



*Micro-Manager<sup>TM®</sup>*

and

*Micro-Manager<sup>®</sup> Pro*

(Receiver Management and Control Software  
for the Ashtech  $\mu$ Z-Family of GPS Receivers)

**User's Manual**

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# Chapter 0

## Micro-Manager vs. Micro-Manager Pro

There are two basic editions of **Micro-Manager**: **Micro-Manager** and **Micro-Manager Pro**. Throughout this document we generically refer to **Micro-Manager** and do not highlight the differences between **Micro-Manager** and **Micro-Manager Pro**.

The primary differences between the two editions, at the current time, are the remote access features. That is, **Micro-Manager Pro** provides facilities for remote access (i.e., local computer modem configurations, telephone dialing directories, modem dialing and disconnect options, and automatic/command-line driven remote modem connections) while the standard **Micro-Manager** does not. Additional features are being considered for Micro-Manager Pro.

By product design and definition Micro-Manager Pro has all of the features and functionality of Micro-Manager plus additional features. While both products may change and mature this assumption is expected to remain valid. Please refer to the table below.

To verify which edition you have, see the Help About window of the program. When the professional configuration is in use, a clear indication of the “Professional” version will be indicated.

Current Features	Micro-Manager	Micro-Manager Pro
32 bit multitasking & multithreaded architecture running on Windows 95/98/NT/2000	Yes	Yes
Windows Graphical User Interface	Yes	Yes
Choice of GUI (manual) or Command Line (automatic) interface	Yes	Yes
Ring file data control	Yes	Yes
Receiver data file management	Yes	Yes
Session programming	Yes	Yes
Receiver script file uploading feature	Yes	Yes
Powerful terminal window capability	Yes	Yes
User configurable alerts	Yes	Yes
Reliable firmware uploads	Yes	Yes
Z-modem protocol for data transfers	Yes	Yes
File translations to Ashtech or RINEX formats	Yes	Yes
RTCM base station configuration control status	Yes	Yes
Built in user safeguards	Yes	Yes
User configurable real time information screens	Yes	Yes
Direct receiver connection	Yes	Yes
Remote (modem) receiver connection	No	Yes
Full control over dialing parameters and hardware handshaking for modems	No	Yes
Dialing directory facilities	No	Yes
Modem settings	No	Yes



# Chapter 1

## Introduction to Micro-Manager

### 1.0 OVERVIEW

**Micro-Manager** is a PC based program that was designed for the management of remotely and locally operated  $\mu$ Z-family GPS receiver. **Micro-Manager** software provides users with the ability to control critical essential receiver parameters and logging features while allowing full access to all of the data stored within the receiver. User's can interface with the program using its state-of-the-art Graphical User's Interface (GUI) or through command-line options which facilitate automation. The result is an advanced reference station system capable of managing numerous GPS receivers. These receivers can be located locally or, through its modem access features, virtually anywhere in the world.

**Micro-Manager** was designed to run on Windows 95/98/NT/2000 platforms. While capable of operating on all of these platforms, **Micro-Manager** is 32-bit in nature and takes full advantage of the preemptive multi-tasking and multi-threading capabilities of the Windows NT and 2000 platforms. These features provide the user with a stable and secure platform that requires minimal maintenance.

**Micro-Manager** currently supports the Ashtech  $\mu$ Z-Family of GPS receivers. This includes the  $\mu$ Z CGRS and  $\mu$ Z-Surveyor receivers. It has been designed to allow both direct connections (i.e., via RS-232 cables) to the GPS receiver and remote connections through modems. **Micro-Manager** offers extensive modem configuration options and, as such, will support a wide variety of modems. Furthermore, the modem configuration options support a wide variety of installation needs. For example, one installation of **Micro-Manager** is configured to use a spread-spectrum modem. That modem employs a TDMA network access scheme and utilizes several repeaters to reach some of the remotely located receivers. Without the availability of the extensive configuration options, such an installation may not have been possible.

**Micro-Manager** is capable of exploiting the following major features of the  $\mu$ Z-Family of GPS receivers.

- 1) GPS data collection and data file storage.
- 2) GPS data collection "configuration" parameters including satellite filtering and site information.
- 3) Session programming features.
- 4) Receiver communication port configuration.
- 5) RTCM configuration and control.

- 6) Remote Firmware Uploading.
- 7) Parameters controlling protocol used in the transfer of GPS data.

Using **Micro-Manager**, users can configure receiver logging sessions. This feature, referred to as the Session Programming feature, establishes the time periods during which GPS data will be recorded and the parameters governing that collection. For example, the user can define a data collection session beginning at 1:00 AM every day, lasting 1 hour, based upon a 1-second data epoch, with an elevation mask of 5 degrees. The user could then define another data collection session (up to 24 sessions) beginning at 10:00 AM every day, lasting 4 hours, based upon a 20-second data epoch, with an elevation mask of 10 degrees, and storing data only when there are 4 or more satellites.

**Micro-Manager** also can be called from a command-line. This facilitates automatic and/or unattended management of local or remote receivers. Using this feature, one can command **Micro-Manager** to dial-up and download receiver data. Furthermore, you can instruct **Micro-Manager** to delete the successfully downloaded files from the receiver's memory, thereby enabling further data collection within the receiver. For Windows NT users, the "AT" command of the "Scheduler" service can be used to schedule runs of **Micro-Manager**. In fact, one can set up a batch file containing commands to dial your entire set of remote receivers and then use the AT feature of Windows NT to schedule the execution of that batch program. Users desiring more elaborate and/or user-friendly scheduling features can employ commercially available scheduling programs, such as Norton Scheduler.

When it becomes necessary to change your receiver's firmware, you will find that Magellan has paid particular attention to providing reliable and stable firmware uploads. That is, **Micro-Manager** contains a built in firmware uploading capability that utilizes a protective firmware upload protocol, reliable firmware file formats, and very stringent firmware crosscheck procedures. The result is a reliable means of upgrading your receiver's firmware either through a direct connection or a remote connection.

Additionally, **Micro-Manager** has been designed to operate in concert with other commercially available software packages, such as Bulletin Board Systems (BBS) and FTP servers. It must be emphasized that **Micro-Manager** does not, by itself, contain *all* of the tools necessary for automated Internet and BBS operation. Rather, it has been designed to work in concert with such packages. Magellan recommends obtaining commercially available and well-recognized FTP and BBS systems to support these needs.

## 1.1 Minimum System Requirements

**Micro-Manager** requires a Windows 95, Windows 98, Windows NT or Windows 2000 based computer. While **Micro-Manager** requires less than 5 megabytes of memory

to run, Windows platforms impose higher minimums. It is recommended, for performance reasons, that your computer have no less than 32 megabytes of RAM memory for Windows 95/98 and 64 megabytes for Windows NT/2000 platforms. Magellan strongly recommends a Windows NT or Windows 2000 platform because of their true 32-bit nature.

Your disk space requirements will vary depending upon your unique installation and data collection needs. **Micro-Manager** actually requires less than 10 Megabytes of disk space to store the program and its ancillary files, but it is recommended that your available disk space be much larger to accommodate your data storage needs. Storage solutions such as ZIP (100 Mb or 250 Mb) and JAZ (1 or 2 Gb) from Iomega provide alternate storage solutions.

To optimize the performance of **Micro-Manager**, please give special consideration to the PC you choose to run the software. It is important to choose a leading brand system to avoid less capable components such as serial cards often found in cheap knock-offs. Although **Micro-Manager** will run on most all Intel processors (486 and up), it's performance will be superior on a well built Pentium system specifically designed for Windows NT/2000.

To communicate with remotely located receivers, you will need a minimum of two modems: i.e., one for the computer and one for every remotely-located GPS receiver. Magellan Corporation recommends that you utilize modems from the same manufacturer throughout your installation to avoid compatibility problems. Furthermore, Magellan recommends that you use either US Robotic Courier or Sportster Modems. Check with Magellan regarding other modems, including spread-spectrum type radio modems.

It should be emphasized that Magellan does not support all modems; so it is necessary to verify that the modems you wish to use are supported.

## **1.2 Demo Modes of Micro-Manager**

There are two basic modes of **Micro-Manager**: fully operational and demonstration (i.e., demo). This document applies to both modes. Demo modes, which are freely distributed over the Internet or provided on diskette, have a greatly reduced capability when compared with a fully operational program but do not require a sentinel key. Demos will differ from operational programs by disallowing at least the following: (1) all file download and delete features, (2) the editing of receiver control parameters, and (3) the command-line features. Basically the demos permit one to observe but not accomplish.

One can obtain a Demo **Micro-Manager** from the Ashtech web page at the following address: <http://www.ashtech.com/refstats.html>

# Chapter 2

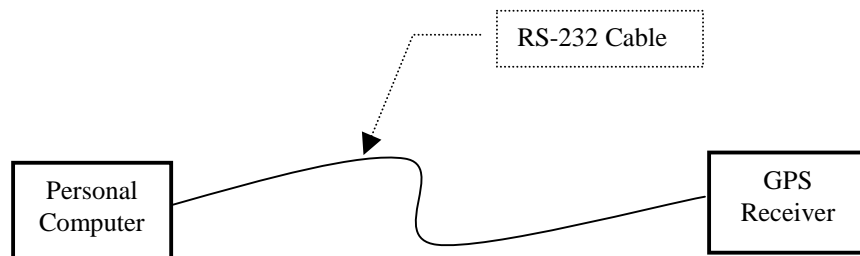
## Installation Instructions

### 2.0 INSTALLATION OVERVIEW

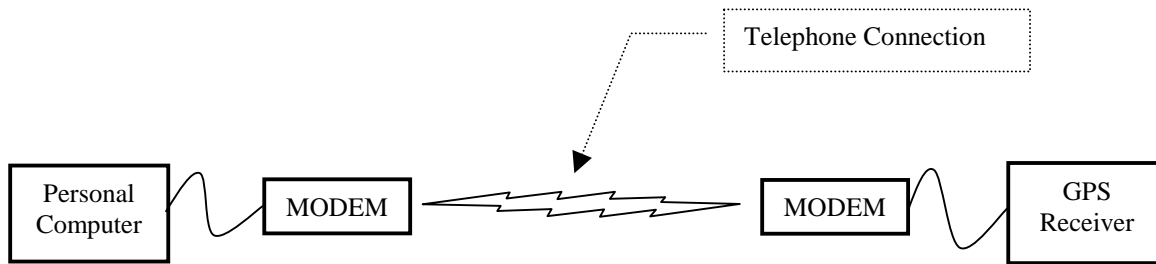
From a total system perspective, there are two primary sides of the installation process: 1) installing hardware and 2) installing software. The primary purpose of this manual is to describe the installation and use of the **Micro-Manager** software package. We will not provide in-depth installation guidelines and steps for hardware installation; we refer you to the appropriate computer and receiver manuals for details. We will, however, introduce some important GPS receiver, MODEM and computer installation issues as they relate to the operation of the **Micro-Manager** software package.

### 2.1 Hardware Installation

**Micro-Manager** has been designed with two primary configurations in mind: 1) direct connections and 2) remote connections. Figures 2.1.A and 2.1.B provide basic block diagrams for these configurations. Figure 2.1.A provides a direct connection (also called a local receiver connection) block diagram while Figure 2.1.B provides a remote receiver connection block diagram.



**Figure 2.1.A:** Direct Connection



**Figure 2.1.B:** Remote Connection

As can be seen in the above block diagrams, the primary difference between these two configurations is the use of MODEMS to establish the link between the Personal Computer and the GPS Receiver. For details on connecting MODEMS to your GPS receiver, please consult the appropriate receiver manual. Likewise, the manuals of your Personal Computer should describe how to connect/install MODEMS.

To communicate with remotely located receivers, you will need a minimum of two modems: i.e., one for the computer and one for every remotely located GPS receiver. Magellan Corporation recommends that you utilize modems from the same manufacturer throughout your installation to avoid compatibility problems. Furthermore, Magellan recommends that you use either US Robotic Courier or Sportster Modems. Check with Magellan regarding other modems, including spread-spectrum type radio modems. It should be emphasized that Magellan does not support all modems; so it is necessary to verify that the modems you wish to use are supported.

The particular type of receiver, and, for certain receiver types, the communication port of the receiver used for **Micro-Manager** functions, plays a key role in the **Micro-Manager** configuration process. This is because there are slight hardware variations in the various  $\mu$ Z-Family of GPS receivers. With the exception of Port A of  $\mu$ Z-CGRS receivers, the DTR/DSR hardware handshaking lines ARE NOT implemented. It is essential to understand this because many MODEMS are pre-configured so that when the DTR line is dropped, it signals the MODEM to terminate a telephone connection. Therefore, when using  $\mu$ Z-CGRS receivers it is suggested that you connect the receiver's MODEM to Port A of the receiver. When connecting a MODEM to a non- $\mu$ Z-CGRS receiver (or Ports B through D of a  $\mu$ Z-CGRS receiver), ensure that you configure the receiver to instruct its MODEM to ignore the DTR/DSR signal (See Section 4.1.5.4.2). For direct connections, this is key because **Micro-Manager** must be configured according to the availability of the DTR/DSR flow control of the receiver or receiver port. Section 3.1.1.3.5 describes the configuration of the DTR/DSR hardware flow control for direct connections.

## 2.2 Micro-Manager Installation

In this section, we describe the installation of the **Micro-Manager** software program (and its ancillary programs and files).

For most users of **Micro-Manager** the installation is very straightforward. The installation diskettes use an industry recognized installer program. If for any reason you decide to remove **Micro-Manager** (such as to install an upgrade to **Micro-Manager**), it can be removed (along with all of its support components) using normal Windows 95/98/NT/2000 software uninstall mechanisms. Please see the end of this section for details on uninstalling **Micro-Manager**.

Please note that when installing **Micro-Manager** on a Windows NT or Windows 2000 machine, it is necessary to install **Micro-Manager** under an account that has full administrative privileges (such as the Administrator's account). If you attempt to install **Micro-Manager** under an account that does not have full administrative access, **Micro-Manager** will not install and run properly. This is because the **Micro-Manager** installer needs to add device drivers for its sentinel key.

During the installation of **Micro-Manager** the following major components will be installed:

- **Micro-Manager** Program files
- Sentinel Drivers
- **Micro-Manager** Sound Files
- **Micro-Manager** Ancillary/Support Program Files

The program files include the executable program and its configuration files. The sentinel drivers are required to allow **Micro-Manager** to communicate with its sentinel key. In fact, without these drivers, **Micro-Manager** would not be expected to run. This sentinel key comes standard with each copy of the program. The sentinel key allows **Micro-Manager** and its support utilities to run on a single workstation. Please note that multiple copies of **Micro-Manager** can be run on a single workstation based upon a single sentinel key (i.e., without the need of additional sentinel keys). Furthermore, there is virtually no limit to the number of remote receivers that can be controlled using a single copy of the program.

The **Micro-Manager** sound files are a set of WAV files that **Micro-Manager** can be configured to play when certain events occur (see Section 3.1.4.1). The user selects which sound files to play, in each situation, during the configuration of **Micro-Manager**.

The ancillary program files, installed when **Micro-Manager** is installed, include the programs UPACKU12.exe and XYZAshRx.exe. These programs convert receiver memory files to standard Ashtech GPS data files and to RINEX, respectively.

## 2.2.1 The Installation Process

To install **Micro-Manager** onto your computer, insert the **Micro-Manager** installation diskette labeled “**Micro-Manager** Install Disk 1” into the A (or B) drive of your computer. Press the “Start” button and select “Run”. Use the “Browse” command to locate and run the “Setup” program on the diskette located in the A (or B) drive of the computer.

The install program guides you through the installation of the **Micro-Manager** software. At each step you will be given an opportunity to accept default options or tailor these to your individual needs. You will be required to enter your 8-character serial number. This serial number is located on each of the **Micro-Manager** installation diskettes. The **Micro-Manager** serial number is the first eight characters located on your installation diskettes. For example, your diskette may be labeled as follows:

KF004561-MICROM-011598

For this example the **Micro-Manager** serial number is KF004561. Please note that without the proper serial number you will not be able to continue the **Micro-Manager** installation.

Upon completing the installation of the **Micro-Manager** program and data files, you will be asked two questions:

- 1) Do you want a **Micro-Manager** entry in the Windows Start Program menu?
- 2) Do you want a shortcut to **Micro-Manager** on your desktop?

Answering no to either question does not prohibit you from later manually activating or deactivating the features. Likewise, answering yes to either question will not prohibit you from manually deactivating the features. Manually activating and deactivating these features can be accomplished through standard Windows configuration parameters (such as creating shortcuts) at any later time.

If you decide to add **Micro-Manager** to the Windows Start Program menu, then you will be able to quickly launch **Micro-Manager** using the Windows “Start” button. If you choose to have a **Micro-Manager** shortcut added to your desktop, then the installer will place the program icon onto your desktop. To launch the program from the desktop, you will simply need to double-click the program icon. In both cases, the link to the program is installed without any additional command-line parameters (i.e., double-clicking the program icon will place the program into its GUI mode, rather than its command-line mode).

### 2.2.1.1 Installing the Sentinel Key

Before actually running **Micro-Manager**, you will need to install the software sentinel key. Please note that **Micro-Manager** will not run without this sentinel key. Also note that you cannot start **Micro-Manager** with the key and then later remove the key while **Micro-Manager** is running. The software sentinel key is installed by attaching the end of the sentinel key labeled **↑COMPUTER↑** to a parallel printer port of your computer. Please tighten the screws of the sentinel key to securely connect the key to your computer. If a printer is connected to your computer, attach that cable to the sentinel. If the sentinel cannot be installed because of an obstruction behind the computer, you can place the sentinel key later in the parallel sequence (for example, you could attach the sentinel key to a DB-25 male to DB-25 female cable which is connected to your computer's parallel port). To ensure a good connection between the computer, the sentinel key and other parallel devices, use only IEEE standard parallel printer cables.

The sentinel key allows **Micro-Manager** to run on a single workstation. As stated earlier, multiple copies of **Micro-Manager** can be run on a single workstation without need of additional keys.

### 2.2.1.2 Uninstalling **Micro-Manager**

**Micro-Manager** and all of its components can be uninstalled via the "Add/Remove Programs" feature of the "Control Panel" in Windows. Please note that **Micro-Manager** must be removed prior to installing a new version. The Install Shield program, which installs **Micro-Manager**, does not detect and remove old versions.



# Chapter 3

## Configuring Micro-Manager

### 3.0 CONFIGURATION OVERVIEW

Before actually running **Micro-Manager**, you will need to install the software sentinel key. Please note that **Micro-Manager** will not run without this sentinel key. Also note that you cannot start **Micro-Manager** with the key and then later remove the key while **Micro-Manager** is running. The software sentinel key is installed by attaching the end of the sentinel key labeled **↑COMPUTER↑** to a parallel printer port of your computer. Please tighten the screws of the sentinel key to connect the key securely to your computer. If a printer is connected to your computer, attach that cable to the sentinel. If the sentinel cannot be installed because of an obstruction behind the computer, you can place the sentinel key later in the parallel sequence (for example, you could attach the sentinel key to a DB-25 male to DB-25 female cable which is connected to your computer's parallel port). To ensure a good connection between the computer, the sentinel key and other parallel devices, use only IEEE standard parallel printer cables.

The sentinel key allows **Micro-Manager** to run on a single workstation. Multiple copies of **Micro-Manager** can be run on a single workstation without need of additional sentinel keys.

Prior to connecting to the GPS receiver, **Micro-Manager** needs to be configured to suit your data collections needs. Please note that this configuration process is extremely important, as the **Micro-Manager** factory defaults will probably *not* meet your needs.

The **Micro-Manager** configuration information is stored in 3 files:

- 1) MICROMGR.PNM;
- 2) MICROMGR.MDM; and
- 3) MICROMGR.INI.

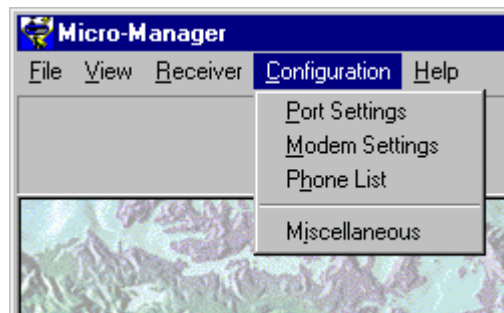
All of these configuration files are located in the same directory where the main program file (i.e., MICROMGR.EXE) is stored. The file named MICROMGR.PNM stores the telephone numbers to be dialed to reach each of your remote receivers. The file named MICROMGR.MDM stores all of the configuration information associated with each of the modems you have configured to be used with your PC. Finally, the file named MICROMGR.INI contains all other configuration information related to the program.

**Micro-Manager** automatically updates the contents of the configuration files as the operator makes changes using the “configuration” menus. Changes are written to these files so that the configuration may be recalled at the start of the next run of the program. In this way, once the desired configuration is set, the operator no longer needs to change it -- unless, of course, it needs to be altered to support a new configuration. The “Configuration” sub-menus of the **Micro-Manager** program are used to set a majority of these parameters. Details of the contents of the Configuration sub-menus will be provided in later sections of this document.

The above mentioned configuration files are text (i.e., ASCII) files. As such, the configuration can also be modified with any text file editor. However, you are strongly discouraged from making configuration changes using this approach. In fact, after you get **Micro-Manager** configured as desired, it would be prudent to make a backup copy of these configuration files. Should you need to modify any of these files with a text editor, please verify that you have a backup copy before editing them.

### 3.1 Configuration Menus

Most **Micro-Manager** parameters are set through the main menu "Configuration" option. The “Configuration” drop-down menu is divided into 4 different selections. These 4 selections become available when “Configuration” is selected (a drop-down menu appears).



The following Sub-Sections describe each of the 4 configuration windows (i.e., sub-menus).

It is intended that **Micro-Manager** be configured before connecting to a receiver. One can, however, change the configuration of the *receiver* while **Micro-Manager** is connected to that receiver. Special features have been built into **Micro-Manager** to change the GPS receiver’s parameters while **Micro-Manager** is connected to the GPS receiver. These will be described in later sections.

Earlier we stated that it is generally expected that **Micro-Manager** be configured before it is actually connected to a receiver. However, whenever a valid communication port is specified in its configuration files, **Micro-Manager** will, upon startup, open that

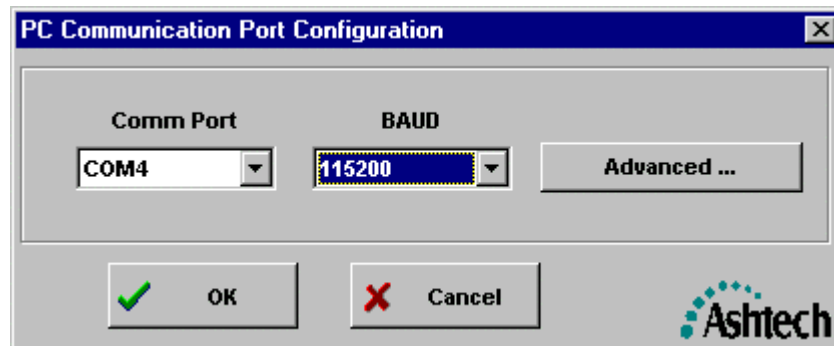
communication port and attempt to determine the type of receiver, if any, that is connected on that port. For introductory users of this package, this may be a somewhat confusing point. However, experienced users will find this to improve their productivity by requiring fewer steps to begin their work. This topic will be described in more detail later in this document (see Sections 3.1.1, 3.1.4.5, and 4.1.2)

### 3.1.1 PC Communication Port Settings

The PC (or Personal Computer) Communication Port Configuration window allows the operator to set the communications port parameters governing the connection with the GPS receiver. The items configured through this window affect the settings of the computer communication port over which **Micro-Manager** is communicating with the GPS receiver, and not the port settings of the GPS receiver (see Section 4.1.5.4.2).

The Communication Port Configuration window permits the editing of the following communication parameters:

- 1) The PC communication port (labeled "Comm Port");
- 2) The PC communication port speed (labeled "BAUD");
- 2) Advanced communication options (labeled "Advanced ...");



When making configuration changes through this window (or the window reached by pressing the "Advanced ..." button), keep in mind that you are configuring the communication port of the local PC (not the parameters of the device attached to that port). However, your configuration settings will depend on the device (i.e., either a modem or a GPS receiver) attached to the communication port.

Upon accepting the changes to this window, by pressing the OK button, **Micro-Manager** will immediately attempt to configure and open the communication port of the local PC. Please note that when you accept the port settings, if any of the receiver status windows are open (see Sections 4.1.4 through 4.1.4.7), **Micro-Manager** will immediately attempt to obtain that status data. This is important because if a live GPS receiver is not connected to that serial port (or that receiver's communication port is not operating at the same communication speed or the connection to the receiver is normally

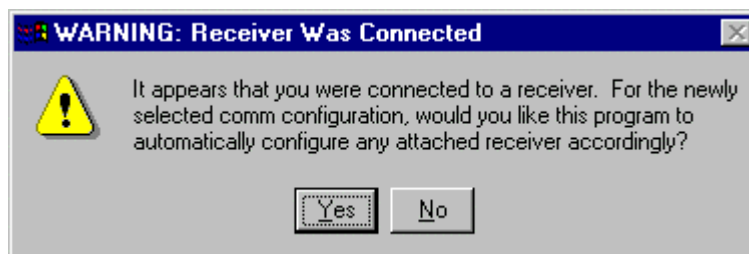
done through a MODEM), then **Micro-Manager** will begin generating error messages. In other words, when the receiver status windows are open, **Micro-Manager** expects the receiver to be connected and begins issuing commands to obtain the status data. Because the receiver is not attached (or is configured at a different communication speed), no responses are forthcoming and, thus, **Micro-Manager** believes that there are errors in communication. To avoid these problems, simply close the receiver status windows whenever changing the PC's communication port settings.

Upon pressing the OK button in this window and assuming **Micro-Manager** is currently aware that it is directly connected (i.e., not connected via MODEM) to a GPS receiver, **Micro-Manager** will perform some additional processing. To fully understand the discussion to follow, some background information is required. There were two somewhat opposing design goals in the early stages of the **Micro-Manager** development effort:

- 1) To allow users to utilize some minimal features of the program with other Magellan (i.e., non  $\mu$ Z-Family) GPS receivers and as a general terminal program; and
- 2) To boost the user's productivity by performing some behind the scenes processing.

These two goals are somewhat conflicting because, in order to reach the second goal, one must be communicating with the receiver (i.e., the communication rates of both the receiver's port and the computer's port must be the same). In order to reach this second goal, **Micro-Manager** must determine the receiver type whenever possible. **Micro-Manager** achieves this by issuing receiver specific query commands over the communication port. However, this conflicts with the first goal, particularly to the use of the program as a general terminal program. Thus, when you change the communication configuration of the local computer (through this window), the settings may not be compatible with those of the receiver.

When **Micro-Manager** is directly connected to a GPS receiver, and **Micro-Manager** knows that it is connected to a  $\mu$ Z-Family GPS receiver, as would be indicated by the lower-right portion of the status bar (see Section 4.1.1.4), any changes to the communication configuration will result in the issuance of the following prompt:



This prompt is really indicating that you are changing the communications of your local computer port such that you may not be able to communicate with the receiver. Furthermore, the point of the prompt is to determine if you want to attempt to

automatically set the communication configuration of the receiver to match that of your computer. If you answer “Yes”, **Micro-Manager** will first set its local port configuration, then go through a polling process to determine the receiver’s type and communication parameters (because you may have, through this window, selected a different local computer port), and then command the receiver to desired communication speed.

Additionally, there are some slight hardware differences among the members of  $\mu$ Z-Family of receivers. One should be aware of these hardware differences when making changes to the communication parameters. These should be only of concern when directly connected (i.e., NOT connected via modem) to the GPS receiver. Specifically, with the exception of Port A of  $\mu$ Z-CGRS receivers, the DTR/DSR hardware handshaking lines ARE NOT implemented. As such, **Micro-Manager** must be configured according to the availability of the DTR/DSR handshaking of the receiver or receiver port. Section 3.1.1.3.5 describes the configuration of the DTR/DSR hardware handshaking for direct connections.

Finally, when **Micro-Manager** has established a MODEM connection to the receiver (see Section 4.1.2), you are strongly advised not to change the communication parameters of the local computer (i.e., you should avoid using this window). Changing these communication parameters when connected via MODEM may cause the MODEM to break the telephone connection. If you must change the communication speed, you are strongly encouraged to manually disconnect (see Section 4.1.3), change the configuration of the local PC as desired, and then re-dial the telephone number of the target GPS receiver (see Section 4.1.2).

#### 3.1.1.1 Configuration | Port Settings / Comm Port

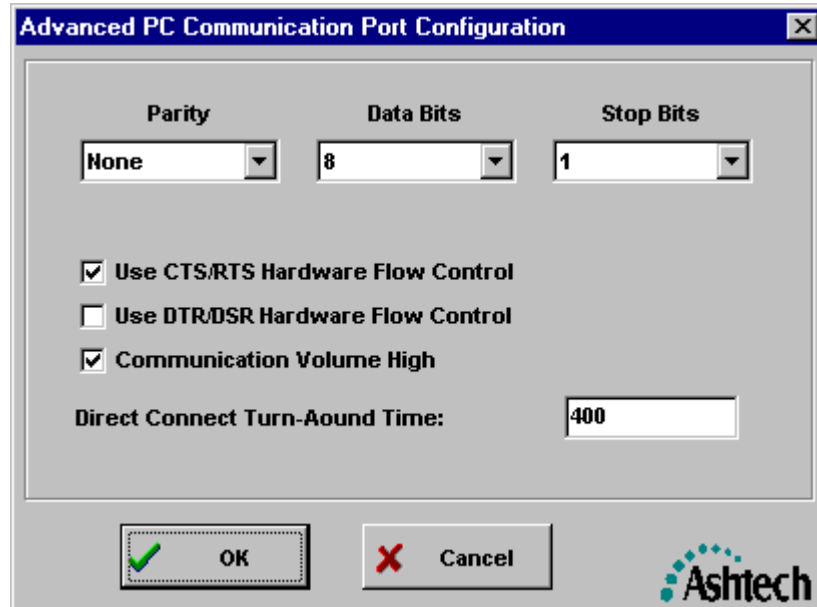
The port selection allows the operator to specify the communications port of the computer used to communicate with the Ashtech receiver. The selectable values are "COM1" to "COM16".

#### 3.1.1.2 Configuration | Port Settings / BAUD

The BAUD selection establishes the communications speed of the communications port of the computer used to communicate with the Ashtech receiver or the modem through which **Micro-Manager** communicates with the receiver. The selectable values are 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200.

### 3.1.1.3 Configuration | Advanced Settings

The advanced communication settings are accessed by pressing the “Advanced...” button of the PC Communications Configuration window. Upon pressing this button you will be presented with a window similar to the following:



Through this window, the following items can be configured:

- 1) Parity used in serial communications;
- 2) Data Bits used in serial communications;
- 3) Stop Bits used in serial communications;
- 4) RS-232 control line handshaking;
- 5) The level of Windows interaction; and
- 6) Turn-around wait time for direct connections.

#### 3.1.1.3.1 Advanced Port Settings / Parity

The Parity selection allows the operator to specify the parity mode used over the selected serial port. To date, all Ashtech receivers communicate using the no parity mode (i.e., the “None” selection). The permissible values are Even, Odd, Mark, and None.

#### 3.1.1.3.2 Advanced Port Settings / Data Bits

The Data Bits selection allows the operator to specify the number of data bits used when communicating over the selected serial port. To date, all Ashtech receivers communicate using 8 data bits. The permissible values are 7 and 8 data bits.

### 3.1.1.3.3 Advanced Port Settings / Stop Bits

The Stop Bits selection allows the operator to specify the number of stop bits used when communicating over the selected serial port. To date, all Ashtech receivers communicate using 1 stop bit. The permissible values are 1, 1.5, and 2 stop bits.

### 3.1.1.3.4 Advanced Port Settings / Use CTS/RTS Hardware Flow Control

The CTS/RTS Hardware Flow Control checkbox allows you to specify whether or not the normal CTS/RTS hardware flow control handshaking is enabled. In most configurations, this checkbox should be checked. Those who uncheck this checkbox should have clear rationale as to why they should eliminate the CTS/RTS hardware handshaking. For example, there are certain modems that do not employ the CTS/RTS hardware handshaking. In these cases, **Micro-Manager** needs to be made aware of the difference.

### 3.1.1.3.5 Advanced Port Settings / Use DTR/DSR Hardware Flow Control

The DTR/DSR Hardware Flow Control checkbox allows you to specify whether or not the normal DTR/DSR hardware flow control is enabled.

For direct connections with GPS receiver (See Section 2.1) you will need to alter this depending upon the receiver type or the port of the particular receiver that will be used. This is because there are some slight hardware variations between different models of  $\mu$ Z-Family receivers. **With the exception of Port A** of  $\mu$ Z-CGRS receivers, the DTR/DSR hardware handshaking lines ARE NOT implemented. As such, **Micro-Manager** must be configured according to the availability of the DTR/DSR handshaking of the receiver or receiver port. For most users, this checkbox should be unchecked (i.e., disabling the use of the DTR/DSR handshaking for flow control).

For remote connections, you will need to set this configuration depending on the type of MODEM that will be used to establish the remote connection. For nearly all types of MODEMS, you will need to disable this setting (i.e., have the checkbox unchecked). Please see the appropriate MODEM manual for details on its DTR/DSR signal use.

In most configurations, this checkbox should be unchecked (i.e., disabling DTR/DSR for flow control). Those who uncheck this checkbox should have clear rationale as to why they should use the DTR/DSR hardware handshaking. For example, there are certain Ashtech receivers and modems that do not employ the DTR/DSR hardware handshaking for flow control. In these cases, **Micro-Manager** needs to be made aware of the difference.

#### 3.1.1.3.6 Advanced Port Settings / Direct Connection Turn-Around Time

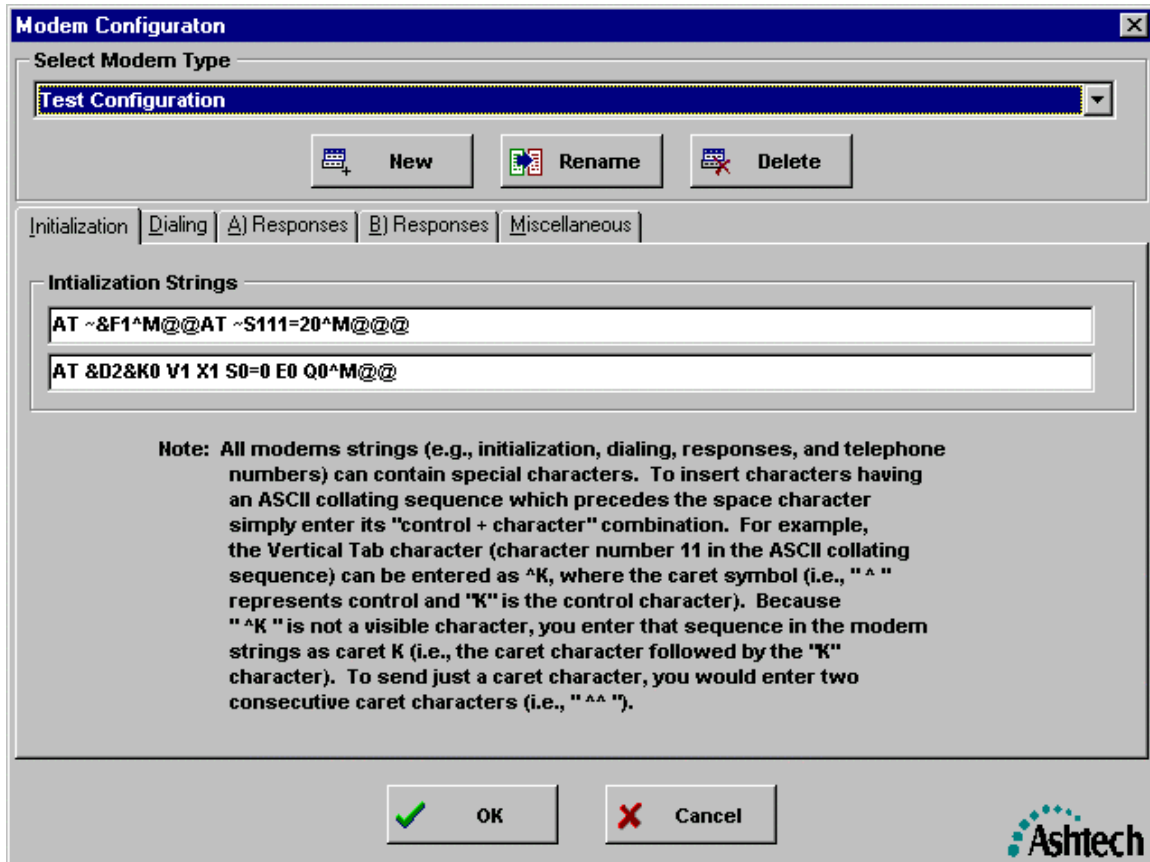
Each **Micro-Manager** installation can exhibit slight variations in system performance, particularly in the area of RS-232 data communications. Poor communication links, operating system loads and other such factors can influence the RS-232 communication performance. The default configuration of **Micro-Manager** should handle nearly all of these variations.

The “Direct Connect Turn-Around Time” parameter specifies the maximum amount of time (in milliseconds) between the issuance of a command to the receiver and receipt of a response to that command. **Micro-Manager** permits 3 non-response failures for each command before reporting an error. Thus, if you tend to get a high number of errors during normal operations with a GPS receiver, particularly during a file download operation, then you will want to increase the turn around time. On the other hand, increasing the number to an overly large value will cause **Micro-Manager** to take a long time to report errors. For example, if you set the parameter to 9000 (or nine seconds), then when there are truly errors in data communications, it will take up to 27 seconds to start reporting the errors. In most cases, you will not need to modify this parameter.

### 3.1.2 Modem Settings

The Modem Configuration window allows the operator to configure a single or a set of modems used by **Micro-Manager**. By selecting the “Configuration | Modem Settings” menu option, you will be presented with the following window.





Through this window, you can perform the following tasks:

- 1) Add, Delete and Rename instances of modems;
- 2) Edit the modem initialization strings for each modem;
- 3) Edit the modem dialing and hang-up parameters for each modem;
- 4) Edit the expected modem command responses; and
- 5) Edit specialized control features used during communication with modem and GPS receiver using that modem.

Before continuing with the description of each edit field, it is important to note that there are two special character sequences that can be entered as part of the modem strings. Often strings sent to the modem to configure it and responses from that modem contain special (i.e., non-printable) characters. ASCII control codes (listed in Appendix B of this document) are used to represent these special characters. For example, the end of an initialization string often requires a carriage return character. The ASCII control code for this character is ^M (i.e., normally entered by pressing the keyboard “control” character and then, while holding the control key down, pressing the “M”). Because Windows uses these special control sequences for other purposes, one cannot enter these codes directly into the edit field. As such, we must represent the control character in the edit fields in another way. We have chosen to use caret character to represent the control character. Thus, to enter ^M, you enter the caret character (i.e., “^”) followed by capital

“M”. That is, ^M is entered as “^M”. To enter a single “^” symbol into the modem strings, enter “^^” (i.e., two caret characters).

It is also often desired to introduce a delay when sending characters to the modem. In the above window, you will see the “@” symbol in a modem initialization string. This character will not be transmitted to the modem. Rather, the characters preceding the @ character will be transmitted, **Micro-Manager** will delay an amount of time, and then the characters after the @ symbol will be transmitted. Both the character used to represent the delay and the duration of the delay are set by you using the “Miscellaneous” tab of this window (See Section 3.1.2.8). Please note that all instances of the delay character will be translated to delays. That is, there is no sequence through which you can send the character when it has been assigned the role of the delay character. If you need to send the character that is represented by the delay character, then change the delay character to something not used in the modem strings.

It is also important to note that the delay character that you select should not be confused with that used by the modem. To explain, most Hayes-compatible modems use the comma character to insert a delay. Consider the following examples of strings sent to the modem from **Micro-Manager**:

- 1) ATDT 9@@@18005551212^M
- 2) ATDT 9,,,18005551212^M

In both of the examples, we will assume that the “@” character is the **Micro-Manager** delay character and the comma character is the modem delay character. In case 1, **Micro-Manager** sends the string “ATDT 9”, waits three times the delay programmed for the “@” symbol, sends the string “18005551212”, and then sends a carriage return character in place of the ^M sequence. In case 2, **Micro-Manager** sends the string “ATDT 9,,, 18005551212” and then sends a carriage return character in place of the ^M sequence. The difference may not be obvious but it is important. For example, most modems do not process many commands until the receipt of the carriage return. The dialing command (i.e., “ATDT”) is one such command. Therefore, in case 1, the modem would end up dialing “918005551212” immediately after receiving the carriage return (i.e., the @ symbol has no effect other than to increase the amount time to send the string). In case 2, the modem dials 9, waits 3 times the delay for the comma character (see your modem manual for details), and then dials the remaining characters. The latter case shows how one uses the dialing sequence first to obtain an outside line and then to dial the desired telephone number.

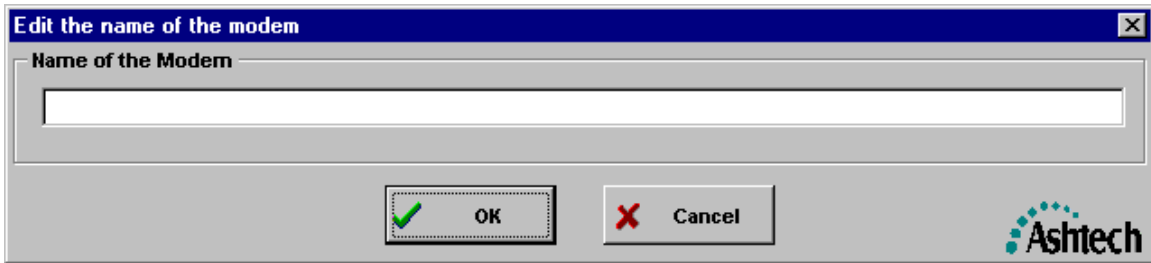
Finally, you will need to consult the manual for your modem to determine the how to and the strings required for configuring your modem. You can use the Terminal Window of **Micro-Manager** to test your modem strings (see Section 4.1.6).

