH - Deliberately place a VM thread into an infinite loop (for testing).
Usage: VMLOCKUP

VMOOM - Deliberately crash the VM by consuming all heap space (for testing).
Usage: VMOOM

VMPROPS - Display the Virtual Machine properties.
Usage: VMPROPS

VTDSET - Set voltage range during ATE testing. 0=2.5V, 1=5V, 2=20V
(intended for factory use only)
Usage: VTDSET range

WATCHDOGTEST - Cause a system restart via a software watchdog.
Usage: WATCHDOGTEST

6.1 Batch Mode

The Rockhound Command Console supports a limited batch mode process to make it somewhat easier to perform routine activities such as periodic maintenance. The MKBATCH command is used to create a batch file by name, accepting input until RETURN only is entered. Lines of the file are executed as commands as if typed by the user. Lines starting with ";" or "#" are treated as comments and ignored.

The batch file will be created with the extension ".BAT" on the unit. For example:

```
> mkbatch mybatch
Type in lines of commands, one command per line.
When done, press RETURN only to close the file.
> ; Quarterly Maintenance
> ; Get GPS status
> gps stat
> ; Do a sensor calibration
> snscal
> Batch file creation complete. >
```

To run the batch file, type:

```
> run mybatch
```

Chapter 7

Non-Networked Use

If you don't intend to normally connect your Etna2 to a network, we still recommend that you set up the Etna2's network so that you can control it from your local PC when you're on site.

7.1 Standalone

To communicate directly between the Etna2 and a PC over Ethernet without using any supporting network hardware, you'll connect to the PC using an Ethernet crossover cable. Once connected, you should be able to operate the Etna2 in its typical networked modes. In this case, we recommend the following parameters: Etna2:

- IP Address: 192.168.1.1
- Netmask: 255.255.255.0
- Gateway: 192.168.1.100
- DNS: None PC:

- IP Address: 192.168.1.100
- Netmask: 255.255.255.0
- Gateway: 192.168.1.100
- DNS: None

7.2 Acting as a DHCP Server

You may also consider configuring the Etna2 to act as a DHCP server, meaning that the Etna2 can supply the IP address to your PC when you connect it without having to reconfigure the PC. Using the Etna2 as a DHCP server can only be done if the Etna2 is not on a network with another DHCP server, such as in a standalone configuration. To use the Etna2 as a DHCP server: Etna2:

- IP address: 192.168.9.1
- Netmask: 255.255.255.0
- Gateway: 192.168.9.1
- DNS: None

Then enable the DHCP server:

initdconfig isc-dhcp-server on reboot

PC:

- IP address: Automatically assigned

When configured as a DHCP server as alove, the Etna2 will serve addresses in the range 192.168.9.100-200 by default. More in depth configuration is available to the savvy user who may edit /etc/dhcp/ at their own risk.

7.3 Multiple Units

If you will have multiple Etna2s on an internal network at the site and you will NOT use a DHCP server (you need static addresses), then we suggest using an addressing sequence such as 192.168.1.10 for the first, 192.168.1.11 for the second, and so on. Reserve the address 192.168.1.1 (or the equivalent) for a router that might be used later.

Chapter 8

Storage

The unit supports various storage options including one internal System (software) SDHC card (required), one internal Data SDHC card (required), and additional external storage via USB Thumb Drives.

Memory cards provided through Kinemetrics are Industrial Temperature range (-25 degrees C through +85 degrees C) to be compatible with the overall temperature specifications of the unit.

Kinemetrics DOES NOT recommend the use of commercial grade memory cards (although they are definitely less expensive) unless the user clearly understands that by using them they are degrading the overall temperature range of the equipment (and life expectancy of the cards themselves).

NOTE: Use of commercial grade memory cards may compromise correct operation of the unit, cause loss of important data, or both.

8.1 System SDHC Flash

The system card is internal to the unit's case and is not physically accessible by the user. The card contains the operating system and applications software that will be used to operate the unit. Typically, user data is stored on another memory card. As of this writing, all Etna2s ship with a 4GB SDHC System card.

Should it become necessary to replace the System card, please contact Kinemetrics for support.

CAUTION: Possible equipment damage. If it becomes necessary to open the unit and you do not correctly replace the lid and the seal screw the watertight integrity of the unit can be compromised and damage can occur.

Potential ESD equipment damage. The Etna2 circuit boards contain CMOS components that can be damaged by electrostatic dis charge (ESD) if not properly handled. Use a grounded wrist strap, with impedance of approximately 1 MOhm, to protect components from ESD damage when handling circuit boards. Before removing any circuit boards or disconnecting any internal cables, be sure that all batteries and the charger are disconnected.

8.2 Data SDHC Flash

The data card is internal to the unit's case and is not physically accessible to the user. The card holds recorded data and working data.

Data to be offloaded to a USB Thumb Drive is recorded on the Data card, and then copied to the Thumb Drive.

As of this writing, all Etna2s ship with a 32GB SDHC Data card.

8.3 USB Subsystem

The Etna2 supports USB 2.0 with one dual function USB Device/Host port and one dedicated USB Host port.

The difference between a USB Host and a USB Device is a significant one. Generally, you can think of a USB Host as a computer and a USB Device as a "device". So for example, when you plug a USB Thumb Drive into your computer, the computer is the USB *Host* and the Thumb Drive is the USB *Device*.

In general, a Device must talk to a Host. Two Devices cannot talk to each other and *generally speaking* two USB Hosts can't either.

The Etna2 is not a general purpose computer. It has to be programmed specifically for every device it supports. Only specific devices are known or expected to work, although this list is expected to grow over time. At the moment, only the following are true:

- The Etna2's dual function USB Device/Host allows you to connect to your PC as a virtual COM port. This can be helpful when you need to log into Linux but do not have a "serial port" available on your computer. Later versions of Windows and Linux will automatically load the proper driver to talk to the Etna2's USB device.
  - With the correct cable, you can also connect a USB device (such as a thumb drive or cellular modem) to the dual function port. Once you do this, the Etna2 software will reconfigure the port to act as a host to that the USB device can be used. Once connected, the port will act as a USB Host until the Etna2 is rebooted.
- The USB Host port can be used to connect USB Thumb Drives. As of this writing, every model of thumb drive we have tested has worked OK.
- The USB Host port can be used to communicate with a limited subset of wi-fi and cellular modem adapters.

We would discourage the use of USB devices that draw significant power, or the use of line-powered USB hubs.

(The Etna2 can provide up to 0.5A to each USB device, but this is equivalent to the entire power use of the unit in normal operation.)

8.3.1 USB Device

When you plug the USB Device cable into your PC, the proper driver will automatically be loaded on most modern versions of Linux or Windows. Make sure that your computer is connected to the internet in case it needs to search for the driver.

Remember that the Etna2's dual function USB Device/Host port will only function as a USB device after reboot. If you plug a USB device (such as a thumb drive) into the port, then the port will be configured as a USB Host until the unit is rebooted.

Once identified the Etna2 USB device connection will appear to your computer as a COM port. On Windows you might need to look at the Device Manager to get the COM port number (which usually will remain the same if you use the same physical port). Once you know the port, you can open the connection with PuTTY or your favorite terminal program. Hit <RETURN> to get a login prompt and get started.

NOTE: On the virtual COM port, baud rate and flow control values are not used.

8.3.2 USB Host

The USB Host port is used to communicate with USB Devices such as USB Thumb Drives, and a limited subset of wi-fi and cellular modem adapters.

8.3.2.1 USB Thumb Drives

The Etna2 leaves drives unmounted normally. This means that virtually all of the time it is safe to remove the drive without corrupting the data on it.

The data formats used on the USB Thumb Drive that is supported by the Etna2 is Windows VFAT or Linux EXT3. VFAT format can also be read directly by Windows, MacOS, or Linux. EXT3 will require some additional software on your PC.

Drives larger than 32GB require use of the Linux EXT3 file system. Windows filesystems that support drives larger than 32GB will likely not be supported by non-Windows machines because the exFAT and NTFS filesystems that support drives larger than 32GB are proprietary to Microsoft.

Using an EXT3 filesystem has additional advantages over a FAT filesystem because EXT3 is a journalled filesystem and is less easily corrupted - more important the larger the drives become.

Accessing EXT3 is also significantly faster if you have a lot of data files - so if you use USB drives to offload at lot of continuously recorded data files we would recommend using EXT3 even for drives smaller than 32GB.

The Etna2 has facilities to format thumb drives for an EXT3 file system and utilities such as Linux Reader are available to allow you to read these drives under Windows. EXT3 formatted drives should be fully supported in MacOS and all versions of Linux.

Software to read Linux EXT3 file systems on a Windows PC is posted on the KMI Support Wiki. It is called Linux Reader.

When a USB Thumb Drive is detected, the Etna2 will identify the drive, mount it, copy data to it, and then unmount it.

The directories copied to from the Etna2 to the USB Thumb Drive include everything stored under the /data directory with the exception of:

- /data/rb (normally used to hold an RBServer ring buffer)
- /data/sys (reserved for future use)

Data will be copied to the directory /kmi/data/uname-unitid where:

- **uname** is the Etna2's host name
- **unitid** is the Etna2's Tag number (serial number)

The Etna2 can support up to two USB Thumb Drives, one on each port. The two drives are treated as "mirrors" of each other, and all will get copies of the same data. Make sure the USB Thumb Drive is large enough to copy off all data you want. There is no provision for spanning data over multiple smaller drives.

The status of the data offloading operation is indicated on the Media LED as follows:

- Off - Drive is unused and may be inserted or removed
- Green - Drive is being mounted
- Green flashing - Data is being copied to/from the drive

8.3.2.2 Drive Formatting

USB drives can be formatted in the system with the command “usbdriveformat”. This command will take you through the process of selecting the file format (VFAT or EXT3), removing and re-inserting the data drives, and then formatting the drive itself.

The command “usbdrvwipe” can be used to quickly erase the contents of all USB thumb drives. The action must be confirmed by the user, but once done cannot be undone.

On insertion the Etna2 will adapt to use of VFAT or EXT3 formatted drives.

8.3.2.3 Drive Transfer Modes

By default the Etna2 will transfer all available data files to an inserted thumb drive. When new files are created, any new files will be transferred at the next opportunity. In addition, if files are updated (or were not complete at the last transfer) then updated copies of the files will be transferred.

Drive transfer mode can be selected with the command “usbxferconfig mode” where “mode” is as follows:

- ALL - Transfers all files not currently stored on the drive (default)
- LATEST - Transfers only files less than 2 days old. This mode is useful when periodically replacing drives to extract continuously recorded data. A small overlap protects against data loss without filling the drive with lots of redundant data.

8.3.2.4 Temporary Insertion

If a USB Thumb Drive is temporarily inserted to extract data, you can insert a drive and wait for the Media LED to blink and then go off again. Then remove the drive. If you insert the same drive again, only new data will be copied to the drive (which might mean no new data is copied).

If you want multiple copies of the data, use multiple drives and insert and remove them one at a time.

8.3.2.5 When left inserted

If you leave one or more USB drives inserted, the will be mounted and offloaded to once per hour. This allows you to automatically offload continuously recorded data (or a lot of recorded events). Note:

- If multiple drives are used, then will be serviced one at a time in sequence
- The hourly offloads are not necessarily on the hour

8.3.2.6 Firmware updates

The USB Thumb Drive can be used to install software/firmware updates.

To install firmware from the drive, place the update files in the folder /updates on the drive. Insert the drive and wait for the Media LED to blink and then go off again, then power cycle the unit to install the software.

The software files that can be installed are as follows:

- Rockhound updates named rockhound_update-XX.jar
- Tomcat (web server) updates named tomcat_rh_update-XX.war
- Linux updates named NN-xx (where NN is a numeric value and xx is any string)
- A Multi-update file named Multi_update-XX.tgz

8.3.2.7 Passwording

Passwording is often not necessary since use of a USB Thumb Drive requires that you have physical access to the Etna2 (meaning you could just steal the unit rather than extracting data).

However, a passwording provision exists as follows:

- The command usbdatapass can be run from Linux to set a required password that must match the contents of the file /data/usb_data_pass on the drive.
- The command usbupdpass can be run from Linux to set a required password that must match the contents of the file /updates/usb_update_pass on the drive.

If the password does not match, the protected operation will not happen.

8.3.3 USB WiFi

The Etna2 supports the use of a TP-Link TL-WN721N, and the Netgear WNA1100 USB WiFi adapters. While other adapters may work, they have not been tested and are unsupported.

The USB WiFi adapter can operate as a client or in Access Point (AP) mode.

Configuration requires console access and root login. Items

Needed Before Configuration:

1. A WiFi access point if using client mode.
2. The SSID and password.

3. Knowledge of the security mode (WPA/WPA2, WEP, or Unsecured)
4. An available IP address if using a static IP.
5. A known free channel in your location if using Access Point mode.

8.3.3.1 Setting Up WiFi

netconfig is used for WiFi configuration. For the maximum WiFi options you should choose to set "eth0" disabled. If you want to use Access Point mode then "eth0" must be disabled. If you want to use WiFi with DHCP then you may not use DHCP for "eth0", but you may use a static IP.

Run netconfig and follow the prompts.

After you get past the setup for "eth0" you will be asked about the "Mode for USB wireless adapter wlan0". Here you can make your choices and supply the info collected above.

After completing netconfig reboot and verify network operation.

8.3.3.2 WiFi Verification

If you chose client mode you can verify operation by pinging an outside host. If you chose Access Point mode you will need a PC/laptop/etc which you can configure to connect to the unit and observe on that device that you are successful.

8.3.4 USB Cellular Modem

The Etna2 supports 2 models of USB Cellular Modem manufactured by MultiTech, the MTC_H5 and the MTC_EV3.

The MTC_H5 is a GSM modem which supports the ATT network. The MTC_EV3 is a CDMA modem which supports the Verizon network.

You will need to register your modem with the provider and have an active account with them before setup. You must be sure to deploy the modem in a location that has adequate RF signal strength. This is can be verified on the spot with a cell phone from the SAME provider. These modems require an external antenna which MUST be connected. Do not plug in the unit without an antenna connected.

The following will guide you through a full-time modem setup. An as-needed connection is also possible and requires choosing the "AS_NEEDED_CELLULAR" option in pppconfig instead. An as-needed connection will only be active when Rockhound deems it necessary.

Configuration requires console access and root login.

8.3.4.1 Setting Up The MTC_H5_GSM On ATT

Be sure the antenna is connected then plug the USB cable into a Etna2 USB host port. You will need the following from the provider:

1. A registered SIM card installed in the modem.
2. Dial-Out Ph#: Typically "*99#"
3. APN String: i.e: "i2gold"

Run "pppconfig" and choose "FULLTIME_CELLULAR".

Continue and supply the above provider-supplied info when prompted.

You will also be asked for a "Reliable host IP address" that the PPP process can occasionally ping to verify connectivity. You should supply an IP address for a public host that you own which has a high up-time. For example, your organization’s web server. This host must be able to respond to ping requests.

You will also be asked for a "Network IP address for PPP traffic routing". This is typically left BLANK, and should only be used by advanced users who need a special route added.

After pppconfig completes be sure to REBOOT and verify network operation.

8.3.4.2 Setting Up The MTC_EV3_CDMA On Verizon

Be sure the antenna is connected then plug the USB cable into a Etna2 USB host port.

The MTC_EV3_CDMA modem requires a 1-time activation on the Verizon network. This is best done in the same general location that the modem will be deployed, and requires that adequate RF signal strength be available.

To activate the modem be sure that no modem is currently configured. (You can use pppconfig to delete a previous config if needed.)

Run the following to activate the modem and follow the prompts:

```
activate-mtc-ev3
```

This usually completes in about 1 minute. Activation only needs to be done once, unless you change regions i.e: Moving from the West coast to the East coast. In this case re-run activation once at the new site.

You will need the following from the provider:

1. Dial-Out Ph#: Typically "#777"
2. Dial-Out user: Cell Ph# for modem.
3. Password: i.e: "vzw"

Run "pppconfig" and choose "FULLTIME_CELLULAR".

Continue and supply the above provider-supplied info when prompted.

You will also be asked for a "Reliable host IP address" that the PPP process can occasionally ping to verify connectivity. You should supply an IP address for a public host that you own which has a high up-time. For example, your organization's web server. This host must be able to respond to ping requests.

You will also be asked for a "Network IP address for PPP traffic routing". This is typically left BLANK, and should only be used by advanced users who need a special route added.

After pppconfig completes be sure to REBOOT and verify network operation.

8.3.4.3 Cellular Verification After Setup

After reboot you may need to wait a couple minutes for the modem to establish a connection. You can verify a full-time cellular connection by typing “ifconfig” and observing that “ppp0” is present.

If you chose an as-needed connection then you can manually force it to connect by typing “pppdial”, then use “ifconfig” to see that “ppp0” is present. Note: This connection will drop after a few minutes of inactivity.

You should also ping an outside host to verify the connection. i.e:

ping nnn.nnn.nnn.nnn

Chapter 9

FAQs

9.1 What is “dig1”?

Sometimes in looking at the parameters or other information, you’ll see “dig1”. This represents the current unit (for example, your Etna2). This is used because the general Rockhound software is capable of collecting data from more than one unit (as is sometimes done when Rockhound is run on a PC or on a Slate).

It would also be possible and useful in some applications to collect data from another digitizer (such as a Q330 or a K2) and collect and process it within the local unit digitizer. In this case, the local unit would be “dig1”, and a second digitizer would be “dig2”.

9.2 Changing trigger levels

To change trigger levels, use the web interface to open Configuration parameters, and then locate the trigger for the selected virtual channel:

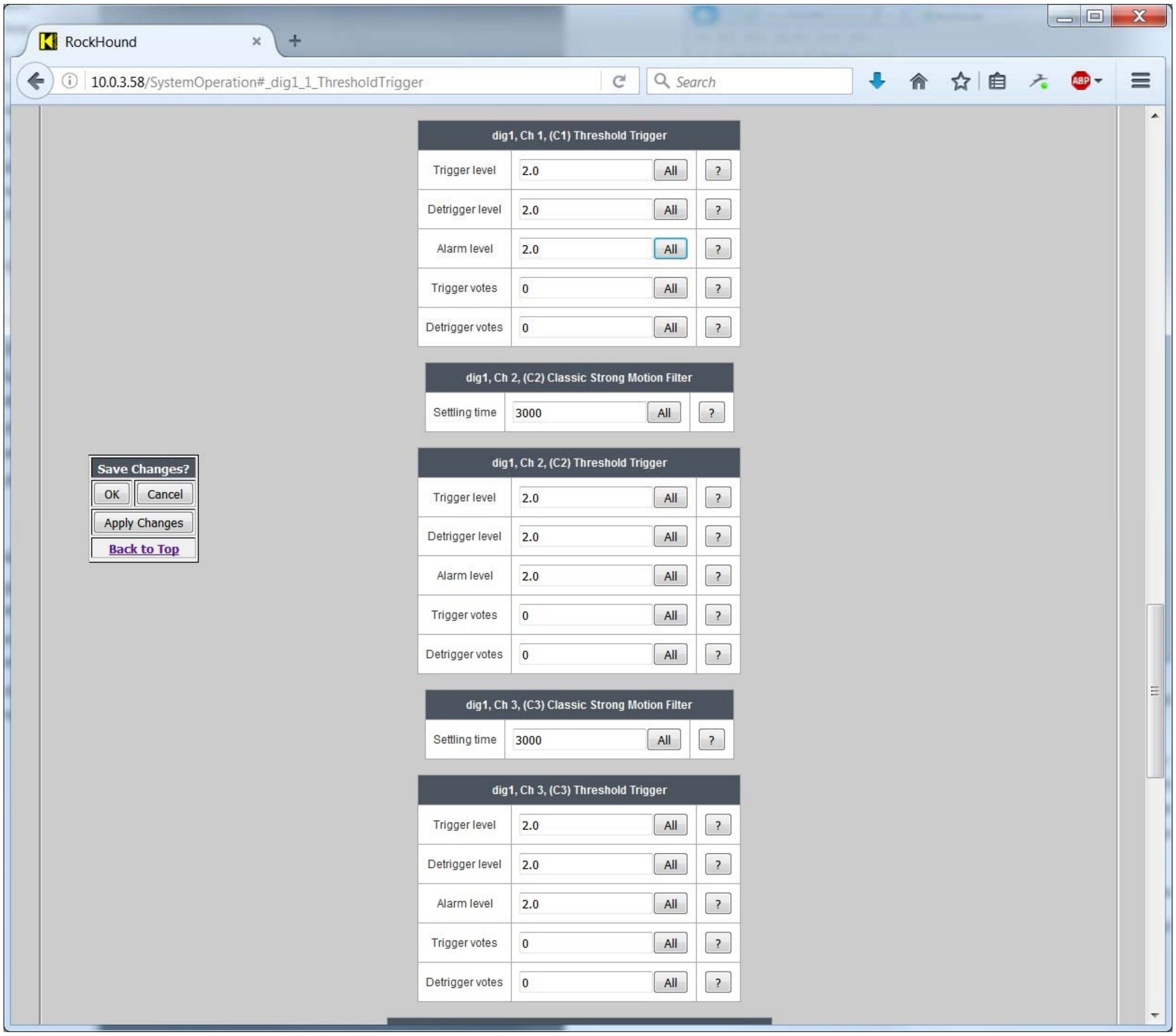


Figure 59: Trigger Levels

Trigger levels are the level at which the system will decide that a channel is triggered and that it should contribute that channel's votes toward triggering the entire system. By default, the system uses threshold triggers, which are set as a percentage of full scale. So if your full scale range is +/-2G and your threshold is set to 2%, then your trigger level is 2% of 2G, or 0.04G.

After completing your changes, be sure to press OK to save your changes.

Once you have completed your parameter changes, activate the completed parameter changes by selecting "Apply Changes".

9.3 Using Different Triggers or Trigger Filters

To use a different type of trigger (e.g. an STA/LTA trigger rather than a Threshold Trigger), or to use a different trigger filter (e.g. an IIR Filter rather than the Classic Strong Motion

Filter), you need to replace the corresponding modules in the layout. Note that you can select different triggers and different trigger filters for each virtual channel. For example, to replace the Threshold Trigger for virtual channel 3 with an STA/LTA Trigger, use the web interface. Choose Module Replace from the Tools menu:

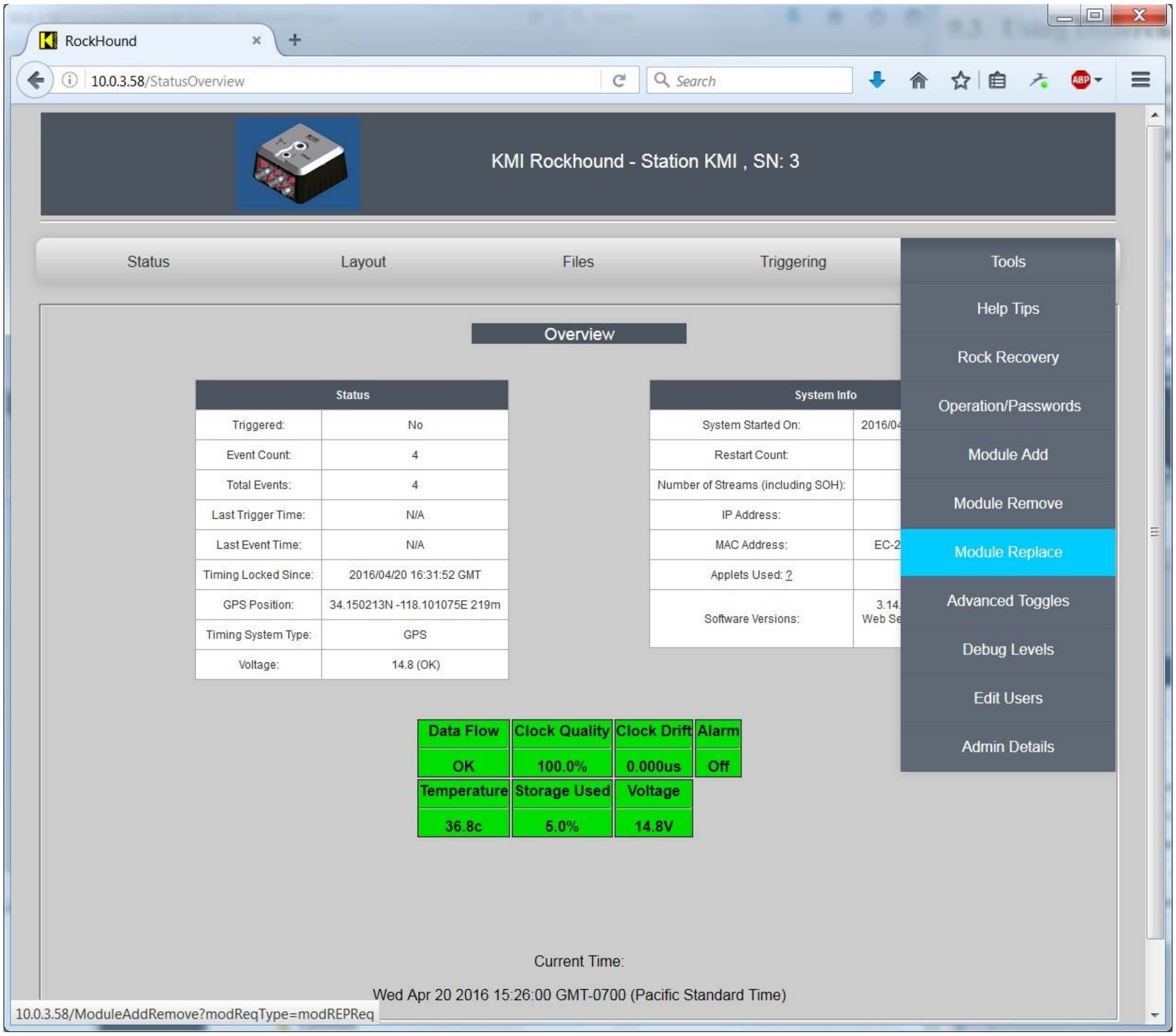


Figure 60: Module Replace

You will now see:

