INSTRUCTION MANUAL

WaveData® SIMbox - SIMtube

Modem and Data Collection System

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WaveData™

Environmental Data Meets the Digital World

INW™

True data, measure by measure

Data is complicated…retrieving it shouldn't be.

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THE FOLLOWING OPERATING INSTRUCTIONS ARE FOR ADVANCED USERS AND FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID DAMAGE OR MALFUNCTION, DO NOT PERFORM ANY OPERATING OTHER THAN THAT CONTAINED IN THIS MANUAL. ANY OPERATOR SHOULD BE SKILLED WITH A TECHNCAL BACKGROUND BEFORE OPERATING THE DEVICE.

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PREFACE

Congratulations on your purchase of a new SIMbox or SIMtube!

This manual describes the operation and (hardware) installation of the device.

The chapter *Getting Started* briefly describes the data logger, prepares you to install it, and tells you how to put it into operation.

The Chapter *Operating Basics* covers basic principles of operation of the data logger. The operating interface (menu) and the tutorial examples, rapidly help you to understand how your data logger operates.

The Chapter *Reference* teaches you how to perform specific tasks and provides a complete list of operating tasks and useful background information.

The Appendices provide lists with all available options, and other useful information.

We recommend that you carefully read this manual prior to field deployment of the device.

1 Product Description

The SIMbox/SIMtube is a superb tool for acquiring, measuring, storing and retrieving data from various sensors. Its key features are;

- A maximum sample rate of 4 Hz,
- Recording up to 2 GB
- 12 bit A/D Convertor for accurate measurements,
- Internal micro SD Card with standard FAT-32 File system for easy use with a PC,
- Various analog and digital inputs for use with sensors (see specification sheet),
- Easy configuration by means of embedded menu
- Can be used with Windows XP,Vista,7
- Low power / long Battery life (see specification sheet),
- Embedded GPRS/GSM modem for remote operation,
- Quad band modem for use all over the world,
- Alarming,
- Internal voltage converter for supplying 12 VDC power to the connected sensor(s),
- Firmware upgrade over the air for adding new features to your device.

The SIMbox/SIMtube is designed to retrieve, and store data from various sensors. This data is logged onto the embedded SD-Card. Also the stored data can be sent from the data logger to any remote computer.. If you prefer not to provide a dedicated computer to act as a server, INW offers a hosting service that sends the data to a secure, remote server that is managed by INW for a low monthly fee.

The device is designed to operate on a single 3.6 Volt Lithium Battery, but accepts auxiliary power sources as well. Captured data can be stored, sent, visualized and manipulated in many ways with the use of OMC-Data-Online Software.

1.1 Contents of the package

- SIMbox/SIMtube
- CD with documentation
- Test certificate
- Antenna
- Optional USB Cable (USB A to Mini USB B)

Warranty

All SIMbox/SIMtube data loggers are warranted against defective materials and workmanship. Any questions with respect to the warranty mentioned above should be taken up with INW

Warranted: free replacement of defective parts during a period of 12 months after installation or maximum 18 months from date of delivery whichever is the shortest. Excluded from warranty are damages caused by improper use or handling.

2 Description

2.1 General

The SIMbox/SIMtube is a multi-purpose data acquisition platform with integrated modem. It is intended for measurement of environmental parameters, e.g. for hydrological applications.

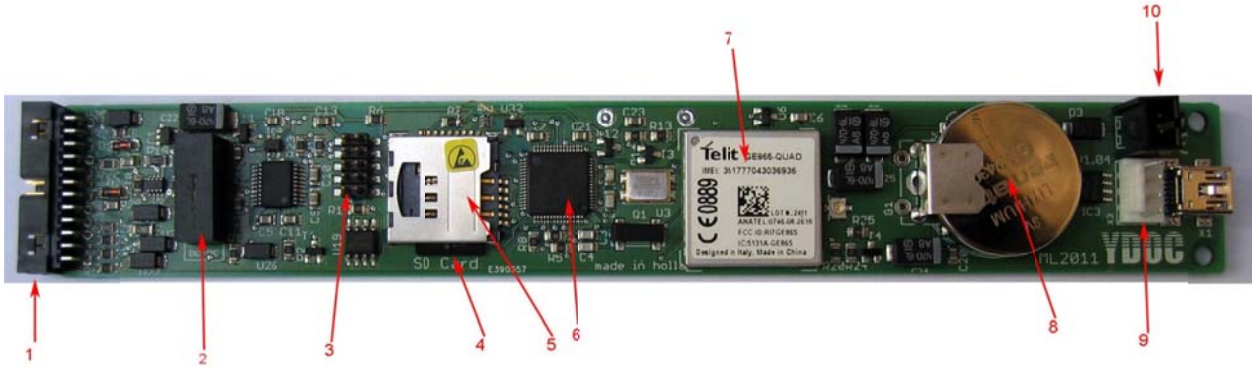
2.2 Implementations

The data logger is available in either a box or tube version. The tube version is designed for use in well applications, with an OD of <2", but can only be used with one sensor. The box version can work with several sensors connected; however, this will not fit in most well completions.

The electronics for both these versions are the same. This manual applies to both versions. Only mechanical aspects vary.

