

TiltMeters PHIVOLCS Edition 1.1

Quality Software for Volcano Monitoring

May 2003



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TiltMeters PHIVOLCS Edition User's Guide

TiltMeters PHIVOLCS Edition

Volcano Deformation Monitoring Manual & User's Guide

by Steve JORDI

TiltMeters PHIVOLCS Edition

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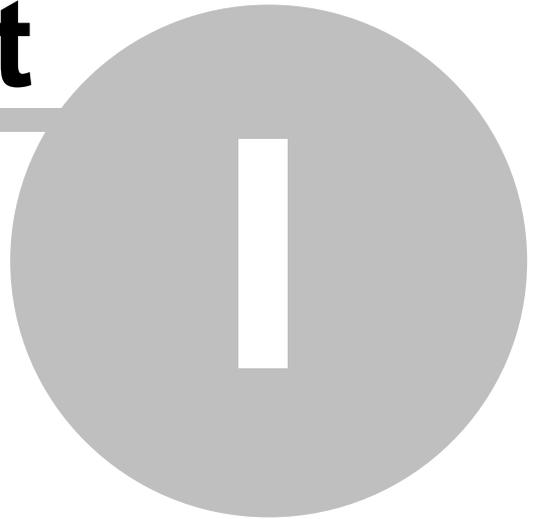
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TiltMeters PHIVOLCS Edition

Part



1 Welcome

1.1 TiltSoft Software

Welcome to the **TiltMeters PHIVOLCS Edition** application.

This help file is organized in 2 sections:

1. Installation related matters.
How to setup the tiltmeters, connect the instruments.
But also how to setup the provided PC208W software that comes with the Applied Geomechanics instruments.
Please read carefully as this section deals with the data retrieval.
2. Monitoring related matters.
How to setup the TiltMeters PHIVOLCS Edition application and how to view the data.

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Contractor / manufacturer is
Stephane Jordi.

Contact:

Stephane Jordi

On the web: www.TiltSoft.com

Email: support@tiltsoft.com

1.3 Technical Support

To obtain technical support for TiltMeters PHIVOLCS Edition please read the Tech Support section at the end.

Support is provided by email.

1.4 If you don't read manuals

There is no quick start on what you have to do to have the entire monitoring network setup and working.

Not reading manuals is not a good idea, as this specific one is definitely designed to help you setup your deformation monitoring environment and the software that monitors alarms and backs up data.

The instructions depicted in this document have been written in the more concise way in order to give highlights on what you have to focus on.

You **CAN'T SKIP THOSE** steps if you want the system to be operated correctly.

1.5 Release History

May 11, 2003

- version 1.1.2 released to PHIVOLCS

- + Improved: Export enhanced (from Databases, not from DAT files)
- + Improved: Export avoids duplicates (based on date/time stamps)
- + Improved: Misc Import enhancements
- + Improved: Empty now clears DB and directories from all files

- * Fixed: Empty also clears all points in charts (speed slowing down at each import).
- + Added: Progress status for Export and Import
- + Added: Data Acquisition Campaign explanations in help file and documentation

May 5, 2003

- version 1.1 released to PHIVOLCS

- * Fixed: [units] display problem
- * Fixed: Reinit of charts for temperatures & batteries
- * Fixed: Formula default to "X" if nothing specified
- * Fixed: X Axis can't be "- Nothing -" anymore
- * Fixed: Scale factors missing in battery and temperature data
- * Fixed: Small bug in displaying data on Right Axis
- * Fixed: Lost chart colors between sessions
- * Fixed: Display problem when the first chart was not tiltmeters
- * Fixed: "All Batt" and "All Temp" windows (immediately updated)
- * Fixed: A minor bug when setting the number of devices (the device tree was wrong)

- + Improved: Formula parsing for batteries and temperatures
- + Improved: Chart positioning

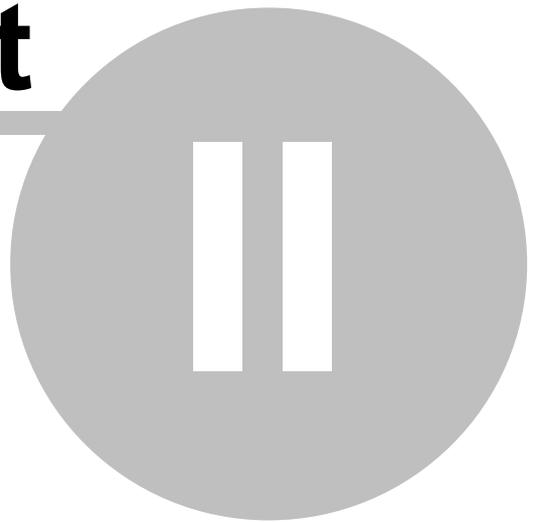
- + Added: Grid window for viewing the raw data in columns
- + Added: Hints over thermometers to indicate current temperature
- + Added: "All" charts button to display all graphes, not only by Tilt/Batt/Temp groups.

Feb 14, 2003

- version 1.0 released to PHIVOLCS

TiltMeters PHIVOLCS Edition

Part



2 Monitoring Volcano Deformation

2.1 Tiltmeter devices

The tiltmeter devices are provided by [Applied Geomechanics](#). For specific information, please refer to the supplied documentation that came with the devices themselves.

2.2 Hardware Requirements

The hardware required for monitoring volcano deformation with tiltmeters depends on the way you setup the device network, but also on the communication model you decide to implement. For PHIVOLCS requirements, established in 2002, you can check the diagram provided in the two sections "[Connecting devices \(on site\)](#)" and "[Connecting devices \(at the observatory\)](#)" further in this document.

2.3 Installation: housing, site

It is very important to decide where to install the tiltmeter devices.

Volcanoes are **hostile environments** and of course the lifetime of the devices and accuracy of their measurements will depend directly on the quality of the site you have chosen: noise, weather conditions, etc.

If you plan to install the devices on the mid- to long-term range, building a small concrete plate as a base is a good idea.

Volcanic terrain is usually made out of uncompacted ashes, subject to subsiding in case of rain falls or if exposed to strong winds.

Also setting a tiltmeter device in a shelter will protect it from falling rocks, branches, animals, vandalism, as well as keeping the operating temperatures and humidity in tight ranges. (See the Applied Geomechanics documentation for specifications of operations).

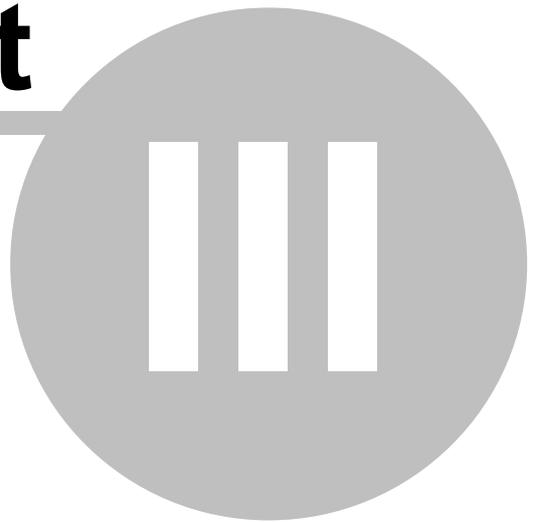
Unfortunately, this is not always possible.

But avoid to set it directly on loose ashes: this kind of base ground will likely move for no apparent reasons and trigger alarms for nothing.

If you have to place one tiltmeter on a lava dome, try to place it on top of it, far from gas emanations and in the most stable area.

TiltMeters PHIVOLCS Edition

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3 Configuring Tiltmeters Devices

3.1 Selecting devices by pairs

The Applied Geomechanics tiltmeter devices have to be operated in pairs with the Handi-Loggers.

You can't mix them, you have to couple them as defined in the table provided by Applied Geomechanics for them to communicate.

Here are the matching pairs (horizontal lines):

Tiltmeter		Handi Logger	
Serial Number	Name	Serial Number	Name
5190	SOC1	5427	HLP001
5186	SOC2	5423	HLP002
5191	SOC3	5428	HLP003
5192	SOC4	5429	HLP004
5193	SOC5	5430	HLP005
5189	SOC6	5426	HLP006
5188	SOC7	5425	HLP007
5187	SOC8	5424	HLP008
5185	SOC9	5422	HLP009
5194	SOC10	5431	HLP010

3.2 Calibration tests

This is an important step you **should not skip** in setting up your tiltmeters network.

You should always calibrate your instruments before installing them on the field. To proceed, use the Applied Geomechanics 771 DRU (Digital Readout Unit).

Connect the Tiltmeter device directly to the "Tilt In" input



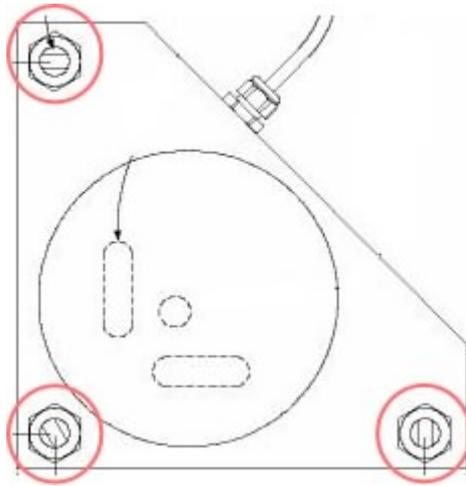
Make sure that the polarity is correct. This is explained in the tiltmeter manual.

3.3 Leveling the devices

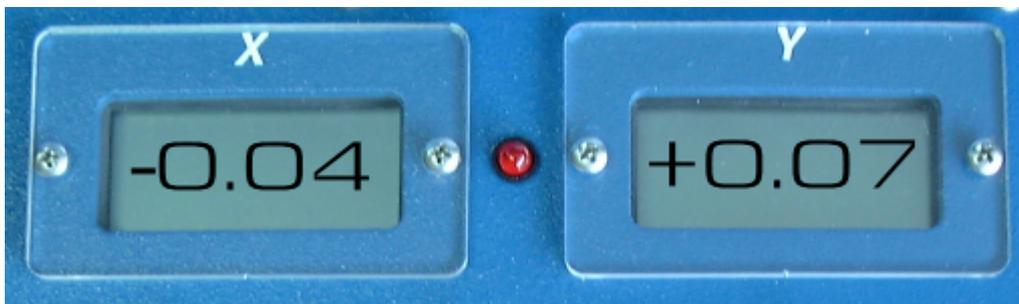
To be efficient, tiltmeter devices need to be leveled when installed on site.

To help you in this task you have to use the **Applied Geomechanics 771 DRU (Digital Readout Unit)** (See its manual to understand how to operate this unit).

Connect the tiltmeter to the 771 DRU Unit and adjust the screws on its base (circled in red below).



Try to level the device until the 771 DRU displays values very close to 0.0 on both the X and the Y axis.



The closer to 0.0 the better.

Also make sure to align the X and the Y axis to a North-South and West-East axis. It is up to you to decide which axis points in which direction and which represents a Radial or a Tangential measurement.

Those latter have to [be configured](#) in the TiltMeters PHIVOLCS Edition software as well.

Once this is done, you can disconnect the tiltmeter device from the 717 DRU unit and connect it to the Handi Loggers.

3.4 Handi Loggers

Handi Loggers are actually the devices that collect the data from the monitoring instruments (tiltmeters, GPS, seismometers, etc...).

They are the interface between you, the user, and the instruments.

Data is stored in the internal circular memory and you access them using the PC208W software.

Note: for 1 sample/hour, with all 10 devices connected, you can store 6 months worth of data.

This means that you won't lose the data in case of communication problems.

If you need to go to the field to check about the communications, the Handi Loggers will continue to collect and store the data. The data will be available for retrieval once the communication are re-established.

The only thing you will lose in such a case would be the *near real-time* monitoring.

See "[Connecting devices \(on site\)](#)" for operations on cabling and connections to the Handi Loggers.

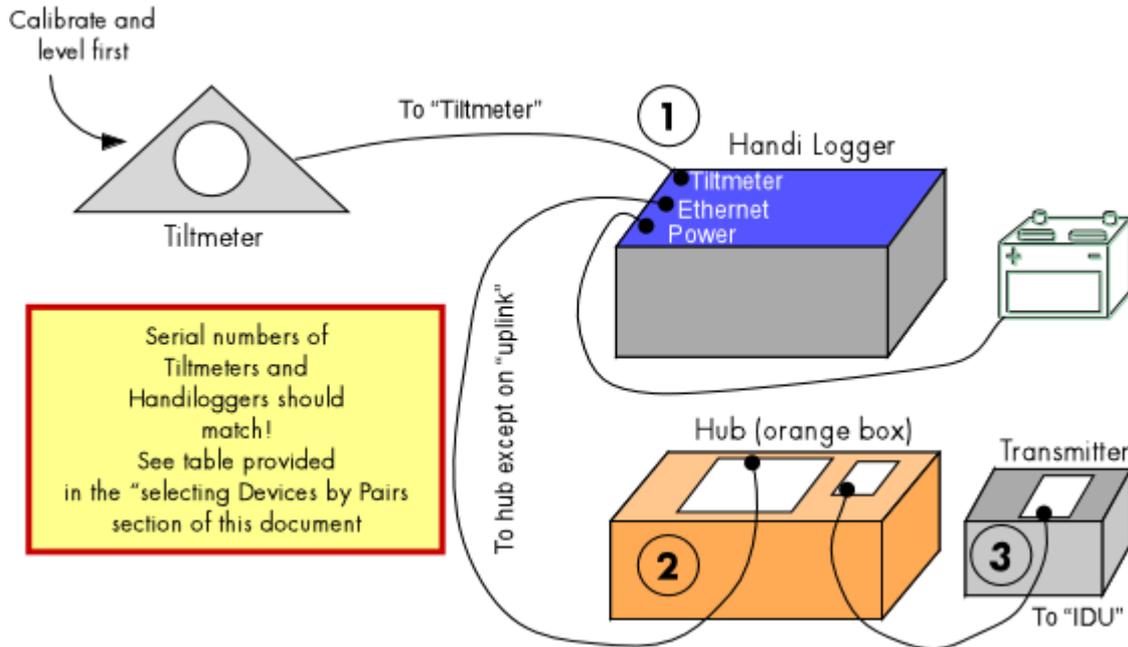
3.5 Connecting devices (on site)

Here is a diagram explaining:

1. how to connect the devices,
2. how to connect the transmitter

This is on the **volcano side**.