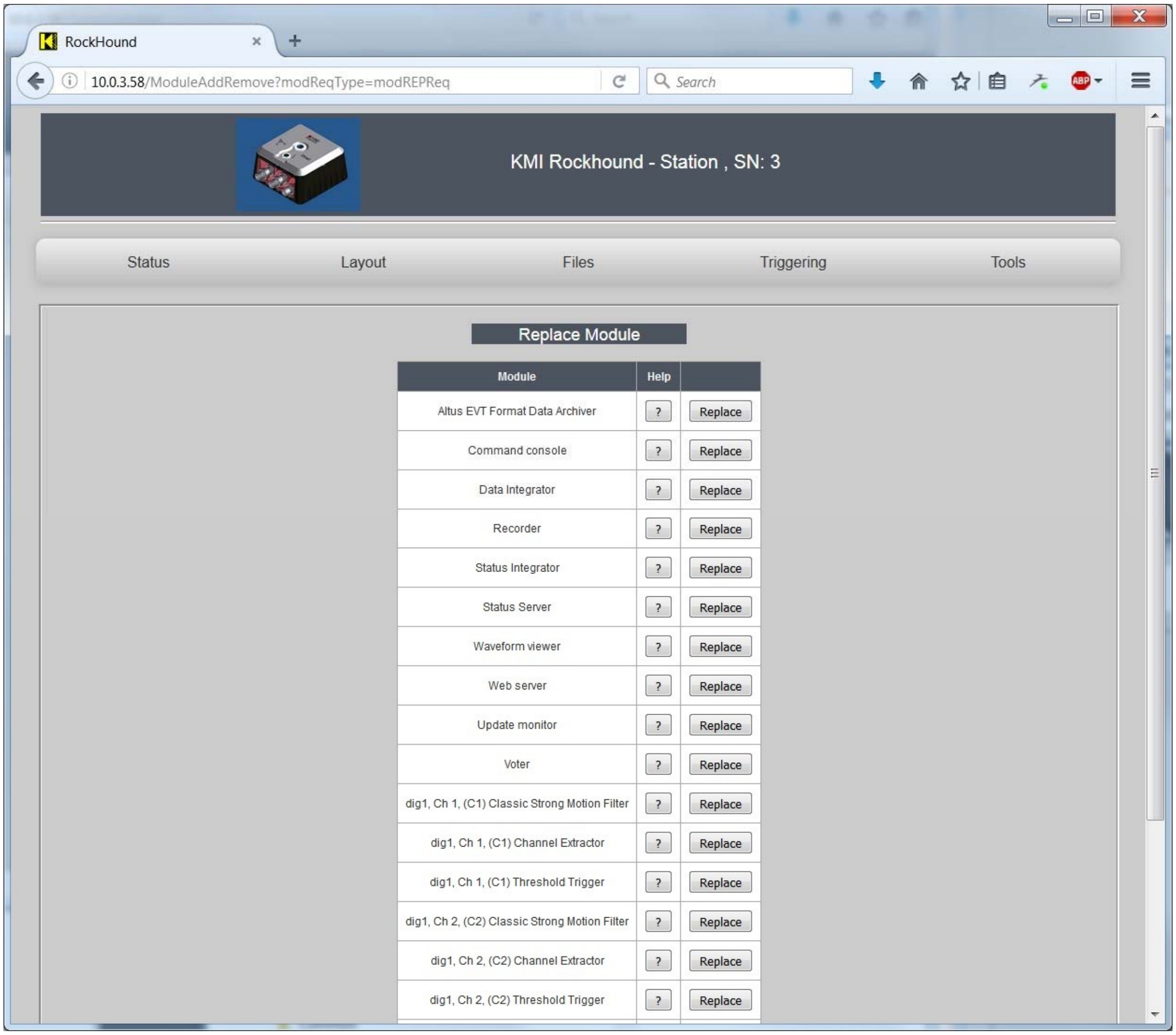


Figure 61: Module Replacement Options

Click "Replace" for the Channel 2 Threshold Trigger and you'll see your choices:

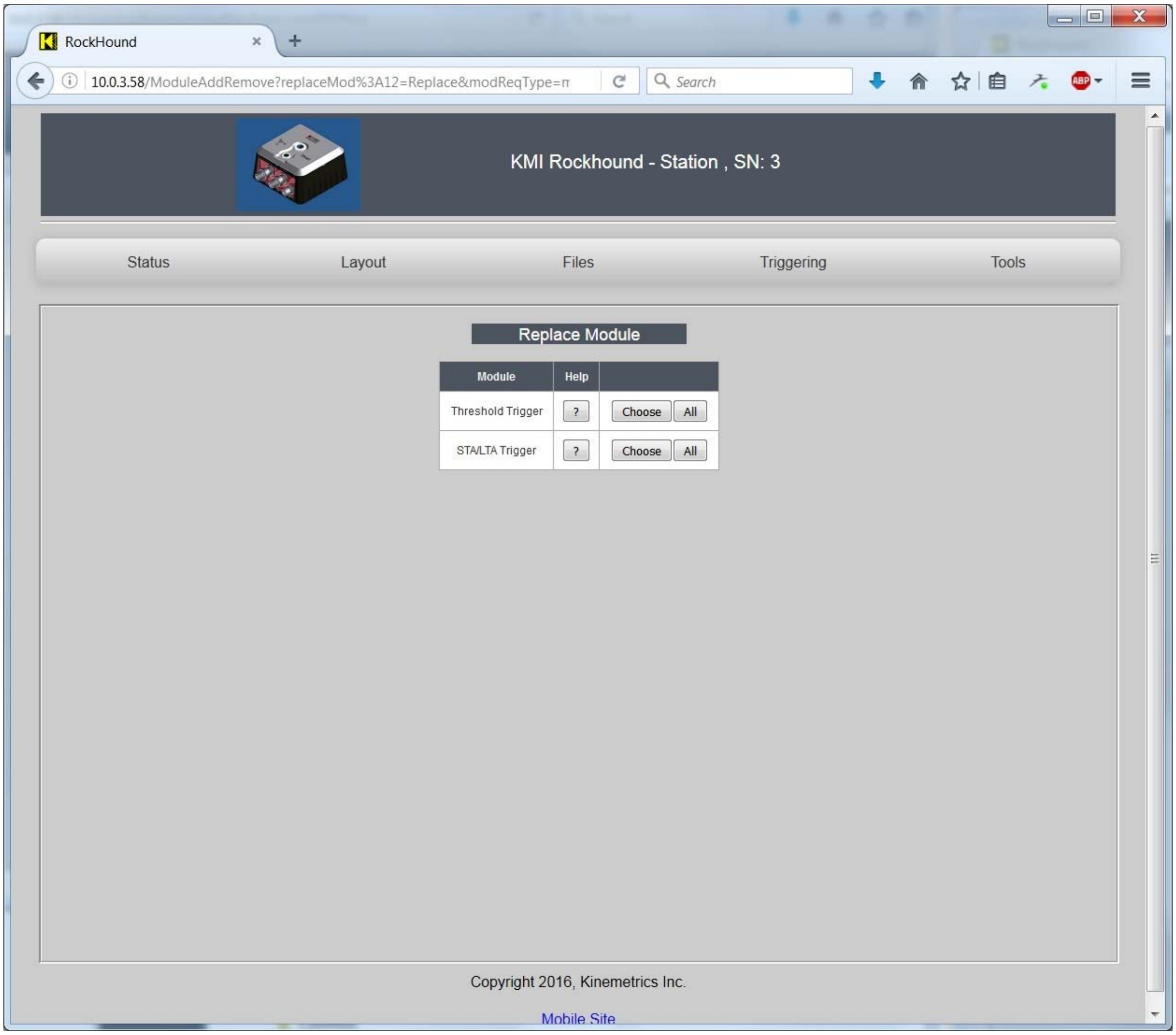


Figure 62: Replacing Trigger Module

If you select "Choose" next to STA/LTA, then you'll replace the Threshold Trigger for channel 2 only. If you select "All", you'll get a chance to replace all Threshold Triggers in the system with STA/LTA Triggers.

If you select "All", then the Module Replacement screen will now look like this:

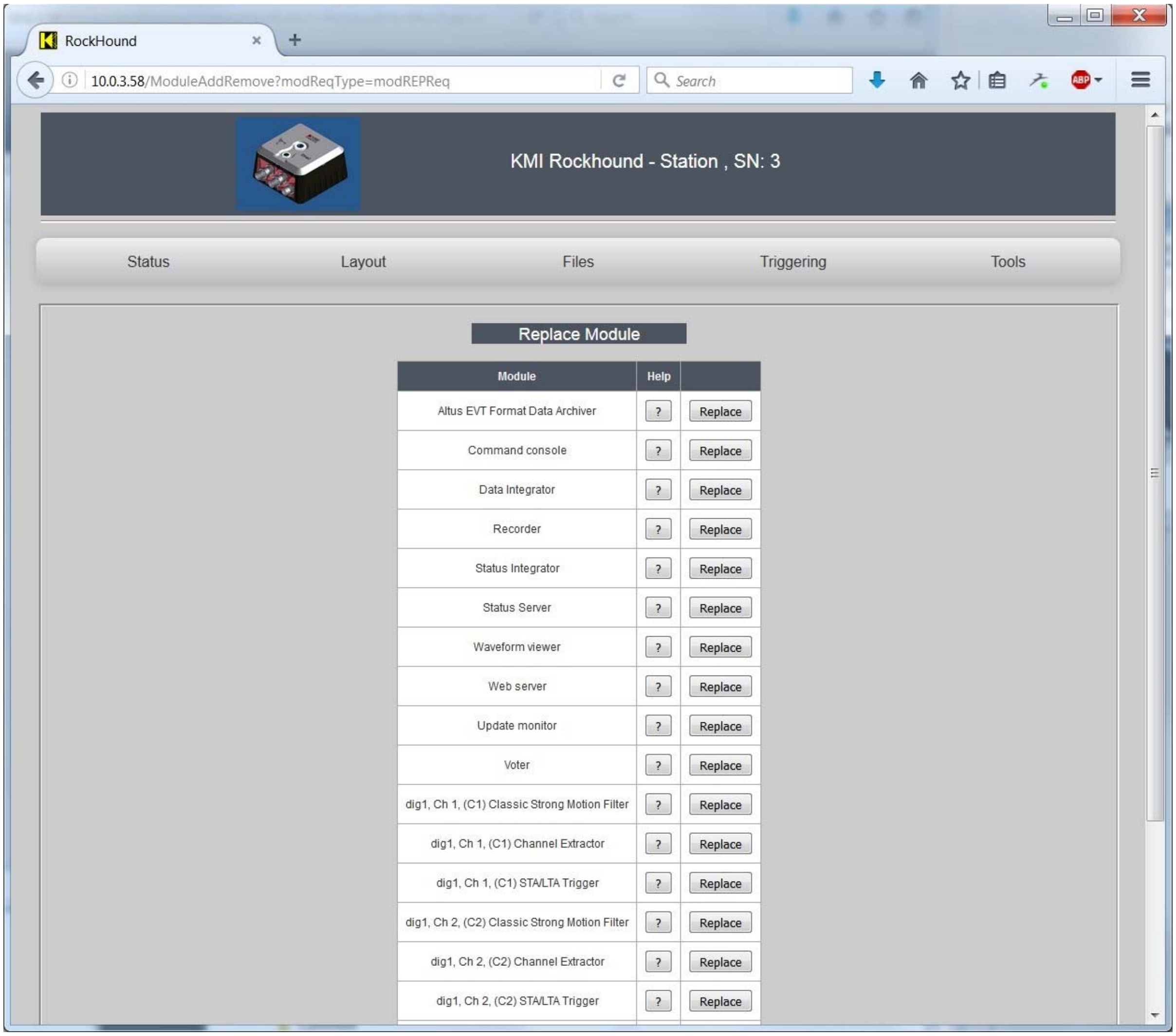


Figure 63: Modules Replaced

Once you have completed your parameter changes, activate the completed parameter changes by selecting "Apply Changes".

9.4 Adding Channels

Strictly speaking, you cannot “add” channels to an existing layout.

The Etna2 supports data generation at two different sample rates, so the default configuration for an Etna2 produces three physical channels and six virtual channels. This would allow you (for example) to produce data channels as follows:

Physical	Virtual
1	Physical 1 at 100sps
2	Physical 2 at 100sps
3	Physical 3 at 100sps
1	Physical 1 at 10sps
2	Physical 2 at 10sps
3	Physical 3 at 10sps

This module layout by default will have the first three channels flowing through the triggering system, but the second three channels will not. In addition, the second three channels are disabled by default. You can reconfigure these channels as needed from the Configuration menu.

For recording purposes, you’ll have to decide whether to record all channels at both sample rates when there is a trigger, or to limit recording to only one set of channels, using the Channel List parameter or the Record Only parameter.

The Channel List parameter allows you great flexibility in that you can choose each channel to be recorded.

The Record Only parameter is not as flexible, but is easier to set up for many situations. For example, if you only want to record the 100sps data in EVT file format, then set Record Only to “100sps” and only the 100sps channels will be recorded. Be careful to set this parameter correctly because it is possible to make mistakes such as telling the Etna2 Data Interface to produce two sample rates - say 200sps and 10sps and then tell the EVT Archiver to “Record Only” 100sps. The result is that NOTHING is recorded because the data rate selected for recording is not being produced.

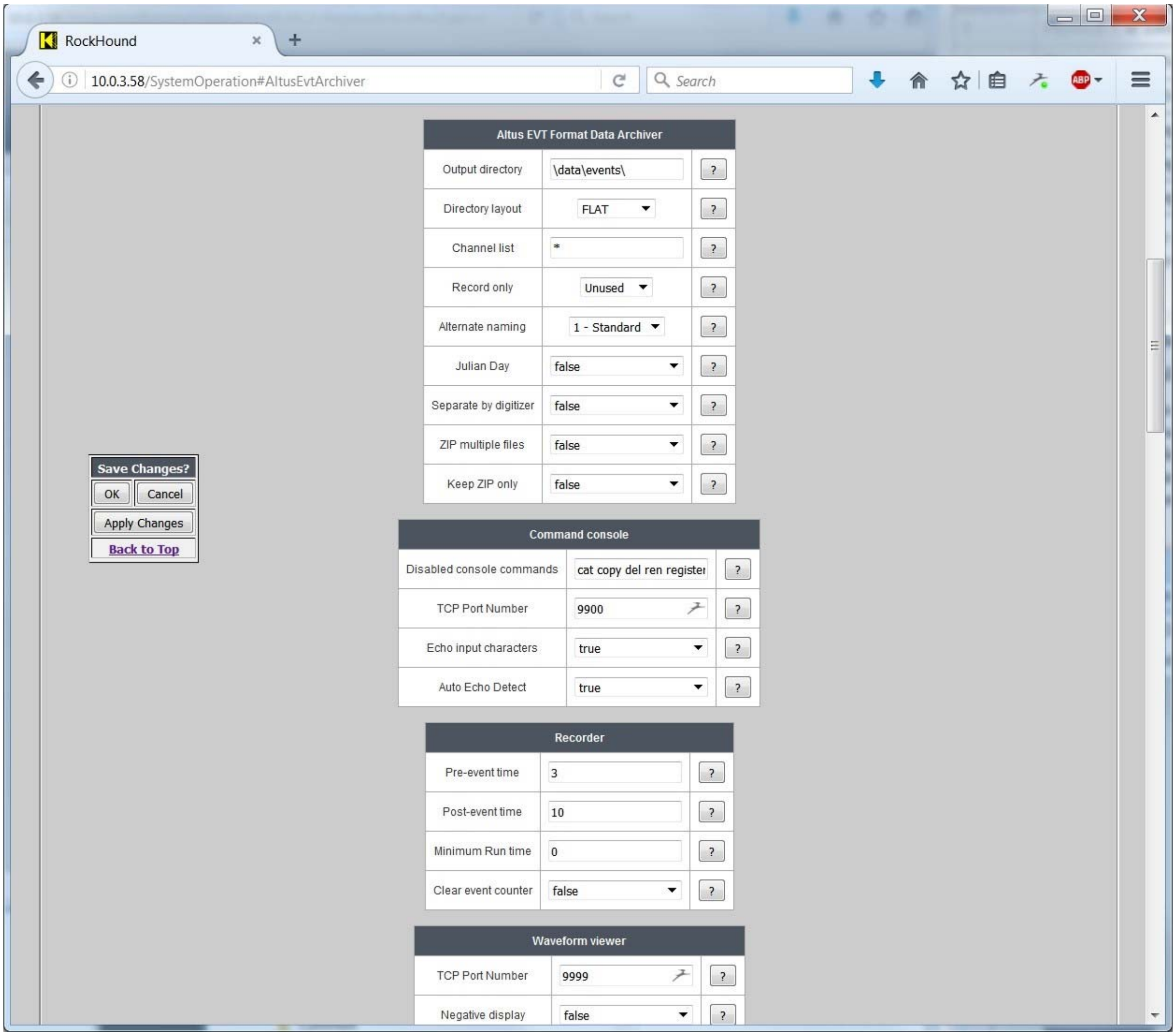


Figure 64: Channel List

A Channel List of “*” will record all channels. A channel list of “dig1:1, dig1:2 ... dig1:3” will record only the first 3 channels. See Layout Wizard .

9.5 Switching Between Layouts

If you will sometimes operate in one mode, and then another time operate in a completely different mode, you can save two or more layouts by keeping a copy of the layout and the parameter configuration for each, all of which is kept in a single file called “config.jar”.

The first thing you need to do is to build a layout and configure the parameters the way you want them to be. Then, from the web interface go to Admin Details from the Tools menu and click Parameters to download and save a copy of the parameters. You can give this file you are saving a name that is meaningful to you such as “event-recorder-at-10sps-and200sps.jar”. Repeat this process with as many system configurations as you need.

To put a layout that you’ve saved back on the system, use the web interface and go to Admin Details from the Tools menu and find Send Parameters File. Browse to the .jar file that you want to send back and then click Send. After the file is uploaded, click Verify/Apply Patch to verify and load it:

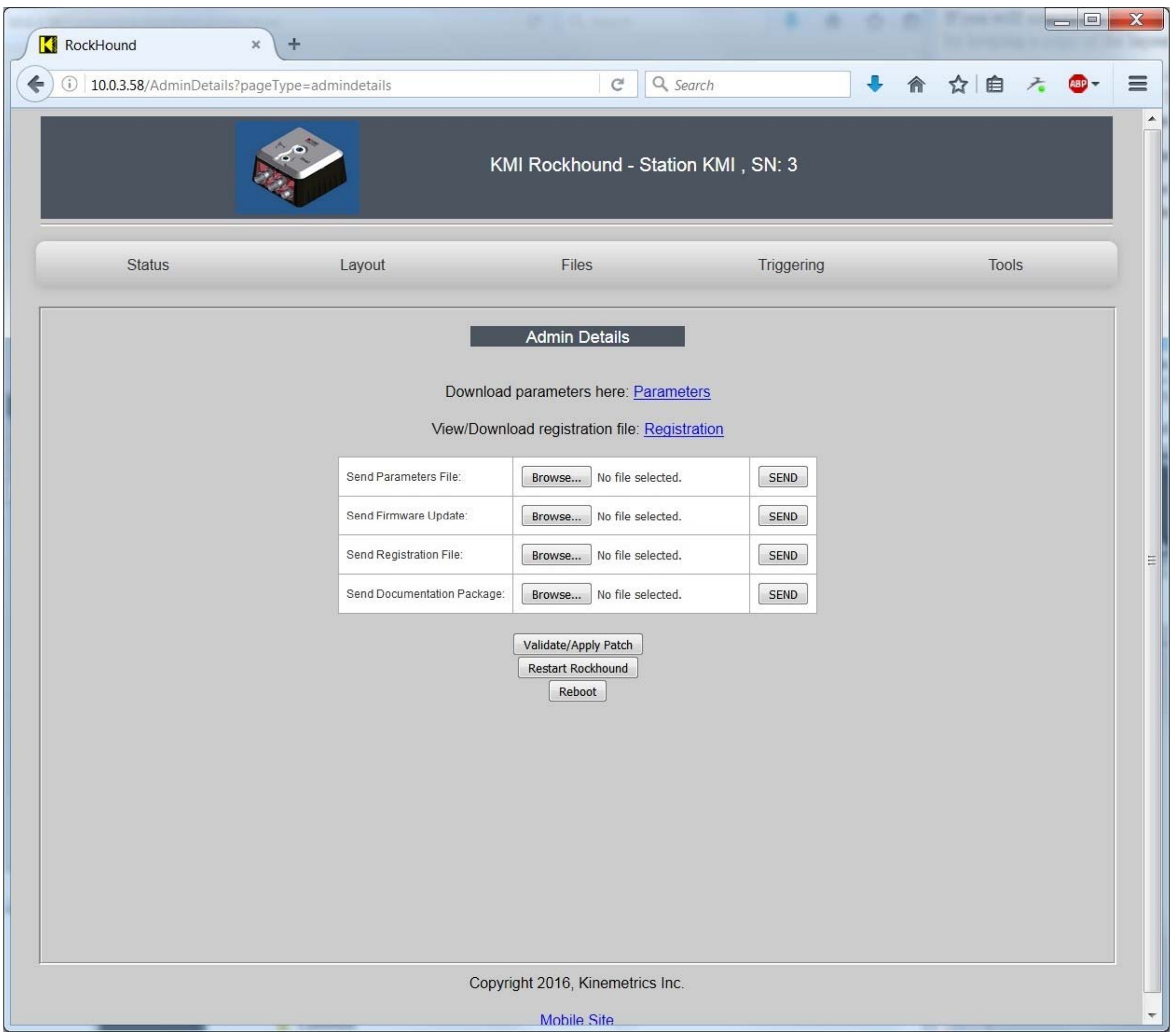


Figure 65: Sending Parameters

9.6 Changing Output Data Formats

Rockhound-based Etna2s do not require you to use a single data format. They are not, for example restricted to creation of just EVT files, or just MiniSEED, or any other single format.

To use a different data format for created files than that currently configured, you need to replace the corresponding data archiver module in the layout. For example, to change the data format from Kinemetrics EVT file format to MiniSEED, use the web interface. Choose Module Replace from the Tools menu. You will now see:

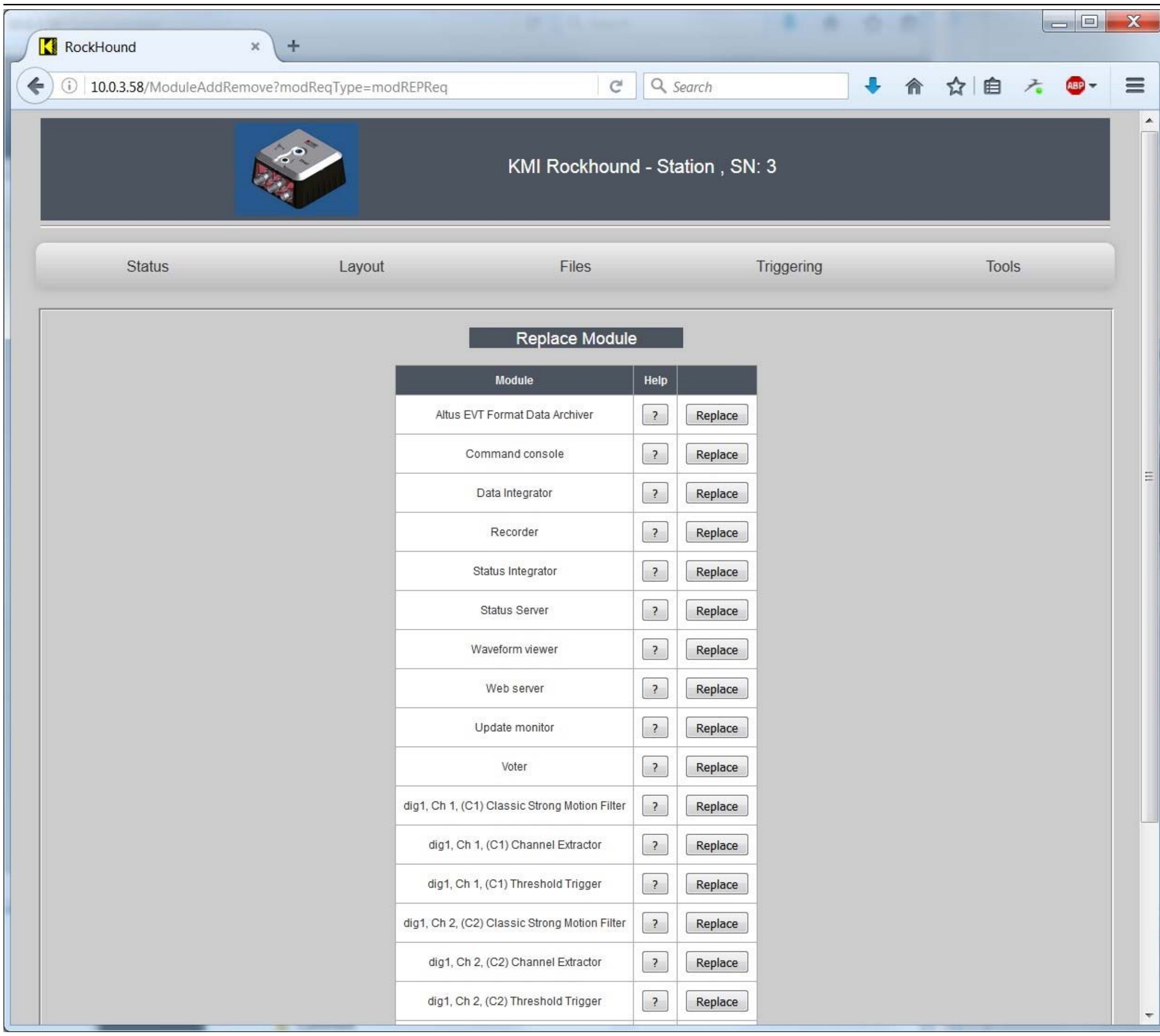


Figure 66: Module replace

Click “Replace” for the Altus EVT Format Data Archiver and you’ll see your choices:

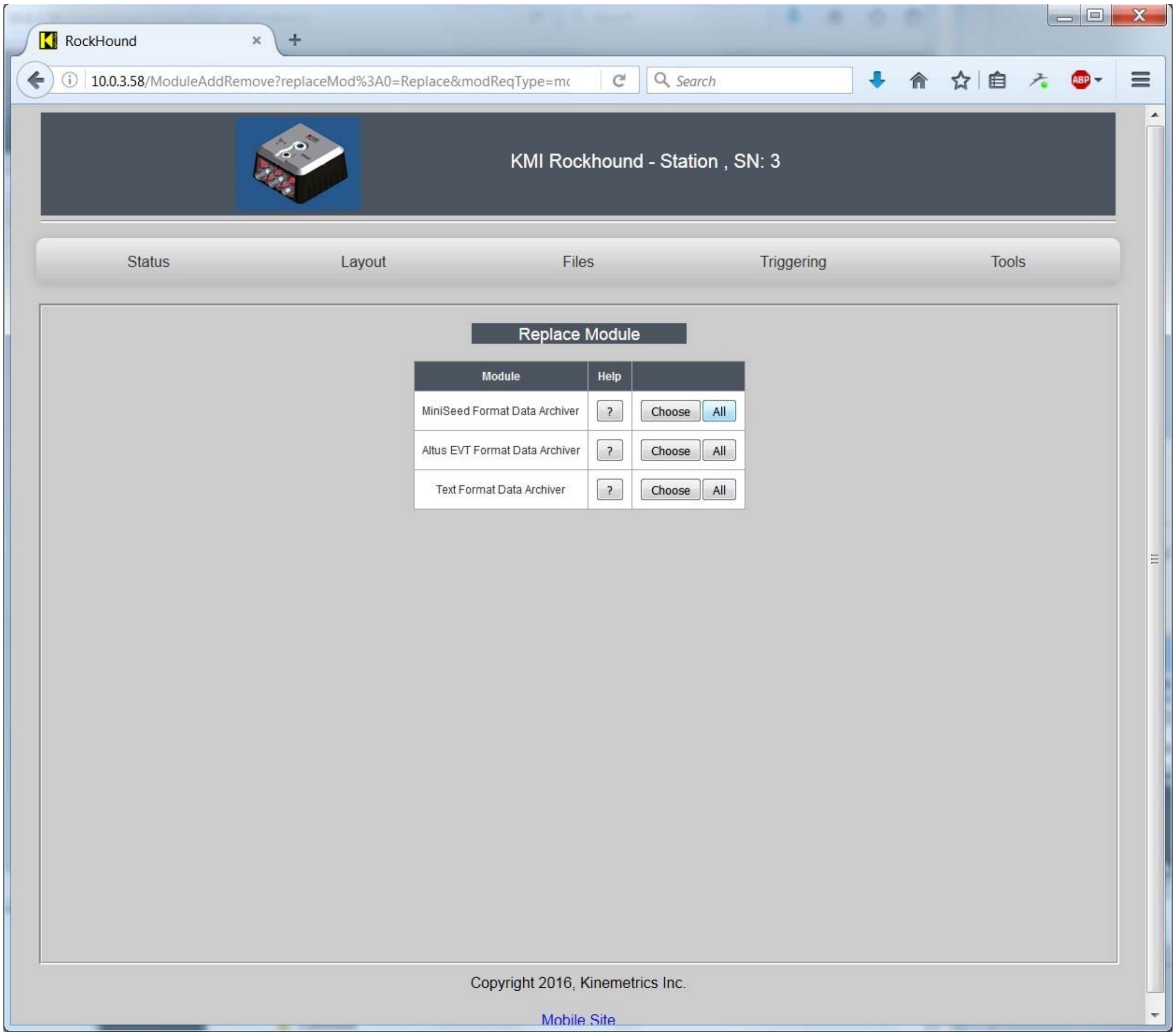


Figure 67: Format Choices

If you select “Choose” next to MiniSEED Format Data Archiver, then you’ll replace the Altus EVT Format Data Archiver with MiniSEED.