2.2.1 SIMbox

The SIMbox contains two PCB's. The main PCB holds all electronics needed for all operations. The platform PCB, to which the main PBC is connected, holds the battery, connection terminals, and various associated parts. The main PCB is shown below:



1) Multipurpose connector, fits flat-cable connector, for connection with PCB connector
2) DC-DC Convertor for switching 12 volt power operation (powered from 3.6 Volt Battery)
3) JTAG In Circuit Programmer Connector (factory use only)
4) SD Card Holder
5) SIM Card Holder (for use with GSM versions only)
6) Processor
7) Modem
8) Backup Battery (20 year life)
9) USB Connector
10) External Power Connector

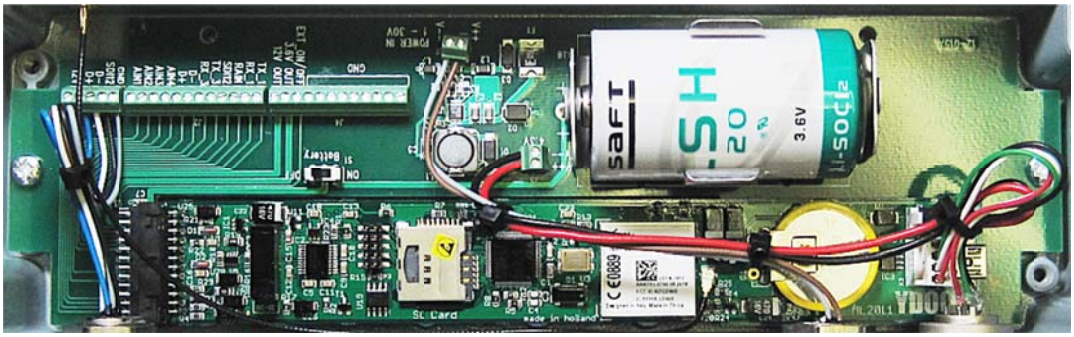
Case

Sensor Connection
(May be more than one, depending on configuration)

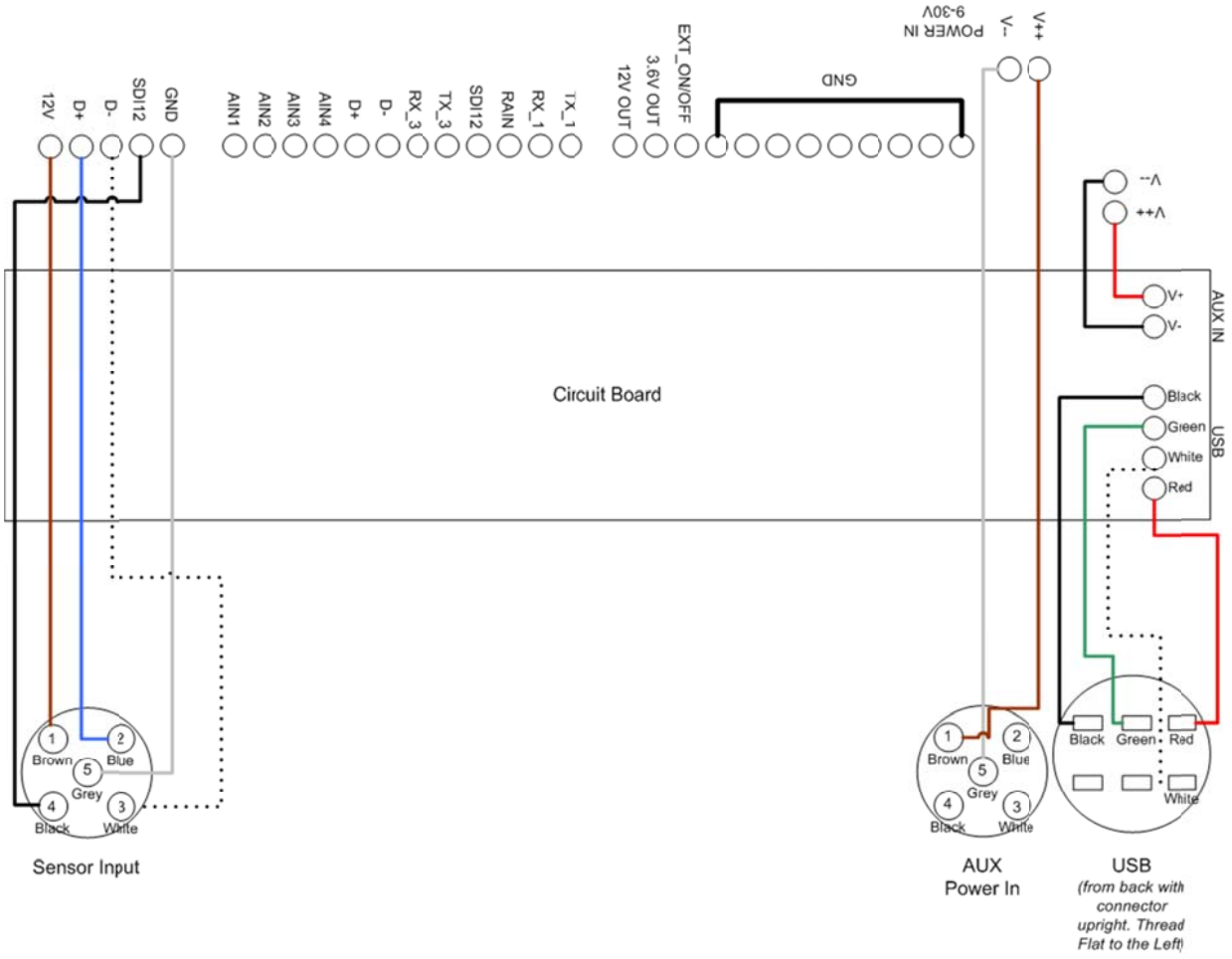
Aux Power In
9 – 30 VDC

USB
Programming
Connection

Inside



Wiring Diagram



2.2.2 SIMtube

There are no user-serviceable parts inside the SIMtube. Opening the SIMtube case will void the factory warranty.