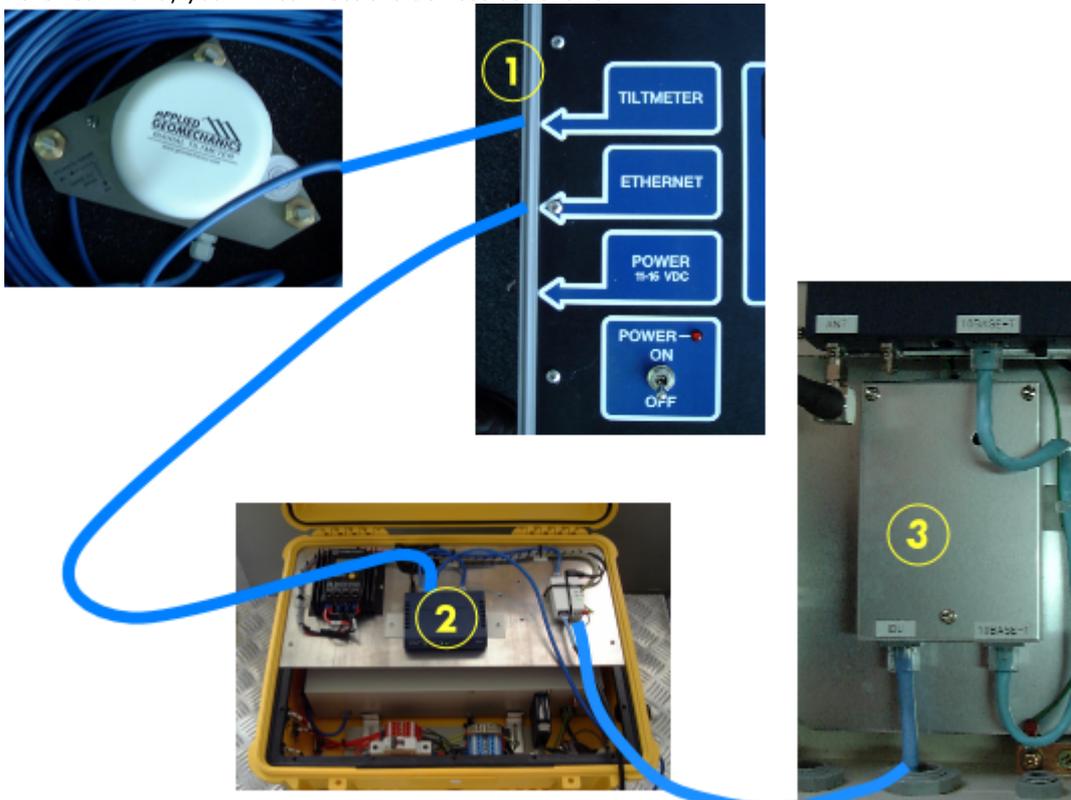
Again the tiltmeter devices should be installed on a concrete base if this is possible. Also the equipment will last longer if protected in a shelter.



Where

- ▶ 1 is the Handi Logger collecting data from the devices.
- ▶ 2 is the hub (connect the Ethernet cable from the Handi Logger to any available plug except UPLINK)
- ▶ 3 is the transmitter that will send the data to the observatory.

In the real world, you will connect the devices as follows:



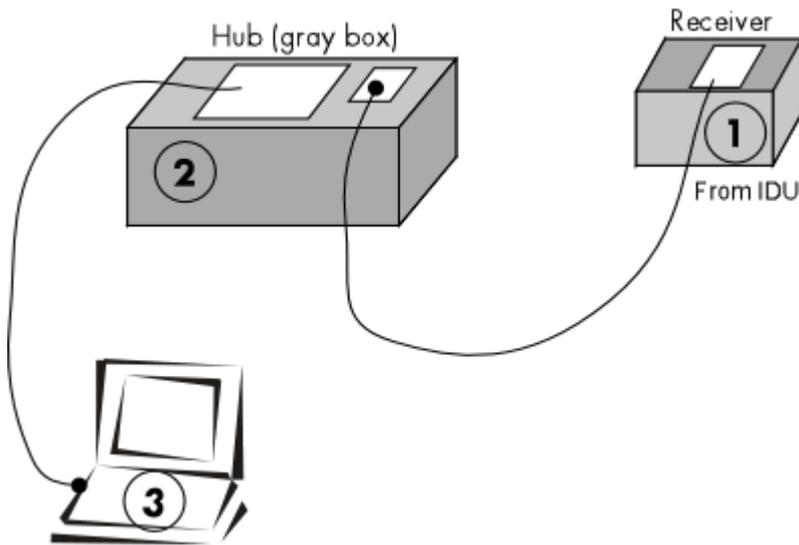
3.6 Connecting devices (at the observatory)

Here is a diagram explaining:

1. how to connect the boxes at the volcano observatory.
2. how to connect the receiver and the notebook computer.

This is on the **observatory side**.

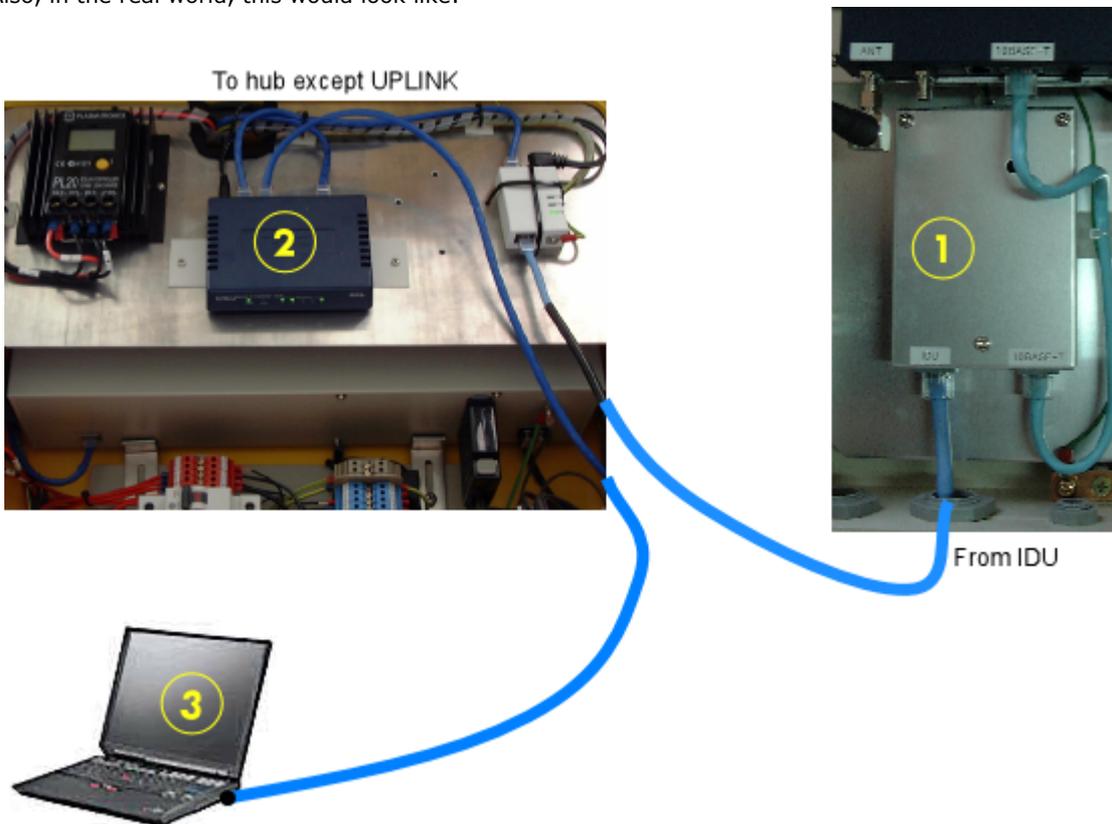
To receive the data sent from the sites, here is the connection diagram:



Where

- ▶ 1 is the receiver (with the antenna). Connect the Ethernet cable to IDU.
- ▶ 2 is the hub (connect the cable to any available plug except UPLINK).
- ▶ 3 is the Tiltmeter Notebook connected to that Ethernet cable.

Also, in the real world, this would look like:



3.7 Tiltmeters notebooks

The Tiltmeter notebooks are the central piece of the monitoring system.

They connect to the Handi Loggers in order to retrieve the data.
They display the results, check alarms, backup the data, transmit the data.

Configuring the notebooks is explained at several places in this document:

1. They host the PC208W software provided by Applied Geomechanics to collect the data to the observatory.
2. They host the TiltMeters PHIVOLCS Edition software.
3. They communicate to the Handi Loggers and to the base station desktop computer at PHIVOLCS.

The major requirement for those notebooks is in their network settings.

The TCP/IP number of each notebook has to be in the same range of IP address than all the Handi Loggers and the transmitters/receivers.

For the Tiltmeter network, the IP addresses are used as follows:

Handi Logger	IP Address
HLP001	192.168.1.48
HLP002	192.168.1.45
HLP003	192.168.1.40
HLP004	192.168.1.41
HLP005	192.168.1.42
HLP006	192.168.1.43
HLP007	192.168.1.44
HLP008	192.168.1.46
HLP009	192.168.1.47
HLP010	192.168.1.49
Notebook 1	192.168.1.200
Notebook 2	192.168.1.201

**Please note that IP addresses are shared among all parts of the monitoring network.
Do not change those addresses unless explicitly asked for.
IP addresses can conflict with other devices on the network.**

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IV

4 Data Acquisition

4.1 Installing PC208W

Applied Geomechanics provides a software called PC208W. This software must be installed on the notebook connected to the tiltmeter network.

PC208W is used to:

- Talk to the tiltmeter devices.
- Setup the devices.
- Collect the data.

PC208W has to run in the background 24 hours a day

Note: If you don't run it to retrieve the collected data, the Handi Loggers can store up to 6 months worth of data if you have 10 tiltmeters connected to them with a 1 data per hour sampling rate. The data can be collected at any time, but monitoring should be a **near real-time** process.

Install PC208W from the Applied Geomechanics provided CD-ROMs.

Follow their instructions, **in the order specified**:

1. Install the software in c:\pc208w
2. Copy the device technical files from the CD-Rom into the **C:\PC208W\Inifiles** subdirectory

**ONCE PC208W HAS BEEN SETUP AND IS RUNNING
DO NOT TOUCH IT ANYMORE.
DO NOT MOVE ITS FILES
DO NOT OPEN / EDIT / RENAME ITS FILES.**

ALL FILES ARE PART OF THE MONITORING MECHANISM

**TO VIEW THE FILES, USE THE VIEW FEATURE FROM
TiltMeters PHIVOLCS Edition**

**TO COPY THE DATA, USE THE EXPORT FEATURE FROM
TiltMeters PHIVOLCS Edition**

4.2 Raw Data Format

The text data files generated by the Handi Loggers are formatted as follows:

```
511,ID,Day,Year,Time,Seconds,X,Y,Temperature
99,ID,Day,Year,Time,Seconds,Batt,Batt,BattTemp
```

where

511	is the Array ID (always 511)
ID	is the ID of the device itself
Day	is the Julian Day (from 1 to 365/366)
Year	is the 4 digit Year
Time	is a 24 hours format 4 digit time: 1427 means 14:27
Seconds	is the number of seconds
X	is the value (mV) measured from the Tiltmeter X Axis
Y	is the value (mV) measured from the Tiltmeter Y Axis
Temperature	is the temperature of the device in 1/10°C (23.7°C is shown as 237)

Note: the second line, starting with 99 is the BATTERY information. Here, X and Y are similar and both show the battery level in Volts And then the temperature of the battery in 1/10°C

You can import the data into any spreadsheet. The files are comma delimited.

Please check the "[PC208W Updates](#)" section.

4.3 Storing Data

Data can be stored anywhere on your notebook computer.
But it is worthy to spend some time thinking about the way you want it to be stored.

Since this is a mobile system, it could be nice to organize the data into directories (folders) and subdirectories (sub folders) that reflect the monitoring missions.

As an example you could organize the data by volcanoes, then by dates and devices.