The Module Replacement screen will now look like this:

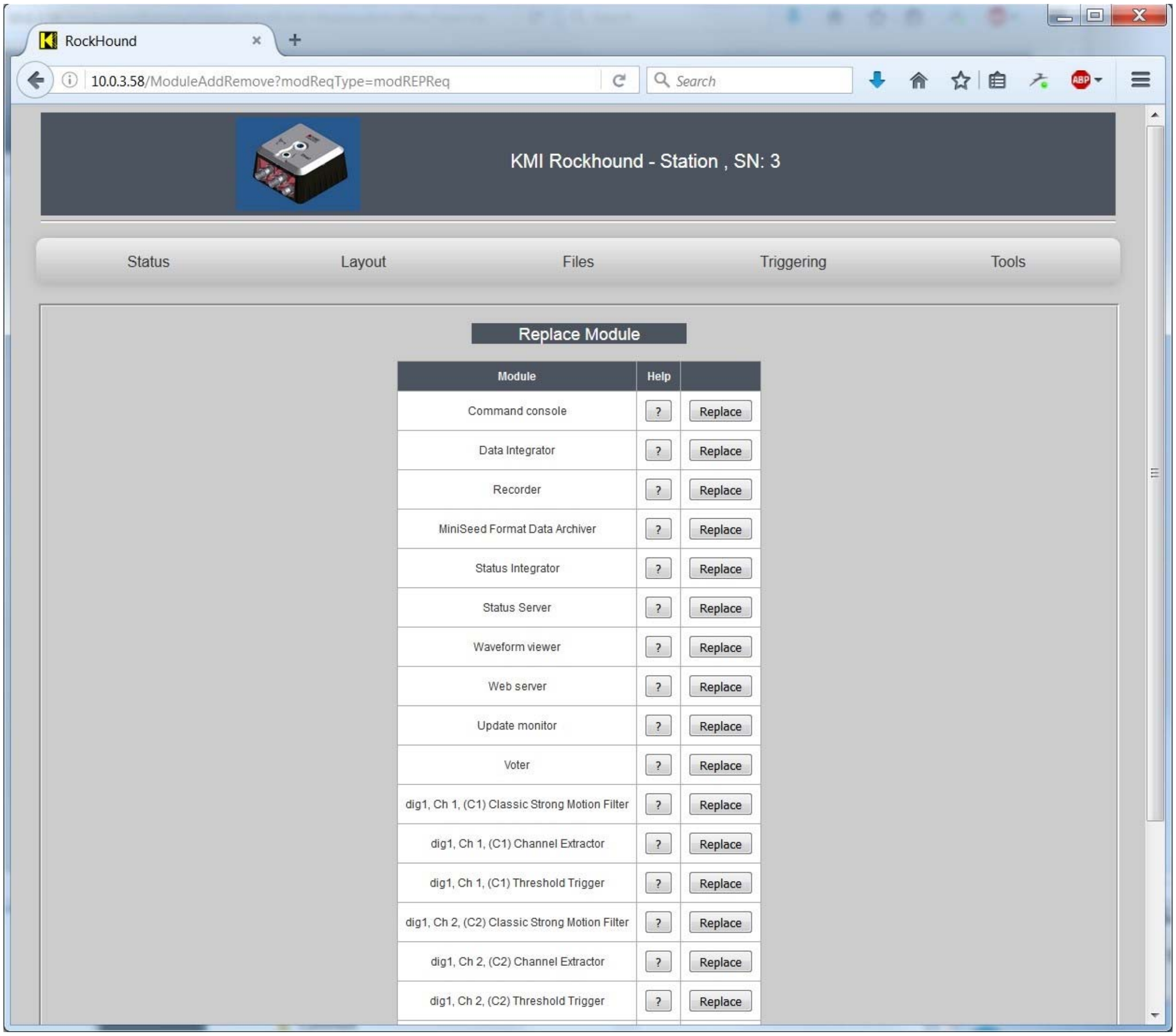


Figure 68: Output Format Changed

Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes”.

9.7 Network Triggering

The Etna2s support interconnected triggers over a network connection. This interconnect mechanism is network based only and is not compatible with earlier TRIG-IN/TRIG-OUT interconnect schemes such as those used in the Altus.

The factory default Etna2 event recorder configuration does not include a Network Trigger module, but you may choose to add the module manually should you choose to build your own layout. Adding the Network Trigger module is done similarly to how other modules are added to the layout. See the section Adding Modules . Note that only one Network Trigger module may be added to the system.

The Network Trigger module parameters can be found under Configuration in the Layout menu:

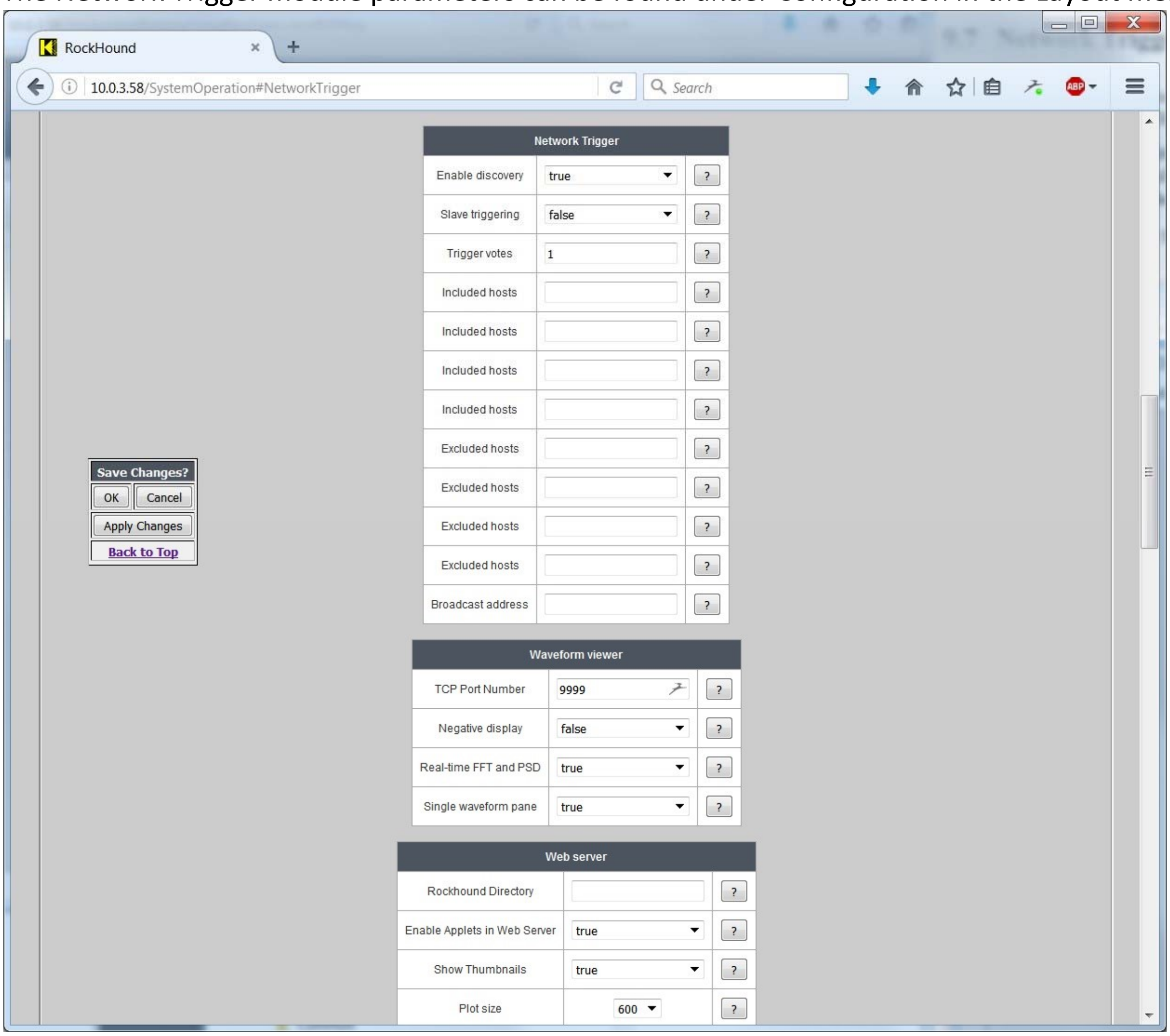


Figure 69: Network Trigger

The default behavior of the Network Trigger module is that it is assigned one vote to trigger the system.

Without making any further edits, Etna2s on the same local network will discover each other and will automatically trigger one another. So if one unit triggers due to a console trigger, seismic trigger, timed recording, or sensor test, then all interconnected units will trigger.

Please note that since triggering is done through the network that trigger times may not be exactly the same on all units, though they will be close – typically within a second or two. Other considerations:

- Enabling Slave Triggering will allow the unit to respond to triggers from other interconnected units, but will not generate outbound triggers.
- Sensor tests will forward the type of trigger to other units so for example all interconnected units will perform sensor tests.
- In some cases, you may wish to perform a console trigger or sensor test on one unit during maintenance and NOT want to cause triggers on all interconnected units. To allow for this, you can use the console command NWDEFER secs to defer network triggering for a specified amount of time. For example, NWDEFER 300 would give you 5 minutes to perform your tests with the interconnection temporarily disabled. After five minutes, interconnection would automatically be re-enabled.
- The Excluded hosts lists allow you to manually specify units within the local network that should NOT be treated as part of the interconnection.
- The Included host's lists allow you to manually specify units outside of the local network that are to be included. For example, units might be interconnected from within two separate networks. An example might be two units located at opposite ends of a very long bridge that are connected to separate networks. By giving each unit the others' addresses in the Included hosts list they will be able to communicate with each other and command interconnected triggers.

9.8 Telemetry Options

The overall design of the Rockhound software allows for many optional modules. Some of these modules include options for telemetry (real time data streams). Presently the modules available to support this capability include (but are not limited to):

- The "Telemetry Connection" module used to produce the Waveform Data displays. See Waveform Viewing .
- A Ring Buffer module, compatible with BRTT's Antelope software.
- A third party add-on module to act as a SEEDLink server is available through ISTI.
- A third party add-on module to act as an Earthworm server is available through ISTI.

Another non-real time monitoring and data collection option would be to use the Rock Monitor software as described in Application Note 79.

Chapter 10

Software Utilities

Etna2s are designed to work with standard software utilities wherever possible. In many cases, these utilities are provided along with most computers or are easily available for download. In some cases utilities are required that may not come standard on every computer. In these cases, Kinemetrics has provided publicly available utilities on the Rock Support Software CD (300654-PL). Those provided are ones that Kinemetrics has found to work well, although you are of course free to use other similar utilities that you prefer.

The Rock Support Software CD programs are specific to the Windows Operating Systems. If you are running Linux or MacOS, suitable programs are easily available for those Operating Systems.

For example: For Linux:

- For Telnet: Use telnet
- For Serial Terminal Emulation: Use minicom
- For Secure Terminal connections: Use ssh
- For Secure File Transfers: Use sftp

If you do not have other utilities such as terminal emulation programs, telnet client, and secure file transfer programs that you know you want to use, and you are using Windows, we suggest that you install the software from the Rock Support Software CD (300654-PL) now.

10.1 Web Browser

As indicated, the Etna2 is intended to operate with little more than a web browser. Most modern web browsers are sufficient, and need meet only a few requirements to operate well with the Etna2:

- Support HTML 1.1 or later
- Support Java and Java Applets

10.2 Java

The web interface of the Etna2 will function without installing Java, but many of the most useful and important feature of the interface require Java. Kinemetrics recommends that your computer have Java installed and that Java support be enabled in your web browser. Java Virtual Machines are available from several suppliers and are usually free.

One such program is available from java.sun.com. On the Oracle website it is called the Java SE JRE.

10.3 Terminal Program

In order to communicate with the Etna2 through a serial port (such as communicating via the RS-232 Linux console) you will need a terminal program that can communicate through RS-232. Historically this was done on Windows based computers using HyperTerminal. However, in Windows 7 HyperTerminal is no longer included.

You can download and purchase HyperTerminal from www.hilgraeve.com, or you can use the free program PuTTY, which is provided on the Rock Support Software CD. PuTTY is described below.

10.4 Telnet Client

To communicate with the Etna2 through its command console (or USB Client port) you will need a telnet client program. Most computers include telnet as part of the normal distribution, but Windows 7 no longer includes telnet.

As a replacement you can use the free program PuTTY, which is provided on the Rock Support Software CD. PuTTY is described below.

10.5 WinSCP

WinSCP is a free program that allows you to make secure connections for file uploads and downloads. WinSCP is included on the Rock Support Software CD.

Since WinSCP is not Kinemetrics software and is provided only as an example, we make no attempt to thoroughly describe all capabilities. However we will describe basic operation here. When you start WinSCP you will see a dialog that looks something like this:

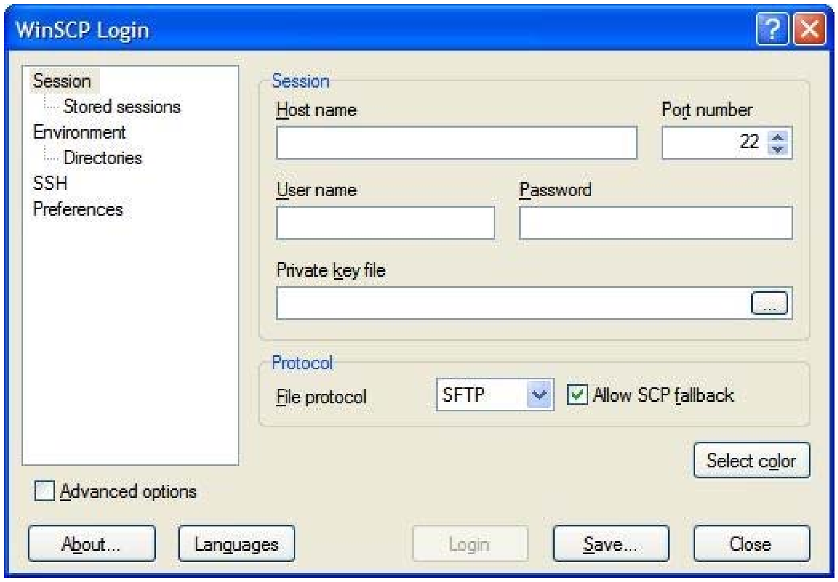


Figure 70: WinSCP

To connect to an Etna2, enter the IP address of the Etna2 as "Host name" as well as the User name and Password as shown here: Press "Login" and you will initially see the following confirmation:

Figure 71: WinSCP Key Confirmation

This message indicates that you are about to make a secure connection to the Etna2 and is a warning that you have to be sure you're talking to the correct unit. Normally, once you accept the key you will not have to do this again when connecting to the same Etna2 from the same computer.

Once WinSCP has logged into the Etna2, you will see something that looks like this:

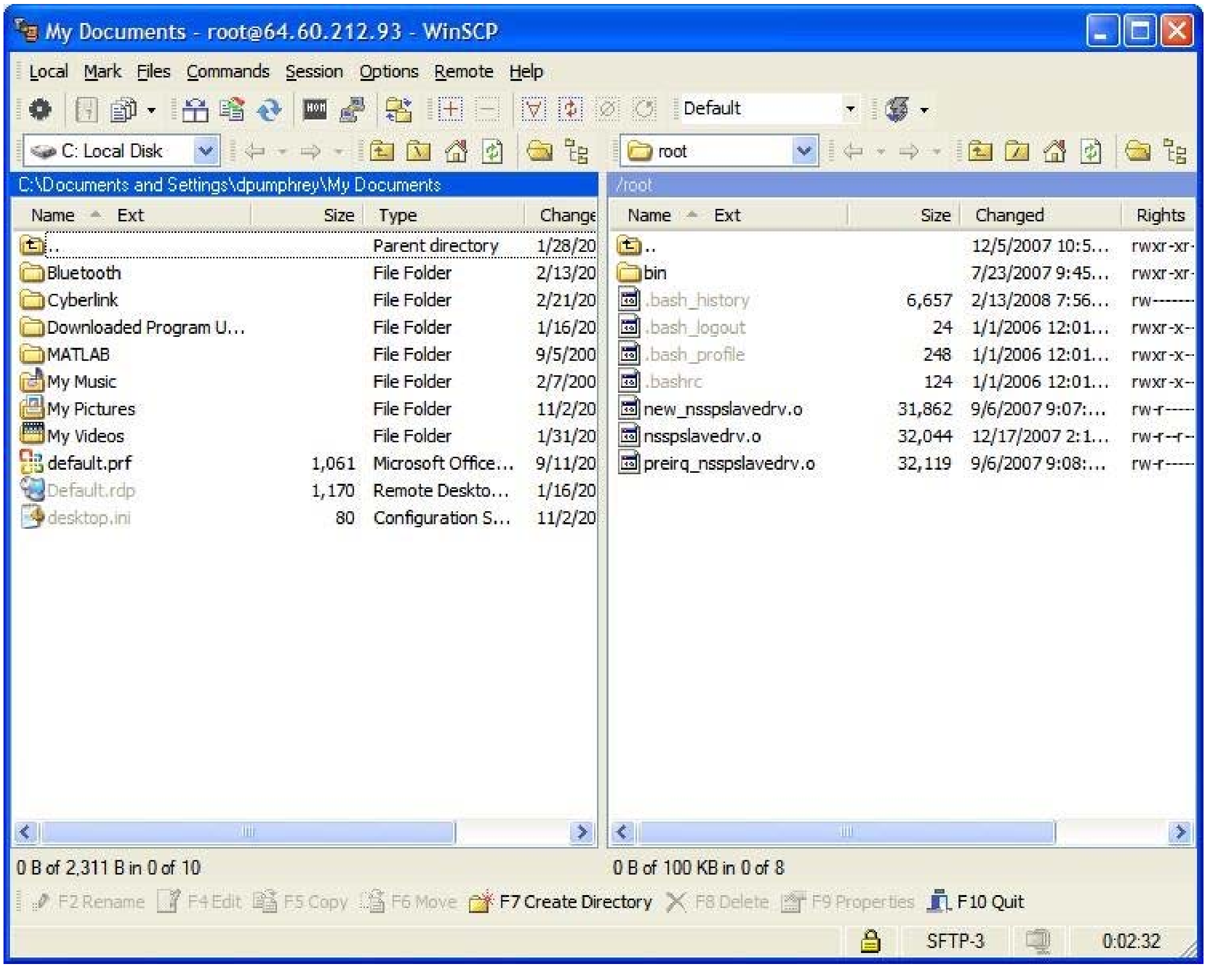


Figure 72: WinSCP Panes

The left pane of the program represents your computer and the right pane represents the Etna2. You can navigate the panes independently and can then upload or download files by simply dragging the files from one side to the other. You can also drag files directly to or from other applications such as your desktop or Windows Explorer.

If you have a set of directories that you access often, such as downloading recorded files from the Etna2's /data/events directory to a working folder on your computer, you can set the folders correctly and then select Session → Save Session.

Later when you restart WinSCP, you can choose the session from the list and click "Login". This will save you from having to manually enter the IP address, username, or passwords each time. In addition, the panes for your computer and the Etna2's directories will be set automatically.

10.6 PuTTY

PuTTY is a secure terminal program that you can use to open a secure Linux console to your Etna2. PuTTY uses the SSH layer to make a secure connection.

Since PuTTY is not Kinemetrics software and is provided only as an example, we make no attempt to thoroughly describe all capabilities. However we will describe basic operation here. When you start PuTTY you will see a dialog that looks something like this:

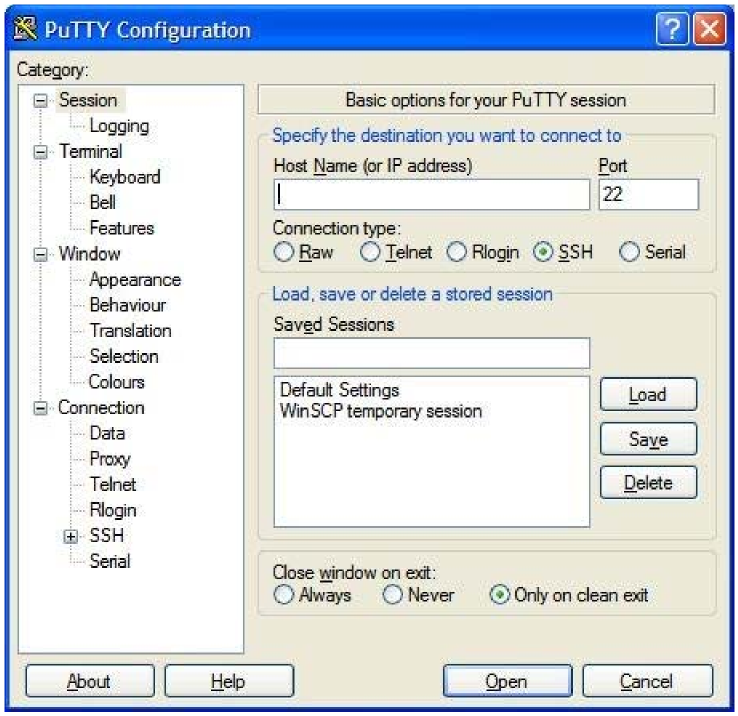


Figure 73: PuTTY

To log into the Etna2, enter the IP address of the unit and press "Open":

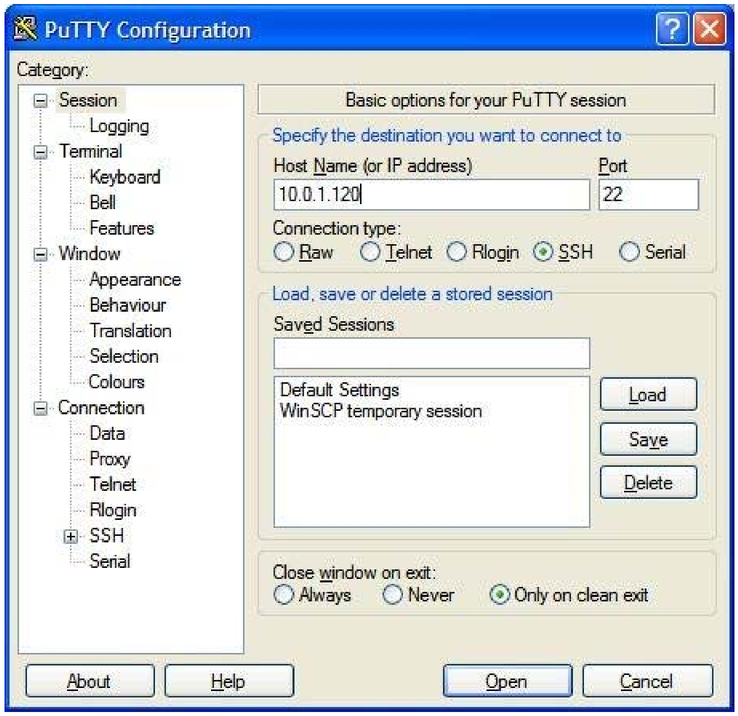


Figure 74: PuTTY IP Address

Next, you will see a secure console window as follows:

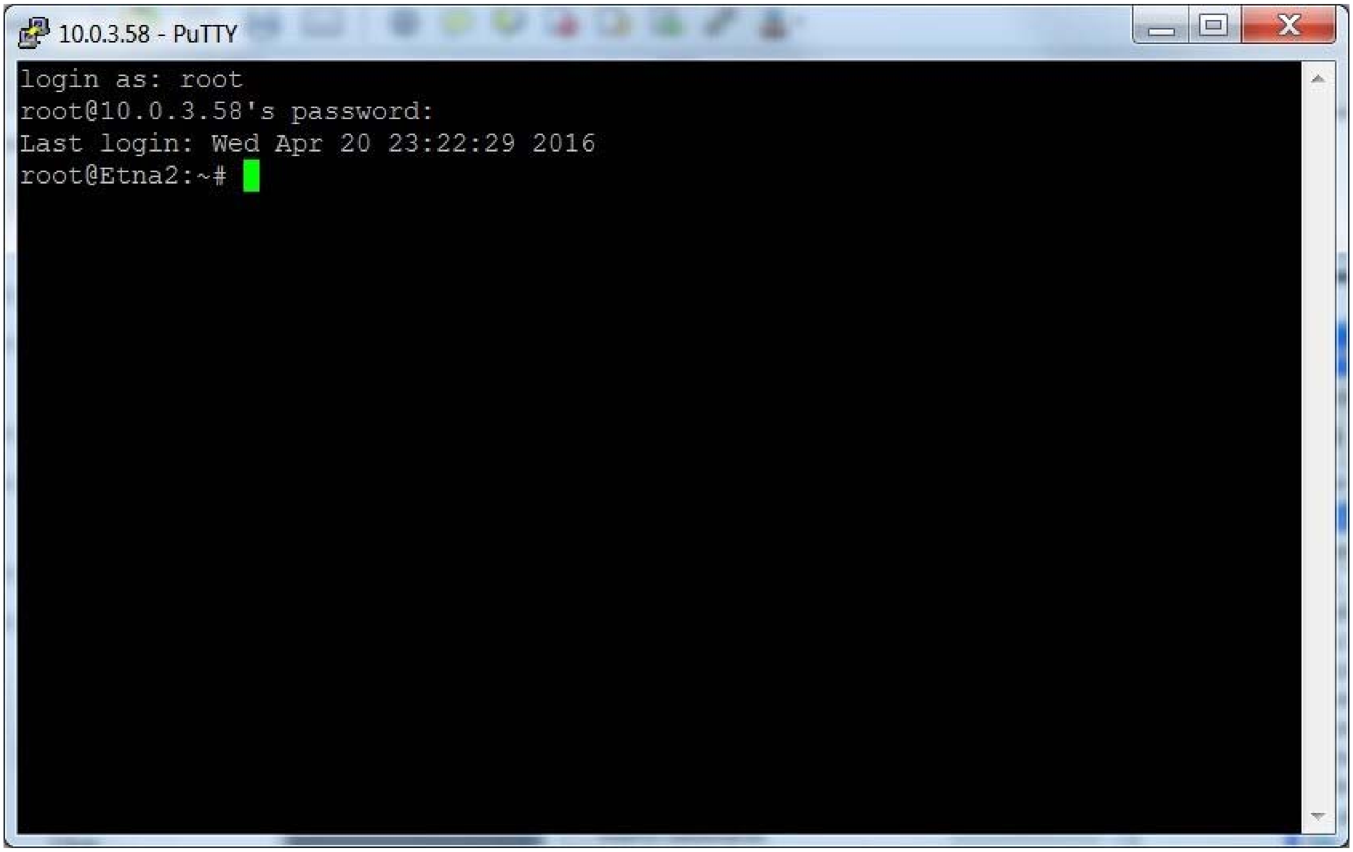


Figure 75: PuTTY Window

As with WinSCP you can save sessions to avoid typing in the future by entering the IP address at “Host name”, the name you assigned to the Etna2 under “Saved Sessions”, and then press “Save”.

Please also note that PuTTY can be used as a telnet client, so you can connect to the Command Console by entering the IP address under “Host name”, selecting “Telnet”, entering the “port” as 9900 and clicking “Open”.

As with WinSCP and the PuTTY SSH connection, you can save this session by entering a name under “Saved Sessions” and clicking “Save”.

PuTTY can also be used as a simple terminal program to open a serial console to your Etna2 (for example, to connect to the Linux console). Select “Serial” and specify the Serial line (e.g.: COM2) and the baud rate.

NOTE: On the Etna2 the Linux serial console is at 115200 baud.

You can save your serial session by selecting “Serial”, entering the COM port and baud rate, entering the name as a “Saved Session” and clicking “Save”.

Chapter 11

Advanced Operation

The Rockhound software provides for several advanced features that allow the user to add, remove and replace modules, allow access to advanced and/or test mode parameters, allow for initial layout creation and other special capabilities.