The SIMtube is IP 67 or IP 68 rated only when the watertight caps for Power and USB connector are both in place and the antenna connector is sealed with self amalgamating tape.

3 Getting Started

3.1 Opening the case

SIMtube Case

Do not open the SIMtube case. Service is to be performed by trained INW factory personnel only, including battery replacement. Opening the SIMtube case will void the factory warranty. For service, please contact INW support.

SIMbox Case

To open the SIMbox, use a standard screwdriver and loosen all four screws on the cover. Carefully lift the cover off the plate to expose the inside.

Batteries can be replaced by carefully snipping the cable tie securing it to the battery holder. REPLACEMENT BATTERIES MUST BE PURCHASED FROM INW. USING ANY BATTERY OTHER THAN REPLACEMENT BATTERIES PURCHASED FROM INW WILL VOID WARRANTY OF THE PRODUCT.

3.2 Vibration

At all times the SIMbox/SIMtube must be protected against vibrations. These vibrations can harm the performance of the data logger. Especially the real time clock can be harmed by long-lasting vibrations.

3.2.1 Do's and Don'ts

Do's

- Always provide a dry and clean environment when you open the case of the SIMbox.
- Protect the data logger against mechanical stress and vibrations.

Don'ts

- Never open the case in the field.
- Avoid touching the PCB directly.

3.3 Inserting the SIM card

(Note: CDMA versions do not have SIM cards.)
INW provides support for INW provided SIM cards with an active subscription only. All other SIM cards, provided by the client or other companies, are not supported by INW staff and are not eligible for any technical phone support from INW. However, if a customer still chooses to use their own SIM card, we recommend the following:

The wireless data functions will only work when an activated SIM card with a valid subscription is placed in the SIMbox/SIMtube. In the menu the configuration and network settings must also match those supplied by the SIM card provider. The pin code of the SIM card must be removed prior to insertion in the data logger. To prevent problems with the SIM card it can be inserted in a mobile phone or GSM data modem. In a Mobile phone or GSM modem the GPRS, SMS and GSM data functionality can be tested.

Beware:

- Remove the PIN code (this can be done with the use of a mobile telephone).
- Check the settings of your mobile provider (see chapter 4.1).
- Check the settings for communicating via FTP / Email / Native (see chapter 4.1).
- Check the capability of data communication for your service-provider.
- Make sure the SIM-card is installed correctly, and not upside down. The oblique side of the card should be visible. (See photo).

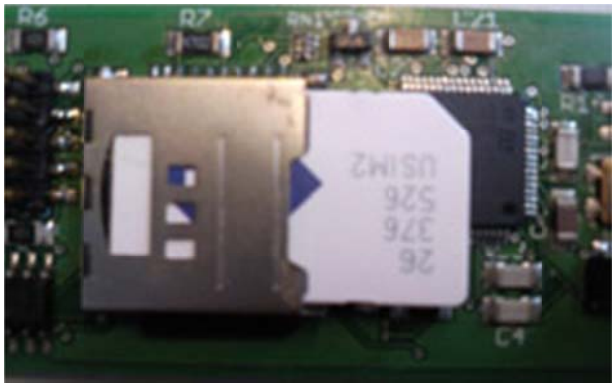


Figure 1: Correctly mounted SIM card

Installation of the SIM card needs to be done in a clean and dry environment. Avoid contact with the electronic parts around the SIM card. Remove power before changing or inserting a SIM card.
The same applies to the SD card.

ESD Attention: Although the SIMbox is designed to withstand certain amounts of electrostatic discharge, it is advised to avoid discharged risks, especially when the housing is open and the electronic parts are exposed. Please do not touch the PCB if you don't have to. It is strongly recommended to use an earth grounded wrist-band when touching the PCB.

The data logger must be handled with care and never exposed to ESD discharges. When installing a sensor or other wiring, make sure there is no power on devices. ESD discharges could cause invisible damage. This endangers long term stability and proper operation.

3.4 Power on for the First time

The SIMbox/SIMtube comes supplied with a 3.6V lithium battery. It can also be powered via an external 9-30VDC power supply via the AUX power connector.

The SIMbox version is shipped with the power turned off. To turn power on, remove the lid. Slide switch to the left of the battery to the ON position. Replace the lid. The unit immediately begins collecting and transmitting on the programmed schedule. (Note: you may want to turn the power off when transporting the unit via air or shipping the unit.)

In the factory, the data logger is programmed with the necessary system information. This information is viewable in the menu. The data logger is ready to use out of the box provided the following are true.

