

SENSEDOC™ 2.0

USER MANUAL V. 3.2

with SenseAnalytics Software guide

SenseDoc - Advanced multisensor capacities from Mobysens

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**AVIS IMPORTANT
(SUPPLÉMENT AU MANUEL DE L'UTILISATEUR)**

Déclaration relative à la réglementation canadienne

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Déclaration de conformité de la FCC

Cet appareil est conforme à la partie 15 des règles de la FCC. Son fonctionnement est soumis aux deux conditions suivantes : (1) cet appareil ne doit pas provoquer d'interférences préjudiciables, et (2) il doit accepter toute interférence reçue, y compris les interférences pouvant entraîner un mauvais fonctionnement.

Important : Les changements et modifications apportés à cet appareil et non autorisés par Technologies Mobysens inc. peuvent annuler la compatibilité électromagnétique (EMC) et la conformité sans fil et résilier votre droit à utiliser le produit. Ce produit a été testé compatible EMC sous certaines conditions, notamment l'utilisation de périphériques conformes et de câbles blindés pour connecter les différents composants du système. Il est important d'utiliser des appareils périphériques conformes et des câbles blindés entre les différents composants du système pour réduire les probabilités d'interférences avec des radios, télévisions et d'autres appareils électroniques.

Déclaration de conformité pour l'UE

Technologies Mobysens Inc. déclare que l'appareil sans fil est conforme aux exigences essentielles et aux autres dispositions pertinentes des directives R&TTE 1999/5/CE. Une copie de la Déclaration de conformité pour l'UE est disponible à l'adresse :

www.mobysens.com/euro-compliance

**IMPORTANT NOTICES
(USER MANUAL SUPPLEMENT)**

Canadian regulatory statement

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

FCC compliance statement

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

Important: Changes or modifications to this product not authorized by Mobysens Technologies inc. could void the electromagnetic compatibility (EMC) and wireless compliance and negate your authority to operate the product. This product has demonstrated EMC compliance under conditions that included the use of compliant peripheral devices and shielded cables between system components. It is important that you use compliant peripheral devices and shielded cables between system components to reduce the possibility of causing interference to radios, televisions, and other electronic devices.

EU Compliance Statement

Mobysens Technologies Inc. hereby declares that this wireless device is in compliance with the essential requirements and other relevant provisions of the R&TTE Directive. A copy of the EU Declaration of Conformity is available online at :

www.mobysens.com/euro-compliance



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1. DOCUMENT HISTORY

Revision	Date	Changes	Location
0	2014-07-15	First issue	Montreal
1.0	2014-09-22	Beta version	Montreal
2.0	2014-10-03	LED status, AXL specs, RESET procedure	Montreal
3.0	2014-10-06	Setup procedure	Montreal
3.1	2015-01-14	Battery, Manufacturer address	Montreal
3.2	2015-10-14	Edition of specifications and certifications	Montreal

2. SCOPE, AUDIENCE, AND CONTACT INFORMATION

This user manual is for use of the Sensedoc™ 2.0 by Mobysens. This document describes the hardware and the accompanying software for device configuration, data download and data analysis.

Please read all content of this manual before usage. For all inquiries regarding the SenseDoc 2.0, please contact Mobysens at support@mobysens.com , or visit our website for possible manual or SenseAnalytics firmware updates at www.mobysens.com.

Address: Mobysens Technologies inc, 2177 rue Masson, suite 414, Montréal (Québec), H2H 1B1, Canada

Phone : (514) 360-1413

3. PACKAGE CONTENT

Thank you for purchasing the Sensedoc™ 2.0! The package you received contains:

- 1 SenseDoc™ 2.0 unit



- One 110-240V, 50-60Hz wall-plug charger with either North American/Japan, European, Australian, or UK socket



- One gold-plated USB cable



- One Torx screwdriver to be used to open the unit for installation/change of SIM card



- One velvet pouch to store all items



- One licence of SenseAnalytics, the SenseDoc configuration and analysis software, stored on the SenseDoc™ 2.0 internal memory (USB storage)
- One little magnet

4. SENSEDOC 2.0 OVERVIEW

You have just acquired the Sensedoc™ 2.0, an advanced multisensor device for high capacity tracking with strong autonomy and multiple communication streams. SenseDoc was proudly designed and assembled in Canada, in our Montreal offices. This new generation device has been designed for versatile and prolonged usage, allowing remote patient monitoring, athlete tracking, or civil security applications, among others. Embedded sensors include a high-sensitivity GPS receiver and a tri-axial accelerometer. Communication protocols further allow connection to a variety of additional sensors, RFID tagging and real-time data transmission.

The Sensedoc™ 2.0 contains a MAX-M8 Global Navigation Satellite System receiver from u-blox with exceptional performance able to acquire positional data from GPS, GLONASS, BeiDOU, and QZSS satellites. With an amazing navigation tracking sensitivity of -167 dBm, it provides minimal acquisition times and very high spatial accuracy.

The ADXL 345 tri-axial accelerometer from Analog Devices offers high-sensitivity accelerometry readings along three orthogonal axes, with possible readings at very high frequency, up to 3600 Hz. ADXL tri-axial accelerometers have largely been used and validated in the areas of physical activity and energy expenditure estimation.