11.1 RockTalk with Add-ons

RockTalk can be downloaded from the Etna2 as an executable jar file from the web page via the Layout → Layout Wizard menu selection. When you run RockTalk and access the configuration, the program will extract two important working files modules.cfg and canned.cfg into the working directory. These files are necessary for processing the configuration files.

If you use 3rd party Rockhound add-on modules such as RockToEW or RockToSLink, then you must manually place the file mergedcustmodules.cfg into your working directory so that RockTalk can process the add-on as part of the configuration.

11.2 Layout Wizard

The Layout Wizard allows you to create a completely new layout for your system. During this process, you can define the source of the data (on an Etna2, the source will be an Etna2 Data Interface), as well as defining the types of triggers, output formats, and so on.

In the example here we'll create a 3 channel event recorder and add the Network Triggering. The Layout Wizard is part of the RockTalk application, which can be installed separately by installing Rockhound, or can be downloaded from the web page via the Layout → Layout Wizard menu selection.

Start RockTalk and then select Setup → RockTalk Setup from the menu:

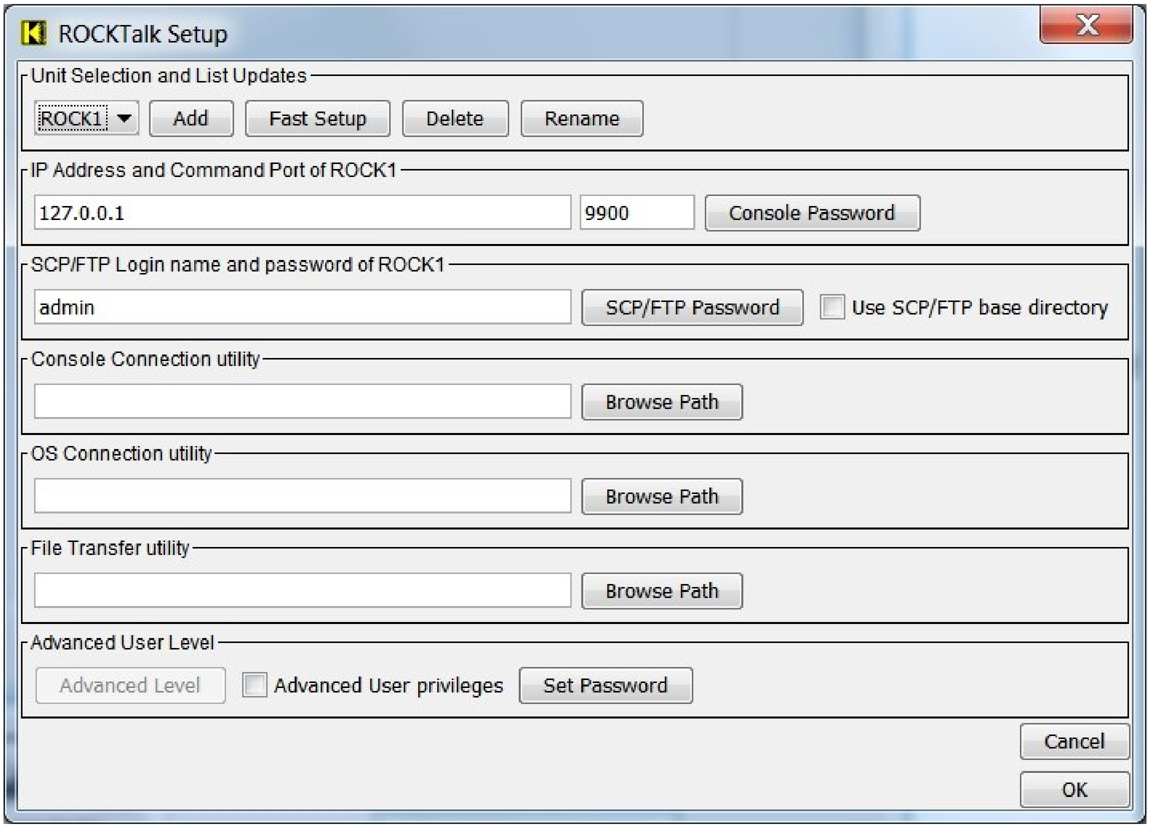


Figure 76: RockTalk Setup

Next, we'll click "Rename" to rename this Unit to Etna2:

Figure 77: Renaming Unit in RockTalk

We'll now use "Fast Setup" to configure the connection:

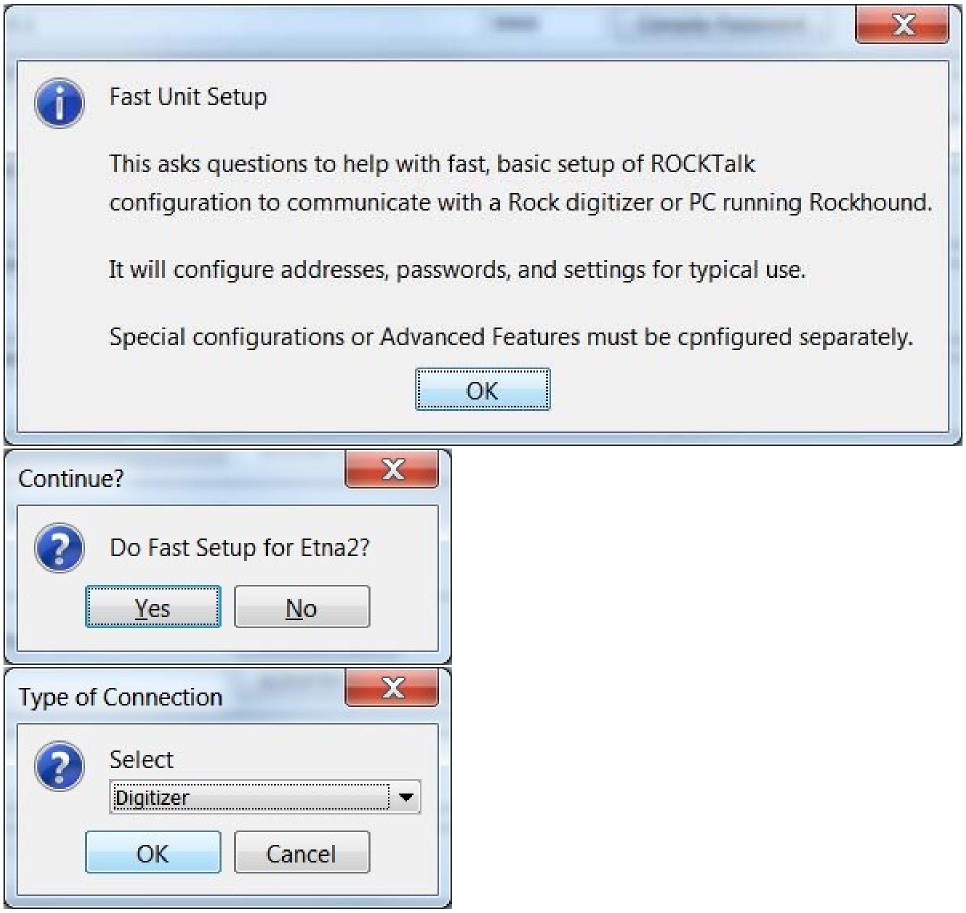


Figure 78: Fast Setup

Figure 79: Fast Setup (continued)

Close RockTalk Setup by clicking OK and then select Layout Wizard from the Setup menu. First question about the new layout is to choose the basic type of layout. There are four basic types: Simple (only one data source), Complex (more than one data source), Event Recorder (triggered recording), or Continuous Recording (no triggering). To record event data on an Etna2, select "Simple Event Recorder":

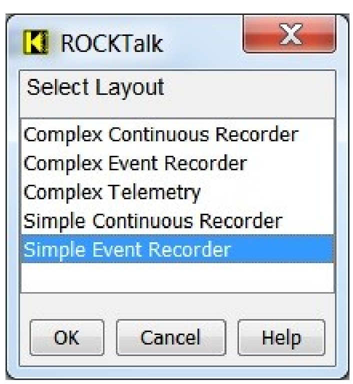


Figure 80: Select Layout to Build

Next, specify the number of physical channels (actual hardware channels):

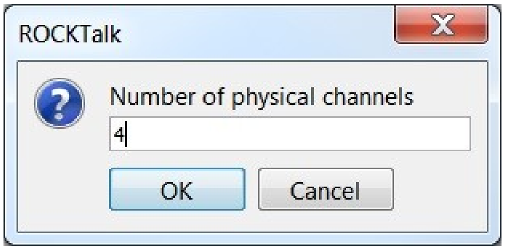


Figure 81: Set Number of Channels

Next select the number of virtual channels. To record 4 channels as a single sample rate, select 4. If you wanted to record 3 of the 4 channels at two different sample rates, you'd select 7 (the maximum allowed on an Etna2). In this case we'll select 7:

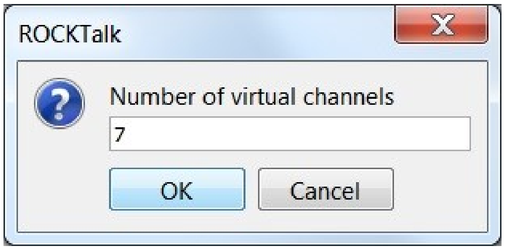


Figure 82: Set Virtual Channels

Select the data source, in this case a Etna2 Data Interface:

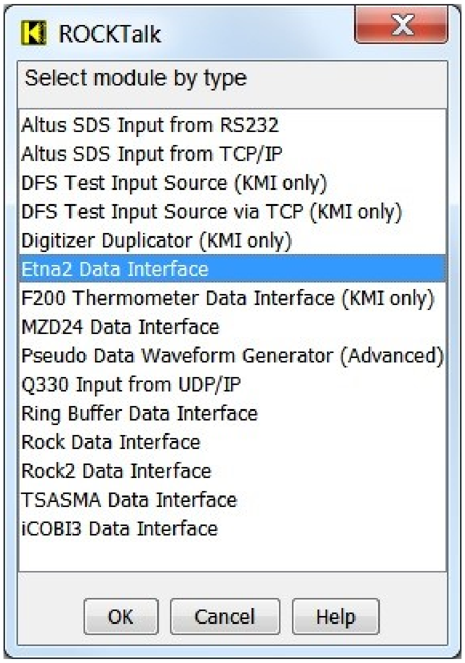


Figure 83: Set Data Source

Select the type of trigger filter:

Figure 84: Set Trigger Filter

You'll now be asked if you want to use the same type of filter on all channels. If so, select "Yes" and you can avoid the next 2 questions about filters. If you select "No", you'll have to choose the filter for each of the 3 channels:

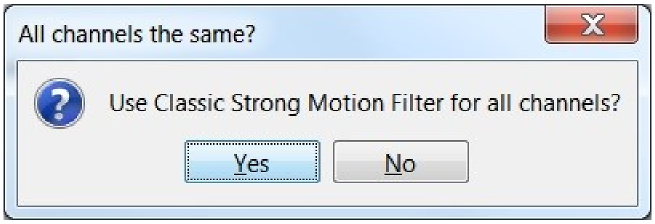


Figure 85: Use Same Filter for all Channels

Choose the type of trigger used:

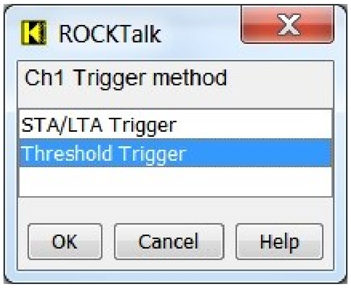


Figure 86: Set Trigger Type

Again, you'll be asked if all channels will use the same type of trigger:

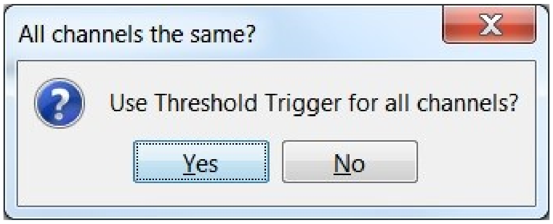


Figure 87: Use Same Trigger for all Channels

Next, choose the output data format:

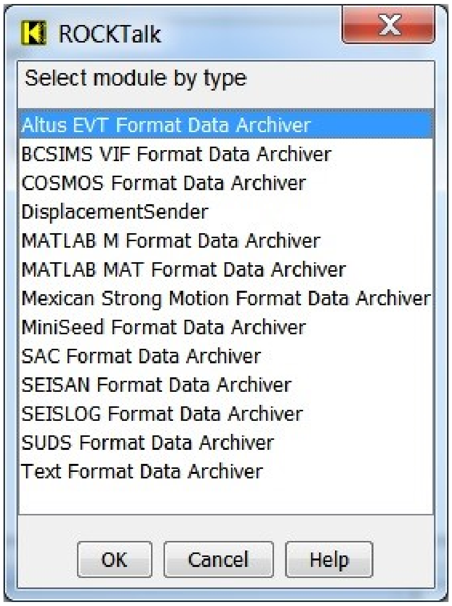


Figure 88: Set Output Type and Data Format

Finally, select the web server:

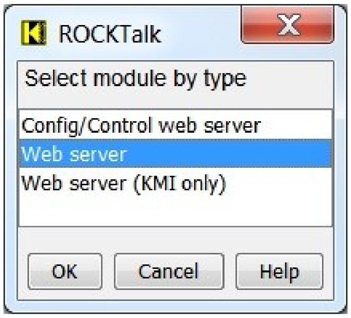


Figure 89: Replace Web Server

At this point, the basic layout is complete:

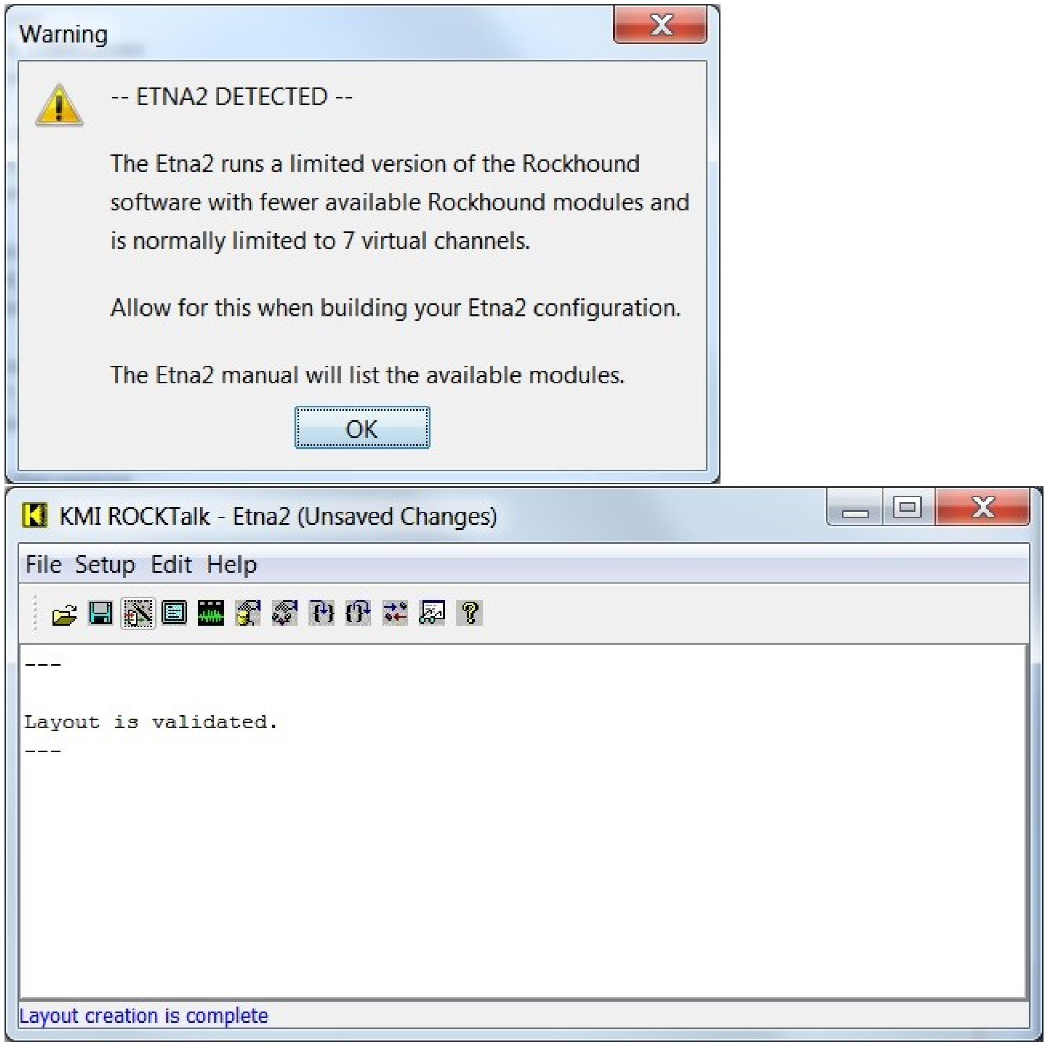


Figure 90: Layout Complete

Choose File → Save Layout to send the Created Layout.

When the system restarts, log into the web interface if necessary and select Tools → Module Add:

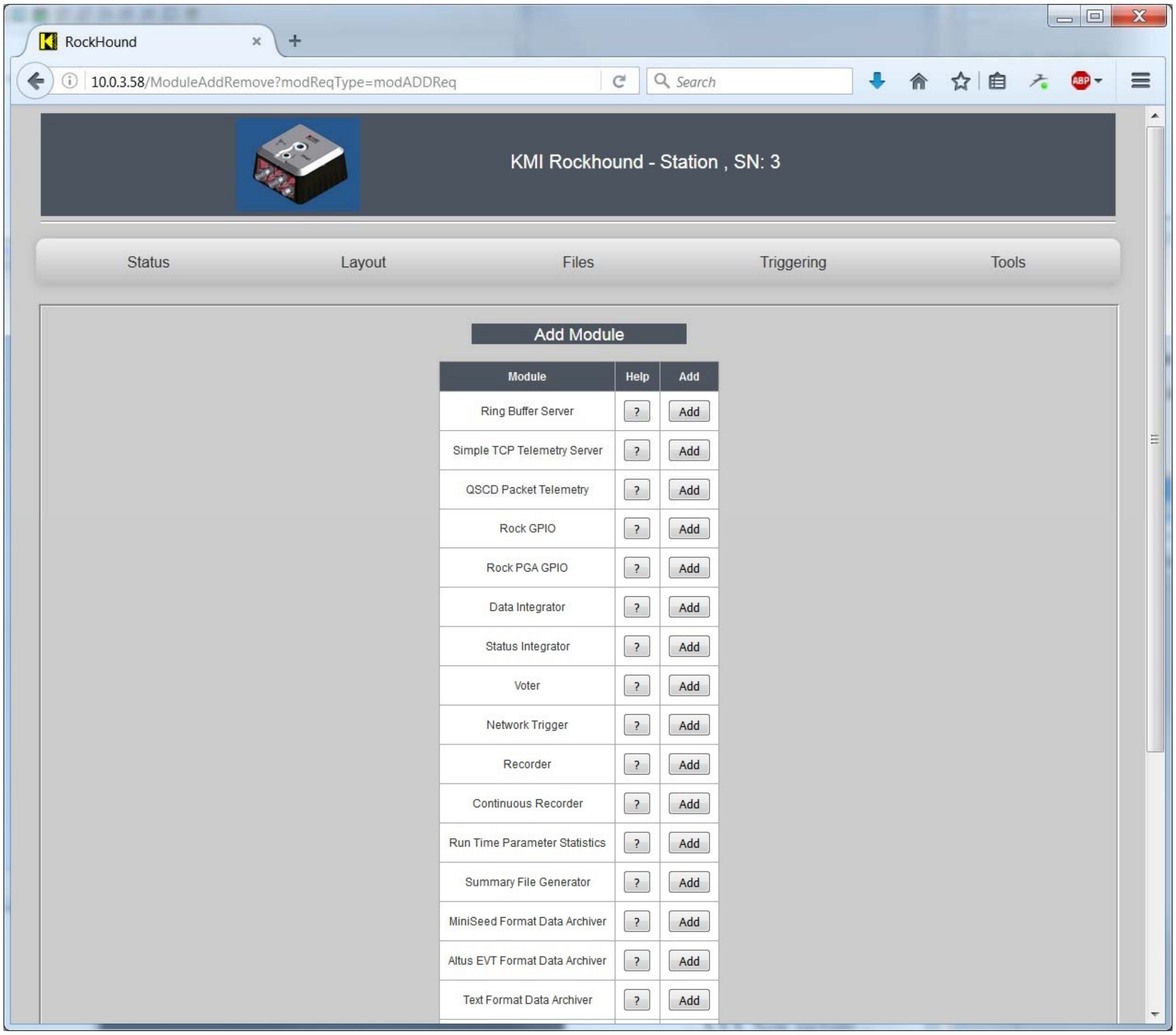


Figure 91: Adding Network Trigger

Select Network Trigger by pressing the Add button. Since only one of these can be added to the layout, the choice will disappear from the list of available modules.

If you need to edit passwords in modules that have password parameters, select Tools → Operation/Passwords from the menu and you will get a warning that password editing is not secure. The warning is because passwords will be sent in the parameter data. Ideally you should not do this over the internet routinely or you will expose your web access passwords. If you are not specifically editing passwords, we recommend that you use the Layout → Configuration function instead to edit parameters.

Click OK to save any changes made.

We're almost done with the layout configuration. Add any additional modules that you need and verify parameters such as sample rates, G ranges and others as described in Basic Setup. Once all changes have been made, select Layout → Apply Changes Now from the menu.

In a few minutes, the system will have restarted and will be operational with your new layout.

11.3 Configuration Options

There are other configuration features that can be used to customize your Etna2 outside of the Rockhound configuration. These additional features are briefly described in this section.

11.3.1 Network Parameters

You can set the network parameters for your Etna2 using the netconfig script from Linux. This script allows you to set IP addresses, as well as other related parameters such as the use of DHCP, setting the net mask, gateway, and DNS servers. The netconfig script is more fully described in the NetConfig section.

11.3.2 Relays

There are two relay outputs available on the Etna2. These are provided to perform such functions as alarm outputs (indicating alarm level threshold exceedance), or for control of external devices such as powering an external modem or radio.

The various Rockhound modules activate these signals logically by name. For example:

- The Alarm Exceedance logic drives a signal named "AlarmGPIO"
- The Modem power logic drives a signal named "ModemPwrGPIO"
- A heartbeat drives a signal named "HeartbeatGPIO"

In order to "connect" these logical signals to actual hardware bits, you will need to add an additional module named Rock GPIO to the layout:

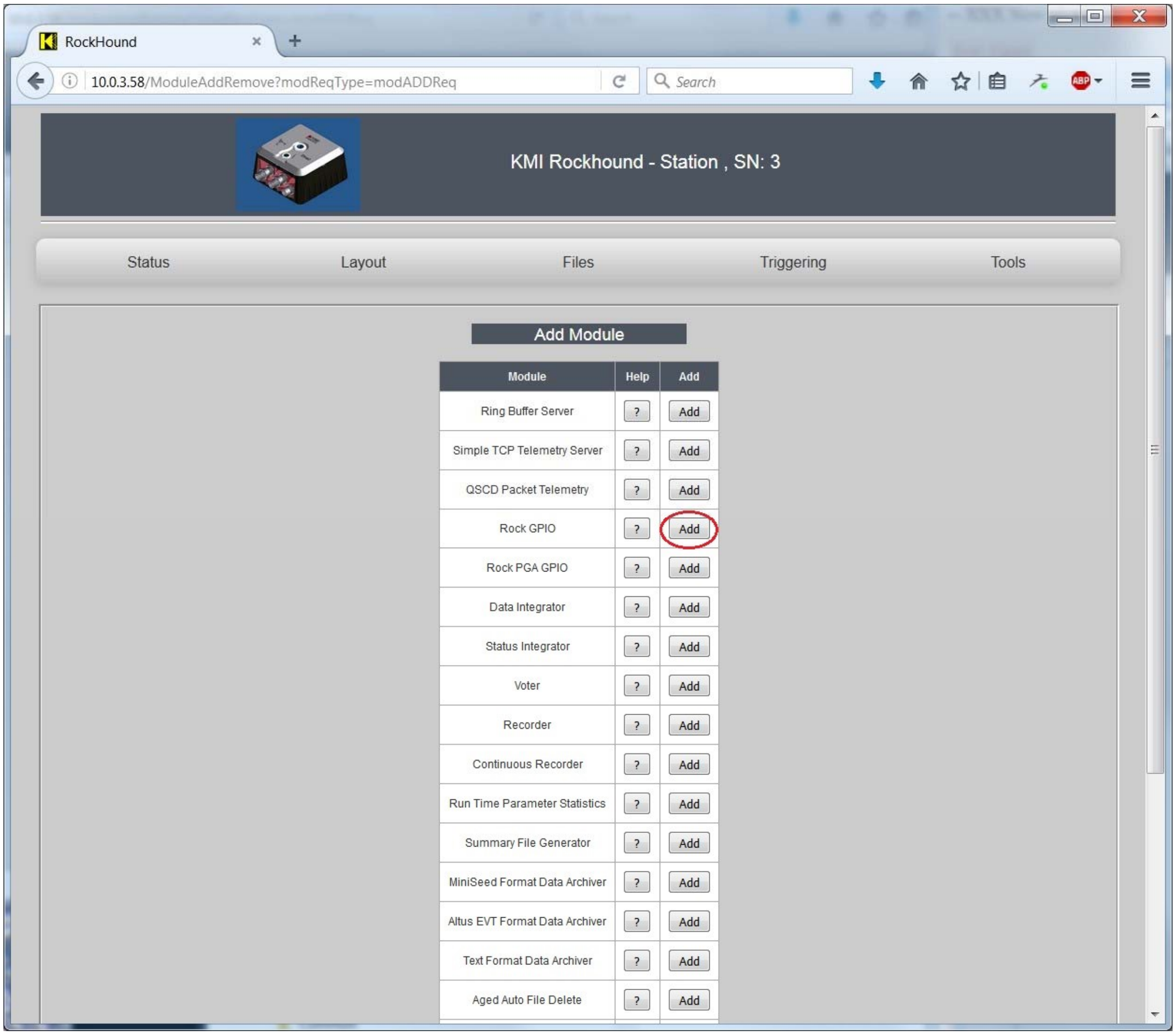


Figure 92: Adding RockGPIO

The module's parameters allow you to connect each logical signal to either of the two relays available as shown here:

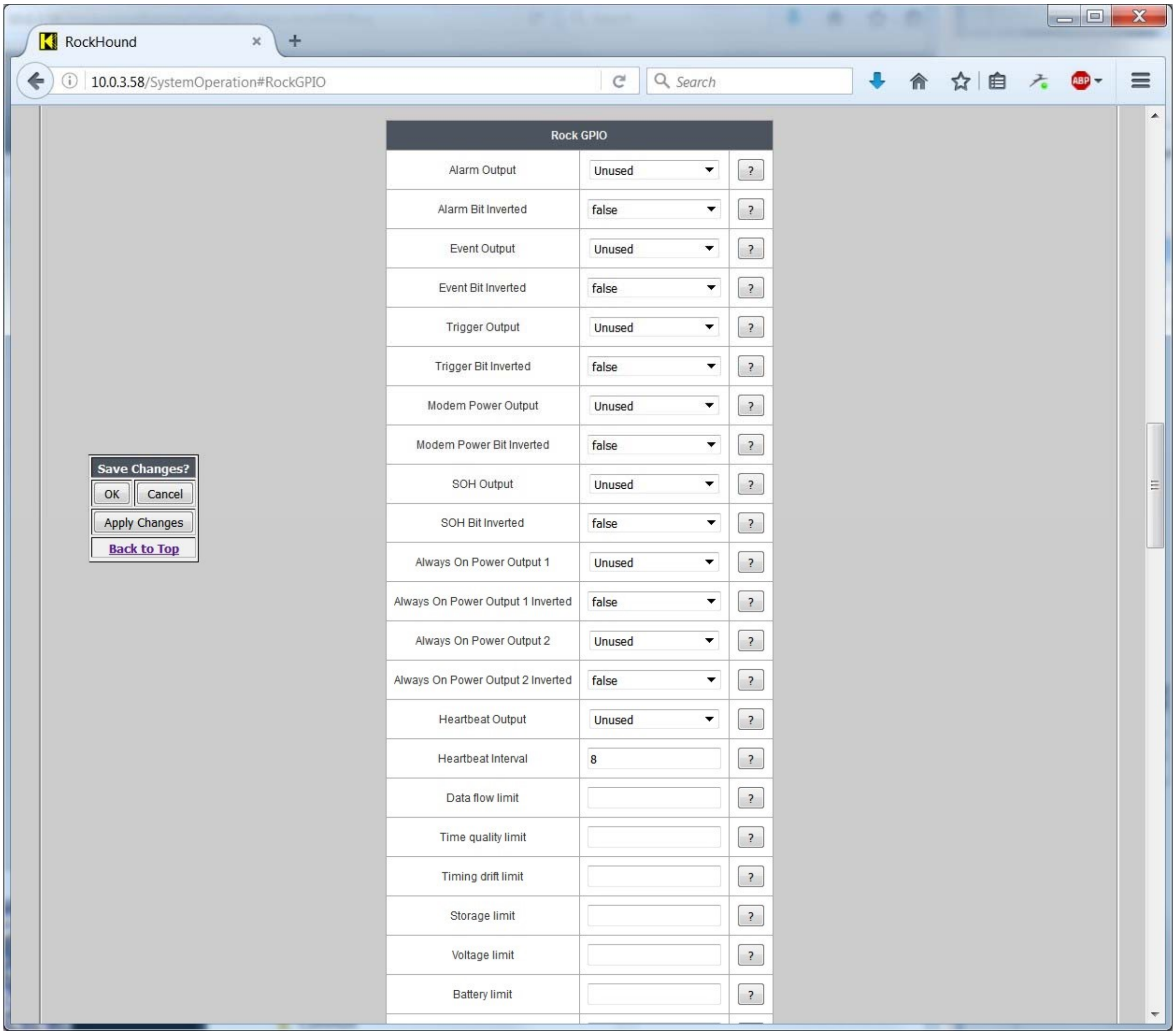


Figure 93: RockGPIO Parameters

Bits 1 and 2 are assigned to the Etna2's two relay outputs. Depending on the external hardware connected to the relay, they may be logically inverted or utilized directly. RockGPIO functions can also be used to control an optional external relay board.

