TuffCOM

v1.2.0.8

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1 Introduction & Welcome to TuffCOM

Even in today's industrial, geosciences, and civil engineering applications, engineers struggle to reliably control and extract data from instrumentation in a fast and effective manner. *Applied Geomechanics* TuffCOM software drastically improves this ongoing struggle by allowing engineers and field technicians to quickly connect to instruments and to control, maintain, and automate data downloading for up to hundreds of instruments.

TuffCOM data acquisition software is unlike the vast majority of data collection software currently available both in and outside of our industry. Once installed, our software is always running in the background, regardless of whether or not a client logs in to the computer or if the application's user interface is being displayed. This 'auto-ON' feature automatically reestablishes connections and data download schedules for a configured instrument array—even if the computer is rebooted or restarted.

TuffCOM is unique because it grows with a customer's site requirements—instruments using different communication methods can be used simultaneously and data files can be absorbed for upload to our Atlas graphical web service. This centralizes data collection and simplifies remote monitoring.

TuffCOM augments your investment in *Applied Geomechanics* high quality digital instrumentation and Campbell Scientific datalogging systems by enabling any computer running TuffCOM to actively collect and push data to a server, ftp site, or other office computer.

We sincerely hope you find TuffCOM as useful with your applications as we have found it with ours.

2 System Requirements

On a PC, this release of TuffCOM requires the following:

- Pentium III 1GHz CPU or equivalent, minimum.
- Windows XP or Vista.
- 1GB RAM or higher recommended.
- 10GB Hard disk space recommended.
- Ethernet or Serial Port.

On a Single Board Computer (SBC), this release of TuffCOM requires the following:

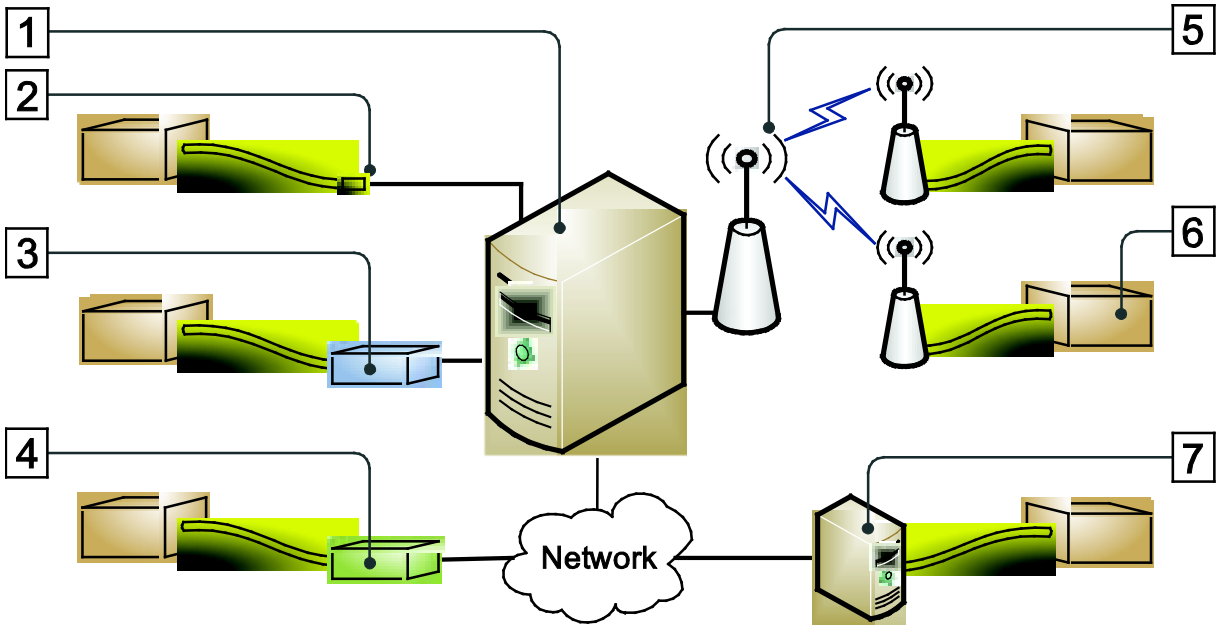
- Atom Processor N280 (recommended) or equivalent.
- Windows XP.
- 1GB RAM or higher recommended.
- 4GB Extended Temperature Compact Flash (recommended) or 10GB Hard disk space.
- Ethernet or Serial Port.

3 Quickstart Guide

1. Install TuffCOM.
2. Connect compatible hardware & instruments.
3. Power hardware & instruments.
4. Set up TuffCOM Instrument Array.
5. Test instruments using the Console tab with *Ping* and *Info* buttons.
6. Configure the TuffCOM Settings tab for the desired data format & timeout periods.
7. Enable the TuffCOM Scheduler & verify data validity.
8. Set up FTP agent to upload data files to Atlas or another destination server.

4 Overview

TuffCOM is a software application which automates and centralizes data collection for local processing or upload to a web service. TuffCOM works with *Applied Geomechanics* digital Tiltmeters. The diagram below shows possible instrumentation configurations for use with TuffCOM.



1 PC with TuffCOM

A desktop or laptop running TuffCOM can connect to hundreds of instruments for local processing or for upload to a server

2 Direct Serial Connection

Any PC with built-in RS232 port can use TuffCOM to connect AGI digital tiltmeters

3 USB to Serial Converter

AGI pin-compatible USB to RS232 and RS422 serial converters

4 Ethernet to Serial Converter

AGI pin-compatible RS232 or RS422 to Ethernet Converter

5 Radio Network

Any direct radio connection and AGI addressable radio networks

6 AGI Digital Tiltmeter

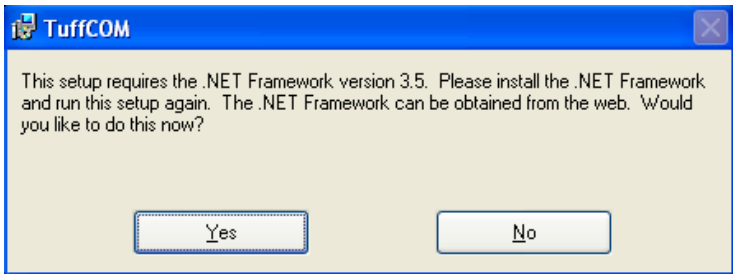
Any Applied Geomechanics digital tiltmeter (Including Lily, MD900, MD800, D700-Series, etc.)