Several communication protocols are included for data transmission and communication with additional sensors or hardware. Two 2.4GHz short-range communication options – ANT+ and OpenBeacon – allow configurations of various applications including interior tracking, social contact tracking, and interfacing with various complementary sensors. A built-in cellphone further allows real-time data transmission towards remote servers or towards other cell-phones. Furthermore, pickup of cellphone tower signals open possibilities for triangulation and location tracking in absence of GPS data. Combining the GPS and cellphone capacities, the Sensedoc can also be used to automatically send alerts or messages when entering/leaving an area (geofencing) or when accelerometry readings cross certain thresholds, such as for fall detection applications.

A full-speed USB 2.0 communication port allows quick transfer of data. A strong 2,200 mAh battery allows several days of continuous tracking without recharge, and a built-in micro-SD memory card can hold up to 4 GB of data! Such storage capacity allows saving continuous GPS tracking at one second epoch for several years, or combined GPS and raw 30Hz tri-axial acceleration collection for a period of 2 months!

The Sensedoc™ 2.0 has further been designed to optimize data collection and minimize burden for the user. Because we consider data confidentiality and security an important aspect of data collection, various hardware and firmware configurations allow limiting access to local memory data.

Finally, because each project is unique, this unit allows advanced parametrization, including activation/desactivation of sleep modes to prolong battery life, various configurations of GPS or accelerometry sampling and recording, and possible modifications of LED signaling or of the behavior of the ON/OFF button.

We hope you enjoy using the SenseDoc 2.0 and look forward to hear from your exciting applications!

5. SENSEDOC 2.0 LED INDICATORS

The LED situated on top of the unit indicates device status. The LED situated on the side, next to the micro-USB connector, indicates charging status.



On/Off button

Micro USB connector

Charging status LED



Device status LED

DEVICE STATUS

There are four main device statuses:

STATUS	HOW
Device is ON. It will acquire and log signals.	To turn the unit ON, press the ON/OFF button. The device status LED will be pulsing in green.
Device is in SLEEP mode. This means the device is ON but because it has not been moving for some time (no accelerometry readings) it went into sleep and stopped recording data. If device is moved, the device wakes up and starts acquiring data again.	The device will automatically turn into SLEEP mode if sleep mode has been activated in the Initialisation tab in SenseAnalytics. SenseAnalytics asks to specify the delay for sleep (number of consecutive seconds of null accelerometry before sleep, and SLEEP delayed if no valid GPS fix)

Device is in DEEP SLEEP mode. This means the device has been turned into deep sleep manually to stop data acquisition. No data is acquired or logged when in deep sleep. Exiting deep sleep to return to acquisition mode is done by pressing the ON/OFF button.	To turn the unit into deep sleep mode when the device is ON, press the ON/OFF button for a prolonged period and wait until the LED first turns red and then turns off before releasing button. The LED will then pulse in red.
Device is OFF.	To turn the unit completely OFF, push the ON/OFF button for a prolonged period (roughly 8 seconds) and wait until LED first turns red, turns off and then turns back on before releasing button (thus reducing risks of turning device on unintentionally). The LED will then emit a short red pulse before turning off indicating it the SenseDoc has been completely turned off. When the LED emits no signal at all, the device has been turned off, either by the user or because of a low battery.

In most cases, units will be used under ON, SLEEP and DEEP SLEEP modes. OFF mode is mainly meant for prolonged storage or when device needs to be fully shut down with no electric activity. For most uses, the DEEP SLEEP mode is the *de facto* 'OFF' position (no logging).

A hard RESET can also be done for debugging by holding the ON/OFF button during a prolonged period of 15 seconds. Then, wait at least 20 seconds before turning the unit ON again.

LED SIGNIFICATIONS

STATUS LED (On top of unit)	
Behaviour	Meaning
Green fixed	Standby, no acquisition. Interfacing to a computer host
Green pulse	Acquisition (logging) mode
Green pulse (short pulse)	Sleep mode
Red pulse	Data acquisition problem
Red fixed	Data acquisition problem
Amber (Red+green) pulse	Acquisition mode, low battery
Amber (Red+green) pulse (short)	Sleep mode, low battery
Amber fixed	Firmware update mode
Blinking red and green	Device in mass storage mode

CHARGING LED (Next to micro-USB connector)	
Behaviour	Meaning
Red fixed	Device connected to power source, battery charging
Red pulse	Battery error
Off	When connected, indicates battery fully charged

6. PRODUCT NOTICE

- Device operates at temperatures between -20 and + 45 degrees Celsius.
- Do not leave the SenseDoc in high temperature environments, such as below windshield in the sun.
- Exposure to temperatures above 60 degrees Celsius may damage the unit or the battery, which may overheat and cause fire due to overheating.
- Heat caused damages are not covered by the product warranty.
- Do not charge under freezing point.
- Because the SenseDoc contains a wireless cellphone and other sensors which use radio frequency, it needs to be turned off in areas that forbid such emissions, such as in hospitals or on planes.
- The manufacturer assumes no responsibility for any damages and loss resulting from the use of the SenseDoc, or from loss of data as a result of a malfunction, dead battery, or from misuse of the product in any way.
- Clean unit with a dry and soft cloth. Do not use cleaning solvents, chemicals or detergents.
- The SenseDoc unit can be opened in order to insert/retrieve a micro-SIM card for data transfer through the cellphone network. Please consult with your local cellphone provider for obtention of a micro-SIM card and appropriate data plan.
- To open the SenseDoc to place SIM card, only use the original Torx screwdriver provided with your kit to avoid damage to the screws.
- Do not try to hack the unit. Unauthorized hacking of the SenseDoc may damage the unit and voids the warranty.
- This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:
 - o (1) This device may not cause interference; and
 - o (2) This device must accept any interference, including interference that may cause undesired operation of the device.
- This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
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7. FEATURES