11.3.3 Networking and Security

The Etna2 provides standard SSH services as well as most standard IP services. The following services are enabled by default:

- SSH
- NTP
- PING
- POC

The following services are disabled by default:

- TELNET
- FTP
- TFTP

The TELNET and FTP services can easily be enabled if needed using the inetdconf script. See the IP Services section.

11.4 Low Latency Telemetry

The Etna2 normally provides data in 1 second packets from the data acquisition section. In most cases this is quite adequate for triggering, recording, and even many telemetry applications. It is generally a good trade-off between latency, instrument workload and communication bandwidth.

However in some cases it is desirable to reduce latency for early warning applications. For these purposes you need to produce data in smaller "chunks" understanding your instrumentation will work harder and your communications links will not be as efficient.

First of all, what we're talking about here is NOT the DFS protocol. That is a different simplex serial-only protocol stream that is not supported in the Etna2.

When enabling the Etna2's specific low-latency features, it will produce two different data streams:

- The normal 1 second data that is used for typical recording activities
- A smaller 0.1 second data packet that is used ONLY for telemetry

To enable this low latency mode you need to:

- Enable Low Latency Mode in the Etna2 Data Interface. For lowest latency, also:
  - Enable Reduced Packet Latency (Etna2 feature)
  - Use Causal FIR filters for low latency channels
- Enable Low Latency Mode in a Telemetry module that supports Low Latency. As of this writing, only the Antelope compatible Ring Buffer and the Simple TCP Telemetry modules support this Low Latency mode.
- For lowest latency, also:
  - Enable Low TCP Latency to disable packet nageling (will increase communications bandwidth utilization)

NOTE: You MUST enable Low Latency modes in both places, or you will not get Low Latency data.

We also recommend highly that you increase CPU speed to 800Mhz. See Setting Processor Speed

Obviously the low latency mode only makes sense for sample rates greater than 1sps.

Chapter 12

Software Topics

In this section we discuss recommended advanced topics such as start-up and shut-down sequencing, configuration, monitoring, software installation, and a brief overview of the underlying Linux Operating System.

The Etna2 contains no user replaceable fuses or internal batteries.

12.1 Powering Up the System

To successfully deploy your Etna2, you will need to physically install the hardware in a suitable environment, provide your primary and backup power sources (if any), connect any communications links used, and configure the software for correct operation if the needed setup differs from the default factory configuration of the unit. When power is applied to the system, it goes through a specific power up sequence. When power is connected via the external DC supply:

- All LEDs off - This is the initial condition
- Power LED flashes green - The system is in its initial power up phase and is allowing the system to stabilize (this phase also prevents system motorboating in case the power input is marginal or erratic)
- Power LED flashes fast green - The system is charging the supercapacitor pack
- Power LED flashes green occasionally - The system is starting up the processor
- Ethernet LEDs active - Ethernet interfaces are enabled
- Power LED flashes green occasionally, Status LED flashes fast green - Rockhound is starting
- Power LED flashes green occasionally, Status LED flashes red - Timing system not started yet

- Power LED flashes green occasionally, Status LED flashes occasional red - Timing system running, but not accurate yet
- Power LED flashes green occasionally, Status LED flashes occasional green - Timing system runnng and accurate

12.2 Powering Down the System

When input power is lost, the system goes down quite quickly (less than a second), but internally through a specific power down sequence. What you will see is:

- All LEDs off - The system has powered off
- Ethernet LEDs off - Ethernet interfaces are disabled

12.3 Software Installation

Initial setup of your unit will require you to modify or at least review the software configuration. Every attempt has been made to have the default behavior of the unit be as useful as possible, or at least rational. However, each deployment has its own variations and may require configuration changes in order to be best used.

Setting up the unit will require the use of a Serial/USB cable that supports the Console port connection. You'll also need a PC or equivalent running a terminal emulation program such as HyperTerminal or PuTTY on Windows or minicom on Linux.

You may need to use a USB to serial adapter if your PC does not have an available COM port. If so, install the software and then plug in the adapter, making note of the COM port assigned to the port.

Note that you can also use the USB device connection as an alternate virtual COM port.

Kinemetrics includes the PuTTY application as an alternative to using HyperTerminal on Windows, or if you are using an Operating System (such as Windows Vista) that does not supply HyperTerminal. Please see the Software Utilities section that includes a basic description of PuTTY setup and operation.

Set the terminal emulation program up for 115200 baud, no flow control, 8 data bits, 1 stop bit, no parity.

Alternatively, you may connect in these ways:

- Use the USB Device port and cable, which will appear to your PC as a virtual COM port

- Log in using a static address. Out of the box, the Etna2 has two addresses defined for the Etna2's Ethernet interface - a DHCP address assigned by your DHCP server and a static address of 192.168.222.245. Once the network has been configured with netconfig, only the configured address will be defined.

See Clearing the ARP Cache

Factory Configuration Including:

Name	Comments
Eth0	Enabled for DHCP and static
SSH	Enabled
NTP	Enabled (client)
NTP	Disabled (server)
Ping	Enabled
Telnet	Disabled
FTP	Disabled
TFTP	Disabled
System card	Mounted as /dev/root
Data card	Mounted as /mnt/data1
Console	/dev/console

12.4 IP Services

The following IP services are enabled by default from the Kinemetrics factory:

- SSH
- NTP
- PING

The following services are disabled by default but can be enabled if needed:

- TELNET
- FTP
- TFTP

Non-secure services (like TELNET and FTP) should be disabled or only used where network security is not in question (such as a protected private network). Although these services use passwords, the user names and passwords are sent "in the clear" meaning that any third party who happens to be listening can capture the needed information to compromise your system.

To change the IP services configuration, run the inetdconf script after logging onto the unit through the console port as “root”.

inetdconf allows you to configure, enable and disable some common IP services such as FTP, TELNET, and TFTP.

The inetdconf exchange will look something like the following:

```
# inetdconf ftp on
ftp service enabled.
```

-or-

```
# inetdconf ftp off
ftp service disabled.
```

-or-

```
# inetdconf ftp status
ftp service is currently disabled.
```

After completing IP services configuration, it is recommended that you reboot the system to ensure that the services come up correctly.

12.5 Network Configuration

The default network configuration is as follows:

- Ethernet (eth0): Enabled, DHCP

To change the network configuration, run the netconfig script after logging onto the unit through the console port as "root".

netconfig allows you to set up the IP address, netmask, gateway, DNS servers, and other basic networking parameters of your primary and (if available) secondary Ethernet connections.

The netconfig exchange will look something like the following:

```
Etna2:~# netconfig
Network Host Name for this unit
> Etna2
Network Domain Name
>
Mode for eth0
1. disabled
2. static
3. dhcp
(Note: To use wireless AP mode you must set eth0 disabled.)
Make a selection and press [Enter]
> 2
IP Address for eth0
> 10.0.3.71
NetMask for eth0
Default: 255.255.255.0
>
```

```
Default gateway
Default: 10.0.3.1
> 10.0.1.1
Mode for USB wireless adapter wlan0
     1. disabled
     2. static
     3. dhcp
Make a selection and press [Enter]
> 1
Net Watcher is a service that attempts to recover lost network connectivity.
Do you want to enable Net Watcher?
(Y/N)? > y
Net Watcher needs a remote host to occasionally ping. This should be a high up-time
host such as a router or gateway.
Enter the IP address for the remote host
Default: 10.0.1.1
> 10.0.1.1
IP Address for primary DNS
> 8.8.8.8
IP Address for secondary DNS
>
New parameters to be saved:
HOSTNAME         = [Etna2] DOMAINNAME = []
DNS1             = [8.8.8.8] DNS2 = []
PUBLIC_ADDR = [] NW_PING_HOST = [10.0.1.1] eth0
Parameters:
     MODE      = [static]
     ADDR           = [10.0.3.71] NETMASK = [255.255.255.0] GATEWAY = [10.0.1.1]
wlan0 Parameters:
     MODE      = [disabled]
     ADDR         = [] NETMASK = [] GATEWAY = []
     SSID       = [] SECURITY = []
     PASS      = []
     CHANNEL = []
Press [Enter] to Continue, or [Ctrl-c] to Quit.
Saving parameters...
Do you want to stop and re-start the network NOW?
(Y/N)? > y
Restarting eth0... fec 63fec000.ethernet eth0: Freescale FEC PHY driver
[NatSemi DP83640]
(mii_bus:phy_addr=63fec000.etherne:01, irq=-1) libphy:
63fec000.etherne:01 - Link is Up - 100/Full
```

After completing the network setup, it is recommended that you reboot the system to ensure that the network parameters come up correctly. Rebooting also assures proper operation of system services that may be terminated when the network(s) are stopped. To review current network parameters, type ifconfig as follows:

```
Etna2:~# ifconfig eth0 Link encap:Ethernet HWaddr
70:b3:d5:ce:92:8f inet addr:10.0.3.71 Bcast:10.0.7.255
Mask:255.255.248.0 inet6 addr: fe80::72b3:d5ff:fece:928f/64
Scope:Link
UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
RX packets:68597 errors:430 dropped:0 overruns:430 frame:0 TX
packets:191 errors:0 dropped:0 overruns:0 carrier:0 collisions:0
txqueuelen:1000
RX bytes:5463702 (5.2 MiB) TX bytes:20075 (19.6 KiB) lo
Link encap:Local Loopback inet addr:127.0.0.1
Mask:255.0.0.0 inet6 addr: ::1/128 Scope:Host
UP LOOPBACK RUNNING MTU:65536 Metric:1
RX packets:32 errors:0 dropped:0 overruns:0 frame:0 TX
packets:32 errors:0 dropped:0 overruns:0 carrier:0
collisions:0 txqueuelen:0
RX bytes:2240 (2.1 KiB) TX bytes:2240 (2.1 KiB)
```

12.6 Dynamic DNS

The Etna2 supports Dynamic DNS services.

The details for setting up DDNS can vary depending on your DDNS provider. We have included a popular DDNS client (ddclient) and a utility for simple configuration (ddnsconfig).

In cases where this utility does not accomplish what your provider needs you may be able to manually edit the ddclient config file at "/etc/ddclient/ddclient.conf". Your provider may be of assistance in this case. Kinemetrics does not track provider requirements or compatibility of ddclient with respect to any DDNS provider. Some providers may have requirements that are not met with ddclient.

Configuration requires console access and root login.

You will need the following from a compatible DDNS provider:

1. An active account with your user name and password.
2. A fully qualified hostname assigned for your Etna2 unit. Most providers offer a web interface for configuring this.
3. Possibly more information depending on the provider.

12.6.1 Setting Up DDNS

Run ddnsconfig and follow the prompts.

1. Select whether or not to use SSL (check with your provider).
2. Select the IP Address determination method?
    - "if" (IP address is determined from the Ethernet interface).
    - "web" (IP address is determined by querying an outside web server).

    NOTE: If you specify "if" for interface you will be asked to choose between "eth0" for a wired network, or "ppp0" for a cellular modem. If you specify "web" you must supply the provider URL.
3. Select the protocol.
    - ddclient supports several. Choose the one that matches your provider.
4. Supply the server URL (provider-specific) or leave blank for defaults.
5. Supply your DDNS account login name (chosen when you opened your account).
6. Supply your DDNS account password (chosen when you opened your account).
7. Supply the fully qualified hostname for your Etna2.
   For example: "myetna2.no-ip.org"

    NOTE: Your Linux hostname (set through netconfig) should match the hostname portion of this string i.e: "myetna2"
8. Review the parameters and save.
9. Reboot and verify operation.

12.6.2 DDNS Verification

It usually takes at least 10 minutes for ddclient to push IP address changes to your provider. Eventually you should be able to ping the fully qualified hostname (i.e: "myetna2.no-ip.org") and get replies. You may be able to log into your provider web interface and see more info. Note: It can take several minutes to hours for a DDNS provider to activate changes to your account.

12.7 Software Watchdog

The system includes an advanced power system that provides watchdog and powerfail protection with powerfail warning capabilities.

The watchdog provision is independent of the main processor, but does interact with it. The watchdog exists as part of the power supply subsystem, and requires that it be "pinged" by the main processor every 10 minutes. Failure to do so will be interpreted by the watchdog as a lockup of the main processor and the main processor will be shutdown and restarted in an attempt to get the system back into operation. Exceptions:

- The watchdog is initially held off for 4 hours after processor power on, allowing for initial startup and worst case filesystem repair on a large system disk.
- If operating in the system's bootloader, the watchdog will be "pinged" every time that a bootloader command is executed so that the processor is allowed to continue to run during low-level maintenance activities. Each bootloader command extends the watchdog for 4 hours.

12.7.1 Default Behavior:

The watchdog is normally serviced by a Linux service in order to keep the system alive. By default, only a failure of Linux to boot or a crash of the operating system or of the watchdog service will cause the watchdog to trigger and restart the system.

12.7.2 Powerfail Protection:

The system includes an internal power backup called a supercapacitor array. This backup provides enough residual power to terminate any running applications and shut down Linux properly. Once powerfail has been detected, the system begins to operate off of the residual power and issues a request to Linux to shutdown. A Linux service watches for the shutdown request, and once received immediately forces all user processes to terminate and then shuts down Linux. When Linux has completed the shutdown, the shutdown request will be acknowledged and the processor will power off.

12.8 Linux Passwords

The default Etna2 Linux passwords are as follows:

root	kmi
kmi	kmi

NOTE: Kinemetrics STRONGLY recommends that you change the system passwords to something well known to your organization, but which is different from the Kinemetrics factory defaults.

To change a Linux password for the current user, type:

```
root@Etna2:~# passwd
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
```

To change the password of a Linux user account from “root”, type:

```
root@Etna2:~# passwd kmi
Enter new UNIX password:
Retype new UNIX password:
passwd: password updated successfully
```

To change the Rockhound console password, change it within the RockTalk or Web Interface Parameter Editor.

12.9 File Retrieval

File Retrieval can be done in a couple of ways:

- By clicking the filename from the Recorded Files page of the Web Server
- Using the SFTP service and a program such as WinSCP, that is described in another section
- Using the USB subsystem and a USB thumb drive

12.10 Save/Restore Parameters

Once you've configured Rockhound for how you intend to operate your system, you should save your configuration. This saved copy of the parameters will be used to restore the Rockhound parameters in case they become corrupted. This is done in two ways:

- From a Linux login, use the command rhsave to save a copy of your parameters within the system that can be restored in case your parameters become corrupted.
- cd /usr/rock/SMARTSDist/bin
- ./rhsave

If the unit's configuration is destroyed, the system will revert to the copy of the configuration most recently saved by rhsave, or to the factory default if the configuration was never saved using rhsave.

- From the web interface use the Admin Details to download a copy of the parameters to your PC. Near the top of the Admin Details screen, there is a link "Download parameters here", that will download the parameter from the instrument. You can give this file you are saving a name that is meaningful to you such as "event-recorderat-10sps-and200sps.jar".
- Kinemetrics recommends that you save a copy of your Rockhound parameters any time that you make significant changes to the parameters so that you can quickly restore them in the event of loss.

To put a configuration that you've saved back on the system, use the web interface via the Send Parameters File function on the Admin Details screen. Select the function "Send Parameters File", and then select the file to send and after it is sent, press "Validate/Apply Patch":

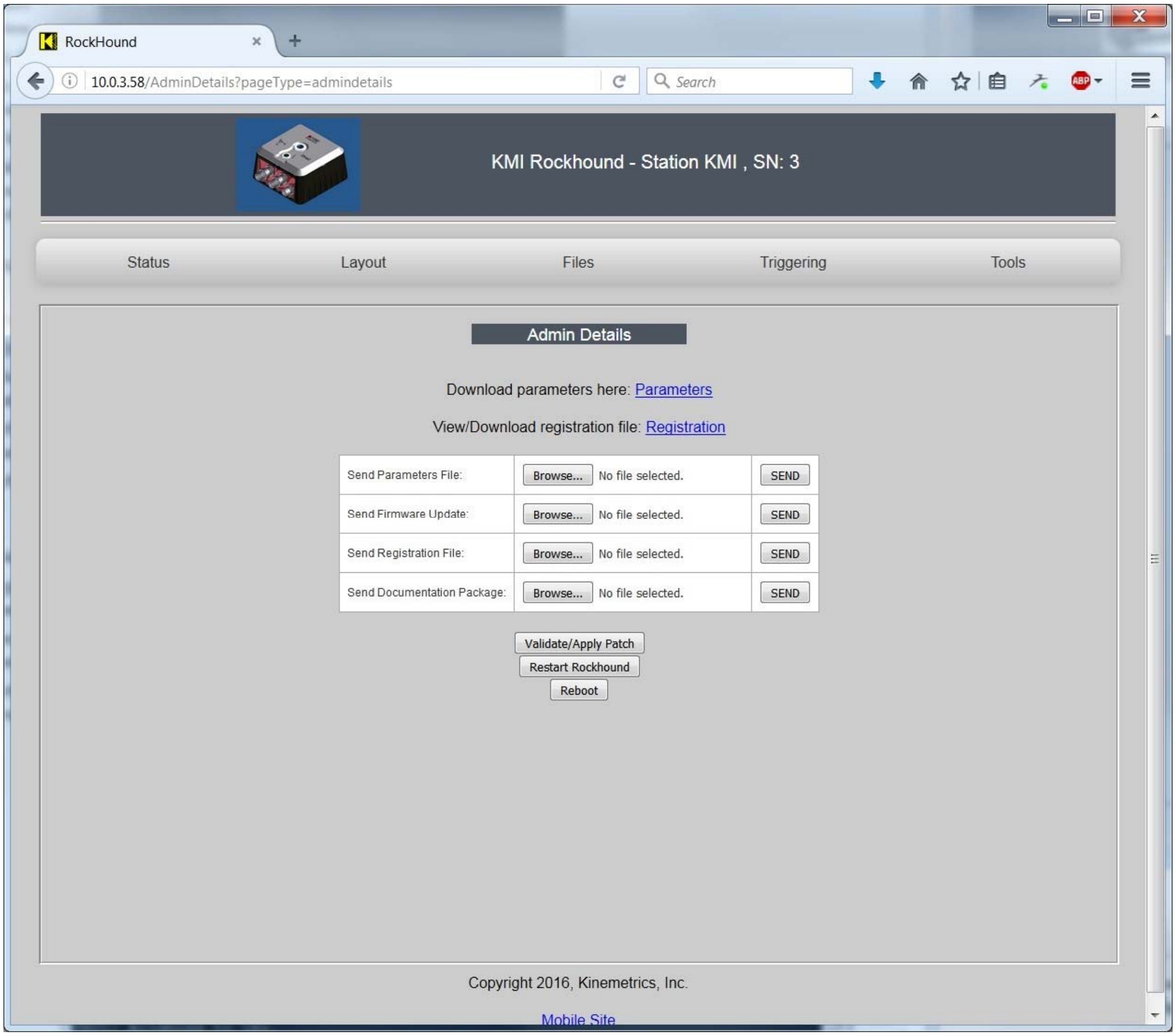


Figure 94: Admin Details

Your parameters can also be saved within the system using the rhsave function from a Linux login. Note that you can use this any time you wish to store the current configuration as a baseline:

- cd /usr/rock/SMARTSDist/bin
- ./rhsave

To restore parameters saved by the rhsave feature, use the command rhrestore:

- cd /usr/rock/SMARTSDist/bin
- ./rhrestore

To return the system to the Rockhound configuration as it shipped from the factory, use the command rhfactoryrestore:

- cd /usr/rock/SMARTSDist/bin
- ./rhfactoryrestore

If the unit's configuration is destroyed, the system will revert to the copy of the configuration most recently saved by rhsave, or to the factory default if the configuration was never saved using rhsave.

The system will also automatically make copies of the last five (5) configurations so that you can go back to these configurations at any time. Note that in this case, it is not necessary for you to do anything proactive to save the configurations in advance, as the copies are save automatically for you.

The saved configuration files are time stamped with the GMT creation time, as:

config_YYMMDD_HHMMSS.jar.

To restore a saved configuration:

- cd /usr/rock/SMARTSDist/save
- ls

config_20091027_145129.jar config_20091029_161551.jar config_20091029_161636.jar config_20091029_161712.jar config_save.list factory.jar user.jar

- cp config_20091027_145129.jar /usr/rock/SMARTSDist/injar/config.jar
- rock restart

You can also restore to a user save point, factory default configuration, or an automatic configuration save-point from the Rock Recovery page:

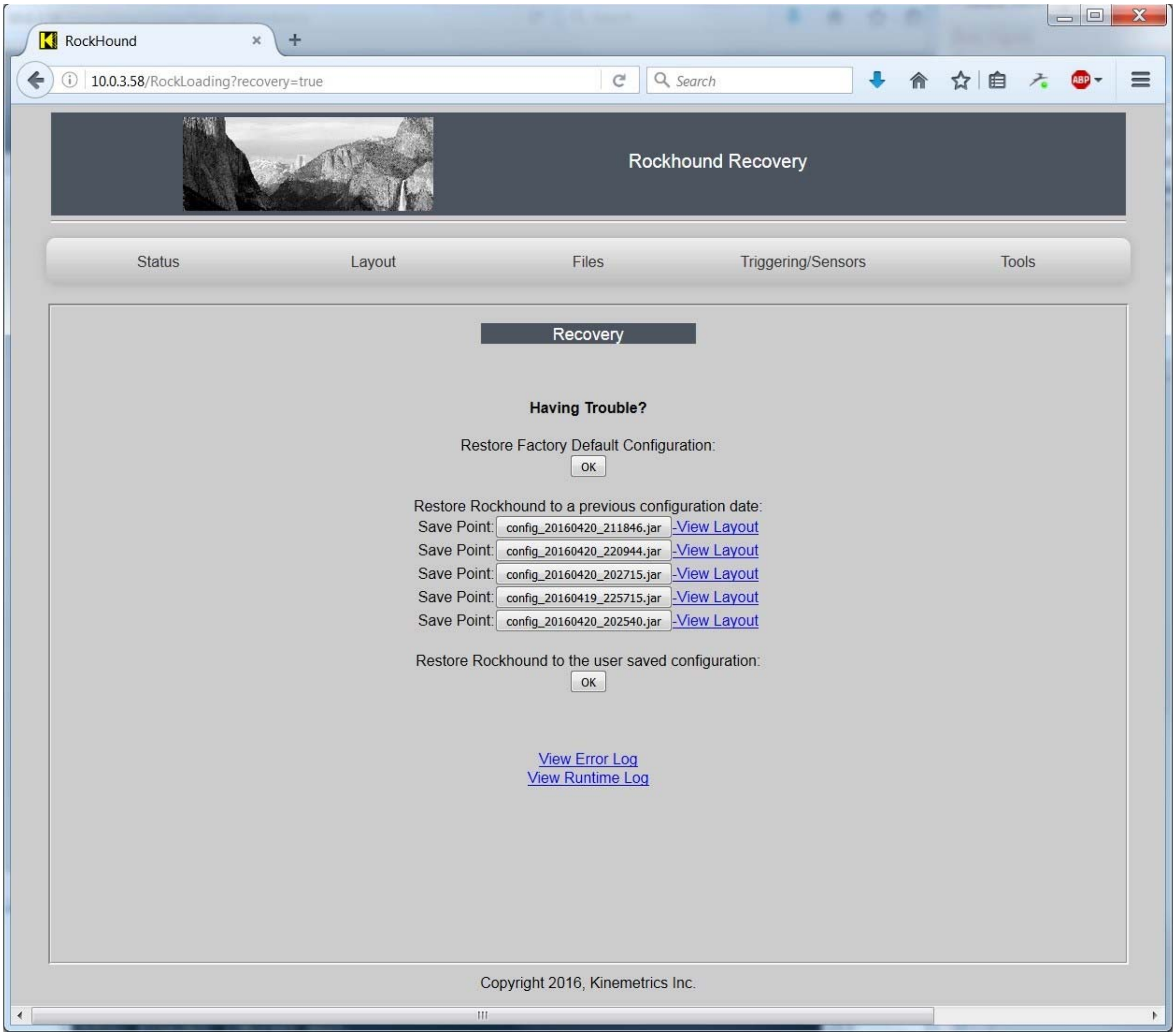


Figure 95: Rock Recovery

12.11 Software Updates

Software updates can be installed remotely through the web interface. The software updates will be either Rockhound updates or updates to the underlying Linux Operating System.

To install a Rockhound, Linux, or Tomcat (web server) update, enable the Admin Details screen. Select Send Firmware Update and choose the file to be sent.

After the file transfer is complete, press “Validate/Apply Patch” to install the update. The Etna2 will automatically determine what kind of update is being installed and will install it the correct way.

This may take a few minutes until the system is restarted and operational with your update.

> **NOTE: If you wish, you may also directly use SFTP rather than the web interface to install updates.**

To install a Rockhound update through SFTP:

- Connect to the unit using a tool like WinSCP
- Place the Rockhound update in the /usr/rock/SMARTSDist/injar directory
- Rename the update file to update.jar
- Using the Administrative Details page, select Validate/Apply Patch to install the update

To install a Linux or Tomcat update through SFTP:

- Connect to the unit using a tool like WinSCP
- Place the Linux update in the directory /opt/kmi/updates/pending
- Using the Administrative Details page, select Validate/Apply Patch to install the update

12.12 Log files

To help you maintain your system, the Rockhound software keeps log files of most important system actions, messages, and exceptions. These are kept in two different log files, the Runtime-log, which keeps track of normal system messages and reporting, and the Error-log, which keeps track of error messages and conditions. Both logs are trimmed automatically to keep their size down.

