

# Orion Manual

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H	27 Oct 99	Appendix P added.
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## 1. Introduction

Congratulations on your choice of Orion. As you use your new Orion we know you will appreciate the many features that provide excellent performance.

It is very important to understand how the Orion operates before you use it. On the following pages you will find a wealth of information regarding all aspects of Orion. Please read the instructions carefully.

If you have problems or need technical support, please submit requests for technical support by e-mail or fax. This permits you to fully explain your problem and include "evidence" as it allows us to submit your problem to the most knowledgeable person for reply.

**by e-mail: support@nanometrics.ca**

**by fax: To: Orion support at fax (613) 592-5929**

**by phone: Please ask for Orion support at (613) 592-6776**

**Nanometrics Inc.  
250 Herzberg Road  
Kanata, Ontario Canada  
K2K 2A1**



### **WARNING**

This is a Class A product. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

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## 2. Organization of this Manual

This manual is organized in ten major sections:

<b>Chapter 1</b>	Introduction.
<b>Chapter 2</b>	Organization of this Manual.
<b>Chapter 3</b>	Unpacking and Post Delivery Inspection identifies the components you have purchased. It also references an "as-shipped" section. This is important as it lists exactly which version of Orion you have purchased and lists certain settings and defaults which may vary between models and serial numbers.
<b>Chapter 4</b>	User Guide covers the preparation of Orion for use in field experiments and includes connecting the instrument to sensors.
<b>Chapter 5</b>	Orion Tutorial leads you through a number of sample sessions operating the Orion. The initial sessions get you to operate Orion with no sensor. Successive sessions introduce more features until you are familiar with all the power of Orion.
<b>Chapter 6</b>	The Orion Reference Manual presents the full capability of all the menus in Orion and also includes the reference manuals for the supporting programs.
<b>Chapter 7</b>	Servicing describes how to troubleshoot Orion to the board level.
<b>Appendices</b>	These list mostly tabular material such as error messages, and pin connections.

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### 3. Unpacking & Post Delivery Inspection

Open and inspect the shipment for possible damage. Carefully check each item for damage or defects. If the Orion needs to be returned to the factory, please use the original shipping box.

The system should have the following contents:

1. Orion (yellow box)
2. Disk Data Cartridge
3. GPS Antenna and Mounting Bracket
4. 2m Antenna Cable
5. Orion Manual
6. Signal 1 Mating Connector
7. Communications Mating Connector
8. Power Cable with battery clips
9. 2 internal 6V 12 AmpHr Batteries
10. As-shipped Sheet
11. Listing of as-shipped ini file
12. Diskette containing backup of required files

#### Options that may have been ordered

1. Signal 2 Mating Connector (if you have ordered a 6 channel Orion)
2. External Mains Power Supply

#### Packaging - Return Policy

Save the original shipping box for the Orion. This box has been designed to protect the Orion during shipping and should be used in the event that the Orion needs to be returned to the factory.

#### *Warning*

*Do not ship an Orion with the data cartridge installed. This will damage the cartridge and the SCSI connectors.*

#### Checking the As-Shipped Sheets

The as-shipped sheet lists the serial numbers of the parts shipped, the exact hardware configuration and calibration constants associated with your hardware. It also includes a hard copy of the as-shipped Orion configuration file. This will determine how your Orion operates when first turned on.

#### Backup

It is strongly recommended that you back up the executable file diskette.

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## 4. User Guide

### **WARNINGS -- IMPORTANT**

1. **DO NOT ship the Orion with the data cartridge installed. It could damage the disk.**
2. **DO NOT power off the Orion while the disk is active. It could result in a TOTAL LOSS OF DATA.**
3. **DO NOT plug or unplug the GPS antenna cable while the Orion is powered on. It could permanently damage the GPS engine.**
4. **DO NOT plug or unplug the sensor cable while the Orion is powered on. It could permanently damage the ADC.**
5. **DO NOT plug or unplug the comms cable while the Orion is powered on. It could permanently damage the communications circuits.**
6. **DO NOT subject the Orion data cartridge to excessive shocks and vibrations. It could result in the LOSS OF DATA or physical damage to the disk drive.**
7. **Ensure that the Orion is properly grounded using the extra connection on the power connector. Failure to properly ground the Orion could result in damage to the Orion.**
8. **Ensure that the GPS antenna is floating relative to ground. Failure to float the GPS antenna could result in damage to the GPS engine.**
9. **DO NOT short out the GPS antenna cable while the Orion is running. This WOULD PERMANENTLY DAMAGE the GPS engine.**
10. **DO NOT pull on the cables while they are connected. It would damage the cable -- connector joint and could permanently damage the Orion.**

## Introduction

Each section of the User guide covers an aspect of the operation of Orion requiring some depth and understanding. These sections are in no particular order. Whole sections can be skipped on first reading. For example, connecting a sensor. When the time comes to connect a sensor this section will show the way.

### Overview

The Orion is a modern field portable seismic data logger which can have three or six high resolution (24-bit) input channels. Timing is referenced to UTC by means of an internal GPS receiver. Data is recorded on a removable disk cartridge. The Orion includes a built-in LCD display with four control keys. In addition six LEDs provide additional status information.

The Orion includes comprehensive software both for recording earthquakes and other events and for detecting and reporting events within the dataset. Orion can operate in continuous recording mode or in scheduled (windowed) recording mode. The Orion also includes auxiliary data channels for recording other information such as battery voltage, sensor mass position and internal temperatures. In addition, it can record a number of external state-of-health (SOH) parameters. The Orion includes internal batteries which can operate the instrument for up to approximately one day. For extended operation an external (provided) power supply is used, or as an alternative, the Orion can be operated from car batteries.

### Data cartridge hardware

The data cartridge contains a hard disk drive with a capacity of about 1200Mb depending on the data cartridge model purchased. The data cartridge typically consumes 5-10W of power (depending on drive) when operated continuously. Data are recorded on the cartridge in the field until the cartridge is full. The cartridge is then swapped for an empty one. The full cartridge is taken to a host computer for playback.

The Orion disk cartridge has a standard SCSI interface and can be directly connected to computer systems which can accept SCSI drives. The underlying file structure is FAT and will be recognized by most host computer systems.

### Controls and User Interface

Please refer to Figure 4.1. Opening the lid of the Orion reveals the operating controls and indicators. There are 4 buttons, 6 bicolor LEDs and a 240 x 64 graphical LCD. The 4 buttons (enter, escape, up and down) allow the user to navigate through the menus displayed on the LCD. The LEDs indicate the status of the Orion. They are active when the user interface is on and may also be activated by a button press.

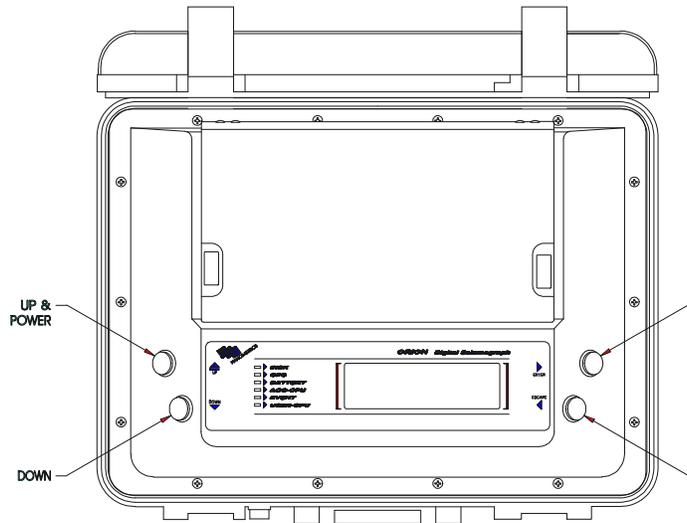


Figure 4.1

## Switches and Fuses

There is a switch and a fuse inside the drive bay. The red switch is the master power switch for the Orion. The power to the Orion is protected with a slow blow 3 Amp fuse.

This switch has three positions: <charge battery> <off> <Orion on>. The internal battery is protected with a 3 Amp slow blow fuse.

## Input-Output Connectors

The Orion has four input-output connectors. The function of each is summarized below. Actual connector pin assignments are given in Appendix B.

### Power

The power connector requires 11 to 18 volts to operate an Orion.

### GPS Antenna

Coaxial connector for antenna.

### Signal

This connector accepts 3-channel seismic input signals. The connector also includes three low resolution inputs which are typically used to monitor mass position. Refer to "Connecting a Sensor" in this Chapter for details when connecting to specific types of sensor.

### Communications

This connector provides for connection to a terminal or modem with full modem control. It also includes inputs for the external state-of-health inputs.

## Orion Grounding

Orion provides full isolation between the sensitive front end and the digitally noisy DOS processor which is also used for communications. Orion allows the user to connect sensors, Orion and modems without creating noisy ground loops. This is discussed further in "Making Connections to Orion".

The four grounds are:

- } signal ground
- } chassis ground

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} digital ground (modem ground)

} 12V power common

Each of these is electrically isolated from the other to allow systems to be configured without creating ground loops.

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## General care and handling precautions

### Installing the Data Cartridge

Inspect the data cartridge for damage (i.e. dents in aluminum). Check to ensure the connectors are free of dust and dirt. If dirty, blow air and use a fine brush (camera brush) to clean. **DO NOT USE WATER TO CLEAN.** If the contacts on the connector are dirty use a cotton swab dipped in alcohol to clean.

Lift the Orion lid and open the drive door. Insert the data cartridge into the drive bay. The connectors should face to the right. Slowly and firmly push the drive onto the mating SCSI connectors. You should feel the connectors mate. Lastly, ensure the data cartridge is straight within the drive bay.

#### *Warning*

*Do not ship an Orion with the data cartridge installed. This will damage the cartridge and the SCSI connectors.*

### Keeping water out

The Orion is a self-contained, waterproof recording system. The yellow box provides a waterproof seal when the lid is closed and latched shut.

The pressure valve (the black knob by the handle) should be screwed tight to provide a waterproof seal. With the lid shut and the valve closed the Orion is waterproof. There are dust covers provided for the external panel receptacles. These should be used to keep the receptacles clean.

Opening the lid breaks the waterproof seal but the instrument is still water resistant. The switches, LCD window, LED window and panel ring are all waterproof. The disk door is water resistant only when the door is shut.

The only route for water entering the instrument is via the disk bay. Try to avoid getting water inside the disk bay. Do not operate the Orion with the disk bay door open.

### Shipping by air

The pressure valve (the black knob by the handle) should be loosened prior to air flights to allow pressure equalization. After the flight it should be screwed tight to provide a waterproof seal.

### Batteries

Remember lead acid batteries can sometimes produce hydrogen. **NEVER** have an open flame near the Orion when opening the Orion box. **NEVER SMOKE WHEN SERVICING AN ORION.**  
Handling the disk cartridge

A hard disk drive is a fragile device and can easily be damaged if it is subjected to excessive shocks and temperatures. The drive has been carefully packaged within the data cartridge to minimize the effects of external shocks and temperature fluctuations. The drive is mounted in foam within the aluminum box. The cartridge provides a degree of weather protection but it is not water resistant. Although the cartridge provides additional protection, always handle the cartridge

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as you would handle a bare disk drive. Always ship the cartridges in a box with a minimum of 1" of PU foam.

## When is it safe to turn power off?

Never power down an Orion while the disk is active because that could cause the disk to become corrupted. This may result in a TOTAL LOSS OF DATA. Follow the instructions in the tutorial section to ensure a safe and orderly shutdown procedure.

If there is a sudden loss of power the Orion attempts to recover the next time power is applied. However, it is not guaranteed to succeed.

## Disk cartridge temperature considerations

The data cartridge has a limited temperature range. This limitation is due to the mechanical nature of the disk drive. The typical operating range of a disk drive is +5°C to +55°C. It should not be operated outside this range. Data loss may occur if operated outside this temperature range.

The Orion data cartridge is equipped with a resistance heater and a temperature sensor to permit extended ambient temperature range operation. The heater is designed to extend the low temperature range of the disk drive to below 5°C. In order to allow this, the Orion monitors the temperature of the drive at all times and, when configured, uses the temperature to determine if heat is required. Note also that the disk temperature is recorded in the state-of-health files.

The heater consumes 15 watts when on. This should be taken into account when selecting a power source for the Orion.

The upper operating point of the disk drive is a hard limit. Do not exceed 50°C or data may be lost. The Orion can be programmed not to operate the disk outside the designed temperature range. The user at his own risk can override this feature.

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## Connecting a sensor

### Discussion

Making the most effective connections between the Orion and the sensor can be fairly complex if you wish to fully utilize Orion's capability. It is highly recommended that you order the correct cable from the factory. The following paragraphs discuss some of the issues involved so that a user will understand what is supported by a 'standard' connection. Changes in the input configuration are dealt with in Chapter 7 of this manual.

### User-configurable inputs

#### ADC sensitivity

The 'default' sensitivity of an Orion is nominally 2.55 uV per least significant bit. Full scale on the A-D converter is typically plus or minus 7.5 million counts. The exact sensitivity is specified separately for each channel on the as-shipped sheet. Thus, the full scale input voltage will be  $2.55 \text{ uV} * 7.5 \text{ million} = +/- 19.1 \text{ volts}$ . Signals somewhat larger than this will be clipped.

'Active' seismometers such as the Guralp CMG40 are usually used with the 'default' sensitivity setting. 'Passive' seismometers such as the S13 often require a customized sensitivity.

The as-shipped input sensitivity of the Orion is shown in the as-shipped sheets. To change the sensitivity please refer to Chapter 7 of this manual.

#### Input impedance

The input impedance of the Orion is normally shipped in a high impedance state (see the as-shipped sheet). The user may change the input impedance to dampen the seismometer response if desired. There is one resistor required for each channel to set the impedance. To change the input impedance please refer to Chapter 9 of this manual.

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## Active and passive sensors

Passive sensors are those having no internal electronics. Active sensors generally use a displacement transducer. The connections for the two classes of sensor can be quite different. Orion can support both classes of sensor.

## As-shipped hardware configuration

Orions are usually ordered with the signal input circuits configured in the most convenient configuration. First, check the as-shipped sheet to see exactly what you have received.

Standard connections have been defined for the following sensors:

Mark Products L4C

Kinometrics Ranger

Geotech S13

Guralp CMG40T

These examples show typical values using nominal calibration values. See the as-shipped sheets for both the Orion and the sensor for precise values.

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## Planning for deployment

### Types of field experiment - discussion

#### Introduction

This section outlines a few scenarios and examples of how the Orion would be configured.

#### Long term seismicity experiment at remote site

**Scenario:** A seismograph must be located at a very remote site. Weekly visits are out of the question. There is no electricity or telephone.

**Solution:** Orion is operated in the event trigger mode. Events are recorded on a 1200 Mbyte disk drive. To give good resolution 200 s/s on 3 channels is used. Power is provided from a 100 Amp-hr 12V battery and a 1 sq m solar panel. In most locales, this will provide power indefinitely. Assuming twenty events per day, each of 3 minutes duration, the disk has sufficient capacity for  $3 \times 200 \times 1.3 \times 180 \times 20 = 2.8$  Mbytes/day. The site will have to be visited once per year to collect the data.

#### Aftershock survey

**Scenario:** A large earthquake has occurred in a region where large events are infrequent and unexpected. Experience gives no clues as to the expected aftershock pattern. The region is in a remote area with hard crystalline rock. Aftershocks are expected to have lots of high frequency energy.

**Solution:** Orion is operated in continuous mode since the frequency of aftershocks may be high. This avoids having to make an unrealistic prediction of number of events per day. Orion is operated at 100 s/s with three component sensors. 200 s/s would be better but in this case we must trade off data volume. 100 s/s will give a three dB bandwidth of 40 Hz which is quite acceptable. Each day we will record  $3 \times 100 \times 1.3 \times 86400 = 34$  Mbytes of data per day. Orion is used with a 1200 Mbyte disk cartridge to permit 35 days between site visits. Orion will use 15 Amp-hr from its batteries each day; 100 Amp-hr for the ten day period. To allow for batteries not

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being fully charged and not having 100% of their rated capacity, we use two 80 Amp-hr car batteries. Orion state-of-health will tell us the site environmental conditions (temperature) and will give us the discharge curve for the battery. In subsequent deployments we can apply this knowledge together with the actual data compression ratio to adjust the time between visits. The Orion event log will list all events that occurred in the ten-day period. We can choose to extract only events or we may prefer to copy the entire cartridge to CD-ROM using Nanometrics archive package.

### Wide angle refraction experiment

- Scenario:** A long refraction line crosses a major lake. Orions are to be located on a number of islands in the lake. Shooting will take place each afternoon with tentative shot times of 2:00 pm, 2:30, and every half hour until 6:30 pm (ten windows). Timing must be better than 100 uS. Each shot window should be of 120 seconds duration. The experiment lasts ten days.
- Solution:** Orions are programmed to wake up at fifteen minutes before shot time. This will provide ample time for the GPS to stabilize to obtain the required 100uS accuracy. Each day, Orions will use power for  $10 \times 7 = 70$  minutes. Power required will be  $10 \times 70 / 1440 = 0.5$  Amp-hr per day. We derate Orion's internal 12 Amp-hr batteries by 50% to be very conservative showing that the entire experiment can be done using a single pre-deployment charge of the batteries. Data quality and experiment signal/noise ratios will be monitored by retrieving Orion data cartridges after the first day of shots and thereafter each three days. This will be done by a quick visit to each site to hot-swap the disk cartridges. On-site time will be up to twenty minutes maximum at each site. A quick look at the LCD display will confirm that every thing is in order without disturbing the setup. At HQ the data cartridges are plugged directly into the field computer's SCSI port for instant access to the data.

### Extended regional seismicity experiment

- Scenario:** The summer field season is over and the Institute's Orions are available for extended deployment during the winter months. Broadband sensors will be used. Instruments will be deployed at rural farmhouses having limited phone service and mains electricity. The farmer will be paid a small stipend to operate and look after the equipment.
- Solution:** Orion is operated at 40 s/s on 3 channels. Expected data volume is thus  $3 \times 40 \times 1.3 \times 86400 = 13$  Mbyte per day. A 1200 Mbyte cartridge will last about 92 days, roughly 3 months. Orion will derive power from mains using its internal battery to provide uninterruptible power. The clear user interface allows the farmer to be quickly trained to report status on the Orion LCD display. He also learns how to hot swap the disk. He responds to occasional phone calls from the data center asking him to read off some numbers from the display. Every three months he receives a replacement data cartridge from the center and uses it to hot swap the existing cartridge. He then mails the cartridge to the data center. At the data center the operations technician copies all the data to CD-ROM, cleans the disk and then mails the disk back to the farmer.

## Selecting a Power Source

The Orion can be powered from a number of different power sources. The type of power source used will depend mainly on the location of the instrument and the duration of the experiment. Remote locations will require batteries and possibly solar panels. Mains power should be used where available.

### Internal batteries

The Orion has two internal 6V 12 Amp-Hr sealed lead-acid batteries which can operate Orion for ten to twenty hours and have no corrosive gas generation during normal use. The operating time for this amount of energy will depend on the way the Orion is configured. See Appendix C for how to estimate the power consumption of the Orion.

The detailed specifications for the internal batteries are given in Appendix A.

### Orion battery charger

For mains operation the Orion is supplied with an external universal charger. The charger incorporates continuous universal input allowing it to operate from any worldwide line voltage without changing wires or straps. The supply has a convenient IEC input voltage receptacle which is used worldwide. The detailed specifications for the supply are given in Appendix A.

The charger is not designed for outdoors use. Therefore, if operating the Orion outdoors, it should be protected from the elements.

## Understanding Orion internal power supply connections and the power switches

The interdependency between the supplies and switches is as shown below:

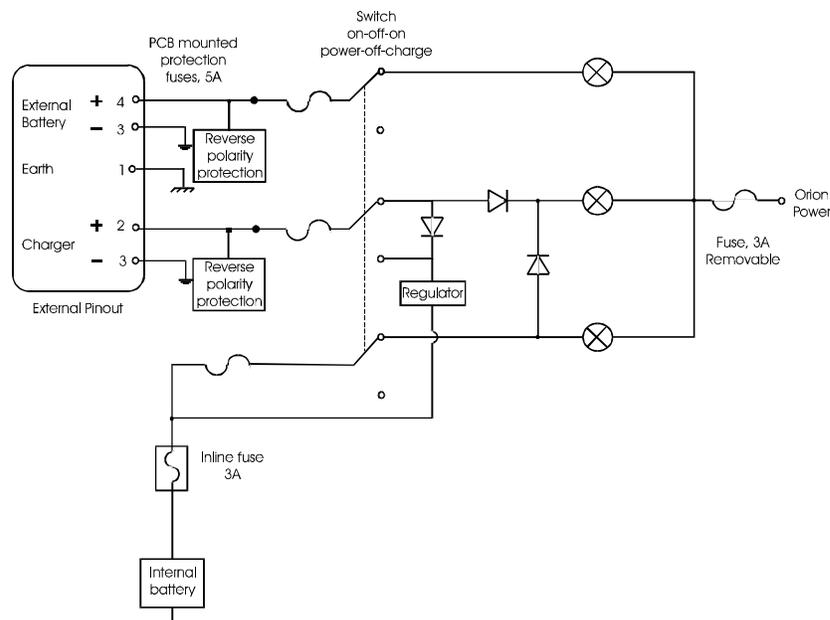


Figure 4.2

*Note the following:*

1. The power switch has three positions: charge, off and on. In the Charge position the internal battery is charged, but the Orion is not powered. In the Off position the

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power is disconnected from the Orion and charger. In the On position, the Orion and charger are powered.

2. When mains is present, the charger always charges the internal battery through the charge controller.
3. The internal charger can only charge the internal batteries. External batteries cannot be charged by the internal charger.

Pin connections for the Orion power connector are given in Appendix B.

The Orion supports hot-swapping batteries. If any power source (internal or external batteries, or mains) dies, Orion will automatically switch to another source without interrupting data recording. This means if you unplug the external batteries or mains, the Orion will automatically switch to the internal batteries. Try it. Pull the plug (ensure you have charged internal batteries). With two external batteries connected, one to mains and one to external battery, the Orion will discharge one battery at a time. This simplifies the logistics of battery cycling and reduces the likelihood of data loss due to dead batteries. Each time you visit the remote site, you have one completely discharged battery and one partially charged battery rather than two partially charged batteries. This means you have only one battery to change rather than two.

## UPS mode

Because mains power is susceptible to power outages and surges it is recommended that the Orion be operated in UPS mode. This is the default mode. To use this feature the two internal batteries should be connected and the mains supply plugged into the Orion.

## External Batteries

The Orion has an external 12V battery input and can operate from a 12V battery. This input is intended for large external batteries. Typically, car or truck batteries are connected to this input.

## Battery duration calculation

See Appendix C.

## Choosing the type of external battery

Large batteries for powering the Orion should be selected with care. Generally, batteries used for powering the Orion will be deep cycled. Deep cycle batteries are preferable to SLI (engine starting, lighting, ignition: car batteries) batteries. A deep cycle battery will have four times the cycle life of an automotive battery.

## Getting the most from batteries

From our experience, poor estimates of battery capacities are the single largest cause of data loss on experiments. Always ensure that a battery is fully charged before deploying. Generally, the deeper a battery is discharged, the shorter the cycle life of the battery. Therefore, discharging a battery to a higher end voltage will prolong the life of the battery. Unfortunately, in most deployments the batteries are fully discharged, limiting the battery life which in turn can lead to disappointing data losses.

When the Orion is started, use the LCD display to check the battery voltage. It should read 12.8 volts if the battery is fully charged.

Because batteries are the greatest source of data loss, take the time to manage and monitor the battery usage. Start by calculating the power consumption of the Orion for a specific configuration. Derate the batteries for temperature and especially for age (number of cycles). If possible, don't completely discharge the batteries.

Also, take advantage of Orion's battery state-of-health monitoring capability to understand the discharge characteristic of your batteries. After one run, check the Orion SOH for battery voltage

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and determine the discharge time for the batteries. This state-of-health is very useful for verifying that a dead battery was the cause of a data loss.

## Some tips for conserving battery energy

1. Reduce the time in the field configuring the Orion. When in user mode the Orion consumes 16W of power. In data recording mode the Orion consumes 5-6W.
2. Use the LCD backlight only when necessary. It consumes 2.5 W.
3. If possible, protect the batteries from wide temperature swings. Typically, the battery loses 1% of its energy for a 1°C drop in temperature.
4. While configuring an Orion in the field use a different battery.
5. Lower sample rates use less power. Quiet sites use less power. Use event mode rather than continuous mode.

## Orion control of battery life end-point

The Orion monitors its supply voltage. If the supply voltage drops below the powerdown threshold the Orion will power itself off. When the voltage level rises, the Orion will power-up and continue recording. The battery thresholds are preset in the factory configuration.

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## About the GPS Antenna

The Orion is shipped with an active antenna and a 2m cable.

An 8m RG213 extension cable may also be connected to lengthen the reach of the GPS Antenna.

### Antenna position

The position of the antenna is critical to the operation of the GPS. Ideally, the antenna should be placed in an electrically quiet location with a clear view to the horizon in all directions. The GPS engine tracks the satellites from the horizon to overhead and down to the horizon again. Therefore, it is important that the antenna has a clear view to the horizon. The antenna should be elevated above obstructions such as buildings, power lines, metal structures, trees, etc. The GPS engine can 'see' through foliage but the signal is scattered and attenuated. The antenna should be oriented level.

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## Using state-of-health inputs

### Physical connections to external state-of-health signal sources

The external state of health (SOH) inputs have a very high input impedance of 2.0 Mohms. They accept inputs from +/- 25V. There is over voltage protection provided. However, care should still be used to minimize transients on these lines. To provide the best noise performance of the Orion analog circuits, the return for the SOH signals should be connected to chassis ground or left open if another DC path already exists. The connections for the external SOH are found on the communications connector pins 17-19 (see Appendix B).

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## The SOH ADC

The calibration and sense of the SOH inputs provide the following relationships:

Input voltage	Output counts
+25V	0
0V	512
-25V	1023

## Setting up the configuration parameters for SOH

The Orion software provides for each SOH channel having a scale calibration factor and an offset.

The scale calibration factor is the sensitivity of the sensor. This might be expressed as "units" per volt. For example, with a temperature sensor, this might be set to 44 degrees Celsius per volt.

The offset is used to allow for the sensor not producing zero output volts when registering zero "units". The offset is expressed in "units". For example, for a temperature sensor, the offset is expressed in degrees Celsius.

## Using the LCD display with SOH

The LCD display shows the current data value displayed both in "units" and in native counts. The counts reading can be used to assist in calibrating SOH sensitivities and offsets.

## Internal SOH parameters

The appropriate scale and offset values for the internal SOH parameters are determined during the Orion final test and are entered into the factory configuration. These cannot be modified from the Orion menus or configuration file.

---

## Field deployment

### Deployment

The following steps are suggested to start up the Orion after the sensor has been placed. More detail about starting the Orion is provided in the tutorials in Chapter 8.

1. Place the Orion on a level surface and connect the external power supply to the 4-pin power connector on the left-hand side of the Orion.
2. Connect the GPS antenna to the GPS cable and plug the cable into the coaxial GPS connector on the left-hand side of the Orion. Position the antenna in a location with an unobstructed view of the sky.
3. Plug the sensor cable into the sensor connector on the left-hand side of the Orion.
4. Open the Orion case to access the front panel and disk drive bay.
5. Insert the data cartridge, sliding it to the right so that the SCSI and power connectors mate firmly.
6. Turn on the Orion by moving the red power switch to the ON position.
7. Wait for the Orion to complete its power-up sequence.
8. (Optional) Reconfigure the Orion if necessary.
9. Check the GPS, waveform and instrument status as outlined in tutorial 2.
10. When satisfied that the Orion is operating properly, return to the main menu and select UserExit to exit from the user interface and leave the Orion recording.

## Site Visits During Normal Operation

The following steps are suggested to check the operation of the Orion during a site visit.

1. Press the **Up** key for about 1 second to turn on the front-panel LEDs. Check that the Battery LED is green. If the Battery LED is OFF or flashes red, check the power supply and power connections, then restart the Orion following the procedure described above. If the Battery LED is red or amber the batteries need to be charged. If the Battery LED blinks red there is not sufficient power to start the Orion.
2. Start the user interface by pressing the **Up** key for about 1 second.
3. When the user interface comes up, check the GPS status and waveform.
4. Select the Logfile function from the main menu. It is useful to set the error level filter in the Log Setup screen to "Warning" or "Error" in order to view only those messages which indicate unusual conditions or significant events which may affect data quality or timing accuracy.
5. When satisfied that the Orion is operating properly, return to the main menu and select UserExit to exit from the user interface.

## Hot-swapping the data cartridge

The Orion data cartridge (disk) may be changed at any time without turning off the power or interrupting data recording. Use the following procedure to ensure that all files are properly closed and no data are lost:

1. Start the user interface by pressing the **Up** key twice for about 1 second.
2. When the user interface comes up, select the User Exit command; this instructs the Orion to flush its memory banks to the data cartridge and prepare it for removal. The Orion will display an information screen showing how much data remains to be written. The user interface will shut down when the cartridge is ready for removal.
3. If you do not want to wait for the Orion to flush its memory banks, select "Exit Now". The user interface will shut down immediately, and data in the memory banks will be written to the replacement disk.
4. When the user-interface shuts down (the screen goes blank), open the disk access door, remove the data cartridge, insert the new data cartridge (making sure that it is seated properly against its connectors), and close the disk access door.
5. (Optional). Restart the user interface and confirm that the Orion is operating properly.

*Note: The new data cartridge MUST contain the Orion programs and the DOS directory in order for the Orion to function (See "Contents of the Data Cartridge"). All other files (old data, log and configuration files) should be deleted from the cartridge before inserting it to ensure that there is adequate space for new data. The Orion will automatically create new files when it is restarted. The Orion will maintain the same configuration during a disk swap; the configuration file will be automatically written to the new data cartridge when the Orion is restarted.*

## Shutting down at the end of the experiment

At the end of the experiment use the following procedure to ensure that all files are properly closed and no data are lost:

1. Start the user interface by pressing the Up key for about 1 second.
2. When the user interface comes up, select the User Exit command; this instructs the Orion to flush its memory banks to the data cartridge and prepare the unit for shutdown. The Orion will display an information screen showing how much data remains to be written. The user interface will shut down when the cartridge is ready for removal.

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3. If you do not wish to wait for the Orion to flush its memory banks, select "Exit Now" to shut down the interface immediately. **Warning: any data remaining in the memory banks will be lost when you switch the Orion power off.**
4. When the user-interface shuts down (the screen goes blank), open the disk access door and switch the Orion OFF.
5. Remove the data cartridge and pack it separately for transport.
6. Disconnect the power, sensor and GPS cables from the Orion, and pack them separately for transport.

---

## Understanding files and formats

### Contents of the Orion Data Cartridge

The data cartridge contains a SCSI hard disk drive formatted as a single logical drive using the FAT file format. The contents of the disk are as follows:

#### Root directory

ORION.BAT	Batch file which starts the Orion user interface program.
DOS	Directory containing necessary DOS system files.
BIN	Directory containing the Orion software.
USER	Directory containing the Orion data.

#### BIN directory

This directory contains the following programs and utility files which should not be modified or deleted:

ORION.EXE	The Orion user interface program.
ORION.MSG	File containing log message definitions.
SCANMSG.EXE	Utility program used by the Orion.
TCPWAIT.EXE	Utility program used by the Orion.
TIMESTMP.COM	Utility program used by the Orion.

#### USER directory

This directory is used to store configuration, log and data files. The directory and its contents are created automatically by the Orion. This directory will typically contain the following files (where nnn is the serial number of the Orion):

ORIONnnn.INI	The most recent Orion configuration for Orion serial number nnn.
ORIONnnn.DSK	A configuration file (for Orion nnn.) which can be loaded from disk.
ORIONnnn.LBF	The instrument log file for Orion nnn.
ORIONnnn.mmm	Previous configuration files for Orion nnn.
DATA	Directory containing the data ringbuffers and the SOH file.

Tutorial 3 in the Orion Basic Playback Manual provides instructions for initializing the data cartridge prior to deployment and for restoring the Orion software in the event that it has been deleted.

### Orion Data Filename Conventions

Seismic ringbuffer filenames are automatically generated from the station, site, and channel orientation names specified in the configuration using the following formula:

filename = "R"  
+ Station\_Name (5 characters)  
+ Site-Name (2 characters)  
+ "."

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+ Orientation\_Name (3 characters)

The state-of-health ringbuffer filename is:

```
filename = "R"  
          + Station_Name (5 characters)  
          + Site-Name of Channel 1 (2 characters)  
          + "."  
          + "SOH"
```

These files are located in the \USER\DATA subdirectory on the data cartridge.

## Specifying Data File Sizes

The Orion allocates all data files with a user-specified fixed size in order to reserve that space for data. The file size is normally specified in the File Settings configuration menu. However, the file size may also be set in the Restart Options menu which appears as a confirmation screen when you change the configuration.

The sizes of the data and SOH files may be set manually (in MBytes) or you may choose the Automatic file sizing option which allocates all available space on the data cartridge to data and SOH files in a 95/5 ratio. Automatic sizing is also used if the user-specified sizes exceed the available disk space.

Because of the internal structure of the data files, **the file sizes cannot be changed after the initial creation without destroying the data.** Therefore, it is very important to create the files with an appropriate size at the initial deployment and to leave the file size unchanged throughout the experiment.

## Creating vs. Appending

The Orion user interface program opens its data files:

1. when it is started (by a power-up or user key-press or by the digitizer for data transfer) or
2. when the configuration is changed.

The Orion will **append** to existing files or **create** new ones according to the following rules:

1. If files with the appropriate names do not exist they will be created. Therefore, the Orion will automatically create the required files on a new data cartridge on initial deployment or after a disk swap.
2. If files with the appropriate names exist and have the correct size they will be opened for update. New data is appended to the files. This is the normal situation when the Orion interface is started by a user keypress or by the digitizer for a data transfer.
3. If files with the correct names exist but have the wrong size, they will be deleted and new files will be created with the correct sizes. This will occur during reconfiguration if the specified file sizes have changed.

## Creating multiple sets of data files

The Orion opens and updates files with names determined by the configuration as explained above. Files with different names are ignored. This makes it possible to archive data from several different experiments on the same disk simply by changing the station name. This might be most appropriate in an experiment involving numerous changes of configuration. The following set of experiments would result in 3 separate sets of data files, encoded by their filenames, using a total of 220 MB.

1. Experiment A: Station Name = TESTA, RingBufferSize = 100.
2. Experiment B: Station Name = TESTB, RingBufferSize = 60.
3. Experiment C: Station Name = TESTC, RingBufferSize = 60.

## Single-Write files vs. RingBuffers

As explained above the Orion allocates a fixed size to each file on creation. What happens when the file is full? The Orion supports two file types which are identical except for their behavior when the file is full:

Single-Write	data received after the file is full is discarded.
RingBuffer	new data continually overwrites the oldest data in the file.

For example, a single-write file with a capacity of three days worth of data will record for three days and then stop. A ringbuffer with the same capacity will always contain the most recent 3 days of data. The file type is set in the File Settings configuration menu. File type is set independently for data files and the SOH file.5.