7 PC or Single Board Computer Serial Port to IP Address

Any PC or SBC with serial port to IP address conversion software

5 Installation

1. If an installation CD was provided insert it into your CDROM drive, otherwise proceed to step 3.
2. If the 'Auto-run' feature is enabled, a message will automatically be displayed to install the software. If the 'Auto-run' feature is disabled, use Windows Explorer to browse to your CDROM drive.
3. Run the TuffCOM installer: 'setup.exe'
4. If '.NET Framework 3.5 SP1' or later is not already installed the TuffCOM setup utility will automatically download and install this framework from the Microsoft servers. If your computer's internet security settings prevent this from automatically occurring, the latest .NET framework can be downloaded from Microsoft's web page.



5. TuffCOM will install and appear in your 'Start' menu under the following location: 'Start->All Programs->Applied Geomechanics' (Note: TuffCOM may be downloaded via our website: www.geomechanics.com/TuffCOM)

6 How TuffCOM Works

The TuffCOM application is comprised of two parts: the TuffCOM Graphical User Interface (GUI), and the Instrument Service (I.S.). The TuffCOM GUI is a means of interfacing with and configuring the I.S. All instrument communication, data collection and storage, etc., is performed in the I.S. The I.S. runs as a 'Windows Service' in the background of Microsoft Windows—whether or not the TuffCOM GUI is open.

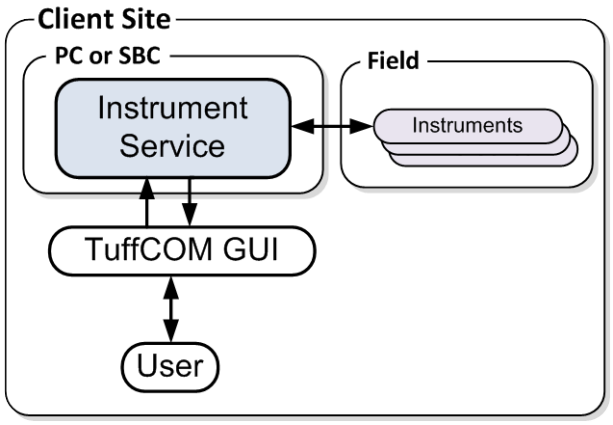


Figure 1. User interaction with TuffCOM GUI to Configure Instruments

When a personal computer (PC) or single board computer (SBC) running Windows is rebooted, the I.S. automatically restarts—even if a client has not logged into the computer. Data downloads resume once the computer has finished rebooting. No additional interaction is necessary to collect or view retrieved data once an I.S. has been configured. Data viewing web services like *Applied Geomechanics* Atlas may be used to navigate and explore live data being streamed from a field installation.

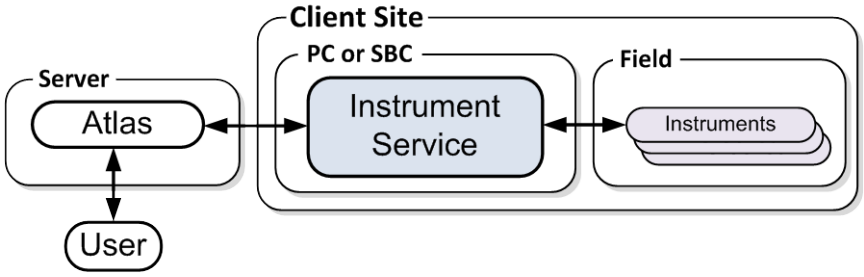


Figure 2. User interaction with Atlas Web Server to View Live Instrument Data

7 TuffCOM Functionality

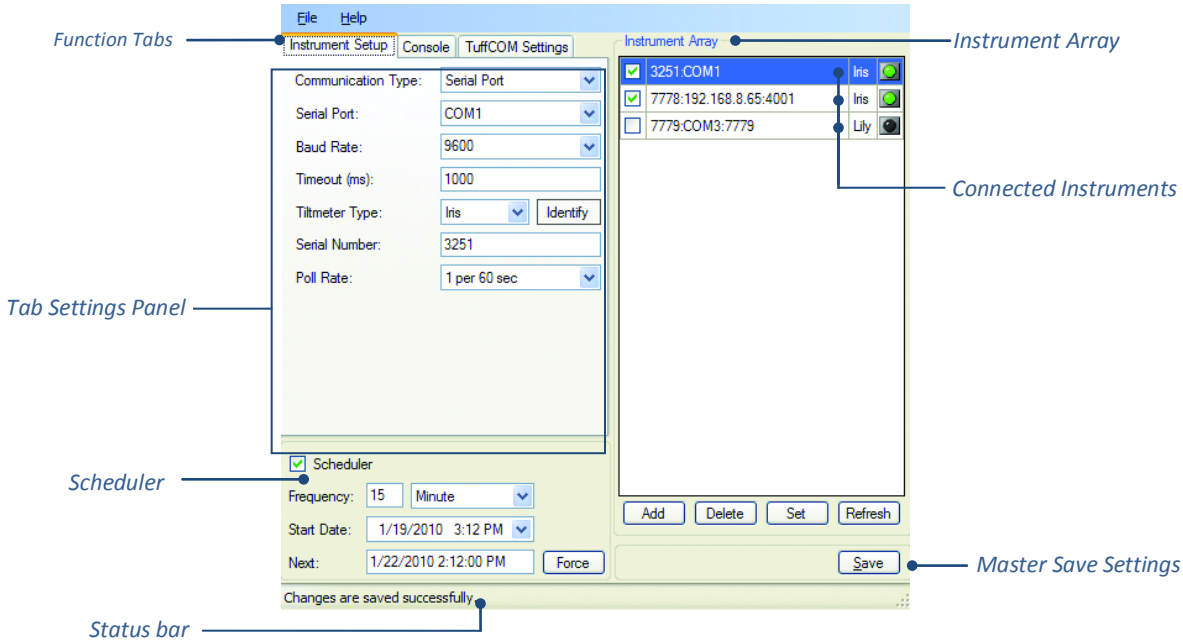


Figure 3. Main Screen

TuffCOM has three main interface sections: Function Tabs, Instrument Array and Scheduler. The Function Tabs are broken into three areas controlling specific settings: Instrument Setup, Console, and TuffCOM Settings.

7.1 The Function Tabs

The TuffCOM function tabs allow for quick set up and verification of any connected instrument or general TuffCOM configuration.

7.1.1 The Instrument Setup Tab

TuffCOM allows the number of connected instruments to grow or shrink as your project's requirements change. The Instrument Setup tab displays the settings required to communicate with any given instrument—allowing the instrument to be added to the Instrument Array. Additionally, selected instruments in the Instrument Array will display their current settings in this tab. This is shown in Figure 3.