The log files can be useful as a diagnostic aid with the assistance of Kinemetrics where needed.

The Runtime-log can be selected from the Files menu as shown:

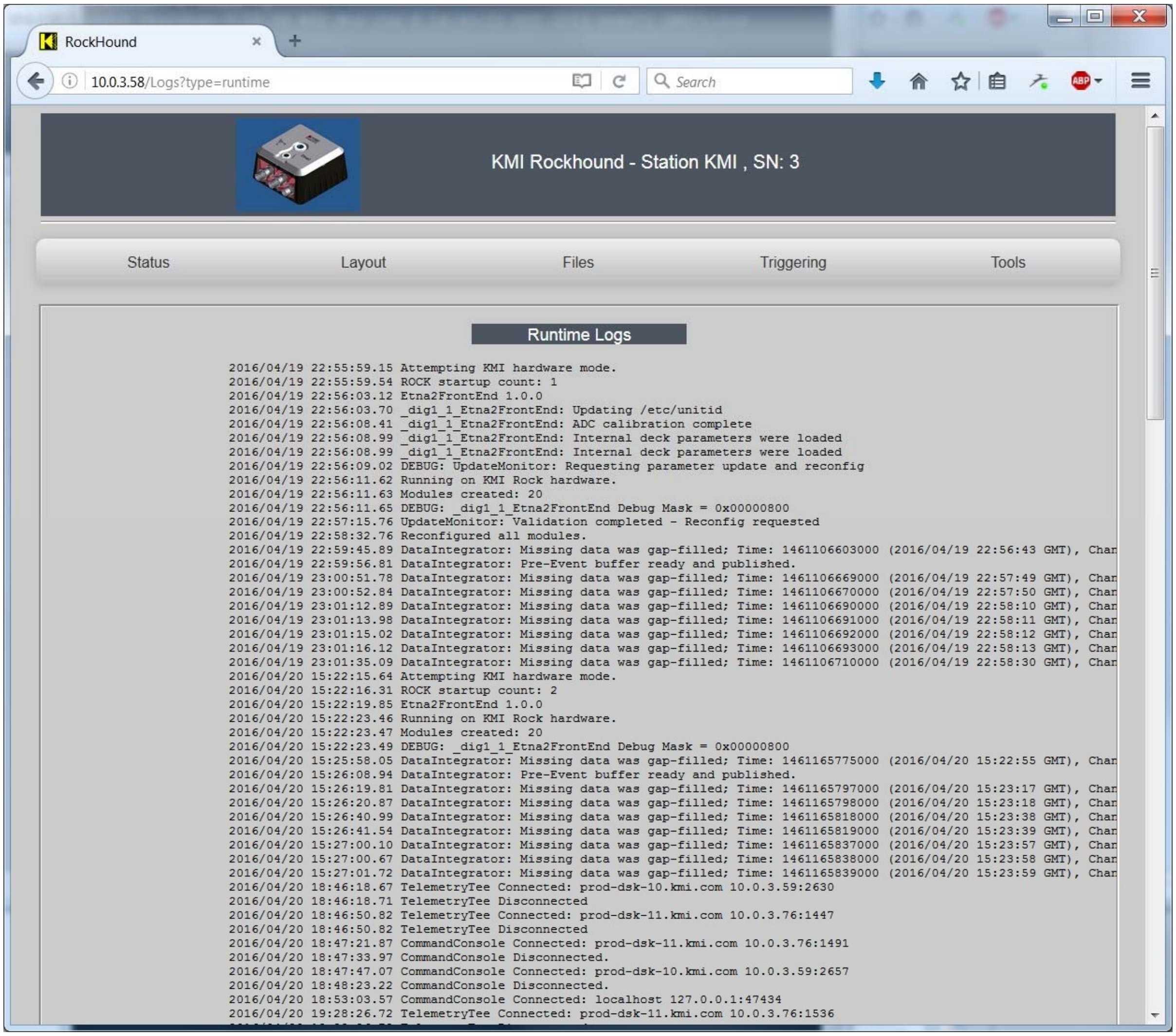


Figure 96: Run Time Log

The Error log can be selected from the Files menu as shown:

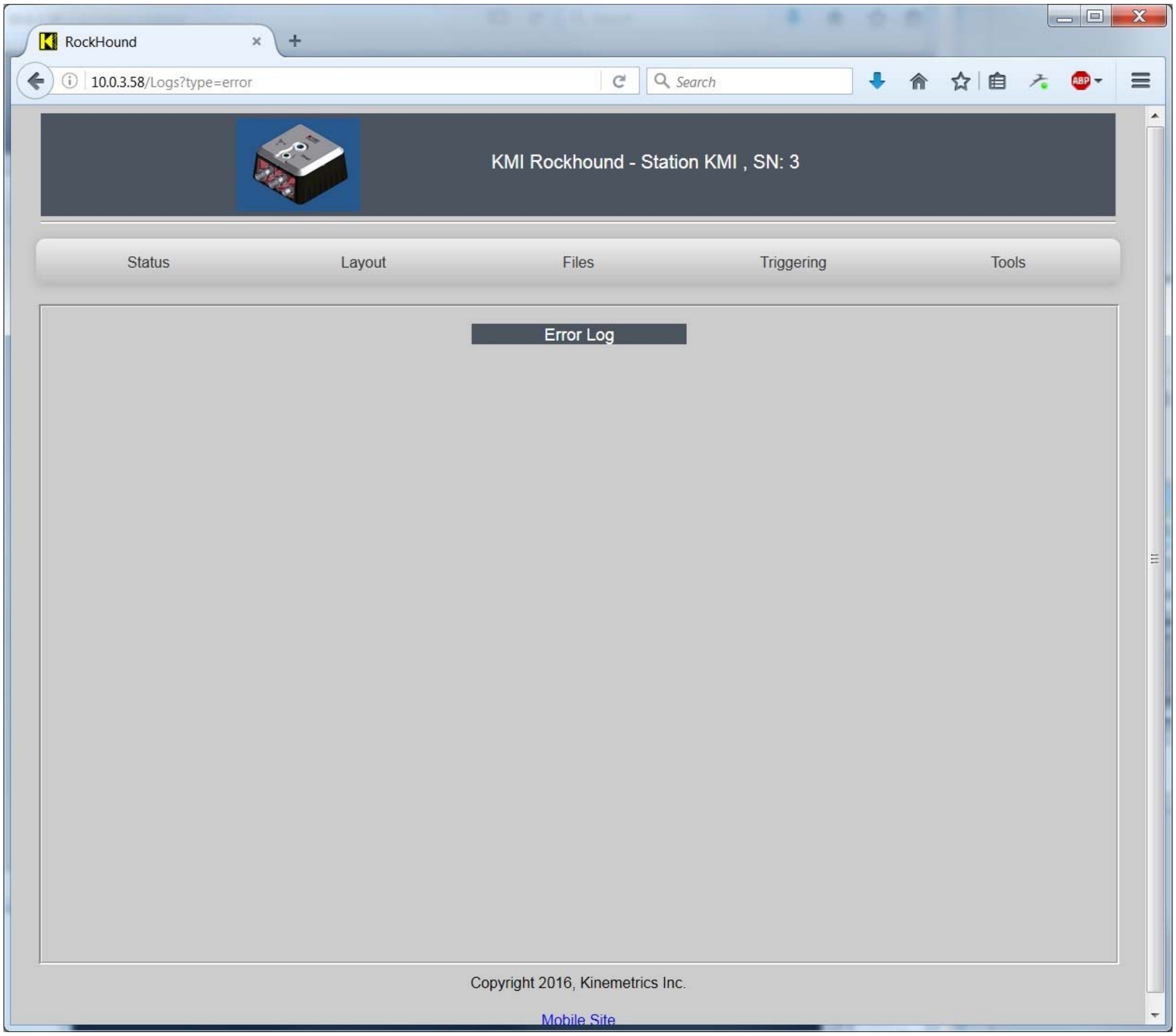


Figure 97: Error Log

Time stamps within the log files are relative to system time (UTC).

12.13 State of Health

The Etna2 tracks several State of Health (SOH) parameters that can be used to monitor system environmental values such as temperature as well as system voltages, GPS drift, clock phase and clock quality.

These values are enabled in the parameters for the Etna2 Front End:

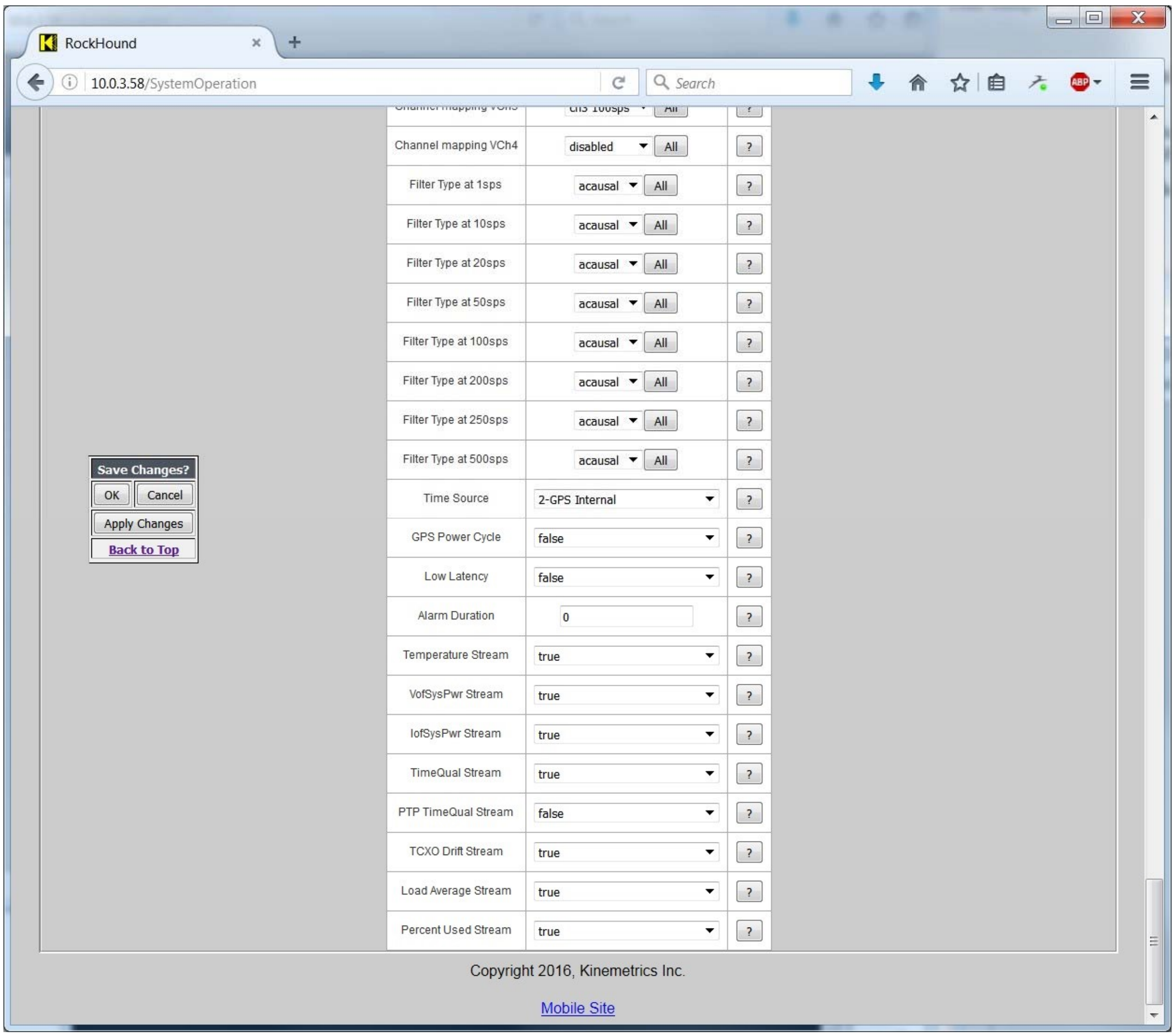


Figure 98: SOH Selection

Other values are available in the advanced and test mode module parameters.

Scaling of SOH values:

SOH Name	Default	Scale	Description
Temperature	true	X 10	Record temperature stream as .deg
VofSysPwr	true	X 1000	Record system voltage stream as .vep
IofSysPwr	true	X 1000	Record system current stream as .vec
TimeQual	true	X 1	Record time quality stream as .lcq
PTP TimeQual	false	X 1	Record PTP time quality stream as .lcp
TCXO Drift	true	X 1	Record clock phase stream as .lce (ns)
Load Average	true	X 100	Record CPU Load Average stream as .cpu (Note 1)
Percent Used	false	X 100	Record Percent of Data Storage Used stream as .dsk
RAM Used	false	X 1	Record RAM Used stream as .mem
TCXO DAC	false	X 1	Record TCXO DAC stream as .vco
User Stat	false	X 1	Record user status stream as .usr (Note 2)

1: Values < ~300 indicate sufficient idle time

2: See the Etna2 Console command "userstat"

In addition to the ability to record and display these State of Health values as normal 1sps data streams, the values are also saved in Short Term (last 24 hours) and Long Term (last year) history.

These SOH histories can be displayed by selecting State-of-Health from the Status menu, and then selecting the requested displays:

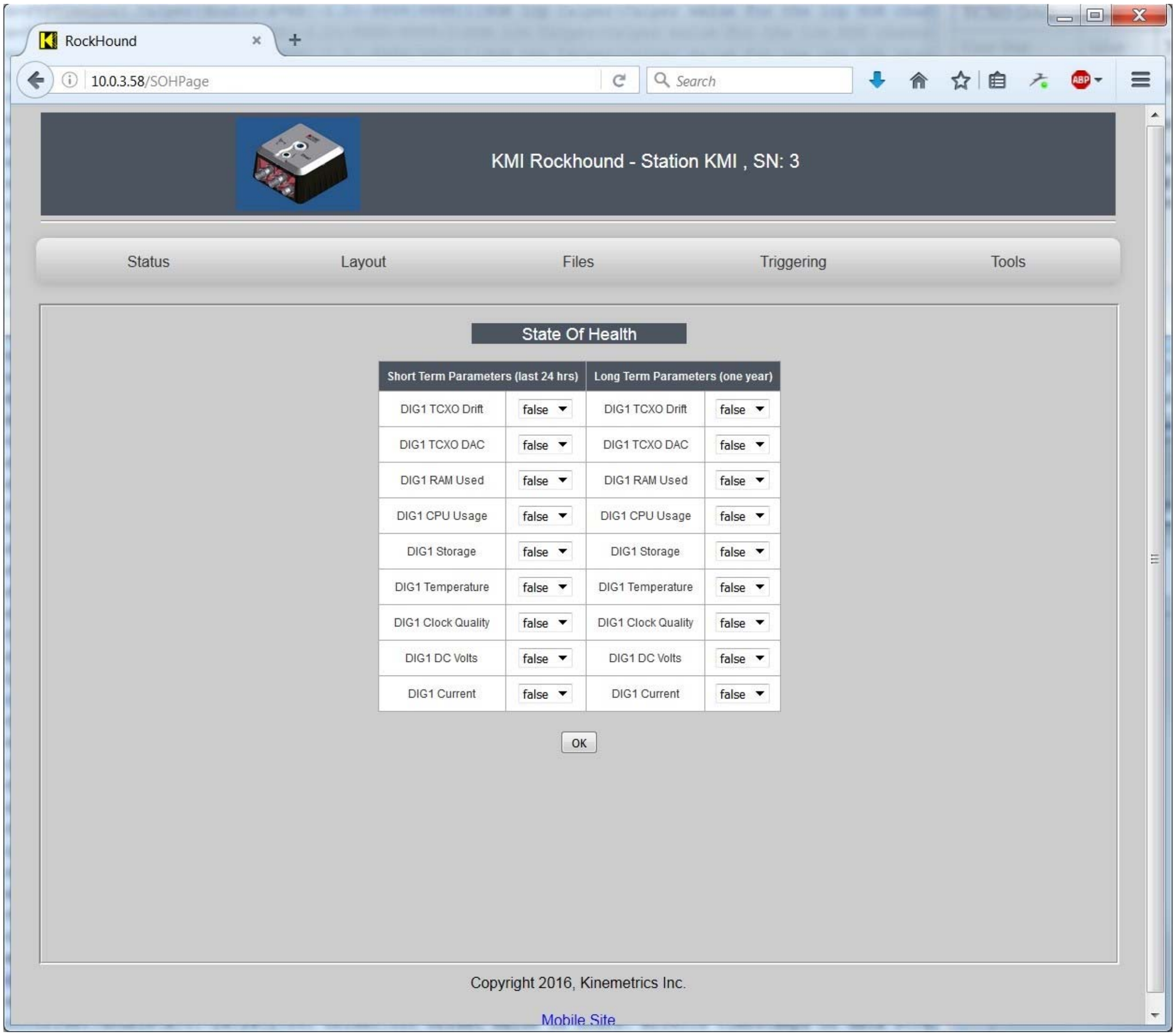


Figure 99: SOH Display Selection

Once you press OK, the history displays must be updated (this may take a few minutes), but then the displays will show as follows:

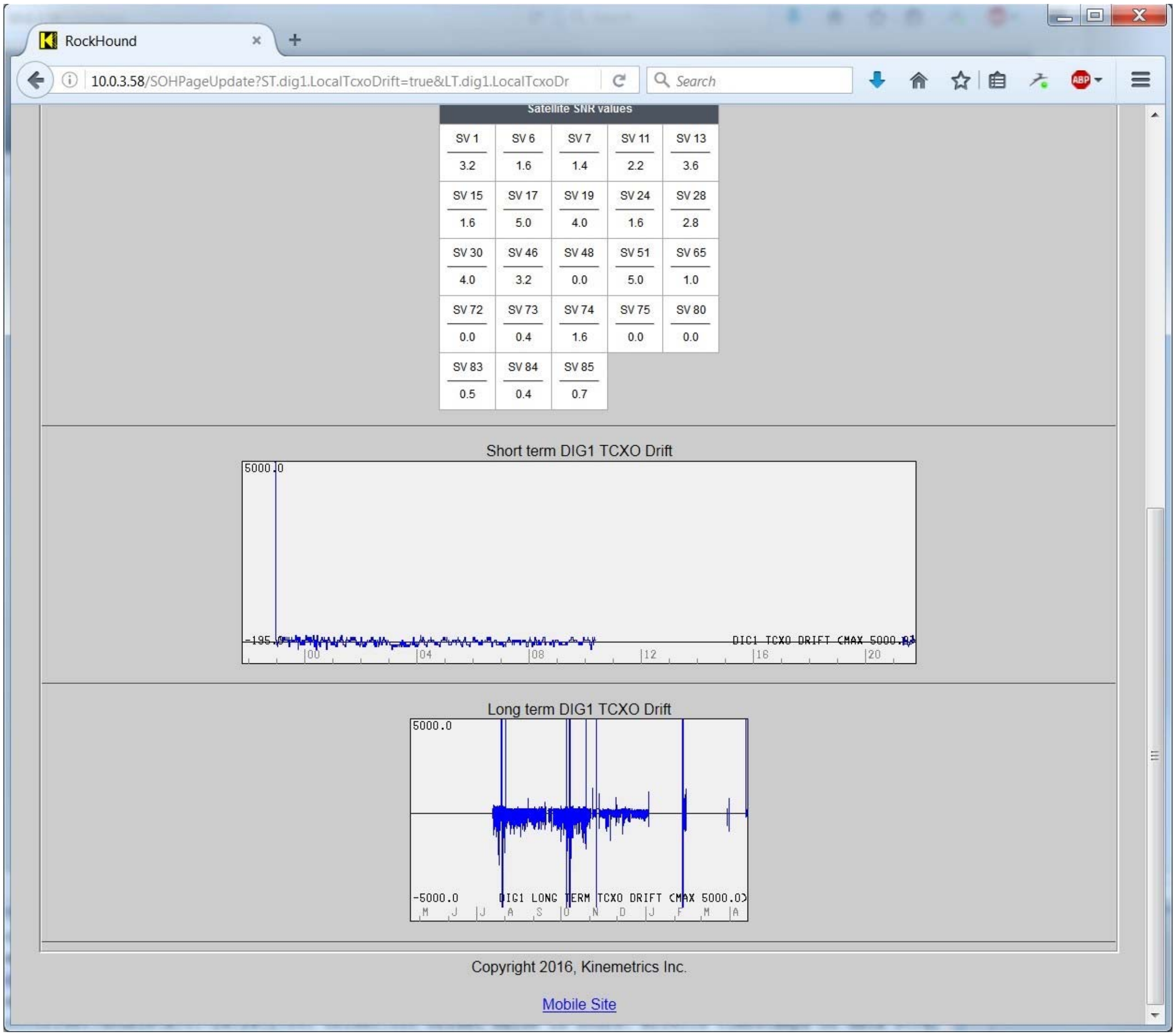


Figure 100: SOH Graphs

Note that the displays include limits (left margin), description (lower right corner), and a time scale (bottom). The time scale is hour of day (UTC) for the short term display and months for the long term display.

12.14 Linux Overview

The Etna-2 uses the Linux operating system based on GNU Linux v3.12.53 as of this writing, built from kernel.org resources with additions to support Kinemetrics hardware.

The Bootloader, Linux kernel and boot filesystem are located on the primary System SDHC memory card. Once the Linux kernel initially loads, control is transferred to the boot filesystem located on the secondary partition of the System SDHC card. This partition is mostly read-only to improve reliability. Recorded data is recorded to the secondary Data SDHC card.

The primary and secondary flash cards use the EXT4 journaling filesystem to give the system improved reliability by making it less susceptible to corruption caused by improper shut downs or power outages.

It is possible to operate the Etna-2 with minimal interaction with the Linux operating system but the sections below give a basic overview of how to interact with the Operating System.

Since the Linux distribution is for a specialized low power embedded system, it is important to note that it may not include some utilities that experienced Linux users might expect to find on a typical Linux desktop or server. Some of the Linux capabilities supplied by this distribution include vi, bash, fsck, ssh, telnet, ftp, and awk. This is of course only a partial list, and some of these features may require the user to enable or configure them before use. The Bootloader, Linux kernel and boot filesystem are located on the primary System SDHC memory card. Once the Linux kernel initially loads, control is transferred to the boot filesystem located on the secondary partition of the System SDHC card. This partition is mostly read-only to improve reliability. Recorded data is recorded to the secondary Data SDHC card.

The primary and secondary flash cards use the EXT4 journaling filesystem to give the system improved reliability by making it less susceptible to corruption caused by improper shut downs or power outages.

It is assumed that the user has some familiarity with Linux. No attempt is made here to familiarize the user with the internals of Linux or with all available Linux commands, although some very introductory Linux command information is included here for reference. For more detailed information, the user is referred to any one of the many books, users groups, or other resources available on this topic.

Source for the parts of Linux that are licensed under the GPL is available on request under section 3(b) of the GPL.

12.15 Common Linux Commands

The following is a list of commonly used Linux commands which may be of value as reference information. Remember that Linux is case sensitive. Options or flags which can be used with a command are placed in [ ]. The [ ] are not part of the command and should not be included in the command that you type.

This information is not an exhaustive listing of commands!

cd

Change directory

cd .. moves you backwards to the next higher subdirectory level

cd / moves you to the highest directory level

chmod permissions filenames

Changes the permissions for a file

Permissions should include a letter designating who gets permissions (u for the user, g for the group, o for others, or a for all)

followed by a + or - (to give or take away the permission)

followed by the kind of permission (r for read access, w for write access, x for execute if the file is a program or script)

The complete command that you type should look like:

chmod g-w filename

chown user:group filenames

Changes ownership of a file

clear Clears the screen

cp oldfiles newfiles

Copies a file; this leaves the old file intact and makes a new copy with a new filename

date

Tells you the current date and time

df

Displays how much space on the disks (storage partitions) is free

du [-a] [-s] directories

Tells you how much disk space your files occupy The -a option displays the space used by each file, not just each directory The -s option displays the total space used for each directory but not subdirectory

help

Provides online help; several topics have been included in the help system

login username

Allows you to login for a terminal session, either through telnet, the console, or SSH logout
Logs you out of a terminal session

ls [-l] [-a] [-p] [-r] [-t] [-x]

Lists the files in a directory

l displays detailed information about each file and directory, including permissions, owners, size and time/date when the file was last modified

a option displays all the files and subdirectories including hidden files (with names that begin with a dot)

p displays a slash at the end of each directory name to distinguish them from filenames

r displays files in reverse order t displays files in order of modification time x displays the

filenames in columns across the screen.

mkdir new_directory

Makes a new subdirectory with the name specified by new_directory

mv [-i] oldname newname

Renames a file or moves it from one filename or directory to another. The -i option tells mv to prompt you before it replaces an existing filename.

passwd

Changes your password

ping IP address or alias

Sends a ping packet to another system; this provides information concerning the time it takes for information to make the round trip to the other computer; it will also tell you whether the other system is on-line at that time

ps

Displays information about your processes/jobs/programs which are running on the system

rm [-i] [-r] filenames

Removes or deletes files. -i option asks you to confirm that you want to delete each file -r option is dangerous because it allow you to delete an entire directory and all of the files it contains rmdir directory Removes a directory; you can use the -i and -r options which are described in the rm command

tail [-r] [-lines] filename Displays the last few lines of a file

-r displays the lines in reverse order

-lines specifies the number of lines, starting at the end of the file, you want to see

touch [-a] [-c] [-m] [date] filenames

Changes the date and time for a file without changing the content of the file a changes only the

date and time the file was last accessed

c doesn't create a file if it does not already exist

m changes only the date and time the file was last modified

date specifies the date and time to give the file in the mmddhhnn format (month, day, hour, minute) touch with a new filename will create a new, empty file.

traceroute IP address or alias

Provides information concerning the route which packets must take to get from your computer to a remote computer/server; typically used to diagnose possible problems in packet routing **vi**

VI is a text editor. Further information concerning the editing commands for VI can be found in a following section.

w

Provides information concerning who is logged into the system and some details on how they are connected

who Tells you who is using the system at that time

12.16 The VI Editor

VI is a standard text editor found on Linux systems. With VI you can create new files or edit existing files. To start VI you should type ’vi filename’ where filename is the name of a new or existing file which you wish to edit. Use the arrow keys to scroll through the document. The following is a list of the commands which are used in VI to edit documents. For a more complete description of the use of the VI editor, check out the section concerning VI in the Linux Users’ Guide written by Larry Greenfield.

This is a partial list of common VI commands. To enter one of these commands, press the ESC key then the command key which is listed below:

a appends text after the cursor
A appends text at end of the line
b back up to beginning of word in current line
d delete line
e move to end of word
G go to end of file
h move the cursor to the left
H move the cursor to the top of the screen
i insert text before the cursor
I insert text at beginning of line
j move the cursor down
k move the cursor up
l move the cursor to the right
o open a line below the current line
O open a line above the current line
r replace character at cursor with the next character typed
u undo the last change made
U restore current line, discarding changes
w move to beginning of next word
x delete character at cursor
X delete character before cursor
y Yank (or copy) operator
Y make copy of current line
$ go to end of line
:q! quit VI without saving changes
:wq write changes to file then quit VI

12.17 Updating Linux

The Linux distribution provides for field updates of the kernel, init filesystem, boot loader, and files on the primary System SDHC flash card.

Updates can be installed by placing update files into the directory

/opt/kmi/updates/pending

When the system is rebooted it will attempt to install updates found there in numeric sorted order. Updates will follow a naming convention like:

Etna2-3.2-Update-4

The results of updates are kept in the file:

/opt/kmi/updates/update.log

If an update succeeds it will be moved to the directory:

/opt/kmi/updates/applied

You may then delete the applied patches if you wish.

If an update fails, the update system will be suspended until the following file is removed:

/opt/kmi/updates/update.failure

The log may be consulted for further details about the failure.

