EQMet

TSA-SMA Digitizer

User Manual

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We warrant each new EQMet product for a period of one year from date of shipment. Defects in material or workmanship found within that period will be replaced or repaired (at our option) without charge for materials or labor. Before returning any product to EQMet please request an RMA number through EQMet Technical Support and make reference to this number in any following correspondence. Once the warranty return of a product Is authorized we will pay the round trip freight charges to the factory for repair under warranty. If subsequent evaluation establishes that necessary repairs are due to misuse, then the customer must assume all charges.

Insurance for all shipments, either first sale or repair, is the responsibility of the customer.

Other Equipment Manufacturers (OEM) included in systems (e.g. peripherals, options) are warranted for 90 days from date of shipment.

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OEM Software may carry its own warranty and the customer should sign any appropriate license agreement(s) and return to software manufacturer. No responsibility is assumed for such third-party software.

Software and software updates provided for EQMet products have a warranty period of one year. An update shipped under warranty will be covered by the original system's warranty for the balance of the one year period.

Warranty claims shall be made on Software Change Request forms (SCRs). Problems reported by filing an SCR within one year will be corrected free of charge. SCRs filed after the one year period will be billed at the then-current rates.

Software corrections may be supplied via a software patch, or by shipping updated software.

Shipment of updated software will sometimes require hardware or configuration changes to the system. Hardware changes may include, but are not limited to, memory and disk drives. Required hardware or configuration changes are not included in the cost of a software update, and may represent an additional cost to the customer.

Requests for Technical Support

All Technical Support questions should be directed via email to EQMet Technical Support at the address below. This includes any hardware or software questions. The website and this manual contain information required to support the vast majority of applications. Please note that phone support is not provided for EQMet products.

Technical Support: **support@eqmet.com**
Website: www.eqmet.com

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Safety

These symbols may appear on EQMet 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 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 digitizer. The unit is powered by an 8-16 VDC source or 15.5 VDC supplied by the optional power supply assembly, from external batteries or from a solar charging system..

Optional Power Supply Assembly

If you plan to power the digitizer from the AC mains, we recommend EQMet's Power Supply and Console Cable Assembly (PSCCA)(113125-PL) which includes plug adaptors for a variety of common AC outlet configurations. After selecting and installing the appropriate plug adaptor, connect the power module to an AC outlet supplying between 100VAC and 240VAC at 50/60 Hz. The PSA is designed for indoor use only; it must not be subject to immersion in water, high humidity, or temperatures below 0C or above 40°C.

User-Supplied Batteries or Charging System

If you supply your own charging system, we recommend EQMet's Battery Supply and Console Cable Assembly (BSCCA)(113129-PL). Make sure your system provides the correct voltage and current required by the unit. If you derive power from the AC mains, 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 a battery, use a properly rated charger and do not overcharge it.

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 PSA provide no explosive protection from static discharges or arcing components. Do not operate the equipment in an atmosphere of explosive gases.

The EQMet TSA-SMA Digitizer 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)

Introduction

This manual describes the basic operation of the EQMet TSA-SMA Digitizers. 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 of the digitizer, 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 of the digitizer, as well as operational information on the digitizer's software. See the section Further Information for additional software and hardware references. The diagram below shows where you will find particular information.

Introduction	•Basic Navigation
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System Overview

The TSA-SMA data acquisition system consists of a self-contained 3 channel digitizer housing internal sensors, electronics, and storage. The signals from the sensors are digitized on individual Analog to Digital Converters. The signals are then filtered, processed by a high speed Digital Signal Processing system and passed over a high speed link to the systems main processor. This consists of a low power, highly integrated processor running Linux and Rockhound software, an Ethernet interface, USB Host and Device Interfaces, and integral SDHC storage device.

The user interaction with the system is through Kinemetrics Rockhound software for set-up, control, and operation of the system, using various connectors for the physical connection of power, communication devices, and GPS to the system.

What is Rockhound?

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

The Rockhound software provided with the TSA-SMA is a limited edition version of the full Rockhound software package with some functionality restricted.

By default, Rockhound is configured as a triggered event recorder with traditional trigger methods, levels, and data formats. You are free to reconfigure software not only to change trigger settings, but to change triggering criteria and output data formats. 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.

Connections

The unit is provided with connectors for power and console, GPS, USB host, USB device, and Ethernet.

Connectors are provided for:

- Power/Console/Serial
- USB host
- USB device
- Ethernet port
- GPS Antenna

LEDs are provided for:

- Power
- Status
- Event
- Ethernet Link – On the Ethernet Connector
- Ethernet Data – On the Ethernet Connector

Standard Interfaces

The standard interfaces (those provided with all units) include the following:

Console Serial/User Serial/Power:

This connector provides access to the console serial port connection, user serial port, and main power input.

Cables to this connector are available in several configurations from EQMet.

The external power input allows provision of an external DC power source to operate the unit. The voltage should be limited to 9-18VDC and 12 VDC is recommended if the customer is supplying a lead acid battery backup charging system.

EQMet supplies cables assemblies for use with a variety of AC to DC power supplies and access to various serial ports. The following are available:

- Power Supply and Console Cable Assembly (113125-PL). A universal AC power adapter with DB9 3-wire console serial port.
- Battery Supply Cable Assembly (113126-PL). A direct battery connection (via lugs) only.
- Power Supply and Serial Cable Assembly (113127-PL). A universal AC power adapter with DB9 6-wire user serial port.
- Battery Supply and Console Cable Assembly (113128-PL). A direct battery connection (via lugs) with DB9 3-wire console serial port.

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

The console serial port is an RS-232 serial port that is used to provide access to an operating system console that can be used 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 serial port provides signals TxD, RxD, and ground.

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

Alternatively, the USB device connection can be used instead of the Console for initial setup of the system.

See Software Installation

The user serial port is an RS-232 serial port that can be used by user application software for a variety of purposes. The user serial port supports hardware handshaking and signals Tx, Rx, RTS, CTS, CD, and ground.

The user serial port is /dev/ttyS1, the default baud rate is 9600.

USB:

Two USB 2.0 compatible supporting Full Speed (12 MbPS) ports are provided:

USB Host:

The USB host interface allows the TSA-SMA to operate with selected devices such as USB "thumb" or "jump" drives.

If a USB drive is plugged into the USB Host connector, the TSA-SMA will mount the drive and copy all files in the /data directory to a unique folder consisting of the unit's host name and tag number. See the USB Organization parameter of the TSA-SMA Data Interface for a complete list of options.

NOTE: The USB drive must be formatted to use the FAT32 file system. Linux file systems such as EXT3 or other Windows file systems such as NTFS will not work.

During file transfer, the Event LED will flash rapidly. When the Event LED stops flashing rapidly, the thumb drive may be removed.

If the thumb drive is left installed, the TSA-SMA will mount the drive once per day and transfer any new files to the drive. In this way, the user may simply remove the drive and have copies of all data files – being careful not to remove the drive while the Event LED is flashing rapidly.

USB Device:

The USB device interface allows use of the unit as a COM port from a USB host (the host is typically something like a PC). A driver is required on the host end to utilize this interface. This interface allows login to the Linux console for initial setup.

Ethernet:

This connector provides a low power 10/100Mb Ethernet connection. The 14-foot cable to connect to this port is P/N 84105-PL, Standard Ethernet.

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 1 Connector section.

GPS:

This connector provides the connection to an active 3.3V GPS Antenna to allow reception of GPS timing and position signals. These antennas contain low noise amplifiers which are powered by a DC current through the antenna cable. The following cable options may be supplied with your unit:

- No GPS antenna or cable
- Trimble MiniMag 3V antenna with 5 meter cable (P/N 110905-PL, GPS 5 Meter, MiniMag)
- Trimble Bullet 3V antenna with:
- 25 meter plenum cable (P/N 111095-01-25-PL, GPS Bullet Antenna 25m Cable)
- 50 meter plenum cable (P/N 111095-01-50-PL)
- 25 meter UV-resistant cable (P/N 111095-02-25-PL)
- 50 meter UV-resistant cable (P/N 111095-02-50-PL)

For additional information on the Antenna and Cabling consult the GPS Antenna Connections section.

LEDs

The LEDs on the top of the unit provide the following information:

Power:

- OFF - No power (either external or from internal super capacitors)
- Steady Green - Running on external power or internal super capacitors
- Flashing Green - The system is starting up

Status:

- OFF - Working, no time source
- Steady Red - Power supply boot loader turn on. Used to load new power supply firmware
- Flashing Red - System Fault detected
- Infrequent Red - System Error detected
- Steady Green - Waiting to turn on. In initial start-up delays or timed operation window
- Flashing Green - The system is starting up
- Infrequent Green - Working, a time source is being used (digitizers only)
- Orange – Super capacitors are being charged
- Alternating Red and Green - The system is shutting down

Event:

- OFF - No events
- Steady Green - Real time data stream (digitizers only)
- Flashing Green - Unused condition
- Infrequent Green - Events stored (digitizers only)
- Rapid Flashing – Data transfer to USB drive

The LEDs incorporated into the Ethernet connector provide the following information:

Ethernet Link (Green):

- ON - Ethernet 10/100Mb link detected
- OFF - No Ethernet link detected

Ethernet Data (Amber):

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

Seal Screw

The small screw located in the lower right of the front panel is the seal screw. It is used at the factory for leak testing.

Caution: This screw should NOT be removed by the user as doing so for an extended time may expose the internals of the unit to the environment and damage it.

Internal Accelerometer Deck

The TSA-SMA contains a tri-axial sensor deck connected to channels 1-3 of the ADC. The deck provides three orthogonal 4g Full Scale sensors mounted internally to the unit. This unit must be leveled and securely mounted to ensure high fidelity string motion recording.

Installation & Setup

To successfully deploy your digitizer, 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 GPS antenna and connect the cable to unit, and configure the software for correct operation if your requirements differ from the default factory configuration of the unit.

If you have not already done so, we recommend that you download and install the Rock Support Software (300654-PL) now from www.eqmet.com 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 digitizer are as follows:

- Secure the unit physically in position
- Attach the grounding stud
- Mount the GPS Antenna
- Connect the Ethernet LAN
- Connect the GPS Antenna
- Connect other communication interfaces
- Connect the DC power source
- Connect a laptop or equivalent to the USB device connection or to the Console serial 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
    - Configure Rockhound (See Basic Setup)

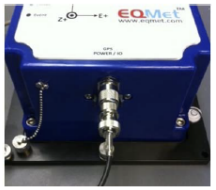
At this point, the system should be functional. See the section on Basic Operation for further details on initial configuration of the system.

Note that several of the configuration and update steps listed above can be tested in the lab before the unit is deployed.

TSA-SMA QUICK SET UP GUIDE

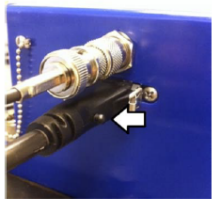
1 Carefully unpack your TSA-SMA and check it is not damaged and all accessories are present.

2 Connect a standard Ethernet Cable to the TSA-SMA and then to your Local Area Network (LAN).



3 Place the GPS Antenna where it has a good view of the sky and connect it to the TSA-SMA. (Shown here using a BNC to TNC adapter)

4 Connect a USB cable to the USB Device port on the TSA-SMA and to the an available USB port on your computer (see detail)

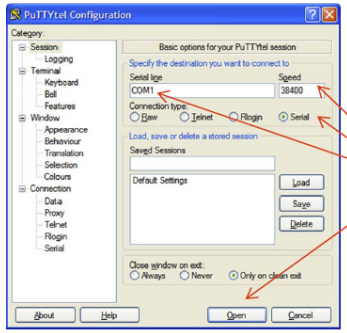


5 Connect the power connector to the TSA-SMA and connect to the AC (If you have a DC power or battery charging system refer to the supplied document)

6 The TSA-SMA's Power LED will turn green and then the Status LED will turn Orange for several minutes as the system charges its internal UPS system. When Status flashes green you can connect to the unit

```
Debian GNU/Linux 6.0 TSASMA ttyS0

TSASMA login: root
Password:
Last login: Thu Jul 28 13:12:48 UTC 2011 on ttyS0
Linux TSASMA 2.6.38.8 #20 PREEMPT Mon Jul 25 23:28:19 PDT 2011 armv5tejl

The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.

(For product info visit www.kinemetrics.com)

TSASMA:~# ipaddr eth0
10.0.1.85
TSASMA:~#
```

7



Before proceeding, make sure to install the PuTTYtel program that you can download from www.eqmet.com, and to make sure the USB device driver is installed as shown **HERE**

The USB device connection presents as a serial port on your PC. Select Serial connection, COM port, and then press Open. Speed is not important.

You may have to get the COM port number for the Gadget Serial from the Windows Device Manager.

Note also that user names and passwords are case sensitive and must be entered in lower case.

8 Using a terminal program such as HyperTerminal or PuTTYtel, log in to the digitizer using user "root" with password "kmi".

Type "ipaddr eth0" <return> and the unit will give you its Ethernet IP Address.

10 Using the Web Interface record a sensor test or review the live data using the Waveform Viewer. See the TSA-SMA User's manual p/n 300950 for additional details.

9 Now use a web browser to connect to the IP address using the user name "rock" and the password "kmi" - now you can operate your TSA-SMA using the Web Interface.

After you have configured your unit it should be installed in its permanent location. Level it and bolt it down securely using the three mounting holes to ensure accurate recordings of earthquake motion.

To use the USB Device connection on Windows *the first time*, you will have to install a device driver. The driver, `linux-cdc-acm.inf` is available on the web site www.eqmet.com

To install the driver on Windows 7:

- Unplug the USB cable from the PC
- Copy `linux-cdc-acm.inf` to the desktop
- Plug the USB cable into the PC
- Windows will attempt to install Gadget Serial driver v2.4 – this driver will be replaced
- Find the Gadget Serial under Ports in the Device Manager and right click to Update Driver
- Click Browse My Computer For Driver Software
- Click Let Me Pick From a List of Drivers
- Click Have Disk (don't pick what's shown)
- Browse to Where the INF file is located
- Select the driver, click Open
- Click OK
- Click Next
- Ignore warnings, use anyway
- When done installing, unplug the USB cable, wait 5 seconds, and plug back in
- Get COM port number from the Device Manager

This guide is intended to provide a simple initial out-of-the-box sequence for starting up your TSA-SMA. It in no way is a comprehensive operating guide. For details on further setup of the system, including configuration, features, and support software, please see the TSA-SMA User's manual p/n 300950 available from www.eqmet.com

P/N 300951 Rev. NC

Operating Environment

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

Operating Temperatures

The digitizer's operating temperature range with the standard options is:

Standard digitizer -20 to +60 ^{O}C Operation

The unit should not be placed where it is exposed to direct sunlight and the external battery of used should be located in the same temperature environment as the unit and should again not be exposed to direct sunlight.

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. The unit should be protected from rain and snow and should not be allowed to stand in water for longer than one hour.

Operating Altitude

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

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 digitizer 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.

See Practice Assembly

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

Requirements for Installation

Below we provide lists of the tools, supplies and equipment required to install a TSA-SMA digitizer in a typical configuration.

Specialized installations may require additional tools, supplies or equipment, depending on specific sites and needs.

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.

Optional Tools

Communication options, GPS systems, and other advanced installations may require additional tools such as:

- Tools for mounting the antenna
- Cable tie wraps
- A short length of insulated braid

Required Supplies

- Mounting hardware, screws, nuts, washers, concrete anchors studs etc. (Dependent on selected mounting method)
- Material to make grounding straps for the unit
- cable tie-wraps, and electrical tape

Required Equipment

- A computer running Windows, Linux, or other suitable operating System
- An Ethernet network interface if you intend to use the networking capabilities
- One of two connections:
    - A USB port on the computer and a USB device cable in order to access a Linux login prompt.
        - Or -
    - A serial port on the computer and a serial cable in order to access the system console. This may be an internal PC serial port or provided through a USB to serial adapter.
- EQMet's Power Supply and Console Cable Assembly (PSCCA)(113125-PL) to link a laptop with a Console serial port or similar

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.

See Unpacking and Inspecting the Unit

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 digitizer.

Before installing the digitizer, 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 digitizer 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.

Free-Field Installations

In a free-field accelerograph installation, the digitizer is installed some distance from buildings in a "free field" and sheltered by a small, lightweight structure that allows the sensor 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 digitizer 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 digitizer, 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 digitizer 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 stud to a 6'- to 8'-long copper rod embedded in the ground.

If no AC power is available, a solar charging system is required.

If the digitizer has a GPS system, the GPS antenna will need a suitable mounting mast. A telephone line, DSL line, or other communication link is required to communicate with the digitizer remotely.

Structural-Monitoring Installations

In a structural-monitoring installation, you provide protection to the digitizer by installing it within an existing building or structure (a bridge, a dam, a high-rise, etc.). The main purpose for installing the digitizer 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 digitizer, and that the space provides enough protection so the digitizer and its sensors will not be disturbed or vandalized. Powering the digitizer requires a mains supply close to the installation point.

Plan to locate the GPS antenna close enough to the digitizer so the supplied GPS cable will reach between the two.

Installing the Digitizer

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.

WARNING! Antenna, Phone, & LAN Cabling. Never install antenna 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 LAN wiring to measure the voltage before working on the wiring. 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.

Mounting the TSA-SMA Accelerograph

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

The unit has three holes that can be used to mount the unit. A suggested method is to use heavy-duty wedge type expansion anchor studs with 1/4-20 thread, a tool to set the anchors, a flat washer, and 1/4-20 stainless steel bolts to screw the unit down. Alternatively you can fabricate a custom plate to bolt the unit to and then attach this to the ground.

Caution: Invalid data. *The TSA-SMA must be securely floor-mounted to ensure the acceleration levels of the actual structure are measured.*

Mounting the TSA-SMA Accelerograph with the Optional Single Point Mounting Plate Kit

The optional Single Point Mounting Plate Kit (KMI 113105-PL) simplifies installation by requiring only a single anchor.

Single Point Adaptor Plate Kit KMI (113105-PL) contents

Parts required:

1. 3x 870701, ¼-20 9/16 inch OD Knurled Thumb Nut, SS (supplied with TSA-SMA)
2. 3x 860814, ¼-20 x 1 inch, Cup Point Set Screw, SS (supplied with TSA-SMA)

3. 1x, 150119 Single Point Adaptor Plate
4. 3x 860826, ¼-20 x 3/4 inch, Cup Point Set Screw, SS
5. 3x 860815, ¼-20 Nut, SS
6. 3x 861811, ¼-20 x 1 inch Socket Head Cap Screw, SS
7. 1x 870668, ¼-20, 3/8 inch OD Drop-in Anchor, SS
8. 1x 867706, ¼-20 x 1 inch, 7/16 Hex Head Screw, SS
9. 1x 880870, Anchor Setting Tool

Tools required:

1. Anchor setting tool (KMI 880870, supplied with kit)
2. Hammer
3. Hex wrenches
4. Open end wrench
5. Socket wrench
6. Level (optional)
7. Masonry bit, 3/8 inch, and drill

Procedure

1. Drill a 3/8 inch diameter hole to a depth of one inch with a masonry bit at the location where the Anchor Plate is to be attached.
2. Push the Drop-in Anchor into the newly drilled hole with the anchor slots down and threaded hole up using the Anchor Setting Tool. Tap the tool with hammer to secure the Drop-In Anchor.
3. Thread 3 ¼-20 Cup Point Screws into the Anchor Plate such that the Screw tops are flush with the top of the Anchor Plate (the top of the Anchor Plate is identified by the countersunk area around the hole in the center of the Anchor Plate).

Adaptor Plate, top side down with 3 Cup Point Set Screws set flush to top

4. Loosely install 3 ¼-20 Nuts on the screws just installed so they are flush against the bottom of the Anchor Plate

Adaptor Plate, top side down, with 3 Nuts installed on Cup Point Set Screws

4. Place the center mounting hole of the Adaptor Plate directly over the Drop-in Anchor
5. Loosely attach the Anchor Bolt to the Drop-in Anchor.
6. Using a level (for best results) or by eye (if desired), level the Adaptor Plate by lowering the Cup Point Set Screws as needed using a hex wrench (making sure that no Screw protrudes above the Anchor Plate).
7. Tighten the three Nuts against the Anchor Plate while holding the Set Screws with a hex wrench and turning the Nut with an open end wrench.
8. Firmly attach the Anchor Bolt to the Drop-in Anchor with a wrench.

Adaptor Plate, top side up, with anchor bolt installed.

9. Confirm that the Anchor Plate is level. If not, remove the Anchor Bolt, loosen the Nut(s), adjust the Screw(s), retighten the Nut(s), reinstall the Anchor Plate with the Anchor Bolt, and repeat until level.
10. Loosen the 3 ¼-20 Thumbnuts and 3 ¼-20 x 1 inch Socket Head Cup Set Screws on the TSA-SMA and adjust so that the tops of the Screws are flush with the tops of the Thumbnuts and the Thumbnuts are flush against the top of the TSA-SMA baseplate.
11. Place the TSA-SMA over the Adaptor Plate so that the 3 clearance holes in the corners of the TSA-SMA baseplate align with the 3 threaded holes in the corners of the Adaptor Plate.

Clearance holes in TSA-SMA baseplate aligned above threaded holes in Adaptor Plate.

Socket Head Set Screw installed a few turns into Adaptor Plate while leveling.

12. Insert the 3 ¼-20 x 1 inch Socket Head Cap Screws through the clearance holes in the TSA-SMA baseplate thread them into the Adaptor Plate until the tips of the Screws are flush with the bottom of the Adaptor Plate.

Bubble level with bubble nearly centered.

13. Adjust the Thumbnuts and the Cup Point Set Screws until the bubble is centered in the bubble level and lock the Thumbnuts against the Screws with a hex wrench.
14. Tighten the Socket Head Cap Screw in the middle of one side. **Important: Do this screw first before tightening the two Screws in the corners**.
15. Tighten the Socket Head Cap Screws in the two corners evenly until both are snug.
16. Confirm that the bubble is still centered in the level. If not, loosen the Socket Head Cap Screws and the Thumbnuts, make adjustments, tighten again with same procedure and recheck until level.

TSA-SMA attached and leveled on Adaptor Plate.

Grounding the Unit

All users should complete this procedure. You must provide the digitizer 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.

Determine what earth ground you will connect the digitizer 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 case grounding bolt on the left center of the front rail. Then connect the other end of the conductor/grounding strap to the selected earth ground.

> **NOTE: To ensure the unit's low noise performance, you must still connect the digitizer's grounding stud to a good earth ground as described above.**

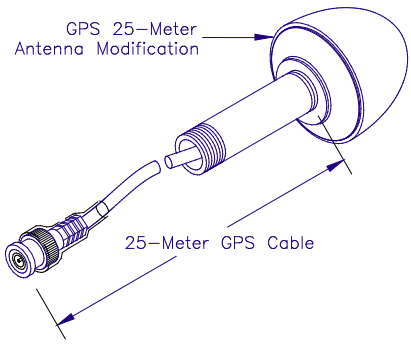
Mount the GPS Antenna (when using the internal GPS)

The GPS Antenna should be mounted following the directions below:

Mounting the MiniMag Antenna (P/N 110905-PL, GPS 5 Meter, MiniMag)

Mount the antenna by placing it on a flat surface within 5 meters of the TSA-SMA Digitizer. Make sure the antenna has a good view of the sky, without any obstruction from large buildings or trees.

Mounting a Bullet Antenna



The optional bullet antenna is used when a longer cable run is required or when a more rugged antenna us required. The antenna has a 3/4" NPT adapter for use with standard pipe fittings.

To mount the antenna, run the antenna cable down through the pipe. Plan the installation so that the cable from the antenna to the TSA-SMA Digitizer is no longer than the Cable length (25 or 50 meters). Like the MiniMag antenna, the bullet antenna requires a good view of the sky, without obstruction from large buildings or trees.

The bullet antenna comes screwed onto one

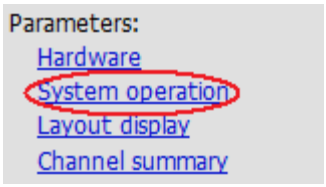
end of a 3/4"-diameter NPT adapter pipe (which threads into standard pipe fittings). Within the adapter, the antenna is joined to a TNC connector on one end of a 25-meter or 50-meter coaxial cable. As shown in the bullet antenna illustration, the other end of the cable has a BNC or TNC connector. When the antenna's mounting post is installed with a female NPT adapter at the end, the NPT adapter should screw snugly into the female adapter.

Caution: If the GPS system will operate in an area at high risk for lightning strikes, consider installing a lightning protector on the GPS antenna.

Connect the GPS Antenna

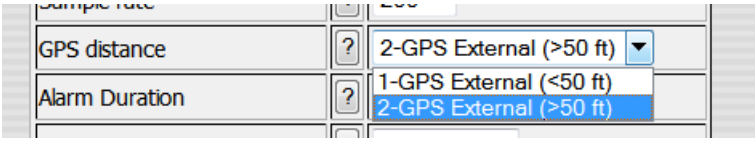
The GPS antenna Cable can now be connected to the Digitizer using the TNC connector on the Front panel. A BNC to TNC connector is provided with the unit to be used if your antenna cable has a BNC connection.

Configure the Timing Source



The Timing Source of the digitizer defaults to the internal GPS.

In order to use the external GPS, you must change the Timing Source parameter of the TSA-SMA Data Interface to select GPS External.



There are two selections for GPS External. Less than 50 feet (~15m) and Greater than 50 feet are the available choices.

If there is a question, the Greater than 50 feet selection will always work, but will use slightly more power than the Less than 50 feet selection.

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

Connect the Ethernet Connection

The digitizer can now be connected to the Local Area Network using a standard Ethernet patch cable plugged into the RJ45 jack on the unit. The cable is then connected to a hub, switch, Router or other Ethernet based communication device. If directly connecting to a Laptop or PC a crossover adapter will be required.

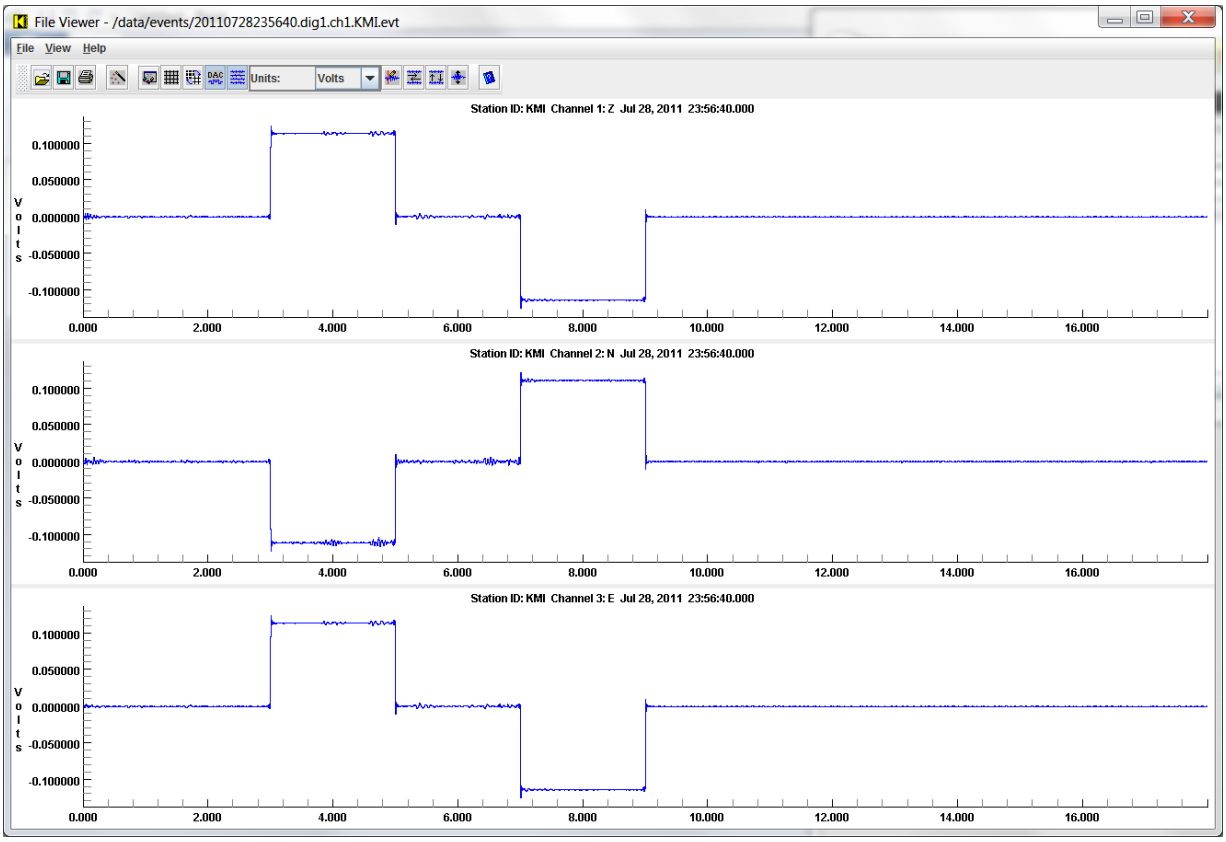
Triaxial Connection Convention

The TSA-SMA digitizer follows the ZNE channel mapping convention.

Functional Test Sequence

The functional test feature sends a calibration sequence from the digitizer to the sensor.

The TSA-SMA will produce the following calibration result:



Note that the second (N) channel is inverted in the calibration sequence with respect to the Z and E channels.

Connecting the Power Supply

The unit optionally includes a wide-input DC power supply assembly which connects to a standard AC outlet.

*Caution: **Using the wrong power supply unit with the unit can permanently damage its circuit boards.** Do not attach any power supply assembly to the digitizer other than the one supplied by EQMet unless it exactly matches the voltage and current ratings required for the digitizer. Older Altus power supplies are not compatible with TSA-SMA digitizers.*

Before plugging in the PSA:

- Make sure that the AC outlet is properly wired.
- Find out if the local AC power is subject to interruption, brownouts, or spikes. If it is, plug a suitable surge suppresser into the AC outlet. (Strongly recommended!)

Then do the following:

1. Plug the PSA into the AC power outlet or surge suppressor.
2. Push the 20 pin power connector into the digitizer's POWER connector until it latches.

NOTE: The PSA automatically adjusts for line voltages from 90 to 260 VAC (either 50 or 60Hz) without user intervention.

Connect a laptop or equivalent to the console port

The digitizer should now be connected to a Laptop or PC using either a USB device connection or a console serial connection (a serial to USB connector may be required if using the Console serial connection.)

Either one can be used. See Software Installation

The initial set-up of the device can now be performed over this link as described in the Initial Setup in the next section.

Basic Operation

The digitizer can operate stand-alone, requiring only power and sensors to operate. Beyond these basics, if you provide a GPS antenna connection for accurate timing and a network connection, then the digitizer really is able to provide tremendous additional capabilities. The digitizer is designed for use with a network, and will serve you best in that environment. This section describes how to set up the Digitizer and perform the basic operations.

Initial Setup

Initial setup of the digitizer is done using a USB device connection or through a console serial cable. Either one connects your computer to a Linux prompt so that you can do preliminary setup. Once done, the console cable (if needed) will rarely be used, so a single console cable is usually sufficient to maintain a large number of digitizers.

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

When using the USB device connection:

Be sure you have the USB device connection's driver installed.

Make note of the COM port assigned to the connection

When using the Console serial connection:

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.

When using the console, 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 digitizer. 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 TSA-SMA.

EQMet 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 Tools section that includes a basic description of PuTTY setup and operation.

See Software Installation

Network Address

The first thing that you'll need to do is to set (or determine) the network address of the digitizer. You need to do this even if your digitizer 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@TSA-SMA:~]# ifdown –a
```

```
[root@TSA-SMA:~]# ifup -a
```

The digitizer 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@TSA-SMA:~]# 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 digitizer can also act as a DHCP Server, which can be useful if you will occasionally connect to a standalone digitizer 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 digitizer to normally be connected to a network.

Viewing System Information

Use the `sysinfo` command to view System Information:

```
[root@TSA-SMA:~]# sysinfo
Hostname:          TSA-SMA
Millivolts:        14927
OS Time:           Thu Jun 16 19:31:09 UTC 2011
Up-Time:           19:31:10 up 6 days, 23:38, 1 user,
                      load average: 1.21, 1.16, 1.15
eth0 IP Addr:      10.0.1.146
Services Up:       cron inetd kpongd ntpd sshd
Via inetd:         telnet ftp
MemFree:            2612 kB
SwapFree:          65120 kB



Filesystem            Size   Used  Avail Use% Mounted on
```

```
/dev/mmcblk0p3          1.1G   640M   364M  64% /
/dev/mmcblk0p4          6.8G   150M   6.3G   3% /opt
```

Use the `versions` command to view the major software versions:

```
[root@TSA-SMA:~]# versions
KMI Arm EABI filesystem 0.2 Beta
KMI initrd 1.2
KMI Kernel, build: Jun  9 2011, 18:10:47
KMI Rockhound 3.8
```

The Web Interface

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

See Overview of the Web Interface.

Basic Setup

Although EQMet makes every effort to make the digitizer 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.

TSA-SMA Internal Deck Zero Adjustment

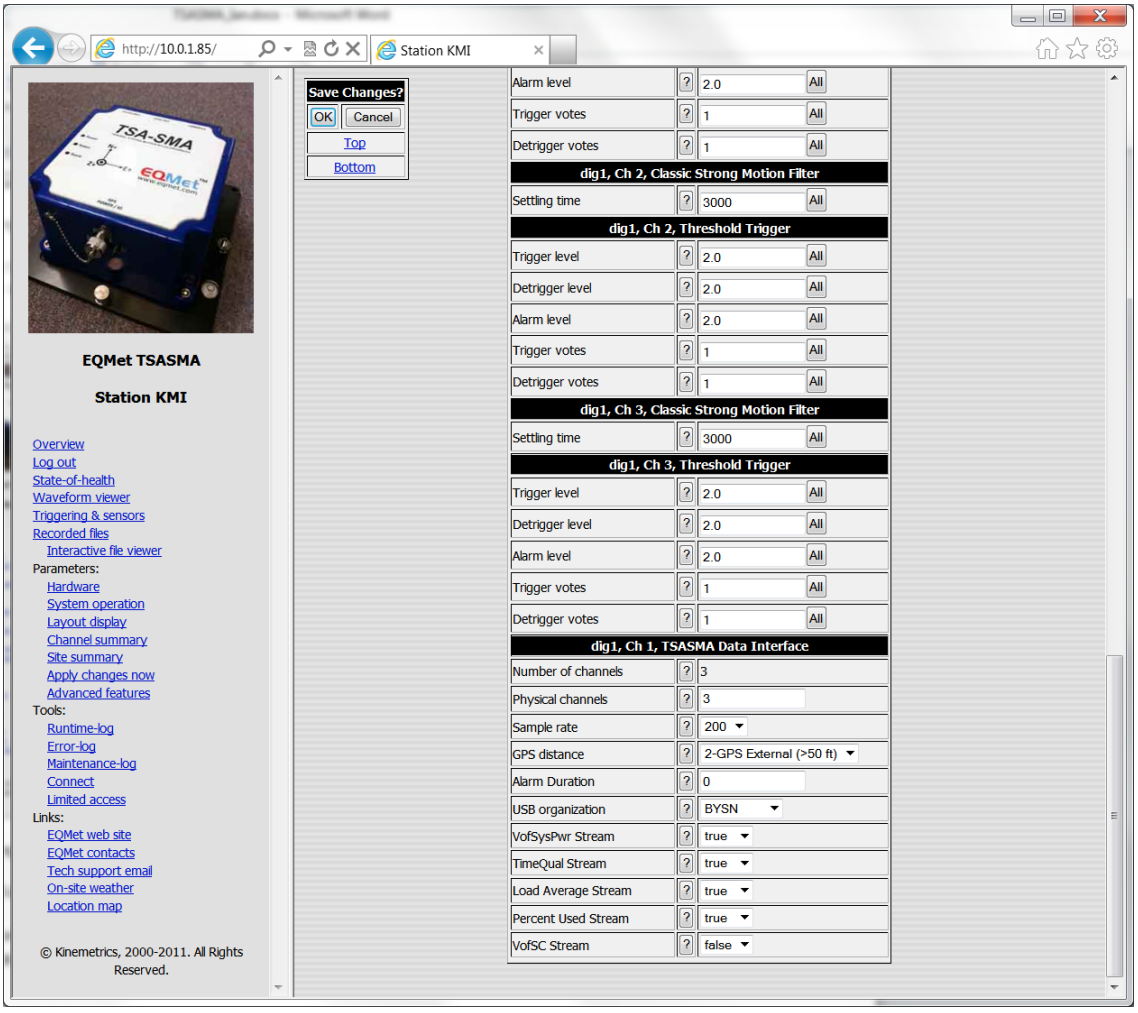
The TSA-SMA is zeroed at the factory, and does not include a mechanical adjustment for zero.

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.

You select the sample rates and the produced sample rates on the System Operation parameters for the TSASMA Data Interface at the parameter called Sample Rate:



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

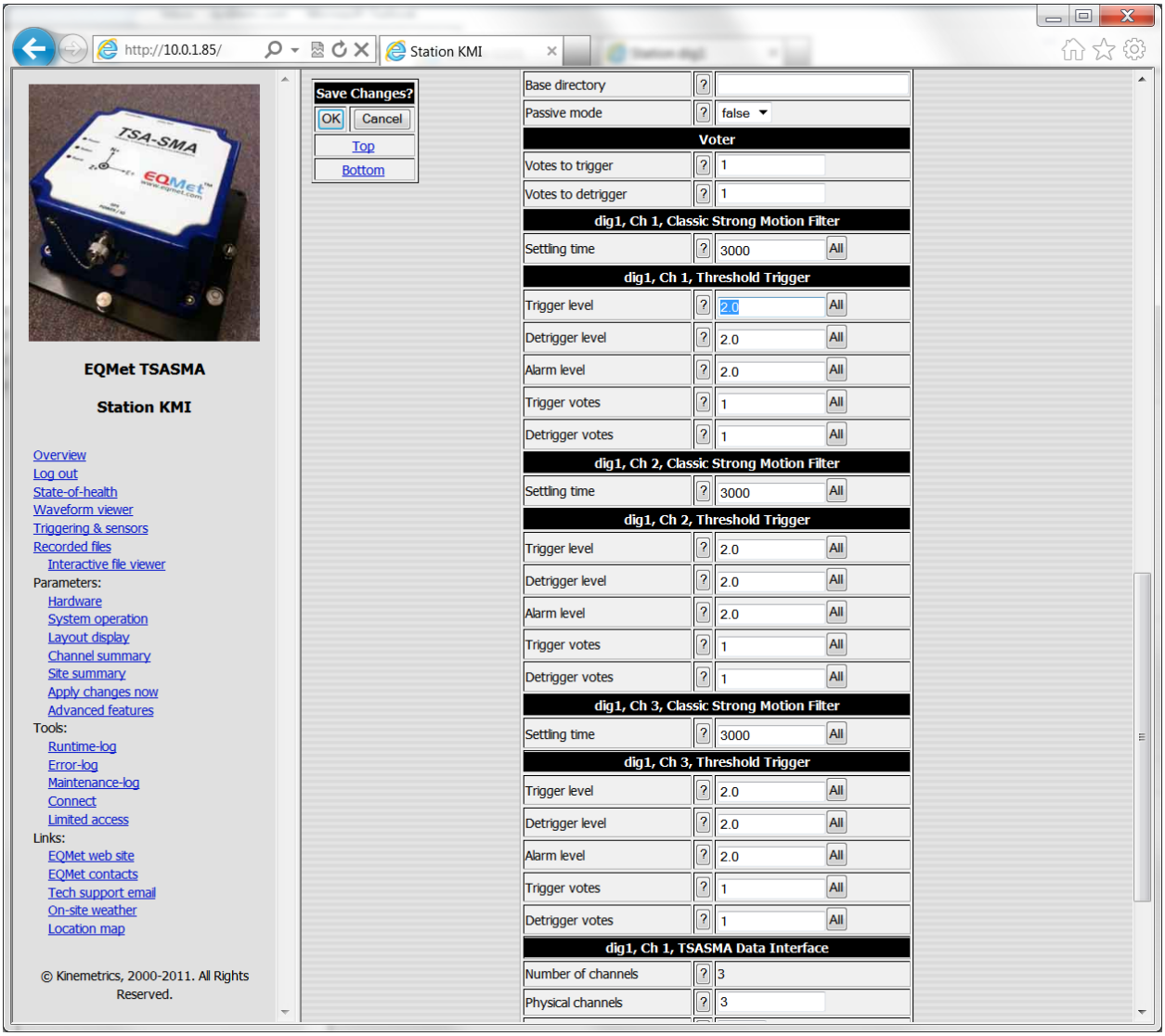
State-of-Health Streams

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 and time quality. These streams are produced at 1sps, so to record them; you'll need a data format that can record data to 1sps. The SOH streams are selected in the System Operation parameters.

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

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 +/-20V and your threshold is set to 2%, then your trigger level is 2% of 20V, or 0.4V. Trigger levels are set in the System Operation parameters:



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.

Voting Options

Using the Voter, 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 for triggered channels does 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.

Other Parameters

Other basic parameters that are worth reviewing are:

- Voter parameters
- Digitizer pre-event and post-event times
- Channel trigger and detrigger votes

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

Activating Parameter Changes

Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes Now” from the left pane of the display.

Passwords

All digitizers are shipped with the same default passwords. Before deployment, EQMet 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?

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.
- EQMet 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 Saving and Restoring Parameters

Triggered Recording

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.

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.

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.

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.

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.

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.

Triggering in Weak Motion Applications

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

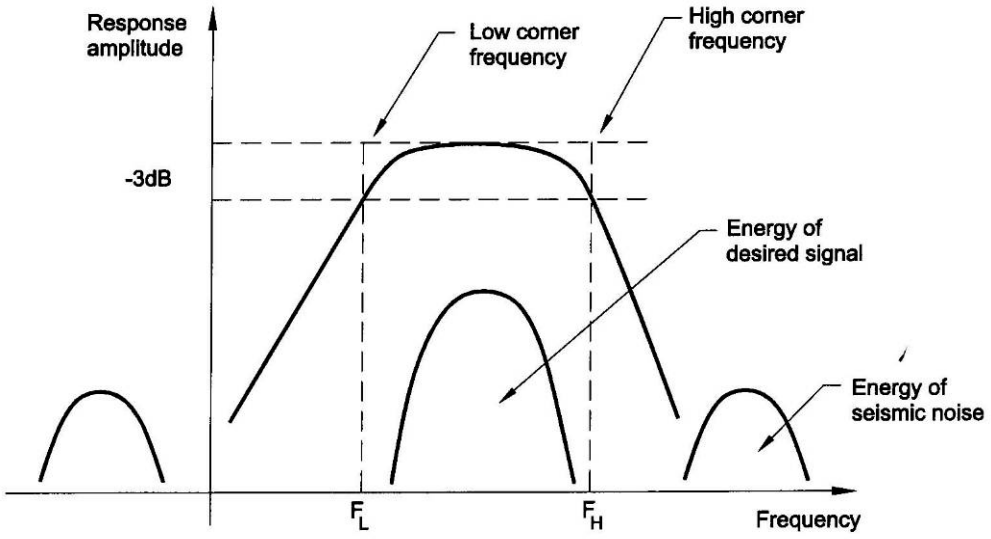
- Three different trigger filters that allow the trigger band of interest to be optimized.
- STA/LTA triggering to support the recording of small amplitude events.

The use of these specific features is discussed below.

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 pre-trigger 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.

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 100 Hz sampling rate can record regional events with broadband sensors. Its 0.6 Hz low-corner frequency gives some protection to the dominant component of natural marine seismic noise. Its high-corner frequency gives protection against excessive high-frequency man-made seismic noise.
- 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.
- The classic strong motion filter at a 250 Hz sampling rate can record for short periods with a short-period seismometer. In this case, the sensor itself protects against ~0.3 Hz marine seismic noise.
- 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.

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

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.

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. The TSA-SMA implements only non-causal filters. Non-causal filters have 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 de-convolution 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.

The 32 KHz data stream from the A/D converter is decimated within the converter using a sinc^5 filter to produce a 4 kHz output sampling rate. This output is further filtered and decimated by FIR filters to produce the final data stream. These filters are implemented as two 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 or less. The table below lists various properties of the filters for each of the available sampling rates available in the TSA-SMA Recorder.

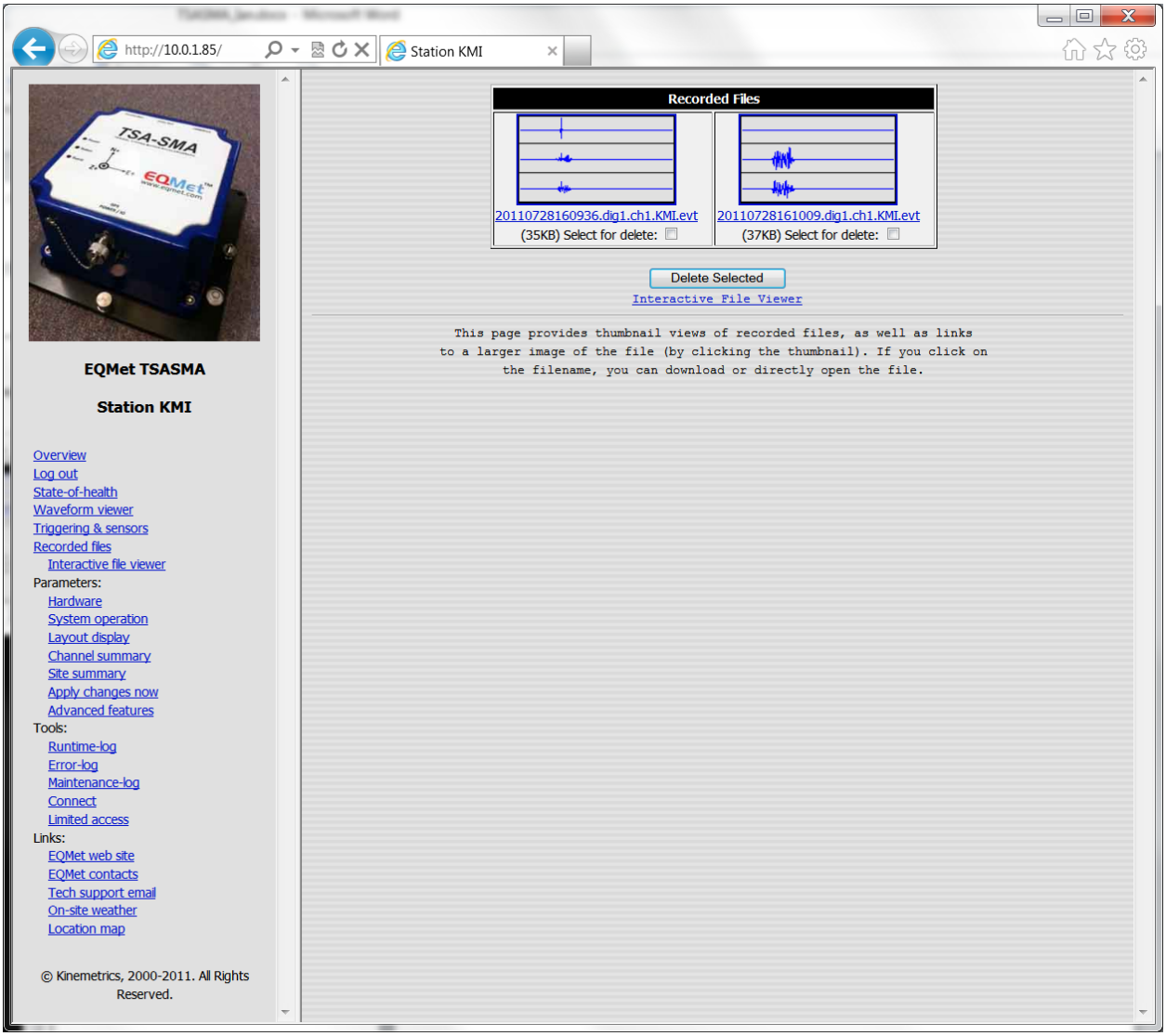
Final output rate	50	100	200	250	500
Number of taps in final filter	277	277	139	139	139

Output rate from the first FIR filter	200	400	400	500	1000
Number of taps in first filter	503	265	265	211	105
Output rate from the sinc^5 ADC filter	4000	4000	4000	4000	4000

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

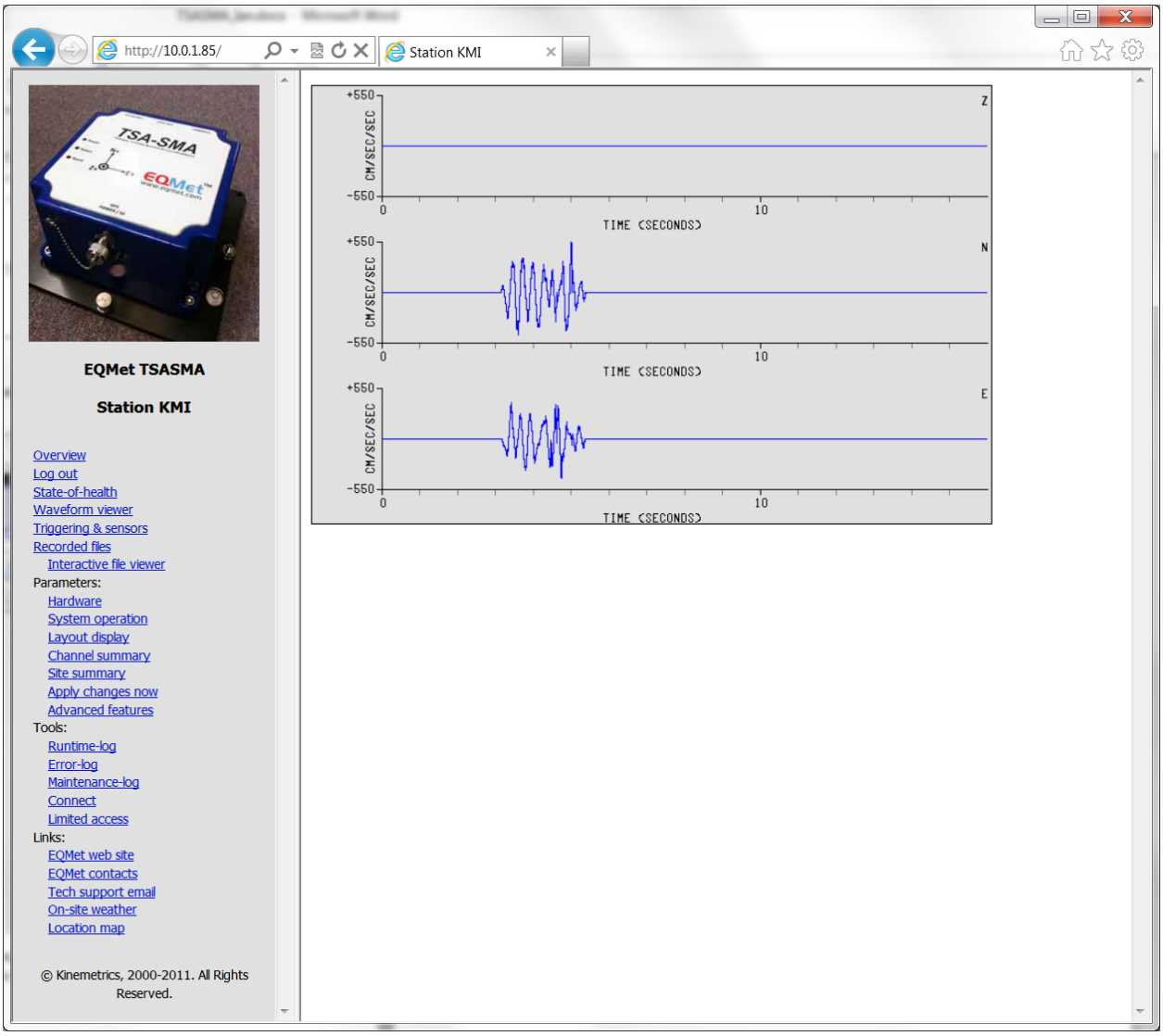
File Management and Retrieval

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



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:



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).

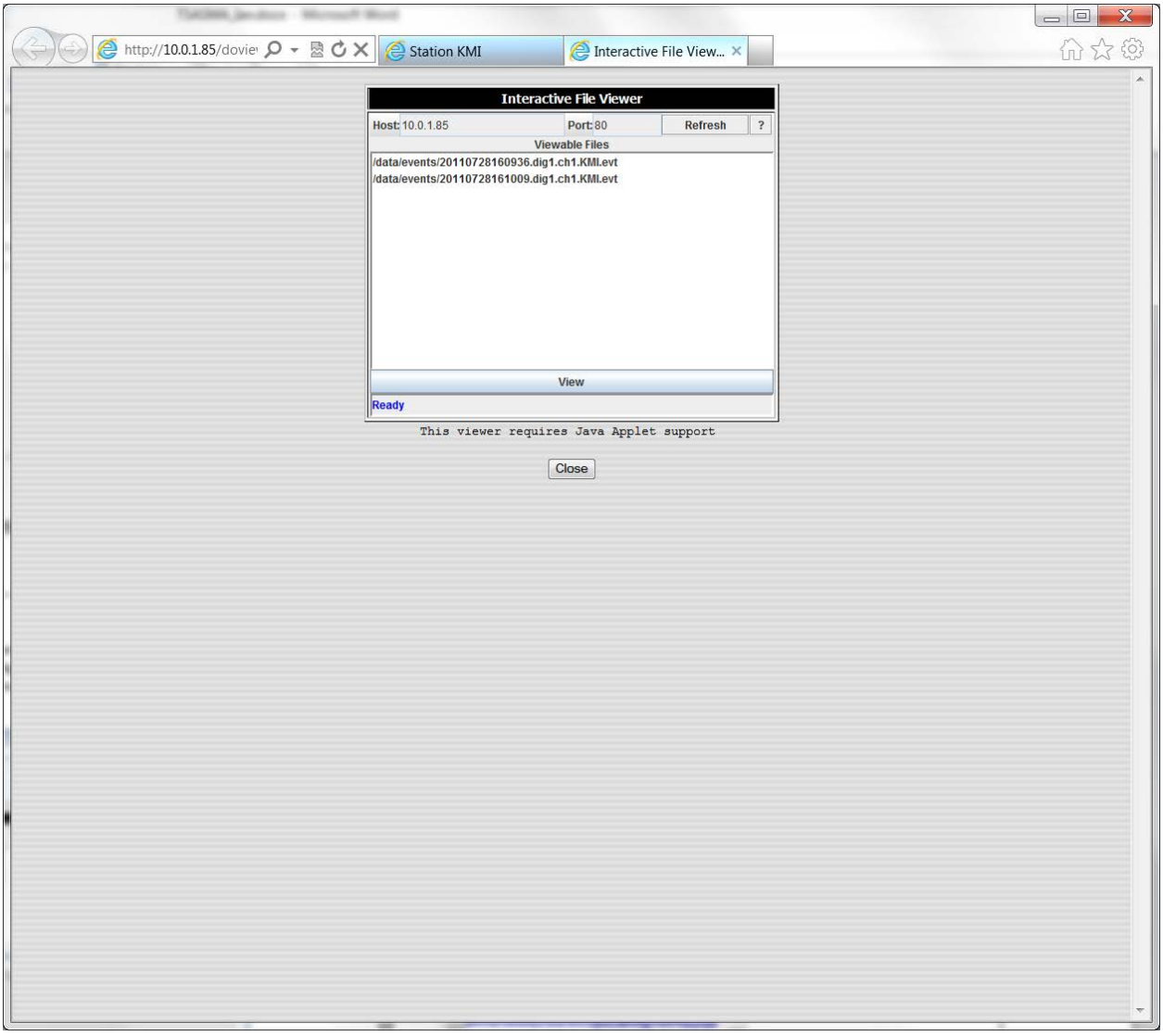
Individual files can be downloaded by clicking the file name (like "aza001.evt") and selecting "save".

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

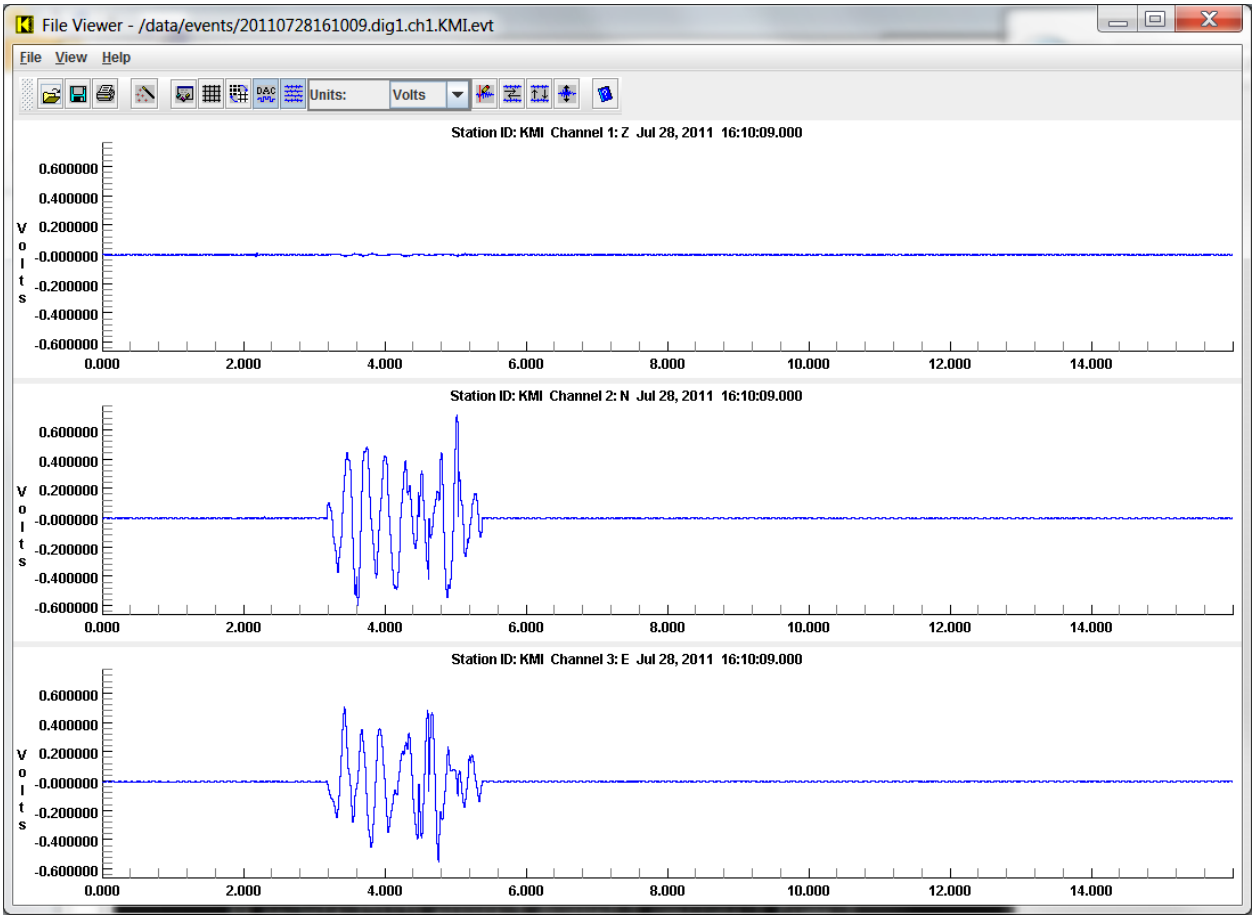
To manage large numbers of files (downloading and/or deleting them), you should use a program such as WinSCP, which is described later in this manual under Tools.

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 digitizer includes an Interactive File Viewer. The Interactive File Viewer can be accessed either from the bottom of the Recorded Files page, or directly from the left pane. It will open in a separate browser window:



To view a file, select the filename and press View. The file and the Interactive File Viewer application will be downloaded into your PC:



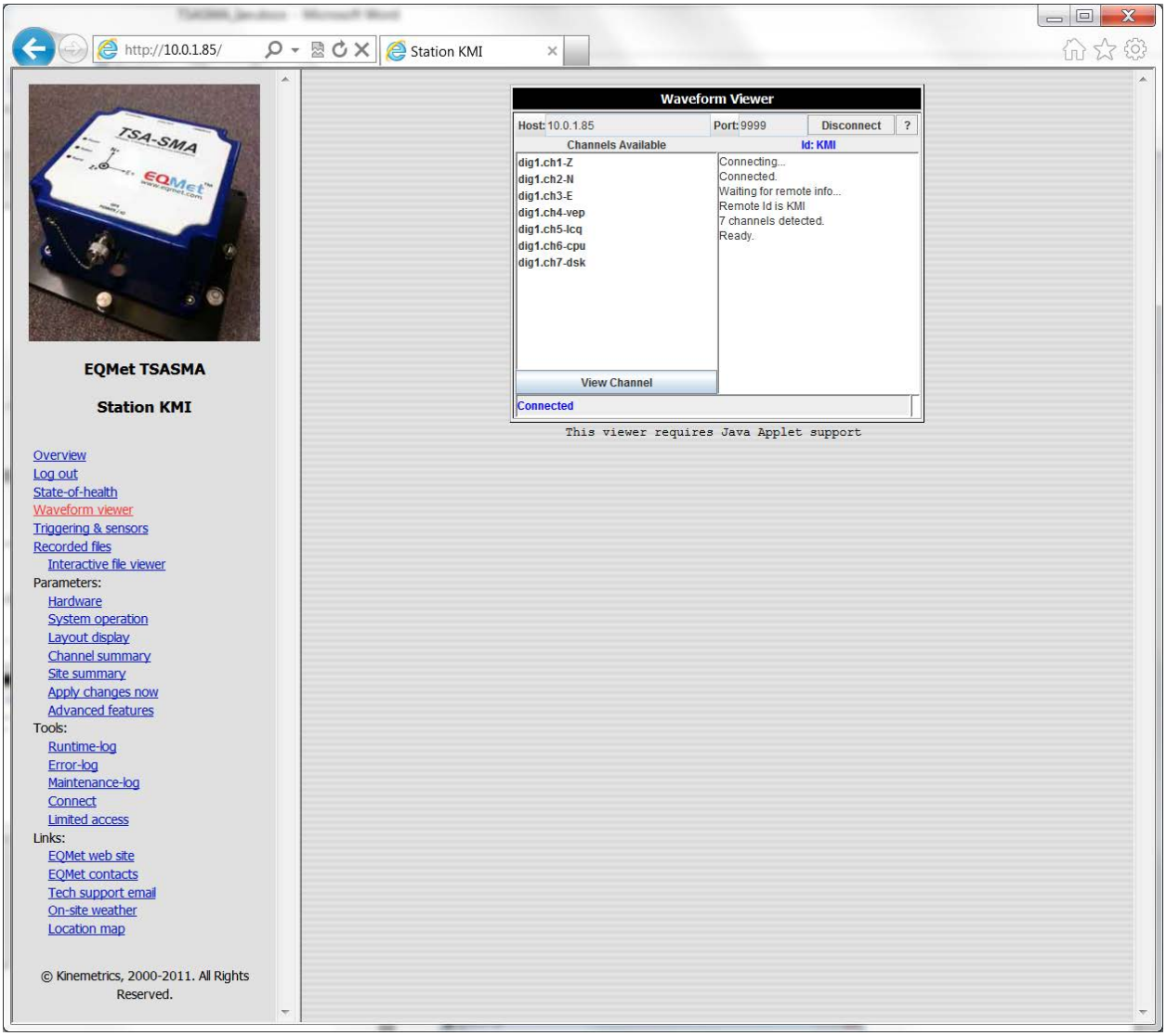
Though not covered in detail here, note that you can zoom, pan, change display units, apply grid lines, sync displays in the X and Y axes, and do many other things.

The viewer does not have to be installed in your computer. It will download from the digitizer when it is needed.

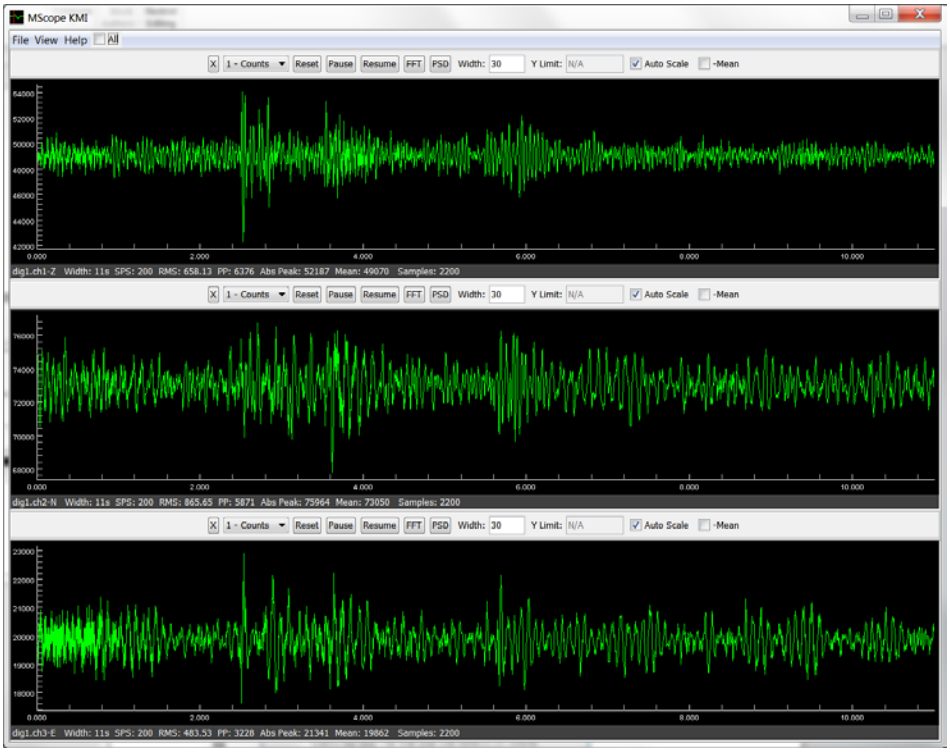
> **NOTE: If the Interactive File Viewer does not display files, it may be that port 80 access is restricted by your Anti-Virus software. See Interactive File Viewer Doesn't List Any Files**
>
> **NOTE: If the Interactive File Viewer won't download large files, see** FileViewer and Large Files

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:

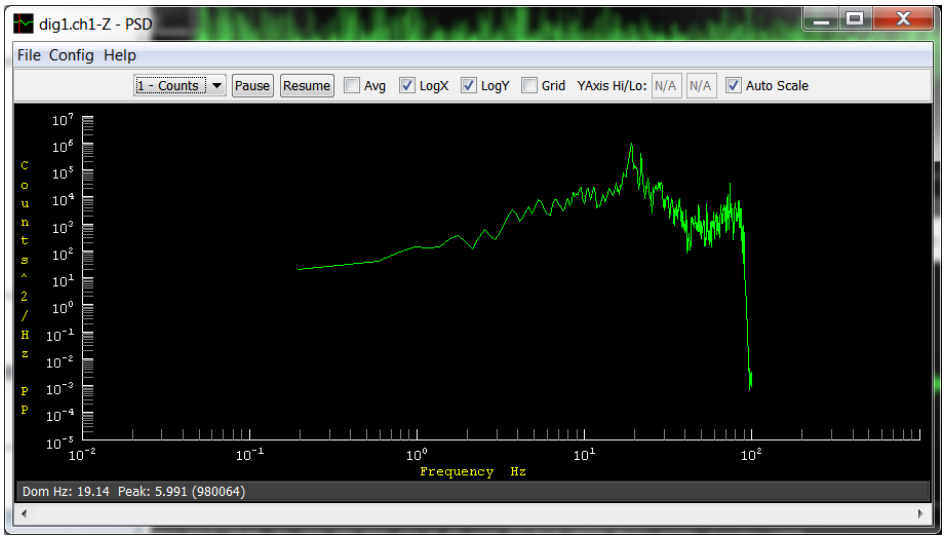


Once the list is displayed, select one or more virtual channels from the list on the right (including SOH channels) and then press View Channel:



Note that you can select the display units.

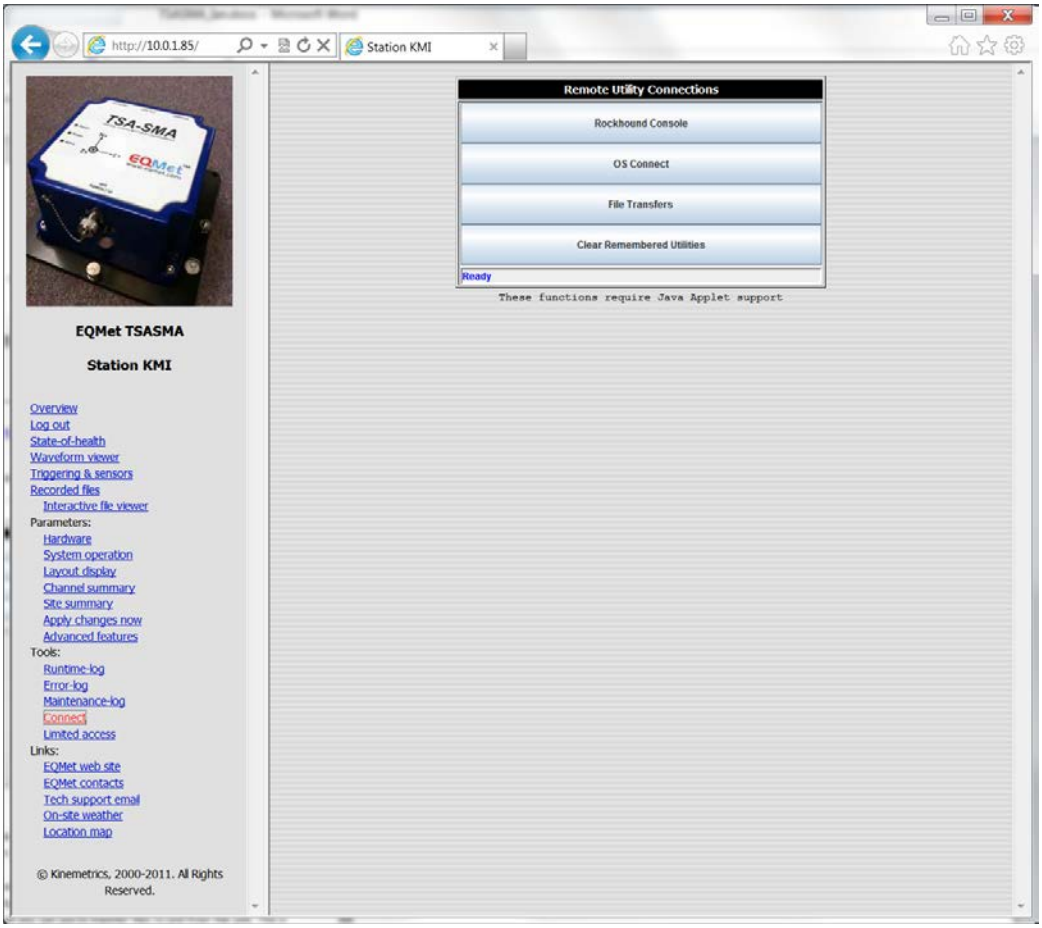
If selected, notice the buttons for live FFT and PSD displays, which will produce something like this:



NOTE: If the Waveform Viewer starts and then stops, see Waveform Viewer Stops Updating

Remote Connections

The Connect link will open a pane with a Remote Utility Connections display:

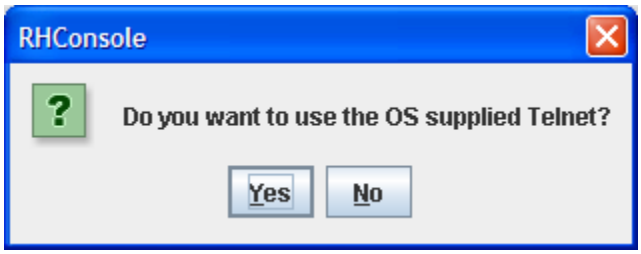


The four features listed top to bottom are:

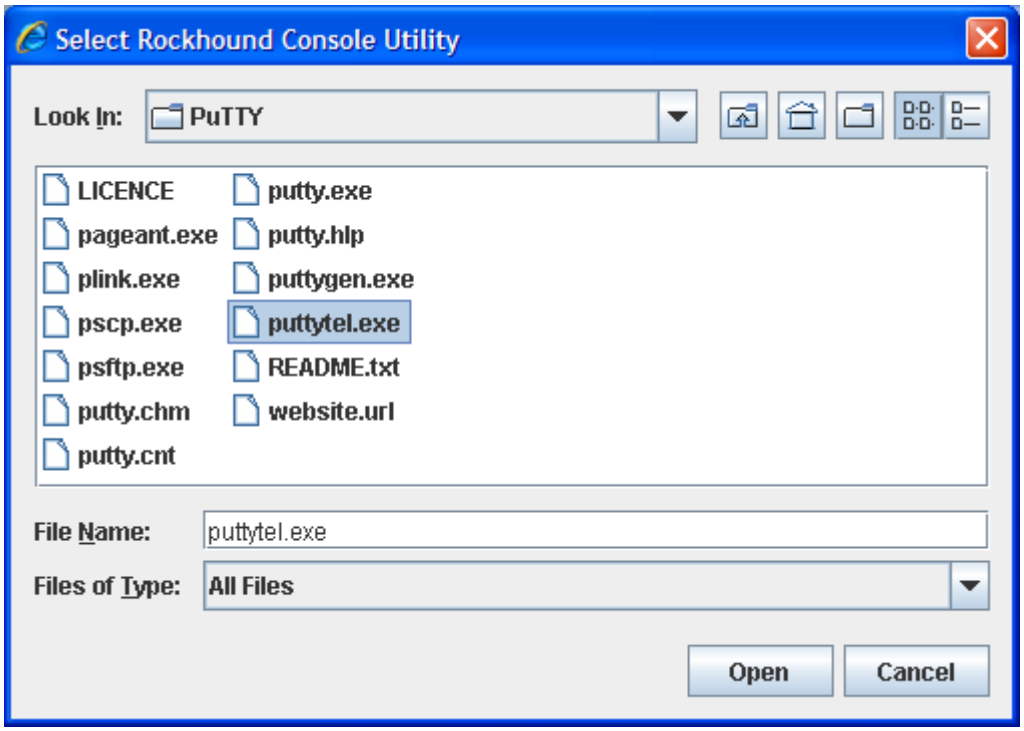
- Rockhound console. This opens a Rockhound console on the unit which you can use for digitizer-specific utility functions such as commanding a keyboard trigger or a functional test. This is normally done using PuTTY or telnet.
- OS Connect. This will open an Operating System connection, giving you a Linux login prompt, so that you can do Operating System level maintenance. This is normally done using a secure connection like PuTTY.
- File Transfers. This will open a File Transfer utility that you can use to transfer files to and from the unit. This is normally done using a secure program like WinSCP.
- Clear Remembered Utilities. This will erase the utilities currently remembered that are to be used with these features. This will allow you to reassign the features on your PC to a new program.

The first time that you use one of these functions, it will ask you which program should be used for this function. Once you make a selection, that program will be used on your PC from here forward until you clear the remembered utilities.

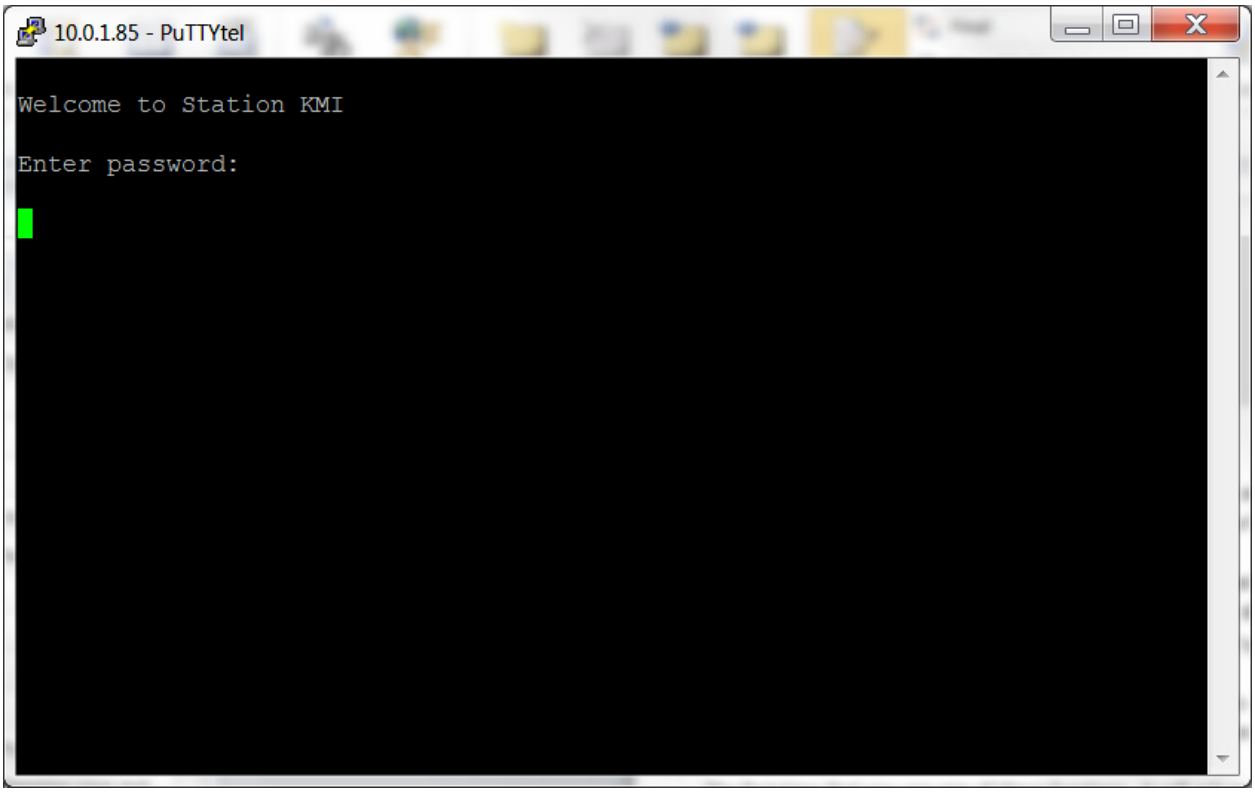
For example, if you press “Rockhound Console”, you will see:



If your Operating System provides a working telnet, you can click “Yes” and the setup will be complete. If you’d like to use another program, click “No” and navigate to the appropriate program, for example:



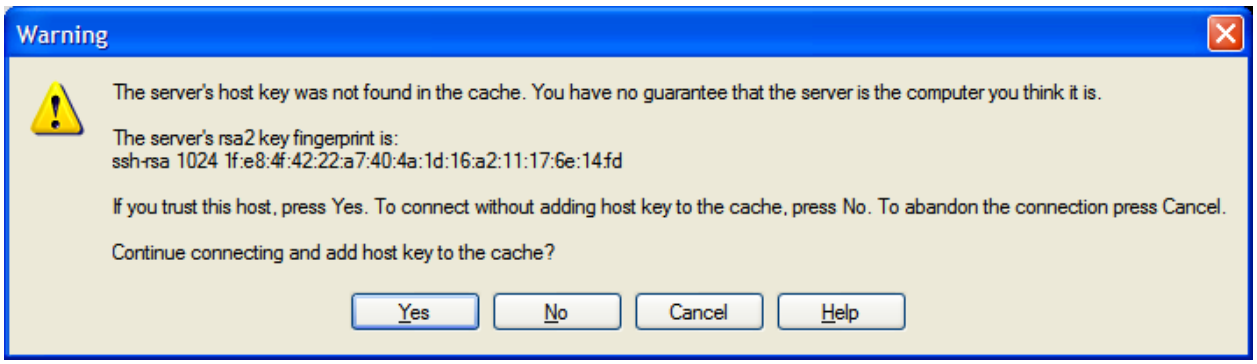
After clicking “Open”, the connection will open as shown:



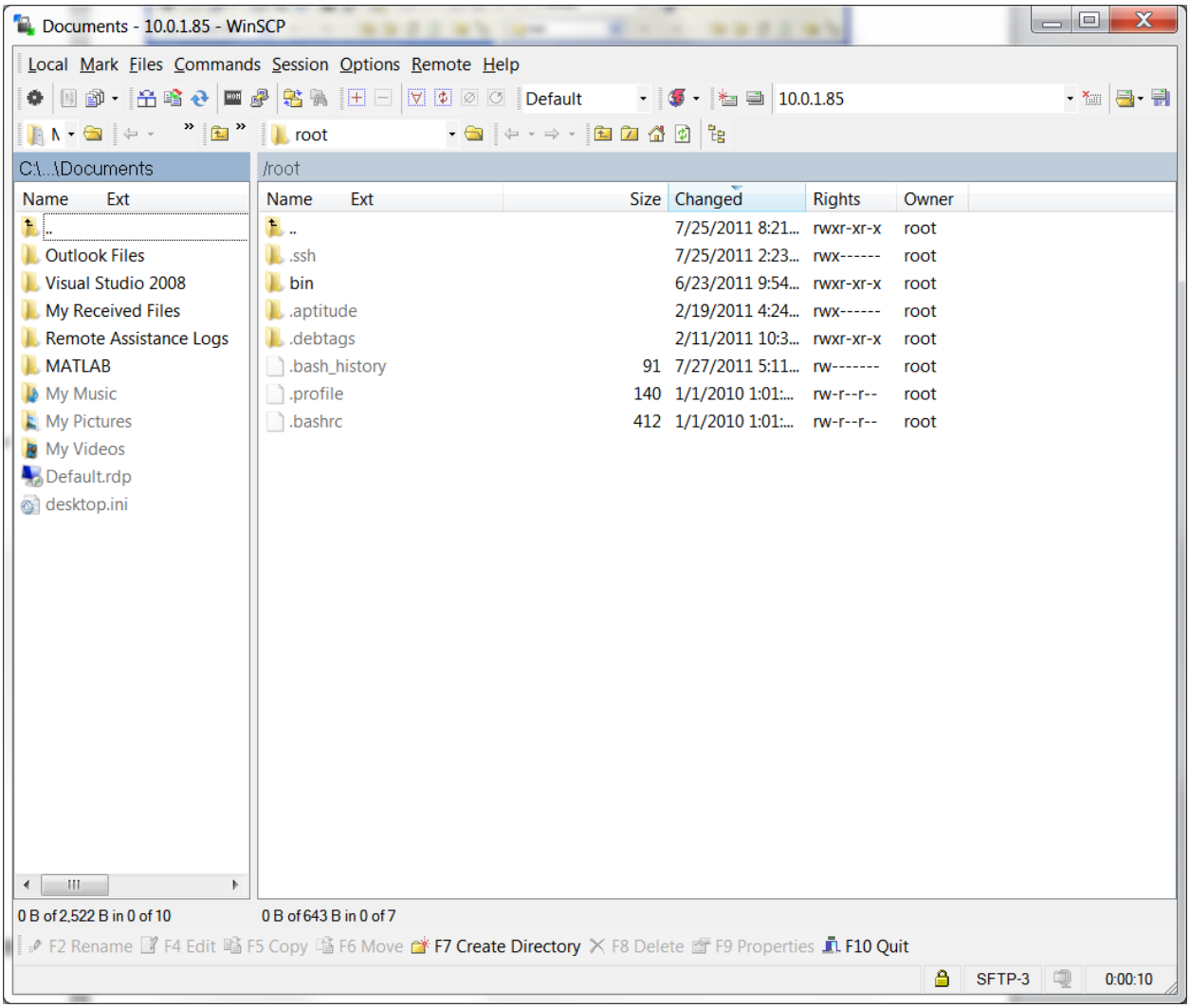
For more details on PuTTY, see PuTTY.

When selecting the OS Connect, it is recommended that you use a secure connection like PuTTY.

When selecting the File Transfer utility, it is recommended that you use a secure file transfer program like WinSCP. After assigning it, you will see this:



This is a one-time message that you will get warning you that your PC and the digitizer are exchanging security keys so that they “know about” each other. You’ll then be asked for a Linux user name and password to log in, and then you’ll see:



Once this window opens, you are now in WinSCP and can transfer files by dragging and dropping files.

For more details on WinSCP, see WinSCP.

Overview of the Web Interface

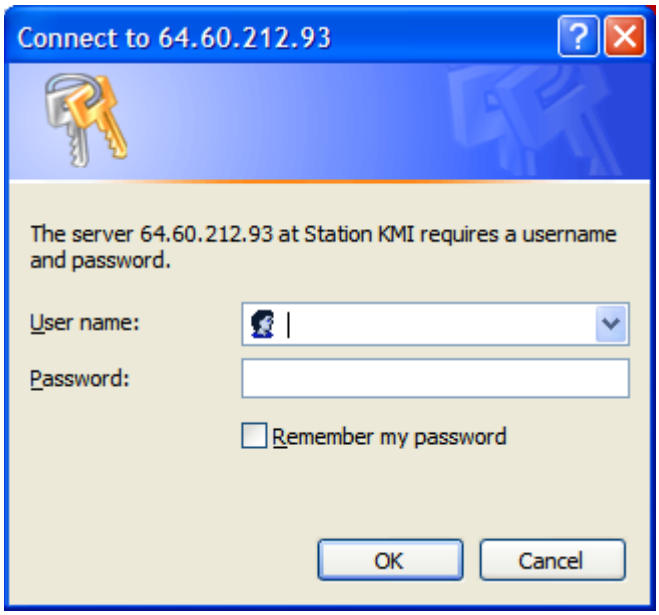
The web interface to the digitizer allows you to configure and operate your digitizer using a web browser without installing any EQMet-specific software. The web browser should be HTML 1.1 compliant (or later), support frames, and should support Java and Java applets.

You need to have Java installed on your PC in order to use most of the interesting features of the digitizer. You can get Java from java.sun.com. If you have to use the PC without Java, it will still basically work, but you will not be able to use some features. In case there's a question, what you want is the JRE or Java Run Time for J2SE.

If you plan to display large files or many channels in the Waveform Viewer, you may want to go ahead now and increase the memory available to Java Applets. See FileViewer and Large Files

To access the digitizer through the web interface:

Open a web browser on your PC. In the address bar of the browser, type the IP address of the digitizer – for example `64.60.212.93`. You'll be presented with a 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:

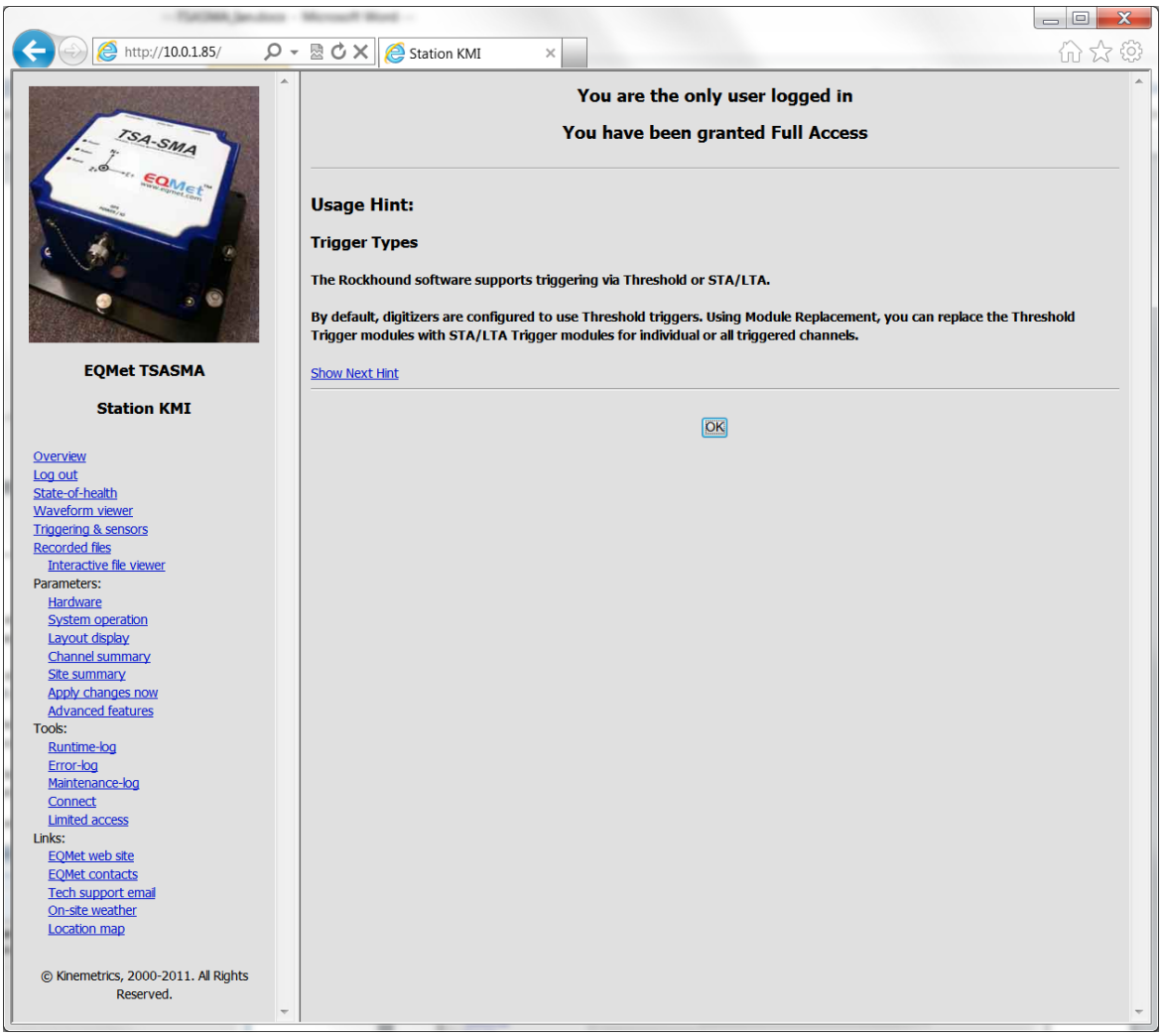
- Client level users can view things, but cannot make any changes.
- Admin level users have administrative access, meaning that configuration changes can be made.

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).

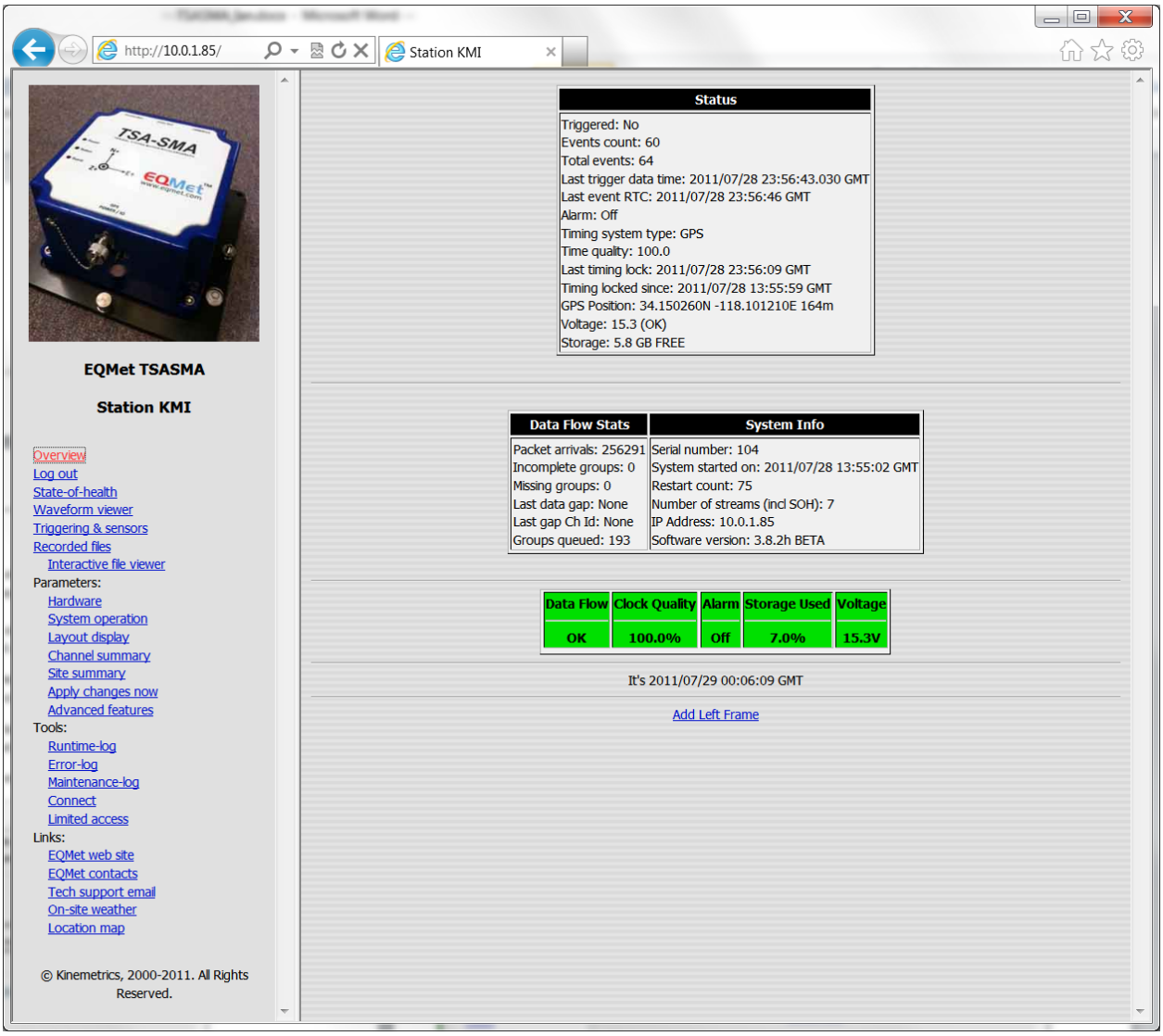
Admin users who are given Limited Access can force the other Admin user to log off so that they can obtain Full Access. Client users are not affected since they only have Limited Access.

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*. Note the semi-random usage tip that displays at login:



Press *OK* to go on to the *Overview* screen:



The links in the left-hand frame (top to bottom) are:

Overview: The main status screen

Log Out: Log out of the web interface

State-of-Health: Access to State-of-Health displays

Waveform Viewer: Display of real-time waveforms

Triggering & Sensors: Commanded triggers, sensor tests, and sensor control

Recorded Files: A display of recorded file thumbnails

Interactive File Viewer: Download and display files interactively

Parameters:

Hardware: Edit of hardware specific parameters

System Operation: Edit of application specific parameters

Layout Display: Graphical display of the module layout

Channel Summary: Displays a table of channel configurations

Site Summary: Displays summary information for the site (including networking setup)

Apply Changes Now: Apply parameter changes and restart

Advanced Features: Access to more advanced setup options

Tools:

Runtime-Log: A display of the run time log file

Error-Log: A display of the error log file

Maintenance Log: Make maintenance history entries

Documentation: Online documentation access

Connect: Connect for console use or file transfers

Limited Access: Relinquish Full Access to other users

Log Out: Log out of the web interface (will automatically happen after 1 hour)

Links:

EQMet Web Site: www.eqmet.com

EQMet Contacts: EQMet Contact page

Technical Support: E-mail support@eqmet.com

Local Events: Link to Local events web site using current GPS position

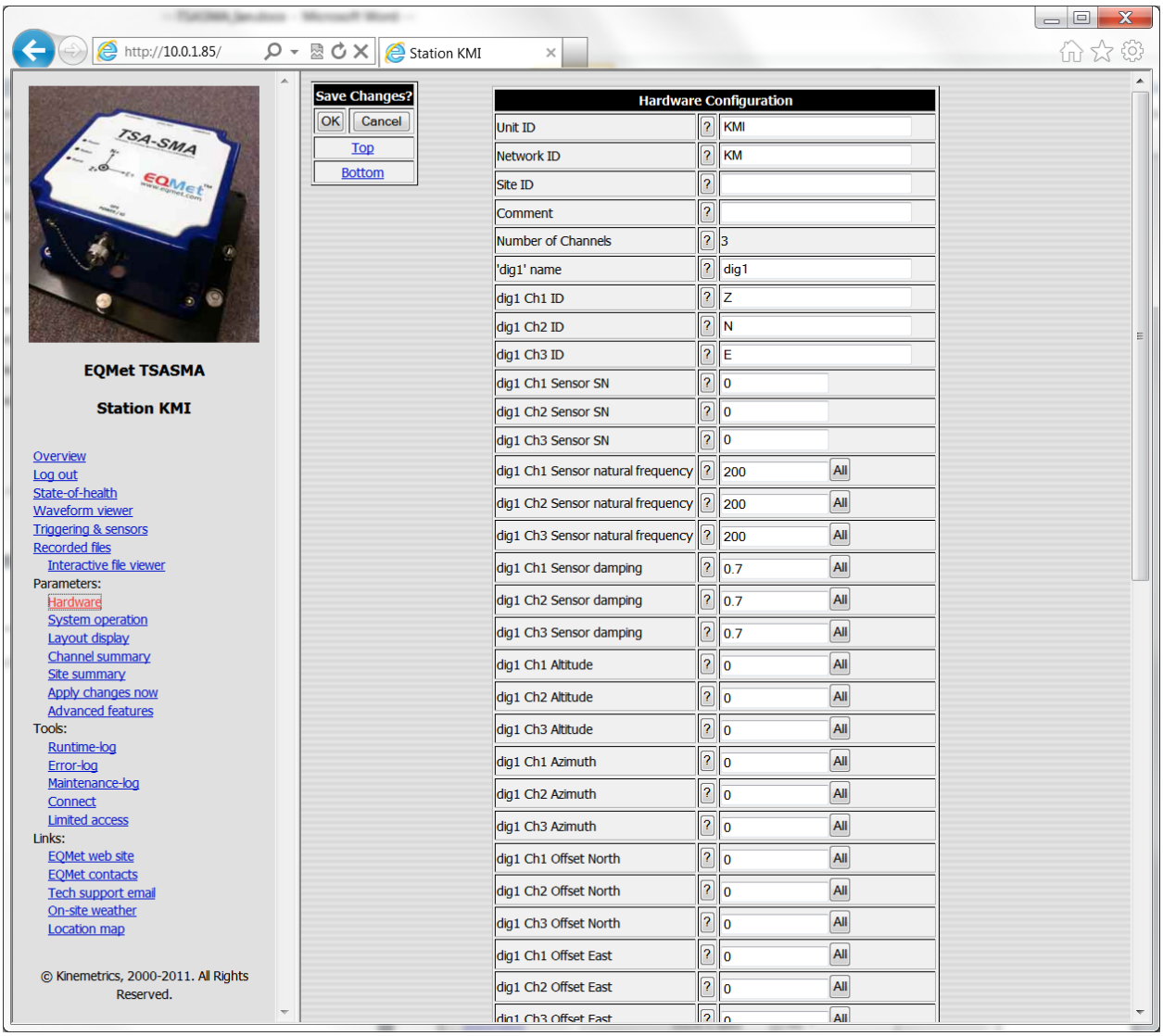
On-site weather: Link to local weather widget

Location map: Link to mapping web site for information about site based on current GPS position.

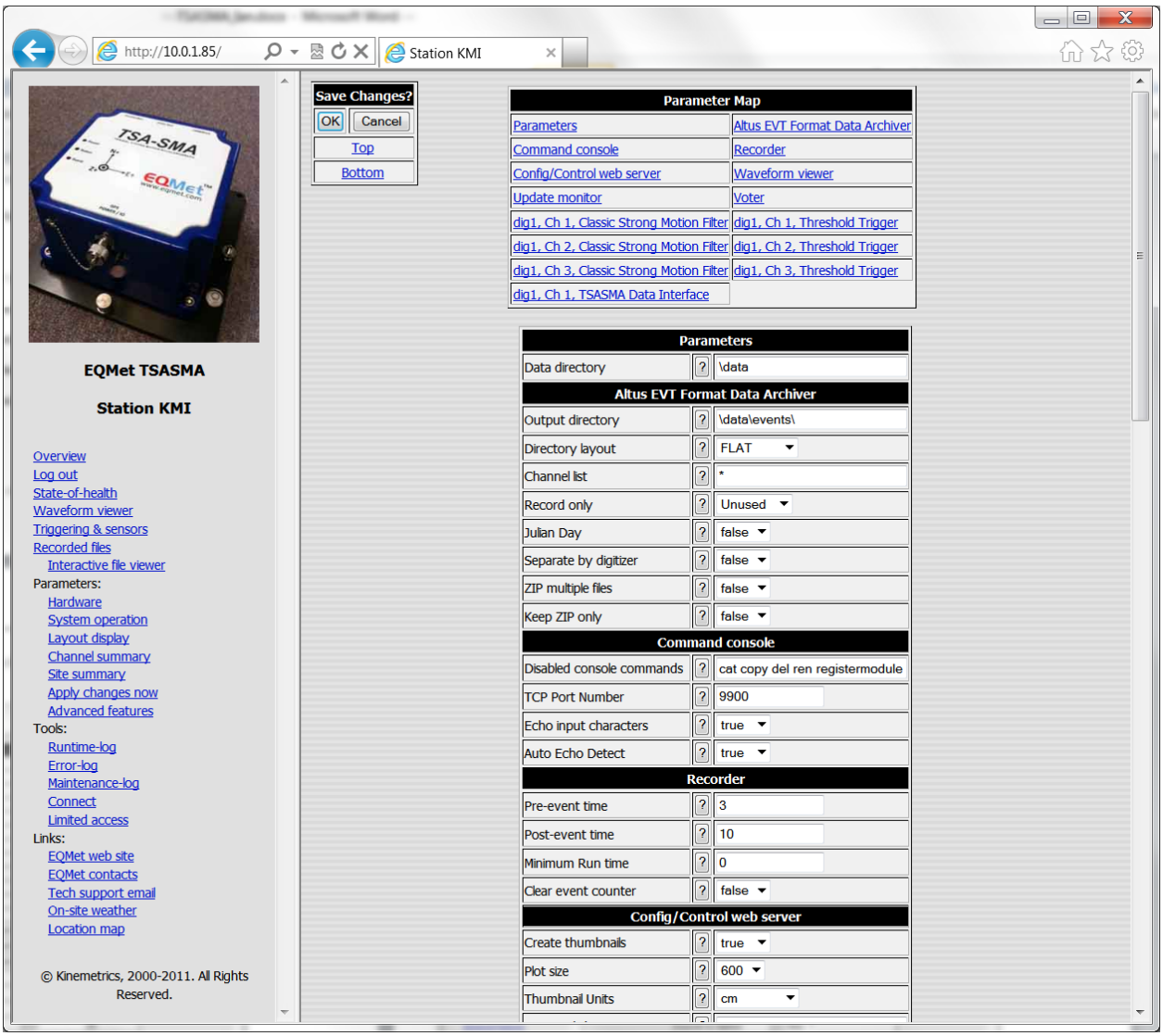
Other links (not shown) are optional:

Contact: Opens a customer-specific contact link

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

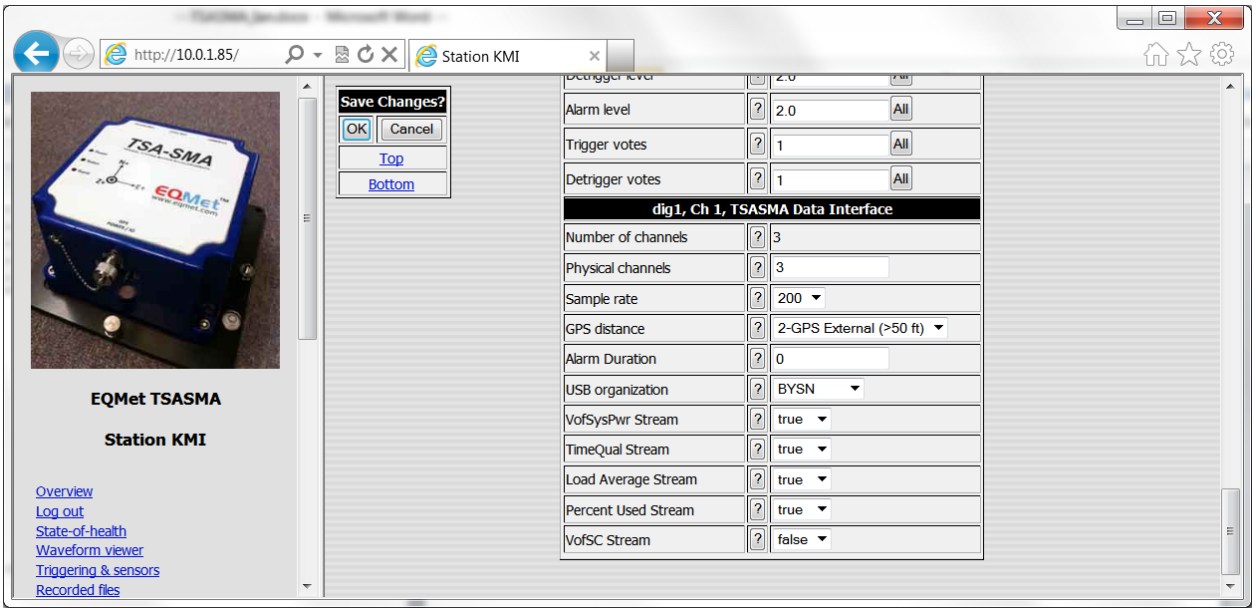


System Operation accesses installation independent values such as pre-event time, post event time, sample rates, and other operational parameters.

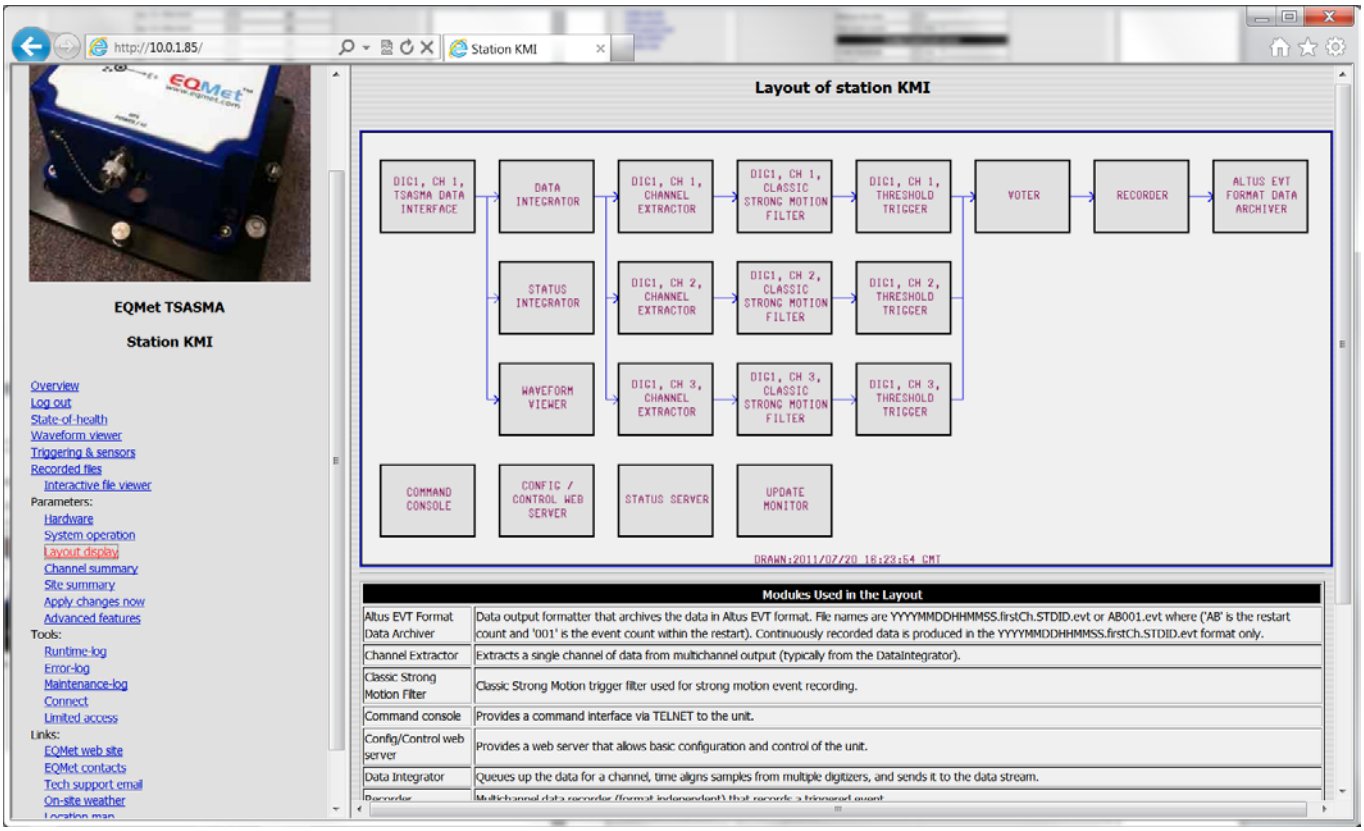


The top of the *System Operations* page is a Parameter Map, which is a set of links to the individual parameter sets of each module. This can be faster than scrolling to find a parameter.

For example, to access the TSA-SMA Data Interface, click on that link and you will get:

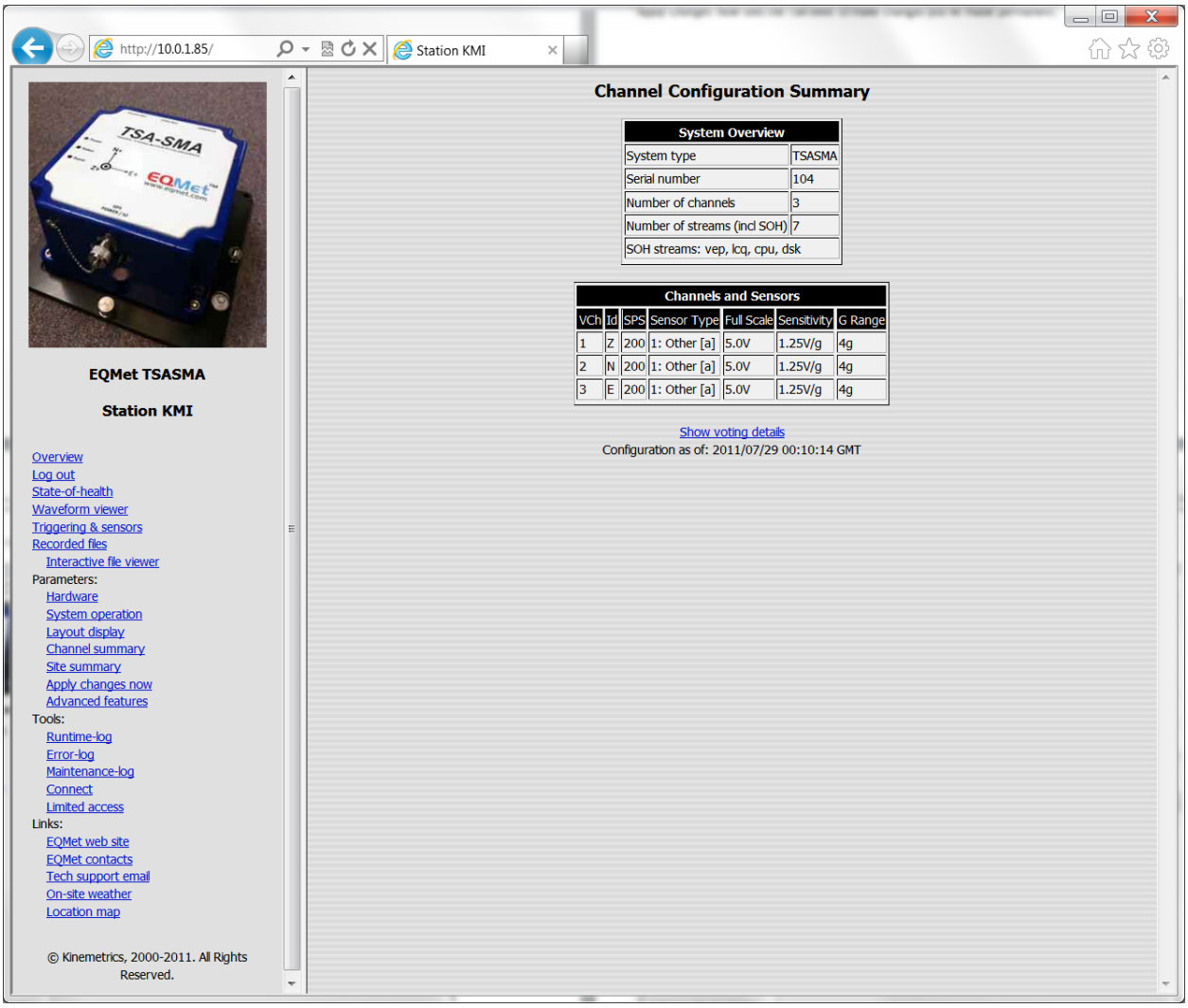


Layout Display displays a picture of the current layout, along with a brief explanation of each module.

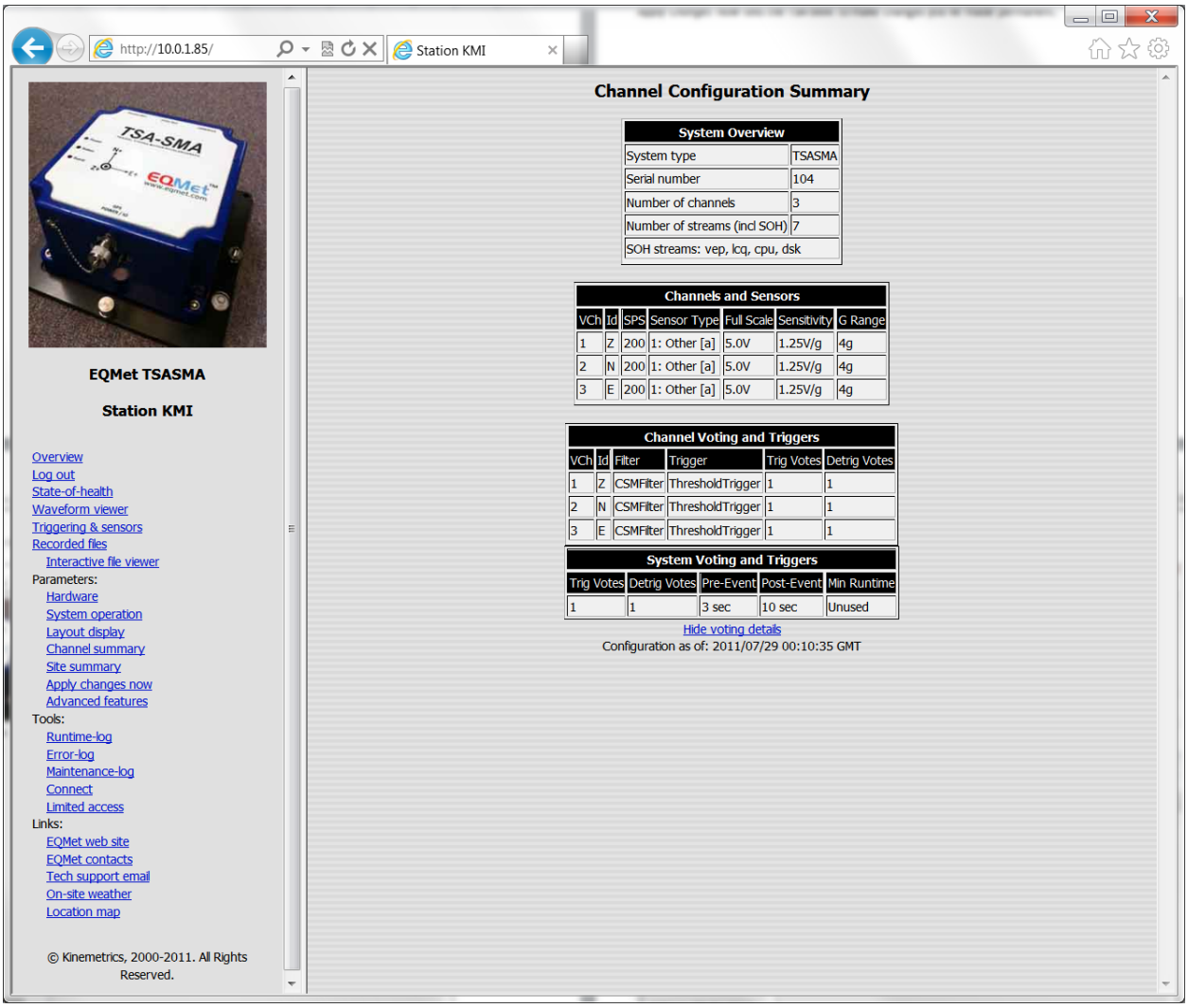


Apply Changes Now tells the TSA-SMA to make changes you've made permanent.

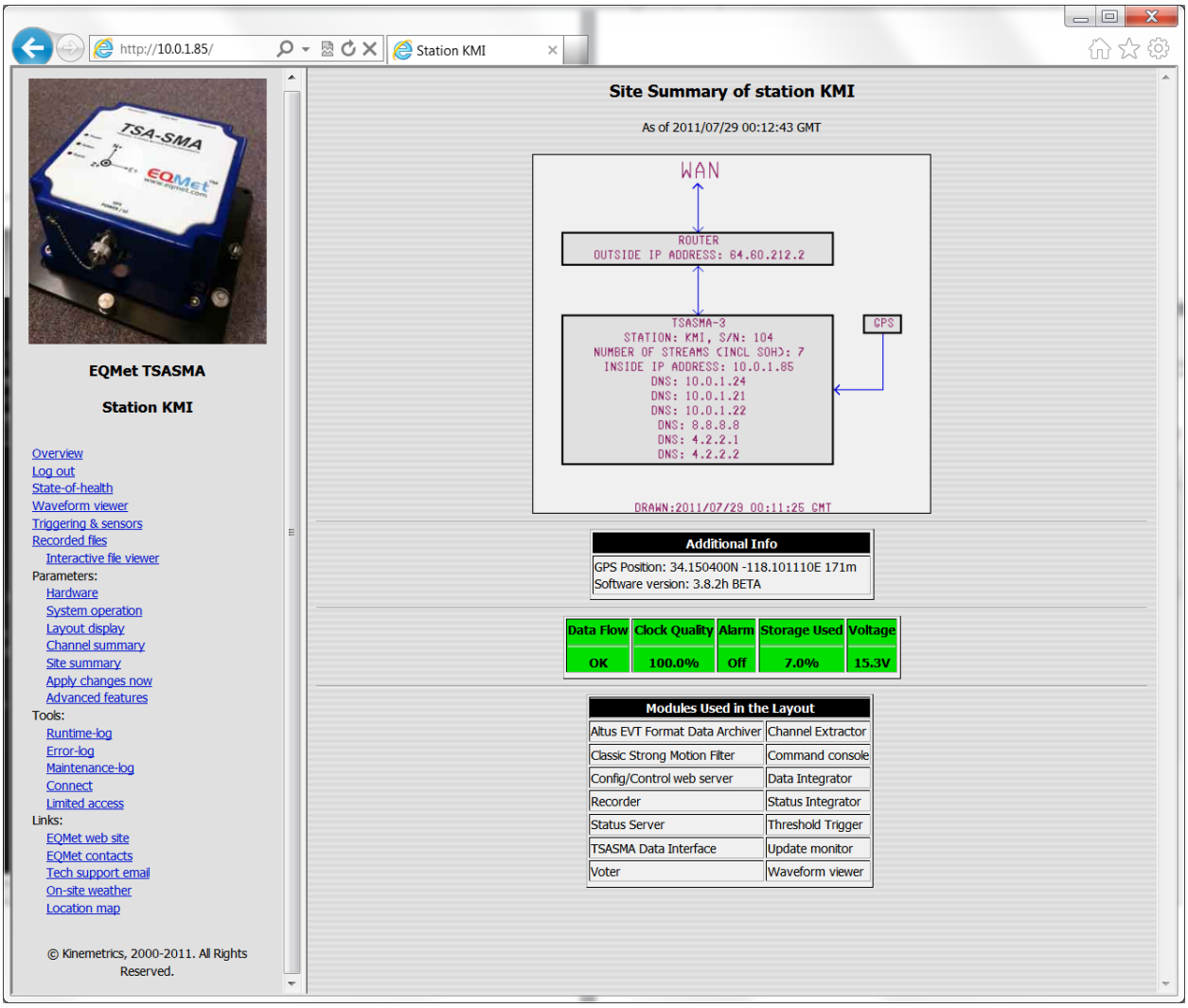
Channel Summary displays channel information:



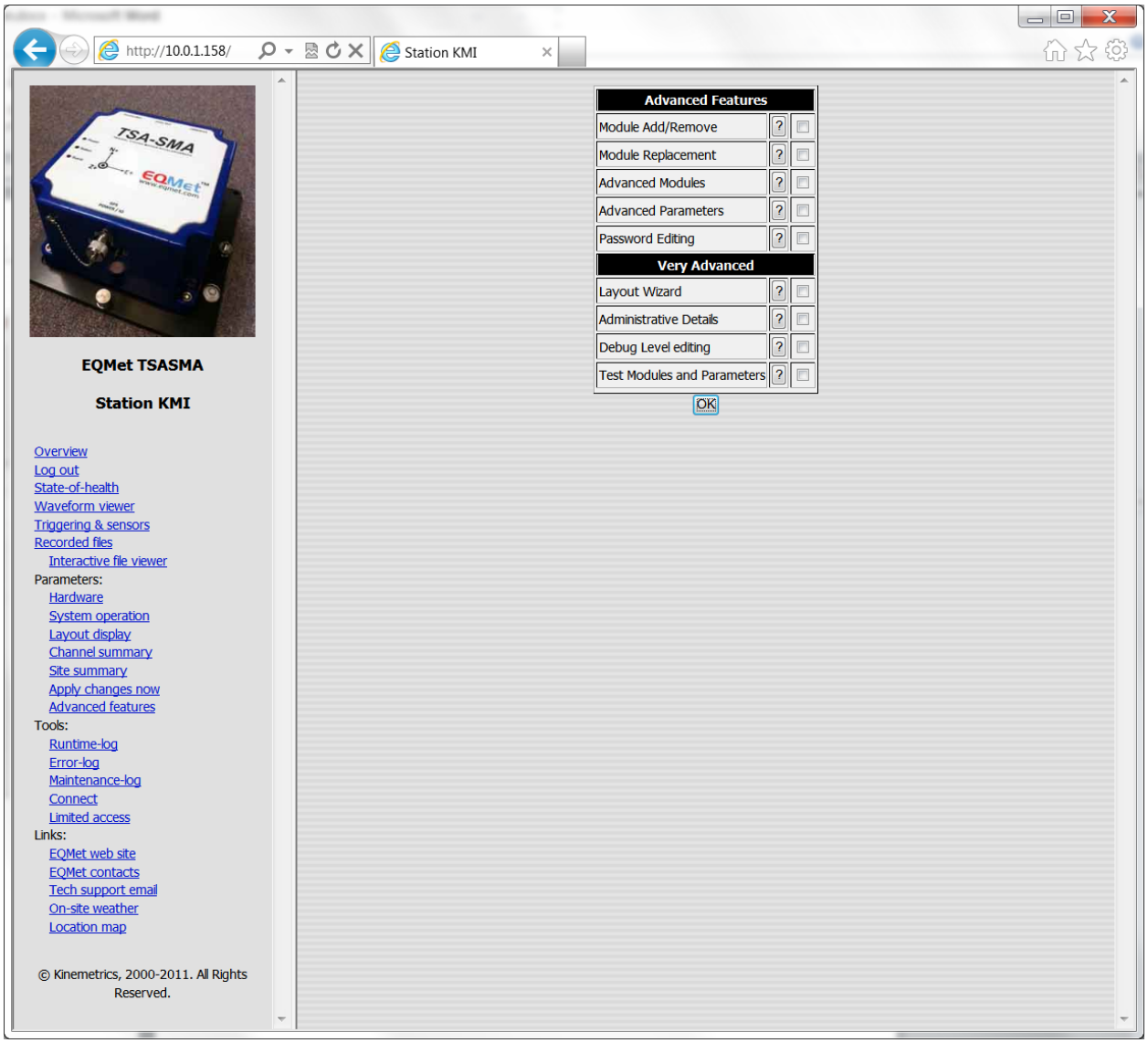
Expanding the voting details shows:



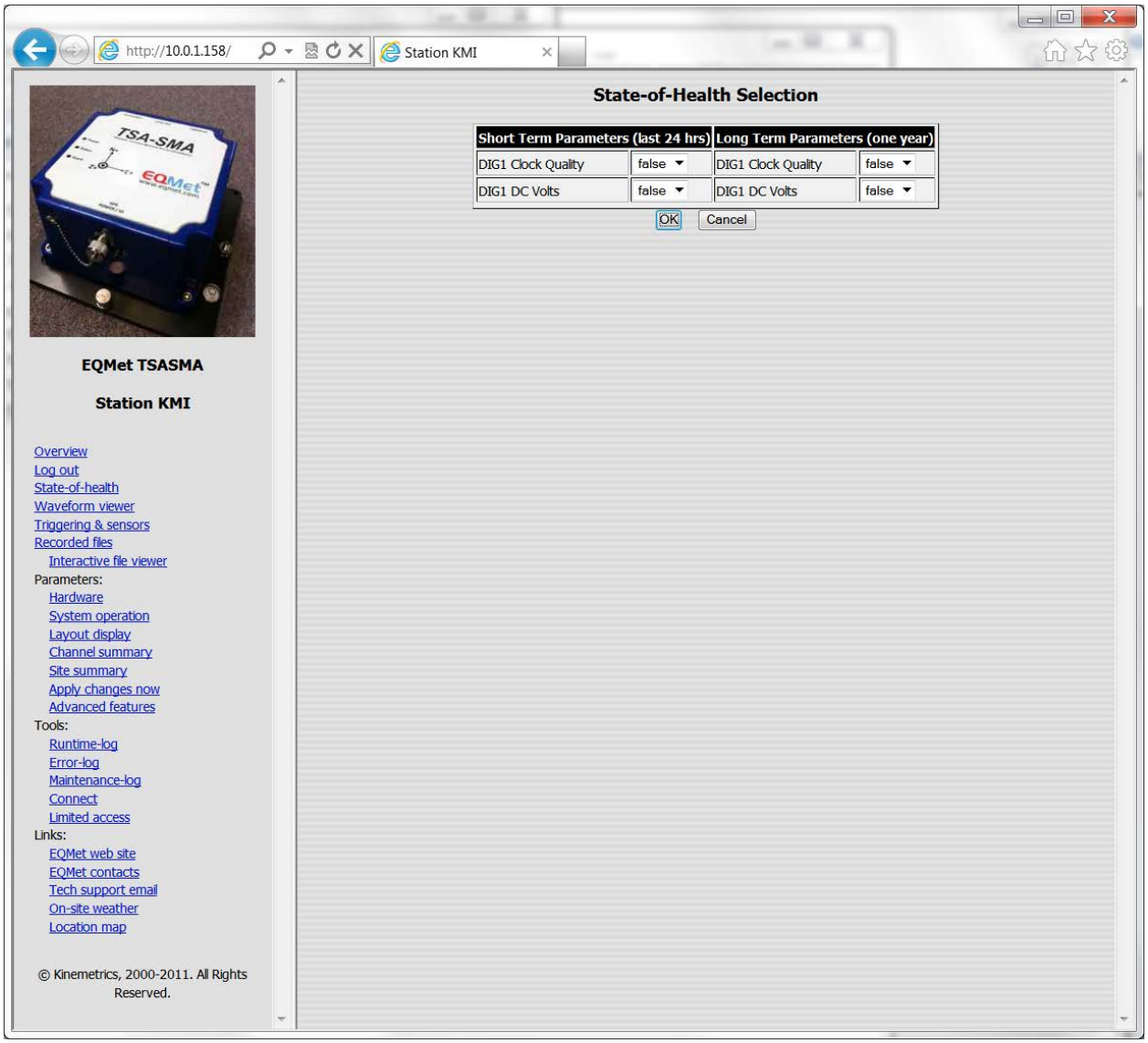
Site Summary shows:

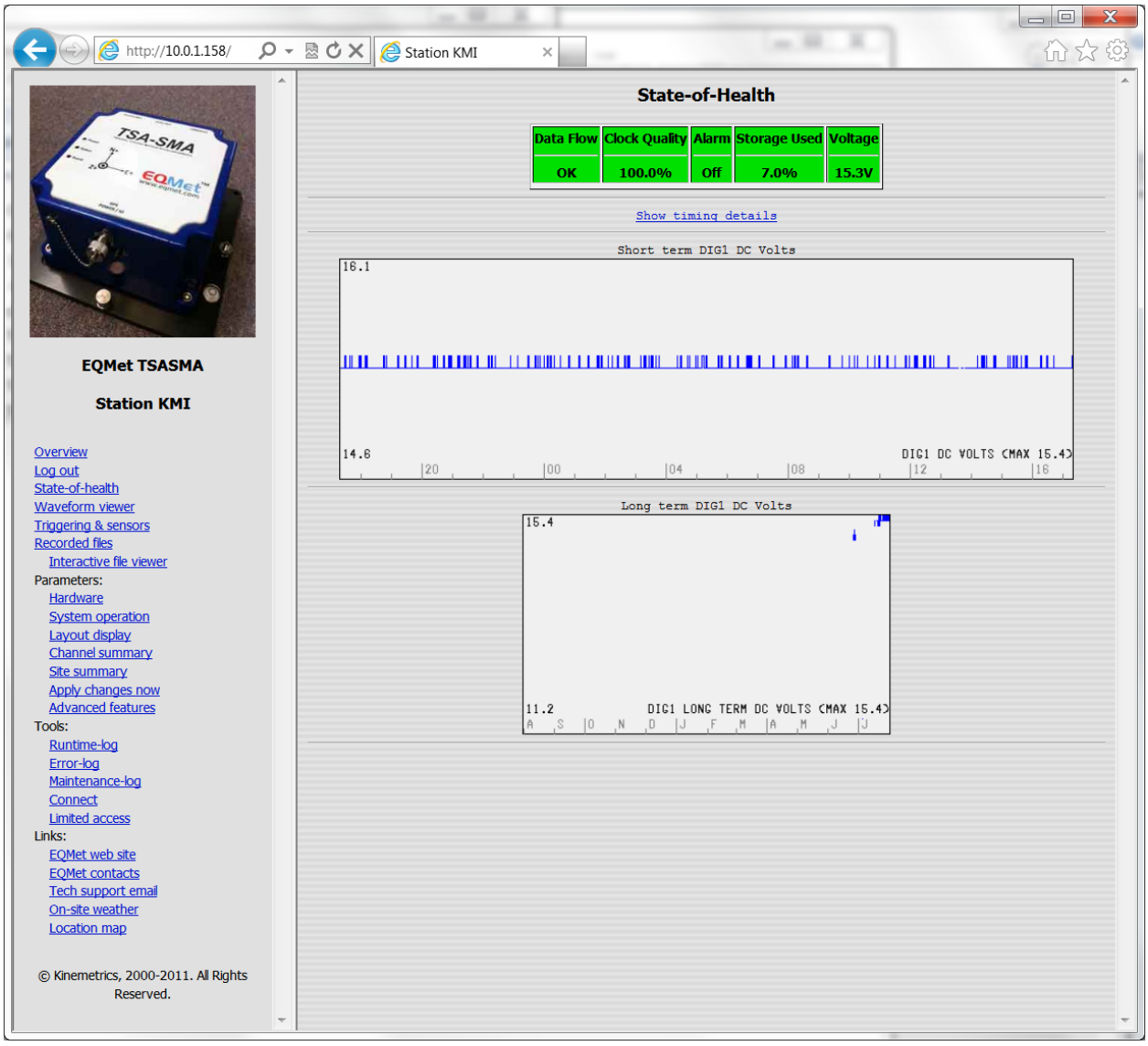


Advanced Features allows you to enable/disable special functions.



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




http://10.0.1.158/
Station KMI
TSA-SMA
EQMet
EQMet TSASMA
Station KMI
Overview
Log out
State-of-health
Waveform viewer
Triggering & sensors
Recorded files
Interactive file viewer
Parameters:
Hardware
System operation
Layout display
Channel summary
Site summary
Apply changes now
Advanced features
Tools:
Runtime-log
Error-log
Maintenance-log
Connect
Limited access
Links:
EQMet web site
EQMet contacts
Tech support email
On-site weather
Location map
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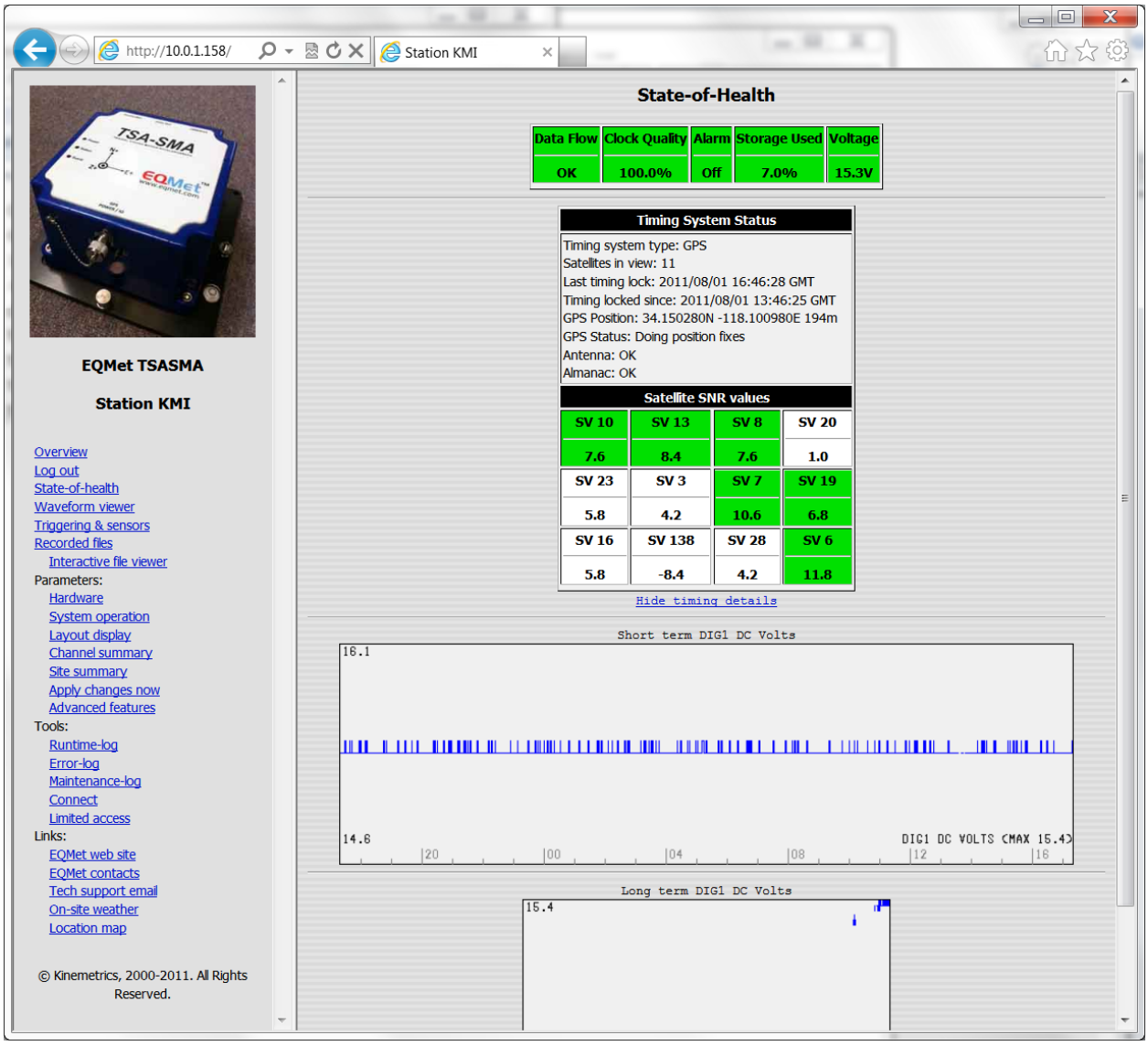
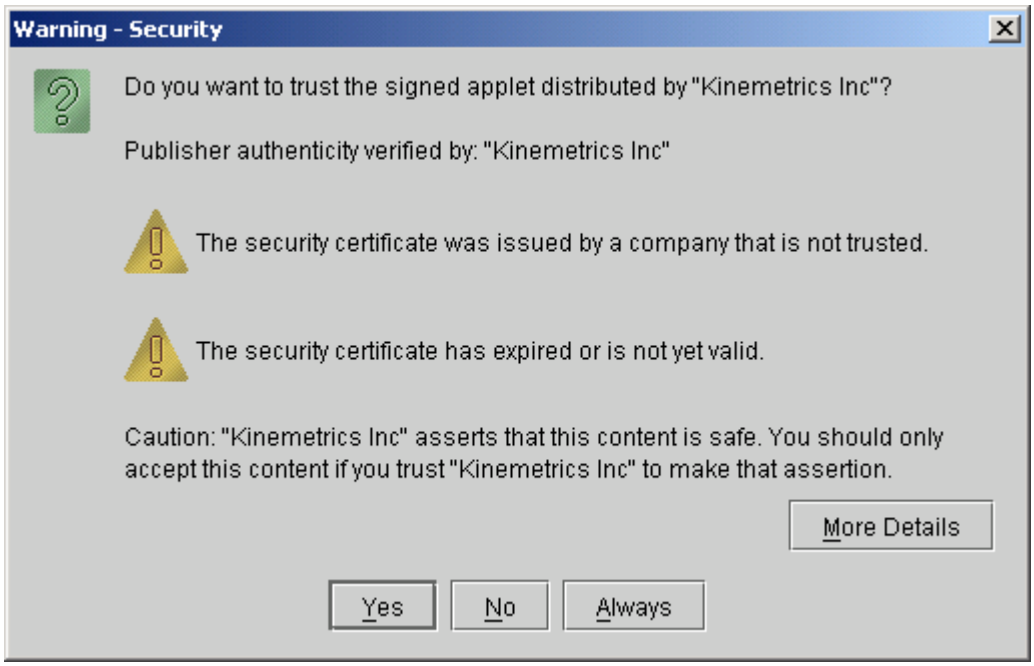
State-of-Health
Data Flow
Clock Quality
Alarm
Storage Used
Voltage
OK
100.0%
Off
7.0%
15.3V
Show timing details
Short term DIG1 DC Volts
18.1
14.8
DIG1 DC VOLTS (MAX 15.4)
20
00
04
08
12
16
Long term DIG1 DC Volts
15.4
11.2
DIG1 LONG TERM DC VOLTS (MAX 15.4)
A
S
O
N
D
J
F
M
A
M
J
J

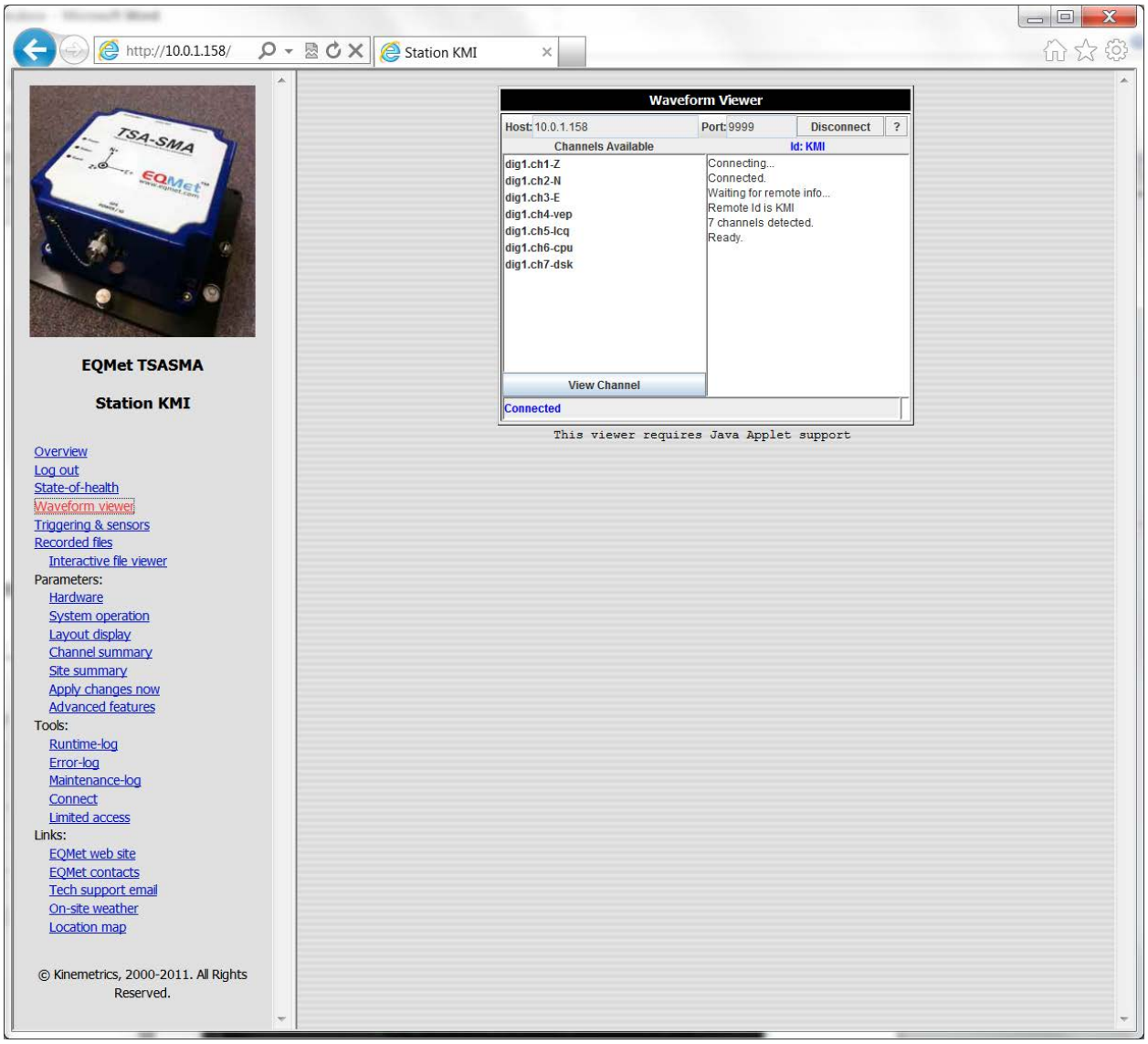

http://10.0.1.158/
Station KMI
TSA-SMA
EQMet
EQMet TSASMA
Station KMI
Overview
Log out
State-of-health
Waveform viewer
Triggering & sensors
Recorded files
Interactive file viewer
Parameters:
Hardware
System operation
Layout display
Channel summary