An instrument's Communication Type depends on its current hardware configuration. The information in the Tab Settings Panel changes as a result of the selected Communication Type. For an instrument to successfully connect with TuffCOM, the Communication Type must match the attached hardware. Once the correct information has been entered into the Tab Settings Panel, clicking the *Add* button will populate the newly configured instrument into the Instrument Array.

TuffCOM currently supports three types of hardware communication (See Section 8, Compatible Hardware for more details).

Communication Types: There are three types of communication methods available for use:

TCP/IP: Uses an IP Address and associated port to send serial information to/from instruments. (PC and instruments communicate over a network).

Serial Port: Uses a standard COM port on a PC, typically RS232 or RS485/422 (PC communicates directly with instruments).

Radio System: Uses a network of radios to sequentially communicate with instruments on the same network (PC is standalone with a radio network of instruments). See the RS series datasheets and manuals for more information

The Serial Port Communication Type displays the following Tab Settings Panel information:

Function	Description
Serial Port	A drop-down list of available COM ports currently enabled on a PC. The selected COM port should correspond to the physical COM port that is connected to the instrument.
Baud Rate	A drop-down list of available data communication speeds compatible with AGI instrumentation.
Timeout(ms)	A value representing the time in milliseconds for determining if an instrument is not communicating properly.
Tiltmeter Type	A drop-down list of the two main hardware architectures AGI digital instruments use.
Serial Number	This field should contain the factory set serial number for a connected instrument. This can be automatically collected by pressing the *Identify* button when all other serial port connection information is properly set.
Poll Rate	The logging frequency at which an instrument will collect data samples.

Table 1. Serial Port Tab Settings Panel Descriptions

The TCP/IP Communication Type displays the following Tab Settings Panel information:

Function	Description
IP Address	An IPv4 address following the xxx.xxx.xxx.xxx format of the target AGI instrument.
Port	The associated IPv4 port number that is reserved for communication with the target AGI instrument.
Tiltmeter Type	A drop-down list of the two main hardware architectures that AGI digital instruments use.
Serial Number	This field should contain the factory set serial number for a connected instrument. This can be automatically collected by pressing the *Identify* button when all other serial port connection information is properly set.
Poll Rate	The logging frequency at which an instrument will collect data samples.

Table 2. TCP/IP Tab Settings Panel Descriptions

The Radio System Communication Type displays the following Tab Settings Panel information:

Function	Description
Serial Port	A drop-down list of available COM ports currently enabled on a PC. The selected COM port should correspond to the physical COM port that is connected to the radio.
Baud Rate	A drop-down list of available data communication speeds compatible with AGI instrumentation.
Timeout(ms)	A value representing the time in milliseconds: used for determining if an instrument is not communicating properly.
Net Address	The radio network address used to link with all connected radios for a specific deployment.
Radio Address	An individual address for a radio. A host radio should be address '1' and each other radio address should match the serial number of the attached instrument (for example, '8000'). See Section 8.3.2 for more information on radio network configuration.
Sleep Mode	When checked, the attached radio will operate in low power mode. While active, additional time is required while collecting data with the Scheduler, as each radio requires time to "wake-up" before data can be transmitted. See Section 8.3.2.1 for general notes on radios operating in Sleep Mode.
Tiltmeter Type	A drop-down list of the two main hardware architectures that AGI digital instruments use.
Serial Number	This field should contain the factory set serial number for a connected instrument. This can be automatically collected by pressing the *Identify* button when all other serial port connection information is properly set.
Poll Rate	The logging frequency at which an instrument will collect data samples.

Table 3. Radio System Tab Settings Panel Descriptions

7.1.2 The Console Tab

The Console Tab provides means for direct communication with a selected instrument in the Instrument Array. Communicating with an instrument outside of the normal Instrument Setup/Scheduler is very useful during initial instrument verification and setup. The Console Tab allows for instrument-specific firmware commands to be issued to a connected instrument.

To use the Console, select a configured instrument in the Instrument Array. The Console Tab only communicates with one selected instrument at a time.

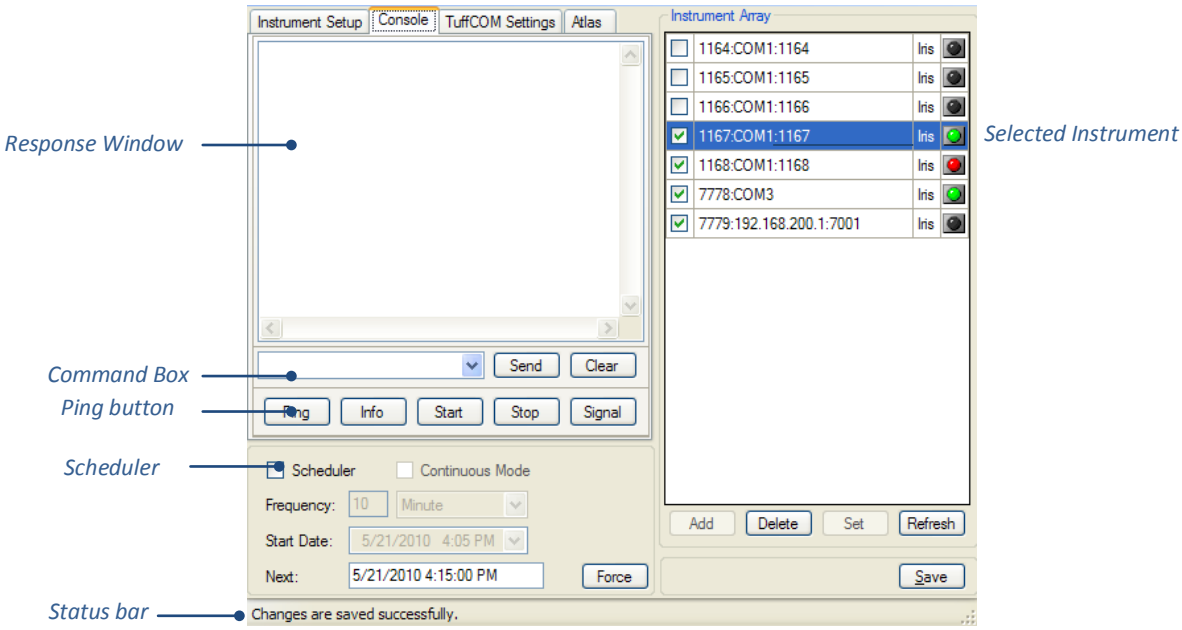


Figure 4. A successful Ping in Console (shown in Status Bar)

To verify an instrument has been properly configured, press the *Ping* button. TuffCOM will show the response in the Status Bar. A successful *Ping* will display a success message in the status bar (shown in Figure 4). A failed *Ping* attempt will show a red error message with a failure description. See Section 9 for troubleshooting tips.