- High sensitivity GPS tracking allowing use of GPS, GLONASS, Beidou , and QZSS satellites
- Results in very quick time to first fix (TTFF)
- Possibility of assisted GPS for even quicker TTFF
- High spatial accuracy (2.5 m)
- Real-time data transmission with GSM cellphone
- High-sensitivity tri-axial accelerometer, up to 100 Hz for physical activity and sedentary time assessment
- Advanced step counting algorithm
- ANT+ and OpenBeacon 2.4 GHz RFID data transmission
- ANT+ module compatible with hundreds of existing hardware
- Simple hardware design for optimal usage and limited interference with user
- Strong battery life for extended usage
- USB mass-storage capacity for easy data retrieval
- 4GB internal memory
- Advanced parametrization capabilities
- On-demand customization of firmware (contact us!)
- Shock-resistant ABS casing
- LED signals can be customized
- Behaviour of physical ON/OFF button can be customized
- Internal magnetic button for advanced applications

8. PRODUCT SPECIFICATION

GLOBAL NAVIGATION SATELLITE SYSTEM

Parameter	Type	GPS and GLONASS	GPS and BeiDo	
			u	GPS
Time-To-First-Fix	Cold start	26 s	27s	29 s
	Aided start	2 s	3 s	2 s
	Hot start	1 s	1 s	1 s
Sensitivity	Tracking & Navigation	–167 dBm –	–165	–166
	165 dBm –166 dBm	–167 dBm	dBm	dBm

Reacquisition	–160 dBm	–160 dBm	–160 dBm
Cold start	–148 dBm	–148 dBm	–148 dBm
Hot start	–156 dBm	–156 dBm	–156 dBm
Max navigation update rate	10 Hz	10 Hz	18 Hz
Velocity accuracy	0.05 m/s		
Heading accuracy	0.3 degrees		
Horizontal position	Autonomus	2.5 m	
accuracy	SBAS	2.0 m	
Accuracy of time pulse signal	RMS	30 ns	
	99%	60 ns	
0.25Hz ---- 10 MHz			
Frequency of time pulse signal	(configurable)		
Operational limits	Dynamics	≤ 4 g	
	Altitude	50,000 m	
	Velocity	500 m/s	

NB1: The SenseDoc can further use satellite data from the Quasi-Zenith Satellite System (QZSS) for the Pacific region covering Australia and Japan

NB2: The SenseDoc can use AssistNow™ online or offline options to optimise time to first fix. Please contact Mobysens if this option is of interest for you.

ACCELEROMETER

Parameter	Value	Comment
Measurement range	±2, ±4, ±8, ±16 g	User selectable
Output data rate	0.1 to 3,200 Hz	User selectable

ANT+ PROTOCOL

Worldwide 2.4 GHz ISM band operation

-85 dBm sensitivity

Nordic nRF24AP2-8CH chip

1 Mbps on air data rate

1 MHz frequency programming resolution

Compatible with ANT+ protocols

0dBm RF output power at 2457MHz

NB: More information on ANT compatibility and products at www.thisisant.com

OPEN BEACON DATA TRANSMISSION

Worldwide 2.4GHz ISM band operation

Open Source and Hardware Active 2.4 GHz RFID reader system

Nordic nRF24L01 chip

2Mbps on air data rate

1MHz non-overlapping channel spacing at 1Mbps

X 2MHz non-overlapping channel spacing at 2Mbps

-82dBm sensitivity at 2Mbps

-85dBm sensitivity at 1Mbps

Frequency selectable from 2410MHz to 2475MHz

0dBm RF output power

NB: More info on Openbeacon protocol at www.openbeacon.org

GSM / GPRS MODULE

Quad band telecommunications

33dBm peak output power on the GSM-850/900 bands

30dBm peak output power on the DCS-1800/PCS-1900 bands

BATTERY

Battery type	Voltage	Power	Dimensions
Lithium-ion polymer	3.7 V	2,200 mAh	9.2mm*48mm*50mm

NB1: The Sensedoc is not delivered fully charged. Mobysens recommends fully charging the device before initial use.

NB2: Do not charge the device while wearing or below freezing point.

NB3: No data is recorded during charging.

NB4: Device (and battery) is to be used between -20 and +45 degrees Celsius only

NB5: The SenseDoc battery is not user replaceable. Do not attempt to remove it from the device, this could lead to battery rupture and fire hazard. Please contact Mobysens Technologies for battery replacement.

NB6: When storing the device for a prolonged period, it is recommended not storing fully charged, to increase battery durability.

EXPOSURE TO RADIOFREQUENCIES

Maximum exposition (hip-worn) : 0,41W/kg

SETUP SENSEDOC 2.0 WITH SENSEANALYTICS

Charging

! Please charge the unit fully before first use !

The SenseDoc unit may be charged using the micro-USB cord received with your package. Plug the micro-USB connector into the device, and the USB connector either to the wall-plug charger, or to a USB connector on a computer. Always use the gold-plated USB cord and the wall-plug charger provided by Mobysens, for it respects necessary standards required for your unit. When storing the unit for a prolonged time, do not store fully charged as this will decrease the battery capacity. Rather store with battery charged at 40-60%.