The directory structure would look like:

```
c:\data
c:\data\pinatubo
c:\data\pinatubo\2003
c:\data\pinatubo\2003\February
c:\data\pinatubo\2003\November
c:\data\taal\2002\June
c:\data\taal\2003\August
```

Within the month directories, you still could create subdirectories for devices themselves:

```
c:\data\pinatubo\2003\February\01
c:\data\pinatubo\2003\February\02
c:\data\pinatubo\2003\February\03
c:\data\pinatubo\2003\February\04
```

But this is not really necessary as data filenames are explicit and usually show the device ID in their names.

Of course the way you structure and organize data collection is up to you.
Just avoid to store all volcano data in a single directory.

By default, each device is called HLPnn where nn is the device ID.

Keep those names. This will ease technical support issues for both TiltMeters PHIVOLCS Edition and for Applied Geomechanics.

Remember that data is appended to existing files.
You easily can mix different volcanoes into one file by mistake. That's why using directory structures is highly recommended!

4.4 Configuring Data Retrieval

Once you have decided about a data storage directory structure, you have to enter that information in the PC208W application.

This has to be done for **each** device that you will use in your mobile monitoring setup.

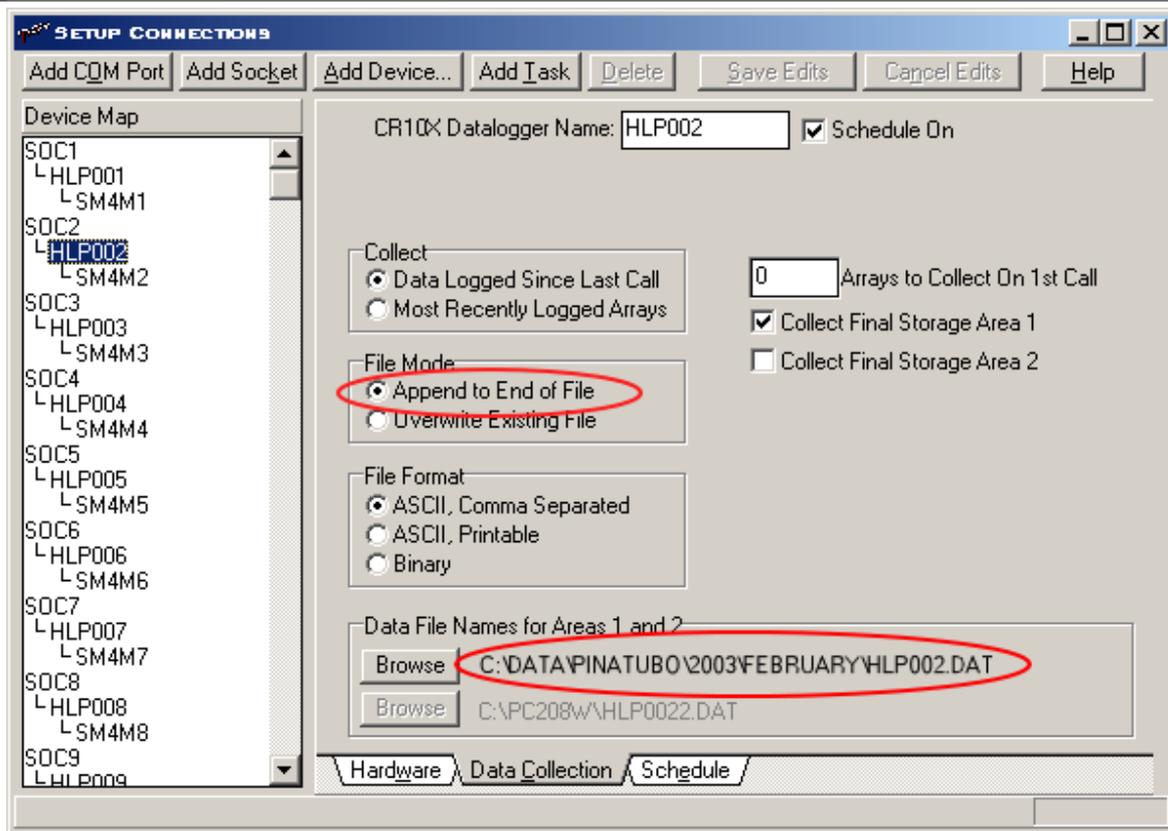
If you have 5 devices installed, you will repeat the steps 5 times (one for each device).

Example: configuring HLP002

- In PC208W click the SETUP button.
- Click the Data Collection tab at the bottom of the window.
- Click the BROWSE button to point to the directory where you want to store the data for that device.

▶ For example: c:\data\pinatubo\2003\February\HLP002.DAT
▶ NOTE that you keep HLP002.DAT as the filename. The .DAT extension is also added.

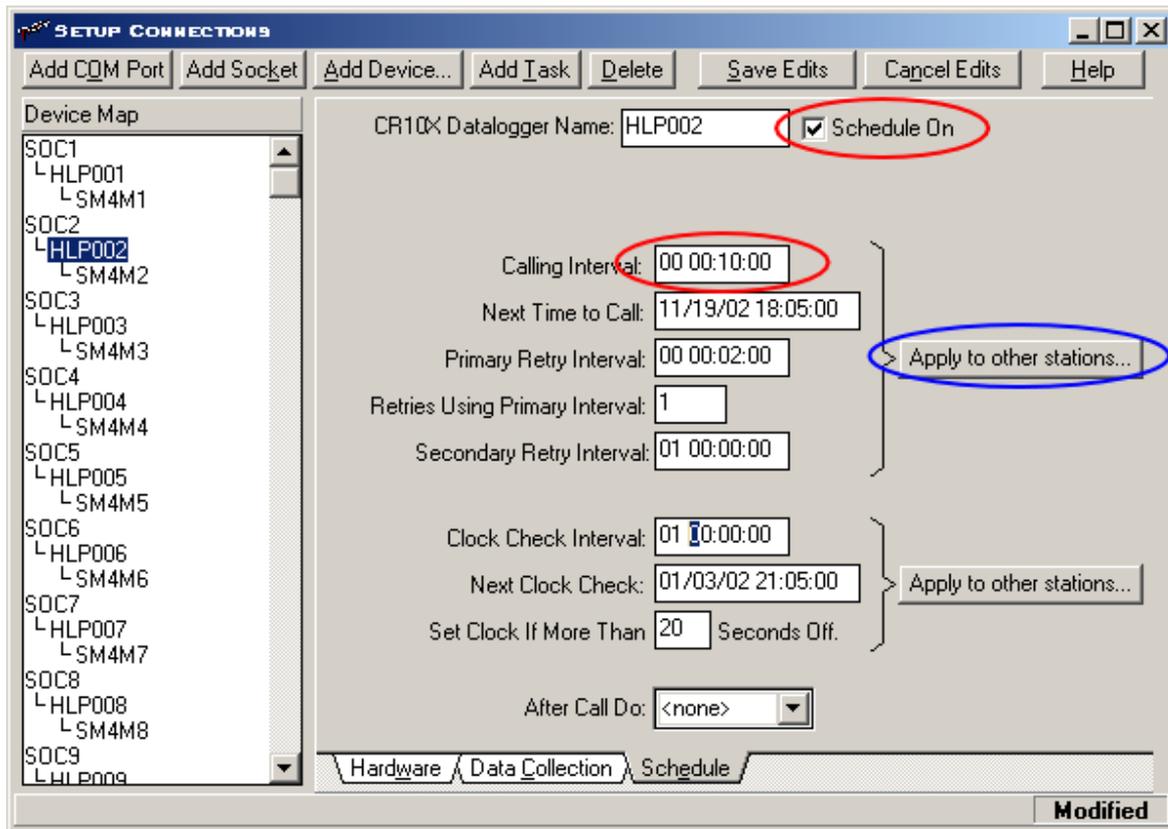
- Make sure to click on the "Append To End Of File" radio button in the "File Mode" section.



4.5 Scheduling Data Retrieval

To enable the automatic data retrieval open the SETUP window in PC208W.
(See "[Configuring Data Retrieval](#)").

- Click on the **Schedule** tab at the bottom of the dialog box.
- Define the **Calling Interval** you want (red circle).
- Check the **Schedule On** box to make sure that PC208W will retrieve the data from that device (red circles).
 - ▶ Note that if you want to apply those settings to all devices you can click the "Apply to other stations..." button (blue circle).
 - ▶ **If you apply those settings to all stations, the "Schedule On" check box is not replicated to all stations!**
You have to manually turn each schedule check box on or off.



In this example, data will be retrieved every 10 minutes.

For more detailed information, please refer to the supplied PC208W manuals.

Power consumption issues:

It is recommended to retrieve data every 1 hour or every 4 hours.

Be aware that your devices are powered by batteries and solar panels. Communications with the devices is a power consuming operation and connecting to the Handi Loggers every 10 minutes may not be the best approach.

You can fine tune those parameters once you have practiced a little bit. If you see that batteries are drained down too rapidly, schedule data retrievals only every 4 hours.

TILTMETER MONITORING IS A SLOW PACE DATA ACQUISITION. IT IS USED ONLY IN NEAR REAL-TIME EARLY WARNING SYSTEMS.

4.6 PC Clock Synchronization

The PC clock can be adjusted to the device clocks.

This is done in the same PC208W setup window (see [Scheduling Data Retrieval](#)).

This is useful when the notebook clock is drifting.

The Handi Loggers are seen as the reference clock in order to keep data time stamps synchronized.

PC clocks are reset against Handi Loggers ones.

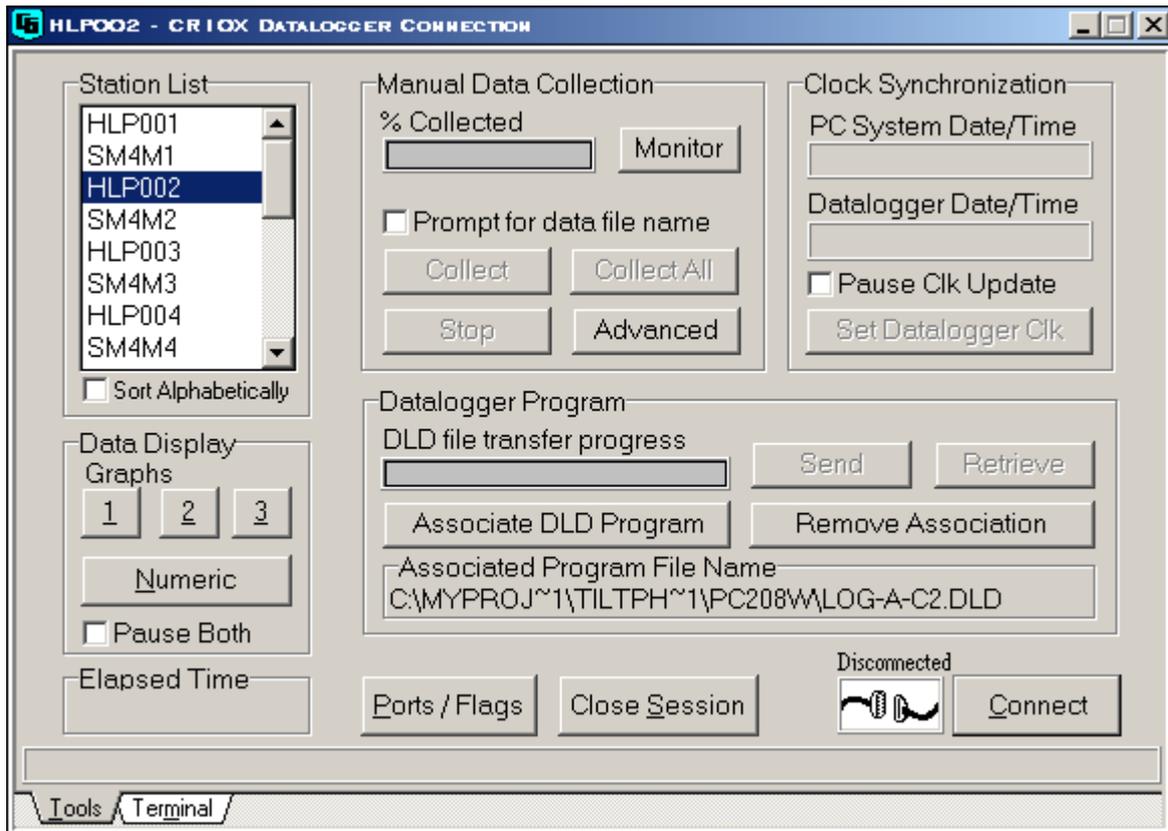
Most of the time you may have GPS time based devices. Those latter are more likely to have an accurate time than the notebooks.

4.7 Starting Data Monitoring

Once all steps defined in the "Data Acquisition" section are set, you then have to click on the device you want to connect to.

This is done in the main PC208 Window.