The Signal button is displayed when the selected instrument in the instrument array is a part of a Radio System. This button displays additional information such as radio signal strength and host battery voltage.

To obtain a connected instrument's configuration, press the *Info* button. The instrument's response will be shown in the Response Window. The *Info* button sends the *9900XY-DUMP-SETTINGS and *9900XY-DUMP2 commands to the selected instrument.

Compatible instrument commands (found in the associated hardware manuals) may be typed into the Command Box. Pressing the *Send* button will deliver the message to the selected instrument in the Instrument Array Window. Any responses are displayed in the Response Window. An example command that may be entered is *9900XY-DUMP2.

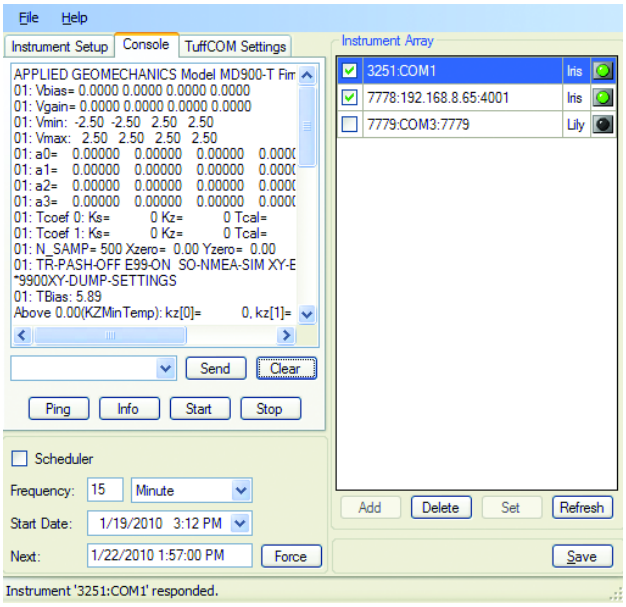


Figure 5. A successful Info response in Console

TuffCOM is capable of actively monitoring data from one Tiltmeter at a time using the Console tab. Pressing the *Start* button will actively display instrument data at a rate of one sample per second (the equivalent issuing the *9900XYC2 to an AGI digital Tiltmeter). Data is displayed after a delay of a few seconds while it is parsed by TuffCOM. Pressing the *Stop* button will halt data output for the selected instrument. Pressing the *Clear* button will empty the Response Window.

Actively monitoring a Tiltmeter is extremely useful if it needs physical 'zeroing' or 'nulling' of its tilt sensors (moving the tilt sensors to the middle of their full scale range). Active monitoring is also an excellent way of verifying that instrument installation has occurred successfully.

When a Lily instrument is selected in the Instrument Array, the *Level* button is available to automatically level the Lily tilt sensors. This is shown in Figure 6.

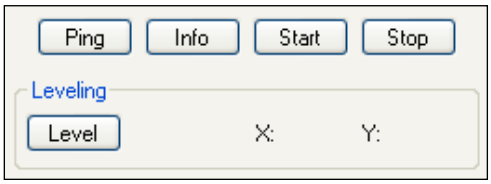


Figure 6. Additional Console Tab *Level* Button when a Lily is selected

7.1.3 The TuffCOM Settings Tab

The Settings Tab controls how TuffCOM stores and formats collected data. It also handles general instrument communication timeouts (failed connection attempts) by configuring the background Instrument Service.

TuffCOM attempts to communicate with each instrument up to the *Command Timeout* value (in milliseconds) before proceeding to the next instrument in the Instrument Array. After this connection has been established, TuffCOM will assign the instrument a time window to complete its data download, after which it will proceed to the next instrument; this time period is determined by the *Download Timeout* value (in minutes). If a timeout occurs, TuffCOM will revisit all enabled instruments during the next download schedule.

Baud Compatibility Mode ensures maximum connection throughput when used with *Applied Geomechanics* instruments at 57600 and 115200 baud rates, or with devices that may have small transmit/receive data buffers.

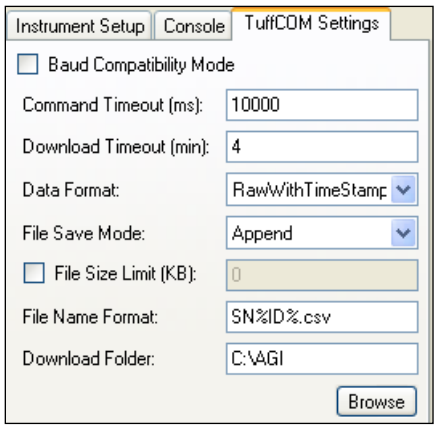


Figure 7. The TuffCOM Settings Tab

WARNING: Data may be lost if *Download Timeout* is improperly set. This may occur if a large dataset is being downloaded that requires more than the 4 minute default value.

TuffCOM supports three file structures (*Data Formats*) with various options allowing a user to select how the data is saved.

Data Format	Description
Raw	Unaltered streamed data from an instrument.
RawWithTimeStamp	Unaltered streamed data from an instrument, with an additional column containing the date and time of the PC.
CampbellTable	Campbell Scientific's datalogger table output format—this format is fully functional with AGI's Atlas web service.

Table 4. TuffCOM File Data Formats

Data files may be set -up to append to existing files (default), create a new file (with file creation timestamp in the filename) or be overwritten for each new download. These configuration options are selectable from the *File Save Mode* dropdown box. Any of these options may be configured to have a limitation on the file size (in bytes) by checking the *File Size Limit* checkbox.

The *File Name Format* can also be customized by adding the following text strings into the filename:

File Name Code	Description
%ID%	Adds a numeric instrument serial number to the filename
%ADDRESS%	Adds the connection address based on the Communication Type to the filename.
%DATETIME%	Adds the file creation date & time to the filename.

Additionally, any standard text may be inserted into the filename.
The default value is: SN%ID%.csv (Filename example: SN1234.csv)

The *Download Folder* defines where all data downloads are stored and defaults to "C:\AGI", with datasets being stored to a subdirectory for the current year ("C:\AGI\2010", for example). If the *CampbellTable* data format is selected, data downloads will only be stored to the "C:\AGI" directory. Typically, this will be used in conjunction with an FTP program that will move, upload, backup and append downloaded data.

After changing any settings in the TuffCOM Settings Tab, press the *Save* button to apply the new changes.

7.2 The Instrument Array

As instruments are set up according to their communication requirements, clicking the *Add* button will populate the Instrument Array with the configured instruments. Figure 8 shows several instruments in the Instrument Array using various Communication Types.

