

# Tilt Logger

## User Manual





### **What's this manual about?**

This manual tells you about the standalone MEMS Tilt Logger with integrated datalogger and GSM/GPRS modem and how to use to measure rotation in the vertical plane.

### **Who does this apply to?**

Installers, field engineers and technicians who need to acquire readings from a MEMS Tilt Logger.

# Welcome!

Thank you for choosing the Soil Instruments Tilt Logger.

This manual has been written to provide you with relevant information and to guide you in the best practice for the use of a Tilt Logger in order for you to get the most out of our product.

Please read this manual thoroughly before use to help avoid any problems and keep it handy when using a Tilt Logger.

## Tilt Logger

The Tilt logger is a highly advanced, rugged, low-power, standalone MEMS Tiltsensor with integrated datalogger and GSM/GPRS modem that measures the rotation of structures in the vertical plane.

The logger runs on a single D-Cell Lithium battery and is housed in a compact, robust enclosure for reliable use in the field.

Readings are stored on a local SD card and are transmitted in engineering units to any FTP site via the GSM/GPRS modem.

Logger settings are easily configured by the user, allowing full control of settings and alarms, making the device completely adaptable to site specific changes.

The Logger incorporates an intelligent '**passive**' to '**active**' alarm system with up to six user defined prioritisation thresholds, reducing battery consumption and overload of needless data.

With continuous monitoring, automatic data transmission and active alarming, combined with the accuracy and reliability of a MEMS sensor, supplied in one compact and robust unit, the Tilt Logger is the perfect solution for your monitoring requirements.

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# Part I – Overview

## Contents

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## Introduction: Important information

The following symbols are used throughout the manual



IMPORTANT  
INFORMATION



QUESTION



WARNING



TIP



**! Important:** Failure to adhere to the warnings in this manual may result in network disruption and possible data loss.

Failure to observe the warning may result in injury, product malfunction, unexpected readings or damage to the product that may invalidate its warranty.



Tips give additional information that may be helpful when using a Tilt Logger

### PRODUCT CHANGES

Soil Instruments Limited has an on-going policy of design review and reserves the right to amend the design of their product and this instruction manual without notice.

### WARRANTY

Refer to our terms and conditions of sale for warranty information. The batteries are a consumable item and are excluded from the warranty.

### DISPOSAL

Products marked with the  symbol are subject to the following disposal rules in European countries:

- This product is designated for separate collection at an appropriate collection point
- Do not dispose of as household waste
- For more information, contact Soil Instruments or the local authority in charge of waste management.

## System Description

### Things You Need to Know about the Tilt Logger

#### FEATURES

- Uniaxial MEMS sensor
- On-board GSM/GPRS modem
- Data delivered in engineering units
- Completely cable free; plug-and-play
- Intelligent alarming with 6 user defined thresholds and alarm notification via SMS and FTP
- Optional alarm suppression
- Low power; requires one D-Cell Lithium battery
- Micro SD card

#### BENEFITS

- MEMS sensor provides highly accurate and stable data
- Data delivered direct to 'ARGUS' Software via FTP
- No post-processing of data required
- Quick and easy to install
- Swift notification of changes in site conditions, alerting multiple users
- Reduces the likelihood of false alarms
- Operates for up to 2 years without battery change
- Internal logging of millions of data points

#### APPLICATIONS

The Tilt Logger is used to monitor vertical rotations of structures; it is commonly used to monitor settlement and heave of existing structures caused by adjacent excavations or tunnelling works.

Typical applications include:

- Brick and stone buildings
- Vertical rotation (heave and settlement) due to adjacent construction activities
- Bridges and dams
- Impounding and loading effects in short or long-term
- Slope stability
- Land/mudslide prone areas
- Differential levels

## System Details

### THE TILT LOGGER

The MEMS Tilt Logger is a comprehensive cable free monitoring unit; therefore it requires no cable or wiring of sensors and dataloggers. The only requirement is a GSM/GPRS signal and an FTP site, however, the unit can be configured and data retrieved manually via a Field PC and USB cable, if preferred.

The Tilt Logger contains a mini USB connector; the USB interface will mount both as a Flash Drive (MSC) and a serial COM port (CDC).

When connected to a PC, the Flash Drive will mount as an external hard drive without the need for a software driver, allowing access to the files on the micro SD card.

The serial COM port can be mounted on a Windows PC by installing the driver supplied on the SD card.

The Logger can either be programmed manually using a laptop with a USB cable, or remotely via the FTP server using an editable settings file from which reading, logging and uploading parameters are set and calibration factors and alarms defined.

The alarm system, SMS functions, reading intervals and schedules can be programmed or changed at any time quickly and efficiently via the FTP site. The data can then be viewed by anyone at any time; all that is required is an internet connection and the log on details for the FTP server.

The multi layered '**passive**' to '**active**' alarm system incorporates up to six user defined prioritisation thresholds. Once setup, the Logger remains in '**passive**' mode logging at user defined intervals, until any of the pre-set alarm levels are breached, at which point it will automatically switch to '**active**' mode and initiate increased data logging and transfer to the FTP site whilst simultaneously sending out multi-level SMS text alerts to multiple contacts.