### 3.1.2.1 Selecting an Existing Modem

When you leave the “Modem Configuration” window using the OK button, the modem currently selected for use by the program will be shown as the selected entry in the drop-down list of modems in the window box entitled “Select Modem Type”. To choose a different modem, simply select that modem from the drop-down list of modems. Upon selecting the desired modem, the configuration parameters for that modem will become immediately visible and available for editing throughout the rest of the window. If the modem you desire to use is not in the list or the list is empty, you will have to make a new entry (see Section 3.1.2.2).

### 3.1.2.2 Adding a Modem to the List of Modems

To add a modem to the list of modems, simply press the “New” button. You will be presented with the following dialog window.



Here you simply enter a string of characters that identifies the modem and then press the “OK” button. After doing so, the “Modem Configuration” window will become active and will be loaded with initial data for each of the configuration items. You are then free to edit each of the configuration items for the newly created modem entry.

### 3.1.2.3 Deleting a Modem from the List of Modems

From the Modem Configuration window, you can delete a modem entry by first selecting that entry from the drop-down list and then pressing the “Delete” button. You will not be asked to confirm the deletion. All configuration information associated with that entry will be deleted as well.

### 3.1.2.4 Renaming a Modem in the List of Modems

From the Modem Configuration window, you can rename any modem entry by first selecting that entry from the drop-down list and then pressing the “Rename” button. Upon doing so, you will be provided with the same window as described in Section

3.1.2.2. Simply make changes to that name in that window and press the “OK” button of that window.

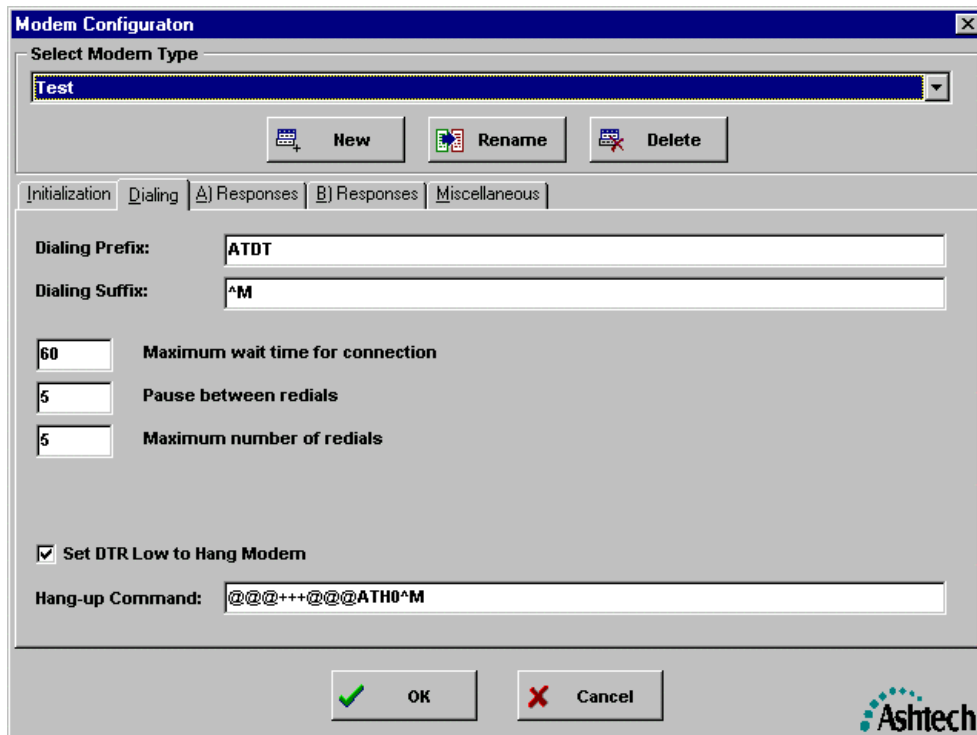
### 3.1.2.5 Entering/Editing the Modem Initialization Strings

The modem initialization strings are sent before each attempt to connect to the receiver through a modem. To obtain access to these strings, press the “Initialization” tab of the “Modem Configuration” window. Two lines of entry are permitted. These two strings will be sent back-to-back when **Micro-Manager** attempts to initialize the modem.

- NOTES: 1) Consult the user’s guide for your modem for specifics on configuring your modem.  
2) Consult Section 3.1.2 for specifics on entering special character sequences.

### 3.1.2.6 Entering/Editing the Modem Dialing and Hang-up Strings

To get access to the dialing and hang-up parameters of the selected modem press the “Dialing” tab of the Modem Configuration window. The following provides an example of the window with the “Dialing” tab selected.



The “Dialing Prefix” contains the set of characters sent to the modem just before the actual telephone number is sent. The “Dialing Suffix” contains the set of characters sent to the modem just after the actual telephone number is sent. Section 3.1.3 and its sub-sections describe the entry of telephone numbers.

The “Maximum wait time for connect” defines the maximum number of seconds to allow the modem to actually establish the connection with the remote system. When attempting to establish a connection, **Micro-Manager** starts a timer just after sending the dialing suffix. If the modem does not report a connection (i.e., to the GPS receiver; see Section 4.1.2) within the specified time, then **Micro-Manager** terminates the connection attempt. It is important to note that this value only specifies how long **Micro-Manager** will wait for the modem to indicate that a valid connection with a remote modem has been established. That is, modems have their own parameters (i.e., independent of the “Maximum wait time for connect” parameter of **Micro-Manager**) and timers which govern how long the modem will wait for the detection of a remote modem carrier signal. For example, the S7 register of a US Robotics Sportster modem is typically set to 60 seconds by the factory. If a valid connection is not established within this amount of time, the modem will signal **Micro-Manager** that the connection attempt failed. In summary, when you change the “Maximum wait time for connect” within **Micro-Manager**, you also should set the associated register of the modem to the same value in the modem initialization strings (see Section 3.1.2.5).

The “Pause between redials” specifies the amount of time (in seconds) to wait between failed connection attempts. The “Maximum number of redials” defines the number of attempts to establish the connection before terminating. These two parameters are particularly important for unattended operations (see Section 4.2). You should configure these parameters to suite your expected demands on your remote systems and the urgency to obtain the data. For example, if other users are dialing your remote receiver, then you should set the “Pause between redials” to a large value to account for possible file download times by other users.

The last two parameters of this tab section deal with how to hang-up the modem at the completion of communicating with the receiver. “Set DTR Low to Hang Modem”, when checked, will cause **Micro-Manager** to drop the RS-232 DTR status line signal to terminate the connection. The “Hang-up Command” text box defines the modem string to be sent by **Micro-Manager** to terminate the connection. Using both approaches is acceptable but are dependent upon the specifics of your modem. Most Hayes-compatible modems support both.

In the example provided in the above screen capture, **Micro-Manager** will send the Hayes-compatible “command attention sequence” (i.e., “+++”), delay 3 times the amount of delay for the delay character, and then send “ATH0” (i.e., to hang the modem) followed by the carriage return character. After sending the “Hang-up Command” **Micro-Manager** will drop the RS-232 DTR line signal for approximately one-half a second.

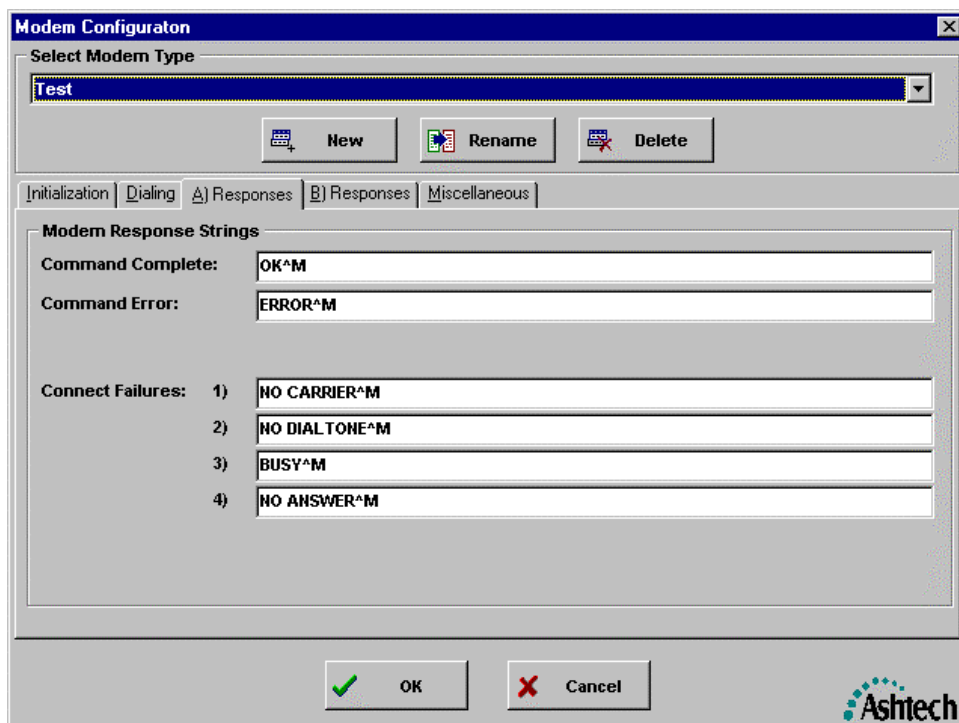
Again, the Dialing Prefix, Dialing Suffix, and Hang-up commands are modem strings subject to the same special characters discussed in Section 3.1.2. You will need to

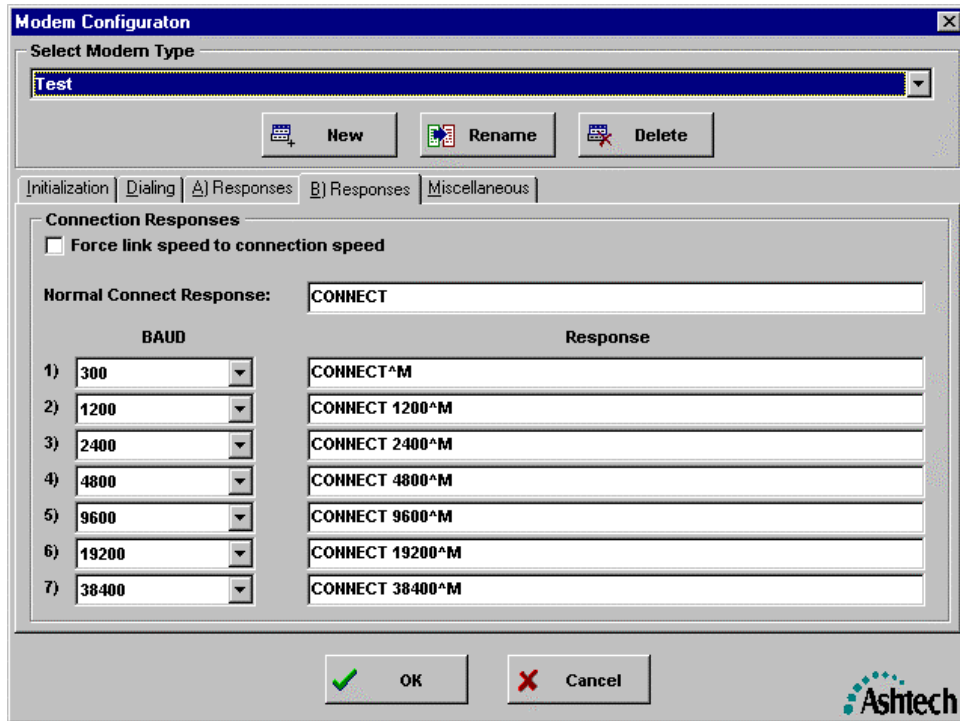
consult the user's guide for your modem to determine the settings of this window which are appropriate for your modem.

- NOTES: 1) Consult the user's guide for your modem for specifics on configuring your modem.  
2) Consult Section 3.1.2 for specifics on entering special character sequences.

### 3.1.2.7 Entering/Editing the Modem Response Parameters

Due to the volume of possible modem response parameters, the editable parameters span two tabbed sections of the Modem Configuration window. The following provides an example of each.





The first set of response parameters defines the general modem responses. The second set deals more with modem responses sent when the modem successfully establishes a connection with another modem. Each of the strings entered in this tabbed section are modem strings subject to the same special characters discussed in Section 3.1.2. You will need to consult the user’s guide for your modem to determine the settings of this window which are appropriate for your modem.

The “Command Complete” and “Command Error” responses are important because they provide **Micro-Manager** with the expected positive responses for both valid and erroneous commands, respectively. The set of “Connection Failure” strings defines possible errors reported by your modem which occur when attempting to establish a connection with a remote modem. **Micro-Manager** will report only these errors to you. If a reported error does not fall into one of these four “Connect Failure” categories, **Micro-Manager** will not detect it.

The set of connection responses helps **Micro-Manager** detect when a connection is actually established. Older generation modems required that the computer to modem, modem to modem, and modem to receiver data links maintain the exact same communication speed. Newer modems do not have this requirement. When using older modems you must force **Micro-Manager** to change the PC communication port speed to that reported by the modem. You do this by selecting the checkbox labeled “Force link speed to connection speed” and then enter the correct modem responses for each possible modem speed. Again, newer modems do not have this requirement. Most modems will respond to the connection with strings like the following:

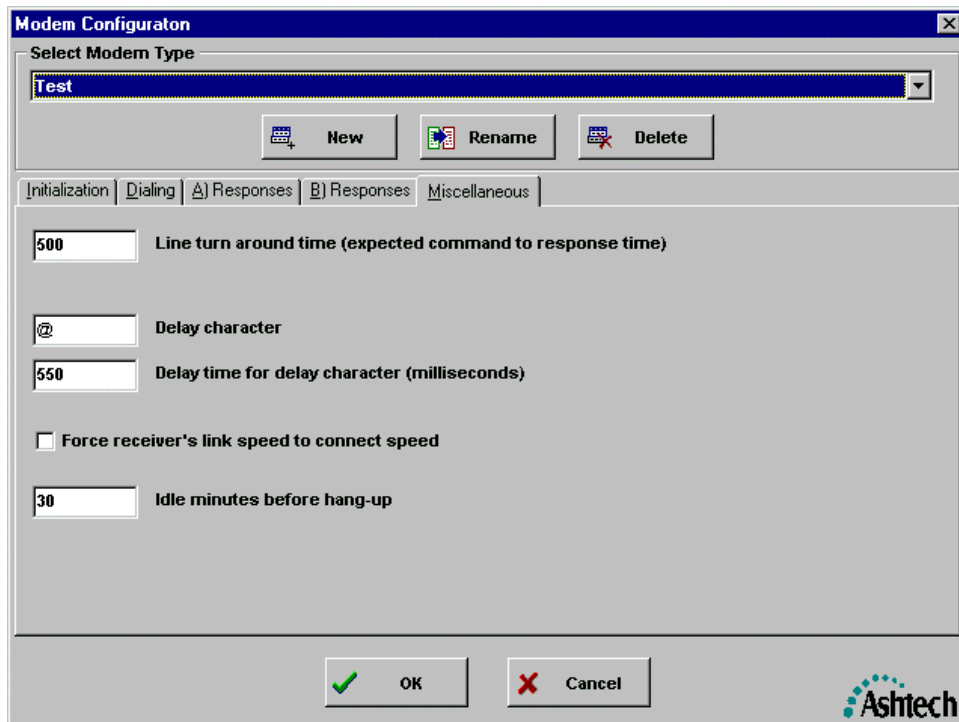
CONNECT 19200 Vbis  
CONNECT 33600 Vbis/V90  
CONNECT 53333

In each case, **Micro-Manager** does not need to obtain the full response from the modem to determine that the connection was successful. In the above example, we have simply encoded the string “CONNECT”; that is, we do not need to know the connection speed nor do we need to detect the carriage return character. We do not need to know the connection speed because with the newer modems the PC to modem speed can be independent of the speed over the other links. Thus, when the modem response string contains the word “CONNECT” we know that the connection was established.

- NOTES:
- 1) Consult the user’s guide for your modem for specifics on configuring your modem.
  - 2) Consult Section 3.1.2 for specifics on entering special character sequences.

### 3.1.2.8 Entering/Editing the Miscellaneous Modem Configuration Items

The Miscellaneous Modem Configuration Items are reached by selecting the “Miscellaneous” tab of the Modem Configuration window. The following provides an example.



The first parameter (i.e., the “**Line turn around time**”) is probably the most important parameter affecting communication performance. This parameter does not actually affect the configuration of the modem. Rather, it deals with the expected



performance of the communication interface using this modem. The parameter specifies the maximum amount of time between the issuance of a command to the remote receiver and receipt of a response to that command. For example, if you are using a spread-spectrum radio modem which uses several repeater sites to reach the remote receiver, then you will want to set this parameter to the maximum amount of time required for the full round trip of messages through the network. **Micro-Manager** permits three non-response failures for each command before reporting an error. Thus, if you tend to get a high number of errors during data transmission, particularly during a file download operation, then you will want to increase the turn around time. On the other hand, increasing the number to an overly large value will cause **Micro-Manager** to take a long time to report errors. For example, if you set the parameter to 10000 (or ten seconds), then when there are truly errors in data transmission, it will take up to 30 seconds to start reporting the errors.

The second and third parameters define the modem string character representing the delay and the duration of that delay. Section 3.1.2 describes how these two parameters are used.

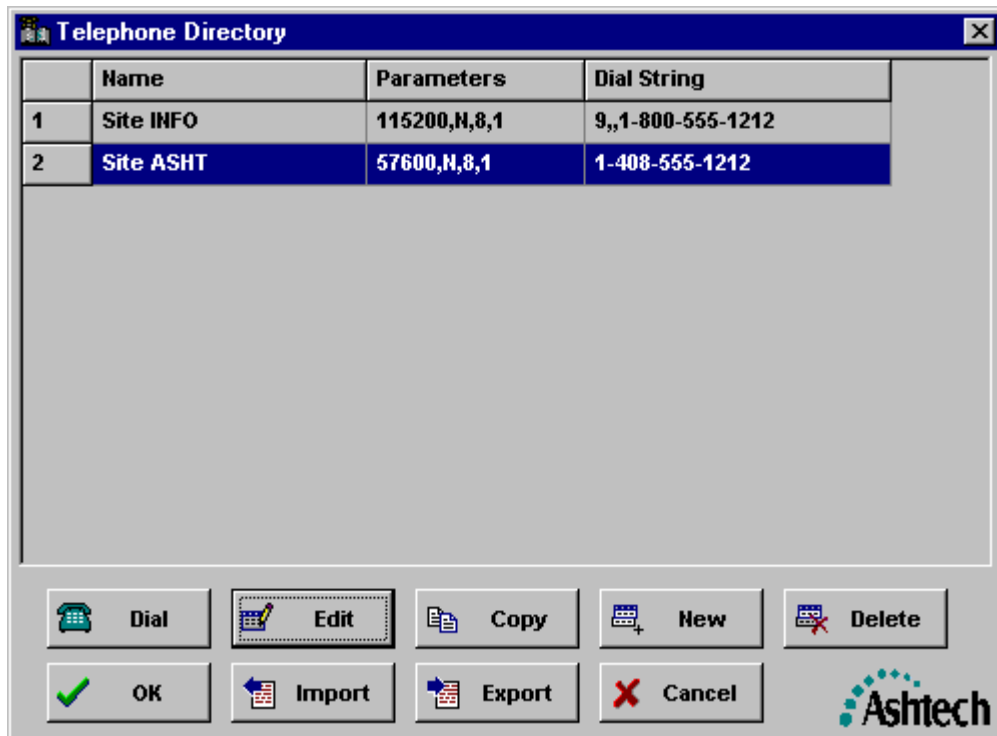
The fourth parameter (i.e., “Force receiver’s link speed to connect speed”) should only be used when employing older modems where the PC to modem, modem to modem, and modem to receiver link speeds should all be the same. See Section 3.1.2.7 for more information on this subject.

The final parameter of this section deals with ‘dead time’. That is, one can easily forget to log off a remote system. When these connections are long distance, expensive telephone bills can result. The “Idle minutes before hang-up” specifies how long (in minutes) there can be no activity before an existing connection is terminated. The inactivity counter is disabled during file downloads. Otherwise, the user must make changes to the program or move the mouse to reset the inactivity counter to avoid automatic log-off. Please note that a value of -1 for this parameter disables the termination due to inactivity.

### 3.1.3 Telephone List

**Micro-Manager** allows one to enter dialing parameters needed to establish a connection with each of your remote receivers. The most notable parameter in these entries is the telephone number of the remote system. Note that some spread-spectrum radio modems still require a telephone-number-like means of identifying remote modems. For example, one TDMA spread-spectrum modem vender uses the ATDT prefix but uses the remote modem’s serial number in place of the telephone number.

Upon selecting the “Phone List” submenu entry of the Configuration menu, you will be provided with a display similar to the following.



With this window you can perform the following operations:

- 1) Dial a remote system;
- 2) Edit an entry in the telephone directory list;
- 3) Create a new entry from an old entry;
- 4) Create a new entry not based upon an old entry;
- 5) Delete an entry;
- 6) Import an exported telephone directory; and
- 7) Export your telephone directory.

To perform an operation on any entry in the directory list, you must first select that entry and then press the button of the operation related to that entry. You can immediately invoke the Dial operation simply by double-clicking that entry. The remainder of Section 3.1.3 will describe the operations of this window in more detail.

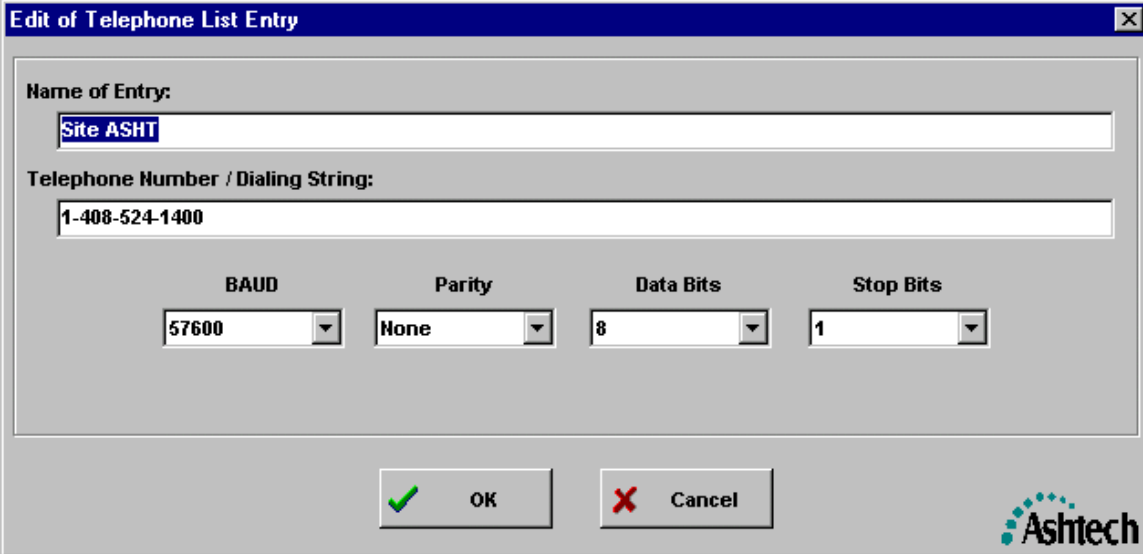
The appearance of the Telephone Directory window is also configurable by the operator. Not only can you resize the window, you can resize the columns within the directory list. To resize the columns of the directory list simply place your cursor over the column divider in the column heading, wait for the mouse pointer style to change, press down and hold the left mouse button, move the mouse left or right to resize the column as desired, and then release the left mouse button.

### 3.1.3.1 Dialing a Telephone Directory Entry

By pressing the “Dial” button of the Telephone Directory window, **Micro-Manager** will attempt to establish a connection with a remote system by dialing the number listed for the selected entry. We defer the discussion of establishing a connection with a remote system until Chapter 4 (see Section 4.1.2: Connecting to the GPS Receiver).

### 3.1.3.2 Editing a Telephone Directory Entry

To edit a telephone directory list entry simply select the desired entry and press the “Edit” Button. Upon doing so, a dialog window similar to the following will be displayed.



The screenshot shows a dialog box titled "Edit of Telephone List Entry". It has a blue title bar with a close button. The main area is light gray and contains the following fields and controls:

- Name of Entry:** A text input field containing "Site ASHT".
- Telephone Number / Dialing String:** A text input field containing "1-408-524-1400".
- BAUD:** A dropdown menu showing "57600".
- Parity:** A dropdown menu showing "None".
- Data Bits:** A dropdown menu showing "8".
- Stop Bits:** A dropdown menu showing "1".
- Buttons:** "OK" (with a green checkmark icon) and "Cancel" (with a red X icon).
- Logo:** The Ashtech logo is located in the bottom right corner.

The “Name of Entry” field is simply a text string you wish to use to identify the telephone directory entry. This field will not be passed to the modem during dialing operations; nor will it be used for any other configuration purposes.

The “Telephone Number / Dialing String” allows you to specify the telephone number of the remote system to be dialed. Please note that this is a modem string which is subjected to the same special character rules described in Section 3.1.2.

The last four parameters (i.e., BAUD, Parity, Data Bits, and Stop Bits) of the window describe the communication link between the PC and the modem when establishing a connection to the remote system identified by this entry. Specifics on the values of these parameters are the same as is described in Sections 3.1.1.2 through 3.1.1.6. The comm port used to establish the connection is that which was chosen by you in the Communication Port Configuration window (see Section 3.1.1).

### 3.1.3.3 Copying an Existing Telephone Directory Entry

To copy an existing telephone directory list entry simply select the desired entry and press the “Copy” Button. Upon doing so, the same dialog window presented in Section 3.1.3.2 will be displayed. This time, however, **Micro-Manager** will have created a new entry and copied the values from the selected entry.

### 3.1.3.4 Creating a New Telephone Directory Entry

To create a new telephone directory list entry, simply press the “New” Button. Upon doing so the same dialog window presented in Section 3.1.3.2 will be displayed. The strings providing the entry ID and telephone number will initially be blank.

### 3.1.3.5 Deleting a Telephone Directory Entry

To delete an existing telephone directory list entry simply select the desired entry and press the “Delete” Button. **Micro-Manager** does not confirm your desire to delete the entry. If you have erroneously selected the “Delete” button, simply press the “Cancel” button of the Telephone Directory window, thereby causing **Micro-Manager** to discard all changes to the telephone directory.

### 3.1.3.6 Importing a Telephone Directory List

You can import a previously exported telephone directory list by simply pressing the “Import” button of the Telephone Directory window. Upon doing so, you will be provided with a dialog box requesting the name of the file to be imported. After selecting the file, you will be asked whether or not you want to replace your existing telephone directory with that which you are importing or whether you wish to append to your current list.

### 3.1.3.7 Exporting the Current Telephone Directory List

You can export your entire telephone directory by simply pressing the “Export” button of the Telephone Directory window. Upon doing so, you will be provided with a dialog box requesting the name of the export file to be created. **Micro-Manager** will create the export file after clicking the OK button. The file created through this operation is an ASCII file which can be edited using any normal ASCII file text editor. Appendix D describes the format of the exported Telephone Directory List.

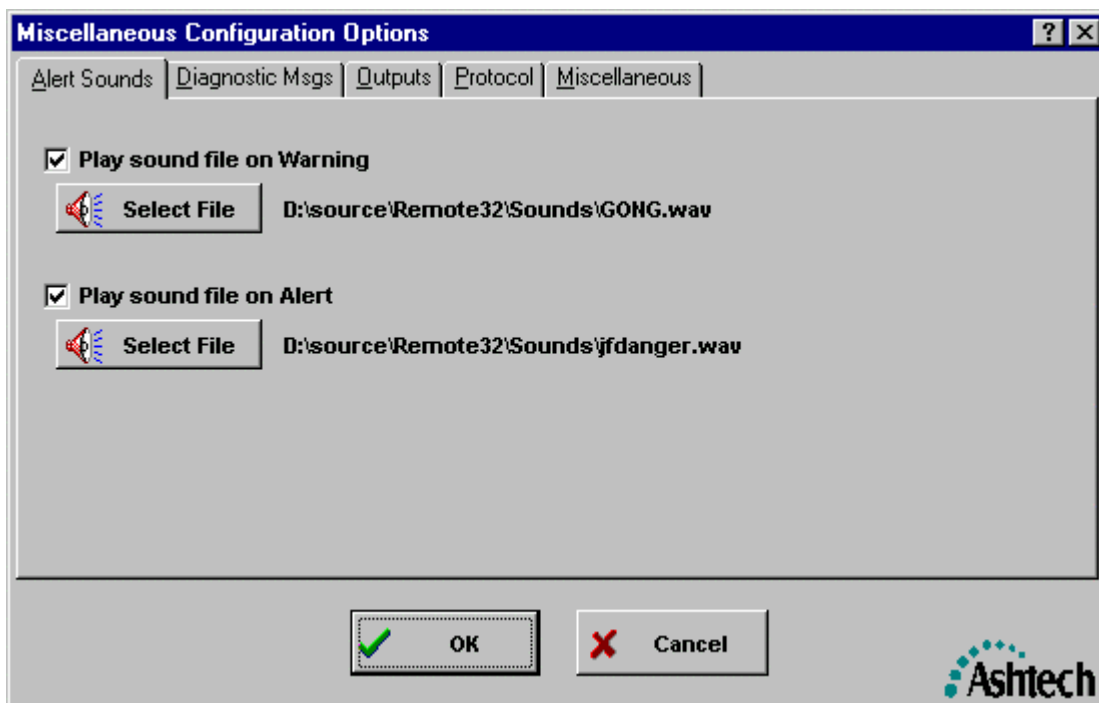
### 3.1.4 Miscellaneous Configuration Items

The Miscellaneous Configuration Options window allows you to configure the following options:

- 1) Sounds played to indicate warning and alert conditions;
- 2) How diagnostic messages are displayed and printed to the log file;
- 3) The directory in which to store output files;
- 4) Parameters describing maximum errors during a file download operation; and
- 5) Other miscellaneous configuration items.

The Miscellaneous Configuration Options window is divided into tabbed sections, each of which relates to the topics described above.

#### 3.1.4.1 Configuring Alert Sounds



**Micro-Manager** is capable of playing audio WAV files when an alert or warning condition arises. IT IS IMPORTANT TO NOTE THAT **Micro-Manager** DOES NOT CHECK TO ENSURE THAT A) YOU HAVE A SOUND CARD AND B) THAT YOUR SOUND CARD IS CAPABLE OF PLAYING WAV FILES. If your computer does not have a sound card, it is suggested that you not attempt to play any sounds: i.e., that you leave the “Play sound file on Warning” and “Play sound file on Alert” checkboxes unchecked.

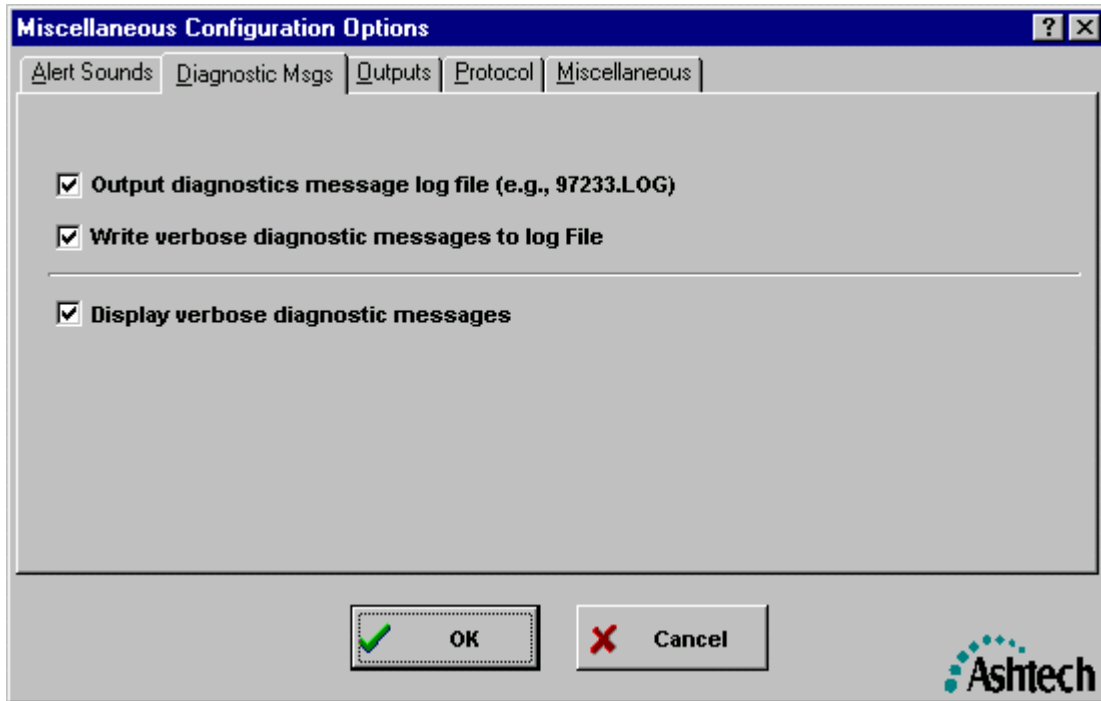
To play a sound file on the Warning condition, ensure that the “Play sound file on Warning” checkbox is checked and you use the associated “Select File” to select the

desired WAV file. Upon making your file selection, **Micro-Manager** will test play that selected sound file.

To play a sound file on the Alert condition, ensure that the “Play sound file on Alert” checkbox is checked and you use the associated “Select File” to select the desired WAV file. Upon making your file selection, **Micro-Manager** will test play that selected sound file.

When either a warning condition or an alert condition exists, **Micro-Manager** will attempt to play the selected sound files repeatedly with about a 2-second cycle time. While **Micro-Manager** will play sound files longer than 2 seconds, you are advised to keep your warning and alert sound files shorter than 2 seconds.

### 3.1.4.2 Configuring Output Diagnostic Messages



When the “Output diagnostics message log file” checkbox is checked, the Log file will be written to the directory specified under the “Outputs” tab of this window (see Section 3.1.4.3). Also when checked, diagnostic messages will be written to the Log file. Some of these diagnostic messages may not be of interest to some users. For this reason you are provided a means of reducing the diagnostic messages to ones which are critical. The checkbox labeled “Write verbose diagnostic messages to log file”, when unchecked, keeps the diagnostic messages to their minimum.

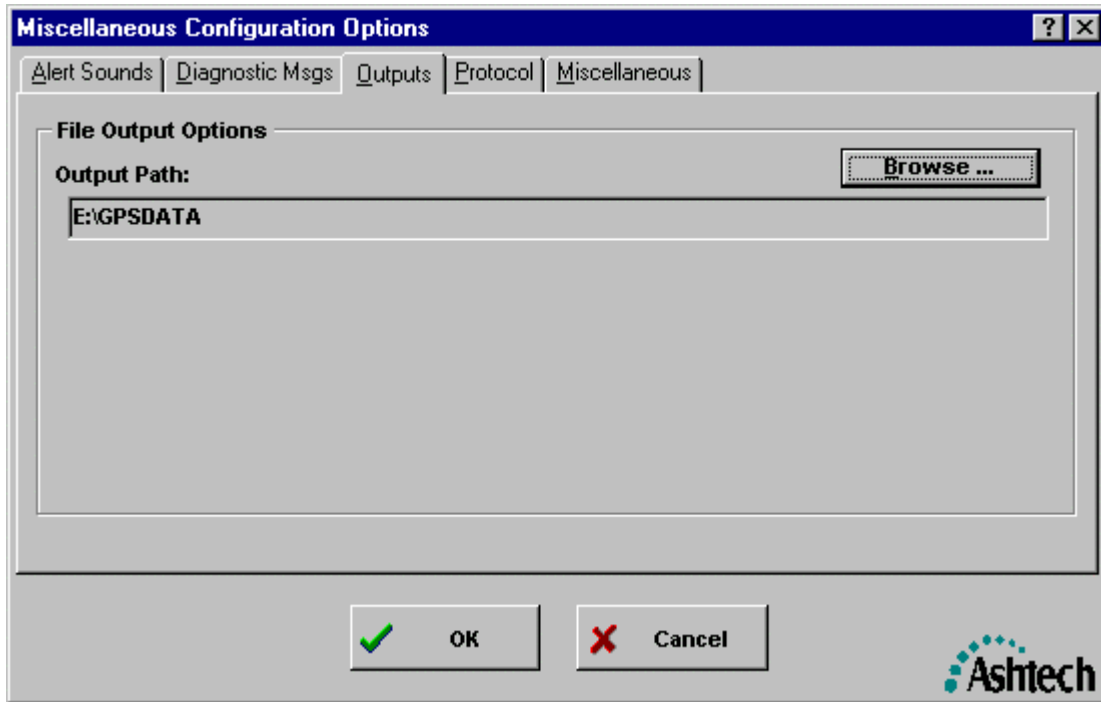
Log files contain the diagnostic messages generated by **Micro-Manager** for an entire GPS day. The format of the Log file name is described in Appendix A.2.

The “Display verbose diagnostic messages” checkbox controls the level of diagnostic messages written to the Diagnostic Messages window (see Section 4.1.4.1). Some users may not be interested in seeing all of the diagnostic messages. Leaving this checkbox unchecked keeps the diagnostic messages to a minimum (i.e., displaying only critical messages).

The system resources (e.g., CPU time) of some older computers may be unnecessarily taxed when updates occur in the Diagnostic Messages Display window. Leaving this checkbox unchecked will help to free up some of these resources.

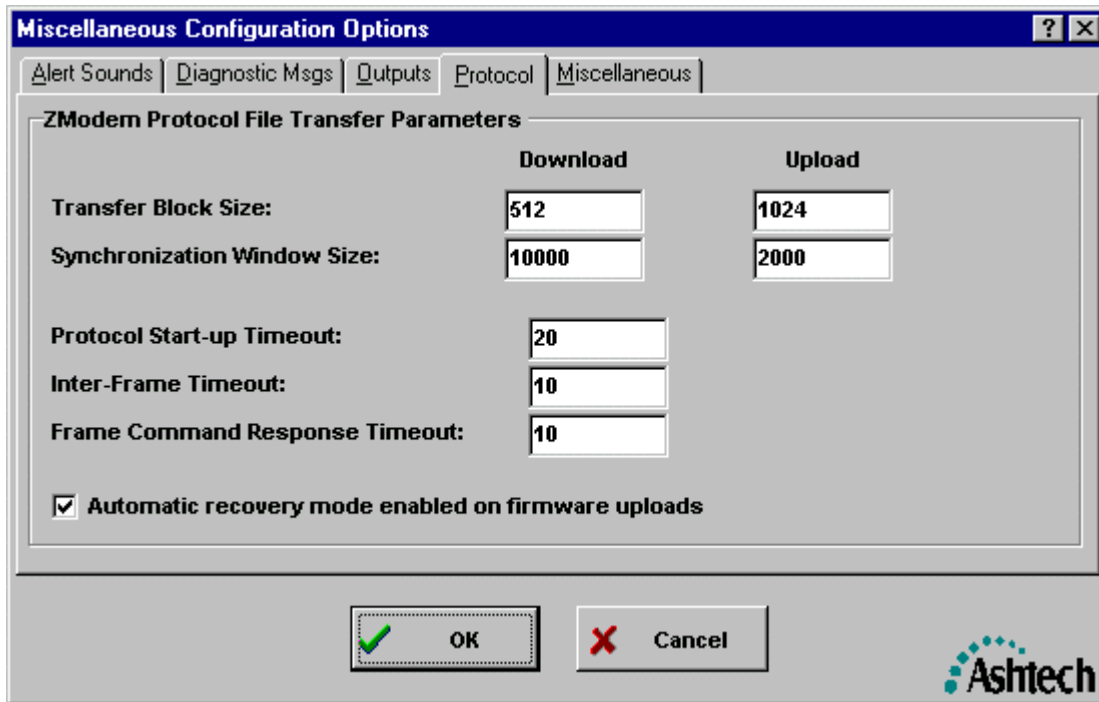
### 3.1.4.3 Specifying the File Output Directory

Upon selection of the “Outputs” tab of the “Miscellaneous Configuration Options” a window similar to the following will be displayed.



The currently selected output path is displayed in this window. You cannot directly edit the output path (hence the grayed background color of the edit box for the current path). However, you can use the “Browse...” button to locate an exiting target directory and/or create new directories. Upon selecting a new output path, and closing this window with the “OK” button, the diagnostics log file (see Section 3.1.4.2), if open at the time of the directory change, will close and a new one will open in the target directory.

### 3.1.4.4 File Transfers Protocol Parameters



**Micro-Manager** uses a Z-Modem protocol for file transfers. The Z-Modem protocol is used for file downloads and firmware file uploads. There are seven parameters that govern the handshaking during a Z-Modem file transfer (three of which are the same for both file upload and file download operations). The settings of these parameters normally need not be changed. However, they can be altered to improve the performance of file transfers, particularly when bad telephone connections are expected. In order to understand how to change these parameters, one must be somewhat familiar with how the Z-Modem file transfer protocol functions.

To start the file transfer, the Z-Modem participants exchange several specialized packets of information. Through these packets the sender and receiver negotiate the rules governing the transfer. This negotiation can take several packets of information and is completely transparent to you, the user. The Z-Modem protocol definition, in and of itself, does not specify any timeouts for this initial negotiation. However, we have provided such a timeout through the “Protocol Start-Up Timeout” parameter. This parameter specifies the maximum amount of time (in seconds) that **Micro-Manager** will permit for a transfer to start once the first negotiation packet is exchanged. If the protocol transfer does not start within the timeout period the transfer will be terminated.



The “Protocol Start-Up Timeout” parameter is important for two primary reasons:

- 1) Once **Micro-Manager** enters the file transfer mode, all other functions of the program are disabled (with the exception of the “Exit” program function) until after the transfer completes or is terminated; and
- 2) During unattended operations (such as downloading using the command-line approach), **Micro-Manager** could theoretically never terminate once a file transfer operation has been started.

Again, you should never need to alter this parameter, but you are given control in case some condition, unforeseen to the developer of this program, arises that may cause you to need to alter this parameter.

The Z-Modem file transfer protocol breaks the object to be transferred up into blocks (or packets). The size of these packets is dictated by the “Transfer Block Size” parameter. Each packet of data is sent individually. These packets contain overhead information. Among this information is a CRC (like a checksum) for validating the integrity of the individual block. The recipient of these packets first validates the packets using the supplied CRC, then strips the packet of the overhead information, and then assembles them into a contiguous file. Unlike older generation transfer protocols, the Z-Modem protocol uses a “stream data until interrupted” philosophy. That is, the sender will send out packets continuously (and in order) until the recipient detects an error or becomes confused. At that point, the recipient will send the sender a special packet that tells the sender where in the file transfer it lost track. The sender, upon receiving this information, will start the transfer back at the point specified by the recipient.