- SIM card is inserted.
- SD card is inserted.
- Internal battery is connected.
- Antenna is connected.

Next, connect your sensors. If the sensors were not purchased with the SIMbox, please consult your sensor's manual for wiring to the INW "Connector for 3rd Party Sensors", available for purchase.

3.5 Connect to a PC

OS compatibility: The SIMbox/SIMtube can be connected to any PC with USB 2.0 running on Microsoft Windows XP, Vista , 7, 8.0, or 8.1.

Installation procedure for the internal USB adapter for Windows XP is given on the CD.

4 Operating Basics

4.1 Configuration menu

The SIMbox/SIMtube can be configured by means of a terminal application. On the CD, you'll find a terminal application which is suitable. It is called "OMC-040-terminal."

The menu is very comprehensive and easy to use. For each different sensor the same approach is used. Below, one example is given to fully understand the operation of the menu. The example takes you through a configuration from start to final stage. All menu items use the same approach which is explained in this example.

Example:

Let's Configure a SIMbox for operation with the following:

- Analog pressure transmitter 4-20 mA
- CT2X conductivity / temperature sensor
- FTP data output

First connect logger to PC

SIMtube
. Note: If you are programming a SIMtube, only the SIMtube USB cable provided by INW can be used, normal cables will not fit. For SIMtube, use large Flat head screw driver to remove plug. Insert Mini-USB end into mating connector. Connect standard USB end into your computers USB 2.0 Port.

SIMbox
For SIMbox, Remove Waterproof Bulkhead Cap. Insert Mini-USB end into mating connector. Connect standard USB end into your computers USB 2.0 Port.

To Enter the Configuration menu type: Press <Ctrl>+A, then <Shift>+M, and then <Ctrl>D in fast sequence.

You'll see a screen similar to this:

Running
Configuration Menu OMC-040 Logger Version 0.2 Build 4

```
[0] Run
[1] Date & Time          >> 2011/10/07 12:58:21
[2] System Information   >> 3002389
[3] Configuration Setup  >> Brasil
[4] Configuration Review
[5] Maintenance
>
```

First we like to give this data logger appropriate identification codes.
So, press 3 to enter <Configuration Setup> menu.
You'll see this screen:

```
General settings

[0] Exit
[1] System Name                        >> 0MC-040
[2] Data logging interval              >> Normal 00:01:00; Alarm Not Used
[3] Direct Data output on Data Alarm   >> 0ff
[4] Deployment date and time           >> 2011/09/23 20:17:42
[5] Time zone                          >> 2
[T] SD-Card test                       >> Passed
>
```

Next press 1 to enter <System Name> menu

The screen will look like this:

```
Configuration Setup

[0] Exit
[1] General settings   >> 0MC-040
[2] Modem settings
[3] NTP Time update    >> Not Used
[4] Alarm SMS          >> Not Used
[5] SMS Commands       >> Not Used
[6] Internal sensors   >> Not Used
[7] Analog sensors     >> Not Used
[8] Digital sensor     >> Not Used
[9] GSM signal sensor  >> Not Used
[A] Serial port 1      >> Not Used
[B] Serial port 2      >> Not Used
[C] Email output       >> Not Used
[D] FTP output         >> Not Used
[E] TCP output         >> Not Used
>
```

Now press 1 to enter < General settings> menu

```
General settings

[0] Exit
[1] System Name                        >> Brasil
[2] Data logging interval              >> Normal 00:01:00; Alarm Not Used
[3] Direct Data output on Data Alarm   >> 0ff
[4] Deployment date and time           >> 2011/09/23 20:17:42
[5] Time zone                          >> 2
[T] SD-Card test                       >> Passed
>
```

1. Press 1, type the name of your preference, and then press enter to save.
2. Choose your data logging interval. We used 10 minutes, and NO Alarming.

3. Enter the deployment date & time. This can be a time in the future when logger should start working. We will use the actual date & time to start right away.
4. When done, press “0” to exit, and strike “Y” when prompted to save changes.
5. Exit and save changes.
6. Now the overall configuration is setup and we proceed with the configuration of the sensors and data output.

Now that you are back at the configuration menu again, type 7 to enter the Analog Sensors Menu

```
Analog sensors

[0] Exit
[1] Port 1 (mA)        >> Not Used
[2] Port 2 (mA)        >> Not Used
[3] Port 3 (V)         >> Not Used
[4] Port 4 (V)         >> Not Used
[T] Analog input test >> Passed
>
```

Choose 1 (mA).

Now the next screen will appear:

```
Analog sensor

[0] Exit
[1] Name                                >> Analog
[2] Sensor power switch                 >> Disabled
[3] Sample interval                     >> Normal 00:00:01; Alarm Not Used
[4] Port mode                           >> 4-20 mA
[5] Parameter                           >> Analog 1
[6] Parameter value at analog minimum >> 0
[7] Parameter value at analog maximum >> 100
[8] Auto calibrate at restart           >> Off
[R] Remove
>
```

1. Assign a name to the sensor (1: Name).
2. Set the power switch to enabled and enter the warm-up time. (The power switch will supply the sensor with 12 volts and will be activated the amount of time you specify before the measurement is taken). Warm-up time required by the sensor should be provided by the sensor manufacturer.
3. Set the sample interval. We use 10 seconds, to quickly check the sensor’s operation. A high range sample interval is no problem for battery-life, because the sensor will sleep until its data logging interval is reached.
4. Set your parameter name.
5. Set both maximum and minimum values for your sensor – they may be written on the sensor or in its specification sheet. This will scale your sensor properly.
6. Save and Exit