The readings are automatically transferred to the FTP site in engineering units, so data can be directly imported into '**ARGUS**' Monitoring Software.

# System Components





Follow the precautions outlined in this manual at all times to ensure the correct working order of your instrument.



It is essential that the equipment covered by this manual is handled, operated and maintained by competent and suitably qualified personnel.



To guide you in the competence required for installing each instrument in our product range, Soil Instruments provides a **recommended skill level** in all of our manuals and datasheets.

## Quick Start Guide to Using the Modem Logger

itmsoil recommend an **intermediate** skill level for setting up the Modem Logger

### INSTALLING THE BATTERY



Ensure that battery is installed with the correct polarity.



The Modem Logger is powered with a DC voltage source of 3.6V nominally. Peak current use can be up to 1A during GSM operation.



Make sure you use the correct battery type for the Modem Logger, as specified in '*Part II – Detailed Modem Logger User Guide – Start-Up of the Modem Logger*'



To make the file extensions visible in 'Windows 7', go to '*Control Panel – Appearance and personalization – Folder Options – View*' and un-tick '*Hide extensions for known file types*'.

**STEP****ACTION**

1

Insert the battery in the holder with the positive (+) pole oriented as indicated in picture below. Push in firmly.



Positive (+) pole

Negative (-) pole

**CONNECTING  
VIA USB**

The Tilt Logger has a mini USB connector mounted within the external housing. The USB interface will mount both as a Flash Drive (MSC) and a serial COM port (CDC).

**STEP****ACTION**

1

Remove the protective cap located at the top of the Tilt Logger to access the USB connection as shown in the pictures below.



2

Using the USB cable supplied with the logger, connect the mini USB plug to the mini USB connector.

3

Connect the other end to your PC.

4

The device should automatically mount as a USB disk drive. The SD card mounted as a disk drive will contain the following files and folders:

- **'Settings.ini'** file contains all the devices settings for measurements, logging, modem and alarming.
- **'Log'** files contains the latest measurements and alarms
- **'Log'** and **'back-up'** folders with historic measurement data.

Please refer to '*Part II - Detailed Tilt Logger User Guide - Start-up of the Tilt Logger*' in this manual for more details.

5

The device will also attempt to mount as a **'Virtual COMport'** (CDC - serial bus). This allows direct interfacing to the device using a common terminal program, such as **'HyperTerminal'** or **'Termite'**.

The **'Virtual COMport'** will appear as a regular COM port in PC manager.

Please refer to '*Part II - Detailed Tilt Logger User Guide - Start-up of the Tilt Logger*' in this manual for more details.

## INSERTING THE 'GSM' SIM CARD

The GSM module has an onboard holder for a standard size SIM card.



Avoid touching the surface of the PCB when inserting the SIM to avoid damaging the component. If possible ground yourself before inserting the SIM.



Make sure that the SIM card is suitable for GPRS data transmission privileges. If you are unsure, check with your mobile operator provider.

STEP	ACTION
1	<p>Slide to unlock the holder and hinge upwards as shown in the picture below.</p> <p>Slide to unlock</p>  <p>Lift to open</p> 
2	<p>Slide the SIM card into the guidance rail.</p> 
3	<p>Push down and slide back to lock.</p> 

## SETTING UP THE 'GSM' CONNECTION

The following settings may need to be modified to the 'settings.ini' file in order for your mobile operator to initiate a GSM connection for SMS messaging;

If authentication is needed on the network you need to modify the following lines;

[gsm]cmd=AT+CPIN=xxxx, default is '0000' please check with SIM card provider if different.

[gsm]apn=yourapn

[gsm]login=yournetworkusername

[gsm]password=yournetworkpassword

Please refer to '*Part I - Overview - UK 'GPRS' Settings*' in this manual for more details.

The modem is set to 'pap' authentication as standard. To change to 'chap' authentication, add the following line to the 'settings.ini' file;

[gsm]cmd=AT#GAUTH=2 (0=none, 1=pap, 2=chap)

If you have made any changes to the 'settings.ini' file, you can force the device to load the updated settings using either of the following two options;

- Type the command '**readsettings**' and click '<ENTER>' in the command line of the terminal application ('**HyperTerminal**' or '**Termite**') connected to the '**VirtualCOM**' port.
- Unplug the battery from the Modem Logger board, wait for 1 minute and re-connect.

**UK 'GPRS'  
SETTINGS**

The following table contains the GPRS settings for UK mobile operators;

<b>MOBILE OPERATOR</b>	<b>GPRS SETTINGS</b>	<b>OPERATOR SETTINGS</b>
<b>O2 UK (contract)</b>	GPRS APN:	mobile.o2.co.uk
	Username:	mobileweb
	Password:	password
	Gateway IP:	193.113.200.195
<b>O2 UK (pre-pay)</b>	GPRS APN:	payandgo.o2.co.uk
	Username:	payandgo
	Password:	password
	Gateway IP:	193.113.200.195
<b>Vodafone (Contract)</b>	GPRS APN:	wap.vodafone.co.uk
	Username:	wap
	Password:	wap
	Gateway IP:	212.183.137.12
<b>Vodafone (pre-pay)</b>	GPRS APN:	pp.vodafone.co.uk
	Username:	wap
	Password:	wap
	Gateway IP:	212.183.137.12
<b>Orange UK (EE )</b>	GPRS APN:	orangeinternet
	Username:	user
	Password:	pass
	Gateway IP:	192.168.71.35
<b>T-Mobile (all)</b>	GPRS APN:	general.t-mobile.uk
	Username:	user
	Password:	wap
	Gateway IP:	149.254.1.10