Site summary
Apply changes now
Advanced features
Tools:
Runtime-log
Error-log
Maintenance-log
Connect
Limited access
Links:
EQMet web site
EQMet contacts
Tech support email
On-site weather
Location map
© Kinemetrics, 2000-2011. All Rights Reserved.
State-of-Health
Data Flow
OK
Clock Quality
100.0%
Alarm
Off
Storage Used
7.0%
Voltage
15.3V
Timing System Status
Timing system type: GPS
Satellites in view: 11
Last timing lock: 2011/08/01 16:46:28 GMT
Timing locked since: 2011/08/01 13:46:25 GMT
GPS Position: 34.150280N -118.100980E 194m
GPS Status: Doing position fixes
Antenna: OK
Almanac: OK
Satellite SNR values
SV 10 7.6
SV 13 8.4
SV 8 7.6
SV 20 1.0
SV 23 5.8
SV 3 4.2
SV 7 10.6
SV 19 6.8
SV 16 5.8
SV 138 -8.4
SV 28 4.2
SV 6 11.8
Hide timing details
Short term DIG1 DC Volts
16.1
14.6
DIG1 DC VOLTS (MAX 15.4)
20
00
04
08
12
16
Long term DIG1 DC Volts
15.4

Waveform Viewer will load a Java applet that displays waveforms. For security reasons, you may have to accept the applet:

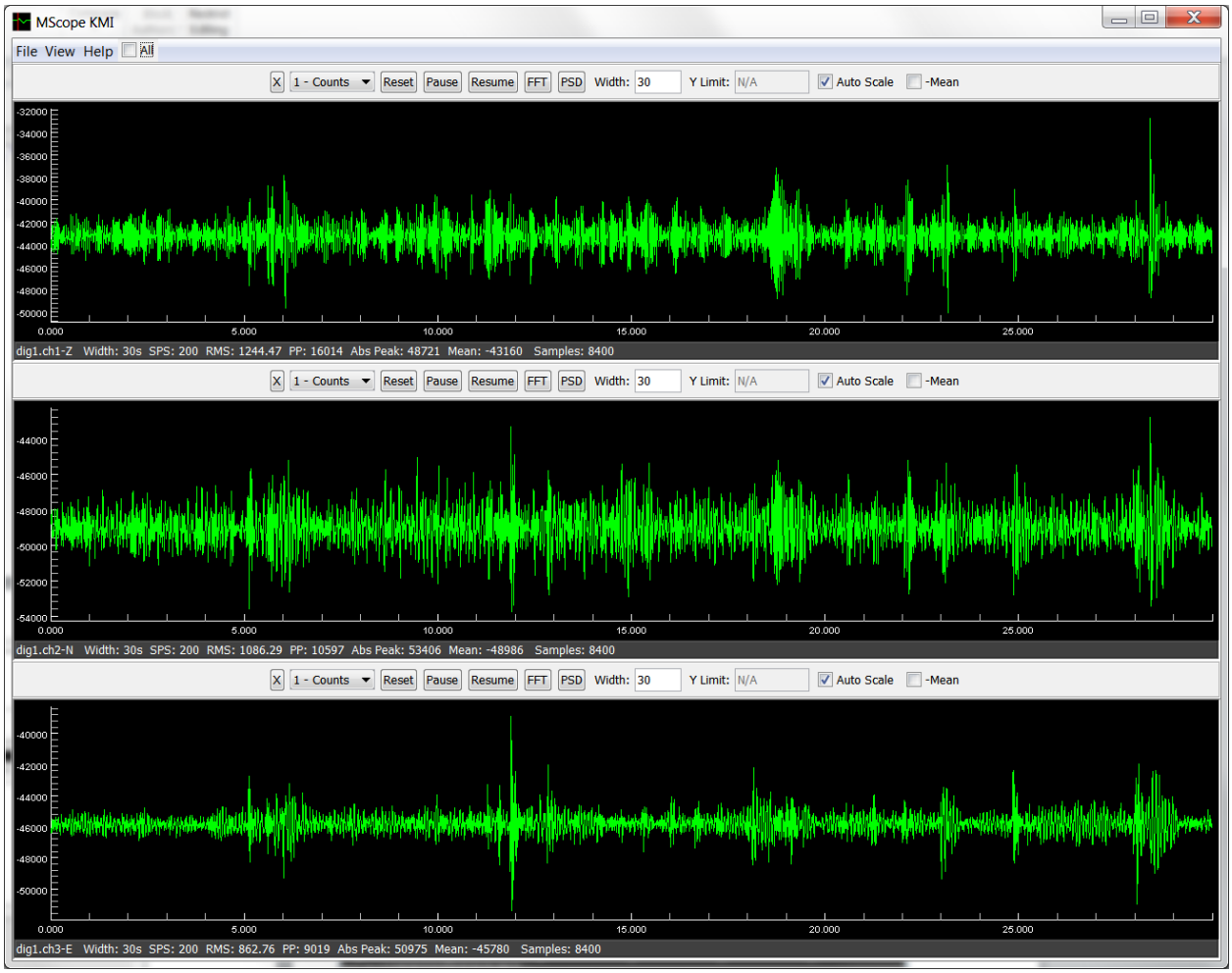


Click on YES to proceed to the Viewer.

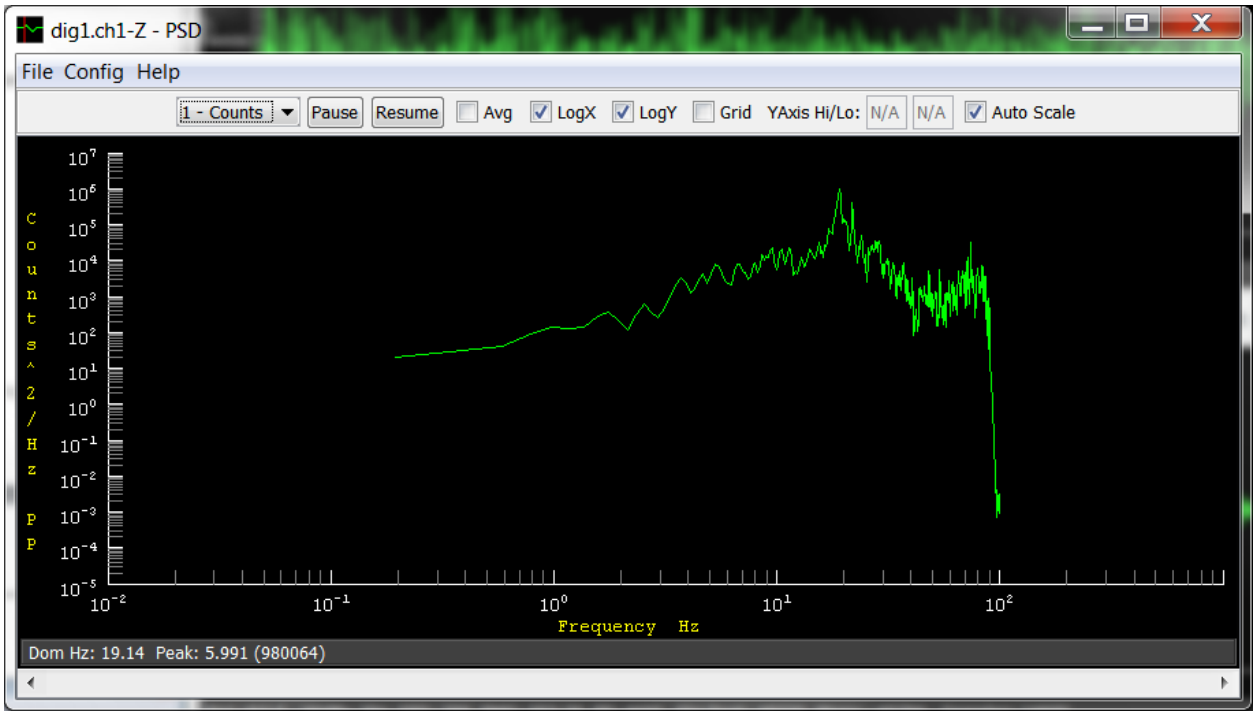
Once you've selected *Yes*, you'll see this:



Select the channel(s) you want to see and press *View Channel*:

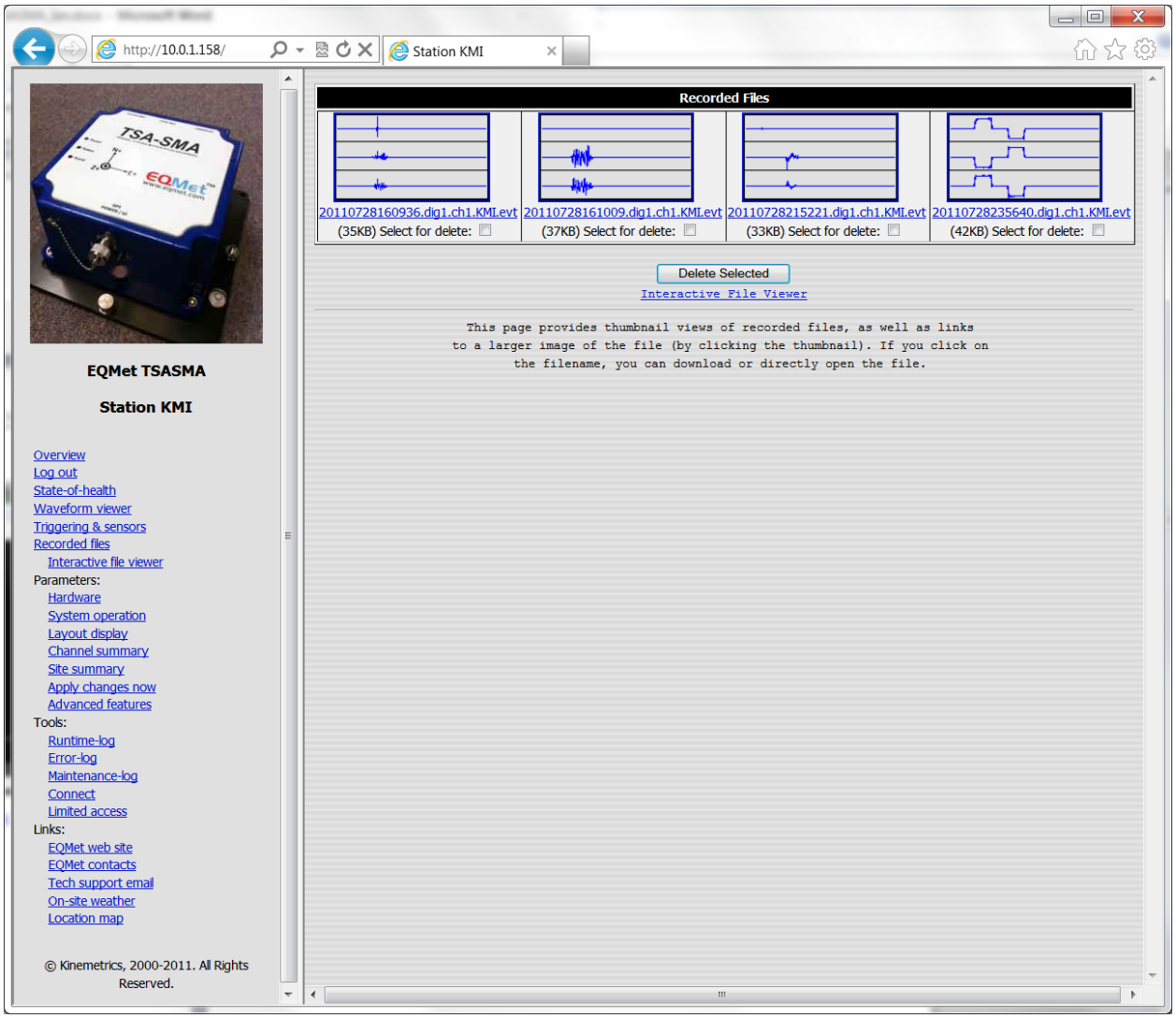

MScope KMI
File View Help All
X 1 - Counts Reset Pause Resume FFT PSD Width: 30 Y Limit: N/A Auto Scale -Mean
-32000
-34000
-36000
-38000
-40000
-42000
-44000
-46000
-48000
-50000
0.000
5.000
10.000
15.000
20.000
25.000
dig1.ch1-Z Width: 30s SPS: 200 RMS: 1244.47 PP: 16014 Abs Peak: 48721 Mean: -43160 Samples: 8400
X 1 - Counts Reset Pause Resume FFT PSD Width: 30 Y Limit: N/A Auto Scale -Mean
-44000
-46000
-48000
-50000
-52000
-54000
0.000
5.000
10.000
15.000
20.000
25.000
dig1.ch2-N Width: 30s SPS: 200 RMS: 1086.29 PP: 10597 Abs Peak: 53406 Mean: -48986 Samples: 8400
X 1 - Counts Reset Pause Resume FFT PSD Width: 30 Y Limit: N/A Auto Scale -Mean
-40000
-42000
-44000
-46000
-48000
-50000
0.000
5.000
10.000
15.000
20.000
25.000
dig1.ch3-E Width: 30s SPS: 200 RMS: 862.76 PP: 9019 Abs Peak: 50975 Mean: -45780 Samples: 8400

Note the options for FFT and PSD display:

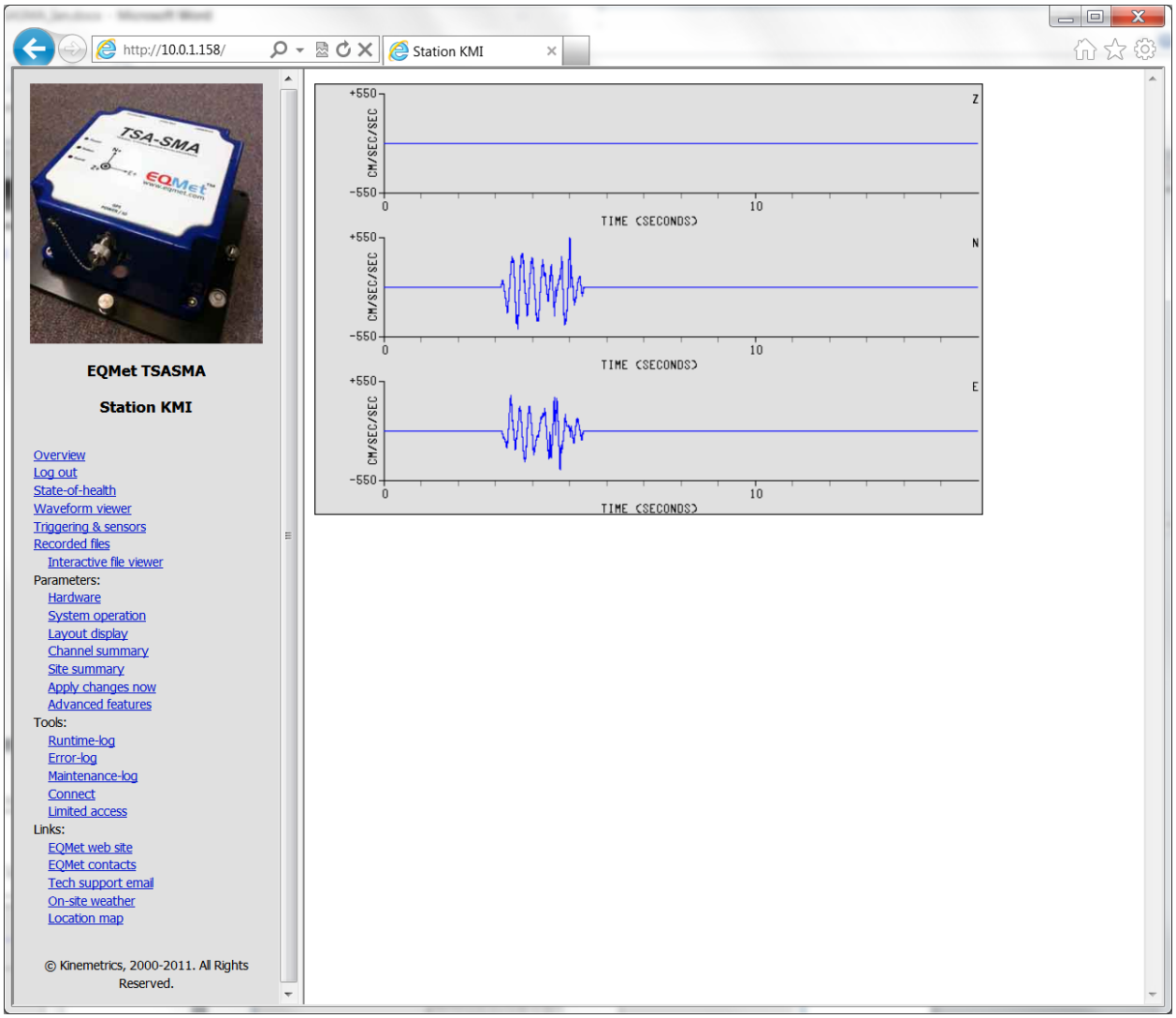


NOTE: If the Waveform Viewer stops updating, see Waveform Viewer Stops Updating

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

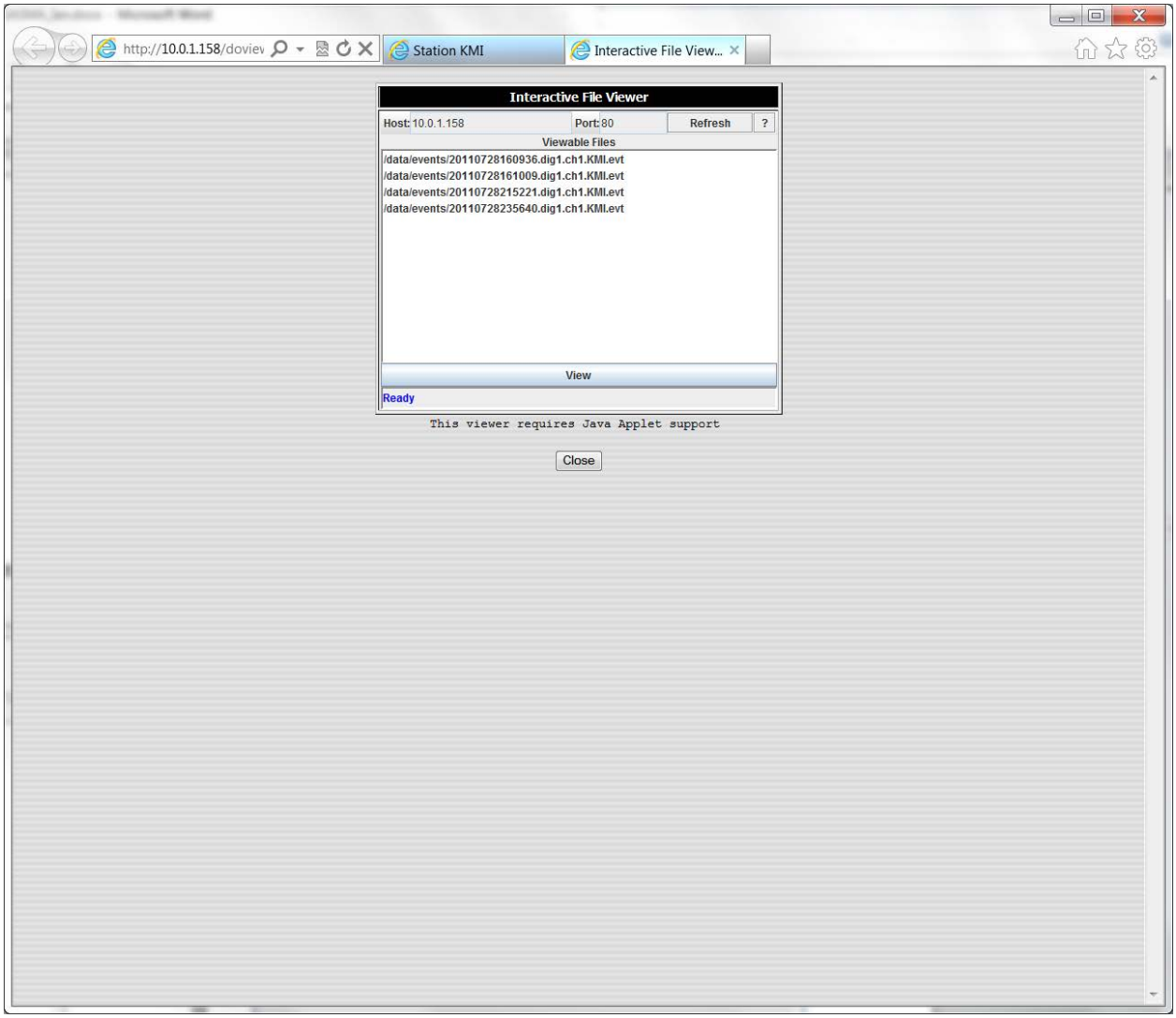


If you click on a thumbnail, you can see a larger (6-10kb) thumbnail:

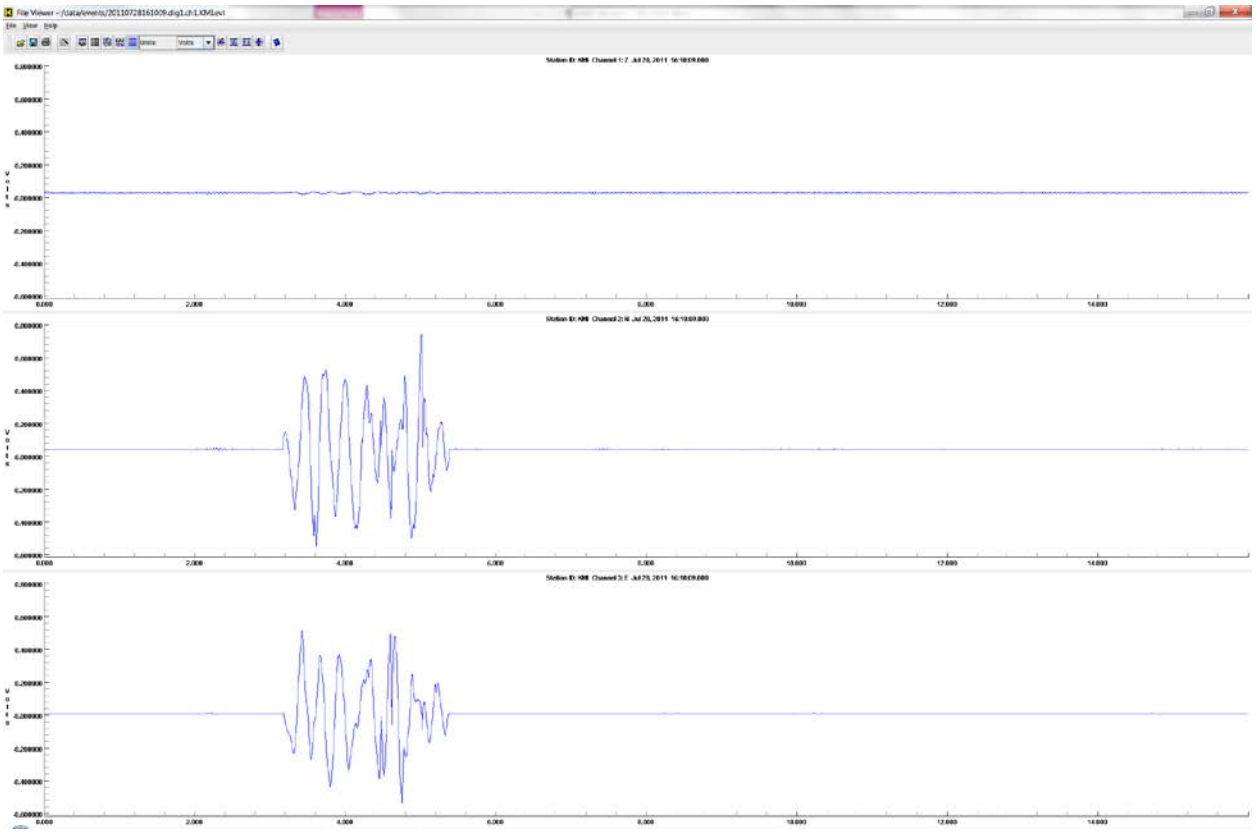


The links and buttons below the small thumbnails allow you to download or delete the files (one at a time) via HTTP. Larger scale file maintenance is best done via SFTP or WinSCP.

The *Interactive File Viewer* allows you to download and interact with recorded files using software that is something like Altus QuickLook and that actually is downloaded FROM THE UNIT:



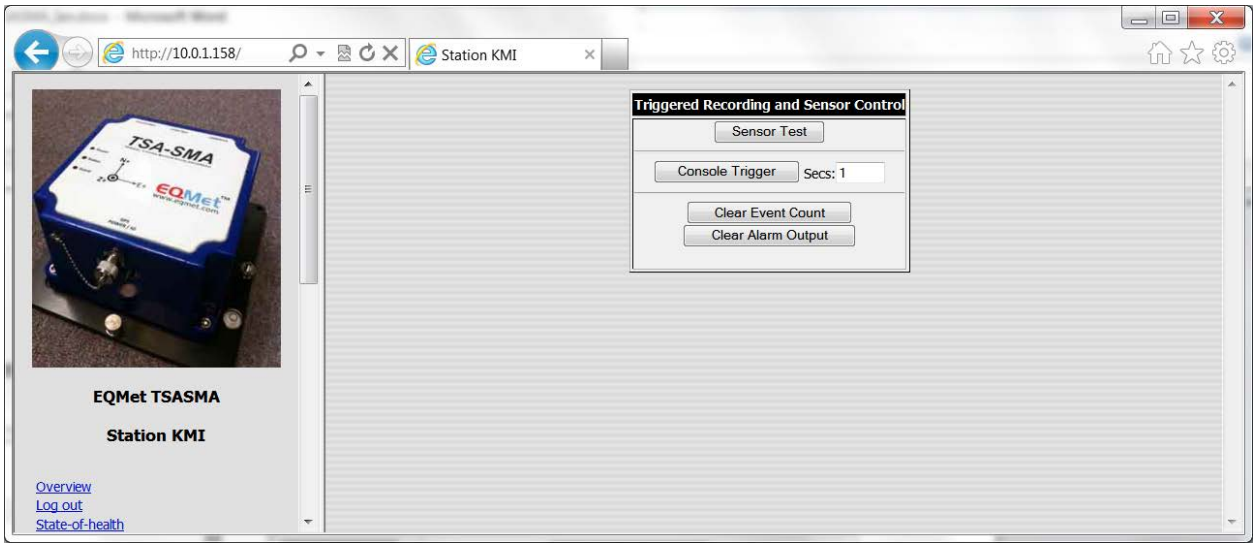
Clicking on the file name and then clicking VIEW will start the interactive file viewer:



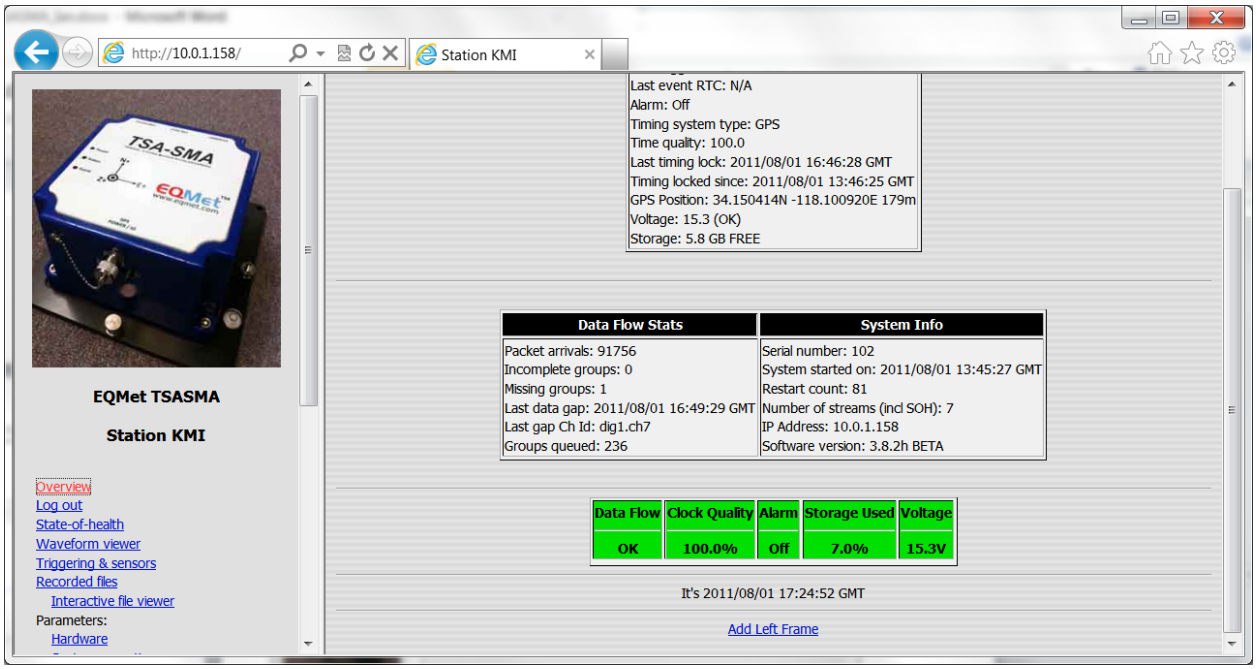
The buttons along the top allow you to change grid mode, DAC mode, background color, units, number of columns, mean removal, and autoscale. Plus you can zoom each channel individually (by drawing a box), pan (with arrow keys), re-sync the X or Y axes, view the header, save the file, etc., etc.

NOTE: If the Interactive File Viewer won't download large files, see FileViewer and Large Files

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



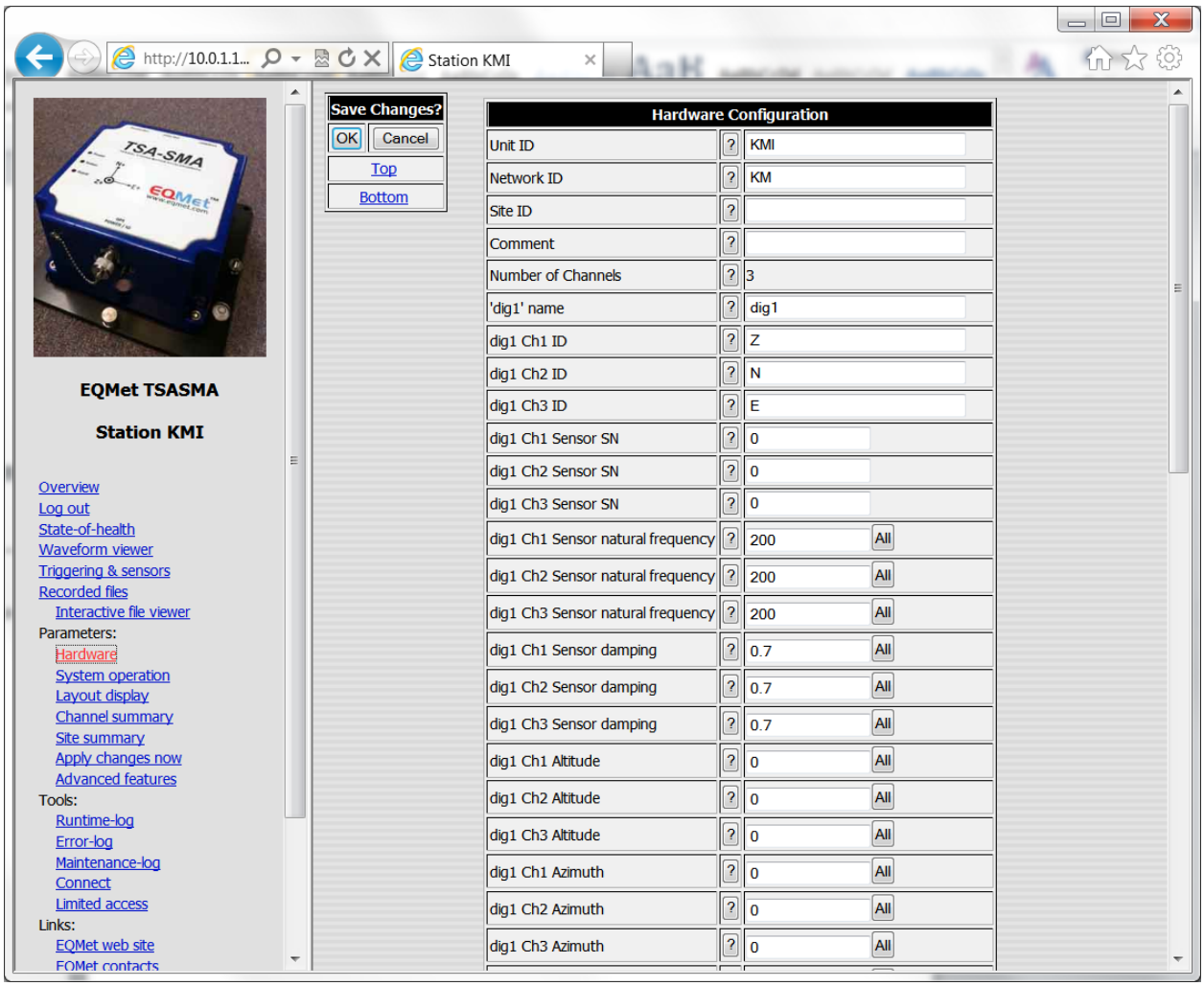
Back on the Overview, status information is displayed at the bottom:



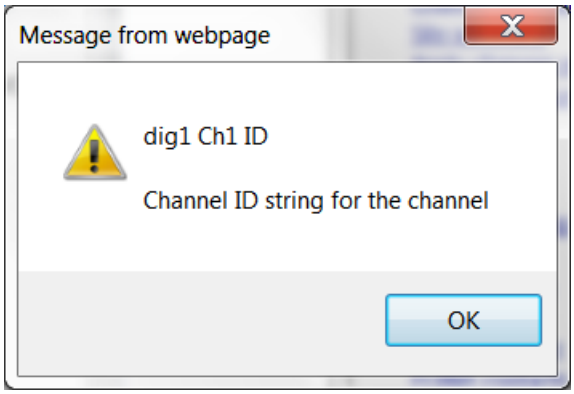
Editing Parameters

Parameters are divided into two main sections. Hardware parameters are those that are typically hardware related such as sensor and channel specifics. System Operation 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 Parameters from the left pane and you'll see something like this:

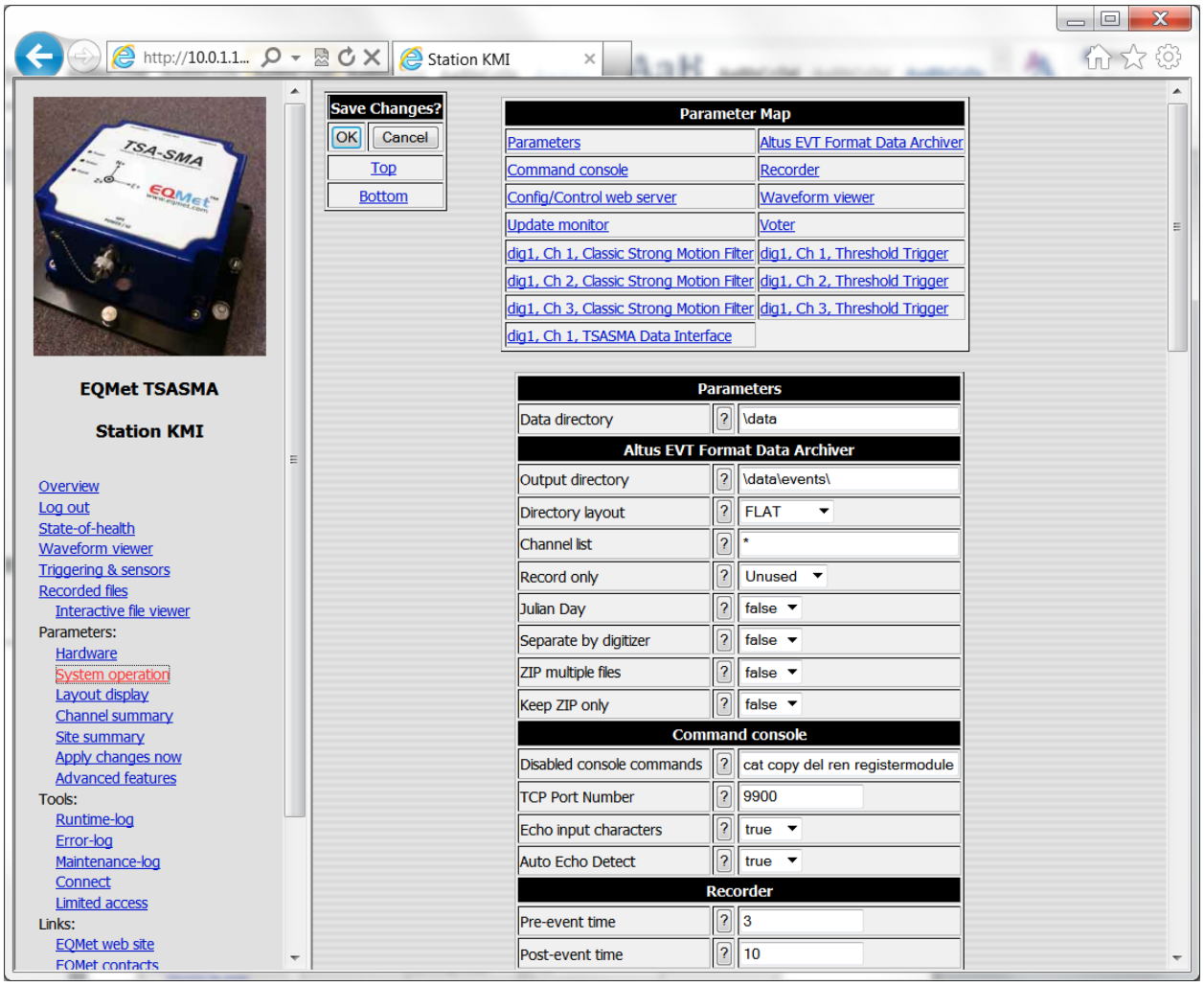


Note that when you click the "?" next to the name of a parameter that you'll be shown the help string that provides more detail about the purpose of the parameter:



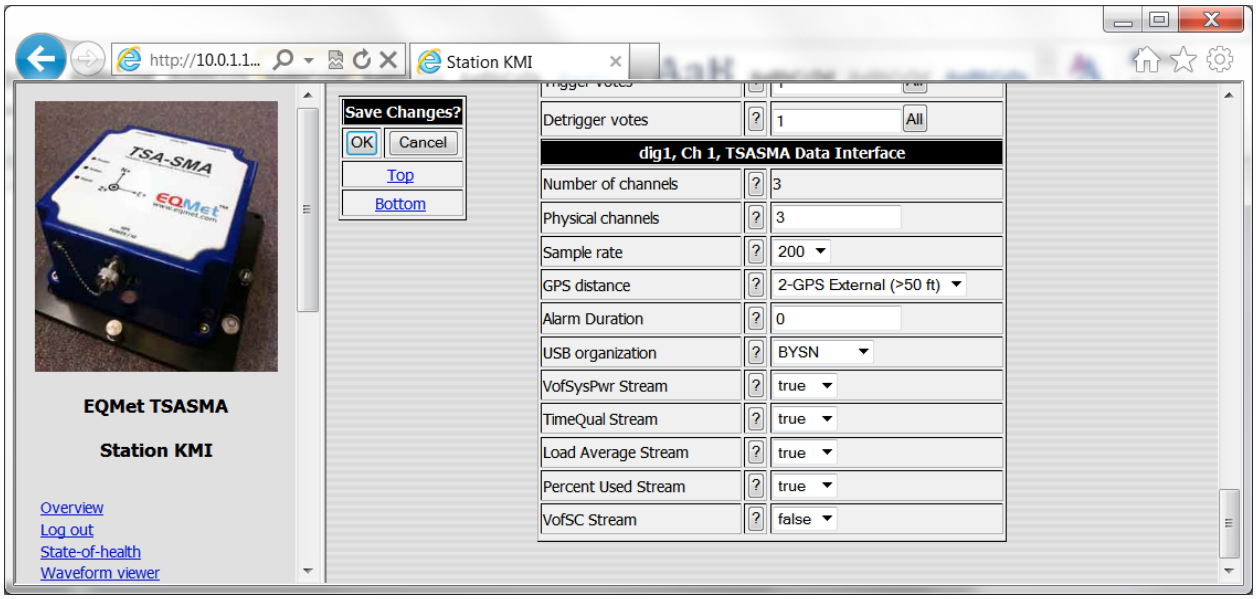
When you've finished editing the Hardware Parameters, click OK to save your changes.

To edit System Operation Parameters, select System Operation from the left pane and you'll see:



The top of the *System Operations* 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 TSA-SMA Data Interface, click on the link and you will get:

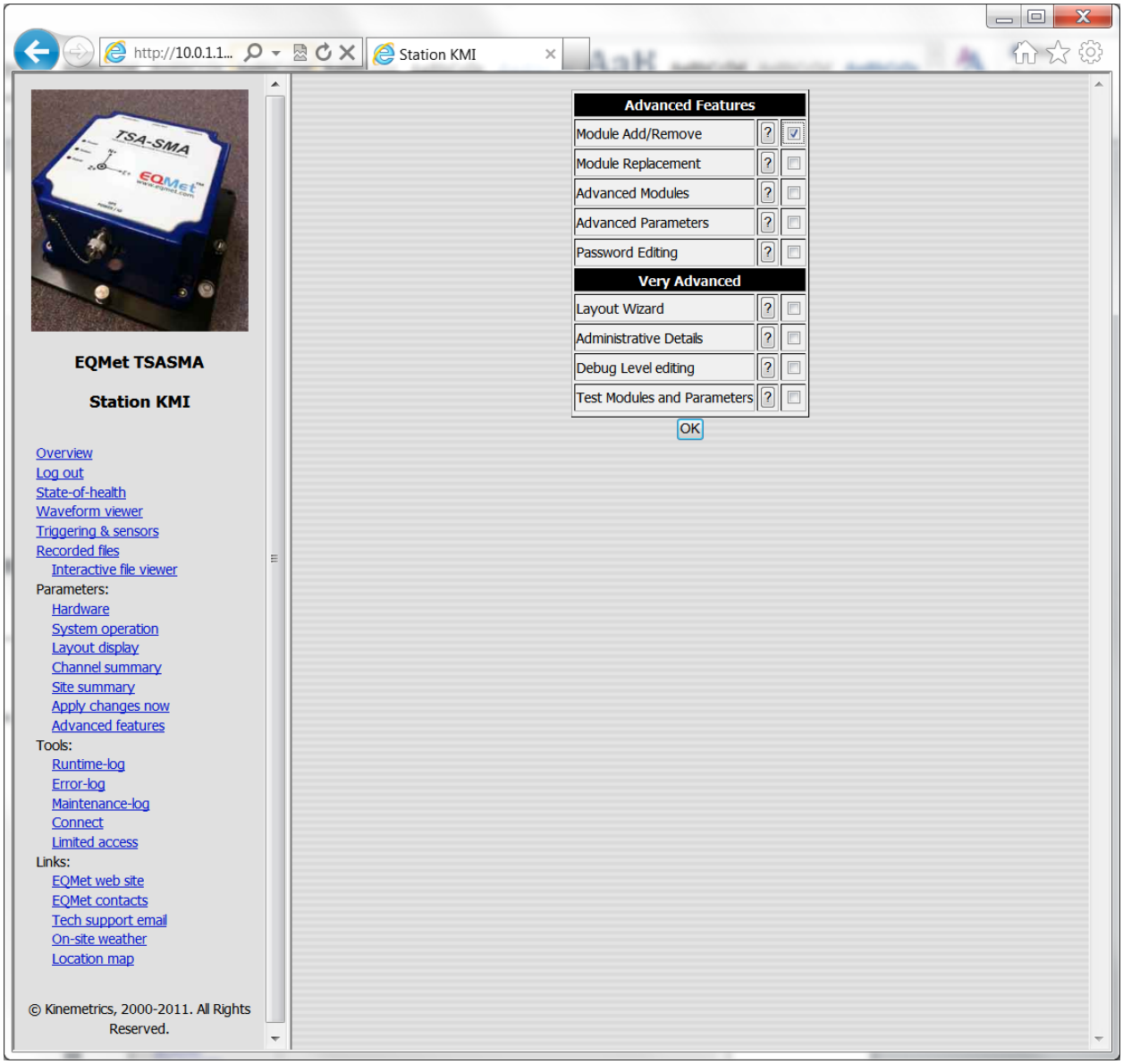


After completing your changes, be sure to press OK to save your changes.

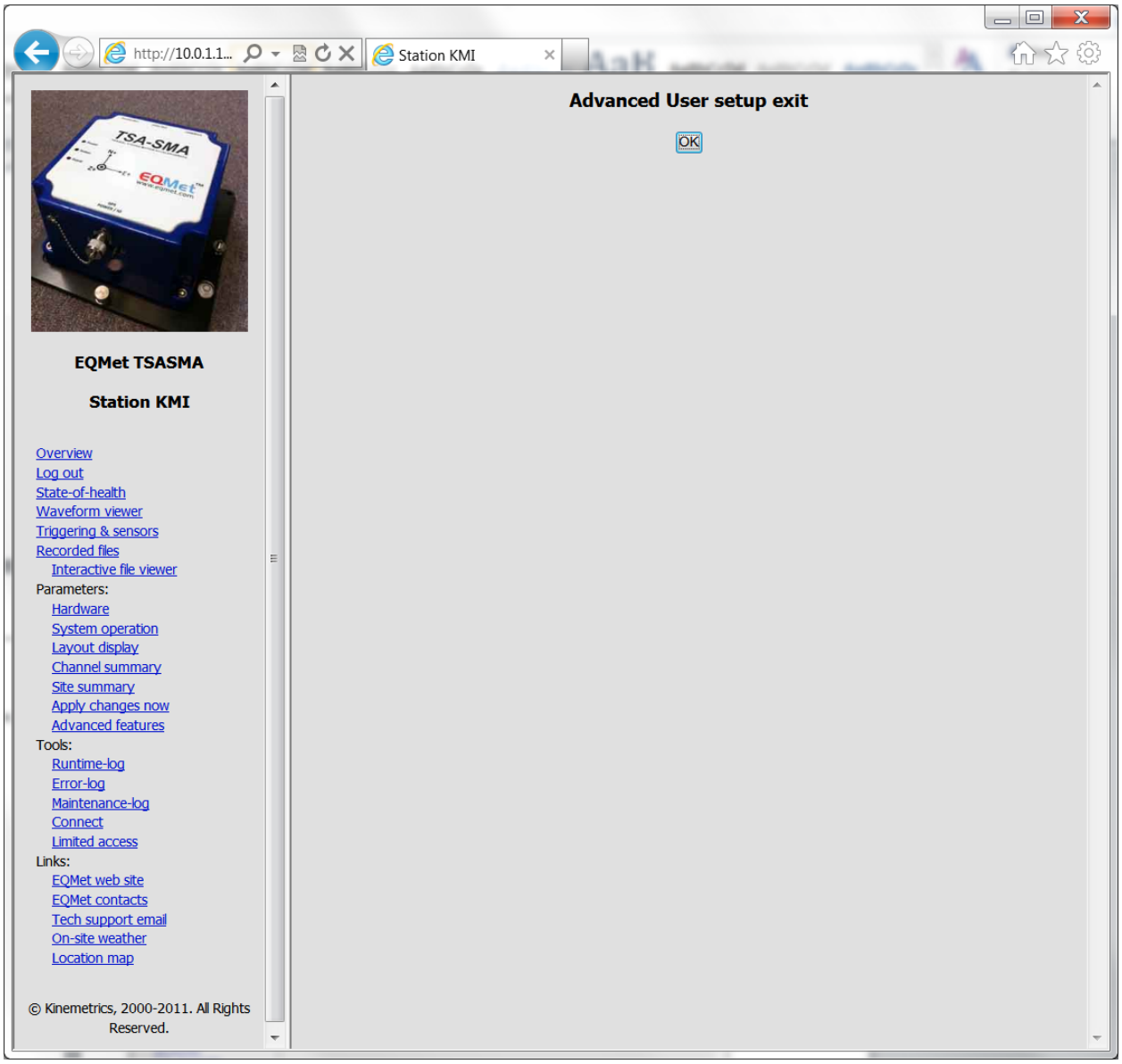
Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes Now” from the left pane of the display. The system will restart and reconfigure itself to make your changes. This may take a few minutes until the system is restarted and operational with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

Adding Modules

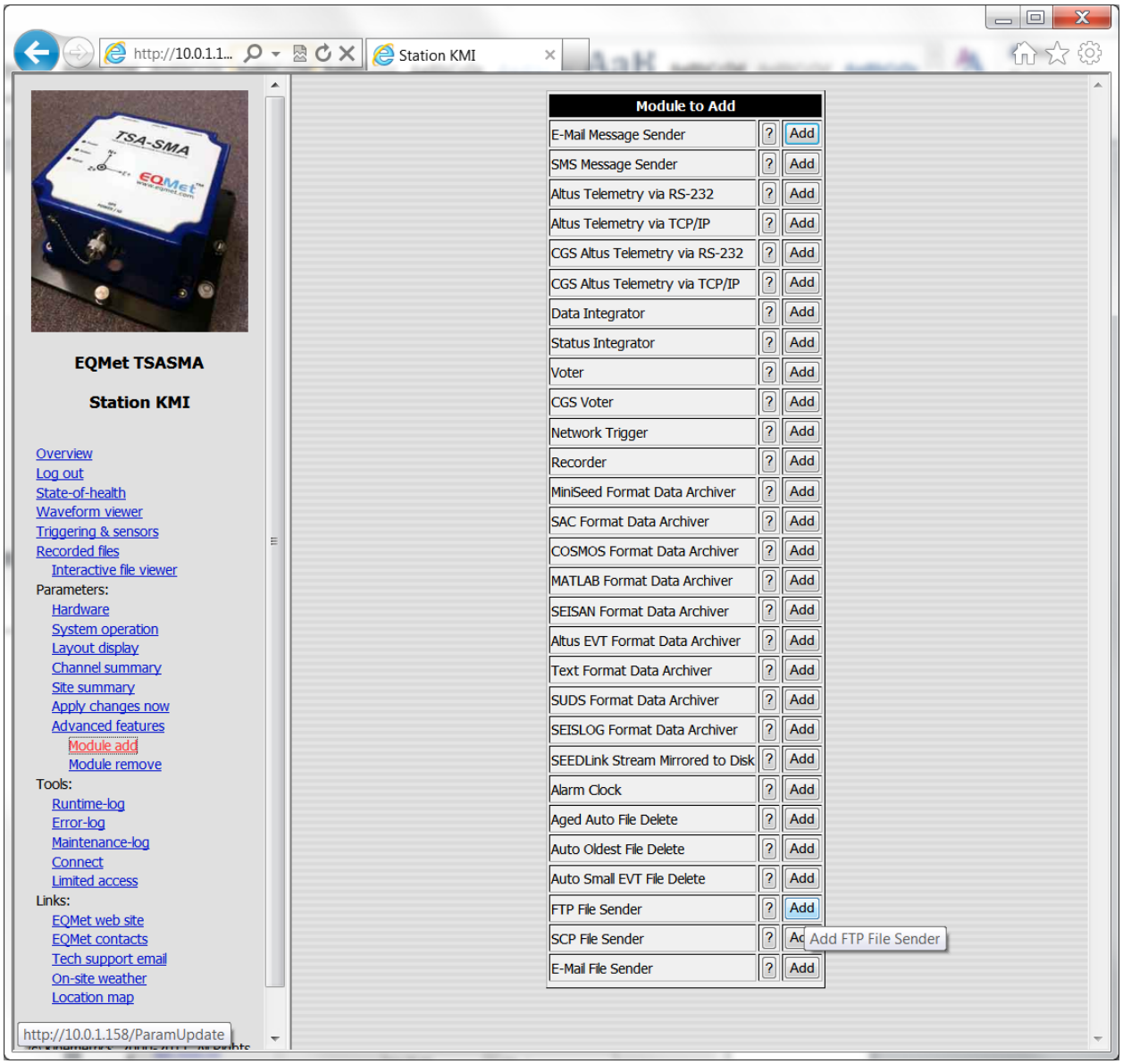
You can add capabilities to your system by adding additional modules. The process is the same for adding modules of any type. For example, to add a module to the system to push recorded event files automatically to a remote FTP server, you will need to add an FTP Sender module. To accomplish this, select Advanced Features on the left pane and select Module Add/Remove as shown:



Next, click OK and then click OK on Advanced User Setup Exit:

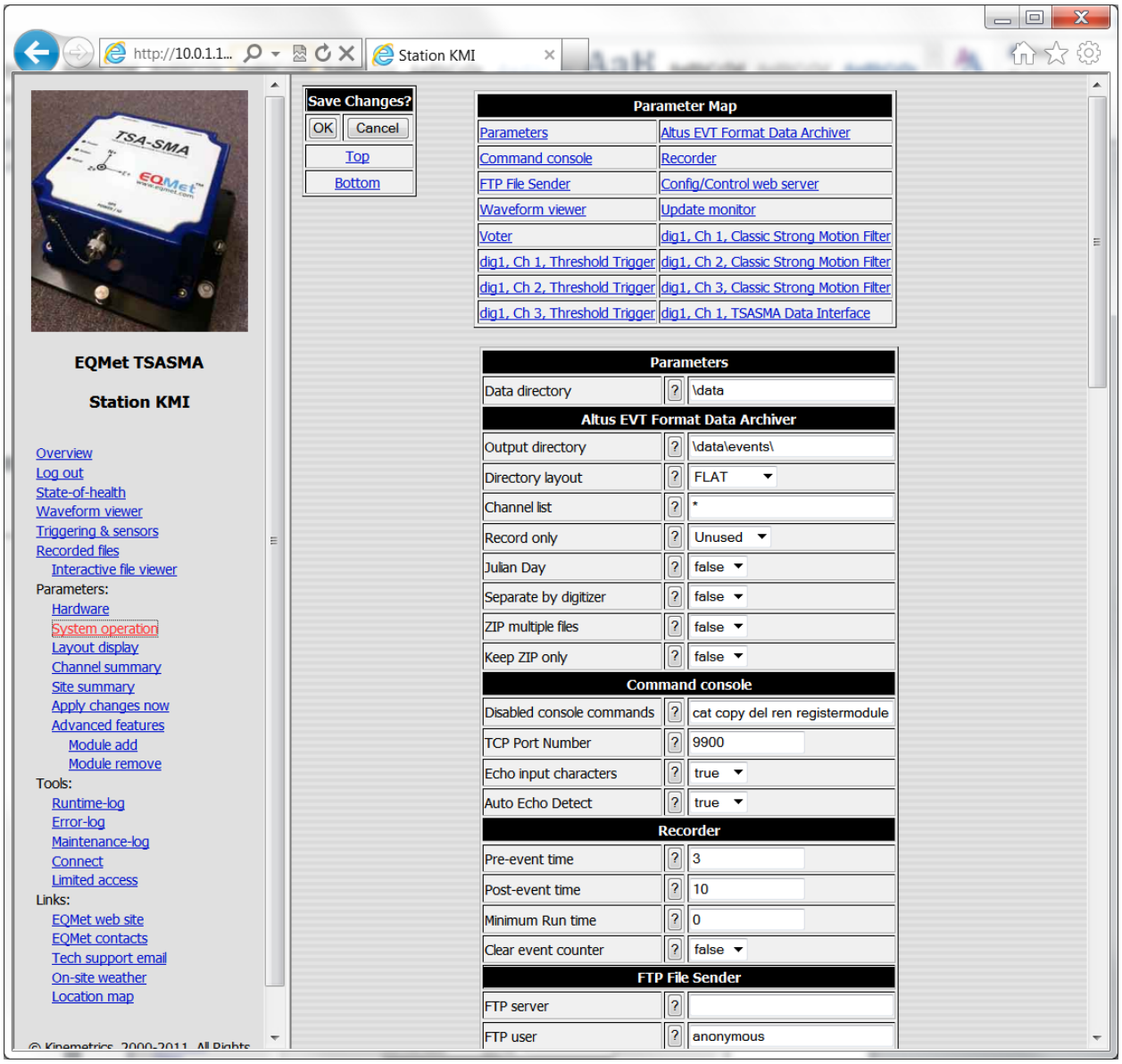


Select Module Add in the left pane and scroll down in the right pane to locate the FTP Sender:

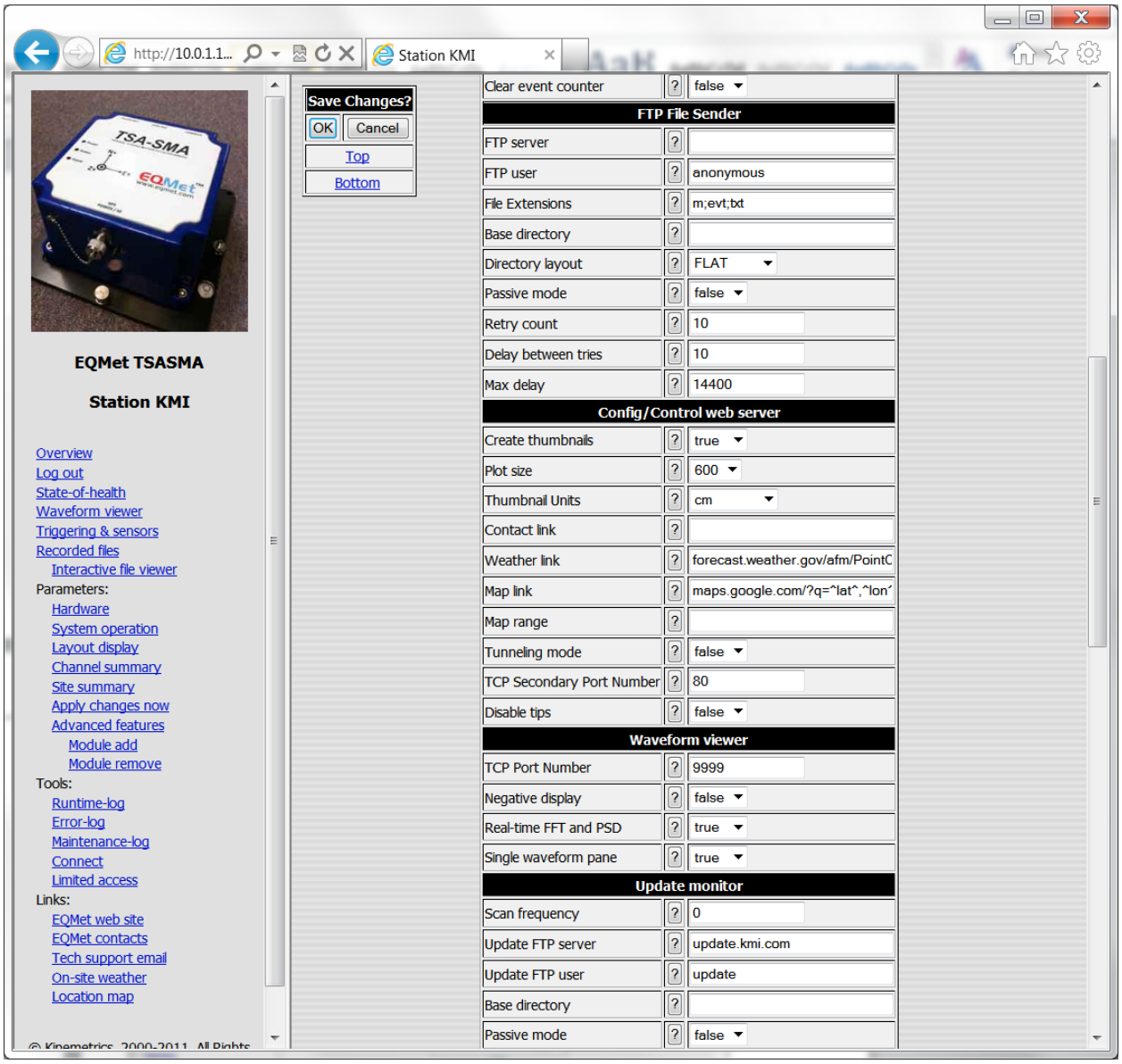


Click “Add” to add the module.

Next, click “System Operation” in the left pane and select “FTP Sender” from the parameter map:



The FTP Sender parameters will now appear at the top of the right pane as shown:



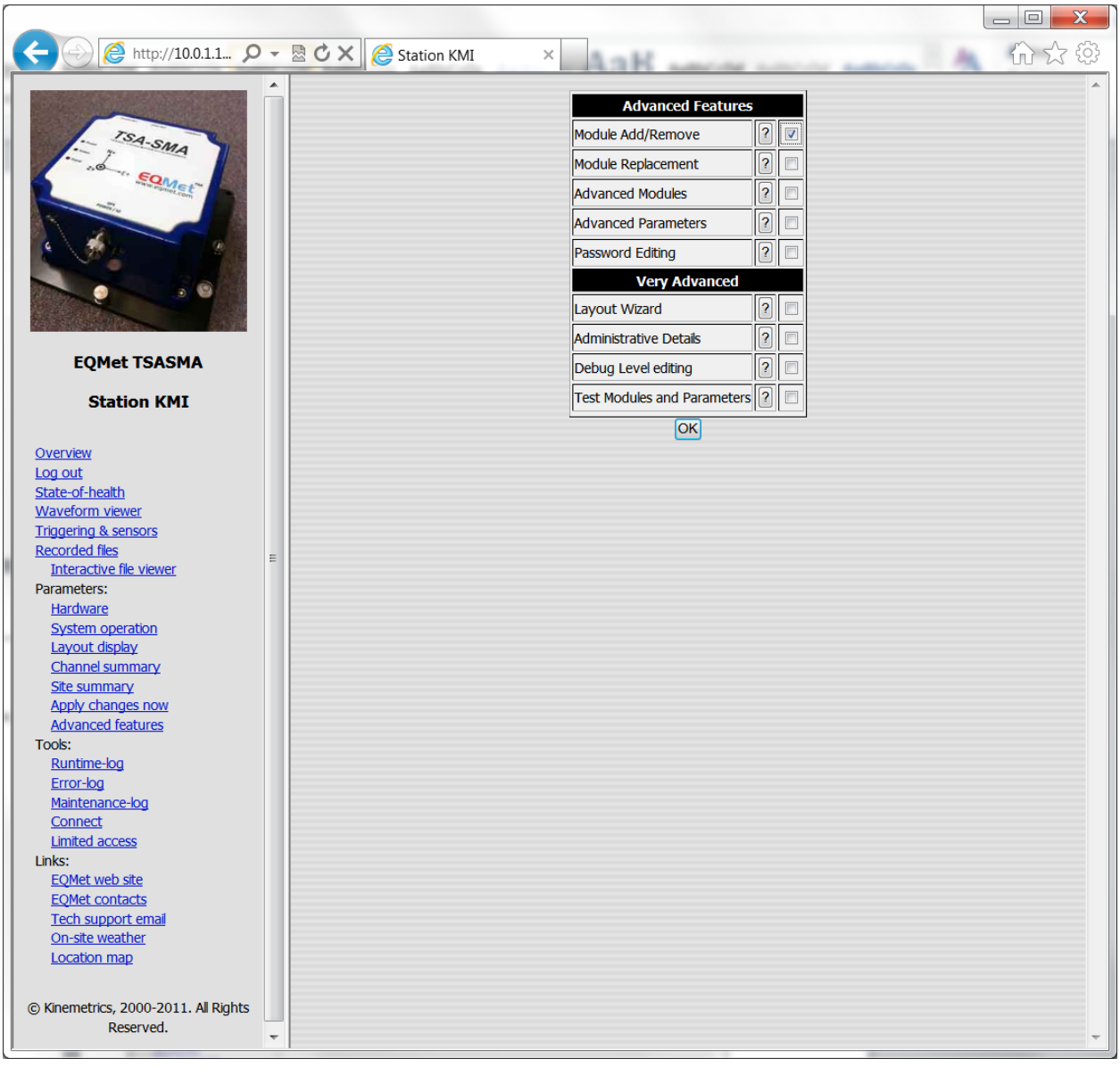
Configure the parameters for your new module as needed, then click OK to save your changes.

Next, click “Apply Changes Now” in the left pane. The system will restart and reconfigure itself to add the FTP Sender module. This may take a few minutes until the system is restarted and operational with your new module.

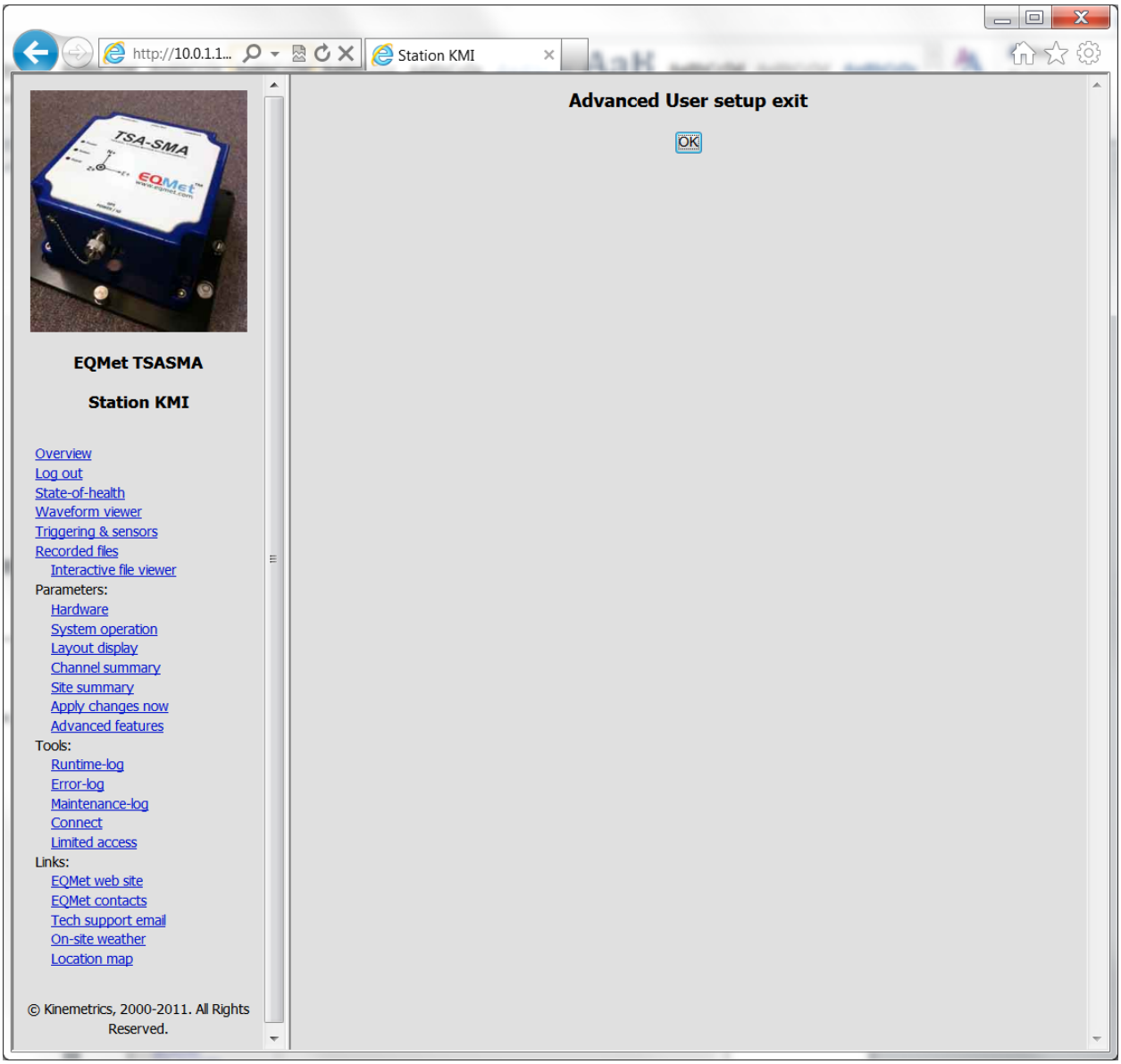
Please note than for most modules (including the FTP Sender module used as an example here) that you can usually add multiple modules of the same type. This could be useful where for example you want to send recorded files to more than one remote FTP server. To do this, you would add one FTP Sender module for each destination.

Removing Modules

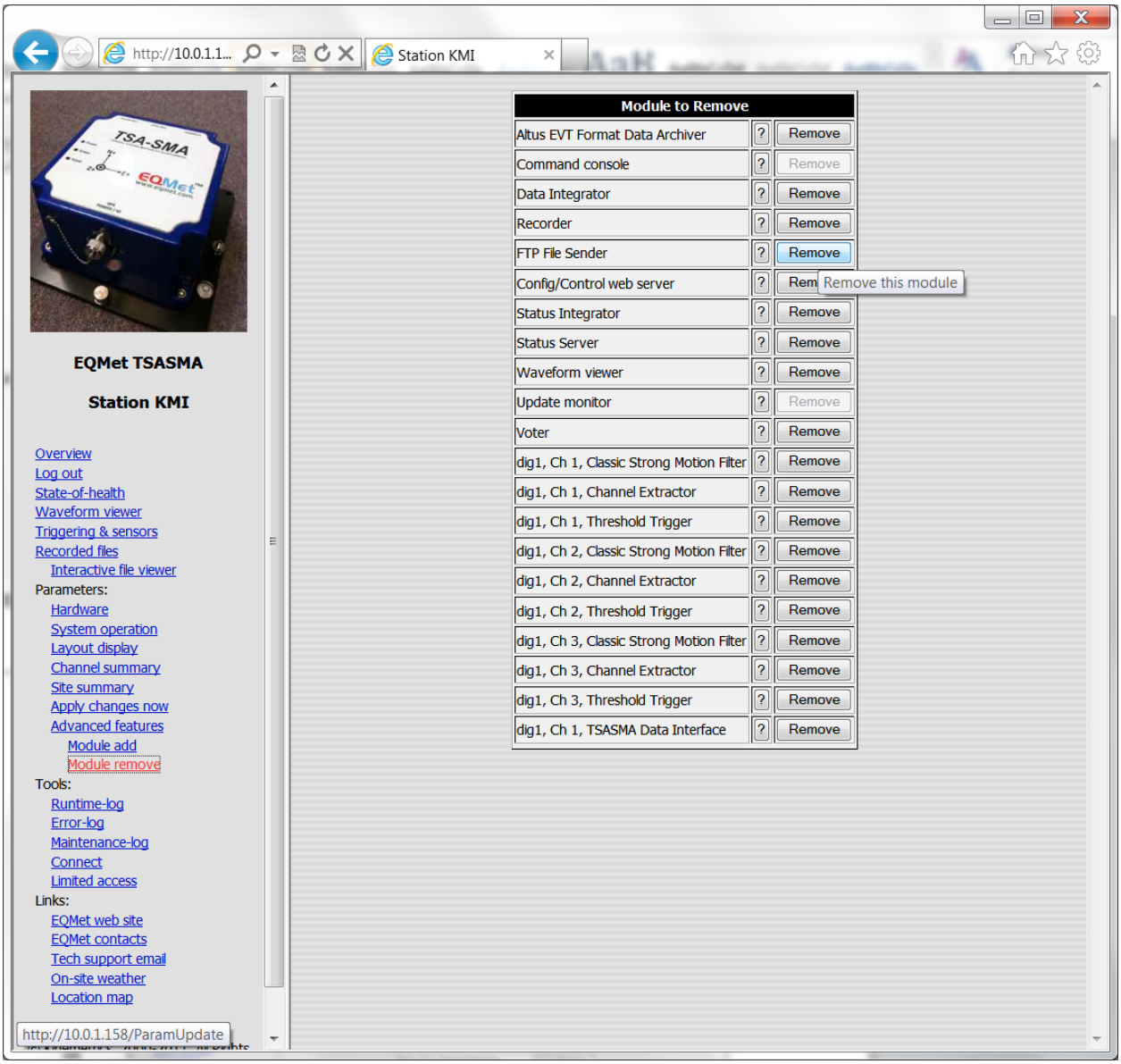
You can further alter the capabilities of your system by removing modules. The process is the same for removing modules of any type. For example, to remove an FTP Sender module from the system, select Advanced Features on the left pane and select Module Add/Remove as shown:



Next, click OK and then click OK on Advanced User Setup Exit:

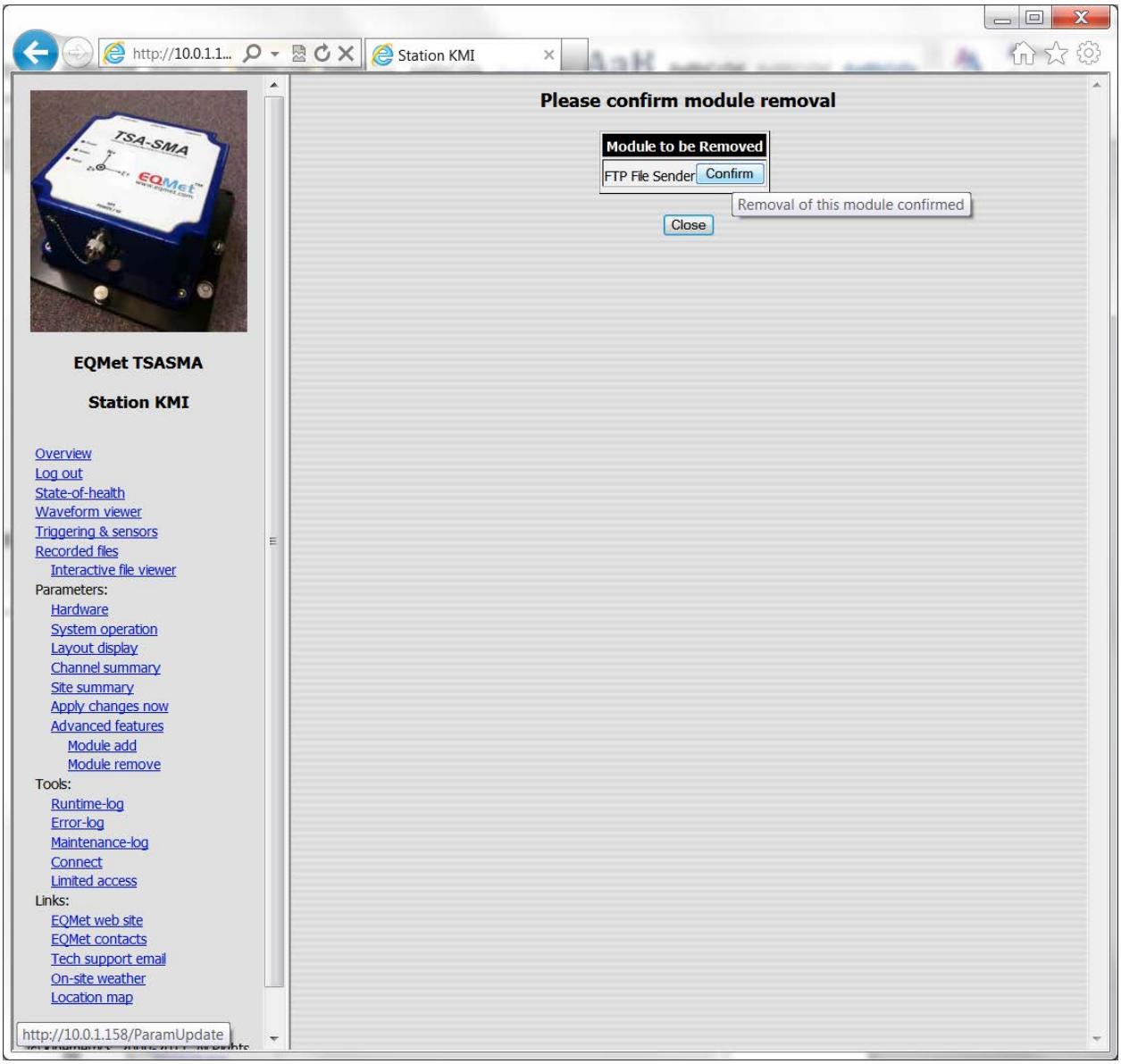


Select Module Remove in the left pane and scroll down in the right pane to locate the FTP Sender:



Click “Remove”.

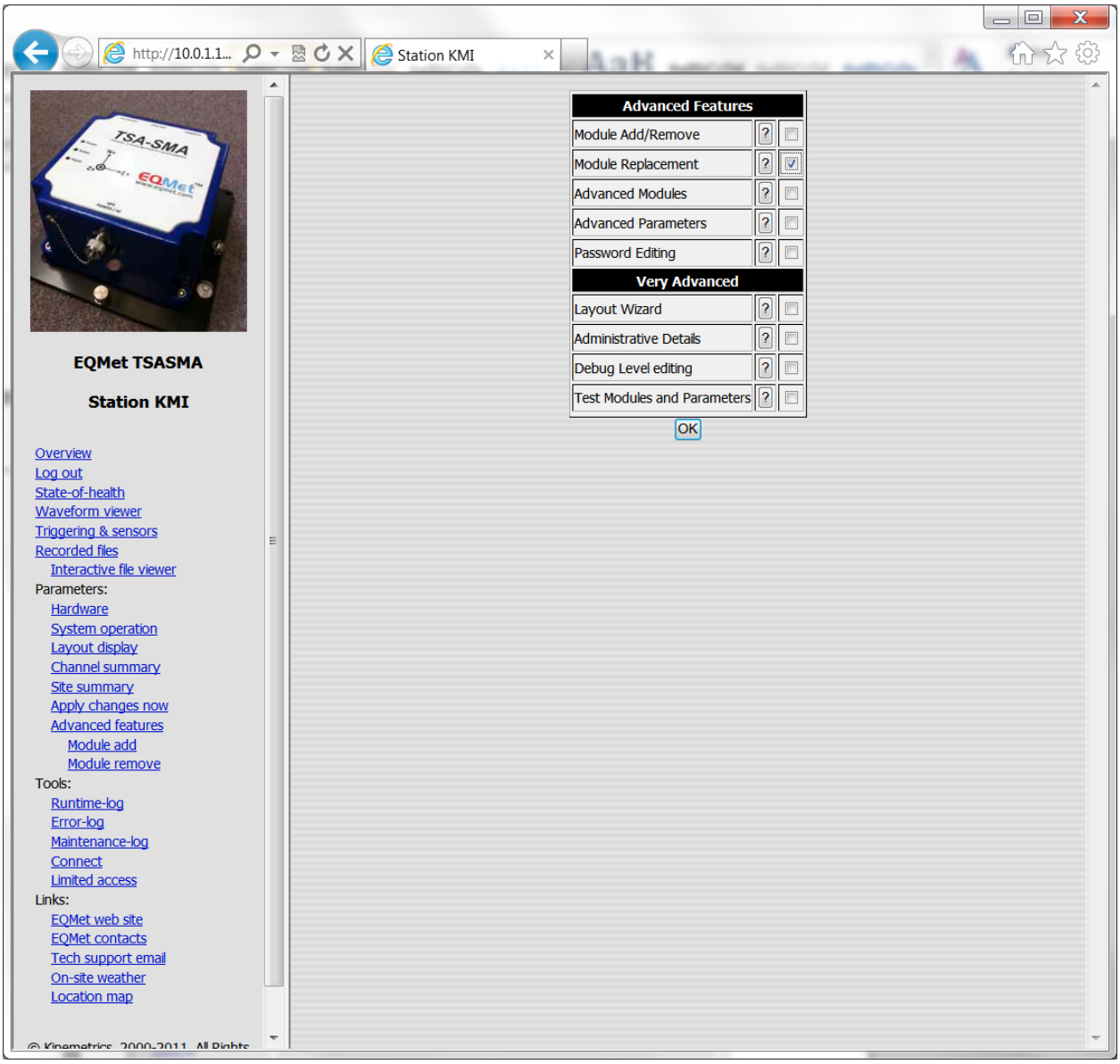
You will be asked to confirm the removal as shown:



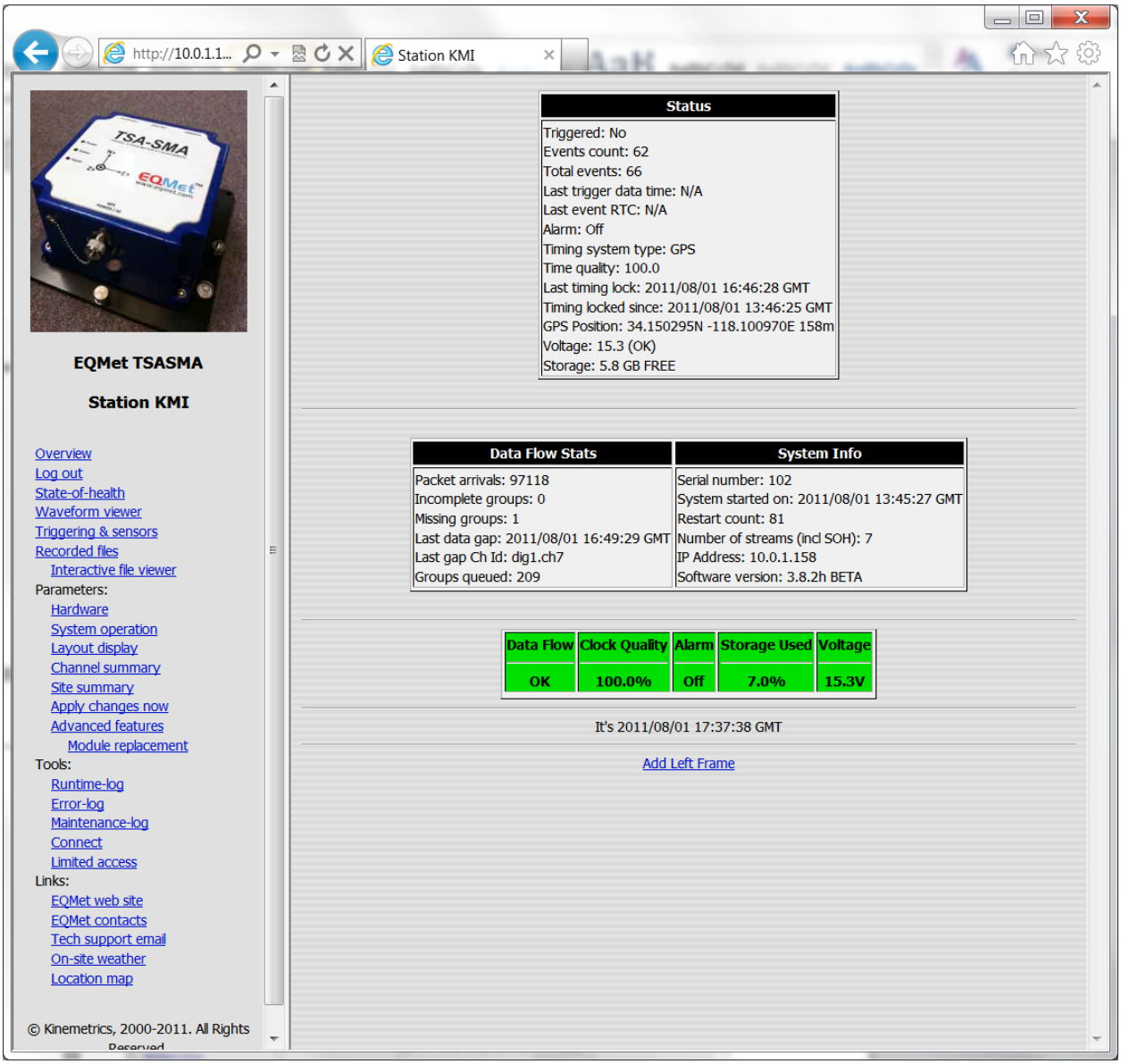
Next, click “Apply Changes Now” in the left pane. The system will restart and reconfigure itself to remove the FTP Sender module. This may take a few minutes until the system is restarted and operational with your changes.

Replacing Modules

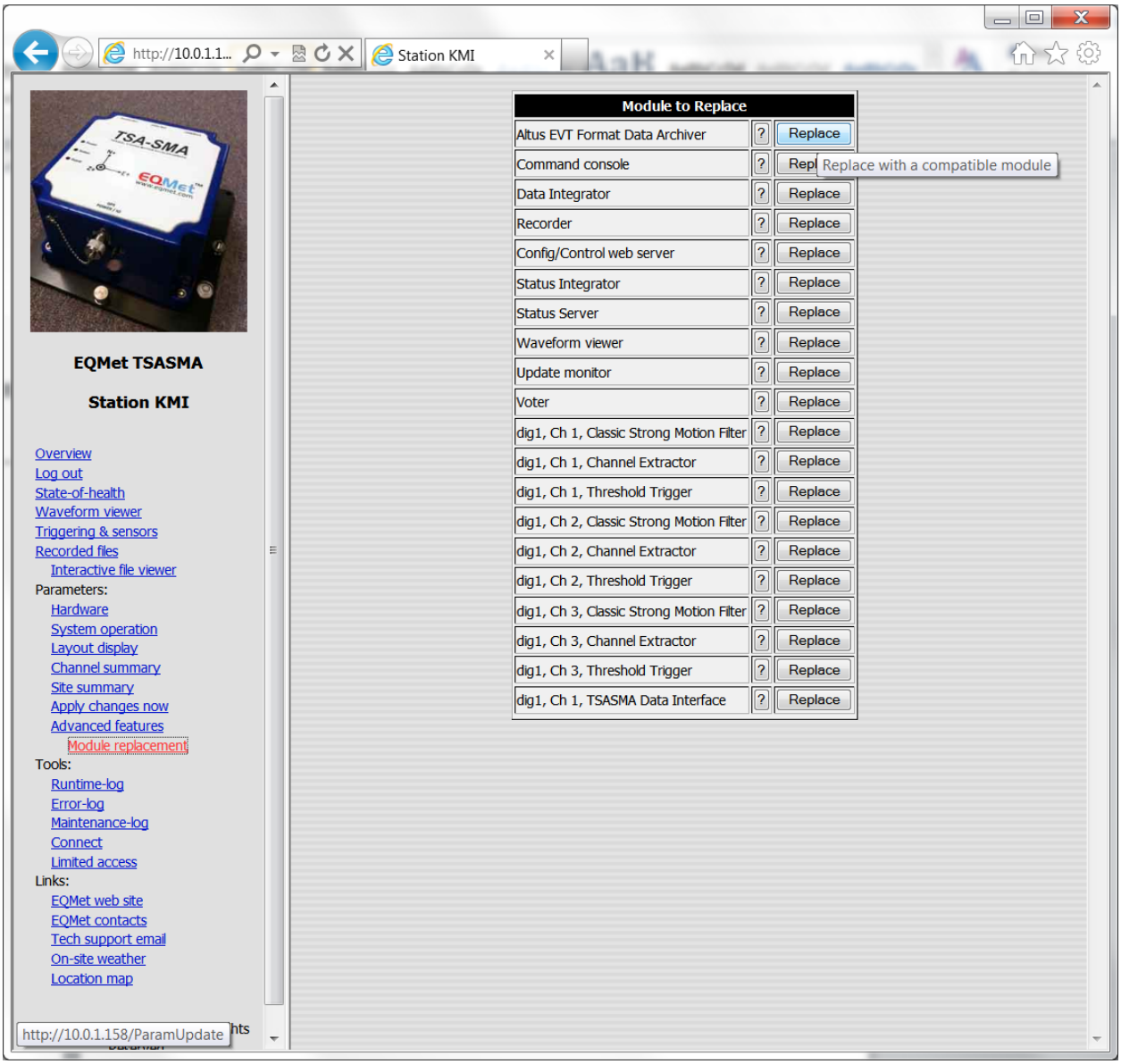
Sometimes what you need to do is replace a module in the system with another that has the same basic functionality. For example, you may want to replace a data archiver that produces EVT files with one that produces MiniSEED files, or you may want to replace a Threshold Trigger with an STA/LTA Trigger. For example, to change the data format from Kinemetrics EVT file format to MiniSEED, use the web interface. Choose Advanced Features from the left side of the display. Select Module Replacement and click OK:



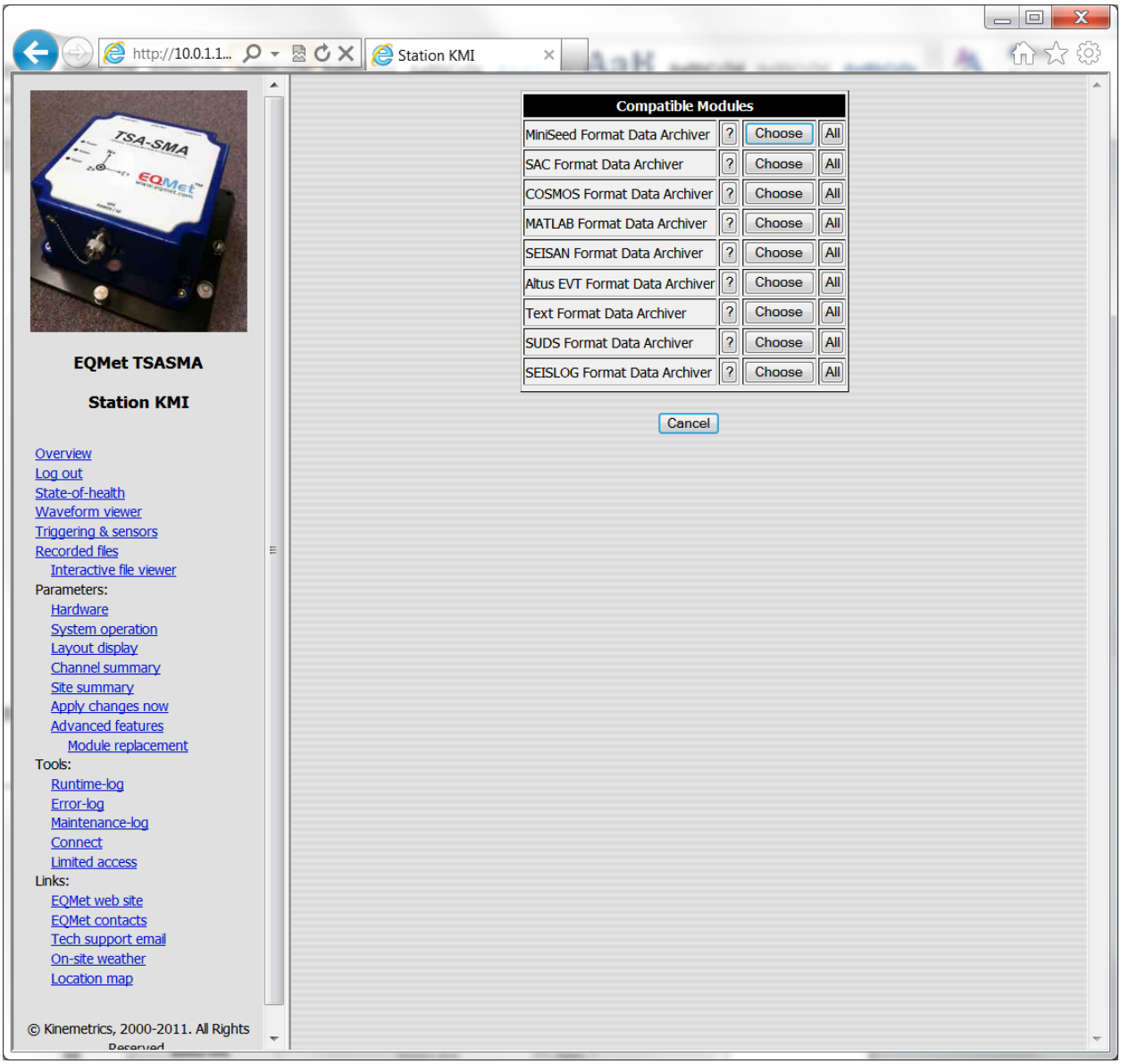
On the left pane of the screen, Module Replacement will now be an option below Advanced Features:



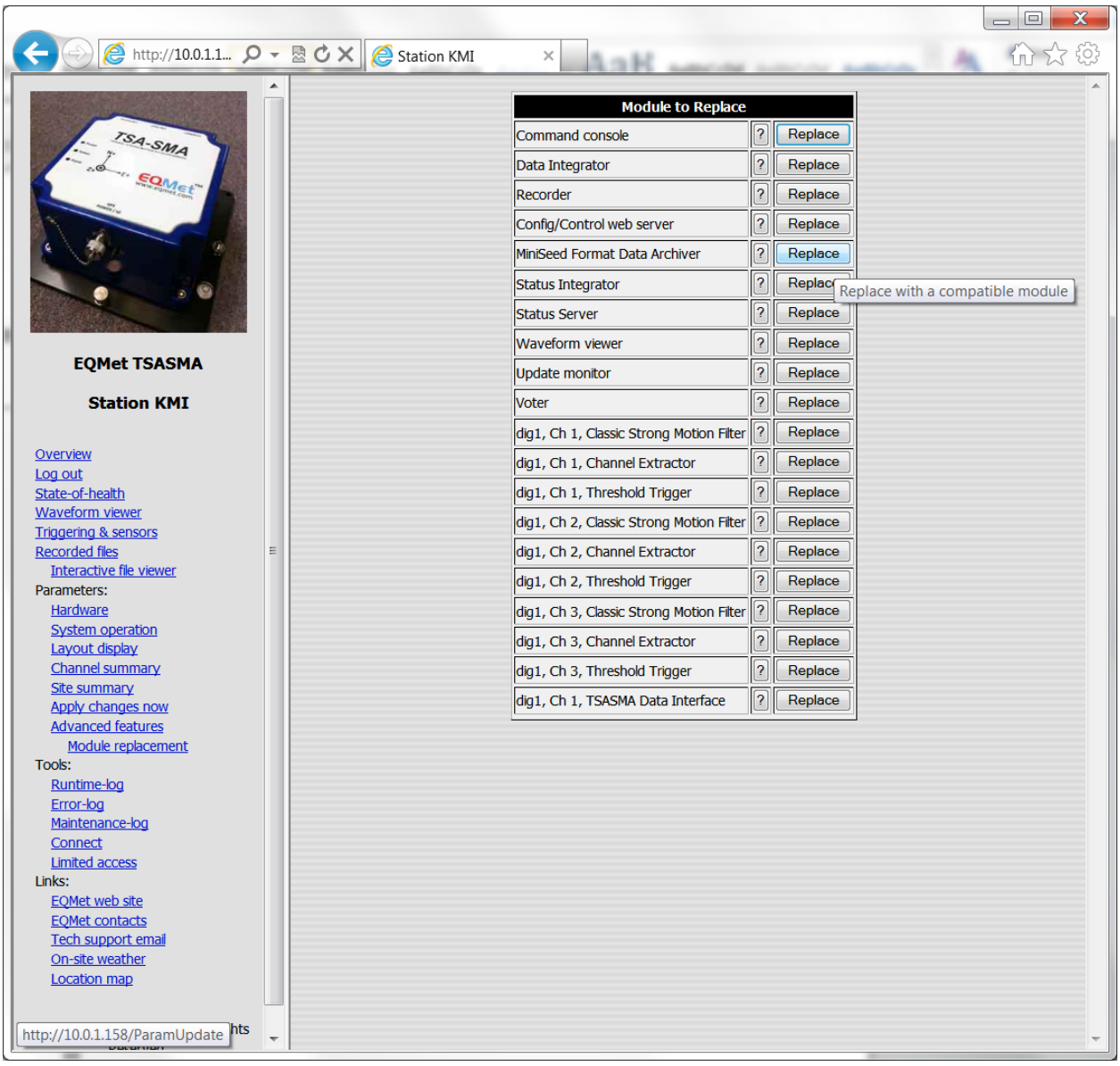
Click Module Replacement and you'll see:



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

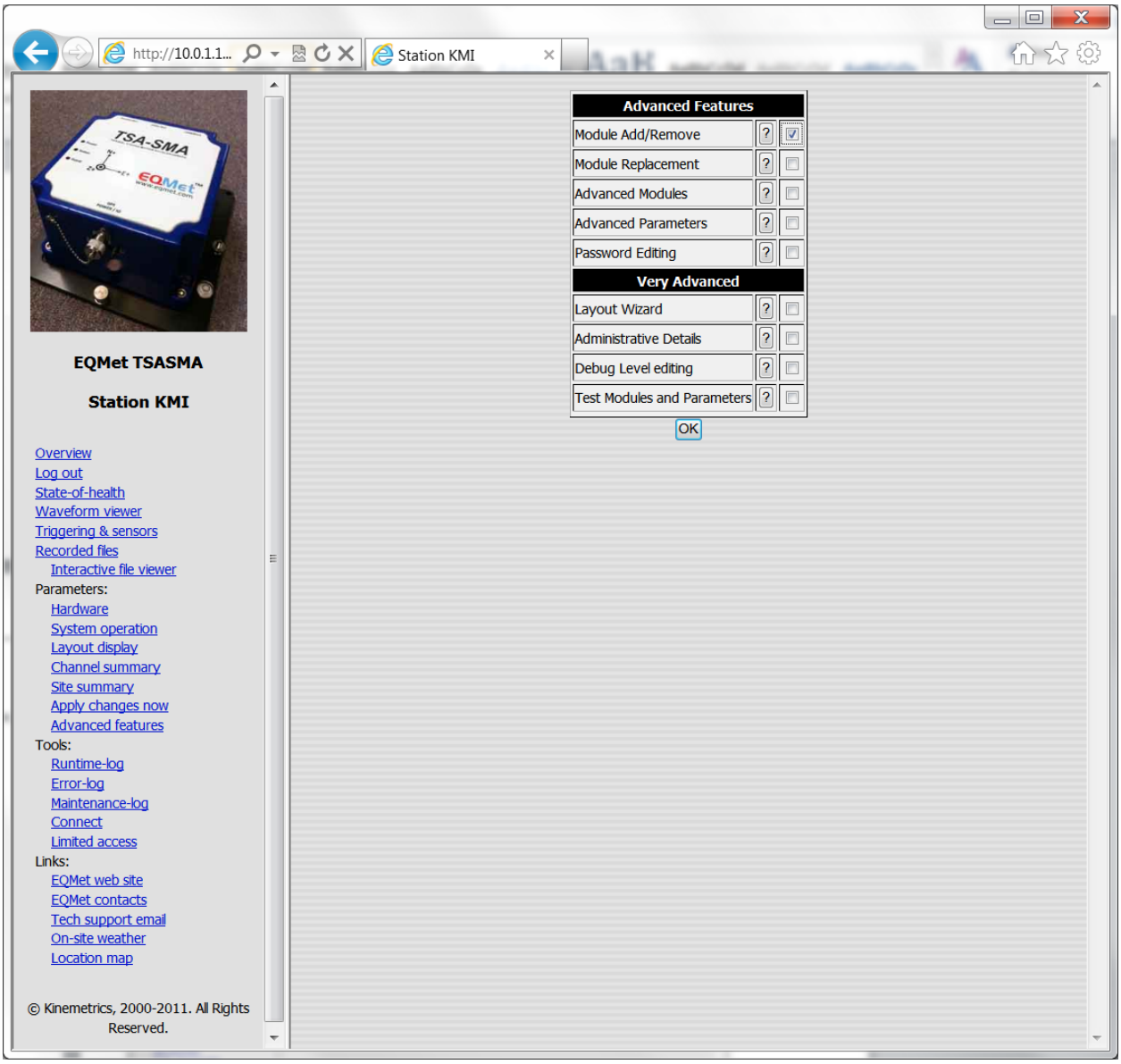


In this example, it was pretty simple because there was only one EVT Archiver module in the system. To make this a little better, you can select “All” instead of “Choose” when you are shown the Compatible Modules pane. You can then replace all modules of one type with another.

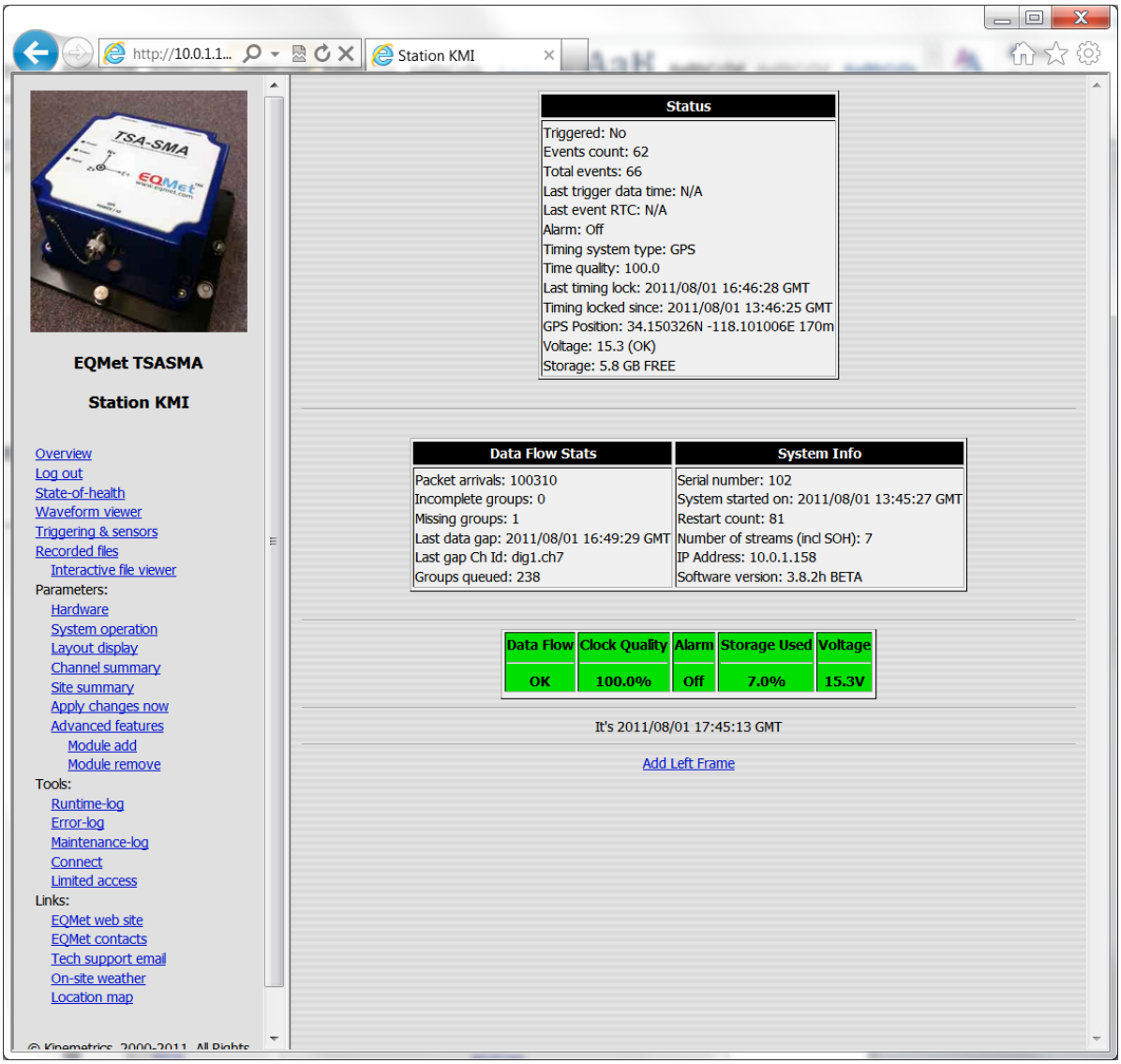
Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes Now” from the left pane of the display.

Web Interface Advanced Features

The Advanced Features screen (selected by clicking Advanced Features in the left pane) appears as follows:



These features are often unneeded in basic operation of the system, and as such are hidden to simplify normal operation. When you select an advanced feature on the right and then click OK, that feature will now show up on the left pane as an option:



The features listed here are as follows:

Module Add/Remove: Allows you to add additional modules into the layout or to delete modules from the layout. In most cases, you can add multiple modules of a given type into the system. In some cases though there may be limits on the maximum or minimum number of modules of a given type. See Adding Modules.

Module Replacement: Allows you to replace a module with any compatible module. Replacement options must perform the same basic function in order to be compatible. For example, you could replace a Classic Strong Motion Trigger Filter with any other trigger filter (but you would not be able to replace the module with something incompatible such as an FTP Sender).

Advanced Modules: Some specialized modules require specialized or advanced knowledge of the system in order to be successfully used. These modules are normally “hidden” as Advanced Modules and can only be seen as possible selections by enabling this feature.

Advanced Parameters: Some specialized parameters for existing modules require specialized or advanced knowledge of the system in order to be successfully used. These parameters are normally “hidden” as Advanced Parameters and can only be seen and edited by enabling this feature.

Password Editing: In general, it is never a good idea to advertise passwords. So normally, system passwords (such as the password for your Web Interface) are not included in the parameters presented for editing. To access your passwords, select this feature and choose “System Operation and Passwords” from the left pane.

Layout Wizard: Will allow you to create a completely new layout by answering some basic questions about the type of layout, number of channels, and so on. After creating the basic layout, you may still need to add some additional modules that you need as well as doing initial setup of the parameters. The process is further described in the section Layout Wizard.

Administrative Details: The Administrative Details pane allows you to perform various administrative functions such as:

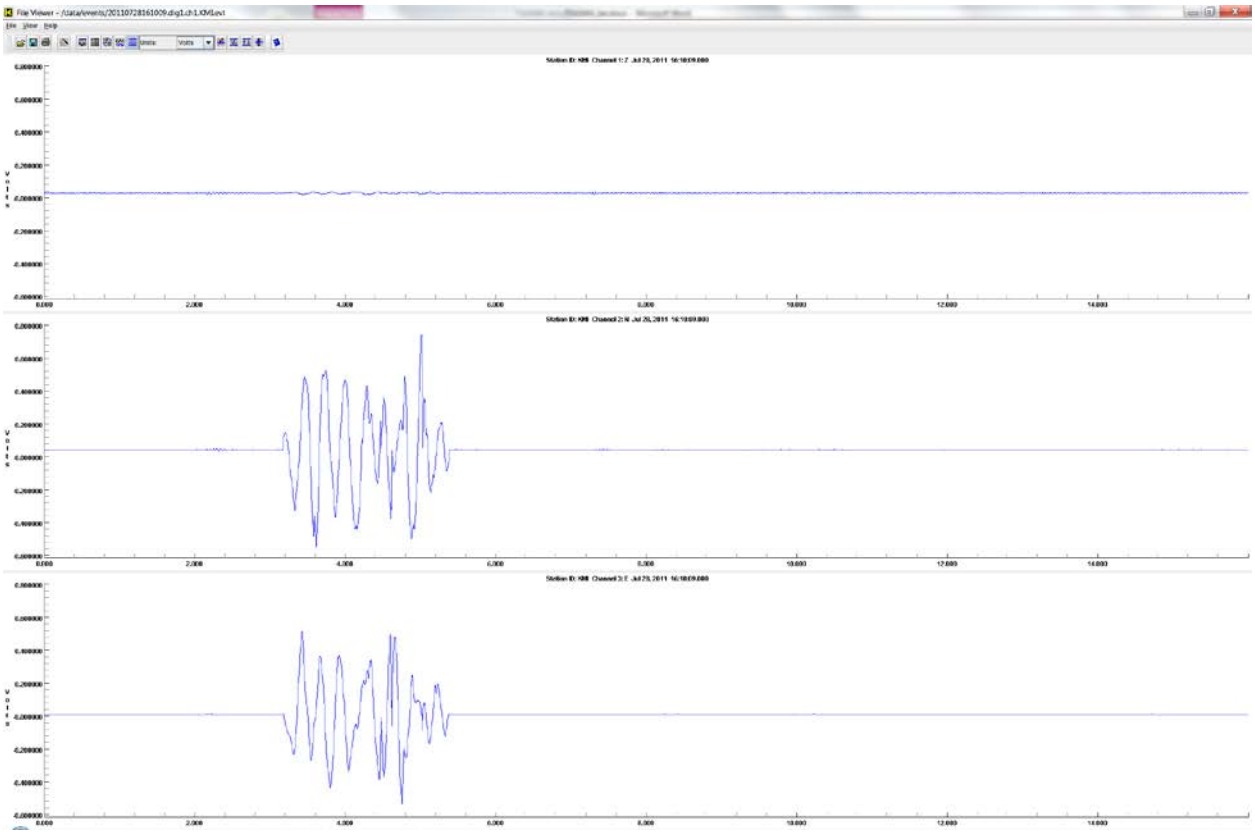
- Uploading or downloading parameter files
- Uploading or downloading system registration (used for enabling some special features)
- Uploading software updates
- Creating and sending documentation packages

Debug Level Editing: The various software modules which contain specialized debugging modes that can be enabled using this pane. These modes should only be used by or under the direction of factory personnel.

Test Modules and Parameters: Some specialized modules and parameters are classified as “test” features and are accessed using this pane. They should only be used by or under the direction of factory personnel.

File Viewer

The File Viewer is a downloaded Java application that is loaded into your PC from the Interactive File Viewer. A brief summary of capabilities follows. Upon launch, the initial File Viewer display looks like this:



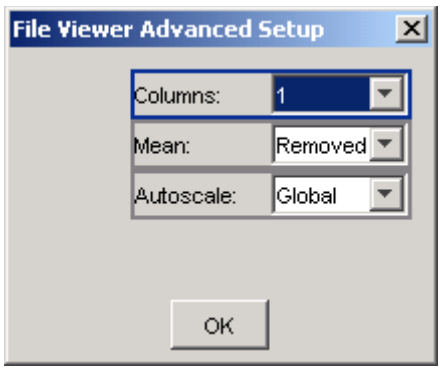
The File Viewer consists of a graphic display area (below), a menu, and a set of toolbar buttons. Left to right, the toolbar buttons are as follows:

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 an ".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:



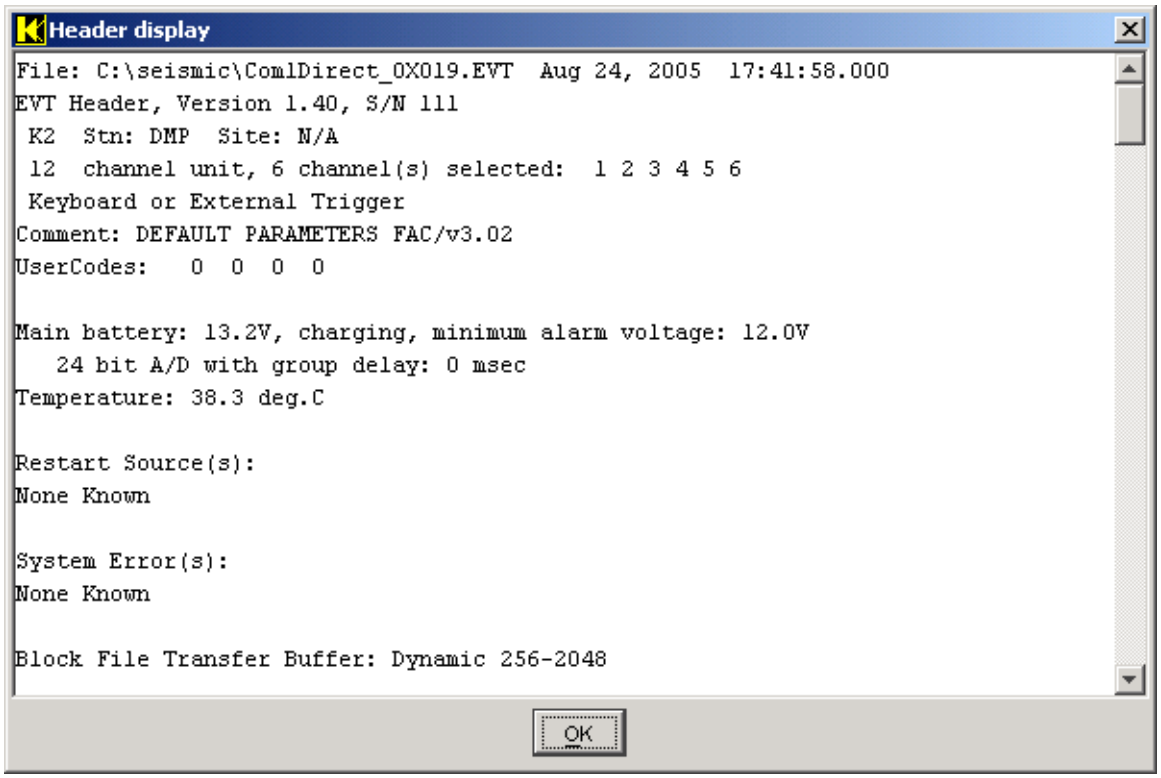
Setup selections include:

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:



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

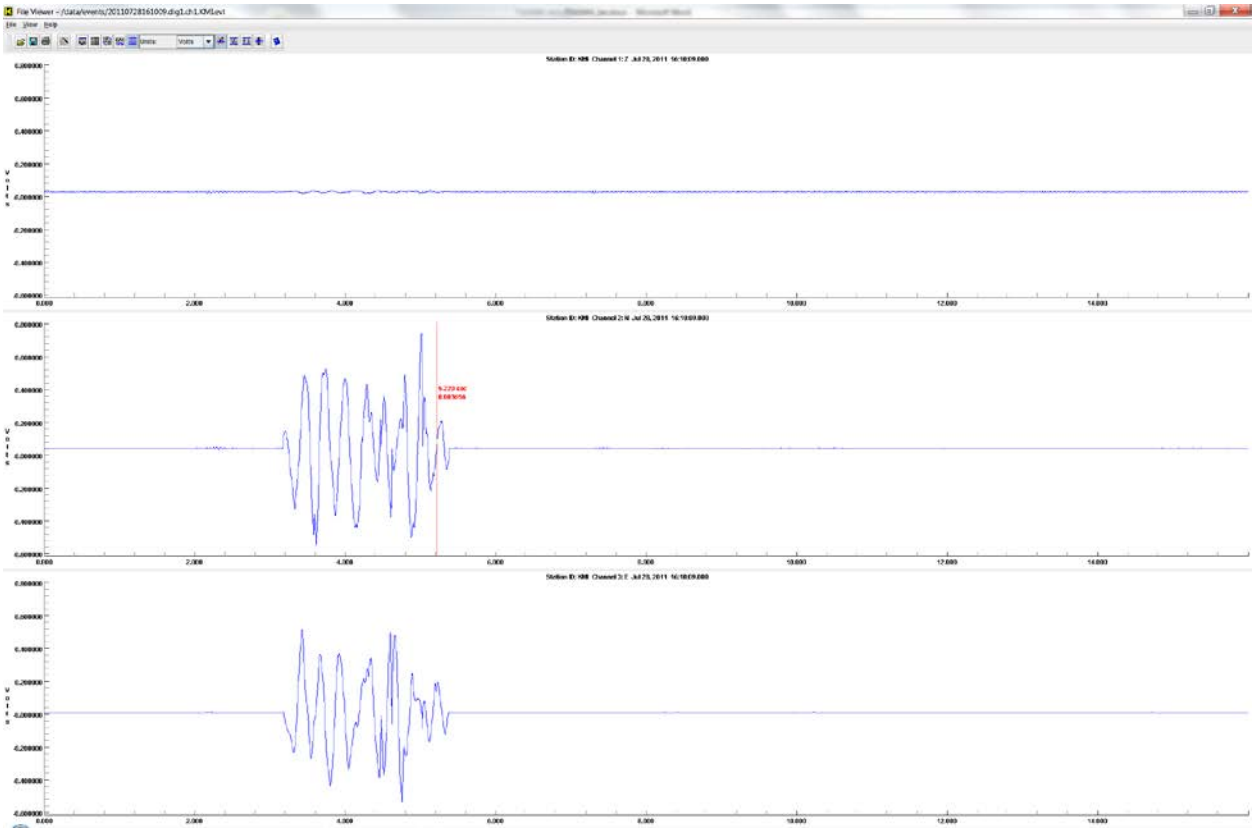
Negative Display – Displays plots as green on black or blue on white.

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/s^2, 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:



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.

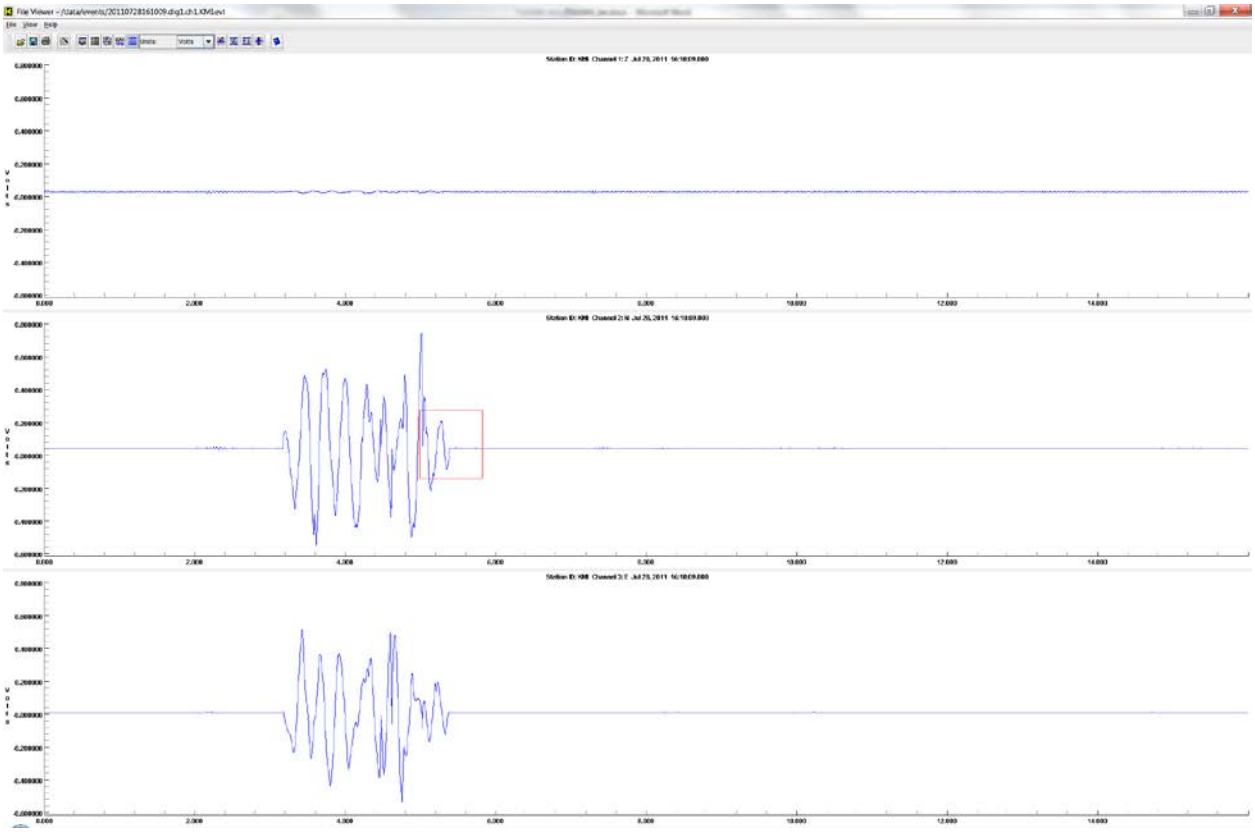
About – Shows the current version of the program.

NOTE: If the Interactive File Viewer won't download large files, see FileViewer and Large Files

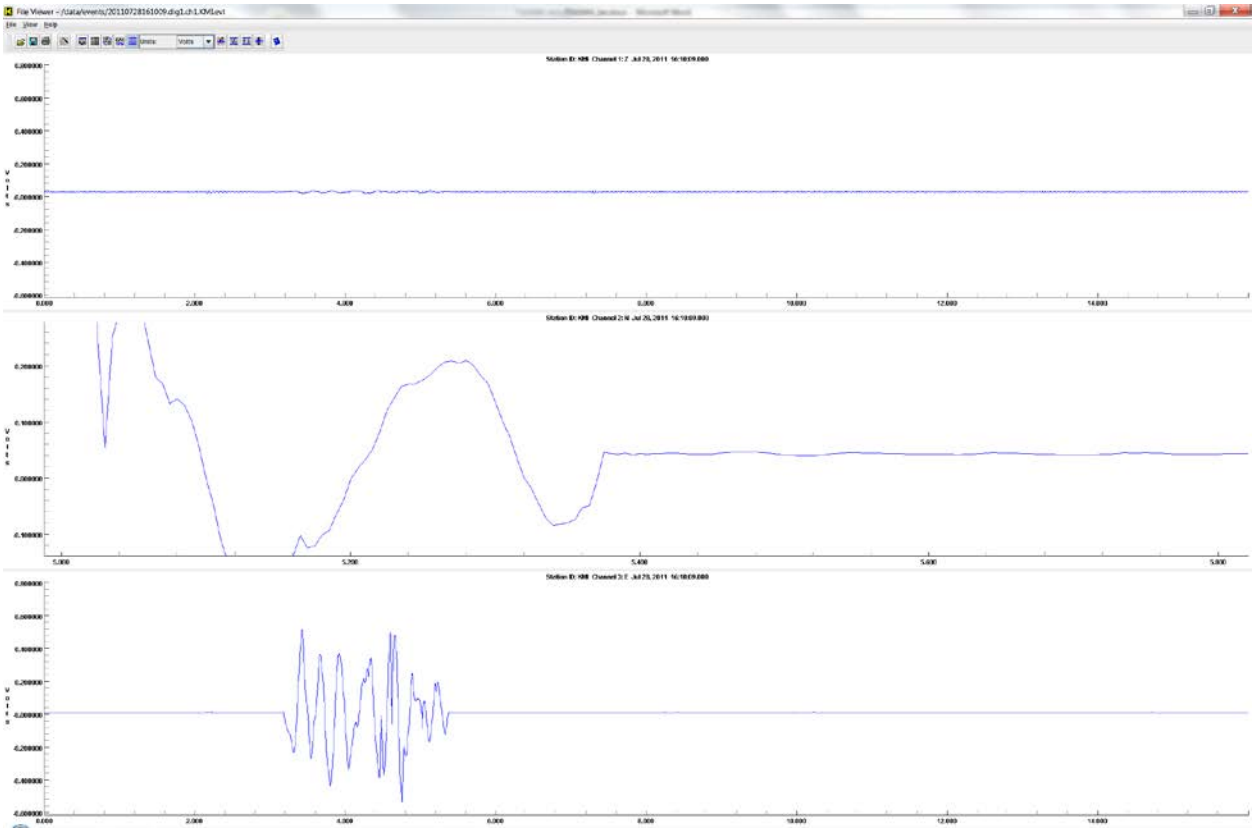
File Viewer Dynamic Operation

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:



Once zoomed, the display will look like this:



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.

NOTE: If the Interactive File Viewer won't download large files, see FileViewer and Large Files

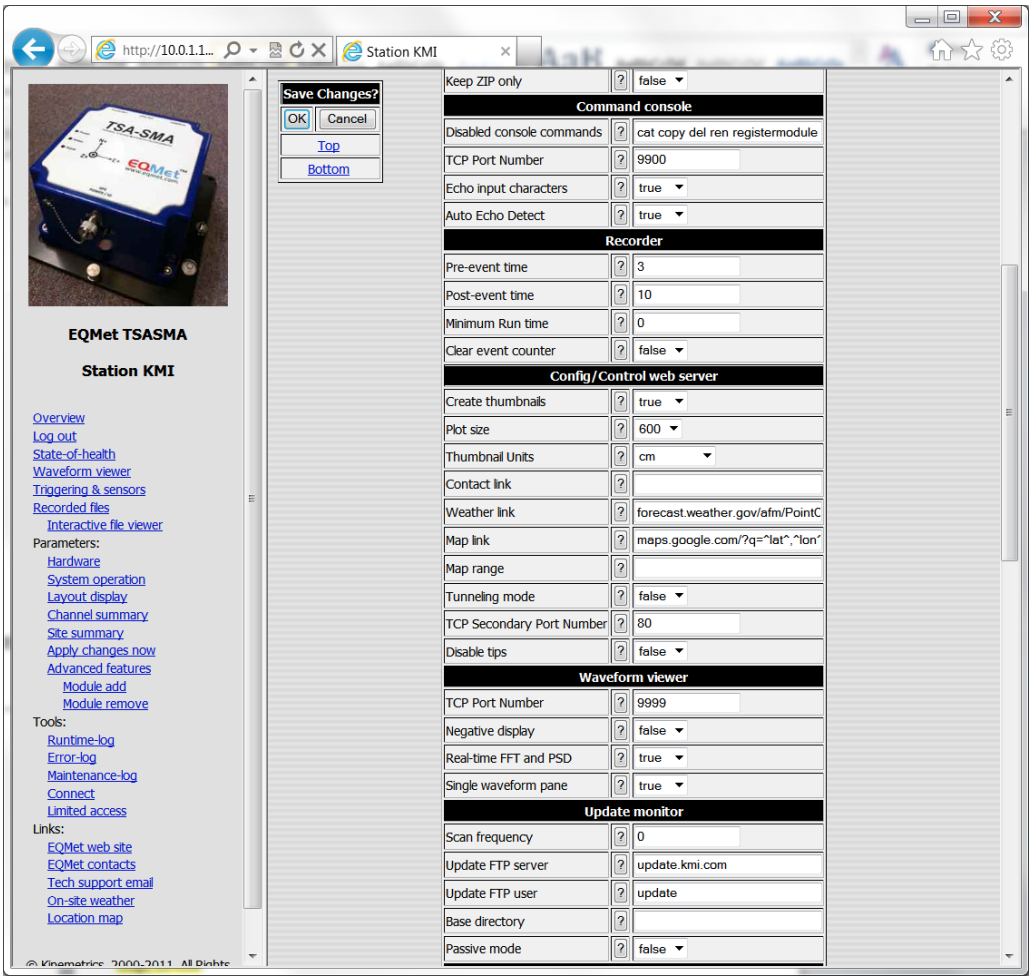
Rockhound Command Console

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

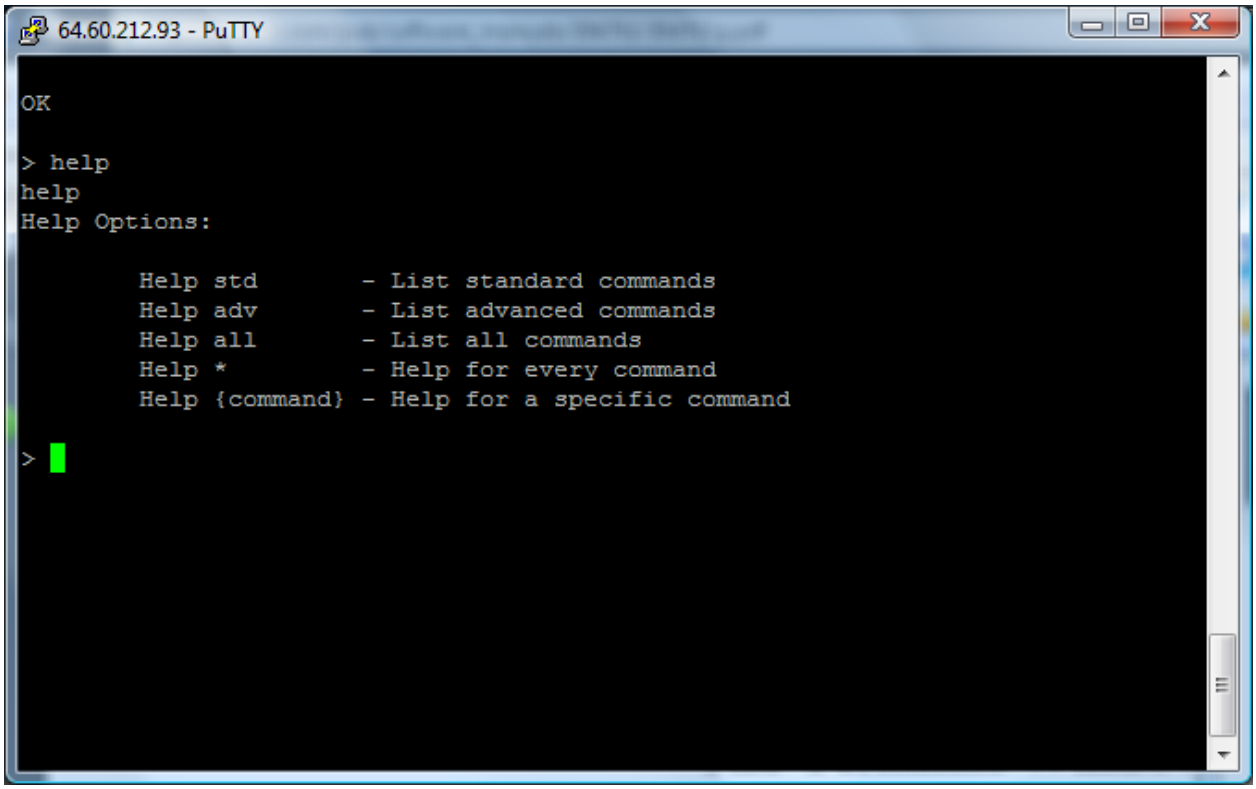
- Through the “Connect” link in the left pane of the web interface. Select “Connect” and then choose “Rockhound Console” from the right pane.
- If you are using RockTalk rather than the web interface, then you can open the Command Console using the “Terminal Window” feature of RockTalk.
- You can also 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.

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:



The Command Console once open will look like this:



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

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

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

EXIT - Exits the console session.
Usage: EXIT

GPS - GPS and Timing control functions.
Usage: GPS STAT: Timing system status
GPS ID: Timing system type and version
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

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

NOISETEST - Performs and reports a main channel noise test.
(intended for factory use only)
Usage: NOISETEST

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]

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

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

STIME - Display the system start time.
Usage: STIME

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

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

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

VMEXIT - Exits the Virtual Machine, restarting...
Usage: VMEXIT

VMGC - Force Garbage Collection in the Virtual Machine.
Usage: VMGC

VMPROPS - Display the Virtual Machine properties.
Usage: VMPROPS

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

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 digitizer.

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 2 minute battery test
> batterytest 120
> ; Wait a bit
> sleep 150
> ; Do a sensor calibration
> snscal
>
Batch file creation complete.
>
```