Basically, you need to fix the problem, and then delete the update.failure file. The system will resume updates at the next reboot.

12.17.1 Milestone and Point Updates

Linux updates for the Etna2 will be either a Milestone update or a Point update. The differences between the two are as follows:

- A Milestone update is a “roll-up” and contains all fixes and updates of all previous updates. It is therefore often quite large. You can install the latest Milestone update at any time over any previous update. So you can for example, install update 3.0 over previous versions 1.8 or 2.1.

- A Point update only includes changes since the last Milestone update. This is done to keep intermediate minor releases small in size. However, this means that a Point update does not contain all previous updates and you can only install within the Milestone release. Do you can for example install update 3.2 over update 3.0, but you cannot install update 3.2 over update 2.1.

12.18 Software Versions

There are several different software components in your system and each has its own version. The versions of each will be listed on the data sheet that came with your unit. Software versions include:

- The Power Supply Bootloader
- The Power Supply Application
- The Main Processor's Bootloader
- The Boot Script
- The Linux Kernel
- The Linux File System
- The Java virtual machine (JVM) version
- The GNSS hardware and firmware versions
- Rockhound version

The versions command, available at the Linux prompt will list the most important software versions (of those available to Linux) as in the example below. In order, they are:

- The GNSS hardware and firmware versions
- The Linux file system version
- The Linux kernel version
- Linux update (patch) level
- The Rockhound version

[root@Etna2:~]# versions

KMI GPS MOD NEO-M8N-0, ROM BASE 2.01 (75331) Oct 29 2013 13:28:17

KMI Etna2 Arm Filesystem 0.40

KMI Etna2 Kernel 3.12.53-kmi-AM335x-PD15.1.1 #186 SMP PREEMPT Mon Apr 4 11:09:39 PDT 2016

KMI Rockhound 3.16

The process of updating each software component will be described within the section that describes the package itself.

Chapter 13

Troubleshooting

13.1 Private Networks

If your system will operate on a private network without an outside connection, DNS should be disabled. Current versions of the netconfig script remove the DNS entries if you do not specify them. However, if you have an older version of the netconfig script, it may be necessary to do this manually by deleting /etc/resolv.conf.

13.3 Deleting a large Linux directory

If a configuration error inadvertently results in the creation of lots of useless files – such as when you have inadvertently set the trigger levels too low, you may find that Linux has problems dealing with the large directories. In this case you may find that trying even to delete the files fails with the message "too many files". One way to correct the problem is with a simple script:

cd /tmp/kmi for I in 'ls'; do echo $I; rm $I; done

13.4 Cannot delete data files

If you are unable to data delete files when logged in as the “admin” user, it is probably because permissions are not set correctly for the data directory and any subdirectories. This applies to login via SSH (PuTTY) or SCP (WinSCP).

One temporary solution is to log in as root. While this will work and is generally safe over a secure connection, it is best to avoid logging in as root whenever there is an alternative that will do the job.

If you are storing your data in an alternate location, such as a secondary memory card or an external storage device, then you will have to set the permissions properly for the parent data directory as well as for any subdirectories that already exist. Once the changes are made, further subdirectories created by the system will be correct.

In this example we will use the name "MyData" as the desired data directory name.

- login as root.
- cd to where you want the new directory created. Storing your data on the data drive is usually best.
- mkdir MyData
- chmod 775 MyData
- chmod g+s MyData
- chgrp -R admin MyData

NOTE: If you are trying to fix an existing directory skip the process of making the directory (mkdir MyData). Additionally you will need to do a "chmod g+s" on any pre-existing sub-directories under MyData.

Once done, you should be able to access and manage your files when logged in as the “admin” user, and be able to access (read only) your files when logged in as the
“client” user.

13.5 IP issues and Firewalls

If you're having problems with IP communication, here are some basic troubleshooting tips: If the Etna2 and computer are connected through the internet, make sure that both units can communicate through the internet. The easiest way is to ping a third party server such as Google. Most common mistakes are specifying the wrong gateway or wrong DNS servers. If the Etna2 and computer are on the same private network, make sure that both the computer and the Etna2 are on the same network (first three parts of the IP address the same). Make sure the two units can ping each other.

Check each service manually that you plan to use, whether FTP (port 21), TELNET (port 23), SSH (port 22), NTP (port 123) or Rockhound specific services such as the Rockhound Console (port 9900), Waveform Viewer (port 9999) or others.

If you have problems accessing any particular service, check to make sure that the ports are open on any Operating System provided or third party software firewall. If you're going through a router, you will also need to check that the ports are open through the router.
Finally, some antivirus software includes port blocking features you may have to check.

13.6 Can't Change Password

If you are unable to change Linux passwords, you may have gotten a response such as this:

```
Obsidian:/data/events# passwd
Enter new UNIX password:
Retype new UNIX password:
passwd: Authentication token manipulation error
passwd: password unchanged
```

The reason for this is because the majority of the filesystem is locked to provide further protection against accidental corruption. See Locked File System

Chapter 14

Maintenance

14.1 Run Remote Check Tests

Etna2 accelerographs have been designed to allow the system status to be determined remotely via any available communication links. This prevents the need for most preventative maintenance visits.

The following remote checks can ensure that the unit is functional and the peripheral systems are operational.

- Verify the power input to the unit is at the correct voltage (9-28V External DC)
- Verify the units current draw is within normal ranges
- Verify that the temperature is within normal operating ranges
- Review the reported internal voltages to ensure that they are all normal. (The most effective way of doing this is comparing readings with previous readings to look for significant changes.)
- Verify sensor offsets are within range
- Perform sensor functional tests
- Verify the operation of the timing system – for GNSS systems check that the system is seeing the correct constellation of satellites.
- Review software and communication logs for signs of communication problems or security breaches.
- Check for firmware upgrades available on the Kinemetrics web site.
- Perform maintenance on disk files to remove older unused files.

These checks will indicate if a field visit is required to investigate an abnormal value or to change batteries, and or desiccant. See Power System Display

14.2 Advanced Self Test Capabilities

Etna2 Accelerographs are designed to allow automated performance verification. The Analog toDigital converters are connected to internal sensors and the unit functions as a digitizer. For verification and testing the inputs can be connected to the calibrator signal. The digitizer inputs can also be grounded to allow the noise performance of the ADC to be verified. These features allow performance to be tested both on the bench and as part of a system test/diagnostic procedure in the field.

14.3 Troubleshooting & Service

If your unit needs repair or service, we strongly recommend that you return it to Kinemetrics. If you wish to diagnose hardware problems yourself, we provide some cautions below.

The procedure for loading new firmware/software into the unit is also detailed below.

14.4 Hardware Problems

> **CAUTION: Only a qualified electronic technician should diagnose and repair the unit. Be sure the technician carefully follows both the ESD precautions and the precautions described in the Safety section.**

Do not attempt to repair the unit at the board level. The boards in the Etna-2 are high density surface mount assemblies with state of the art packages that require specialized equipment to replace Kinemetrics provides no support to repair the boards and any attempt will invalidate any warranty on the unit.

We strongly recommend that you send the entire unit back to Kinemetrics for repair and do not attempt to troubleshoot it.

14.5 Installing New Firmware

There are several different software components in your system and each has its own versions. The process of updating each software component will be described within the section that describes the package itself. For example, the process of updating the Power Supply Application will be discussed within the section that discusses the Power Supply.

See Software Versions

14.6 Preventive Maintenance

14.6.1 Desiccant Replacement

To help maintain low humidity inside the unit, Kinematrics places a packet of desiccant inside to absorb any water vapor. If the unit is opened multiple times or if the unit is operated in a high humidity location the desiccant may need to be periodically replaced. Contact Kinematrics for further information if you think this applies to you.

CAUTION: You can order new desiccant packets (P/N 700049) from Kinematrics. Possible equipment damage. If you do not correctly replace the lid and the seal screw the watertight integrity of the unit can be compromised and damage can occur.

Potential ESD equipment damage. The Etna2 circuit boards contain CMOS components that can be damaged by electrostatic discharge (ESD) if not properly handled. Use a grounded wrist strap, with impedance of approximately 1 MOhm, to protect components from ESD damage when handling circuit boards. Before removing any circuit boards or disconnecting any internal cables, be sure that all batteries and the charger are disconnected.

14.6.2 Cleaning the Etna2

Disconnect all power from the unit before cleaning. Then wipe off the exterior surfaces with a mild detergent and a damp soft cloth. Do not use an abrasive cloth especially on the label area as this will damage the unit.

CAUTION: Possible water damage. Do not loosen the seal screw or lid before cleaning the unit. Do not use water to clean the inside of the Etna2. Doing so will severely damage the unit!

The Etna2 should not normally be opened so the interior of the units should be clean. If dust or debris does get inside the unit, we recommend you use a small "computer vacuum cleaner" to remove this debris. Make sure you have turned the power off before vacuuming the unit.

Debris in the unit can seriously degrade the performance of the low noise sensors which is why we suggest only opening the unit if required to replace a card and/or desiccant. The unit should only be opened in a clean dry environment.

14.7 Decommissioning & Recycling

Kinemetrics is committed to ensure the preservation of the environment for current and future generations. We designed the Etna2 to comply with the requirements of the RoHS (Reduction of Hazardous Material) directive to reduce possible contamination of landfills. The Etna2 should be recycled and not thrown in the normal waste stream destined for the local land fill.

We have made the product easy to disassemble and recycle the constituent parts. The recycling passport describes the various materials in the Etna2 and any hazards than can be encountered in disassembling the unit.

14.7.1 Kinemetrics Recycling Passport

Product Name	**Etna2**
Product Model Number	114200
Date	6/9/2016
Version	1.0
Contact Information	www.kinemetrics.com

Product Contains	Substance	Present	Location	Comment
Batteries				
External	Mercury/NiCad/Lithium/Other	Option	External	SLA Battery Optional
Internal	Mercury/NiCad/Lithium/Other	No	N/A	
Parts Containing RoHS Hazardous Substances				
	Lead	Ext. Battery	External	Note 1
	Mercury	No	N/A	
	Cadmium	No	N/A	
	Hexavalent Chromium	No	N/A	
	Polybrominated Biphenyls (PBB)	No	N/A	
	Polybrominated Diphenyl Ethers (PBDE)	No	N/A	
Other Potentially Hazardous Substances/Information				
	Printed Circuit Board Assembly >10cm^2	Yes	Inside	Note 2
	Capacitors w/ PCBs or items of concern	No	N/A	
	Gas Discharge Lamps	No	N/A	
	Backlight Lamps	No	N/A	
	Backlight Lamps containing Mercury	No	N/A	
	Plastics w/ brominated Flame Retardants	No	N/A	
	LCD >100 cm^2	No	N/A	
	Asbestos	No	N/A	
	Refractory Ceramic Fibers	No	N/A	
	Radio-active Substances	No	N/A	

	Beryllium Oxide	No	N/A	
	Other forms of Beryllium	No	N/A	
Other Hazards				
	Parts under Pressure	No	N/A	
	Liquids	No	N/A	
	Gasses	No	N/A	
	Hidden Mechanical Springs	No	N/A	
	High Storage Density Capacitors	Yes	Internal	Note 3

1: Covered by the Battery Directive. Should be recycled in the normal Lead Acid Battery Recycling Stream.

2: Etna2 boards are RoHS compliant, sensor modules may contain high temperature solder.

3: SD Card/GPS Circuit Board Can discharge significant current do not discharge with an electrical short.

14.7.2 Disassembly Procedure for Recycling

Step	Description	Comments & Hints
1	Remove all Power Sources	For Safety!
2	Remove and recycle external Sealed Lead Acid Battery	Note 1
3	Remove all cables and GPS Antenna and Recycle	
4	Unscrew Levelling Feet and Nuts	
5	Remove Seal Screw	Note 2
6	Remove Enclosure Central Nut	Note 3
7	Remove Cover	Pry up
8	Remove 2 SD Cards	Right Side Front
9	Remove Main Circuit Board	3 Hex Screws
10	Remove Processor From Main Circuit Board	2 Hex Screws
11	Remove Sensor Mounting Block Assembly	Note 4
12	Remove SD/GPS Board – Disconnect GPS Antenna Cable	2 Hex Screws

13	Remove 3 Sensor Interface Boards	4 Hex Screws
14	Remove 3 Sensor Modules	Note 5
15	Unscrew the 5 Connector Nuts on the Front of the Base	
16	Push from the outside to remove the Front Panel PCB	
17	Remove the Front Panel Label	Note 6

1: Battery can normally be recycled wherever auto batteries are recycled.

2: Seal Screw has secure Torx Head either use tool available from Kinemetrics or for final decommissioning vice grips can be used to remove. Unseals unit to allow cover to be removed easily.

3: Unscrew using a tool available from Kinemetrics or for final decommissioning vice grips can be used to remove.

4: Sensor Mounting Plate Assembly is retained by three hex head screws at the bottom of the enclosure.

5: Remove the Sensor Modules by unscrewing them from the underside of the sensor mounting plate – 7 Hex Screws. The modules can be further disassembled if desired but they do contain strong magnets so exercise caution.

6: Insert thin blade under edge of label and pull off.

While the Recycling Materials show the exact materials that make up the various components of the unit. By following these instructions a large portion of the unit can be re-used.

14.7.3 Materials for Recycling

Name	Material	Qty	Location	Comments
Cables & GPS Antenna	E-Waste contains copper wire	Varies	External	
Feet & Locking Nuts	Stainless Steel	3	Exterior	
Enclosure Cover	Painted Nickel Plated Aluminum Alloy 6063-T6	1	Case	Note 1
Enclosure Bottom	Painted Nickel Plated Aluminum Alloy 6063-T6	1	Case	Note 2
Front Panel Label	Lexan Sheet with Adhesive	1	Exterior	Note 3
Sensor Mounting Plate	Anodized Aluminum Alloy 6063-T6	1		Note 4
Enclosure Central Nut	Stainless Steel	1		
Enclosure Central Bushing	Stainless Steel	1		
PWBs	PWB with RoHS Compliant Components	7		Note 5
Sensor Modules	Various	3		Note 6
SD Cards	Electronic Components	2		
Misc hardware	Stainless Steel	Varies		Note 7
O-Rings	EPDM	4		

1: RoHS Compliant Finish – Bubble Level is Plastic and can be removed

2: RoHS Compliant Finish

3: Can be removed by peeling off enclosure base

4: RoHS Compliant Anodized Finish

5: Seven circuit boards RoHs compliant E-Waste

6: Sensor Modules can be disassembled into circuit boards and aluminum and steel components – they contain strong magnets and high temperature solder.

7: Screws, Nuts, Washers, & Hex Spacers. Hardware is mainly 304, 316 Stainless Steel

Chapter 15

Hardware Reference

The hardware reference section contains information that may help you with more advanced system installations and if you wish to make your own cable systems or power supplies.

15.1 System Power

The exact current drawn by the Etna2 depends on the unit's configuration, any power the system is providing to USB devices, and how heavy a computational load is placed on the system. Thus, it is difficult to give definitive power figures for a system and the user is advised to measure a system in operation with your exact configuration to precisely determine the load.

A standard out of the box Etna2 will consume a little above 250mA running at 12V DC from the DC supply (~3W). This is running 3 channels at 100 sps as both an event recorder and a continuous recorder. Including a 100Mb Ethernet connection and with the internal GPS receiver and antenna operating. Power can be reduced further to below 3W by turning off the GPS and network interface and disabling continuous recording.

During turn-on the Etna2 will draw an initial current surge when the supply is connected and as the voltage rises this can be >1A for low internal resistance supplies and batteries. The turn-on surge is well within the capabilities of most AC/DC supplies but the user should check their power system to ensure it can turn-on the unit. The units will then draw about 10mA for 10 seconds as it configures the power system. It will then charge its internal super capacitors for ~1 minute at a level of about 75mA and it will then turn-on the main system when there is sufficient charge on the super-capacitor to complete an orderly shutdown of the system. It will then enter its standard operating mode using ~250mA from 12 VDC.

Power consumption from the external DC inputs will be comparable over the range of 9 to 28 VDC although the current will obviously decrease as the voltage is increased. The unit is protected from reversed 12V VRLA batteries and their chargers. However, reversed voltages above 15V will damage the system so if you are using a 24V supply ensure it is correctly connected or you will damage the unit.

The Etna2 does not have an in system battery charger so you will need to supply both DC power and back-up power in case power is lost. Kinemetrics offers several battery power systems that provide both power and charge a VRLA battery which will provide back-up power. Contact Kinemetrics for more information on these systems.

If you are providing you own power system the power supply should be CE rated and rated for operation over the temperature range expected for the system. When you know the current consumption of your system at the battery voltage, its actual autonomy with any battery can be calculated using this formula:

T (hours) = Capacity (Ah)/ I (A) = hours of autonomy

For example a 3 Channel System with Sensors equipped with a 12Ah battery would have autonomy of about ~48 hours.

We recommend using a 12V VRLA battery that you trickle charge as the back-up power system.

15.2 Connector Reference

This section contains cable and connector reference material that can be used for creating or customizing cables for your unit. However, Kinemetrics strongly recommends that you purchase the cable assemblies for the Etna2 from Kinemetrics. The factory supplied cables have been tested and are designed to comply with the interface requirements, wiring your own cables to these small connectors and not degrading system performance is a difficult task.

This information can be useful for electrical diagnosis of cabling or electrical problems.

The connectors can be grouped into several categories: Power/Relay, Ethernet, Serial Console/USB, USB Host, and GNSS Antenna.

15.2.1 Power/Relay

The Power connector on the Etna 2 is used to supply power to the unit, but also contains access to the PhotoMOS relays that are controlled by the unit. The connector is a 9-Pin, Code A, Male, M12 Connector referred to as J4. The connections are show below.

The DC power is applied to Pin 1 and the power supply return is on Pin 2. Pin 3 connects to the Protective Ground (PGP) which is connected to the case of the unit and the power supply cable shield. The power into the unit should be limited between 9-28 VDC.

The Relay connections are for two relays Relay 1 and Relay 2. These are two 1-Form-C (SPDT) PhotoMOS Relays. The Relays are isolated from the rest of the system and the user can connect to the Relay Common (RELAYXCOM), the Normally Closed connection (RELAYXNC), and the Normally Open (RELAYXNO) connection. This coupled with the software configuration allows the system to provide control outputs for a variety of purposes.

The relays have a maximum ON resistance of 35Ω, and 3750V of isolation. The relays can support high voltages but for safety we only recommend using them at 28VDC. For reference the relays are IXYS LCC110 relays.

Power and Relays are on J4.

15.2.1.1 Power Connector Description

Pin	Name	I/O	Color	Description	Protection
J4.1	XVIN0	Power	Blue	Input Power	ESD/EMI/Transient
J4.2	GND	Power	Brown	Input Power	ESD/EMI/Transient
J4.3	PGP	Power	Purple	Protective Ground	
J4.4	RELAY1COM	Isolated	Orange	Relay 1 Common	Isolated
J4.5	RELAY1NC	Isolated	Grey	Relay 1 Normally Closed	Isolated
J4.6	RELAY1NO	Isolated	White	Relay 1 Normally Open	Isolated
J4.7	RELAY2COM	Isolated	Red	Relay 2 Common	Isolated
J4.8	RELAY2NC	Isolated	Yellow	Relay 2 Normally Closed	Isolated
J4.9	RELAY2NO	Isolated	Green	Relay 2 Normally Open	Isolated
J4.Shell				Drain wire for cable shield	

Connector and Cable Information

Description	KMI Number
Connector	853755
Mating Connector	853756
Cable	853764

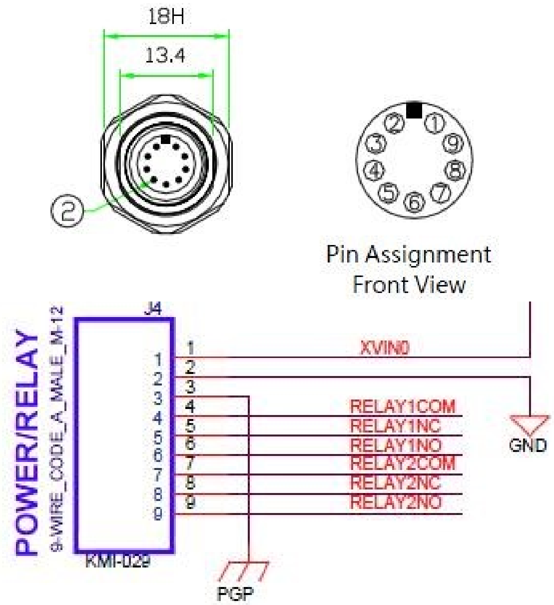


Figure 101: Power Connector Pins and Schematic

15.2.2 Ethernet

The Ethernet connector provides a 10/100 network interface. The X-Code M12 connector used adheres to a standard used in some European industrial Ethernet equipment, such as, switches and routers that also use this connector. The 853608 cable maps the Etna2 X-Code Ethernet connector to a standard RJ-45 Ethernet plug. Commercial X-Code to X-Code cables may also work if appropriate network equipment is in use.

Connection speed is automatically determined. The Etna2 Ethernet interface also supports auto sensing so there should be no need for crossover adapters.

PTP is a standard feature in the Etna2 Ethernet interface.

LINK/SPEED and ACTIVITY LEDs on the Etna2 front panel indicate network traffic and connection speed.

The Ethernet is on J3

Ethernet Connector Description

Pin	Etna2 Name	I/O	Description	RJ-45 Pin	Name	I/O	Protection
J3.1	MDX+0	Output	Transmit +	1	TD+	Input	ESD
J3.2	MDX-0	Output	Transmit -	2	TD-	Input	ESD
J3.3	MDX+1	Input	Receive +	3	RD+	Output	ESD
J3.4	MDX-1	Input	Receive -	6	RD-	Output	ESD
J3.5	MDX+3		Reserved	7			
J3.6	MDX-3		Reserved	8			
J3.7	MDX+2		Reserved	5			
J3.8	MDX-2		Reserved	4			
J3.Shell			Drain wire for cable shield				
	X-Code Ethernet						

Connector and Cable Information

Description	KMI Number
Connector	853594
Mating Connector	853602
Cable	853608

Figure 102: Ethernet Connector Pins

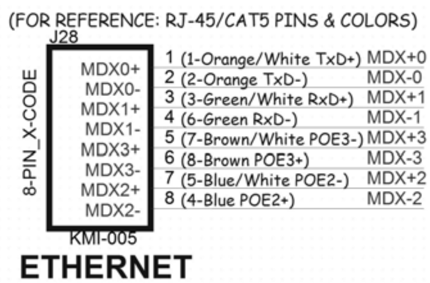


Figure 103: Ethernet Connector Schematic

15.2.2.1 Ethernet Wiring

Ethernet straight through wiring conforms to the following wiring standards:

RJ45 Pin #	Wire Color (T568B)	Wire Diagram (T568B)	10Base-T Signal 100Base-TX Signal	1000Base-T Signal
1	White/Orange		Transmit+	BI_DA+
2	Orange		Transmit-	BI_DA-
3	White/Green		Receive+	BI_DB+
4	Blue		Unused	BI_DC+
5	White/Blue		Unused	BI_DC-
6	Green		Receive-	BI_DB-
7	White/Brown		Unused	BI_DD+
8	Brown		Unused	BI_DD-

Figure 104: Ethernet Wiring Colors

Ethernet cross over wiring conforms to the following wiring standards:

RJ45 Pin # (END 1)	Wire Color	Diagram End #1
1	White/Orange	
2	Orange	
3	White/Green	
4	Blue	
5	White/Blue	
6	Green	
7	White/Brown	
8	Brown	
RJ45 Pin # (END 2)	**Wire Color**	**Diagram End #2**
1	White/Green	
2	Green	
3	White/Orange	
4	White/Brown	
5	Brown	
6	Orange	
7	Blue	
8	White/Blue	

Figure 105: Ethernet Cross Over Cable Pinouts

NOTE: The cross over cable layout is suitable for 1000Base-T operation, all 4 pairs are crossed.

Connection to RJ11 Jack Pair 1 (T1 & R1)

Usually the primary dial tone or talk circuit is wired to the center two pins (pins 3 & 4) and is the white/blue and blue/white pair (AKA: T1 & R1 - tip 1 and ring 1). A standard single line phone draws dial tone from these center pins.

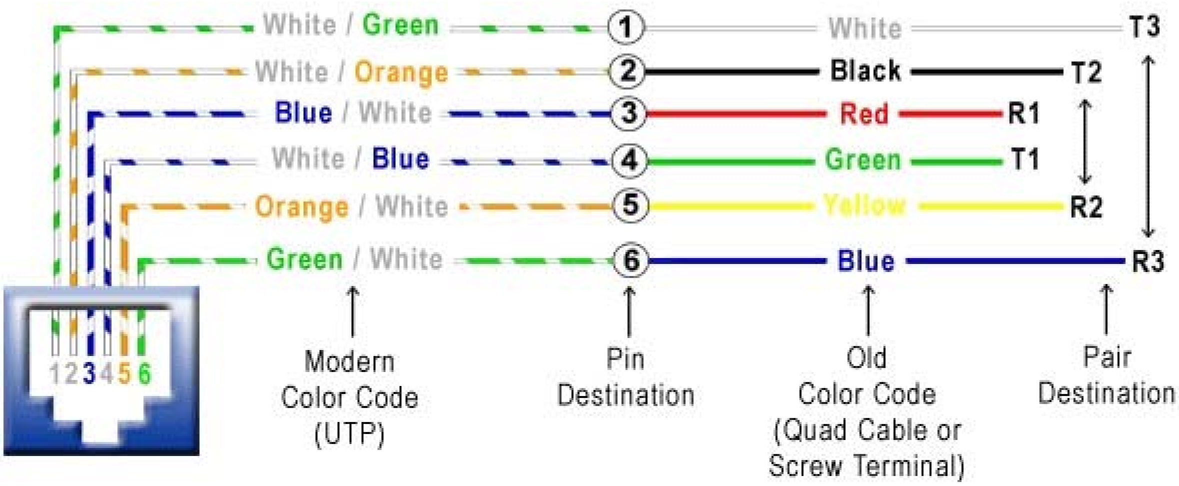


Figure 106: Ethernet RJ11 Wiring

15.2.3 Console/USB

The Console/USB Connector provides an RS232 Linux Console and a dual function USB 2.0 Port. The connector is J2 in the Etna2 and the schematic is shown below.

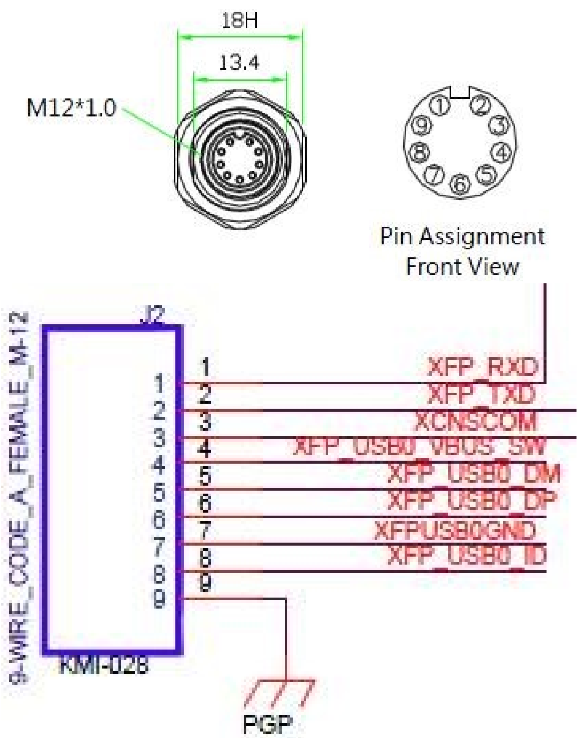


Figure 107: Console/USB Connector Schematic

15.2.3.1 Console

The CONSOLE connector provides a 115.2Kb 3-wire UART interface (TX data, RX data, and Ground) to access Linux console function. Most Etna2 features are controlled through the Rockhound interface but certain functions, mainly netconfig, need to be set up before a network connection can be achieved.