To safeguard against the potential for the loss of the recipient’s stream interruption signal, the protocol also permits a negotiated synchronization point. That is, at various and predetermined points during the transfer of large files, the sender and receiver of the data streams agree that streaming will be halted so that both the sender and receiver can acknowledge their progress to one another. The “Synchronization Window Size” parameter is used to govern how often, in number of packets, this synchronization process occurs. The smaller the number, the more frequent these synchronization events occur. This parameter, like most other parameters controlling the Z-Modem protocol should be altered only by advanced users.

The “Inter-Frame Timeout” parameter governs the maximum amount of time (in seconds) between two consecutive packets in the transfer. This parameter is another that helps to safeguard against confusion in the protocol transfer. During the transfer, communication errors induced in the communication medium (e.g., static in the telephone lines) can cause the loss of packet information. In these instances, the recipient can become confused and not recognize any packet information. This parameter indicates the maximum amount of time the recipient will “stay confused” before asking the sender to start sending from a designated point on the file.

During a Z-Modem file transfer, the sender and receiver may need to send specialized commands. The exact purposes of these commands are not important for this

discussion as they relate to how the transfer functions and what information is exchanged. The recipient of these commands has a specified amount of time to respond to these commands (i.e., the “Frame Command Response Timeout”). This parameter, like most other parameters controlling the Z-Modem protocol, should be altered only by advanced users.

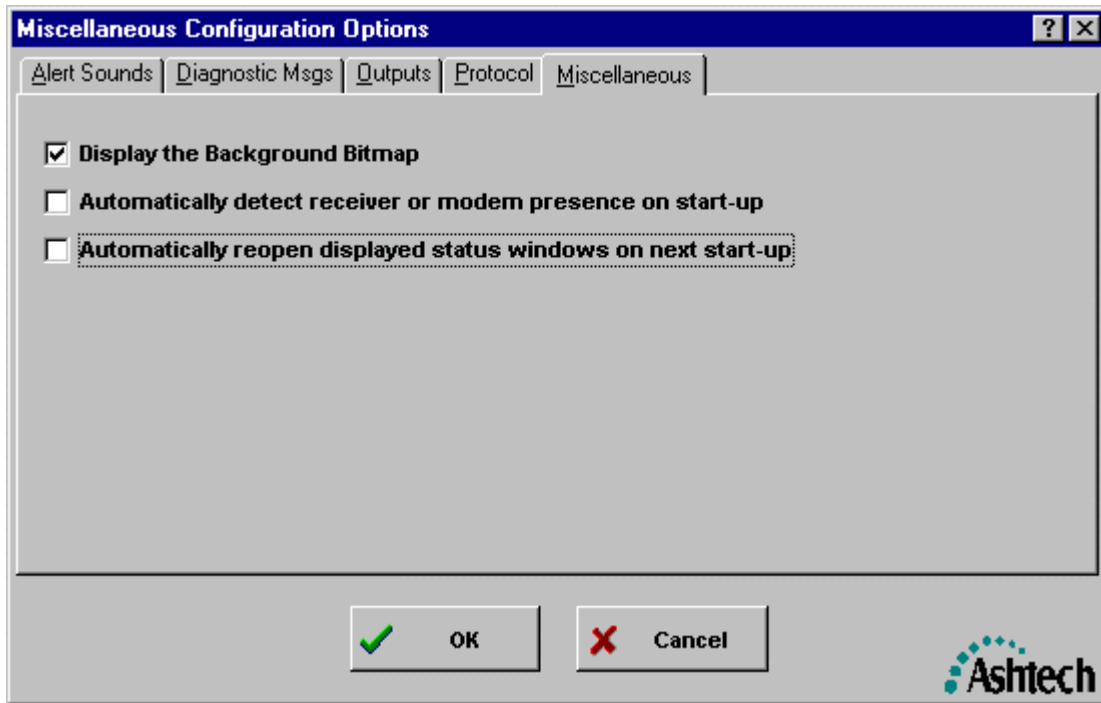
Thus far we have discussed the protocol transfer parameters and what they mean. We have cautioned against changing most of the parameters. We have not cautioned against changing the “Transfer Block Size” parameter simply because this parameter can affect the overall throughput of your file transfers. The “Transfer Block Size” parameter indicates how many actual data bytes (i.e., no overhead bytes) will be included in each packet. The larger the packet, the more susceptible an individual packet is to errors induced in the communication medium. Remember that the Z-Modem protocol operates on a streaming basis. This is important because by the time the recipient detects a block error, the sender is already sending the next packet of information. By the time the sender can respond to the recipient’s interruption packet, the sender has already sent the next packet (which will be discarded). The larger the “Block Size”, the longer it will take to recover from an error. On the other hand, the larger the “Block Size” the fewer the overhead bytes required to transfer the file.

The question still remains as to how one should set the “Transfer Block Size” parameter. The answer is really quite simple. Use the default settings as a baseline for normal (relatively noise free) installations. During file transfer operations, observe the status information presented, particularly when the status indicates transfer errors. When the transfer errors occur, **Micro-Manager** and the receiver will, through the Z-Modem protocol mechanism, enter a recovery process. Observe the amount of time required to recover from the error (not the number of errors that have occurred). If your connection is relatively noisy and file transfers seem to spend a large amount of time in the error recovery process, then consider decreasing the “Transfer Block Size” by a factor of 2. In general, decreasing the block size increases the total amount of overhead required but promotes a faster recovery from communication errors, while increasing the block size decreases the overhead requirements but causes the error recovery processing time to increase.

The last parameter of this window deals with “partial firmware file uploads”. Magellan has implemented a multi-tiered firmware validation process that safeguards against incorrectly uploaded firmware files. In many remote locations where communications are very difficult, and often noisy, it becomes increasingly difficult to get firmware files uploaded to the receiver in a single upload. Because of these potentially harsh communication environments, we have allowed parts of the firmware to be uploaded at different times. In this way, you can begin a firmware file upload, allow the upload to continue until the environment makes it difficult to continue, stop the upload process, and continue where you left off at another time. The “Automatic recovery mode enabled on firmware uploads” parameter, when checked, allows this partial firmware upload processing to take place. Please keep in mind that regardless of

the state of this “recovery” parameter, the receiver employs its multi-tiered validation process before allowing uploaded firmware files to replace the existing receiver firmware. That is, once a full firmware file is uploaded to the receiver (whether uploaded over a single or multiple attempts), there are several quality and validation checks that take place before the receiver permits the actual “burning” of the firmware program into flash memory.

#### 3.1.4.5 Miscellaneous Configuration Items



There are three parameters in this section. The first parameter (i.e., the “Display the Background Bitmap” checkbox), when checked, displays the program’s background bitmap. When unchecked, the background bitmap will not be displayed. It is important to note that changes made to this parameter will only have an effect once you restart the program: i.e., you will need to terminate **Micro-Manager** and then restart it for the change to take effect.

The second parameter (i.e., the “Automatically detect receiver or modem presence on start-up” checkbox) defines two startup modes of **Micro-Manager**. In the first mode (i.e., the checkbox is unchecked) **Micro-Manager** simply attempts to open the configured communication port (see Section 3.1.1). Under the second mode, **Micro-Manager** attempts to detect the presence of a GPS receiver or modem attached to the configured communication port. In this latter mode, **Micro-Manager** first attempts to detect the GPS receiver and, if one is not detected, then proceeds to detect the presence of a modem. To detect a GPS receiver, **Micro-Manager** issues the Ashtech receiver port configuration command “\$PASHQ,PRT” attempting all possible BAUD rates. Upon

receipt of a valid response to this query command, **Micro-Manager** has established that it is connected to a valid Ashtech GPS receiver. When detecting a modem, the program uses the “Modem Initialization” string (Section 3.1.2.5) and the expected “Command Complete” string (Section 3.1.2.7) of the modem configured for the program (see Section 3.1.2). If the modem responds with the proper “Command Complete” string, then **Micro-Manager** concludes that a valid modem is attached to the computer on the specified communications port.

The third parameter (i.e., the “Automatically reopen displayed status windows on next start-up”) establishes the behavior of the receiver status windows at the next start of the **Micro-Manager** program. When checked, any receiver status windows that were displayed when **Micro-Manager** was exited will automatically be reopened when **Micro-Manager** is started again. When unchecked, none of the receiver status windows will be displayed on the next start of **Micro-Manager**. The selection of this parameter depends upon your operating environment. For example, if you normally connect to the same receiver at the same BAUD over the same communication ports (receiver and personal computer), then you will probably want this parameter CHECKED. If this is not the case, then you probably want this box unchecked. The rationale is simply that, whenever a receiver status window is displayed, **Micro-Manager** assumes that it is connected to a receiver and that the BAUD rate has been established between the receiver and your computer. Following this assumption, **Micro-Manager** attempts to obtain status window information from the receiver. After making several attempts, **Micro-Manager** will begin reporting errors. These reports will persist while the receiver status windows are active.

# Chapter 4

## Running Micro-Manager

### 4.0 RUNNING Micro-Manager - OVERVIEW

This chapter provides a description of **Micro-Manager** once it has been configured. Before actually running **Micro-Manager**, you will need to have installed the software sentinel key and then have configured **Micro-Manager**. Chapter 3 provides a description of the configuration process.

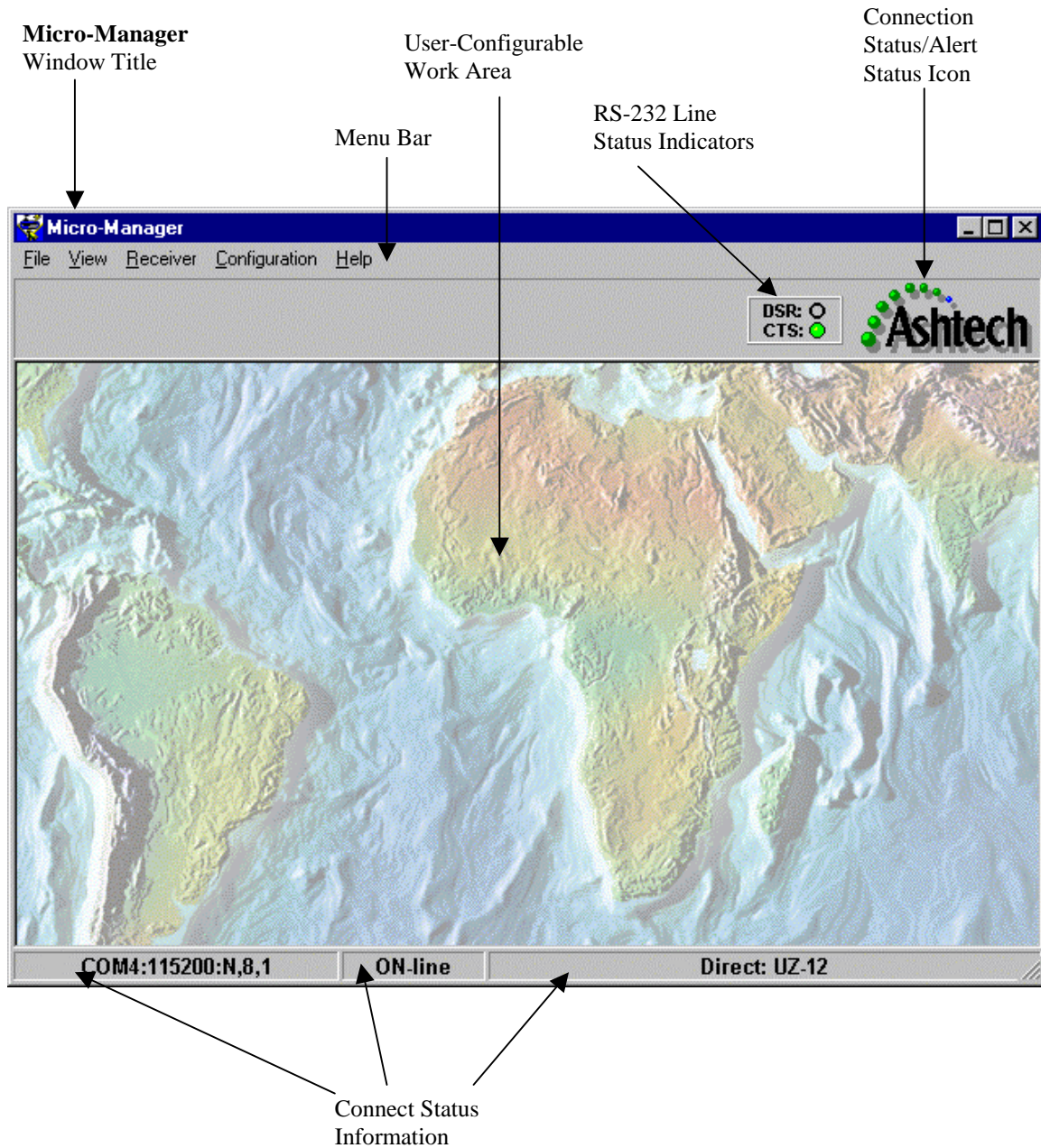
**Micro-Manager** provides two main modes of operation: 1) user interactive mode and 2) command-line mode. In user interactive mode, described in Section 4.1, user's are free to interact with the program through its extensive Graphical User Interface (GUI). When it is desired to operate the program in an automated fashion (e.g., using a batch file), the command-line mode is used. The command-line mode, described in Section 4.2, utilizes all of the configuration information entered by the user during the previous GUI-mode run of the program. That is, one uses the GUI mode to configure the program to suite particular needs and then subsequently launches **Micro-Manager** in command-line mode. It is important to note there are no software protections within **Micro-Manager** to prohibit you from interacting with the program when it is in command-line mode. However, you are strongly urged not to do so unless you have a specific reason to do so. **Micro-Manager** does not implement this software protection because there may be some limited reasons to interact with the program when it is in command-line mode. For example, suppose that during a periodic check on an automated run of the program, you discover that a particular file transfer is experiencing an unusually large number of errors. You may want to abort the transfer operation, terminate **Micro-Manager**, and then diagnose the problem.

### 4.1 User Interactive Mode

In the user interactive mode, the user is free to interact with the program through the normal GUI methods. **Micro-Manager** is placed in the user interactive mode simply by launching the program with no command-line options. In this section, we describe all of the features that can be exploited to gain the most benefit from the program.

### 4.1.1 Main Display Window

Below you will find an annotated example of the main window displayed when **Micro-Manager** is started in its interactive mode.



With the exception of the “Main Window Title” and the “Menu Bar” items, the subsections which follow describe each of the above labeled items.

#### 4.1.1.1 User-Configurable Work Area

The user-configurable work area of the main window is used to display all of the status windows described under Sections 4.1.4 and 4.1.6. You are free to move all of the sub-windows within this area. Moving a window beyond the display region of this area will cause scroll bars within the work area to be displayed. These scroll bars will allow you to “scroll” through the display area.

#### 4.1.1.2 RS-232 Line Status Indicators

The RS-232 Line Status Indicators are located in the upper right area of the **Micro-Manager** window and are used to provide a positive indication of the RS-232 status lines. They become active as soon as a valid communications port has been specified (see Section 3.1.1).

For remote connections (i.e. via MODEM), both the CTS indicator is normally green while the DSR does not filled with a color. For direct connections, the status of the DSR and CTS indicators depends upon the type receiver connected (or the port of certain receiver types) and whether or not the associated hardware flow control lines have been enabled **in Micro-Manager**. In Section 3.1.1, we described the slight hardware variations in the  $\mu$ Z-Family of receivers and how to configure the Local PC's communication port according to the hardware capabilities of the port of the GPS receiver. Again, with the exception of Port A of  $\mu$ Z-CGRS receivers, the DTR/DSR hardware handshaking lines ARE NOT implemented. This implies that, with the exception of being connected to Port A of  $\mu$ Z-CGRS receivers, the DSR indicator should be blank (i.e., neither green nor red).

If you do enable the DTR/DSR hardware handshaking (see Section 3.1.1.3.5) and the receiver port does not support it, the DSR indicator will likely become green when connected to the receiver. This is because the port of the receiver (i.e., all but Port A of  $\mu$ Z-CGRS receivers) ties the CTS line to the DSR line. However, you will get erratic communication behavior when the communication volume becomes high. The rationale is really quite simple. When the local PC gets too busy it will use the CTS/RTS hardware handshaking to slow the data sent by the GPS receiver. But because the receiver's port has tied two handshaking lines together, the DSR/DTR handshaking will be affected and cause confusion. To overcome these problems you should avoid using the DTR/DSR hardware handshaking unless you have a clear rationale for doing so.

#### 4.1.1.3 Connection Status/Alert Status Icon

The Connection Status/Alert Status Icon is used to represent the current state of the link connection and alert states of the program. What follows provides a description of each state.



When the icon is steady and unchanging, then a valid communication port has not yet been opened.



The circles above the lettering rotate between green and blue. This state indicates that **Micro-Manager** is operating normally and without any reported alert or warning conditions.



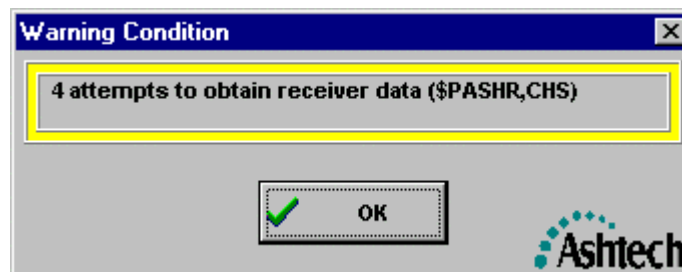
The letters of the icon toggle between yellow and black. This state indicates a warning condition and is accompanied by a window which details the warning.



The letters of the icon toggle between red and black. This state indicates an alert condition and is accompanied by a window which details the alert.

There are two levels of error conditions reported through this program: 1) Warnings and 2) Alerts. Warnings (i.e., the yellow flashing icon) are used to designate conditions which require your attention but are not potentially fatal to proper execution of the program. Alerts (i.e., the red flashing icon), on the other hand, are used to designate conditions which may arise that have a potentially adverse effect on the continued operation of the program and you are advised to immediately terminate the program upon receiving such an alert. During command-line mode (see Section 4.2), **Micro-Manager** will terminate the program when Alert (i.e., not Warning) conditions arise.

As mentioned earlier, when an alert or warning condition arises, **Micro-Manager** will display a window explaining the rationale for the condition. The following is an example of a window displayed during a warning condition.





Each of these windows, announcing alert and warning conditions, are controlled by a timer. If you fail to respond with the “OK” button within that window and the timer expires, then the window will be removed. We have taken this approach because error conditions may arise during the command-line (i.e., unattended) mode of the program. When this occurs, these windows will still be displayed and removed when the timer runs out. The error condition will be written to the log file (see Section 3.1.4.2) and the Diagnostic Message Window (see Section 4.1.4.1.).

**Micro-Manager** can be configured to play a sound file when the alert or warning conditions occur. A separate sound file can be played to distinguish the warning and the alert conditions. Refer to Section 3.1.4.1 for more details on configuring **Micro-Manager** to play sound files.

#### 4.1.1.4 Connection Status Information

The lower status bar of the **Micro-Manager** main window contains additional connection status information. When a valid communication port has been opened, the left-most field of this area will contain the port connection information. The center field of this area will contain an On-line or Off-line status. **Micro-Manager** is considered to be “On-Line” when either the DSR or RTS RS-232 status line indicators are active. Otherwise, **Micro-Manager** is considered to be “Off-Line”. The right-most field of the status bar reports whether or not **Micro-Manager** is directly connected to the GPS receiver or connected to the receiver via modem. This field also indicates whether or not **Micro-Manager** recognizes a GPS receiver and, if so, what type of receiver is recognized.

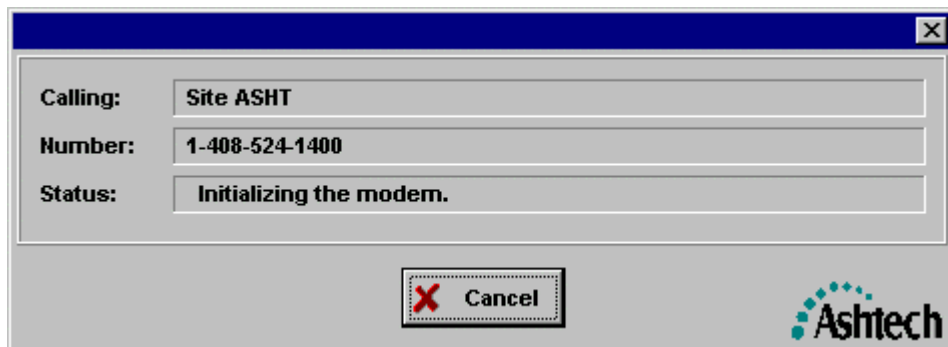
#### 4.1.2 Connecting to the GPS Receiver

**Micro-Manager** can be connected to the GPS receiver either directly or through a modem.

When **Micro-Manager** is started, it immediately attempts to open the specified communications port (see Section 3.1.1). If the receiver is directly connected to the specified port (i.e., the receiver is connected via RS-232 cable to the computer), then the connection is established simply by opening the communication port. At this point, however, **Micro-Manager** does not know the communication parameters of the GPS receiver. If the receiver is configured with the same values specified in **Micro-Manager** (i.e., under Section 3.1.1), then no further work is needed to connect with the receiver. However, if you are unsure of the receiver’s communication settings (or the lower right corner of the status bar indicates that **Micro-Manager** does not know the type of receiver connected), simply select the “File” menu option of the main window and then select the

“Poll Receiver Baud” sub-menu option. This will force **Micro-Manager** to detect the receiver’s communication parameters.

A modem connection can be initiated using one of two approaches. In the first case, select the main program’s “File” menu item and then select the “Dial” submenu item. In the second case, select the main program’s “Configuration” menu item and then select the “Phone List” sub-menu item. In either case, the “Telephone Directory” window (described in Section 3.1.3) will be displayed. Simply select the desired target system’s telephone number and then press the “Dial” button. During the attempt to establish a modem connection a status window will be displayed reporting the progress. An example is provided below.



Once the connection is established, the window will be removed.

#### 4.1.3 Terminating a Remote Connection with the GPS Receiver

To terminate a remote connection (i.e., a modem connection) to a receiver you can either terminate the program or select the “File” main menu option followed by the “Disconnect” sub-menu option. If you issue these commands during a file download or firmware upload operation, you will be asked to confirm the termination of the link.

#### 4.1.4 Status and Display Sub-Windows

**Micro-Manager** provides the following sub-windows that can be displayed while connected to a receiver:

- 1) Diagnostic Messages window
- 2) Receiver Tracking Status window
- 3) Earth-Centered Earth-Fixed Position and Time window
- 4) Geodetic Position and Time window
- 5) Receiver Information window
- 6) RTCM Status window
- 7) Satellite Visibility window

Each of these windows is accessed via the “View” menu selection from **Micro-Manager** and then selecting the appropriate display. You can also access the latter six windows by selecting the “Receiver” main menu option and then selecting the “View Receiver Status” sub-menu option. Once a status window is displayed, you are free to resize any one of them to suite your individual layout desires. To return any window to its default size, with the exception of the Diagnostic Messages window, simply right-click within the display area of the window and choose the “Window Size to Default” option.

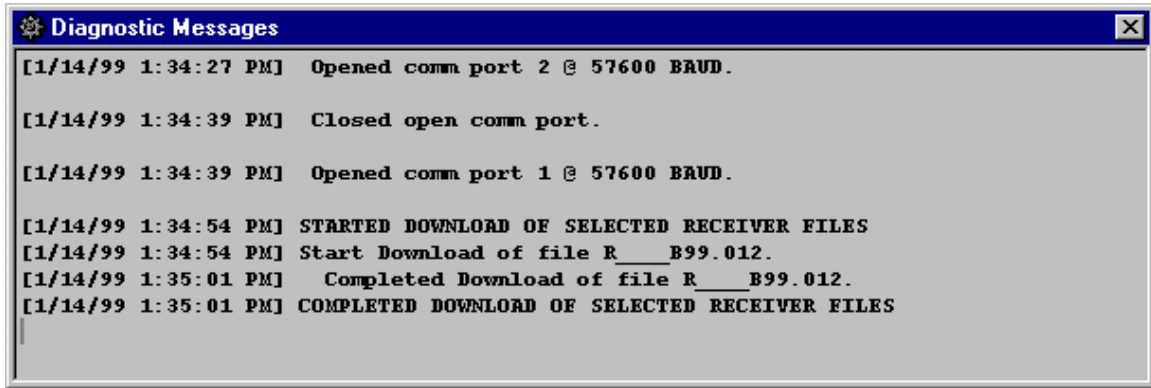
It is important to note that when any of the latter six windows are displayed, **Micro-Manager** will attempt to query the receiver for the information needed. This may seem obvious but it is important. It is important because even if you do not have a receiver attached to the computer, either directly or through a modem, **Micro-Manager** will attempt to request the data from the receiver. Because no receiver would be responding to the query, **Micro-Manager** will begin reporting errors. To circumvent the error reporting, you will need to close the window and then re-open it after you have established a connection.

If you exit the program and have not closed these sub-windows, then the next time you start **Micro-Manager**, the windows will still be in their opened state. If, at that moment, a receiver is not attached, the program will again begin reporting errors. Section 3.1.4.5 describes how to have these windows automatically suppressed at the start of **Micro-Manager**. Suppressing these windows at program start-up will ensure that **Micro-Manager** does not attempt to obtain the status data immediately and will, therefore, not report the aforementioned start-up errors when a receiver is not connected.

It is also important to note that if any of these status windows are displayed when any of the receiver interfacing windows (see Section 4.1.5) become active, then the status windows will become disabled and will not update. This is because **Micro-Manager** disables all status updates during the interfacing activities described in Section 4.1.5. Once the interfacing windows are closed, any visible status windows are then re-activated and commence their normal updating operations.

#### 4.1.4.1 Diagnostic Message Window

The Diagnostic Messages window displays real-time textual messages providing information regarding current activities of **Micro-Manager**. Most messages are time tagged with the current CPU time (i.e., not the current GPS time). These time tags are enclosed within bracket characters (i.e., “[“ and “]”). The following is an example of the Diagnostic Message window.



If you have selected the log file output option, some or all of these messages will be written to the log file (see Section 3.1.4.2).

#### 4.1.4.2 Receiver Tracking Status Window

The following is an example of the Receiver Tracking Status window.

Channel	1	2	3	4	5	6	7	8	9	10	11	12
Satellite PRN	3	23	17	9	21	6	15	14	31	10	26	18
L1 CA S/N	50	49	47	SRC	43	44	49	SRC	SRC	SRC	46	SRC
L1 P S/N	45	50	45	SRC	43	43	43	SRC	SRC	SRC	43	SRC
L2 P S/N	40	46	40	SRC	38	38	39	SRC	SRC	SRC	39	SRC
L1 CA Cnt	999	999	999		999	999	999				999	
L1 P Cnt	999	999	999		999	999	999				999	
L2 P Cnt	999	999	999		999	999	999				999	
Elevation	8	49	81		7	19	6				57	
Azimuth	318	303	314		280	207	316				45	
URA	1	1	2		1	0	0				1	
Health	0	0	0		0	0	0				0	

The receiver tracking status display is based upon channel numbers, which are shown across the top of the window.

The row labeled “Satellite PRN” is used to show which satellite, by its Pseudo-Random Noise number, is being tracked on each channel. Columns which are mostly empty and have the “SRC” status below the PRN ID show channels which are not actually tracking satellites, however tracking is being attempted (i.e., the receiver is in a search mode on those channels).

The rows labeled “L1 C/A S/N”, “L1 P S/N”, and “L2 P S/N” display the signal to noise value reported by the receiver for that satellite on the L1 C/A Code tracking loop, the L1 P-Code tracking loop, and the L2 P-Code tracking loop, respectively. For specifics on the exact meaning of the reported signal to noise values, you should consult your receiver manual.

The rows labeled “L1 C/A Cnt”, “L1 P Cnt”, and “L2 P Cnt” display the continuous tracking count values reported by the receiver on the L1 C/A Code tracking loop, the L1 P-Code tracking loop, and the L2 P-Code tracking loop, respectively. These continuous tracking counters are used to indicate how long the tracking loop has maintained “lock”. The counters will reset to zero when “loss-of-lock” occurs and increase while continuous tracking is maintained. Once a counter reaches 999, it will stay at 999 until a “loss-of-lock” is reported by the receiver. Again, for specifics on the exact meaning on the continuous tracking counters, consult your receiver manual.

The “Elevation” row displays the elevation (degrees) of the satellite being tracked. The “Azimuth” row displays the azimuth (degrees) of the satellite. When the receiver cannot compute a position (e.g., when there are too few satellites to compute a position), the reported satellite elevations and azimuths will be zero.

The reported “URA” (User Range Accuracy) and “Health” are obtained from the most recent broadcast navigation message transmitted by the satellite. For specifics on the exact meaning of the URA and Health indicators, consult your receiver manual.

As with all other windows in the program, **Micro-Manager** will show the units of a displayed field if you rest the cursor over that field for a couple of seconds. Also, please see the Section 4.1.4 note on how **Micro-Manager** queries data for this window from the receiver.

#### 4.1.4.3 Earth-Centered Earth-Fixed Position and Time Window

The Earth-Centered Earth-Fixed (ECEF) Position and Time window displays the following information:

- 1) The current GPS time as reported by the receiver;
- 2) The current GMT time reported by the receiver;
- 3) Information on the current position computed by the receiver; and
- 4) Information on the fixed receiver position stored in the receiver.

The following are two examples of this window.

ECEF Position and Time			
Epoch GPS Time:	Sep 26, 2000 14:23:45.00	(Wk: 1081	Sec: 224625.00)
Epoch GMT Time:	Sep 26, 2000 14:23:32.00	(Wk: 1081	Sec: 224612.00)
Autonomous Point Position (WGS-84)			
X:	1091080.838	PDOP:	3
Y:	-4881729.272	HDOP:	1
Z:	3943922.059	VDOP:	2
Num Sats:	7	TDOP:	1
Count:	518120	COG:	75.30
Site:	????	SOG:	0.10
Base Station Reference Position (WGS-84)			
X:	1091086.993		
Y:	-4881714.997		
Z:	3943894.007		

ECEF Position and Time			
Epoch GPS Time:	Sep 26, 2000 14:24:31.20	(Wk: 1081	Sec: 224671.20)
Epoch GMT Time:	Sep 26, 2000 14:24:18.20	(Wk: 1081	Sec: 224658.20)
Autonomous Point Position (WGS-84)			
X:	1091080.708	PDOP:	3
Y:	-4881729.970	HDOP:	1
Z:	3943922.344	VDOP:	2
Num Sats:	7	TDOP:	1
Count:	518582	COG:	340.20
Site:	????	SOG:	0.10
Base Station Reference Position (WGS-84)			
X:	None		
Y:	None		
Z:	None		

In the first example, a reference position has been set in the receiver (see Section 4.1.5.4.3). In the second example, a reference position has not been set in the receiver.

The ECEF Position and Time window is divided into three parts: 1) The current GPS and GMT time reported by the receiver; 2) the current point position computed by the receiver; and 3) the reference station position. The upper area of the window contains the GPS and GMT time reported by the receiver. The middle portion contains information obtained from the most recent point position solution reported by the receiver. The lower portion of the window contains the reference position information configured for the receiver (see Section 4.1.5.4.3). When no reference station position information has been stored by the receiver, all components of the lower portion of the window will be displayed as “none” (i.e., no fixed position entered).

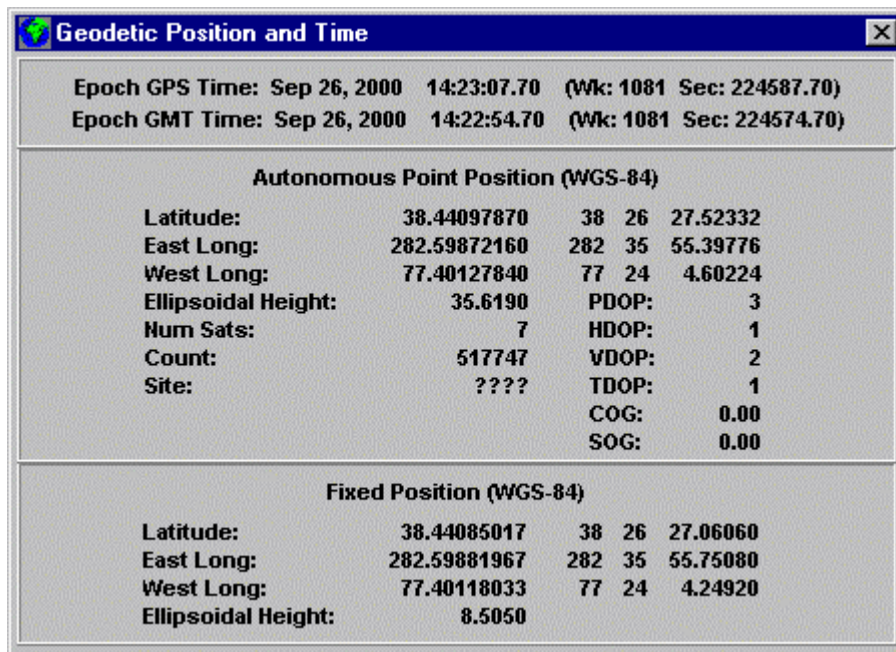
As with all other windows in the program, **Micro-Manager** will show the units of a displayed field if you rest the cursor over that field for a couple of seconds. Also, please see the Section 4.1.4 note on how **Micro-Manager** queries data for this window from the receiver.

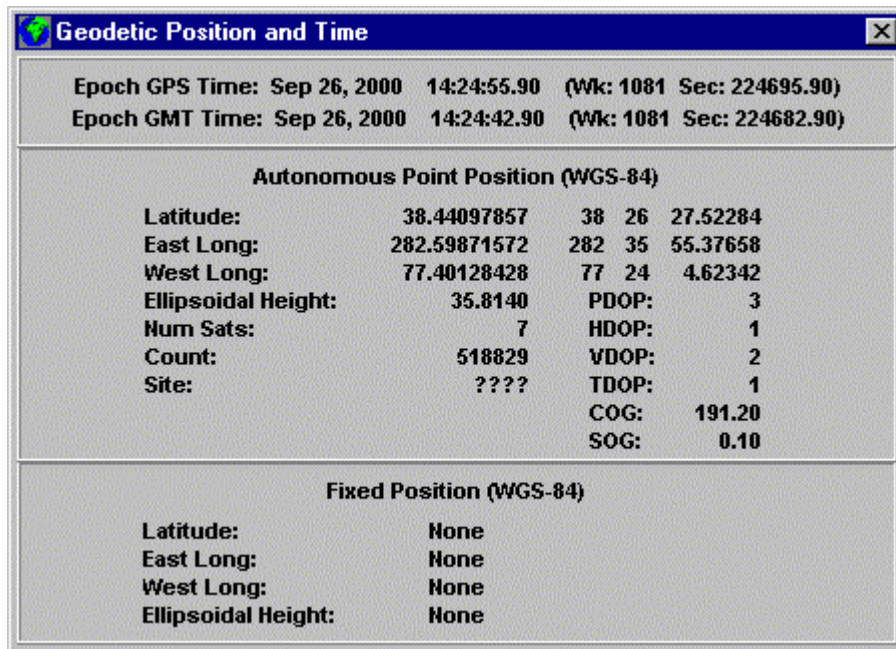
#### 4.1.4.4 Geodetic Position and Time Window

Like the Earth-Centered Earth-Fixed (ECEF) Position and Time window, the Geodetic Position and Time window displays the following information:

- 1) The current GPS time as reported by the receiver;
- 2) The current GMT time reported by the receiver;
- 3) Information on the current position computed by the receiver; and
- 4) Information on the fixed receiver position stored in the receiver.

The following are two examples of this window.





In the first example, a reference position has been set in the receiver (see Section 4.1.5.4.3). In the second example, a reference position has not been set in the receiver.

The Geodetic Position and Time window is divided into three parts: 1) The current GPS and GMT time reported by the receiver; 2) the current point position computed by the receiver; and 3) the reference station position. The upper area of the window contains the GPS and GMT time reported by the receiver. The middle portion contains information obtained from the most recent point position solution reported by the receiver. The lower portion of the window contains the reference position information configured for the receiver (see Section 4.1.5.4.3). When no reference station position information has been stored by the receiver, all components of the lower portion of the window will be displayed as “none” (i.e., no fixed position entered).

As with all other windows in the program, **Micro-Manager** will show the units of a displayed field if you rest the cursor over that field for a couple of seconds. Also, please see the Section 4.1.4 note on how **Micro-Manager** queries data for this window from the receiver.

#### 4.1.4.5 Receiver Information Window

The Receiver Information window displays various information about the receiver; an example of this follows.



The screenshot shows a window titled "Receiver Information" with the following fields and values:

Receiver Type:	UJZ-12
Serial Number:	ANNTIEN
Nav Version:	UFB5
Channel Version:	0A16
Configuration:	N/A
Options:	BUEXMFT3JK
Number of Files:	8
Free Memory:	75%
Receiver Port:	A
Port Speed:	115200
Settings Save Mode:	On
Ring File Mode:	Off
Clock Used:	Internal
External Clock Freq:	n/a
Internal Clock Steering:	Enabled

The table which follows provides a description of each of the values in this window.

Field	Description
Receiver Type	Describes the type of receiver currently connected to <b>Micro-Manager</b> .
Serial Number	Provides the receiver's serial number.
Nav Version	The receiver's navigation firmware version number.
Channel Version	The receiver's channel firmware version number.
Configuration	The receiver's configuration options (consult the Receiver Operations Manual for details). This parameter is not reported currently by the $\mu$ Z-Family receivers.
Options	The current options supported by the receiver (consult the Receiver Operations Manual for details).
Number of Files	The number of data files stored in the receiver's memory.
Free Memory	The percentage of memory remaining (i.e., unused receiver memory).
Receiver Port	The communications port of the receiver over which <b>Micro-Manager</b> is currently communicating.
Port Speed	The speed of the communications port over which <b>Micro-Manager</b> is currently communicating.

Field	Description
Settings Save Mode	Indicates whether or not various receiver parameters (e.g., satellite elevation mask and epoch interval) will be saved between receiver power cycles (i.e., turned off and then later turned back on). For $\mu$ Z-CGRS receivers, this parameter will always be “On”: i.e., the receiver is always in “Save Mode”. For other $\mu$ Z-Family receivers, the save mode is selectable and can be configured through <b>Micro-Manager</b> (see Section 4.1.5.4.6). The value reported here is the value set by the receiver command “\$PASHS,SAV,...” command. Please consult your receiver manual for details on that command and the receiver parameters affected by the receiver parameters save mode.
Ring File Mode	Indicates whether or not the receiver’s Ring Buffer File Mode is enabled. When this mode is enabled, the receiver is designed to always make room for the most recent data by deleting older files. When in this mode, the receiver manages the files automatically (i.e., deleting the oldest file when more room is needed to store recent data). When the Ring Buffer File Mode is not enabled, the receiver will stop recording data once the receiver’s memory becomes full. For complete details on the Ring Buffer File Mode, please consult the receiver manuals. <b>Micro-Manager</b> does permit the changing of this mode (see Section 4.1.5.4.6).

<b>Field</b>	<b>Description</b>
Clock Used	<p>Indicates the clock in use. That is, the <math>\mu</math>Z-Family receivers, support the use of external clocks. The receiver can be configured (see Section 4.1.5.4.1) such that it will utilize the internal clock, utilize an external clock, or to automatically switch between the two clocks. Values displayed in this field indicate the current clock use mode:</p> <p>“Internal”                      Implies that the internal clock is being used.</p> <p>“External (locked)”            Indicates that an external clock is configured and that the receiver has locked onto its clock signal.</p> <p>“External (unlocked)”        Indicates that an external clock is configured and that the receiver is not able to, or has not yet, locked onto its clock signal.</p> <p>“Auto-switch (locked)”       Indicates that the automatic clock switching mode has been enabled and that the receiver has locked onto the external clock signal (and, therefore, the external clock is in use).</p> <p>“Auto-switch (unlocked)”    Indicates that the automatic clock switching mode has been enabled, but also that the receiver is not able to, or has not yet, locked onto its clock signal.(and, therefore, the internal receiver clock is in use).</p> <p>For more details on the use of external clocks, please consult the appropriate receiver operations manual.</p>
External Clock Freq.	<p>When the “Clock Used” field indicates the external clock frequency configured for the receiver when an external clock (or Auto-switched) is configured for the receiver (see Section 4.1.5.4.1 for configuration details).</p>

Field	Description
Internal Clock Steering	<p>This field is used to indicate whether the steering of the receiver's internal clock is enabled or disabled. This parameter has no meaning (and is therefore displayed as "n/a") when an external clock is being used. However, when in an Auto-switch external clock mode, an "Enabled" status means that the clock steering will be used whenever the receiver switches to the internal clock</p> <p>When "Enabled" is displayed, the receiver's internal clock is steered such that its clock offset remains close to zero (i.e., the receiver's clock will remain very closely aligned with the GPS time system). When "Disabled" is displayed, the receiver's clock will not be steered and be permitted to drift with respect to the GPS time system. In this mode, the receiver's clock offset (and pseudo-range observations) will experience 1 millisecond jumps. These jumps occur when the receiver's clock offset has been computed to be approximately 1 ms offset from GPS time. For further details on this subject, please consult the appropriate receiver operations manual.</p>

As with all other windows in the program, **Micro-Manager** will show the units of a displayed field if you rest the cursor over that field for a couple of seconds. Also, please see the Section 4.1.4 note on how **Micro-Manager** queries data for this window from the receiver.