- Select the device in the "Station List" (here HLP002)



- Click on Connect

PC208W will try to connect to the device. The connection status is displayed as follows:

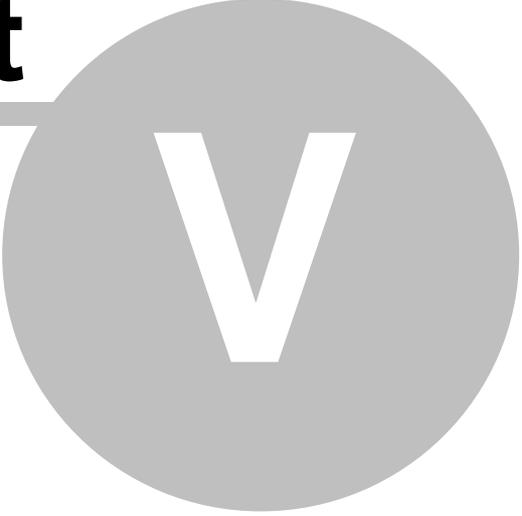


If the connection fails, check the 3 possible reasons:

1. the Tiltmeter devices are not **used in pair** with the matching Handi Logger
2. the **TCP/IP number of the notebook** is not in the same domain as the tiltmeters and Handi Loggers
3. the radio communication is not working. Check connections and/or contact the communication team.

TiltMeters PHIVOLCS Edition

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V

5 Tiltmeters PHIVOLCS Edition

5.1 Overview

The TiltMeters PHIVOLCS Edition software is the corner stone in monitoring your deformation data.

It centralizes and compiles all the data into easy to understand charts.

TiltMeters PHIVOLCS Edition is a visualization tool, not a data acquisition one. Acquisition is performed with 3rd party softwares.

Charts are fully customizable to fit your needs.

This section covers:

1. how to navigate in the application
2. the software configuration (data, alarms, etc.)
3. how to use the charts
4. how to handle alarms
5. how to manage data

5.2 Requierments

The software is designed to run under Microsoft™ Windows XP.
You need at least a Pentium III with 128Mb RAM.

Of course you need a device network to retrieve the data.

But you can use the software in **non real-time** mode to visualize the data acquired differently, by FTP or by Floppy/ZIP/CD discs.

In order to work for the PHIVOLCS specific needs, 3rd party applications like Applied Geomechanics PC208W are required to perform the data acquisition itself.

This 3rd party application runs concurrently to TiltMeters PHIVOLCS Edition.

TiltMeters PHIVOLCS Edition has to run in the background 24 hours a day

5.3 Managing the charts

Launching the application will display a main toolbar and n charts depending on how many devices you are using.

Each chart is linked to one device, whatever it displays.

A chart can display either the tiltmeter X or Y axis, as well as the device temperature, the battery voltage or the battery temperature.

See the "Configuring the software" section to learn how to specify what you want to display on the charts.

5.4 Installing The Software

To install the software:

- Insert the CD-ROM.
- Launch the "setup.exe" application if the CD-ROM doesn't do this automatically for you.
- Follow the instructions on screen.
- **It is important to read the legal matter screen as this software is used in a dangerous environment (volcanoes).**

Once done, you can remove the CD-ROM.

A menu will be created in the Start menu, as well as a shortcut icon on your desktop.

5.5 Windows XP Look and Feel

Windows XP comes with a new user interface, which is a bit bulky.

Since TiltMeters PHIVOLCS Edition will be run on laptop computers with 15" screens at 1024x768 resolutions, it is better to deactivate the XP look in order to gain some precious space on screen. The charts will look a bit more larger this way.

To proceed, go to

- Start
- Control Panel
- Select Display
- In the Appearance Tab, select "Windows Classic style" in "Windows and buttons".
- Click OK and close the control panel.

5.6 Main Toolbar

5.6.1 Monitoring Section

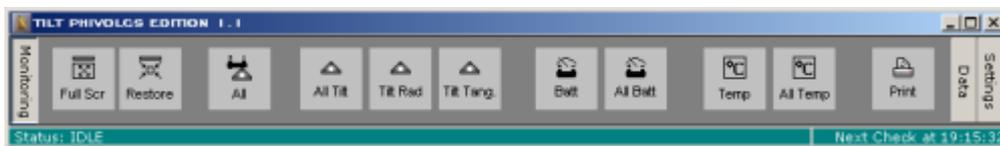
5.6.1.1 Sections

The main toolbar is displayed at the top of the screen. It is the "command center" of the application.

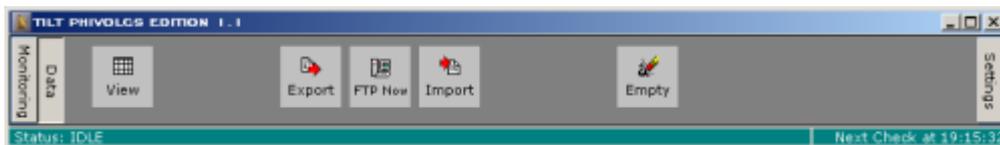
The toolbar is divided into 3 sections:

1. Monitoring
2. Data
3. Settings

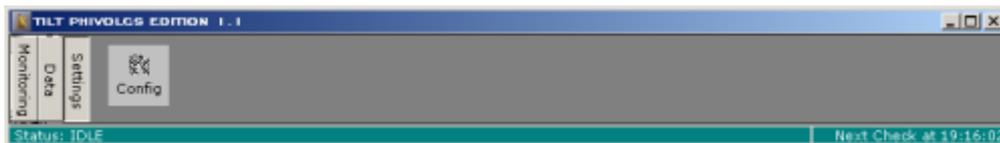
The **Monitoring** section manipulates the way charts are displayed and organized.



The **Data** section lets you import/export data, back up data and send them by FTP.



Finally, the **Settings** section is used to [configure the software](#).



5.6.1.2 Grouping Charts

Monitoring section: grouping charts.

This toolbar section lets you group the charts by [categories](#).



The "All" button displays ALL THE DATA no matter which [category](#) they belong to. You will have all tiltmeter, battery and temperature charts at once.



The Tilt buttons displays only the charts that are [categorized](#) as "Tiltmeter"

- All Tilt will show all tiltmeter information

- Tilt Rad will show only the Radial information
- Tilt Tang. will show only the Tangential information



The Batt buttons will display only the charts [categorized](#) as "Battery"

- Batt will show the battery charts
- All Batt will display a [dedicated battery window](#) displaying all current battery levels.



Finally the Temp buttons will display only temperature based information ("Temperature" category)

- Temp will show the temperature charts
- All Temp will display a [dedicated temperature window](#) displaying all current temperatures.

Note: category assignments to charts is explained in the [Axis](#) topic in the "Configuring the Software" section.



The Print button will print the **currently selected (active)** chart.

5.6.1.3 Moving, resizing charts

You can resize each chart individually by grabbing any border of the windows with the mouse. But you also can display one specific chart full screen as well as restoring it to its initial size and position.



The **Full Scr** button will enlarge the currently active chart (selected one) to the entire screen space (without covering the main toolbar).

The **Restore** button will resize that chart and position it back to its original location on screen.

Note: the chart sizes are automatically calculated in order to be organized the most efficient way on screen.

The initial display configuration may be different depending on how many charts belong to one category.

Having 2 charts in the "Tiltmeter" category will split the screen in two.

If you have 5 charts in that category, TiltMeters PHIVOLCS Edition will calculate the best chart sizes and positions to let you visualize all of them at once.

5.6.1.4 Status information

The main toolbar also has a **status bar**.

The activity information is depicted in that bar. The bar is split into two parts.

The left part displays the **current activity**

Status: IDLE

whereas the right part indicates the when the next check will be performed.

Next Check at 12:35:40

Current Activity:

- IDLE
This means that the application is standing by. It is available to you.

- Checking for new data
The application is currently checking for new data.
If new data have been retrieved from the Handi Loggers by the PC208W application, they will be read, added to the charts, and alarms will be checked.

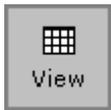
- UPDATING CHARTS
New data has been found and has been added to the charts. Those latter are currently updated.
Depending on how many points are displayed in a chart, it may take a few seconds to refresh.

- Resetting charts... please wait.
The application is currently updating the chart configurations.
This is typically shown once you close the Configuration Window in order to apply the new options.

- SHUTTING DOWN MONITORING - PLEASE WAIT
This message may be displayed once you close TiltMeters PHIVOLCS Edition.
Since the data detection, the chart updates and the alarm tests are done in parallel, if you close the application during those checks, you will have to wait for them to terminate before the application can gracefully exit.

5.6.2 Data Section

5.6.2.1 Viewing Raw Data



By clicking the "View" data in the "Data" section of the toolbar, you will access a window showing all data acquired by the tiltmeter network.

Data will be shown in columns, and **in raw format**.
Temperatures are not converted into degrees using scale factors.
The data shown in this window is **as-is**. As it is collected by PC208W.

You can't modify the data in that window.

Date/Time	Tilt X	Tilt Y	Tilt Temp	Battery	Batt. Temp
4/21/2003 19:50:15	-160.79	111.92	385.58	13.534	377.93
4/21/2003 20:00:35	-102.48	186.92	373.85	14.22	375.02
4/21/2003 20:10:35	-94.769	196.01	365.93	13.113	371.31
4/21/2003 20:20:35	-79.849	204.09	357.67	14.182	367.65
4/21/2003 20:30:35	-75.138	205.72	351.95	14.222	364.03
4/21/2003 20:40:35	-70.981	208.97	348.37	13.187	360.85
4/21/2003 20:50:35	-65.951	214.05	345.33	14.195	357.69
4/21/2003 21:00:35	-65.314	213.75	343.35	14.162	354.96
4/21/2003 21:10:35	-61.915	218.39	342.35	14.169	352.7
4/21/2003 21:20:35	-61.446	220.21	341.66	14.136	350.41
4/21/2003 21:30:35	-57.174	224.42	340.81	14.103	349.33
4/21/2003 21:40:35	-50.133	228.94	339.33	13.154	348.21
4/21/2003 21:50:35	-49.513	230.45	337.67	13.141	347.08
4/21/2003 22:00:35	-52.263	230.28	337.36	14.05	345.58
4/21/2003 22:10:35	-43.88	234.04	335.98	13.154	344.83
4/21/2003 22:20:35	-37.827	236.87	334.34	13.991	343.7

Temperatures are shown in RAW data, not converted into °C using scale factors.

Please select the device:  Close

- To switch from device to device, just select the desired one in the combo box at the bottom of the window.

Data is presented sorted by date/time, from the oldest to the newest values.

5.6.2.2 Exporting Data



The Data Section has an EXPORT button that lets you actually save the current data (databases) into a specific directory on your computer.

It allows **local** backup of your current databases.

This way you can save data to a ZIP disk, or anywhere else on the hard disk or network (if any).

Databases are not in raw data. You can't edit them directly.

5.6.2.3 FTP Now



TiltMeters PHIVOLCS Edition lets you send the data files via FTP to another computer.

This latter will probably be based at PHIVOLCS itself. Data will be sent to it and will then be available on that remote computer for import into TiltMeters PHIVOLCS Edition for others to view the data.

This remote computer will not be used as a monitoring one though as data streams are not in near real-time.

Files sent by FTP are **on demand** and are not an automatic process.

Sent files are in [RAW DATA](#) format (text files).

Note: in order to reduce the traffic over the communication network, only the newest data recorded since the last FTP will be sent to the remote computer.

Note: sending files by FTP **overrides** current files on the remote computer. The FTP protocol does not allow to append data to existing files.
So make sure that when you FTP the newest data, you do this in accordance with the persons in charge of retrieving the data at PHIVOLCS.

5.6.2.4 Importing Data



Data that has been retrieved by FTP can be imported into TiltMeters PHIVOLCS Edition. To do this click this button and select the directory where the data files are stored.

**Note: you must have the desktop computer configured THE SAME WAY as the remote notebook which has sent you the files.
Make sure to configure all parameters in the settings windows the same way as the notebook.**

Note: the received data files are in the directory specified in the [FTP Settings Dialog](#).

5.6.2.5 Empty Databases



From time to time, you may be interested in emptying the databases.

When would this be required?

1. When you move to a new volcano and start a **new monitoring**.
2. When you use TiltMeters PHIVOLCS Edition as a viewer at PHIVOLCS and want to switch from one monitoring network to another one.
For example, you decide to check the data from a different volcano you will need to Empty the database and adjust all the settings to the new network.

**Be careful in emptying the databases. The data will be lost.
You may want to export the data first before emptying the databases.
Exporting the data will save the current databases to a safe place.**

5.6.3 Settings Section

Please check the dedicated section called "[Configuring the Software](#)"

5.7 Configuring the Software

This section is very important.

It covers the entire configuration procedure to have TiltMeters PHIVOLCS Edition work accordingly to your needs.

Please read the entire section, as it takes you step by step through the final working setting.

5.7.1 Main navigation

The settings window is organized by categories. You navigate between them using the navigation bar on the left, by selecting the item you want to configure.

The tree list in the middle shows the currently selected device to let you know which device you are

actually configuring.

A volcano icon is set at the top and can't be selected. Then the type of devices is represented in the tree list.

Currently, TiltMeters PHIVOLCS Edition is tailored to only work with tiltmeters (the triangle icon), so you won't have much other choice to pick up a different device.