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## Tutorial

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### Overview

This chapter provides a series of tutorials designed to introduce you to the Orion and its many features. The first two tutorials provide basic familiarization. You will learn:

1. How to use the Orion's user interface.
2. How to check the Orion's operating status.

The remaining tutorials demonstrate some of the Orion's more advanced features, including:

1. How to change the configuration of your Orion.
2. How to use the Orion's different recording modes.
3. How to configure your Orion for scheduled recording.
4. How to setup event-detection logic and triggers.

The tutorials have been written to be as complete as possible. However, you may occasionally find it necessary to refer to other sources of information. Complete descriptions of each of the Orion's interface menus are provided in Chapter 6. Some hints on troubleshooting the Orion are given in Chapter 8. Full instructions for installing and using the various playback software programs are given in the Orion Basic Playback Manual.

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### Tutorial 1: Familiarization with Orion's Controls

#### Goals of the tutorial

In this tutorial you will learn how to turn the Orion on and how to use the pushbuttons to navigate the menus and edit values and settings.

#### Powering on the Orion

1. Place the Orion on a level surface and connect the external power supply to the power connector on the left-hand side of the Orion.
2. Connect the GPS antenna to the GPS cable and plug the cable into the coaxial GPS connector on the left-hand side of the Orion. Position the antenna in a location with an unobstructed view of the sky.
3. Open the Orion case to access the front panel and disk drive bay.
4. Open the disk drive bay by releasing the two swell latches and lifting open the door. Within the drive bay there are SCSI connectors on the right side and power switch and fuse on the left side.
5. Insert the data cartridge into the disk bay, sliding it to the right so that the SCSI and power connectors mate firmly. The data cartridge must be aligned with the connectors on the right-hand side and properly connected prior to powering on the Orion.
6. Turn on the Orion by moving the red power switch to the ON position. The red switch is the master power control for the Orion.
7. Wait for the Orion to complete its power-up sequence.

As the Orion starts up, the LEDs will display the power-on sequence as described in the Front Panel LEDs section of the Reference Manual. The LEDs should then take on their normal

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operating values. The ACQ-CPU and BATTERY LEDs should be green. The GPS LED will progress through red and amber to green as the GPS locks.

The USER-CPU LED will show amber until the user interface has completed its start-up sequence. About 30 seconds after turning the power on the front panel LCD should display a few startup messages and then will display a message "Waiting for config and opening files". When the startup sequence is finished and all data files have been opened the LCD will display the top-level menu and the USER-CPU LED will turn green.

If your Orion does not start up properly please see the troubleshooting section of this manual.

## Organization of the Orion interface

The Orion front panel comprises four yellow input keys and a 240 x 64 LCD display. Command options and other information are displayed on the LCD in the form of menus and information screens. The input keys allow the user to navigate from menu to menu and to change settings and configuration variables.

Each Orion display screen has two sections: a menu and a dialog box or information area. The menu section is a column of commands on the left-hand side of the screen. Selecting a command typically invokes an action or moves to another menu. The information area on the right-hand side of the screen is used to display messages, status information, or configuration settings. The top-level Orion menu is shown below.

```
Config      Time: 1995/12/14 13:57:01
Go/Stop     Disk: 53 / 1329  KbLeft:1347
GPS         GPS : FineLock  Memory:185420
Waveform    State:Scheduled Wait
Instrmnt    Next: Start Recording Cont
DataFile    At: 1995/12/14 16:00:00
LogFile     Dta:45          29          94
UserExit    0              0              0
```

*Menu*

*Information section*

The Orion menus can be divided into two categories: Operational Menus and Configuration Menus. The Operational Menus allow the user to perform a variety of online actions such as checking the status of the GPS, viewing realtime waveform data, starting and stopping recording, and checking the log file. The Configuration Menus allow the user to change the operating characteristics (configuration) of the Orion. All menus can be accessed while the Orion is running, without stopping data recording.

## Navigating through the menus

Within each menu, the four input keys allow the user to select and invoke the available commands or to select and change any editable variables in the information section of the screen. A highlighted cursor is used to show which command or variable is currently selected.

When the cursor is in the menu section of the screen the keys assume the following functions:

- Up** Moves the cursor up or to the last editable field in the information section.
- Down** Moves the cursor down or to the first editable field in the information section.
- Enter** Invokes the selected command.
- Escape** Returns to the previous higher level menu.

*Note:* When in the top level menu the Escape key is used to adjust the display contrast level. Repeatedly depressing this key will cycle the display through the various contrast options. This is useful in cold weather.

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When the cursor is in the information section of the screen, the keys assume the following functions:

<b>Up</b>	Moves the cursor to the previous editable field or to the last item on the menu.
<b>Down</b>	Moves the cursor to the next editable field or to the first item on the menu.
<b>Enter</b>	Changes the value of the selected field to the next enumerated value or enters edit mode for the selected field at the left end below).
<b>Escape</b>	Changes the value of the selected field to the previous enumerated value or enters edit mode for the selected field at the right end (see below).

## Tutorial Practice

1. Start the Orion following the procedure given above. When the Orion has completed its start-up sequence it will display the top-level menu. The cursor will be positioned over the "Config" command at the top left-hand corner of the screen.
2. Press the **Down** key four times to move the cursor to "Instrmnt."
3. Press the **Enter** key to invoke the "Instrmnt" command. The Orion will now display the "Instrument Status" menu.
4. Press the **Escape** key to return to the main menu.
5. Move the cursor to "Waveform" and press the **Enter** key to invoke the "Waveform" command. The Orion will now show the Waveform options menu.
6. Press the **Down** key once. The cursor will move to the first editable field of the information screen.
7. Press the **Down** key again to move the cursor to the next editable field. Continue until the cursor is back on the menu item "Start."
8. Press the **Escape** key to return to the main menu.

## Editing Orion parameters

In addition to navigating the menus, the input keys can also be used to edit various runtime or configuration parameters in the information area of the screen. The Orion interface supports two types of editable parameters: enumerated parameters and parameters which accept arbitrary values.

### Enumerated parameters

Enumerated parameters are constrained to hold one of a predefined set of possible values. These can be easily changed by scrolling through the set of values using the **Enter** and **Escape** input keys. As an example, we will change the time width of the realtime waveform display.

1. Select "Waveform" in the top-level menu to enter the Waveform Options menu.
2. Using the Down key, move the cursor until it is positioned over the field "Time Width".
3. Change the time width by scrolling through the predefined values using the **Enter** and **Escape** keys until the desired value is displayed.
4. Move the cursor back to the menu item "Start" using the **Up** or **Down** key.
5. Press the **Enter** key to start the waveform display. The waveform plot shown will have the specified width (along the time axis).
6. Press the **Escape** key twice to return to the top-level menu.

### Parameters which accept arbitrary values

Parameters which accept arbitrary values are more difficult to edit since they must be changed character by character. In order to edit these parameters it is necessary to enter a string edit mode.

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In edit mode the selected character is highlighted by a secondary cursor and the input keys take on the following functions:

<b>Up</b>	Change the selected character to the next higher legal value.
<b>Down</b>	Change the selected character to the next lower legal value.
<b>Enter</b>	Select the next character to the right.
<b>Escape</b>	Select the next character to the left.

Moving the character cursor off the end of the field (at either the right or left end) exits from edit mode and restores the **Up** and **Down** keys to their normal, navigational function. It should be noted that some fields have a constrained range. If they are set to a value outside that range during string edit, they will be reset to the minimum or maximum value upon exit from edit mode.

As an example, we will edit the Y-Max value on the Waveform Options screen.

1. Enter the Waveform Options menu as in the example above.
2. Using the **Down** key, move the cursor until it is positioned over the Y-Max field.
3. Press the **Enter** key to start editing the field from the left side. Note the character highlight on the first character.
4. Press the **Up** key to change the first digit of Y-Max to 3.
5. Press the **Enter** key to select the second character (digit) then press the **Up** key to change to digit to 5.
6. Press the **Escape** key twice to move the character cursor off the field and exit from edit mode.

You can also delete or insert characters (or digits) in edit mode. For example, to delete the first digit of Y-Max:

1. Press the **Enter** key to highlight the first digit of Y-Max.
2. Press the **Down** key until the digit disappears.
3. Press the **Enter** or **Escape** key to move the character cursor. The digit has now been deleted.

To insert a character or digit:

1. Move the character cursor to the first digit, then press the **Down** key until the digit disappears.
2. Press the **Down** key once more. The initial digit will be restored with a zero inserted in front of it.
3. Move the character cursor to the second digit, then back to the first (the inserted zero). Now use the **Up** and **Down** keys to change the inserted zero to any desired value.

Note that the cursor must be moved to the left or right after inserting or deleting a character in order for the character to stay inserted or deleted.

---

## Tutorial 2: To record data with no sensor

### Goals of the tutorial

In this tutorial you will learn how to change the user interface settings, what the common items are to look at on the Orion interface menu screens and how to shut down and restart the Orion. For the sake of simplicity the Orion will be operated from the external power adapter without the use of a sensor. While the tutorial is in progress, the Orion will be recording a dataset which can be played back and verified later.

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## Changing the interface settings

1. From the top level menu select the Instrmnt command to display the Instrument Status screen (more on this screen later) and then select the Infrface command to display the Interface Settings menu.

```
-- Interface Settings --  
  
      Contrast: 50  
      Backlight: Off  
  
      User Timeout: 10 min  
  
OK
```

2. Change the LCD display contrast by changing value in the Contrast field. This field cycles between the values 0 to 100 in increments of 5. Note that this feature is also available on the top level menu using the **Escape** key.
3. Turn the backlight for the LCD display on and off by changing the value in the Backlight field. This field can be either On or Off.
4. Increase the length of time in minutes the Orion interface stays on without any buttons being pressed to 20 minutes by changing the value in the KB Timeout field. Do this so the interface does not shut down while learning how to use the interface. This field cycles between the values 1, 2, 5, 10, 20 and 60 minutes.
5. When finished, move the cursor to "OK" then press the **Escape** key twice to return to the top level menu.

## Checking the run-time status screens

The Orion user interface makes its current status available to the user via several run-time status screens. This way the user can get an idea of the operation of the Orion without shutting it down and analysing its data on a PC. The user can view the status of the GPS and the state-of-health inputs, the log generated by the Orion, and even view the seismic data as it is being recorded.

### Checking the GPS status

The Orion contains an internal GPS receiver which provides the Orion with an accurate time source with which to timestamp the data. To view the available status information from the GPS, do the following:

1. From the top level menu select the GPS command to display the main GPS real-time status screen.

```
GPS Time 1996/01/31 16:31:37  
  
GPS:3D Nav      S/N dB Activity  
Clk:FineLock   Ch1 47 Track 22  
Fig Merit:1    Ch2 49 Track 24  
Horz Err:2     Ch3 42 Track 26  
Location Vert Err:3 Ch4 0 Search 0  
GPS Init Time Err:0 Ch5 42 Track 39
```

2. The top of the screen contains the time reported by the GPS. This time should always be fairly accurate, even without an antenna ever being connected, since the GPS has a battery backed-up real-time-clock.
3. The GPS field indicates the status of the GPS engine. Search indicates the GPS is not tracking any satellites. Track 1-4 indicates that the GPS is tracking 1 to 4 satellites and has time accurate to 1us. 2D or 3D Nav indicates that the GPS is tracking enough satellites to compute a 2D or 3D navigation position. The GPS should normally be navigating within 15 minutes after turning the Orion on with the antenna connected.

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- The Clk field indicates the status of the Orion's internal clock. Unlocked indicates that the GPS time is not valid and the Orion is free-running in temperature compensated mode. CoarseLk indicates that the GPS time is valid and the Orion is slowly correcting its time towards the GPS time. FineLock indicates that both the GPS and the Orion time are correct.
- The Figure-Of-Merit, Horizontal Error, Vertical Error and Time Error are only meaningful when the GPS is locked and are used by the GPS to give an indication of the quality of its output navigation solution.
- The right side of the screen contains information on the 5 satellites which the GPS is currently tracking or searching for. Under dB is the signal-to-noise ratio for that channel. Under Activity is the state of the channel which is one of Track, Search or Idle followed by the ID of the satellite being tracked or searched. The signal-to-noise ratio should be checked to ensure that it is above 40 to maintain a good GPS lock. Although it may be possible to track a satellite with a lower signal-to-noise ratio, it is harder to lock onto one.
- Select the Location command to display the GPS Location real-time screen.

```
-- GPS Location --
Time: 1996/01/31 16:31:37
Latitude: 45.0000
Longitude: -70.0000
Elevation: 300.20
Status: 3D Nav
OK
```

- Notice that this screen displays the same GPS time and status as the previous GPS screen.
- The Latitude, Longitude and Elevation of the Orion as determined by the GPS are displayed. It is necessary for the GPS to have been locked for these values to be accurate. Note that the location is only accurate to about 100m for the horizontal position and 150m for the vertical position.
- Return to the main GPS real-time display screen when finished viewing the GPS Location display using the **Escape** key.
- Return to the top level menu when finished viewing the real-time GPS data using the **Escape** key.

### Checking the instrument status

The Orion contains 6 sources of state-of-health information which are sampled once every 8 seconds. To view the available state-of-health information do the following:

- From the top level menu select the Instrmnt command to display the Instrument Status screen.

```
-- Instrument Status --
Counts
Battery: 13.78 Volts 540
Disk Temp: 28.92 o C 415
Vxco Temp: 30.65 o C 423
Intrface Slow SOH1: -2.489 units 461
Senstvty Slow SOH2: -2.489 units 461
Power Slow SOH3: -2.440 units 462
```

- This screen contains the real-time readings from the state-of-health analog to digital converters. The first 3 instrument state-of-health inputs are factory configured to read the battery voltage, disk temperature and VCXO temperature. The remaining 3 state-of-health inputs are available externally for the user to setup. For the 3 Slow

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user SOH values to be accurate the Slow SOH Calibration factors in the External SOH Calibration menu must be correct.

3. Along the right side of the display, under Counts, is the actual value read from the A to D converter in counts (0-1023).
4. Return to the top level menu when finished viewing the real-time Instrument Status using the **Escape** key.

## Viewing the log file

The Orion creates a log of its actions which may contain information on significant events causing the loss of data or loss of time quality. To view the Orion log do the following:

1. From the top level menu select the LogFile command to display the LogFile View Filter menu.

```
-- LogFile View Filter --
Display: Selected Records
From: 1996/01/31 14:31
Until: 1996/02/01 16:31
View Log   Severity: Info
Mark Log   Source: All
Clear Log  Err Code: 0
```

2. Select the ViewLog command to display the View Log screen without filtering out any of the entries in the Orion logfile.

```
31 16:31:37 Orion up - ver 04.00
Up      31 16:31:37 CoreLeft(0)=176112
Down   31 16:31:39 Config unchanged
PageUp 31 16:31:40 Open SOH file 2097152
PageDn 31 16:31:40 Open RB0 = 524288
Top     31 16:31:40 Open RB1 = 524288
Bottom 31 16:31:40 Open RB2 = 524288
Detail 31 16:31:41 Enter User Mode
```

3. Select the Up and Down commands to slowly scroll the log up and down 1 line at a time.
4. Select the PageUp and PageDn commands to quickly scroll the log up and down 7 lines at a time.
5. Select the Top and Bottom commands to quickly scroll to the top and bottom of the log.
6. Select the Detail command to get additional information on the log entries.
7. Select the Detail command again to restore the screen to displaying the error message text.
8. Return to the top level menu when finished viewing the Orion logfile by pressing the **Escape** key two times.

## Viewing real-time seismic data

The Orion user interface can display a waveform plot of the current data being recorded on any one of the input channels. This is very useful to get a general idea of the background seismic noise level at a particular site. To view the real-time seismic data waveform do the following:

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1. From the top level menu select the Waveform command to display the Waveform Options menu.

```
      == Waveform Options ==
      Channel: 1
      Time Width: 30 sec
      Y Scale Max: 500
      Y Scale Multiplier: 10
      Remove DC: Yes
Start
```

2. Note the values listed on the right hand of the display and select the Start command to start plotting the seismic data.
3. Watch the seismic data that is plotted in real-time (as it arrives to the Orion seismograph). Notice that the time it takes to display 1 full screen is the Time Width value entered on the previous screen and that the full scale values as displayed on the right of the screen is the YMax \* YMax Multiplier values entered on the previous screen. Note that if the data to be plotted is off the scale, the data is clipped at the top or bottom of the screen and may appear as a flat line if the data never appears within the full scale values.
4. Return to the Waveform Options menu using the **Escape** or **Enter** key.
5. Change the channel to be plotted by changing the Channel field. This field cycles between 1 and the number of channels digitizing as entered in the Configuration menus.
6. Select the Start command to start plotting the new channel selected. As only digital noise is being recorded there may not be much difference between the channels except for the DC offset which may be filtered out (more on that later).
7. Return to the Waveform Options menu when finished viewing the waveform data. Repeat from step 5 if desired.
8. Change the vertical scale quickly by changing the Y Max Multiplier field. This field cycles between powers of 10 (from 1 to 1000000) to be multiplied by the Y Max so that a rough estimate of the peak signal can be quickly determined.
9. Select the Start command to start plotting using the new Y Max Multiplier selected. Notice the new values for the full scale indicated on the right of the display.
10. Return to the Waveform Options menu when finished viewing the waveform data. Repeat from step 8 if desired.
11. After a rough estimate for the peak number of counts has been determined, the full scale value can be more accurately fine-tuned by changing the Y Max field. This field can contain any value between 1 and 1000 to give up to 3 significant digits of accuracy for the full scale value.
12. Select the Start command to start plotting using the new Y Max selected. Notice the new values for the full scale indicated on the right of the display.
13. Return to the Waveform Options menu when finished viewing the waveform data. Repeat from step 8 if desired.
14. Change the time scale by changing the Time Width field. This field cycles between the valid horizontal scale times in seconds 1, 2, 5, 10, 15, 30, 60 and 120.
15. Select the Start command to start plotting using the new Time Width selected. Notice that for time scales up to 30 seconds each tick along the top and bottom represents 1 second. For the longer time scales (60 and 120 seconds) only 30 ticks are displayed so each tick represents 2 and 4 seconds respectively.

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16. Return to the Waveform Options menu when finished viewing the waveform data. Repeat from step 14 if desired.
17. Enable or disable the DC offset removal filter on the plot data screen. This filter is necessary to view the seismic data on channels that do not have the DC removal filter enabled, otherwise they will appear as flat lines at a DC offset. It is also useful on startup to remove the DC offset faster than the digitizer. The DC offset is only removed when the plot data screen is cleared.
18. Select the Start command to start plotting with or without the DC removal as selected.
19. Return to the Waveform Options menu when finished viewing the waveform data. Repeat from step 5 if desired.
20. Return to the top level menu when finished viewing the real-time seismic data using the Escape key at the Start command.

### Shutting down the user interface

1. From the top level menu select the UserExit command to indicate to the user interface that you have finished using it and that it should shut down leaving the digitizer running.
2. If there is additional data to be downloaded from the digitizer to the data cartridge, the user interface will not shut down immediately. Instead, it will display a screen indicating how much more data is to be received before it will shut down. You may select "Exit Now" if you wish to force an immediate shutdown without flushing the data buffer to disk.
3. When the user interface shuts down the screen will go blank and all the Orion LEDs will be turned off to conserve power.

### Restarting the user interface

While the digitizer is running the LEDs may be reactivated and the user interface may be restarted at any time by pressing the **Up** key, as follows:

1. To turn the LEDs back on press the **Up** key. The LEDs will turn on within a second.
2. If 5 minutes elapse without the user pressing the **Up** key again the LEDs will turn off again to conserve power.
3. To restart the user interface (with the LEDs on) press the **Up** key again. The USER-CPU LED will turn amber within a second. In addition the LCD and the DISK LED may flicker and a beep may be heard.
4. Wait for the user interface to start up (about one minute). A beep will be made in the middle of the startup sequence. When the user interface is available for use the top level menu will be displayed and the USER-CPU LED will turn green.
5. When you have finished using the interface select UserExit from the top-level menu to shut down the user interface again.

### Turning off the Orion

1. When the user interface shuts down, it is safe to turn off the Orion using the red switch inside the disk compartment.
2. After the Orion has been turned off the disk may be removed for analysis of the recorded data.

## Tutorial 3: Configuring the Orion

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### Goals of this tutorial

The Orion **configuration** is the complete set of parameters and settings which govern the operating characteristics of the Orion. The configuration can be easily customized to suit any particular application. This tutorial will discuss the basics of setting up the Orion's configuration. We will cover:

1. How to change the Orion configuration using the menus.
2. How to re-initialize the data cartridge during configuration.
3. How to load a new configuration from the disk.
4. How to copy the configuration from one Orion to another.
5. How to restore the Orion to its "as-shipped" default configuration.

### Where the configuration is stored

The master copy of the Orion's configuration is stored in non-volatile flash memory in the digitizer. This allows the Orion to maintain its configuration when it is powered-off and when the data cartridge is changed. When a new data cartridge is initialized or when the configuration is changed, a copy of the configuration is written to the disk as file ORIONnnn.INI, where nnn is the Orion serial number. The previous configuration file is renamed and saved as file ORIONnnn.mmm, where mmm is a 3-digit number selected to create a unique filename. At the end of an experiment the data cartridge will contain a complete record of configuration changes made since the disk was initialized.

Appendix E provides a description of the configuration file format and a complete definition of all configuration parameters.

### The default configuration

The Orion is shipped with the same default configuration stored both in the internal flash memory and on the disk cartridges. A backup copy is also on the diskette. This default configuration defines how the Orion will behave when power is first applied.

The default configuration provides the following setup:

Sampling is at 100 samples per second on three channels (6 channels for a 6-channel Orion), in the continuous recording mode. The Orion will start recording automatically when it is turned on. The state-of-health channels have been set to a moderate sample rate (1 sample/minute). The event detector is enabled and three STA/LTA triggers have been defined (for channels 1, 2 and 3).

### Changing the configuration using the menus

The configuration may be viewed and edited using the interface menus while the Orion is running, without stopping the digitizer. After making all of the desired changes, you may choose one of two options:

- |                       |  |
|-----------------------|--|
| <i>Accept/Restart</i> | to instruct the Orion to stop digitizing, store the revised configuration in its flash memory, and restart using the new configuration, or |
| <i>Cancel</i>         | to return to the main menu without saving your changes (i.e. to continue using the same configuration).                                    |

To demonstrate the basic procedure used to change the configuration, we will work through an example in which we change two parameters: the sample rate and the data file size. We will

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restore the Orion to its default configuration later in the tutorial. Please see Tutorial 1 for instructions on selecting menu commands and editing fields.

To change the sample rate and file size:

1. From the top-level menu select "Config" to enter the configuration menu tree. After a few seconds, the top-level configuration menu will be displayed. Some of the main configuration parameters, including sample rate and file size, are shown on the right-hand side of the display.
2. Select "Digitizer" to enter the Digitizer Configuration submenu.
3. Move the cursor to the Sample Rate field.
4. Adjust the Sample Rate to 200 sps. Sample rate is an enumerated field.
5. Select "Files" to enter the File Settings submenu.
6. Move the cursor to the "Data Buffer Size" field and change the buffer size to 5 MB. This field accepts arbitrary values.
7. Select OK to return to the Data Settings menu.
8. Press the **Escape** key to return to the main Configuration menu.

To exit from the configuration menu without saving your changes

If you decide at this point that you do not want to save these changes:

1. Select "Cancel" (in the main Configuration menu) to return to the top-level menu without changing the Orion's configuration.
2. Select "OK" when the Orion asks if you wish to lose your changes (Cancel returns to the configuration menu).

To save the new configuration

If you are satisfied with the changes you have made and wish to save the new configuration:

1. Select "Accept/Restart" (in the main Configuration menu) to initiate the configuration change sequence. The Orion will display the Restart Options menu which shows the file sizes to be allocated when the Orion restarts.
2. Select "OK" to accept the file sizes shown and confirm the configuration change (Cancel returns to the configuration menu). See note below.
3. If the Orion displays the "Waiting To Configure" menu, select "Do It Now" to change the configuration immediately (Cancel returns to the configuration menu).
4. Wait about 30 seconds while the Orion reconfigures. After the Orion has been restarted with the new configuration, it will display "Configuration changed OK".
5. Select "OK" to return to the main menu.

*Note: Due to their internal structure, Orion data files cannot be resized without destroying the data. If the file sizes are changed during configuration, but the filenames remain unchanged, the Orion will delete the existing data files and allocate new files with the correct sizes. See the section on data files in Chapter 6.*

What happens when you change the configuration

When you change the configuration using the above procedure, the Orion:

1. Stores the new configuration to its flash memory.
2. Stops digitizing and re-initializes its memory buffers.
3. Restarts using the new configuration.
4. Saves a copy of the new configuration to the data cartridge.
5. Closes all open data files.

6. Opens or creates data files using the names and sizes specified in the new configuration.

### What you will see

While the Orion is reconfiguring, you will see the following:

1. The LCD will display "Changing Configuration" and the buttons will be disabled.
2. The front panel LEDs will display the restart sequence described in Chapter 8.

### Re-Initializing the data cartridge during configuration

If the data cartridge has not been initialized prior to deployment it is still possible to clear the data area during on-site configuration. This is achieved using the Restart Options menu:

1. After editing the configuration, select "Accept/Restart" to save the new configuration. The Orion will display the Restart Options menu.
2. Set "Delete Data\\*.\* on Restart" to Yes, then select "OK" to proceed with the reconfiguration. This instructs the Orion to delete the entire contents of the data directory during reconfiguration allowing all available space to be used for new data files.

### Loading a new configuration from the disk

Because the Orion configuration is stored onboard the digitizer, the Orion retains its configuration even when the disk is changed. Occasionally, it may be desired to place a new configuration file on a data cartridge and force the Orion to use that configuration instead of the version in memory. This can be accomplished using the "Load From Disk" command.

To use this feature:

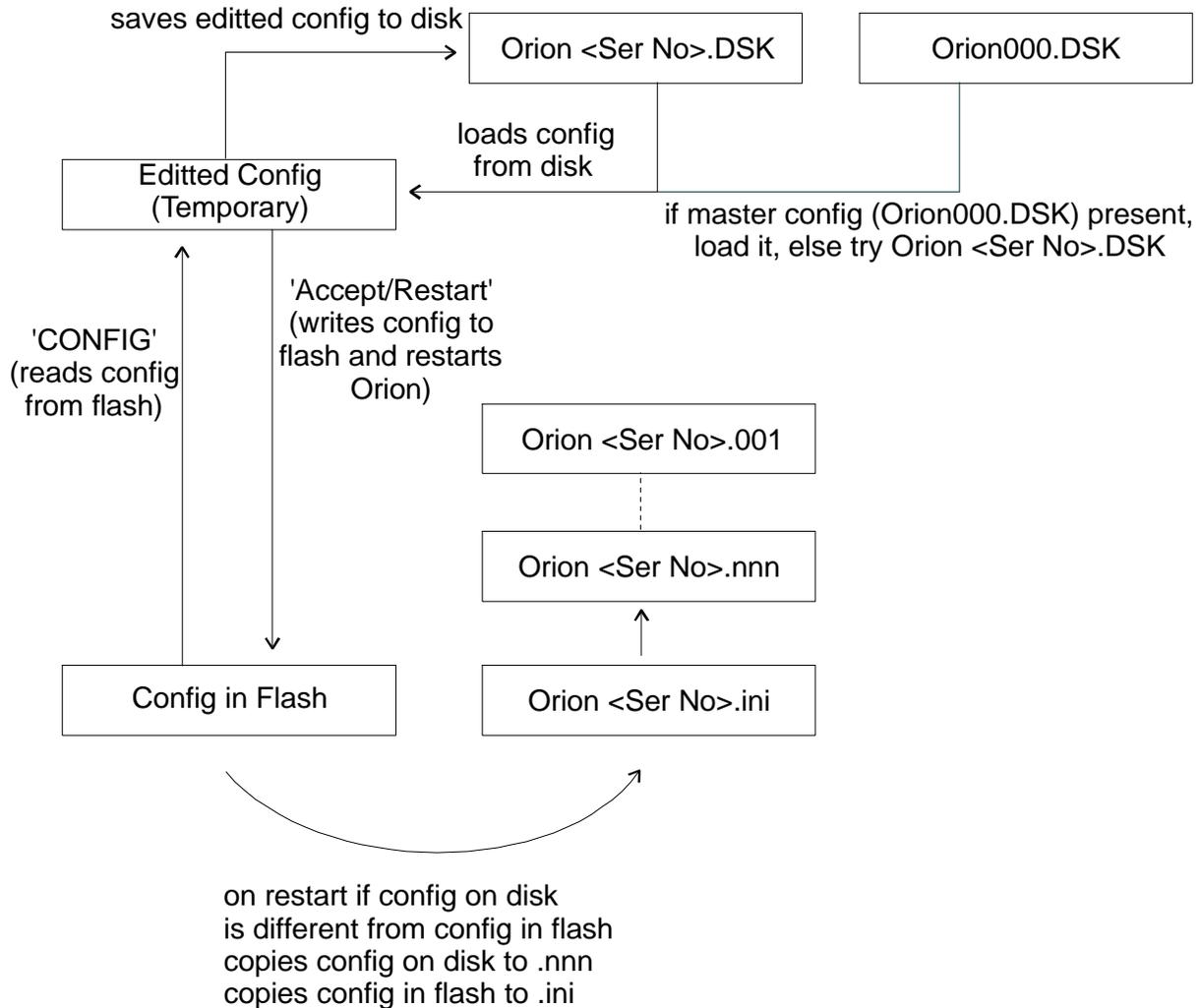
1. Connect the data cartridge to the playback PC as described in the Orion Basic Playback Manual. Be sure to run CHKDSK /F before attempting to access the disk.
2. Copy the new configuration file to the \USER directory on the data cartridge with filename ORIONnnn.DSK or ORION000.DSK for a master configuration.

*Note: the Orion can load one of two .DSK files. An Orion<SerNo>.DSK or ORION000.DSK. With ORION<SerNo>.DSK a specific configuration for a specific Orion can be created. With ORION000.DSK a common or master configuration can be created which can be read by all Orions.*

3. Insert the data cartridge into the Orion, turn on the Orion, and wait for the user interface to start up.
4. Select "Config" to enter the configuration menu.
5. Select "Load From Disk" to load the ORIONnnn.DSK file.
6. Select "Accept Changes" to install the new configuration.

*Note: selecting "Save To Disk" from the main Configuration menu will save the current edited version of the configuration to ORIONnnn.DSK. Since this can be reloaded at any time, this provides a convenient place to "back up" your changes partway through editing the configuration. It also provides a convenient way to create a configuration file which can then be copied to another data cartridge and loaded on another Orion. However, be aware that saving the configuration as ORIONnnn.DSK will overwrite any existing ORIONnnn.DSK file.*

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### Restoring the as-shipped configuration

The "Load From Disk" feature may also be used to restore your Orion's configuration to the as-shipped configuration, as follows:

1. Connect the data cartridge to the playback PC as described in the Orion Basic Playback Manual. Be sure to run CHKDSK /F before attempting to access the disk.
2. Copy the ORIONnnn.DSK file from your Orion software diskette to the \USER directory on the data cartridge.
3. Insert the data cartridge into the Orion, turn on the Orion, and wait for the user interface to start up.
4. Select "Config" to enter the configuration menu.
5. Select "Load From Disk" to load the ORIONnnn.DSK file.
6. Select "Accept Changes" to install the new configuration.

## Tutorial 4: Scheduled Recording

---

### Goals of this tutorial

In this tutorial, we explore the different recording modes and options supported by the Orion and show how to configure the Orion for scheduled recording.

### Continuous, Scheduled and Event recording

#### Global recording modes

The Orion supports three global recording modes:

<i>Continuous</i>	records continuous data to the ringbuffers.
<i>Event</i>	records only event-triggered data to the ringbuffers.
<i>Scheduled</i>	records only during user-defined recording schedules or windows.

The global recording mode is set using the Digitizer Configuration menu.

#### Scheduled recording modes

If the global recording mode is set to Scheduled, then you must define at least one (and up to ten) recording schedule specifying when the Orion is to record. Each recording schedule is a repeating recording window, with a specified start time, duration, repeat interval and total count. Also, each recording schedule specifies a recording mode (continuous or event) to be used during its windows. For example, the Orion can easily be configured to record event-triggered data from 9:00 to 12:00 every day, and continuous data from 9:00 to 17:00 every Monday. The schedule parameters and the schedule-specific recording mode is set using the Recording Schedules configuration menu.

Overlapping recording windows are permitted; if a continuous-mode window overlaps an event-mode window, continuous data will be recorded during the overlap period.

The Orion can go into a very low power mode between schedules. In the very low power mode, the Orion consumes about 3mA. This mode helps conserve batteries between recording schedules. The algorithm for entering the very low power mode is as follows:

```
if (time to the next schedule) > warmup delay
    (prepare for entering very low power mode)
    heat (if necessary) and boot PC processor
    download existing data
    turn off the PC processor
    if (time to the next schedule) > warmup delay
        shutdown, and enter very low power mode
else
    stay on until the next schedule
```

### Using Start and Stop

The Start and Stop commands in the Go/Stop menu provide the user with direct control over the Orion's recording. The Start and Stop commands enable and disable recording.

#### In Continuous Mode

Start	Starts recording continuous data immediately.
Stop	Stops recording immediately.

#### In Event Mode

Start	Starts recording event-triggered data. Starts recording immediately if there is an event in progress.
Stop	Stops recording immediately.

## In Scheduled Mode

Start	Enables scheduled recording. Starts recording immediately if the current time falls within a recording window.
Stop	Stops recording immediately and disables scheduled recording.

## Configuring the Orion for scheduled recording

Consider the following scenario: You are deploying your Orion for a blast-monitoring application in which you wish to record event-triggered data from 9:00 to 12:00 every day and continuous data all day (9:00 to 17:00) every Monday. The experiment is to start on Monday, March 18, 1996 and continue for 12 days. How do you configure the Orion?

Your recording requirements can be met by defining two repeating recording schedules: a 3-hour (event-mode) window starting on March 18 at 9:00 and repeating every day and an 8-hour (continuous-mode) window starting on March 18 at 9:00 and repeating after 7 days.

To configure the Orion:

1. Select "Config" to enter the main configuration menu.
2. Select "Digitizer" to enter the Digitizer Configuration menu.
3. Change the "Recording Mode" field to read "Scheduled."
4. Select "Schedule" to enter the Recording Schedules menu.
5. Select "Delete" repeatedly until there is only 1 schedule remaining.
6. Select "Add" to add a second schedule.
7. Select "Next" to display the information for recording schedule 1.
8. Edit the information screen to read as follows:  
Recording Mode: Event  
Start Time: 1996/03/18 09:00:00  
Duration: 3h (3 hours)  
Repeat: 12 times  
Every: 1d (1 day).
9. Select "Next" to display the information for recording schedule 2.
10. Edit the information screen for schedule 2 to read:  
Recording Mode: Continuous  
Start Time: 1996/03/18 09:00:00  
Duration: 8h (8 hours)  
Repeat: 2 times  
Every: 7d (7 days).
11. Return to the main configuration menu and select "Accept Changes" to save the configuration.
12. Observe the recording state displayed on the top-level menu.