To run the batch file, type:

```
> run mybatch
```

Non-networked Use

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

To communicate directly between the digitizer and a PC over Ethernet without using any supporting network hardware, you'll connect the digitizer to the PC using an Ethernet crossover cable. Once connected, you should be able to operate the digitizer in its typical networked modes.

In this case, we recommend the following parameters:

Digitizer:

- 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

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

Digitizer:

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

Then issue the command "`initdconfig isc-dhcp-server on`" and reboot the digitizer with the "`reboot`" command.

PC:

- IP address: Automatically assigned

FAQs

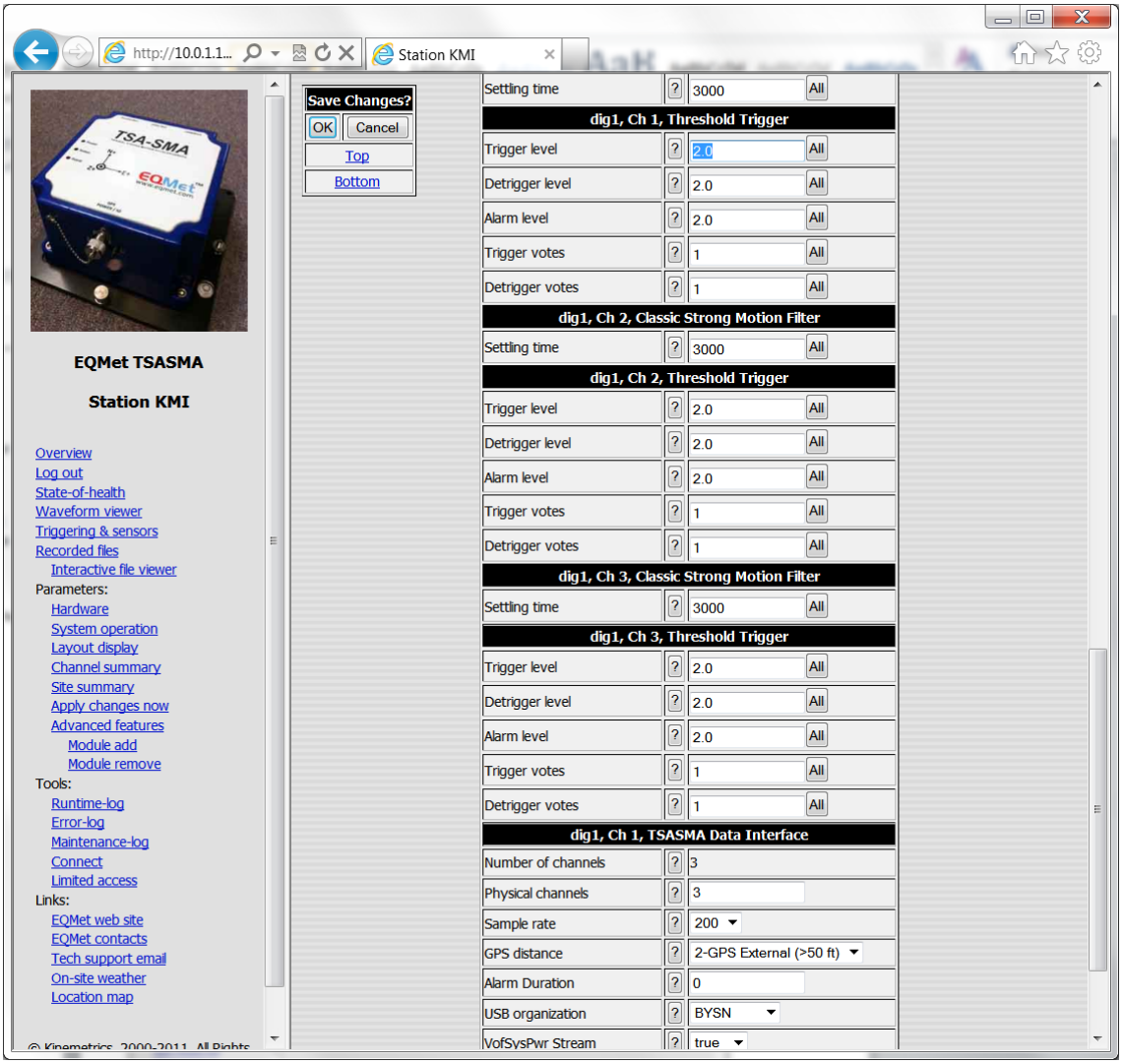
What is "dig1"?

Sometimes in looking at the parameters or other information, you'll see "dig1". This represents the current digitizer (for example, your digitizer). This is used because the general Rockhound software is capable of collecting data from more than one digitizer (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 digitizer. In this case, the digitizer would be "dig1", and a second digitizer would be "dig2".

Changing trigger levels

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



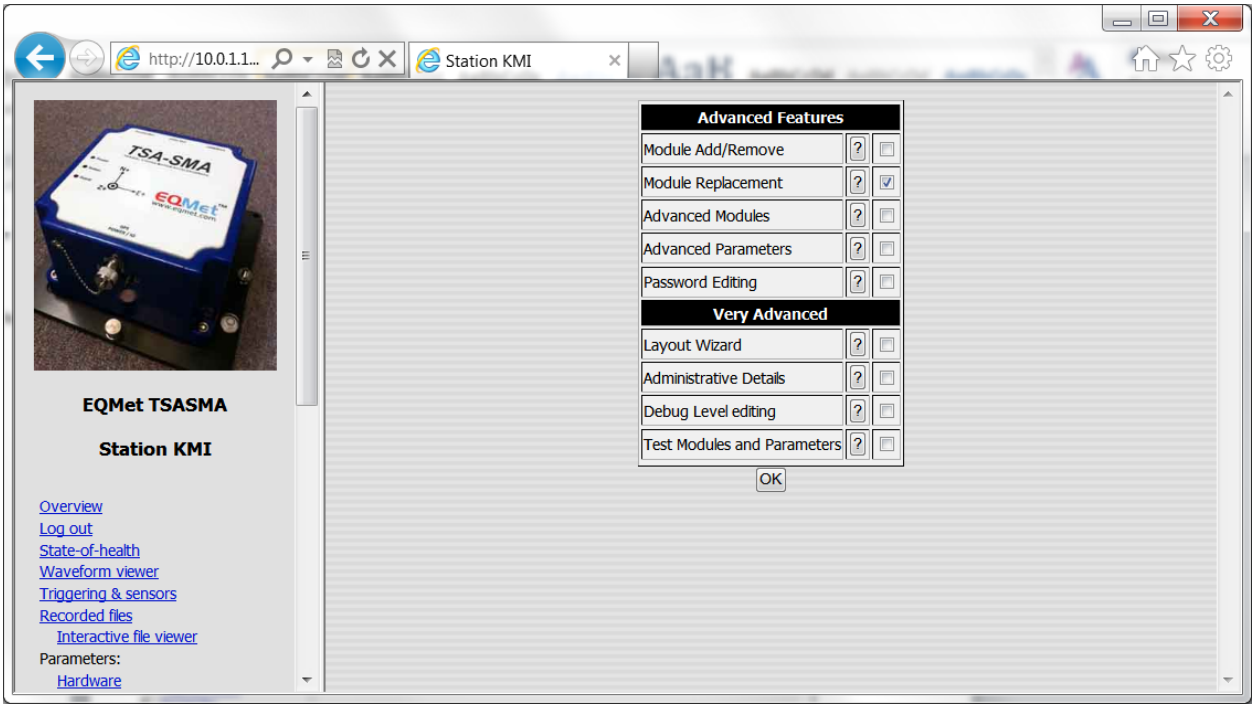
Trigger levels are the level at which the system will decide that a channel is triggered and that it should contribute that channel's votes toward triggering the entire system. By default, the system uses threshold triggers, which are set as a percentage of full scale. So if your full scale range is +/-20V and your threshold is set to 2%, then your trigger level is 2% of 20V, or 0.4V.