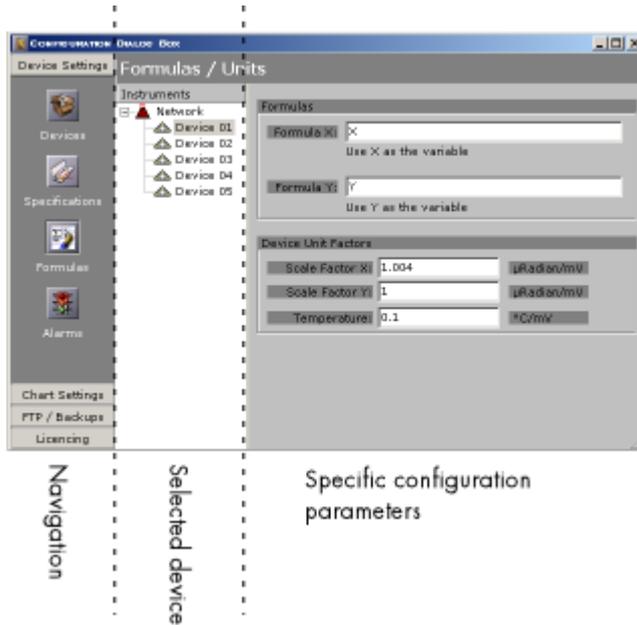
If further developments and customizations are requested to integrate monitoring from other sources (RSAM, seismometers, rain gauges, etc.), then the list could display those other devices.

The tree list is used to pick the specific device you want to configure.

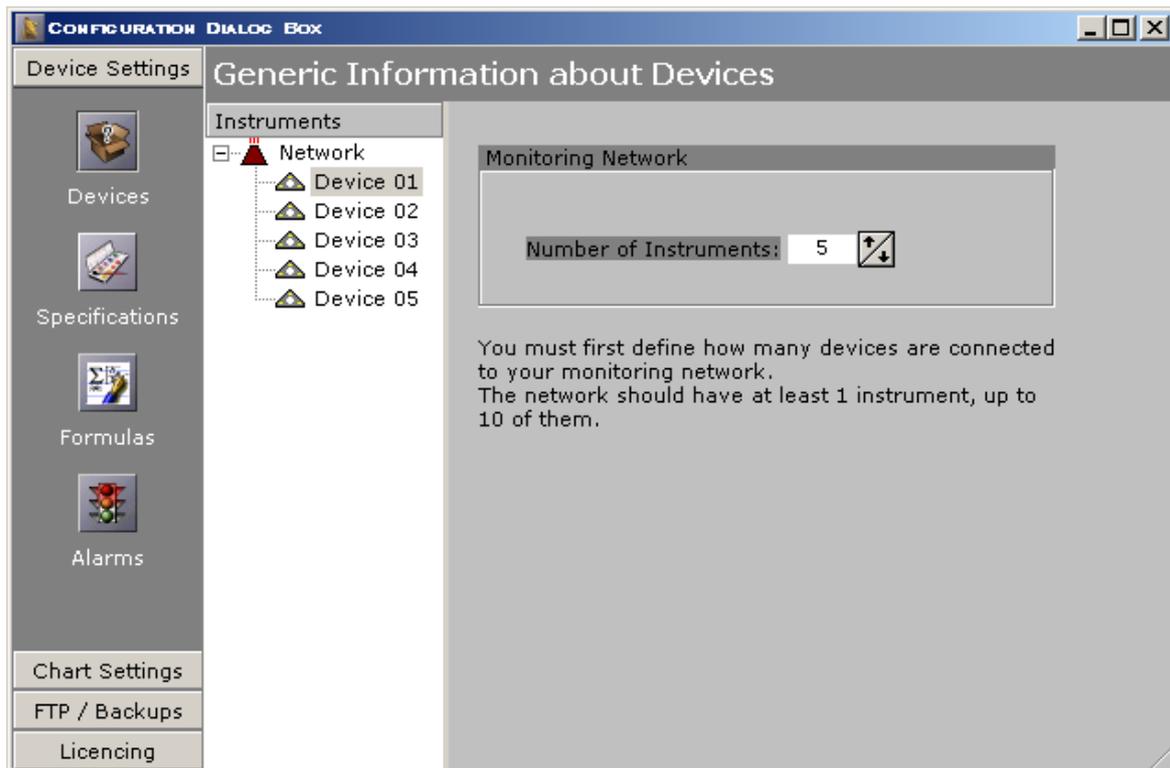
So first of all, click on the appropriate device.

That selected device remains selected through all screens as you browse between configuration sections.

The right part of the window has context sensitive parameters accordingly to the current configuration topic you have selected.



5.7.2 Devices



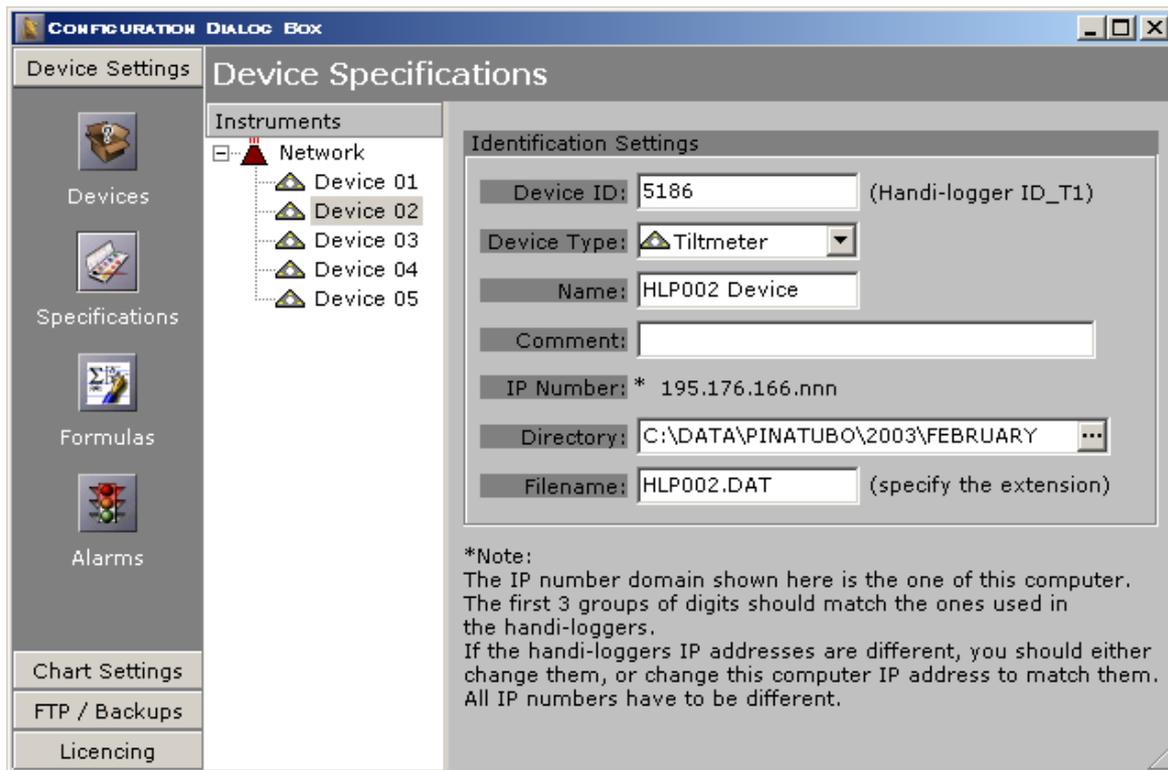
This is the first screen displayed in the configuration window.

It is where you specify how many devices you are using on that specific network deployed on the field.

If you use 5 tiltmeters, then you set it to 5.

The valid range is 1 to 10 tiltmeters.

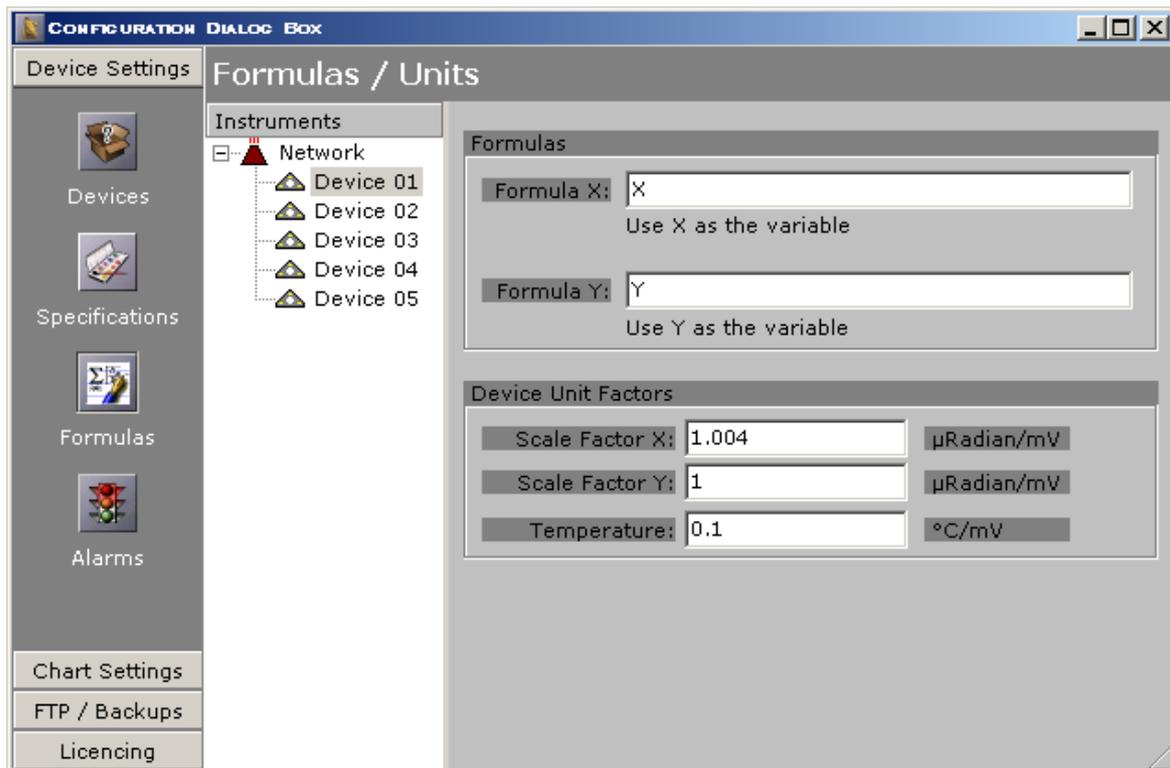
5.7.3 Device Specifications



- **Device ID**
that is the Handi Logger ID taken from Applied Geomechanics documentation (see also the table in "[Selecting devices by pairs](#)")
- **Device Type**
You have to select the kind of device you are monitoring.
Depending on your version of the application, you have a choice of tilemeters, rain gauges, seismometers, RSAM, etc.
- **Name**
You can assign a name to the device (this is just to help you recall what it is)
- **Comment**
You can add a more descriptive comment to the device.
- **IP Number**
Here, you have the IP number of your notebook.
This is very important to make sure that this IP number is in the range of all device IP numbers.
The range of all IP numbers is defined in the "[Tiltmeters notebooks](#)" section of this document.
If the IP number of the notebook is not in the same domain as the devices, you won't be able to talk to them.
The IP number shown in this document is just generic and doesn't reflect your actual specific configuration needs.
- **Directory**
Specify the directory where the data files **retrieved from the PC208W** application are stored on the notebook computer.
This is the same information as the one specified in PC208W (see "[Configuring Data Retrieval](#)")
Note that there is no filename specified here.
- **Filename**
Finally this is the filename where the data is stored.
You have to include the extension as well.
The file has to exist to be used for monitoring.

Please repeat these steps for all devices you are using as the filenames are different for each one of them.

5.7.4 Formulas



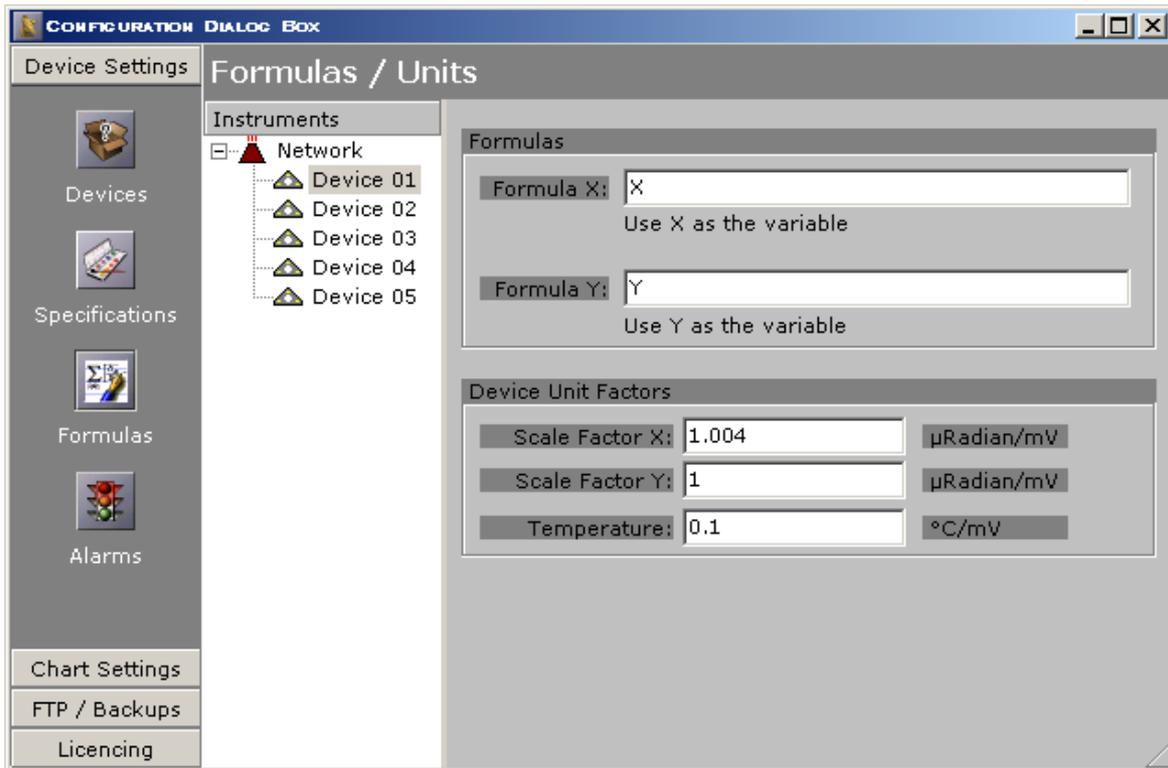
TiltMeters PHIVOLCS Edition offers a unique feature in volcano monitoring: applying formulas on the data. This allows you to perform several operations on the measured data. A formula is applied to all points (all samples) collected by the computer.