Your screen will look similar to the one underneath:

```
   Analog sensor

   [0] Exit
   [1] Name                                >> Upperstream
   [2] Sensor power switch                 >> Enabled; Warm up time 00:00:01
   [3] Sample interval                     >> Normal 00:00:10; Alarm Not Used
   [4] Port mode                           >> 4-20 mA
   [5] Parameter                           >> Waterlevel
   [6] Parameter value at analog minimum >> 0
   [7] Parameter value at analog maximum >> 100
   [8] Auto calibrate at restart           >> Off
   [R] Remove
   >
```

Now we add the CT2X to the system:
Go to menu-option A <serial port 1> => RS 485 sensors

Choose the INW CT2X and set its Address. To find out the address of the sensor you need to use Aqua4Plus software. New sensors purchased from the factory are defaulted to address 2 with a baud rate of 38400, except PT12s, which have a baud rate of 19200.

Choose your sample interval; we choose 10 seconds.

Note: If you are using a PT2X, you should choose PT2X B if your firmware is version 2.0 or higher. Choose PT2X A for all earlier firmware versions.

```
   RS485 Sensors

   [0] Exit
   [1] INW CT2X
   [2] INW PT2X A
   [3] INW PT2X B
   [4] INW PT12
   [5] INW TempHion
   [6] OMC506
   [7] WPD40
   >
```

Attention:

Because this is a digital sensor, it takes a little bit more time to measure than an analog sensor. So don't set the sample interval of digital sensors too short. 1 second is possible, but there could be issues with less. Just to be sure, we choose 10 sec. Consult the manual of your digital sensor and check the response time. The sample-interval must be larger than the response time of the sensor.

Your screen should look like this:

```
   INW CT2X sensor

   [0] Exit
   [1] Name                >> INW CT2X
   [2] Port settings       >> Port 1; 38400 Baud; RS485; Address 1
   [3] Sensor power switch >> Disabled
   [4] Sample interval     >> Normal 00:00:10; Alarm Not Used
   [5] Temperature         >> Temperature
   [6] Pressure            >> Pressure
   [7] Conductivity        >> Not Used
   [8] Conductivity nLFn   >> Not Used
   [R] Remove
   >
```

Make sure you check the parameter settings individually. For instance, going into the pressure menu reveals the following:

```
INW CT2X Parameter Settings

[0] Exit
[1] Name                    >> Pressure*
[2] Code                    >> PRS*
[3] Unit                    >> psi
[4] Decimals                >> 2
[5] Data logging            >> On
[6] Data transponding       >> Off
[7] Alarm SMS               >> Off
[8] Alarm logging           >> Off
[R] Remove
```

Ensure the parameters have the correct units and decimal places. Also, make certain data logging is set properly as well as alarming. You will need to perform these checks for each parameter on every sensor.

Now your sensors are added to the configuration of the SIMbox.

Next thing is the setup of the data outputs.

Now we can set up the FTP output.
Go to menu-option: D FTP Output.
Enter your server-settings.

It is strongly recommended to include some internal sensors in the configuration, because of the monitoring of the performance of the data logger itself. Most users like to keep track of the battery-life for example.

Go To menu-option 6 <internal sensors>

```
   Internal sensors

   [0] Exit
   [1] Name                    >> Internal
   [2] Sample interval         >> Normal 00:00:01; Alarm Not Used
   [3] Battery Capacity (mAh) >> 13000
   [4] Battery replaced        >> Yes
   [5] Rest Capacity           >> Rest Capacity
   [6] Rest Power              >> Not Used
   [7] Processor Temperature   >> Processor Temperature
   [8] Voltage                 >> Not Used
   [9] Current                 >> Not Used
   [A] Max Current             >> Not Used
   [B] Min Current             >> Not Used
   [C] Average Current         >> Not Used
   [D] Free Disk Space         >> Not Used
   [E] Operating Cycle         >> Not Used
   [R] Remove
   >
```

A sample interval of 1 second is fine. All internal sensors are very fast.

Set the “Battery Replaced” to “Yes”, only at the time of battery replacement with a new battery, provided by INW.

Now, your data logger is configured and ready to use.

When exited all the way back out of the menus in the terminal, you can check your wiring and sensors by evaluating the actual values

To see them press: <Ctrl>+A, then <Shift>+V, and then <Ctrl>+D in fast sequence.
The result should be like this:

```
11/10/07 14:22:04 Actual Values OMC-040 Logger Version 0.2 Build 4
AIN1    Waterlevel                      -25             meters MSL
TMP     Temperature                     20.2            C
PRS     Pressure                        0.2             psi
RCi     Rest Capacity                   100             %
PTi     Processor Temperature           57.4            C
Vi      Voltage                         3.6             V
Ci      Current                         82              mA
```

5 Reference

5.1 Principle of Operation

Your SIMbox Data logger is capable of collecting and storing data from multiple sensors. To accomplish this, many tasks are performed. These “tasks” are scheduled and executed on their specified times.
The timing of this process is very important and is determined by the internal scheduler. This scheduler keeps track of all the internal states of the various tasks and assigns processor time to the different tasks.
Each task is executed at its own interval. So you will understand more about this, we will now explain the different intervals.