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

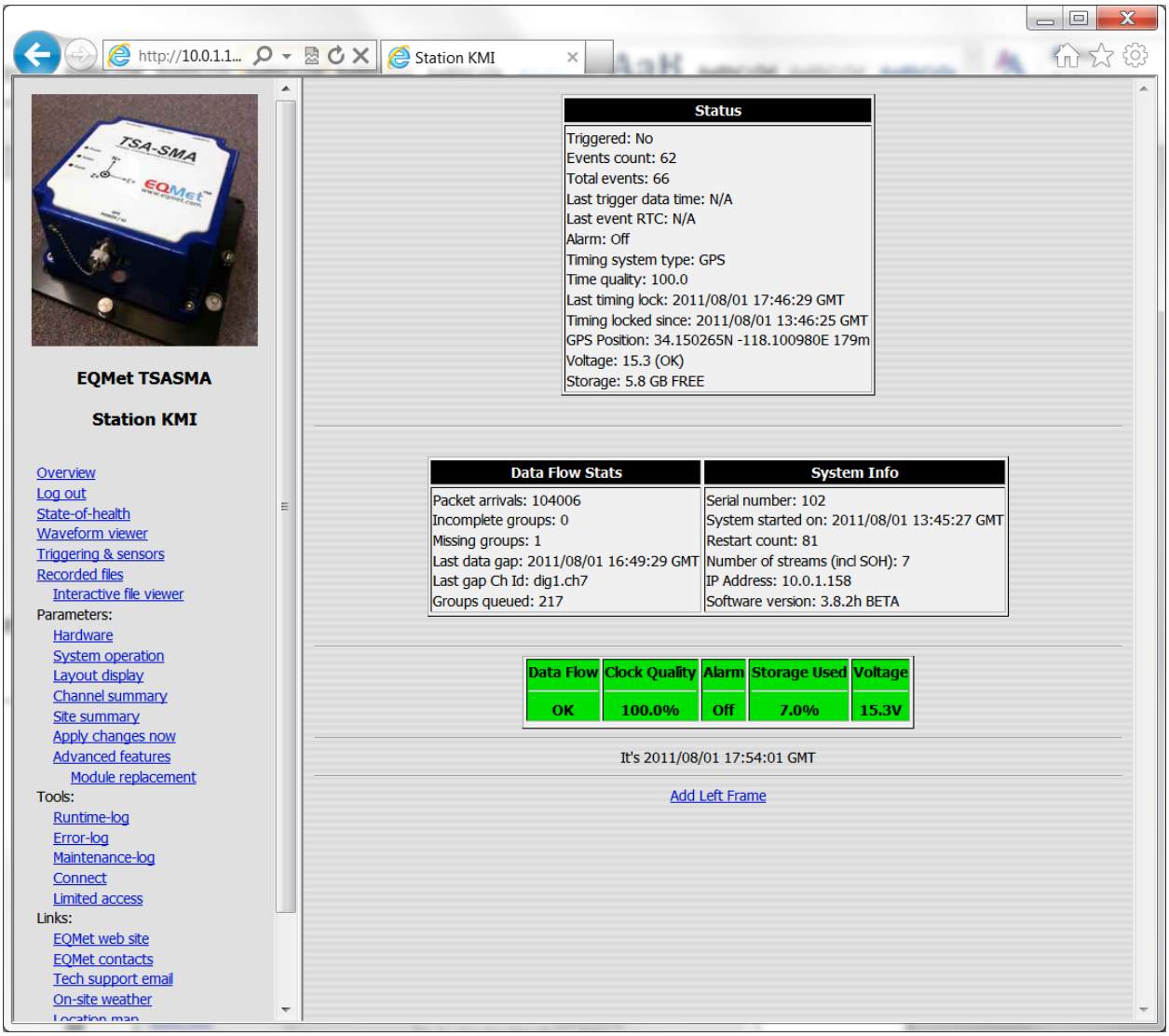
Once you have completed your parameter changes, activate the completed parameter changes by selecting "Apply Changes Now" from the left pane of the display.

Using Different Triggers or Trigger Filters

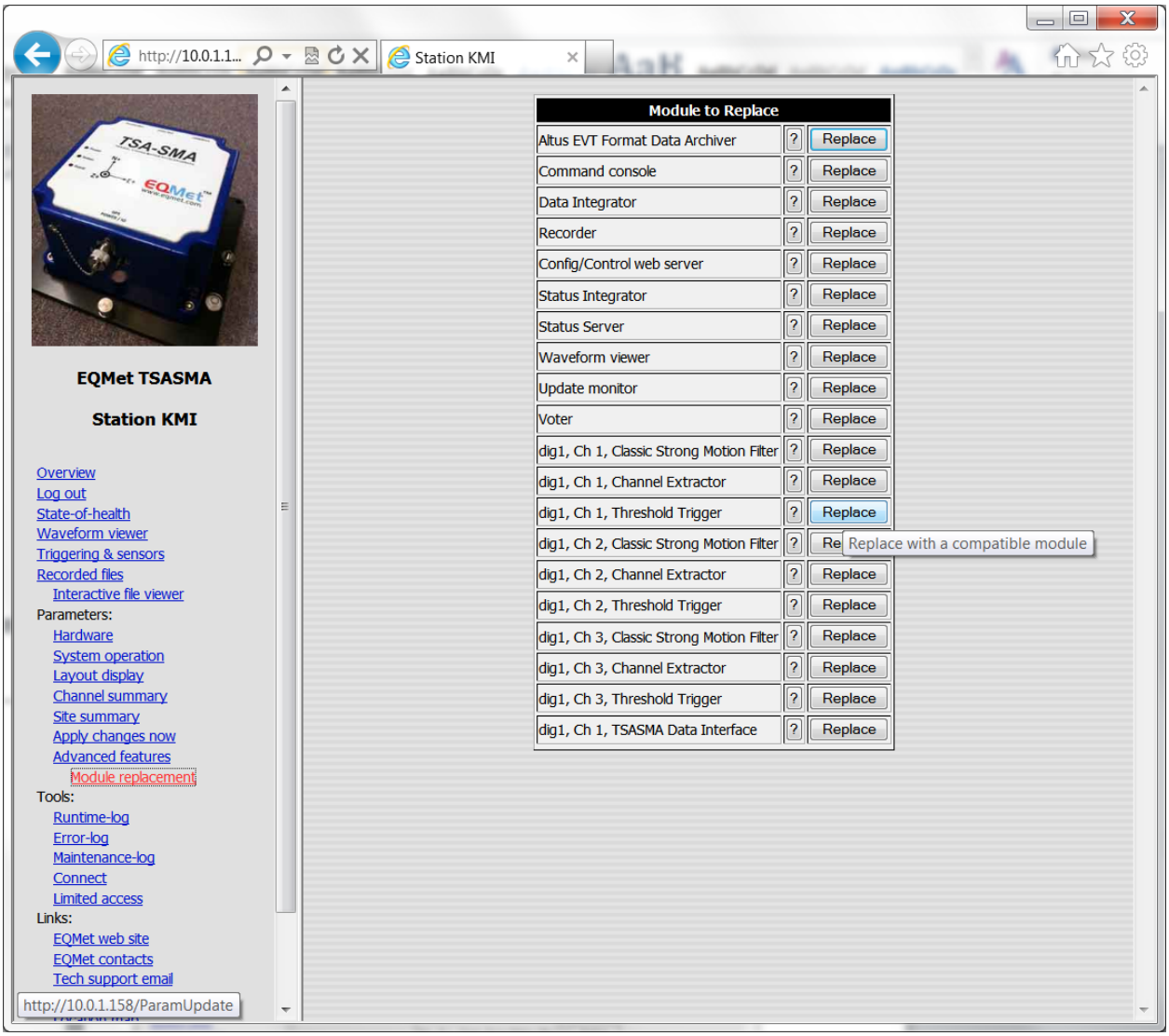
To use a different type of trigger (e.g. an STA/LTA trigger rather than a Threshold Trigger), or to use a different trigger filter (e.g. an IIR Filter rather than the Classic Strong Motion Filter), you need to replace the corresponding modules in the layout. Note that you can select different triggers 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 Advanced Features from the left side of the display. Select Module Replacement and click OK:



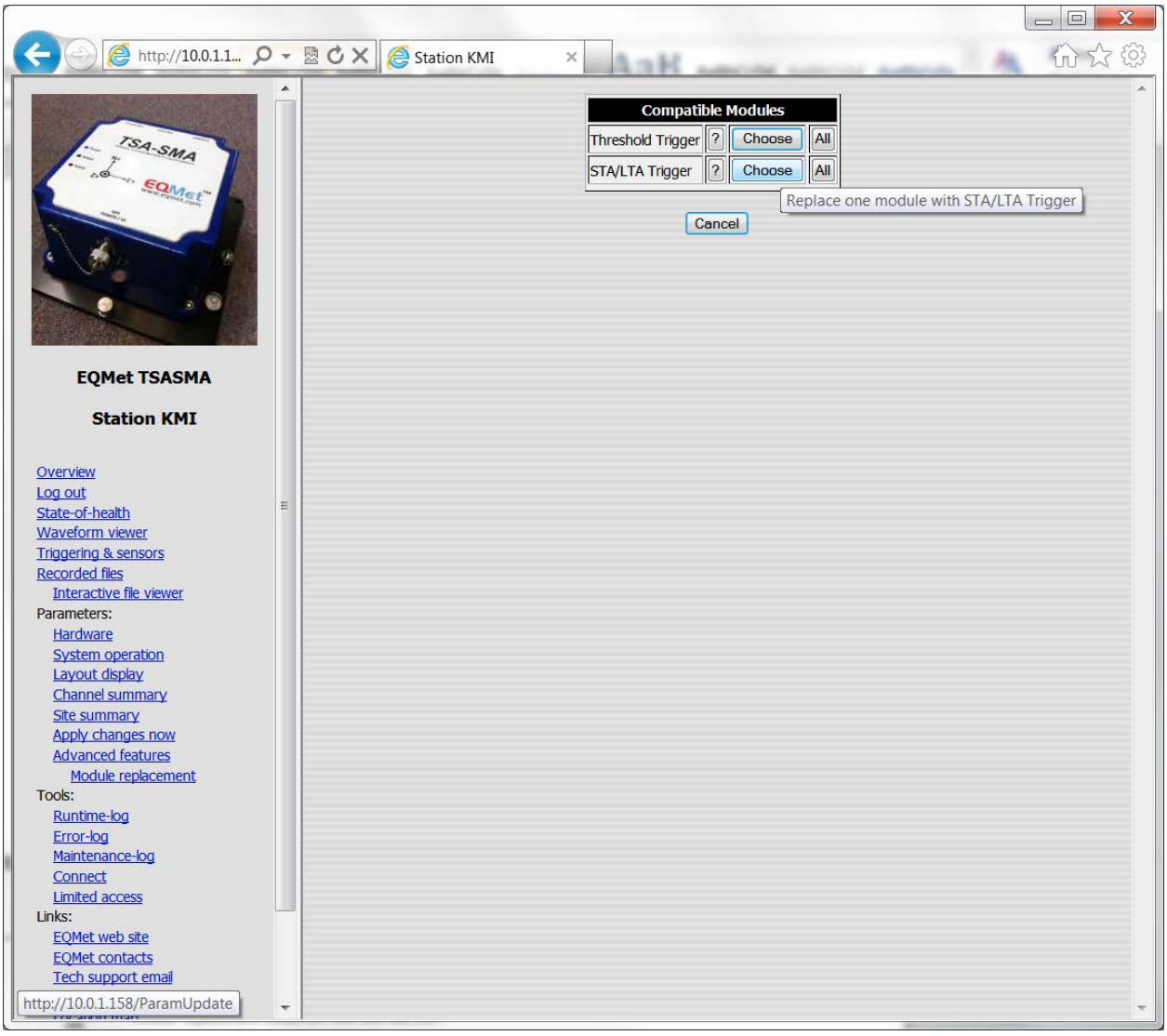
On the left pane of the screen, Module Replacement will now be an option below Advanced Features:



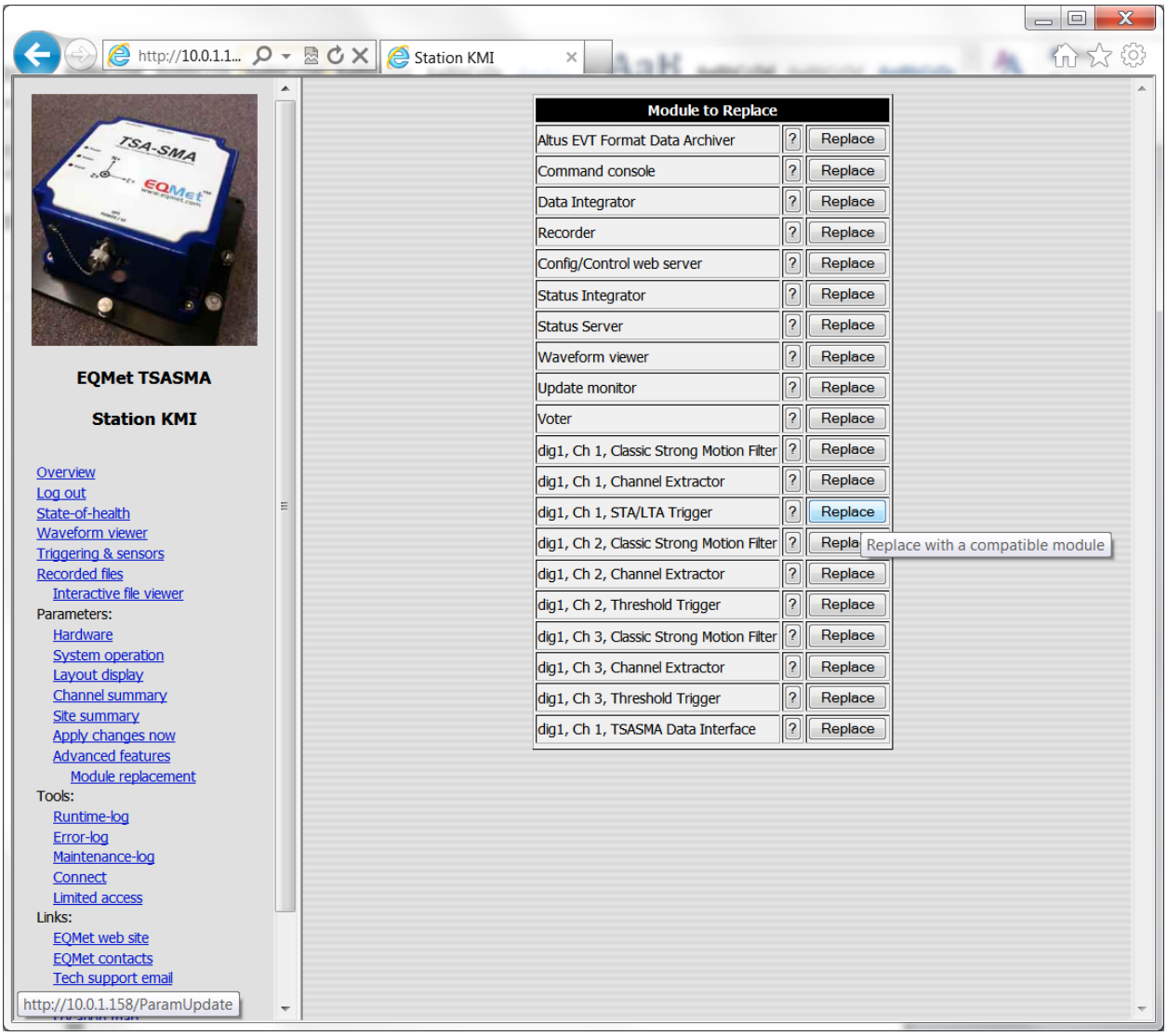
Click Module Replacement and you'll see:



Click “Replace” for the Channel 3 Threshold Trigger and you’ll see your choices:



If you select “Choose” next to STA/LTA, then you’ll replace the Threshold Trigger for channel 3 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:



Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes Now” from the left pane of the display.

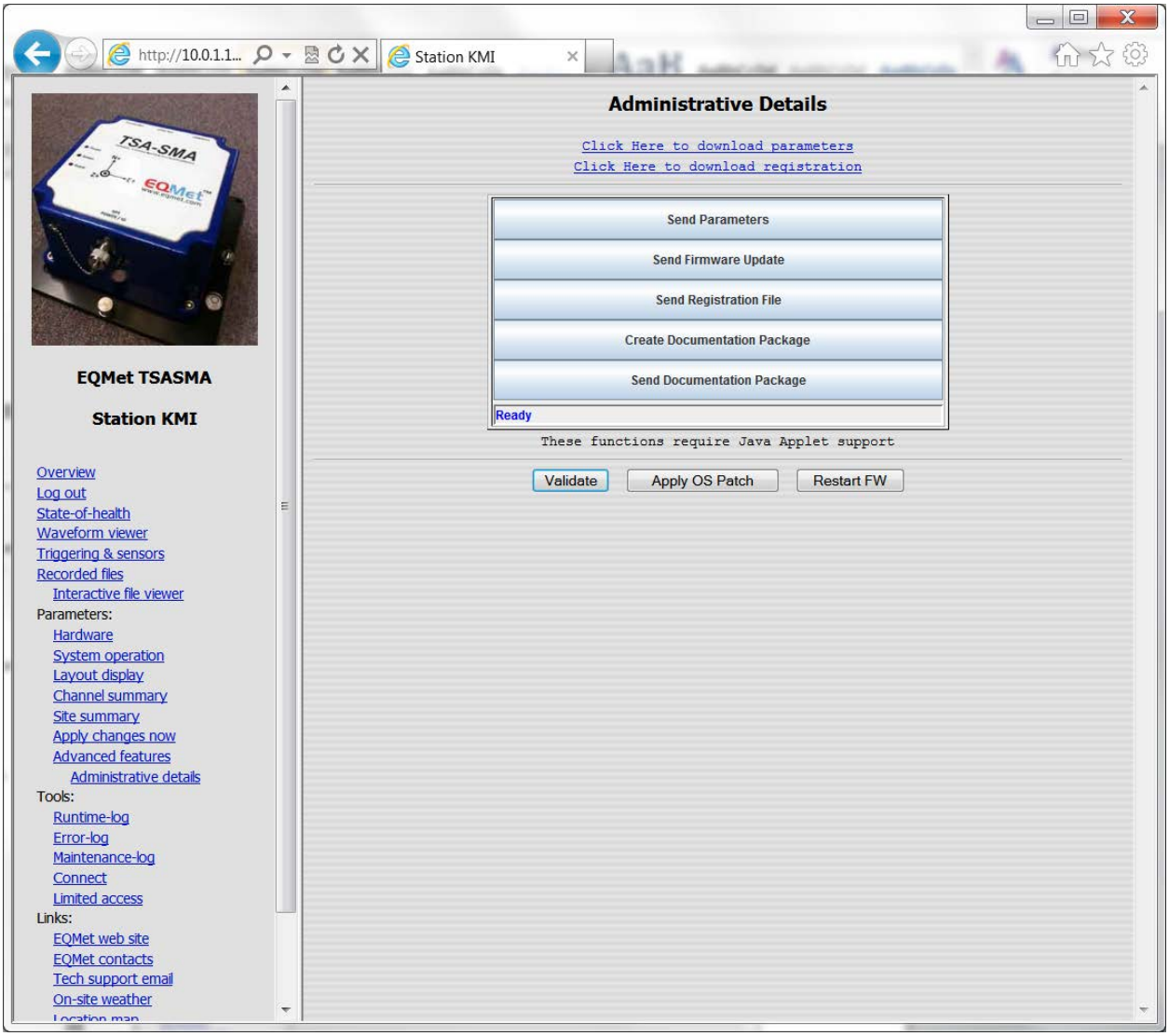
Switching Between Layouts

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 use the Advanced Features function Administrative Details, download and save a copy of the parameters. At the top of the Administrative Details screen, there is a link “Click Here to download parameters”. You can give this file you are saving a name that is meaningful to you such as “event-recorder-at-100sps.jar”.

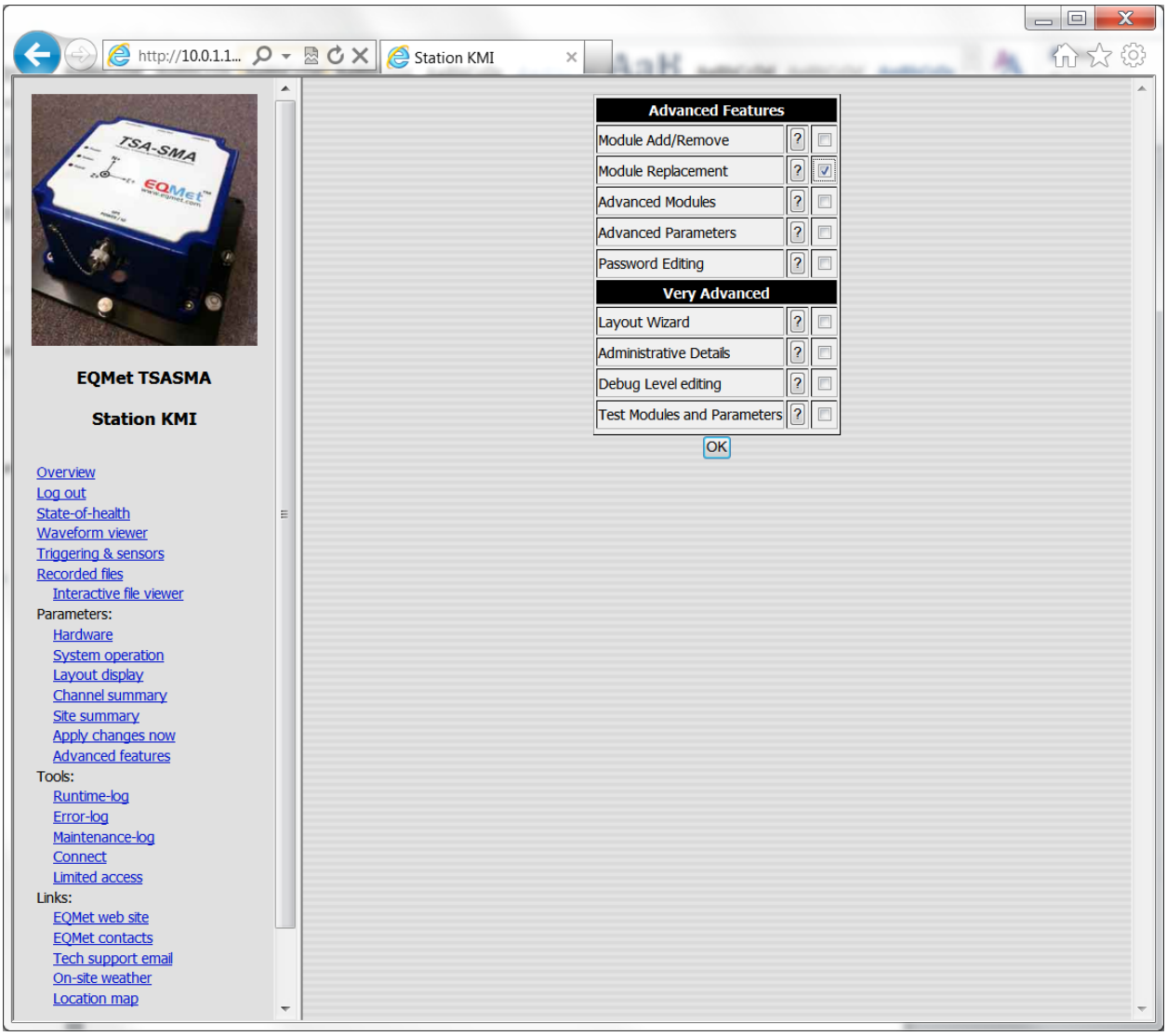
Repeat this process with as many system configurations as you need.

To put a layout that you’ve saved back on the system, use the web interface via the Advanced Features function Administrative Details. Select the function “Send Parameters”, and then select the file to send and after it is sent, press “Validate”:

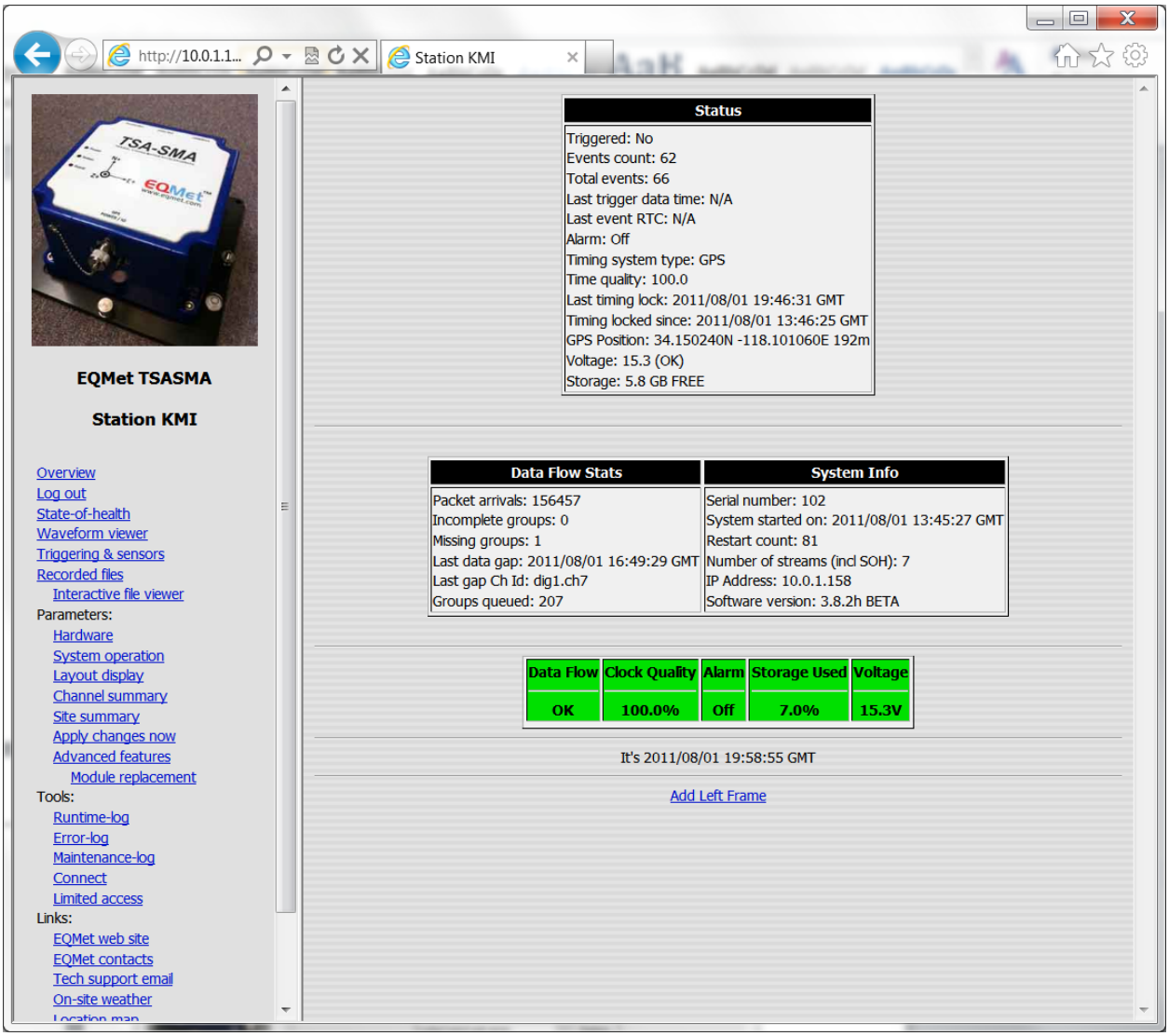


Changing Output Data Formats

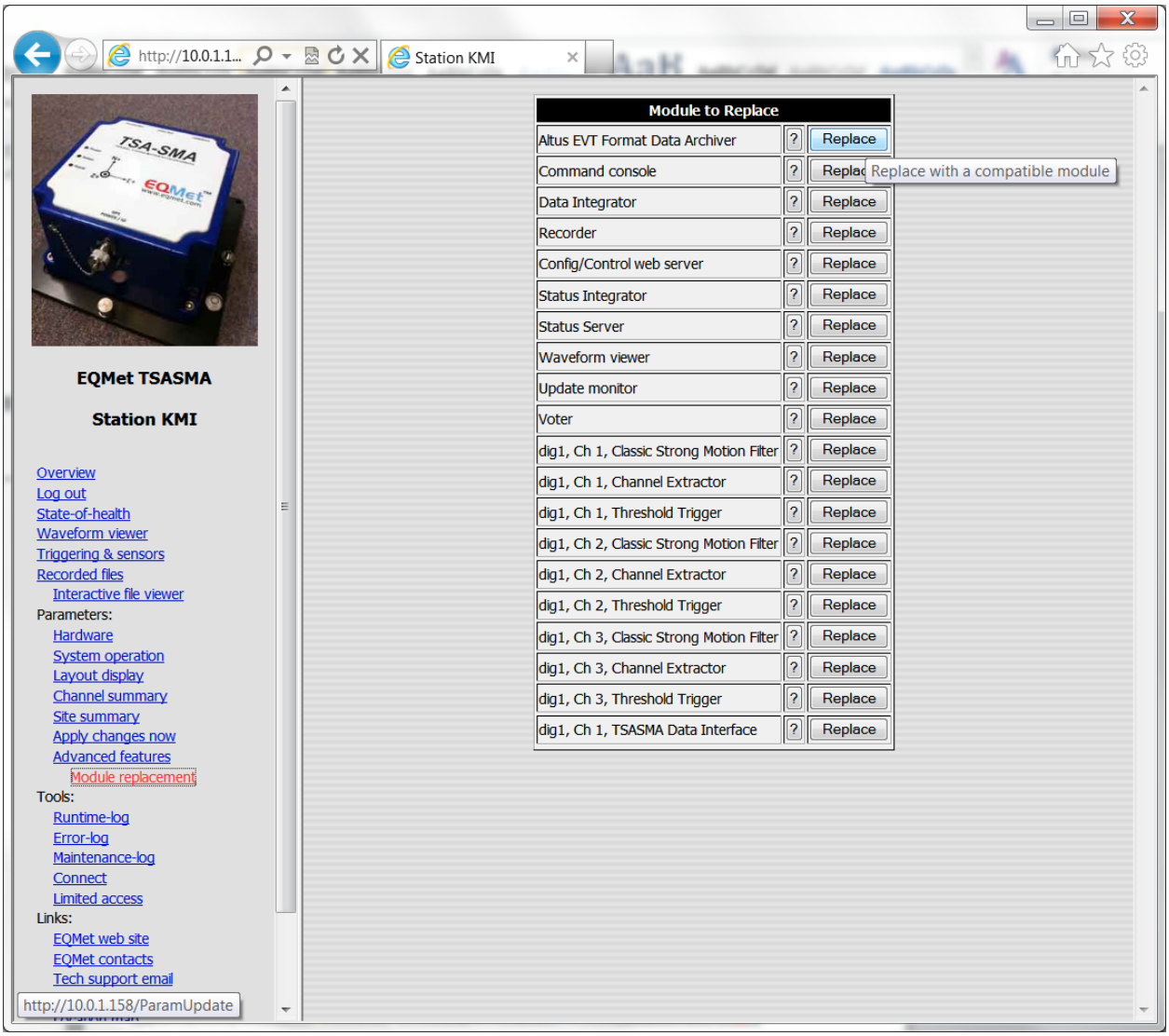
The Rockhound-based digitizers do not require you to use a single data format. They are not, for example restricted to creation of just EVT files, or just MiniSEED, or any other single format. To use a different data format for created files than that currently configured, you need to replace the corresponding 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 Advanced Features from the left side of the display. Select Module Replacement and click OK:



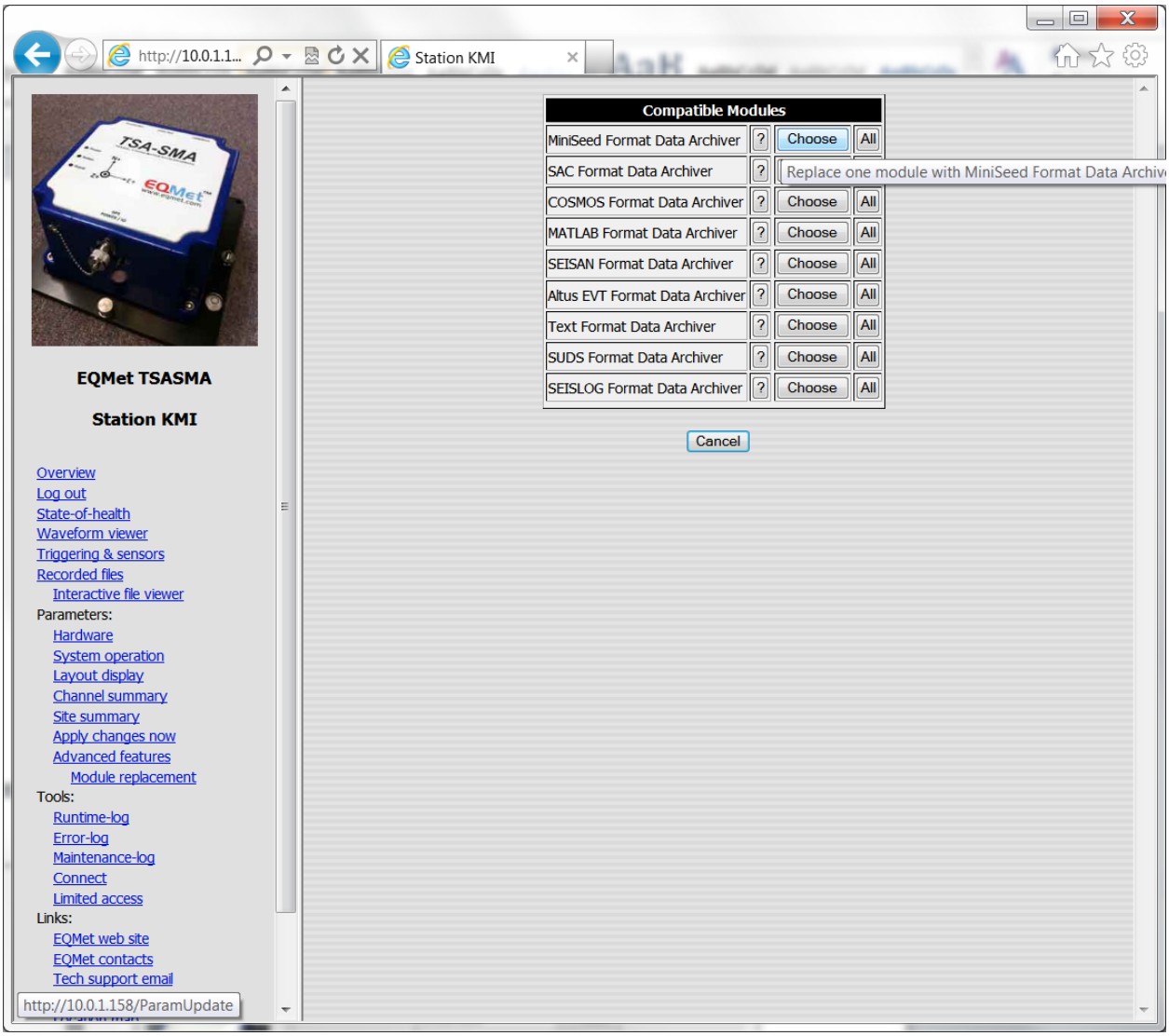
On the left pane of the screen, Module Replacement will now be an option below Advanced Features:



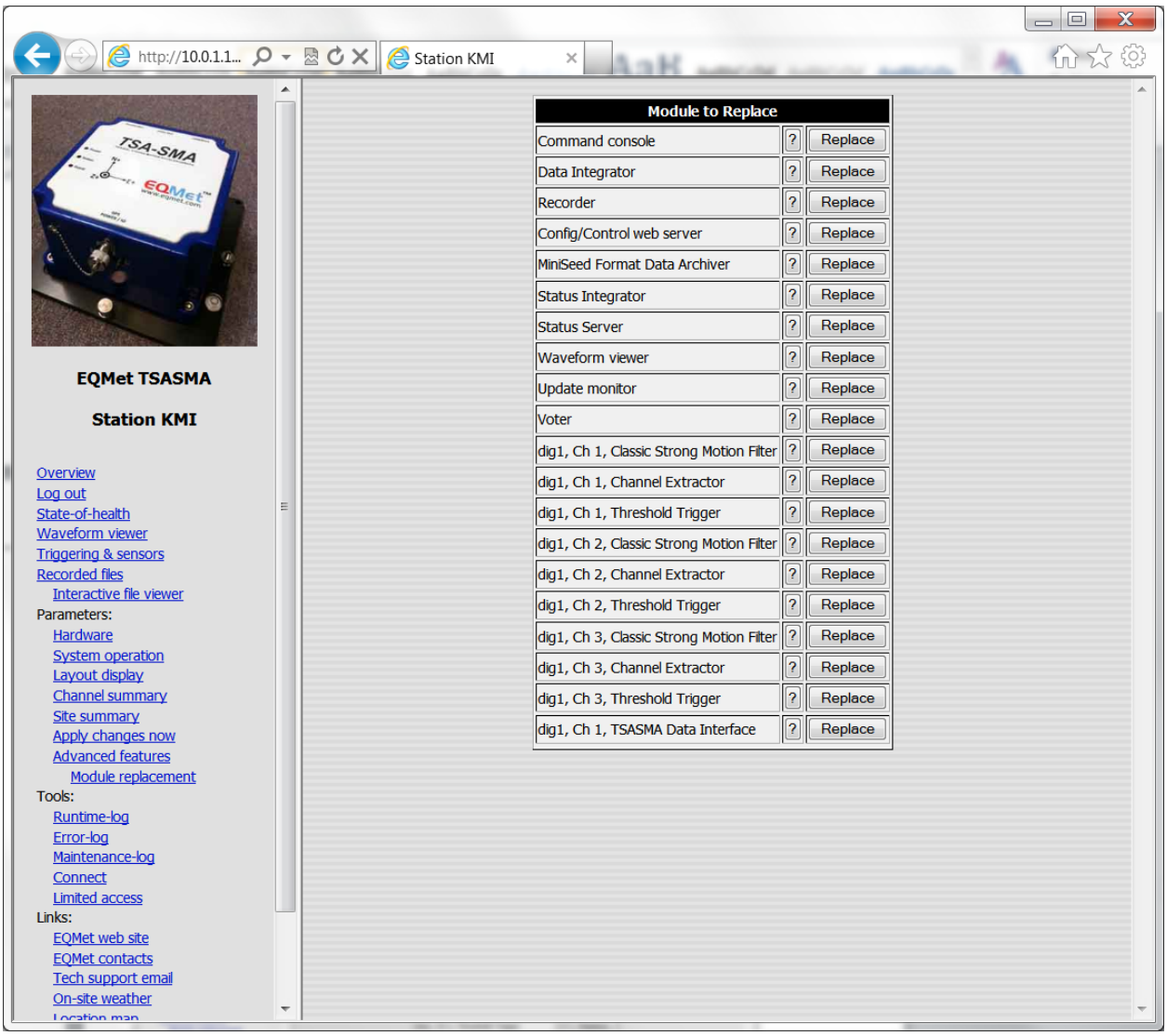
Click Module Replacement and you'll see:



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



Once you have completed your parameter changes, activate the completed parameter changes by selecting “Apply Changes Now” from the left pane of the display.

Timed Recording

Timed recording is done by triggering the system using an Alarm Clock module.

The module reads a set of configured times that will cause an action to occur at specified times according to Days of the Week, Days of the Month, Times of Day, or Alarm minute interval parameters.

When an alarm clock is triggered, the Alarm Clock's "Alarm message" parameter will be sent to the system just as if it had been typed in by the user at the Rockhound Console.

Parameters used are:

" Days of the Week " - Space separated days of the week (M T W TH F SA SU)

" Days of the Month " - Space separated days of the month (1 2 3 ... 31)

" Times of Day " - Space separated times of day (2:15 15:54)

" Alarm minute interval " - Minute interval between alarm actions. If used alone, one alarm action will be generated immediately (assuming no conflict with the Days of the Week or Days of the Month parameters), and the next one generated the number of minutes specified from the current time.

" Alarm message " - Message to be sent when the alarm clock triggers. This message should be specified as a command, such as "KBTRI 600".

NOTE: Alarm minute interval parameter is not limited to small numbers. For example, it could be used to indicate alarm actions every 5 minutes, 360 minutes (6 hours), or 129600 minutes (90 days).

NOTE: If Alarm minute interval is used in conjunction with the Times of Day parameter, indicates minute intervals relative to the first Times of Day parameter, which will act as the base time. In this case, once the base time is set, the Times of Day parameters will be overridden and ignored.

Examples:

To record 10 minutes of data every 3 days at 2:16 pm:

Times of Day =14:16

Alarm minute interval =4320

Alarm message =KBTRI 600

To record 10 minutes of data every Monday and Friday at 8:00 am:

Times of Day =8:00

Days of the Week =M F

Alarm message = KBTRI 600

To record 10 minutes of data once an hour on the hour:

Times of Day =12:00

Alarm minute interval =60

Alarm message = KBTRI 600

To record 10 minutes of data on the first and 15th of the month at 8:00 am:

Days of the Month =1 15

Times of Day =8:00

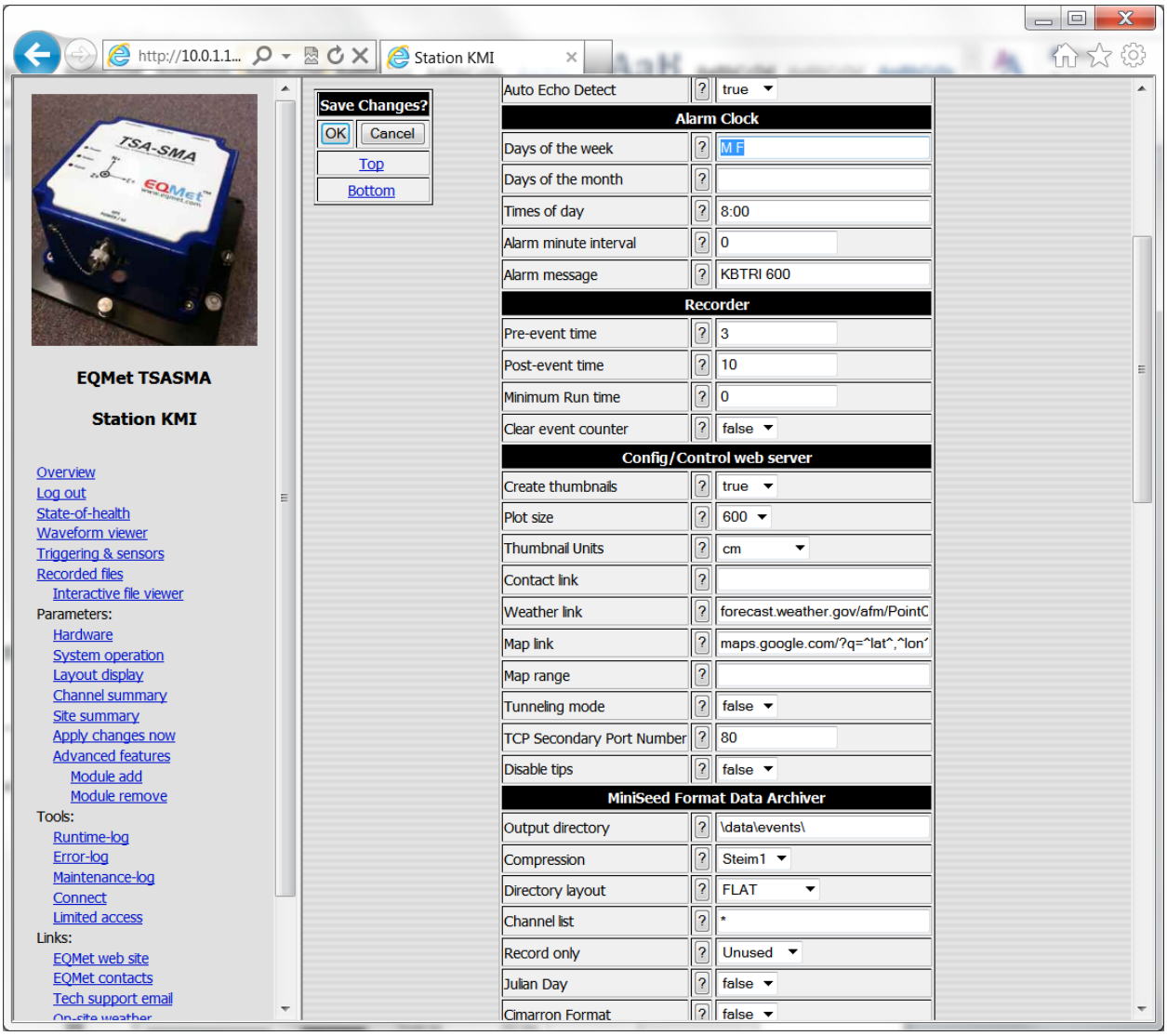
Alarm message = KBTRI 600

To do timed recording for 60 seconds at 8:00 am and 2:00pm every day:

Times of Day =8:00 14:00

Alarm message =KBTRI 60

See the section Adding Modules for the procedure on how to add a new module into the system. Once added to the system, the parameters for the Alarm Clock module can be found in the System Operation parameters and can be edited as shown here:



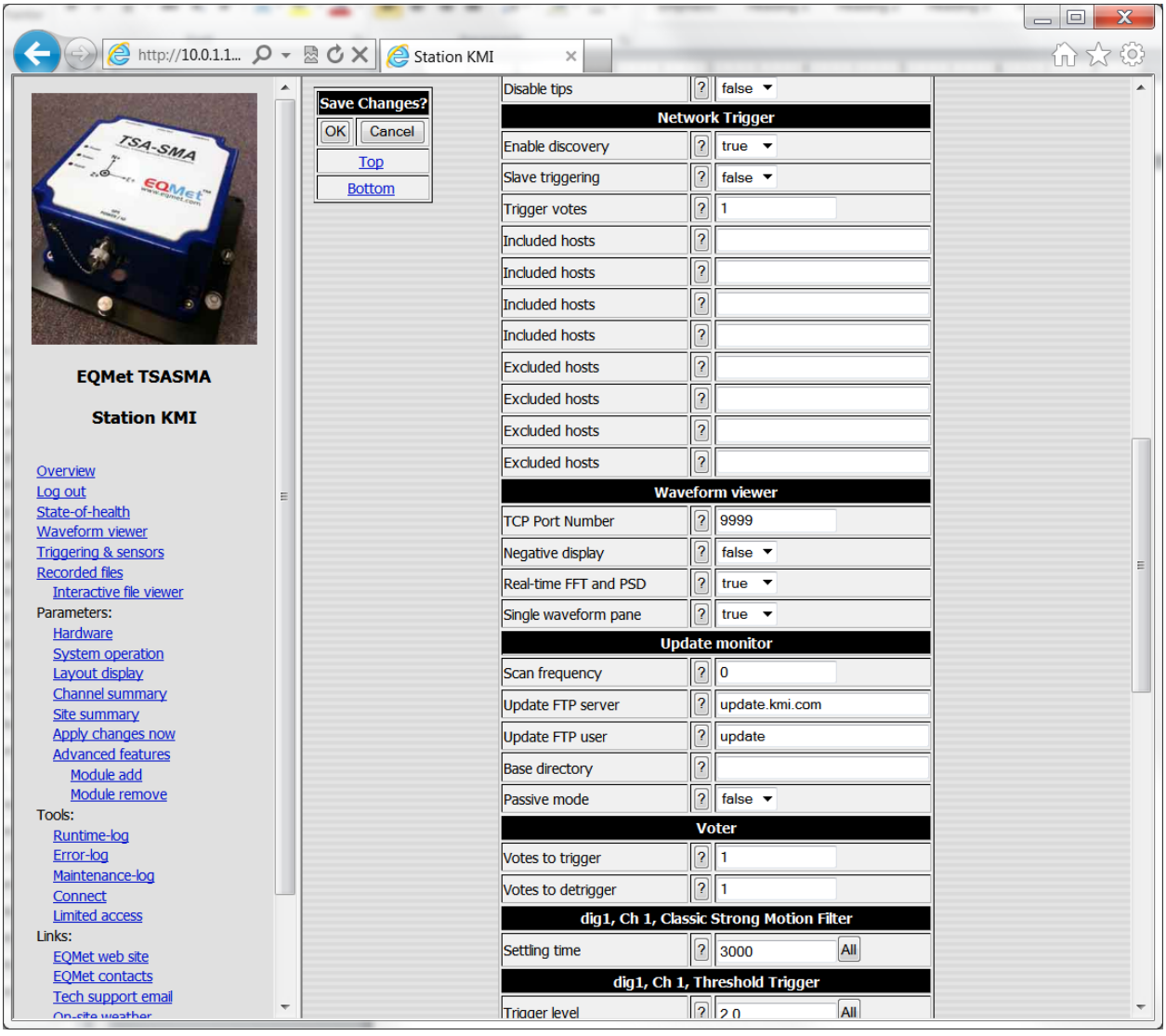
Remember that multiple Alarm Clock modules may be added to the system to record at different times.

Network Triggering

The TSA-SMA digitizers' 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 TSA-SMA digitizer event recorder configuration includes 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 in System Operation:



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

Without making any further edits, TSA-SMA digitizers 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.

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.
- The Altus-style Serial Data Streams (SDS) protocol is supported through the Altus Emulation modules.
- The low-latency DFS telemetry stream is supported through an optional DFS telemetry option board for channels 1 through 4.

Advanced Operation

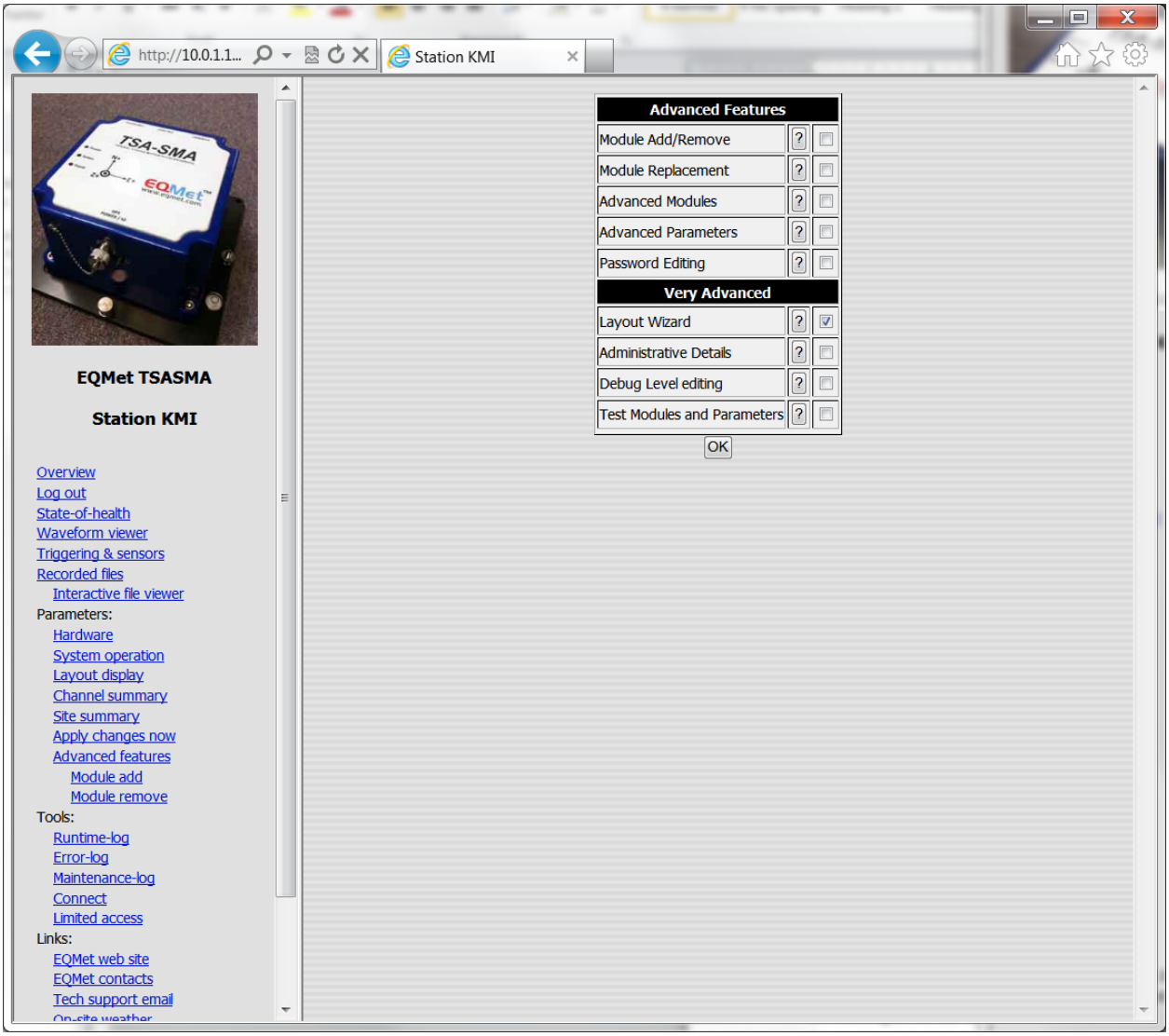
The Rockhound software provides for several advanced features that allow the user to add, remove and replace modules, allow access to advanced and/or test mode parameters, allow for initial layout creation and other special capabilities.

Layout Wizard

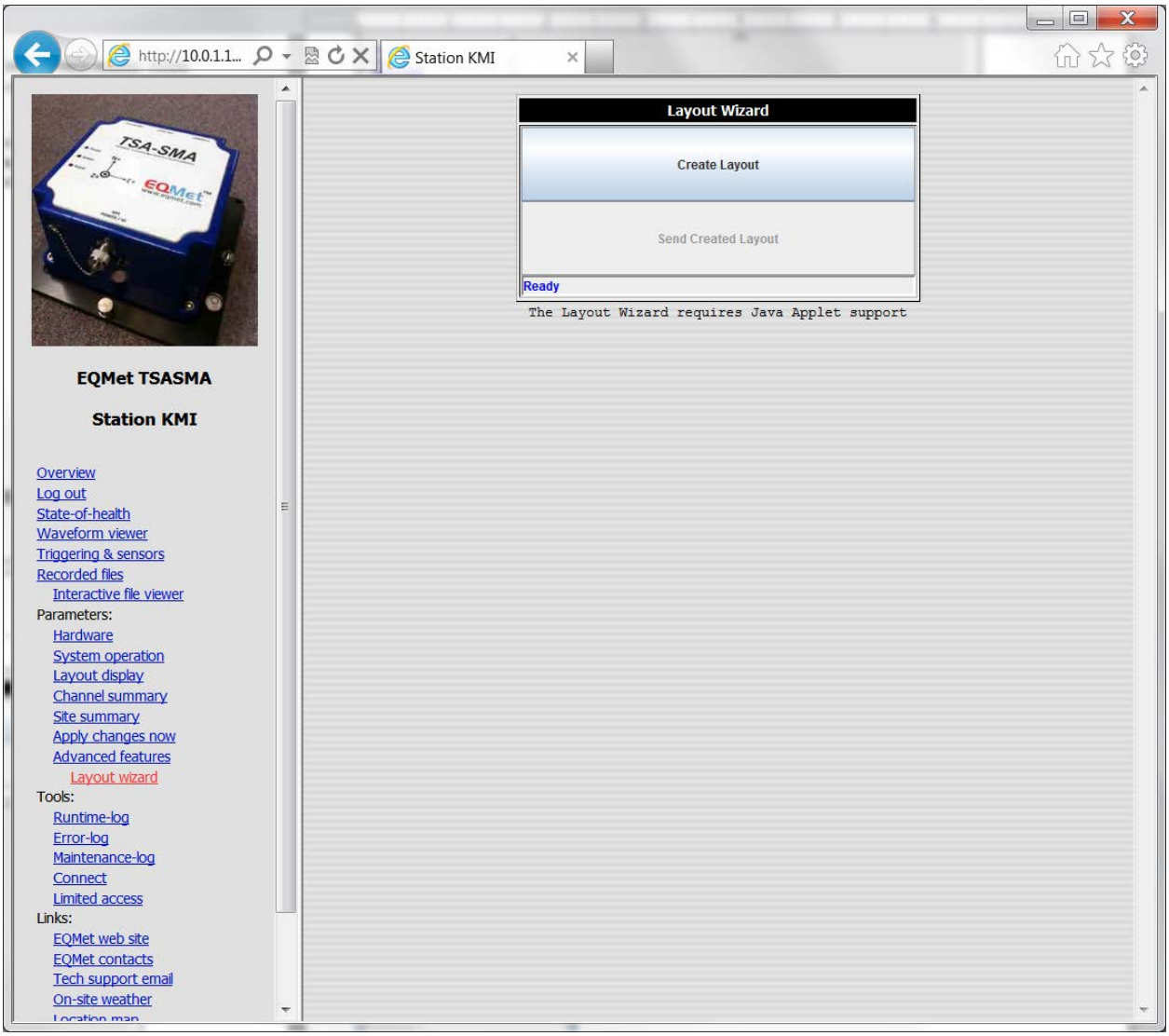
The Layout Wizard allows you to create a completely new layout for your system. During this process, you can define the source of the data (on a TSA-SMA Digitizer, the source will be a TSA-SMA Data Interface), as well as defining the types of triggers, output formats, and so on.

In the example here we'll create a 12 channel event recorder and add the Network Triggering.

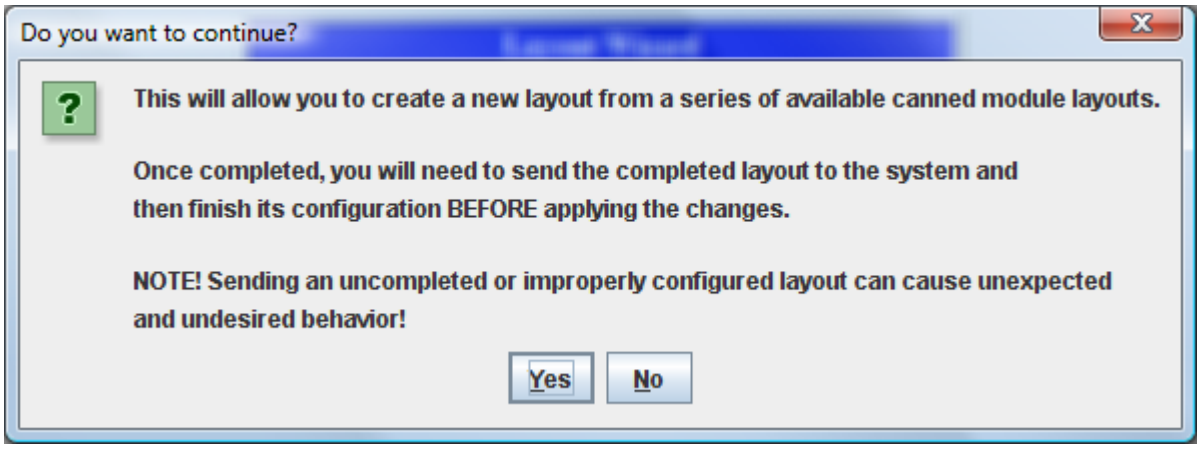
To start, choose Advanced Features and select "Layout Wizard":



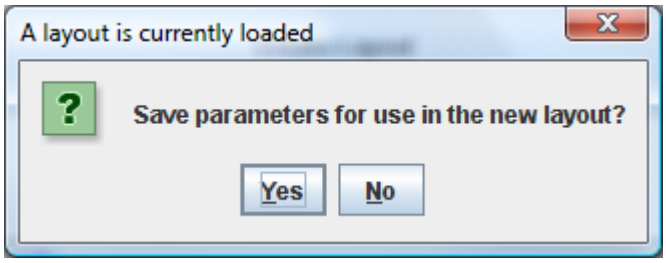
Then from the left pane, choose Layout Wizard, and then select “Create Layout”:



You’ll get the following warning:

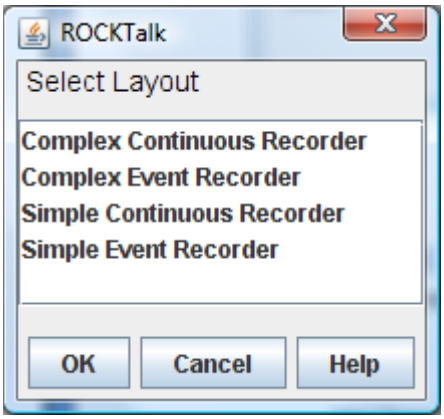


Once you select “Yes”, you’ll be asked if you want to save any parameters possible from the existing layout. Your answer depends on how close the layout is expected to be to the current one. In this case we’ll select “Yes”:

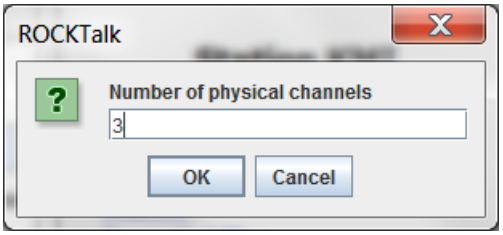


NOTE: If the Layout Wizard does not download files, it may be that port 80 access is restricted by your Anti-Virus software. See Web Server’s Layout Wizard Doesn’t Transmit Files

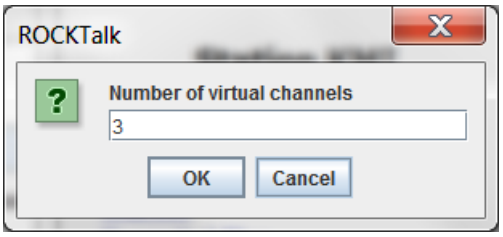
First question about the new layout is to choose the basic type of layout. There are four basic types: Simple (only one data source), Complex (more than one data source), Event Recorder (triggered recording), or Continuous Recording (no triggering). To record event data on a TSA-SMA Digitizer, select “Simple Event Recorder”:



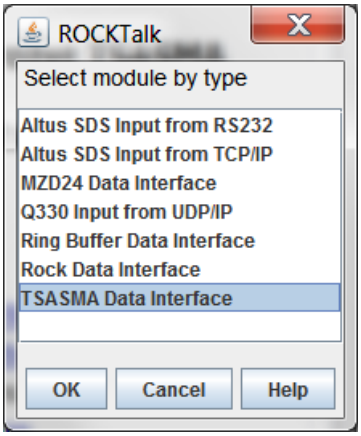
Next, specify the number of physical channels (actual hardware channels):



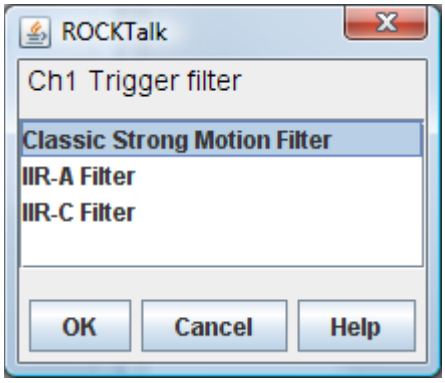
Next select the number of virtual channels. To record 3 channels as a single sample rate, select 3:



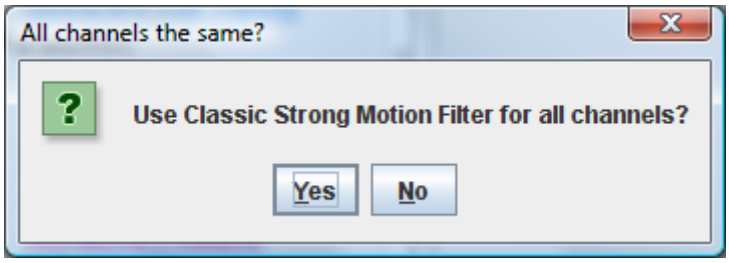
Select the data source, in this case a TSA-SMA Data Interface:



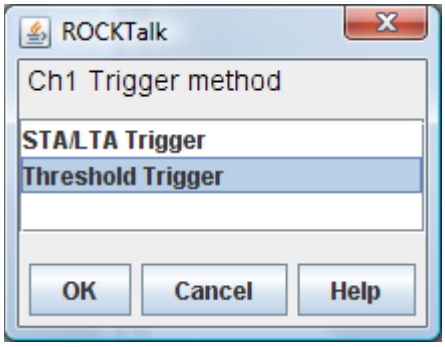
Select the type of trigger filter:



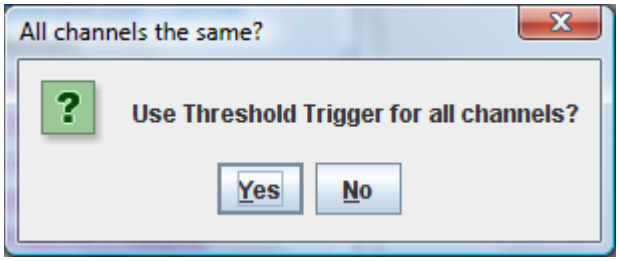
You'll now be asked if you want to use the same type of filter on all channels. If so, select "Yes" and you can avoid the next 2 questions about filters. If you select "No", you'll have to choose the filter for each of the 3 channels:



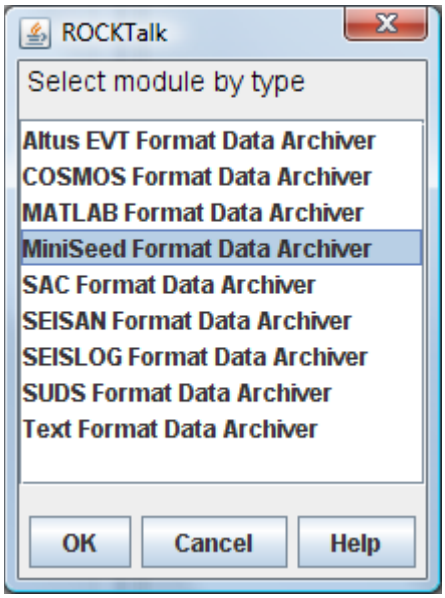
Choose the type of trigger used:



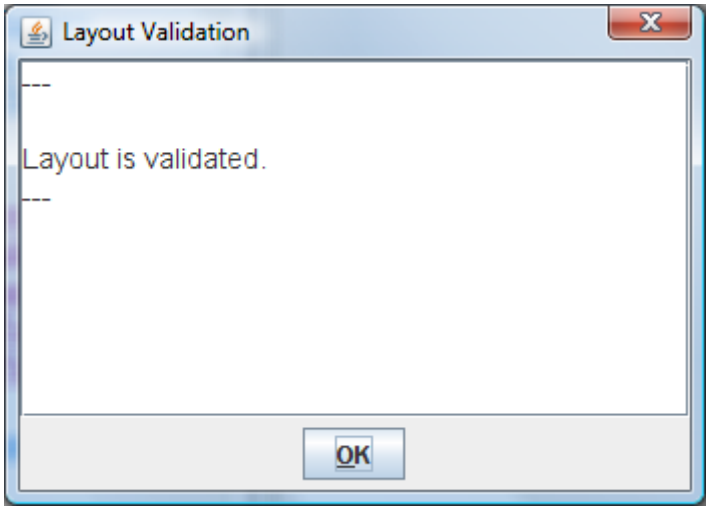
Again, you'll be asked if all channels will use the same type of trigger:



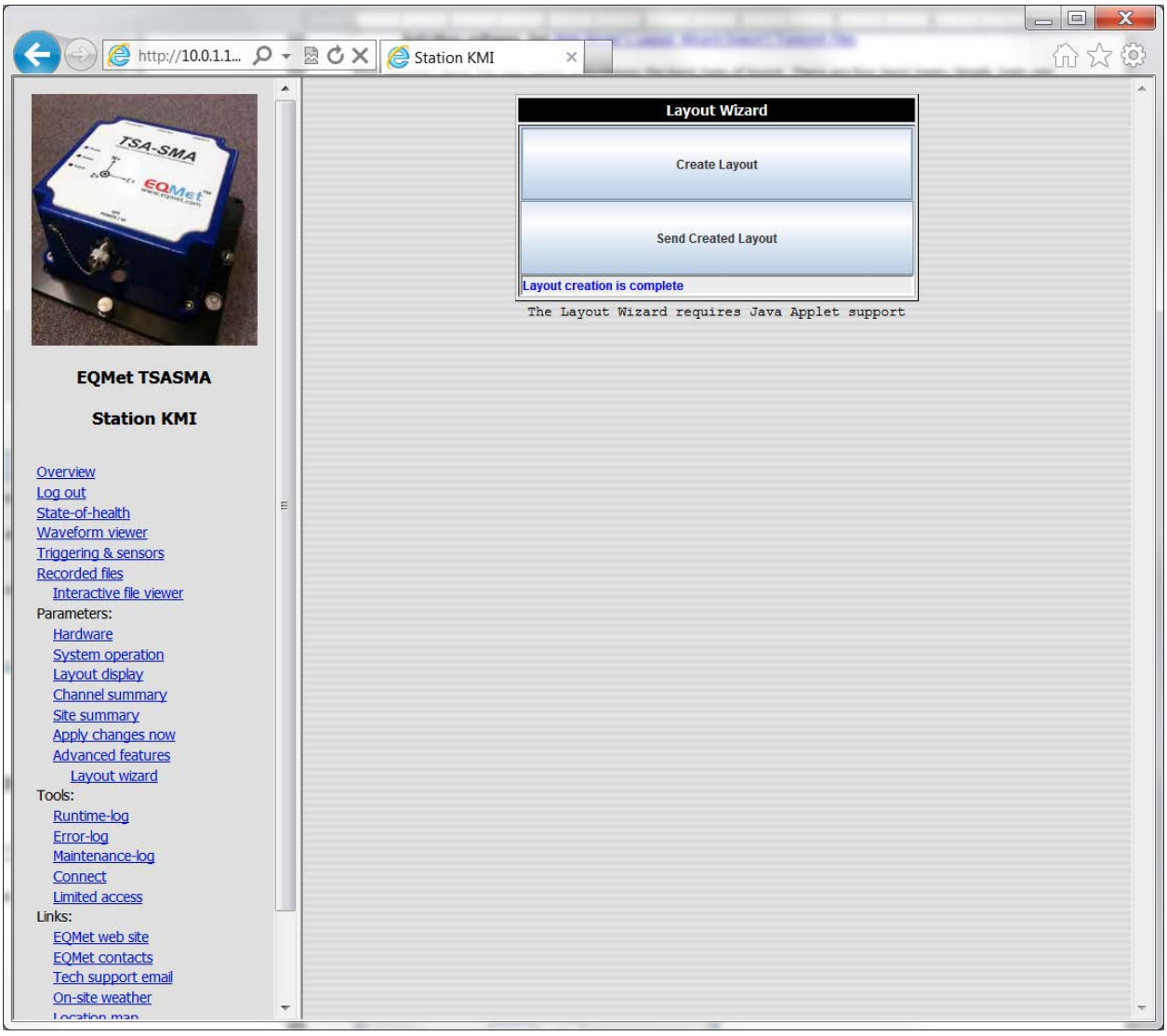
Next, choose the output data format:



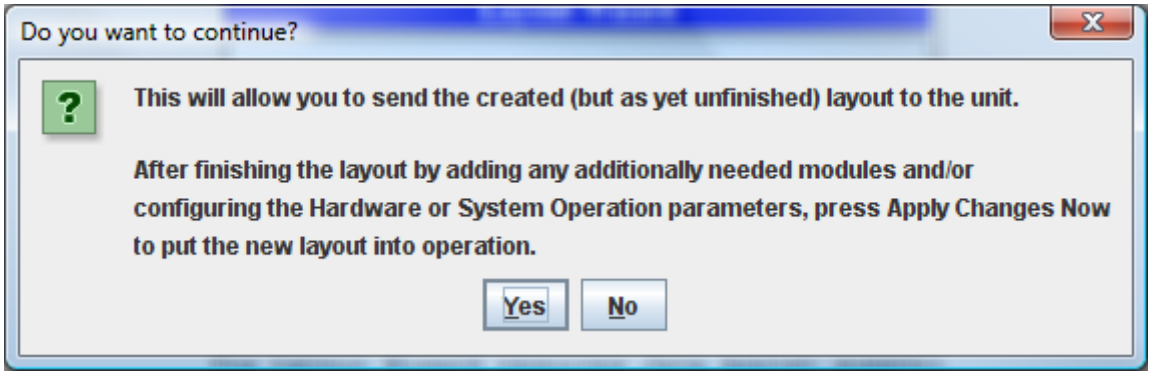
At this point, the basic layout is complete:



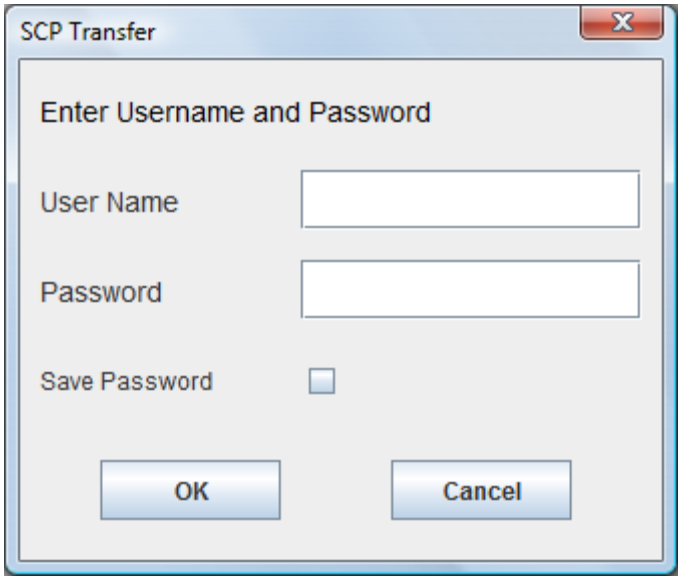
Press Send Created Layout:



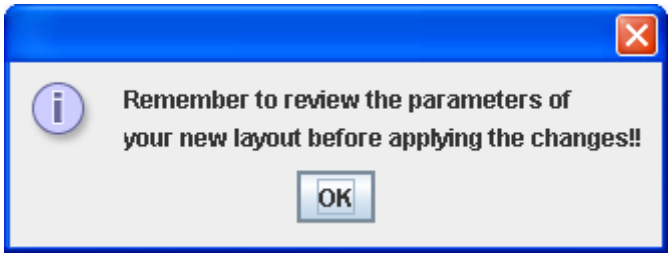
You'll get another informational warning:



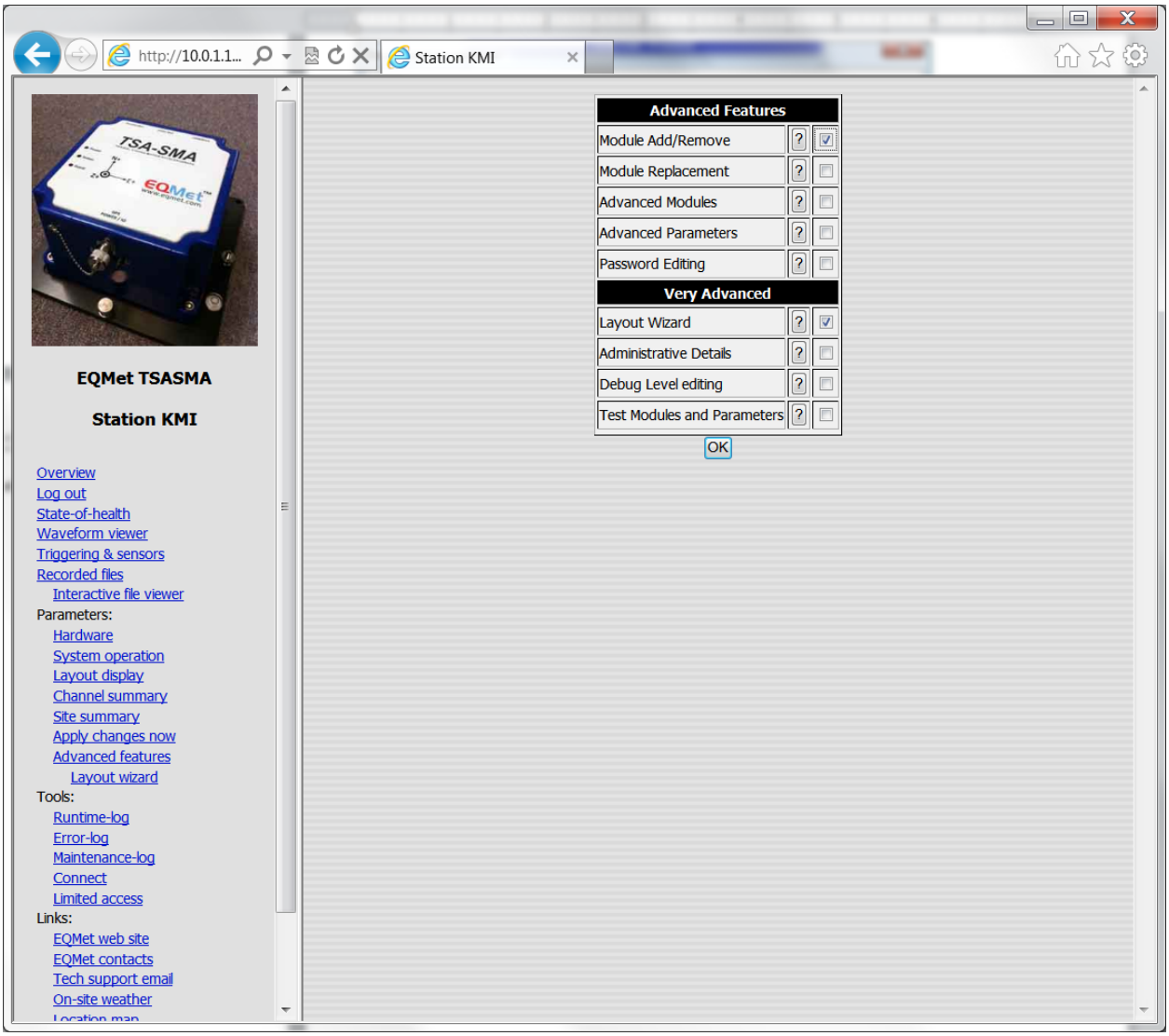
You'll be asked for the SCP login and password. You can choose to save the login information on your local machine if you like:



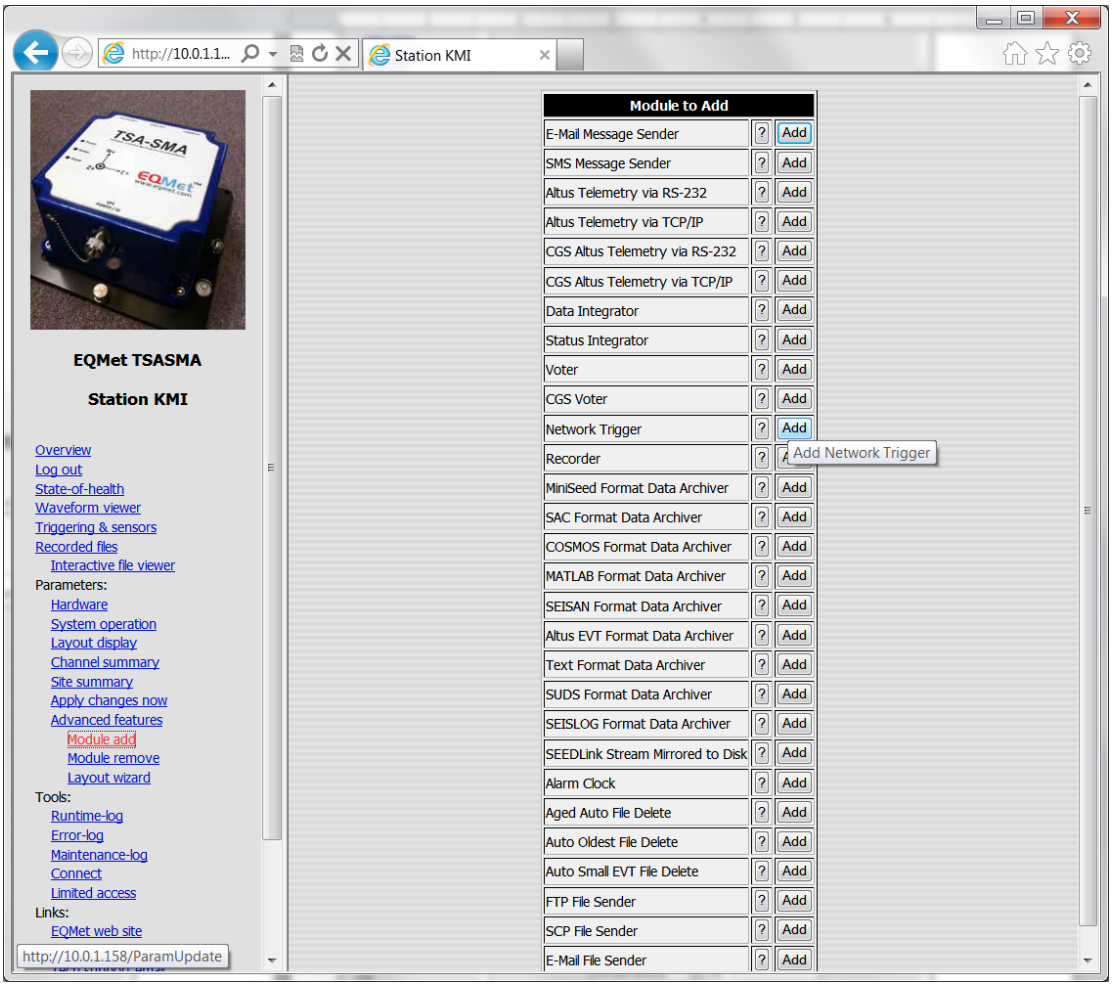
You'll be given this notification when the transfer is complete:



Go back to Advanced Features and enable Module Add/Remove and Password Editing:

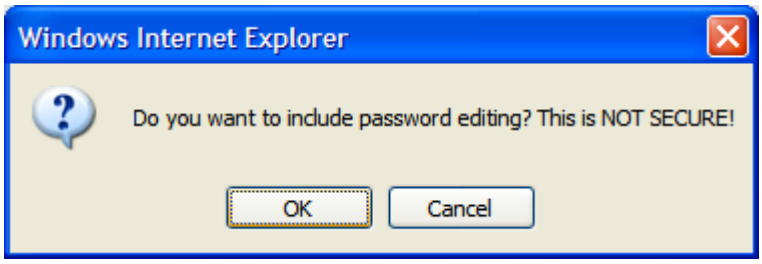


Then click OK and select Module Add from the left pane:

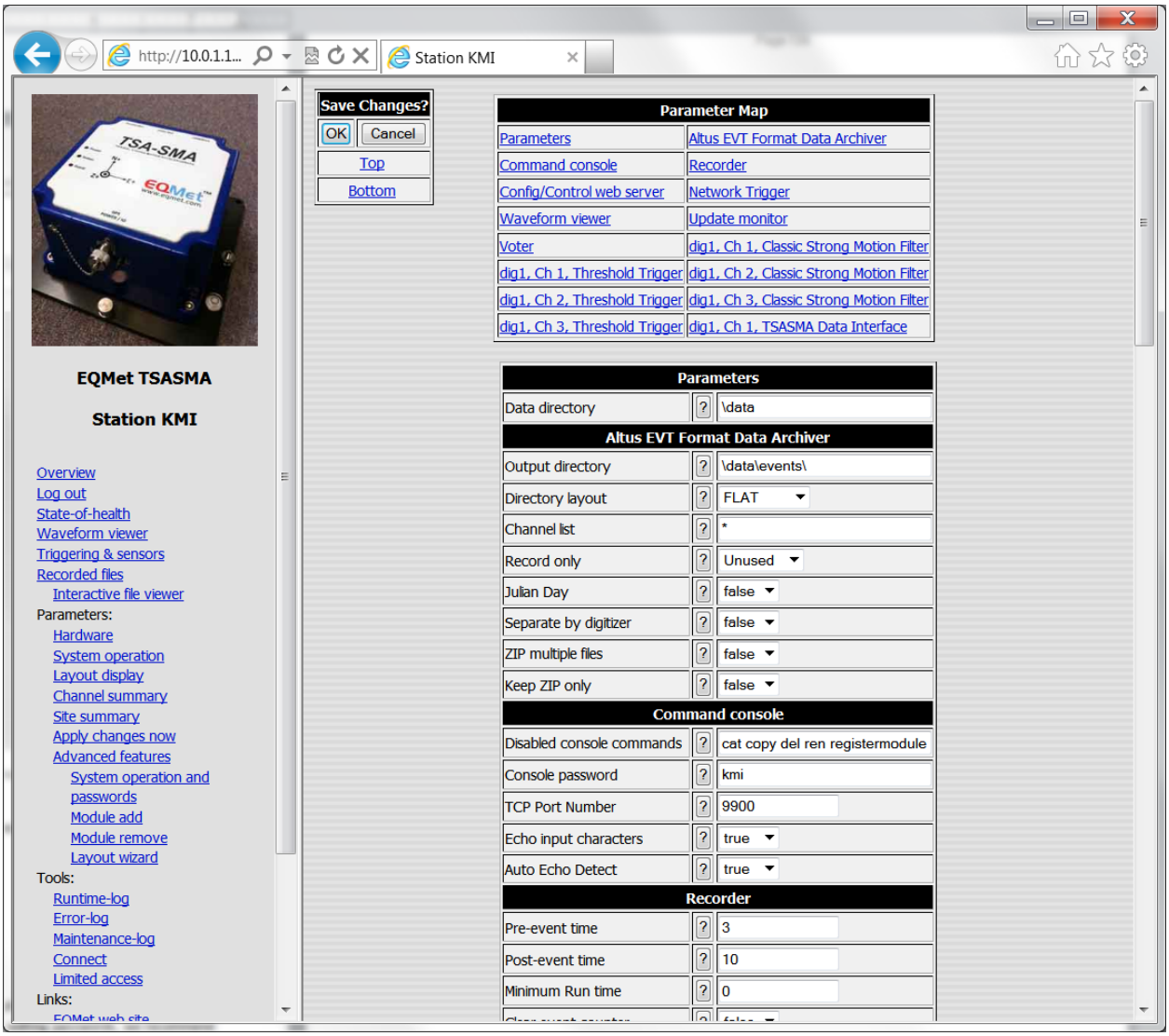


Select Network Trigger by pressing the Add button. Since only one of these can be added to the layout, the choice will disappear from the list of available modules.

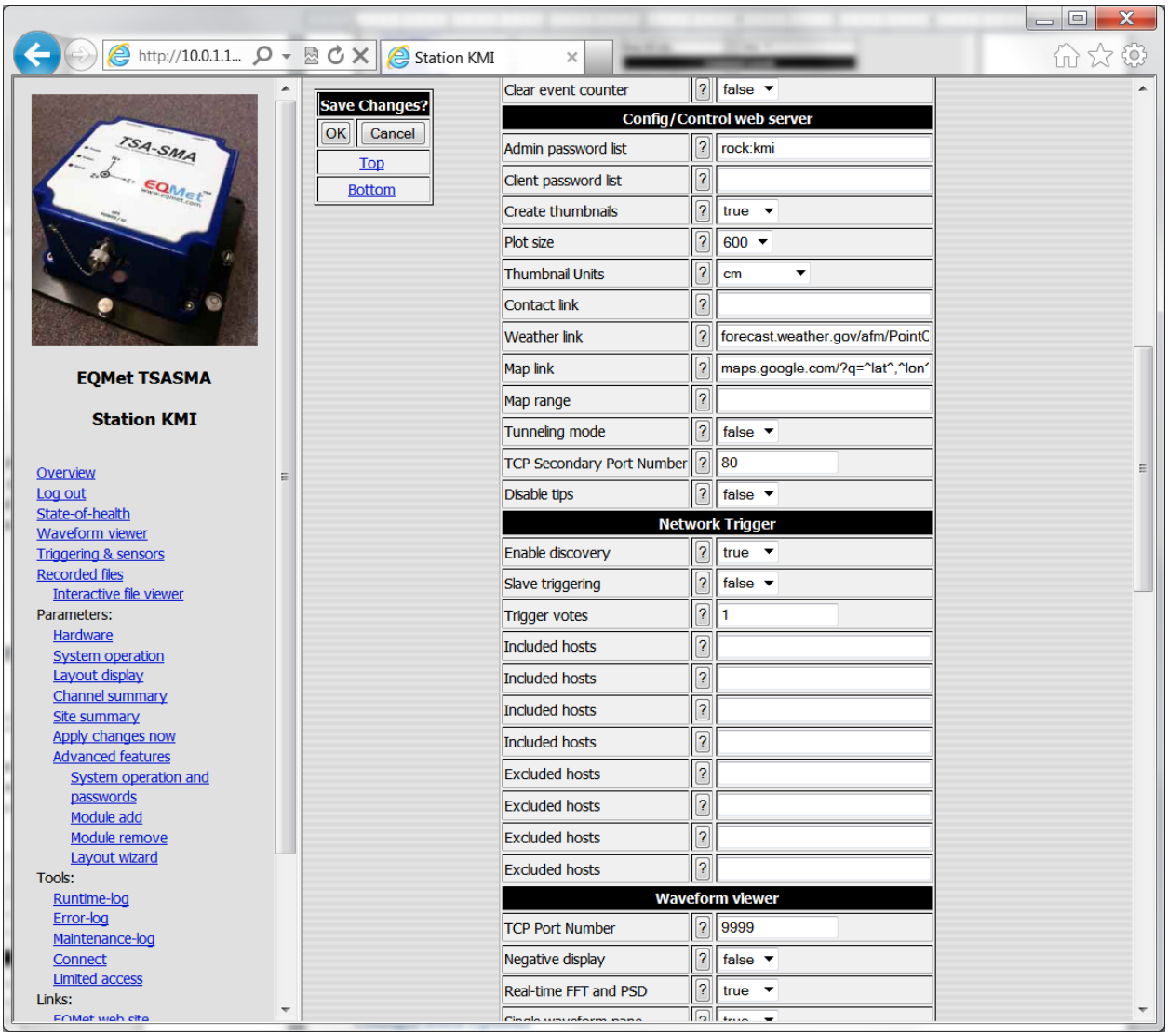
Select System Operation and Passwords from the left pane and you will get a warning:



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 System Operation function instead to edit parameters. If you need to edit the passwords (which you will need to do in order to initially set up the web server password) click OK and you'll get the parameter map:

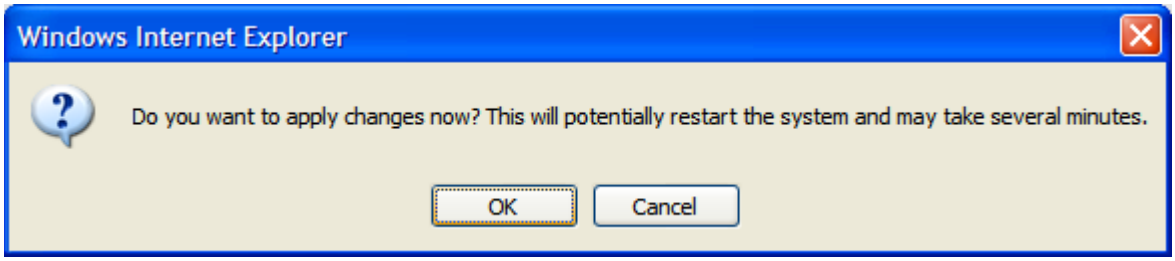

http://10.0.1.1...
Station KMI
Save Changes?
OK
Cancel
Top
Bottom
EQMet TSASMA
Station KMI
Overview
Log out
State-of-health
Waveform viewer
Triggering & sensors
Recorded files
Interactive file viewer
Parameters:
Hardware
System operation
Layout display
Channel summary
Site summary
Apply changes now
Advanced features
System operation and passwords
Module add
Module remove
Layout wizard
Tools:
Runtime-log
Error-log
Maintenance-log
Connect
Limited access
Links:
Parameter Map
Parameters
Altus EVT Format Data Archiver
Command console
Recorder
Config/Control web server
Network Trigger
Waveform viewer
Update monitor
Voter
dig1, Ch 1, Classic Strong Motion Filter
dig1, Ch 1, Threshold Trigger
dig1, Ch 2, Classic Strong Motion Filter
dig1, Ch 2, Threshold Trigger
dig1, Ch 3, Classic Strong Motion Filter
dig1, Ch 3, Threshold Trigger
dig1, Ch 1, TSASMA Data Interface
Parameters
Data directory
\data
Altus EVT Format Data Archiver
Output directory
\data\events\
Directory layout
FLAT
Channel list
*
Record only
Unused
Julian Day
false
Separate by digitizer
false
ZIP multiple files
false
Keep ZIP only
false
Command console
Disabled console commands
cat copy del ren registermodule
Console password
kmi
TCP Port Number
9900
Echo input characters
true
Auto Echo Detect
true
Recorder
Pre-event time
3
Post-event time
10
Minimum Run time
0

Select Config/Control Web Server from the parameter map to get to the parameters for the web server. At a minimum, you'll need to set the passwords for Admin and/or Client level users. Passwords are set as a comma separated list of username and password pairs. For example, "user1:pwd1,user2:pwd2". To set the Admin level username to "rock" and the password to "kmi", enter "rock:kmi":



Click OK to save your changes.

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



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

Configuration Options

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

Network Parameters

You can set the network parameters for your digitizer 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.

Networking and Security

The TSA-SMA digitizer 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.

Software Maintenance & Service

In this section we discuss recommended maintenance and service procedures.

The TSA-SMA digitizer contains no user replaceable fuses or internal batteries.

Powering Up the System

To successfully deploy your digitizer, 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 green – Initial power detection
- All LEDs flash rapidly - There is brief period (a few seconds) where the all LEDs flash as the processor starts running.
- Power green – After the processor initially starts up, the kernel is loaded from the memory card.
- Power green, Status LED orange - The system is charging the super capacitor array
- Power green - The software is loading
- Power green, Status LED flashing – The system has good time quality (usually through GPS)
- Ethernet LEDs active - Ethernet interfaces are enabled

Powering Down the System

When input power is lost, the system goes through a specific power down sequence:

- Power green, Status LED alternating red and green – The system is powering down
- All LEDs off - The system has powered off
- Ethernet LEDs off - Ethernet interfaces are disabled

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 either a Serial/USB cable that supports the USB device cable *OR* a Console serial port connection. Either one of these will allow you to connect to the unit to perform initial setup.

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

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

When using a serial cable to communicate with the Console serial port:

> 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.
>
> Set the terminal emulation program up for 115200 baud, no flow control, 8 data bits, 1 stop bit, no parity.

When using a USB device cable:

> To use the USB Device connection on Windows *the first time*, you will have to install a device driver. The driver, `linux-cdc-acm.inf` is available on the web site www.eqmet.com
>
> To install the driver on Windows 7:
>
> - Unplug the USB cable from the PC
> - Copy `linux-cdc-acm.inf` to the desktop
> - Plug the USB cable into the PC
> - Windows will attempt to install Gadget Serial driver v2.4 – this driver will be replaced
> - Find the Gadget Serial under Ports in the Device Manager and right click to Update Driver
> - Click Browse My Computer For Driver Software
> - Click Let Me Pick From a List of Drivers
> - Click Have Disk (don’t pick what’s shown)
> - Browse to Where the INF file is located
> - Select the driver, click Open

- Click OK
- Click Next
- Ignore warnings, use anyway
- When done installing, unplug the USB cable, wait 5 seconds, and plug back in
- Get COM port number from the Device Manager

Regardless of whether you use the console serial connection or the USB device connection, operation is otherwise the same.

Factory Configuration Including:	
Eth0	Enabled for DHCP
SSH	Enabled
NTP	Enabled
PING	Enabled
TELNET	Disabled
FTP	Disabled
TFTP	Disabled
SD Card	/dev/mmca mounted as '/mnt/sd'
Console	/dev/console
Virtual Memory	64MB

The unit includes an overall configuration menu to assist you with some of the most common configuration tasks. To access this menu, type the command `sysconfig` from the Linux prompt. (The links will take you to explanations of these functions in this document.)

```
System Configuration Utility
1. View System Info
2. Software Versions
3. Configure System Time
4. Configure Network
5. Change Passwords
6. View Update Log
98. REBOOT
99. Exit
Make a selection and press [Enter]
```

IP Services

The following IP services are enabled by default from the EQMet 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 USB device connection or the console serial port as “root”. See Software Installation

`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.

Network Configuration

The default network configuration is as follows:

- Ethernet 1 (eth0): Enabled, DHCP

To change the network configuration, run the `netconfig` script after logging onto the unit through the USB device connection or the console serial port as “root”. See Software Installation

`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:

```
Network Host Name for this unit

> TSASMA103

Network Domain Name

>
```

(RETURN if no domain used)

```
Mode for eth0

1. disabled

2. static

3. dhcp

Make a selection and press [Enter]

> 2

IP Address for eth0

> 10.0.1.205

NetMask for eth0

Default: 255.255.255.0

>
```

```
Default gateway
Default: 10.0.1.1
> 10.0.1.200
Do you want eth0 to Auto-Start at reboot?(Y/N)?
> y
Mode for USB wireless adapter wlan0
1. disabled
2. static
3. dhcp
Make a selection and press [Enter]
> 2
IP Address for wlan0
> 10.0.2.50
NetMask for wlan0
Default: 255.255.255.0
>
Wireless network ESSID for wlan0
> Wireless-KMI
Wireless security mode for wlan0
    1. WPA/WPA2
    2. WEP
    3. Unsecured
Make a selection and press [Enter]
> 1
WPA ASCII Pass-Phrase for wlan0
> MyPassPhrase
Do you want wlan0 to Auto-Start at reboot?
```

```
(Y/N)? > y
IP Address for primary DNS
> 10.0.1.2
IP Address for secondary DNS
> 10.0.1.222
Review the new parameters.
HOSTNAME = TSASMA    DOMAINNAME =
eth0 Parameters:
    MODE     = static
    ADDR     = 10.0.1.205
    NETMASK  = 255.255.255.0
    AUTO     = 1
    GATEWAY  = 10.0.1.200
wlan0 Parameters:
    MODE     = static
    ADDR     = 10.0.2.50
    NETMASK  = 255.255.255.0
    AUTO     = 1
    GATEWAY  =
    SECURITY = WPA
    SSID     = Wireless-KMI
    PASS     = MyPassPhrase
DNS Parameters:
    DNS1 = 10.0.1.2    DNS2 = 10.0.1.222
PUBLIC_ADDR =
Press [Enter] to Continue, or [Ctrl-c] to Quit.Save the parameters?
(Y/N)? > Y
```

```
Do you want to stop and re-start the network NOW?(Y/N)?

> Y

Stopping network...

Starting network...

Done - Remember to verify your network operation.
```

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` and you will see something similar to this:

```
root@Rock103:~# ifconfig

eth0  Link encap:Ethernet HWaddr 00:30:23:00:00:03
      inet addr:10.0.1.205 Bcast:10.255.255.255 Mask:255.255.255.0
      UP BROADCAST RUNNING MULTICAST MTU:1500 Metric:1
      RX packets:214206 errors:0 dropped:0 overruns:0 frame:0
      TX packets:796 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:100
      RX bytes:16476666 (15.7 Mb) TX bytes:0 (0.0 b)
      Interrupt:50 Base address:0x300
Lo    Link encap:Local Loopback
      inet addr:127.0.0.1 Mask:255.0.0.0
      UP LOOPBACK RUNNING MTU:16436 Metric:1
      RX packets:6 errors:0 dropped:0 overruns:0 frame:0
      TX packets:6 errors:0 dropped:0 overruns:0 carrier:0
      collisions:0 txqueuelen:0
      RX bytes:732 (732.0 b) TX bytes:732 (732.0 b)
```

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 5 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 2 hours.

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.

Powerfail Protection:

The system includes an internal power backup called a super capacitor 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.

Linux Passwords

The default digitizer Linux passwords are as follows:

```
root                    kmi

kmi                     kmi
```

NOTE: EQMet STRONGLY recommends that you change the system passwords to something well known to your organization, but which is different from the EQMet factory defaults.