SenseDoc configuration with SenseAnalytics

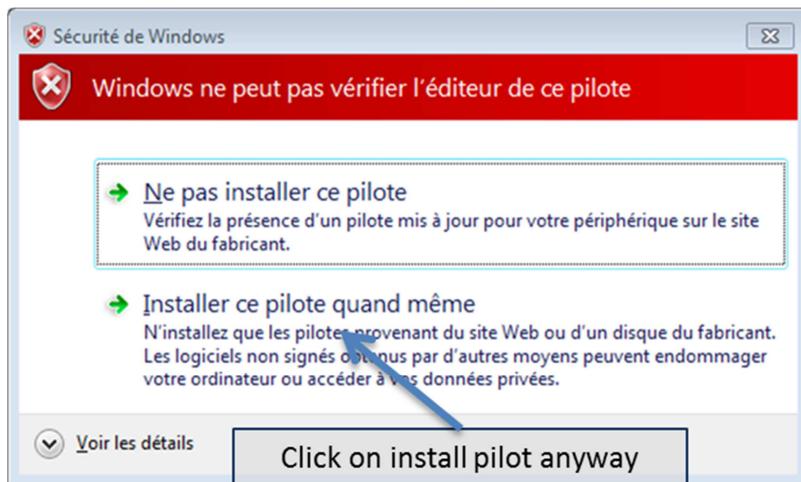
The SenseAnalytics software serves to configure your device, retrieve data stored on the device, and transform raw GPS and accelerometry data into secondary variables such as step counts, or physical activity level estimations.

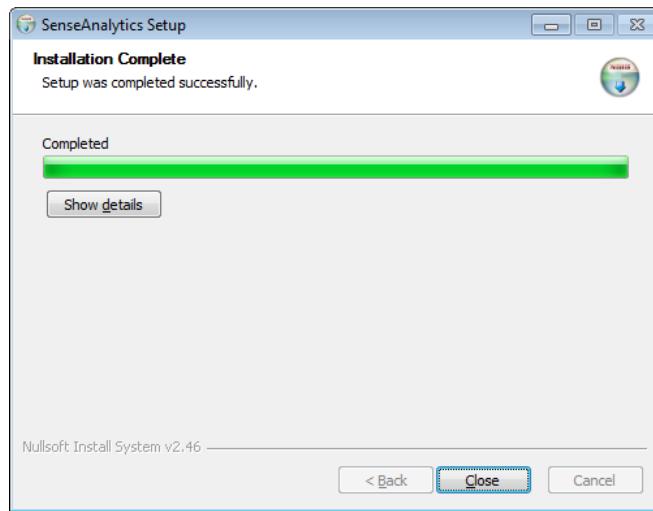
9. SENSEANALYTICS: SOFTWARE INSTALLATION

The SenseAnalytics software is stored by default on the internal memory of your unit. SenseAnalytics is developed for Windows 7 or 8. SenseAnalytics is not supported with Windows XP. When first plugged in, the SenseDoc will appear as a mass storage unit, and will contain an executable file, sdsetup.exe.

With Windows 7

Launch installation by clicking on this file (or right-clicking and install as administrator). Default options will install all necessary files. Windows may not be able to verify the editor of the pilots that are being installed. Select 'Install pilot anyway'.





The installation process will install a link to SenseAnalytics in your start menu.

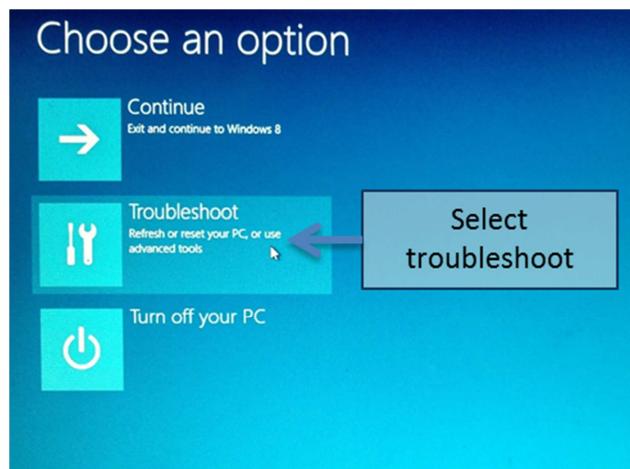
With Windows 8

The procedure with Windows 8 is slightly different because the computer must be restarted in a particular mode to be able to install the pilots correctly.

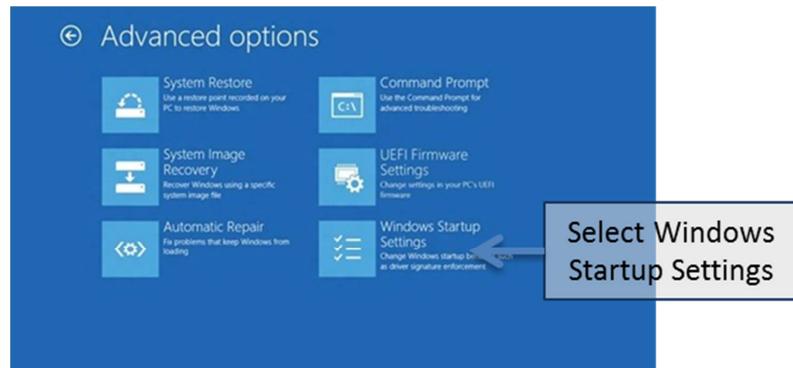
In Windows 8 control panel, select 'Advanced startup'..