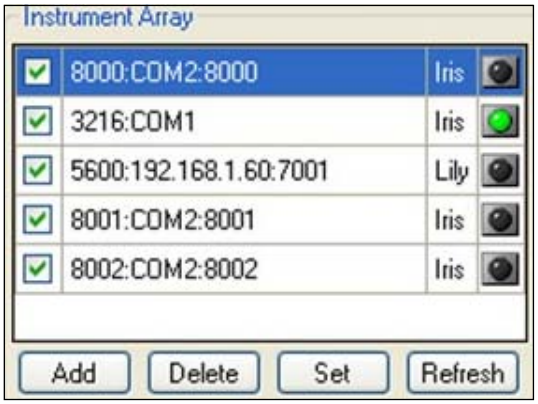


Figure 8. A Typical Instrument Array

The Instrument Array is a list of instrument serial numbers and communication addresses which a host computer will use to communicate with corresponding instruments. Instruments that have successfully communicated with TuffCOM will show a green status indicator on the right side of the Instrument Array. Individual instruments may be temporarily disconnected/removed from scheduled downloading by un-checking their checkbox in the Instrument Array.

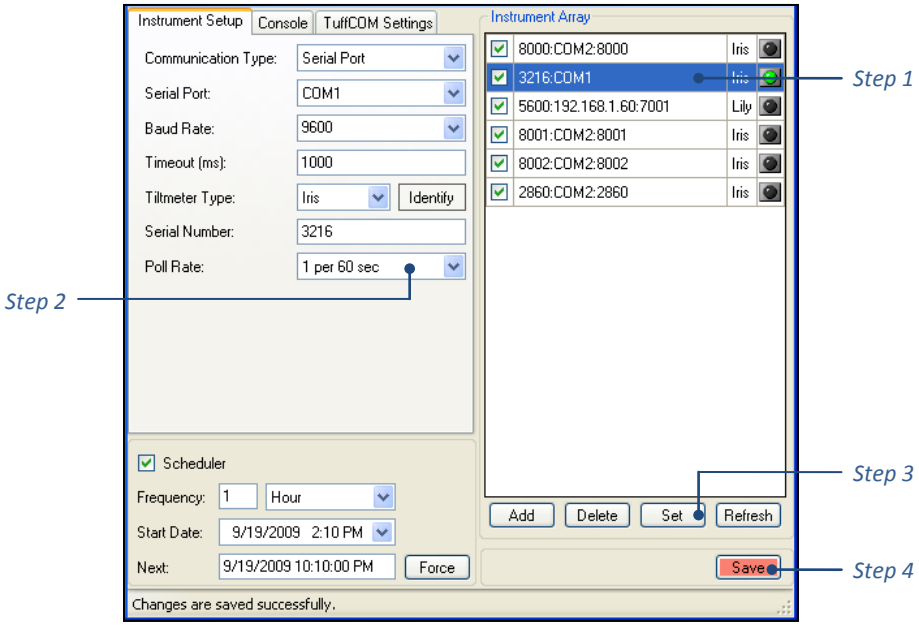
Color	Description
Green	Connected/in a logging state.
Yellow	Communication in progress/actively performing an action.
Red	Communication/action failed.
Black	Disconnected/disabled instrument.

Table 5. Instrument Array Light Status Descriptions

The *Refresh* button is used to update the screen with current the connection status for each instrument in the Instrument Array. The *Delete* button removes a selected instrument from the Instrument Array. The *Set* button applies any new changes made on the Instrument Setup Tab to the currently selected instrument.

Example: Instrument Reconfiguration

The user can change the configuration of an instrument at any time.



1. Select instrument in the Instrument Array.
2. Change parameters (poll rate for example) in the Instrument Setup Tab.
3. Press *Set* button.
4. Press *Save* button. Notice that the *Save* button changes color if a Save is required.

Example: Instrument Removal

1. Select instrument in the Instrument Array.
2. Press the *Delete* button.
3. Press the *Save* button.

7.3 The Scheduler

Automatic data downloads may be scheduled using the TuffCOM Scheduler. Figure 9 shows the Scheduler setup box. A user can set the start date and time of the first download along with the download frequency thereafter. Although the schedule is the same for all instruments in the Instrument Array (sequentially downloaded), each instrument can have a different poll rate (how frequently measurements are stored).

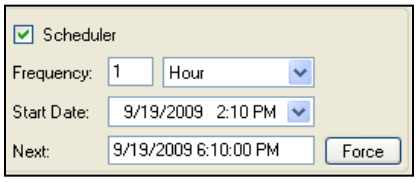


Figure 9. The Scheduler

To start automatic downloading select the Scheduler Checkbox (a checkmark appears) and press the *Save* button. Once the start date has passed, any data stored in an instrument's internal memory will be collected and cleared before the recording of new data commences. Only instruments that are enabled (have a checkmark status in the Instrument Array) will be included in automatic downloading. Recordings are stored at the selected Poll Rate found in the Instrument Setup Tab. The *Force* button can be used to download a dataset ahead of schedule.

The Scheduler is designed to continue with its download queue if an instrument stops responding. An instrument's failure to respond during a scheduled download can result from a discharged battery, a damaged cable, radio interference or other unknown problems. During a scheduled download, TuffCOM attempts to communicate with every enabled instrument (for which a checkmark is present) in the Instrument Array. Each communication event is logged in the installation directory of TuffCOM in the file name *threadlog1.txt*. The installation directory is typically "C:\Program Files\AGI\TuffCOM".

WARNING: If the *Scheduler* checkbox is unchecked, automatic downloading WILL NOT OCCUR.

IMPORTANT: It is important to take into consideration the size of instrument's internal memory, poll rate and downloading schedule. If not observed, gaps in data downloading may occur.

IMPORTANT: As the number of instruments in the Instrument Array increases, the potential exists for TuffCOM to remain in a continuous download state. Please observe data download times depending on baud rate and total data throughput for each instrument in the list, then set each instrument's *Poll Rate* and download frequency accordingly.

7.4 The Status Bar

The status bar, shown in Figure 3, displays the status of TuffCOM and its connected instruments. Status messages are constantly updated and are a good indication of how TuffCOM and the connected instruments are performing. Messages will typically include successful/unsuccessful communications, current wait times/timeout periods, current program states (logging, downloading, etc.) and the last successful action performed in TuffCOM.