Hint: recovering deleted schedules

*If you delete a schedule by mistake you can restore it by selecting "Add." This adds the deleted schedule to the end of the schedule list. This feature can also be used as a cut-and-paste method to create several similar schedules.*

## Tutorial 5: Event Detection and Event Recording

---

### Goals of this tutorial

This tutorial introduces the event detection and event recording features of the Orion. We start with a brief discussion of triggers and events, then step through an example in which you will configure your Orion to detect certain classes of event.

### Triggers and Events

Event detection on the Orion is a two-step process. The Orion issues a trigger message when the signal on a specific channel meets a user-specified trigger criterion. An event is declared to have occurred when a user-specified number of triggers occur within a given coincidence window. Both trigger messages and event messages are written to the SOH file and can be extracted later. Event messages also serve to start and stop data recording in the event-triggered recording mode.

The Orion can monitor up to 6 independent triggers. Each trigger definition has an associated filter, level, and type (threshold or STA/LTA), and may be applied to any valid data channel. Trigger-on and trigger-off messages are generated in real time by comparing the trigger-filtered signal with the trigger level criteria. For a threshold trigger:

*Trigger-on* occurs when the amplitude of the trigger-filtered signal exceeds a user-specified absolute threshold.

*Trigger-off* occurs when the amplitude of the trigger-filtered signal falls below the threshold for a given period of time (Detrigger Time).

For an STA/LTA trigger:

*Trigger-on* occurs when the short term average amplitude of the trigger-filtered signal exceeds a given multiple of its long term average amplitude (that is, when the ratio of short-term average to long-term average exceeds the specified level).

*Trigger-off* occurs when the ratio of short-term average to long-term average falls to 1.

A trigger filter may be highpass, lowpass, or bandpass to a maximum of 5 poles; the filter for each trigger is defined separately to allow full customization of triggers for different applications. *Note that the channel data goes through a DC removal filter before the trigger filters.* Triggers are defined using the Trigger Setup menu. See Chapter 6 for a full definition of all trigger parameters.

### Configuring the Orion for Event Detection

Suppose that you want to setup two triggers to detect teleseisms (on channels 1 and 2), and two triggers to detect high-frequency local activity (also on channels 1 and 2). For teleseisms, you want to capture frequencies between 0.5 Hz and 2.0 Hz; for the local microseisms you are interested only in frequencies above 3 Hz. All triggers are to be StaLta triggers with a trigger ratio of 6.

#### Configuring the triggers

Triggers are configured using the Trigger Setup menu.

1. Select "Config" to enter the main configuration menu.
2. Select "Digitizer" to enter the Digitizer Configuration menu.
3. Select "Triggers" to enter the Trigger Summary menu.
4. Select "Setup" to enter the Trigger Setup menu.
5. Select "Next" until the information screen shows the data for trigger 1.
6. To setup the teleseism trigger on channel 1, edit the information to read:  
Trigger: 1    Channel: 1

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Type: STA/LTA Level: 6  
Report Dly: 1.0 Detrig T: 10.0  
STA Time Constant: 5 sec  
LTA Time Constant: 30 sec  
HP Filter Order: 2 Freq: 0.5 Hz  
LP Filter Order: 3 Freq: 2.0 Hz

7. Select "Next" to display the data for trigger 2.
8. To setup the teleseism trigger on channel 2, edit the information to read the same as that shown in step 4, except:  
Trigger: 2 Channel: 2
9. Select "Next" to display the data for trigger 3.
10. To setup the microseism trigger on channel 1, edit the screen to read:  
Trigger: 3 Channel: 1  
Type: STA/LTA Level: 6  
Report Dly: 1.0 Detrig T: 10.0  
STA Time Constant: 1 sec  
LTA Time Constant: 10 sec  
HP Filter Order: 5 Freq: 3.0 Hz  
LP Filter Order: 0 Freq: 0.0 Hz
11. Select "Next" to display the data for trigger 4.
12. To setup the microseism trigger on channel 2, edit the screen to read the same as shown in step 8, except:  
Trigger: 4 Channel: 2
13. Select "Next" to display the data for trigger 5.
14. Disable trigger 5 by setting the channel field to "Off."
15. Select "Next" to display the data for trigger 6.
16. Disable trigger 6 by setting the channel field to "Off."
17. Return to the Trigger Summary menu and view the list of triggers.
18. Return to the Digitizer Configuration menu.

### Enabling and Configuring Event Detection

In addition to the triggers, you want to generate a list of events. To avoid false detections you wish to declare an event only when two or more triggers occur within a 1-second window.

The event detection parameters are specified in the Event Detection menu.

1. From the Digitizer Configuration menu, select "Events" to enter the Event Detection menu.
2. Set the Coincidence Window to 1 second, and set Triggers On to 2. This specifies that at least 2 triggers must be on within any 1-second window in order to declare an event.
3. Set Triggers Off to 1. This specifies that the event will end when the number of active triggers falls below 1.
4. Set Pre-Event to 5 seconds, and Post-Event to 10 seconds. These parameters are used in the event-triggered recording mode. They specify the number of seconds of data to recorded before and after the event on and off times.
5. Set Max Duration to 600 seconds. This forces an event to end after 600 seconds even if the Event-Off criterion (step 3) has not been met.
6. Return to the Digitizer Configuration menu.

## Configuring the MinMax preview channels

The MinMax channels provide a highly compressed summary of seismic activity for quick preview and identification of interesting time segments. Rather than subsampling a data channel, the MinMax identifies the minimum and maximum counts over a given interval. Therefore it shows an envelope of all significant activity, even brief, high frequency bursts which would be lost by normal subsampling. Also, the MinMax channels are based on trigger-filtered data which allows them to be customized for specific applications by choosing appropriate trigger filters.

For the current example, it might be appropriate to assign the two MinMax channels to triggers 1 (teleseism) and 3 (microseism) to provide a summary of teleseismic and local activity, respectively.

1. From the Digitizer Configuration menu, select "Log/Soh" to enter the Log and SOH Settings menu.
2. Set the MinMax Channel 1 to Trig1 and set the MinMaxChannel 2 to Trig3.
3. Set the MinMax SOH Interval to 60 seconds. We have found that a 60 second interval provides adequate precision in locating events of interest without generating too much data (one week of data is summarized in about 10,000 data points).

## Saving the configuration

To save the configuration, return to the main Configuration menu and select "Accept/Restart." This will reconfigure the Orion to use the triggers and event logic that you have entered above.

## Configuring for Event Recording

In the example above we left the Orion in the Continuous recording mode. Continuous data is written to the ringbuffers and the trigger messages and event messages are written to the SOH file. These can be extracted during playback as outlined below.

Event messages can also be used to control event-triggered recording. In the event-recording mode, recording is started and stopped by the event detector. Only events, together with their pre-event and post-event records, are written to the ringbuffers. Trigger messages and event messages are written to the SOH file, as before. To configure the Orion for event recording:

1. In the Digitizer Configuration menu, set Recording Mode to "Event."
2. Configure the triggers as desired, following the example above.
3. Enable and configure event detection as desired following the example above.
4. Return to the main Configuration menu and select "Accept/Restart" to reconfigure the Orion.

## Playing Back Triggers, Events and MinMax

The triggers, events and MinMax data can be viewed and analyzed during playback.

1. Connect the data cartridge to the playback PC as described in the Orion Basic Playback Manual. Be sure to run CHKDSK /F before attempting to access the disk.
2. Change directory to the \USER\DATA subdirectory on the data cartridge.
3. Run the SOH extraction program by typing:  
**sohextrp filename.soh**  
where filename.soh is the name of your SOH file.
4. Print the filename.trg file (or load it into a text editor) to view the triggers. The data fields are defined in the SOHEXTRP manual pages in the Orion Basic Playback Manual.
5. Print the filename.elf file (or load it into a text editor) to view the event messages. The data fields are defined in the SOHEXTRP manual pages in the Orion Basic Playback Manual.

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6. Load the filename.mx1 file into a spreadsheet as comma-separated text.
7. Plot column 2 (min) and column 3 (max) vs. column 1 (time) to create a summary of the MinMax 1 channel. In the above example this will provide a summary of the teleseismic activity.
8. Repeat steps 6 & 7 using the filename.mx2 file to create a summary of the MinMax 2 channel.

---

### Tutorial 6: Data Cartridge and Disk Heater

Disk drives are typically rated for operation in the range 5 to 55 degrees C. Operating a disk outside this range will result in a loss of data and possibly permanent damage to the disk. The disk heater within the Orion extends the low end operating temperature to -20 degrees C. For experiments where the temperature may dip below 5 degrees C occasionally, the Orion with the disk heater is ideally suited.

#### Operation

The Orion has three modes of operation: safe, extended, and unlimited

*Safe:* the disk is limited to an operating range of 5 to 50 degrees C.

*Extended:* the disk heater is enabled, extending the operating range to -20 to 50 degrees C. The disk heater will preheat the disk drive until it reaches the required temperature before turning the PC processor on. The high temperature cutoff is enabled.

*Unlimited:* the disk heating is disabled, and there are no checks on the disk temperature. It is not recommended that this mode be used, as operating a disk outside the allowable temperature range may damage the disk and result in a total loss of data.

The Orion in the *Extended* mode continuously monitors the temperature of the disk drive. If the temperature is too high the Orion will not powerup the disk drive, thus preventing any damage. At cold temperatures, the Orion has the disk heater. If the temperature drops below 5 degrees C, the Orion will enable the heater. The 15 W heater turns on and preheats the disk to 5 degrees before powering the PC processor and disk.

Operating the Orion with the disk heater below 5 degrees C is convenient, but there is downside: the power consumption of the heater. If you are operating with batteries, the heater may drain the batteries too quickly. In this case, the best solution is to place the Orion in an insulated box and save the heater for the odd time when it is exceptionally cold. Ideally, with the insulation, you want to shift the average temperature of the Orion to above the 5 degrees C threshold, so that the heater comes on rarely, and the battery power is conserved.

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### Front Panel LEDs

The Orion front panel has 6 LEDs labelled as follows: DISK, GPS, BATTERY, ACQ-CPU, EVENT and USER-CPU. Each of the 6 LEDs can be in one of four states: off, red, green or amber.

On power-up the LEDs show the progress of the instrument start-up sequence. At all other times the LEDs indicate the operating state of the Orion. The LEDs are turned off automatically when the user interface is shutdown to conserve power. Pressing the Up button once will turn on the LEDs without turning on the user interface for a 5 minute period. Pressing the Up button while the LEDs are on will restart the user interface.

#### Power On Sequence

When the Orion is first powered on the GPS, BATTERY, ACQ-CPU and USER-CPU LEDs will flash red, amber and green each for a third of a second. These LEDs will then all be turned off and the BATTERY LED will indicate the voltage of the power supply in use. If the input voltage is less than 10.8 Volts the BATTERY LED will flash red 5 times and the Orion will shutdown until the voltage rises. If the input voltage is greater than 10.8 Volts, the BATTERY LED will indicate the voltage by the colour: green (above 12.8 Volts), amber (between 11.8 and 12.8 Volts) or red (between 10.8 and 11.8 Volts). The LEDs will remain in this state for several seconds while the digitizer does a memory test on its extended memory buffer. This length of time depends on the amount of extra memory installed (about 7 seconds per Megabyte of memory). The LEDs will then start displaying their proper running states as outlined below.

#### Low Power Situation

If the input power voltage is less than 10.8 Volts when the Orion is powered on it will not do a complete startup. Instead the Orion will flash the BATTERY LED 5 times and then wait for one of the input voltages to rise above 10.8 Volts to continue its power on sequence. If the Orion has shut down because all the input voltages are below the shutdown threshold, it will wait for an input voltage to rise above 11.8 Volts to start running again. If the Up-arrow button is pressed while the Orion is waiting for the voltage to rise, the BATTERY LED will flash red 5 times then return to its waiting state.

#### Reboot Sequence

Whenever the digitizer reboots due to a reconfiguration from the Orion interface, the LEDs will be frozen at their last state for about ten seconds while the new configuration is saved and the digitizer restarts using the new configuration.

#### Normal Operation

##### The DISK LED

The DISK LED indicates read or write activity to the hard disk.

Off	The disk is not currently being accessed. If the USER-CPU LED is off the disk has no power. Otherwise, the disk is just idle.
Green	There is read or write activity in progress. This is similar to the disk LED found on the front of most PCs.
Red	The LED should never be in this state.
Amber	The LED should never be in this state.

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## The GPS LED

The GPS LED indicates the status of the GPS engine and the time quality of the Orion with reference to the GPS. Note that a power cycled GPS is automatically turned on whenever the LEDs are turned on.

Off	The GPS engine is missing or not working properly. Since the GPS is always on whenever the LEDs are on, this LED should never be in this state.
Red	The GPS is unlocked or the Orion does not trust the time reported by the GPS engine. The Orion internal clock is free running using its internal temperature compensation table. If the GPS is unlocked, the GPS antenna may not have a sufficient view of the sky. It is expected that the GPS may be unlocked for up to 15 minutes when the Orion is first powered on and longer if the Orion has been transported over 100km since the last time the GPS was locked.
Amber	The GPS time is valid and that the Orion is phaselocking (slowly adjusting its internal clock) to correct an error in its time with reference to the GPS time.
Green	The GPS time is valid and the Orion is phaselocked so that its time is within 10 microseconds of the GPS time. It is doing very minor corrections to compensate for temperature changes. A power cycled GPS would be off if not for the LEDs being on.

## The BATTERY LED

The BATTERY LED indicates the voltage level of the input power supply. See the section on Low Power Situation for further information on how the Orion handles dead batteries.

Off	The LED should never be in this state.
Red	The voltage level of the input power supply is critically low (between 10.8 and 11.8 Volts). Damage may be done to the batteries and their life span may be shortened. The Orion will continue to run. However, if it drops below the shutdown voltage, the Orion will shut down completely to prevent further damage to the batteries. A flashing red indicates the Orion has shut down; see the section on Low Power Situation for further information.
Amber	The voltage level of the input power supply is no longer at full voltage (between 11.8 and 12.8 Volts). The batteries should be recharged soon to prevent damage and shortening of the battery life span.
Green	The voltage level of the input power supply is at full voltage (above 12.8 Volts). This is the ideal operating condition.

## The ACQ-CPU LED

The ACQ-CPU LED indicates the status of the main acquisition processor.

Off	The LED should never be in this state.
Red	The user has entered the digitizer setup menus. This action should not be done in normal operations.
Amber	The digitizer is in its startup sequence. It is initializing all internal operations. This should only happen when the Orion is first powered on or after a reconfiguration.
Green	The digitizer is running properly and collecting data as per its configuration.

## The EVENT LED

The EVENT LED indicates the status of the internal Orion event detector which receives individual channel trigger on and off messages from the DSP processor. The parameters used for configuring the event detector are located in the configuration menu under digitizer/events, while

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the parameters for configuring the trigger detector are located in the configuration menu under digitizer/triggers.

Off	No events recorded and no event is in progress as determined by the event detector.
Red	The LED should never be in this state.
Amber	Events recorded, but none in progress.
Green	The event detector has determined that an event is in progress.

### The USER-CPU LED

The USER-CPU LED indicates the status of the auxillary processor.

Off	The AUX processor is currently off, the digitizer is currently buffering data in memory and access to the Orion interface has not been requested by the user. This should be the most common state of operation to minimize power consumption. Only in this state is it safe to remove the disk cartridge, insert a new one or turn the unit off.
Red	The data cartridge has been removed, the Orion will not attempt to start the AUX processor in this condition and if the data cartridge is left out for too long data may be lost. Another possibility is the AUX processor is running the DOS scandisk utility to correct possible disk errors since the disk was not shutdown properly the last time it was on. This situation should not occur in normal operations.
Amber	The Orion digitizer is waiting for the AUX processor to boot up so that it can start downloading data. The user must wait for the AUX to finish booting to access the Orion interface. If the data cartridge is cold the disk heater will be powered up first until the disk cartridge warms up sufficiently to start the AUX processor. The user will have to wait longer than the usual one minute to access the Orion interface.
Green	The AUX processor is running and data is being downloaded to it. The user may also utilize the Orion interface at this time.

## Operational Menus

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### Top Level Menu

```
Config      Time: 1995/12/14 13:57:01
Go/Stop    GPS : FineLock   Memory:185420
Gps        Disk: 53 / 1329  KbLeft:1347
Waveform   State:Scheduled Wait
Instrmnt   Next: Start Recording Cont
DataFile   At:   1995/12/14 16:00:00
LogFile    Dta:45      29      94
UserExit   0         0         0
```

The top level menu is the base from which all other menus are accessed. It provides a summary display of the Orion's operating state. The **Escape** key in this menu adjusts the contrast. This allows you to set the contrast without having to navigate the menus. This is important when the temperature changes and the LCD screen is blank.

### Commands

Config	Displays the top level configuration menu. All Orion setup menus are accessed via this command (see Configuration menus, next section). The Orion configuration can be viewed without interrupting the acquisition of data.
Go/Stop	Displays the Go/Stop sub-menu. This menu allows the user to start and stop data acquisition.
GPS	Displays the GPS status menu.
Waveform	Displays the waveform menu and real-time display screens.
Instrmnt	Displays the instrument status menu.
DataFile	Displays the data menus. These show the size of the data files and their contents. Displays the log file during data acquisition.
LogFile	Displays the log menus.
UserExit	Instructs the Orion to shut down the user interface. When the Orion has finished transferring all of its memory banks to the data cartridge, it will shut down the user interface and the screen will go blank. The action only shuts down the user interface; it does not stop data acquisition. This command should be used when you have finished configuring or checking an Orion and you wish to leave the instrument recording.

### Displayed Fields

Time	The instrument time.
GPS	Current status of the GPS (fine locked, coarse locked, or unlocked).
Memory	The number of bytes of free RAM memory.
Disk	The disk space available and the total size of the disk in MBytes.
KbLeft	The amount of data remaining to be transferred from the digitizer to disk.
State	Displays the Orion's acquisition state (recording, stopped, waiting).
Next	Displays the next programmed action that the Orion will undertake.
At	Displays the time at which the next programmed action will occur.
Dta	Displays the most recent data value recorded on each input channel.

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## Go/Stop Menu

```
-- Start/Stop Control --  
  
State:Recording Continuous  
Next:Stop Recording  
At:User Stop  
Start  
Stop           KBytes to receive: 1347
```

The Go/Stop menu enables the user to start or stop recording or shut down the Orion.

### Commands

Start	Start initiates data acquisition. Selecting start will initiate the recording of data according to the Orion configuration setup. If the Orion is programmed for continuous recording, data acquisition will start immediately.
Stop	Stop will take the Orion out of the data acquisition mode.
Escape key	Returns the Orion to the top level menu.

### Displayed Fields

State	Displays the Orion's acquisition state (recording, stopped, waiting).
Next	Displays the next programmed action that the Orion will undertake.
At	Displays the time of the next programmed action.
KBytes to receive	Shows the amount of data remaining to be transferred from the digitizer to disk, in kilobytes.

## GPS Status Menu

```
GPS Time 1996/01/31 16:31:37  
  
GPS:3D Nav      S/N dB Activity  
Clk:FineLock   Ch1 47 Track 22  
Fig Merit:1    Ch2 49 Track 24  
Horz Err:2     Ch3 42 Track 26  
Location Vert Err:3  Ch4 0 Search 0  
GPS Init Time Err:0  Ch5 42 Track 39
```

The GPS Status menu shows the current status of the onboard GPS receiver.

### Commands

Location	This command displays the GPS location menu.
GPS Init	This command displays the GPS initialization menu.
Escape key	Returns the Orion to the top level menu.

### Displayed Fields

GPS Time	Displays the current GPS time.
GPS	Indicates the GPS status (searching/tracking/navigating).
CLK	Indicates the status of the internal clock (locked to GPS/unlocked).
Fig of Merit	The figure of merit is based on the horizontal position error. A value of 1 represents the lowest error while a figure of 9 represents the highest.
Horz Err	Horizontal position error in meters.
Vert Err	Vertical position error in meters.
Time Err	Time error in microseconds.

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S/N dB	GPS signal to noise ratio (dB) on each channel.
Activity	Indicates the status of each of the GPS channels (idle, search, tracking). The display also shows the PRN number of the satellite being tracked.

### GPS Location Menu

```
-- GPS Location --  
Time: 1996/01/31 16:31:37  
Latitude: 45.0000  
Longitude: -70.0000  
Elevation: 300.20  
Status: 3D Nav  
OK
```

The GPS Location menu shows the current time and location as determined by the GPS receiver.

#### Commands

OK Returns the user to the GPS Status menu.

#### Displayed Fields

Time	Displays the current GPS time.
Latitude	Displays the current latitude as determined by the GPS receiver.
Longitude	Displays the current longitude as determined by the GPS receiver.
Elevation	Displays the current elevation as determined by the GPS receiver.
Status	Indicates the GPS status (searching/tracking/navigating).

### GPS Initialization Menu

```
-- Initialize GPS --  
Data to set: Position Only  
GPS Time 1996/01/31 16:31:37  
New Time N/A  
New Latitude: 45.00  
New Longitude: -70.00  
Cancel  
Set New Elevation: 300.0
```

The GPS initialization menu enables the user to manually initialize the GPS time and position. This can help the GPS to lock faster if the Orion has been moved a great distance (several hundred kilometres or more) since the GPS was last locked.

#### Commands

Cancel Return to the GPS Status menu without initializing the GPS.  
Set Initialize the GPS with the time and position shown and returns to the GPS Status menu.

#### Displayed fields

GPS Time The current GPS time.

#### Editable Fields

Data to set	Specifies whether to set position only (if the GPS time is approximately correct) or time and position.
New time	Specify the correct time (U.T.)
New latitude	Specify the latitude in degrees.

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New longitude	Specify the longitude in degrees.
New elevation	Specify the elevation in metres above sea level.

## Waveform Menu

```
== Waveform Options ==
      Channel: 1
      Time Width: 30 sec
      Y Scale Max: 500
      Y Scale Multiplier: 10
      Remove DC: Yes
Start
```

The Waveform menu enables the user to set plotting options for the realtime waveform display, and to start plotting.

### Commands

**Start** Initiates the real-time display of waveform data for the specified channel.

*Note:* At higher sample rates the LCD screen may display the message: "Waveform not Available". This message is displayed when the digitizer is running out of room to store data. When this occurs, the digitizer stops sending the waveform data and sends data to be logged to the ringbuffers on the hard disk. This prevents the loss of data by the Orion due the waveform. Pressing "OK" at this point returns the Orion to the waveform options screen. You can enter the waveform screen again at this point, but you will be bumped out of the waveform screen again as soon as the buffer is full again. This bumping only occurs in the waveform screen because at high sample rates, the realtime data takes such a large percentage of the communications bandwidth between the digitizer and PC processor.

### Editable Fields

Channel	Specifies which channel is to be displayed.
Time width	Sets the time width for the waveform display.
Y Scale Max	Sets the amplitude scale for display in counts (1 to 1000).
Y Scale Multiplier	The Y Max value is multiplied by this factor to increase the vertical scale. This provides an easy way to change the vertical display range quickly.
Remove DC	Controls whether or not the DC component of the displayed data is removed.

## Instrument Menu

```
== Instrument Status ==
                                Counts
      Battery: 13.78 Volts 540
      Disk Temp: 28.92 o C 415
      Vxco Temp: 30.65 o C 423
Interface Slow SOH1: -2.489 units 461
Sensvtvy Slow SOH2: -2.489 units 461
Power      Slow SOH3: -2.440 units 462
```

The instrument menu displays the current readings from the state-of-health sensors.

### Commands

**Interface** Displays the interface settings menu, which is used to control LCD contrast, backlighting, and user timeouts.

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Sensvty	Displays the channel sensitivity menu, which shows the input impedance and sensitivity for each sensor component.
Power	Displays the power menu, which shows the state of the Orion's batteries and power supply.

## Displayed Fields

Battery	Shows the current voltage level of the input power source.
Disk temp	Shows the current disk drive temperature.
VCXO temp	Shows the current temperature of the VCXO.
Slow SOH1	Displays the current value of external state-of-health channel one in user-specified units. The last column shows the actual value in counts.
Slow SOH2	Displays the current value of external state-of-health channel two in user-specified units. The last column shows the actual value in counts.
Slow SOH3	Displays the current value of external state-of-health channel three in user-specified units. The last column shows the actual value in counts.

## Interface Menu

```
-- Interface Settings --

      Contrast: 50
      Backlight: Off

      User Timeout: 10 min

OK
```

The interface menu allows the user to change the LCD display characteristics, timeout values, etc.

## Commands

OK	Returns the display to the instrument menu.
----	---

## Editable Fields

Contrast	Sets the contrast of the LCD display.
Backlight	Turns the backlight on and off.
User Time out	Sets the time out period for the user interface. If no entry keys have been used for this period the user interface will time out and power down.

## Channel Sensitivity Menu

```
-- Channel Sensitivity --
Ch  Impedance  nV/bit  units/bit
1   500 K      2550    1.02e-09 m/s
2   500 K      2550    1.01e-09 m/s
3   500 K      2550    1.04e-09 m/s
4   5.36 K     378     1.00e-06 g
5   5.36 K     378     1.01e-06 g
OK 6   5.36 K     378     1.00e-06 g
```

This menu describes the channel sensitivity and input impedance for the Orion. The input impedance and digitizer (ADC) sensitivity are set in the TCP menus when the user selects a sensor (see the servicing section). The system sensitivity for each channel is calculated from the digitizer sensitivity and the sensor sensitivity (specified in the sensor configuration menu).

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## Commands

OK returns the display to the instrument menu.

## Displayed Fields

Impedance Displays the input impedance of each channel in ohms.

nV/bit Displays the digitizer sensitivity in nanovolts per bit.

units/bit Displays the system sensitivity in sensor units per bit (e.g. m/s/bit). The sensor units are defined in the sensor configuration menu.

## Power Source Menu

```
== Power Source ==  
  
Source      Voltage  State  
Int Battery 12.68   Charging  
Ext Battery 0.00    Not Present  
Mains       15.02   In Use  
  
OK Estimated average power: 5.2 W
```

This menu shows the input voltages from the internal batteries, external batteries and mains. It also indicates the state of the different power sources. The different states are: ready, discharged, charging, in use, shorted cell, not present.

The Orion also calculates the estimated power consumption based on the sample rate and GPS duty cycling.

## Commands

OK returns the display to the instrument menu.

## Displayed Fields

Source the Orion power sources: internal battery, external battery, mains

Voltage the voltage of the source

State the status of the source (charging, discharged, not present, in use)

## Data Menu

```
== Data File Allocation Summary =  
Ch  Filename      Size  Type  Free  
1  RORIONS1.SPZ  100MB R    76%  
2  RORIONS1.SPE  100MB R    72%  
3  RORIONS1.SPN  100MB R    72%  
4  RORIONS2.SPZ  100MB R    74%  
Detail 5  RORIONS2.SPE  100MB R    74%  
Reset 6  RORIONS2.SPN  100MB R    71%
```

The data menu shows the name, size and percent of free space in the data ringbuffers, and provides additional commands to view details of the data file contents or reset (clear) the files.

## Commands

Detail Displays the data file contents menu showing start and end times of the data files.

Reset Deletes the entire contents of the data, SOH and log files. This command is useful to delete unwanted data collected during the initial deployment and configuration sessions.

## Displayed Fields

Channel Channel number.

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Filename	Ringbuffer name for this channel.
Size	Ringbuffer size.
Type	Either R for ringbuffer or S for single-write file.
Free	Percent of unused space in the file. This will read Wrap for a ringbuffer that has wrapped or Full for a Full single-write file.

Disabled channels will read "File Not Open".

## Data File Contents Menu

```
-- Data File Contents --
Ch   First      Last      Free
 1  04/02 12:14  04/06 17:27  93h
 2  04/02 12:14  04/06 17:27  91h
 3  04/02 12:14  04/06 17:27  88h
 4  04/02 12:14  04/06 17:27  95h
 5  04/02 12:14  04/06 17:27  93h
OK   6  04/02 12:14  04/06 17:27  93h
```

This menu shows the start and end time of data in each ringbuffer and an estimate of the unused space in each file (expressed as a duration at the current data rate).

### Commands

OK Return to the data menu.

### Displayed Fields

Channel Channel number.  
First Time of the first data packet in the file.  
Last Time of the last data packet in the file.  
Free The unused space in the ringbuffer expressed as a recording duration at the current data rate (e.g. 3d = 3 days; 16h = 16 hours).

## Reset Files Menu

```
-- Reset Files--

This will reset the data,
log and SOH files.
All existing data and
log messages will be lost.
Cancel
OK Do you want to proceed?
```

This menu requests confirmation of the Reset Files command.

### Commands

Cancel Returns to the Data menu without resetting the data, SOH and Log files.  
OK Resets the data, SOH and Log files and returns the user to the Data menu.  
Escape Same as Cancel.

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## Log Menu

```
-- LogFile View Filter --
Display: Selected Records
From: 1996/01/31 14:31
Until: 1996/02/01 16:31
View Log Severity: Info
Mark Log Source: All
Clear Log Err Code: 0
```

The log menu allows the user to specify selection criteria for viewing the log file online, and provides additional commands to clear the log or place a marker in the log.

### Commands

- Viewlog** Displays the log file based on the menu filter settings.
- Marklog** Allows the user to place a marker at a specific point in the log file.
- Clear** Deletes the log file and starts a new log.

### Editable Fields

- Display** Determines whether the log display is filtered or not. If filter is selected, the information displayed will depend upon the time, error level, processor, area and error code values set in this menu. If unfiltered is selected, all entries in the log file are displayed.
- From** Determines the start time of the log file information to be displayed.
- Until** Determines the end time of the log file information to be displayed.
- Severity** Only errors which meet or exceed the selected level will be displayed.
- Source** Selects the processor for which the log file information should be displayed. Refer to the Logview manual pages for information on log entry categories.
- Err Code** If non-zero, filters log file messages by error code. Refer to the Appendix entitled Instrument Log Messages for detailed information on error codes.

## View Log Menu

```
31 16:31:37 Orion up - ver 04.00
Up 31 16:31:37 CoreLeft(0)=176112
Down 31 16:31:39 Config unchanged
PageUp 31 16:31:40 Open SOH file 2097152
PageDn 31 16:31:40 Open RB0 = 524288
Top 31 16:31:40 Open RB1 = 524288
Bottom 31 16:31:40 Open RB2 = 524288
Detail 31 16:31:41 Enter User Mode
```

The View Log menu allows the user to view the instrument log file online.

### Commands

- Up** Scrolls the log file display up by one line.
- Down** Scrolls the log file display down by one line.
- PageUp** Pages up through the log file.
- PageDn** Pages down through the log file.
- Top** Moves to the top of the log file.
- Bottom** Moves to the bottom of the log file.
- Detail** Toggles the display between text error message display and error code message display.

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## Displayed Fields

In Text mode the display shows the date (day of month only) and time of each log entry, followed by a brief text message. In Error-code mode the display shows:

- } the sequence number of the entry in the log file
- } the full date and time of the message (yy/mm/dd hh:mm:ss)
- } a 3-character sequence indicating the severity, source processor, and context area for the log entry
- } the numerical error code

The "Detail" command allows the user to toggle between these two display modes. A full explanation of the log entries is given in the Logview manual. The error codes are defined in the Appendix entitled Instrument Log Messages.

## Insert Marker Menu

```
-- Insert Mark In Log --

Set number then press Insert
to insert marker...

Marker Number:31
Insert
```

This menu allows the user to insert a numeric marker in the log for reference during playback.

### Commands

- |        |   |
|--------|---|
| Insert | Inserts a marker into the Log file with the marker indicated and returns the user to the View Log menu. |
| Escape | Returns to the View Log menu without inserting a marker into the Log.                                   |

### Editable Fields

- |               |   |
|---------------|---|
| Marker Number | The marker to insert into the Log. Note that the marker number increments automatically each time a marker is inserted. |
|---------------|---|

## Clear Log Menu

```
-- Clear Log --

This will reset the log file.
All previous log messages
will be lost.

Cancel   Do you want to proceed?
OK
```

This menu requests confirmation of the Clear Log command.

### Commands

- |        |  |
|--------|--|
| Cancel | Returns to the View Log menu without clearing the Log file.    |
| OK     | Clears the Log file and returns the user to the View Log menu. |
| Escape | Same as Cancel.  |

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## User Exit Menu

```
      == UserExit ==  
  
      Waiting for Exit  
      Receiving data. Please wait...  
Cancel  
Exit Now  KBytes remaining: 9999
```

This menu is displayed when you select UserExit from the top level menu. It will remain displayed until all data has been transferred from the digitizer to the data cartridge; then the user interface will shut down. If you wish to shut down the user interface immediately (say, to change the data cartridge), select Exit Now.

### Commands

Cancel	Returns the user to the Top Level menu.
Exit Now	Shuts down the user interface immediately.
Escape	Same as Cancel.

## Configuration Menus

The configuration menus allow the user to fully configure the Orion seismograph. The Orion does not need to be taken out of the acquisition mode to access the configuration menus. If the configuration is changed and the changes accepted the **Orion must be stopped and restarted for the changes to take effect.**

### Main Configuration Menu

```
Digitizer          -= Configuration -=
Channel Setup      Serial Number: 303
Instrument         Num Channels: 3
-----          Sample Rate: 100 sps
Load From Disk     Record Mode: Scheduled
Save To Disk       Log Verbosity: Normal
Accept/Restart     RingBuffer Size: 100
Cancel            SOH Buffer Size: 10
```

The main configuration menu provides top-level access to the Orion setup menus, as well as commands to load or save a configuration file and to initiate the configuration-change sequence. It also provides a read-only summary display of several important configuration parameters. After browsing and modifying the various configuration parameters, select:

- Cancel** to return to the main menu without making the changes, or
- Accept/Restart** to instruct the Orion to stop digitizing and restart with the new configuration.

### Commands

- Digitizer** Displays the data settings menu. The data settings menu is used to configure sample rate, number of channels, scheduled recording, event triggers, event logic, log file and state-of-health setup and ringbuffer file setup.
- Channel Setup** The Channel setup menu is displayed. This menu is used to set channel, sensor and site specific information.
- Instrument** The instrument setup menu is displayed. This menu is used to set instrument defaults and GPS operational settings.
- Load From Disk** This command will load an Orion configuration file from the Orion disk.
- Save to Disk** Saves the edited configuration to the Orion disk. This command does NOT change the configuration of the Orion. The saved configuration can be reloaded later using the "Load From Disk" command.
- Accept/Restart** Initiates the configuration-change sequence. As the first step, this displays the **Restart Options** menu to allow the user to confirm data file sizes.
- Cancel** Returns the display to the top level menu without saving the configuration changes to the flash memory.

### Displayed Fields

- Serial Number** The serial number of the Orion.
- Num Channels** The number of channels to be digitized.
- Sample Rate** The sample rate in samples per second.
- Recording Mode** The global recording mode (continuous, event, or scheduled).
- Log verbosity** The minimum error level for log messages to be recorded (normal or debug).

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Ringbuffer Size	Total space to be used for ringbuffer files in MBytes.
Soh Buffer Size	Total space to be used for SOH file in MBytes.

## Digitizer Configuration

```
-- Digitizer Configuration --
                               Num Channels: 3
Schedule      Sample Rate: 100 sps
Triggers      Recording Mode: Scheduled
Events        DC Filter Freq: 10 milli-Hz
Log/Soh
Files
```

The Digitizer configuration menu is used to set the number of channels to record, the sample rate, the recording mode, and the DC removal filter frequency.