MOBILE OPERATOR	GPRS SETTINGS	OPERATOR SETTINGS
<b>Three</b>	GPRS APN:	three.co.uk
	Username:	guest
	Password:	guest
<b>BT Mobile</b>	GPRS APN:	btmobile.bt.com
	Username:	bt
	Password:	bt
	Gateway IP:	212.183.137.12
<b>Tesco Mobile</b>	GPRS APN:	prepay.tesco-mobile.com
	Username:	tescowap
	Password:	password
	Gateway IP:	193.113.200.195
<b>Virgin Mobile</b>	GPRS APN:	goto.virginmobile.uk
	Username:	user
	Password:	{blank}
	Gateway IP:	193.30.166.3

### UPDATING DEVICE SETTINGS FROM FTP SERVER

The device settings for the logger can be modified via the FTP site using a text file with the file name; '**<unitname>-settings.new**'.

This file is a '**delta-list**', which means it only needs to contain the settings that you want to be added or changed; it does not need to be a full '**settings.ini**' file.

The settings will be retrieved by the logger during the next connection to the FTP site. An acknowledgement file with the extension '**.ack**' will be placed on the FTP server from the device to confirm that the settings have been updated. Please refer to '**Part II – Detailed Tilt Logger**' user Guide in this manual for more details.



The new file for the FTP site, must have '**.new**' extension as the logger will download this file and replace it on the SD card as a '**.ini**' file.

# **Part II – Detailed Tilt Logger User Guide**

## Contents

This section contains the following topics.

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## Start-up of the Tilt Logger

### POWER SUPPLY

The Tilt Logger is powered with a DC voltage source of 3.6V nominally. Peak current use can be up to 1A during GSM operation.



Make sure you only use the batteries specified for the Tilt Logger.

Suitable Li-SOCI2 3.6V batteries include;

- TADIRAN TL-5930 (19Ah capacity)
- SAFT LSH20 LG 33600 (17Ah capacity)
- EVE ER34615 (19Ah capacity)
- XENO XL-205F (19Ah capacity)
- VARTA ERD7120 (19Ah capacity)

### USB INTERFACE

The Tilt Logger has a mini USB connector mounted within the external housing. The USB interface will mount both as a Flash Drive (MSC) and a serial COM port (CDC).

When connected to a PC, the Flash Drive will mount as an external hard drive without the need for installing a software driver, enabling access to the files on the micro SD card.

The serial COM port can be mounted on a Windows PC by navigating to the file named **TinySense\_V2.inf** when prompted for the driver software location. This file can be found on the loggers SD card.



The Tilt Logger is supplied with a Micro SD containing all the required files.



After power up or reboot of the logger, make sure you remove and reinsert the USB cable.

**GETTING STARTED** To get the Tilt Logger started, follow the steps outlined below;

STEP	ACTION
1	Connect the battery (3.6V DC).
2	Connect the USB interface to a PC.
3	A green LED will start blinking at regular intervals; 3 seconds off, 1 second on.
4	Follow the prompts, selecting the option to locate the driver manually on your PC.
5	Browse to the SD Card and select the file <b>TinySenseV2.inf</b> .

**'VIRTUAL COMPORT'**

The Tilt Logger can be mounted as a **'Virtual COMport'** when connecting to a PC via the USB cable. This allows direct interfacing to the device using a common terminal program, such as **'HyperTerminal'** or **'Termite'**.



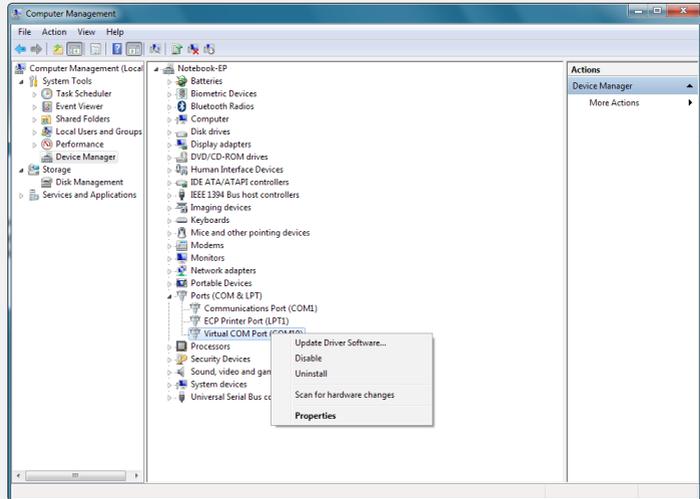
Make sure that **'Debug=1'** in **'[main]'** section of the settings file to enable interaction with the device using **'Virtual COMport'**.