#### 4.1.4.6 RTCM Status Window

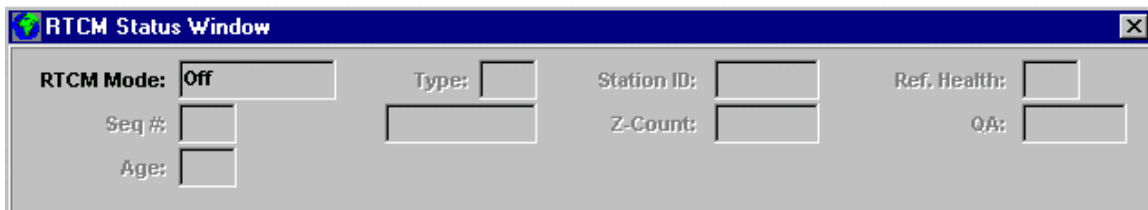
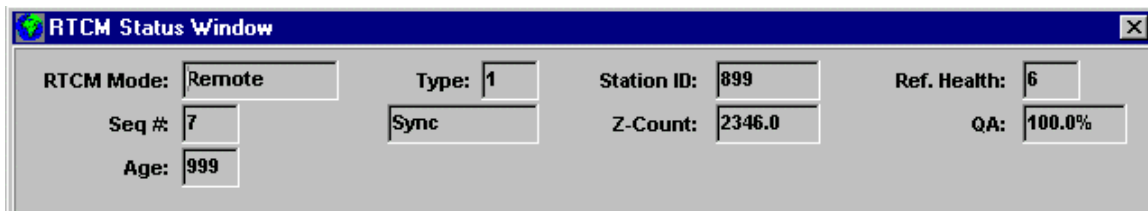
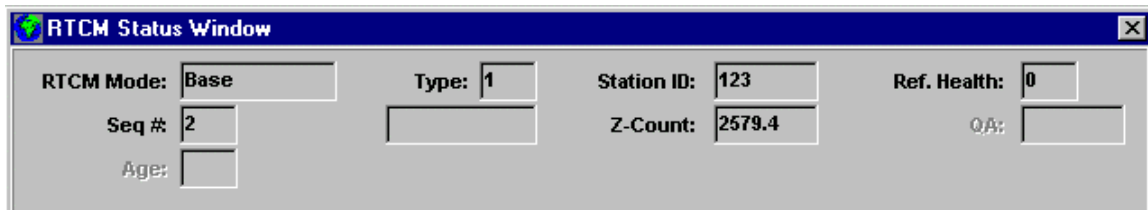
The RTCM Status window provides RTCM status information provided by the GPS receiver. The appearance of the window and the general meaning of the parameters differ depending upon the RTCM mode of the receiver. That is, when the GPS receiver is configured as an RTCM base station (see Section 4.1.5.4.7) the RTCM Status window displays status information about the base station and information about RTCM messages output by the base station. When the GPS Receiver is configured as an RTCM remote station (see Section 4.1.5.4.7) the RTCM Status window displays status information about the remote station and information about RTCM messages received by the remote station. The receiver can also be configured such that its RTCM mode is disabled (i.e., it is not an RTCM participant).

The RTCM Status window consists of two major sections. The upper section of the window deals with RTCM status of the receiver and contains information about the most recently sent or received RTCM message (depending upon base or remote RTCM mode of the receiver). The lower section of the window provides information on each type of RTCM message sent or received by the receiver.

It is important to note that while **Micro-Manager** supports the configuration and display of  $\mu$ Z-Family receivers participating as RTCM remote receivers. At the time of

the publication of this document, Magellan had not fully tested the support of the  $\mu Z$ -family receivers as RTCM remote stations in the **Micro-Manager** environment. In this document we will still fully describe the information displayed by remote RTCM participants but caution the user that they use this option at their own risk.

To distinguish which mode the receiver is in, one must view the upper section of the RTCM status window. In particular, one should pay attention to the value of the “RTCM Mode” parameter. Below are screen captures from **Micro-Manager** when the receiver is in each of the three RTCM modes (Base Station Mode, Remote Station Mode, and non-participating, respectively).



Notice in the above windows examples that some fields are disabled (denoted by the light gray) in different modes. This is because these fields are not applicable under those modes. For example, the QA parameter, a parameter that describes the quality of communications based upon received RTCM messages, is reported only by an RTCM remote station.

The following table contains a description of each parameter displayed in the upper section of the RTCM Status Window.

Field	Description
RTCM Mode	Provides an indication of the RTCM mode of the receiver (Base/Remote/Off).
Type	The RTCM message type of the most recent message sent (Base mode) or received (Remote mode).

<b>Field</b>	<b>Description</b>								
Station ID	The RTCM identifier of the reference station (0 to 1023), also known as the RTCM STID. When the receiver is in Base mode, this indicates the station ID of the receiver as an RTCM reference station. When the receiver is in the Remote mode, this field indicates the reference station from which the RTCM messages are being received.								
Ref. Health	The health flag being reported by the Reference RTCM receiver. When the receiver is an RTCM base station, this value indicates the health that the station is broadcasting in its RTCM messages. When the receiver is an RTCM remote station, this value indicates the health of the participating reference station as is reported in the RTCM messages received from the participating RTCM base station.								
Seq #	The RTCM Sequence Number (SQNU) attached to the RTCM messages being sent (Base mode) or received (Remote mode).								
<i>Field under Type</i>	<p>The field under the “Type” field represents the RTCM Synchronization Flag and is only reported when the receiver is participating as an RTCM remote site. The flag is used to indicate synchronization with the RTCM messages. The three possible values and their meanings are as follows:</p> <table border="1"> <thead> <tr> <th><u>Value</u></th> <th><u>Description</u></th> </tr> </thead> <tbody> <tr> <td>No Msg</td> <td>No RTCM Messages have been received.</td> </tr> <tr> <td>Not Sync.</td> <td>The RTCM Messages are not synchronized: i.e., the received RTCM message appears to be older than the maximum RTCM age parameter (see Section 4.1.5.4.7).</td> </tr> <tr> <td>Sync.</td> <td>The received RTCM messages are synchronized and fit within the maximum age parameter (see Section 4.1.5.4.7).</td> </tr> </tbody> </table>	<u>Value</u>	<u>Description</u>	No Msg	No RTCM Messages have been received.	Not Sync.	The RTCM Messages are not synchronized: i.e., the received RTCM message appears to be older than the maximum RTCM age parameter (see Section 4.1.5.4.7).	Sync.	The received RTCM messages are synchronized and fit within the maximum age parameter (see Section 4.1.5.4.7).
<u>Value</u>	<u>Description</u>								
No Msg	No RTCM Messages have been received.								
Not Sync.	The RTCM Messages are not synchronized: i.e., the received RTCM message appears to be older than the maximum RTCM age parameter (see Section 4.1.5.4.7).								
Sync.	The received RTCM messages are synchronized and fit within the maximum age parameter (see Section 4.1.5.4.7).								
Z-Count	The RTCM message Z-Count (ZCNT). The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).								
QA	The communication quality factor and is displayed/enabled only when the receiver is a participating RTCM remote station. This factor is defined as 100 times the number of good messages divided by the total number of messages.								
Age	Used in remote mode to indicate the age (in seconds) of the received RTCM messages.								

As with all other windows in the program, **Micro-Manager** will show the units of a displayed field if you rest the cursor over that field for a couple of seconds. Also, please see the Section 4.1.4 note on how **Micro-Manager** queries data for this window from the receiver.

Section 4.1.5.4.7 describes the **Micro-Manager** window used to configure the receiver RTCM mode.

The following subsections provide a description of the lower portion of the RTCM Status Window. In each of these subsections, we will refer to the messages as being sent by the RTCM base station even though the contents of the message could have been received by the participating RTCM remote station. We do this only in the interest of reducing the redundancy in this document. Therefore, unless otherwise noted, we will be referring to both messages sent and received (by the RTCM base and RTCM remote stations, respectively).

Additionally, this document was written when Version 2.2 of the RTCM standard was in effect and implemented by the receiver firmware. Should your receiver not implement this standard then the descriptions which follow may or may not be applicable. For complete details on the RTCM standard, please contact:

Radio Technical Commission for Maritime Services  
 655 Fifteenth Street, NW, Suite 300  
 Washington, D.C. 20005 (USA)

#### 4.1.4.6.1 RTCM Type 1 Display

RTCM Type 1 messages communicate Differential GPS Corrections. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 1 messages. The display shows the last RTCM Type 1 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		16:29:52.00 (age: 00:00:06.20)											
Station ID:		123				Z-Count:		1804.2					
Ref. Health:		0				Seq #:		1					
SVPRN	23	21	15	29									
PRC	-1.12	4.70	4.22	4.86									
RRC	0.000	0.002	-0.002	0.000									
IODE	172	17	84	31									
UDRE	0	0	1	0									

The following table contains a description of each parameter displayed in the RTCM Type 1 message display.

<b>Field</b>	<b>Description</b>
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 1 message was sent (for Base station) or received (for Rover stations). If the message is over one second old, then the time will also contain an age display. If such a message has not yet been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 1 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 1 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 1 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 1 message.
SVPRN	The SVPRN row displays the GPS satellite numbers for which there are RTCM correctors in the Type 2 message.
PRC	The Pseudo-Range Correctors (meters) for each satellite contained in the Type 1 message.
RRC	The Range-Rate Correctors (meters/second) for each satellite contained in the Type 1 message.
IODE	The Issue of Data Ephemeris for each satellite corrector contained in the Type 1 message.
UDRE	The User Differential Range Error for each satellite corrector contained in the Type 1 message.



#### 4.1.4.6.2 RTCM Type 2 Display

RTCM Type 2 messages communicate Delta Differential GPS Corrections. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 2 messages. The display shows the last RTCM Type 2 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		17:09:15.00 (age: 00:00:20.32)											
Station ID:		123				Z-Count:		567.6					
Ref. Health:		0				Seq #:		2					
SVPRN	9	21	15	29									
Delta PRC	0.140	0.140	0.240	0.000									
Delta RRC	0.000	0.000	0.000	0.000									
IODE	160	16	83	30									
UDRE	1	0	1	0									

The following table contains a description of each parameter displayed in the RTCM Type 2 message display.

Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 2 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 2 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 2 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 2 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 2 message.
SVPRN	The SVPRN row displays the GPS satellite numbers for which there are RTCM correctors in the Type 2 message.
PRC	The change in the Pseudo-Range Correctors (meters) for each satellite as caused by a change in the satellite navigation message.

Field	Description
RRC	The change in Range-Rate Correctors (meters/second) for each satellite as caused by a change in the satellite navigation message.
IODE	The Issue of Data Ephemeris for each satellite prior to the change in the satellite navigation message.
UDRE	The User Differential Range Error for each satellite corrector as obtained with the navigation data prior to the change.

#### 4.1.4.6.3 RTCM Type 3 Display

RTCM Type 3 messages communicate the Reference Station Parameters (i.e., the position of the reference receiver). The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 3 messages. The display shows the last RTCM Type 3 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		17:26:48.00 (age: 00:00:38.85)											
Station ID:		123					Z-Count:		1620.0				
Ref. Health:		0					Seq #:		0				
North Latitude:		38.4408725034			38		26		27.141013				
East Longitude:		282.5987937879			282		35		55.657637				
West Longitude:		77.4012062121			77		24		4.342363				
Ellipsoid Height:		23.949											
ECEF - X			ECEF - Y			ECEF - Z							
1091087.0900			-4881725.7900			3943905.5500							

The following table contains a description of each parameter displayed in the RTCM Type 3 message display.

<b>Field</b>	<b>Description</b>
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 3 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain “None Received”.
Station ID	The RTCM Base Station ID contained in the Type 3 message
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 3 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 3 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 3 message.
North Latitude, East Longitude, West Longitude, and Ellipsoid Height	The geodetic position (WGS-84) of the reference RTCM receiver identified by the “Station ID” field of the Type 3 message.
ECEF-X, ECEF-Y, and ECEF-Z	The Earth-Centered Earth-Fixed coordinates (WGS-84) of the reference RTCM receiver identified by the “Station ID” field of the Type 3 message.

#### 4.1.4.6.4 RTCM Type 6 Display

RTCM Type 6 messages are the RTCM Null Frame messages. These messages contain no parameters and are used as a transmission fill. According to the RTCM standard, they are used to “provide messages when the Reference Station has no other messages ready to be sent”. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 6 messages. The display shows the last RTCM Type 6 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		17:39:34.00											
Station ID:		123				Z-Count:		2385.6					
Ref. Health:		0				Seq #:		2					
No Message Body in a Type 6 Message (i.e., the RTCM Null Message)													

The following table contains a description of each parameter displayed in the RTCM Type 6 message display.

Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 6 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 6 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 6 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 6 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 6 message.

#### 4.1.4.6.5 RTCM Type 9 Display

RTCM Type 9 messages communicate a partial set of Differential GPS Corrections. The contents of the message are the same as that for Type 1 messages. The only difference between the two messages is that Type 1 was designed to contain correctors for all visible satellites in a single message, while Type 9 was designed to interleave the correctors over several messages. Ashtech  $\mu$ Z-Family receivers will send up to 3 sets of correctors per Type 9 message.

The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 9 messages. The display shows the last RTCM Type 9 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		17:46:28.00											
Station ID:		123				Z-Count:		2800.8					
Ref. Health:		5				Seq #:		6					
SVPRN		5				PRC		-13.9					
RRC		0.000				IODE		157					
UDRE		1											

The following table contains a description of each parameter displayed in the RTCM Type 9 message display.

Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 9 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 9 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 9 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 9 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 9 message.
SVPRN	The SVPRN row displays the GPS satellite numbers for which there are RTCM correctors in the Type 9 message.
PRC	The Pseudo-Range Correctors (meters) for each satellite contained in the Type 9 message.

Field	Description
RRC	The Range-Rate Correctors (meters/second) for each satellite contained in the Type 9 message.
IODE	The Issue of Data Ephemeris for each satellite corrector contained in the Type 9 message.
UDRE	The User Differential Range Error for each satellite corrector contained in the Type 9 message.

#### 4.1.4.6.6 RTCM Type 15 Display

RTCM Type 15 messages communicate Ionosphere and Troposphere parameters. However, the  $\mu$ Z-Family receivers do not currently report this message to **Micro-Manager**. As such, this section simply maintains a placeholder for future developments.

The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 15 messages. The display shows the last RTCM Type 15 message sent.

The screenshot shows a software interface with a menu bar at the top containing buttons for 'Type 1', 'Type 2', 'Type 3', 'Type 6', 'Type 9', 'Type 15', 'Type 16', 'Type 18', 'Type 19', 'Type 20', 'Type 21', and 'Type 15' (highlighted). Below the menu, there are several input fields: 'Time Of Message:' with the value 'None Received', 'Station ID:' with an empty box, 'Ref. Health:' with an empty box, 'Z-Count:' with an empty box, and 'Seq #:' with an empty box. The main content area displays the text 'No Type 15 Message Body Available from Receiver'.

The following table contains a description of each parameter displayed in the RTCM Type 15 message display.

Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 15 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 15 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 15 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 15 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 15 message.
	No message body as the $\mu$ Z-Family receivers do not yet communicate the contents of Type 15 messages to <b>Micro-Manager</b> .

#### 4.1.4.6.7 RTCM Type 16 Display

RTCM Type 16 messages communicate a special text message. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 16 messages. The display shows the last RTCM Type 16 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		18:08:48.00 (age: 00:00:03.37)											
Station ID:		123				Z-Count:		540.0					
Ref. Health:		0				Seq #:		0					
Type 16 Message Body:													
This is a test message from Base Station													

The following table contains a description of each parameter displayed in the RTCM Type 16 message display.

Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 16 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 16 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 16 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 16 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 16 message.
Type 16 Message Body	The text of the special message in the Type 16 message.

#### 4.1.4.6.8 RTCM Type 18 Display

RTCM Type 18 messages communicate uncorrected carrier phase measurements typically used in Real-Time Kinematic applications. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 18 messages. The display shows the last RTCM Type 18 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty <	>
Time Of Message:		18:12:28.00 (age: 00:00:06.52)										
Station ID:		123					Z-Count:		759.6			
Ref. Health:		0					Seq #:		0			
SV	Freq	Wlen	Code	Qual	Loss	Carrier						
5	L1	F	CA	3	0	-587575.617						
5	L2	F	P	3	0	-482272.703						
11	L1	F	CA	3	0	1219760.664						
11	L2	F	P	3	0	7466706.645						
21	L1	F	CA	3	0	1312941.797						
21	L2	F	P	3	0	-1048926.887						
25	L1	F	CA	3	0	2981896.988						
25	L2	F	P	3	0	2275523.359						
29	L1	F	CA	3	0	5313191.570						
29	L2	F	P	3	0	2240148.387						



The following table contains a description of each parameter displayed in the RTCM Type 18 message display.

<b>Field</b>	<b>Description</b>																		
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 18 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".																		
Station ID	The RTCM Base Station ID contained in the Type 18 message.																		
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 18 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).																		
Ref. Health	The health flag being reported in the Type 18 message.																		
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 18 message.																		
SV	Each element <i>SV</i> column contains satellite number pertaining to that row.																		
Freq	Each element of the <i>Freq</i> column contains the frequency (L1 or L2) of the carrier phase observation for the satellite on that row.																		
Wlen	Each element of the <i>Wlen</i> column contains the wavelength (F=Full, H = Half) of the carrier phase observation for the satellite on that row.																		
Code	Each element of the <i>Code</i> column contains the codephase tracking loop (CA = C/A, P = P-Code) of the carrier phase observation for the satellite on that row.																		
Qual	Each element of the <i>Qual</i> column contains the quality indicator for the carrier phase observation for the satellite on that row. According to the RTCM standard (Version 2.2), the carrier phase quality indicator is the one sigma phase measurement error as indicated below: <table border="1" data-bbox="500 1444 1386 1793"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Phase Error <math>\leq</math> 0.00391 Cycles</td> </tr> <tr> <td>1</td> <td>Phase Error <math>\leq</math> 0.00696 Cycles</td> </tr> <tr> <td>2</td> <td>Phase Error <math>\leq</math> 0.01239 Cycles</td> </tr> <tr> <td>3</td> <td>Phase Error <math>\leq</math> 0.02208 Cycles</td> </tr> <tr> <td>4</td> <td>Phase Error <math>\leq</math> 0.03933 Cycles</td> </tr> <tr> <td>5</td> <td>Phase Error <math>\leq</math> 0.07006 Cycles</td> </tr> <tr> <td>6</td> <td>Phase Error <math>\leq</math> 0.12480 Cycles</td> </tr> <tr> <td>7</td> <td>Phase Error <math>&gt;</math> 0.12480 Cycles</td> </tr> </tbody> </table>	Value	Description	0	Phase Error $\leq$ 0.00391 Cycles	1	Phase Error $\leq$ 0.00696 Cycles	2	Phase Error $\leq$ 0.01239 Cycles	3	Phase Error $\leq$ 0.02208 Cycles	4	Phase Error $\leq$ 0.03933 Cycles	5	Phase Error $\leq$ 0.07006 Cycles	6	Phase Error $\leq$ 0.12480 Cycles	7	Phase Error $>$ 0.12480 Cycles
Value	Description																		
0	Phase Error $\leq$ 0.00391 Cycles																		
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5	Phase Error $\leq$ 0.07006 Cycles																		
6	Phase Error $\leq$ 0.12480 Cycles																		
7	Phase Error $>$ 0.12480 Cycles																		

Field	Description
Loss	Each element of the <i>Loss</i> column contains the cumulative loss of continuity indicator for the carrier phase observation for the satellite on that row. According to the RTCM standard (Version 2.2), the cumulative loss of continuity indicator will be incremented each time there is an unfixed cycle-slip or loss of lock. Once the counter reaches its maximum value (i.e., 32) it will roll over to 0.
Carrier	Each element of the <i>Carrier</i> column contains the carrier phase observation (cycles) for the satellite on that row.

#### 4.1.4.6.9 RTCM Type 19 Display

RTCM Type 19 messages communicate uncorrected pseudorange measurements typically used in Real-Time Kinematic and differential applications. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 19 messages. The display shows the last RTCM Type 19 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty
Time Of Message:		18:34:18.00 (age: 00:00:05.02)									
Station ID:		123					Z-Count:		2069.4		
Ref. Health:		0					Seq #:		3		
SV	Freq	Smooth	Code	Qual	MP	Range					
11	L1	0	CA	7	15	23738609.860					
11	L2	0	P	7	15	23738619.340					
15	L1	0	CA	7	15	23767573.240					
15	L2	0	P	7	15	23767585.780					
21	L1	0	CA	7	15	20520511.760					
21	L2	0	P	7	15	20520518.040					
23	L1	0	CA	7	15	23807011.660					
23	L2	0	P	7	15	23807026.160					
25	L1	0	CA	7	15	21897281.780					
25	L2	0	P	7	15	21897286.440					

The following table contains a description of each parameter displayed in the RTCM Type 19 message display.

<b>Field</b>	<b>Description</b>										
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 19 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".										
Station ID	The RTCM Base Station ID contained in the Type 19 message.										
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 19 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).										
Ref. Health	The health flag being reported in the Type 19 message.										
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 19 message.										
SV	Each element <i>SV</i> column contains satellite number pertaining to that row.										
Freq	Each element of the <i>Freq</i> column contains the frequency (L1 or L2) of the pseudorange observation for the satellite on that row.										
Smooth	Each element of the <i>Smooth</i> column contains the smoothing interval of the pseudorange observation for the satellite on that row. According to the RTCM standard (Version 2.2), the smoothing interval indicates the interval for carrier smoothing of the pseudorange observation. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Value</th> <th>Smoothing Interval (minutes)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0 to 1</td> </tr> <tr> <td>1</td> <td>1 to 5</td> </tr> <tr> <td>2</td> <td>5 to 15</td> </tr> <tr> <td>3</td> <td>Indefinite</td> </tr> </tbody> </table>	Value	Smoothing Interval (minutes)	0	0 to 1	1	1 to 5	2	5 to 15	3	Indefinite
Value	Smoothing Interval (minutes)										
0	0 to 1										
1	1 to 5										
2	5 to 15										
3	Indefinite										
Code	Each element of the <i>Code</i> column contains the codephase tracking loop (CA = C/A, P = P-Code) from which the pseudorange observation is obtained.										

Field	Description																																		
Qual	<p>Each element of the <i>Qual</i> column contains the quality indicator for the pseudorange observation for the satellite on that row. According to the RTCM standard (Version 2.2), the pseudorange quality indicator is the one sigma pseudorange measurement error as indicated below:</p> <table border="1" data-bbox="500 436 1383 1094"> <thead> <tr> <th>Value</th> <th>Description</th> </tr> </thead> <tbody> <tr><td>0</td><td>Pseudorange Error ≤ 0.020 meters</td></tr> <tr><td>1</td><td>Pseudorange Error ≤ 0.030 meters</td></tr> <tr><td>2</td><td>Pseudorange Error ≤ 0.045 meters</td></tr> <tr><td>3</td><td>Pseudorange Error ≤ 0.066 meters</td></tr> <tr><td>4</td><td>Pseudorange Error ≤ 0.099 meters</td></tr> <tr><td>5</td><td>Pseudorange Error ≤ 0.148 meters</td></tr> <tr><td>6</td><td>Pseudorange Error ≤ 0.220 meters</td></tr> <tr><td>7</td><td>Pseudorange Error &gt; 0.329 meters</td></tr> <tr><td>8</td><td>Pseudorange Error ≤ 0.491 meters</td></tr> <tr><td>9</td><td>Pseudorange Error ≤ 0.732 meters</td></tr> <tr><td>10</td><td>Pseudorange Error ≤ 1.092 meters</td></tr> <tr><td>11</td><td>Pseudorange Error ≤ 1.629 meters</td></tr> <tr><td>12</td><td>Pseudorange Error ≤ 2.430 meters</td></tr> <tr><td>13</td><td>Pseudorange Error ≤ 3.626 meters</td></tr> <tr><td>14</td><td>Pseudorange Error ≤ 5.409 meters</td></tr> <tr><td>15</td><td>Pseudorange Error &gt; 5.409 meters</td></tr> </tbody> </table>	Value	Description	0	Pseudorange Error ≤ 0.020 meters	1	Pseudorange Error ≤ 0.030 meters	2	Pseudorange Error ≤ 0.045 meters	3	Pseudorange Error ≤ 0.066 meters	4	Pseudorange Error ≤ 0.099 meters	5	Pseudorange Error ≤ 0.148 meters	6	Pseudorange Error ≤ 0.220 meters	7	Pseudorange Error > 0.329 meters	8	Pseudorange Error ≤ 0.491 meters	9	Pseudorange Error ≤ 0.732 meters	10	Pseudorange Error ≤ 1.092 meters	11	Pseudorange Error ≤ 1.629 meters	12	Pseudorange Error ≤ 2.430 meters	13	Pseudorange Error ≤ 3.626 meters	14	Pseudorange Error ≤ 5.409 meters	15	Pseudorange Error > 5.409 meters
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9	Pseudorange Error ≤ 0.732 meters																																		
10	Pseudorange Error ≤ 1.092 meters																																		
11	Pseudorange Error ≤ 1.629 meters																																		
12	Pseudorange Error ≤ 2.430 meters																																		
13	Pseudorange Error ≤ 3.626 meters																																		
14	Pseudorange Error ≤ 5.409 meters																																		
15	Pseudorange Error > 5.409 meters																																		

Field	Description																																		
MP	<p>Each element of the <i>MP</i> column contains the estimated multipath error indicator for the pseudorange observation for the satellite on that row. The following lists the error associated with the <i>MP</i> value according to the RTCM standard (Version 2.2).</p> <table border="1" data-bbox="500 394 1388 1087"> <thead> <tr> <th data-bbox="500 394 662 430">Value</th> <th data-bbox="662 394 1388 430">Description</th> </tr> </thead> <tbody> <tr><td>0</td><td>Multipath Error <math>\leq</math> 0.100 meters</td></tr> <tr><td>1</td><td>Multipath Error <math>\leq</math> 0.149 meters</td></tr> <tr><td>2</td><td>Multipath Error <math>\leq</math> 0.223 meters</td></tr> <tr><td>3</td><td>Multipath Error <math>\leq</math> 0.332 meters</td></tr> <tr><td>4</td><td>Multipath Error <math>\leq</math> 0.495 meters</td></tr> <tr><td>5</td><td>Multipath Error <math>\leq</math> 0.739 meters</td></tr> <tr><td>6</td><td>Multipath Error <math>\leq</math> 1.102 meters</td></tr> <tr><td>7</td><td>Multipath Error <math>&gt;</math> 1.644 meters</td></tr> <tr><td>8</td><td>Multipath Error <math>\leq</math> 2.453 meters</td></tr> <tr><td>9</td><td>Multipath Error <math>\leq</math> 3.660 meters</td></tr> <tr><td>10</td><td>Multipath Error <math>\leq</math> 5.460 meters</td></tr> <tr><td>11</td><td>Multipath Error <math>\leq</math> 8.145 meters</td></tr> <tr><td>12</td><td>Multipath Error <math>\leq</math> 12.151 meters</td></tr> <tr><td>13</td><td>Multipath Error <math>\leq</math> 18.127 meters</td></tr> <tr><td>14</td><td>Multipath Error <math>&gt;</math> 18.127 meters</td></tr> <tr><td>15</td><td>Multipath error not determined</td></tr> </tbody> </table>	Value	Description	0	Multipath Error $\leq$ 0.100 meters	1	Multipath Error $\leq$ 0.149 meters	2	Multipath Error $\leq$ 0.223 meters	3	Multipath Error $\leq$ 0.332 meters	4	Multipath Error $\leq$ 0.495 meters	5	Multipath Error $\leq$ 0.739 meters	6	Multipath Error $\leq$ 1.102 meters	7	Multipath Error $>$ 1.644 meters	8	Multipath Error $\leq$ 2.453 meters	9	Multipath Error $\leq$ 3.660 meters	10	Multipath Error $\leq$ 5.460 meters	11	Multipath Error $\leq$ 8.145 meters	12	Multipath Error $\leq$ 12.151 meters	13	Multipath Error $\leq$ 18.127 meters	14	Multipath Error $>$ 18.127 meters	15	Multipath error not determined
Value	Description																																		
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1	Multipath Error $\leq$ 0.149 meters																																		
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9	Multipath Error $\leq$ 3.660 meters																																		
10	Multipath Error $\leq$ 5.460 meters																																		
11	Multipath Error $\leq$ 8.145 meters																																		
12	Multipath Error $\leq$ 12.151 meters																																		
13	Multipath Error $\leq$ 18.127 meters																																		
14	Multipath Error $>$ 18.127 meters																																		
15	Multipath error not determined																																		
Range	Each element of the <i>Ranger</i> column contains the pseudorange observation (cycles) for the satellite on that row.																																		

#### 4.1.4.6.10 RTCM Type 20 Display

RTCM Type 20 messages communicate RTK Carrier Phase Corrections. That is, corrections to the carrier phase observations. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 20 messages. The display shows the last RTCM Type 20 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		19:08:48.00 (age: 00:00:08.04)											
Station ID:		123				Z-Count:		539.4					
Ref. Health:		0				Seq #:		3					
SV	Freq	Wlen	Code	Qual	Loss	Corrected Carrier							
5	L1	F	CA	3	0	-161412.453							
5	L2	F	P	3	5	1778576.809							
11	L1	F	CA	3	0	993643.168							
11	L2	F	P	3	0	7290522.598							
25	L1	F	CA	3	2	721529.168							
25	L2	F	P	3	6	529455.613							
29	L1	F	CA	3	1	-12187.910							
29	L2	F	P	3	3	-7723.102							
30	L1	F	CA	3	3	-865833.129							
30	L2	F	P	3	3	-676746.570							

For Type 20 messages, the displayed fields and their meanings, with the exception of the *Corrected Carrier* column, have the exact same meaning as that discussed for type 18 messages (and therefore you should refer to Section 4.1.4.6.8 for a description of these fields). The primary difference between type 18 and 20 messages is that Type 18 messages contain uncorrected carrier phase observations while Type 20 messages contain corrections to the carrier phase observations. **Micro-Manager**, in its *Corrected Carrier* field, displays the remote's carrier phase observation as corrected by the correctors supplied in the Type 20 message.

#### 4.1.4.6.11 RTCM Type 21 Display

RTCM Type 21 messages communicate RTK Pseudorange Corrections. That is, corrections to the pseudorange observations. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 21 messages. The display shows the last RTCM Type 21 message sent.

Type 1	Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Ty	◀	▶
Time Of Message:		19:19:08.00 (age: 00:00:03.34)											
Station ID:		123				Z-Count:		1159.8					
Ref. Health:		0				Seq #:		3					
SV	Freq	Smooth	Code	Qual	MP	Corrected Range							
5	L1	0	CA	7	15	24155594.900							
5	L2	0	P	7	15	24155602.300							
11	L1	0	CA	7	15	24096707.400							
11	L2	0	P	7	15	24096714.780							
29	L1	0	CA	7	15	21019184.680							
29	L2	0	P	7	15	21019189.580							
30	L1	0	CA	7	15	21728502.560							
30	L2	0	P	7	15	21728505.460							

For Type 21 messages, the displayed fields and their meanings, with the exception of the *Corrected Range* column, have the exact same meaning as that discussed for type 19 messages (and therefore you should refer to Section 4.1.4.6.9 for a description of these fields). The primary difference between Type 19 and Type 21 messages is that Type 19 messages contain uncorrected pseudorange observations while Type 21 messages contain corrections to the pseudorange observations. **Micro-Manager**, in its *Corrected Range* column, displays the remote's pseudorange observation as corrected by the correctors supplied in the Type 21 message.

#### 4.1.4.6.12 RTCM Type 22 Display

RTCM Type 22 messages communicate corrections to the Base station position communicated in the Type 3 message. These corrections in the Type 22 messages to provide a more accurate position than can be reported in the Type 3 message. The screen capture that follows shows an example display generated by **Micro-Manager** to report RTCM Type 22 messages. The display shows the last RTCM Type 22 message sent.

Type 2	Type 3	Type 6	Type 9	Type 15	Type 16	Type 18	Type 19	Type 20	Type 21	Type 22	
Time Of Message:		19:26:33.00 (age: 00:00:11.71)									
Station ID:		123				Z-Count:		1605.0			
Ref. Health:		0				Seq #:		4			
Position Correction Values											
X:		1.0700			Y:		-0.1200		Z:		0.1600
Corrected Type 3 Position											
North Latitude:		38.4408716693		38	26	27.138010		Delta North:		0.0926	
East Longitude:		282.5988054490		282	35	55.699617		Delta East:		-1.0181	
West Longitude:		77.4011945510		77	24	4.300383		Delta Height:		-0.3740	
Ellipsoid Height:		24.323									
ECEF - X			ECEF - Y			ECEF - Z					
1091088.1600			-4881725.9100			3943905.7100					

The following table contains a description of each parameter displayed in the RTCM Type 22 message display.

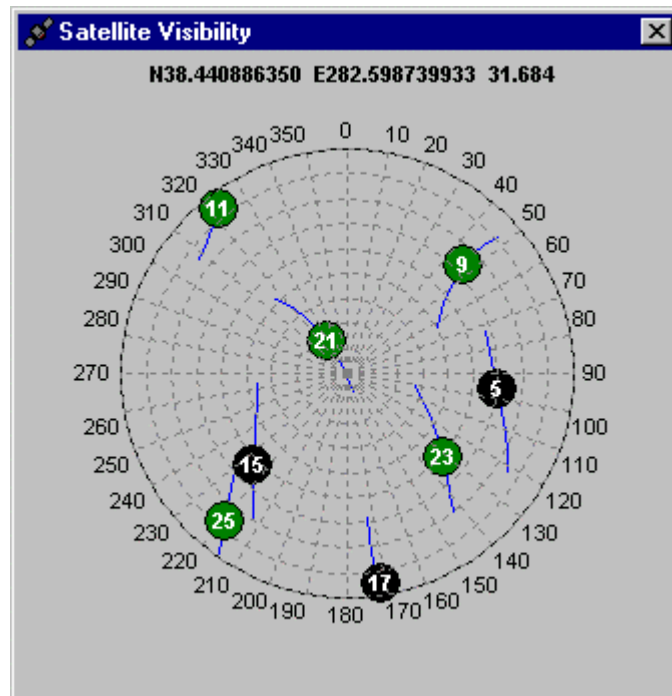
Field	Description
Time Of Message	The GPS time (expressed as time of GPS day) at which the Type 22 message was sent (for Base station) or received (for Rover stations). If the message is over a second old, then the time will also contain an age display. If such a message has not been sent or received, then this field will contain "None Received".
Station ID	The RTCM Base Station ID contained in the Type 22 message.
Z-Count	The RTCM message Z-Count (ZCNT) of the Type 22 message. The RTCM Z-Count is the time tag of the message and is displayed as seconds of the hour (GPS time frame).
Ref. Health	The health flag being reported in the Type 22 message.
Seq #.	The RTCM Sequence Number (SQNU) attached to the RTCM Type 22 message.
Position Corrections for X, Y, and Z	The Earth-Centered Earth-Fixed coordinate correction values (WGS-84) that are to be applied to the position reported in the Type 3 message.
North Latitude, East Longitude, West Longitude, and Ellipsoid Height	The geodetic position (WGS-84) of the reference RTCM receiver identified by the "Station ID" field of the message. The values presented in these fields are the corrected receiver coordinates (i.e., Type 3 message position plus the Type 22 position corrections).



Field	Description
ECEF-X, ECEF-Y, and ECEF-Z	The Earth-Centered Earth-Fixed coordinates (WGS-84) of the reference RTCM receiver identified by the “Station ID” field of the message. The values presented in these fields are the corrected receiver coordinates (i.e., Type 3 message position plus the Type 22 position corrections).
Delta North, Delta East, and Delta Height	Provides the change to the Geodetic coordinates of the Type 3 message (in meters of North, East and Height, respectively) due to the correction supplied in the Type 22 message.

#### 4.1.4.7 Satellite Visibility Window

The Satellite Visibility Window provides a polar plot of the satellites in view (i.e., above the horizon) of the receiver.



The polar plot is an Azimuth/Elevation plot. All displayed satellites are displayed with respect to the position reported by the GPS receiver. Azimuth (0 to 360 degrees) should be obvious. Elevation is represented by the position of the satellite with respect to the center and outermost ring. That is, if the satellite is displayed exactly at the center, then its elevation is 90 degrees. If the satellite is displayed on the outermost ring, then its elevation is 0 degrees. Examples from the window above are:

Satellite	Elevation	Azimuth
9	27°	47°
11	6°	324°
17	6°	173°
21	76°	325°

It is important to note that when the GPS receiver does not provide enough information to generate the display (which is a rare event), the display will remain blank. The information required by **Micro-Manager** for this display includes the receiver's position, tracking information, and satellite almanac information. There are several reasons why the receiver may not be able to report its position. The most common occurrences are:

- 1) The receiver is initially turned on and has not acquired enough satellites to compute a position.
- 2) You have either not attached an antenna to the receiver or have placed the antenna where it cannot track enough satellites to compute a position.

The satellite almanac contains information about every satellite in the constellation. Normally the receiver keeps a copy of this almanac in memory, even between power cycles. However, when you reset the receiver (see Section 4.1.5.2) or load new firmware (see Section 4.1.5.3), the receiver may not contain the necessary almanac information. Once the receiver begins to track satellites, however, it can obtain the required almanac information for all GPS satellites from any one satellite being tracked. This almanac collection process can take up to 12.5 minutes or longer. This is how long it takes to transmit one cycle of the entire broadcast message.

#### 4.1.5 Receiver Interfacing Windows

The receiver interfacing windows are separate from the “Status and Display Sub-Windows” described in Section 4.1.4 because they provide you with the ability to **configure the receiver, download data from the receiver, delete data from the receiver, and/or upload firmware to the receiver**. These receiver interfacing windows can be activated through the use of the “Receiver” main menu option. Upon selecting this option, you will be presented with the following pull-down menu.



All of the options of the pull-down menu, with the exception of the “View Receiver Status” option, are directly related to these receiver-interfacing windows. The “View

Receiver Status” option provides access to the windows described under Section 4.1.4 (and is provided here to make a logical relationship with other “receiver” functions).

Selecting the first sub-menu item (i.e., “Files”) will provide you with a window that permits download and deletion of files stored by the receiver. The “Reset Receiver” selection will provide you with a window that allows you to select various levels of receiver firmware (including a full reset, which resets the firmware back to the factory default settings and fully initializes the file storage area). The “Upload Firmware” option permits you to upload firmware to the receiver. Selecting the “Settings” option will cause **Micro-Manager** to provide you with another menu that lists all of the windows that control the parameters of the receiver. That is, upon selecting the “Settings” menu option you will be presented with the following sub-menu:



Each of these menu options allow one to gain access to windows which control various settings of the receiver. Selecting the “Port Settings” option will cause the Receiver Port Settings Configuration window to be displayed. The “Position” menu option will give you access to the receiver’s reference position (which is used when the receiver is an RTK or RTCM base station). The “Project Information” menu option gives one access to various information that is used to document the project information stored with each observation file (including the 4-character site ID). Selecting the “Program Sessions” option gives one access to the receiver’s session programming features. The “RTCM Setup” option provides a window through which you can configure the RTCM modes and capabilities of the receiver. The “Satellite Tracking” option provides a window through which you control the satellites tracked by the receiver.

#### 4.1.5.1 Downloading and Deleting Receiver Files

By selecting the “Files” sub-menu option of the “Receiver” main menu you will be provided with a window similar to the following:



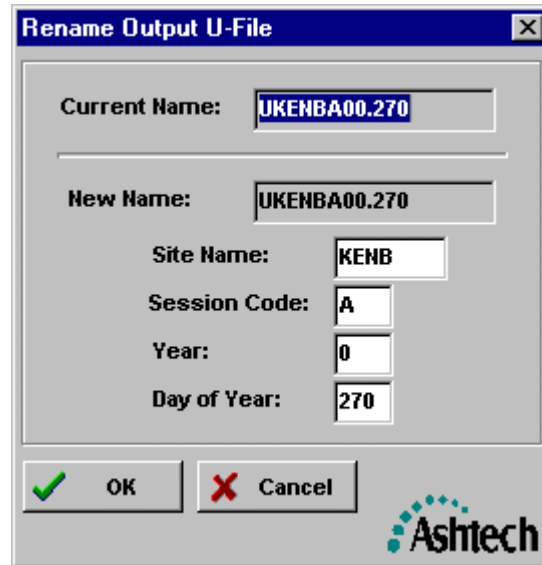
The displayed window provides information about the receiver memory and the files stored in that memory. In the above example, there are four files stored in the receiver’s memory – the last of which is still active (i.e., still collecting data). Additionally shown, toward the bottom, is the amount of free receiver memory available. The file list shows each of the files stored in the receiver’s memory. The columns of this list are described in the following table.

Column Label	Description
Sel	Indicates whether or not a file has been selected for a particular operation. To select a file, put the mouse cursor over that row and click. With each click, you will see the “Sel” column for that file toggle between No and Yes and you will see that row displayed with a green background. The download and delete operations will act upon those files having their “Sel” flag set to “Yes”.

Column Label	Description
File Name	<p>The name of the file as generated by <b>Micro-Manager</b>. The file name is generated using the other file information displayed in the directory listing and depends upon whether the “Use file start time to name files” checkbox is checked. When checked, the file names generated are based upon the start times of the files. When unchecked, the file names are based upon the end times of the files.</p> <p>The file naming approach is described in Appendix A.</p>
Type	<p>The format of the data being collected. These are often referred to as “Ranger Modes”. Please consult your Receiver Operations Manual for the meanings of the values displayed.</p>
Session	<p>The session code is either obtained from the receiver or generated by <b>Micro-Manager</b>. <b>Micro-Manager</b> will generate session codes only when there are none stored as part of the file information or there are duplicates that will result in file-naming duplicates.</p>
Start Time	<p>Describes the start time of the file in the following format:</p> <p style="text-align: center;">DDD/HH:MM:SS</p> <p style="text-align: center;">Where, DDD is the day of the year,  HH is the hour of the data,  MM is the minutes of the hour, and  SS is the seconds of the minute.</p> <p>All times and days are based upon GPS time.</p>
End Time	<p>Describes the end time of the file in the following format:</p> <p style="text-align: center;">DDD/HH:MM:SS</p> <p style="text-align: center;">Where, DDD is the day of the year,  HH is the hour of the data,  MM is the minutes of the hour, and  SS is the seconds of the minute.</p> <p>All times and days are based upon GPS time. When a file is currently open, to collect more data, the receiver reports the file to be “—ACTIVE—”.</p>
Bytes	<p>Provides the number of bytes (in receiver memory) currently being used by the file. Note that this field describes the number of bytes required by the receiver’s [compressed] internal storage format (i.e., it does not reflect the number of bytes required to store the file in B-, E- and S-File formats-which are less efficient.).</p>

Upon selecting a file, thereby changing its “Sel” status to “Yes”, **Micro-Manager** performs a two-staged file name duplication check. In the first stage, **Micro-Manager** checks the output file directory (see Section 3.1.4.3) to see if the file already exists. In the second stage, **Micro-Manager** checks the selected files in this window for duplicate

names. If a duplicate name is detected in either stage, **Micro-Manager** will display a window indicating the duplication and present an opportunity to rename the output U-File (i.e., the file that will contains an exact image of the file from the receiver’s memory). The following is an example of the “Rename Output U-File” window.