The Orion can be configured for continuous, event or scheduled recording by setting the recording mode. This variable should be thought of as a global variable as it sets the complete operational state of the Orion. For example, if the recording mode is set as continuous, the Orion will produce a continuous data record and a list of start times for detected events. If the recording mode is set as "Event" then the Orion will operate as an event recorder.

When continuous recording is selected the Orion will start and stop recording based on user initiated start and stop commands; **all schedule information will be ignored by the Orion.** When scheduled recording is selected the operator must program the required schedules in the schedule menu.

### Commands

Schedule	Displays the Schedule Menu. The Schedule menu is used to configure recording schedules.
Trigger	Displays the Trigger Menu. The trigger menu allows the operator to specify STA/LTA and threshold triggers and to apply these triggers to specific data channels.
Events	Displays the Events Menu. The events menu is used to set the coincidence logic for event triggering.
Log/Soh	Displays the Log/Soh Menu. This menu is used to set the log file parameters and the acquisition characteristics of the state-of-health channels.
Files	Displays the files menu. The files menu allows the user to specify the size and type of the various data files such as ringbuffers and log files.

### Editable Fields

Num Channels	Sets the number of channels for data recording. This value cannot exceed the physical number of channels on the Orion. Allowable values are from 1 to 6.
Sample rate	Sets the sample rate for recording. Allowable sample rates are 40, 50, 100, 125, 200, 250, 500 and 1000 sps. The sample rate selected will be applied to all active channels. The maximum allowable sample rate is a function of the recording mode used and the number of channels being recorded.
Recording modes	Sets the recording mode for the Orion: continuous, event or scheduled. In both the continuous and event modes the Orion will ignore all programmed schedules and start and stop recording based only on operator commands. In the scheduled mode the Orion will record data according to the user programmed schedule.
DC Filter Freq	Corner frequency of the DC removal filter.

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## Schedule Menu

```
-- Recording Schedules --
Schedule 1 of 4
Next      Recording mode: Continuous
Prev      Start Time: 1995/11/18 12:00:00
Add        Duration: 1h 30m
Delete     Repeat: 12 times
OK         Every: 12h
```

The schedule menu enables the user to program recording schedules to be used if the recording mode has been set to "Scheduled" in the Digitizer configuration menu.

Recording windows can overlap one another. The Orion "or's" together all the windows when determining whether or not to record.

### Commands

Next	Displays the next schedule window.
Prev	Displays the previous schedule window.
Add	Adds a copy of the last deleted schedule to the end of the schedule list and displays it. If no schedule has been deleted it adds a copy of schedule 1 as it was when the user interface started.
Delete	Deletes the schedule displayed in the information section of the screen.
OK	Returns the display to the Data Settings Menu.

### Displayed Fields

Schedule 1 of 4      Indicates the schedule being displayed and the number of active schedules.

### Editable Fields

Recording mode	Determines the recording mode for this schedule (event or continuous).
Start Time	Specifies starting date and time for the recording window.
Duration	Sets the recording window duration in days, hours, minutes and seconds.
Repeat	Sets the number of times to repeat the window.
Every	Sets the interval between repeats in days, hours, minutes and seconds (e.g. 3d 12h = 3 days, 12 hours).

## Trigger Summary Menu

```
-- Trigger Summary --
Trig  Chan  Type  Level
  1     1  StaLta  10
  2     1  Threshold 10000
  3     2  Threshold 10000
  4     2  StaLta  10
Setup  5     Off  StaLta  10
OK     6     Off  StaLta  10
```

The Orion allows the user to configure six independent STA/LTA or threshold triggers and then apply each of these triggers to a particular channel. The trigger summary menu provides a brief summary of the trigger types, levels, and channel assignments and allows these values to be changed. The trigger setup menu must be used to view and edit trigger definitions in detail.

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Several triggers may be applied to each channel. For example, the trigger summary table above shows four triggers active and two triggers off. Triggers 1 and 2 are both applied to data channel one while triggers 3 and 4 are both applied to data channel two.

## Commands

Setup	Displays the trigger setup menu. This menu is used to configure the STA/LTA and filter parameters for each of the triggers.
OK	Returns the Orion to the Data Setting menu.

## Editable Fields

Chan	Sets the assigned input channel for the trigger.
Type	Sets the trigger type (STA/LTA or Threshold).
Level	The trigger level (STA/LTA ratio or Threshold level in counts).

## Trigger Setup Menu

```
== Trigger Setup ==
Trigger: 2      Channel: 1
Type: Threshold Level: 10000
Report Dly: 1.0 DeTrig T: 10.0
STA Time Constant: 0.200 sec
Next LTA Time Constant: 30.0 sec
Prev HP Filter Order: 2 Freq: 1.0 Hz
OK LP Filter Order: 3 Freq: 5.0 Hz
```

The trigger setup menu is used to define each of the six individual triggers in detail.

## Commands

Next	Displays the next trigger in the sequence.
Prev	Displays the previous trigger.
OK	Returns to the Trigger Summary menu.

## Displayed Fields

Trigger	Indicates which trigger is being displayed.
---------	---

## Editable Fields

Channel	Determines which channel the trigger will be applied to. This parameter can be changed from both the Trigger setup and Trigger summary menus.
Type	Toggles between STA/LTA and threshold trigger types.
Level	Sets the trigger ratio for STA/LTA triggers and the absolute trigger threshold for threshold triggers. The de-trigger ratio for an STA/LTA trigger is set to one. The de-trigger criteria for a threshold trigger is set using the DeTrigger Time (see below).
Report Delay	All trigger messages issued by the Orion include the trigger time, peak amplitude and half period. The Report Delay value sets the period that the trigger waits to calculate these values. If the Report Delay value were set to 1 second the trigger message would include the trigger time and the peak amplitude and half period as determined from the first one second of the event.
Detrigger Time	The Detrigger Time determines how long the absolute value of a threshold trigger must remain below the trigger level before an end of trigger message is issued.
STA time constant	STA time constant set in seconds. (Maximum 10 seconds.)

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LTA time constant	LTA time constant set in seconds. (Maximum 999 seconds.)
HP filter order	Sets the high pass filter order. (0 to 5.)
HP Freq	Sets the 3db point for the high pass filter.
LP filter order	Sets low pass filter order (0 to 5).
LP Freq	Sets the 3db point for the low pass filter.

*Note: The sum of High pass and low pass filter order cannot exceed 5.*

### Event Menu

```
-- Event Detection --
Coincidence Window: 3.0 sec
  Triggers On: 3   Off: 1
    Pre-Event: 20 sec
    Post-Event: 30 sec
    Max Duration: 900 sec
OK
```

The event detection menu allows the user to set the coincidence logic for event triggering and the pre-event and post-event periods for event recording.

Coincidence Window Specifies the duration of the trigger coincidence window in seconds.

Trigger On Specifies the number of triggers that must be active within the coincidence window for an event to be declared.

Off Specifies the number of triggers that must remain active in order to continue as event. When the number of active triggers falls below this number, the event detector will declare the event to be over and initiate the post event recording period.

Pre-event Specifies the pre-event memory in seconds. Maximum 99 seconds.

Post-event Specifies the post event period in seconds. Maximum 200 seconds.

Max Duration Specifies the maximum event duration. Maximum 3600 seconds.

### Log and SOH Menu

```
-- Log and SOH Settings --
  Log Verbosity: Normal
  MinMax Channel 1: Trigl
  MinMax Channel 2: Off
  MinMax SOH Interval: 60 sec
  GPS SOH Interval: 60 sec
  Fast SOH Interval: 60 sec
  Slow SOH Interval: 60 sec
OK
```

The Log and state-of-health settings menu is used to set the level and frequency of log file and state-of-health reporting.

#### Commands

OK Returns to the Data Settings menu.

#### Editable Fields

Log Verbosity Sets the verbosity of the log file reporting (normal or debug). In most cases this should be set to Normal; the debug level includes additional trace information, most of which is for development purposes only.

MinMax 1 Signal source for MinMax channel 1.

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MinMax 2	Signal source for MinMax channel 2.
MinMax Interval	Sampling interval for MinMax data.
<i>MinMax channels provide a highly compressed summary of the seismic data for quick location of high amplitude signals and events. Rather than providing a strictly decimated signal the Max/Min channel provides a measurement, at a user defined sample interval, of the minimum and maximum trigger filtered data during that interval.</i>	
GPS SOH Interval	Sets the reporting interval for GPS information in seconds. This value can be set between 1 and 600 seconds.
Fast SOH Interval	Sets the sample interval for the fast state-of-health channels. There are three fast state-of-health channels all of which are wired for external sensor connection. Interval can be set from 1 to 600 seconds.
Slow SOH Interval	Sets the sample interval for the slow state-of-health channels. Three of the slow state-of-health channels are internally configured to measure Supply voltage, disk temperature and VCXO (timing crystal) temperature. Three additional slow state-of-health channels are wired for external sensor connection. Interval can be set from 8 to 600 seconds.

## Files Menu

```
== File Settings ==
Automatic File Sizing: Off
Data Buffer Type: RingBuffer
Data Buffer Size: 300 MB
SOH Buffer Type: RingBuffer
SOH Buffer Size: 30 MB
OK
```

The Orion records a variety of data including waveform data, state-of-health data and log file information. When initializing a data cartridge, either at start up or after a disk swap, the Orion must allocate space on the drive to the various data types to be recorded. It is important to allocate the correct amount of space to each of the recording areas. In practice the log file is limited to 1 Mbyte, sufficient for one month of very verbose log file information, so that the remaining space may be divided between waveform and state-of-health data. The file settings menu allows the user to determine the size of the waveform and state-of-health data files.

## Commands

OK Returns to Data Settings menu.

## Editable Fields

Automatic file sizing	Automatic file sizing will determine the available disk space and divide this between the waveform data and state-of-health data using a 95/5 ratio.
Data buffer type	Selects between ringbuffer recording and single write recording. In ringbuffer recording the Orion will begin overwriting the oldest data once the files are full. In single write mode the Orion will stop recording when the disk is full and will not overwrite any data.
Data Buffer size	Sets the maximum capacity of the waveform data buffer. This will be set by the Orion if automatic file sizing is enabled or if the requested size exceeds the available space.
SOH Buffer type	Selects between ringbuffer and single write recording for the state-of-health data. In ringbuffer recording the Orion will begin overwriting the oldest data once the disk is full. In single write mode the Orion will stop recording once the disk is full and will not overwrite any data.

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SOH Buffer Size Sets the maximum buffer size for the state-of-health information. This will be set by the Orion if automatic file sizing is enabled.

## Channel Setup Menu

-- Channel Setup --				
Chan	FiltDC	Site	Filename	
1	Yes	1	ROTTAWS1.BHZ	
2	Yes	1	ROTTAWS1.BHE	
Station	3	Yes	1	ROTTAWS1.BHN
Site	4	Yes	2	ROTTAWS2.BHZ
Sensor	5	Yes	2	ROTTAWS2.BHE
Orientn	6	Yes	2	ROTTAWS2.BHN

The channel setup menu and station, site, sensor and Orientation sub-menus are used to enter information relating to the location of the Orion and associated sensors. The channel setup menu provides a summary of this information.

### Commands

Station Displays the station menu.  
Site Displays the site menu.  
Sensor Displays the sensor menu.  
Orientn Displays the sensor orientation menu.

### Editable Fields

FiltDC Specifies whether or not the DC-removal filter should be applied to this channel.  
Site Specifies the site index for the channel.

### Displayed Fields

Chan Channel number. Parentheses () around the channel number indicate that it is not enabled (see the Data Settings menu).  
Filename Shows the name of the file in which data for this channel will be recorded. The filename is constructed from the station name, site name and component as follows:  
R-----,--- All data files begin with "R".  
-OTTAW--,--- Five character station name. Set in the Station Menu.  
-----S1,--- Two character site name. Set in the Site Menu.  
-----BHZ Three character component name set in the Orientation Menu.

In most applications, the three or six components of data will be recorded at the same site and will therefore share the same site name. In some applications each component of data will be arriving from a different site and, as such, the two character site name will vary for each component.

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## Station Menu

```
-- Station Name & Location --
Station Name: OTTAWA
Latitude: 45.0347
Longitude: 75.9932
Elevation: 235.00
Gps Loc
OK      Comments: Y-File comments
```

The station menu is used to enter information relating to the Orion as a station. Each Orion represents a single station.

### Commands

- GPS Loc** Instructs the Orion to use the GPS position as the station position. **The position used is the GPS position at the time of executing the command. This command should only be used when the Orion is at its recording location and the GPS system is locked and displaying a low figure of merit. This command has a verification screen.**
- OK** Returns to the Channel setup menu.

### Editable Fields

- Station Name** Seven character station ID name. *Note only the first five are used.*
- Latitude** This field allows the user to manually enter the station latitude.
- Longitude** This station allows the user to manually enter the station longitude.
- Elevation** This field allows the user to enter the station elevation.
- Comments** This field allows the user to enter comments to be inserted in the data file.

## Site Menu

```
-- Site Name & Location --
Site: 1
Next
Prev      Site Name: S1
Gps Loc   Latitude: 45.0347
Stn Loc   Longitude: 75.9932
OK        Elevation: 235.00
```

The Orion can be operated with up to six sensors at six different sites. To accommodate this possibility, the Orion can be programmed with 6 different site locations.

In most cases the Orion will be operated with one three-channel sensor located at the same physical location as the Orion itself. In this case there will be only one site with the same location as the station. In applications where the Orion is receiving data from several sensors located at a number of sites i.e. via radio or land line the user will need to enter information for each of the sites.

### Commands

- Next** Displays information relating to the next site in the site list.
- Prev** Displays information relating to the previous site in the site list.
- GPS loc** Uses the present Orion GPS position to update the site position.
- Stn Loc** Updates the site position using the position information entered in the Station Menu. When the Orion and sensors are located at the same site this command will force the site and station information to agree.
- OK** Returns to the channel setup menu.

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### Displayed Fields

Site Indicates the site number of the information displayed. Use the Next and Prev commands to change the site number being displayed.

### Editable Fields

Site Name Enter the two character site name in this field.

Latitude Enter the site latitude or use the GPS Loc or Stn Loc commands to update this field.

Longitude Enter the site longitude or use the GPS Loc or Stn Loc commands to update this field.

Elevation Enter the site elevation or use the GPS Loc or Stn Loc commands to update this field.

### Sensor Information Menu

```
-- Sensor Information --
      Channel: 1
      Sensor Model: CMG-40
      Serial Num: 101JVT
Next   Component: 1
Prev   Sensitivity: 2500.0 V per m/s
OK     System Sens: 1.020e-09 m/s /bit
```

The Orion maintains a data base of information relating to six sensors. The Sensor Information menu is used to enter sensor information and sensitivity for each channel. This information is not mandatory but can be very useful during the data processing phase.

### Commands

Next Displays information relating to the next sensor in the list.

Prev Displays information relating to the previous sensor in the list.

OK Returns to the channel setup menu.

### Displayed Fields

Channel Indicates the channel number of the information displayed. Information for a sensor on each channel is provided.

System Sensitivity This is the calculated system sensitivity, computed from the ADC sensitivity (nV/bit) and sensor sensitivity (units/V).

### Editable Fields

Sensor Model User defined seven character sensor model.

Serial Num Seven character user defined serial or ID number.

Component The orientation of the sensor component connected to this channel.

Sensitivity The sensitivity of the sensor for this channel in units per volt. The user can also enter the units as m/s, m/s/s, g, or UDU (user-defined units).

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## Channel Orientation

```
-- Channel Orientation --
Chan  Name  Azimuth  Dip
  1    BHZ    0.0    90.0
  2    BHN    0.0    0.0
  3    BHE    90.0   0.0
(4)   BHZ    0.0    90.0
(5)   BHN    0.0    0.0
OK    (6)   BHE    90.0   0.0
```

This menu allows the user to enter information concerning the orientation of the sensors and the component code. The channel name is used as part of the data filename; azimuth and dip are used for archiving purposes only.

### Commands

OK Returns the display to the channel setup menu.

### Displayed Fields

Chan Channel number. Parentheses ( ) around the channel number indicate that it is not enabled (see the Data Settings menu).

### Editable Fields

Name Accepts a three character component name. This name is used as the file extension for the data filename for the specified channel.

Azimuth Records the azimuth angle in degrees for the sensor component.

Dip Records the dip angle in degrees for the sensor component.

## Instrument Setup Menu

```
-- Instrument Settings --
                               Power-On Values
GPS
Waveform      Contrast: 50
Startup       Backlight: Off
SOH Cal       User Timeout: 10 min
Dialup        Dialup Access: Enabled
```

The Instrument setup menu and its associated sub-menus are used to configure startup and hardware parameters. In general these values will be initially set to suit the preferences of the user and the nature of the field work and will not be changed very often. It is important to set these values correctly as they will affect the overall power consumption and general operation of the Orion.

### Commands

GPS Displays the GPS setup menu.

Waveform Displays the waveform initial settings menu.

Startup Displays the startup settings menu.

SOH Cal Displays the external SOH calibration settings menu.

Dialup Displays the dialup menu.

### Editable Fields

Contrast Specifies the power-on contrast setting for the LCD screen (0 to 100).

Backlight Specifies the power-on state of the LCD backlight (on/off).

User Timeout Specifies the power-on value of the user timeout in minutes.

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*Note: The contrast, backlight, speaker and timeout values are initialized to these power-on values whenever the PC processor is started. They may be changed online without changing the power-on defaults by using the Interface menu (see previous section).*

## GPS Parameters Menu

```
-- GPS Parameters --  
Tracking Mode: SingleSat  
Power Mode: DutyCycled  
  
Duty Cycle Interval: 60 min  
Max Gps On Time: 5 min  
  
OK
```

This menu sets the basic operational mode for the GPS receiver.

### Commands

OK Returns to the Instrument setup menu.

### Editable Fields

Tracking mode Configures the operating mode of the GPS as:  
*SingleSat:* the GPS time is considered valid and used for phase locking if 1 or more satellites are being tracked.  
*2D Find:* the GPS time is considered valid only if the GPS is tracking enough satellites for 2D navigation.  
*3D Find:* the GPS time is considered valid only when it is tracking enough satellites for 3D navigation.

Power Mode Configures the GPS for either continuous or duty-cycled operation.

Duty cycle interval Specifies the time between successive GPS power on periods.

Max Time GPS On Specifies the maximum duration of each GPS power-on cycle.

*For most applications, the GPS should be run in SingleSat mode, duty cycled with 5 minutes on per 30 or 60 minute cycle.*

## Power-on Waveform Settings Menu

```
-- Power-On Waveform Settings --  
  
Channel: 1  
Time Width: 30 sec  
Y Scale Max: 500  
Y Scale Multiplier: 10  
Remove DC: Yes  
  
OK
```

This menu is used to set the power-on start up values for the waveform display. Note that the waveform settings can be modified online without changing the power-on values using the waveform menu.

### Commands

OK Returns to the Instrument setup menu.

### Editable Fields

Channel Specifies which channel is to be displayed.

Time width Sets the time width for the waveform display.

Y Scale Max Sets the amplitude scale for display in counts (1 to 1000).

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Y Scale Multiplier	The Y Max value is multiplied by this factor to increase the vertical scale. This provides an easy way to change the vertical display range quickly.
Remove DC	Controls whether or not the DC component of the displayed data is removed.

## Startup Options Menu

```
-- Startup Options --
Warmup Delay: 1 min
Disk Temp Range: Extended
Disk Heater: Enabled

Disk range is 5 to 50 C
OK Preheat disk to 5 C if cold
```

The Startup options menu is used to set the start up options for the Orion.

### Commands

OK Returns to the Instrument setup menu.

### Editable Fields

Warmup Delay Time allotted to restart the Orion and gain GPS lock before recording, when the Orion is powered on automatically during scheduled recording.

Disk Temp Range Safe / Extended / Unlimited  
*Safe:* the disk is limited to an operating range of 5 to 50 degrees C.  
*Extended:* the disk heater is enabled, extending the operating range to -20 to 50 degrees C. The disk heater will preheat the disk drive until it reaches the required temperature before turning the PC processor on.  
*Unlimited:* the disk heating is disabled, and there are no checks on the disk temperature. It is not recommended that this mode be used, as operating a disk outside the allowable temperature range may damage the disk and result in a total loss of data.  
See the tutorial chapter for more information on disk heating.

### Displayed Fields

Disk Heater Indicates if the disk heater is Enabled. The heater is enabled only if the Disk temperature range has been set to Extended.  
The Orion also displays the operating temperature range for the disk.

## External SOH Calibration Menu

```
-- External SOH Calibration --
Channel Units/Volt Offset
Slow 1 5.00 0.600
Slow 2 44.4 -32.0
Slow 3 44.4 -33.2
Fast 1 1.00 0.00
Fast 2 1.00 0.00
OK Fast 3 1.00 0.00
```

The state-of-health calibration menu is used to set the sensitivity and offset of the 3 fast SOH channels and the 3 external slow SOH channels.

### Commands

OK Return to the instrument setup menu

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## Editable Fields

Units/Volt	User-set sensitivity for the transducer connected to the SOH input.
Offset	User-set offset for the transducer, defined as the level (in physical units) which corresponds to a zero-volt output.

## Dialup Menu

```
== Dialup Password ==  
  
To change dialup password,  
enter current and new password  
then press Set.  
  
Cancel   Current password: XXXXXXXX  
Set      New password: XXXXXXXX
```

Remote access to the Orion is password protected. Each Orion is accessible through two different passwords. The first is the feature-enable password provided for each Orion by Nanometrics. This password is unique to each Orion (i.e. serial-number dependent) and may not be changed. The second password is a user password which may be changed at any time by anyone who knows the current password.

We recommend that the Orion owner record the feature-enable password in a safe place, then set the user password to any desired value for general use. This provides several benefits:

1. the same user password can be used for several Orions, simplifying network administration
2. the user password can be changed at any time, should it become necessary for security reasons
3. the feature-enable password can always be used to reset the user password if the current user password is lost or forgotten.

The remote-access password may be set using the Orion front-panel menu, in the Config - Instrument - Dialup menu.

## Commands

Cancel	Aborts the dialup password menu.
Set	Sets the new password that has been entered.

## Editable Fields

Current password	The current user password or the feature enable password.
New password	The new user password.

## Restart Options Menu

```
== Restart Options ==  
Data   Soh  
New File Size: 30   10  
Requested Size: 30   10  
Disk Space (MB): 858   Max: 879  
Automatic File Sizing: Off  
Cancel   Reset files on restart: Yes  
OK       Delete DATA\*. * on restart: No
```

The restart options menu is displayed when the configuration-change sequence is initiated by selecting "Accept Changes" in the main configuration menu. This menu serves three purposes. First, it confirms to the user the sizes of the data and state-of-health buffers and provides an opportunity to change those sizes if required. Second, the user can specify whether any old data and information files should be deleted when the Orion is restarted. Finally, it confirms that the

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configuration is about to be changed and allows the user to cancel the configuration-change sequence if it has been started inadvertently.

### Commands

Cancel	Aborts the configuration-change sequence and returns to the main configuration menu.
OK	Accepts all changes and the file sizes displayed and instructs the Orion to stop recording and restart with the new configuration.

### Displayed Fields

New File size	Displays the size of the data and SOH files based on the available disk space and the user configuration. These will be the same as the requested size if there is sufficient space on the disk.
Disk Space	Displays the available disk space for data and state-of-health files.
Max	Displays the maximum disk space that would be available if all old data and state-of-health files were deleted from the disk.

### Editable Fields

Requested Size	Specifies the file size requested by the user for data and SOH files (these are the same values entered in the File Settings menu). These fields will display "Auto" if the user has enabled automatic file sizing.
Automatic file sizing	When enabled, the Orion will use all available space on the disk for data storage, allocating 95% to data ringbuffers and 5% to the SOH file.
Reset files on restart	When enabled, the Orion will reset all log and state-of-health files. When disabled, the Orion will append information to the existing files (provided that they have not been resized).
Delete data on restart	If enabled the Orion will delete all existing data on the disk when it restarts with its new configuration.

***Important:*** Changing the file sizes results in deletion of the existing files, and allocation of new files. All data in the deleted files is lost. Therefore, the file size should be set to a suitable value when the Orion is first deployed.

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## 7. Orion Remote Access

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### DIALUP

#### Version

1.05

#### Synopsis

**dialup [-p port] [-b baud] [-d number] [-c cmdfile] [-L logfile]**

#### Description

Dialup is a specialized communication program designed to provide remote access to the Orion portable data recorder via serial line or modem. It supports:

1. remote access to the Orion front-panel menu
2. access to the Orion disk using DOS commands
3. file transfer to and from the Orion
4. data-extraction from the Orion ringbuffers

while maintaining the continuity and integrity of the Orion's main data-logging function. Dialup allows you to check the operation of your Orion or reconfigure your Orion remotely using the front-panel menu exactly as you would on-site. The other functions extend the capability of your Orion, allowing you to extract and download data from a remote Orion without stopping data recording. Dialup can communicate with the Orion via any Hayes-compatible modem, or directly through a null-modem cable.

Some Orions may require a software upgrade or hardware modifications to support remote access. See *Preparing Your Orion for Remote Access*, below.

#### Using Dialup

Dialup provides access to all functions through a simple, familiar, command-line interface similar to DOS. Actions are invoked by typing a brief command at the command prompt. Typing *help* provides a summary of the available commands. Dialup maintains a record of the command-line history; previous commands can be recalled and edited using the cursor keys, following DOSKEY conventions. UP and DOWN arrows recall commands; ESC clears the command line; F7 displays the command history; ALT+F7 clears the command history; F8 searches for a command whose leading characters match the current command line.

#### Command Line Options

To start the Dialup program, type the following at the DOS command prompt:

**dialup [-p port] [-b baud] [-d number] [-c cmdfile] [-L logfile]**

where the command-line options are defined as follows:

- |            |   |
|------------|---|
| -p port    | specifies which comm port to use. This may be either com1 or com2. If port is not specified, dialup uses com1.            |
| -b baud    | specifies the baud rate. This may be 2400, 4800, 9600, 19200 or 38400. The default is 9600 baud.                          |
| -d number  | specifies the phone number to dial to contact the Orion.<br><i>This parameter is required when running in batch mode.</i> |
| -c cmdfile | indicates that Dialup is to be run in batch mode, taking its commands from the specified command file.                    |

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## Orion Remote Access

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`-L logfile` indicates that a full record of the Dialup session is to be written to the specified logfile.

### Connecting to the Orion

To connect to the Orion, it is necessary to specify a port, baud rate, and telephone number. Port and baud rate should normally be specified as command-line parameters when starting Dialup, but they may also be changed inside the Dialup program. Similarly, the Orion phone number may be specified as a command-line parameter or by using Dialup's *dial* command. The following commands control connection to the Orion:

<i>port</i>	displays the current port being used by Dialup
<i>port</i> [com1 com2]	sets the Dialup port to com1 or com2
<i>baud</i>	displays the current Dialup baud rate
<i>baud</i> baudRate	sets the baud rate to <i>baudRate</i>
<i>dial</i> phoneNumber	dials the specified number to connect to the Orion. The phone number may include any punctuation or special characters recognized by your modem.
<i>redial</i>	redials the last-dialed number

Use the *dial* or *redial* command to connect to the Orion. The Orion firmware detects the modem ring, and wakes up the Orion interface to accept the call. This may take 45 to 60 seconds. When Dialup has established a connection to the Orion, it will print a message on the screen, and the command prompt will change to *remote*.

### Logging On

Dialup access to the Orion is password protected using a password stored in the Orion configuration. After you connect to the Orion, you must log on to the Orion by sending it the appropriate password using the *password* command. There are two forms of this command:

<i>password</i> <PW>	Dialup will send the specified password to the Orion
<i>password</i>	Dialup will prompt you for the password

The first method is required when operating in batch mode. The second method is preferable in an interactive session, since the password never appears on the screen. The Orion will indicate whether or not your password is valid. Note that passwords are case-sensitive. Once you have entered a valid password, the prompt will change to *Orion-xxx* (where xxx is the Orion serial number), and you may use any of the remote access commands described below.

### Disconnecting

To disconnect from the Orion, you may use any of the following commands:

hangup	hangs up the modem
reset	hangs up and resets the modem
exit	hangs up the modem and exits from the Dialup program

As a power-saving feature, the Orion will terminate a dialup connection and shut down the user interface after a specified period of inactivity (the Orion keyboard timeout). Therefore, if you establish a dialup connection but then do nothing for several minutes, the Orion will disconnect. Dialup will detect the lost connection, display a message on the screen, and change the prompt to *local*. To continue your remote access session, you must reconnect using *dial* or *redial*.

### Exploring the Orion Disk using DOS Commands

The Orion supports a number of DOS file and disk access commands via Dialup. You must be properly connected and logged on to the Orion to use these commands. The following commands are supported:

<i>dir</i> [filespec]	Display a directory listing
<i>del</i> filename	Delete the specified file

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<i>copy</i> source dest	Copy file source to dest (dest may be a filename or a directory)
<i>move</i> source dest	Move (rename) source to dest
<i>md</i> dirname	Make the specified directory
<i>rd</i> dirname	Remove the specified directory (it must be empty)
<i>type</i> filename	Type the specified file to the screen
<i>time</i>	Display the system time in UTC

These commands follow the usual DOS syntax and file-naming conventions. Commands and filenames are not case-sensitive. Only short filenames (8.3) are supported. Wildcards (\* and ?) are permitted in filenames. Wildcards follow DOS conventions (\*.ext, filename.\*, \*.\* , etc.). The directory-separation character is the backslash (\). The change-directory command is not supported, in order to protect other file operations on the Orion.

The same DOS commands, prefixed by L, may be used to access files and directories on the local dialup computer from within Dialup. For example, *LDIR* or *ldir* (i.e. *local dir*) gives a directory of the local current working directory. Similarly, *LMD D:\Event.001* makes a directory named Event.001 on the D: drive of the local machine.

**WARNING: DOS commands must be used with care; misuse of these commands can destroy data or disable the Orion. In particular, you must never delete or modify the Orion executable (C:\BIN\ORION.EXE), the log file (\*.LBF), or the current Orion ringbuffers (DATA\\*.\*) .**

### Transferring Files

Dialup supports file transfer to and from the Orion using the *put* and *get* commands. Files are sent using the robust Z-modem file-transfer protocol. The command syntax is:

<i>put</i> filespec	transfer files matching filespec from the dialup machine to the Orion
<i>get</i> filespec	transfer files matching filespec from the Orion to the dialup machine

Note that filespec may include wildcards, and may include the source directory as well as the filename. Also note that in the current release, the destination directory for all file transfers is the current working directory on the receiving end. For example, all files transferred to the Orion are written to the C:\USER directory of the Orion data cartridge. Once files have been transferred, they may be copied or moved to another directory using the DOS commands described above.

File transfer progress is shown on the status line at the bottom of the Dialup window. The blocks shown in the status window correspond roughly to kilobytes. You may cancel a file transfer at any time by pressing the ESCAPE key.

### Extracting Data

Dialup supports extraction of time-series data and state-of-health data from the Orion ringbuffers through the *getdata* command. The command syntax is:

**getdata startTime duration fileSpec**

where:

startTime	is the start time of the interval to be extracted, in the format YYYY-MM-DD_hh:mm:ss
duration	is the duration of the interval to be extracted, in seconds
filespec	specifies the files from which to extract (default all files)

Data is extracted into small ringbuffer files (mini-ringbuffers) and transferred back to the Dialup machine. These files have the same format as all Orion ringbuffers, so the data can be further extracted and processed using the Orion playback programs (e.g. *extractp*, *sohextrp*, etc.). Note that *getdata* can extract only from the current Orion ringbuffers.

As noted above, the destination directory for all file transfers is the current working directory on the receiving end. Therefore, if you want to extract two (or more) segments of data, the files

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## Orion Remote Access

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returned from each *getdata* operation should be moved to a subdirectory before extracting the next data set.

Data extraction progress is shown on the status line at the bottom of the Dialup window. The blocks shown in the status window correspond roughly to kilobytes. You may cancel the *getdata* operation for any individual file by pressing the Q key.

### Viewing the Orion Front-Panel Menu

One of the most useful features of Dialup is the ability to view and use the front-panel menu of the Orion. To use this feature, connect and log on to the Orion as described above, then type *menu* at the Dialup prompt. A replica of the Orion front-panel menu will appear on the screen. You may navigate this menu using the four cursor keys (UP, DOWN, LEFT and RIGHT arrow keys) for the four Orion buttons.

This menu is a fully-functional, realtime replica of the Orion front panel. It provides complete access to the Orion; you may carry out any operation that is available from the Orion keyboard. For example, you can examine the GPS status, view the log file, or change the Orion configuration exactly as you would on-site. You can even view realtime waveforms (with a rough character-based display). For instructions on using the Orion menu, see the Orion manual.

The menu display may become corrupted if some messages are lost in transmission. If this occurs, simply type R to refresh the display. Hit the ESCAPE key to exit from menu mode and return to command mode.

Note: if you select *UserExit* from the Orion main menu, the Orion will enter the UserExit menu, but will not exit immediately because there is a remote user active. Select *ExitNow* from the UserExit menu to force the Orion to disconnect and shut down the user interface. Dialup will detect the lost connection, display a message, and return to command mode.

### Batch Mode Operation

While Dialup is designed primarily as an interactive program, it may also be run in batch mode. This allows Dialup to connect to the Orion and carry out any remote-access tasks without human intervention. This feature may be used in conjunction with a task scheduling program to query each of several Orions on a regular basis. All remote access features except front-panel menu access are available in a batch session.

To run Dialup in batch mode, simply create a file containing all of the commands for the session, then run Dialup with the *-c* option. The first command in the file must provide the password so that the Orion will accept subsequent commands. The last line in the file should be *exit*; however, Dialup will exit automatically when it reaches the end of the command file. Comments may be inserted anywhere in a command file using the double-slash (*//*) comment delimiter. All text following (and including) the double slash on any input line is ignored by the command processor.

In batch mode, Dialup attempts to connect to the Orion immediately when it is started, and exits if it is unable to connect. Therefore, it is essential to provide the correct port, baud rate and phone number on the command line when starting Dialup for a batch session.

#### **Example**

This batch file, *getelf.cmd*, simply connects to the Orion, obtains a directory listing, and gets the *orionxxx.elf* event listing file, then exits.

```
// Comments are permitted following double slash (//)
password orionpw
dir
get *.elf
exit
```

The following line runs this batch session using a modem on com2:

```
dialup -p com2 -d 1-613-555-1212 -c getelf.cmd
```

---

# Orion Remote Access

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## Logging your session

Use the `-L` command-line option to record the entire Dialup session to a log file. Interactive sessions are not logged unless the `-L` option is specified. Batch sessions are always logged; Dialup uses the default log file `dialup.log` if the `-L` option is not specified. If the log file already exists at the beginning of a session, log info for the new session is *appended* to the file.

## Preparing Your Orion for Remote Access

### Hardware Compatibility

Remote access via Dialup is supported for all Orions with serial number XXX and up. Older Orions may require minor hardware modifications. The following ECO's are required to support remote access.

ECO 148            Comms Board Assembly 10657 (Rev H or greater include this change).