**'Virtual COMport'** will allow the following;

- Viewing measurement sampling and logging activity
- Viewing debug messages
- Viewing GSM activity
- Entering commands from the command line

The **'Virtual COMport'** will appear as a regular COM port in PC manager.

## The 'Virtual COMport' in PC manager.



If the 'Virtual COMport' does not install automatically when the USB cable is inserted into the PC, you may need manually update the driver software.

The driver software is located on the SD card; the file name of the driver is 'TinySenseV2.inf'.

You can manually select the driver location using the following options;

- Pointing manually to the file 'msp430tools', using the USB driver installation process when first connected
- Manually initiating a driver update by locating the device using the 'Computer Management' option on your PC and following the steps below;

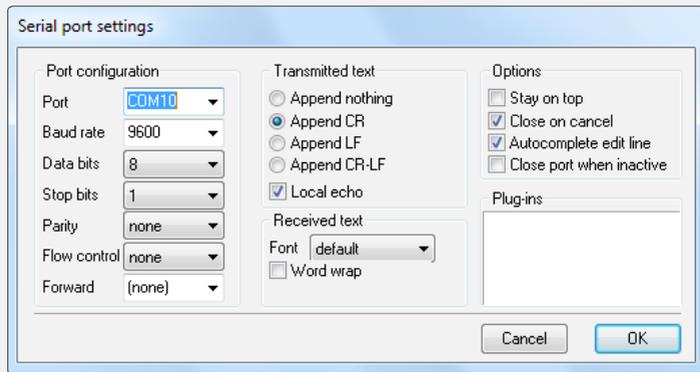
STEP	ACTION
1	Right click on 'My Computer' and select 'Manager'.
2	Select 'Device Manager' and open the 'Ports (COM & LPT)' menu by clicking on the arrow next to the title.
3	It will most likely be listed as 'unknown device'.
4	Right click on the device and select 'Update Driver Software...'
5	Follow the prompts, selecting the option to locate the driver manually on your PC.
6	Browse to the SD Card and select the file 'TinySenseV2.inf'.

Once the device has been successfully installed, the 'Virtual COMport' will appear as a standard COM port with an assigned number in PC Manager in the category 'Ports (COM&LPT)'.

The application 'Termite' will also list all available COM port numbers in its settings menu.



Make sure that the correct COM Port for the Tilt Logger is selected before continuing.



### COMMAND LINE FUNCTIONS

The most commonly used commands on the "Virtual COMport" are displayed in the following table;

COMMAND	FUNCTION
'status'	Displays the status of the measurement channels.
'readsettings'	Reads the new settings of a 'settings.ini' file.
'FTP'	Forces an FTP data transmission.
'reset'	Restarts the unit and reads the 'settings.ini' file.
'help'	Displays all available commands.

# **Part III – Tilt Logger Configuration & Data Files**

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## Configuring the Tilt Logger

### OVERVIEW

To interact with the Tilt Logger and define user settings the device incorporates;

- A command interface via the serial COM port
- A user editable text file (plain ASCII) on the SD card with the file name '**settings.ini**'.



Soil Instruments recommends using the text editor '**NotePad++**' as it will display the lines in a more organised fashion.

### COMMAND INTERFACE

The command interface is directly accessed through the COM port.



You can look up the COM port number that was assigned to the Tilt Logger on your PC by right clicking on '**My Computer**' and selecting '**Manager**'. Select the '**Device Manager**' and expand the tree with '**Ports (COM&LPT)**'. You can now see the available COM ports.

Any serial terminal program will enable you to interface with the COM port in '**command line mode**'. Suitable open source applications include '**HyperTerminal**', '**Termite**' or '**PuTTY**'.

The standard Baudrate settings for the Tilt Logger are;

- 9600 baud
- 8 bit
- no parity
- 1 stop bit (9600 8-N-1)

### AVAILABLE LINE COMMANDS

The following table displays the available line commands with a brief description of each command line function;

COMMAND	FUNCTION
'dir'	Show the directory list on the SD card
'del <filename>'	Delete the file named within the brackets <filename>
'cd <directory>'	Go to directory named within the brackets <directory>
'ren <old filename> <new filename>'	Rename a file named within the brackets from <old> to <new>
'info'	Shows hardware info about the unit and the SD Card
'ver?'	Shows current version of the installed firmware
'readsettings'	Forces a reading of the 'settings.ini' file from the SD card and stores it in the on-board memory
'setting <groupname> [help]'	Request the settings, optionally with 'groupname' to reduce the length of the list. When adding 'help' as a parameter it will show the required syntax
'[groupname]<setting> =parameter'	Changes a setting to 'parameter'
'[groupname]<setting>?'	Shows the current value of this setting
'savesettings'	Stores current settings in the 'settings.ini' file on the SD Card
'FTP'	Manually triggers transmission of files via FTP
'alive < optional smsnumber> <optional wait time in seconds>'	Sends a 'keep-alive' message via SMS text
'reset'	Restarts the unit and reads the 'settings.ini' file
'status'	Shows status and current measurement values of all channels. Also provides info on the GSM telecom provider and signal strength (if communication has taken place)
'help'	Provides a short list of selected commands
'bat?'	Shows the supply voltage in Volts
'baro?'	Shows barometric air pressure value in mbar
'time <date/time>'	Sets the internal clock. Syntax; 'dd-mm-yyyy hh:mm:ss' typically only done when not using the GSM modem. The GSM modem will sync the time and date of the unit with an external server upon each connection event
'time?'	Shows the current time and date setting of the unit
'tgsm'	Enables direct AT command communication with the GSM module (for debugging only)

## Settings File

All the settings for the Tilt Logger are stored in and retrieved from the 'settings.ini' file which is located in the root directory of the SD card.