The Advanced startup menu can also be reached by holding down the SHIFT key while clicking on Restart.

Click on 'Restart now'. The computer will restart and offer the following options: Continue, Troubleshoot, or Turn off. Select 'Troubleshoot',

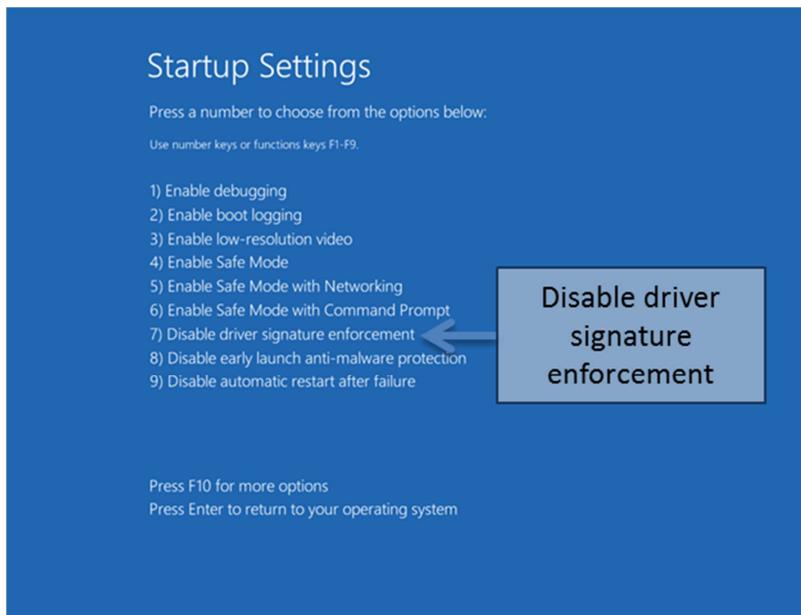


then 'Advanced Options', then 'Windows Startup Settings',



then 'Restart'.

The computer will now restart. Once the boot menu appears, choose 'Disable Driver signature Enforcement'



Proceed to SenseAnalytics installation by clicking on the sdsetup.exe file. Drivers and software will now be installed under Windows 8.

Accessing your data through mass storage mode:

In case of emergency, you can access the local memory of your device in mass-storage mode, similarly as when you plug a USB key into your computer. To do so, select 'Switch to mass-storage mode' in the 'Help' menu. As the SenseDoc unit turns into mass-storage mode, the LED blinks green and red, and it is disconnected from SenseAnalytics. You can now browse your data on your SenseDoc in Windows Explorer.

10. SENSEANALYTICS: CONFIGURATION OF THE SENSEDOC UNIT

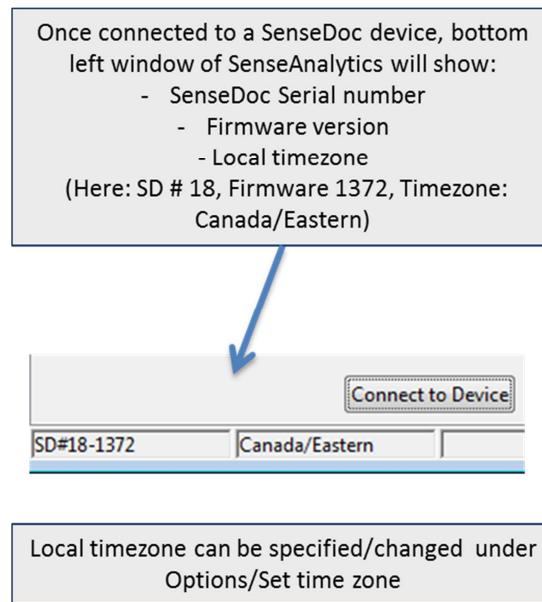
! Warning! To be able to plug a SenseDoc unit on a computer and use with SenseAnalytics, two pilots need to be installed! If those have not been properly installed, the unit will not be correctly detected and parametrisation with SenseAnalytics will not be possible. See previous section for installation procedure.

SenseAnalytics can be used for the following operations:

- Configure the SenseDoc unit through the 'Initialize' tab,
- Transfer locally stored data to your personal computer through the 'Download' tab,
- Derive a series of relevant indicators from the GPS and accelerometry sensors through the 'Processing' tab.
- Update the SenseDoc firmware

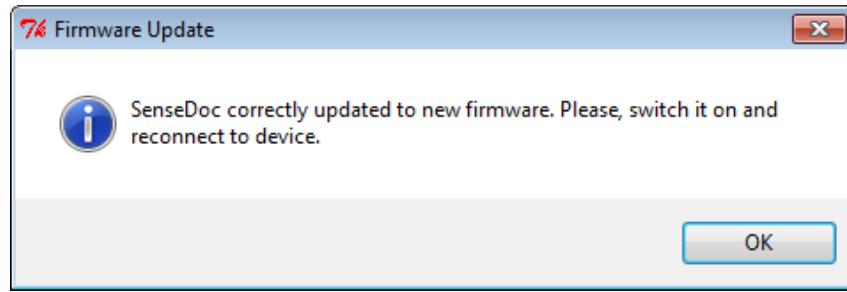
Connection of the SenseDoc unit to SenseAnalytics

Turn SenseDoc on and connect to your computer using the USB cable. In SenseAnalytics, click on 'Connect to Device'. The SenseDoc device number, firmware number will appear in the bottom left corner of SenseAnalytics, indicating SenseDoc has been recognized.