### Software Compatibility

Dialup is compatible with Orion software release 6.0 and later. If you are running older software, you will need to upgrade to release 6.0. This requires installing new software to the Orion data cartridge and upgrading the HRD firmware. See *Software & Firmware Updates* in the Orion manual.

## Configuring the Orion to Enable Remote Access

Remote access can be enabled or disabled within the Orion configuration. When remote access is enabled, the Orion firmware will monitor the modem status and start the user interface program when the modem ring indicator (RI) signal is detected. For optimum security and power efficiency, remote access should be disabled unless it is actually being used.

Remote access may be enabled or disabled using the Instrument Settings configuration menu.

## About Passwords

Remote access to the Orion is password protected. Each Orion is accessible through two different passwords. The first is the feature-enable password provided for each Orion by Nanometrics. This password is unique to each Orion (i.e. serial-number dependent) and may not be changed. The second password is a user password which may be changed at any time by anyone who knows the current password. Both passwords are case-sensitive.

We recommend that the Orion owner record the feature-enable password in a safe place, then set the user password to any desired value for general use. This provides several benefits:

1. the same user password can be used for several Orions, simplifying network administration
2. the user password can be changed at any time, should it become necessary for security reasons
3. the feature-enable password can always be used to reset the user password if the current user password is lost or forgotten.

The remote-access password may be set using the Orion front-panel menu, in the Config - Instrument - Dialup menu.

## Restrictions

Remote access is not supported for use on Orions with an aggregate sample rate over 600 sps (e.g. 3 channels at 200 sps).

## Environment

Dialup is a 16-bit DOS program which may be run from the command prompt under DOS, Windows 3.x, OS/2, Windows 95 or Windows NT. Dialup is fully self-contained; no additional files or DLLs are required.

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## 8. Servicing Orion

### Hardware technical description

#### Orion

The Orion is functionally split into two components: the digitizing engine and the PC processor. The digitizing engine digitizes and temporarily stores the data, controls the GPS, monitors the state-of-health, performs calibration and schedules recording. The digitizing engine is the heart of the Orion. The PC processor's primary tasks are to periodically log data to a SCSI disk and to control the user interface. A hardware block diagram is shown in Figure 8.1. The digitizing engine contains a three or six channel 24 bit analog front end, a filtering DSP and a timing and control processor (TCP). The Orion has an internal GPS which is used to synchronize the internal time and sampling to the UTC time.

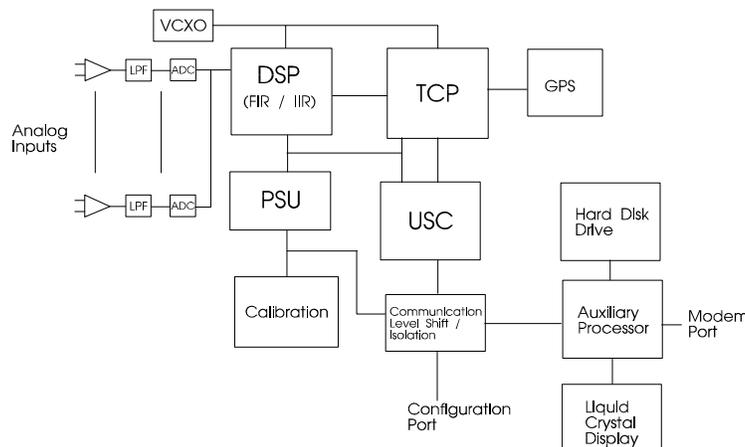


Figure 8.1

#### Digitizing Engine

This section gives a brief overview of the digitizing engine hardware. The digitizing engine has two software filters. The first filter is a decimating FIR (Finite Impulse Response) filter which is used for low pass filtering of the data. This is always required due to the nature of Delta-Sigma converters. The second filter is an IIR (Infinite Impulse Response) high pass filter. This filter optionally removes the DC offset from the data. Appendix B gives the frequency response of the FIR filters.

#### Differential Amplifier

There is an input differential amplifier for each channel input signal. The gain of this stage is used to set the overall system sensitivity. Gains of between 1 and 256 are typical. A potentiometer is associated with each input and is adjusted to give maximum common mode rejection. The input impedance is usually left as a high impedance input (>50K). The gain and input impedance are user settable parameters which are set through one resistor respectively for each channel. The user should refer to the as-shipped data sheet to get actual values for the resistors.

#### Analog Anti-alias Filter

The anti-alias filter requirements are quite low due to the high input sample rate used with delta-sigma converters. The anti-alias filter is a 3rd order Bessel filter to give linear phase

# Servicing Orion

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response. A single operational amplifier generates the low pass poles. The filter has a gain of 1 and is configured for low noise.

## Analog-digital Converter (ADC) & Digital Anti-alias Filter

A 120 dB Delta-sigma modulation ADC is used for conversion. This IC samples at a high rate, digitally filters and decimates the data, and then outputs the data. This output data is then filtered and decimated by the DSP before the final resolution is achieved. Different sample rates are achieved by decimating more or less. Delta Sigma ADC outputs one bit of data at a high rate which is filtered to produce higher resolution at lower sample rates. Sample rate is traded off for resolution. This works because the delta sigma modulator has its quantization noise at frequencies which are later filtered out.

## State-of-Health

The Orion monitors a total of ten analog state-of-health (SOH) channels, seven 'slow' and three 'fast'. Four of these channels are used internally to monitor the input voltage, the internal temperatures of the VCXO and hard disk.

The three external user SOH channels have input amplifiers configured as virtual ground inverters. There is a low pass filter incorporated with a 1.6Hz roll off. An open input will appear as a +2.5V input. These inputs have a range of +/- 25V and a nominal sensitivity of 48.8mV/bit.

The battery level monitor has a nominal sensitivity of 70.8 mV/bit, with an offset of +0.1V as a result of internal voltage drops.

The temperature monitors each have nominal input sensitivities of 0.217°C/bit with an offset of -61°C.

These SOH are typically sampled at 0.125Hz. The software controls how often they are logged.

In addition to these SOH there are three FAST SOH channels typically sampled at one Hz. These FAST SOH have an input range of ±10V and a sensitivity of 19.7mV/bit. An open input will appear as a 2.5V input. These inputs are used to monitor mass position in an active sensor.

*Note that correctly scaled SOH displays on the LCD require a number of scale/offset parameters to be correctly set in the Orion configuration.*

## CPU

The Orion digitizer uses three separate processors, a Motorola DSP56002, an Intel 80C196NT and a NEC V40. The DSP interfaces to the ADCs and performs the digital filtering and data compression on the raw data. After filtering and compression is completed the data is transferred to the 80C196NT. This processor collects packets of data from the DSP and stores them for transmission to the V40 processor. It also performs all the other timing and housekeeping functions. The V40 processor is a PC compatible processor which logs data to the SCSI disk and controls the LCD interface.

## Watchdog Timer

The main processor in the Orion has a built in watchdog timer that protects the Orion from getting caught in an endless software loop. If for any reason the watchdog is not serviced by the software at the correct frequency, an automatic hardware reset signal is generated which restarts the entire digitizer.

## Flash Memory

A Flash memory chip is used to store both firmware and user parameters. The contents of this chip are read on system initialization to establish such parameters as sample rate.

## Serial I/O

The Orion uses isolated serial communication links to communicate between the internal components and with external users.

# Servicing Orion

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Internally the GPS and the TCP communicate using a CMOS level link and the TCP and the PC processor communicate using a synchronous serial link.

Externally the TCP can be accessed using the config port. This is an RS232 link using TX and RX only to give access to the control menu. The AUX PC processor COM2 is an RS232 communication link, using all control lines, for direct access to the auxiliary processor.

*Note: RS232 convention states that:*

*'Mark' or off = '1' = -ve voltage on signal line*

*'SPACE' or on = '0' = +ve voltage on signal line.*

*where voltage measurements are with respect to ground.*

## Physical Construction

The Orion digitizer is designed to accept Eurocard size boards. They plug into a custom backplane. The chassis supports up to 6 cards. However, not all positions are populated at all times.

A minimum system (3 channel) consists of 5 cards: analog, TCP, communications, Mem-Cal and power supply. The analog board contains the front-end analog components and the interface between the DSP and the ADC. The TCP contains both processors, the USC, and SOH ADC circuits. The power supply contains a switching power supply. The comms card contains RS232/RS422 level shifting, SOH amplifiers and transient protection. The Mem-Cal board contains 2.0 megabytes of RAM and calibration circuits.

A six channel digitizer has an additional analog board installed beside channels 1-3. The board for channels 4-6 is different than the board for channels 1-3. However, they may be placed in either ADC slot. The board for channels 1-3 must be present at all times when the unit is running. Note that a 1-3 channel ADC is different from a 4-6 channel ADC and they are not interchangeable.

## Internal batteries

### *Main batteries*

Two 6Volt 12 Ahr sealed gel cell batteries provide for operation of Orion without an external power source. Please refer to the specifications for more information on batteries. The Orion internal batteries can be charged by the Orion. Battery specifications are listed in Appendix A.

### *Memory retention battery*

This rechargeable lithium battery is used by the GPS engine to maintain its satellite almanac and other parameters and to run a low power real time clock. The lithium battery will maintain the GPS for 3 to 6 months.

## Basic troubleshooting

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### Orion looks dead after power on

- Check that the Data Cartridge is properly connected.
- Check batteries.
- Check connections.
- Check fuses.

### Power on LED sequence correct, but no LCD display

The data cartridge may not be correctly initialised. If a data cartridge does not appear to operate, first test it in another Orion. If that fails, plug it into the PC using the SCSI switch and try to access the drive. Check to see that the correct files are on the disk. Refer to tutorial 3 in the Orion Basic Playback Manual if the disk needs reinitialising.

### GPS not locking

Most problems with the GPS engines can be traced to a poorly placed antenna. If the GPS is not receiving well, try re-positioning the antenna to a more favourable location. Lastly, ensure the antenna cable is not hanging from the antenna. Secure the antenna cable with a few tie wraps near the antenna to carry the weight of the cable.

The GPS should lock on its own if there is sufficient signal strength. If the GPS is not locking within 15 minutes of power-on, follow the procedure below:

1. Go to the GPS screen on the Orion.
2. Examine the GPS status on the screen. Are any satellites being tracked?
3. Examine the signal strength values. The signal strength (S/N) from the satellites should be greater than 38.
4. Re-position the antenna to a better location.
5. The GPS clock should lock now.

If the Orion has been moved a long distance since it was last used, locking time may be improved by manually resetting the GPS to the new location.

1. From the GPS screen on the Orion, select GPS Init.
2. Enter the correct location (preferably within 0.1 degrees).
3. Select Set to re-initialize the GPS.

### Orion Does Not Work

If you suspect the hardware in the Orion is faulty, there are a few basic tests that can be done. First remove the cover (see the disassembly instructions). Then try the following tests:

1. Check that the connectors are properly mated  
unplug and replug all the connectors. Replace the cover and test the Orion.
2. Check that the PCB cards are properly seated  
Remove the front cover on the card cage. Remove and reinstall each PCB in the card cage. Replace the front cover on the card cage. Replace the cover and test the Orion

If the two tests above don't solve the problem, try board swapping with another Orion and isolate the board that is causing the problem.

# Servicing Orion

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## Maintenance

### Repair philosophy

Object is to troubleshoot to the board level and replace the board.

### Disassembly Instructions

The following tools are required:

1. Phillips screwdriver for #4 and #8 screws.

Instructions:

1. Remove all power from Orion.
2. Remove disk cartridge.
3. Remove the 2 batteries and disconnect.
4. Remove 14 #8 screws around the edge of the cover .
5. Lift cover from the right side and rotate 180° so that it is upsidedown to the left of the Orion.
6. Disconnect all the connectors on the card cage and the cover to the left of the Orion.

The Orion may now be separated into three components:

1. Card Cage.
2. The Orion Box.
3. The Cover.

### Card Cage

The cards may be removed from the card cage by removing the front cover and extracting the cards.

### Orion Box

The box now contains the panel connectors, foam and plastic walls. The connectors can be removed using a wrench. Take care not to stress the wires and connectors, as wires may break off the connectors.

### Cover

The cover contains the PC processor card, LCD, AUX Interface PCB, switches and buttons. To disassemble, follow the procedure below:

1. Remove 8 #4 screws from the cover.
2. Disconnect the button connector.
3. Disconnect the SCSI data and power cables.
4. Remove the 9 screws that attach the AUX Interface PCB to the metalwork.
5. Lift the AUX Interface out of the cover.

### Assembly Instructions

The assembly instructions are the reverse of the disassembly instructions.

# Servicing Orion

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## Factory Test Port

The factory test port is an RS-232 port used for factory testing and firmware downloading. It is a three pin port: RX, TX, and GND. The port is on the 19 pin communications connector:

TX      Pin 10  
GND    Pin 11  
RX      Pin 12

The factory test port should only be used to download new firmware into the Orion. Do not use the other features available. **Changing other parameters accessible from the factory test port may prevent the Orion from operating!**

A cable for connecting to the factory test port can be purchased from Nanometrics. To build one, use the following components:

19 Pin Female Cable Plug LEMO                      FGL.2K.319.CLL (supplied with Orion)  
D-sub 9 Pin Female                      AMP                      DE09-S  
Shroud for D-sub                      Amphenol                      17D-09DV  
24 AWG 3 conductor Cable

The cable should be wired as follows:

Signal Name	From LEMO Conn.	To D-Sub	Wire Gauge (AWG)
TX	Pin 10	Pin 2	24
GND	Pin 11	Pin 5	24
RX	Pin 12	Pin 3	24

---

## Software & Firmware Updates

### Firmware Update Procedure

New firmware is downloaded through the factory test port. See the section above for a description of the factory test port.

1. Copy the firmware received on the update diskette to the PC's hard drive
2. Connect cable to factory test port via the communications connector.
3. Connect the cable to a PC communications port.
4. Start a PC terminal emulator program.
5. Set baud rate to 9600, 8 data bits, no parity, 1 stop bit.
6. Disable all modem handshaking options like RTS/CTS, DSR, Xon/Xoff DCD detection
7. Remove data cartridge.
8. Power up the Orion.
9. There should be a few beeps on the emulator then the text  
"TCP Version X.XX, compiled (data, time)  
Press 'M' key within 5 seconds or during memory test".

If this does not appear, then check connections and emulator settings. Note the firmware version and date at this point.

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10. Press the "M" key. A menu will appear when the memory test is complete. The memory test takes 15 seconds to complete.

*The factory test port should only be used to download new firmware into the Orion. Do not use the other features available. **Changing other parameters accessible from the factory test port may prevent the Orion from operating!***

11. Press the "D" key to select the download new firmware option.
12. From the terminal emulator, initiate an ASCII upload of the new hex file on the update diskette.
13. The firmware is uploaded into the Orion. This will take about 1 minute. When the upload is complete, a message "download completed, programming flash" will appear. A few seconds later the flash will be programmed and the Orion reboots. The text for the TCP version will appear again and it should display the new firmware version and date. At this point the firmware upload procedure is complete. Power off the Orion and insert the data cartridge. The Orion is now ready for use. If the download fails, a download error message will be displayed, try downloading again.

*NEVER powerdown the Orion while it is doing a upload. This will have catastrophic results.*

### Software Update Procedure

The Orion software is contained on the data cartridge. Updating this software is a simple procedure. Copy the new software from the update diskette into the \BIN directory on the data cartridge.

---

## Orion Disk Partition and Format Procedure

### Introduction

1. Shutdown the PC using the appropriate shutdown sequence. Connect the disk cartridge to the PC using the SCSI cable. Connect the disk power/SCSI ID selector cable to the disk cartridge.
2. If the PC can correctly partition and format disks using OS/2 follow the OS/2 Partition and Format Procedure instructions, otherwise follow the DOS Partition and Format Procedure instructions. If unsure follow the DOS Partition and Format Procedure instructions. Do not attempt to use the DOS Partition and Format Procedure instructions using the OS/2 boot 'DOS from Drive A:' command prompt.

### OS/2 Partition and Format Procedure

1. Power on the PC and wait for OS/2 to finish booting.
2. If no partitioning is required skip to step 26.
3. Open an OS/2 Window session.
4. Type 'fdisk' and press enter at the OS/2 command prompt.
5. Press the tab key to move the cursor to the Disk section in the top left of the screen.
6. Press the right and left arrow keys until information on the Orion disk cartridge is being displayed in the main section of the screen. The Orion disk will probably be the last of the disks listed. If unsure which disk is the Orion disk, do not proceed! Ask someone who knows, as this will completely erase all data.
7. Press the tab key to move the cursor back to the main section of the screen.

## Servicing Orion

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8. If there is just one line with ': Pri/Log' under the 'Access' heading and 'FreeSpace' under the 'FS Type' heading proceed to step 13.
9. Press the up and down arrow keys until the highlighted line does not contain 'FreeSpace' under the 'FS Type' heading.
10. Press the Enter key to display the Options menu.
11. Press the D key to select 'Delete Partition'.
12. Return to step 8 and continue deleting partitions.
13. Press the Enter key to display the Options menu.
14. If the 2nd line 'Create Partition' is not in black OS/2 will not allow a partition to be created now so press the Esc key to remove the Options menu and proceed to step 21. Sometimes OS/2 won't let partitions be deleted and created at the same time.
15. Press the C key to select 'Create Partition'.
16. A 'Size of Partition' dialog box should appear with the default value the size of the entire disk.
17. Press the Enter key to select the default size.
18. A 'Type of Partition' dialog box should appear.
19. Press the L key to select 'Extended Logical Drive'.
20. Confirm that a new partition was created. Under the 'Access' heading there should be 'X:Logical', where X: is the drive letter to access the Orion disk. Under the 'FS Type' heading there should be 'Unformatted'. Under the 'MBytes' heading there should be a value close to the size of the entire disk. Note that OS/2 reserves a bit of space at the beginning of the disk for a primary partition.
21. Press the F3 key to select 'Exit'.
22. Press the x key to select 'Save and Exit'.
23. When prompted press Ctrl-Alt-Del.
24. Wait for OS/2 to finish rebooting.
25. If a partition was not successfully created return to step 3.
26. Open an OS/2 Window session.
27. Type 'format x: /fs:fat /l' where x: is the drive letter to access the Orion disk and press enter at the OS/2 command prompt.
28. Press the y key and press enter at the 'Proceed with FORMAT (Y/N)' prompt.
29. Wait for OS/2 to finish formatting the disk.
30. Type 'DCxxxx' where xxxx is the serial number of the disk cartridge at the 'Enter up to 11 characters for the volume label or press Enter for no volume label' prompt.
31. Copy the required files to the disk cartridge in the correct tree structure.

### **DOS Partition and Format Procedure**

1. Insert a DOS boot disk into the A: drive of the PC.
2. Power on the PC and wait for DOS to finish booting.
3. Note that DOS will not recognize any OS/2 HPFS partitions and will start assigning drive letters at C: to FAT partitions only.
4. If no partitioning is required skip to step 40.
5. At the DOS command prompt type 'fdisk' and press enter.
6. At the 'Enter choice' prompt press the 5 key then press enter to select 'Change current fixed disk drive'.

## Servicing Orion

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7. At the 'Enter Fixed Disk Drive Number' prompt press the number that corresponds to the Orion disk then press enter. If unsure which disk is the Orion disk, do not proceed! Ask someone who knows, as this will completely erase all data.
8. At the 'Enter choice' prompt press the 3 key then press enter to select 'Delete partition or Logical DOS Drive'.
9. If the message 'No partitions to delete' is displayed press the Esc key to continue and proceed to step 30.
10. At the 'Enter choice' prompt press the 3 key then press enter to select 'Delete Logical DOS Drive(s) in the Extended DOS Partition'.
11. If the message 'No Logical DOS Drives(s) to delete' is displayed press the Esc key to continue and proceed to step 18.
12. At the 'What drive do you want to delete' prompt press the letter that corresponds to one of the drives listed then press enter.
13. At the 'Enter Volume Label' prompt type the volume label that corresponds to the drive specified in step 12 then press enter.
14. At the 'Are you sure (Y/N)' prompt press the y key then press enter.
15. If the message 'All logical drives deleted in the Extended DOS Partition' is displayed press the Esc key to continue and proceed to step 17.
16. Return to step 12 and continue deleting Logical Dos Drives until the message indicated in step 15 is displayed.
17. After the message 'No logical drives defined' is displayed press the Esc key to continue.
18. At the 'Enter choice' prompt press the 3 key then press enter to select 'Delete partition or Logical DOS Drive'.
19. At the 'Enter choice' prompt press the 2 key then press enter to select 'Delete Extended DOS Partition'.
20. If the message 'No Extended DOS Partition to delete' is displayed press the Esc key to continue and proceed to step 23.
21. At the 'Do you wish to continue (Y/N)' prompt press the y key then press enter.
22. After the message 'Extended DOS Partition deleted' is displayed press the Esc key to continue.
23. At the 'Enter choice' prompt press the 3 key then press enter to select 'Delete partition or Logical DOS Drive'.
24. If the message 'No partitions to delete' is displayed press the Esc key to continue and proceed to step 30.
25. At the 'Enter choice' prompt press the 1 key then press enter to select 'Delete Primary DOS Partition'.
26. At the 'What primary partition do you want to delete' prompt press the 1 key then press enter.
27. At the 'Enter Volume Label' prompt type the volume label that corresponds the partition to be deleted then press enter.
28. At the 'Are you sure (Y/N)' prompt press the y key then press enter.
29. After the message 'Primary DOS Partition deleted' is displayed press the Esc key to continue.
30. At the 'Enter choice' prompt press the 1 key then press enter to select 'Create DOS partition or Logical DOS Drive'.

## Servicing Orion

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31. At the 'Enter choice' prompt press the 2 key then press enter to select 'Create Extended DOS Partition'.
32. At the 'Enter partition size in Mbytes or percent of disk space (%) to create an Extended DOS Partition' prompt press the enter key to select the default value of the entire disk.
33. After the message 'Extended DOS Partition created' is displayed press the Esc key to continue.
34. At the 'Enter logical drive size in Mbytes or percent of disk space (%)' prompt press the enter key to select the default value of the entire partition.
35. Note the drive letter assigned to the partition just created.
36. After the message 'All available space in the Extended DOS Partition is assigned to logical drives' is displayed press the Esc key to continue.
37. At the 'Enter choice' prompt press the Esc key to exit FDISK.
38. After the message 'System will now restart' is displayed press any key when ready.
39. Wait for DOS to finish rebooting.
40. At the DOS command prompt type 'format x:' where x is the drive letter assigned to the disk and press enter.
41. At the 'Proceed with Format (Y/N)?' prompt press the y key then press enter.
42. Wait for DOS to finish formatting the disk.
43. At the 'Volume label (11 characters, ENTER for none)?' prompt type 'DCxxxx' where xxxx is the serial number of the disk cartridge.
44. Copy the required files to the disk cartridge in the correct tree structure.

---

## Internal Configuration Options

### Related to the seismometer input

#### Input Impedance

The ADC board provides space for an optional input shunt resistor which can be used to damp a seismometer. Calculate the required damping resistor value using instructions provide by the seismometer manufacturer. 'Active' seismometers such as the Guralp CMG40 should be used with no damping resistor.

The input impedance of the Orion is normally shipped in a high impedance state (see as-shipped sheet). The user may change the input impedance to dampen the seismometer response if desired. There is one resistor required for each channel to set the impedance.

The resistor value is determined by the desired input impedance and the parallel resistance of 5.0Mohms.  $R_{set} = (R_{damp} * 5 * 10e6) / (5 * 10e6 - R_{damp})$ . For most practical applications set the resistor value to the desired input impedance. Figure 8.2 shows the location of the damping resistor for each channel. The damping resistor for channel 1 is R85, channel 2 is R86, and channel 3 is R87. The resistors are located on the ADC board for channels 1-3 respectively. If the unit has six channels then channels 4-6 can be set in exactly the same way.

#### Input Sensitivity

The as-shipped input sensitivity of the Orion is shown in the as-shipped sheets. The user may change the input sensitivity if desired. There is one resistor required for each channel to set the sensitivity.

The resistor value is determined by the following formulae:

## Servicing Orion

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$$\text{gain} = 1.275 \text{ uV/bit} / \text{desired sensitivity (uV/bit)}$$

$$\text{Rgain} = 2 * 10e4 / (\text{gain} \times 2 - 1)$$

The maximum input voltage will be 40 Vpp/gain.

The sensitivity can be increased by soldering one resistor per channel onto the ADC printed circuit board. For example, to achieve an overall sensitivity of 192 nV per bit, each gain-setting resistor should be set to 1.62K ohms. Figure 8.2 shows the location of the gain-setting resistor for each channel. The gain resistor for channel 1 is R18, channel 2 is R19, and channel 3 is R60. The resistors to set are on the ADC board for channels 1-3 respectively. If the unit has six channels then channels 4-6 can be set in exactly the same way.

Note with no gain resistor installed, the gain = 0.5 and the sensitivity = 2.55 uV/bit

### Configuring for an active seismometer with mass position monitoring

The first step required when connecting to an active seismometer is setting the input sensitivity and input impedance of the ADC. The input sensitivity would either be chosen to give a system sensitivity of 1nm/s or to set the full scale levels of the seismometer and the Orion to be the same. The input impedance should be left in the high impedance state.

Seismometer	Input Sensitivity	Input Gain	Input Gain Resistors	System Sensitivity
CMG 40T	800 nV	1.6	9.09K ohms	1nm/s
CMG 40T	2550 nV	1	none	3.186 nm/s

Connection to an active sensor (such as CMG 40T) will consist of connecting the main sensor coil to the signal inputs with the positive (+) coil connected to the positive (+) input and negative (-) to negative (-). Connect the '+' calibration output to the motor coil '+' and the '-' calibration output to the motor coil return. The output impedance of the calibration signal is 500 ohm with a maximum current of 10mA at a voltage of 5V. A series resistor is used on the calibration '+' outputs to ensure the current is limited to this value. This is not a factor with active sensors since they buffer the calibration signal internally.

## Servicing Orion

The connection for three components of the CMG 40T sensor is as follows:

Orion Sensor Connector	Signal Name	CMG40T
1	Channel 1 +	A - pair 1
2	Channel 1 -	B - pair 1
3	Calibration 1 +	P - pair 4
4	Calibration 1 -	R-pair 4
14	Channel 1 Gnd	N-pair 1 draw
5	Channel 2 +	C-pair 2
6	Channel 2 -	D - pair 2
7	Calibration 2+ /mass pos 1	G-pair 6
8	Calibration 2 -	N/C
16	Channel 2 Gnd	N-pair 2 drain
9	Calibration 3+	E-pair 3
10	Channel 3-	F-pair 3
11	Calibration 3+ /mass pos 2	J - pair 5
12	Calibration 3- /mass pos 3	L- pair 5
18	Channel 3 Gnd	N-pair 3 drain
15	Sensor power +12V	c-pair 7
13	Sensor power Gnd	b-pair 7
17	Sensor power -12V	m-pair 6
19	Chassis Gnd	Connector shell

*Note: Belden Cable 8167*

The best performance will be found using cables built in the following manner:

The connection to each sensor should be made with a 6 pair, double shielded with individual internal shielding, 24 AWG (or smaller) cable. An example cable of this type would be Belden 8167. The inner shields of the cable should be connected only at the Orion connector and the sensor end should be left open. The inner shield should be kept isolated from the outer shield. The outer shield should be connected to the Orion chassis ground and to the sensor chassis ground. If the sensor has a ground pin the connection can be done using that pin, however if there is no ground connection (ie. SS1 sensor) then the chassis connection should be made by connecting to the shell of the connector with as short a connection length as possible. A second cable should be connected directly from the battery to the CMG40T for the power connection.

See the next section to configure for passive seismometer calibration with current calibration drive.

# Servicing Orion

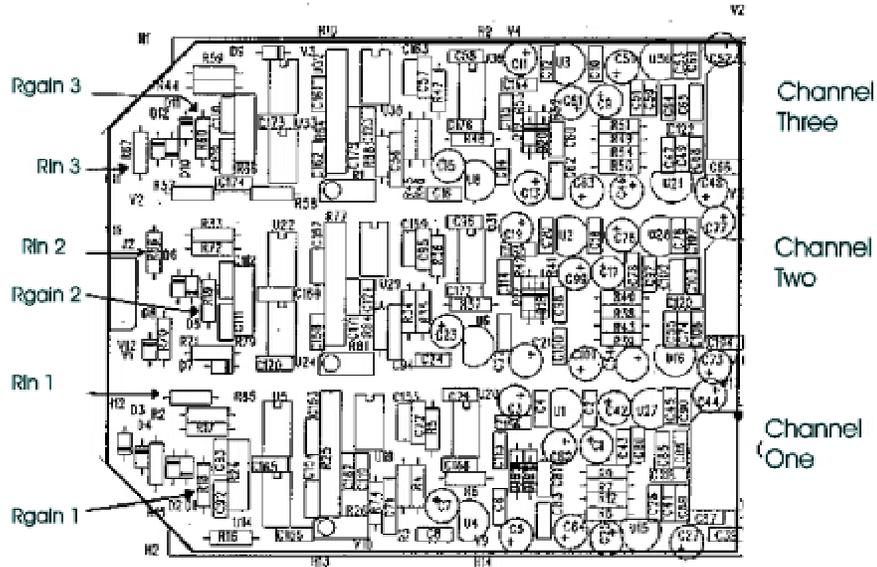


Figure 8.2

### *Configuring for a passive seismometer*

The first step required when connecting to a passive seismometer is setting the input sensitivity and input impedance of the ADC. The input sensitivity would normally be chosen to give a system sensitivity of 1nm/s. The input impedance should be set to a value to give the critical damping resistance of the seismometer.

Seismometer	Input Sensitivity	Input Gain	Gain Resistors	Input Impedance
Geotech S13	378 nV	3.37	3.48K ohms	5360 ohms
Kinemetrics SS1	159 nV	8.02	1.33K ohms	4220 ohms
Mark Prod. L4C	170.1 nV	7.49	1.43K ohms	8870 ohms

Connection to a passive sensor will consist of connecting the main sensor coil to the signal inputs with the positive (+) coil connected to the positive (+) input and negative (-) to negative (-). Connect the '+' calibration output to the motor coil '+' and the '-' calibration output to the motor coil return. The output impedance of the calibration signal is 500 ohm, with a maximum current of 10mA at a voltage of 5V. A series resistor is used on the calibration '+' outputs to ensure the current is limited to this value.

The best performance will be found using cables built in the following manner:

The connection to each sensor should be made with a 2 pair, double shielded with individual internal shielding, 24 AWG (or smaller) cable. An example cable of this type would be Belden 8162. The inner shields of the cable should be connected only at the Orion connector and the sensor end should be left open. The inner shield should be kept isolated from the outer shield. The outer shield should be connected to the Orion chassis ground and to the sensor chassis ground. If the sensor has a ground pin the connection can be done using that pin, however if there is no ground connection (ie. SS1 sensor) then the chassis connection should be made by connecting to the shell of the connector with as short a connection length as possible.

The connection for three manufacturers of the several passive sensors is as follows:

# Servicing Orion

Orion Sensor Connector	Signal Name	Geotech S13	Kinometrics SS1	Mark Products L4C
1	Channel 1 +	A - pair 1	A - pair 1	A - pair 1
2	Channel 1 -	B - pair 1	B - pair 1	B - pair 1
3	Calibration 1 +	C - pair 2	D - pair 2	C - pair 2
4	Calibration 1 -	D - pair 2	E - pair 2	D - pair 2
5	Channel 2 +	A - pair 3	A - pair 3	A - pair 3
6	Channel 2 -	B - pair 3	B - pair 3	B - pair 3
7	Calibration 2 +	C - pair 4	D - pair 4	C - pair 4
8	Calibration 2 -	D - pair 4	E - pair 4	D - pair 4
9	Channel 3 +	A - pair 5	A - pair 5	A - pair 5
10	Channel 3 -	B - pair 5	B - pair 5	B - pair 5
11	Calibration 3 +	C - pair 6	D - pair 6	C - pair 6
12	Calibration 3 -	D - pair 6	E - pair 6	D - pair 6
13	Gnd Sensor			
14	Channel 1 Gnd	inner shields 1,2	inner shields 1,2	inner shields 1,2
15	+12V Sensor			
16	Channel 2 Gnd	inner shields 3,4	inner shields 3,4	inner shields 3,4
17	-12V Sensor			
18	Channel 3 Gnd	inner shields 5,6	inner shields 5,6	inner shields 5,6
19	Chassis Gnd	E - all outer shields	Connector shell - all outer shields	E - all outer shields

See the previous section to configure for mass position monitoring with voltage calibration drive.

### User Configurable Jumper Settings

Mem-Cal:

J3	1-2	Calibration Enable = +5V
	2-3	Calibration Enable = +12V

### Factory configured jumpers

The Orion is configured using jumpers on various boards. The function of all the jumpers are explained in the following tables. Please see the as-shipped sheets for the actual jumper settings. Note that where applicable, jumper pin 1 has a square pad. The following jumper settings are set at the factory. These jumpers should never be changed. They are listed here for reference only. User configurable jumpers are considered under the function in which the jumper is referenced.

#### ADC 1-3:

Jumper	Setting	Function
J3	1-2	PS_SYNC
J6	5-6	Channel 1 Address
J7	1-2	Channel 2 Address
J8	1-2	Channel 3 Address
J10-J18	2-3	Time Slot

#### Mem-Cal:

Jumper	Setting	Function
J5	1-2	Voltage Calibration
J4	--	Not Used
J7	--	Not Used
J6	2-3	SOH1 = Mass POS 1

#### ADC 4-6:

Jumper	Setting	Function
J6	3-4	Channel 4 Address
J7	2-3	Channel 6 Address
J8	2-3	Channel 6 Address

#### TCP:

Jumper	Setting	Function
J5	1-2	USCA CLK
J6	1-2	USCB CLB
J11	1-2	Flash Program

#### COMMS:

Jumper	Setting	Function
--------	---------	----------

Jumper	Setting	Function
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## Servicing Orion

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J3A	1-2	Event_In CMOS Level	J3B	5-6	Event_In CMOS Level
J4A	2-3	Event_Out CMOS Level	J4B	5-6	Event_Out CMOS Level
J5A	2-3	RX232	J5B	5-6	CTS232
J6A	2-3	TX232	J6B	--	N/A
J7A	--		J7B	3-4	RTS232
J7C	--		J12A	1-2	AUX_CLK
J12B	5-6	USCA_RI			

### AUX I/F:

<i>Jumper</i>	<i>Setting</i>	<i>Function</i>
J16A	1-2	A0
J16B	3-4	A1
J16C	--	A2

### Standard seismometer configurations

#### *Kinometrics Ranger*

Generator constant 345 volt-seconds/ meter  
 Gain set to 8.02 with 1.33K ohm gain set resistor  
 Damping set to 4200 ohms with damping resistor  
 Configure for current drive with no mass position monitoring  
 System sensitivity 1 nanometer per second per bit

#### *Mark Products LAC*

Generator constant 276.4 volt-seconds/ meter  
 Gain set to 7.49 with 1.43K ohm gain set resistor  
 Damping set to 8870 ohms with damping resistor  
 Configure for current drive with no mass position monitoring  
 System sensitivity 1 nanometer per second per bit

#### *Geotech S13*

Generator constant 629 volt-seconds/ meter  
 Gain set to 3.37 with 3.48K ohm gain set resistor  
 Damping set to 5340 ohms with damping resistor  
 Configure for current drive with no mass position monitoring  
 System sensitivity 1 nanometer per second per bit

#### *Guralp CMG40T*

Generator constant 800 volt-seconds/ meter  
 Gain set to 1.6 with 9.09K ohm gain set resistor  
 Damping set to open circuit with no damping resistor  
 Configure for voltage drive with mass position monitoring  
 System sensitivity 1 nanometer per second per bit

OR

Generator constant 800 volt-seconds/ meter  
 Gain set to nominal with no gain set resistor  
 Damping set to open circuit with no damping resistor  
 Configure for voltage drive with mass position monitoring enabled  
 System sensitivity 3.186 nanometers per second per bit

## Orion Software

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### Acquisition Software

#### Introduction

Orion software operates in the following areas:

- } FIR low pass and decimation to support the sigma delta AD converters
- } Precision timekeeping and synchronization with UT using GPS
- } Continuous non-approximating broadband seismic data compression with saving to disk ringbuffers
- } Lowpass, highpass or bandpass filtering of seismic data prior to trigger detection algorithms
- } Either STA/LTA or level (%g) individual channel triggers
- } Multi-trigger event detection criteria
- } Power on self-test
- } Support and digital filtering and recording of internal and external state-of-health signals
- } Support of two sub-sampled preview seismic data channels
- } Support of a comprehensive information and error logging facility
- } A menu-driven user-interface for setting configuration and monitoring performance
- } Support of a comprehensive scheduler to determine recording windows, GPS on/off, etc.