The 'settings.ini' file must remain in the root directory of the SD card.

This file can be directly edited via the mounted Flash Drive of the Tilt Logger.

### STRUCTURE OF THE 'SETTINGS.INI' FILE

Definitions in the 'settings.ini' file are divided into several groups;

COMMAND	FUNCTION
'[main]'	General device settings
'[gsm]'	GSM modem settings
'[FTP]'	Settings for the FTP client
'[sms]'	List of telephone numbers to receive SMS text messages
'(for alarms and status updates)'	Shows hardware info about the unit and the SD Card
'[channel_1/2/3/5]'	Measurement channel settings
'channel_1'	Main sensor channel (MEMS Tiltensor)
'channel_2'	Pulse sensor
'channel_3'	On-board barometer
'channel_5'	Supply (battery) voltage

'[main]'	
'name=<name>'	Device name <max 18 characters >
'enable=<0/1>'	Device is active (1), or inactive(0)
'keepalivetime=hh:mm'	Time of day for sending a 'keepalive' message
'keepaliveinterval=x'	Interval for sending a 'keepalive' message (0-255) in days
'keepalivesms=n'	SMS number index to which 'keepalive' message is sent
'header_1= <text>'	Header line in log file (= data file) <max 10 characters>
'header_2= <text>'	Second header line in log file <max 43 characters>

**'[main]'**

'logseparator=<ascii value>'	Separator between timestamp and measurement value (59 = semicolon)
'excvolt=<0,1,2,3>'	Programmable sensor excitation voltage (on channel_1) 1=12V, 2=15V, 3=24V
'events=<0/1>'	Enable (1) / Disable (0) logging of events (in 'events.txt')
'debug=<0/1>'	Enable (1) / Disable (0) debug messages on COM port
'buttonstatus=x'	Sets the actions initiated by pressing the 'attention' button
'buttonstatus=1'	Read 'settings.ini' file
'buttonstatus=2'	Measure, store and FTP session
'buttonstatus=4'	Send SMS text to '<sms_index>' including measurement values of all channels
	Values of 'buttonstatus=7' status can be summed to enable multiple functions, for example; <ul style="list-style-type: none"><li>• <b>buttonstatus=3 performs operations 1 and 2</b></li><li>• <b>buttonstatus=7 performs all of the above functions</b></li></ul>
'buttonsms=<sms_index>'	SMS number from SMS list for reception of 'attention button SMS'

**'[gsm]'**

'debug=<0/1>'	Enable (1) / Disable (0) debug messages of GSM module
'smsrecv=<0/1>'	Enable (1) / Disable (0) reception of SMS messages
'cmd=<cmd>'	Program an extra GSM command (AT protocol) (e.g. pincode AT+CPIN1234 )
'gsmontime=<x>'	Time in seconds that the GSM stays active after FTP transmission in order to check for incoming SMS messages
'apn=<text >'	Mobile network operators Access Point Name for GPRS access (max 24 characters)
'login=<text >'	Optional GPRS login username (max 24 characters)
'password=<text >'	Optional GPRS login password (max 24 characters)
'daytimeserver=<url>'	URL address of a daytime server for time synchronization
'utc=<correction>'	Optional correction of unit time w.r.t. UTC (in hours)

**[FTP]**

'server=<server address>'	Server address (URL) of the FTP data server (max 22 chars)
'path=<remote path>'	Directory on the FTP server (max 18 chars, start with '/') <b>Note:</b> using this option may increase length of FTP session
'login=<password>'	FTP login name (max 18 chars)
'password=<password>'	FTP password (max 18 chars)
'time=<hh:mm>'	Absolute time (on day, 24hr notation) for FTP transmission
'interval=<interval>'	Interval for FTP transmission (days)
'time=hour'	FTP transmission on the whole hour
'time=work'	FTP transmission on the whole hour between 7 am and 4 pm
'time=min'	FTP transmission on the whole minute
'interval=<interval>'	Interval for FTP transmission (in hours or minutes) depending on the mode
'passive=<0/1>'	Passive(1) of active (0) connection type to FTP server (typically passive)
'nobackup=<0/1>'	Turn of creation of backup files (1) or leave on (0 = default)
'getsettings=<0/1>'	Get 'settings.ini' file updates from FTP server (1 = default)
'getfirmware=<0/1>'	Get new firmware from FTP server (0 = default)
'sendsettings=<0/1>'	Units current 'settings.ini' file will be put on the FTP server; Filename: '<unitnaam>-set-yyyymmddhhmmss.ini'; the <b>Timestamp</b> in the filename is the date the file was changed on the SD card. File transfer only if not present on FTP server. This way only a changed 'settings.ini' file will be placed on the FTP server upon next transmission