Firmware update

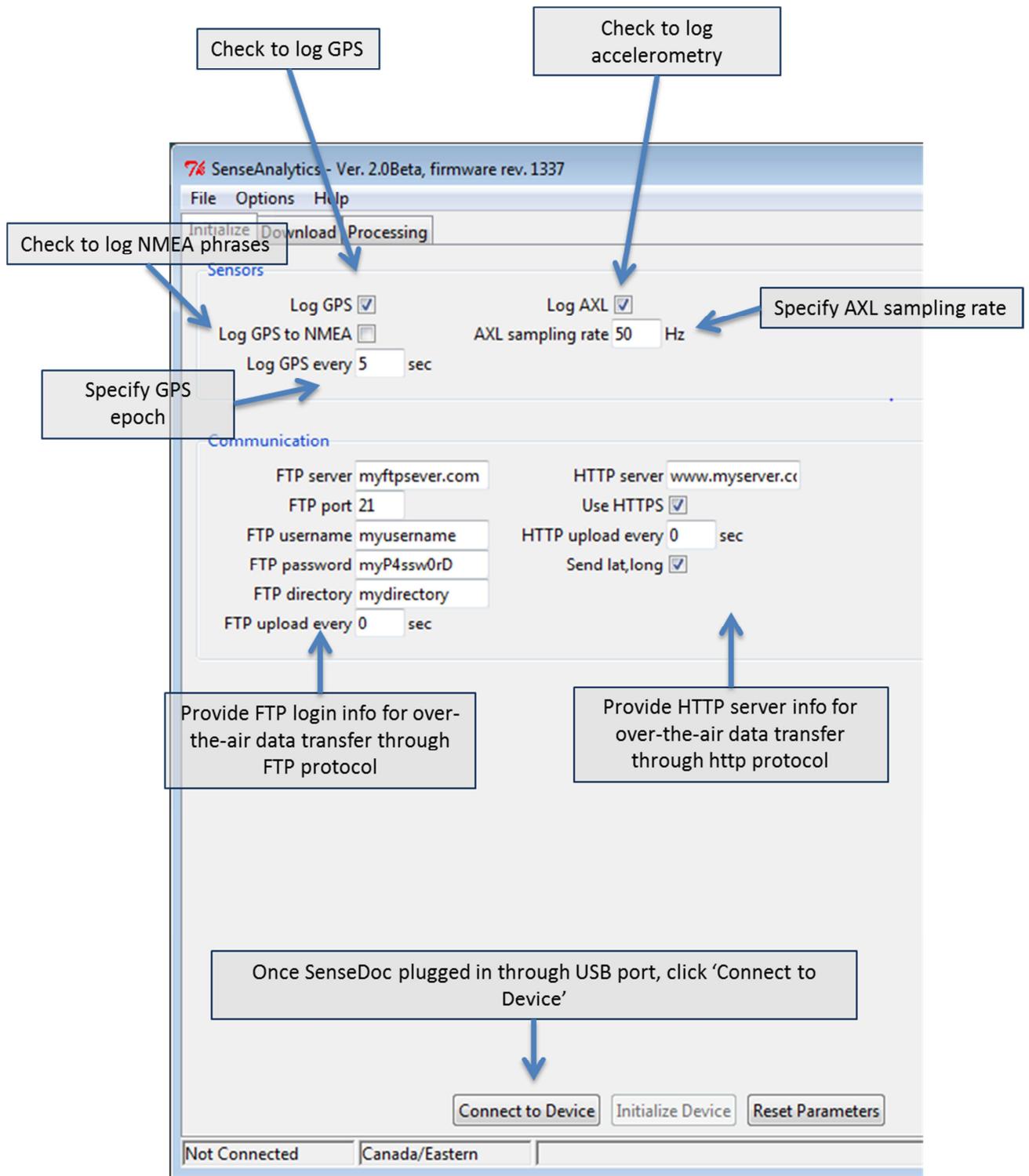
If needed, you can update the SenseDoc firmware. To do so, select 'Update device firmware' in the Help menu. Browse to _fw_rev and select last firmware. SenseAnalytics will confirm firmware update, and turn the SenseDoc off.



Initializing

By default, the Initialize tab appears with the basic parameters. Advanced settings can be defined through 'Options/Toggle advanced settings'.