#### Code storage and software updates

The software code supports three processors. Low level code is stored in electrically programmable ROM. Higher level code is preloaded onto the data cartridge. Service procedures allow the low level code to be updated without disassembling the Orion.

#### Orion configuration file

The behavior of Orion is defined by a configuration file. The master copy resides in the electrically programmable ROM so that behavior will not change unexpectedly during disk cartridge changes. Menu procedures allow either individual parameters to be changed or force a complete new configuration to be loaded from the disk cartridge. If users edit the configuration, then an audit trail of prior configurations is kept on the disk cartridge.

### Data on the Orion cartridge

#### Prior to deployment

The Orion cartridge must be formatted as a SCSI FAT file system with a certain directory structure. Some directories are then reserved for Orion data acquisition programs and a backup configuration (optional). Other directories are prepared to hold data.

#### After deployment

Seismic data will have been recorded in compressed ringbuffers, one per seismometer channel. In addition all state-of-health data will be saved in a single auxiliary ringbuffer. Another file holds all log messages. If the configuration has changed copies of older configurations will be on the disk as well.

# Servicing Orion

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## Battery Switching Algorithm

first power-up threshold = 10.5 V  
threshold = 10.9V  
charged-threshold = threshold + 1.0V

### Startup State:

if charger, int, ext. < first power-up threshold  
    blink the battery LED red, insufficient voltage  
if Charger > int. battery & Charger > ext. battery  
    switch on charger  
else if int. battery > ext. battery  
    switch on internal battery  
else  
    switch on external battery

### Discharge Control:

if ext-bat discharged set and ext-bat > charged-threshold  
    clear discharged bit

### Low Power Shutdown State:

do an orderly shutdown  
startup again when any power source is above the charged threshold

### Charger State:

if charger < threshold  
    if ext. battery > threshold  
        switch off charger, switch on ext., enter ext. bat state  
    else if int. battery > threshold  
        set external battery discharged bit  
        switch off charger, switch on int., enter int. bat state  
    else  
        enter low power shutdown state

### External Battery State:

if charger > threshold  
    switch off external battery, switch on charger, enter charger state  
else if external battery < threshold  
    if int-bat > threshold  
        set external battery discharged bit  
        switch off external battery, switch on internal battery, enter internal battery state  
    else  
        enter low power shutdown state

### Internal Battery State:

if charger > threshold  
    switch off internal battery, switch on charger, enter charger state  
else if external battery > threshold and not discharged  
    switch off internal battery, switch on external battery, enter external battery state  
else if internal battery < threshold  
    enter low power shutdown state

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## Appendix A - Specifications

### Input Channels

Sensor channels	3 standard 6 optional
Type	Differential
Sensitivity	2.55uV/bit, default
Gain	Resistor programmable
Input level	40 V <sub>pp</sub> Differential
Damping	Provisions for internal resistor
Impedance	Typically 1 Mohm with no damping
Noise level	Typically 1.25 counts rms at 1.9 microVolts/bit & 100 sps (shorted input)
Dynamic Range	132 db rms-rms

### Digitizer

Type	24-bit delta-sigma
Analog filter	3rd order Bessel -3db 3.7 KHz
Digital filter	-140db at output Nyquist
Hardware Sample rate	256 KHz
Phase	Linear in passband
Cross talk	>-80 dB typical
Sample Instant	Simultaneous
Sample rates	10, 20, 40, 50, 80, 100, 125, 200, 250, 500,1000 Consult factory for other sample rates
Output format	Compressed, non-approximating first difference Absolute UTC time reference
Preview channels	2 Channels at 1 sps to 600 seconds Bandpassed filtered min & max over interval

### Auxiliary Data Channels

Fast Channels	3 channels +/- 10V at 1 to 1/600 sps
Slow Channels	3 channels +/-10V at 1/8 to 1/600 sps
Resolution	10-bit
Sensitivity	49 mV/bit

### State-of-Health

Internal	Temperature, disk temperature, supply voltage
Self-test	Performs a complete self test at power up

### Timing System

Timing System	UTC timed with DCXO disciplined to GPS
System accuracy	1 ms (typically 20 microseconds GPS 100%)
Internal oscillator	DCXO, typically 0.4 ppm over temperature range
Type	Five channel GPS receiver
GPS Duty cycle	1 to 99% operator set

## Appendix A

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Antenna	Active, typically 25 dB gain
Cable length	2m standard Optional 10m cable
Time to first fix	Typically 30 seconds
Power Consumption	1.3 watt continuous mode, one fix per second

### Acquisition Modes

Continuous mode	Operator set start / stop time Continuous with trigger flags
Event mode	As determined by event trigger
Window mode	Ten programmable windows with repeats Continuous or event recording in each window
Recording method	Ring buffer or no overwrite

### Event Detector

Trigger pre-filter	Band pass, high pass or low pass, to 5th order
Triggering	STA / LTA or absolute level (%g) trigger Up to 6 independent triggers
Trigger threshold	Ratio 1 to 99.9
Pre-event memory	1 to 99 seconds
Post-event memory	1 to 200 seconds

### Data Cartridge

Data Compression	Non-approximating, typically 1.3 bytes / sample
Shock	Drives float in foam within the disk drive package for added shock protection
Temperature range	-20 to +40 C (with heating)
Drive heating	All cartridges include a 15 W heating element Heating is operator-set, and can be enabled or disabled
Size	Length 22 cm, height 6 cm, width 14 cm
Weight	0.5 kg (1.1 lbs.) varies with drive capacity

### User Interface

Liquid crystal display	240x64 graphic display
Contrast & backlight	Set via menu
Input keys	Four push buttons

#### LED's indicators:

Disk	Disk activity
GPS	GPS locked or unlocked
Battery	Battery voltage & low voltage shutdown
Event	An event is being processed
ACQ-CPU	Acquisition processor status
USER-CPU	User interface processor status

### Power

Typical:	5.2 watts (100 sps, 3 channels and GPS 10% duty cycled)
Voltage	11V to 17V DC

## Appendix A

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Battery:	12 Ahrs (two 6 volt 12 Amp Hr) internally mounted
Overvoltage protection	No damage at +/- 30 V

### **Mains power supply / charger**

Input Voltage	85 VAC to 264 VAC
Input Frequency Range	47 Hz to 440 Hz
Output Voltage	13.5 VDC

### **Connectors**

#### External

Sensor	19 pin for Three channel sensor
GPS antenna:	Coaxial
Communications:	19 pin I/O, serial port, SOH
Power:	4 pin 12V battery, charger input and earth
Data Cartridge	50 pin SCSI connector for data cartridge 24 pin 'D' connector for cartridge power / control

### **Environmental**

Operating Temperature	-20 to +40 C
Humidity	100%
Packaging	ABS alloy case
Dimensions	Length 47 cm, Width 37 cm, Depth 19 cm
Weight	10.9 kg (24 lbs) including batteries

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## Appendix B

### Appendix B - Connector pinouts

#### Pinouts for Lemo Connectors

	Power		GPS		Signal 1		Communications		Signal 2
1	Earth	1	Signal	1	Channel #1 +	1	Modem-DCD	1	Channel #4 +
2	Charger+	2	Shield	2	Channel #1 -	2	Modem-RX	2	Channel #4 -
3	GND Return			3	Cal #1 +	3	Modem-TX	3	Cal #4 +
4	+12 Bat			4	Cal #1 -	4	Modem-DTR	4	Cal #4 -
				5	Channel #2 +	5	Modem-GND	5	Channel #5 +
				6	Channel #2 -	6	Modem-DSR	6	Channel #5 -
				7	Cal #2 +   Mass Pos 1	7	Modem-RTS	7	Cal #5 +
				8	Cal #2 -	8	Modem-CTS	8	Cal #5 -
				9	Channel #3 +	9	Modem-RI	9	Channel #6 +
				10	Channel #3 -	10	Debug-TX	10	Channel #6 -
				11	Cal #3 +   Mass Pos 2	11	Debug-GND	11	Cal #6 +
				12	Cal #3 -   Mass Pos 3	12	Debug-RX	12	Cal #6 -
				13	Sensor Power GND	13	Reserved	13	Sensor Power GND
				14	Channel #1 GND	14	Reserved	14	Channel #4 GND
				15	Sensor Power +12V	15	SOH1	15	Sensor Power +12V
				16	Channel #2 GND	16	SOH2	16	Channel #5 GND
				17	Sensor Power -12V	17	SOH3	17	Sensor Power -12V
				18	Channel #3 GND	18	HRD-RX	18	Channel #6 GND
				19	Chassis GND	19	HRD-TX	19	Chassis GND

*Note: Pin 15 Sensor Power +12V supplies 12V at 48 mA  
Pin 17 Sensor Power -12V supplies 11.3V at 48 mA*

#### Pinouts for Bendix Style (Sourinau) Connectors

	Power		GPS		Signal 1		Communications		Signal 2
A	Earth	A	Signal	A	Channel #1 +	A	Modem-DCD	A	Channel #4 +
B	Charger+	B	Shield	B	Channel #1 -	B	Modem-RX	B	Channel #4 -
C	GND Return			C	Cal #1 +	C	Modem-TX	C	Cal #4 +
D	+12 Bat			D	Cal #1 -	D	Modem-DTR	D	Cal #4 -
				E	Channel #2 +	E	Modem-GND	E	Channel #5 +
				F	Channel #2 -	F	Modem-DSR	F	Channel #5 -
				G	Cal #2 +   Mass Pos 1	G	Modem-RTS	G	Cal #5 +
				H	Cal #2 -	H	Modem-CTS	H	Cal #5 -
				J	Channel #3 +	J	Modem-RI	J	Channel #6 +
				K	Channel #3 -	K	Config-TX	K	Channel #6 -
				L	Cal #3 +   Mass Pos 2	L	Config-GND	L	Cal #6 +
				M	Cal #3 -   Mass Pos 3	M	Config-RX	M	Cal #6 -
				N	Sensor Power GND	N	Reserved	N	Sensor Power GND
				P	Channel #1 GND	P	Reserved	P	Channel #4 GND
				R	Sensor Power +12V	R	SOH1	R	Sensor Power +12V
				S	Channel #2 GND	S	SOH2	S	Channel #5 GND
				T	Sensor Power -12V	T	SOH3	T	Sensor Power -12V
				U	Channel #3 GND	U	HRD-RX	U	Channel #6 GND
				V	Chassis GND	V	HRD-TX	V	Chassis GND

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### Appendix C - Power Consumption Calculations

This appendix will describe how to calculate the power consumed by the Orion. The power consumption varies considerably and depends on the sample rate, number of channels, GPS duty cycle, and the degree of compression. All these factors except the compression level can be summed to arrive at a mean power consumption. The compression level will vary with the amplitude of the data being collected and is more difficult to estimate.

Within the Orion, power is consumed by the digitizing engine and the PC processor. The digitizing engine is powered continuously and the PC processor is duty cycled. Duty cycling the PC processor saves a considerable amount of power especially when large capacity disk drives are used. With a 1.2 Gb data cartridge, the PC processor consumes 9.325 W. The LCD backlight consumes an additional 2.9 W. In user mode (PC processor powered) the Orion consumes 16.5 W. A 3 channel digitizing engine with GPS on continuously consumes 4.125 W and a 6 channel digitizing engine with GPS on consumes 5.2 W. The table below summarizes the power consumed:

3 Channel Digitizing Engine	4.125 W
6 Channel Digitizing Engine	5.2 W
PC Processor + Disk	9.325 W
Backlight	2.9 W
GPS Engine	1.3 W

The power also varies with the aggregate sample rate. This is because more data must be written to the disk, and this increases the PC processor duty cycle. For example, a 3 channel 50 sps Orion has a PC processor duty cycle of 2.7%, whereas a 6 channel 250 sps Orion has a duty cycle of 27%. This duty cycle can be reduced to a simple formula:

$$\text{PC Processor Duty Cycle} = (\text{number of channels recorded}) \times (\text{sample rate in sps}) \times 0.018$$

For example:

$$\begin{aligned} \text{PC Processor Duty Cycle} &= (3 \text{ Channels}) \times (50 \text{ sps}) \times 0.018 \\ &= 2.7 \% \end{aligned}$$

Now the duty cycle needs to be corrected for the compression level. The compression algorithm works by calculating the first difference from the 24 bit data and storing the difference as a byte, word, or long. So an estimate of the signal level is required. This is gained from experience. Some sites are very quiet and almost all the data is stored as byte differences. Noisier or more active sites may have a large percentage of word differences. The following formula can be used as a guideline:

$$\begin{aligned} \text{Compression Factor} &= 1 \times (\% \text{ of byte diffs}) + 2 \times (\% \text{ of word diffs}) \\ &\quad + 4 \times (\% \text{ of long diffs}) \end{aligned}$$

A typical site would look like this:

$$\begin{aligned} \text{Compression Factor} &= 1 \times (.80) + 2 \times (.15) + 4 \times (.05) \\ &= 1.3 \end{aligned}$$

The compression factor is used to correct the duty cycle and is only AN ESTIMATE of the compression.

The GPS power consumption is approximated as follows:

$$\text{Maximum GPS Duty Cycle} = (\text{maximum GPS on-time}) / (\text{GPS interval})$$

For example: For a GPS interval of 60 minutes and a maximum GPS on-time of 5 minutes we get:

$$\text{GPS Duty Cycle} < 5 \text{ minutes} / 60 \text{ minutes} = 8.3\%$$

Now the average power consumption can be estimated using the following formula:

## Appendix C

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$$\begin{aligned}\text{Power} &= (\text{Digitizing Engine Power}) \\ &+ (\text{PC Processor Duty Cycle})(\text{Compression Factor})(\text{PC Processor Power}) \\ &+ (\text{GPS Duty Cycle})(\text{GPS Power})\end{aligned}$$

For example, a 3 channel, 50 sps, Compression Factor 1.3 Orion would consume:

$$\begin{aligned}\text{Power} &= 4.125 \text{ W} + (3 \times 50 \text{ sps} \times 0.018\%)(1.3)(10.8 \text{ W}) + (5 / 60)(1.3 \text{ W}) \\ &= 4.125 \text{ W} + 0.38 \text{ W} + 0.11 \text{ W} \\ &= 4.615 \text{ W}\end{aligned}$$

Therefore, the total power consumption is 4.9 W. Notice the effect of duty cycling the PC processor; the 9.325 W is reduced to 0.38 W of power!

Lastly, the energy required for an Orion for a period of time is:

$$\text{Energy} = \text{Power} \times (\text{Time recording in Hrs.})$$

For example, using the power above of 4.62 W and a 7 day deployment:

$$\begin{aligned}\text{Energy} &= 4.62\text{W} \times 7 \times 24 \\ &= 776 \text{ W-Hrs.}\end{aligned}$$

Usually, batteries are used for powering the Orion. Batteries are rated using Amp-Hrs. Therefore, to convert the energy to Amp-Hrs of 12 V batteries use:

$$\begin{aligned}\text{Amp-Hrs} &= \text{Energy} / 12 \text{ Volts} \\ &= 776 \text{ W-Hrs} / 12\text{V} \\ &= 65 \text{ Amp-Hrs}\end{aligned}$$

If 12V batteries are used remember to derate them for age and temperature.

In summary the constants and formulae are:

3 Channel Digitizing Engine + GPS	4.125 W
6 Channel Digitizing Engine + GPS	5.2 W
PC Processor + Disk	9.325 W
LCD Backlight	2.9 W
GPS	1.3 W
Orion Internal Batteries	2 x 6 V - 12 Amp-Hrs. Batteries

PC Processor Duty Cycle = (Number of Channels Recorded) x (sample rate in sps) x 0.00018  
Compression = 1 x (% of byte diffs) + 2 x (% of word diffs) + 4 x (% of long diffs)  
Maximum GPS Duty Cycle = (maximum GPS on-time) / (GPS interval)

$$\begin{aligned}\text{Power} &= (\text{Digitizing Engine Power}) \\ &+ (\text{PC Processor Duty Cycle})(\text{Compression Factor})(\text{PC Processor Power}) \\ &+ (\text{GPS Duty Cycle})(\text{GPS Power})\end{aligned}$$

Energy = Power x (Time recording in Hrs.)  
Amp-Hrs = Energy / 12 Volts

## Appendix D - Recommended Equipment for Site

### Site Equipment

Orion

Sensor

Sensor cables

Power cable

GPS antenna

GPS antenna cable

batteries

Insulating box for sensor

### Installation Tools and Supplies

Pickaxe

Shovel

Steel brush

Trowel

Small tarpaulin to cover Orion

Plastic box for batteries

Steel chain to secure Orion

Padlocks (2) and keys (and a spare)

Steel or wooden rod, 3 - 4 feet long, for mounting GPS antenna

Electrical tape

Compass

Note book and pen

Mini level

Plaque indicating purpose of equipment

Flashlight

Voltmeter

Battery charger

Set of screwdrivers

Spare battery

Various pliers

Spare battery wire

Crimp tool

Plaster of Paris

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# Appendix E - Glossary of Configuration Parameters

## Introduction

The Master copy of the Orion configuration is contained in non-volatile flash memory on the digitizer so that the Orion will retain its configuration even when it is powered off and the disk is changed. An ASCII copy of the configuration is written to the disk in the \USER directory as filename ORIONnnn.INI (where nnn is the serial number of the Orion) whenever a new disk is initialized and whenever the configuration is changed. Previous configuration files are saved on the disk as ORIONnnn.mmm, thus providing a complete record of configuration changes over the duration of the experiment. These files can be examined to verify the settings of the Orion's operating parameters.

A configuration file may be installed to the data cartridge as filename ORIONnnn.DSK, then loaded into the Orion using the "Load From Disk" command in the configuration menu. This provides a simple way to transfer the configuration from one Orion to another or to set several instruments with the same configuration.

It is generally easiest and most reliable to modify the configuration file using the Orion user interface. However, it is also possible to create or modify a configuration file using a text editor, then loading it into the Orion as described above.

## Format of the Configuration File

The ASCII configuration file for the Orion follows the Nanometrics INI file convention. The file comprises a number of sections, each containing a set of parameter definitions. Each section is identified by the section name enclosed in square brackets. Each parameter definition appears on a separate line with the form Name = Value.

## Parameter List

### GpsParams

This section contains the values used to initialize the GPS.

PositionMode	Mode in which to set the GPS: 3DFind, 2DFind or SingleSat.
PowerMode	Continuous or DutyCycled.
DutyCycleInterval	Length of time in minutes between powering up the GPS.
MaxTimeGpsOn	Maximum length of time in minutes the GPS may be left on in a cycle.

### FileSettings

This section contains the configuration of the files generated by an Orion.

AutoSize	Option to automatically choose file sizes to use up all disk space available.
RingBufferType	Type of seismic data buffer: RingBuffer (new data overwrites oldest data when file is full) or SingleWrite (new data is discarded when file is full).
SohBufferType	Type of state-of-health buffer: RingBuffer (new data overwrites oldest data when file is full) or SingleWrite (new data is discarded when file is full).
RingBufferSize	Total size of the seismic data buffers in megabytes.
SohBufferSize	Size of the state-of-health buffer in megabytes.

### GuiSettings

This section contains the power-on user interface settings used in an Orion.

Contrast	Contrast setting for the LCD display (0 to 100).
BacklightOn	Power-on state of the LCD backlight (On/Off).
KbTimeout	Length of time in minutes before the user interface is automatically shut down if there is no keyboard activity.

### Waveform

This section contains the default waveform settings used in an Orion.

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Channel Channel selected for plotting.

Width	Time duration for one screen width of plotting.
YScale	Maximum value plotted; uses equivalent negative value as minimum value.
YScaleMult	Scaling factor used as a multiplier of YScale.
RemoveDC	Option to remove the DC offset of the waveform (On/Off).

### Station

This section contains information on the digitizer station.

Name	The five letter station name of the Orion digitizer.
Latitude	The latitude of the digitizer in degrees.
Longitude	The longitude of the digitizer in degrees.
Elevation	The elevation of the digitizer in meters.
Comments	Comment to be added in Y-file header.

### Sensor 1-6

These six sections contain information on the sensor connected to each of the six channels.

Type	The (7-character) type of sensor.
SerialNumber	The (7-character) serial number of the sensor.
Component	The one character describing the sensor component. Valid values are one of Z, N, E, V, X, Y, 1, 2, 3, 4, 5, 6.
Sensitivity	The sensitivity of the sensor in volts per unit.
SensitivityUnits	The units for the sensitivity expressed above.

### Site 1-6

These six sections contain information on the sites of the six sensors.

Name	The two character location name of the site.
Latitude	The latitude of the site in degrees.
Longitude	The longitude of the site in degrees.
Elevation	The elevation of the site in degrees.

### Orientation 1-6

These six sections contain the orientation for each of the six channels.

Name	The three character channel name of the channel.
Azimuth	The azimuth of the channel in degrees.
Dip	The dip of the channel in degrees.

### ChannelSetup 1-6

These six sections contain information on the six channels.

FilterDC	Option to automatically remove the DC offset from the seismic data.
SiteIndex	Which of the six sites applies to the channel.

### EventDetection

This section contains values for the event detection algorithm.

Window	The coincidence window (in seconds) in which triggers must occur to be deemed simultaneous.
OnCount	The number of triggers which must be on to declare the start of an event.
OffCount	The number of triggers which must remain on to prevent an event from ending.
PreEvent	The length of time before the event was declared to have started for which data should be recorded when in event recording mode.
PostEvent	The length of time after the event was declared to have ended for which data should be recorded when in event recording mode.

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**MaxDuration** The maximum length in seconds of an event at which time recording is stopped regardless of event status.

### RecordingOptions

This section contains the recording mode options.

**RecordingMode** The mode of operation may be Continuous (record all data), Event (record only events) or Scheduled (record as per windows below).

**AutoStart** Automatically start recording when the unit is turned on (i.e. do not wait for the user to issue the Start command).

**NumSchedules** Number of schedules filled in below.

**WarmupDelay** When not in a recording window, the Orion will turn itself off to conserve power. The digitizer is turned this on this number of minutes before the start of a window to give the digitizer time to remove the data's DC offset and get a correct time from the GPS clock.

**DiskTempRange** The disk operating temperature range (Safe/Extended/Unlimited).

### RecordingSchedule 1-10

These ten sections contain the repeated scheduled recording times.

**DataMode** The recording mode for this scheduled window (Continuous or Event).

**StartTime** The time to start this recording window.

**Duration** The length of time in seconds for this recording window.

**RepeatInterval** The length of time in seconds before repeating this recording window.

**RepeatCount** The number of times to repeat this recording window.

### FastSoh 1-3 / SlowSoh 1-3

These six sections contain the calibration information for the analog external state-of-health fields.

**UnitsPerVolt** The number of units to which each volt corresponds.

**UnitsOffset** The offset in units to which 0V corresponds.

### LogSettings

This section contains the intervals between logging the various state-of-health fields.

**Verbosity** The verbosity level of messages to log, either Normal or Debug.

**GpsInterval** The number of seconds between logging the various GPS messages.

**FastSohInterval** The number of seconds between logging the three fast state-of-health analog values.

**SlowSohInterval** The number of seconds between logging the various slow state-of-health values. Minimum 8 seconds.

### DspSettings

This section contains the values used for configuring the DSP.

**NumChannels** The number of channels to digitize.

**SampleRate** The output sample rate of the digitizer.

**DCFilterFmHz** The corner frequency of the DC-removal filter in milli-Hz.

**MinMaxChannel 1** Which trigger to output on MinMax channel one. Must be a valid trigger number.

**MinMaxChannel 2** Which trigger to output on MinMax channel two. Must be a valid trigger number.

**MinMaxInterval** The number of seconds between logging the two MinMax channels.

### Trigger 1-6

These six sections contain the values for configuring the trigger detection algorithms.

**InputChannel** Which channel to use for detecting the trigger. Must be on a valid digitizer input channel.

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Type	The type of trigger, StaLta (short term average / long term average ratio) or Threshold (absolute value).
Level	The short term average / long term average ratio or absolute level on which to trigger depending on the Type.
ReportDelay	The time in seconds before generating a trigger on message.
DeTriggerTime	The time in seconds a threshold trigger must be off before generating a trigger off message.
StaTimeConstant	The short term time constant in seconds (STA/LTA triggers only).
LtaTimeConstant	The long term time constant in seconds (STA/LTA triggers only).
HighPassOrder	The order of the high pass filter.
LowPassOrder	The order of the low pass filter.
HighPass Corner	The 3db corner frequency of the high pass filter.
LowPassCorner	The 3db corner frequency of the low pass filter.

## Appendix F - Instrument Log Messages

The Orion instrument log provides a record of the normal ongoing operation of the instrument, as well as specific incidents which may affect data quality or timing. The Orion generates 5 different categories of message:

Information	Document the normal operation of the Orion.
Warnings	Minor incidents which may slightly affect data quality or timing.
Errors	Incidents which may result in significant loss of data.
Fatal Errors	Serious malfunctions of the Orion.
Debug Info	Verbose trace messages.

Message numbers below 1000 are generated by the AUX (disk and user interface) processor; these are usually related to data file operations and user input. Message numbers above 1000 are generated by the TCP (timing and control processor); these are usually related to GPS timing and the low-level operation of the Orion. The DSP does not generate log messages.

### Informational Messages

Message 7:	Orion up - ver mm.nn
	Normal message. The AUX processor has started, with software version mm.nn.
Message 8:	AUX Off rc1 rc2 rc3 rc4
	The AUX processor has shut down. The codes rc1 and rc2 indicate the reason for shutdown; rc3 and rc4 are normally zero but may contain extra information in the case of an abnormal shutdown. The shutdown reasons are as follows:
	<b>Normal Shutdown Codes</b>
	rc1 rc2 Reason for Shutdown
	0 34 User selected "Exit To Dos".
	0 35 Normal shutdown (finished transferring data)
	0 69 User selected "User-Exit Now"
	<b>Abnormal Shutdown Codes</b>
	rc1 rc2 Reason for Shutdown
	1 40 Out of memory.
	1 41 No stack space.
	1 47 The AUX is shutting down since it cannot communicate with the TCP.
	1 68 The AUX is shutting down on instruction from the TCP (e.g.in a low-battery condition)
	1 1 A math function exception has been encountered.
	1 2 The AUX has been shut down by its exception handler.
Message 17:	Open RB N =nnnn
	The ringbuffer for channel N is being opened with size nnnn bytes. This message should appear on each data channel when the AUX starts up, and after the configuration is changed.
Message 20:	First X N seq nnnn

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	See Message 21.
Message 21:	X N time: nnnnnnnn Messages 20 and 21 indicate the reception of the first data packet for channel N since the AUX processor started. Message 20 provides the sequence number of the packet; message 21 provides the time stamp of the packet in seconds.
Message 28:	RB close chN seq nnnn The ringbuffer for channel N was flushed and closed. This message is generated when the AUX shuts down, or when the configuration is changed. The message provides the sequence number (nnnn) of the last packet received before closing.
Message 29:	SOH close seq nnnn The SOH ringbuffer was flushed and closed. This message is generated when the AUX shuts down, or when the configuration is changed. The message provides the sequence number (nnnn) of the last SOH packet received before closing.
Message 30:	AUX clock reset nn. The AUX clock was reset by nn seconds to synchronize it with the Orion instrument clock. This usually occurs shortly after the AUX processor starts up, or when the instrument clock is reset when the GPS locks.
Message 34:	AUX Exit To DOS The user has selected "Exit To DOS".
Message 35:	AUX Off (TCP Empty) The AUX is about to shut down because it has finished transferring data from the TCP.
Message 36:	Invoke TCP Stop The user has pressed "Stop Recording".
Message 37:	Invoke TCP Start The user has pressed "Start Recording".
Message 45:	TCP Rebooting The TCP is rebooting normally following a change in configuration.
Message 46:	Sent AUX Alive The AUX sent an AUX Alive message to the TCP to request the configuration. This is normal after a change in configuration. The appearance of this message at any other time may indicate an error.
Message 51:	Bad SCC msg len mm(nn) The message length field in a packet (mm) does not agree with the actual message length (nn) received by the AUX. The AUX re-initializes the SCC and requests retransmission of the message.
Message 61:	TCP buffer nnnn kB This message appears shortly after the AUX starts and indicates the total amount of data (in kilobytes) to be transferred from the TCP.
Message 63:	Enter User mode

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	The AUX processor has entered user mode and is expecting user input. This normally occurs after a key press or after the initial power-up.
Message 64:	Exit User mode The AUX processor has left user mode. This occurs when the user selects "UserExit," "DiskSwap" or "ShutDown" or when the user interface times out (see message 65).
Message 65:	User timeout The user interface has timed out because no keys have been pressed for a while. The timeout interval can be set in the "Settings" menu.
Message 66:	Enter Remote mode The AUX has entered remote-access mode in which the menus can be accessed over a serial port. This occurs in response to a signal on the modem ring indicator.
Message 67:	Exit Remote mode The AUX has left remote-access mode in response to a user request.
Message 69:	AUX Off on User Exit The AUX is shutting down immediately because the user has selected "Exit Now" from the User Exit menu.
Message 70:	Rx XData = nd (md) See Message 72.
Message 71:	Rx Status = ns (ms) See Message 72.
Message 72:	Rx Total = nt (mt) Messages 70, 71 and 72 are generated shortly before the AUX shuts down and provide a summary of the data transferred from the TCP. Message 70 summarizes the seismic data transferred (nd packets, md bytes); Message 71 summarizes the SOH data transferred (ns packets, ms bytes); and Message 72 summarizes all data received (including realtime GPS, waveform and handshaking messages).
Message 77:	Log Marker nn This message is inserted manually using the "Mark Log" feature.
Message 78:	Log Cleared by User The instrument log has been manually cleared by the user.
Message 79:	Files Reset by User The data, SOH and log files were cleared and reset by the user using the Reset feature in the Data menu.
Message 80:	On nn s, cycle mm s See Message 81.
Message 81:	Duty cycle nn.nn Messages 80 and 81 are generated immediately before the AUX shuts down and give a summary of the AUX on/off power cycle. Message 80 gives the time in seconds for which the AUX was powered on (nn) and the time in seconds since the last AUX shutdown (mm). Message 81 gives the duty cycle in percent ( $100 * nn / mm$ ).
Message 82:	First SOH seq nnnn len mm See Message 83

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Message 83:	First SOH Time nnnnnnnn Messages 82 and 83 indicate the reception of the first SOH data packet since the AUX processor started. Message 82 provides the sequence number and length of the packet; message 83 provides the time stamp of the packet in seconds.
Message 84:	Open SOH file nnnn The SOH buffer is being opened with size nnnn bytes. This message should appear when the AUX starts up and after the configuration is changed.
Message 102:	TCP got remote dialup The TCP has received a remote access request and has instructed the AUX to enter remote-access mode.
Message 114:	Downloading new config The AUX is downloading a new configuration to the TCP in response to a user request.
Message 115:	Received new config The AUX received a new (different) configuration when it expected it.
Message 116:	Config unchanged The AUX received a configuration which is identical to that which it was already using. This message should appear each time the AUX is started.
Message 117:	Ini File Loaded The user loaded an ini file from disk in the Configuration menu.
Message 118:	Ini File Saved The user saved the configuration file to disk in the Configuration menu.
Message 1027:	TCP power AUX on The TCP powered the AUX up either because the TCP memory was full or because the user pressed the boot AUX button.
Message 1028:	TCP power AUX off. The TCP powered the AUX down after it requested a shutdown.
Message 1039:	DSP diag RC=r cnt=n. The DSP diagnostics returned the value r on the nth time run. This is an informational message if r is 0 and a warning message otherwise.
Message 1041:	TCP turn LEDs on. The TCP turned on the LEDs after detecting a user button press.
Message 1042:	TCP turn LEDs off. The TCP turned off the LEDs after powering off the AUX or after 5 minutes of no user activity.
Message 1054:	Recording Started. Data recording has started as requested by the AUX.
Message 1055:	Recording stopped. Data recording has stopped as requested by the AUX.
Message 1056:	Window started ssss-eeee. The recording window from time ssss to time eeee has started.
Message 1057:	Window ended ssss-eeee.

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Message 1058:	<p>The recording window from time ssss to time eeee has ended.</p> <p>TCP rx msg ReTx.</p> <p>The TCP received a message from the AUX requesting that it resend the last message. All other messages received by the TCP are logged as Debug/Verbose messages.</p>				
Message 1060:	<p>PLL fine locked.</p> <p>The TCP is phase locked. It is using the average of several seconds of GPS messages. The absolute time error is less than 10 microseconds.</p>				
Message 1061:	<p>PLL coarse locking.</p> <p>The TCP is phase locking, skewing the time to the correct.</p>				
Message 1068:	<p>GPS lost navigation.</p> <p>The GPS engine is not able to generate a navigation solution using the satellites in view.</p>				
Message 1069:	<p>GPS gain navigation.</p> <p>The GPS engine is now able to generate a navigation solution using the satellites it is tracking.</p>				
Message 1070:	<p>User button pressed.</p> <p>The TCP detected a user button press. The next message indicates the action taken which is turning on the LEDs or powering on the AUX.</p>				
Message 1071:	<p>PLL did not fine lock.</p> <p>The GPS was on for its maximum allowed duration before it could correct its time error to within 1 microsecond. The GPS is being turned off anyway.</p>				
Message 1072:	<p>GPS power on.</p> <p>The TCP powered the GPS on so that it can correct its internal time.</p>				
Message 1073:	<p>GPS power off.</p> <p>The TCP powered the GPS off after it had corrected its time to within 1 microsecond or after the maximum on time had elapsed.</p>				
Message 1075:	<p>Disk heater on, dd seconds, tt C.</p> <p>The TCP powered the disk heater on to warm it up in preparation of starting the AUX processor. There are dd seconds of memory left and the current disk temperature is tt degrees Celcius.</p>				
Message 1076:	<p>Disk heater off, dd seconds, tt C.</p> <p>The TCP powered the disk heater off after warming it up in preparation of starting the AUX processor. There are dd seconds of memory left and the current disk temperature is tt degrees Celcius.</p>				
Message 1079:	<p>Disk temperature tt C.</p> <p>The temperature of the disk cartridge has passed one of the safety limits to tt degrees Celcius. If the disk is too hot or too cold the AUX processor may not work correctly. The disk may be heated to within temperature specifications or these limits may be disregarded.</p>				
Message 1080:	<p>GPS engine state sssss.</p> <p>The GPS engine state has changed to sssss, which is one of the following:</p> <table><tr><td>Search</td><td>The GPS engine is searching for satellites.</td></tr><tr><td>Track</td><td>The GPS engine is tracking at least one satellite.</td></tr></table>	Search	The GPS engine is searching for satellites.	Track	The GPS engine is tracking at least one satellite.
Search	The GPS engine is searching for satellites.				
Track	The GPS engine is tracking at least one satellite.				