<b>[sms]</b>	
'sms_1=<sms number 1>'	SMS number 1 including country code (e.g. 44123456789)
'sms_2=<sms number 2>'	SMS number 2 including country code
'sms_3=<sms number 3>'	SMS number 3 including country code
'sms_4=<sms number 4>'	SMS number 4 including country code
'sms_5=<sms number 5>'	SMS number 5 including country code
'sms_6=<sms number 6>'	SMS number 6 including country code
'sms_7=<sms number 7>'	SMS number 7 including country code
'sms_8=<sms number 8>'	SMS number 8 including country code
'sms_9=<sms number 9>'	SMS number 9 including country code

<b>[channel_1/2/3/5]</b>	<b>Measurement channel settings</b>
'channel_1'	Main sensor channel (MEMS Tiltensor)
'channel_2'	Pulse sensor
'channel_3'	On-board barometer
'channel_5'	Supply (battery) voltage
'name=<channel name>'	Name of this channel (appears in data file name) (max. 13 chars)
'tagname=<tagname>'	Optional tag that can be added to each data line (max 31 chars)
'enable= <0/1>'	Turn channel on (1) or off (0)
'inputtype=<0/1/2/3>'	Sensor input type (1 = pulse, 2 = 0-10V)
'measuretime=<msec>'	Voltage excitation time of sensor (in millisecond) before taking reading
'measureinterval=<interval>'	Sampling interval in seconds (when not in alarm zone), not stored
'logtime=<tijd>'	Logging interval in seconds (when not in alarm zone), data stored
'validlow=<value>'	Lower limit for validation of data GOOD/BAD in log
'validhigh=<value>'	Higher limit for validation of data GOOD/BAD in log
'units=<text>'	Units of output data, e.g. 'Volt' or 'mBar', appears in alarm messages
'logging=(0/1)'	Turn logging of data to SD Card on (1= default) or off (0)
'precisionlog=<0,1,2,3,4>'	Number of decimal points when storing measurement values

# **Part IV – Detailed Software Guide**

## Contents

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## PERFORMING CALCULATIONS ON A CHANNEL

The following describes the functions required for performing calculations on a sensor channel.

'**calc=<calc string>**' Calculation string performed on sensor value in order of declaration. Operations are declared separated by comma's (e.g. \*8,-0.1,^1). Max total string length is 63 characters.

Available operators are defined in the following table;

OPERATOR	FUNCTION
'+'	Add
'-'	Subtract
'*'	Multiply
'/'	Divide
'^'	Power
'='	Set equal to
'b'	Barometer value
'c<n>'	Value of channel <n>
'sin, cos, tan'	Sine, cosine, tangent. Input values in degrees
'asin, acos, atan'	Reverse sine, cosine, tangent. Output values in degrees
'log'	Natural logarithm (base e)
'log10'	Standard logarithm (base 10)
'sqrt'	Square root
'pcalc'	2nd order polynomial (abc-equation)



when declaring a calc string, the result of the calculation replaces the sensor output signal for all other operations; logging, checking against alarm thresholds and checking against validation limits.

**SETTING ALARMS ON A CHANNEL**

Mult-layered alarms and SMS text functions can be setup on each channel according to your requirements. These are explained in the following diagram and table;



All settings are preceded by '[channel\_n]' for the channel to which the alarming applies. For example '[channel\_1]\_limit1=-8.5'.

	Alarm Activation Delay	Measuring	Transmitting on Alarm Activation by Limits
Alarm Zone (A3)	<b>Global:</b> Alarmacttime, Alarmclrtime (checked for each limit crossed)	Sample_A3, Log_A3	Ftppush_A3=0/1, ftpint_A3, ftptime_A3, smspush_A3=0/1, sms_text_A3="", smslist_A3=<index>
Warning Zone (A2)		Sample_A2, Log_A2	Ftppush_A2=0/1, ftpint_A2, ftptime_A2, smspush_A2=0/1, sms_text_A2="", smslist_A2=<index>
Alert Zone (A1)	Or activation by number consecutive samples above limits: Alarmact=n Alarmclr=m	Sample_A1, Log_A1	Ftppush_A1=0/1, ftpint_A1, ftptime_A1, smspush_A1=0/1, sms_text_A1="", smslist_A1=<index>
Normal Zone		Measureinterval, Logtime	<b>Global:</b> [ftp]interval, [ftp]time
Alert Zone (A1)	I_limit1 I_limit2 I_limit3	Sample_A1, Log_A1	Ftppush_A1=0/1, ftpint_A1, ftptime_A1, smspush_A1=0/1, sms_text_A1="", smslist_A1=<index>
Warning Zone (A2)		Sample_A2, Log_A2	Ftppush_A2=0/1, ftpint_A2, ftptime_A2, smspush_A2=0/1, sms_text_A2="", smslist_A2=<index>
Alarm Zone (A3)		Sample_A3, Log_A3	Ftppush_A3=0/1, ftpint_A3, ftptime_A3, smspush_A3=0/1, sms_text_A3="", smslist_A3=<index>

Referring to the preceding alarm scheme;