7.5 TuffCOM Settings

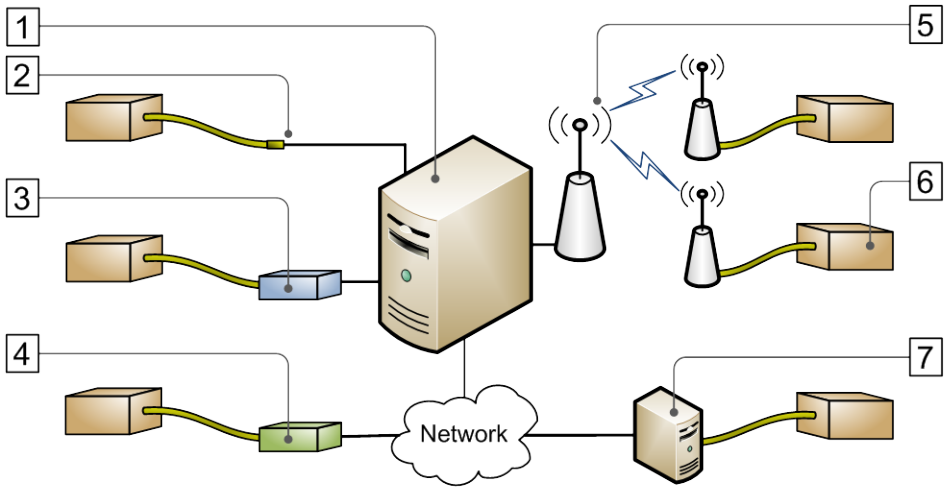
The entire TuffCOM program configuration can be saved or loaded as a .TuffCOM configuration file. This is useful during standard backup procedures, computer migrations/upgrades and TuffCOM software upgrades. This also allows users to quickly test various configurations before deployment.

Function	Description
File->Save Configuration	Saves the entire TuffCOM setup.
File->Load Configuration	Loads a previous TuffCOM setup.

Table 6. TuffCOM Configuration Functions

8 Compatible Hardware

All *Applied Geomechanics* digital Tiltmeters and Radio Systems are compatible with TuffCOM. Non-AGI radios that offer a straight-through or "invisible" serial connection are always compatible. Visit www.geomechanics.com for information on Applied Geomechanics Radio Systems.



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4 Ethernet to Serial Converter

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5 Radio Network

Any direct radio connection and AGI addressable radio networks

6 AGI Digital Tiltmeter

Any AGI digital Tiltmeter (Including Lily, MD900, MD800, D700-Series, etc.)

7 PC or Single Board Computer Serial Port to IP Address

Any PC or SBC with serial port to IP address conversion software

8.1 Instruments

Applied Geomechanics digital Tiltmeters and clinometers are compatible with TuffCOM. All Tiltmeters and clinometers include full signal conditioning electronics that produce stable output signals over a wide selection of angular ranges and resolutions. Please refer to the specific model's user manual for detailed information on installation, power and communication requirements.

When using a Tiltmeter with TuffCOM, verify that sufficient storage capacity exists for your downloading schedule. Additional embedded memory is available as an upgrade.

Example: Serial Instrument Setup

1. Open TuffCOM and select the Instrument Setup Tab.
2. Select the attached instrument's Serial Port Communication Type.
3. Select the computer Serial Port of the attached instrument.
4. Select the configured Baud Rate of the attached instrument. Note that all *Applied Geomechanics* instruments are defaulted to either 9600 (Iris) or 19200 (Lily) Baud.
5. If the *Applied Geomechanics* hardware architecture and factory programmed serial number are known, enter them. Otherwise, press the *Identify* button.
6. Select the desired Poll Rate (instrument sampling frequency). This value determines how frequently the measurements will be taken and stored in the deployed instrument's non-volatile memory.
7. Press the *Add* button.
8. Press the *Save* button.

8.2 TCP/IP to Serial Bridge Devices

Several devices exist that enhance the functionality of *Applied Geomechanics* RS232 or RS422 serial communication instruments, and are readily available through several online vendors as well as *Applied Geomechanics*. When purchased with a Tiltmeter system, all 3rd Party equipment is tested before shipping to a field environment.

TCP/IP to serial bridge devices are extremely useful for projects with pre-existing local area networks (LANs). These devices may be purchased pre-configured for specific LAN configurations through *Applied Geomechanics*.

MOXA TCP/IP to serial bridge devices are among the supported products. These devices plug into any Ethernet port (10/100Mbps) and are fully compatible with *Applied Geomechanics* digital Tiltmeters. Once configured, TuffCOM can send and receive information through the TCP/IP Communication Type directly to the instrument, provided that TuffCOM is connected to the same LAN.

Example: TCP/IP Instrument Setup

1. Open TuffCOM and select the Instrument Setup Tab.
2. Select the TCP/IP Communication Type.

3. Enter the configured IP Address and Port number for the connected serial bridge device.
4. If the *Applied Geomechanics* hardware architecture and factory programmed serial number are known, enter them. Otherwise, press the *Identify* button.
5. Select the desired Poll Rate (instrument sampling frequency). This value determines how frequently the measurements will be taken and stored in the deployed instrument non-volatile memory.
6. Press the *Add* button.
7. Press the *Save* button.

8.3 Radio Systems

Applied Geomechanics instruments and TuffCOM software are compatible with any 'invisible' or 'direct serial replacement' radio systems. TuffCOM currently operates with three radio products: Intuicom (RS200) and Quatech/DPAC Tech 802.11 (RS300) serial bridge radios and the *Applied Geomechanics* RS100 radio system. For detailed information, please see www.geomechanics.com/users manuals.

8.3.1 Quatech/DPAC and Intuicom Radios

The Quatech/DPAC Technologies and Intuicom 802.11 to serial bridge devices are good choices when an 802.11 wireless network exists. These devices must be pre-configured to a specific wireless network (per the manufacturer instructions) and then attached to *Applied Geomechanics* instrumentation. TuffCOM connects to an instrument through the TCP/IP Communication Type and a specified Port.

8.3.2 The Applied Geomechanics RS100

Applied Geomechanics RS100 is a weather-resistant, solar/battery or AC powered system that can be quickly deployed to the field using TuffCOM. The RS100 can be configured as either a Host or a Remote device, allowing for flexibility in the field. A Digi International radio allows for maximum flexibility and ensures data is properly delivered. World-wide radio frequencies are available.

Each AGI RS100 is pre-configured to be associated with a specific Tiltmeter in order to easily manage a deployed system.

8.3.2.1 RS100-XX: Power Considerations

Using power effectively with deployed installations is critical to ensuring a successful monitoring. Each *Applied Geomechanics* RS-100 contain an internal 8AHr non-spillable gel cell battery, solar panel power connection, and DC power connection. The RS-100 is an easily deploy unit that continues working around the clock—even during power grid failures. RS-100's are typically ordered with solar panels and larger backup batteries, depending on latitude and desired fail-safe run time, for projects where power sources are not locally available.