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2D Nav     The GPS engine is navigating in 2D, constant altitude.  
3D Nav     The GPS engine is navigating in 3D.

Message 1087:     Startup reason rrrrr.  
The Orion is indicating the reason rrrrr it was powered on. The possible reasons are one of the following:  
PwrSwrch    The main power switch was turned on.  
Button      The Orion was awoken from a scheduled off by the user pressing the button.  
LowPower    The Orion had previously shutdown since there was insufficient power for operation.  
TimedOff    The Orion was automatically exiting a scheduled off period to start recording.

Message 1093:     Modem ring detected.  
The TCP detected a modem ring on remote dialup port. It will boot up the AUX processor if it is not already active.

### Warning Messages

Message 8:        AUX Off rc1 rc2 rc3 rc4  
The AUX processor has shut down. This message may appear as information (for a normal shutdown), or as a warning (for an abnormal shutdown). See Informational Messages for an explanation of the return codes.

Message 9:        Msg buffer timeout  
The AUX has not received a message from the TCP for 5 seconds. This may indicate a temporary communications failure or may indicate that the TCP is rebooting.

Message 22:       RingBuffer N is full  
The Orion attempted to write a data block to the file for channel N when the file is full and the user has selected single-write mode. A message is generated only on the first attempt to write a block.

Message 32:       Invalid time nnnn  
The AUX was instructed to synchronize its time with the instrument clock but has not done so since the instrument time is not valid (it is pre-1980). The parameter indicates the specified instrument time in seconds. This usually indicates an invalid reading from the real-time clock.

Message 48:       Unexpected Msg type nn  
The AUX received an unexpected message (type nn) while waiting for the TCP to send the configuration.

Message 52:       Bad msg type nn  
The AUX received an unrecognized message type (nn) from the TCP. The message is ignored.

Message 86:       SOH Seq exp nn got mm  
A sequence error was encountered on the SOH data stream. The AUX was expecting a packet with sequence number nn, but got mm. If mm is zero it indicates that the TCP rebooted and was unable to recover its data buffer.

Message 87:       SOH Buffer is full

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	The Orion attempted to write a data block to the SOH file when the file is full and the user has selected single-write mode.
Message 90:	Sequence Error on ch N See message 91.
Message 91:	Exp nn, got mm Messages 90 and 91 indicate that a sequence error was encountered on the channel N data stream. The AUX was expecting a packet with sequence number nn, but got mm. If mm is zero, this probably indicates that the TCP rebooted and was unable to recover its data buffer.
Message 99:	Lost nn log messages The log message buffer overflowed and nn log messages were lost.
Message 101:	No Remote com, rc=nn The Orion was unable to enter the remote-access mode. This normally indicates that the serial port was not available.
Message 110:	TCP program failed The TCP failed to reprogram the Orion configuration properly. This condition also generates an interactive error message on the Orion display.
Message 112:	Unexpected config The AUX received a configuration message at an unexpected time. However, the configuration was identical to the current configuration.
Message 126:	Inifile load rc=nn The user attempted to load an ini file in the Configuration menu, but the load failed with the specified return code. This indicates that the file was not found or not readable.
Message 127:	Inifile save rc=nn The user attempted to save an ini file in the Configuration menu, but the save failed with the specified return code. This message should not appear.
Message 1024:	TCP version m.nn. The TCP startup message with version number m.nn.
Message 1025:	Clock zap sss, mmm The internal time of TCP has changed by sss seconds and mmm milliseconds. A discontinuity in data timing will result.
Message 1026:	TCP rx msg=mmm, st=xx. The TCP received the unexpected message mmm from the AUX while in state xx.
Message 1039:	DSP diag RC=r cnt=n. The DSP diagnostics returned the value r on the nth time run. This is an informational message if r is 0 and a warning message otherwise.
Message 1043:	GPS error, ssss. The TCP detected an error in the reception of messages from the GPS. The error ssss is one of the following: Missing      No GPS was detected at startup. Overrun      A byte was not received in time. Frame        A byte was received with an invalid stop bit.

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	Parity	A byte was received with an invalid parity bit.
	InvSync	A message header had an incorrect sync word.
	HdrCs	A message header had an incorrect checksum.
	DataSize	A data message had an invalid length.
	DataCs	A data message had an incorrect checksum.
	BufFull	The GPS message buffer was full.
Message 1044:	GPS lost lock.	The GPS has lost lock; its time is unreliable. The TCP is no longer using the GPS for phase locking its time.
Message 1045:	GPS gain lock.	The GPS has gained lock; its time is now valid. The TCP is once again using the GPS for phase locking its time.
Message 1046:	GPS online.	Messages are now being received from the GPS.
Message 1047:	GPS offline, rebooting.	The TCP has not received a valid message from the GPS in over 10 s. Power to the GPS is turned off immediately and back on in 10 s.
Message 1049:	TCP rx err len=nnn, xxxx	The TCP received an invalid message from the aux of length nnn. The status word from the serial port was xxxx.
Message 1050:	Inv msg len exp nnn got mmm.	The TCP received an invalid message length from the aux. The message said it was nnn bytes; instead it received mmm bytes.
Message 1052:	Config saved ok.	The configuration was saved successfully. The TCP is now rebooting to use the new configuration.
Message 1062:	Battery voltage, nn.nn.	The input voltage has changed over a battery voltage threshold value. The current voltage reading is nn.nn volts.
Message 1066:	Rx invalid config	The TCP received an invalid configuration from the AUX. The TCP is ignoring it and continuing to run with its current configuration.
Message 1074	Using xxxx power source.	The Orion switched the source of its input voltage. The Orion will use the mains/charger power supply if present, otherwise it will use the external battery if it has not been discharged, otherwise it will use the internal batteries.
Message 1077	Disk removed.	The Orion has detected that the disk cartridge has been removed. The AUX processor will not be booted until after it has been inserted. If not inserted before running out of memory, data will be lost.
Message 1078	Disk inserted.	The Orion has detected that the disk cartridge has been inserted.

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- Message 1081: GPS time error sss, mmm.  
The GPS is reporting the digitizer time is incorrect by sss seconds and mmm milliseconds. This error must remain stable for some time before the digitizer will accept it as correct. If the time error is 0, this indicates that the GPS is no longer indicating that the digitizer time is incorrect.
- Message 1082: Digitizer time valid.  
The digitizer time is now accepted as correct and any the GPS must indicate the same error for a prolonged period for it to be accepted. Any large errors in with respect to GPS time are corrected by resetting the GPS engine.
- Message 1083: Digitizer time invalid.  
The GPS engine has repeatedly indicated that the digitizer time is wrong so the digitizer will believe it and proceed as on startup.
- Message 1085: Charger mode mmmm.  
The internal disk charger is now on either a slow charge or off, indicated by mmmm.
- Message 1086: PIC switch to sssss.  
The PIC processor detected a sudden loss of voltage on the input power source and automatically switched to the sssss power source.
- Message 1088: PIC comms error eeeee.  
There was an error eeeee in the communications between the TCP processor and the PIC processor. The error is one of the following:
- TFrame The TCP detected a frame error in a message from the PIC.
  - TParity The TCP detected a parity error in a message from the PIC.
  - TOverrun The TCP detected an overrun error in a message from the PIC.
  - TChksum The TCP detected an error in the message checksum from the PIC.
  - PFrame The PIC detected a frame error in a message from the TCP.
  - POverrun The PIC detected an overrun error in a message from the TCP.
  - TBoot2 The PIC is incorrectly indicating that it has rebooted the TCP.
  - TNoData The TCP has not received a message from the PIC and is attempting to reestablish communications.
- Message 1089: Start rrrrr shutdown.  
The Orion is starting its shutdown sequence for the reason rrrrr. The reason is one of the following:
- LowPower The Orion does not have sufficient power to continue operation.
  - TimedOff The Orion is about to enter a scheduled off period to conserve power.
- Message 1090: Cancel rrrrr shutdown  
The Orion is canceling its shut down sequence for the reason rrrrr. See Message 1089 for explanation of why it started the shutdown sequence.

### Error Messages

- Message 10: TCP not responding  
The AUX has not received a message from the TCP for about 30 seconds, and is shutting down to ensure that existing data files are not corrupted. This may occur due to a communications failure or may indicate that the TCP is rebooting or stopped.
- Message 12: RAX err nnnnn ch N

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	The Orion was unable to write a data block to file for channel N (return code = nnnnn).
Message 18:	RB Open err nnnnn ch N The Orion was unable to open the data file for channel N (return code = nnnnn).
Message 23:	RingBuffer N not open The Orion received a data packet for channel N but the data file for that channel is not open. The packet is discarded.
Message 31:	LCD not available The LCD display hardware is not responding. This indicates a hardware error, e.g. the LCD might be disconnected. The Orion will still run but will be unable to update the LCD display.
Message 45:	TCP Rebooting The TCP is rebooting at an unexpected time. This suggests that the TCP has detected an internal error.
Message 50:	Bad SCC status 0xnn The SCC detected a transmission error on transmission from TCP to AUX. The status byte is given as the message parameter. The AUX re-initializes the SCC and requests retransmission of the message.
Message 53:	Bad msg len mm(type,nn) The message length field in a packet (mm) does not agree with the expected length (nn) for the given message type.
Message 54:	Bad channel (N) A data packet was received for an illegal channel N. Legal values are 0 to 5. The packet is discarded.
Message 68:	TCP Invoked Shutdown The TCP instructed the AUX to shut down. This occurs when the TCP is about to shut down the Orion (e.g. due to a low battery). The AUX is shut down first to avoid corrupting the data files.
Message 85:	SOH Open failed, RC=nn The Orion was unable to open the SOH file (return code = nnnnn).
Message 88:	SOH file is not open The Orion received a SOH data packet but the SOH file is not open. The packet is discarded.
Message 89:	SOH Write err nnnnn The Orion was unable to write a data block to the SOH file (return code = nnnnn).
Message 111:	Wrong config len nnnn The AUX received a configuration message with the wrong length (nnnn). The message is discarded and the configuration is not changed.
Message 113:	Unexpected new config The AUX received a new (different) configuration at an unexpected time. The new configuration is used.
Message 1034:	DSP send cmd not ready.

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	The TCP tried to send a command to the DSP but it was not ready to receive one. The TCP will restart the DSP to ensure proper acquisition.
Message 1035:	DSP send cmd failed. The TCP sent a command to the DSP which it did not acknowledge as completed. The TCP will restart the DSP to ensure proper acquisition.
Message 1036:	DSP send word not ready. The TCP tried to send a word to the DSP but it was not ready to receive one. The TCP will restart the DSP to ensure proper acquisition.
Message 1037:	DSP send word failed. The TCP sent a word to the DSP which it did not acknowledge as received. The TCP will restart the DSP to ensure proper acquisition.
Message 1038:	DSP read word not ready. The TCP tried to read a word from the DSP but it was not ready to send one. The TCP will restart the DSP to ensure proper acquisition.
Message 1040:	DSP startup failure. The TCP failed to download the runtime code to the DSP.
Message 1053:	Config failed to save. The configuration failed to save. The TCP is continuing to run with its current configuration.
Message 1065:	Mem bank invalid m of n A memory check detected an error in memory bank m. The memory was configured to use n memory banks.
Message 1067:	DSP invalid bundle xxxx. The TCP received an invalid bundle from the DSP. The TCP is ignoring this bundle and is allowing the DSP to continue to digitize.

### Fatal Error Messages

Message 40:	Out Of Memory The AUX is about to shut down because it has no memory remaining.
Message 41:	No Stack The AUX is about to shut down to avoid a stack overflow.
Message 42:	AUX crash, need scandisk The AUX was shut down or powered off improperly the last time it was running, so files may have been left in an undefined state. Scandisk needs to be run to reset the disk. Note that scandisk should be run by the ORION.BAT file when this situation is detected, therefore, the presence of this message may indicate that the ORION.BAT file has been altered.
Message 43:	AUX crash, did scandisk The AUX was shut down or powered off improperly the last time it was running so files may have been left in an undefined state. Scandisk was run by the ORION.BAT batch file.
Message 47:	Comm Tx Failure The AUX was unable to transmit messages to the TCP. This indicates a hardware failure (no SCC clock).
Message 1029:	TCP: AUX time out.

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- The AUX is not communicating with the TCP. This results in the TCP cycling power to the AUX. If the communications problem repeats, the TCP will also reboot itself.
- Message 1048: DSP time out, restarting  
The DSP has not sent a valid message to the TCP in over 2 s. The DSP will be restarted.
- Message 1051: Mem corrupt in ffff.  
A memory buffer corruption was detected in function ffff. The TCP is rebooting.
- Message 1059: Mem pointer invalid, xxxxxx.  
The TCP detected the invalid pointer xxxxxx in the memory buffer.
- Message 1084: Main loop stopped, rebooting.  
The TCP detected that the main processing loop is no longer running. It is rebooting to recover.
- Message 1091: Invalid state in ffff ISR.  
The TCP detected an invalid state in the ffff interrupt service routine. It is rebooting to recover.
- Message 1092: HRD transmitter dead.  
The TCP detected it is not transmitting the HRD data. It is rebooting to recover.

The TCP may also report any message as a Fatal Message if on startup it finds an invalid memory buffer but a valid message. This message is sent as a Fatal Message to possibly help explain why it rebooted.

### Verbose Trace (Debug) Messages

- Message 75: CoreLeft(n)=nnnn  
The AUX processor has nnnn bytes remaining on the heap at checkpoint n.
- Message 119: Starting X N seq nnnn  
The AUX is starting to process data packet nnnn on channel N.
- Message 120: Finished X N seq nnnn  
The AUX has finished processing data packet nnnn on channel N.
- Message 121: Starting SOH seq nnnn  
The AUX is starting to process SOH data packet nnnn.
- Message 122: Finished SOH seq nnnn  
The AUX has finished processing SOH data packet nnnn.
- Message 1058: TCP got AUX msg xxx.  
The TCP received the message xxx from the AUX.
- Message 1063: Event started n trigs, m.  
The event detector has declared the start of an event with n triggers; m is a bitmask indicating which triggers were on at the time.
- Message 1064: Event ended n trigs, m.  
The event detector has declared the end of an event with n triggers; m is a bitmask indicating which triggers were on at the time.

### Appendix G - Upgrading Orion firmware using ZOC

*The following is also applicable for upgrading the HRD firmware in an Orion.*

*Remove the disk cartridge from the Orion prior to upgrading its firmware.*

#### Install ZOC on PC

1. Insert the appropriate ZOC installation diskette (**ZOC for OS/2** or **ZOC for Windows**) into the floppy drive of the PC.
2. Open a command prompt window.
3. Change the working directory to the floppy drive by typing **a:** at the command prompt and pressing **Enter**. (assuming A: is the floppy drive)
4. At the command prompt type **install** (if OS/2) or **setup** (if Windows) and press **Enter**.
5. If the "Destination path" box is empty, type **c:\zoc** (or a suitable alternative) in the box.
6. Press the ZOC **Install** button to start the installation.
7. When notified "All files processed - installation complete", press the **OK** button.
8. When asked "Do you want to read ZOC's DOC files now?", press the **No** button.
9. To close the command prompt window, type **exit** and press **Enter**.
10. Remove the ZOC installation diskette from the floppy drive of the PC and save it in a safe place.

#### Configure ZOC

1. Start **ZOC** by double clicking on the icon created on the OS/2 desktop or from the entry in the Windows Start button menu.
2. If notified "No CTS signal from COM1", press the **Abort** button.
3. If a "License Agreement" window is displayed, press the **Agree** button.
4. If notified "New month -- do you want a phone cost report?", press the **No** button.
5. If a "Getting Started" help window is displayed, double click on the button at the top left of the help window to close it.
6. Select the **Options** item from the menu bar.
7. Select the **Settings...** item from the Options drop down menu.
8. Check that the I/O Device is set to **Serial/Modem**.
9. Check that the **Com-Port** is set to the PC com port to which the Orion configuration port is connected.
10. Check that the Com-Port baud is set to **9600**. (The Orion's are shipped with the configuration port set to 9600 baud. However, it may have been changed since then.)
11. Check that the Com-Port is set to **8N1**. (8 bits data, no parity, 1 stop bit is the only option for the configuration port.)
12. Deselect the Com-Port **Valid CD signal** handshaking option. The other handshaking options should already be deselected. (The Orion configuration port does not have any of the modem control signals used for handshaking.)
13. Press the **Transfer** tab at the right (if OS/2) or at the top (if Windows) of the "Options Settings".
14. Select the **Compuserve-B+** Protocol.

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15. Select both the **Disable ENQ** and the **Disable ENQ message** Compuserve-B+ options. This will prevent ZOC from hanging on binary data.
16. Select the **Zmodem** Protocol.
17. If OS/2, press the right arrow button at the bottom right to go to **[Page 2 of 2]** of the transfer options, otherwise if Windows, press the **Transfer-2** tab.
18. Change the ASCII-/Clipboard Sending option **Char delay** to **0**. This will make ASCII uploads MUCH faster.
19. Press the **Safety** tab.
20. Deselect the **... ending program** Confirm ... option.
21. Deselect the **Warning for high speed without RTS/CTS** Miscellaneous option.
22. If a "Getting Started" help window was displayed on startup press the Window tab and deselect the **Initial help window** Screen Elements option.
23. Press the **Save** button at the top of the "Options Settings" window.
24. Close **ZOC** by double clicking on the button at the top left of the ZOC window.

### Copy ORION firmware to PC's hard drive

*Note: the new Orion firmware must be copied to the PC's hard drive since uploading firmware from a floppy drive is not reliable. (A network drive is possible but a local drive is preferable.)*

1. Insert the Orion Release diskette into the floppy drive of the PC.
2. The Orion Release diskette contains 7 files.
3. The file DSPDIAGS.HEX contains a diagnostics program which the DSP runs on startup to do basic hardware checks.
4. The file DSPLOAD.HEX contains a utility program used to transfer the main DSP program into the DSP memory.
5. The file FIRS.HEX contains the FIR filter coefficients used by the DSP.
6. The file DSPxx.HEX contains the main DSP firmware (xx indicates the version number) for the digitizer.
7. The file TCPyyy.HEX contains the main TCP firmware (yyy indicates the version number) for the digitizer.
8. The file HRDzz.HEX contains the previous 5 files released in one file (zz indicates the release number) for uploading into HRDs.
9. The file HRDzz.BIN contains the binary image of the file HRDzz.HEX used for burning into flashes.
10. Open a command prompt window.
11. Change the working directory to **c:\zoc\upload** (assuming ZOC was installed in c:\zoc), at the command prompt type **cd \zoc\upload** and press **Enter**. This directory is chosen to make the ASCII uploads easier, however any directory may be chosen.
12. Copy the new Orion firmware release from the floppy, at the command prompt type **copy a:\orion\*.hex** and press **Enter**.
13. Close the command prompt window.
14. Remove the Orion Release diskette from the floppy drive of the PC and save it in a safe place.

### Accessing the Orion setup menu

1. Start **ZOC**.

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2. Power on the Orion.
3. The Orion will start up with lines similar to the following:  
**TCP Version 5.12, released Mar 17 1997 16:36:40**  
**Press 'M' key within 5 seconds or during memory test**
4. Immediately press the **M** key to access the Orion menu. (There will be at least a 5 second window to press the M key, longer if there is a lot of memory to test.)
5. After a power on the memory test will end with the following lines. (the number of memory banks depends on the Orion)  
**Writing 5555 to 8 banks.....**  
**Checking for 5555, writing aaaa to 8 banks.....**  
**Checking for aaaa, writing 0000 to 8 banks.....**
6. If the Orion has proceeded past the memory test, the menu will still be displayed and the configuration may be changed however it is **UNSAFE** to do a firmware upload. The Orion firmware may be severely corrupted (possibly unrecoverable).
7. If intending to upload new firmware, and the Orion has proceeded past the memory test or unsure if it has, power it off and start again.

### Upload new firmware

1. Access the Orion setup menu as outlined above.
2. Double check that the Orion did not proceed past the memory test.
3. Press the **U** key to select the "Upload new firmware" option. (On older firmware, press the **D** key to select the "Download New Firmware" option.)
4. The Orion will respond with "Ready to Upload..."
5. Select the **Transfer** item from the menu bar.
6. Select the **ASCII-Send...** item from the Transfer drop down menu.
7. Use the **Select ASCII Upload File** dialog box to select the file containing the new Orion firmware release. Change the Drive and Directory as necessary if the firmware was not copied to the c:\zoc\upload directory.
8. Press the **OK** button to start the upload.
9. Do not touch the Orion or the PC while the upload is in progress, this will take almost 8 minutes.
10. When it has finished the Orion will automatically program the new firmware and reboot.
11. The Orion will start up with a line indicating the new version number and release date.

### Uploading at faster than 9600 baud

*Note: 9600 baud is the fastest baud rate that is reliable on all machines. However PCs with buffered com ports (have a 16550 compatible UART) or fast 486's and pentiums should upload reliably at 38400.*

Uploading at 19200 reduces the upload time from 8 to 4 minutes, while uploading at 38400 reduces it to 2 minutes.

1. Access the Orion setup menu as outlined above.
2. Press the **C** key to select the "Configuration menu" option.
3. Press the **H** key to select the "Edit hardware setup parameters" option. (On older firmware press the **G** key to select the "Edit data communications parameters" option.)
4. Press the **B** key to change the "Configuration baud rate" setting.

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5. Type the desired new baud rate and press **Enter**.
6. Check that the baud rate has been changed.
7. Press the **Esc** key twice to return to the main Orion setup menu.
8. Press the **P** key to select the "Program user settings" option.
9. Power off the Orion.
10. Press the button labeled 9600-8N1 at the bottom left corner of ZOC.
11. Change the Com-Port baud to the new baud rate set in the Orion.
12. Press the **Save** button.

### Creating a button for uploading firmware

*Note: this feature is only available on ZOC for OS/2.*

This feature is of most use when the file to upload is not in the c:\zoc\upload directory and requires a lot of drive and directory changing to find it using the **Select ASCII Upload File** dialog box.

1. Start **ZOC**.
2. Open the **Options Settings** window.
3. Press the **Buttons** tab.
4. Find the first line with nothing under the "Value" heading.
5. Under the "Value" heading type **^XFER=type c:\zoc\upload\hrdzz.hex 1>&%ZOCHFC% -r**. The file indicated should contain the new Orion firmware release.
6. Under the "Button Text" heading type **HRDzz** (replace zz with the appropriate release number).
7. Press the **Save** button.
8. A button should have been created with the label HRDzz at the top of the ZOC window.
9. Pressing this button is equivalent to selecting the same file using the **Select ASCII Upload File** dialog box (except no **Bytes sent** status).
10. With the Orion **off**, test the button created by pressing it.
11. A window labeled "ZOC Shell Window" should pop up with the name of the file being uploaded.
12. Double click on the button at the top left of this window to close it. Otherwise it will automatically close several minutes later when the entire file has been uploaded.
13. Close **ZOC**.

## Appendix H - Hardware Menus

### Orion / HRD Setup Menu, Version 5.20

- C: Configuration menu
- P: Program user settings
- V: View user settings
- R: Restart and run with saved settings

**Menu Option:**

HRD Configuration Menu

- H: Edit hardware setup parameters
- I: Edit input sensitivity & impedance parameters
- G: Edit GPS power cycling parameters
- S: Edit SOH calibration parameters
- L: Edit log settings parameters
- D: Edit digitizer parameters
- P: Edit data port parameters
- O: Edit Orion specific parameters
- X: Edit temperature coefficients

**Menu Option:**

Hardware Setup Menu

- S: Serial number: 000154
- C: Number of channels: 3
- M: Number of memory banks: 8
- P: PIC version number: 2
- B: Configuration baud rate: 38400

**Menu Option:**

Input Sensitivity & Impedance Menu

		sensitivity (nV/bit)	impedance (ohms)
1:	Channel 1:	9.890	1270.000
2:	Channel 2:	9.920	1820.000
3:	Channel 3:	1.000	1.000
4:	Channel 4:	1.000	1.000
5:	Channel 5:	1.000	1.000
6:	Channel 6:	1.000	1.000
A:	Channels 1 - 3		
B:	Channels 4 - 6		
C:	Channels 1 - 6		

**Menu Option:**

GPS Power Cycling Menu

- C: Enable power cycling: 1
- I: Power interval (min): 30
- D: Maximum power duration (min): 10

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### Menu Option:

#### SOH Calibration Menu

		Units/Volt	Units Offset
A:	Fast SOH 1:	1.000	0.000
B:	Fast SOH 2:	1.000	0.000
C:	Fast SOH 3:	1.000	0.000
1:	Slow SOH 1:	1.000	0.000
2:	Slow SOH 2:	1.000	0.000
3:	Slow SOH 3:	1.000	0.000
F:	Fast SOH 1 - 3		
S:	Slow SOH 1 - 3		

### Menu Option:

#### Log Settings Menu

V:	Verbosity:	30
F:	Fast SOH interval (sec):	60
S:	Slow SOH interval (sec):	60
G:	GPS interval (sec):	60

### Menu Option:

#### Digitizer Menu

C:	Number of channels:	3
S:	Sample rate:	100
D:	DC removal enabled:	1
F:	DC removal frequency (mHz):	100

### Menu Option:

#### Data Port Menu

B:	Tx & Rx baud rate:	9600	9600
N:	Bundles per packet:	59	
R:	Enable radio mode:	0	
X:	Enable re-tx requests:	0	
2:	Enable tx twice:	0	
D:	Tx twice delay (sec):	60	

### Menu Option:

#### Orion Specific Menu

O:	Enable Orion Mode	1		
M:	Disk heat mode:	3		
H:	Minutes of heat per degree:	8		
R:	Safe disk temperature range (C):	5	50	
V:	Battery voltage levels:	12.250	11.5000	10.900

### Menu Option:

#### Temperature Coefficients Menu

U:	Upload new coefficients
I:	Initialize coefficients
C:	Check coefficient checksum
V:	View coefficients

## Appendix I - Orion: Supported Sample Rates

The following is a table of the sample rate / trigger combinations supported in release 4.5 of the Orion. The Orion user interface only permits configuration within the operating envelope.

cause the DSP to malfunction - causing short (10 ms) time tears once per second.

Also, the Tcp-Aux download is unable to keep up with the highest rates (5 or 6 channels at 1000 sps).

The tests were run under reasonably representative conditions - noise (byte diffs) on channels 1 and 2, and sensor input (word diffs) on channels 3 to 6. However, the Tcp-Aux download may be unable to keep up running near the operating boundary

<b>Sample Rate</b>				
<b># of Channels</b>	<b>10 - 200</b>	<b>250</b>	<b>500</b>	<b>1,000</b>
<b>1</b>	Unrestricted	Unrestricted	Unrestricted	Unrestricted
<b>2</b>	Unrestricted	Unrestricted	Unrestricted	Max 3 triggers
<b>3</b>	Unrestricted	Unrestricted	Unrestricted	Max 3 triggers
<b>4</b>	Unrestricted	Unrestricted	Unrestricted	Max 1 trigger
<b>5</b>	Unrestricted	Unrestricted	Max 3 triggers	Not supported
<b>6</b>	Unrestricted	Max 3 triggers	No triggers	Not supported

Higher sample rates (or more triggers) with prolonged high-amplitude inputs.

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## Appendix J - Frequently Asked Questions

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### Question: Where are the fast state-of-health inputs (FES) on the Orion?

The fast SOH signals are typically used for mass position, so fast soh1 comes out on mass pos 1 (pin 7), soh2 on mass pos 2 (pin11), soh3 on mass pos 3 (pin12) on the lemo connectors. In order to use the fast soh signals the jumper on the mem/cal board must be set to measure the mass position:

- for mass position 1: set jumper J4 to connect pins 1 and 2
- for mass position 2: set jumper J2A to connect pins 1 and 2
- for mass position 3: set jumper J2B to connect pins 4 and 5

*Note: the mem/cal card has all the memory chips on it with calibration at the end of the card. That is where you will find the jumpers.*

---

### Question: How does the GPS duty cycling work?

Here's how the duty cycling works. At the end of a duty cycle, the GPS is turned on. The system then waits for the GPS to lock. The moment the GPS is locked the Orion records the time difference between the GPS time and Orion time. That time difference is recorded in the GTQ soh. Next the Orion phase locks to the GPS time. Over the next 30-90 seconds the phase error (time difference) and frequency error are corrected using a PLL algorithm. Once the phase and frequency error are zero, the GPS is shut off.

During the time the GPS is on, the GPS is correcting its own frequency error to +/- 1 microsecond. But if the GPS does a poor job of correcting a frequency error, it may be off by 2 microseconds. It is this frequency error that causes the large time drifts.

---

### Question: How much will the clock drift while the GPS is off?

The oscillator spec is .4 ppm and the system accuracy is typically 1ms. Assuming that the GPS is duty cycled every 30 minutes. The drift over 30 minutes would be  $.4\text{ppm} \times 30\text{ min.} \times 60\text{ secs.} = 720\text{ microseconds}$ . Typically, we have seen drifts of +/- 250 microseconds (or .14 ppm) 90% of the time and a worst case of 720 microseconds.

---

### Question: Is the time that appears on the display the same as the true GPS time?

During the huddle test, the clock display would sometimes stop and then jump 2 seconds on each of the recorders (though not at the same time), even though the receiver claimed to be in finelock mode. However upon playback, the data timing appears to exactly match an existing seismograph we used for comparison.

In the field, at several sites the display clock appeared to sometimes be up to 1.5 seconds different from a watch set to UTC. We aren't positive our watch was set correctly but the same problem occurred on different days with different watch settings.

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Yes. The clock display will appear a few seconds different from a UTC reference. This is because the LCD is only updated once per second and the screen update routine is a very low priority task (data and timing tasks take priority!). So there can be up to 2 seconds difference.

---

### Question: How do we change the instrument sensitivity menu values?

The channel sensitivity menu reads as follows:

nV/bit	units/bit
802.2	8.02e-07
802.2	8.02e-07
802.2	8.02e-07

It is a software parameter for information purposes and is not used for data calculations, so it is not that critical. But it is easy to change. In the Orion manual there is a procedure for updating the firmware. Follow steps 2-10. Then goto the configuration parameters menu (press C) and select the sensitivity parameter menu (press I), and enter the changes. After setting it, drop back to the main menu (press esc), and select program settings (press p) and lastly run with changes (press R). There are other

menu items in these menus be VERY CAREFUL not to change any of the other parameters, because bad parameters can cause the Orion NOT TO WORK correctly.

---

### Question: How does the timing on the Orion work?

Once the Orion has satisfied itself that the GPS engine is reporting a consistent and reliable time, the Orion looks at the difference in time between the Orion and the GPS clock. If this time error is greater 4 milliseconds, the Orion zaps its own internal time to the GPS time. This results in a time tear in the data and is reported in the log files and also shows up as a gap when you extract the data. If the time error is less than 4 ms, the Orion will phase lock to the GPS time over a few minutes. This results in no time tears in the data. While the GPS engine is on and locked, the Orion will remain phase locked to the GPS engine.

The sampling instant on the Orion is synchronized to UTC. The Orion achieves this by running all the electronics including ADC's off one digitally compensated crystal oscillator which is phase locked GPS.

The Orion can run the GPS in two modes: continuous and duty cycled

#### Continuous Mode

The Orion can achieve microsecond (< 10 us typically) accuracy in this mode. The accuracy is limited by the GPS since the Orion is continuously phase locked to the GPS.

#### Duty Cycled Mode

The GPS is turned on periodically (every 30 minutes for example) and the Orion phase locks to the GPS for a few minutes. The accuracy here is limited to the drift of the Orion crystal while the GPS is off. The Orion specification for the crystal is 1 ppm. But typically we are seeing .2 ppm. We achieve this by using digital temperature compensation of the crystal.

You can verify the timing quality of the Orion by looking at two SOH files: the VCXO calibration data SOH file (.VCX), and the GPS time quality SOH file (.GTQ). In the GTQ file, there is a parameter, VCXO error, which is a calculation of the VCXO drift in ppm over the last duty cycle. In continuous mode, the VCX file shows what our timing algorithm is doing. From these two SOH files, you can determine at any time, the quality of the timing of the data. For a description of these SOH files see the Appendix in the Orion manual.

---

### Question: How does the channel sensitivity work?

On the front end of the ADC there are two resistors that are used to set the damping and gain. The damping resistor is used to match the impedance of a passive sensor. The gain resistor is used to match the sensitivity of the sensor and produce a desired overall system gain. For example, if the ADC sensitivity is set to 399 nV/bit (resistors of xxx ohms were used) nominally. On the Orions, the actual sensitivity could be 400.9, 401.6, 400.9 for each channel respectively. On the firmware download port, we set the nV/bit to 399nV/bit for each channel. So, the nominal value is used here, which is partially why we say "approximately" in the manual. So, the impedance and nV/bit values in the Channel Sensitivity menu are derived from the ADC front end resistors. We have chosen to use nominal values.

The overall system gain is calculated using the following formula:

$$\begin{aligned}\text{System Gain} &= \text{ADC gain (nV/bit)} / \text{Sensor Sensitivity (V/m/s)} \\ \text{System Gain} &= \text{xxx m/s /bit}\end{aligned}$$

So, the next item to consider is the sensor. A sensor has a nominal sensitivity and an actual sensitivity. Some sensors measure velocity, others acceleration. In the "Sensor Information" menu you can setup both these values. Once these values are set correctly, the system gain will be correct. The system gain is displayed in the "Channel sensitivity" menu under the units/bit column and in the "Sensor Information" menu as "System Sens.".

Check the as-shipped sheets for the sensors for sensitivity information. Generally, sensors are not as consistent in their sensitivity as the ADC and typically nominal values are used

So, you will have to set up the fields in the "Sensor Information" field to get the correct nominal sensitivity.

Now having said all that, the information above is for your information only and is not transferred into the X5 files. There is a good reason for this. Generally, people use response files. The response file contains the system sensitivity along with the frequency response (poles and zeroes of the sensor, ADC, and the software filters) and many other parameters. SEED volumes use response files. The generation of the response file is usually done when the data is processed and turned into SEED volumes. You can use an individual response file for each instrument (time consuming) or use a nominal response file for the network.