Through this window, you can edit the components used to create the U-File name. Appendix A describes the file naming convention employed by **Micro-Manager**.

You can also force the rename of any U-File before it is downloaded. Simply click on the desired row (which will highlight that row) and then press the right mouse button. A pop-up menu will appear giving you the opportunity to rename the output U-File.

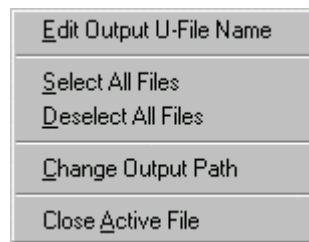
At the top of the Receiver Files window are two checkboxes. The “Decompress files to Ashtech processing data file” checkbox is used to control whether or not the B-, E-, S-, etc. files will be created immediately following the download of the associated receiver file image U-File. **Micro-Manager** will decompress the U-File by using an automated call to UpackU12.exe (see Appendix F). The automated call ensures that the created decompressed files will have the same file name form and output directory as that of the U-File. The decompression program UpackU12.exe is supplied, installed, and made available for use when the installer for **Micro-Manager** is used to install **Micro-Manager**. If you intend to use the decompression option of **Micro-Manager** (i.e., you check the subject checkbox), then the program UpackU12.exe must be located in the same directory in which the MicroMgr.exe program resides. If UpackU12.exe is not there, **Micro-Manager** will generate an error message.

The “Convert decompressed files to RINEX” checkbox allows you to automatically convert the decompressed B-, E- and S-Files to their RINEX counterparts. **Micro-Manager** performs this conversion by an automated call to XYZAshRx.exe. The

automated call ensures that the created RINEX files will have the same file name form and output directory as that of the original U-File. This RINEX conversion program is supplied, installed, and made available for use when the installer for **Micro-Manager** is used to install **Micro-Manager**. If you intend to use the RINEX conversion option of **Micro-Manager** (i.e., you check the subject checkbox), then the program XYZAshRx.exe must be located in the same directory in which the MicroMgr.exe program resides. If XYZAshRx.exe is not there, **Micro-Manager** will generate an error message. When using this automatic decompression option of **Micro-Manager** it is important that you configure XYZAshRx.exe as desired before using **Micro-Manager** for collecting the operational data. There are several RINEX headers that contain installation specific information (such as agency creating the RINEX file). See Appendix E of this manual for information regarding the configuration of XYZAshRx.exe.

If you make a copy of the **Micro-Manager** program files for the purpose of running multiple copies on a single computer, please ensure that you also copy all of the support program files (i.e., .EXE and .INI files) associated with programs UpackU12 and XYZAshRx.

There are several other attributes of the receiver files that one can control by right-clicking in the file list area. Upon right-clicking in this area, a pop-up menu like the following will be displayed:



Selecting the “Edit Output U-File Name” menu option will activate the previously described “Rename Output U-File” window, which enables one to rename the currently selected U-File. The “Select All Files” menu option will cause **Micro-Manager** to set the “Sel” status of all files to “Yes”. The “Deselect All Files” menu option will cause **Micro-Manager** to set the “Sel” status of all files to “No”. Selecting the “Change Output Path” option will present the output path selection described in Section 3.1.4.3. The “Close Active File” will instruct **Micro-Manager** to issue the active file closure command to the receiver (i.e., the “\$PASHS,FIL,C” command). After issuing the file closure command, **Micro-Manager** will immediately attempt to re-load the receiver file directory information.

Two additional items will affect the receiver files window:

- 1) The  $\mu$ Z-Family of receivers have been designed to allow firmware uploads; and
- 2) The  $\mu$ Z-Family of receivers treats the receiver memory in a manner similar to the way your computer handles hard disks.

Both of these items affect the memory use reported in the Receiver Files window.

Firmware uploads are discussed in more detail in Section 4.1.5.3. However, some aspects of firmware uploads affect the Receiver Files window. Specifically, when a firmware upload takes place, part of the receiver's memory is used as a staging area for the upload. To ensure separation between GPS data files and firmware files, the firmware files are stored differently from normal GPS data files: these non-GPS data files are called "non-U-files". If the firmware upload terminates prematurely (e.g., a user cancels the operation) or you have forgotten to erase an uploaded firmware file, that firmware file will remain in the receiver's memory (and will occupy space). Because of the separation between GPS data files and firmware files, these non-U-Files are not reported by the receiver in its directory listing.

As we said earlier, the  $\mu$ Z-Family of receivers treat the memory in a manner similar to the way your computer handles hard disks. When you request a directory listing of the files on your computer, the computer does not normally respond with the number of bad sectors flagged on its hard disk. Like that of your computer, the  $\mu$ Z-Family of receivers does not report these bad sectors in their directory listings. Furthermore, like that of your computer's hard disk, some amount of bad sectors are normal. Also like that of your computer's hard disk, the receiver's memory can degrade over time and extended use. Memory card degradation is rare and normally occurs from extreme age, extreme use, and/or extended operation of the receiver outside of its specified operating environments (e.g., extremely hot environments which are outside the specified operation temperature range).

When total memory utilized by non-U-files and bad sectors surpasses a pre-defined amount, which is editable by you as explained later, the following message will be displayed in the lower-left area of the Receiver Files window:

**Warning: There may be residual non-U-files in the receiver's memory!**

When this message is displayed, you can instruct the receiver to delete any non-U-files from the receiver's memory. This is accomplished by right-clicking in the directory listing area of the Receiver Files window. The right-click operation will cause a pop-up menu to be displayed, and by selecting the "Delete Non-U-files" entry (which is displayed in the pop-up menu only when the above warning message is displayed) **Micro-Manager** will issue a command to the receiver instructing it to delete all non-U-files. After the non-U-file delete command is issued, **Micro-Manager** will re-request the receiver's directory information and the warning message should be removed.

If, after the directory information is reloaded, the warning message has not been removed, there can only be two causes:

- A) The receiver did not receive and process the non-U-file deletion command (because of communication errors); or



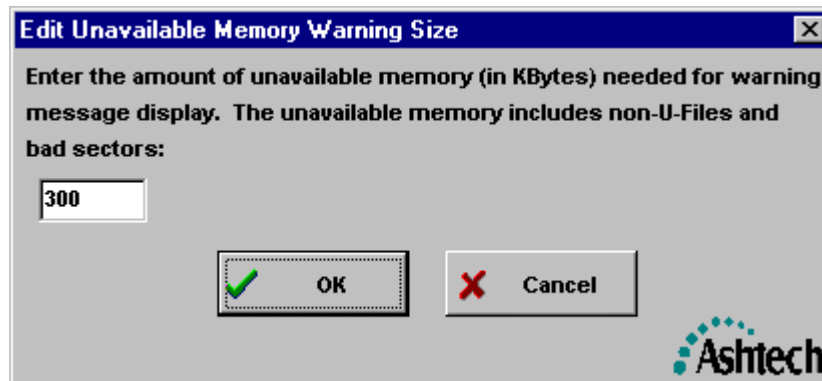
- B) There are a rather large number of bad blocks (or bad sectors) flagged in the receiver's memory.

When either occurs, the following procedure is recommended:

- 1) Reissue the non-U-file delete process several times.
- 2) Completely reset the receiver's "Internal" and "External" memory (see Section 4.1.5.2). This will cause the receiver's memory card to be reformatted.

If, after you have performed the above procedure, the Receiver Files window still displays the warning message, it is possible that your receiver's memory card has begun to degrade. This is because the above procedure should completely remove the non-U-files from the receiver's memory, leaving only bad blocks as the cause of the warning message. At this point, you have the option to raise the criterion used to display the warning message. The rationale for changing the criterion is simply to remove the warning message from the display, and should the card begin to degrade further, the message will be redisplayed (based upon the new criterion). Use the procedure that follows to change the criterion controlling the display of the warning message.

- 1) Position the mouse pointer over the above warning message and right-click. Upon doing so **Micro-Manager** will display a pop-up menu with the single menu entry entitled "Edit Memory Warning Size". Upon selecting that menu entry the following edit window will be displayed:



- 2) Increase the value of the Unused Memory Warning Size through the above edit window. The maximum value accepted by **Micro-Manager** is 1024 KBytes (or 1 Mbyte).

Additionally, you can monitor the receiver's memory and observe any degradation through the "Unavailable Memory" field of the following pop-up window:

Receiver Memory Status	
Total Receiver Memory:	40026112
Boot/Fat/Dir:	91904
Reserved:	512
Files:	8293376
Files Overhead Bytes:	131072
Available File Memory:	31635968
Unavailable Memory:	4352

(Note: The above window will automatically be displayed simply by resting the mouse pointer over the warning message described above. This window will automatically close when you move the mouse pointer outside of the warning message display area or when the window is displayed for 15 seconds.).

The “Unavailable Memory” field of the Receiver Memory Status window displays the number of bytes occupied by the non-U-files and bad memory blocks (or sectors). If there are no non-U-files in the receiver’s memory and the receiver’s memory card begins to degrade, then the “Unavailable Memory” may begin to increase rapidly.

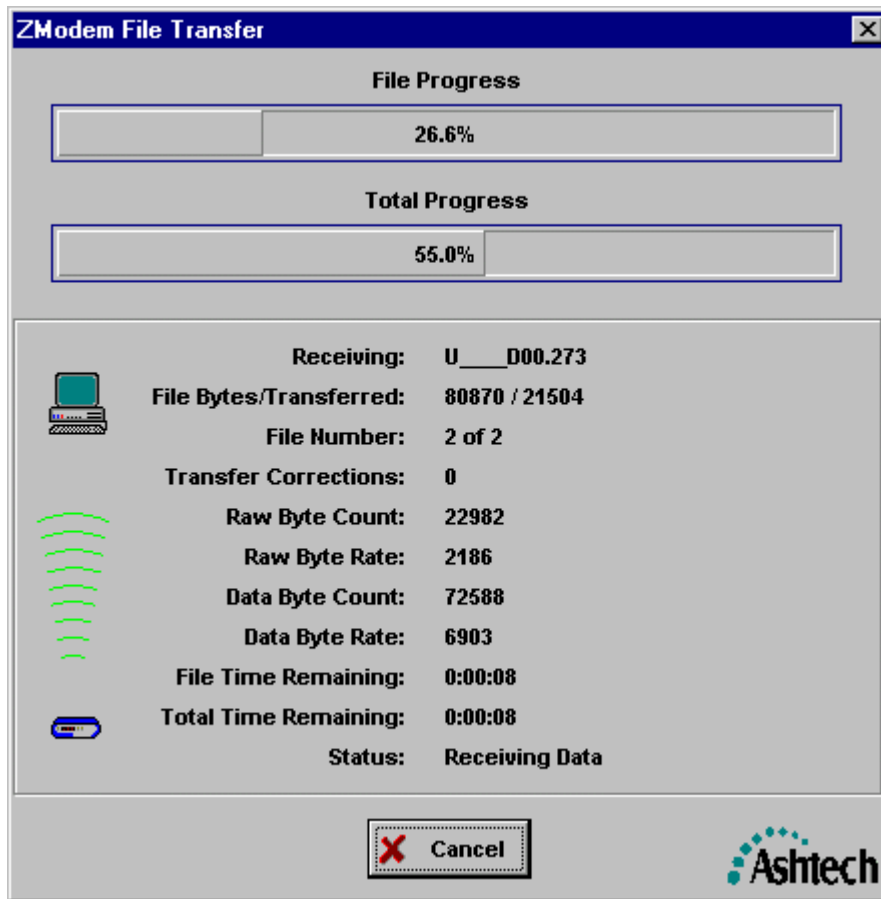
#### 4.1.5.1.1 Downloading Selected Files

To download a given file, or set of files, select the appropriate files and then press the “Download” button. You will be prompted to continue or to abort the current download operation when the available disk space on the target disk drive (see Section 3.1.4.3) may not be enough to accommodate the selected files. The values calculated for the required disk space are merely estimated because of the following:

- A) The log file may have data written to it which **Micro-Manager** cannot predict; and
- B) When a file is created on the target disk, the amount of space used by Windows for that file on disk differs from disk type to disk type.

As such, the amount of space required can only be estimated and you are warned when it appears that the disk **may** become too full.

During the download operation you will be provided with a display which describes the download progress. This window, shown below, describes the progress of a single download operation (that has more than one download file selected).



The fields of the download window are described in the table that follows.

Field	Description
File Progress Bar	The File Progress Bar shows the percentage of the “Receiving” file transferred thus far.
Total Progress Bar	The Total Progress Bar shows the percent complete of the total number bytes of all the files selected for download.
Receiving	Describes the target file name (i.e., the local computer disk file name). The output directory is not displayed but all downloaded files are output to the directory specified under Section 3.1.4.3.
File Bytes / Transferred	Displays the ratio of total bytes required by the file over the total number of bytes of the file transferred thus far. Sometimes the word “Extended” will appear in this field. When this occurs, <b>Micro-Manager</b> is currently downloading the “Active” receiver file (i.e., the file that the receiver is currently storing data to) and has detected that the file size exceeds that reported by the receiver when the transfer started. This is NOT an erroneous condition. Rather <b>Micro-Manager</b> is simply indicating that it will download more bytes for this file than it originally indicated.

Field	Description
File Number	Displays the file number in an X of Y format, where Y is the total number of files selected for download and X is the number of the current file being downloaded.
Transfer Corrections	Whenever the file transfer process detects any error and is able to recover from that error, the “Transfer Corrections” value will increment by one. This number is provided as a communication quality measure to you, the user. Normally, this number will stay very small (say less than 10 for a 4 Mb file). Should you see larger values for this number, you should consider decreasing the communication speed (see Sections 3.1.1.2 and 4.1.5.4.2) because the likely cause is a noisy data link (which is normally improved by decreasing the data communication rate).
Raw Byte Count and Raw Byte Rate	These fields provide information about the raw data communicated between the receiver and <b>Micro-Manager</b> . That is, the protocol used for the file transfer requires some overhead bytes. These numbers include these overhead bytes as well as actual file data byte (i.e., they deal with all data bytes communicated). The “Raw Byte Count” is the actual count of the bytes required thus far to transmit the file. The “Data Byte Rate” provides an indication of the effective throughput (in bytes per second) of the transfer including protocol overhead bytes. These numbers are provided only as status information that lets you know that <b>Micro-Manager</b> and the GPS receiver are communicating data.
Data Byte Count and Data Byte Rate	These fields provide information about the data bytes of the file being transferred between the receiver and <b>Micro-Manager</b> . That is, the protocol used for the file transfer requires some overhead bytes. These numbers provide counts of actual file bytes transmitted thus far (and do not include the overhead bytes of the protocol used). The “Data Byte Count” is the actual count of the file bytes transferred thus far (including any re-transmits that the protocol has requested). The “Data Byte Rate” provides an indication of the effective throughput (in bytes per second) of the file transfer. These numbers are provided only as status information that lets you know that <b>Micro-Manager</b> and the GPS receiver are communicating data.
File Time Remaining	This field provides an estimated time to complete the transfer of the current file which is based upon the data transferred thus far (and the time required to transfer that data). Sometimes you may see this estimated time suddenly change. This IS normal and CAN be caused by such factors as communication delays, noisy communication lines, delays caused by the handshaking mechanisms of the file transfer protocol and recovery from transfer errors.

Field	Description
Total Time Remaining	This field provides an estimated time to complete the transfer all selected files which is based upon the data transferred thus far (and the time required to transfer that data). Sometimes you may see this estimated time suddenly change. This IS normal and CAN be caused by such factors as communication delays, noisy communication lines, delays caused by the handshaking mechanisms of the file transfer protocol and recovery from transfer errors.
Status	This field provides a short text description of what the protocol transfer is doing and any errors it is trying to recover from.

The downloaded files are stored in the Ashtech U-File format. The U-File format is also referred to as the  $\mu$ Z-Receiver image format. This is based upon a proprietary compression formulation. To convert these files to normal receiver data files (such as the Ashtech B-, E-, and S-Files) you will need to run UpackU12 either automatically (see Section 4.1.5.1) or manually (see Appendix F).

It is important to note that if an image file is partially downloaded, it will not be automatically decompressed or converted to RINEX. Partially downloaded files occur when you press the “Cancel” button of this window or too many errors occur in the transfer. Furthermore, if you attempt to manually decompress partial receiver image files (i.e., using UpackU12), the unpacking program will report checksum errors and only decompress a portion of that file.

#### 4.1.5.1.2 Deleting Selected Files

To delete a given file, or set of files, select the appropriate file, or files, and then press the “Delete” button. Upon pressing the “Delete” button **Micro-Manager** issues a command to the receiver which will delete all selected files. **Micro-Manager** will then re-request the directory listing of the receiver and re-display that listing in the window described in Section 4.1.5.1.

#### 4.1.5.1.3 Download and then Delete Selected Files

To download and then delete a given file, or set of files, select the appropriate files and then press the “Download & Delete” button. After doing so, **Micro-Manager** will begin the download of the selected files and will show the window described in Section 4.1.5.1.1. Only after the files are successfully downloaded (and converted, when appropriate) will **Micro-Manager** begin the process of deleting the selected files. The deletion process operates as described under Section 4.1.5.1.2.

The downloaded files are stored in the Ashtech U-File format. The U-File format is also referred to as the  $\mu$ Z-Receiver image format. This is based upon a proprietary

compression formulation. To convert these files to normal receiver data files (such as the Ashtech B-, E-, and S-Files) you will need to run UpackU12 either automatically (see Section 4.1.5.1) or manually (see Appendix F).

It is important to note that if an image file is partially downloaded, it will not be automatically decompressed or converted to RINEX. Furthermore, it will not perform the deletion processing. Partially downloaded files occur when you press the “Cancel” button of this window or too many errors occur in the transfer. Furthermore, if you attempt to manually decompress partial receiver image files (i.e., using UpackU12), the unpacking program will report checksum errors and only decompress a portion of that file.

#### 4.1.5.2 Resetting Receiver Firmware

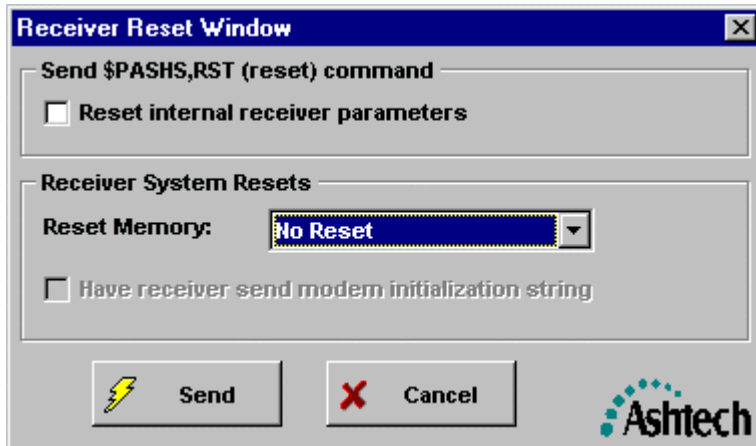
Built into **Micro-Manger** is the ability to reset the receiver’s firmware. There are various reasons why one would want to reset the receiver’s firmware, examples of which include the following:

- 1) You have just loaded firmware and want to reset the receiver back to the factory default settings.
- 2) You simply want to reset the firmware back to the factory default settings.
- 3) You suspect that you had a power supply problem that has corrupted the operation of the receiver.
- 4) You want to reset the file storage memory, which erases it but gives you a positive response on the health of the memory board.

Firmware resets DO NOT alter options currently set in the receiver. For example, if your receiver was initially shipped without the RTK mode enabled and you later received an update that enabled the RTK mode, a firmware reset WILL NOT disable the RTK mode. Or said differently, a firmware reset can reset the firmware back to the factory defaults for the receiver options that are currently available for that receiver.

There are two general types of reset operations that can be performed, one of which permits several options. The type of reset operation, and its options, depends upon what exactly you wish to accomplish. All of these choices have been merged into one convenient window that will prevent incorrect or confusing reset modes. It is important to note that while this window does impose logic to avoid these incorrect or confusing modes, you can still use the terminal window of **Micro-Manager** (see 4.1.6) to perform any type of reset allowed under the receiver command structure.

The Receiver Reset Window (shown below) is divided up into two primary sections.



The first section of the window deals with a relatively simplistic reset of receiver parameters. By selecting the “Reset internal receiver parameters” check box (and then pressing the “Send” button), you will be sending the receiver the \$PASHS,RST command. This command will, with a few listed exceptions, reset all receiver parameters (not data file memory) back to their factory default values. The following table lists these exceptions.

Receiver Command Mnemonic	Description
POW	Receiver battery capacity and voltage parameters.
MET	External Meteorological Sensor device interfacing configuration parameters.
TLT	External Tilt Sensor device interfacing configuration parameters.
MDM	Modem configuration parameters,

The second half of the window deals with firmware resets and file memory storage resets. The following table lists the choices of the drop-down list box and description of each:

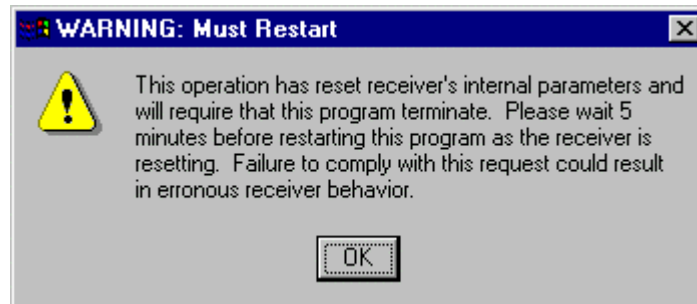
Choice	Description
No Reset	No memory or firmware reset will occur. This is supplied only to avoid possible confusion when you have selected the “Reset internal receiver parameters” checkbox in the first half of the window.
Internal	Reset the receiver’s internal memory (i.e., the battery backed up memory) which stores the configuration parameters of the receiver (e.g., epoch intervals, session programming, and elevation masks). This option, unlike the “Reset internal receiver parameters” checkbox of this window, will reset all of the parameters of the receiver. There is one exception, however, which deals with the MODEM options. This will be described toward the end of this section.

Choice	Description
External	Reset the receiver's file memory storage. This operation will send a command to the receiver that instructs it to fully erase its file storage memory area and then validate that that memory area is operating properly.
Int. & Ext.	Selecting this option (and then pressing the OK button) will result in the issuance of a receiver command instructing the receiver to perform a full Internal and External reset. That is, the above operations described for both Internal and External will be performed.

As was indicated in the above table, whenever the "External" or "Int. & Ext." operations are selected, and you press the OK button, the external memory reset operation will take place. This reset operation will clear the receiver's data file storage memory and, in that process, validate that memory area. You can observe the validation results by Opening **Micro-Manager's** Terminal window (see Section 4.1.6) before opening the Receiver Reset Window. If the terminal window is open when one performs this reset operation, the terminal window will display the response given by the receiver. This response could take several minutes depending upon the amount of memory your GPS receiver has installed. The following is an example response you would see in the Terminal window:

```
$PASHR,ACK
$PASHR,CLM,WAIT*11
$PASHR,CLM,SIZE,03912KB*33
$PASHR,CLM,PASSED*0A
```

Whenever any one of the above reset operations is selected you will be presented the following window.



This window indicates that the reset operation will cause a loss of communication with the GPS receiver. When you acknowledge this window (via pressing the OK button), **Micro-Manager** will terminate. This loss of communication will occur during the period that the receiver is executing the reset command. But, you are advised to disconnect from the receiver for 5 minutes to ensure that the receiver has been fully reset before you attempt to reconnect with it. Please note that we previously stated that you could use the Terminal Window to watch the response to the commands that reset the receiver's file storage memory area. But as soon as you issue the reset command (by pressing the OK



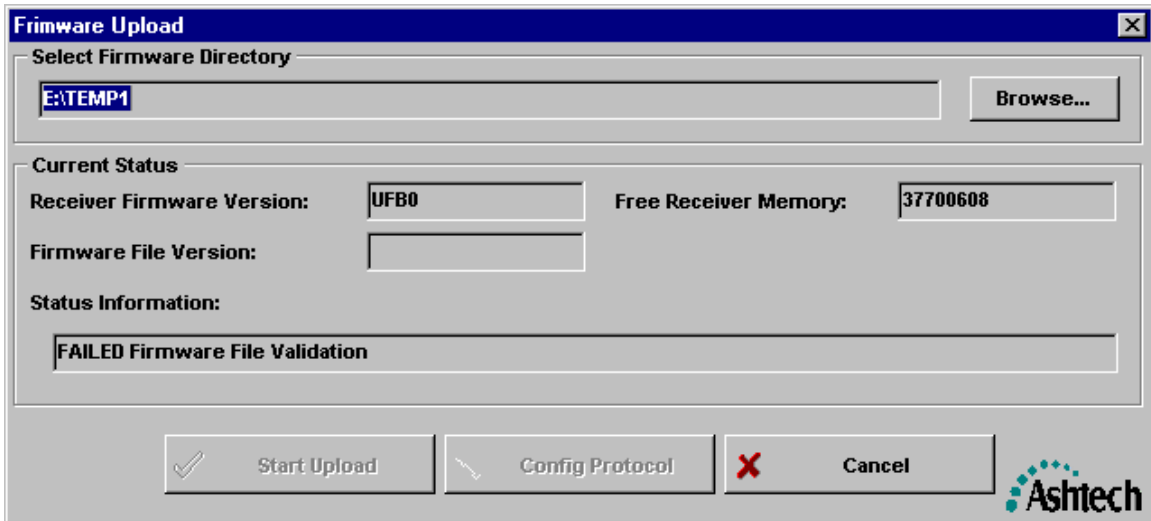
button in the Receiver Reset Window) this restart warning window is displayed. You may wait for the status of the memory clear operation to be reported since the terminal window will still show any responses output by the receiver. If so, do not press the OK button of this restart warning message until after the memory clear operation is reported and you want to exit the program.

The one parameter of this window not yet described is the checkbox labeled as “Have receiver send modem initialization string”. The rationale for this is quite simple. If you are connected to the receiver via a modem or you have configured the receiver such that it will have a MODEM attached, you will want to re-initialize that MODEM whenever the receiver is reset. This will ensure that the MODEM is fully reset and ready to accept incoming calls. This last parameter will become active only when you have configured a MODEM to operate with the receiver (see Section 4.1.5.4.2). If you select a reset option and select the “Have receiver send modem initialization string”, then when you press the OK button, **Micro-Manager** will send a command that causes the desired reset operation and then the receiver will send the MODEM initialization string to the receiver.

#### 4.1.5.3 Upload Firmware

**Micro-Manager** permits the upload of firmware to the  $\mu$ Z-family of receivers. Magellan has paid particular attention to providing reliable and stable firmware uploads. That is, **Micro-Manager** contains a built in firmware uploading capability that utilizes a protective firmware upload protocol, reliable firmware file formats, and very stringent firmware crosscheck procedures. The result is a reliable means of upgrading your receiver’s firmware either through a direct connection or a remote connection.

Upon selecting the “Upload Firmware” option, you will be presented with a window similar to the following:



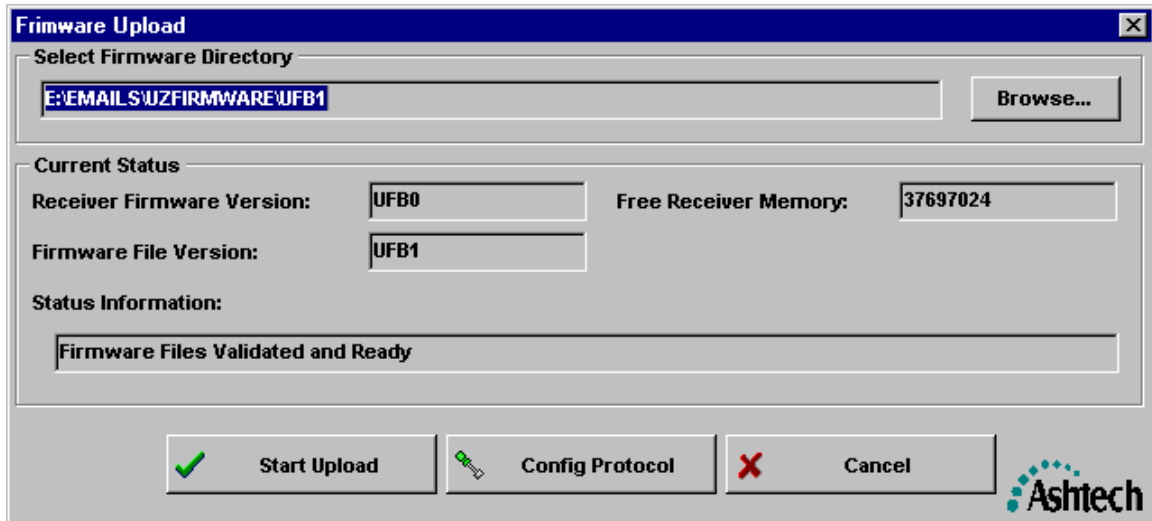
The field labeled as “Receiver Firmware Version” displays the version of firmware currently loaded into the receiver’s memory. The “Free Receiver Memory” field describes how much memory (i.e., within the GPS receiver) is available for firmware uploads. The “Select Firmware Directory” will display the directory in which **Micro-Manager** will look for firmware files to be uploaded to the receiver. To select a different directory, press the “Browse” button and you will be given the opportunity to find the directory that contains your firmware files.

Once you have selected the directory containing the firmware files, **Micro-Manager** will automatically begin scanning and validating those files. During this scanning and validation process, the “Status Information” line will show the status of the validation process. As can be seen in the above example window, the status “FAILED firmware File Validation” was reported. In fact, selection of the above directory also yielded the following message from **Micro-Manager**.



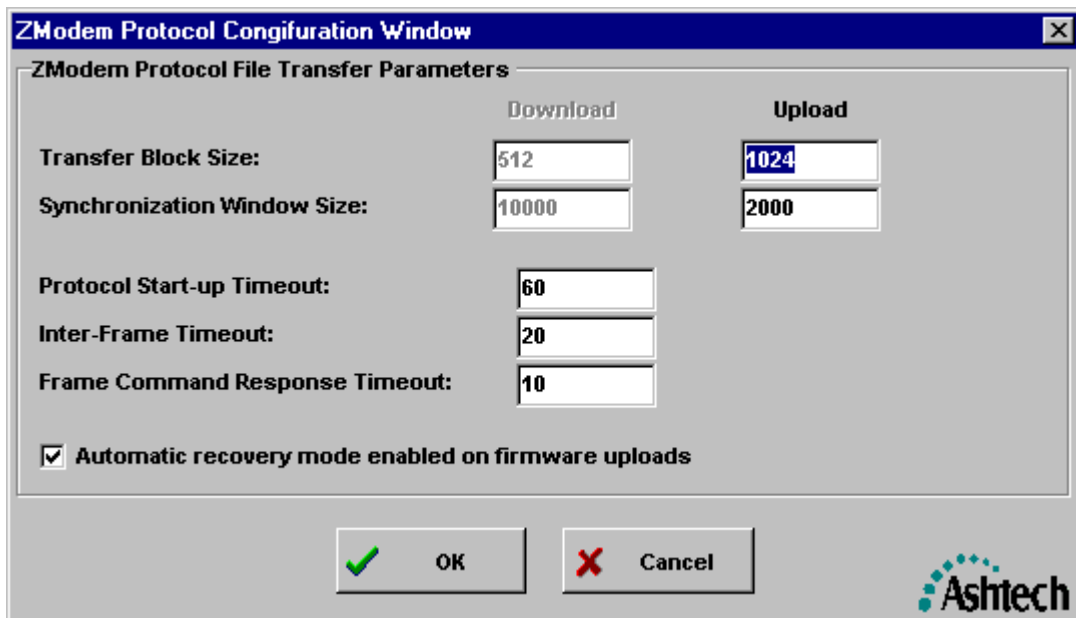
This message and the status displayed in the Firmware Upload window imply that the firmware directory selected (i.e., “E:\TEMP1”) contains no valid firmware files to be uploaded to the receiver. Notice also in the Firmware Upload window that the “Start Upload” and “Config Protocol” buttons are not enabled, as indicated by their slightly grayed-out appearance.

Consider the following window in contrast to the last window example.



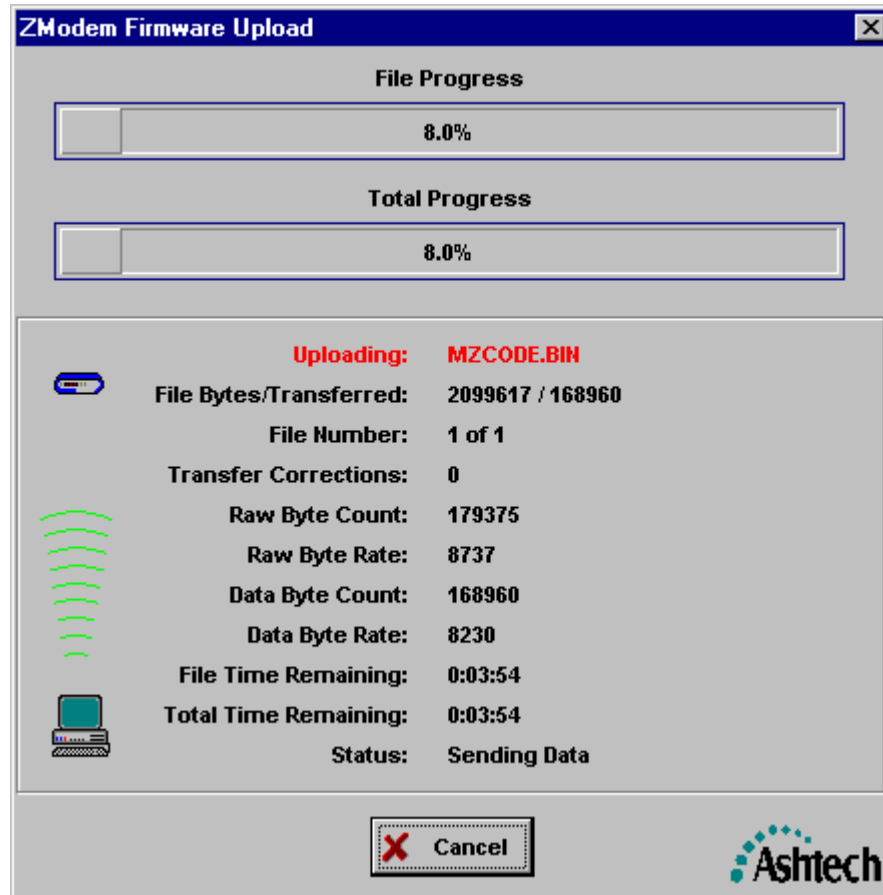
In the above example window, the selected firmware path does contain valid firmware files. This is confirmed by the displayed status (i.e., “Firmware files Validated and Ready”) and by the now-enabled “Start Upload” and “Config Protocol” buttons. When the window has this appearance, **Micro-Manager** is indicating that it has validated the firmware files in the selected directory and is ready to begin the firmware uploading process.

At this point, you could choose to alter the parameters that govern the transfer of the firmware files to the receiver. By pressing the “Config Protocol” button you will be presented with the following window:



The parameters of this window are described in Section 3.1.4.4.

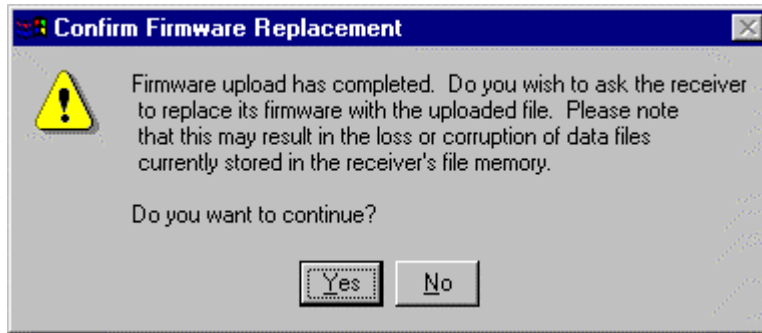
To begin uploading firmware, press the “Start Upload” Button on the Firmware Upload window. Once the upload starts you will be given an upload status window similar to the following:



You may have noticed that the window used for firmware uploads looks very similar to the window used for receiver file downloads (i.e., to the PC). This is true. In fact you can refer to Section 4.1.5.1.1 for a complete description of the parameters displayed in this window. Just keep in mind when reading those descriptions that they are *now* describing the transfer of files to the receiver.

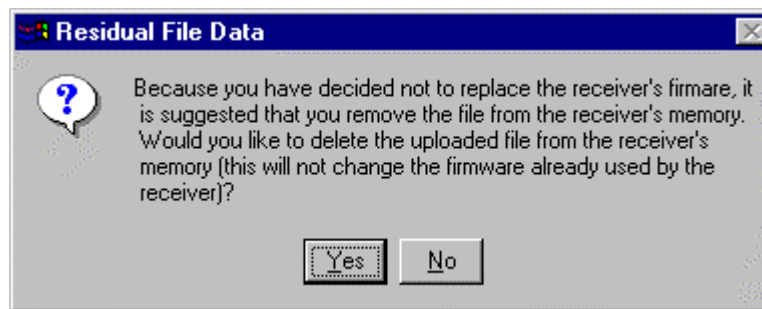
As said earlier, firmware uploads are protected by a multi-tiered mechanism. Should the uploading process fail or be canceled at any stage, the uploaded firmware will not be used by the receiver (i.e., it would continue to use the firmware resident before the firmware upload process was started). This is important because at this point in the upload process, the firmware file being uploaded is being written safely to a staging area. Should this upload be interrupted for any reason and assuming you have selected the “Automatic recovery mode enabled on firmware uploads” option, you can later continue the firmware upload where you left off.

Once the firmware is fully uploaded **Micro-Manager** will ask you to confirm the replacement of the existing firmware with the newly uploaded firmware file.



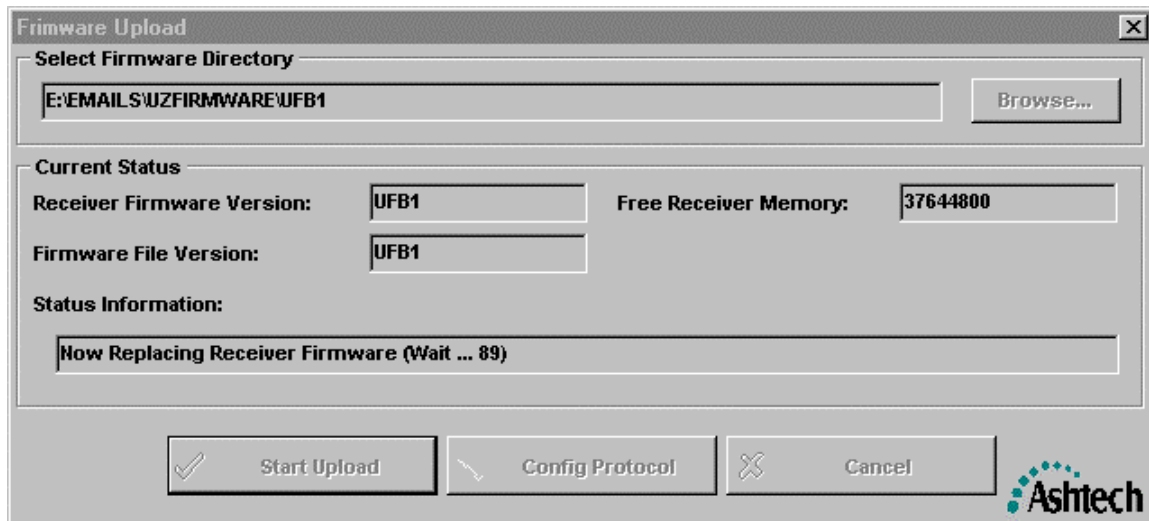
Notice that the Firmware Replacement prompt window warns of the possibility of lost or corrupted data files. For this reason you should download all important files from the receiver memory prior to attempting a firmware change. This is because the new firmware may invoke a new file storage format and it may not recognize the old storage format. Such a change should happen very rarely, but we encourage you to NEVER trust the data files stored in the receiver immediately after a firmware loading operation. Magellan strongly recommends that after loading any new firmware into the receiver, you issue a full “Internal and External” memory reset (as described in Section 4.1.5.2).

If you answer “No” to the above prompt, **Micro-Manager** will issue another prompt window.

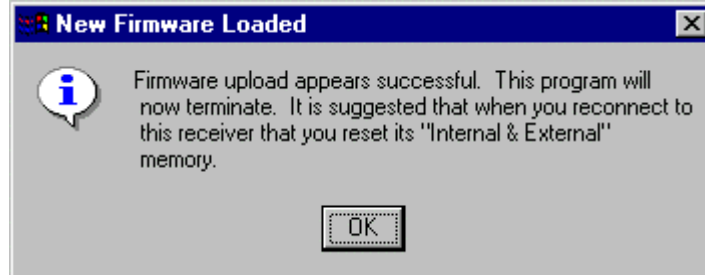


This window is simply indicating that you have left a firmware file in the same memory area as is used for normal data file storage. Because the file is occupying valuable data storage memory, you should delete that file. However, you can leave the firmware file in receiver’s memory (by answering “No”) and then later burn that firmware using the firmware burn command (i.e., the “\$PASHS,FSH,...” command described in your receiver manual) from the Terminal Window of **Micro-Manager** (see Section 4.1.6).

If you answer “Yes” to the “Confirm Firmware Replacement” prompt, the firmware upload window will be redisplayed and show a count-down timer in the status information area.



During this step, the receiver validates the receiver firmware file before it actually replaces its operating firmware with the newly loaded firmware. While the count-down timer (shown in the Status Information message “Now Replacing Receiver Firmware (Wait...89)”) is counting, **Micro-Manager** is awaiting a positive acknowledgement from the receiver that the firmware file is valid. If the acknowledgement is received, **Micro-Manager** will display the following message:



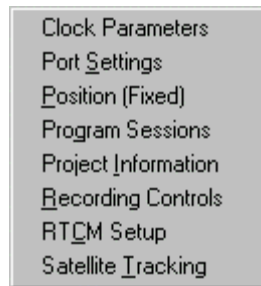
This message indicates that the receiver has acknowledged the validity of the firmware files and is now actually burning that firmware for later use. Because the burn operation will cause the receiver to restart, communications with that receiver will be lost. Thus, **Micro-Manager** will have to be terminated; this will happen when you press the OK button of this window. Notice also that the displayed message includes a suggestion about resetting the receiver’s internal and external memory. This is suggested for two reasons:

- 1) This type of reset will erase the staging area used for the firmware upload; and
- 2) As mentioned earlier, firmware replacement can potentially cause loss or corruption of previously collected data files as the new firmware may invoke a new file storage format and may not recognize the old storage format.