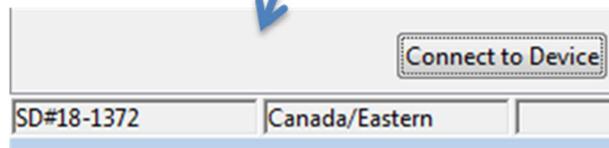
This is the basic view of the Initialize tab:



Once connected to a SenseDoc device, bottom left window of SenseAnalytics will show:

- SenseDoc Serial number
- Firmware version
- Local timezone

(Here: SD # 18, Firmware 1372, Timezone: Canada/Eastern)



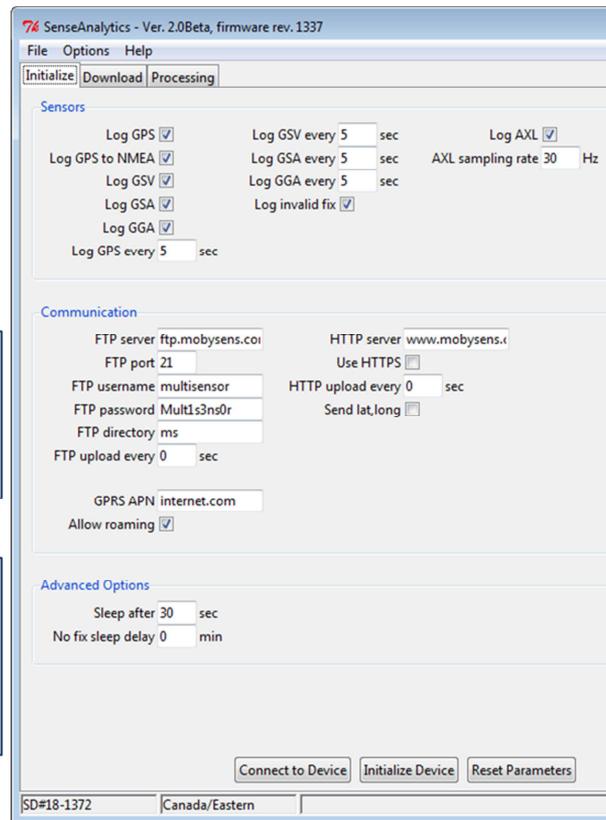
Local timezone can be specified/changed under Options/Set time zone

When switching to the advanced settings tab (Options/Toggle advanced settings), a series of complementary parameters can be set:

In this section, further check advanced options for GPS and AXL logging. Log GSV (Detailed Satellite data), GSA (Overall Satellite data), GGA (Fix information). See details for NMEA format at <http://www.gpsinformation.org/dale/nmea.htm>. Specify epoch for logging of various phrases.

In this section, specify advanced parameters for over-the-air transmission of data, such as GPRS access point name (APN, check with your local service provider). You can further enable or disable data transfer while roaming.

By default, the unit falls into sleep mode after a period of 30 seconds of inactivity (zero accelerometry reading). Change delay for sleep mode here. Activate sleep mode if no fix for GPS is found after n minutes. When indicating 'Zero', sleep modes will be deactivated.



In order to use real-time data transmission through the cellphone network, a SIM card needs to be installed in the device. Please contact your local cellphone provider to obtain a SIM card with an appropriate data plan. To install the SIM card, open the device using the Torx screwdriver and insert SIM card into card holder.

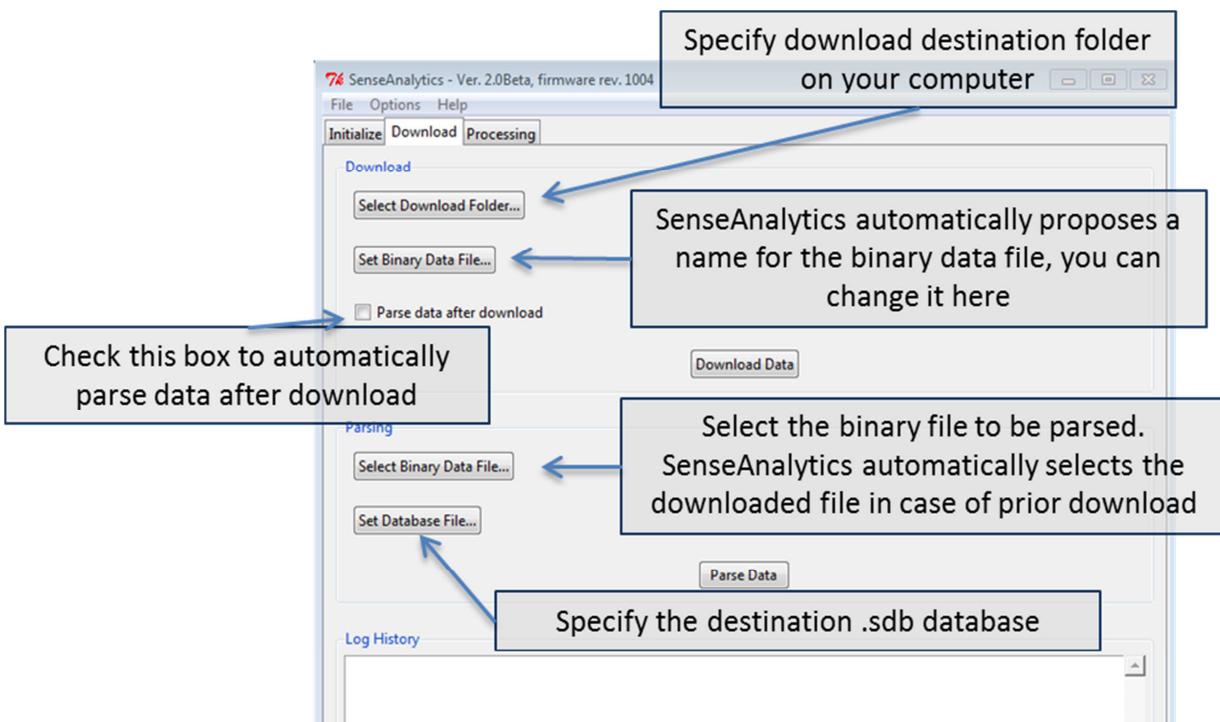
11. SENSEANALYTICS: TRANSFER DATA TO YOUR COMPUTER

SenseAnalytics will create a SenseDoc Database on your local computer. Data that will be transferred from the device's local memory to your computer will be stored in this database. Through the Analysis tab, you can extract relevant indicators into XXXX format (see below).