The Console and the USB Device/Host are on J2

Console Connector Description

J2.4	XFP_USB0_VBUS_SW	Power	Provides power to device	1	VBUS	Output	ESD/EM
J2.5	XFP_USB0_DM	Bidir	Data-	2	D-	Bidir	ESD/EM
J2.6	XFP_USB0_DP	Bidir	Data+	3	D+	Bidir	ESD/EM
J2.7	XFP_USB0GND	Power	Gnd/Common	4	GND	GND	ESD/EM
J2.8	XFP_USB0_ID	Input	Gnd/Common	N/C	ID	Input	ESD/EM
				USB Type A			

Pin	Etna2 Name	I/O	Description	DB-9 Pin	PC Name	I/O	Protection
J2.1	XFP_RXD	Input	Receive Data	3	TD	Output	ESD/EMI
J2.2	XFP_TXD	Output	Transmit Data	2	RD	Input	ESD/EMI
J2.3	XCNSCOM	Power	Ground/Common	5	Ground		ESD/EMI
J2.9	PGP		Protective Ground	Shell	Chassis Ground		
	M12 DTE			9-pin DTE			

15.2.3.2 USB Device/Host

The USB port in this connector can either be a USB Device or a USB Host. In operation the port first is configured as a USB Device allowing the user to talk to the instrument using a connection to a PC. Connecting a host device to the port switches it to the Host mode and the port continue to operate as a Host until the Etna2 is re-booted. Thus, this port can be used as a second Host port and connected to either a USB Memory or communication device.

USB Device/Host Connector Description

i

Connector and Cable Information

Description	KMI Number
Connector	853754
Mating Connector	853757
Cable (DB-9 USB Device)	853762
Cable (USB Host)	853774

15.2.4 USB Host

A USB 2.0 Host Port is provided for devices like USB Flash drives and wireless adapters. This port can only function as a Host port.

The USB Host is on J1

USB Host Connector Description

Pin	Etna2 Name	I/O	Description	RJ-45 Pin	Name	I/O	Protection
J1.1	XFP_USB1_VBUS_SW	Power	Provides power to device	1	VBUS	Output	ESD/EMI
J1.2	XFP_USB1_DM	Bidir	Data-	2	D-	Bidir	ESD/EMI
J1.3	XFP_USB1_DP	Bidir	Data+	3	D+	Bidir	ESD/EMI
J1.4	XFPUSB1GND	Power	Gnd/Common	4	GND	GND	ESD/EMI
	M12 USB Host			USB Type A			

Connector and Cable Information

Description	KMI Number
Connector	853596
Mating Connector	853604
Cable	853610
or Cable	853740

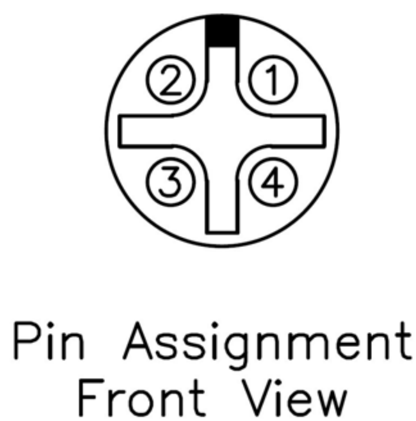


Figure 108: USB Host Connector Pins

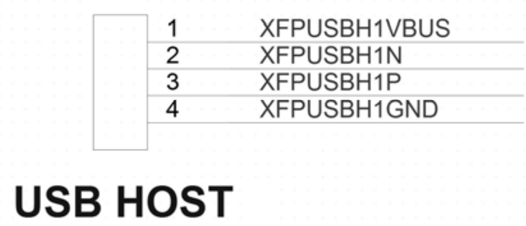


Figure 109: USB Host Connector Schematic

15.2.5 Internal GNSS

The internal GNSS system is built into every Etna2 and provides the very accurate timing system used to time stamp the data typically to sub-microsecond accuracy. The system requires an active antenna that connects to the TNC connector on the front of the unit. The sections below discuss various optional cabling choices for the antenna and the use of an optional lightning protector.

15.2.5.1 Standard Mini-Mag Cabling

The standard antenna kit is an active GNSS Mini-Mag Antenna (P/N 880959) with a 5 meter cable and a TNC Connector (note that the antenna is supplied with a SMA to TNC adapter). This cable length is suitable for short cable runs and will work with multiple GNSS systems.

15.2.5.2 Optional GNSS Bullet Antenna

The optional GNSS Bullet Antenna (P/N 114292-PL) comes with a 25m Plenum rated TNC-TNC cable and a mounting adapter for the antenna.

Plenum cable is typically used in buildings and other structures where, in case of fire, the cable will not produce poisonous gasses that will affect the occupants. Plenum refers to the air conditioning ducting, which is usually the easiest place to run new cable in an existing structure. This cable has good UV and weather resistance and fair water resistance.

For any GNSS antenna cable, a shorter length of cable is preferable to a longer length, due to signal attenuation by the cable. However, too short of a cable can be a problem with active antennas, as their LNA output can overdrive the GNSS module’s input. KMI’s GPS antenna cable comes in 25 meter lengths. If you require longer GPS cable runs Kinemetrics can supply other optional equipment to address these needs.

15.2.5.3 Installing Optional GNSS Lightning Protection

Neither the MiniMag antenna nor the bullet antenna has built-in lightning protection, due to the high cost of protective devices that can pass the low-level, high-frequency signals used in GNSS systems.

> **CAUTION: It is the user's sole responsibility to install and ground the lightning protection system in accordance with safety concerns and applicable electrical and building codes. KMI recommends customers hire an expert in lightning protection to design and install all lightning protection systems.**

The optional lightning protection kit (P/N 114225PL) can be used with internal GNSS timing systems. The lightning protector is a small 3" x 3" x 1½" weather-resistant box which contains surge-protection devices to shunt surges from lightning strikes to ground while still allowing high-frequency signals and the DC power for the active antenna to pass. It has two female TNC connectors, and comes with a 3' (approximately 1 meter) male-to-male TNC coaxial cable. Purchase a weatherproofing kit for the lightning protector from Kinemetrics (P/N 790076) if the lightning protector box will be installed outdoors or in a hostile environment.

Connect the GNSS antenna to the lightning protector as follows:

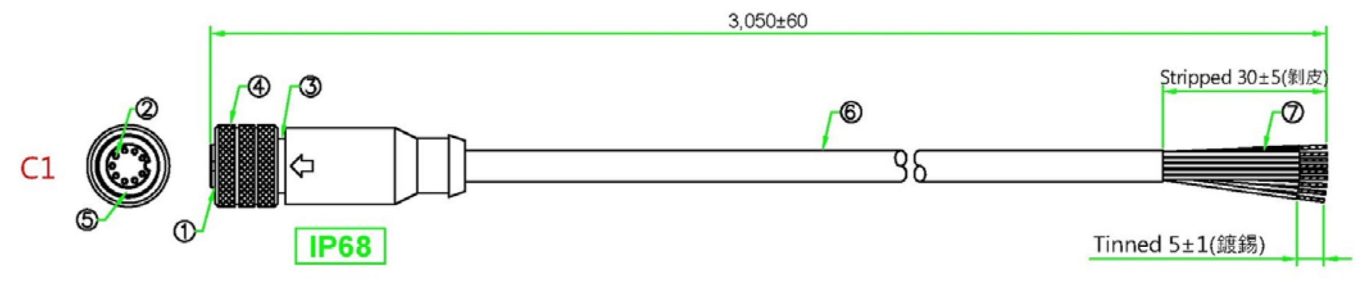
- Connect the antenna cable to the protector's SURGE connector.
- Connect one end of the short TNC male-to-male cable to the protector's EQUIPMENT connector, and connect the other end to the GNSS connector on the Etna2.
- Make sure to provide a good ground. If at all possible, mount the protector to a metal plate approximately 12" square (approx. 30.5 cm sq.), with a good low-resistance and low-inductance ground connection. To mount it to the grounding panel, use approximately 20 inch-pounds (2.26 Nm) of torque on the screws. In addition, the large screw in the base of the protection device should be used to attached a copper strap or braid at least 1" wide to the plate. Details on mounting are supplied by the lightning protection manufacturer.

> **CAUTION*: The lightning protector will not work without adequate grounding.***

The strap connecting the grounding panel to earth ground should be as short and heavy as possible (use a copper strap or braid at least 1" wide) to minimize the resistance and inductance of the ground system. Since a skin effect is present, use a straight strap with as large a surface area as possible, and keep the bends in the strap to an 8" (20.4 cm) or larger radius.

15.3 Cable Drawings

The drawings below show the Etna-2 cables currently available from Kinematics.



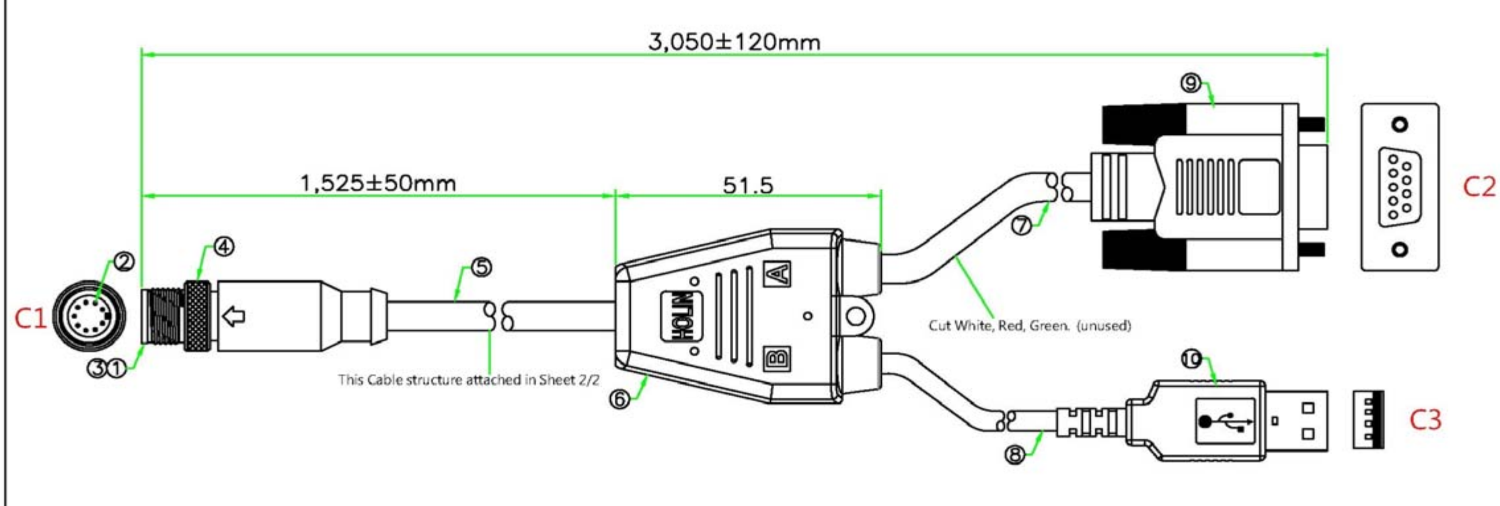
C1

Wiring Diagram	
C1	Function
1 Blue	XVIN0
2 Brown	XVRTN
3 Purple	PGP
4 Orange	RELAY1COM
5 Grey	RELAY1NC
6 White	RELAY1NO
7 Red	RELA2COM
8 Yellow	RELAY2NC
9 Green	RELAYNO
Shielding	Shield

Short

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
7	TUBE	Heat Shrink Tube.	BLACK	1	
6	CABLE	UL2464 26AWG x 9C + D + AL/MY OD:5.5mm ..	BLACK	1	
5	O-RING	VITON.	BLACK	1	
4	RING NUT	BRASS, NICKEL PLATED.		1	
3	METAL SHELL	BRASS, NICKEL PLATED.		1	
2	CONTACT	Brass , 6 u" Gold plated, Female Pin.		9	
1	CONNECTOR	M12 Female 9 pin connector insert. Nylon + GF.	BLACK	1	

Figure 110: P/N 853764, Power and Relays

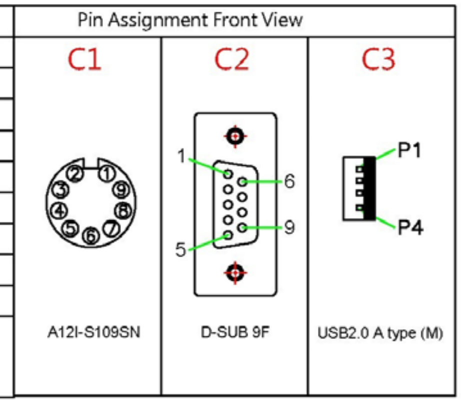


Wiring Diagram attached in Sheet 2/2

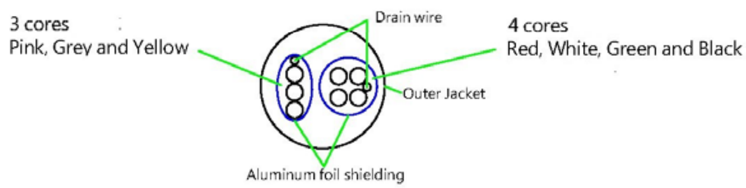
No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
10	CONNECTOR	USB2.0 A type, Male plug, over-molding type.	BLACK	1	
9	CONNECTOR	D-SUB 9P Female, over-molding type.	BLACK	1	
8	CABLE	UL2725 USB2.0 Cable. OD: 4.5.	BLACK	1	
7	CABLE	UL2464 26AWG x 6C + AL/MY + D. OD: 5.0	BLACK	1	
6	Y-Stopper	Overmold: PVC.	BLACK	1	
5	CABLE	UL2464 (26AWG x 3C + D + AL/MY) + (26AWG x 4C + D + AL/MY). OD: 5.5.	BLACK	1	
4	RING NUT	BRASS, NICKEL PLATED.		1	
3	METAL SHELL	BRASS, NICKEL PLATED.		1	
2	CONTACT	Brass , 6 u" Gold plated, Male Pin.		9	
1	CONNECTOR	M12 Male 9 pin connector insert. Nylon + GF.		1	

Figure 111: P/N 853762 Etna2 Console/USB Cable - Page 1

Wiring Diagram			
C1	C2	C3	Function
1 Orange	3 Orange		XFP__RXD
2 Grey	2 Grey		XFP__TXD
3 Yellow	5 Yellow		XCNSCOM
4 Red		1 Red	XFP USB0 VBUS SW
5 White		2 White	XFP USB0 DM
6 Green		3 Green	XFP USB0 DP
7 Black		4 Black	XFPUSBGND
8 N.C			
Short 9			M12_PGP SHIELD
Shielding Drain Wire	Shielding Drain Wire	Shielding Drain Wire	M12_PGP SHIELD

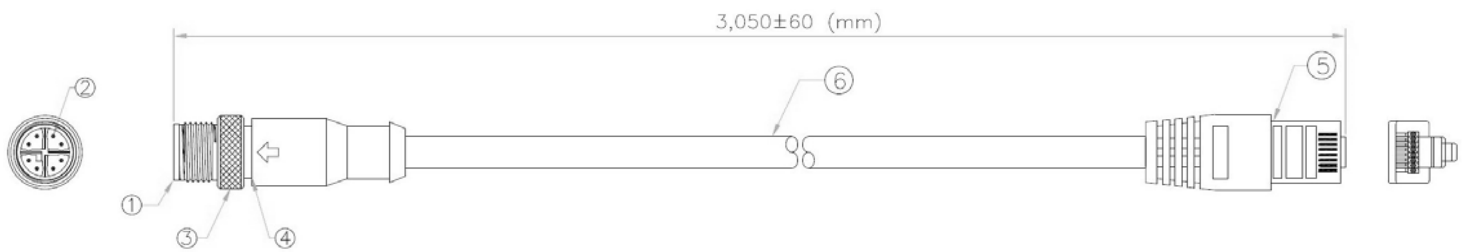


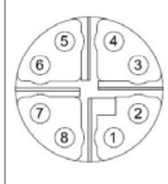
⑤ Cable Structure
UL2464 (26AWG x 3C + D + AL/MY) + (26AWG x 4C + D + AL/MY) + PVC Jacket (Black)



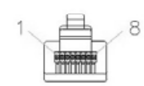
This Picture just for reference

Figure 112: P/N 853762 Etna2 Console/USB Cable - Page 2



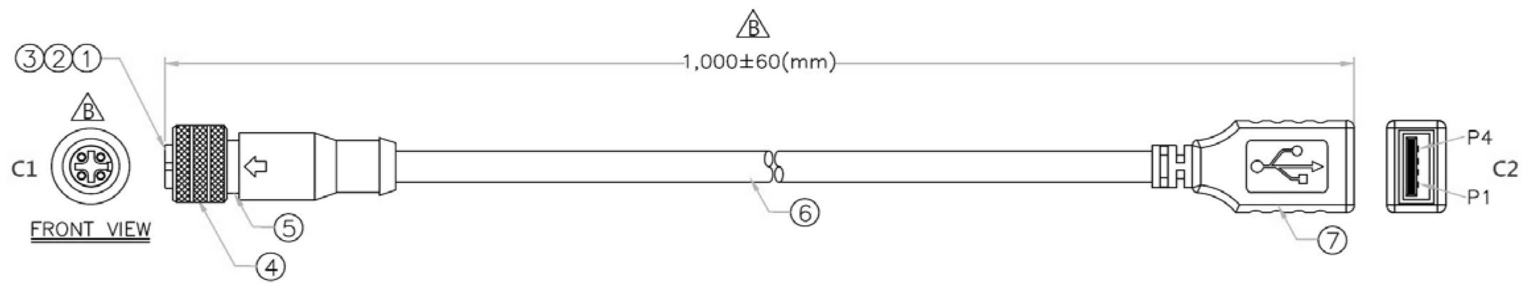


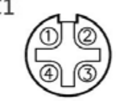
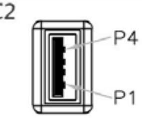
Wiring Diagram		
X12N-S108SN	Wire Color	RJ45
1	Orange/White	1
2	Orange	2
3	Green/White	3
4	Green	6
5	Brown/White	7
6	Brown	8
7	Blue/White	5
8	Blue	4
Shell	Drain Wire	Shell



No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
6	CABLE	CAT.5E FTP CABLE.	BLACK	1	
5	RJ45 PLUG	RJ45 8P8C SHIELDED PLUG.	BLACK	1	
4	SLEEVE	BRASS, NICKEL PLATED.		1	
3	RING NUT	BRASS, NICKEL PLATED,		1	
2	CONTACT	Brass , 6 u" Gold plated .Male Contact.		8	
1	CONNECTOR	M12 X-code male 8 Pin insert.	BLACK	1	

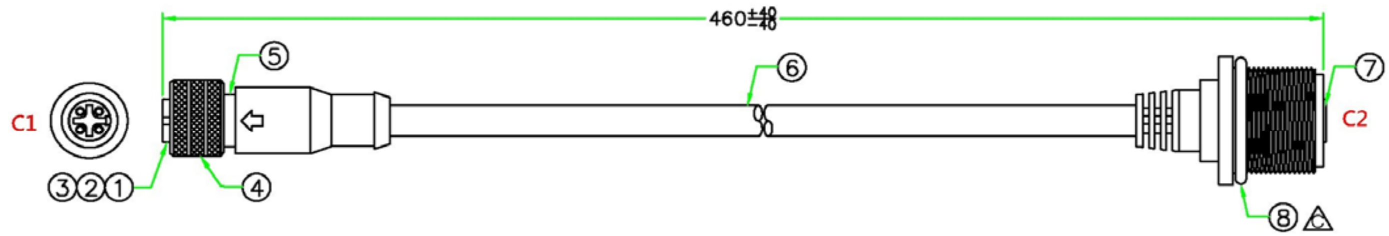
Figure 113: P/N 853608 Etna2 Ethernet Cable



C1	Wiring Diagram						C2
 A12D-S204SN Pin Assignment Front View	C1	Wire Color		C2	Function	Signal	 P4 P1 Pin Assignment Front View
	1	Red		1	+5V	FPUSBHVBUS	
	2	White		2	D−	FPUSBHN	
	3	Green		3	D+	FPUSBHP	
	4	Black		4	GND	FPUSBHGND	
	Shell	Drain Wire		Shell	Shielding	Shielding	

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
7	USB AF	USB A TYPE FEMALE CONNECTOR.	BLACK	1	
6	CABLE	UL2725 28AWGx1P+24AWGx2C. OD: 4.5mm. USB CABLE.	BLACK	1	
5	METAL SHELL	BRASS, NICKEL PLATED.		1	
4	RING NUT	BRASS, NICKEL PLATED.		1	
3	O-RING	VITON	BLACK	1	
2	CONTACT	Brass , 6 u" Gold plated .Female Contact.		4	
1	CONNECTOR	M12 Female 4 Pin insert.	BLACK	1	

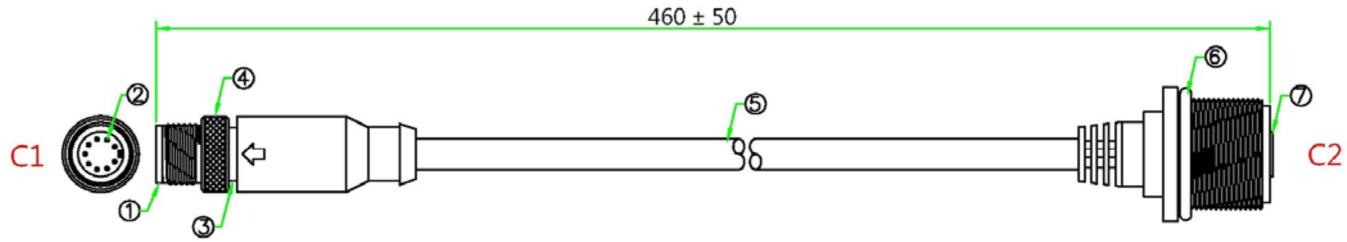
Figure 114: P/N 853610 Etna2 USB Host Cable



C1	Wiring Diagram					C2
	C1	Wire Color	C2	Function	Signal	
A12D-S204SN Pin Assignment Front View	1	Red	1	+5V	FPUSBHVBUS	P4 P1 Pin Assignment Front View
	2	White	2	D-	FPUSBHN	
	3	Green	3	D+	FPUSBHP	
	4	Black	4	GND	FPUSBHGND	
	Shell	Drain Wire	Shell	Shielding	Shielding	

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
8	O-RING	EPDM.	BLACK	1	O-1620-EK
7	USB AF	USB A TYPE FEMALE CONNECTOR.	BLACK	1	
6	CABLE	UL2725 28AWGx1P+24AWGx2C. OD: 4.5mm. USB CABLE.	BLACK	1	
5	METAL SHELL	BRASS, NICKEL PLATED.		1	
4	RING NUT	BRASS, NICKEL PLATED.		1	
3	O-RING	VITON	BLACK	1	
2	CONTACT	Brass , 6 u" Gold plated .Female Contact.		4	
1	CONNECTOR	M12 Female 4 Pin insert.	BLACK	1	

Figure 115: P/N 853740 Etna2 USB Host Cable for use with Protective Cover



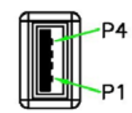
C1's Pin 1, 2 and 3 are N.C.

	Wiring Diagram		
	C1	Wire Color	C2
	4	Red	1
	5	White	2
	6	Green	3
Short	7	Black	4
	8	--------	
Short	9	--------	
	Shell	Drain Wire	Shell

C1

A12I-S109SN
Pin Assignment
Front View

C2



USB2AC-P3CSM
Pin Assignment
Front View

No.	PART NAME	DESCRIPTION	COLOR	Q'TY	REMARKS
7	USB AF	USB A TYPE FEMALE CONNECTOR.		1	
6	O-ring	EPDM.	BLACK	1	
5	CABLE	UL2725 USB2.0 Cable.	BLACK	1	
4	RING NUT	BRASS, Nickel plated.		1	
3	METAL SHELL	BRASS, Nickel plated.		1	
2	CONTACT	BRASS , 6 u" Gold plated, Male Pin.		9	
1	CONNECTOR	M12 Male 9 pin connector insert. Nylon + GF.		1	

Figure 116: P/N 853774 Etna2 2nd USB Host Cable for the Console/USB Connector

Chapter 16

Further Information

The following documents may be useful in providing further information:

- • Rockhound User Manual – Kinemetrics P/N 304702

16.1 Glossary

ADC – Analog to Digital Converter. A device that digitizes an input voltage level and reports it as a single numeric value.

DAC – Digital to Analog Converter. A device that takes a numeric value provided by a computer and produces an output voltage level.

DHCP – Dynamic Host Configuration Protocol. When used, causes the device (such as a digitizer) to “ask” the DHCP server for an IP address, and then use the address assigned by the server.

DSL – Digital Subscriber Line. A low cost “fast” internet connection. Two points to be aware:

- Most inexpensive DSL services use dynamic IP addressing, so the IP address is assigned by the Internet Service Provider. One problem with this can mean that from “outside” you don’t know what the unit’s address is. This can be made easier by using Dynamic DNS (DDNS) or DSL with a “static” IP address, which is more expensive.
- DSL for the most part is actually ADSL, the “A” being “asynchronous”. What this means is that downloads from the unit are slower than uploads “to” the unit, with uploads usually being about 1/6th the speed of downloads. This means that the process of downloading data from the unit will be significantly slower than the “advertised” speed.

DNS – Domain Name Server. This facility is how internet names like www.kmi.com are translated into the numeric address required to locate something on the internet.

DDNS – Dynamic DNS. A third party service that equates your router with a URL (like www.kmi.com) so it can be “found” on the internet by name. DDNS is generally supported in the router (not the digitizer) and must periodically communicate with the DDNS provider. DDNS providers are free or paid subscription services.

DSP – Digital Signal Processor. A specialized processor for performing arithmetic related to signal processing. In the digitizer, DSPs are used for data acquisition and FIR filtering with one DSP used for each 4 physical channels.

FTP – File Transfer Protocol. A method of transferring files over the internet. Generally not considered secure, so SCP or another secure method is preferred. FTP can be used without significant security risks if done carefully.

GNSS – Global Navigation Satellite Systems. A generic term for all such systems, four of which are available as of 2016: GPS (USA), GLONASS (Russian Federation), BeiDou (People's Republic of China), and Galileo (European Union); the GNSS system in the Etna2 supports any two of the four systems.

ISP – Internet Service Provider. A company providing internet communication services such as DSL.

JVM – Java Virtual Machine. Software which is loaded onto a computer allowing it to run Java programs.

LAN – Local Area Network. A network of computers or devices that is private and usually "local" to a building or organization.

NTP – Network time protocol. Useful for setting a computer's "time of day" but generally not accurate enough for sampling.

PC – Personal Computer. In the context of this document, it refers to any computer with a browser capable of running Java. It does not have to be an x86 running Windows. PING – A method of checking communications between two IP addresses over a network.

PTP – Precision Time Protocol (IEEE-1588). Hardware and software that provides for sub-microsecond timing of equipment within a LAN. Most accurate implementations are generally hardware based.

SCP – Secure Copy. A secure method to transfer files that uses the SSH protocol.

SFTP – Secure SFTP. Often used interchangeably with SCP.

SOH – State of Health. Keeps track of information that can be used to help diagnose system problems such as voltages, current, temperature, humidity, etc.

SSH – Secure Shell. Really an overall secure communication protocol used for terminal sessions, file transfers, and other activities.

TELNET – A simple terminal session protocol used on networks. Generally not considered secure.

URL – Uniform Resource Locator. An internet name (like www.kmi.com) that is resolved to a numeric IP address by DNS.

USB – Universal Serial Bus. This increasingly common interface is used for many interfaces from hard drives through keyboards, mice, and serial port adapters.

VRLA – Valve Regulated Lead Acid. Lead Acid Secondary battery designed for back-up power applications.

WAN – Wide Area Network. A large scale network usually employing use of the internet.

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