Therefore, you are strongly encouraged to perform a full internal and external reset (see Section 4.1.5.2) on your next connection with the receiver.

#### 4.1.5.4 Receiver Settings

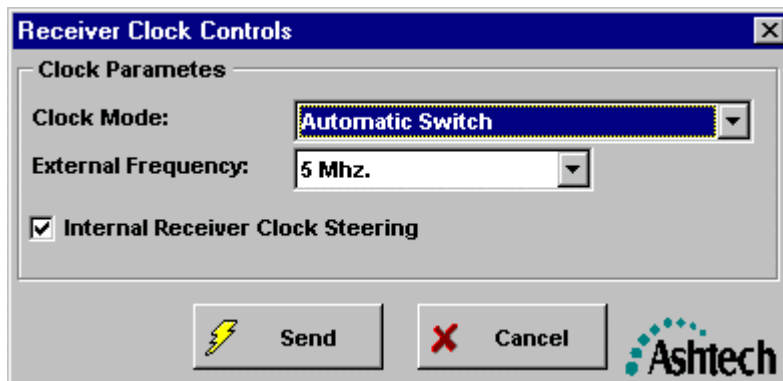
There are seven windows of **Micro-Manager** that deal with the configuration of the receiver. By selecting the “Settings” sub-menu of the “Receiver” main menu item you will be given the following pop-up menu.



From this menu, you can select the aspect of receiver configuration desired. For the parameters you edit through each of these windows, **Micro-Manager** will not permit you to enter values outside the range of permissible values for your particular receiver. Once you have made your desired changes in these windows, simply press the “Send” button of the window and the changes will be sent to the receiver. In all cases, **Micro-Manager** will await validation responses from the receiver to verify that the parameters sent are actually accepted by the receiver. Any failures will be reported.

##### 4.1.5.4.1 Receiver Clock Parameters

The  $\mu$ Z-Family of receivers support the use of external clocks as well as an optional steering of the receiver’s internal clock. The “Receiver Clock Controls” window provides access to these receiver clock parameters.



The table that follows describes the fields of the Receiver Clock Controls.

Parameter	Description
Clock Mode	<p>Describes the desired clock to be used.</p> <p>“Internal”                      When the internal receiver clock will be used.</p> <p>“External”                      When an external clock will be attached to the receiver and used.</p> <p>“Automatic Switch”              When the receiver will automatically switch to an external clock when one is detected, but will use the internal receiver clock whenever an external clock is not detected.</p>
External Frequency	<p>This field can only be edited when the Clock Mode parameter is set to either “External” or “Automatic Switch”. This field is used to specify the frequency of the external clock.</p>
Receiver Clock Steering	<p>This checkbox is used to specify whether or not the receiver internal clock steering should be enabled when the internal receiver clock is used. When selected, the receiver’s internal clock will be steered such that its clock offset remains close to zero (i.e., the receiver’s clock will remain very closely aligned with the GPS time system). When deselected, the receiver’s internal clock will not be steered and be permitted to drift with respect to the GPS time system. In this mode, the receiver’s internal clock offset (and pseudo-range observations) will experience 1 millisecond jumps. These jumps occur when the receiver’s internal clock offset has been computed to be approximately 1 ms offset from GPS time. For further details on this subject, please consult the appropriate receiver operations manual.</p> <p>You are permitted to enable the clock steering whenever an external clock mode is used (i.e., “External” or “Automatic Switch”). However, enabling the clock steering when using an external clock is not recommended and will elicit a warning from <b>Micro-Manager</b>.</p>

To check on the status of the receiver clock parameters, particularly to determine if the receiver recognizes a configured external clock, use the Receiver Information window (see Section 4.1.4.5)

For more detailed information on the internal and external clock usage as well as the internal clock steering mode, please consult the appropriate receiver operations manual.



#### 4.1.5.4.2 Receiver Port Settings

The following is an example Receiver Communication Port Settings Window.

**Receiver Communication Port Settings**

**Comm Port Parameters**

Port A: 115200 **Active** Port C: 38400  
Port B: 9600 Port D: 9600

**Receiver Modem Configuration**

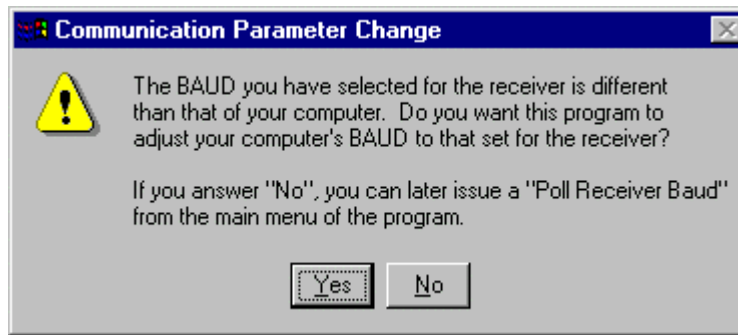
Modem Type: US Robotics Sportster Port: C  
Status: ON Baud: 38400

Initialization String: ATS0=1S12=25&H1X4E0M0&D0  
Config. String: AT&F1  
Data Escape: +++  
Command Escape: ATO

Have receiver initialize the modem

Send Cancel

Through this window you can configure the communication ports of the GPS receiver and any MODEM attached to the receiver. The window is divided up into two areas. The first area deals with the communication speeds of each of the receiver's ports. You can use the drop-down list boxes to set the speed of each port individually. Notice in the example window that there is an "Active" flag next to the Port A field. This flag is used to indicate the receiver port that is currently being used to communicate with **Micro-Manager**. This is important because if you change the communication speed of that port, you may interfere with communication between **Micro-Manager** and the GPS receiver. When connected to the receiver by a MODEM, you are strongly discouraged from changing the "Active" port communication speed (because the effect on communications is MODEM dependent). If you are directly connected to the GPS receiver (i.e., not connected to the receiver via MODEM), you change the "Active" port, and you press the "Send" button, **Micro-Manager** will issue the following prompt:



If you answer “Yes”, then **Micro-Manager** will instruct the GPS receiver to change its communication speed (to that which you have selected) and then command your local computer to change its communication speed as well. If you answer “No”, then **Micro-Manager** will command the receiver to change its communication speed but will not command the computer to change its speed. Thus, the two will be communicating at different speeds and you will be unable to communicate with the receiver until you either correct the computer’s communication speed (see Section 3.1.1.3) or “Poll” the Receiver’s Baud (see Section 4.1.2).

The second area of the “Receiver Communication Port Settings” window deals with the configuration of a MODEM attached to the GPS receiver. Through this area you can configure the type of MODEM and select the receiver port on which the MODEM is attached. There are several predefined MODEM types that can be selected through this window. When you select these predefined types, several edit fields (e.g., Initialization String, Config. String, Data Escape, and Command Escape) become disabled. This is because these fields are pre-defined and cannot be edited. If, however, your MODEM type is not listed or you want something different from the defaults, you can select the “USER DEFINED” MODEM type and provide the other parameters required to define your own modem type.

Shortly we will describe the parameter that you edit when you define a “USER DEFINED” MODEM type. Before doing so, some information about receiver MODEM strings needs to be discussed. In Section 3.1.2 we described how MODEM strings are entered for the configuration of the MODEM attached to the **Micro-Manager** computer. In that section we described special characters that are translated by **Micro-Manager** into delays and special control characters. Those special characters are not available through this window. That is, the MODEM strings entered through this window will NOT be translated as described in Section 3.1.2: what you enter will be sent to the MODEM. Also, you should avoid using spaces in your receiver MODEM strings, unless the initialization of that MODEM absolutely requires that they be present. The table that follows describes the MODEM parameters that can be defined when a “USER DEFINED” MODEM type is selected:

Parameter	Description
Initialization String	The string that will be sent to the MODEM to initialize the MODEM. This string will be sent whenever the receiver power is cycled or is commanded to initialize the MODEM. The contents of the string depend upon the MODEM being used and you should consult your MODEM manual for specifics. Finally, the receiver will attach the proper end-of-line sequence required by the MODEM.
Config. String	This string is another initialization string sent to the receiver. It is sent on the same events as is described for the “Initialization String” but will always be sent before the “Initialization String”. Its purpose is to allow you to send another initialization string (because some MODEMs actually need two initialization strings. Like that of the “Initialization String”, the receiver will attach the proper end-of-line sequence required by the MODEM.
Data Escape	This is the sequence of characters the receiver will transmit to cause the MODEM to transition from the data transmission mode to the command mode. If these terms are not familiar to you, then you should consult your MODEM manuals for details.
Command Escape	This is the sequence of characters the receiver will send to the MODEM to cause it to transition from the command mode to data transmission mode. If these terms are not familiar to you, then you should consult your MODEM manuals for details.

We have stated elsewhere in this manual that there are slight hardware differences between members of the  $\mu$ Z Family of receivers. That is, with the exception of Port A of  $\mu$ Z-CGRS receivers, the DTR/DSR hardware handshaking lines ARE NOT implemented. Most MODEMs employ these lines as a signal to DROP the link (that is, when DTR drops, the MODEM will hang the telephone connection). Therefore, unless you connect the MODEM to Port A of a  $\mu$ Z-CGRS receiver, you should configure your modem not to use the DTR signal. MODEMs that support the Hayes-compatible command structure use the “&D0” setting to disable the use of the DTR signal.

The final parameter of this window is labeled as “Have receiver initialize the modem”. When this checkbox is checked and you press the “Send” button, **Micro-Manager** will not only send parameters according to the settings displayed in the window, but will ask the receiver to send the MODEM initialization strings to the MODEM. The receiver will report to **Micro-Manager** the success or failure to initialize

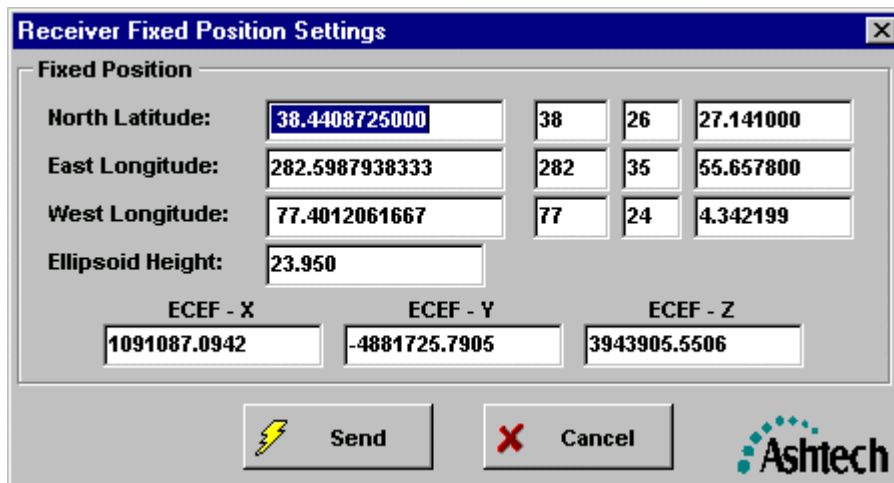
the receiver's MODEM. **Micro-Manager** will pass that report on to you. When you get a failure, you will get the following message:



You can test your MODEM initialization string by directly connecting your Receiver's MODEM (via RS-232) to your computer, configuring **Micro-Manager** to use that port, and using **Micro-Manager**'s Terminal Window (see Section 4.1.6) to manually send the MODEM initialization string to the MODEM. The Terminal Window will report exactly what the MODEM responds with. Thus, you must be familiar with your MODEM manuals to have success with this test.

#### 4.1.5.4.3 Receiver Fixed Position

The Receiver Fixed Position window is used to set the receiver reference position. This reference position is used, when the receiver is configured as an RTCM base station or an RTK base station, in the computations needed to support the base station. For example, when configured as an RTCM base station, the receiver needs to know the reference coordinates needed to compute the differential corrector values and other values transmitted in RTCM messages. The following is an example of this window.



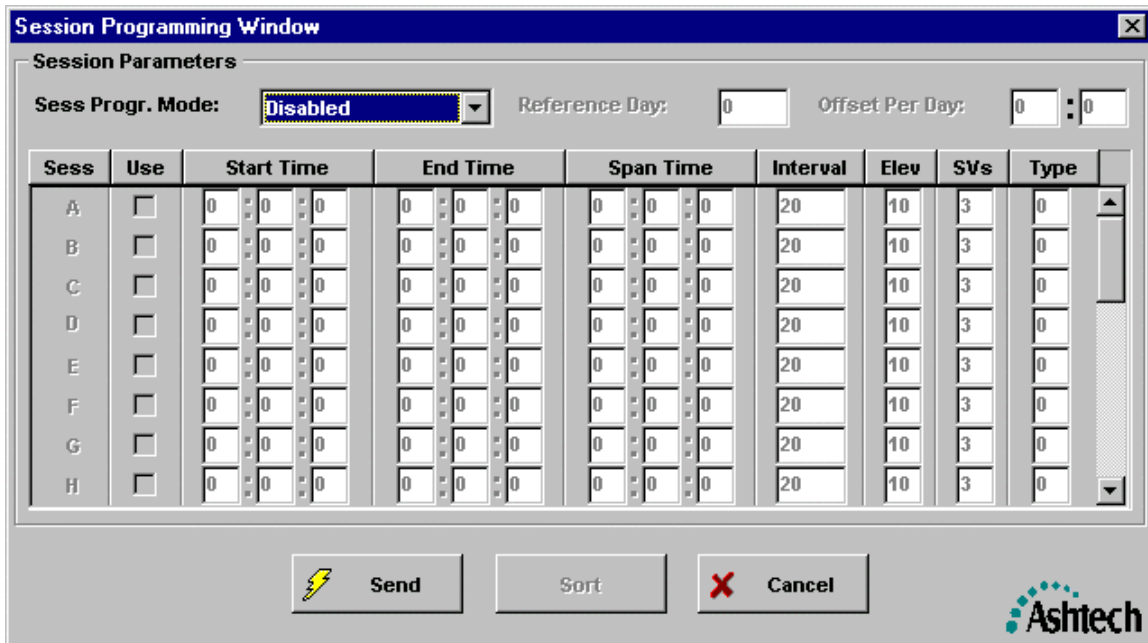
Parameter	Description
North Latitude East Longitude West Longitude Ellipsoidal Height	The reference station position in WGS-84 geodetic coordinates.
ECEF Position (X, Y, and Z)	The reference station position in WGS-84 Earth-Centered Earth-Fixed coordinates.

The positional data fields are very important. These fields, which allow you to enter a reference station position, are used by the receiver for such operations as creating differential correctors when the receiver is used as an RTCM differential base station. Any non-zero values will cause the receiver to use that positional data. When you set the Latitude, East Longitude and Ellipsoidal Height to zero, you are effectively deleting the reference position data. If you set these to zero, then the reference station position data in the Geodetic Position and Time Window, as well as the Earth-Centered Earth Fixed Position and Time Window, will indicate that there is no reference position set (see Sections 4.1.4.3 and 4.1.4.4, respectively).

#### 4.1.5.4.4 Programming Sessions

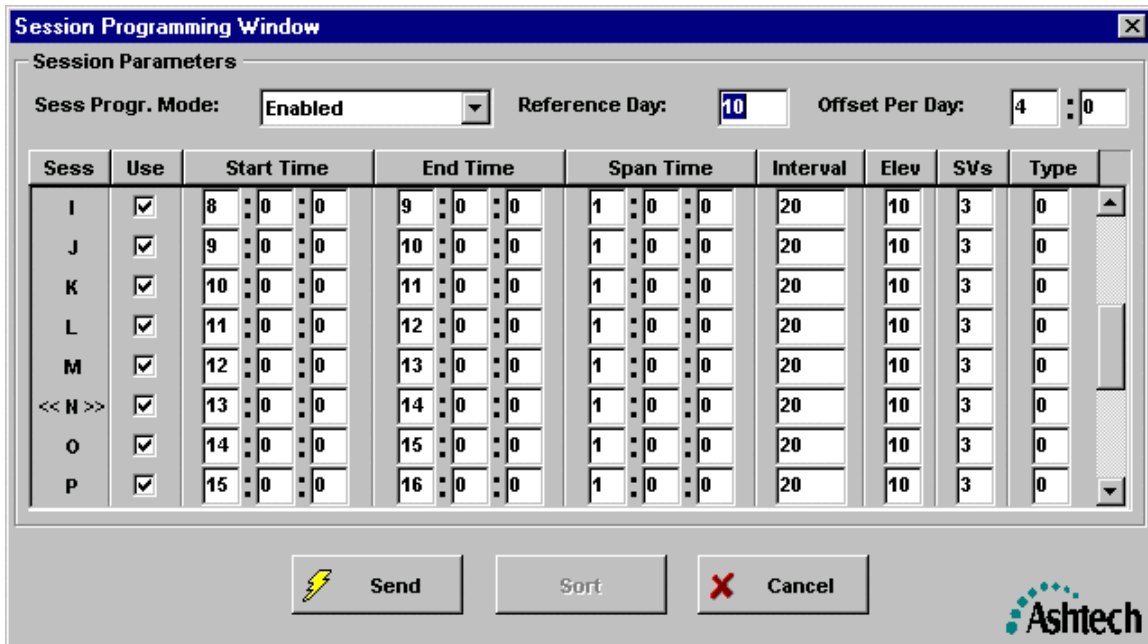
Using **Micro-Manager**, users can configure receiver logging sessions. A session in this context is defined as a time period in which GPS data are collected. This ability to define numerous “sessions” is referred to as the Session Programming capability. These sessions delimit the times and provide the parameters governing the collection of GPS data. For example, the user can define a data collection session beginning at 1:00 AM every day, collecting data for 1 hour, collecting 1-second epoch data during that period, and using an elevation mask of 5 degrees. The user could then define another data collection session beginning at 10:00 AM every day, collecting data for 4 hours, collecting 20-second epoch data, using an elevation mask of 10 degrees, and storing data only when there are 4 or more satellites.

To access the receiver’s session programming through **Micro-Manager** simply select the “Program Sessions” pop-up menu option of the “Settings” sub-menu option of the “Receiver” main menu option. You will be provided with a window similar to the following:



The above window shows an example where the receiver's session programming feature has been disabled. You enable the session programming feature of the receiver by setting the "Sess Progr. Mode" to either "Enabled" or "Sleep Mode" and the "Reference Day" to some reference day of the year. This will be explained later. To disable the session programming feature within the receiver you set the "Sess Progr. Mode" to "Disabled".

The following provides an example where the session programming feature of the receiver has been enabled.



Notice that both the “Sess Progr. Mode” has been set to “Enabled” and the “Reference Day” is set to a non-zero value. The “Reference Day” denotes the day of the year from which the programmed sessions are referenced. That is, the times are defined in the context of that day. The reason for this relationship is because of the “Offset Per Day” fields. These fields describe the amount of time (i.e., minutes:seconds) to subtract per day since the reference day. In this way, you can design your sessions to exactly coincide with the periodicity of the satellite geometry: i.e., the current GPS satellite geometry will be approximately repeated 4 minutes earlier each day. Whereas this feature was once frequently used, we realize this is no longer so. Today users prefer to set the “Offset Per Day” to zero so that the session will cover the exact same time every day. In summary, the “Reference Day” and “Offset Per Day” give the user a second choice: the capability to slide the daily sessions in a manner which retains constant geometry.

We previously stated that the “Sess Progr. Mode” can take on the values of “Disabled”, “Enabled” or “Sleep Mode”. We have already discussed the “Disabled” and “Enabled” modes but have not presented the “Sleep Mode”. The only difference between the “Enabled” and “Sleep Modes” is that much of the receiver’s boards are shut down between sessions to conserve power. These boards will be reactivated a few minutes before the session is scheduled to come active to allow the receiver to fully acquire any satellites visible to the receiver. The power will also be reactivated when the receiver is connected to a MODEM and an incoming telephone call is detected.

The table that follows describes the fields of the session entries.

<b>Column Title</b>	<b>Description</b>
Sess	(Not editable.) The single character session code of the session. When the receiver reports an active session (i.e., currently recording data under that session), <b>Micro-Manager</b> in turn displays that active session by surrounding the session code with “<<” and “>>”. In the example screen display above, the receiver indicated that session N was active.
Use	A check in a ‘Use’ box indicates that the receiver will use the entered session.
Start Time	The start time of the session (GPS time of day). This will be adjusted by the “Offset Per Day” for each day after that reference day.
End Time	The end time of the session (GPS time of day). This will be adjusted by the “Offset Per Day” for each day after that reference day.
Span Time	The time span of the session (i.e., end time minus start time).
Interval	The observation epoch interval for the session: i.e., the epoch data rate.
Elev	The satellite elevation mask used during the session to filter out low elevation satellites.
SVs	The minimum number of satellites required for the data to be recorded at an epoch.

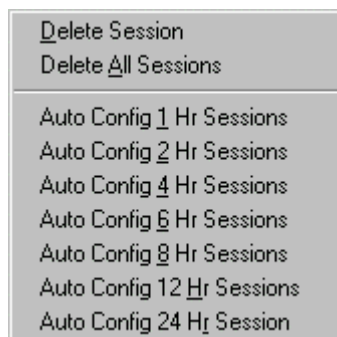
Column Title	Description
Type	This parameter is typically referred to as the “Data Mode” of the receiver. It defines the format of the data stored by the receiver. Consult your Receiver Operations Manual for details on the Data Modes.

To delete a session, simply set its start and span times to zero or place your cursor on one of the fields and right-click (to bring up a special session programming pop-up menu) and select the “Delete Session” item. To add a new daily session, or to insert a new one on a one-time basis, add it in an empty slot at the end of the list of non-zero sessions (i.e., those without zeroed start and end times). You will be given an opportunity to sort the sessions in chronological order. This will be described in the following paragraph.

During the editing of the session programming data, **Micro-Manager** will verify that the enabled sessions do not overlap. Once verified, and **Micro-Manager** detects that the sessions are not in chronological order, you are given the opportunity to sort them. **Micro-Manager** indicates the need to sort the sessions by enabling the “Sort” button and displaying a message in the lower left corner of the Session Programming window. You then can sort the sessions by pressing the “Sort” button. Sorting the sessions simply makes them more readable. When sessions overlap, **Micro-Manager** reports the condition in the lower left corner of the Session Programming window and the “Send” button is then disabled.

After you have completed the changes to the session programming, including enabling and disabling the session programming feature, press the “Send” button to send the sessions to the receiver for programming. **Micro-Manager** will perform a validity check of the sessions programmed by the receiver to ensure that the data were transmitted properly. Any errors will be reported to you through error message windows.

Finally, there is a special session programming pop-up menu that you can use to perform a standard set of configuration options. This pop-up menu (shown below) is accessed by right-clicking once when the mouse cursor is placed in a field of any session.





Selecting the “Delete Session” will cause the session that was being edited, when the right-click operation took place, to be deleted. The “Delete All Sessions”, option deletes all sessions (which is the same as setting the “Sess Progr. Mode” to “Disabled”). The remaining items of the pop-up window allow you to auto-configure the receiver for several session configurations often used. For example, the “Auto Config 1 Hr Sessions”, will cause **Micro-Manager** to create twenty-four 1-hour sessions, while the “Auto Config 6 Hr Sessions” will cause **Micro-Manager** to create four 6-hour sessions. These auto-configurations, like any other configuration set through the Session Programming Window, will not be sent to the receiver until you press the “Send” button.

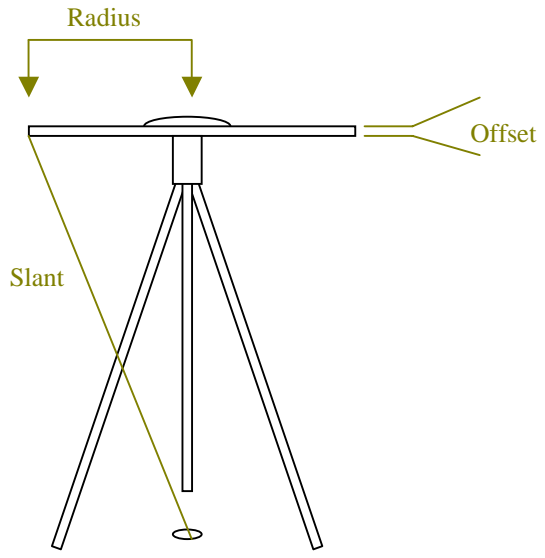
#### 4.1.5.4.5 Project Information

The “Receiver Project Settings” window allows you to edit data that is stored as part of the current file being recorded in the receiver’s memory. Most of the information in this window is what is used to create the Ashtech Receiver Site file (or S-File).

Parameter	Description
Site	The 4 character Site ID. This ID will be written as the Site ID for each epoch recorded and part of the S-File information when recorded data are converted to normal Ashtech data files. Entries must be exactly four characters and contain no blank characters.

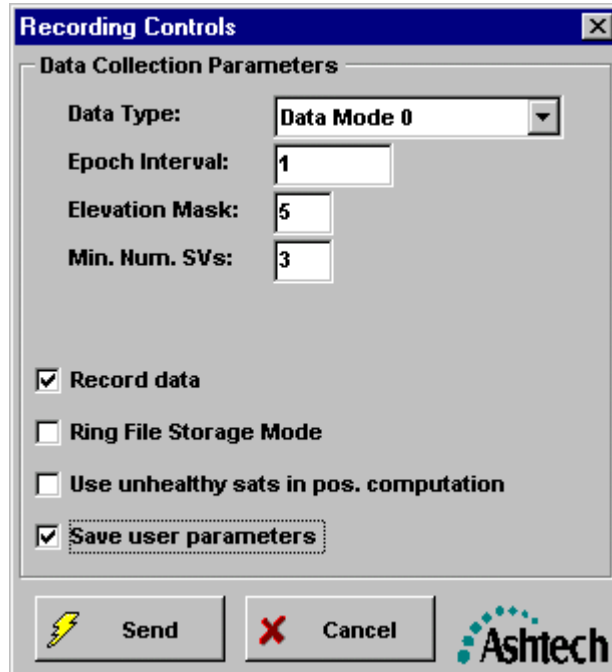
Parameter	Description
Ant. Ht.	<p>The entered Height of Antenna (meters) above the mark. This field is not editable as it is derived from the other Antenna Height information available on the window. That is, it is derived using the following formula:</p> $\text{Ant. Ht.} = \text{Vertical Offset} + \sqrt{\text{Slant}^2 - \text{Radius}^2}$ <p>A drawing of these measurements is provided at the end of this table.</p>
Session	<p>A single character designating the session code. It is recommended that you leave this unchanged as <b>Micro-Manager</b> will automatically designate the sessions during download operations.</p>
Rcvr. S/N	<p>(Max. 3 non-blank characters) Usually used to record the last 3 digits of the receiver serial number.</p>
Ant. S/N	<p>(Max. 3 non-blank characters) Usually used to record the last 3 digits of the antenna serial number.</p>
Month.Day	<p>Month and Day. Used only for documentation purposes.</p>
Operator	<p>(Max. 3 non-blank characters) Usually the operator provides his/her initials.</p>
Code	<p>(Maximum of 13 non-blank characters) Any 13 character code sequence you may desire to be recorded as part of the file information.</p>
Slant, Radius Vertical Offset	<p>The three components that are used to compute the Antenna Height that is stored as part of the project information in the receiver (see the Ant. Ht.) parameter described earlier in this table.</p>
Azimuth and Distance	<p>These fields are place holders for potential future efforts that may allow reference coordinates to be offset from some known mark.</p>

The drawing that follows shows measurements used to compute the full antenna height information. Please note that if you have no slant and radius components, simply enter the antenna height into the field labeled as Vertical Offset.



#### 4.1.5.4.6 Recording Controls

The Record Controls window allows you to set parameters that govern the general data recording controls and to set the “Save” mode of the receiver.



The following table explains the parameters of this window.

Parameter	Description
Data Mode	This parameter is typically referred to as the “Data Mode” of the receiver. It defines the format of the data stored by the receiver. Consult your Receiver Operations Manual for details on the Data Modes. This parameter takes affect in the general recording of GPS data when Session Programming is not in use (see Section 4.1.5.4.4).
Epoch Interval	Specifies the rate (in seconds) at which GPS data are sampled and recorded to memory files. This parameter takes affect in the general recording of GPS data when Session Programming is not in use (see Section 4.1.5.4.4).
Elevation Mask	Specifies the data recording and position computation elevation mask (0 to 89 degrees). That is, any satellites that fall below this elevation angle will not be recorded in the memory files nor will they be used in the receiver’s position computations. This parameter takes affect in the general recording of GPS data when Session Programming is not in use (see Section 4.1.5.4.4).

Parameter	Description
Min Num SVs	Specifies the minimum number of satellites required to allow data recording. That is, when the number of tracked satellites falls below this value, the data observed by the receiver will not be recorded in the memory files. This parameter takes affect in the general recording of GPS data when Session Programming is not in use (see Section 4.1.5.4.4).
Record Data	This parameter can be thought of as a master recording control. When checked, the receiver is permitted to record data and will use other factors (such as Elevation Mask and the minimum number of satellites) to determine what is recorded. When unchecked, the receiver is not permitted to record data regardless of other parameters.
Ring File Storage Mode	<p>When the receiver is in the Ring File Storage mode, the receiver is designed to always make room for the most recent data by deleting older files. When in this mode, the receiver manages the files automatically (i.e., deleting the oldest file when more room is needed to store recent data). When the Ring Buffer File Mode is not enabled, the receiver will stop recording data once the receiver’s memory becomes full. For complete details on the Ring Buffer File Mode, please consult the receiver manuals.</p> <p>It is important to note that when the receiver is in the Ring File Storage mode and you are downloading files (see Section 4.1.5.1), there is a possibility that the file being downloaded can be deleted by the receiver. When this occurs, the receiver will terminate the download operation. While <b>Micro-Manager</b> will report this as an error (and will not perform any automatic conversions of that file) the portion of the file downloaded will be resident on your hard drive. You can later manually convert this file (to other Ashtech file formats or RINEX) by using UpackU12.EXE (supplied with <b>Micro-Manager</b>).</p>
Use unhealthy sats in pos. computation	This parameter, when checked, will instruct the receiver to use satellites, flagged as unhealthy in their broadcast orbit data, in the position computation.
Save user parameters	Indicates whether or not various receiver parameters (e.g., satellite elevation mask and epoch interval) will be saved between receiver power cycles (i.e., turned off and then later turned back on). For $\mu$ Z-CGRS receivers, this parameter will always be “On”: i.e., the receiver is always in “Save Mode”. For other $\mu$ Z-Family receivers, the save mode is selectable and can be configured through <b>Micro-Manager</b> . The value reported here is the value set by the receiver command “\$PASHS,SAV,...” command. Please consult your receiver manual for details on that command and the receiver parameters affected by the receiver parameters save mode.

#### 4.1.5.4.7 RTCM Configuration

Through the RTCM Configuration window, you can configure the RTCM settings employed by your receiver. The GPS Receiver can be configured as an RTCM Base station, an RTCM Remote station, or it can be configured as neither Base nor Remote (i.e., No RTCM mode). The sample windows that follow show the appearance of the window in each of these modes.

The screenshot shows the 'RTCM Configuration' dialog box. The 'RTCM Mode' is set to 'Base'. Other settings include 'Station ID: 0', 'Output Port: C', 'Speed: 300', 'EOT: CRLF', 'Ref Health: 0', 'Max Age: 60', and 'Quality: 0'. There are three unchecked checkboxes: 'Auto-differential mode', 'Reset RTCM processing', and 'Use Sequence Numbers'. A 'Reference Position' button with a globe icon is present. Below these is a table for RTCM message types and frequencies.

Type:	1	2	3	6	9	15	16	18 / 19	20 / 21	22
FREQ:	0	0	0	On	99	0	0	0	0	0

Message:


**Send**      **Cancel**

**RTCM Configuration**

RTCM Mode: Remote      Station ID: 0       Auto-differential mode



Output Port: C      Ref Health: 0       Reset RTCM processing


Speed: 300      Max Age: 60       Use Sequence Numbers

EOT: CRLF      Quality: 0       Reference Position

Type:	1	2	3	6	9	15	16	18 / 19	20 / 21	22
FREQ:	0	0	0	On	99	0	0	0	0	0

Message:

 Send       Cancel




**RTCM Configuration**

RTCM Mode: Off      Station ID: 0       Auto-differential mode



Output Port: A      Ref Health: 0       Reset RTCM processing


Speed: 300      Max Age: 60       Use Sequence Numbers

EOT: CRLF      Quality: 0       Reference Position

Type:	1	2	3	6	9	15	16	18 / 19	20 / 21	22
FREQ:	0	0	0	On	99	0	0	0	0	0

Message:

 Send       Cancel



Notice in the examples provided above that, depending upon the mode selected, several of the edit fields are disabled (denoted by the graying of the entry field and its label). These disabled fields are not applicable under the given mode. Also of note, in the example window shown for the disabled RTCM mode, is that the edit field for the mode itself is disabled. This occurs when the “Output Port” (i.e., the port that the receiver will attempt to communicate RTCM data) is set to the same receiver port that **Micro-Manager** using to communicate with the receiver. In other words, **Micro-Manager** will

not permit you to configure RTCM operations on the same port that **Micro-Manager** is using to communicate with the receiver. This is because the messages exchanged between **Micro-Manager** and the receiver are not compatible with RTCM messages. Thus, to begin configuring the RTCM capabilities of the receiver, you must first change the receiver's RTCM Port to something different than what is being used by **Micro-Manager**. Likewise, the receiver will not permit you to set the RTCM port to the port configured for remote connections (i.e., the port on which the receiver's modem is attached and configured). If you do set the RTCM Port to either of these two ports and you press the "Send" button, the receiver will not accept the values (and **Micro-Manager** will give an error message indicating that the configuration values just sent to the receiver do match those reported by the receiver in its confirmation message).

The table which follows describes the parameters of these windows in more detail. Later we will provide restrictions imposed by these parameters.

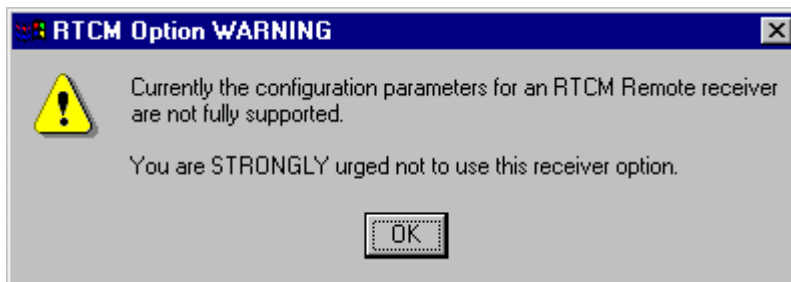
Parameter	Description
RTCM Mode	<p>The current RTCM mode of the GPS receiver (Base, Remote, or Off). When the receiver is configured as an RTCM Base station, the position of the antenna must be entered into the receiver. To enter these parameters, you can press the "Reference Position" button. Upon doing so, the position entry window (described in Section 4.1.5.4.3) will be displayed.</p> <p>If you fail to supply a reference position when configuring an RTCM Base station, the receiver will reject many of the other RTCM configuration parameters. Under such a condition, <b>Micro-Manager</b> will give an error message indicating that the configuration values just sent to the receiver do match those reported by the receiver in its confirmation message.</p>
Output Port	<p>Identifies the receiver port over which RTCM messages are communicated. When the receiver port identified is the same as that used by <b>Micro-Manager</b> to communicate with the receiver, then all other edit fields of this window will be disabled (i.e., you will first need to change and "Send" the RTCM port assignment before configuring the RTCM mode of the receiver).</p>
Speed	<p>Sets the number of bits per second issuing from the assigned RTCM serial port. The selectable range is from 25 to 1500 Bits per second. There is also a "Burst mode" selection. In the burst mode, the receiver will output the data over the selected communication port at a rate no greater than the BAUD rate of that port (see Section 4.1.5.4.2). This field will only be enabled when the receiver is running under the Base RTCM mode.</p>



<b>Parameter</b>	<b>Description</b>
EOT	Identifies the End-Of-Transmission sequence attached to the end of the RTCM messages. This field will only be enabled when the receiver is running under the Base RTCM mode.
Station ID	When in the Base Station mode, the receiver will use this information as its reference station ID (STID). When in Remote Station mode, the field identifies the RTCM Base station source for RTCM messages. This field will be disabled when not in Base or Remote RTCM mode.
Ref. Health	The health of the reference station (or STHE). This field is not editable when in the RTCM Remote mode or the Disabled mode. When set in Base mode, the receiver does not permit lower values of the reference station health unless the RTCM processing is reset. Thus, you will not be permitted to enter values lower than are currently entered in the field unless you check the “Reset RTCM Processing” checkbox in this window.
Max Age	The primary use of this field is to specify the maximum age (MAXAGE), in seconds, of RTCM Base station messages to be applied in a Remote station processing.
Quality	In Remote Mode, this field (QAFREQ) allows for the evaluation of the communication quality between the base station and the user equipment. The field is not applicable when in RTCM Base mode. To get a full meaning of this parameter, please consult your receiver operations manual.
Auto-differential Mode	When checked, permits the automatic differential mode of the receiver (Remote mode only). Allows the receiver to compute autonomous positions when no RTCM differential corrections are available or have exceeded the MAX Age parameter.
Reset RTCM Processing	Checking this checkbox and then pressing the “Send” button will reset the RTCM processing within the receiver. Consult your Receiver Operations Manual for more details.
Use Sequence Numbers	This checkbox instructs the RTCM Remote receiver to utilize the sequence numbers in the RTCM messages to enhance the communication synchronization checks. Consult your Receiver Operations Manual for more details.

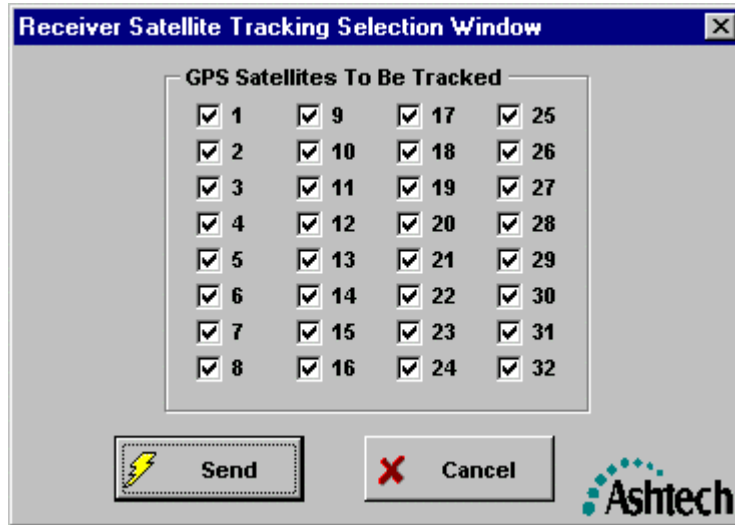
Parameter	Description
FREQ	<p>In the RTCM window, there is a table that represents RTCM message types (labeled as "Type") and their output frequency (labeled as "FREQ"). With the exception of Type 6 messages (i.e., the Null filler message), the output frequencies are from 0 to 99. For Types 1, 9, 18/19, and 20/21 RTCM messages the frequency specifies the output rate in seconds. For Types 2, 3, 16, and 22 RTCM messages, the frequency specifies the output rate in minutes. In all of these cases, 0 implies that the message is turned off and 99 represents a continuous (i.e., as often as possible) output rate. Only one message type can be configured with an output rate of 99. The Type 6 RTCM message is a filler message which is, when enabled, output whenever there is spare communication bandwidth. Thus, the Type 6 message is either on or off. At the time this document was written, the <math>\mu</math>Z-Family of receivers did not implement Type 15 messages. This is why the frequency of Type 15 messages is disabled in all modes (Base, Remote, and neither Base nor Remote).</p> <p>The FREQ fields are only enabled when configured as an RTCM base.</p>
Message	<p>Contains the RTCM "Message" (up to 80 characters) sent as part of the RTCM type 16 message from the Base station to the user equipment.</p>

It is important to note that **Micro-Manager** supports the configuration and display of the  $\mu$ Z-Family of GPS receivers participating as RTCM remote receivers. At the time of the publication of this document, Magellan had not fully tested the support of the  $\mu$ Z-family receivers as RTCM remote stations in the **Micro-Manager** environment. Thus, when you make the Remote RTCM selection, **Micro-Manager** reports the following warning message.



#### 4.1.5.4.8 Satellite Tracking Window

The Satellite Tracking Window allows you to alter the set of GPS satellites that the receiver is permitted to track. Below is an example of this window.