A typical use is adding correction factors, or amplification factors, filters, etc.

- **Formula X:** this is the place where you can define a formula for the tiltmeter X axis data. [To accomplish such a thing, you have to use "X" as the variable.](#)
As an example, if you want to multiply all points by 3 and add 20.3 to each of them, you would write:
 $X*3+20.3$
- **Formula Y:** this is the place where you can define a formula for the tiltmeter Y axis data. [To accomplish such a thing, you have to use "Y" as the variable.](#)
As an example, if you want to display the LOG of Y/2.0, you would write:
 $\text{LOG}_{10}(Y/2.0)$
- **If you don't want to apply formulas,** just set X and Y in the appropriate fields.

**FORMULAS ARE APPLIED ON THE FLY ON EACH DATA POINT BEFORE THEY ARE PASSED TO THE CHARTS.
THE RAW DATA STORED IN THE FILES/DATABASE ARE NOT AFFECTED BY THOSE FORMULAS.**

5.7.5 Scale Factors



Scale Factors are an important topic you have to understand.

Scale Factors are provided by Applied Geomechanics for each tiltmeter devices. You find this information in the manual that came with each device.

When reading the scale factor of a device make sure to have the correct manual (matching serial number between the manual and the device).

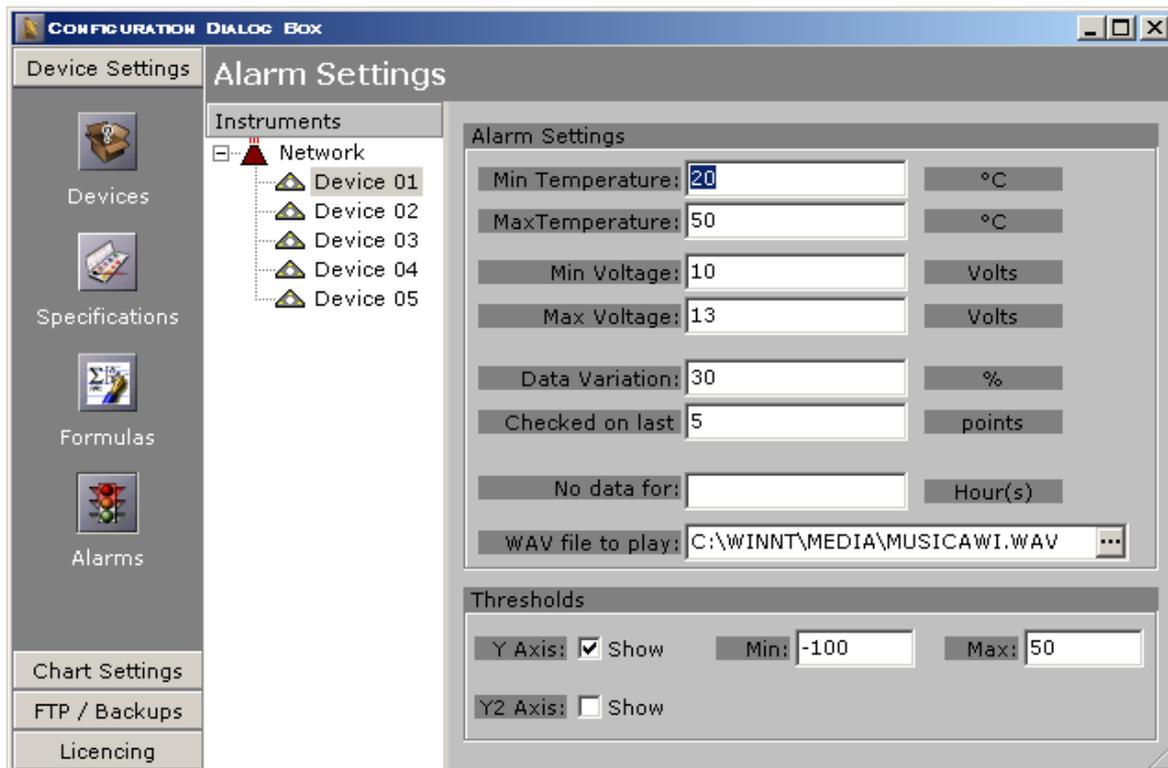
Scale factors are a conversion factor to transform the **raw data** received from the devices (which are actually only **mVolts**) into physical units. For tiltmeters, the physical units are **μRad**.

For example, if a scale factor is 1.004, this means that a value read from the device (in mV) is multiplied by 1.004 in order to obtain a μRad value.

You have to enter each scale factors, for both the X and Y axis, as well as for the temperature. This is explained on page 19 of the tiltmeters' manuals.

Temperature scale factors are 0.1 by default. Raw temperature data is divided by 10 (27.5°C is stored as 275 in the files).

5.7.6 Alarms



TiltMeters PHIVOLCS Edition monitors data and checks whether values like the tilt variation, the battery levels or the tiltmeter temperatures stay within specific ranges.

If data falls outside those ranges, an alarm is triggered, a window is displayed and a sound will be repeatedly be played to get the attention of the persons in charge of the surveillance.

See "[Alarm Window](#)" for explanations on triggered alarms in TiltMeters PHIVOLCS Edition.

- **Min/Max temperature**

The limits in which the device temperatures have to operate.

An alarm will be triggered if the battery level falls below or above those limits.

Units are °C

- **Min/Max voltage**

The limits in which the batteries have to operate.

An alarm will be triggered if the battery level falls below or above those limits.

Units are Volts.

- **Data variation/Checked on last**

These parameters are very important as they define the mechanism to detect tilt variation.

They work in conjunction.

An alarm will be triggered only if there is a variation of **n%** **m** times in a row, where 'n' is the data variation in %, and 'm' is the number of successive times that variation has occurred.

As an example, if you set 30% variation on the last 5 points, it means that the last 5 points will be compared and if between them you have a variation of at least 30% for each one of them, you will trigger an alarm.

Let's say that you have 100 points (P1 to P100), the alarm check will work as follows:

- Delta(P96,P97) > 30%?
- Delta(P97,P98) > 30%?
- Delta(P98,P99) > 30%?
- Delta(P99,P100) > 30%?

An alarm is triggered if ALL tests are true. If, say, the delta between P98 and P99 is 2% only, you won't have an alarm.

You can adjust the trigger sensitivity by modifying those values.

- **No data for**

This parameter triggers an alarm if the application doesn't receive new data during the last n hours, possibly showing a problem in data retrieval or communications.

Note: if you retrieve data from the tiltmeters every 4 hours, you should set a value like 8 or 12 (covering 3 data checks).

Do not set a delta that is under the data retrieval schedules!

Setting 2 hours will always trigger an alarm since you have 4 hour gaps between new data!

The number of hours without new data **should be a multiple of the data schedule period set in PC208W.**

If you retrieve data every 3 hours, set a "No data for" value of 9 or 12.

If you retrieve data every 1 hour, set a "No data for" value of 3 or 4.

Etc.

- **WAV file to play**

This is the WAV file that will be played through the loud speakers connected to your notebooks when an alarm is triggered.

- **Threshold - Y Axis:**

This is threshold value section.

If you decide to show thresholds, they will appear on the chart as horizontal dotted lines.

When their values are set, the data triggers an alarm when at least one point is lower than the "min" threshold, or over the "max" threshold.

The **Y Axis** is the left axis. It displays data you have selected in the "[Axis](#)" topic.

The color of the threshold lines is the one you specified for the Y Axis color.

- **Threshold - Y2 Axis:**

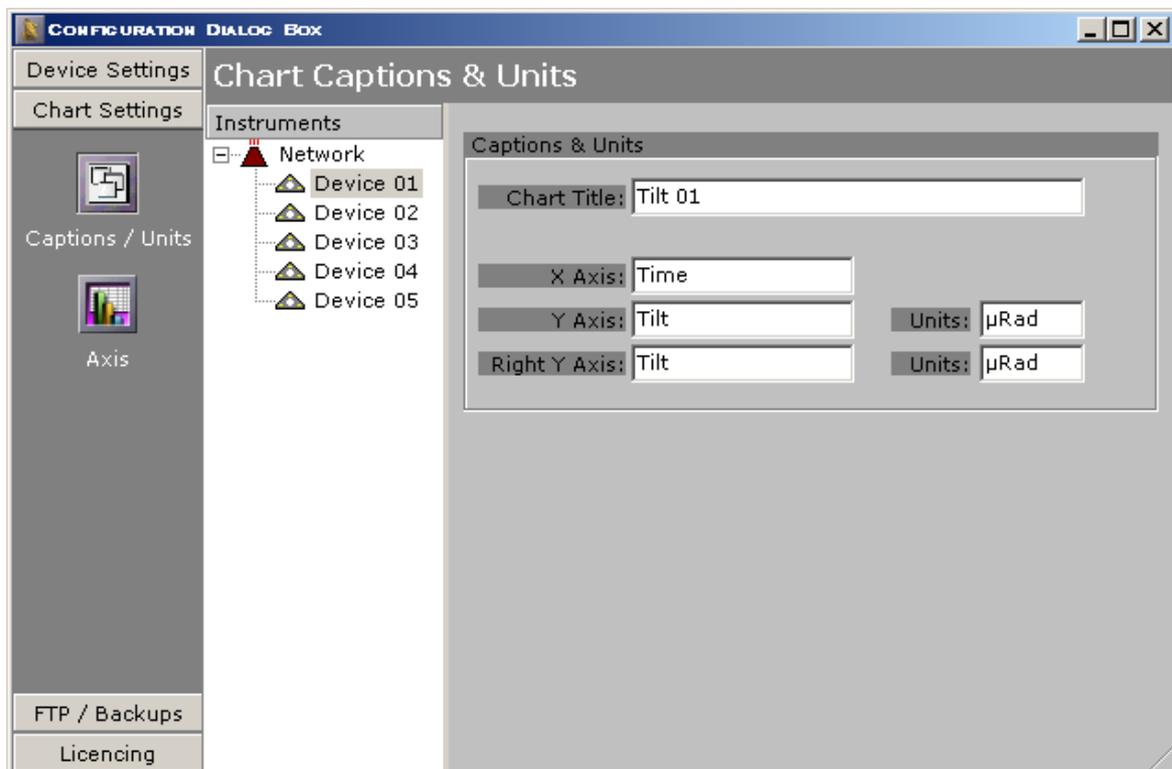
If you decide to show thresholds for the data against the **right axis** (called Y2), they will appear on the chart as horizontal dotted lines.

When their values are set, the data triggers an alarm when at least one point is lower than the "min" threshold, or over the "max" threshold.

The **Y2 Axis** is the right axis. It displays data you have selected in the "[Axis](#)" topic (if any).

The color of the threshold lines is the one you specified for the Y2 Axis color.

5.7.7 Charts Captions & Units



This setting topic is *cosmetic*. It defines the labels on the axis, as well as the units.

The **Chart Title** will be the caption of the chart window.

The **X Axis** sets the X axis label.

The **Y Axis** sets the left Y axis label.
The **Right Y Axis** sets the right Y axis label.

The **Units** fields add information about units of the axis.
If you leave them empty, no information is added to the axis label.
If you fill them, then their values will be added next to the Y or Y2 axis labels, surrounded by square brackets.