To change a Linux password for the current user, type:

```
root@Rock103:~# 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@Rock103:~# 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.

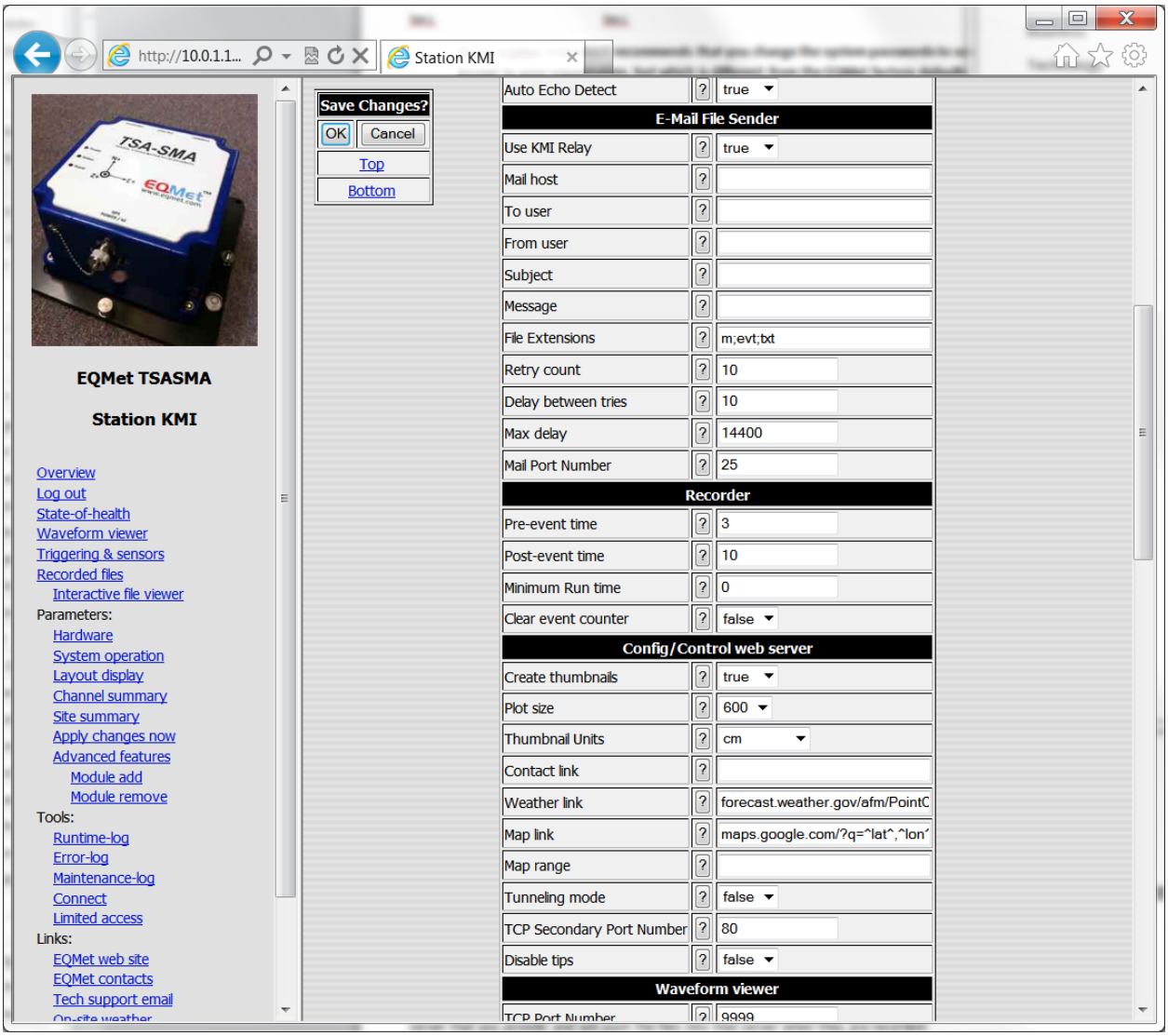
File Retrieval

File Retrieval can be done in a number of ways:

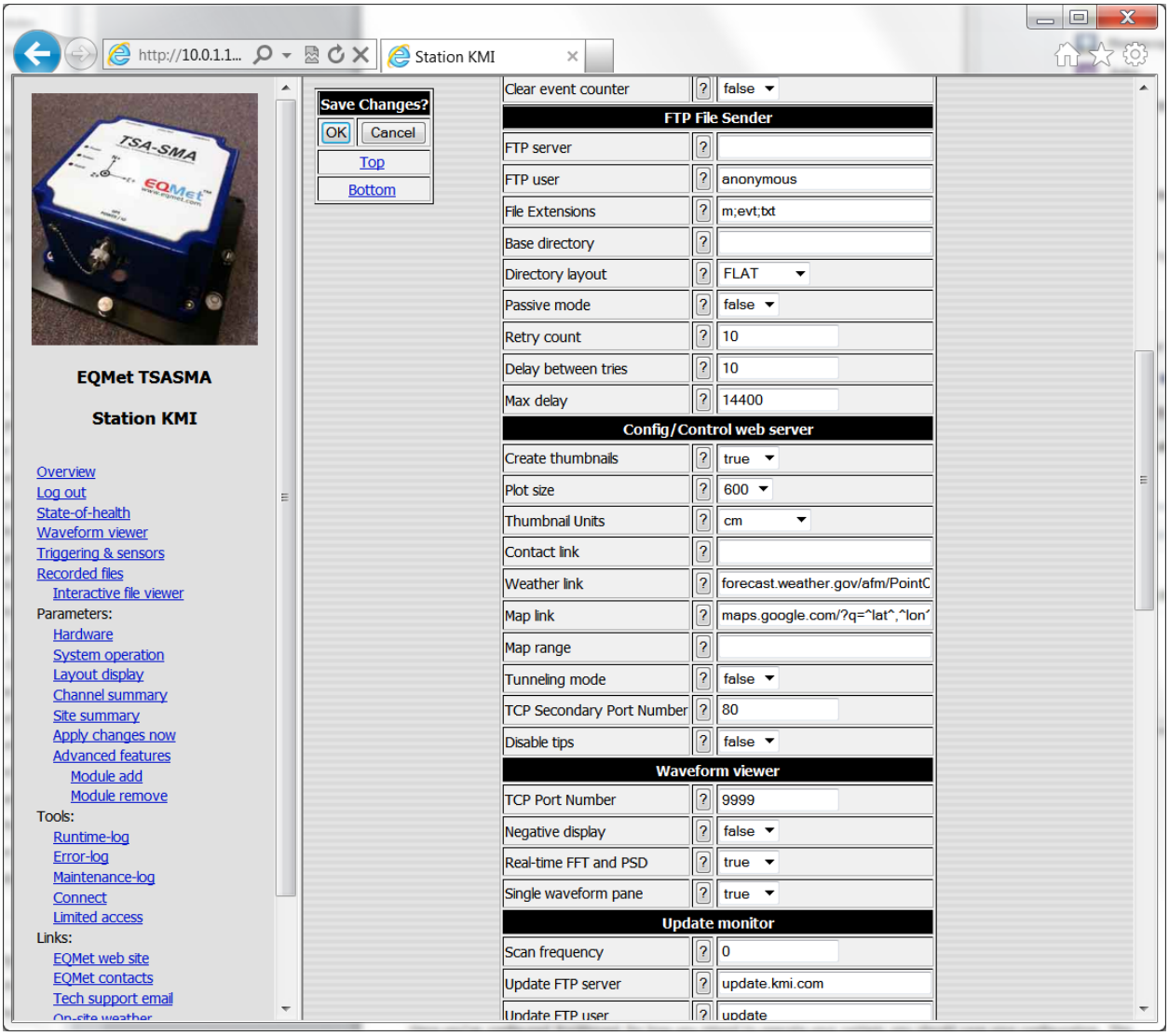
- By clicking the filename from the Recorded Files page of the Web Server
- Using the TX command or Block Mode transfer operations of the Altus Emulation modules
- Using the SFTP service and a program such as WinSCP, that is described in another section

In addition however there are “push” methods available through Rockhound modules that can automatically send out files when they are recorded.

The E-mail File Sender module allows files to be sent via Authenticated SMTP e-mail. Sending files in this way requires that you have access to an E-mail server that will accept Authenticated SMTP e-mail messages:



The other option for a file push is to use an FTP Sender module. This module allows the digitizer to connect to an FTP server that you provide and will push the files into that server when they are recorded:



A representative FTP Server program is provided on the Rock Support Software (300654-PL) that can be downloaded from www.eqmet.com. Setup of this program is as described in the FTP Server section.

Note that multiple file sender modules may be added to the system to send files to multiple destinations as needed.

Saving and Restoring Parameters

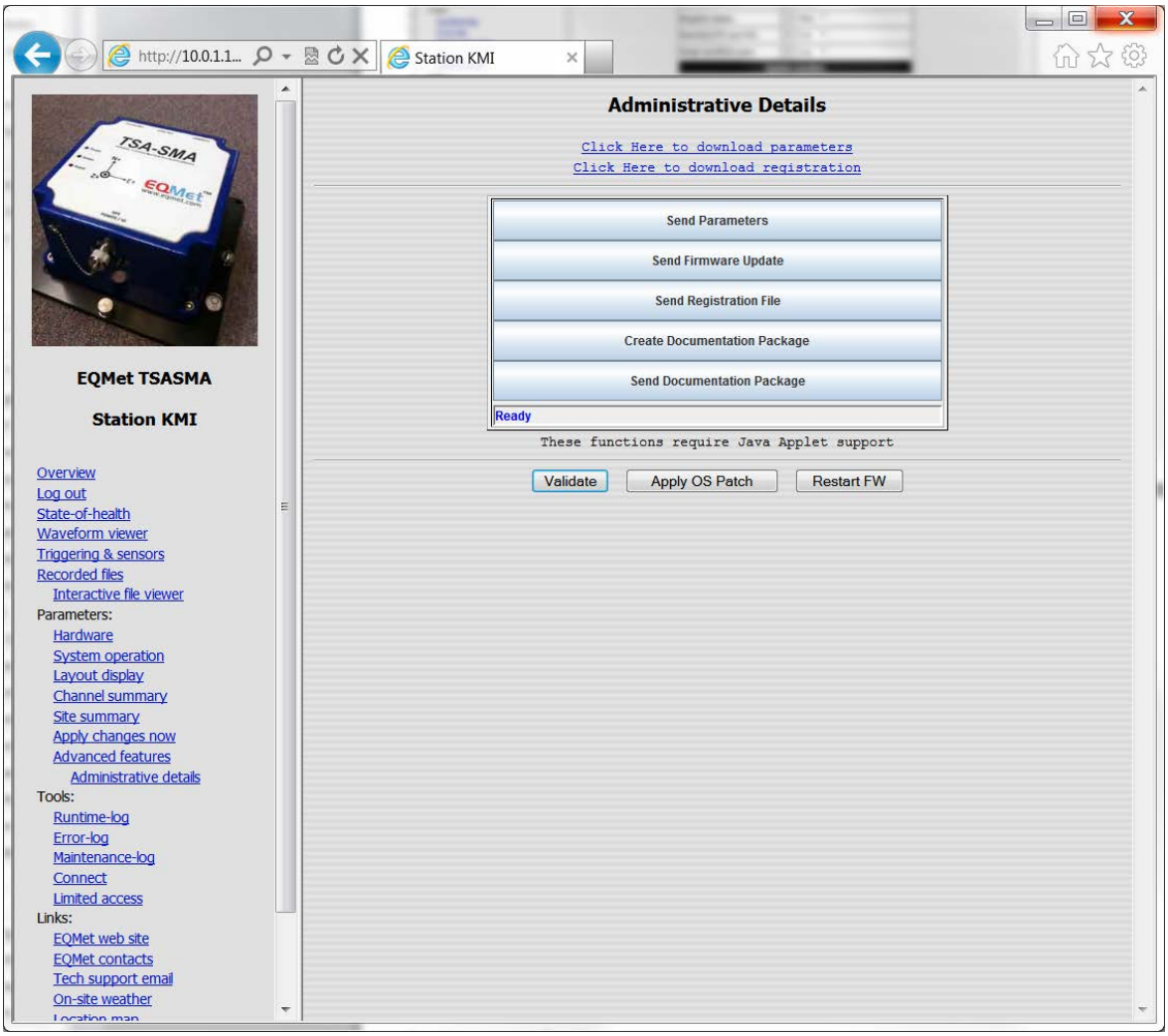
Once you've configured Rockhound for how you intend to operate your system, you should save your configuration. This saved copy of the parameters will be used to restore the Rockhound parameters in case they become corrupted. This is done in two ways:

- 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 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. You can give this file you are saving a name that is meaningful to you such as "event-recorder-at-100sps.jar".
- EQMet 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 Advanced Features function Administrative Details. Select the function "Send Parameters", and then select the file to send and after it is sent, press "Validate".



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

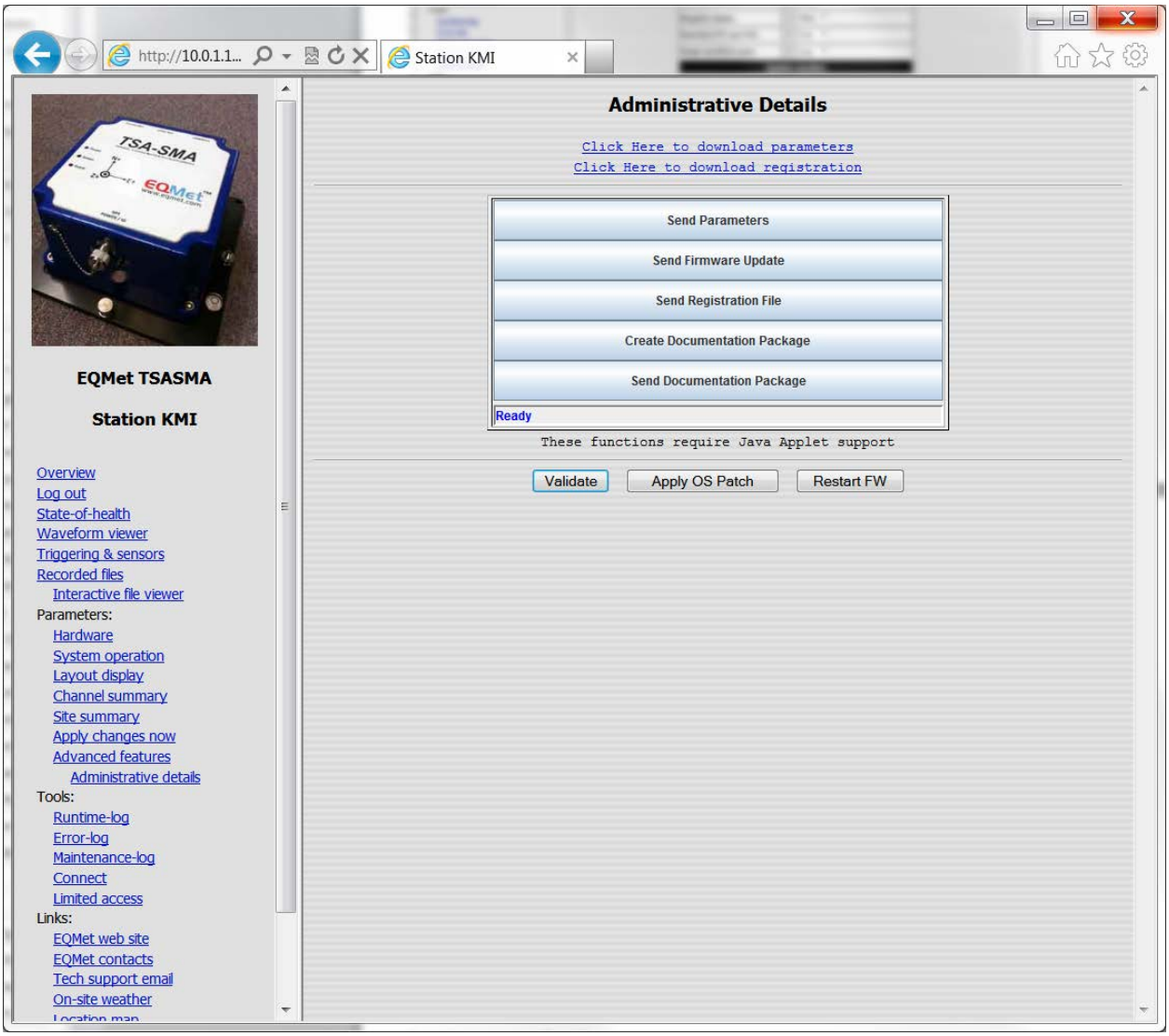
```
config_20091027_145129.jar          config_20091029_161551.jar
config_20091029_161636.jar          config_20091029_161712.jar    config_save.list
            factory.jar
user.jar
```

- cp config_20091027_145129.jar /usr/rock/SMARTSDist/injar/config.jar
- rock restart

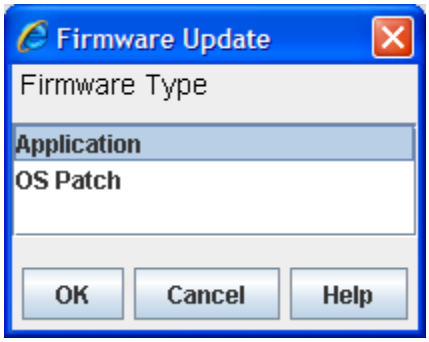
Software Updates

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.

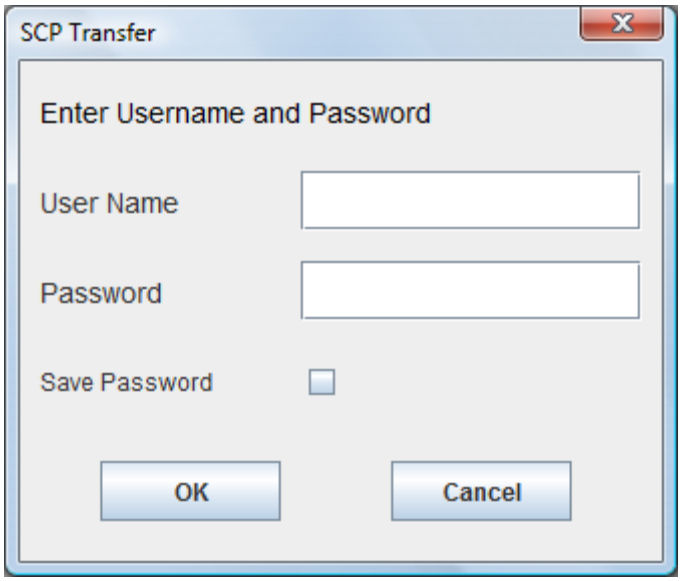
To install a Rockhound update, enable the Administrative Details function through Advanced Features:



Select Send Firmware Update and then select Application:

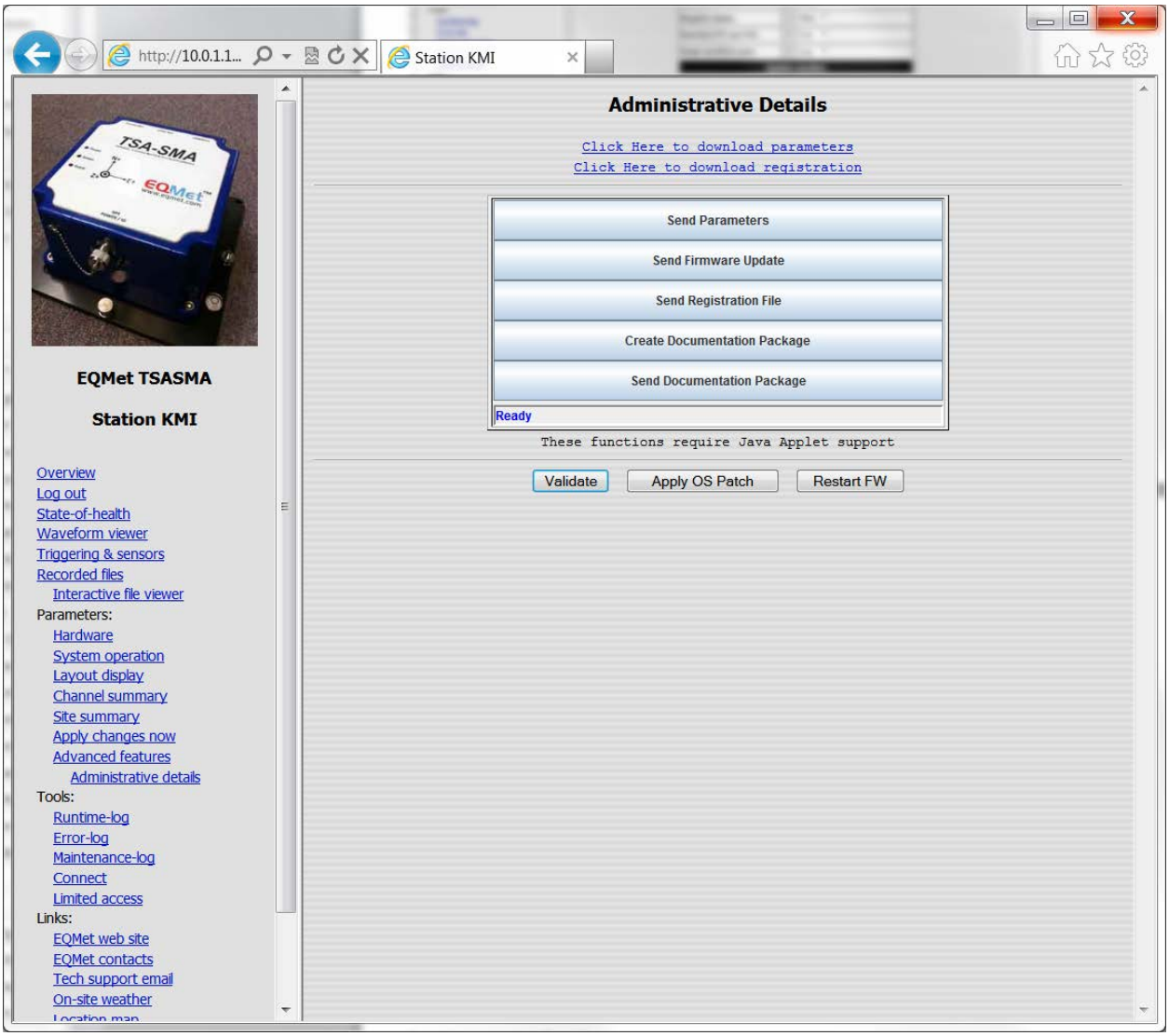


After pressing OK, select the Rockhound update file. It will typically have a name like rock_update_v3.8.jar. After selecting the file, you'll be asked for the SCP login and password. You can choose to save the login information on your local machine if you like:

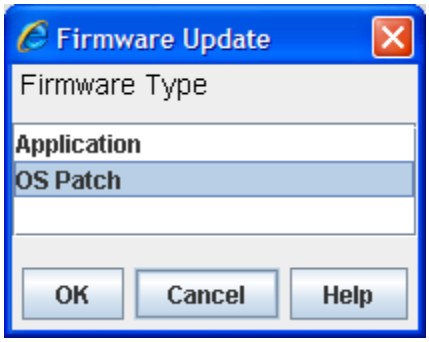


After the file transfer is complete, press "Validate" to install the update. This may take a few minutes until the system is restarted and operational with your update.

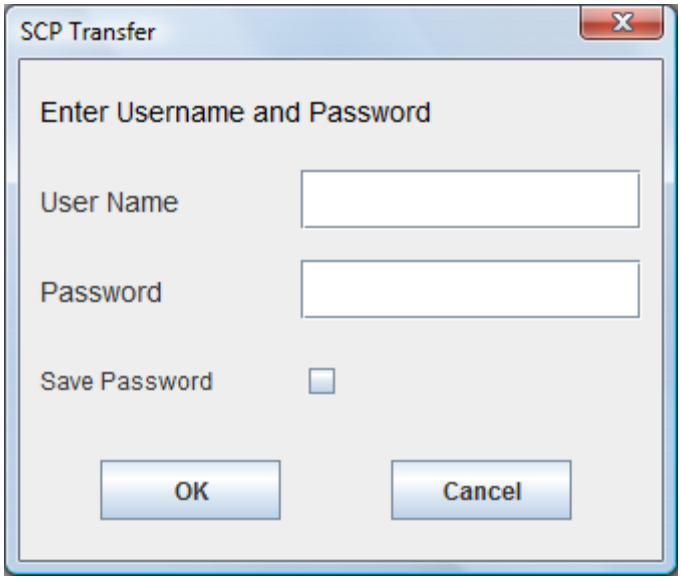
To install a Linux update, enable the Administrative Details function through Advanced Features:



Select Send Firmware Update and then select OS Patch:



After pressing OK, select the Linux update file. After selecting the file, you'll be asked for the SCP login and password. You can choose to save the login information on your local machine if you like:



After the file transfer is complete, press "Apply OS Patch" to install the update. This may take a several minutes until the system is rebooted 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 Restart FW to install the update

To install a Linux update through SFTP:

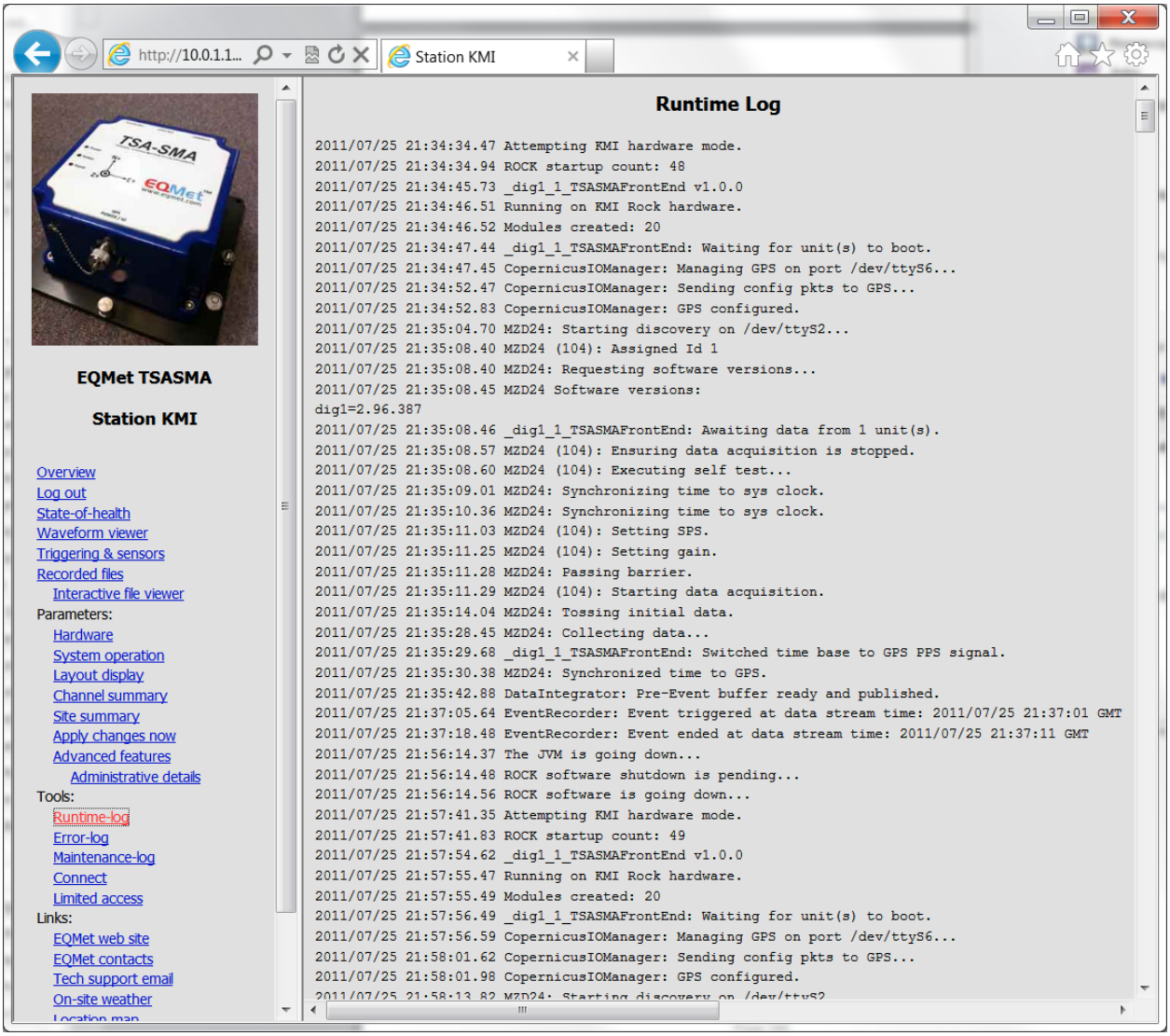
- Connect to the unit using a tool like WinSCP
- Place the Linux update in the directory /opt/kmi/updates/pending
- Using the Administrative Details page, select Apply OS Patch to install the update

Log files

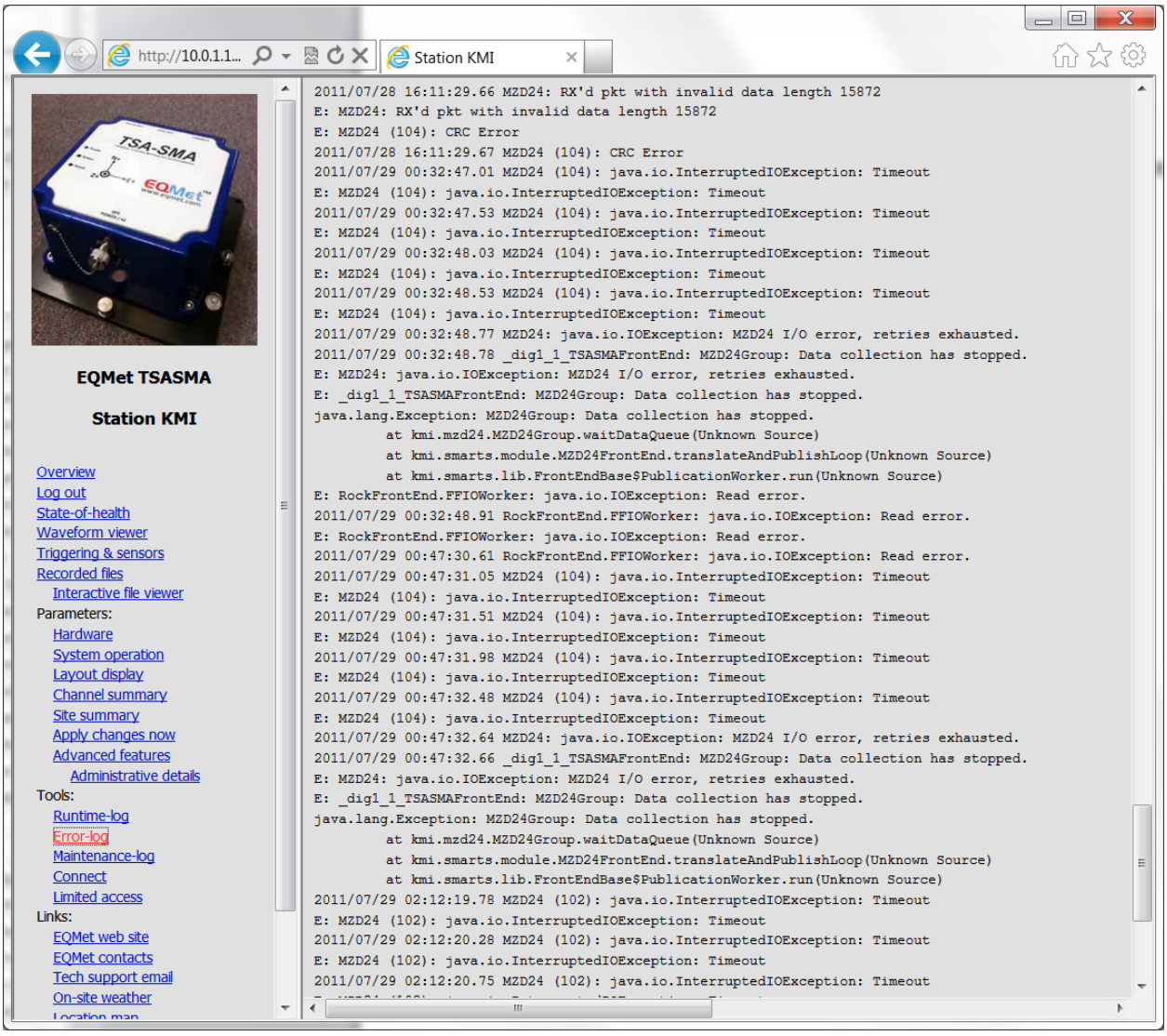
To help you maintain your system, the Rockhound software keeps log files of most important system actions, messages, and exceptions. These are kept in two different log files, the Runtime-log, which keeps track of normal system messages and reporting, and the Error-log, which keeps track of error messages 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 EQMet where needed.

The Runtime-log can be selected from the left pane as shown:



The Error log can be selected from the left pane as shown:

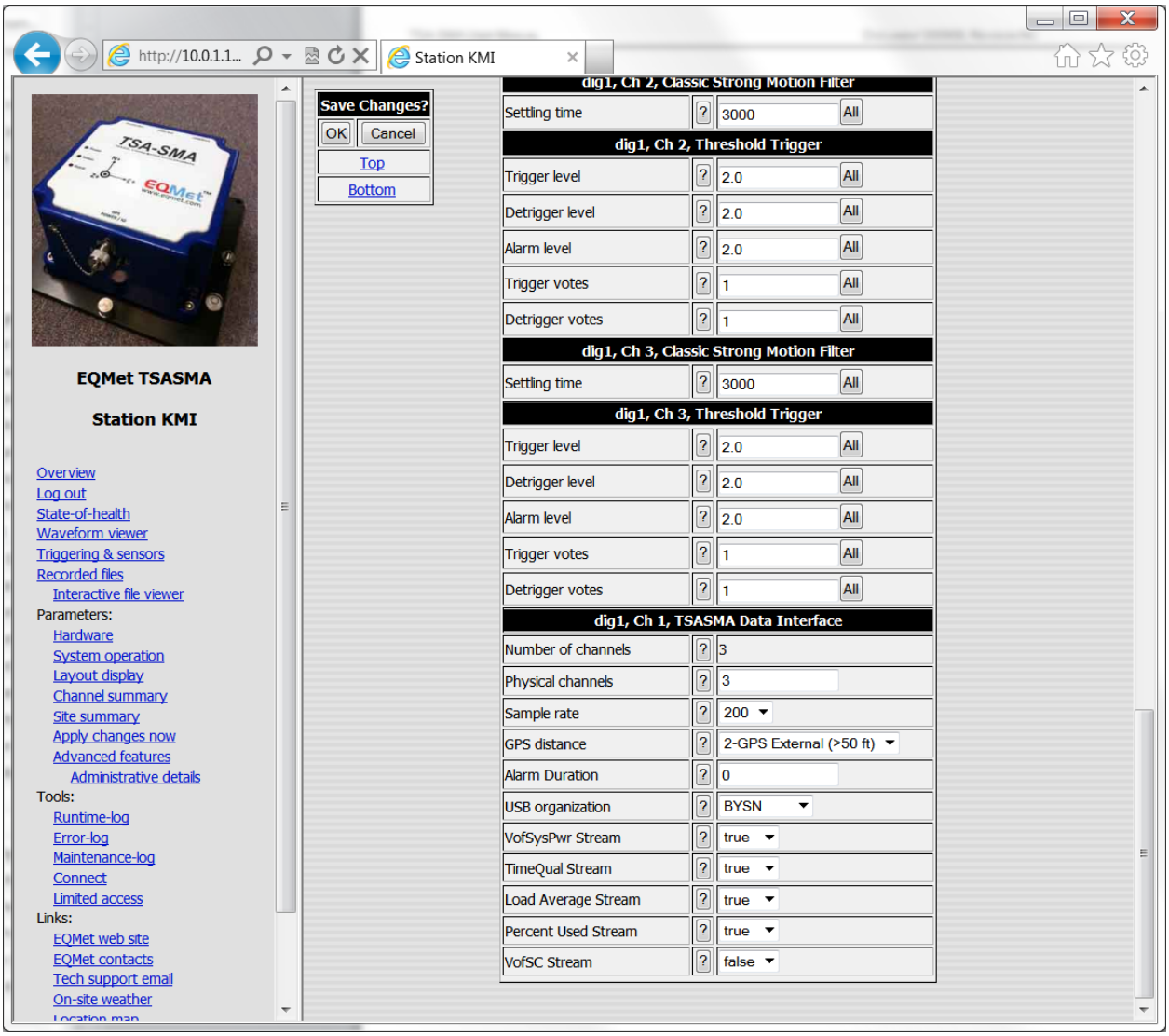


Time stamps within the log files are relative to system time (UTC).

State of Health

The digitizer tracks several State of Health (SOH) parameters that can be used to monitor system environmental values such system voltage and clock quality.

These values are enabled in the parameters for the TSA-SMA Front End:

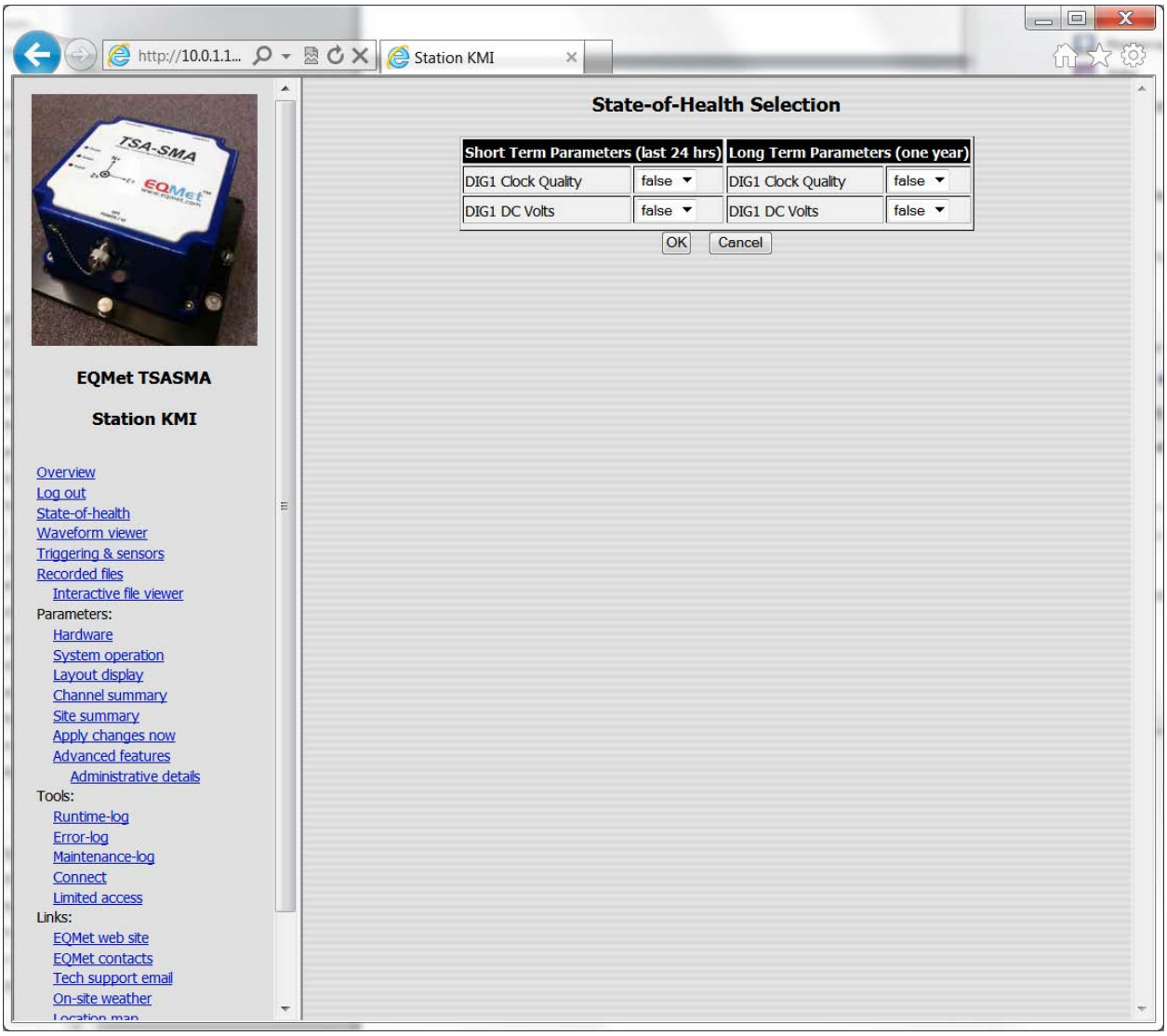


Other values are available in the advanced and test mode module parameters.

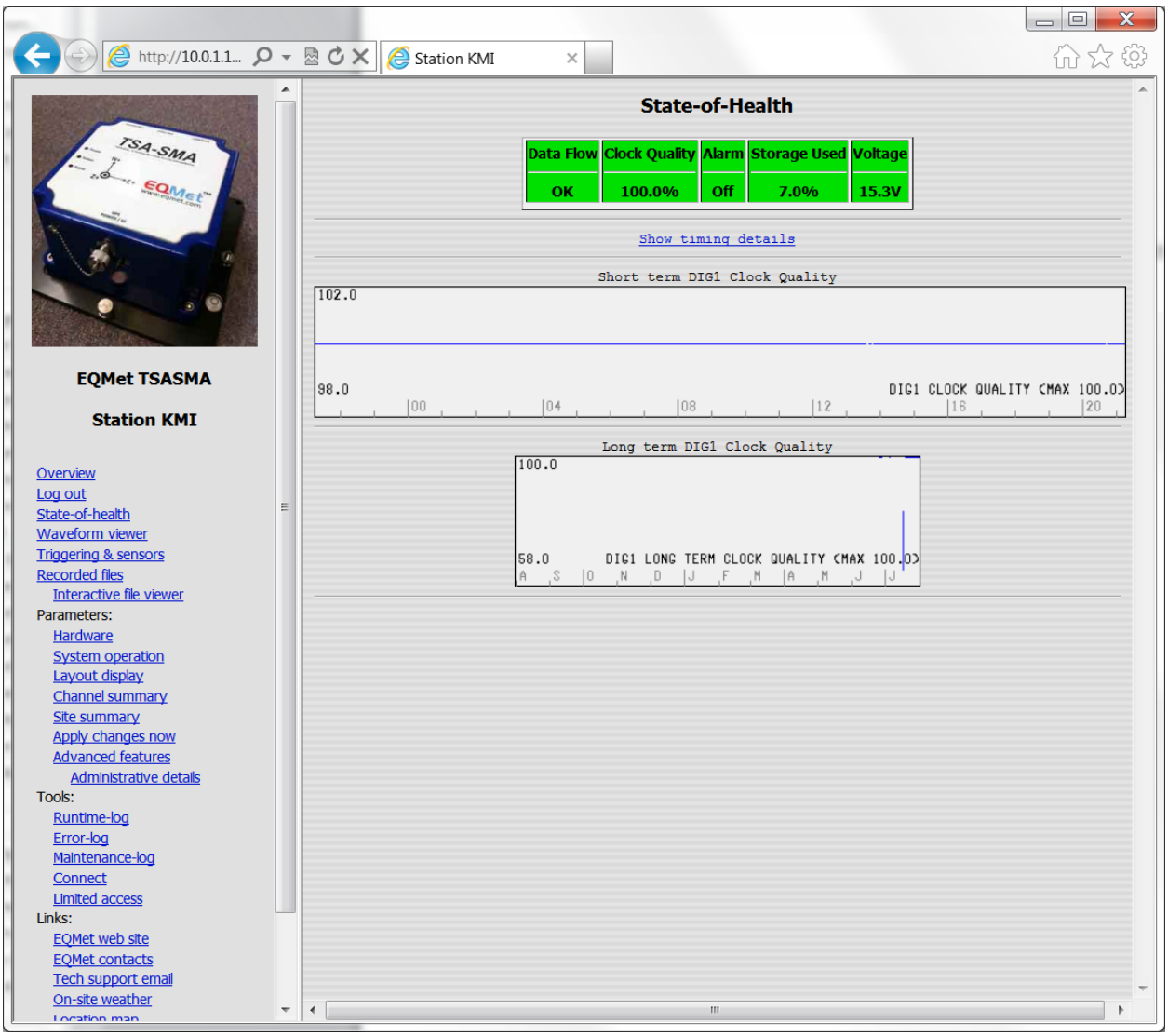
Scaling of SOH values:

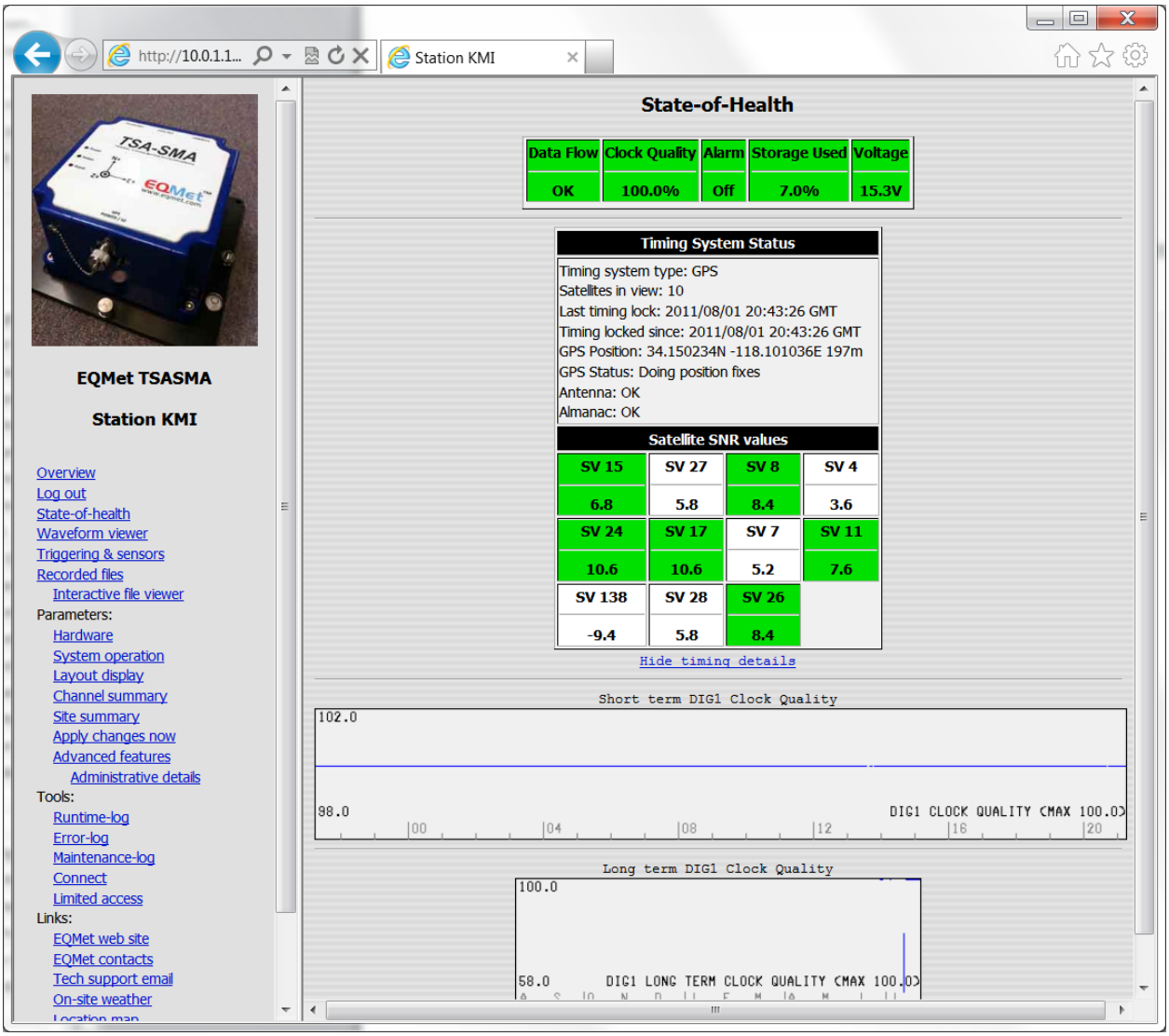
SOH Name	Default	Scale	Description
VofSysPwr	true	X 1000	Record system voltage stream as .vep
VofSC	false	X 1000	Record super capacitor voltage stream as .vsc
TimeQual	true	X 1	Record time quality stream as .lcq
LoadAverage	true	X 100	Record CPU Load Average stream as .cpu (values < ~200 indicate sufficient idle time)
PercentUsed	false	X 100	Record Percent of Data Storage Used stream as .dsk
UserStat	false	X 1	Record user status stream as .usr. See the ROCK 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 left pane, and then selecting the requested displays:



Once you press OK, the history displays must be updated (this may take a few minutes), but then the displays will show as follows:





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.

Software Tools

The TSA-SMA digitizers are designed to work with standard software and hardware tools wherever possible. In many cases, those tools are provided along with most computers or are easily available for download. In some cases tools are required that may not come standard on every computer. In these cases, EQMet has provided publicly available tools on the Rock Support Software (300654-PL). The tools provided are one's that EQMet has found to work well, although you are of course free to use other similar tools that you prefer.

The Rock Support Software programs are specific to the Windows Operating Systems. If you are running Linux or Solaris, 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

For Solaris:

- For Telnet: Use telnet
- For Serial Terminal Emulation: Use tip
- For Secure Terminal connections: Use ssh
- For Secure File Transfers: Use scp

If you do not have other tools 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 (300654-PL) now. You can download it from www.eqmet.com.

Web Browser

As indicated, the digitizer 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 digitizer:

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

Java

The web interface of the digitizer will function without installing Java, but many of the most useful and important feature of the interface require Java. EQMet 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 Sun website it is called the Java SE JRE.

Terminal Program

In order to communicate with the digitizer 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 Vista 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. This can be downloaded from www.eqmet.com. PuTTY is described below.

Telnet Client

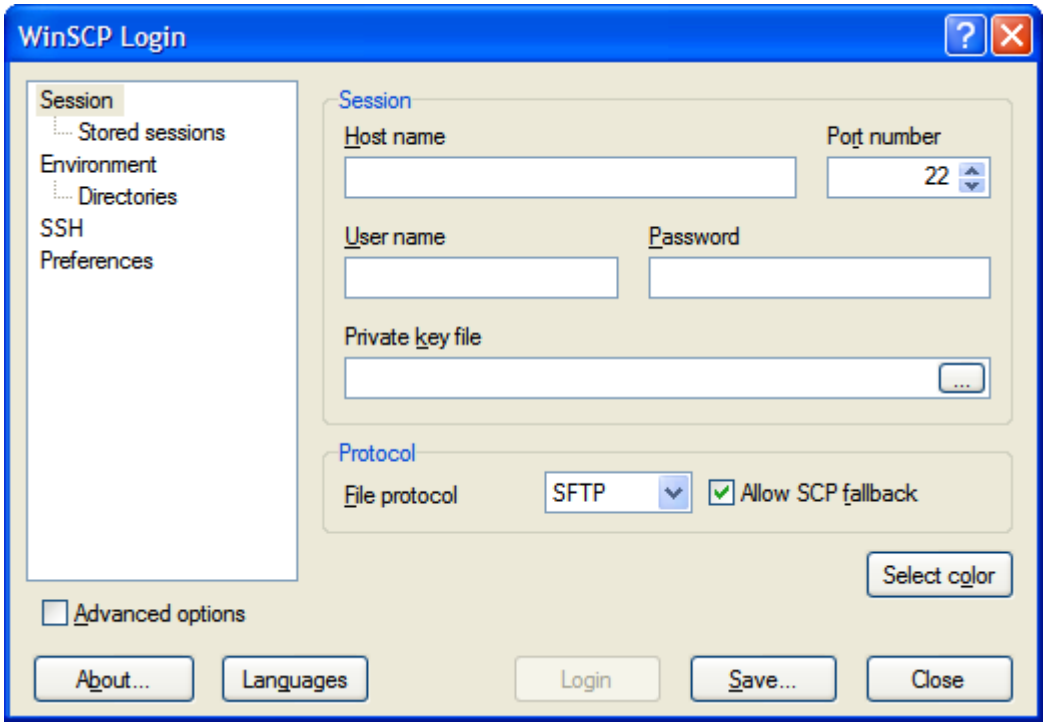
To communicate with the digitizer through its command console you will need a telnet client program. Most computers include telnet as part of the normal distribution, but Windows Vista no longer includes telnet.

As a replacement you can use the free program PuTTY, which is provided on the Rock Support Software. This can be downloaded from www.eqmet.com. PuTTY is described below.

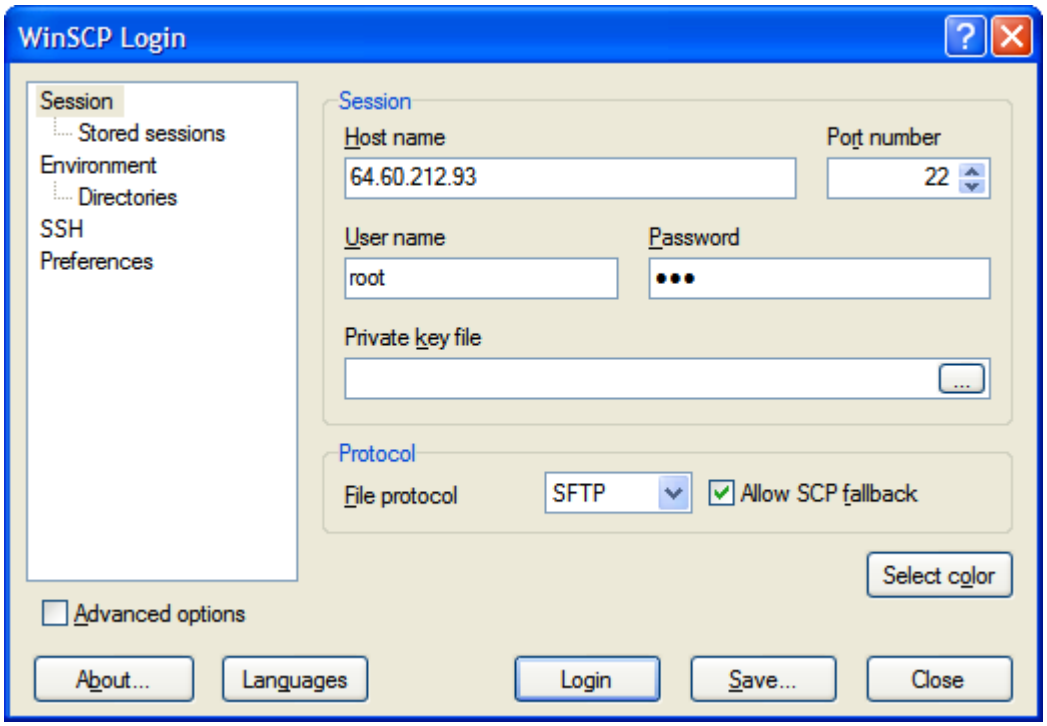
WinSCP

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. This can be downloaded from www.eqmet.com.

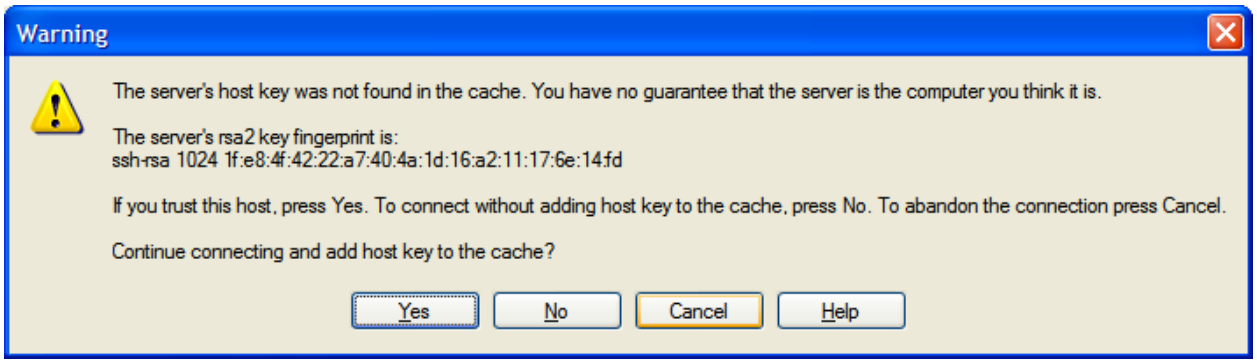
Since WinSCP is not EQMet software and is provided only as an example, we make no attempt to thoroughly describe all capabilities. However we will describe basic operation here. When you start WinSCP you will see a dialog that looks something like this:



To connect to a digitizer, enter the IP address of the digitizer as “Host name” as well as the User name and Password as shown here:

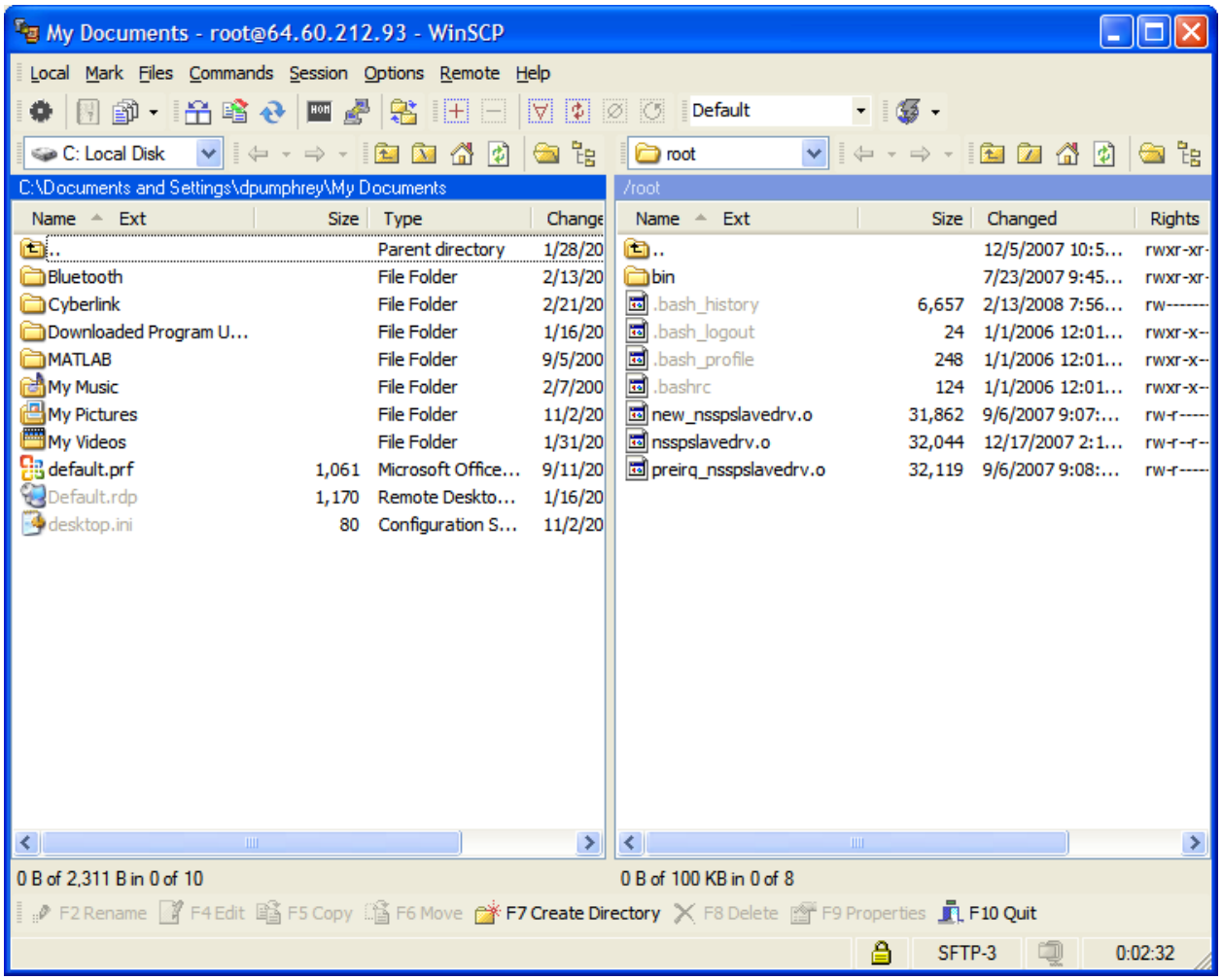


Press “Login” and you will initially see the following confirmation:



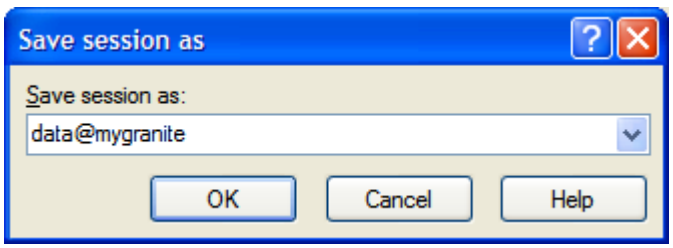
This message indicates that you are about to make a secure connection to the digitizer and is a warning that you have to be sure you’re talking to the correct unit. Normally, once you accept the key you will not have to do this again when connecting to the same digitizer from the same computer.

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

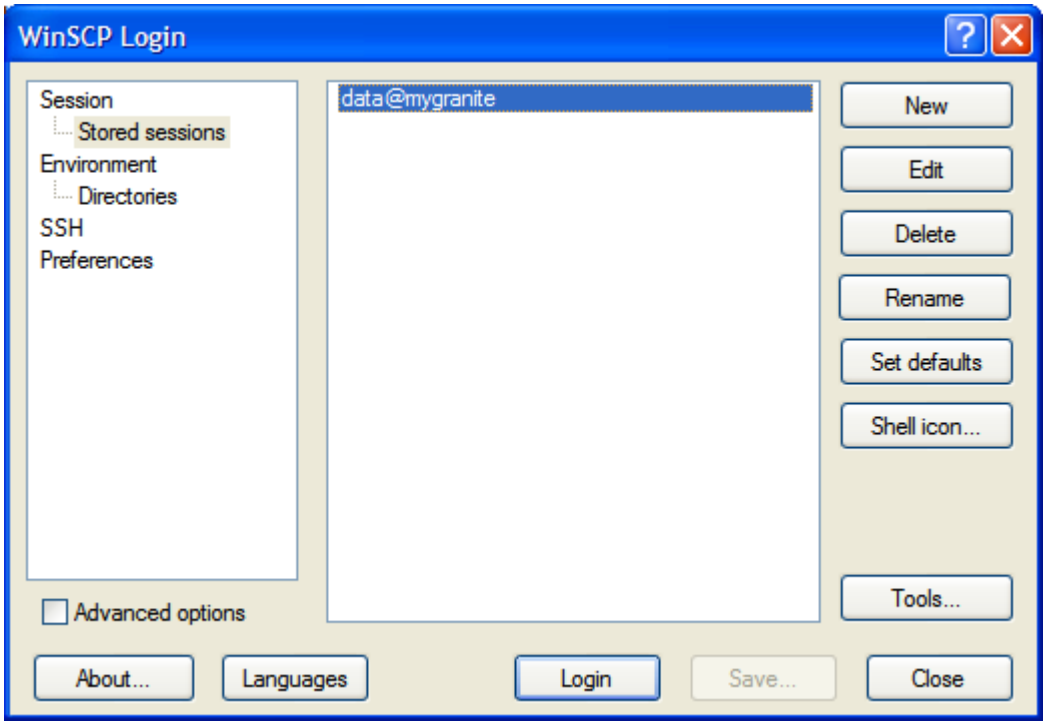


The left pane of the program represents your computer and the right pane represents the digitizer. You can navigate the panes independently and can then upload or download files by simply dragging the files from one side to the other. You can also drag files directly to or from other applications such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

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



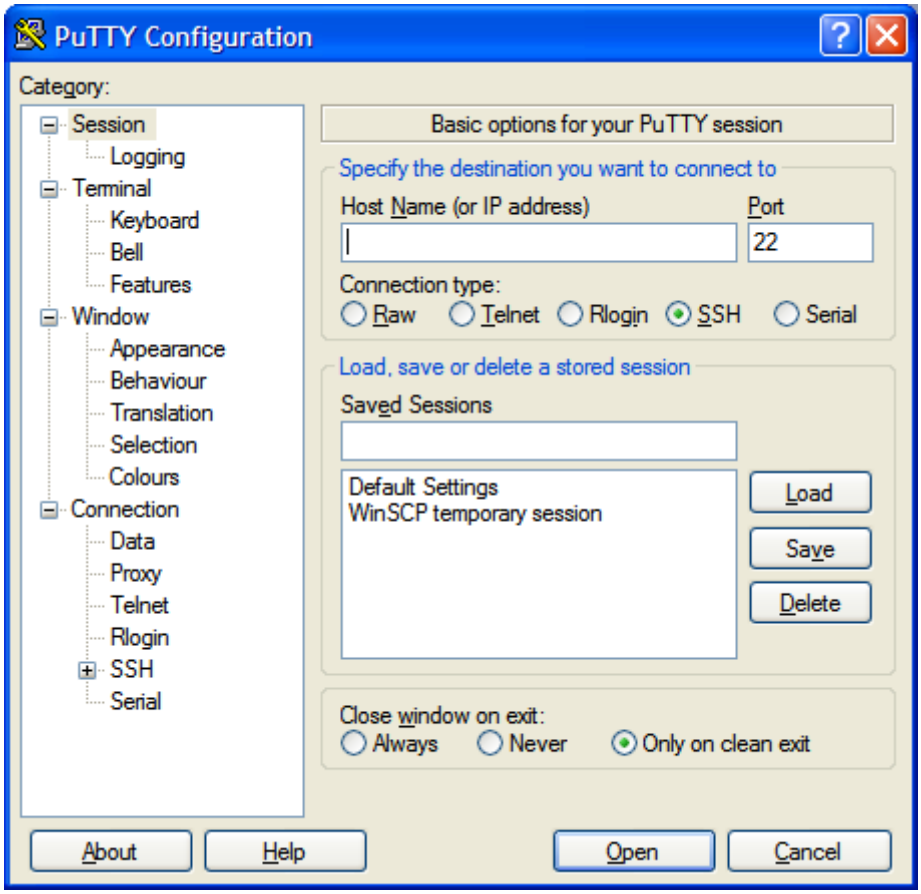
Later when you restart WinSCP, you can choose the session from the list and click “Login”. This will save you from having to manually enter the IP address, username, or passwords each time. In addition, the panes for your computer and the digitizer’s directories will be set automatically:



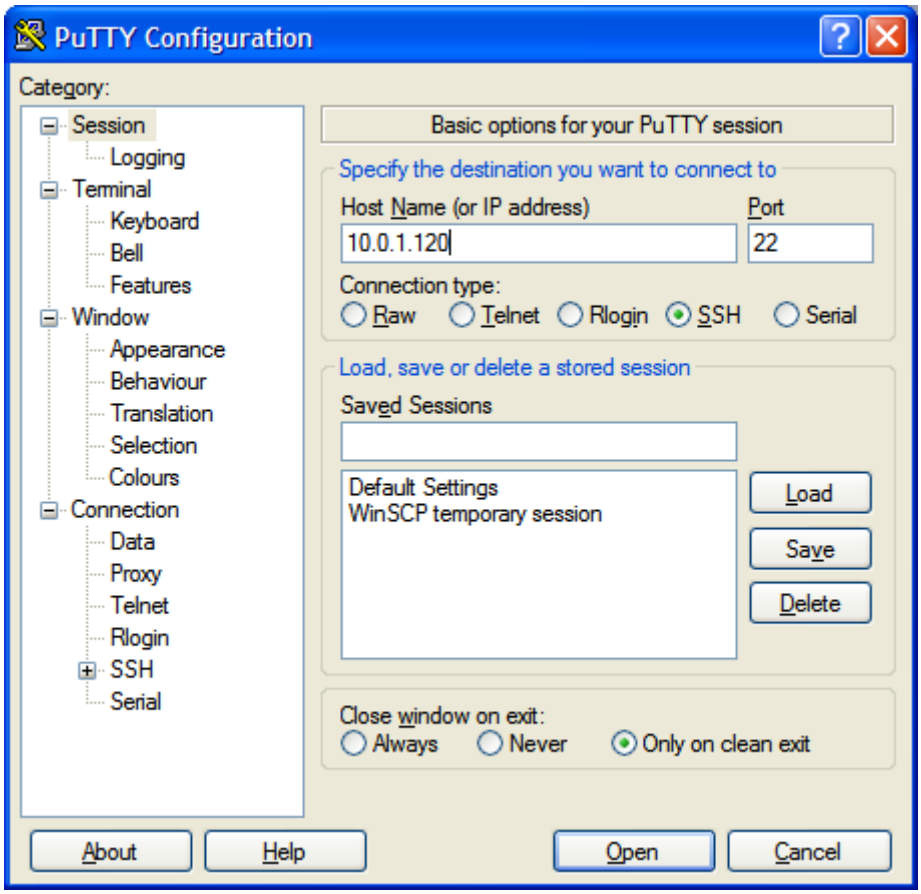
PuTTY

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

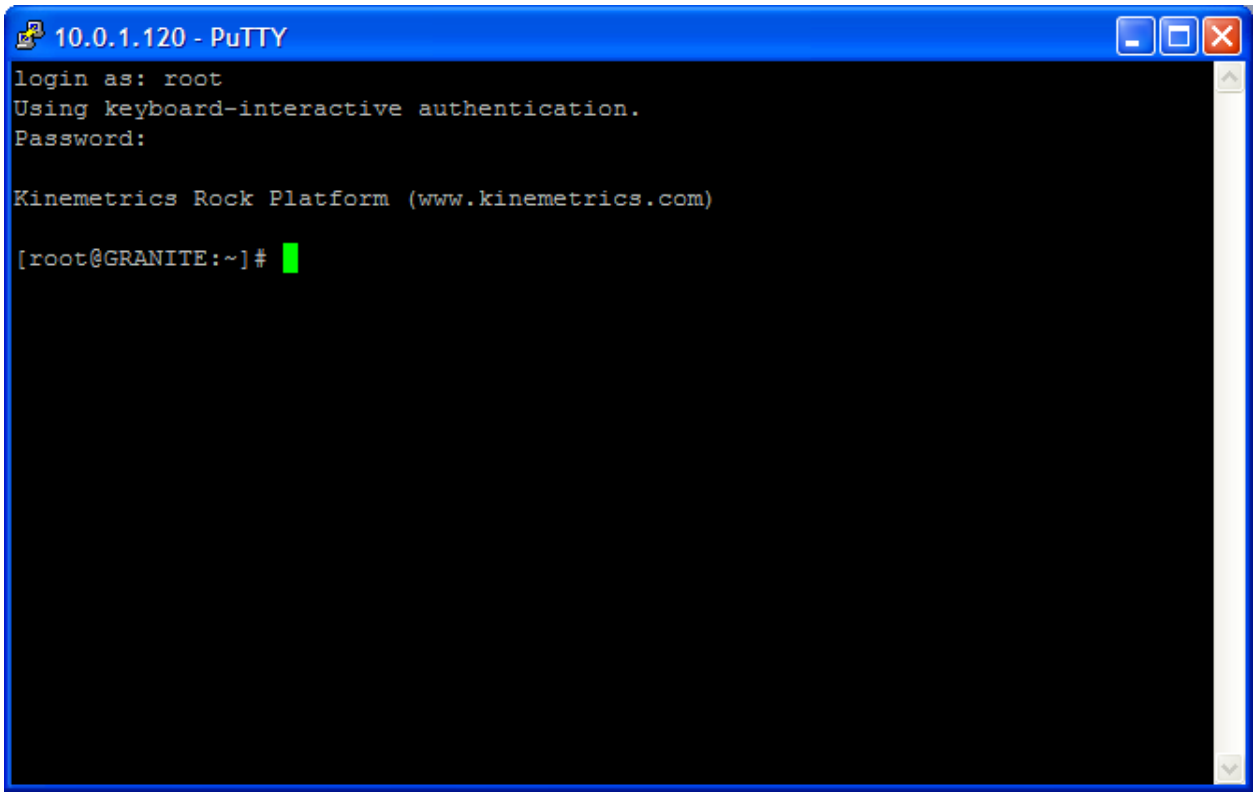
Since PuTTY is not EQMet software and is provided only as an example, we make no attempt to thoroughly describe all capabilities. However we will describe basic operation here. When you start PuTTY you will see a dialog that looks something like this:



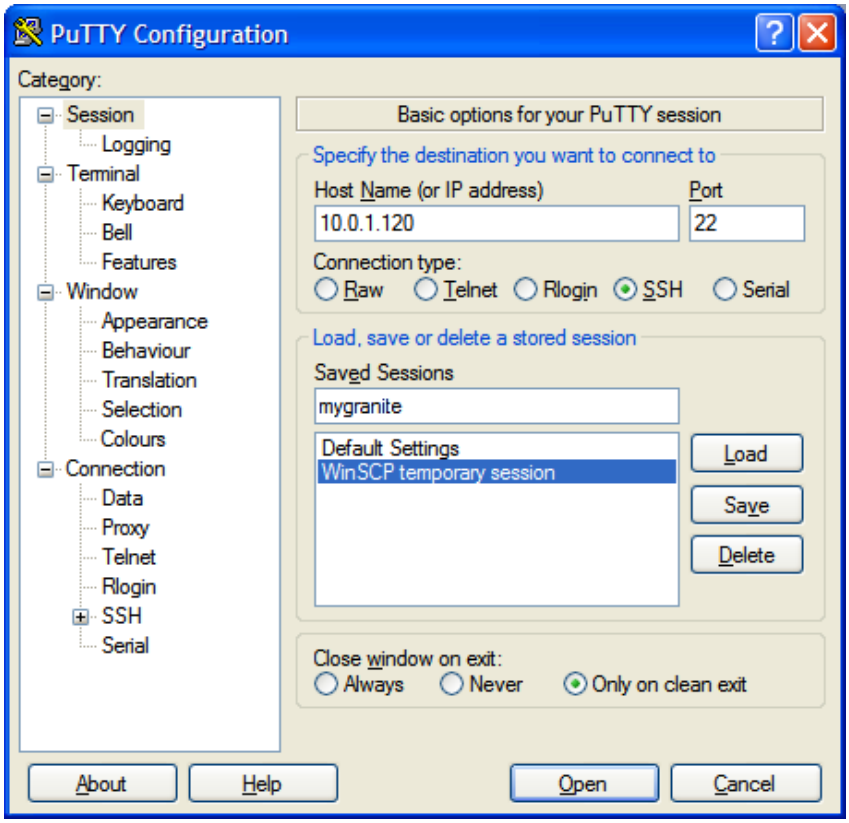
To log into the digitizer, enter the IP address of the unit and press “Open”:



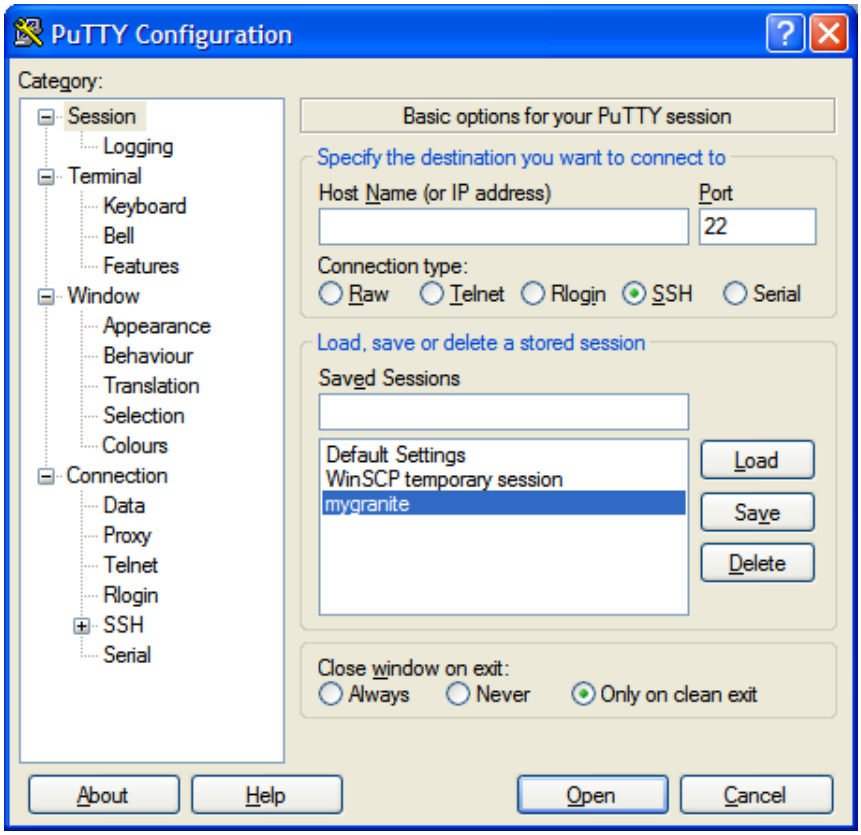
Next, you will see a secure console window as follows:



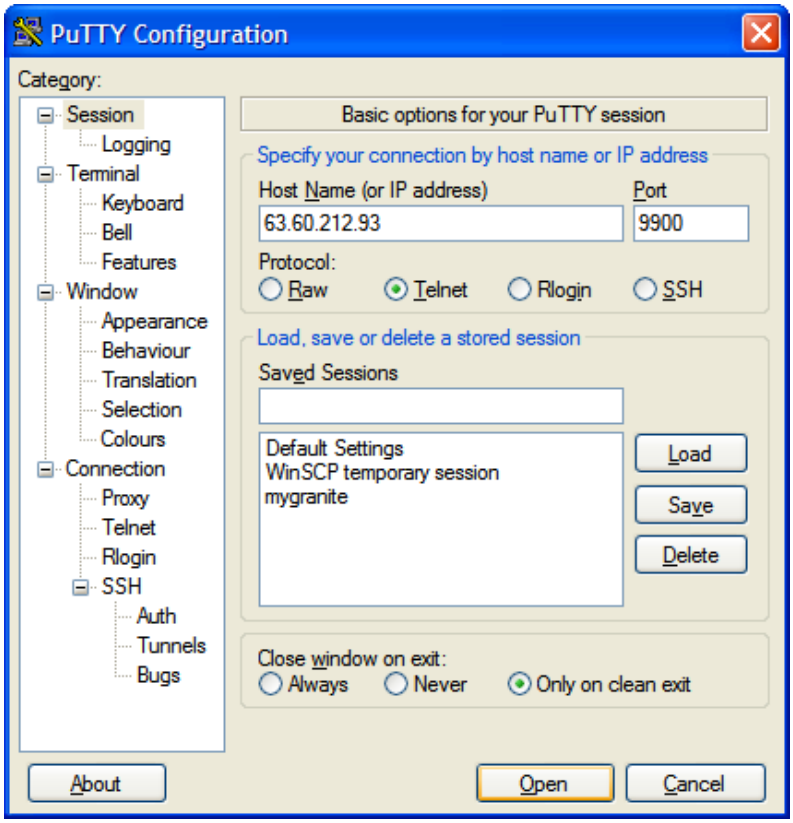
As with WinSCP you can save sessions to avoid typing in the future by entering the IP address at “Host name”, the name you assigned to the digitizer under “Saved Sessions”, and then press “Save”:



The unit will now appear in the list as “mytsa”, so reconnecting involves only starting the program, selecting the unit name (“mytsa”), and then selecting “Open”:



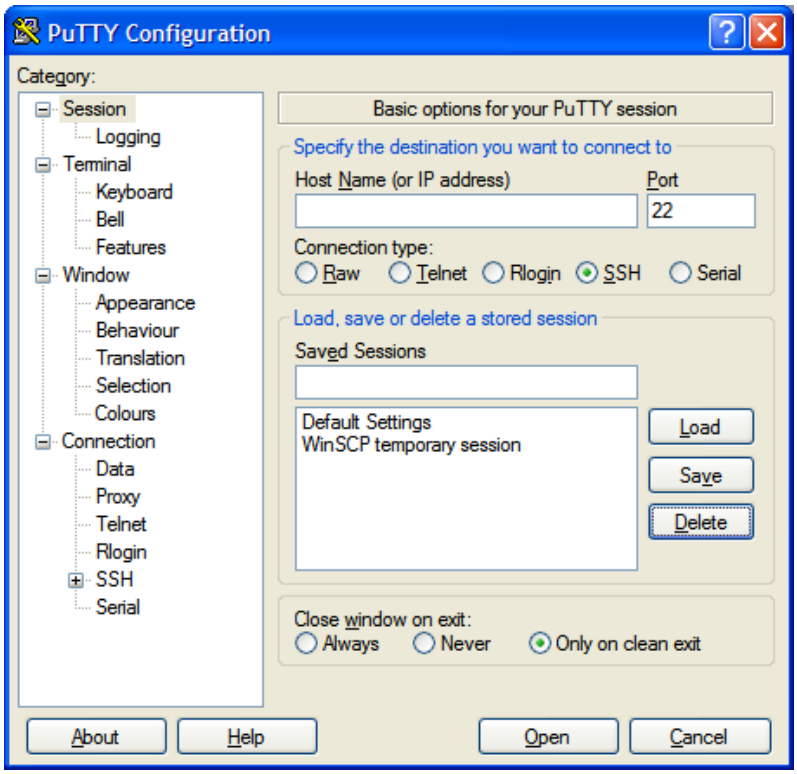
Please also note that PuTTY can be used as a telnet client, so you can connect to the Command Console by entering the IP address under “Host name”, selecting “Telnet”, entering the “port” as 9900 and clicking “Open”:



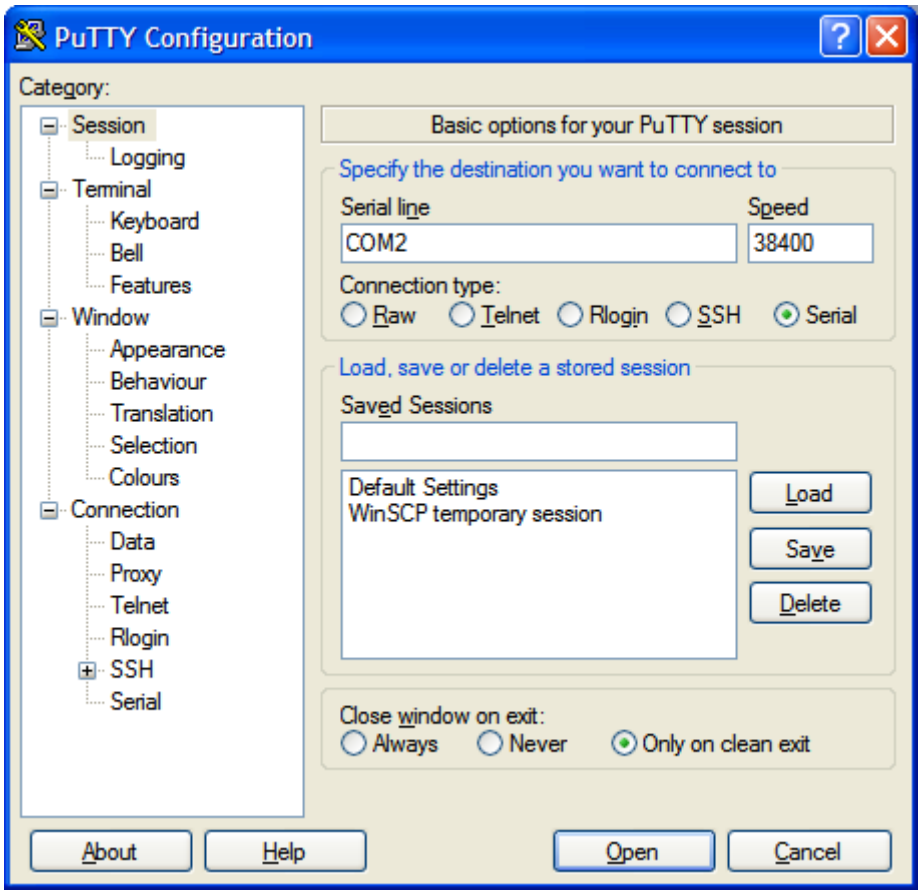
As with WinSCP and the PuTTY SSH connection, you can save this session by entering a name under “Saved Sessions” and clicking “Save”.

PuTTY can also be used as a simple terminal program to open a serial console to your digitizer (for example, to connect to the Linux console).

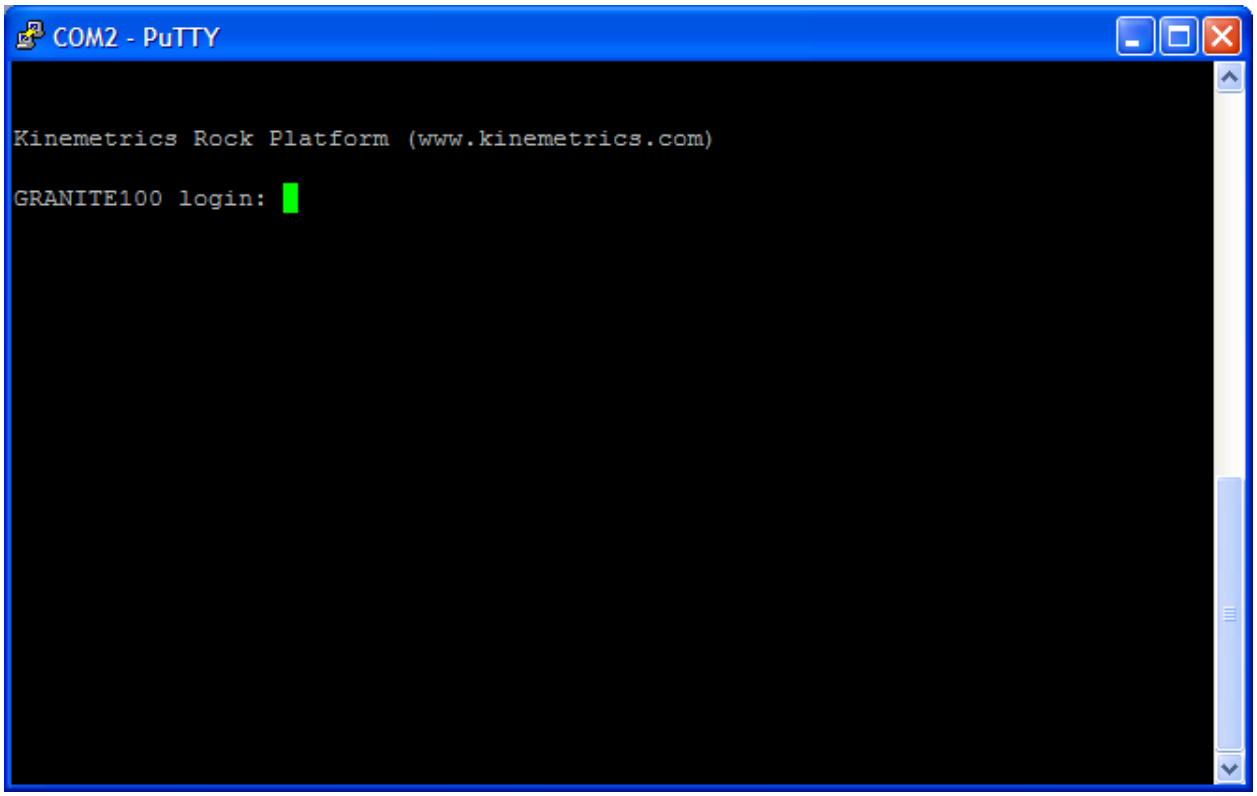
Again, when you start PuTTY you will see a dialog that looks something like this:



Select “Serial” and specify the Serial line (e.g.: COM2) and the baud rate:



Click “Open” and you’ll see something like:



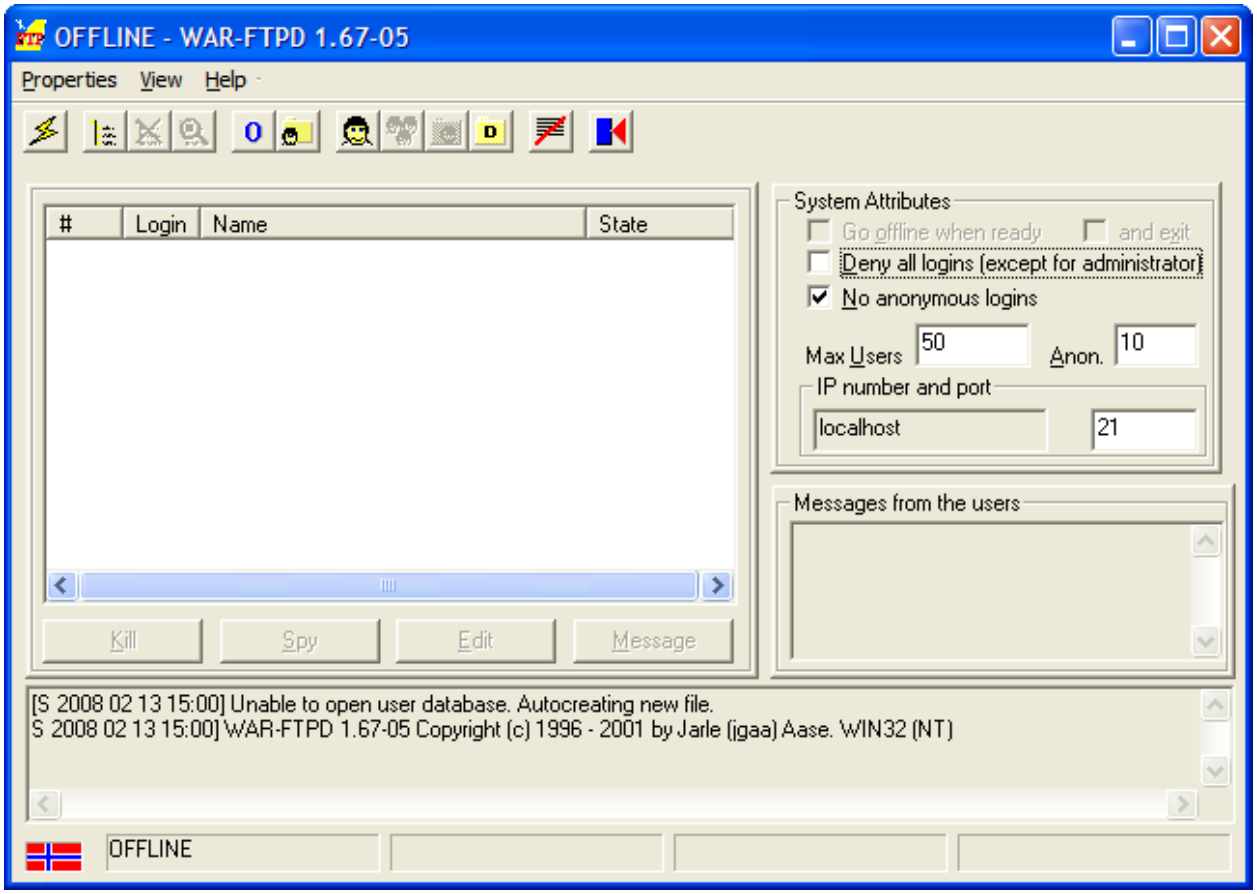
Note that the Linux serial console is at 115200 baud.

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”.

FTP Server

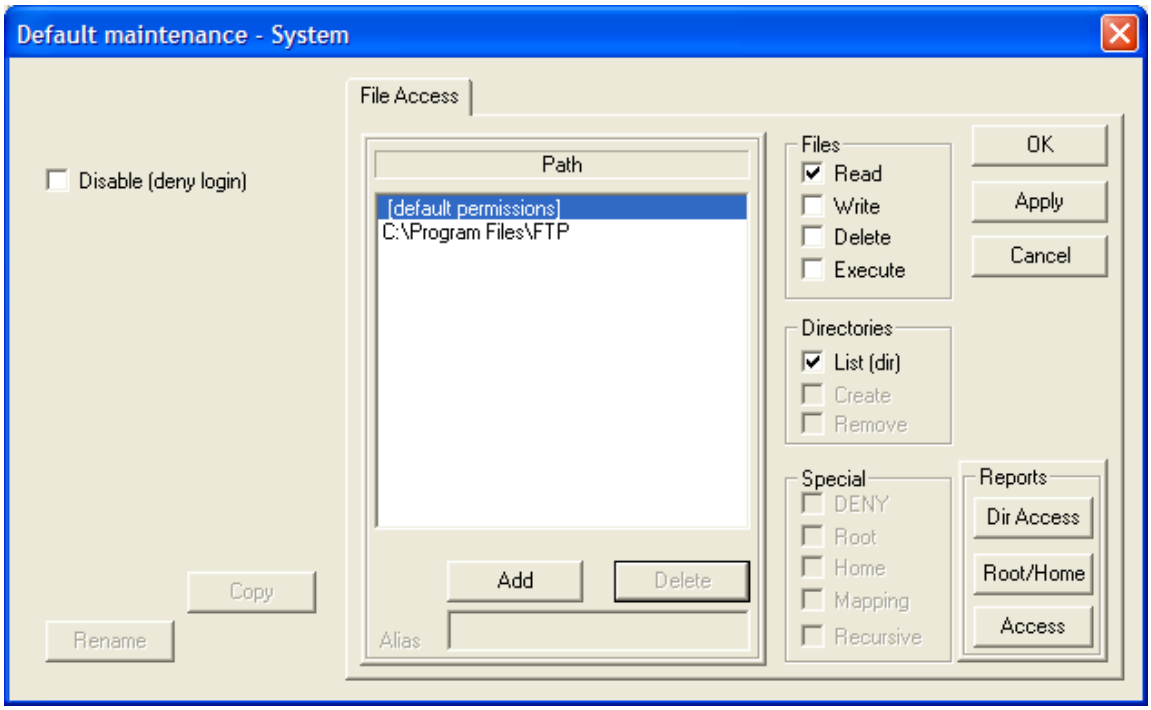
If you wish to transmit files from your digitizer automatically, one way to do this is to send them to an FTP server that receives the files. There are several public domain and commercial FTP server programs that you can choose from, but one such program is the WAR-FTPD.

To install WAR-FTP, place the war-ftpd.exe executable in an appropriate directory (Program Files\FTP is suggested) and start the program:



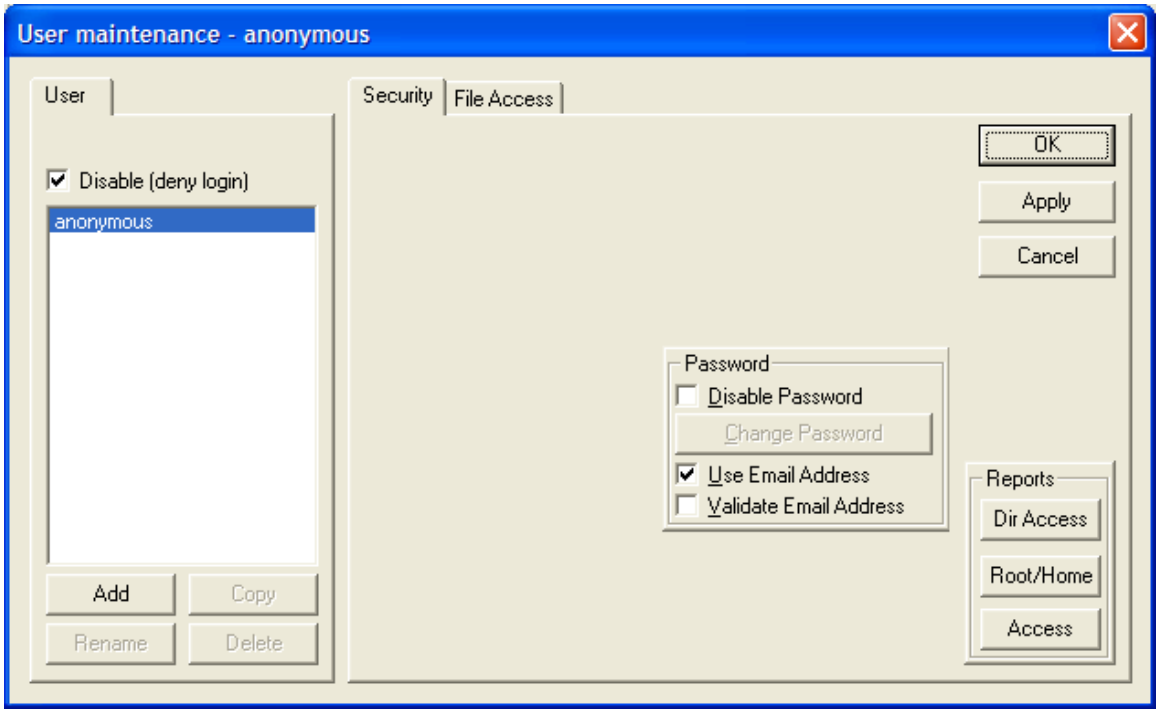
Select “no anonymous logins”.

Select from the menu Properties → Security → Edit Default:

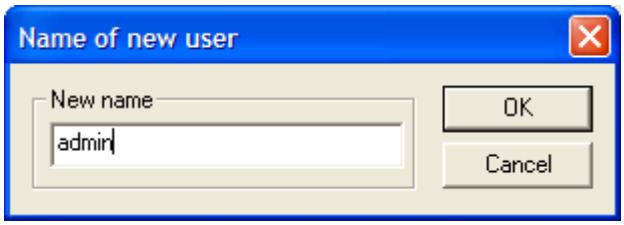


If present, select and DELETE the path for the "\" directory. Click OK.

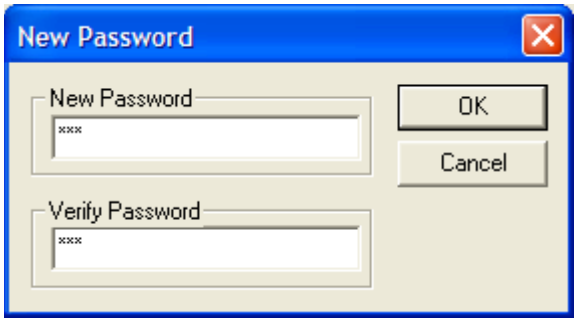
Select from the menu Properties → Security → Edit User:



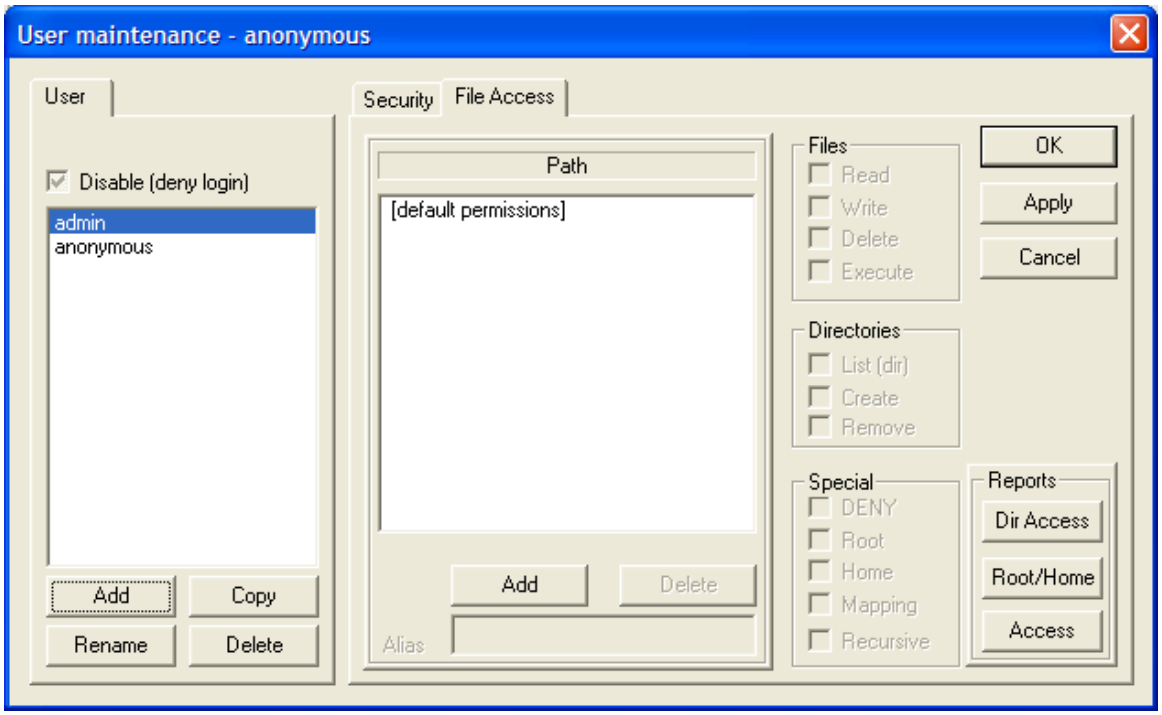
Choose “Add” to add a user. Add an “admin” user:



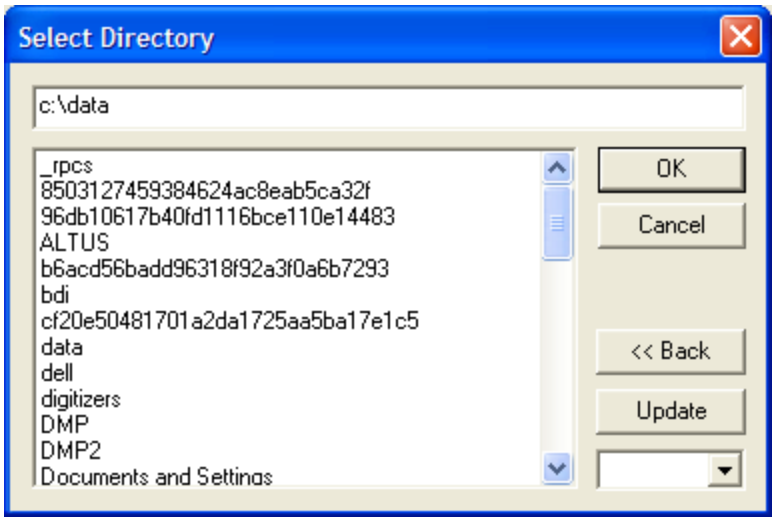
Specify and confirm the password. The default is “kmi” (but you can use what you want):



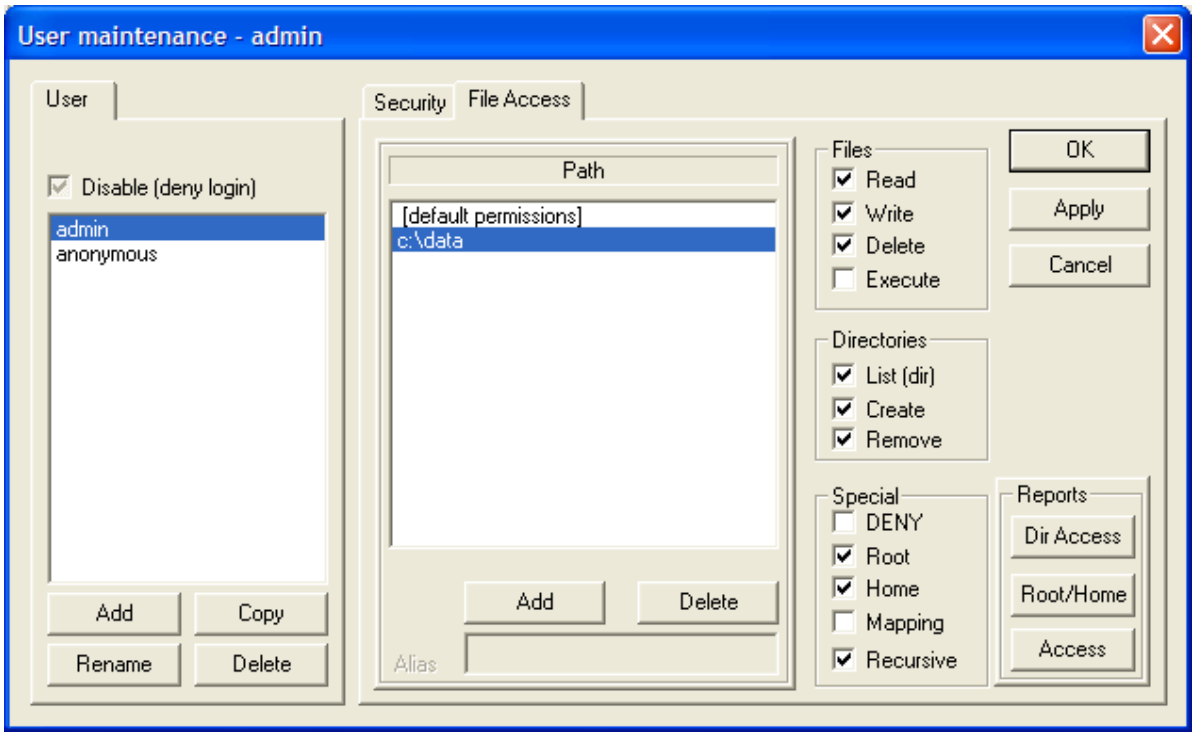
Select the File Access tab:



Press the “Add” button on the File Access tab under “Path”, and specify the directory where files will download to on your PC, such as “C:\data”, then press “OK”:



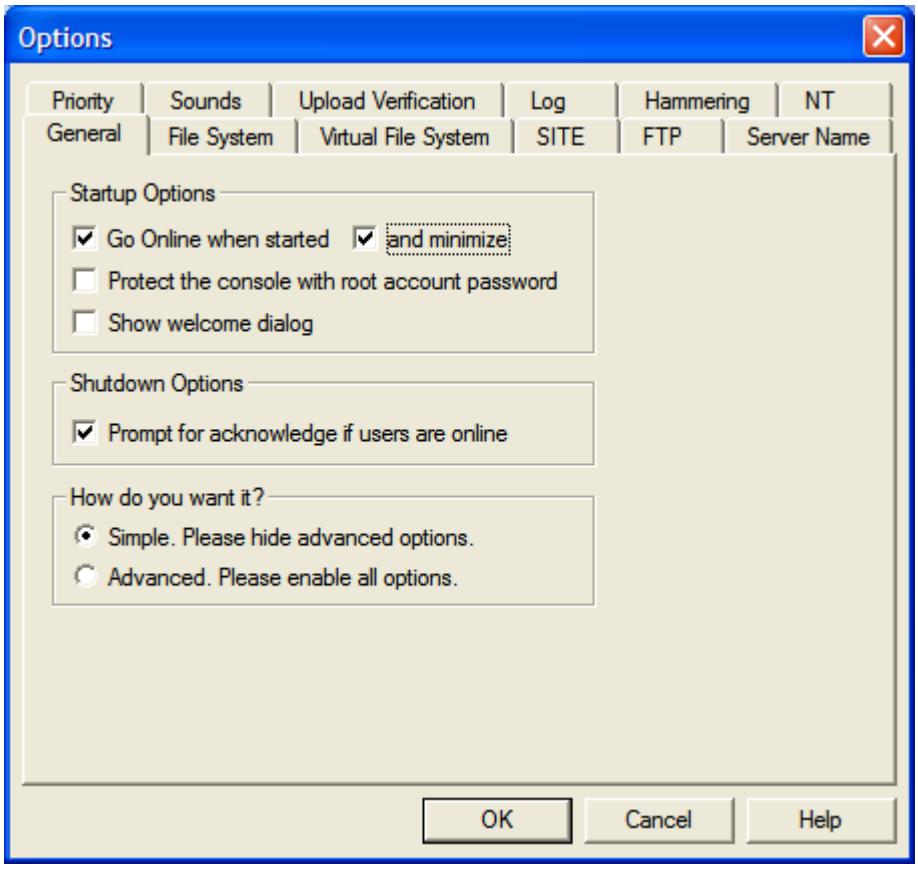
Set the permissions on the directory as follows or as appropriate, then “OK”:



Another way to improve security a bit is to limit permissions (for example, eliminating List, Write, and Delete permissions via FTP), or to run the FTP server from a user with limited access rights that only has access to those directories needed for the task, such as downloading to the C:\data directory on your PC.

You may choose to add other users with different permissions or access to different directories.

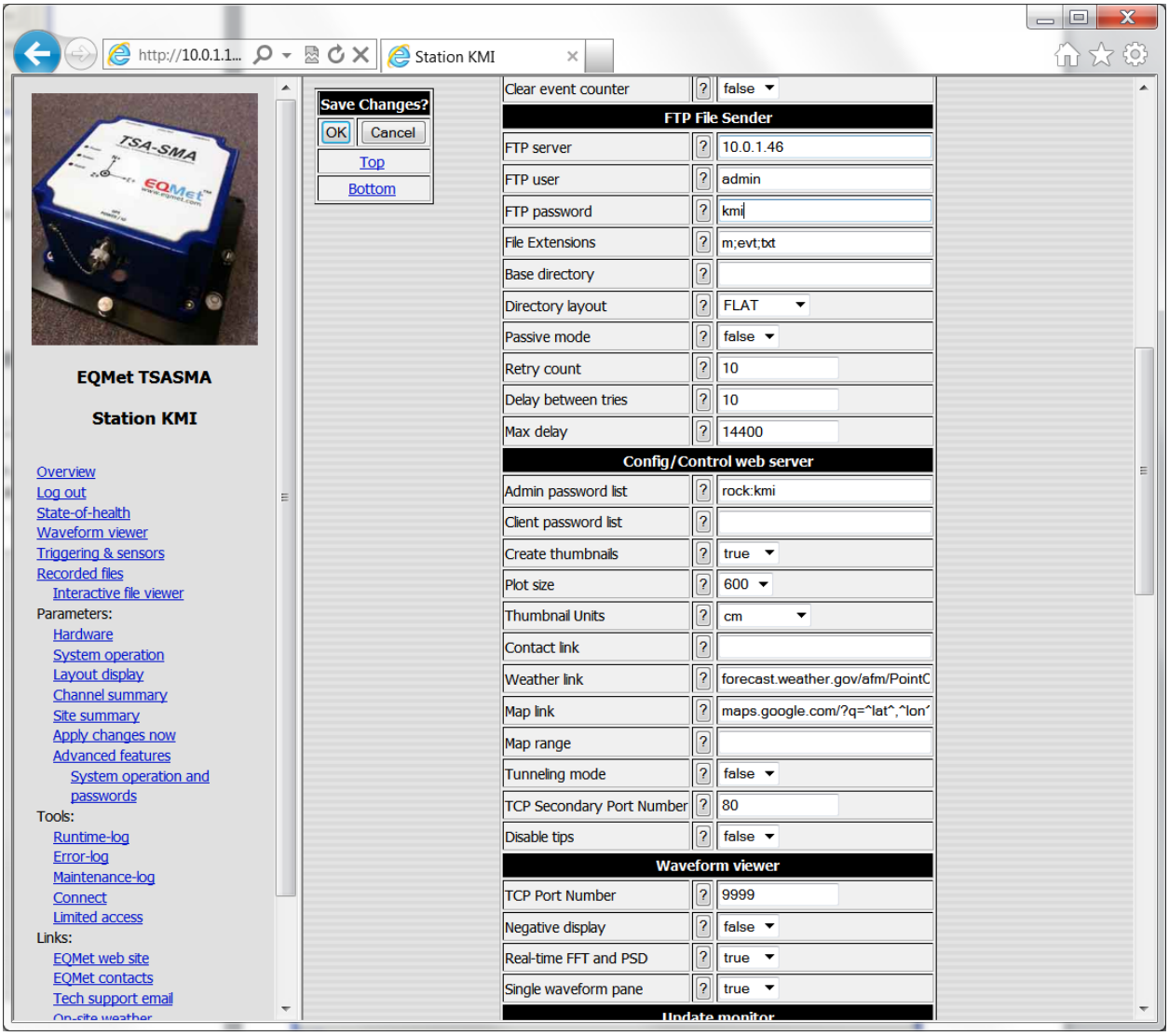
Select Properties →Options and select the General tab. Set startup options as follows:



Click OK.

You may start and stop the FTP server manually from its menu with the selection Properties → Start Service or Stop Service.

Configure the FTP Sender module in your digitizer's layout to match the IP address of the FTP server, the FTP user name and password (using the System Operation and Passwords selection from the left pane) as follows:



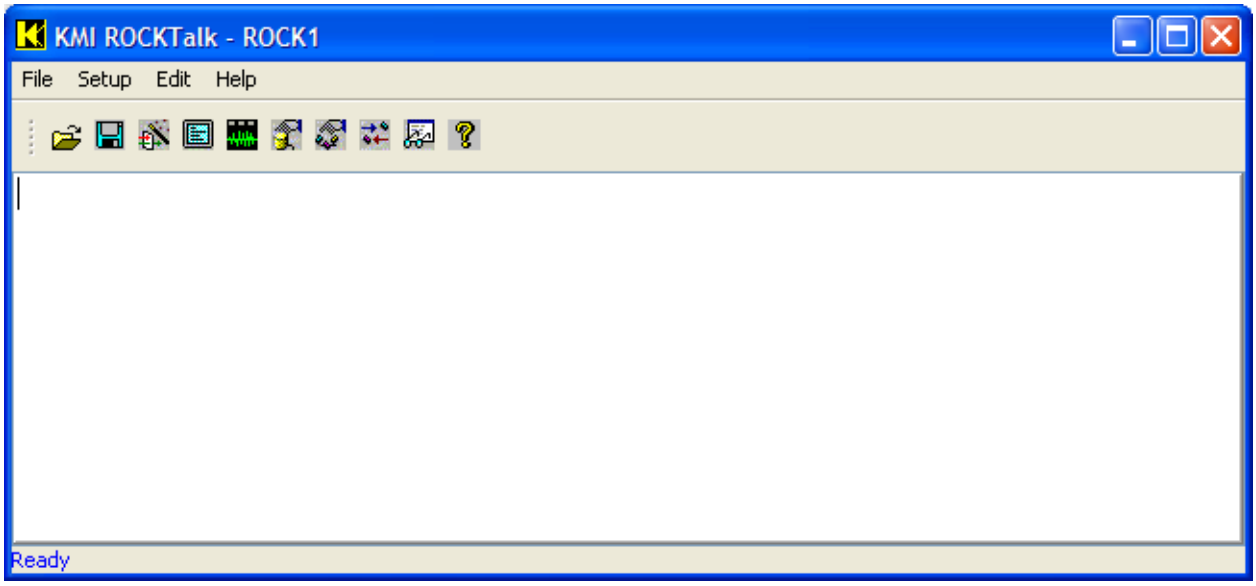
RockTalk

As an alternative to the web interface, you can use the RockTalk program that is part of the Rockhound distribution for PC. Rockhound is a Java program that runs on your PC and allows you to communicate with your digitizer over IP links. Details of RockTalk are contained in the Rockhound manual, p/n 304702. Basic operation is described here.

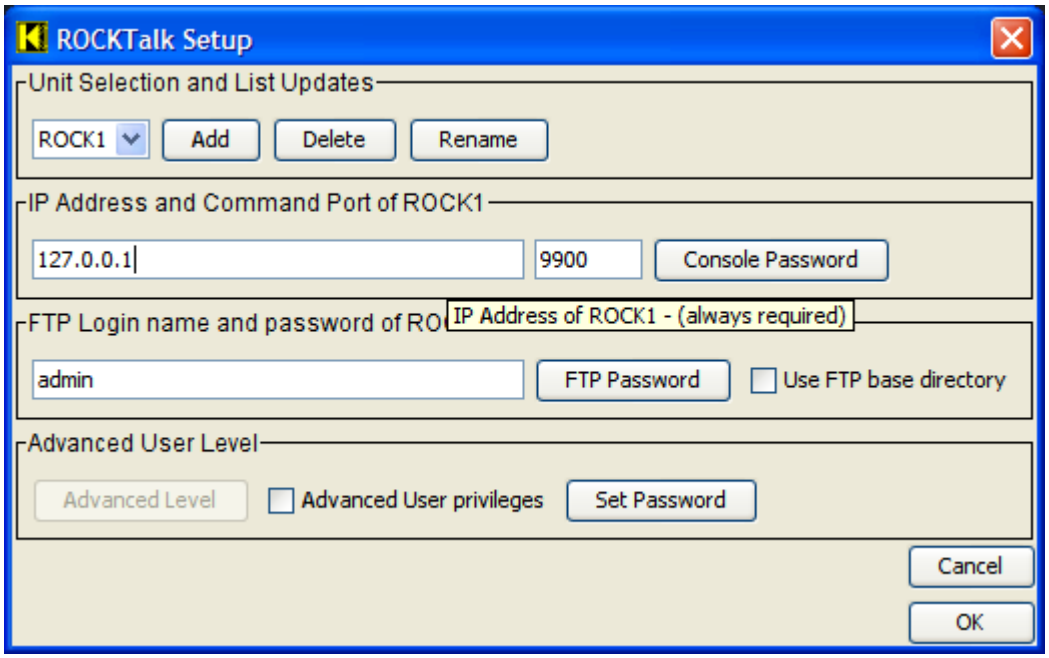
In order to use RockTalk to communicate with your digitizer, you must:

- Install Java
- Install the Rockhound distribution
- Have IP access to your digitizer
- Have the FTP server enabled on the digitizer

RockTalk supports communication with multiple digitizers, so is must be set up to communicate as shown here. Start the program and you'll see:

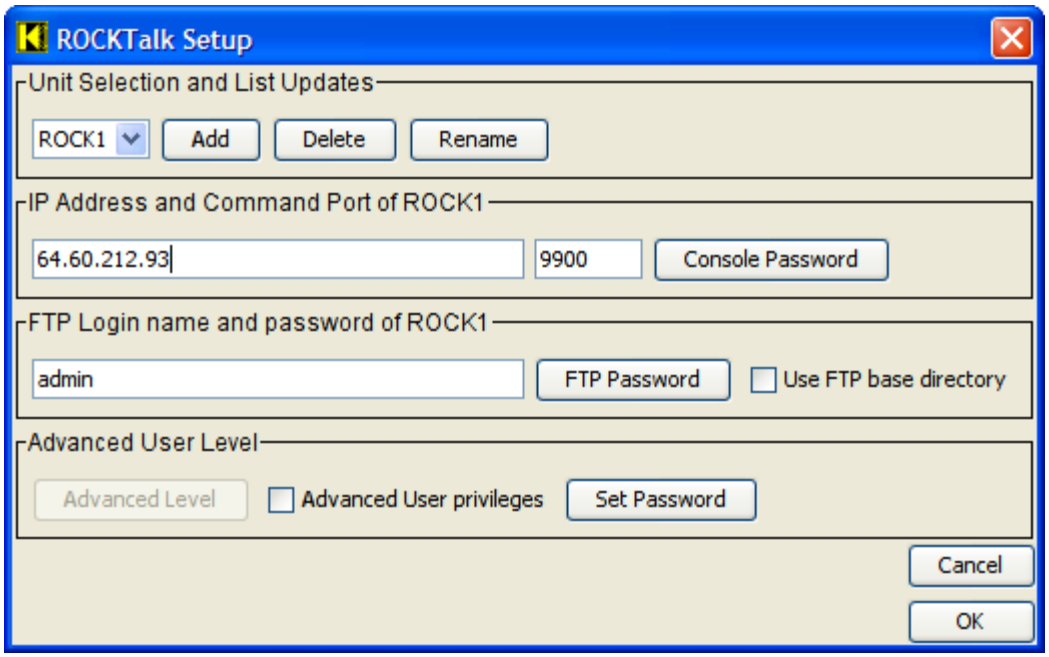


Select Setup → RockTalk Setup:

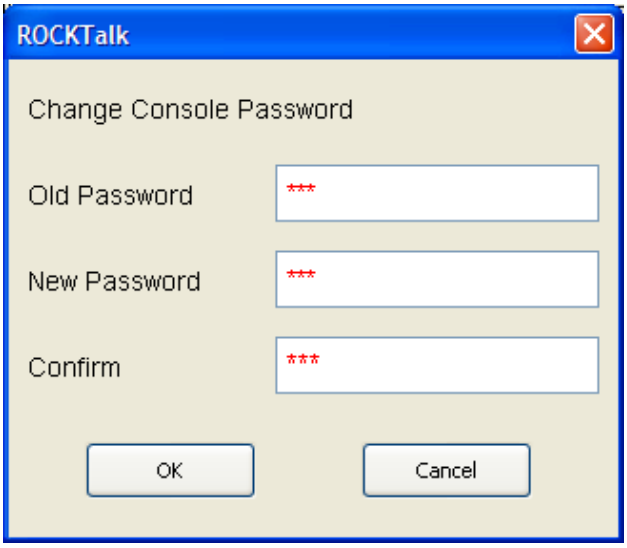


The top section is a list of units to communicate with. Since the initial install has no units set up, it adds one called ROCK1. You can rename this unit by clicking “Rename” and entering a new name. We’ll cover adding additional units later.

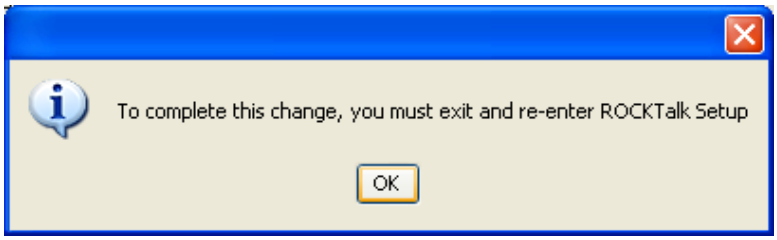
Enter the IP address of the unit as shown:



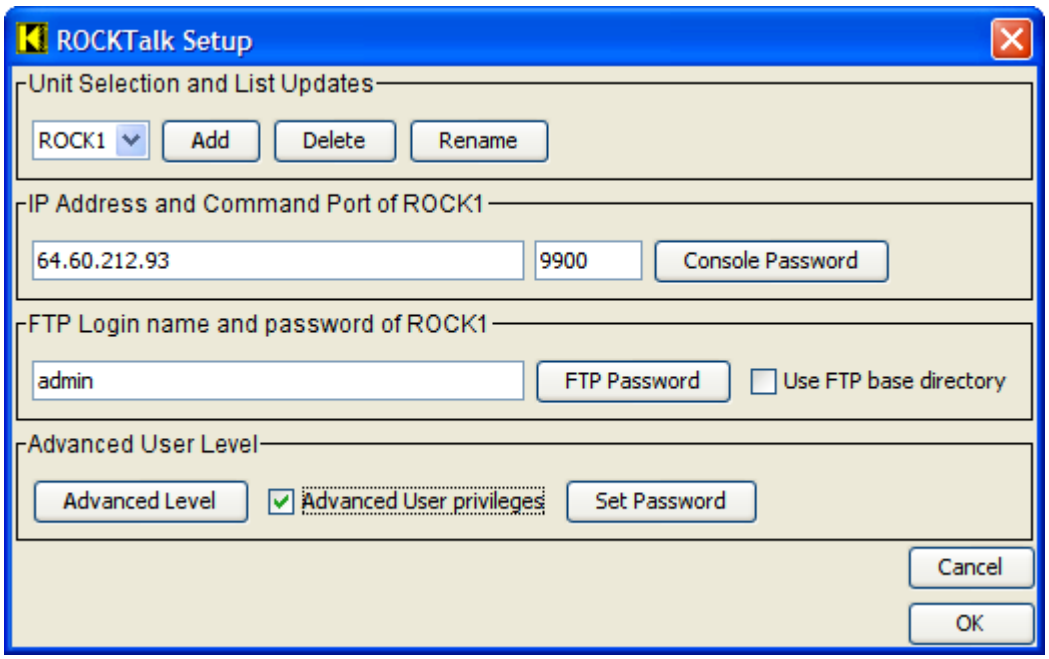
Press Console Password to set the Rockhound Console password used when connecting to the unit. The default (old) password is “kmi”, so enter and confirm the password configured in your unit as shown:



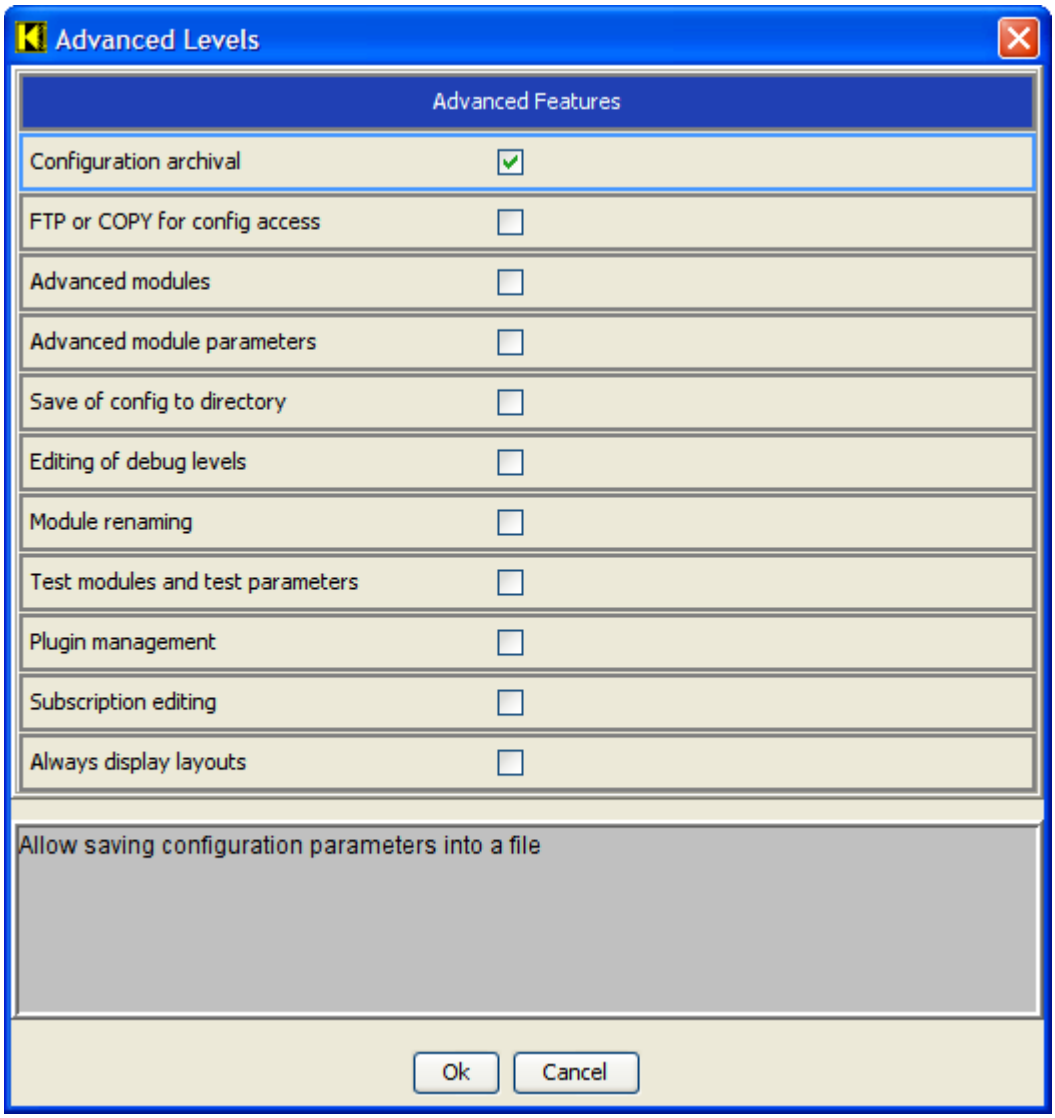
Click “Advanced User privileges” and you’ll get this warning:



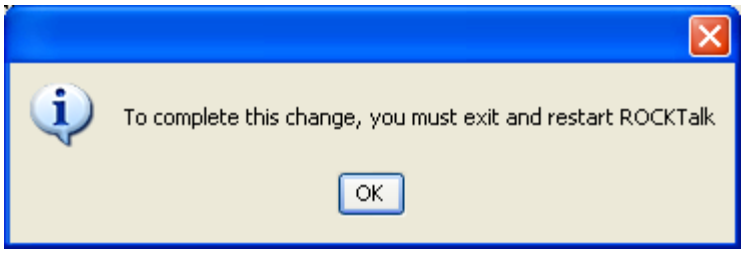
Click “OK” to close RockTalk setup, then re-enter with Setup → RockTalk Setup:



Click Advanced Level:

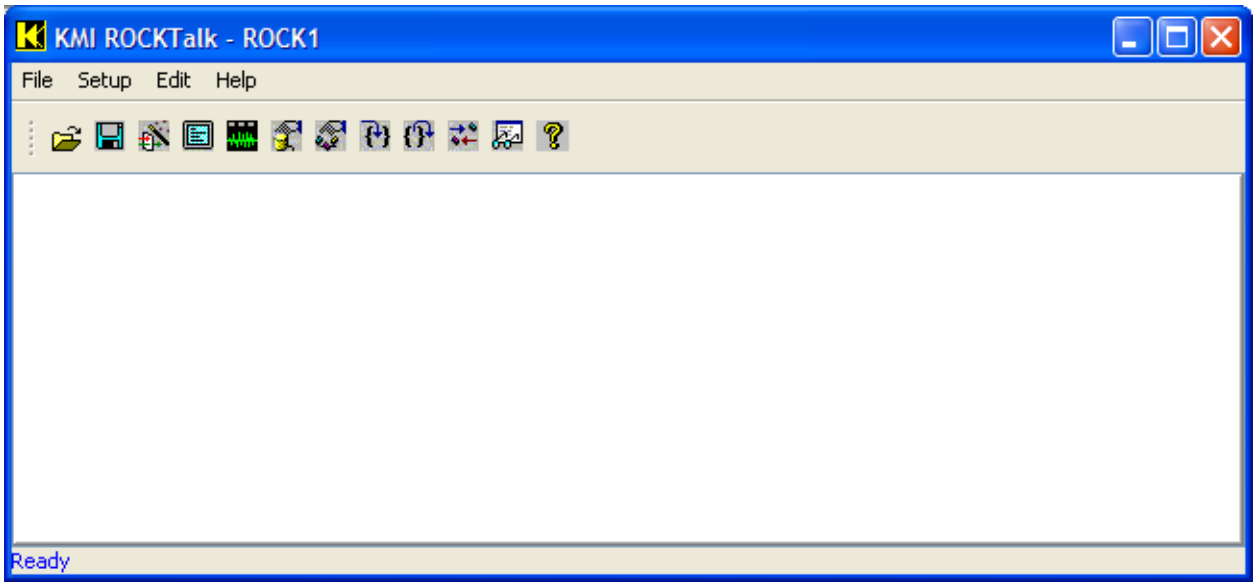


Select “Configuration Archival”, and then press OK:

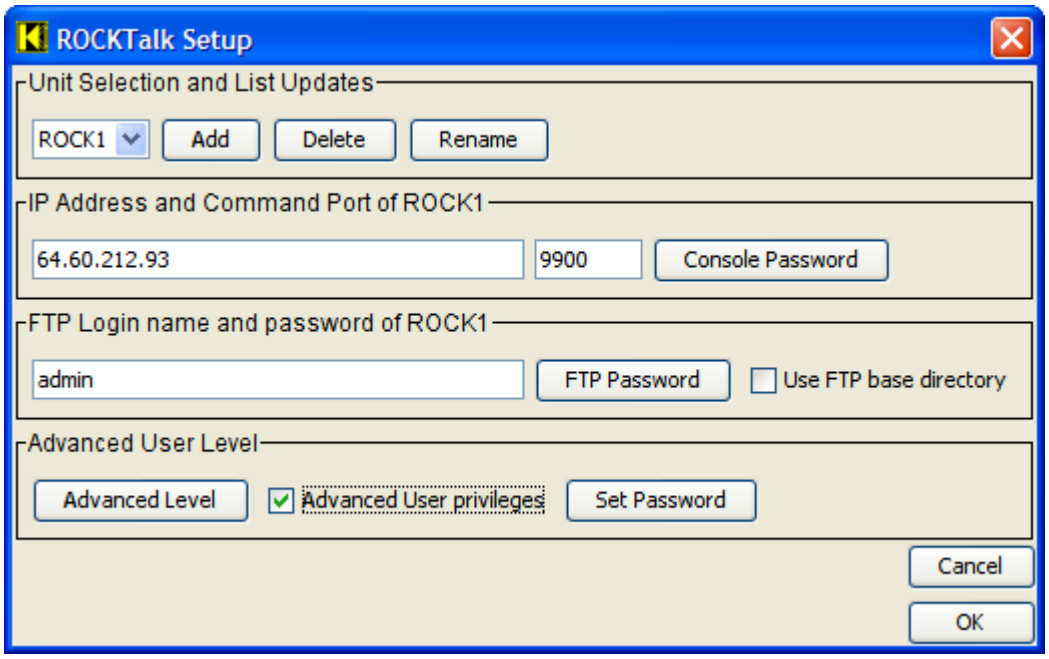


Click OK to close this informational window, click OK to close RockTalk Setup, and then close RockTalk.

Reopen RockTalk and you'll see:



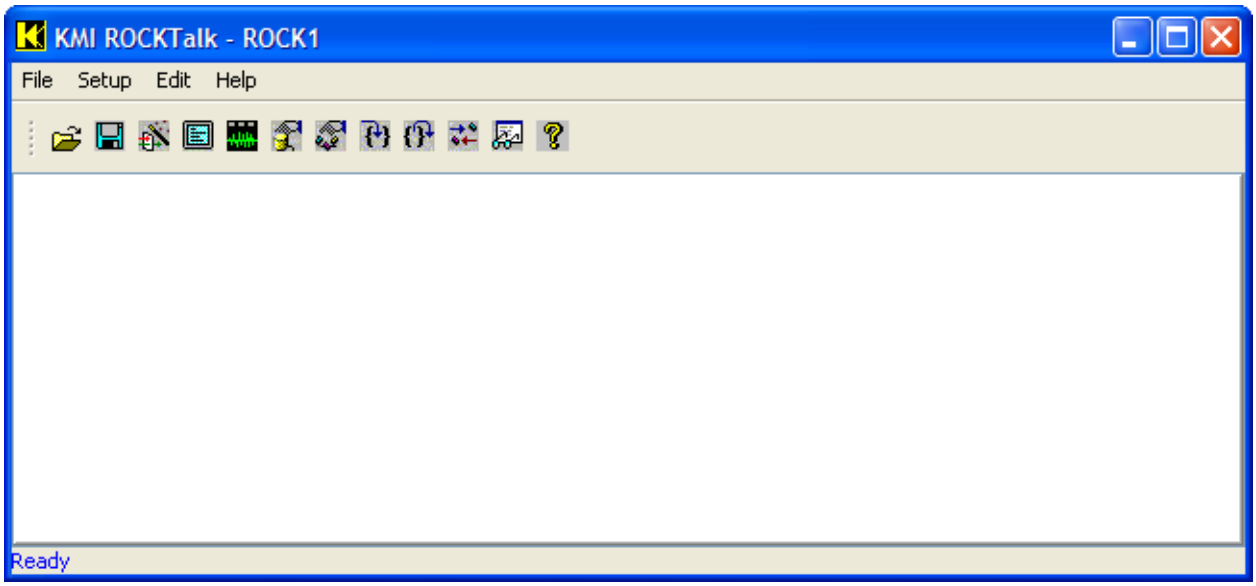
Re-enter RockTalk Setup:



Set FTP Login name to "admin", and set the FTP Password to "kmi" or whatever the passwords has been changed to on the admin account.

Click OK to save.

At this point, RockTalk is set up to communicate with your digitizer. Here is a brief overview of basic functions:



Note the name “ROCK1” in the title bar. This shows the currently selected digitizer (remember we said earlier that RockTalk can be used to communicate with multiple digitizers).

 File → Open Layout will read the current layout and configuration from the digitizer.

 File → Save Layout will send a modified layout and configuration back to the digitizer.

 File → Archive Layout will save a copy of the current configuration locally.

 File →De-archive Layout will read a local configuration so it can be edited.

 Setup → Layout Wizard allows you to create a new layout from scratch.

 Setup → Terminal Window opens a Rockhound command console.

 Setup → Waveform Viewer Window opens the RockVision waveform viewer.

 Edit → Edit Hardware Config allows you to edit hardware parameters of the configuration

 Edit → Edit Parameters allows you to edit operational parameters

 Edit → Replace Module allows you to replace modules in the layout

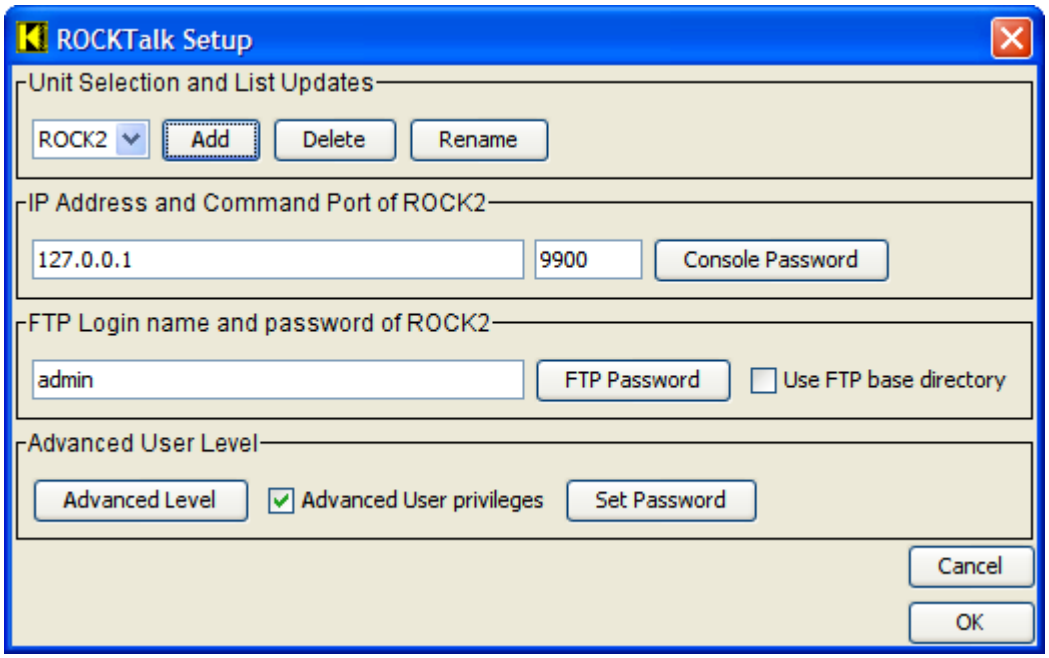
 Edit → Advanced Features allows you to insert or delete modules to and from the layout

 Help → About RockTalk, Version number.

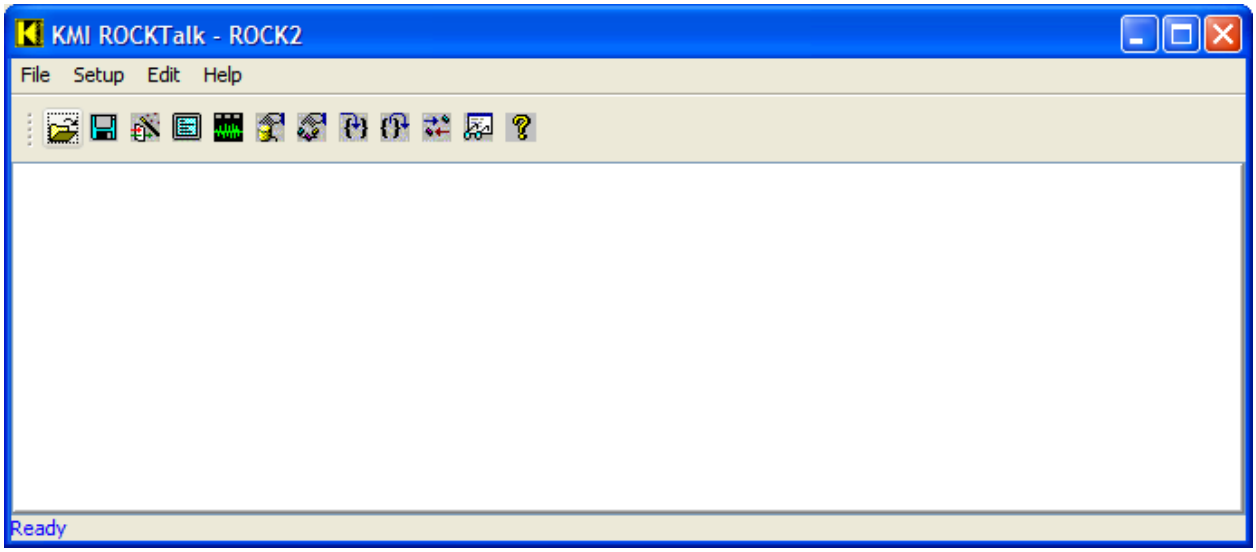
Other capabilities include sending and receiving registration files (not normally required for TSA-SMA digitizers) and updating firmware. Note that the firmware update selection allows you to update multiple units with one operation.

Remember we had indicated earlier that RockTalk could support multiple digitizers. To add more digitizers, go back to Setup → RockTalk Setup and clock "Add":

After assigning the new unit a name, you'll see:



Go ahead now and complete the unit setup, supplying the IP address, console password, and FTP password. When you click OK, you'll see:



Note that the title bar now indicates "ROCK2", so you always know which digitizer RockTalk is communicating with. To switch back to ROCK1, go back to Setup → RockTalk Setup, pull down on the Unit name to "ROCK1" and click OK.

Troubleshooting

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`.

Interactive File Viewer Doesn't List Any Files

Some Anti-Virus programs may restrict non-browser traffic on HTTP port 80. The program Avast! for one is known to do this. The Web Server of the digitizer can overcome this if you assign the Web Server's Secondary Port Number to a different port that the Anti-Virus program doesn't interfere with.

For example, you can assign the Secondary Port Number to 9980.

If necessary, allow the new port through any firewalls or routers.

Web Server's Layout Wizard Doesn't Transmit Files

Some Anti-Virus programs may restrict non-browser traffic on HTTP port 80. The program Avast! for one is known to do this. The Web Server of the digitizer can overcome this if you assign the Web Server's Secondary Port Number to a different port that the Anti-Virus program doesn't interfere with.

For example, you can assign the Secondary Port Number to 9980.

If necessary, allow the new port through any firewalls or routers.

Waveform Viewer Stops Updating

Displaying many channels or a few channels at high data rates may fail because Java Applets don't have enough memory by default. To fix this, increase the amount of memory available to applets. On windows you open Control Panel --> Java. Open the Java tab and Applet Runtime Settings. Set the runtime parameters to something like -Xmx128m. Apply the changes, close the Java control panel, and close and reopen the browser to apply changes.

FileViewer and Large Files

Large files may fail because Java Applets don't have enough memory by default. To fix this, increase the amount of memory available to applets. On windows you open Control Panel --> Java. Open the Java tab and Applet Runtime Settings. Set the runtime parameters to something like -Xmx128m. Apply the changes, close the Java control panel, and close and reopen the browser to apply changes.

Deleting a Linux directory with lots of files

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
```