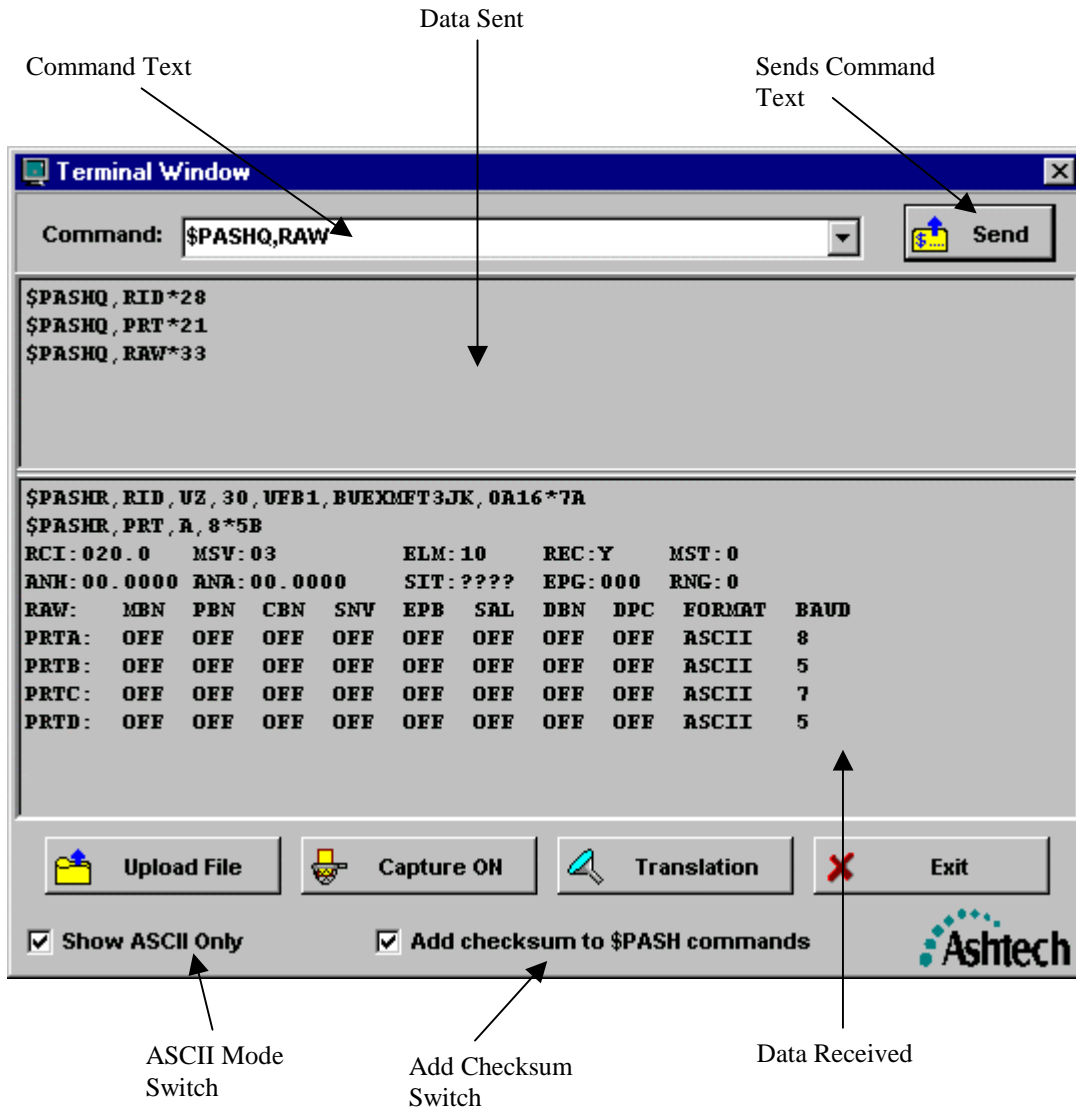
You can enable/disable the tracking of specific satellites by checking or unchecking the checkbox of the desired satellite (listed by pseudo-random noise code numbers).

As with the other receiver configuration windows, you press the “Send” button to send the changes to the receiver. Upon doing so, **Micro-Manager** will await validation responses from the receiver to verify that the parameters sent were accepted by the receiver. Any failures will be reported.

## 4.1.6 Terminal Window

**Micro-Manager** is equipped with a terminal window that allows you to send commands to the GPS receiver and view the responses. To launch this window, select “File” from the main menu bar and then select the “Terminal Window” sub-menu option.

The following provides an annotated example of the Terminal Window.



In the Command Text area (i.e., the area labeled with “Command:”), you can enter the command you wish to send to the receiver or you can use the drop-down list to select a message template. If you select a message template, you may need to edit it before sending the command to the receiver. For example, the template for the RCI command is “\$PASHS,RCI,xxx.xx”. In this case, you will need to edit the “xxx.xx” part of the

command to contain a valid epoch interval before sending the command. Entered commands are sent using the command “Send” Button. To determine valid commands, you must consult the appropriate receiver manual. You do not need to supply the <CR><LF> (i.e., carriage return/line feed) sequences required at the end of the messages, **Micro-Manager** will add those for you. If you have the “Add checksum to \$PASH commands” checked, then **Micro-Manager** will automatically add the checksums to \$PASHS commands sent by pressing the “Send” button.

Another example is the template for enabling and disabling the tracking and use of selected satellites. The general template is “\$PASHS,USE,d,x”. In this case, you should replace the “d” with the two-digit satellite pseudo-random number. For example, satellite 8 should be entered as “08” (i.e., the zero character and the eight character). The “x” should be replaced with “Y” or “N” depending upon whether you want to enable or disable the use of the satellite, respectively.

Right-clicking in the Command Text area will cause **Micro-Manager** to display a pop-up menu that allows one to change the case of the letters that will be sent when the “Send” button is pushed. When the pop-up menu item indicating upper case has been selected (i.e., indicated by the check symbol next to the menu item), Micro-Manager will translate any lower-case characters to upper case before sending the command. To change the “Command” case handling, simply select the pop-up menu item. Selecting the menu item in this way will toggle the case handling to its opposite setting.

The “Data Sent” area of the window displays the commands that you have sent to the receiver. You can also click in this area and then start directly typing characters. As each character is typed, they are sent through the configured communication port (see Section 3.1.1). The primary differences between this approach and the “Command” approach are:

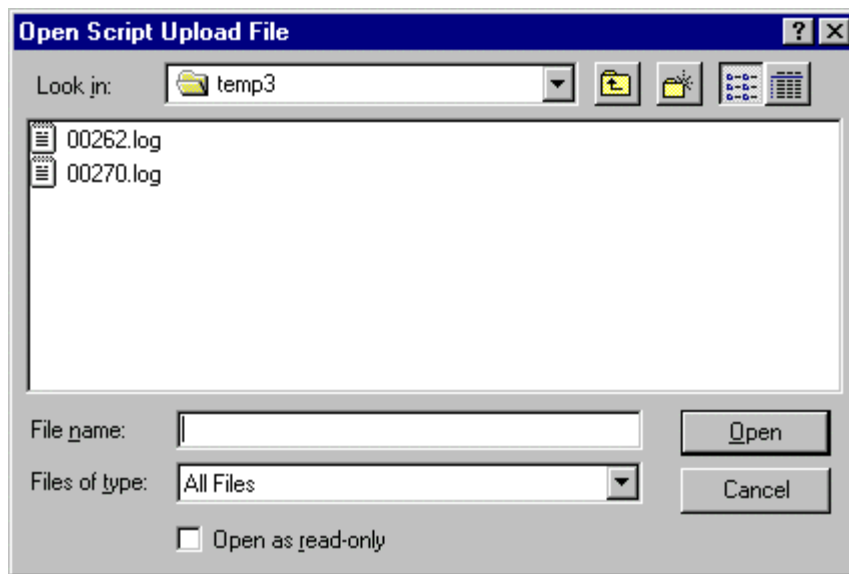
- 1) With the “Command” and “Send” approach, the entire entered command is sent once the “Send” button is pressed (and not until). Using the “Data Sent” area of the window, as each character is typed, it is sent over the communications port.
- 2) With the “Command” and “Send” approach, commands are sent with a <CR><LF> sequence at the end of each message. Using the “Data Sent” area of the window, you need to force the sending of special characters, such as <CR> and <LF>, by entering the proper control sequences. For example, to send an <LF> (i.e., the line feed character), press and hold the CTRL (i.e., the control) key and then press “J”. Appendix B shows the special characters and their associated control key sequences.
- 3) Commands sent using the “Command” and “Send” approach can have the checksum automatically added to the \$PASH commands when the “Add checksum to \$PASH commands” is enabled.

The “Received Data” area of the window displays the data being received from the communications port. In some cases, messages sent from the receiver will not be in a normal human readable form. This is because these messages can contain non-printable/binary characters. **Micro-Manager** will show only the ASCII portions of those messages when the “Show ASCII only” checkbox is checked. When this checkbox is unchecked, the non-ASCII data are shown in a hexadecimal representation of the data (i.e., “0x’ followed by the hexadecimal number of the character being represented).

It is important to note that **Micro-Manager** will display almost all of the traffic exchanged between the receiver and the computer. Some messages are not displayed because they are either too lengthy or too unimportant to review. These messages comprise a few file transfer related windows. All other messages are displayed in the Terminal window.

The “Upload File” button of the Terminal window is used to allow you to send the contents of a script file to the receiver. These script files are in a special format (described in Appendix C). These script files allow you to create sets of specialized commands you can use to configure the receiver in ways not directly supported by **Micro-Manager**. For example, you might define a script file named MET.TXT which contains the commands needed to configure the GPS receiver to interface with a meteorological sensor on a specified port and at a specified baud rate. This feature enables you to pre-define an unlimited number of configurations which are then always available for rapid use at a later date.

When you press the “Upload File” button, you will be presented with a window similar to the following:

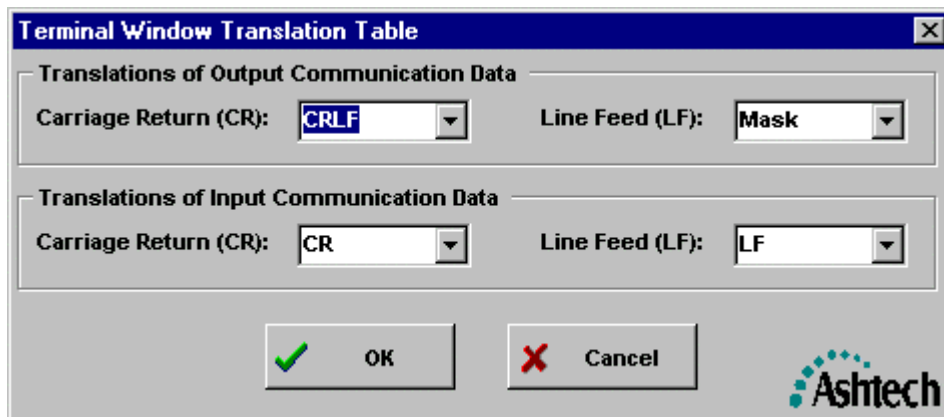


Using this window you browse to the directory containing the script file and then select the script file you would like to upload to the receiver. Again, Appendix C contains a description of the format of these script files.

The “Capture ON” button in the Terminal Window enables one to capture all received data to a file. Upon pressing the button, you will be given the opportunity to select/name a disk file into which the captured data can be stored. Upon successfully selecting/naming a capture file, **Micro-Manager** will begin capturing data to that capture file. At this point, the “Capture ON” button changes to “Capture OFF”. You can terminate the capture of received data to a file by pressing the “Capture OFF” button.

While the capture feature is enabled, all data, displayed as received data in the terminal window, will be written to the named capture file. Your selected state of the “Show ASCII only” checkbox will have no effect on the data written to the capture file. That is, the capture file contains all data received in its binary format.

The “Translation” button enables you to enter/edit a character translation table which will be used when communicating with the receiver through the terminal window. For example, you can translate each received <CR> sequence into a <CR><LF> sequence. The same goes for output characters as well. For example, you can configure the outgoing translation table to transmit a <CR><LF> sequence in response to a simple <CR> character (i.e., which is generated when you hit the carriage return on your keyboard). The following display is an example of the Terminal Window Translation Table window.



## 4.2 Command-Line Mode

**Micro-Manager** was designed to run without the need of user interaction (i.e., in an unattended mode). This is accomplished through the command-line mode. **Micro-Manager** enters the command-line mode when the program is launched with command-line parameters. These parameters follow a strict pattern. Failure to comply with the requirements will cause **Micro-Manager** to reject the commands and terminate.

**Micro-Manager** will also terminate the command-line mode when the estimated amount of disk space required for download operations exceeds, or nearly exceeds, the amount of available disk space for the disk drive specified in the output file directory (see Section 3.1.4.3). The values calculated for the required disk space are only estimated because of the following:

- A) The log file may have data written to it that **Micro-Manager** cannot predict;
- B) When a file is created on the target disk, the amount of space Windows uses for that file on disk differs from disk type to disk type; and
- C) There is not a direct means of calculating the disk space required by the ring buffer file (so a worst-case scenario is estimated).

When the command-line mode terminates the download operation prematurely, and you have configured (i.e., enabled) the output log file (see Section 3.1.4.2), **Micro-Manager** will attempt to output a termination rationale in the log file. Clearly, **Micro-Manager** will not be able to make this notation in the log file if the disk containing it is full.

It is also important to note that when in command-line mode, **Micro-Manager** makes no attempt to protect files already stored on disk. If it generates a name for a file that is already stored on disk, **Micro-Manager** will overwrite that file when the named file is downloaded and provide no preventative screen messages. This is consistent with the automated nature of the command-line mode so beware.

The command-line arguments follow the general form:

MicroMgr.exe [option\_list secondary\_args]

The options list and secondary arguments are as follows:

-c *num*

For automatic call and download of receiver data using a modem. Here *num* represents the phone list entry number from the Telephone List window described in Section 3.1.3. If you are going to direct connect to the receiver using the command-line mode, you should not use the -c option.

-g *hh.h*

Automatically download files which have closed less than *hh.h* hours prior to the current receiver time: i.e., get the most recent files closed less than *hh.h* hours ago. Note: this command-line option cannot be used with the -o option.

-o *hh.h*

Automatically download files which closed over *hh.h* hours prior to the current receiver time: i.e., get the files that have closed over *hh.h* hours ago. Note: this command-line option cannot be used with the -g option.



**-d *hh.h***

Automatically delete downloaded files from receiver's memory. Files over *hh.h* hours old (by time of closure) will be deleted.

Note: if the `-g` and `-d` options are both specified, the deletion operation will not occur when there are any unrecovered errors resulting from the download operation.

**-s *y1/d1/h1:m1 y2/d2/h2:m2***

For automatic download of files having closure times between two specific times (in the GPS time system).

*y* - the year(4 digits),

*d* - day of year,

*h* - hour (optional),

*m* - minute (optional).

**-x *y1/d1/h1:m1 y2/d2/h2:m2***

For automatic deletion of selected files bounded by two specific closure times (in the GPS time system). Note: if this parameter is used with any automatic download command, then the deletion will only occur if all files are successfully downloaded.

*y* - the year(4 digits),

*d* - day of year,

*h* - hour (optional),

*m* - minute (optional).

**-u *uploadname***

For automatic upload of a script file to the receiver, where *uploadname* is the name of the script file, including drive and path, to be uploaded. The format of script files is detailed in Appendix C. Note: this parameter should not be used with any other download and delete command-line parameters (but it can be used with the `-c` parameter). **Micro-Manager** performs no checks to validate compliance with these restrictions.

Example 1: `MicroMgr.exe -c 5 -g 6.0 -d 12.0`

In this example, **Micro-Manager** has been instructed to establish a remote modem connection using telephone list entry number 5. It then obtains files that have been closed less than 6 hours prior to the current receiver time. Upon successful download of those files, **Micro-Manager** then attempts to delete files from the receiver's memory which have been closed more than 12 hours before the current receiver time.

Example 2: `MicroMgr.exe -g 6.0 -d 12.0`

In this example, **Micro-Manager** has been instructed to establish a direct connection with a receiver. It then obtains files that have been closed less than 6 hours prior to the current receiver time. Upon successful download of those files, **Micro-Manager** then

attempts to delete files from the receiver's memory which have been closed more than 12 hours before the current receiver time.

Example 3: `MicroMgr.exe -c 2 -u E:\scripts\Met.txr`

Here, **Micro-Manager** has been instructed to establish a remote modem connection using telephone list entry number 2. After establishing the connection, it will perform an upload of the script file at “E:\scripts\Met.txt”.

# Appendix A

## File Naming Approach

Almost every Ashtech file is named based upon some value of GPS time. **Micro-Manager** will create the receiver-sourced data file names based upon times stored for those files in the receiver. Status files, such as the logging summary (or Log File) are created based upon the CPU clock time. This is because these files are opened and closed independently of the receiver data files. For example, the Log File contains information about the entire remote session (not to be confused with a data collection session). During that session, you may download files from numerous days. The log file will record all of the activities that occurred during that remote session, including an entry for each file downloaded.

It is also important to note that when in command-line mode, **Micro-Manager** makes no attempt to protect files already stored on disk. If it generates a name for a file that is already stored on disk, the **Micro-Manager** will overwrite that file when the named file is downloaded and provide no preventative screen messages. When in its GUI (or manual) mode, you will be warned of potential file overwrites.

### A.1 U-File File Naming Approach

**Micro-Manager** depends upon several sources of information when formulating Ashtech file names. The Ashtech files are named using the following naming convention:

tnnnsyy.ddd

where, t	represents the file type (U for a $\mu$ Z-Family receiver image file),
nnnn	represents the 4-character station name,
s	represents the session code,
yy	represents the last two digits of the year, and
ddd	represents the day of the year.

For example, a file named UASHTD99.005 is an Ashtech U-File ( $\mu$ Z-Family receiver image file) for site ASHT taken in session D of day 5 of 1999. Using this convention, **Micro-Manager** creates the names of the U-Files (See Section 4.1.5.1). The times used to create these file names are stored as part of the file information retrieved from the receiver.

## A.2 LOG File Naming Approach

The **Micro-Manager** Log file names are of the following form:

yyddd.LOG

where, yy represents the last two digits of the year, and  
ddd represents the day of the year.

For example, a file named 97233.LOG is a **Micro-Manager** Log file for day 233 of 1997. In the year 2000 the file name would begin with '00'. Unlike the R-File names, these file names are based upon the CPU clock as is described in the introduction to this Appendix.

# Appendix B

## ASCII Control Characters

The table which follows shows the character sequences entered into **Micro-Manager** to represent the special ASCII control characters. In the table, the “Sequence” column denotes the characters that should be entered to obtain the desired control characters.

When entering these sequences into the modem configuration strings for the computer side modem (Sections 3.1.2.5 through 3.1.2.8) the caret character (i.e., “^”) should be entered as the caret character (i.e., you should not press the CTRL key and the specified key simultaneously). The reason behind this was given in Section 3.1.2 on Modem Settings.

Alternatively, when entering control sequences into the terminal window (Section 4.1.6) the sequence is entered by pressing the CTRL key and the specified key simultaneously.

Sequence	Character Name	Decimal Value	Octal Value	Hexadecimal Value	Description
^A	SOH	1	001	0x01	Start of Header
^B	STX	2	002	0x02	Start of Text
^C	ETX	3	003	0x03	End of Text
^D	EOD	4	004	0x04	End of Transmission
^E	ENQ	5	005	0x05	Inquiry
^F	ACK	6	006	0x06	Acknowledge
^G	BEL	7	007	0x07	Bell
^H	BS	8	010	0x08	Backspace
^I	HT	9	011	0x09	Horizontal Tab
^J	LF	10	012	0x0A	Line Feed
^K	VT	11	013	0x0B	Vertical Tab
^L	FF	12	014	0x0C	Form Feed
^M	CR	13	015	0x0D	Carriage Return
^N	SO	14	016	0x0E	Shift Out
^O	SI	15	017	0x0F	Shift In
^P	DLE	16	020	0x10	Data Link Enable
^Q	DC1	17	021	0x11	Device Control 1
^R	DC2	18	022	0x12	Device Control 2
^S	DC3	19	023	0x13	Device Control 3
^T	DC4	20	024	0x14	Device Control 4
^U	NAK	21	025	0x15	Negative Acknowledge
^V	SYN	22	026	0x16	Synchronize Idle
^W	ETB	23	027	0x17	End Transmission Block
^X	CAN	24	030	0x18	Cancel

Sequence	Character Name	Decimal Value	Octal Value	Hexadecimal Value	Description
^Y	EM	25	031	0x19	End of Medium
^Z	SUB	26	032	0x1A	Substitute
^[	ESC	27	033	0x1B	Escape
^\	FS	28	034	0x1C	File Separator
^]	GS	29	035	0x1D	Group Separator
^_	US	31	036	0x1F	Unit Separator

# Appendix C

## Upload File Format

Section 4.1.6 and 4.2 of this document describe the process of uploading script files to the  $\mu$ Z-Family of receivers using **Micro-Manager**. This section describes the format of those script files.

The general format of the Upload File is ASCII text. However, some messages sent to an Ashtech receiver may need to contain binary data. In fact, almost every message sent to an Ashtech receiver requires the <CR><LF> (carriage return, line feed) sequence at the end of the message. For these reasons we need a means of entering binary data into the upload file. There are also cases where it is helpful to have the upload process pause during the upload of data to the receiver. To accommodate all of these needs, the upload is sent through an interpreter imbedded in **Micro-Manager**. This interpreter sends all ASCII text until it meets with a special escape character. Immediately after these escape characters will be other characters describing the special characters to be sent or which describe other processing that must take place. Once the escape processing is handled, **Micro-Manager** will resume sending the ASCII data in the file.

The special escape character is '\'. If this character is followed by a "+" character, then the escape sequence is considered to be delay processing. A delay sequence is of the form \+*time*+, where *time* is the number milliseconds the interpreter should delay before continuing with the upload. If the character following the escape character is '0' (i.e., the zero character), then **Micro-Manager** will translate the octal escape sequence into a binary character. For example, \015 is the octal representation of the carriage return character. To send a '\' character, the character immediately following the '\' must be a '\'. Finally, the carriage returns (or any line feed characters) that are normally part of an ASCII file are not sent as part of the uploaded data, to send these characters you must use the octal representation of the characters.

The following provides an example upload file:

```
$PASHS,RCI,5.0\015\012
\+100+
$PASHQ,RID\015\012
\+100+
$PASHQ,RAW\015\012
\+100+
$PASHS,RCI,15.0\015\012
\+1000+
```

The interpreter translates the above file as follows:

```
$PASHS,RCI,5.0<CR><LF>
wait 100 milliseconds
$PASHQ,RID<CR><LF>
wait 100 milliseconds
$PASHQ,RAW<CR><LF>
wait 100 milliseconds
$PASHS,RCI,15.0<CR><LF>
wait 1000 milliseconds
```



# Appendix D

## Dialing Directory Export File Format

Sections 3.1.3 through 3.1.3.7 of this document describe the process of exporting **Micro-Manager**'s dialing directory. This section describes the format of these exported files.

The following is an example of an exported dialing directory file:

```
0001 Site JK13
      123-4567
      115200,0,8,0
0002 Site JK23
      123-4568
      57600,0,8,0
0003 Site JK99
      1-010-987-6543
      38400,0,8,0
```

The general format of the dialing directory export file is ASCII text. Each record within the file contains 3 lines of text. The first line of each record is left justified while the remaining two lines are prefixed with 5 space characters. The following describes the format of each record:

```
enum Name_of_Entry
      Telephone_Number
      BAUD,Parity,Data_bits,Stop_bits
```

With the exception of the field labeled “enum”, each element of this record is described in section 3.1.3.2. Nevertheless, a description of each is provided below.

<b>Field</b>	<b>Max. Characters</b>	<b>Description</b>										
<i>enum</i>	4	The record number. The record numbers start at one and are incremented at one per record. Record numbers are written such that the full field width contains digits (i.e., zero padded to the left when appropriate).										
<i>Name_of_Entry</i>	70	This field is simply a text string you wish to use to identify the telephone directory entry. This field will not be passed to the modem during dialing operations; nor will it be used for any other configuration purposes.										
<i>Telephone_Number</i>	70	This field allows you to specify the telephone number of the remote system to be dialed. Please note that this is a modem string and is subjected to the same special character rules described in Section 3.1.2.										
<i>BAUD</i>	6	Contains the speed of the link between the PC and the modem. Acceptable values are: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, and 115200										
<i>Parity</i>	1	Contains the parity of the link between the PC and the modem. These values are coded as follows: <table border="0" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;">Coded Value</th> <th style="text-align: left;">Description:</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>No Parity</td> </tr> <tr> <td>1</td> <td>Odd Parity</td> </tr> <tr> <td>2</td> <td>Even Parity</td> </tr> <tr> <td>3</td> <td>Marked Parity</td> </tr> </tbody> </table>	Coded Value	Description:	0	No Parity	1	Odd Parity	2	Even Parity	3	Marked Parity
Coded Value	Description:											
0	No Parity											
1	Odd Parity											
2	Even Parity											
3	Marked Parity											
<i>Data_bits</i>	1	Contains the data bits used in the link between the PC and the modem. These values are coded as follows: <table border="0" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;">Coded Value</th> <th style="text-align: left;">Description:</th> </tr> </thead> <tbody> <tr> <td>7</td> <td>7 Data Bits</td> </tr> <tr> <td>8</td> <td>8 Data Bits</td> </tr> </tbody> </table>	Coded Value	Description:	7	7 Data Bits	8	8 Data Bits				
Coded Value	Description:											
7	7 Data Bits											
8	8 Data Bits											
<i>Stop_bits</i>	1	Contains the stop bits used in the link between the PC and the modem. These values are coded as follows: <table border="0" style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;">Coded Value</th> <th style="text-align: left;">Description:</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1 Stop Bit</td> </tr> <tr> <td>1</td> <td>1.5 Stop Bits</td> </tr> <tr> <td>2</td> <td>2 Stop Bits</td> </tr> </tbody> </table>	Coded Value	Description:	0	1 Stop Bit	1	1.5 Stop Bits	2	2 Stop Bits		
Coded Value	Description:											
0	1 Stop Bit											
1	1.5 Stop Bits											
2	2 Stop Bits											

# Appendix E

## Utility Program XYZAshRx

### E.1 Introduction to XYZAshRx

XYZAshRx.EXE, written by The XYZ's of GPS, Inc., was designed to convert Ashtech raw GPS observation files to the Receiver INdependent EXchange format (RINEX). The program has been designed to operate on a Windows 95 or NT platform. To facilitate a wide variety of users, XYZAshRx can be configured and run through normal Windows Graphical User Interfaces (GUI) or launched directly from the command-line. That is, a user can use the conversion program just like most other Windows programs or the converter program can be executed, without need of human intervention, from other programs (such as Ashtech's **Micro-Manager** Software), from a DOS command line, or from batch files.

XYZAshRx currently supports the Ashtech GPS and GPS/GLONASS receivers. Data are output in the RINEX Version 2.0 format. The specification for this version of RINEX came from Dr. Werner Gurtner's paper, "RINEX: The Receiver Independent Exchange Format Version 2", Revised in July of 1998.

This document includes discussions pertaining to the Geodetic Base Station Software (GBSS) and the GBSS Meteorological Module. This is because this XYZAshRx is also used with those programs. We have included discussions pertaining to the features of XYZAshRx specific to those programs for completeness. Please be advised that the some of the documentation may not be applicable under **Micro-Manager**.

#### E.1.1 Minimum System Requirements

XYZAshRx requires the target platform to be a Windows 95 or Windows NT based computer. While XYZAshRx requires less than 1 megabyte of memory to run, Windows 95 and NT impose higher minimums. You should consult the appropriate Microsoft documentation to determine the minimum system requirements for Windows.

XYZAshRx requires less than 2 megabytes of disk space. However XYZAshRx creates ASCII output files from your Raw Ashtech Observation files. As a general rule, ASCII RINEX files require approximately 1.5 times the space required by Raw Ashtech Observation Files.

## E.1.2 Demo Versions

There are two basic configurations of XYZAshRx: fully operational and demonstration versions. This document applies to both configurations. Demonstration versions, which are freely distributed over the Internet or provided on diskette without accompanying sentinel keys, are not nearly as capable as the operational versions. For example, demonstration versions will only create RINEX output files of 100 epochs or fewer. This document will not seek to delineate the specific differences between the demonstration and the operational versions. It is important to note, however, that the installation instructions documented herein apply to both configurations.

## E.2 INSTALLATION OVERVIEW

XYZAshRx is currently distributed as part of **Micro-Manager**. The program will be installed in the same directory as that of MicroMgr.exe. For example, if during the installation of **Micro-Manager**, you chose to install **Micro-Manager** into the “D:\Program Files\ASHTECH\MicroMgr” directory, then XYZAshRx would be installed into the same directory.

The automatic installation of **Micro-Manager** does not put XYZAshRx into the Windows search path. One can add XYZAshRx to the Windows search path by right clicking on “My Computer”, selecting the “Properties” menu item, selecting the “Environment” tab, selecting the “Path” system variable and then editing the “Value” field to include the directory in which XYZAshRx is stored.

Additionally, the automatic installation of **Micro-Manager** neither puts an icon onto the desk top nor in the Start Menu bar. To create a program icon on the desktop, simply find the program file XYZAshRx.EXE using “My Computer”, right click and drag the icon to the desktop and select “Create Shortcut Here”. For details on how to add a program to the Start Menu, consult Windows Help searching on “Start Menu” and selecting the topic dealing with adding menu items to the Start Menu.

Finally, XYZAshRx is protected by a software sentinel key (the same key as is used by **Micro-Manager**). The software sentinel key is installed by attaching the end of the sentinel key labeled ↑COMPUTER↑ to a parallel printer port of your computer. Tighten the screws of the sentinel key to connect the key securely to your computer. If a printer was connected to your computer, attach that cable to the sentinel. If the sentinel cannot be installed because of an obstruction behind the computer, you can place the sentinel key later in the parallel sequence (for example, you could attach the sentinel key to a DB-25 male to DB-25 female cable which is connected to your computer’s parallel port).

## E.3 RUNNING XYZAshRx

XYZAshRx creates RINEX Version 2.0 files from Raw Ashtech Observation files (i.e., from Ashtech B-Files). The program can be manually instructed to convert files or can be called directly from the command-line. This latter method allows programs to invoke the converter without the need of human intervention. Throughout the remainder of this documentation, we will call the former approach the Manual/GUI approach and the latter will be called the Command-Line approach.

Both the Manual/GUI and the Command-Line approaches rely upon configuration information contained in the INI file associated with the converter program. This INI file is called “XYZAshRx.INI” and is stored in the same directory as the main program. Changes to this configuration file occur whenever the user changes configuration using the Manual/GUI approach. That is, when desiring to use the Command-Line mode, you should pre-set the configuration using the Manual/GUI approach. Section E.3.1 will describe the Manual/GUI approach to using XYZAshRx and Section E.3.2 will describe the Command-Line approach to using XYZAshRx.

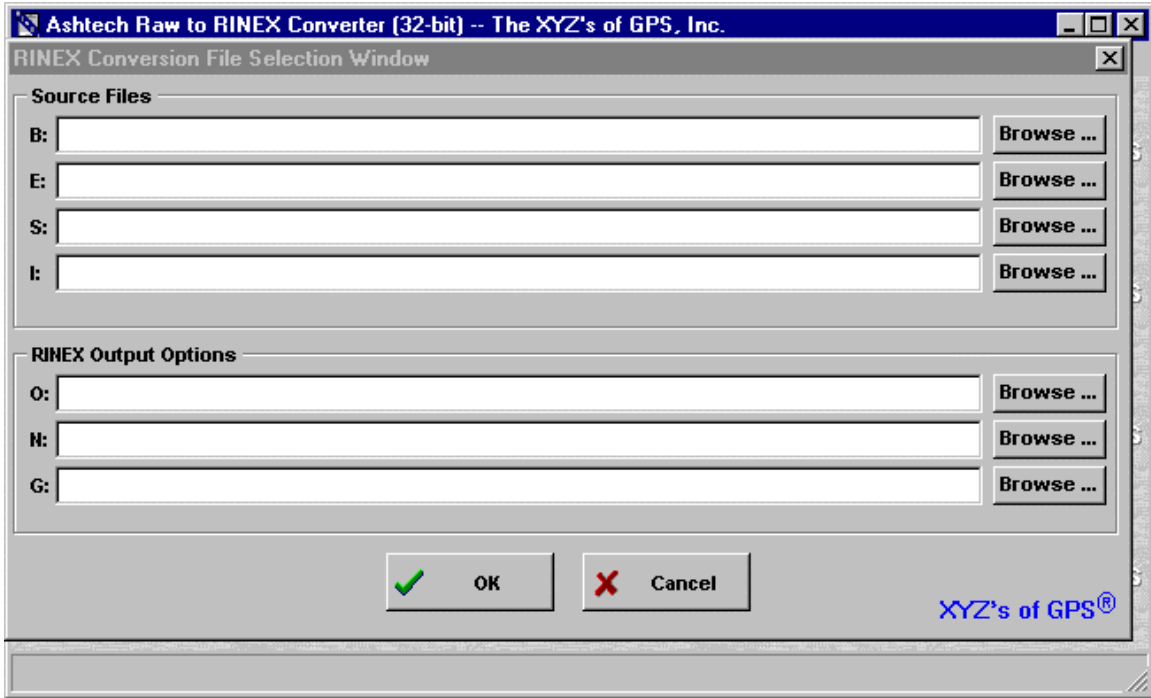
It is important to re-state the fact that the configuration information is stored in the file “XYZAshRx.INI” which is stored in the same directory as the program file (i.e., “XYZAshRx.EXE”). When you desire an alternative configuration, for example to support two **Micro-Manager** installations simultaneously, you should copy the following files to another directory:

```
XYZAshRx.INI
XYZAshRx.EXE
XYZAshRx.BMP
```

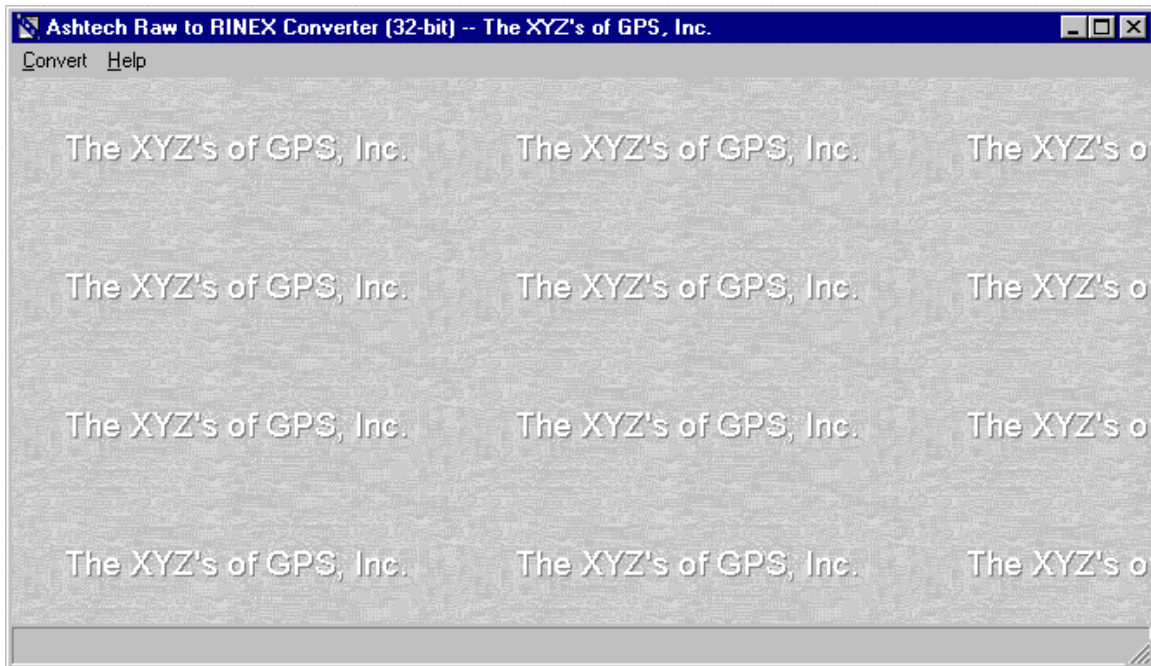
By doing this, you create an independent copy of the .INI file. Launching the program XYZAshRx.EXE in this copied directory causes the program to use the INI file in that directory. This copy would utilize a configuration that is independent of the other copy (i.e., the original copy) of XYZAshRx on your computer. In contrast, launching two copies of the XYZAshRx from the same directory accesses the same INI file. The configuration stored at the end of the runs of the programs is highly dependent upon which copy of the program terminated first. Needless to say, you are strongly advised not to launch more than one copy of XYZAshRx from the same directory (unless both copies will use the exact same configuration information). Launching several copies of XYZAshRx, each originating from its own directory, is perfectly acceptable and supported by the sentinel.

### E.3.1 Manual/GUI Approach

Upon starting XYZAshRx without command-line parameters, the following is displayed:



Presented above are the Main Window of the program and the File Selection Window. The File Selection Window is presented automatically at the start of the program as a means of saving time and will be described in more detail in Section E.3.1.1. For now, we will assume that the File Selection Window has been closed to facilitate the description of the program's main window. The main window of the program has the following appearance:

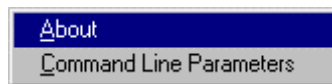


Notice the program has only two main menu items. When you select the “Convert” menu item you will be presented with the following drop-down menu:



That is, you can only “Convert” “To RINEX” using XYZAshRx. Upon selecting the “Obs and Nav to RINEX” option, you will be presented with the File Selection Window presented in Section E.3.1.1. Upon selecting the “Met to RINEX” option, you will be presented with the RINEX Meteorological File Selection” Window presented in Section E.3.1.2. Through both of these windows, you will select the input and output files of a single conversion run.

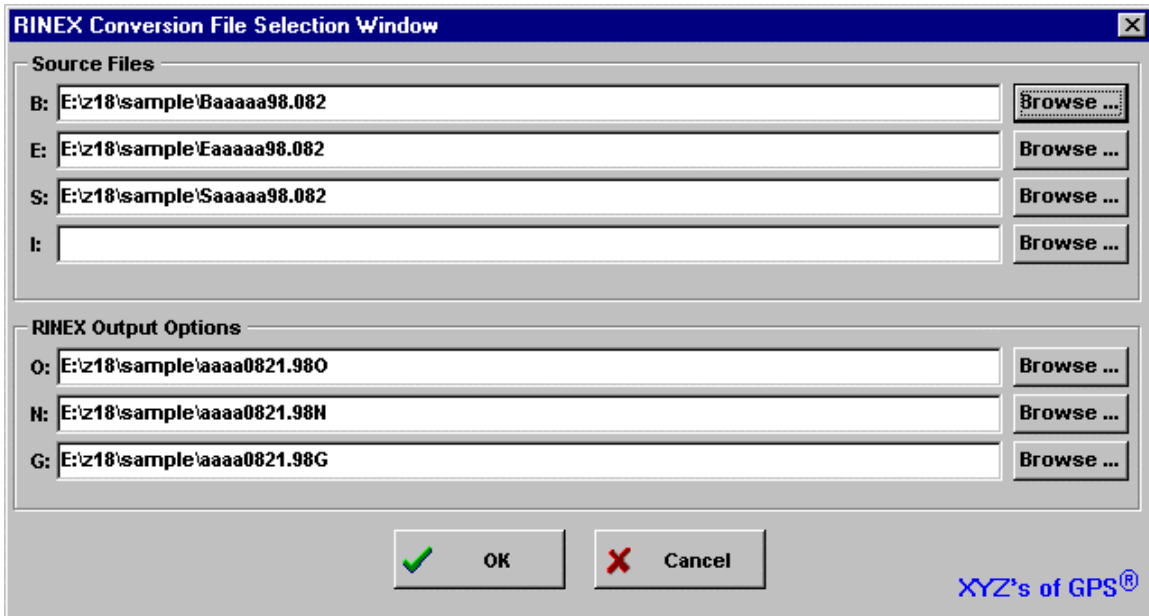
When you select the “Help” menu item from the main menu, you will be presented with the following drop-down menu:



When you select the “About” menu item XYZAshRx will display a window containing information about the program. In response to selecting the “Command Line Parameters” item XYZAshRx will display a window describing how to invoke the Command-Line Mode of the program. The command-line mode is further documented in Section E.3.2 of this manual.

#### E.3.1.1 File Selection Window

The File Selection Window is displayed in response to the “Convert | To Rinex” selection from the program’s main menu. The following provides an example of the File Selection Window:



There are seven edit fields in this window. The first four correspond to the following input file names:

Label	Description	Required
B:	Input Ashtech formatted B-File (raw observations)	Yes
E:	Input Ashtech formatted E-File (broadcast orbits)	Yes
S:	Input Ashtech formatted S-File (site file)	No
I:	Input Ashtech formatted I-File (ionospheric data)	Yes/No

The latter 3 edit fields correspond to the following output file names:

Label	Description	Required
O:	Output RINEX Observation File	No/Yes
N:	Output RINEX GPS Navigation File	No/Yes
G:	Output RINEX GLONASS Navigation File	No/Yes

XYZAshRx seeks to help with the file naming by keying off of the source B-File name. Each time the edit field of source B-File is changed and contains a valid B-File name (i.e., the file exists on disk), XYZAshRx will automatically fill in the other input file names for the files that exist on disk and will automatically create the output file names. In the sample window above, the user used the “Browse...” button of the B-File to select input B-File and XYZAshRx found associated E- and S-Files on the disk (but not an associated I-File) and automatically named the output RINEX Observation and Navigation files.

In the input file table above, notice that the S- and I-Files are optional. When these files are not specified XYZAshRx automatically makes changes necessary to output



header data in the associated RINEX files. In particular, when the S-File is specified, XYZAshRx sets certain default values, for the output RINEX header, based on data contained in the S-File. When the S-File name is not provided, the site related header data is obtained from and saved to the configuration file. The RINEX header data affected by the presence of the S-File are as follows:

- Station Name
- Observer's Name
- Receiver Serial Number
- Antenna Serial Number
- Antenna Offsets (Slant, Radius, and Delta Vertical)

Obviously, the above information would be obtained from the S-File if it were present.

Similarly, the presence of the I-File affects the header of the output RINEX Navigation File. For GLONASS RINEX conversions, the I-File is required. When the I-File is present, XYZAshRx places the ionospheric header data (containing the model alphas and betas) and the leap second header data (i.e., the data needed to determine the integer offset between GPS time and UTC) into the RINEX Navigation File. When the I-File is not present, these header components will not be output to the RINEX Navigation File.

Notice that in the output file table above, the output RINEX Navigation and Observation files appear to be both optional and required. This is because at least one of the output files is required by XYZAshRx.

Once the file names are entered, simply press OK and a window allowing you to edit/change the header data will be displayed (See Section E.3.1.1.1)

#### E.3.1.1.1 RINEX Header Data Edit Window

The RINEX Header Data Edit Window is displayed in response to pressing the OK button on the File Selection Window (See Section E.3.1.1). The following provides an example of this window:

**RINEX Header Data/Options**

Station Name:

Station Position X:  Y:  Z:

Station Number:

Observer's Name:

Observing Agency:

Creating Agency:

Receiver Type:  Receiver Serial Number:

Antenna Type:  Antenna Serial Number:

Comments:

**Antenna Offsets**

North:  Slant:   
East:  Radius:   
Delta Vertical:

**Output Data Type**

**Optional Headers**

Output Epoch Interval Header  
 Output Satellite List and Number of Observations

**Options**

Clock adjustments in Code and Carrier  
 Output Smoothed Codephase  
 Output Site Name Change Records

XYZ's of GPS®

With the exception of the “Output Data Type” the data of each field comes from either the Site File or from the saved configuration data of the program (i.e., stored in the INI file of the program). When the Site File is not used as input to the program, all of the data for this window, with the exception of the “Output Data Type”, comes from the saved configuration data. When the Site File is used as input, the following fields come from that file:

- Station Name
- Observer's Name
- Receiver Serial Number
- Antenna Serial Number
- Antenna Offsets (Slant, Radius, and Delta Vertical)

The “Output Data Type” field is used to specify which RINEX observation fields will be output to the RINEX Observation file. The “Output Data Type” can be one of the following:

<b>Selection</b>	<b>Output Data Types</b>
L1	L1 C/A Carrier and Code (includes Doppler)
L1CP_L2P	L1 C/A, L1 P-Code and L2 P-Code Carrier and Code (includes Doppler)
CDPHASE	L1 C/A Codephase only
L1CP	L1 C/A and L1 P-Code Carrier and Code (includes Doppler)
L1C_L2P	L1 C/A and L2 P-Code Carrier and Code (includes Doppler)

It should be clear that some selections are not available for some receiver types. For example, if the input data is from a G-12 receiver (a C/A L1 only Code and Carrier receiver), the selectable output data types for the receiver will not include any of the P-Code or L2 observables. By default, the selection will be set to output all possible observation types for the input receiver type.