Remote RS100's have their radios configured to a low-power operation mode (the Host is always in a fully powered state). A radio's power status can be found in TuffCOM on the Instrument Setup Tab under the Sleep Mode checkbox. While the Sleep Mode conserves power, it also creates a delay in the TuffCOM software while the radios 'wake up' from their sleep mode in order to communicate.

During initial setup, it is possible determine if a radio is set to sleep mode or not by observing the LEDs on the radio. With the RS100 cover open, turn on the main power switch; a red power light, in either configuration, will turn ON for the first 60 seconds. A Remote radio (typically in sleep mode) will then enter a cyclic sleep mode where the power light will turn OFF (blinking briefly every 16 seconds)—the Host radio will continue to keep its power light ON.

While in the cyclic sleep mode, a Remote RS100 will power-down the radio for 16 seconds and then power the radio for 100ms. If the Remote RS100 receives any communication during this 100ms active time, it will awaken for a full 60 seconds to perform any actions a host radio may be sending. During the receipt of any communication in the 60 second awakened time, the radio will stay in an awakened state for an additional 60 seconds. If no radio activity occurs in this 60 second awakened time, the radio will resume a 16 second sleep cycle. Repowering the radio will force it to awaken for 60 seconds, allowing direct communication with the Remote RS-100 in cyclic sleep mode —this is typically performed while debugging an installation for communication problems, or during initial radio configuration.

IMPORTANT: An RS100 setup as a Host should always have a non-sleeping radio. This allows TuffCOM to communicate with the Host at any time.

Example: Radio System Instrument Setup

1. Open TuffCOM and select the Instrument Setup Tab.
2. Select the Radio System Communication Type. See Figure 11.

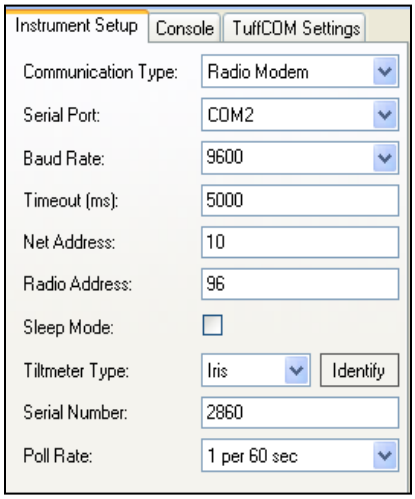

Figure 10. Radio System Instrument Setup

3. Select the computer Serial Port of the attached Host radio system. The serial port combo box is automatically populated with available serial ports.
4. Select the configured Baud Rate of the attached Host radio system and leave default Timeout (ms) value.
5. Set the desired Net and Radio Address to match the same configuration of the Remote RS100 and connected instrument.
6. If the radio is set to operate in a low power, cyclic sleep mode, check the *Sleep Mode* checkbox.
7. If the *Applied Geomechanics* hardware architecture and factory programmed serial numbers are known, enter them. Otherwise, press the *Identify* button. The *Identify* button will only work if the proper Net Address, Radio Address, and Sleep Mode information has been set.
8. Select the desired Poll Rate (instrument sampling frequency). This value determines how frequently the measurements will be taken and stored in the deployed instrument non-volatile memory.
9. Press the *Add* button.
10. Press the *Save* button.

IMPORTANT: In order to start the Radio System network:

1. Working Tiltmeters should be attached to Remote RS100's.
2. The battery should be connected.

8.3.2.3 RS100: Deployment of Networks

An initial functionality test of a configured Instrument Array is best performed in a controlled environment (i.e. an office/test area). To test the functionality of the network, use the *Ping* button in the Console Tab to confirm communication with each instrument in the Instrument Array. As a second test, enable the Scheduler at a short collection rate (5 minute intervals, for example) and confirm that automatic data downloads are occurring. This ensures all connections are properly configured and that antennas and radios are functioning properly.

To reconfigure RS100's, a Radio System setup utility has been programmed into TuffCOM. This can be found in the File menu under Radio System Setup. See Section 8.3.2.5, RS100: Radio Modem Setup Wizard for more information.

Function	Description
File->Radio System Setup	A setup wizard for quickly reconfiguring a radio network.

Applied Geomechanics RS100's are shipped preconfigured and tested. Using the Radio System Setup wizard may be required if there is too much activity on a specific Net Address (Network channel selection) already. Too much activity will result in radio interference and instrument communications will frequently fail.

Host radios are, and should always be, configured with a source address of 1, and should be set up to remain in full power mode (NOT in Sleep Mode).

8.3.2.4 RS100: Radio System Setup Wizard

The Radio System Setup Wizard allows for quick reconfiguration of *Applied Geomechanics* RS-100's. RS-100's are connected one at a time to a serial port of a computer with TuffCOM installed, starting with the Host RS100 and proceeding through all Remote RS100's. The new configurations are stored on each RS100, and after the new settings are verified (see section 8.3.2.5, RS100: Deployment of Networks for verification instructions) the RS100's are ready to be re-deployed. Note that it is not possible to set up Remote radios through a 'live' radio network—a computer running TuffCOM must be attached to the radio that will be reconfigured.

Example: Radio Network Setup using the Radio System Setup Wizard

1. Connect the RS100 to the computer serial port.
2. Open TuffCOM and select File->Radio System Setup.
3. Select the attached radio's Serial Port.
4. Select the configured Baud Rate of the attached radio. This is typically the default parameter.
5. Enter a Timeout value. While the default is recommended, if TuffCOM is having trouble connecting with a radio, increase this value by 1000ms per trial.