COMMAND	FUNCTION
'l_limit<n>=xx'	Sets value of lower limit l_limit<n> (1,2,3)
'h_limit<n>=xx'	Sets value of higher limit h_limit<n>(1,2,3)
'l_limit<n>on=0/1'	Enables (1) / Disables (0) l_limit<n> Default=0 when not declared
'h_limit<n>on=0/1'	Enables (1) / Disables (0) h_limit<n> Default=0 when not declared
'alarmacttime=xx'	Sets time in seconds that measurement value needs to be in an alarm zone before the alarming is activated
'alarmclrtime=xx'	Sets time in seconds that measurement value needs to be in the normal zone before the alarming is deactivated
'alarmact=xx'	Sets the number of consecutive samples with a value in an alarm zone before the alarming is activated
'alarmclr=xx'	Sets the number of consecutive samples with a value in the normal zone before the alarming is deactivated
'sample_a<n>=xx'	Sampling interval in seconds while in zone <n>
'log_a<n>=xx'	Log (=data storage) interval in seconds while in zone <n>
'FTPpush_a<n>=0/1'	Force FTP transfer when activating alarm zone <n>
'smspush_a<n>=0/1'	Force SMS text message when activating alarm zone <n>
'FTPtime_a<n>=<time>'	Sets FTP transmission time while in zone<n> Syntax is the same as for [FTP] time.
'FTPint_a<n>=xx'	Sets FTP interval while in zone<n> Syntax is the same as for [FTP] interval
'smstext_a<n>=<text>'	Define SMS text for alarm message upon activation of zone <n>
'smslist_a<n>=1,2,3,4,5,6'	Sets a list of SMS numbers for message reception upon activation of zone <n> 1,2,3,4,5,6,etc. are the index numbers as declared in the list [sms_<index>]=sms_number



- The settings '**alarmact**' and '**alarmacttime**' cannot both be used at the same time in a settings file. Choose one of the two.
- The settings '**alarmclr**' and '**alarmclrtime**' cannot both be used at the same time in a settings file. Choose one of the two.

## UPDATING SETTINGS VIA FTP

The following table outlines how to update the Tilt Logger settings remotely via FTP;

STEP	ACTION
1	Type any settings that need to be added or changed into a file with the name '<unitname>-settings.new.' the syntax is identical to the 'settings.ini' file; there is no need to include settings that remain unchanged.
2	Place the '<unitname>-settings.new.' file on the FTP server in the folder to which the Tilt Logger unit connects. This is the root directory by default, unless otherwise defined in the Loggers [FTP] path setting.
3	During the next FTP session, the Logger will retrieve the '<unitname>-settings.new.' file and merge it with the 'settings.ini' file on the SD card, after which the settings will be loaded into the loggers memory and start operating according to the changes made.



- The setting '[FTP]getsettings' is by default set to 1, even if not declared in the 'settings.ini' file. This allows the updating of settings via the FTP server, as described above. If you want to prevent settings being updated remotely, you need to declare '[FTP]getsettings=0' in the 'settings.ini' file.



If you change the 'settings.ini' file to prevent remote updates, any future changes to settings, including firmware updates will require a field visit.



If this function is selected it will increase your data traffic.



- Including the line `[FTP]sendsettings=1` in the `'settings.ini'` file will trigger the posting back of the complete updated `'settings.ini'` file from the SD card to the FTP server every time it connects. This allows you to check all of the current updated settings.

## METHODS OF UPDATING FIRMWARE

There are three methods available for updating the firmware for the Tilt Logger, two locally using a USB connection to a PC and one remotely via FTP;

- Copy the file `'firmware.upd'` onto the SD card using the USB connection. Perform the command `'reset'` via the COM port command line. Remove the USB connector, then re-insert once the update is complete.
- Copy the file `'firmware.upd'` onto the SD card using a PC card reader. Insert the SD card into the Tilt Logger, then power on the unit.
- Add the line `[FTP]getfirmware=1` to `'settings.ini'`. Make sure that the new settings file is read; perform the `'readsettings'` command if necessary. Rename the `'firmware.upd'` file to `'<unitname>-firmware.upd'` and place on the FTP server. The logger will retrieve and install the firmware upon the next FTP session.



While the firmware update is loading onto the logger, the green LED will show a series of three short blinks until complete.



When the logger is reconnected via the COM port, you can check if the firmware has been successfully uploaded using the `'ver?'` command.

## COMMANDS VIA SMS TEXT

Commands issued via SMS will be received and handled upon the loggers next scheduled GSM connection, which is usually the next FTP transmission session.

SMS TEXT COMMAND	FUNCTION
'[group]field=parameter'	Changes a specific setting, the syntax is identical to the 'settings.ini' file
*FTP*	Force an FTP transmission
*status*	Request all channel values in a reply SMS message
*reset*	Force a full reset of the unit
*events*	Rename the 'events.txt' file to '<unitname>-events.log' and force a transmission via FTP

You can use multiple commands in a single SMS message by using a semi colon (;) as a separator, for example;

```
'[main]debug=1;*events*;*status*'
```

## USING THE TILT LOGGER AS A LOCAL LOGGER ONLY

You can use the Tilt Logger as a local data acquisition and storage device only, without data transmission and remote management through the GSM modem and without the need to install a SIM card.