There are three different intervals:

1) Sample Interval
2) Data Log Interval
3) Send Interval

5.1.1 Sample interval

The sample interval is the interval on which a sample from the sensor is taken or expected to be taken. Thus, measurements from sensors are done at the sample interval. The sample interval is valid ONLY when the device is in the active state, i.e.: plugged in to the computer and running the terminal. It is only used to ensure the setup is correct.. When the data logger is in sleep-mode, the tasks triggered by the sample interval will NOT execute. These values are not stored.

5.1.2 Data Log interval

This interval determines when a data value, obtained by the sample interval-task, is stored onto the SD Card. This type of interval is ALWAYS valid. So, even when the data logger is in sleep-mode, it will wake up when the Data Log Interval has reached its count.

5.1.3 Send Interval

The send interval determines the interval on which data is sent, via the internal modem, to the server. This interval is ALWAYS valid, even if the data logger is in sleep-mode.

5.1.4 Example

Let’s evaluate the following settings of the data logger:

- Sample Interval: 5 seconds
- Data Log Interval: 10 minutes
- Send Interval: 3 hours

When the configuration is ready and the user disconnects the USB-Cable:

1. SIMbox/SIMtube is switched into sleep-mode, and current draw is reduced to a minimum level.
2. The Sample interval of 5 seconds is discarded, because this interval is only active when the data logger is NOT in sleep-mode. So nothing happens until the Data Log interval has reached its count (This happens on 0, 10, 20, 30, 40, 50 minutes of every hour).
3. When the Data Log Interval count has reached it count, the data logger will awake from the sleep mode, and will take a sample and store the data on the SD card. Once the sample is taken, the data logger goes into sleep-mode again. This is repeated, until the time has reached the send interval. In this example, this is 3 hours.
4. When Data Send interval is reached, the data logger will wake-up, and start to send the previously collected data (stored on the SD card) to the server. In this example, every 10 minutes a sample is taken, and every 3 hours 18 samples are sent.

Note:

The data logger does not perform any averaging. Even if the sample interval is much faster than the data log interval, only one sample is stored.

The use of the sample interval is for evaluating proper behaviour of the system while the USB is connected. In that case, the sample interval is valid, and the user can observe the values obtained from the sensor in real time. In the scenario above, the user can evaluate these values every 5 seconds.

5.2 SDI-12

The SIMbox is provided with an SDI-12 port. This port is connected to port 1 and is shared with the normal RS232 operation. This means that the user has to select whether he wants to use RS232 *or* SDI-12. When SDI-12 is selected, it acts like an SDI-12 recorder and its specific SDI-12 commands are embedded in the driver of the input-sensor. Thus the user can easily select his sensor and specify its SDI-12-adress. For more information see the description of your SDI-12 sensor.

5.3 SDI-12 Hardware

SDI-12 signal levels are quite different from those of RS232 and RS485. Therefore, you cannot connect a SDI-12 sensor to a RS232 or RS485 port, it won't work. The use of converters between RS232/485 and SDI-12 are discouraged, due to performance issues.

5.3.1 SDI-12 Wiring

The SDI-12 electrical interface uses the SDI-12 bus to transmit serial data between SDI-12 data recorders and sensors. The SDI-12 bus is the cable that connects multiple SDI-12 devices.
This is a cable with three conductors:

1) a serial data line
2) a ground line
3) a 12-volt line

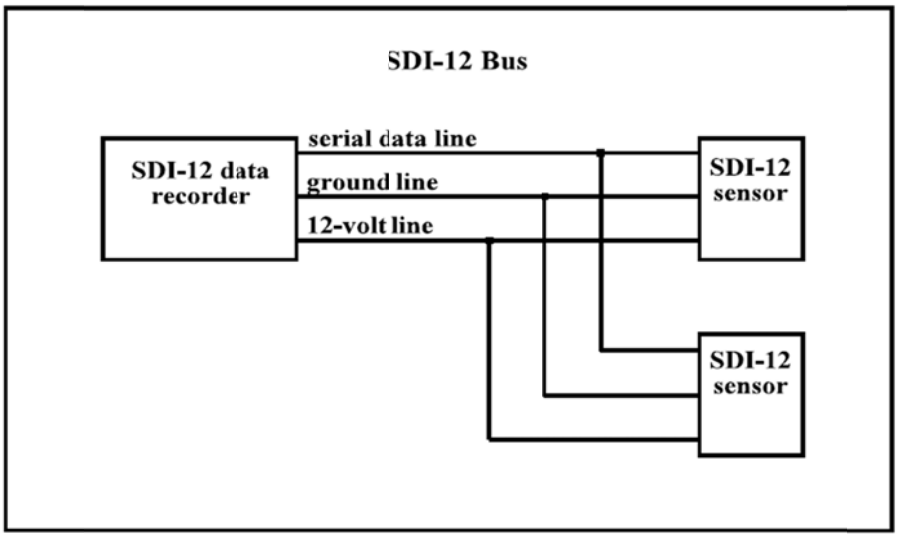


Figure 2: SDI-12 bus

The wiring length between a sensor and the data-recorder must not exceed 180'. The maximum number of sensor connected to a SDI-12 bus is limited to 10. The SIMbox is protected against transients on the SDI-12 bus.