Can't delete data files when logged in as "admin"

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.

```
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.

IP issues. Firewalls and router blocks

If you’re having problems with IP communication, here are some basic troubleshooting tips:

If the digitizer 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 digitizer and computer are on the same private network, make sure that both the computer and the digitizer 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), SMTP e-mail (port 25), NTP (port 123) or Rockhound specific services such as the Rockhound Console (port 9900).

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.

Primary SD Card

The Primary SD 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.

Digitizer Maintenance

Run Remote Check Tests

TSA-SMA digitizers 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
- Verify sensor offsets are within range
- Perform sensor functional tests
- Review software and communication logs for signs of communication problems or security breaches.
- Check for firmware upgrades available on the EQMet 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

Troubleshooting & Service

If your unit needs repair or service, you should return it to EQMet

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.

Preventive Maintenance

Desiccant Replacement

To help maintain low humidity inside the unit, the unit contains a packet of desiccant inside to absorb any water vapor. We that recommend that you replace the desiccant package every 24-36 months.

You can order new desiccant packets (P/N 700049) from EQMet.

To replace the desiccant package proceed as follows:

- Remove all power sources from the system and wait until it has completed its shutdown sequence.
- Remove the four visible socket head hex bolts and remove the lid carefully without disconnecting cables.
- Remove and replace the desiccant. The old package can safely be disposed of in normal trash.
- Replace the lid ensuring that the gasket is correctly located on the base plate.
- Tighten the four screws.
- Reconnect the unit to the power sources.

***Caution: Possible equipment damage**. If you do not correctly replace the end cap and the seal screw the watertight integrity of the unit can be compromised and damage can occur to the unit.*

 ***Caution: Potential ESD equipment damage.** The digitizer 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.*

Cleaning the Digitizer

Disconnect all power from the unit before. 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 cover screws before cleaning the unit.

System Description

This system gives an overview of the Standard TSA-SMA digitizer system 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. A TSA-SMA Digitizer typically includes the following subsystems:

- Intelligent power supply
  - DC power input
  - Internal super capacitor array
  - Power system control processor
- Main processor System
  - Processor
    - Linux Operating System
    - BootLoader
    - Java Virtual Machine
    - RockHound Software
  - On-board flash memory
  - On-board RAM
  - Console port
  - Ethernet Communications
  - Internal Secure Digital socket
  - GPS Timing Module & Disciplined Oscillator
- Three channel high resolution analog to digital converter and supporting circuitry
  - Isolated DC/DC Power supply for Analog Section
  - Isolation Barrier to Analog Section
  - Delta Sigma ADC Converters
- Internal Sensor Deck:
  - +/-4g Sensor Deck
  - Powered from Unit Power

Intelligent Power Supply System

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

- Super capacitor backup
- Sequenced start up

- Sequenced shut down
- Communication with the user via status LEDs
- 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 the voltage levels and other parameters to assure that the system is operating correctly and within operational limits. Under some circumstances, the power supply subsystem may inhibit startup of the system in order to protect the hardware. This system basically ensures the safety of the remainder of the TSA-SMA digitizer.

Super capacitor Backup

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

Reversed Input

The system will protect against a reversed battery but cannot operate from the reversed battery.

Sequenced Start-Up

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

Perform initial start-up delays to avoid system "motorboating"

- Start the processor
- Charge the super capacitor array
- Finish booting and loading operating system
- Power and start the sensor array

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 super capacitor power:

- Power down the sensor array, GPS, and other power loads
- Close any open files on the SecureDigital card
- Send out notifications that shut down is imminent via Console and LEDs
- Close all running processes
- Shut off the processor and all LEDs

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
- Steady Green - Running off of external power
- Flashing Green - The system is starting up

Status:

- OFF - Working, no time source
- Steady Red - Power supply bootloader turn on. Used to load new power supply firmware
- Flashing Red - System Fault detected. For example, system outside of operating limits.
- Infrequent Red - System Error detected. For example, incompatible power sources detected, or running off of a power source other than battery showing invalid voltages.
- Steady Green - Waiting to turn on. In initial startup delays or timed operation window
- Flashing Green - The system is starting up
- Infrequent Green - Working, a time source is being used (digitizers only)
- Orange - Super capacitor is being charged
- Alternating Red and Green - The system is shutting down

Event:

- OFF - No events
- Steady Green - Real time data stream (digitizers only)
- Flashing Green - Unused condition
- Infrequent Green - Events stored (digitizers only)

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 2 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 2 hours.

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.

Power Fail Protection

The system includes an internal power backup called a super capacitor array which is charged with power at system turn on. This backup provides enough residual power to terminate any running applications and shut down Linux properly. Once power fail has been detected, the system begins to operate off of this residual power and issues a request to Linux to shut down. 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.

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 a loading the code into the DSPs on the Analog to Digital Converter (ADC) boards. It also handles updating the code in the other processors in the Power Supply and ADC boards.

Processor

The Processor is an Atmel AT91SAMG20. This is a highly integrated low power processor that is based on the ARM architecture ARM926EJ-. It has 128 MB of SDRAM Memory and 256 MB of redundant (essentially RAIDed) Flash. The system boots Linux from the internal SD Card.

Storage

The unit provides a single internal SD Card slot which is not physically accessible by the user.

Communication Interfaces

The Processor supports multiple communication protocols.

Serial Connections

A Console serial port (3-wire) and User serial port is provided and is available when the appropriate cable is installed. Up to two more serial devices may be available as options.

Ethernet Connections

TSA-SMA Digitizers provide a 10/100 Ethernet connection.

USB Connections

The unit provides a USB Host Port and USB Device Port that are USB 2.0 compatible and run at Full Speed (12 MbPS).

GPS System

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

Hardware Identification

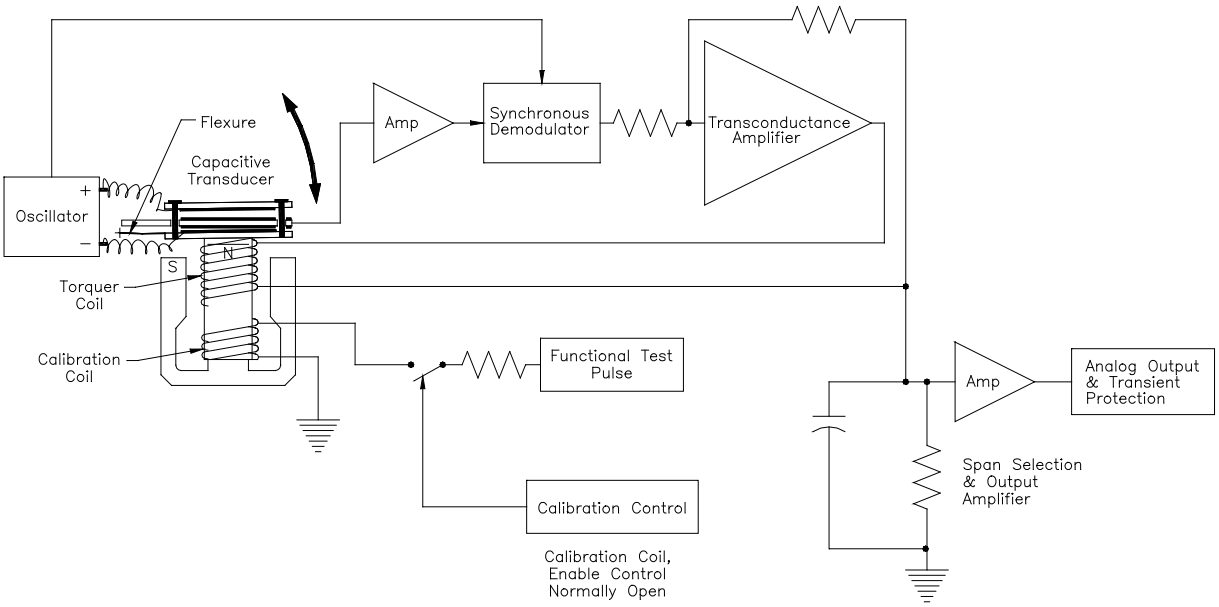
A unit tag number is assigned to the system as a whole. This unit tag number is stored on the main processor board.

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

Sensor Internal Deck Theory of Operation

This section describes the operating principles of the sensor internal deck used in the TSA-SMA.

The Sensor deck consists of three orthogonally mounted force balance accelerometers (FBAs) – Z-axis, N-axis and E-axis. The figure below shows a simplified block diagram of the major components of each of the Sensors.



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 symmetrical 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 is set to provide a 4g output range.

Pole Zero Representation of the Sensor

TSA-SMA 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 $\pm$.0.5 dB over the bandwidth of the sensor. The phase agreement is within $\pm$ 2.5° in the 0-100 Hz band and within $\pm$ 5° 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)
s is the Laplace transform variable
p2 = p1 conjugate
p4 = p3 conjugate
V (s) is the Laplace transform of the output voltage
A (s) is the Laplace transform of the input acceleration

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

Operating Firmware Description

The system operates using the Linux operating system, while the processor digitizer software is written in Java and runs on a JVM on the system. The power supply and calibration processors are programmed in C, while the DSPs run software in C++ on a custom scheduling system.

Linux Overview

The Linux kernel used in the system is based on Linux v2.6.38.8.

The Linux distribution is sized to operate within the processor and storage resources available, but to accommodate the needs of the task at hand.

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.

Additional Linux capabilities may be provided by the major application software.

The Linux kernel and initial boot filesystem are located in flash memory on the processor board itself. Once the Linux kernel initially loads, control is transferred to the boot and data filesystems located on the primary SD card.

The primary SD card uses the EXT3 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 available Linux commands. For more detailed information, the user is referred to any one of the many books, users groups, or other resources available on this topic.

Updating Linux

The Linux distribution provides for field updates of the kernel, init filesystem, boot flash, and files on the primary SD 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:

`2.1.1_rock (version 2.1.1)` `2.1.2_rock (version 2.1.2)`

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.

Software Versions

There are several different software components in your system and each has its own versions. The versions of each will be listed on the data sheet that came with your unit. Software versions include:

- The Linux Kernel
- The Initial File System
- The SD Image
- The Java virtual machine (JVM) version
- Rockhound

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 initial file system version
- The JVM version
- The Linux kernel version
- The SD image version
- Linux update (patch) level
- The Rockhound version

```
[root@TSASMA:~]#   versions

KMI Arm EABI filesystem 0.7 Beta

KMI initrd 1.3

KMI Kernel, build: Jul 25 2011, 23:28:18

KMI Rockhound 3.8
```

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.

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.

System Power Requirements

The power consumption of a TSA-SMA unit with an internal deck is typically 4.2W (260mA at 15V or 340mA at 12V)

Its actual autonomy with any battery can be calculated using this formula:

T (hours) = Capacity (WH)/Consumption (W) = hours of autonomy

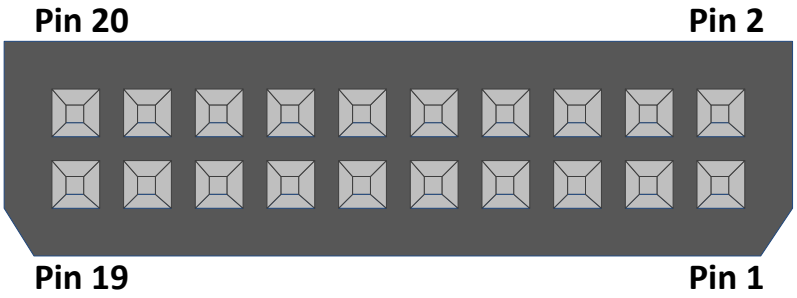
For example, a 12V, 12Ah battery would have a capacity of 12 x 12 = 144 Wh and an autonomy of about 144/4.2 = 34.3 hours.

Connector Reference

This section contains cable and connector reference material that can be used for creating or customizing cables for your unit. In addition, this information can be useful for electrical diagnosis of cabling or electrical problems.

Power, Serial, Console Connector

This 20-pin multifunction connector provides connection for power, Console Serial, Main Serial, and 2 optional serial port/relay options.



External View of 20-pin TSA-SMA Connector

Pin	Name	Group	Description
20	SPDTxD	Console Serial Port	Console TxD
19	SPDRxD		Console RxD
18	Gnd		Console Ground
17	SP0Tx	Serial Port 0	Serial Port 0 TxD
16	SP0RTS		Serial Port 0 RTS
15	SP0Rx		Serial Port 0 RxD
14	SP0CTS		Serial Port 0 CTS
13	SP0CD		Serial Port 0 CD
12	Gnd		Serial Port 0 Gnd
11	VP8To18+	Power	10-12V battery power
10	VP8To18+		10-12V battery power
9	Gnd8To18+		10-12V battery ground
8	Gnd8To18+		10-12V battery ground
7	Rly1NC|SP2TxD	SP2/SPST Relay 1 (option)	Reserved
6	Rly1Com|Gnd		Reserved
5	Rly1NO|SP2RxD		Reserved
4	PGnd	Protective Ground	Protective Ground
3	Rly2NC|SP4TxD	SP4/SPST Relay 2 (option)	Reserved
2	Rly2ComGnd		Reserved
1	Rly2NOSP4RxD		Reserved

You may use one of the KMI cable assemblies that has a universal power module or battery lugs and either a Console Serial or Main Serial Connection previously described or you may construct your own cable assembly using a 2 meter long Samtec Cable Assembly RC5-01-H-D-02.00-BC (available directly from Samtec) that has 20-pin mating connector at one end and 20 unterminated wires at the other end.

USB Host Connector

This standard USB Host connector accepts a full-size USB Type A plug for connection to an external USB device and is USB 2.0 Full Speed (12MbPS) compatible.

USB Device Connector

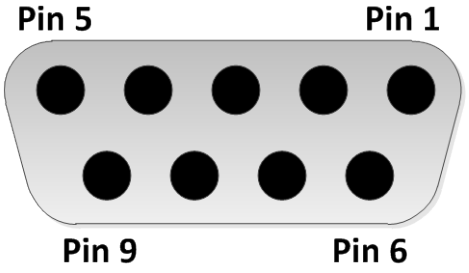
This standard Device Host connector accepts a full-size USB Type B plug for connection to an external USB host and is USB 2.0 Full Speed (12MbPS) compatible.

Ethernet Connector

This connector provides an 8-pin modular RJ-45 jack and is 10BASE-T (10MbPS) and 100BASE-TX (100MbPS) compatible.

Console Serial Port Connector

This 9-pin DB9 connector is provided as part of EQMet's Power Supply and Console Cable Assembly (113125-PL) and as part of EQMet's Battery Supply and Console Cable Assembly (113129-PL).

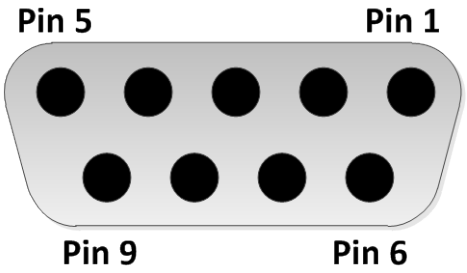


Main Serial Port Connector Pins

Description	Pin
N/C	1
TxD	2
RxD	3
N/C	3
Ground	5
N/C	6
N/C	7
N/C	8
N/C	9

Main Serial Port Connector

This 9-pin DB9 connector is provided as Part of EQMet's Power Supply and Main Serial Cable Assembly (113127-PL).



Main Serial Port Connector Pins

Description	Pin
CD	1
TxD	2
RxD	3
N/C	4
Ground	5
N/C	6
CTS	7
RTS	8
N/C	9

Internal GPS System

The internal GPS system is built into every TSA-SMA Digitizer and provides the very accurate timing system used to time-align the data typically to sub-microsecond accuracy. The system requires an active antenna that connects to the BNC connector on the front of the unit. The sections below discuss various cabling choices for the antenna and the use of an optional lightning protector.

GPS Antenna Connection Cabling

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 but has higher loss and is less flexible than our UV resistant cable. Plenum cables are typically less expensive than our UV-resistant cables.

UV-resistant cable does not require conduit and is very flexible and easy to handle in both indoor and outdoor applications. It also has low loss and good transmission characteristics. It is typically used in temporary and permanent field installations, away from buildings or other structures, where ease of installation is important. It may also be used in non-plenum areas of buildings, as permitted by local building codes. UV-resistant GPS cables

generally perform better electrically than our plenum cables, and so would be a better choice for longer cable runs or installation sites with a marginal GPS signal reception.

For a given type of GPS 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 GPS module's input. In general, lengths of 25M to 50M of cable as supplied are acceptable. Shorter or longer lengths should be discussed with the factory. Lengths between the standard 25M and 50M cables are available as a special order with correspondingly longer lead times.

Installing Optional GPS 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 GPS systems.

The optional lightning protector device (P/N 109457-PL) can be used with internal and external GPS timing systems. The lightning protector is a small 3 ½" x 1 ½" x 1 ½" box which contains surge-protection devices to shunt surges from lightning strikes to the ground while still allowing high-frequency signals and the DC power for the active antenna to pass. It has two female BNC connectors, and comes with a 3' (approx. 1 meter) male-to-male BNC extension cable.

Purchase a weatherproofing kit for the lightning protector from EQMet (P/N 790076) if the lightning protector box will be installed outdoors or in a hostile environment.

Connect the GPS antenna to the lightning protector as follows:

- Plug the antenna cable into the protector connector marked Surge.
- Take the short BNC male-to-male cable (supplied with the protector), and plug its male connector into the receptacle on the TSA-SMA Digitizer.

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.

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" or larger radius.

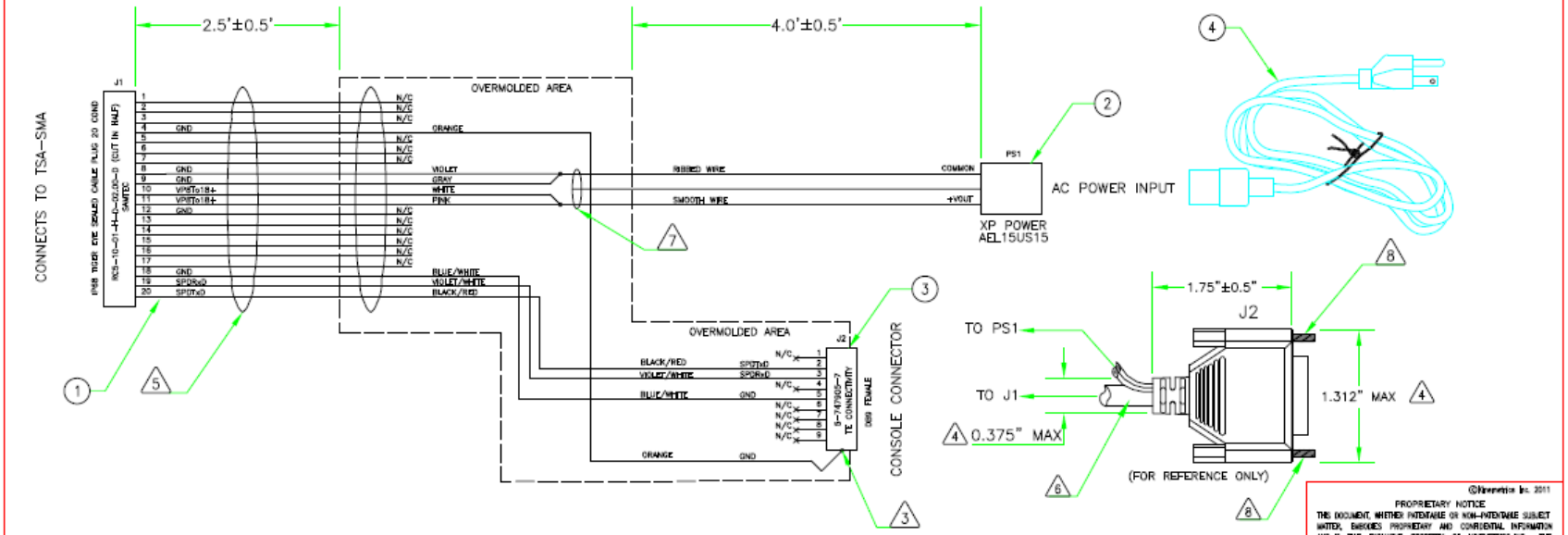
Cable Drawings

Power and Console Cable KMI 113125-PL

REFERENCE LIST

ITEM	COMM#	MFG	UM	QTY	DESCRIPTION	REFERENCE	COMMENTS
1	RC5-10-01-H-D-02.00-D	SAMTEC	EA	0.5	ASSY., PLUG & CABLE, 20 COND, 2M LG, IP68	J1	DO NOT SUBSTITUTE (CUT IN HALF)
2	AEL15US15	XP POWER	EA	1	POWER SUPPLY, DESKTOP SWITCHMODE	PS1	DO NOT SUBSTITUTE
3	5-747905-7	TE CONNECTIVITY	EA	1	CONN, D-SUB, RCPT, 9 POS FEMALE SOC.	J2	OR EQUIVALENT
4	17250	BELDEN	EA	1	CORD, POWER SUPPLY, W/PLUG NA WIRING	FOR PS1	OR EQUIVALENT

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	CHG'D PWR SPLY, ADDED AC CORD, UPDATED REF LIST, SEE ECO 4389	11/1/2011	TZM
B	CHG'D PWR SPLY AND UPDATED REF LIST, SEE ECO 4410	11/3/2011	TZM
C	CHG'D J2 TO THREADED STUDS AND UPDATED REF LIST, SEE ECO 4505		



NOTES:
1. MANUFACTURE PER 700471, SPEC., ASSY., CABLE, W/MOLDED CONNECTORS. (APPLICABLE SECTIONS ONLY.)
2. OVERMOLD COLOR TO BE BLACK.

3. GND WIRE CONNECTED TO CONNECTOR SHELL OR SHIELD.
4. ALL OVERMOLD DIMENSIONS, TYPICAL NOT EXACT.
5. LABEL WITH THE FOLLOWING: "J1" PLUS INFORMATION CALLED FOR BY SPEC CTRL 700471 "LABELING" SECTION.
6. LABEL WITH THE FOLLOWING: "J2 CONSOLE"
7. CUT OFF AND DISCARD OUTPUT POWER CONNECTOR.
8. MALE THREADED STUDS

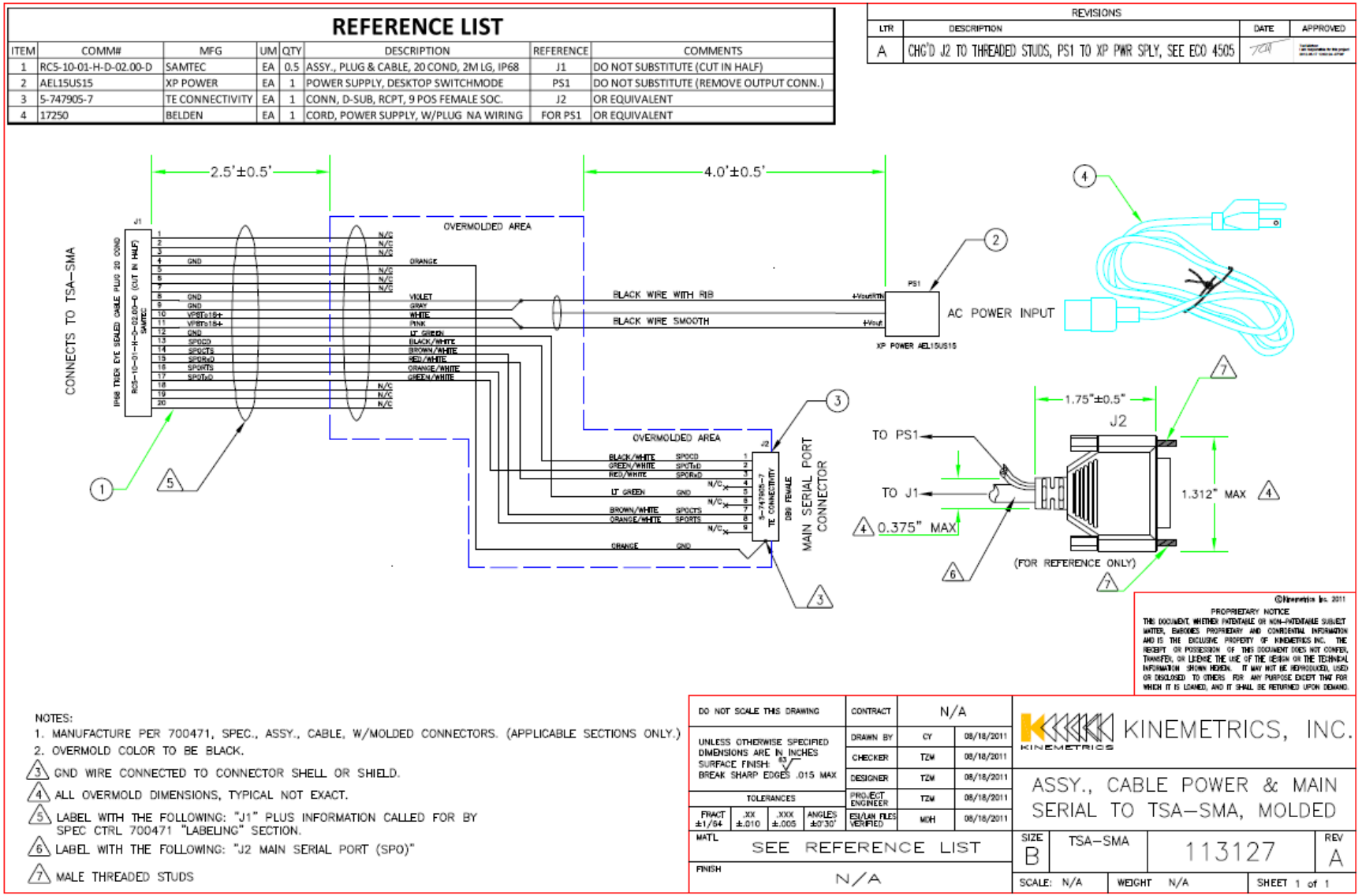
DO NOT SCALE THIS DRAWING	CONTRACT	N/A	
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES SURFACE FINISH: 63 BREAK SHARP EDGES .015 MAX	DRAWN BY	CY	06-15-2011
	CHECKER	TZM	06-15-2011
	DESIGNER	CY	06-15-2011
TOLERANCES	PROJECT ENGINEER	TZM	06-15-2011
FRACT ±1/64 .XX ±.010 .XXX ±.005 ANGLES ±0°30'	ES/LAN FILES VERIFIED	LRE	06-16-2011
MATL SEE REFERENCE LIST			
FINISH N/A			

KINEMETRICS, INC.

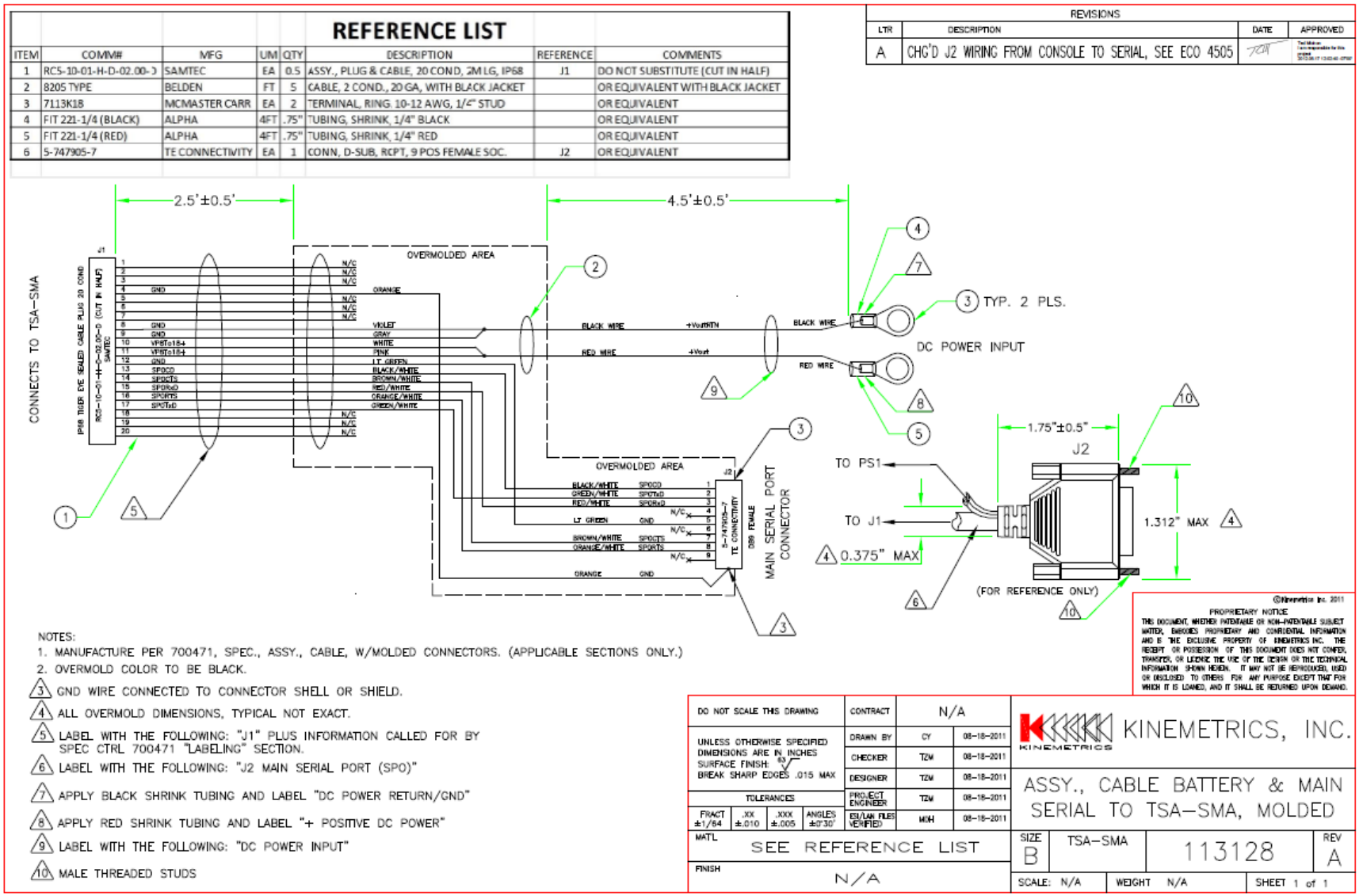
ASSY., CABLE POWER & CONSOLE TO TSA-SMA, MOLDED

SIZE			REV
B	TSA-SMA	113125	C
SCALE: N/A	WEIGHT N/A	SHEET 1 of 1	

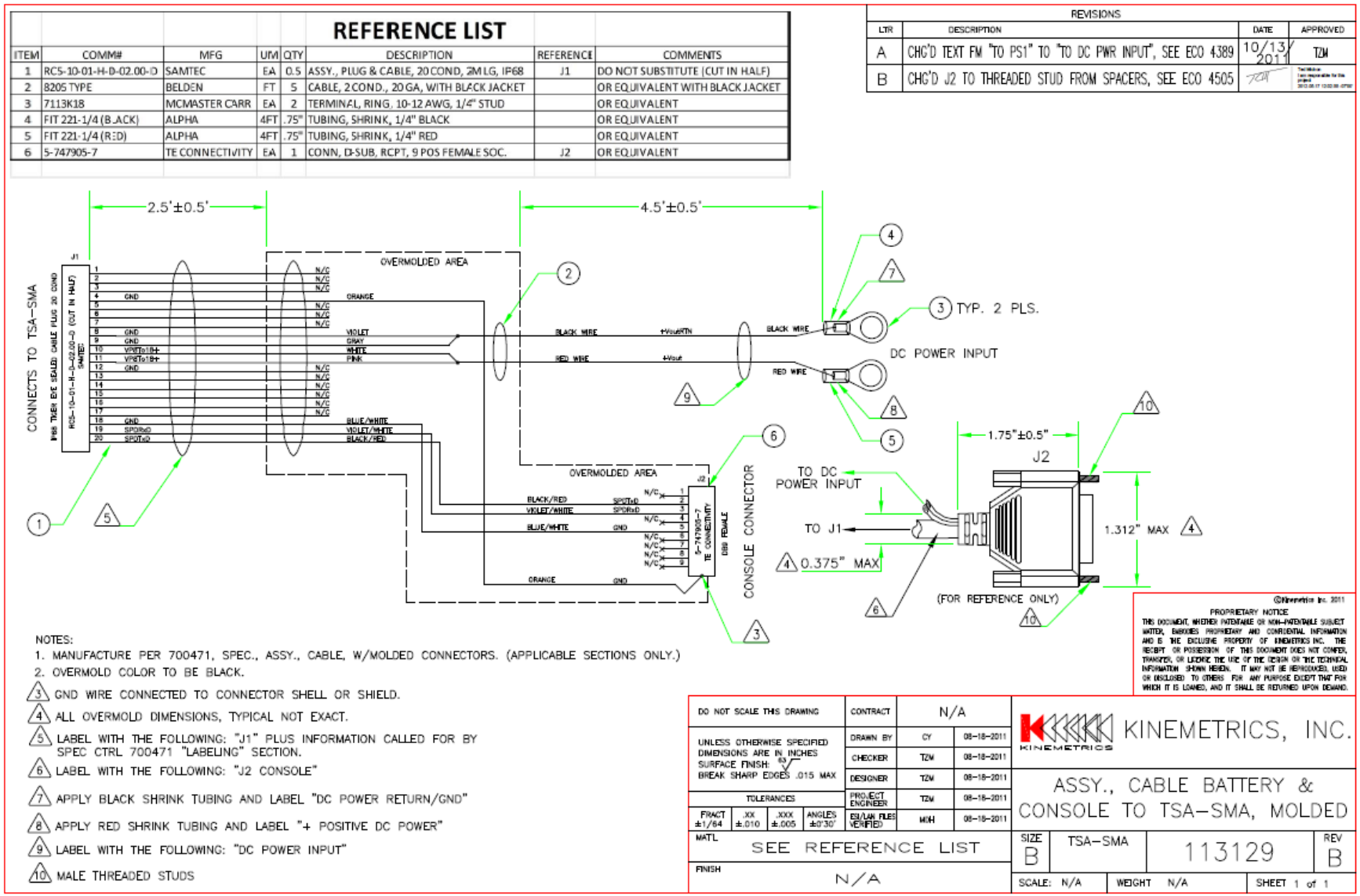
Power and Main Serial Cable KMI 113127-PL



Battery and Main Serial Cable KMI 113128-PL



Battery and Console Cable KMI 113129-PL



Further information

The following documents may be useful in providing further information:

- Rockhound User Manual – Kinemetrics P/N 304702

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