The receiver position (labeled as “Station Position” on the window) will come from either the B-File data or from a user-entered position. This decision is made using the Site Position Window which is accessed by pressing the “Edit Position” button (to the right of the station position) on this window. For further details on the Site Position Window see Section E.3.1.1.2.

Remember that the changes entered into this RINEX Header Data Edit Window will be saved as part of the program’s configuration data (i.e., stored in the program’s .INI file). In this way, the header data need only be configured once. Minor changes to the output header data can then be made during each subsequent run of the program.

#### E.3.1.1.2 RINEX Site Position Window

The RINEX Site Position Window permits you to select the source of the position data output as part of the RINEX header data. This window is accessed from the RINEX Header Data/Options Window (see Section E.3.1.1.1). The following is an example of the RINEX Site Position Window:

**RINEX Site Position**

**Approximate Position**

North Latitude: 39.1301210262 39 7 48.435694

East Longitude: 282.7849427168 282 47 5.793781

West Longitude: 77.2150572832 77 12 54.206219

Ellipsoid Height: 117.935

ECEF - X      ECEF - Y      ECEF - Z

1096351.4093      -4831485.5222      4003607.4647

Get Position from B-File Data

OK      Cancel

The RINEX Site Position Window allows you to specify the position of the receiver to be output as part of the RINEX header data. The RINEX specification indicates that this position need only be approximate and provides no specifics on the required accuracy of the approximation. The position written as part of the header data can come from a manually entered position or from a weighted average of the position and PDOP data of the B-File. To specify that the approximate position is to come from the weighted average of the B-File position data, check the “Get Position from B-File Data” checkbox. Otherwise, uncheck the box and enter the approximate position in the window.

Like the RINEX Header Data Edit Window, the data entered into this window will be saved as part of the configuration information for the program. If the “Get Position from B-File Data” checkbox is checked, then XYZAshRx will obtain the approximate position from B-File on the current and later runs.

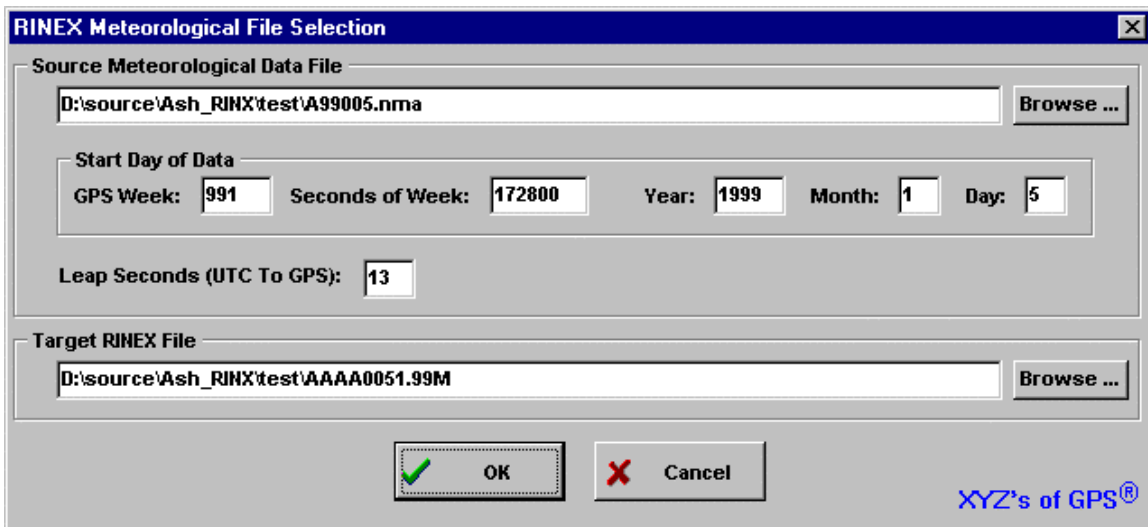
### E.3.1.2 RINEX Meteorological Files

Before continuing, it must be noted that the meteorological option of the RINEX converter is not available unless the presence of a software sentinel key coded for the GBSS (Ashtech’s Geodetic Base Station software) Meteorological module can be found.

To convert collected meteorological data to RINEX using the manual approach simply launch the program XYZAshRx (with no command-line options). On doing so, you will be provided with the main program screen. Using the main menu of the program select the “Convert” menu option and then select the “Met to RINEX” sub-menu option.



Selecting this sub-menu option will provide you with a screen that looks similar to the following:



The primary components of this screen are:

- 1) The source meteorological data file name.
- 2) Start day of the source meteorological data file.
- 3) Leap seconds for converting UTC to GPS times.
- 4) The target RINEX meteorological data file name.

Upon completing the edits, press the “OK” button to enter/edit the header data related to the output RINEX meteorological data (see Section E.3.1.2.5).

#### E.3.1.2.1 Specifying the Source Meteorological Data File

To select the source meteorological data file, simply type its name in the first prompt field provided or use the “Browse” button next to that field. By pressing the “Browse” button, you will be provided with a file selection window similar to that available in other Windows programs.

The file type you will be looking for will normally have a “.NMA” extent. This is because the file is actually created by GBSS and stored in the Ashtech NMEA file format. This is important because you must instruct GBSS to store the NMEA file (via its

“Configuration | File Outputs” menu options). Furthermore GBSS must be configured to store the XDR and GXP NMEA messages. This is because the XDR message will contain the meteorological sensor data and the GXP message will contain the time tag associated with the XDR message. Please note that XYZAshRx assumes that the Meteorological data is sampled near the time stated in the GXP message. That said, it should be clear that the accuracy of the time tag as it relates to the XDR message is +/- the rate at which the GXP messages are being output.

#### E.3.1.2.2 Start Day of the Meteorological Data File

Two key facts must be considered when converting the NMEA capture file created by GBSS: 1) the NMEA GXP message contains only time-of-day time tags and 2) the NMEA GXP message contains UTC time tags. In this Section, we address item 1; item 2 is addressed in Section E.3.1.2.3.

Because the NMEA GXP message (i.e., the message used to time tag the meteorological data) contains only time of day, we must resolve the start day of the data file. It is for this reason that the “Start Day of Data” prompts are provide in the file selection window. You can specify the start day either through GPS time or through a Gregorian time. When you specify the GPS time, you need only be accurate to the day in which the data starts. If you specify a “seconds of GPS week” which falls within the day (i.e., it does not specify a time that is on the exact start of the day) the program will be able to resolve the actual start time of the file. That is, simply specify a time which falls within the correct day in which the start of the file belongs. If the file contains data from multiple days of data, the program will be able to resolve those day changes as well.

If the input meteorological data file name is in the Ashtech file-naming format, the program will be able to resolve the start time of the data without your assistance (but still giving you the chance to override the start time of the file). Once you specify the name of the file, the program will parse that name and determine if it fits the proper naming convention and, if so, it will fill in the fields with the start time of the file. Otherwise the program will default to a start time based upon the CPU clock (which you should override if it is not correct).

#### E.3.1.2.3 Leap Seconds: UTC to GPS Conversion

Two key facts must be considered when converting the NMEA capture file created by GBSS: 1) the NMEA GXP message contains only time of day time tags and 2) the message contains UTC time tags. In this Section, we address item 2; item 1 is addressed in Section E.3.1.2.2.

The RINEX standard requires that the time tags of the meteorological data be in GPS time. The NMEA GXP message (i.e., the message used to time tag the

meteorological data) contains UTC time stamps. As such, we must convert the times to GPS. The “Leap Seconds” data entry field of the window allows you to specify the delta between GPS and UTC. As of January 8, 1999, there are 13 leap seconds between UTC and GPS. That is,  $UTC + 13 = GPS$  time.

The value of the “Leap Seconds” field will be saved between runs of the program. Furthermore it will be used during the command-line conversion of meteorological data (see Section E.3.2).

#### E.3.1.2.4 Specifying the Output RINEX Meteorological Data File

The output file name is specified in one of 4 ways:

- 1) The input meteorological data file name complies with the Ashtech naming convention;
- 2) You cursor through or edit any of the “Start Day of Data” edit fields;
- 3) You manually enter the output file name; and
- 4) You use the “Browse” button next to the edit field pertaining to the output file name.

When either approach 1 or 2 is used, the output file name will comply with the RINEX file naming convention (for details on the file naming convention, see the GBSS User’s Manual).

To select the source meteorological data file, simply type its name in the first prompt field provided or use the “Browse” button next to that field. By pressing the “Browse” button, you will be provided with a file selection window similar to that available in other Windows-type programs.

#### E.3.1.2.5 Entering the RINEX Header Data

After pressing the “OK” button of the window in which you specified the source and target files, you will be provided with a window similar to the following:

**RINEX Meteorological Header Data**

Station Name:

Station Number:

Creating Agency:

Comments:

**Sensor Information**

Pressure | Temperature | Humidity

Model:  Type:

Accuracy:

**Approximate Position**

Sensor Position X:  Y:  Z:

XYZ's of GPS®

In this window you can edit all of the data related to the header data of the output RINEX meteorological file. To obtain the specifics of the meanings of each of these fields it is suggested that you consult the RINEX standard documentation.

The data of this window will be saved between runs of the program. Furthermore, this data will be used in the command-line mode when creating the output file.

### E.3.2 Command-Line Approach

The Command-Line approach to running XYZAshRx is invoked by calling the program with the command-line parameters listed in this section. The Command-Line approach permits automatic conversion to RINEX of raw Ashtech data files without human intervention. In this way, programs or batch files can automatically convert Ashtech data files to RINEX.

Sections E.3.1.1.1, E.3.1.1.2, and E.3.1.2.5 discuss information that is written to the RINEX header when using the Manual/GUI approach. This RINEX header information is also written to the output files when using the Command-Line approach but it is assumed that you have pre-configured the program with the desired information. The pre-configuration is performed by using the Manual/GUI method described in



Sections E.3.1.1.1, E.3.1.1.2, and E.3.1.2.5. Once the configuration has been entered using the menus of Sections E.3.1.1.1, E.3.1.1.2 and E.3.1.2.5 and you have exited the Manual/GUI run of the program, the configuration will be saved and usable from the Command-Line approach.

Before continuing, it is important to re-state that the S-File and I-File inputs are optional. However, the I-File is required when converting GPS/GLONASS data files. As is discussed in Section E.3.1.1, the absence or presence of the S-File and/or the I-File affects header data that is output to both the RINEX Navigation and Observation Files. Please consult Section E.3.1.1 for the specifics in this area as they also apply under the Command-Line approach.

The general form of the command-line call to XYZAshRx is as follows:

```
XYZASHRX.EXE -I bfile efile [sfile] [ionfile] [options]
```

Notice that you are minimally required to use the “-I” option and specify the names of the B- and E-Files (parameters *bfile efile*, respectively). All items enclosed in “[“ and “]” are optional. For example, the names of the S-File and I-File are optional. When specifying the input file names, it is assumed that either the current working directory contains the source data files or the full path to the files is specified as part of each file name. For example, the following call assumes that the input B-, E- and S- Files come from the current working directory:

Example 1:

```
XYZAshRx -I BN102A97.323 EN102A97.323 SN102A97.323
```

In the following example the B- file comes from the directory D:\BDATA and the S-file comes from the directory E:\EDATA (notice that no S-File is specified):

Example 2:

```
XYZAshRx -I D:\BDATA\BN102A97.323 E:\EDATA\EN102A97.323
```

The list of options for the program can be combined in any order and are as follows:

```
-O obsfile  
-N navfile  
-T path  
-S smooth  
-C change
```

When neither the “-N” nor the “-O” options are specified, XYZAshRx will automatically create the names of the output RINEX Navigation and Observation files. Additionally in this case, XYZAshRx will place these output files in the current working directory. When either the “-N” or the “-O” parameters are specified, XYZAshRx will only output the associated file type. Some examples are listed below.

### Example 3:

```
XYZAshRx -I BN102A97.323 EN102A97.323 SN102A97.323
```

The converter uses the files BN102A97.323, EN102A97.323, and SN102A97.323, from the current working directory, as the input B-, E-, and S-Files, respectively. Because no -O or -N parameters were specified, XYZAshRx will automatically name the RINEX observation and navigation output files. The output files will be placed in the same directory as that of the B-File, which is the current working directory in this case.

### Example 4:

```
XYZAshRx -I BN102A97.323 EN102A97.323 -O OBS.DAT -N NAV.DAT
```

The converter uses the files BN102A97.323 and EN102A97.323 from the current working directory as the input B- and E-Files, respectively. Because no S-FILE was specified, the converter will use the site related data stored in the program's configuration file for site related data. Because the -O parameter was specified, the converter will output the Observation data to the file OBS.DAT. The -N parameter specifies that the Navigation RINEX data will be output to the file NAV.DAT. The output files will be placed in the same directory as that of the B-File, which is the current working directory in this case.

The “-T” parameter allows you to specify the target path of the output RINEX files. Some examples are listed below.

### Example 5:

```
XYZAshRx -I BN102A97.323 EN102A97.323 SN102A97.323 -T D:\RINEX.OUT
```

The converter uses the files BN102A97.323, EN102A97.323, and SN102A97.323, from the current working directory, as the input B-, E-, and S-Files, respectively. Because no -O or -N parameters were specified, XYZAshRx will automatically name the RINEX observation and navigation output files but will place these files in the directory D:\RINEX.OUT.

### Example 6:

```
XYZAshRx -I BN102A97.323 EN102A97.323 -O OBS.DAT -N NAV.DAT -T  
E:\RINEX.OUT
```

The converter uses the files BN102A97.323 and EN102A97.323 from the current working directory as the input B- and E-Files, respectively. Because no S-FILE was specified, the converter will use the site related data stored in the program's configuration file for site related data. Because the -O parameter was specified the converter will output the Observation data to the file OBS.DAT. The -N parameter specifies that the Navigation RINEX data will be output to the file NAV.DAT. The output files will be placed in the directory E:\RINEX.OUT.

The “-S” option allows you to specify whether the converter will output smoothed or raw codephase measurements. Permissible values for this parameter are 0 and 1; the value 1 directs the program to output the smoothed codephase contained in the Ashtech B-File. When the -S option is not specified, XYZAshRx will apply the smoothing as if “-S 1” were specified on the command-line. The -C option is used to

specify whether or not the site name change records are to be written to the output RINEX Observation file. Permissible values for this parameter are 0 and 1; the value 1 directs the program to output the site name change records. When the `-C` option is not specified, XYZAshRx will output site name change records as if “`-C 1`” were specified on the command-line. Some examples are listed below.

Example 7:

```
XYZAshRx -I BN102A97.323 EN102A97.323 SN102A97.323 -S 1
```

The converter uses the files BN102A97.323, EN102A97.323, and SN102A97.323, from the current working directory, as the input B-, E-, and S-Files, respectively. Because no `-O` or `-N` parameters were specified, XYZAshRx will automatically name the RINEX observation and navigation output files. The output files will be placed in the same directory as that of the B-File, which is the current working directory in this case. Additionally, the `-S` parameter specifies that the converter will output Ashtech smoothed codephase observations.

Example 8:

```
XYZAshRx -I BN102A97.323 EN102A97.323 -p D:\RINEX.OUT -C 0
```

The converter uses the files BN102A97.323 and EN102A97.323 from the current working directory, as the input B- and E-Files, respectively. Because no `-O` or `-N` parameters were specified, XYZAshRx will automatically name the RINEX observation and navigation output files but will place these files in the directory D:\RINEX.OUT. Additionally, the `-C` parameter specifies that there will be no (i.e. 0) site change records written to the output RINEX observation file.

To convert a meteorological file (stored in a NMEA capture file) from the command-line, use the following form to call XYZAshRx:

```
XYZAshRx -M inmetfile outmetfile [gpswk gpswksec]
```

where,

<i>inmetfile</i>	The name of the input meteorological file. If no path is provided, it is assumed that the file will come from the current working directory.
<i>outmetfile</i>	The name of the output RINEX meteorological file. If no path is provided, it is assumed that the file will be output to <b>the same directory in which the input file is stored.</b>
<i>gpswk</i>	Specifies the start day of the input file. This field allows you to specify the GPS week component of time.
<i>gpswksec</i>	Specify the start day of the input file. This field allows you to specify the seconds of GPS week component of time.

Notice that the *gpswk* and *gpswksec* parameters are optional. However, if you specify either then you must specify both, even if *gpswksec* is zero. If you choose not to specify the start time of the file, the program will use the current CPU time to determine the start day of the data (you are strongly encouraged to avoid this approach).

All other parameters used in the conversion, such as leap seconds and header data (see Section E.3.1.2), will use values maintained from the **last GUI run of the program**.

The following provides an example:

```
XYZAshRx -M A99005.NMA N1020051.99M 991 176752
```

In this example the converter uses the file A99005.NMA from the current working directory as the input meteorological data file. The output RINEX meteorological data file will be placed in the file N1020051.99M. Furthermore the converter will use the GPS time 991, 176752 (i.e., the GPS week and seconds of GPS Week, respectively) to designate the start day of the source meteorological data. Notice that 176752 does not fall on an exact day boundary. This is acceptable because the source data is time stamped with time of day. Therefore, the specified GPS time need only be accurate to the day in which the data falls as the converter will resolve the time of day within that day. Again, the value stored for the leap seconds parameter from the **last GUI run of the program** will be used to convert UTC time tags to GPS time (see Section E.3.1.2).

# Appendix F

## Utility Program UpackU12

### F.1 Introduction to UpackU12

Magellan's  $\mu$ Z-Family of receivers maintains an internal data storage format that differs from normal processing files extracted from these receivers. Normally, users of these receivers process the Ashtech formatted B-, E-, and S-Files or RINEX files. However, Magellan's **Micro-Manager** program downloads the data from the  $\mu$ Z-Family of receivers in the format stored by the receiver (referred to as receiver image files). As a result, the downloaded receiver image files cannot be processed directly with normal processing packages.

UPackU12.EXE was designed to convert receiver image files extracted from the  $\mu$ Z-Family receivers. The program has been designed to operate on a Windows 95/98/NT and 2000 platforms. To facilitate a wide variety of users, UPackU12 can be configured and run through normal Windows Graphical User Interfaces (GUI) or launched directly from the command-line. That is, a user can use the conversion program just like most other Windows programs or the converter program can be executed, without need of human intervention, from other programs (such as Ashtech's **Micro-Manager** Software), from a DOS command line, or from batch files.

UPackU12 currently supports the  $\mu$ Z-Family of Ashtech GPS receivers. Data are output in the Ashtech formatted processing data files. The specific types of files output include:

- 1) B-Files (i.e., raw observation files)
- 2) E-Files (i.e., broadcast navigation message files)
- 3) S-File (i.e., site files)
- 4) C-Files (i.e., corrected position output file)
- 5) Event Files
- 6) Almanac Files
- 7) Photo Files

#### F.1.1 Minimum System Requirements

UPackU12 requires the target platform to be a Windows 95/98/NT or Windows 2000 based computer. While UPackU12 requires less than 1 megabyte of memory to run, Windows 95/98/NT and 2000 impose higher minimums. You should consult the appropriate Microsoft documentation to determine the minimum system requirements for Windows.

UPackU12 requires less than 2 megabytes of disk space. However UPackU12 creates output files from your receiver image files. As a general rule, the output files will require up to 3.5 times the space required by the image files. The exact amount required depends highly upon the type of data stored in the receiver image files (which dictates the type and content of the output files).

## F.1.2 Demo Versions

There are two basic configurations of UPackU12: fully operational and demonstration versions. This document applies to both configurations. Demonstration versions, which are freely distributed over the Internet or provided on diskette without accompanying sentinel keys, will not be nearly as capable as the operational versions. For example, demonstration versions will not allow the output of any data. This document will not seek to delineate the specific differences between the demonstration and the operational versions. It is important to note, however, that the installation instructions documented herein apply to both configurations.

## F.2 INSTALLATION OVERVIEW

UPackU12 is currently distributed as part of **Micro-Manager**. The program will be installed in the same directory as that of MicroMgr.exe. For example, if during the installation of **Micro-Manager**, you chose to install **Micro-Manager** into the “D:\Program Files\ASHTECH\MicroMgr” directory, then UPackU12 would be installed into the same directory.

The automatic installation of **Micro-Manager** does not put UPackU12 into the Windows search path. One can add UPackU12 to the Windows search path by right clicking on “My Computer”, selecting the “Properties” menu item, selecting the “Environment” tab, selecting the “Path” system variable and then editing the “Value” field to include the directory in which UPackU12 is stored.

Additionally, the automatic installation of **Micro-Manager** neither puts an icon onto the desktop nor in the Start Menu bar. To create a program icon on the desktop, simply find the program file UPackU12.EXE using “My Computer”, right click and drag the icon to the desktop and select “Create Shortcut Here”. For details on how to add a program to the Start Menu, consult Windows Help searching on “Start Menu” and selecting the topic dealing with adding menu items to the Start Menu.

Finally, UPackU12 is protected by a software sentinel key (the same key as is used by **Micro-Manager**). The software sentinel key is installed by attaching the end of the sentinel key labeled **↑COMPUTER↑** to a parallel printer port of your computer. Tighten the screws of the sentinel key to connect the key securely to your computer. If a

printer was connected to your computer, attach that cable to the sentinel. If the sentinel cannot be installed because of an obstruction behind the computer, you can place the sentinel key later in the parallel sequence (for example, you could attach the sentinel key to a DB-25 male to DB-25 female cable which is connected to your computer's parallel port).

### F.3 RUNNING UPackU12

UPackU12 creates typical Ashtech formatted processing data files from  $\mu$ Z-Family receiver image format files. The program can be manually instructed to convert files or can be called directly from the command-line. This latter method allows programs to invoke the converter without the need of human intervention. Throughout the remainder of this documentation, we will call the former approach the Manual/GUI approach and the latter will be called the Command-Line approach.

Both the Manual/GUI and the Command-Line approaches rely upon configuration information contained in the .INI file associated with the converter program. This .INI file is called "UPackU12.INI" and is stored in the same directory as the main program. Changes to this configuration file occur whenever the user changes configuration using the Manual/GUI approach. That is, when desiring to use the Command-Line mode, you should pre-set the configuration using the Manual/GUI approach. Section F.3.1 will describe the Manual/GUI approach to using UPackU12 and Section F.3.2 will describe the Command-Line approach to using UPackU12.

It is important to re-state the fact that the configuration information is stored in the file "UPackU12.INI" which is stored in the same directory as the program file (i.e., "UPackU12.EXE"). When you desire an alternative configuration, for example to support two **Micro-Manager** installations simultaneously, you should copy the following files to another directory:

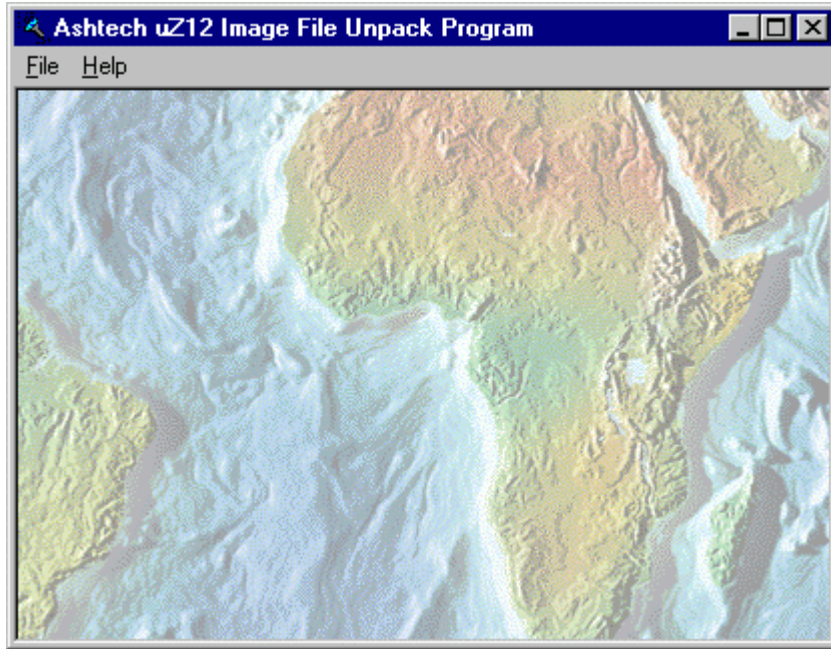
UPackU12.INI  
UPackU12.EXE  
UPackU12.BMP

By doing this, you create an independent copy of the .INI file. Launching the program UPackU12.EXE in this copied directory causes the program to use the .INI file in that directory. This copy would utilize a configuration that is independent of the other copy (i.e., the original copy) of UPackU12 on your computer. In contrast, launching two copies of the UPackU12 from the same directory accesses the same .INI file. The configuration stored at the end of the runs of the programs depends on which copy of the program terminated first. Needless to say, you are strongly advised not to launch more than one copy of UPackU12 from the same directory (unless both copies will use the exact same configuration information). Launching several copies of UPackU12, each

originating from its own directory, is perfectly acceptable and supported by the sentinel key.

### F.3.1 Manual/GUI Approach

Upon starting UPackU12 without command-line parameters, the following is displayed:



Notice the program has only two main menu items. When you select the “File” menu item you will be presented with the following drop-down menu:



That is, you can only “Convert” to Ashtech processing using UPackU12 or set the output path. Upon selecting the “Convert” option, you will be presented with the File Selection Window presented in Section F.3.1.2. Through this window you will select the input and output files of a single conversion run.

When you select the “Help” menu item from the main menu, you will be presented with the following drop-down menu:

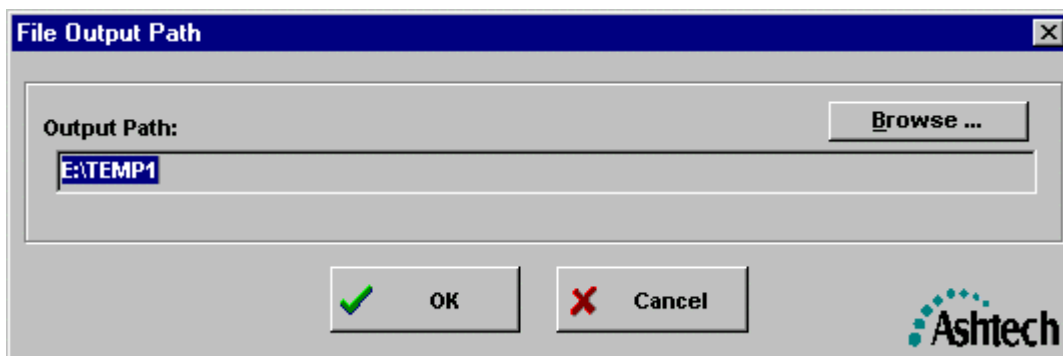




When you select the “About” menu item UPackU12 will display a window containing information about the program. In response to selecting the “Command Line Options” item UPackU12 will display a window describing how to invoke the Command-Line Mode of the program. The command-line mode is further documented in Section F.3.2 of this manual.

### F.3.1.1 Output File Path

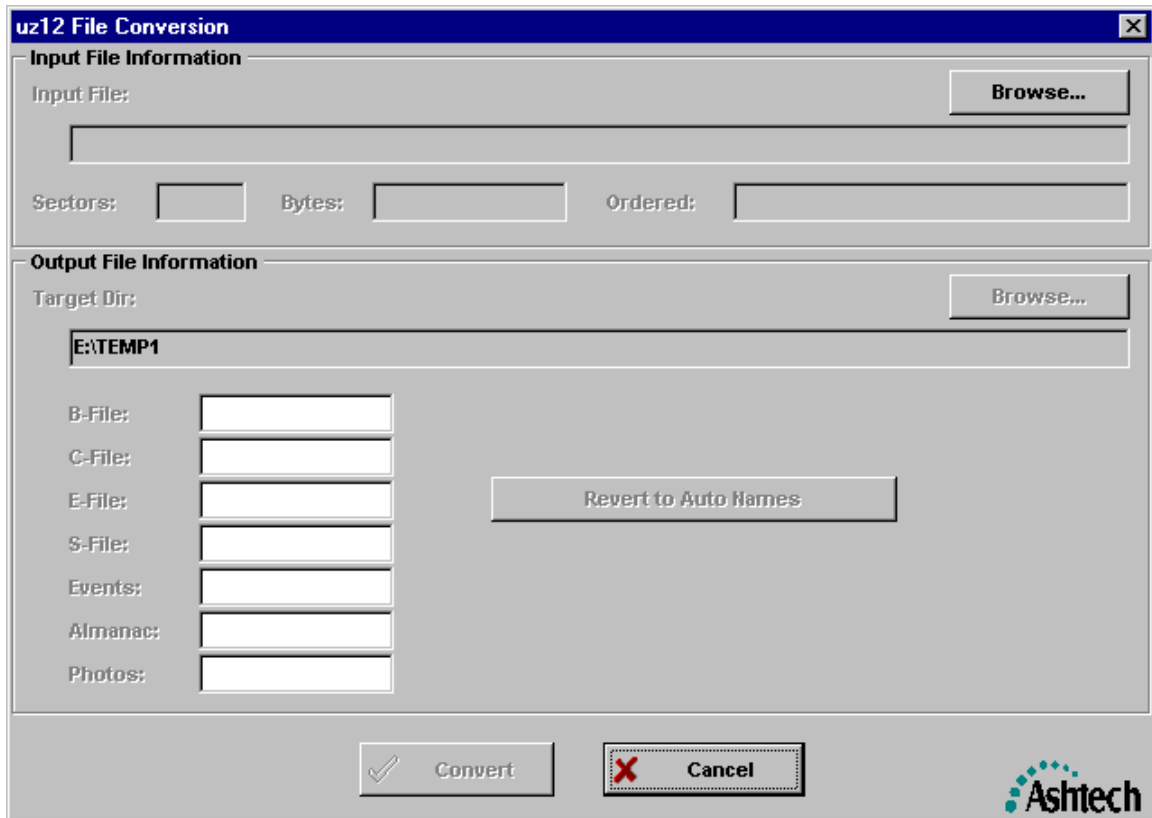
To set the default output path used by UpackU12, select the “Output Path” sub-menu item of the “File” main menu item. Upon doing so, you will be provided a window similar to the following.



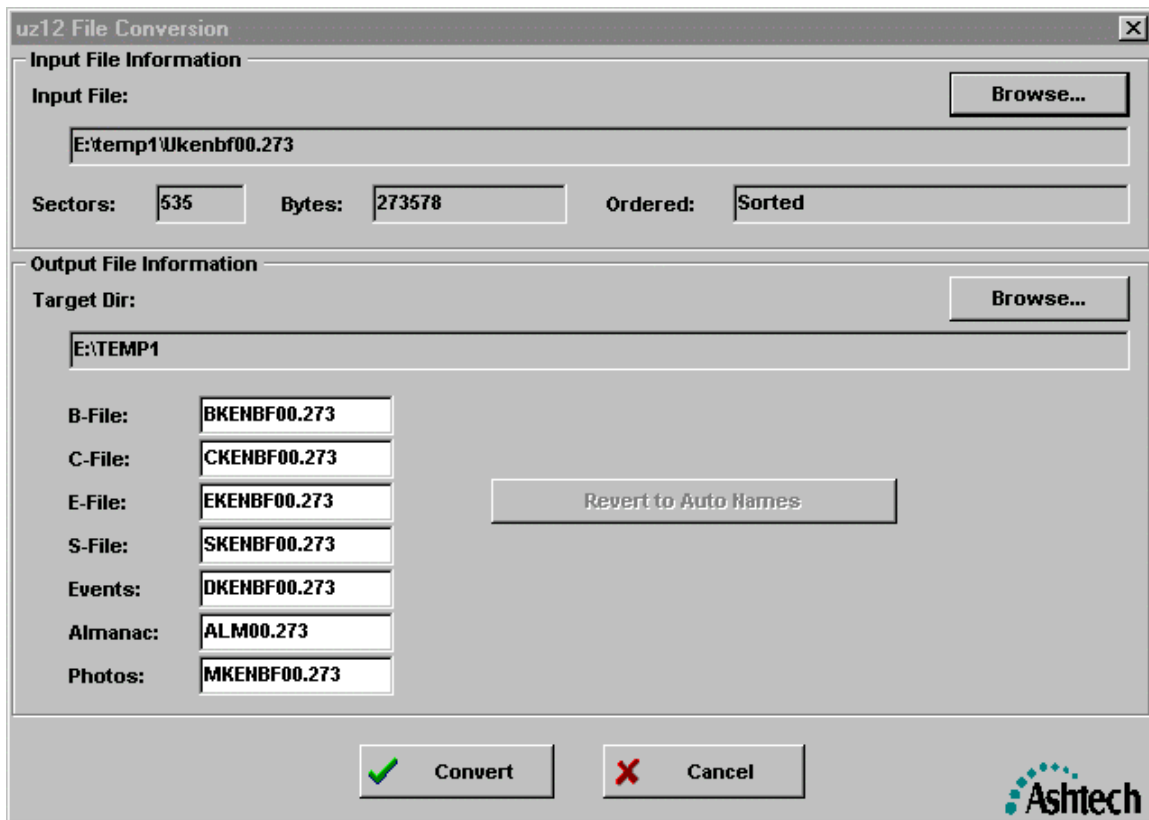
Through this window, you can “Browse” to locate the output directory used for the converted files.

### F.3.1.2 File Selection Window

The File Selection Window is displayed in response to the “File | Convert” selection from the program’s main menu. The following provides an example of the File Selection Window:



Notice in the example that there are several fields and buttons disabled; disabled features are indicated by the light gray appearance of the labels and text contained in the fields. This is because there has been no input file selected. To select an input file (i.e., the image file to be converted), press the “Browse” button. You will be given a window that will allow you to browse through your file system to find and select the file to be converted. Upon selecting a valid receiver image file, the window will change to allow the editing of the disabled fields and will automatically create the names of the output files. These output file names automatically generated by UpackU12 are based upon the time tag information stored in the image file. The screen capture that follows shows one such case.



The table that follows describes the contents of the Input file information.

Field	Description
Input File	The name of the input file (including drive and path) of the receiver image file to be converted.
Sectors	The number of 512 Byte sectors utilized by the image file. These sectors are the file storage sectors of the receiver image as it resided in the receiver's memory (not as stored on your disk).
Bytes	The size of the image file in bytes (not including the per sector overhead information stored as part of the file).

<b>Field</b>	<b>Description</b>										
Ordered	<p>This field was designed to provide a confidence level regarding the input file as an image file. That is, receiver image files are binary and follow a particular pattern. This pattern is mostly contained in the sector information of the image file. Image file sectors have a sorting order and are normally stored according to that sorting order. However, there are cases (such as a full receiver image download operation, which ignores the file boundaries) where the sorting order may not follow the normal pattern. For this reason, we don't just ignore files that do not follow the typical sorting order. Values displayed here are:</p> <table border="1"> <thead> <tr> <th><b>Value</b></th> <th><b>Description</b></th> </tr> </thead> <tbody> <tr> <td>Sorted</td> <td>High confidence that the file is a true receiver image file.</td> </tr> <tr> <td>Out of order (will be sorted)</td> <td>Medium confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.</td> </tr> <tr> <td>Mostly Disordered (may not be U-File)</td> <td>Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.</td> </tr> <tr> <td>Disordered (likely not a U-File)</td> <td>Very Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.</td> </tr> </tbody> </table>	<b>Value</b>	<b>Description</b>	Sorted	High confidence that the file is a true receiver image file.	Out of order (will be sorted)	Medium confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.	Mostly Disordered (may not be U-File)	Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.	Disordered (likely not a U-File)	Very Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.
<b>Value</b>	<b>Description</b>										
Sorted	High confidence that the file is a true receiver image file.										
Out of order (will be sorted)	Medium confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.										
Mostly Disordered (may not be U-File)	Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.										
Disordered (likely not a U-File)	Very Low confidence that the file is a true receiver image file. Unsorted sectors will be sorted as part of the conversion process.										

The table that follows describes the fields of the “Output file Information” area. It is important to note that, while the output files are automatically named when the input image file is specified, you have the opportunity to change the output file names. Once you change any output file name, the “Revert to Auto Names” will become enabled. This button, when active and pressed, instructs UpackU12 to ignore all of your name editing changes and re-display the automatically generated names.

<b>Field</b>	<b>Description</b>
Target Dir	The path of the output files that will be created during the conversion process.
B-File	The name of the output observation file (called a B-File). This file is created when the image file was stored using Ranger Mode 0 (see your Receiver's Operations Manual for details).
C-File	The name of the output corrected position file (called a C-File). This file is created when the image file was stored using Ranger Mode 2 (see your Receiver's Operations Manual for details).

Field	Description
E-File	The name of the output broadcast navigation message file (called an E-File).
S-File	The name of the output site file (called an S-File).
Events	The name of the output event file which contains the events recorded by your receiver (see your Receiver's Operations Manual for details).
Almanac	The output satellite almanac file.
Photos	The output photogrammetry photo file (see your Receiver's Operations Manual for details).

To start the conversion process, press the “Convert” button. Please note that UpackU12 will create and open all of the output files specified through this window. However, if the conversion process yields no data for a given file, that file will be removed from the system upon completion of the conversion process. For example, not all receiver image files contain events. In these cases no data will be output to the Event file. When this occurs, UpackU12 will erase that file from the computer upon completion of the conversion process.

### F.3.1.3 Image Conversion Progress Window

Upon pressing the “Convert” button in the File Selection Window, you will be presented with the Image Conversion Progress window. This window simply details the progress of the conversion process.

The screenshot shows the 'Image Conversion Progress' dialog box. It is divided into three main sections: 'Input File Information', 'Output File Information', and 'Conversion Status'. The 'Input File Information' section shows the input file as 'E:\temp1\Wkenbf00.273' with 535 sectors and 273578 bytes. The 'Output File Information' section lists various output files with their sizes and counts: B-File (428630), E-File (6966), S-File (490), Events (0), Almanac (2240), and Photo (0). It also shows Epochs (718), Nav Messages (54), Almanac Msgs (536), and Photo Msgs (0). The 'Conversion Status' section shows 'Sectors Translated: 535' and a green 'Translation Complete' indicator. A 'Cancel' button is located at the bottom center, and the Ashtech logo is in the bottom right corner.

Input File Information			
Input File:	E:\temp1\Wkenbf00.273		
Sectors:	535	Bytes:	273578
Type:			

Output File Information			
Target Dir:	E:\TEMP1		
B-File:	Bkenbf00.273	Size:	428630
E-File:	Ekenbf00.273	Size:	6966
S-File:	Skenbf00.273	Size:	490
Events:	Dkenbf00.273	Size:	0
Almanac:	ALM00.273	Size:	2240
Photo:	Mkenbf00.273	Size:	0
Epochs:	718	Nav Messages:	54
Events:	0	Almanac Msgs:	536
Photo Msgs:	0		

Conversion Status	
Sectors Translated:	535

Translation Complete

Cancel

As the conversion progresses, this window will be updated.

As we stated earlier, if the conversion process yields no data for a given file, that file will be removed from the system upon completion of the conversion process. In the above example window, the conversion has completed and there were no records written for the Event and Photo files. As such, these files will be erased from the system.

### F.3.2 Command-Line Approach

The Command-Line approach to running UPackU12 is invoked by calling the program with the command-line parameters listed in this section. The Command-Line approach permits automatic conversion to raw Ashtech data files without human intervention. In this way, programs or batch files can call UPackU12 to perform conversions.

Before continuing, it is important to re-state that there is a default output path. Sections F.3.1.1 described the setting of this default output path. This is important because the command-line mode of this program will use this default path unless the "output path" command-line option is specified. When the command-line "Output Path" option is specified, the default output path will be overridden for that run only.

The general form of the command-line call to UPackU12 is as follows:

```
UpackU12.exe [-C Ufilename idx [-N template] [-P outpath]]
```

Use the *-C Ufilename* for automatic decompression of an Ashtech U-XII receiver image file. These files are typically created by **Micro-Manager**. Here, the "Ufilename" is the full path name, including drive, directory, and name of the source receiver image file.

Use the *-N template* only in conjunction with the *-C* parameter. It is used to set the template name of the output files when you wish to override the automatic naming within the program. For example, if you desire the output B-File name to be BASHTA99.010 then set this parameter to "ASHTA99.010". That is, the file names will be created using the file type as the first character and the value of the template as the remaining characters.

Use the *-P outpath* only in conjunction with the *-C* parameter. It is used to set the output path of the converted files. When this parameter is not specified, the program will use the output path configured during the last interactive mode run of the program.

Example 1:

```
UpackU12.exe -C D:\NBS5\REMOTE.DAT\UNBS5A99.010
```

In this example, UPackU12 has been instructed to automatically convert the file D:\NBS5\REMOTE.DAT\UNBS5A99.010. The output file name will

automatically be generated based upon the receiver file information stored in the image file. The output directory will be that configured during the last interactive mode run of the program.

Example 2:

```
UpackU12.exe -C D:\NBS5\REMOTE.DAT\UNBS5A99.010 -N XXXXA99.011
```

In this example, UPackU12 has been instructed to automatically convert the file D:\NBS5\REMOTE.DAT\UNBS5A99.010. The output file names will employ the template "XXXXA99.011". The output directory will be that configured during the last interactive mode run of the program.

Example 3:

```
UpackU12.exe -C D:\NBS5\REMOTE.DAT\UNBS5A99.010 -P E:\TEMP
```

In this example, UPackU12 has been instructed to automatically convert the file D:\NBS5\REMOTE.DAT\UNBS5A99.010. The output file name will automatically be generated based upon the receiver file information stored in the image file. The output directory will be "E:\TEMP".