5.3.2 SDI-12 Baud Rate and Frame Format

The baud rate for SDI-12 is 1200. Frame format is as follows:

1 start bit
7 data bits, least significant bit transmitted first
1 parity bit, even parity
1 stop bit

Note:

SDI-12 is a half-duplex protocol, so the data-recorder has to switch between transmitting and receiving. A converter from RS232 ⇔ SDI-12, must perform this task. However, it is not aware of the exact timing of the protocol. Therefore it uses fixed (or configurable) delays to switch between Tx and Rx. After each byte sent by the converter, it waits, during the fixed delay, for another character, and if it doesn't arrive, it switches to Rx. The intelligence needed to perform these tasks is mostly done by a microcontroller inside the converter. This method is doing the job for most cases, but it is not as good as a real SDI-12 port. The real SDI-12 port is aware of the exact protocol-timings and after the last character; it switches to RX-mode immediately, without the delay. Therefore no replies are missing. Your SIMbox has a true SDI-12 port.

For more information on the SDI-12 protocol: see www.sdi-12.org

5.4 RS232

Your SIMbox comes with two RS232 ports, capable of baud rates of up to 115200 bps (230400 bps on request). The ports are: Port 1 and Port 2. Port one is shared with the SDI-12 port and Port 2 is shared with an RS485 port. The user can choose any combination they like, as long as they are using only one at a time, i.e., you cannot use RS232 and RS485 on one port at a time. If a user needs RS232 and RS485 simultaneously, they need to setup Port 2 also.

5.4.1 A word on RS232 hardware

RS232 is a widely spread interface standard, which uses 3 wires (minimum) for data communication. It is a so called asymmetric interface, which uses one wire for Tx, one for Rx and one for ground. It is called asymmetrical, because it uses only one wire per signal. Therefore it's susceptible for interference, and hence, the maximum cable length is limited to 45 feet (depending on baud rate).
A table of baud rates versus cable length is given below:

RS232 cable length according to Texas Instruments	
Baudrate (bps)	**Maximum Cablelength (m)**
19200	15
9600	150
4800	300
2400	900

Please keep in mind these limitations when you design your system.

RS232 is not a bus system, and therefore it is only allowed for one device to be connected to a RS232 port. Therefore, the maximum number of serial devices to connect to your SIMbox is two. RS232 sensors should be connected to the data logger with their signals crossed. That is Rx ⇔ Tx. We strongly recommend the use of RS485 instead of RS232, when cable lengths exceed the sizes specified in the table above.

5.5 RS485

RS485 is a serial bus-system, which uses 3 wires for its communication. It uses a "differential balanced line," which can span relatively large distances (up to 4,000 feet (1,200 m)). A rule of thumb is that the speed in bit/s multiplied by the length in meters should not exceed 10^8. Thus a 50 meter cable should not signal faster than 2 Mbit/s.
Unlike RS232, RS485 is capable of communicating with more than one device. After all, it is a bus-system. RS485 sensors are called "slaves" and must have their unique address. The SIMbox acts as a master and retrieves the information from the slaves. Only one slave can respond to the requests of the master at a time. To set up your RS485 sensor for use with the SIMbox, make sure that the address is programmed correctly and that the sensor address is unique.

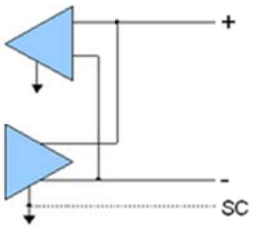


Figure 3: RS485 Wiring

RS485 is often used with Modbus-sensors and is less susceptible to electrical interference than RS232.
Your SIMbox has one RS485 port, which is capable of driving multiple sensors (maximum number of sensors depends on specifications from the manufacturer of the sensor, a practical figure is 10. The maximum number of slaves, defined by EIA/RS485 is 32). For the exact number of sensors you can connect to your SIMbox see chapter Firmware Driver Limitations.

Table below gives detailed information about RS485.

RS 485	
Standard	EIA RS-485
Physical Media	Twisted pair
Network Topology	Point-to-point, Multi-dropped, Multi-point
Maximum Devices	32 drivers or receivers
Maximum Distance	1200 metres (4000 feet)
Mode of Operation	Differential signaling
Maximum Baud Rate	100 kbit/s - 10 Mbit/s
Voltage Levels	-7 V to +12 V
Mark(1)	Positive Voltages (B-A > +200 mV)
Space(0)	negative voltages (B-A < -200 mV)
Available Signals	Tx+/Rx+, Tx-/Rx- (Half Duplex)
	Tx+, Tx-, Rx+, Rx- (Full Duplex)
Connector types	Not specified.

5.6 Firmware Upgrade

The SIMbox is equipped with a boot loader, which enables the firmware upgrade feature.
Firmware upgrading allows a user to overwrite the internal firmware of the data logger with a (newer) updated version of the firmware. Firmware upgrading can be done by USB connection or over cellular.