To use the logger in this mode you will need to implement the following;

- Delete all the settings for the groups '[gsm]' and '[FTP]' in the 'settings.ini' file
- Delete all channel alarm settings that are related to initiating any FTP and SMS transmission in the 'settings.ini' file
- Change the default time of the logger '01-01-2010 00:00' through the line command on the COM port;  
**'time dd-mm-yyyy hh:mm:ss'**

Please refer to '*Part III – Tilt Logger Configuration and Data Files - Available Line Commands - time <date/time>*' for more details.



The default start-up time of the logger is '01-01-2010 00:00'. Measurements and data logging will only start after the date and time have been updated. Usually this is done automatically at power-on by synching with an external internet time server during the first GSM connection event. When using the unit as a local logger this needs to be done manually through the line command on the COM port.

# **Part V – Appendices**

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## Appendix A – Example of 'settings.ini' file

```
[main]name=AST055
[main]enable=1
[main]debug=1
[main]events=1
[main]logseparator=59
[main]excvolt=2
[main]buttonstatus=7
[main]buttonsms=1

[gsm]debug=1
[gsm]smsrecv=1
[gsm]cmd=AT+CPIN=0000
[gsm]gsmontime=10
[gsm]apn=yourapn
[gsm]login=yournetworkusername
[gsm]password=yournetworkpassword
[gsm]daytimeserver=utcnist.colorado.edu

[ftp]server=yourftpserveraddress
[ftp]login=yourftpusername
[ftp]password=yourftppassword
[ftp]time=07:00
[ftp]interval=1
[ftp]passive=1
[ftp]getsettings=1
[ftp]sendsettings=1

[sms]sms_2=31628839709
[sms]sms_1=31642744875

[channel_1]name=CH1_tilt_deg
[channel_1]enable=1
[channel_1]inputtype=2
[channel_1]measuretime=500
[channel_1]measureinterval=60
[channel_1]logging=1
[channel_1]logtime=7200
[channel_1]calc=-5/16,asin
[channel_1]units=deg
[channel_1]precisionlog=3
```

[channel\_1]l\_limit1=-8  
[channel\_1]h\_limit1=8  
[channel\_1]l\_limit2=-11  
[channel\_1]h\_limit2=11  
[channel\_1]l\_limit3=-14  
[channel\_1]h\_limit3=14

[channel\_1]l\_limit1on=1  
[channel\_1]h\_limit1on=1  
[channel\_1]l\_limit2on=1  
[channel\_1]h\_limit2on=1  
[channel\_1]l\_limit3on=1  
[channel\_1]h\_limit3on=1

[channel\_1]alarmact=2  
[channel\_1]alarmclr=3

[channel\_1]ftppush\_a1=1  
[channel\_1]ftppush\_a2=1  
[channel\_1]ftppush\_a3=1  
[channel\_1]smspush\_a1=1  
[channel\_1]smspush\_a2=1  
[channel\_1]smspush\_a3=1  
[channel\_1]smstext\_a1=in warning zone  
[channel\_1]smstext\_a2=in alert zone  
[channel\_1]smstext\_a3=in alarm zone  
[channel\_1]smslist\_a1=1  
[channel\_1]smslist\_a2=1  
[channel\_1]smslist\_a3=1,2

[channel\_1]sample\_a1=20  
[channel\_1]log\_a1=60  
[channel\_1]sample\_a2=10  
[channel\_1]log\_a2=30  
[channel\_1]sample\_a3=5  
[channel\_1]log\_a3=10

```
[channel_1]ftptime_a1=hour  
[channel_1]ftptime_a2=min  
[channel_1]ftptime_a3=min  
[channel_1]ftpint_a1=1  
[channel_1]ftpint_a2=30  
[channel_1]ftpint_a3=15
```

```
[channel_3]name=CH3_baro_mbar  
[channel_3]enable=1  
[channel_3]measureinterval=86400  
[channel_3]logging=1  
[channel_3]logtime=3600  
[channel_3]precisionlog=2
```

```
[channel_5]name=CH5_batt_V  
[channel_5]enable=1  
[channel_5]measureinterval=86400  
[channel_5]logging=1  
[channel_5]logtime=3600  
[channel_5]precisionlog=2
```

## Appendix B – Frequently Asked Questions



### **Do I need a static IP (internet provider) address to operate the Tilt Logger?**

No, the Tilt Logger connects to the FTP directory using a SIM card (supplied by you). All communications with the web portal are initialised by the Tilt Logger; as a result no static IP is required.

### **What size of data plan will I need with my SIM card?**

The size of data plan you need will depend on how often you are reading the sensors and uploading the data. Soil Instruments would suggest a 5MB data plan is more than sufficient for logging two sensors plus battery voltage, every 10 minutes and uploading data every day, allowing for some configuration changes throughout the month (although logging and uploading rates can reduce or increase the battery life).

### **Why doesn't the logger mount as a COM Port?**

Check that the `TinySense_V2.inf` driver has been installed and the COM Port is visible in 'Device Manager'. If the device is connected, the green LED will start blinking at regular intervals; 3 seconds off, 1 second on.

### **Why can't I communicate with the unit?**

Make sure the batteries have been installed with the correct polarity.

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