For example, if you set:

- Y Axis: Tilt
- Units:

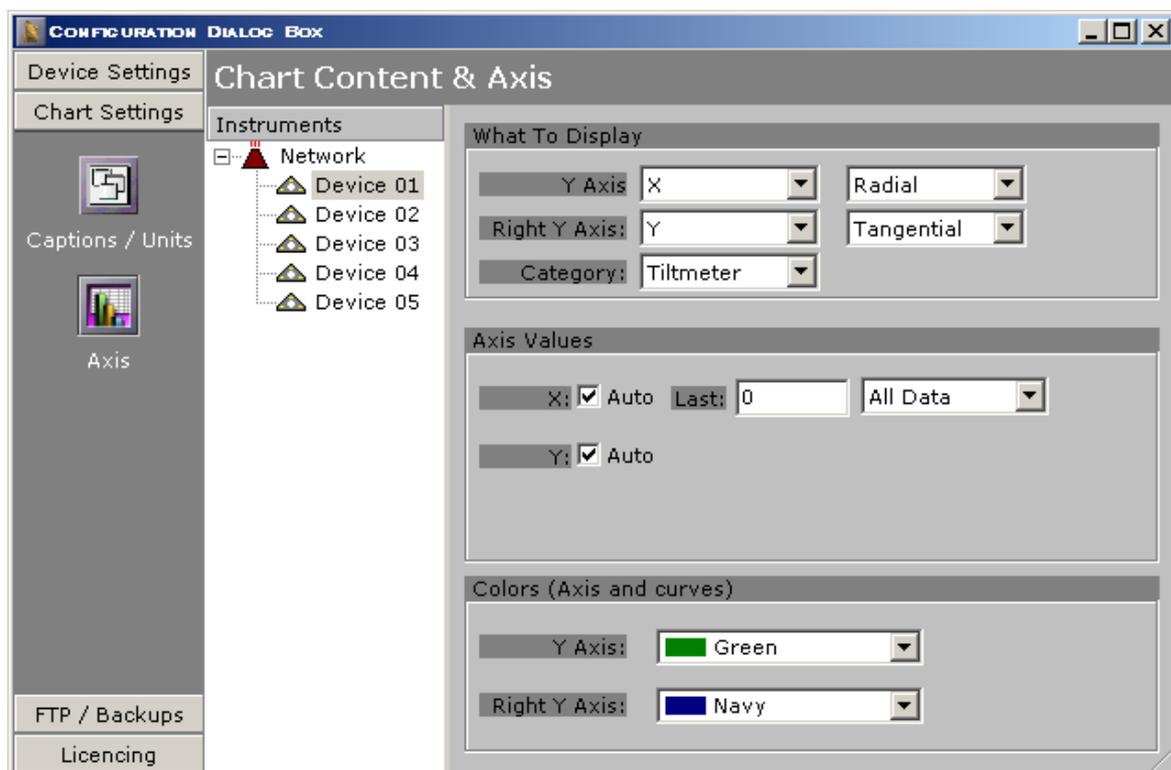
The Y Axis label will be "Tilt".

But if you set:

- Y Axis: Tilt
- Units: μ Rad

Then the Y Axis label will be "Tilt [μ Rad]" (note the square brackets).

5.7.8 Axis, Categories, Colors



This setting topic is **very important**.

That is where you tell each chart **what to display and monitor**.

Also you define a **category** to which the chart belongs to.

The category is used in conjunction with the main [toolbar navigation buttons](#) (Monitoring section).
So pay attention to those parameters.

What to display

- **Y Axis** and **Right Y Axis** defines which data you will plot on the chart, against the left Y Axis.
Possible values are
 - X for the tiltmeter X axis value
 - Y for the tiltmeter Y axis value
 - Tilt. Temp. for the tiltmeter temperatures
 - Battery for the battery voltage
 - Batt. Temp. for the battery temperature
 - - Nothing - if you don't want any data plotted against that axis.

Axis Values

- **X Auto** is checked to display **all data**.

If unchecked, you will be able to set a time range. The two extra fields will let you enter any combination of time ranges.

Your options are displaying the last

1. nn days
2. nn weeks
3. nn months
4. nn years

How does it work? It's easy to understand. Each time you have new data added to the chart, TiltMeters PHIVOLCS Edition checks whether a new day has passed.

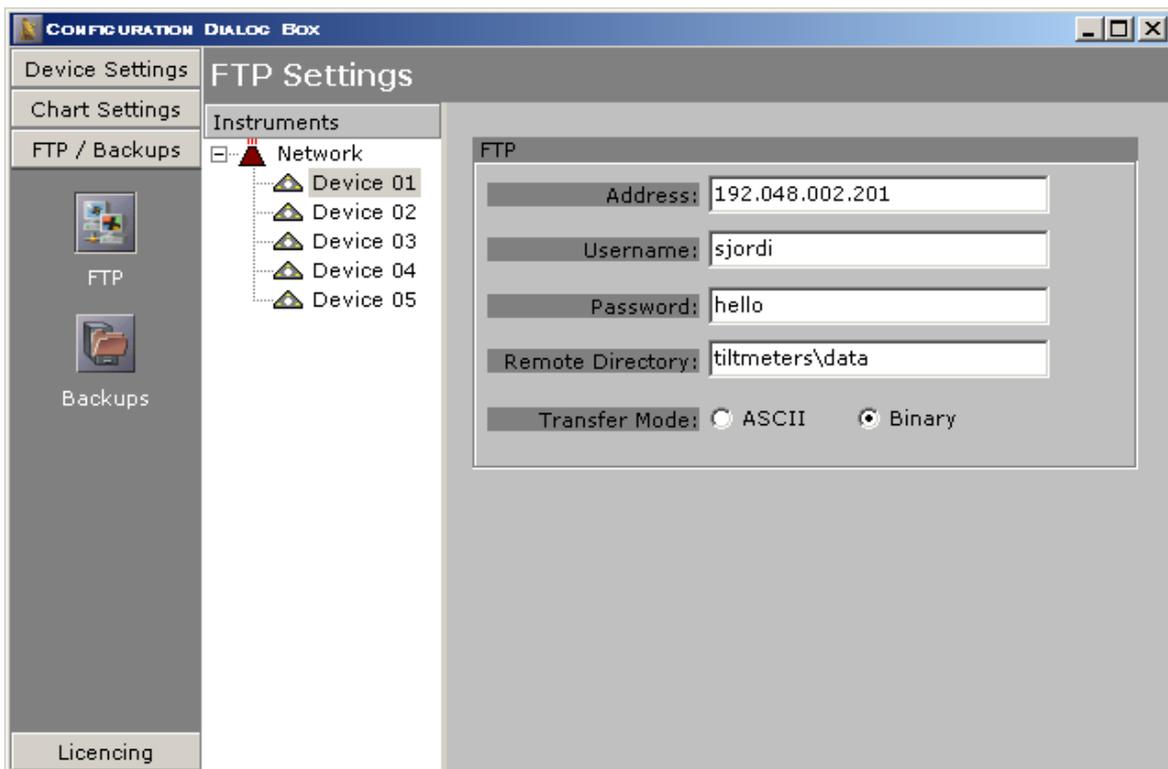
If this is the case, the chart will shift by one day.

This means that you have updates on the X axis only once a day.

Note that if you select "show the last 2 months" and have only 3 weeks worth of data, the chart won't show the first five weeks as empty. You will see just the current data.

- **Y Auto** and **Right Y Auto** work the same way.
If unchecked, then you can manually set the axis minimum and maximum values.
Data not contained in that range will be truncated.
- **Log** lets you force log axis for handling huge variations on Y.
- **Colors (axis and curves)** defines the color you want to display the data.
Remember that those color also affect the [thresholds](#) you set in the alarm configuration section.
If you display data on the Y and the right Y axis then use two colors to differentiate the data.
See also "[What they show](#)" in the "Working with the Charts" section.

5.7.9 FTP

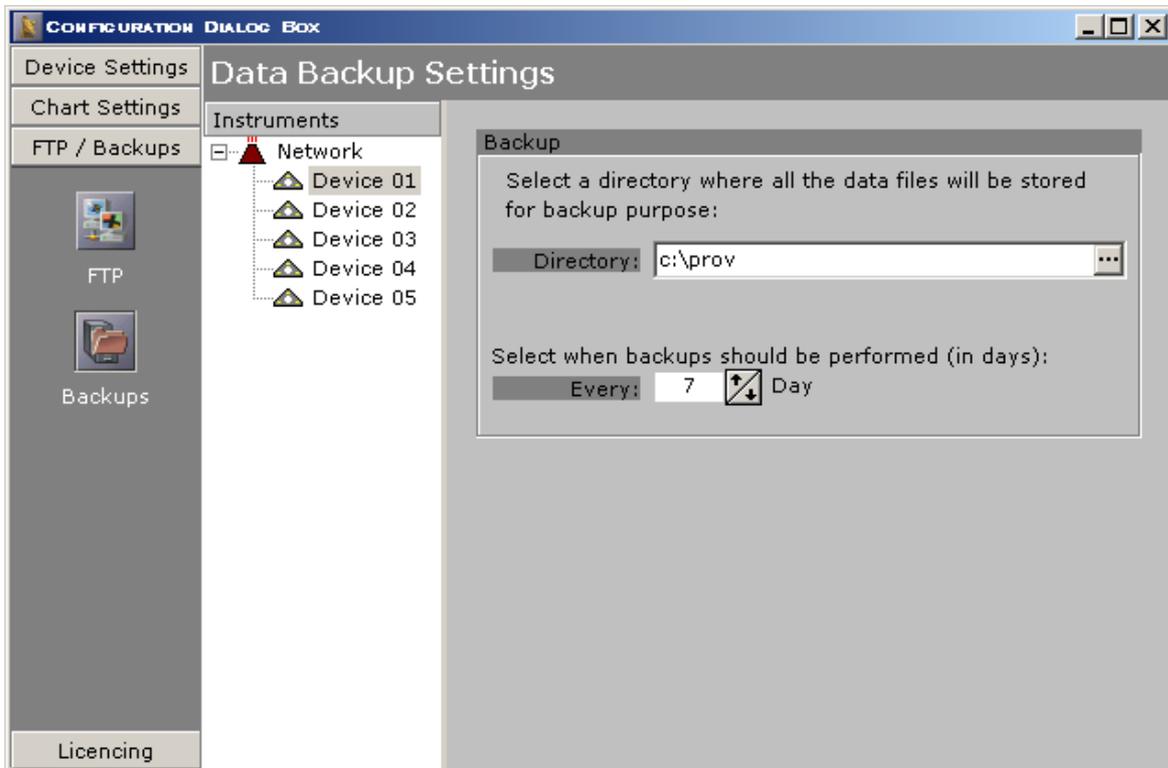


All the following parameters should be available from your network manager.

- **Address** is the TCP/IP of the remote computer you want to connect to.
- **Username** is the username used to log into the remote computer.
- **Password** is the password used to log into the remote computer.
- **Remote directory** is the directory on the remote computer where the data will be transferred to. The directory must exist.
- **Transfer Mode** is the transfer type: ASCII for text files, BINARY for binary files.

Unless explicitly required to, use ASCII to FTP the files since those ones are raw text files.

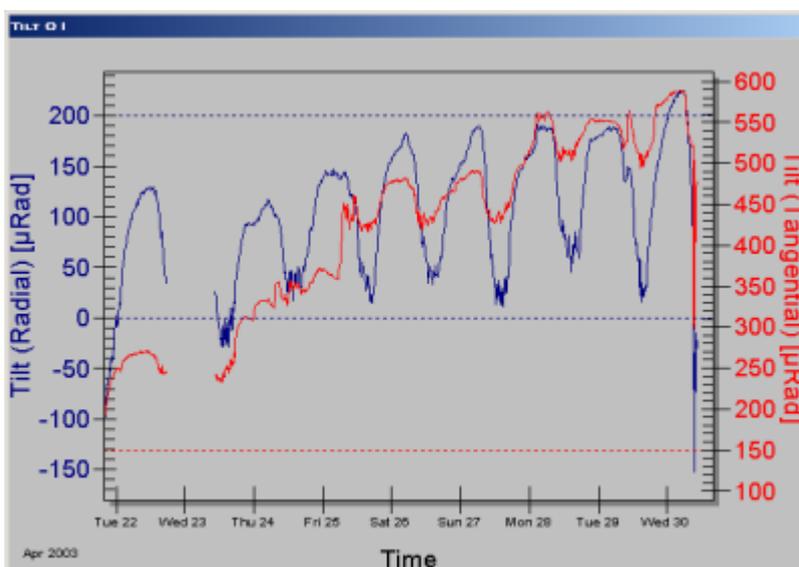
5.7.10 Backup



This setting window defines where you want to store the **raw text files** for backup purpose. The backup is an automated process that can take place every 1 to 7 days. This action copies the files you have in the directory specified in [Configuring Data Retrieval](#). Remember it is the same directory path that is specified in the "[Device Specifications](#)" section.

5.8 Working with the Charts

5.8.1 What they show



A chart display your data against the X axis which is always the **time**.

Depending on the way you have configured it in the "[Axis, Categories, Colors](#)" section, it will display data against the left Y axis and/or the right Y axis.

Colors of the data is always matching the related axis one.

As an example here, the red data is the Tilt Radial data (left axis), and the yellow data is the Tilt Tangential data (right axis).

5.8.2 Zooming

You can zoom and unzoom on any chart.

- Click on the chart where you want one of the corner of the section you want to zoom.
- Drag the mouse where you want.
- Release the button.

To unzoom the chart, right-click on it and select unzoom.

Note: you will see that the X-axis legend will change depending on how deep you zoom into the data. It automatically selects weeks, days, hours, down to 1/100th of seconds if required. Time based axis are not linear, but TiltMeters PHIVOLCS Edition does a fine job in managing those zooming conditions.