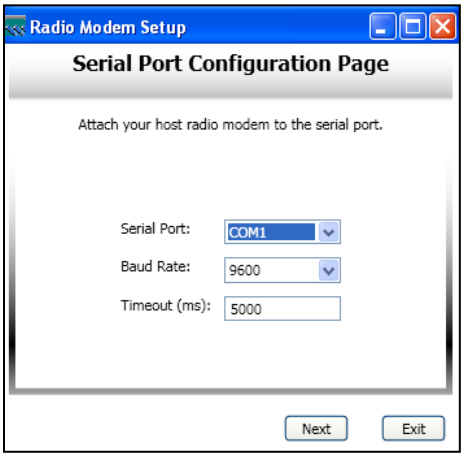

Figure 11. Serial Port Configuration Page

6. Press the *Next* button.

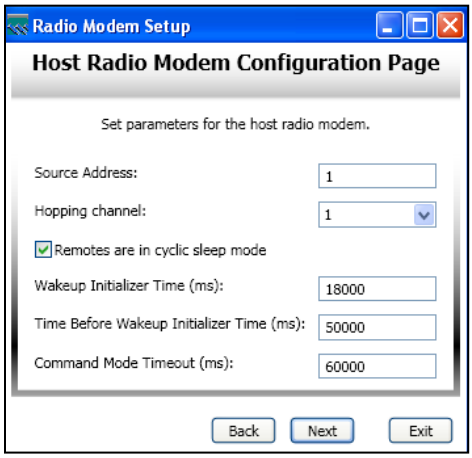

Figure 12. Host Radio System Configuration Page

7. Configure a Host radio system, shown in Figure 13. Default parameters are recommended.

Function	Description
Source Address	The Host Source Address is a radio networking address that is used to receive information from Remote radios. It is recommended this value remains at 1.
Hopping Channel	The Hopping Channel for a radio network can be set to a value from 1 to 9. The selected value represents a different grouping of radio frequencies used to communicate with other radios on the same network. Setting this value applies the same Hopping Channel value to the Host AND Remote radios. The Hopping Channel value should be changed if several radios are having trouble communicating with the Host radio when they once communicated correctly.
Remotes are in Cyclic Sleep mode	When checked, the Host radio will wait additional time in between each communication to a Remote radio for a radio to wake from a Sleep Mode.
Wakeup Initializer Time (ms)	A value representing time in milliseconds for a Host radio to continuously attempt to force a Remote radio to wake up from Sleep Mode. This value must be larger than the longest Sleep Mode time value that a configured Remote radio is configured to (a maximum of 16,000ms).
Time Before Wakeup Initializer Time (ms)	A value representing time in milliseconds that a Host must send a 'stay awake' message to a connected Remote radio. This keeps a connection between the Host and Remote in an active mode, before the Remote has a chance to return to a programmed Sleep Mode. When normal communication with a Remote is complete, the Remote is allowed to return to a Sleep Mode. This value must be *smaller* than the Time Before Sleep value in the Remote radio settings.
Command Mode Timeout (ms)	A value, representing the time in milliseconds, that a Host radio is programmed to exit from command mode if it does not receive any information from TuffCOM to transmit. The Host radio enters an idle mode when the set amount of time elapses.

Table 7. Host Radio System Configuration Page Definitions

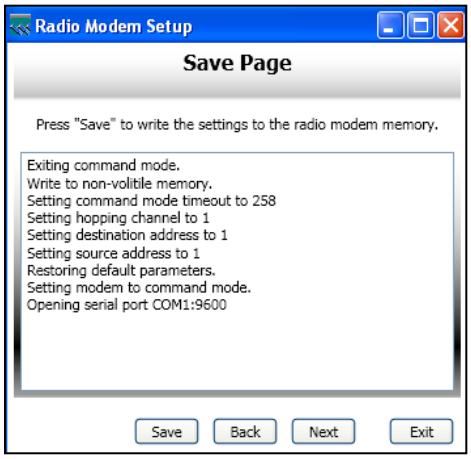

Figure 13. Save Page

8. Press the *Save* button to set the Host radio configuration in the attached Host radio. If a Host did not need to be configured, press the *Next* button to continue through the wizard and proceed to the Remote Radio System Configuration page.

9. Connect a Remote RS100 to the computer serial port. Enter a Source Address and configure the desired Sleep Mode settings (see Table 9. Remote Radio Modem Configuration Page). Default parameters are recommended. Press the *Next* button when configured.

Function	Description
Source Address	The Remote Source Address is a radio networking address that is used to communicate with attached instruments. It is recommended this value matches the connected instrument's factory set serial number. Values can be from 1 to 65536.
Sleep Mode	When checked, the attached Remote radio will operate in low power mode. The drop-down box controls the duration of time spent in Sleep Mode. For 100mSeconds of each sleep cycle, the radio will wake to determine if a Host is attempting to contact it. If it does not detect communication, it repeats the configured sleep cycle. If it detects communication, it will remain fully powered for the Time Before Sleep value (ms).
Time Before Sleep (ms)	A value representing time in milliseconds that a Remote radio will remain fully powered without any communication before returning to a sleep cycle. Each communication received resets this timer in the Remote radio.

Table 8. Remote Radio System Configuration Page

10. Press the *Save* button to set the Remote radio configuration in the attached Remote radio.

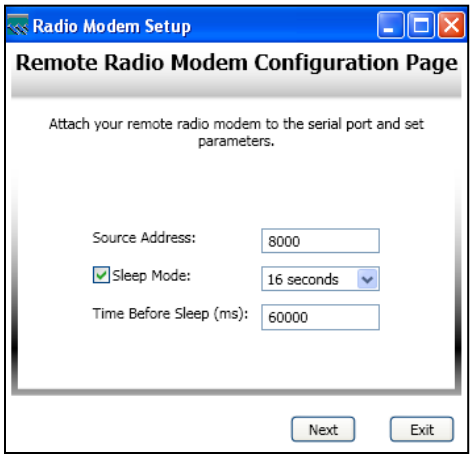

Figure 14. Remote Radio System Configuration Page

11. Repeat steps 9 and 10 as many times as you have Remote radios. Verify that each radio has a unique source address associated with its Tiltmeter.
12. When done press the *Exit* button. A dialog box will appear allowing for new Remote radios to be populated in the Instrument Array. Press the *Yes* or *No* button.
13. Press *Save* button to store the new TuffCOM configuration.

After configuration of RS100's, TuffCOM is ready for the newly created radio network to be verified and then deployed into the field. See Section 8.3.2.4, RS100: Deployment of Networks, for radio verification instructions.

IMPORTANT: In order to start the Radio System network:

1. Working Tiltmeters should be attached to Remote RS100's.
2. The battery should be connected/

9 Troubleshooting

TuffCOM cannot successfully *Ping* a configured instrument:

Serial Port Connection:

- Verify it is attached to the correct serial port.
- Verify you have the correct Baud Rate selected.
- Verify the power connection.
- Verify cables are properly attached and functioning.
- Repower your instrument.
- Reboot your computer.

TCP/IP Connection:

- Verify the correct IP Address and port is entered into TuffCOM.
- Verify the IP Address and port of the instrument.
- Verify the power connection.
- Verify cables are properly attached and functioning.
- Repower your instrument.
- Reboot any serial to IP bridges.
- Reboot your computer.

Radio System Connection:

- Verify the host radio is attached to the correct serial port.
- Verify the host radio is operational with the correct Baud Rate selected.
- Verify the correct network and radio address are selected for the remote radio/instrument.
- Verify the correct sleep mode has been set.
- Verify the power connection.
- Verify cables are properly attached and functioning.
- Repower the remote radio & instrument.
- Repower the host radio.
- Reboot your computer.
- Reconfigure your radio network number and Hopping Channel on both the Remote and Host radios using the File->Radio System Setup wizard in TuffCOM.

10 WARRANTY and LIMITATION of LIABILITY

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