The download tab allows to download the data stored on the device's local memory to your computer.

Please specify paths for download destination, name of binary data file to be created.

SenseAnalytics will transfer the raw data from the local memory towards a local SenseDoc database onto your computer (.sdb format). The log history window shows download progress.



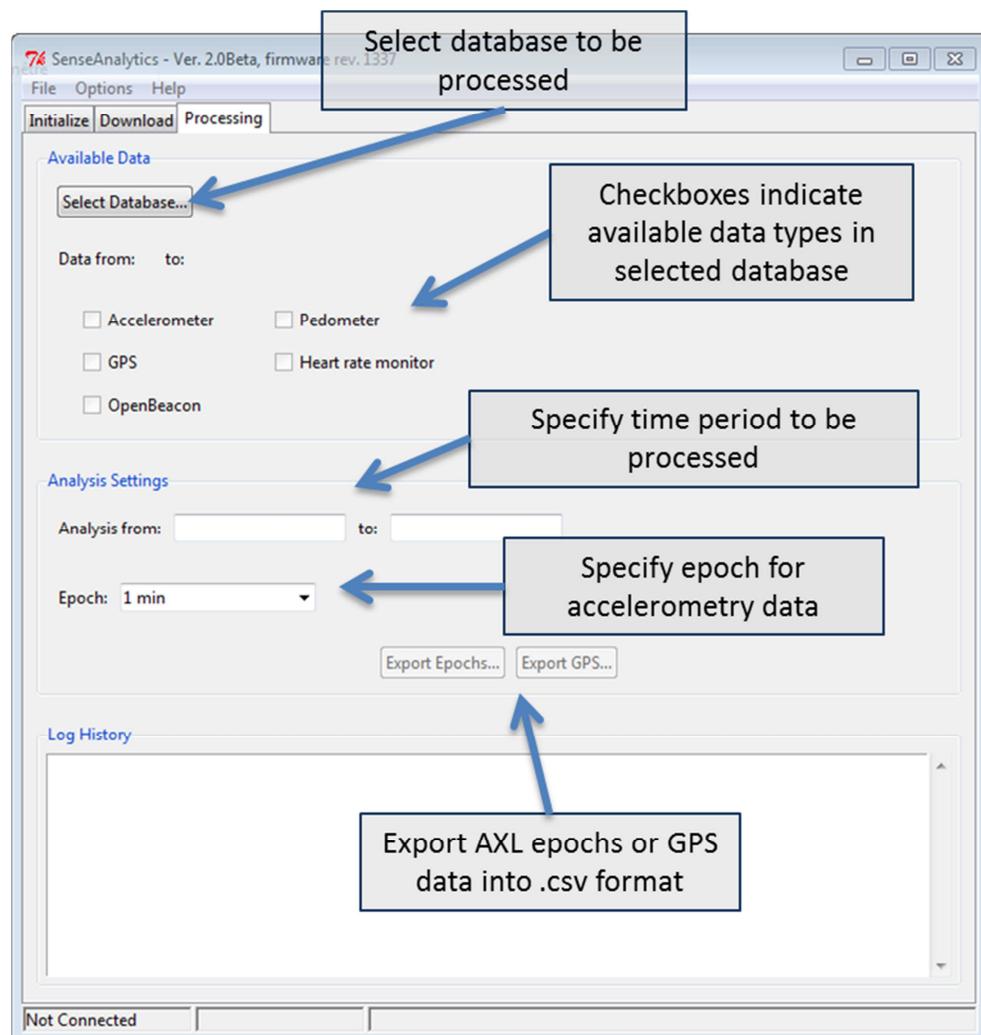
12. SENSEANALYTICS: COMPUTE RELEVANT INDICATORS

Through the processing tab, you can transform the raw data collected by the SenseDoc and stored into your local .sdb database into meaningful indicators, including:

For GPS: latitude, longitude, altitude, speed, HDOP, PDOP, VDOP, number of satellites used, valid fix.

For accelerometry: SenseDoc counts along each axis (XYZ), steps (forthcoming), Vector Dynamic Body Acceleration (VEDBA). NB: When worn at the waist on the right side, X axis is vertical, Y axis is anteroposterior, Z mediolateral.

Data can be exported into .csv format for further processing in your statistical analysis software.



13. TROUBLESHOOTING

Please contact Mobysens at tech@mobysens.com for any issues not resolved through indications provided in this manual.

Sometimes, a hard reset can solve some issues. Hard reset is done by holding the ON/OFF button during a prolonged period of 15 seconds. Then, wait at least 20 seconds before turning the unit ON again.

14. LICENCES

The SenseAnalytics software and SenseDoc firmware use the following licenses:

LUFA Library

http://www.fourwalledcubicle.com/files/LUFA/Doc/140302/html/_page_license_info.html

Copyright (C) Dean Camera, 2014.

dean@fourwalledcubicle.com

www.lufa-lib.org

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NumPy

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SD-reader

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