---

### Question: How do I supply power to a CMG40 sensor?

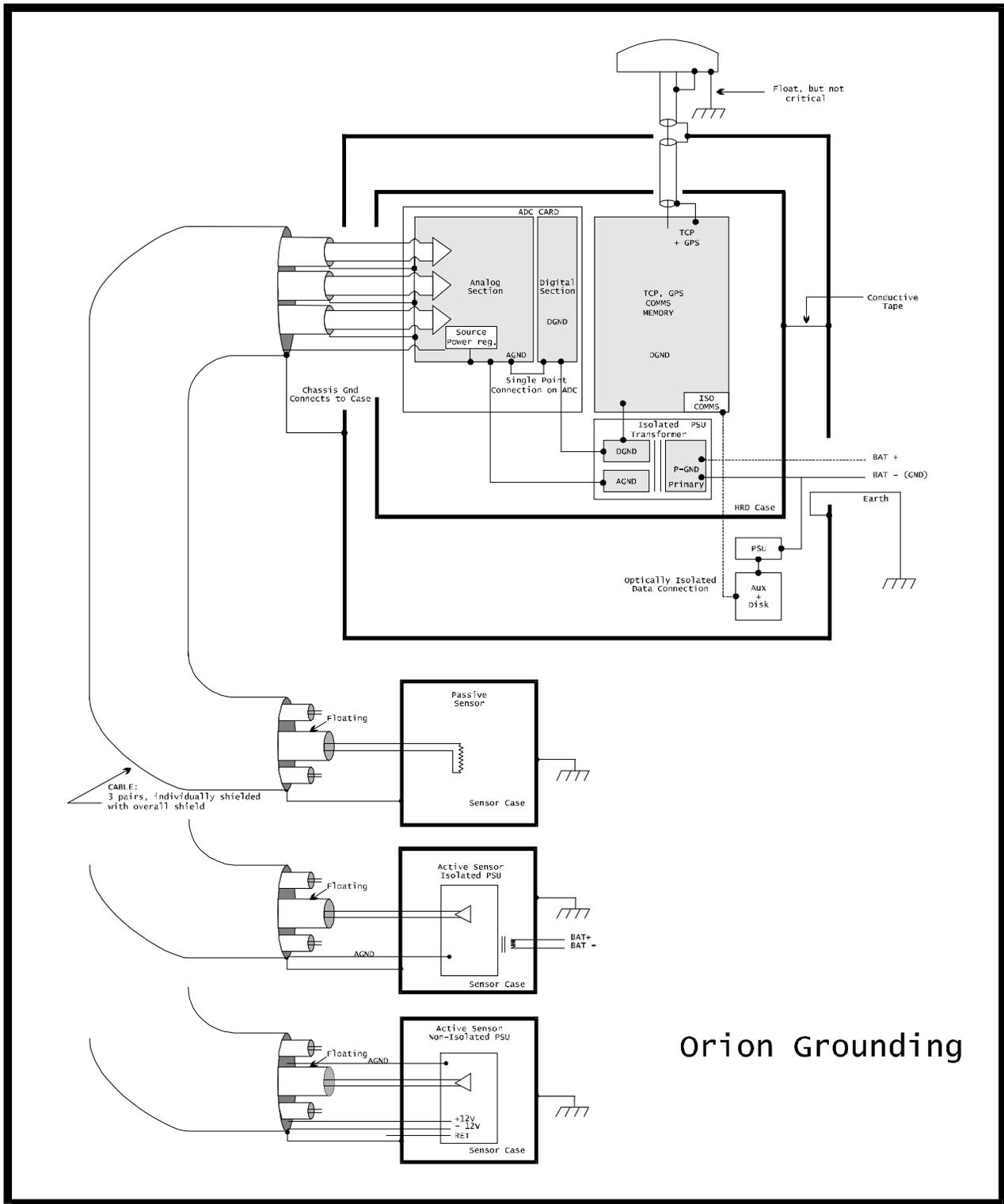
There is sufficient power on the sensor power connections to drive a CMG40. Below are the pinouts:

- on pin 15 Sensor power +12V nom supplies 48mA at 12V
- on pin 17 Sensor power -12V nom supplies 48mA at -11.3V
- on pin 13 there is Sensor GND

There is a wiring diagram on how to wire up a CMG40 elsewhere in the manual

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# Appendix K - Orion Grounding Scheme



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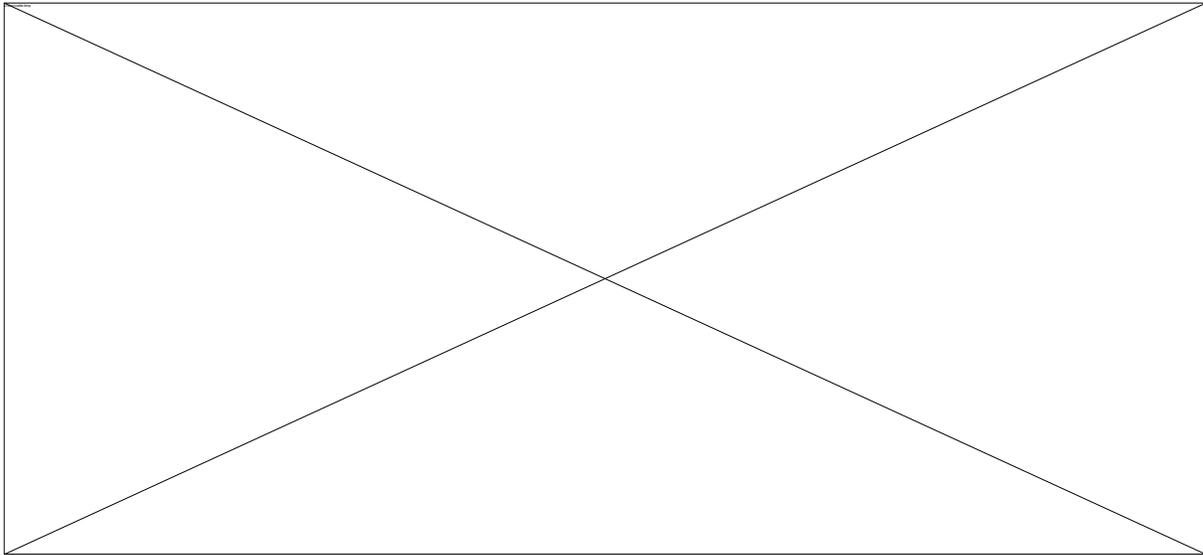
## Appendix L - Orion Communications Test Cable Assembly

### Assembly Instructions

1. Terminate and assemble P1 first. Place heatshrink over all solder connections.
2. Remove 3 feet of jacket from free end of cable.
3. Separate wire bundles for each connector and place heatshrink every 6" on wire bundles. Cut back unused wires (3) to jacket.
4. Place heatshrink over all soldered connections.
5. For P5 and P6; RED wire is pin 1 and BLK wire is pin 2. The black wire from P5 and P6 is connected to the ORG/RED wire of W1.

FROM		TO		WIRE					SIGNAL NAME
CONN	PIN	CONN.	PIN	PART	COL.	AW	TYPE	LEN	
P1	1	P2	1	W1	BLK	24	9543	7'	MODEM-DCD
P1	2	P2	2	W1	WHT	24	9543	7'	MODEM-RX
P1	3	P2	3	W1	RED	24	9543	7'	MODEM-TX
P1	4	P2	4	W1	GRN	24	9543	7'	MODEM-DTR
P1	5	P4	5	W1	ORG	24	9543	7'	HRD-DATA-GND
P1	5	P2	5	W1	ORG/BLK	24	9543	7'	MODEM-GND
P1	5	P5,P6	2	W1	ORG/RED	24	9543	7'	EVENT-GND
P1	6	P2	6	W1	BLU	24	9543	7'	MODEM-DSR
P1	7	P2	7	W1	WHT/BLK	24	9543	7'	MODEM-RTS
P1	8	P2	8	W1	RED/BLK	24	9543	7'	MODEM-CTS
P1	9	P2	9	W1	GRN/BLK	24	9543	7'	MODEM-RI
P1	10	P3	2	W1	BLU/BLK	24	9543	7'	DEBUG-TX
P1	11	P3	5	W1	BLK/WHT	24	9543	7'	DEBUG-GND
P1	11	P8	1	W1	BLK/RED	24	9543	7'	SOH-GND
P1	12	P3	3	W1	RED/WHT	24	9543	7'	DEBUG-RX
P1	13	P5	1	W1	GRN/WHT	24	9543	7'	EVENT-IN
P1	14	P6	1	W1	BLU/WHT	24	9543	7'	EVENT-OUT
P1	15	P7	1	W1	WHT/RED	24	9543	7'	SOH1
P1	16	P7	1	W1	RED/GRN	24	9543	7'	SOH2
P1	17	P7	1	W1	ORG/GRN	24	9543	7'	SOH3
P1	18	P4	3	W1	BLK/WHT/RE	24	9543	7'	HRD-RX
P1	19	P4	2	W1	WHT/BLK/RE	24	9543	7'	HRD-TX

## Appendix L



<b>Revision:</b>	C
<b>FileName:</b>	11038C.xls
<b>Title:</b>	Comms Test Cable Parts List

Description	Vendor	Part Number	Qty.
Straight Plug, Shell 14, 19S, pressure gland with clamp	SOURIAU	851-06JC14-19S-N50	1
D-sub 9-pin female	AMP	DE09-S	2
Backshell, 9 pin	Amphenol	17D-09HV	3
D-sub 9-pin male	AMP	DE09-P	1
Cable, 25 cond., shielded, 24 AWG	Belden	9543	84
Connector, BNC, Female	Pomona	3788	2
Jack, Banana, Red	Johnson	108-0302-001	1
Jack, Banana, Black	Johnson	108-0303-001	1

### Appendix M - Orion Releases

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#### Orion Release 6.3 - Release Date : November 4/99

- } Aux: 4.23 -> 4.26
- } TCP: 5.23 (unchanged)
- } DSP: 4.0 (unchanged)
- 1. Changed ELF module so that file is opened only to write a record, then closed. In previous versions, if a dialup user deleted the ELF, then it would not be recreated until the next Aux bootup, so some events could be lost.
- 2. Changed the naming convention for mini-ringbuffers created by dialup extract.
- 3. Extracted files are now named RnnnnCm.xxx,  
where nnnn is the Orion serial number,  
m is the channel (1-6), and  
xxx is a 3-digit number which is incremented after each extract.  
This allows the user to extract multiple events without name conflicts.
- 4. The minimum and maximum signal amplitude are (optionally) displayed on the waveform screen. These are reset each time a new plot is started.
- 5. Fixed: calculation of FIR filter delay, use filter order -1 instead of filter order.
- 6. Fixed: reset the channel assignments to default when changing the IIR filter enable switch.
- 7. Changed: require GPS engine to be in 3D Nav to do a clock zap.
- 8. Changed: calibration so that during the first and last 1/6 of the duration the calibration output is scaled by a sine squared ramp.
- 9. Changed: serial number to instrument ID which consists of the serial number and the model number.
- 10. Added: option for using GPS baud rate of 9600,8,o,1 instead of 4800,8,n,1.

---

#### Orion Release 6.2 - Release Date : August 20/99

- } Aux: 4.28 -> 4.29
- } TCP: 5.26 (unchanged)
- } DSP: 4.0 (unchanged)
- 1. Added a 500 ms delay before downloading config to TCP to minimize interference from dialup comms.

## Appendix M

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### Release 6.1 - Release Date : July 02/99

- } Aux: 4.28 (unchanged)
- } TCP: 5.23 -> 5.26
- } DSP: 4.0 (unchanged)

1. Changed: the amount of time the processor waits for the flash programming voltage to appear from 80ms to 160ms.
2. Changed: software watchdog timeout on main loop from 1 minute to 2 minutes since it takes longer to boot up with more memory banks (up to 52).
3. Fixed: default channel orientations.

---

### Orion Release 6.0 - Release Date : August 10/98

- } Aux: 4.23 -> 4.26
- } TCP: 5.23 (unchanged)
- } DSP: 4.0 (unchanged)

1. Added remote dialup support

---

### Orion Release 5.4 - Release Date : May 08/98

- } Aux: 4.23 -> 4.24
- } TCP: 5.20 -> 5.23
- } DSP: 4.0 (unchanged)

1. Added: "Load From Disk" now loads Orion000.dsk if serial-number encoded OrionNNN.dsk file is not found.
2. Aux allows maximum ringbuffer size of upto 2.0GB, from 1.2GB.
3. Added: support for remote dialup port
4. Added: new 120 samples/second sample rate.
5. Fixed: default channel orientations.
6. Fixed: removed rounding of sample times, added 5/30k sample delay.
7. Fixed: when entering GPS rx dead state, set pll to unlocked state.
8. Fixed: display the correct LED colour when running from internal batteries.
9. Fixed: other minor bug fixes

## Appendix M

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### Orion Release 5.3 - Release Date : November 18/97

- } Aux: 4.22 -> 4.23
- } TCP: 5.15 -> 5.20
- } DSP: 4.0 (unchanged)

1. Added: support for 25 samples / second.
2. Added: support for detecting AUX modem RI signal and booting AUX.
3. Fixed: other minor bug fixes

---

### Orion Release 5.2 - Release Date: May 13/97

- } Aux: 4.22 (unchanged)
- } TCP: 5.13 -> 5.15
- } DSP: 4.0 (unchanged)

1. minor TCP bug fixes.
2. Fixed: disable GPS checksum error warnings on GPS power on or off.
3. When the GPS is turned on, set the GPS LED to red, don't wait to detect lost lock.

---

### Orion Release 5.1 - Release Date: Apr 4/97

- } Aux: 4.22 (unchanged)
- } TCP: 5.12 -> 5.13
- } DSP: 4.0 (unchanged)

1. Minor TCP bug fixes.

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## **Appendix N - Lid Diagrams**

See following pages

## Appendix N

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# Appendix O - Configuration and SOH Description Sheets

### Configuration Worksheet

This page contains all the settable parameters within an Orion. It includes the range, type and format of all the parameters. Use it as a worksheet to layout a new Orion configuration.

### State-Of-Health Files Description Sheet

This sheet contains a description of all of the fields in each of the state-of-health files. For each field the name of field is given, the units of the field, the type of the field, and a description. If the field is an enumerated type, a description of all the values is given. Note that the time is given in two formats:

1. Seconds
2. Date-time

The seconds format is the count of seconds since Jan 1, 1970 at 00:00:00. The value is stored in a long (32bit) integer format. The Date-time format is:

YYYY-MM-DD HH:MM:SS

Both formats are included in the state-of-health files to give flexibility. When viewing the data manually, it is easier to use the date-time format (i.e.), and when processing the data with spreadsheets it can be easier to use the seconds format

# Appendix O

Orion Configuration Sheet			
Orion Serial Number:		Configuration Name:	
Orion Data Cartridge Serial Number:		Author:	
Configuration File Name:		Date:	

Recording Modes / Digitizer Configuration			
Recording Modes	Recording Mode (Event / Continuous / Scheduled):		
	Num Schedules (1-10):		
Digitizer Settings	Num Channels (0-3 or 0-6):		
	Sample Rate (10, 20, 25, 40, 50, 80, 100, 125, 200, 250, 500, 1000 s/s): Note:high sample rates have limitations! read manual!		
bits Offset		DC Removal Filter Freq (1, 2, 5, 10, 20, 50, 100, 200, 500, 1000 mHz):	
0.00	1		

Recording Schedule					
	Recording Mode	Start Time	Duration	Repeat	Repeat Interval
#	Continuous / Event	YYYY-MM-DD HH:MM:SS.S	xxd xxh xxm xxs	0-65000, int	xxd xxh xxm xxs
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

Trigger Setup						
	1	2	3	4	5	6
Input Channel (off, 1-6):						
Trigger Algorithm Type (stalta,thres):						
Trigger Level / Ratio(unsigned long):						
Trigger Report Delay(0-10.0 secs, float):						
Threshold Detrigger Time(0-999 secs, float):						
Sta Time Constant (0-10.0 secs, float):						
Lta Time Constant (0-999 secs, float):						
High Pass Order (0-5, sum HP+LP <=5):						
Low Pass Order (0-5, sum HP+LP <= 5):						
High Pass Corner (0-500 Hz, float):						
Low Pass Corner (0-500 Hz, float):						

Event Detection			
Max Duration(0-3600 secs, int):		Trigger Coincidence Window(0-60 secs, float):	
Number of triggers for event declaration(1-6):		Number of triggers to continue event(1-6):	
Pre-event Recording(0-99 secs, int):		Post-event Recording(0-200 secs, int):	
Log Settings			
Log Verbosity (Debug / Normal):		MinMax Interval (1, 2, 5, 10, 20, 60, 120, 300, 600secs):	
Min-Max Channel 1 (off, triggers 1-6)*:		GPS Interval (1, 2, 5, 10, 20, 60, 120, 300, 600 secs):	
Min-Max Channel 2 (off, triggers 1-6)*:		FastSoh Interval (1, 2, 5, 10, 20, 60, 120, 300, 600 secs):	
*note:trigger must be on		SlowSoh Interval (8, 10, 20, 60, 120, 300, 600 secs):	

## Appendix O

File Settings						
Data Buffer Type (ringbuffer / single write):		Data Buffer Size*(0-1200 Mbytes, int):				
SOH Buffer Type (ringbuffer/ single write):		SOH Buffer Size(0-1200 Mbytes, int):				
Auto size buffers (On / Off):		*note: data buffer size for all channels				
Channel Setup						
	1	2	3	4	5	6
Channel Setup						
Filter DC (Yes / No):						
Site Index (1-6):						
Sensor						
Type (7 chars):						
Serial Number (7 chars):						
Component(N, E, Z, X, Y, V, 1-6):						
Sensitivity (float):						
Sensitivity Units (m/s, m/s/s, g, udu):						
Orientation						
Name (3 chars):						
Azimuth (-180 to 180 degs, float):						
Dip (-90 to 90 degs, float):						
Site Name and Location						
Site Index	1	2	3	4	5	6
Name (2 chars):						
Latitude (-90 to 90 degs, float):						
Longitude (-180 to 180 degs, float):						
Elevation (-999 to 9999 m, float):						
Station Name and Location						
Latitude (-90 to 90 degs, float):			Station Name (5 chars):			
Longitude (-180 to 180 degs, float):			Comments (15 chars):			
Elevation (-999 to 9999 m, float):						
Instrument Setup						
		Backlight (On / Off):				
Contrast (1-100 in steps of 5):		User Timeout(1, 2, 5, 10, 20, 60 mins):				
GPS Parameters						
Tracking Mode (single sat/2D/3d):		Duty Cycle Interval (30, 60, 120mins):				
Power Mode(duty cycled/continuous):		Max. Time GPS on (5, 10, 20 mins):				
Waveform Settings						
Channel (1-6):		Y scale max. (1-1000 counts, int):				
Remove DC (Yes / No):		Y scale multiplier (1, 10, 100, 1e3, 1e4, 1e5, 1e6 counts):				
		Time width (1, 2, 5, 10, 15, 30, 60, 120 secs):				
Startup Options						
		Disk warmup delay (1, 2, 5, 10, 20, 60 mins):				
		Disk Temperature Range (safe / extended/ unlimited):				
External State - of - Health						
Fast SOH			Slow SOH			
	Units/Volt (float)	Units Offset (float)		Unit/Volt (float)	Units Offset (float)	
1			1			
2			2			
3			3			

## Appendix O

<b>Orion State-of-Health Files Description Internal and External SOH</b>				
<b>Fast External State-of-Health ( .FES )</b>				
1	Time	Seconds	long	The UTC Time since 00:00:00, January 1, 1970 that the fast state-of-health is sampled. Note: to convert longseconds to a date in excel use: B2/86400+25569 and change the cell format to date
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Fast SOH1	User defined	float	Fast state-of-health channel 1 (has user programmable offset and units/volt)
4	Fast SOH2	User defined	float	Fast state-of-health channel 2 (has user programmable offset and units/volt)
5	Fast SOH3	User defined	float	Fast state-of-health channel 3 (has user programmable offset and units/volt)
<b>Slow External State-of-Health ( .SES )</b>				
1	Time	Seconds	long	The UTC time since 1970 that the slow state-of-health is sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Slow SOH1	User defined	float	Slow state-of-health channel 1 (has user programmable offset & units/volt)
4	Slow SOH2	User defined	float	Slow state-of-health channel 2 (has user programmable offset & units/volt)
5	Slow SOH3	User defined	float	Slow state-of-health channel 3 (has user programmable offset & units/volt)
<b>Internal Temperature ( .TMP )</b>				
1	Time	Seconds	long	The UTC time since 1970 that the temperatures are sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	User CPU Temp.	deg. Celsius	float	Measures the user CPU temperature
4	VCXO Temp.	deg. Celsius	float	Measures the temperature of the VCXO circuit
5	Disk Temp.	deg. Celsius	float	Measures the temperature of the disk drive inside the data cartridge
<b>Powering Status ( .PWR )</b>				
1	Time	seconds	long	The UTC time since 1970 that the power status parameters are sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Charge Current	Amps	float	The current supplied to the internal battery while charging
4	Digitizer Voltage	Volts	float	The supply voltage measured at the digitizer
5	External Bat. Status	-	int	defined as: 0 -u nknown                    4 -discharged 1 -not present                5 -charging 2 -in use                        6 -shorted cell 3 -ready                         7 -shorted cell in use
6	Internal Bat. Status	-	int	same as 4
7	Mains Status	-	int	same as 4
8	Power Source	-	int	defined as: 1 -mains supply on 2 -external battery on 4 -internal battery on
9	User CPU State	-	int	defined as: 0 -both User-CPU and heater off 1 -User-CPU on, heater off 2 -heater on, User-CPU off
10	Charger State	-	int	defined as: 0 -charger off 1 -low current charge 3 -high current charge
<b>Source Voltages ( .VLT )</b>				
1	Time	seconds	long	The UTC time since 1970 that the source voltages are sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Ext. Bat. Voltage	Volts	float	External battery voltage
4	Int. Bat. Voltage	Volts	float	Internal battery voltage
5	Mains Voltage	Volts	float	Mains voltage

## Appendix O

<b>Orion State-of-Health Files Description GPS and Timing SOH</b>				
<b>VCXO Calibration Data (.VCX)</b>				
1	Time	seconds	long	The UTC time since 1970 that the VCXO calibration data is sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
2	VCXO Value	counts	int	VCXO value in counts
3	Time Diff. At Lock	microseconds	float	Time difference between GPS time and Orion time at point of GPS lock
4	Time Error	microseconds	float	Time error between the GPS and Orion
5	Freq Error	usecs/sec	float	Frequency error between the GPS and Orion
6	VCXO Temperature	counts	int	Temperature of the VCXO circuit in counts
7	PLL Status	-	int	defined as: 1 -Orion PLL fine locked to GPS 2 -Orion PLL coarse locked to GPS 3 -Orion free-running using temp. compensation 4 -Orion free-running using temp. comp. with GPS on
8	GPS Status	-	int	defined as: 0 -3D navigation 1 -2D navigation 2 -Single satellite 3 -Searching for satellites 4 -GPS engine powered off 5 -Error state
<b>GPS Location (.LOC)</b>				
1	Time	seconds	long	The UTC time since 1970 that the location is sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Latitude	degrees	float	GPS calculated latitude
4	Longitude	degrees	float	GPS calculated longitude
5	Elevation	degrees	float	GPS calculated elevation
<b>GPS Channel Status (.GST)</b>				
1	Time	seconds	long	The UTC time since 1970 that the location is sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Navigation Mode	-	int	defined as: 1 -Cold start 2 -Acquisition 3 -2D Navigation 4 -3D Navigation
4	Figure of Merit	-	int	Figure of Merit is based on Horizontal position error (1- best, 9 - unlocked)
5	# of Satellites for Solution	-	int	Number of satellites used in the navigation solution
6	# of tracked Sats.	-	int	The number of satellites the GPS is tracking
7-1	Channel Activity ACT1-ACT5	-	int	defined as: 0 -Idle 1 -Searching for satellite 3 -Tracking a satellite
12-16	SNR1-SNR5	dB	int	signal to noise ratio for each channel (0-63)
17-21	PRN1-PRN5	-	int	PRN code for the satellite being tracked by each channel
<b>GPS Time Quality (.GTQ)</b>				
1	Time	seconds	long	The UTC time since 1970 that the information is sampled
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	GPS on Time	seconds	int	The time interval the GPS was on during this duty cycle
4	GPS off Time	seconds	int	The time interval the GPS was off during this duty cycle
5	GPS Time to Lock	seconds	int	The time interval the GPS took to lock from GPS power on
6	Time Diff. at Lock	microseconds	float	Time difference between GPS and Orion after GPS first locks
7	VCXO Error	ppm	float	Calculation of the VCXO drift in ppm over the last duty cycle
8	Temp comp. offset	counts	int	The new offset in the temperature compensation table
9	GPS off reason	-	int	defined as: 0 -PLL time error was zero 1 -GPS on time expired
10	GPS final mode	-	int	defined as: 0 -3D Navigation 1 -2D Navigation 2 -Single satellite 3 -Searching for satellites

<b>Orion State-of-Health Files Description Min-Max, Triggers and Event SOH</b>
--

## Appendix O

MinMax Data (.MX1)				
1	Time	seconds	long	UTC Time since 1970 that the min-max sample interval begins
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Minimum	counts	long	Filtered minimum over the sample interval
4	Maximum	counts	long	Filtered maximum over the sample interval
MinMax Data (.MX2)				
1	Time	seconds	long	UTC Time since 1970 that the min-max sample interval begins
2	Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Minimum	counts	long	Filtered minimum over the sample interval
4	Maximum	counts	long	Filtered maximum over the sample interval
Trigger Information (.TRG)				
1	Start Time	seconds	float	UTC start time of the trigger event (note: accurate to 1/10000 sec)
2	Start Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS.ssss )
3	End Time	seconds	float	UTC end time of the trigger event
4	End Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS.ssss )
5	Duration	seconds	float	duration of the trigger event (start time - end time)
6	Channel #	-	int	digitizer channel number (1-6)
7	Trigger #	-	int	trigger number (1-6)
8	Trigger Type	-	int	0 - threshold, 1 - STA/LTA
9	LTA Value	counts	long	Long term average at the start of the trigger
10	Early Peak Amp.	counts	long	Peak amplitude during the first few seconds (programmable) of trigger
11	Early Half Period	samples	int	Half period of the peak amplitude signal
12	Early Time to Peak	samples	int	Time in samples from the start of the trigger to the peak amplitude
13	Final Peak Amp.	counts	long	Peak amplitude over the entire trigger event
14	Final Half Period	samples	int	Half period of the peak amplitude signal
15	Final time to peak	samples	int	Time from the start of the trigger to the peak amplitude
Event Record (.ELF)				
1	Start Time	seconds	long	start time of the event
2	Start Time	Date - Time	n/a	UTC time in a date-time format ( YYYY-MM-DD HH:MM:SS )
3	Event Duration	seconds	long	the length of the event
4	Event Type	-	int	defined as: 1 -External 2 -Internal Triggered 3 -Manual
5	Trigger 1	-	int	defined as: 0 - no trigger, 1 -trigger
6	Trigger 2	-	int	defined as: 0 - no trigger, 1 -trigger
7	Trigger 3	-	int	defined as: 0 - no trigger, 1 -trigger
8	Trigger 4	-	int	defined as: 0 - no trigger, 1 -trigger
9	Trigger 5	-	int	defined as: 0 - no trigger, 1 -trigger
10	Trigger 6	-	int	defined as: 0 - no trigger, 1 -trigger

## Appendix P- Modifying Orion for Full Calibration Support

In the case where power need not be provided by the Orion, the existing sensor power wiring may be rerouted to facilitate calibration and mass center enabling. Follow the procedure below to modify the internal signal cable to achieve this.

### Procedure

1. Refer to Section 8 for an overview of the Orion disassembly procedure. You will need a Philips screwdriver and a pair of tweezers to perform this modification.
2. Check that power to the Orion is off.
3. Remove the black cover containing the LCD and menu buttons by removing the 8 #4 screws.
4. Disconnect the connectors at the bottom of the cover and gently put aside. Be careful not to scratch the LCD.
5. Some Orion models have two plates on the end of the digitizer chassis, while others have only one. If there is only one end plate continue to the next step. If there are two end plates, lift the digitizer chassis part way out of the case so that the screws on the end plates are accessible. Then remove the two screws and gently slide out the plate, being careful not to damage any wires.
6. Identify the internal signal cable harness by comparison with Fig. 1. Disconnect the memory/calibration (P10), ADC (P8) and power supply (P12) connectors from their respective cards in the card cage. Be very careful not to dislodge the GPS connector while doing this as it is complicated to reconnect.

**Fig. 1: Orion Internal Signal Cable Harness**

1. Remove all wires from the sensor power connector housing (P12) by pressing down on the pin locking tabs and gently pulling the wires from the back of the housing. This connector housing should be retained in case the original configuration is to be restored.
2. Carefully lift the pin locking tab on each of the removed pins, so that the pins will lock when reinserted into the memory/calibration connector housing (P10). Insert the pins into the P10 connector housing using Table 1 and Figs. 1 and 2 as a guide.

External		Internal (Original)			Internal (Modified)			Wire Colour
Conn	Pin	Conn	Pin	Signal Name	Conn	Pin	Signal Name	
P7	R	P12	1	SENSOR +12V	P10	1	CALEN1	ORG
P7	T	P12	5	SENSOR -12V	P10	4	CALEN2	GRN
P7	N	P12	3	SENSOR GND	P10	2	DGND	VIO

**Table 1: Original and Modified Wiring List**

1

**Fig. 2: Pin Numbering for P10 (Back View)**

1. Test the cables according to Table 1 using an ohmmeter. Check that each pin is solidly locked into the housing.
2. Reconnect the cables and replace the digitizer chassis and the black cover.

## Appendix P

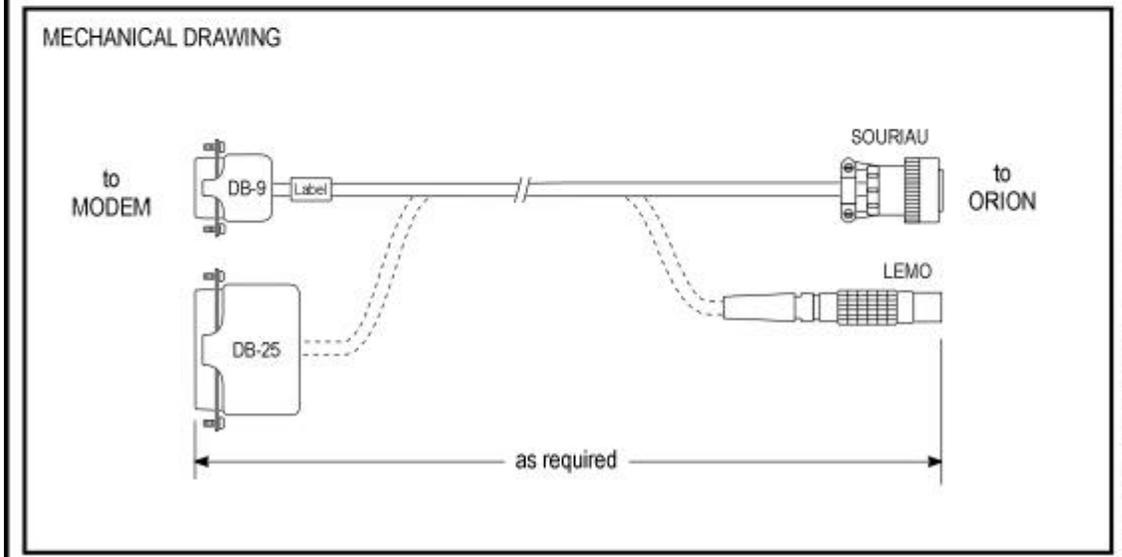
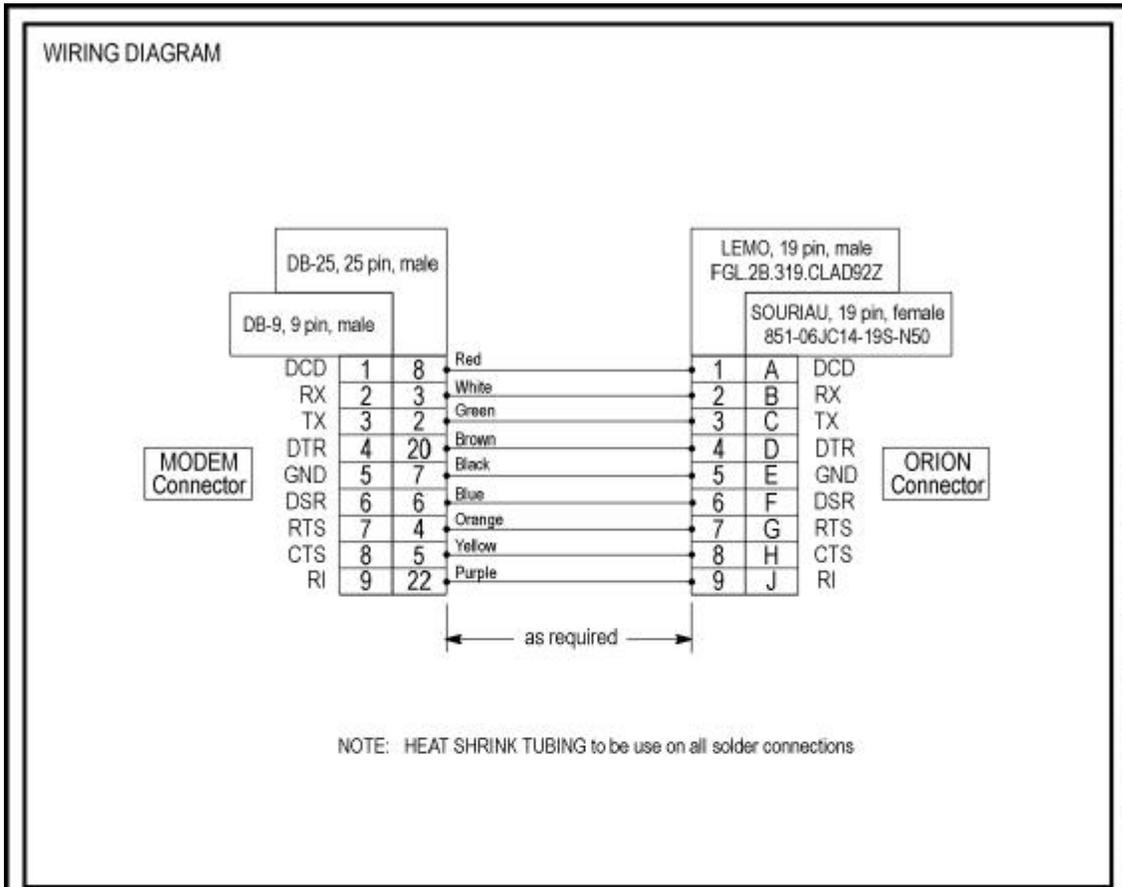
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### Restoring the Original Configuration

If the original internal signal cable harness configuration is to be restored, follow the same procedure as above, and use Table 1 and Figs. 1 and 3 as a guide to removing the appropriate pins from P10 and replacing them in the housing P7.

**Fig. 3: Pin Numbering for P12 (Back View)**

# Appendix Q Cable for Orion Modem Connection



<b>ORION MODEM CABLE</b>					
	Dwg #	FileName	Originator	Approved By	Date
	12103A	12103A.CDR	C.Blake Wright		Oct 15/98