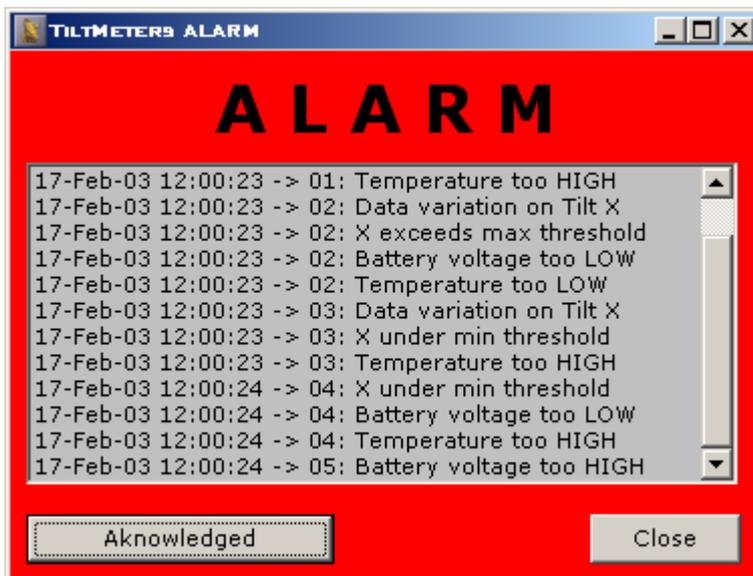
5.8.3 Customizing the charts

You will see a lot of options when you right-click on the charts. The options are also available when double-clicking on the charts.

For a specific help on the chart options, please refer to the provided help file (Pegraphs.hlp).

5.9 Handling Alarms

5.9.1 Alarm Window



When an alarm is triggered (for various reasons explained in the "[Alarms](#)" configuration section) the above window will pop-up.

The window will stay on top of all others, while a sound (if specified) will be played in loop in order to get the attention of the persons in charge of the monitoring.

The windows shows a **log** of all alarms that have triggered.

They are date and time stamped, and the id of the triggering device is mentioned as well:

It reads as follows:

date time -> ID: reason of alarm

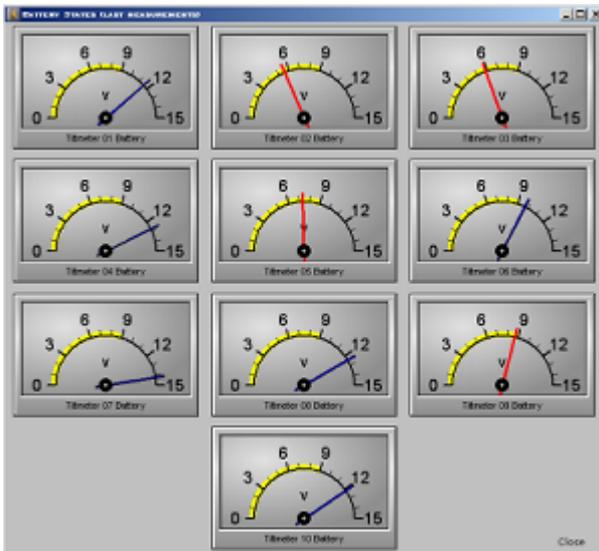
As an example:

17-Feb-03 12:00:24 -> 05: Battery voltage too HIGH

was triggered by the 5th device, for battery reasons.

To turn the sound off, click the *Acknowledged* button.
If a new alarm happens, the sound will be turned back on.

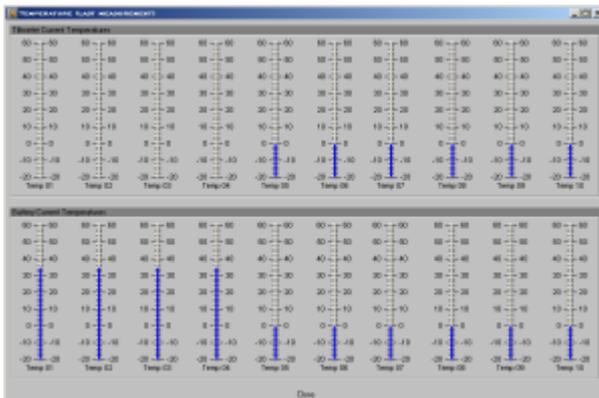
5.9.2 All Batteries



All battery states can be seen at once in this specific window by clicking on the "[All Batt.](#)" button.

If the levels are outside the range defined in the [Alarms](#) settings section, the needles will blink.

5.9.3 All Temperatures



All temperature states can be seen at once in this specific window by clicking on the "[All Temp](#)" button.

Positioning the mouse over a thermometer displays a small windows with the actual value.

5.10 Monitoring Campaigns

5.10.1 Moving from one volcano to another

Here is a quick explanation on how to organize field trips and monitoring campaigns.

Your mobile system is aimed at moving from one volcano observatory to another one. This means that you can use it for different **campaigns**, but this implies several steps in data acquisition and analyzes.

Each time you setup the network for one volcano (campaign) you have to proceed as follows:

1. Set acquisition in PC208W (setting directories as explained in [storing data](#))
2. Acquire data with PC208W
3. Monitor the volcano with TiltMeters PHIVOLCS Edition
4. Once done: EXPORT data to an archive folder
5. Empty databases in order to be ready for the following campaign and avoid mixing data.

As an example, let's say you want to monitor the Pinatubo in July and the Taal in September.

- You would create two directories to host their data as explained under the [storing data](#) section.

```
c:\data\pinatubo\2003\July
c:\data\taal\2003\September
```

- Then you would go to the Pinatubo and set PC208W to use c:\phivolcs\pinatubo\2003\July
- Then you would setup TiltMeters PHIVOLCS Edition in order to tell it how many devices you use, where are the files located, etc...
- Monitor data for, say, 2 months.
- Once you leave Pinatubo, from TiltMeters PHIVOLCS Edition, you would click the **EXPORT** button
- Select an ARCHIVE DIRECTORY
For example c:\archive\pinatubo\2003\July
The data are stored in that directory as RAW data.
- Then you **would EMPTY the databases** from TiltMeters PHIVOLCS Edition in order to ready the application for the next monitoring campaign.

5.10.2 Visualization of former data

If you follow the instructions described in [Moving from one volcano to another](#) you can view the data at a later time.

Be aware that switching to another data set is not compatible with real time monitoring. You would not do this on an acquisition computer, you would do this on a visualization dedicated computer.

Here are the steps to go back to a previous data set from a former data acquisition campaign.

Let's follow the example described in [Moving from one volcano to another](#)

If you have left Pinatubo and Taal and you want to go back to the data you have collected, here is the procedure:

1. Launch TiltMeters PHIVOLCS Edition
2. If you have data displayed, make sure you have archived it somewhere using the **EXPORT** button.
3. **EMPTY** the databases
4. Enter the **Configuration** dialog box and set the number of devices you have used at that time.
5. **IMPORT** the data you want.
For example, point to c:\archive\pinatubo\2003\July
6. TiltMeters PHIVOLCS Edition will import all the data from that directory and display the charts

Now if you want to check the Taal volcano data:

1. **EMPTY the databases**
2. Enter the **Configuration** dialog box and set the number of devices you have used on Taal.
3. **IMPORT** the data you want
For example, point to c:\archive\taal\2003\September

Etc.

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VI

6 Technical Questions And Support

6.1 Monitoring Issues

Data monitoring is turned off while in:

- configuration mode
- all batteries or all temperatures windows
- raw data window

Be aware that the data is not checked as long as the Configuration Dialog box is displayed. You have to close it to go back to monitoring. This latter will resume immediately.

6.2 Mathematical Operators

Built-in Functions and Operators

Symbol	Equivalent	Description	Example
()		Prioritizes an expression	$5*(1+1) = 10$
!	FACT	Factorial	$5! = 120$ fact(5) = 120
%		Percentage	$35\% = 0.35$
^	**	Raised to the power of	$4^5 = 1024$
*		Multiply by	$3 * 6 = 18$
/		Divide by	$9 / 2 = 4.5$
\	DIV	Integer divide by	$9 \setminus 2 = 4$
MOD		Modulo (remainder)	$7 \text{ mod } 4 = 3$
+		Add	$1 + 1 = 2$
-		Subtract	$9 - 5 = 4$
>		Greater than	$9 > 2 = 1$ * see note
<		Less than	$7 < 4 = 0$
==	=	Equal test	$5 == 4 = 0$
>=	>=	Greater or equal	$3 >= 3 = 1$
<=	<=	Less or equal	$\#h3E <= 9 = 0$
<>		Not equal	$\#b10101 <> 20 = 1$
NOT		Bitwise NOT	$\text{NOT}(15) = -16$
AND	&	Bitwise AND	$\#b101 \text{ AND } \#h1E = 4$
OR		Bitwise OR	$13 \text{ OR } 6 = 15$
XOR		Bitwise Exclusive OR	$9 \text{ XOR } 3 = 10$
EQV		Bitwise Equivalence	$6 \text{ EQV } 9 = -16$
IMP		Bitwise Implication	$1 \text{ IMP } 5 = -1$
IIF		If condition	$\text{IIF}(1+1=2,4,5) = 4$
MIN		Minimum value	$\text{min}(10,3,27,15) = 3$
MAX		Maximum value	$\text{max}(1,9)=9$ *see note
SIN		Sine	$\text{sin}(\pi) = 0$ *see note
COS		Cosine	$\text{cos}(\pi) = -1$
TAN		Tangent	$\text{tan}(\pi) = 0$
ASIN		Arc sine	$\text{asin}(1) = 1.570$
ACOS		Arc cosine	$\text{acos}(-1) = 3.141$
ATAN	ATN	Arc tangent	$\text{atan}(0) = 0$
SEC		Secant	$\text{sec}(0) = 1$
CSC		Cosecant	$\text{csc}(1) = 1.18$
COT		Cotangent	$\text{cot}(1) = 0.642$
SINH		Hyperbolic sine	$\text{sinh}(3) = 10.01$
COSH		Hyperbolic cosine	$\text{cosh}(2) = 3.76$
TANH		Hyperbolic tangent	$\text{tanh}(1) = 0.76$
COTH		Hyperbolic cotangent	$\text{coth}(1) = 1.31$
SECH		Hyperbolic secant	$\text{sech}(0) = 1$
CSCH		Hyperbolic cosecant	$\text{csch}(1) = 0.85$
ASINH		Hyperbolic arc sine	$\text{asinh}(2) = 1.44$
ACOSH		Hyperbolic arc cosine	$\text{acosh}(9) = 2.89$
ATANH		Hyperbolic arc tangent	$\text{atanh}(.1) = 0.10$
ACOTH		Hyperbolic arc cotangent	$\text{acoth}(7) = 0.14$
ASECH		Hyperbolic arc secant	$\text{asech}(.3) = 1.87$
ACSCH		Hyperbolic arc cosecant	$\text{acsch}(2) = 0.48$
ABS		Absolute value	$\text{abs}(-8) = 8$
EXP		e to the power of	$\text{exp}(3) = 20.08$
EXP2		2 to the power of	$\text{exp2}(3) = 8$

EXP10		10 to the power of	$\text{exp10}(3) = 1000$
LOG	LN	Natural log	$\text{log}(16) = 2.77$
LOG2		Log base 2	$\text{log2}(8) = 3$
LOG10		Log base 10	$\text{log10}(100) = 2$
CEIL		Round up	$\text{ceil}(6.2) = 7$
RND		Random number	$\text{rnd}(1) = .969$
INT		Truncate to an integer	$\text{int}(6.8) = 6$
SGN	SIGN	Sign of expression (-1, 0, 1)	$\text{sgn}(-9) = -1$
SQR	SQRT	Square root	$\text{sqr}(64) = 8$

Note:

- The MIN and MAX functions accept any number of parameters.
- The definition for the IIF function is as follows: IIF(condition, true, false). If the value of condition is true, then the value of true is returned, else the value of false is returned.

Information presented here is used by permission of Ucalc (www.ucalc.com).

6.3 Math Order of Precedence

Here is the precedence list from highest to lowest priority:

Anything inside parenthesis is performed first ()

Factorial, percentage !, %

Exponentiation ^

Negation (unary)

Multiplication, division *, /

Integer division \

User defined operator (default position)

Modulo (remainder)

Addition, subtraction +, -

Relational operators <, >, >=, <=, =, <>

AND operator

OR, XOR (exclusive or)

EQV (equivalence)

IMP (implication)

When consecutive operators have the same priority, the expression is evaluated from left to right. This means that an expression such as "a-b-c" is evaluated as "(a-b)-c".

Information presented here is used by permission of Ucalc (www.ucalc.com).

6.4 Support by email

Support is provided by:

- Email at: support@tiltsoft.com
- Fax at: + 41 22 362-3704

6.5 Updating the Software

Updates to the TiltMeters PHIVOLCS Edition will be available for download from the TiltSoft web site, or from a different web address specified by email directly to you.

On demand a new version can be sent on CD-ROM as well.

A coming version will allow the software to automatically update over the Internet if you have a connection.

More information will be provided when this feature will be available.

TiltMeters PHIVOLCS Edition

Part

VII

7 3rd Party Upgrades

7.1 PC208W updates

If you receive a new version of PC208W from Applied Geomechanics, make sure that the data file format remains structured the same way as it was before (see "[Raw Data Format](#)").

Any modification to the data structure will lead to a failure of monitoring by TiltMeters PHIVOLCS Edition.

If you're unsure whether you can upgrade or not, it is safer to first ask the technical support at support@tiltsoft.com.

7.2 Changing the notebook

If you need to buy a new notebook computer to replace the ones you are using, you will have to reinstall PC208W as well as TiltMeters PHIVOLCS Edition.

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