5.6.1 When to use Firmware upgrades.

Normally, a user never uses this feature, as long as they are satisfied with the performance of the system.
In time however, the need for additional features may arise. For example, a new serial sensor is introduced on the market and a customer wants to connect this sensor to their SIMbox. When INW has extended the firmware to support that sensor, a new version of the firmware is released. After the user has performed the firmware upgrade, their “old” SIMbox, now supports the new sensor. Normally, when the system is running fine, and no additional requests exist, we recommend NOT performing a firmware-upgrade.

5.6.2 Firmware upgrade procedure

Contact INW if you think you need to upgrade your firmware.

5.7 Alarming

In some circumstances, normal data-logging is not sufficient for managing your process. For keeping track of certain, often critical, conditions, the SIMbox/SIMtube is equipped with direct alarming options. Alarming-limits and hysteresis are used to manage these special events. The table below shows the different types of alarming-limits.

Alarm Limit	Description	Remarks
Low Low	Alarm level for lowest value	This alarm level is reached when the datalogger encounters a value which is lower than the low-low Limit, this is the 2nd and most urgent state of alarming. This type of alarming is used for very rare and critical conditions (often called STOP level).
Low	Alarm level for low value	This alarm level is reached when the datalogger encounters a value which is Lower than the Low Limit, but Higher than the Low-Low Limit. This is the first stage of alarming. (often called WARNING level)
High	Alarm Value for high value	This alarm level is reached when the datalogger encounters a value which is higher than the high Limit, but lower than the High-High Limit. This is the first stage of alarming. (often called WARNING level)
High High	Alarm level for highest value	This alarm level is reached when the datalogger encounters a value which is higher than the high-high Limit, this is the 2nd and most urgent state of alarming. This type of alarming is used for very rare and critical conditions (often called STOP level).

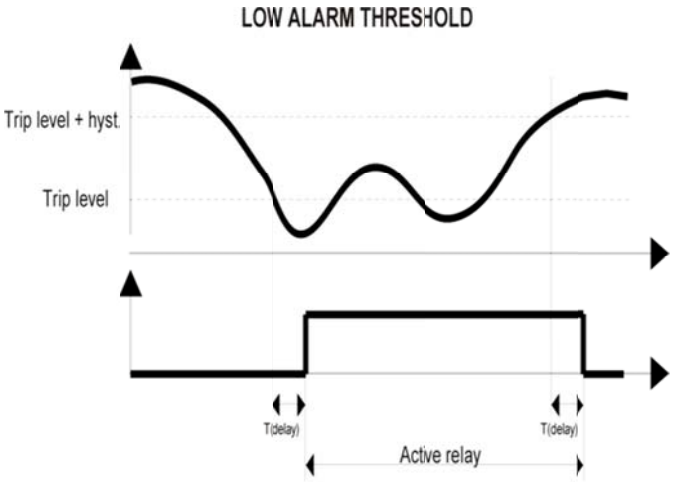
5.7.1 Alarming - principal of operation

When a data logger is running and a measurement is out of bounds, the data logger will immediately switch over the alarm sample interval. So the first time a –out of bounds-value will be detected is at the normal data-log interval and from this moment on, the data logger will increase its sample interval to the alarm-sample interval. The “alarm sample delay” determines what happens next. If this value is equal to zero, action is taken immediately. If the sample interval delay is 1, the logger will wait for one more alarming cycle before taking action. If the alarm interval delay is 2, it will take 2 cycles, etc.
When this alarm-state is entered, the data logger will add the ‘*A’ data modifier to the data-records. The user has the following options for the requested action:

1) Alarm log (log an alarm level)
2) Alarm SMS (send an SMS to cell phone, charges may apply)
3) Alarm TCP
4) Alarm FTP

When the conditions of alarming are met (data value out of bounds and the alarm sample delay is expired) one or more of these actions can take place.

Note:
The data modifier *A is automatically placed into the D-records.
So, the entry of an alarm state is NOT affected by a hysteresis. Hysteresis is only used for switching back to the normal mode. The amount of hysteresis has an effect on the “sensibility” of the alarming.
It is strongly advised to use a certain amount of hysteresis to prevent multiple alarming warnings. The amount of hysteresis is determined by experience and information from the sensor.



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5.7.2 Firmware Driver limitations

The SIMbox Data logger is equipped with various drivers, for several tasks. The number of total drivers is limited to 16. This means you can choose maximum 16 drivers from all the drivers available. Each driver can handle (collect or send) a number of parameters. The total number of parameters is limited to 64. So, theoretically, the SIMbox can handle up to 16 sensors with 4 parameters each. But in this case there is no output possible. In most cases two or three drivers are needed for minimum operation. (internal driver, tcp output-driver, or email-driver). When a user has an additional analog sensor, it will take a driver as well.

Example:
A user wants to connect a large number of INW CT2X sensors. This sensor measures temperature and conductivity. So each sensor "uses" two parameters. Also, they may like to send the data via FTP and they enable the following internal sensors: Rest Capacity, Battery Voltage, and Current.
So, besides the Sensor drivers there are 2 drivers needed:

- Internal Driver
- Output Driver

So the maximum number of Sensor-drivers is: 16 – 2 = 14
So there are 14 Sensor-drivers left for use with the CT2x sensors.
The total number of parameters is: 14 * 2 + 3= 31
So the number of parameters is no problem (31 < 64)
They can connect 14 CT2X sensors max.

5.7.3 Power Switch Limitations

The Power Switch is capable of powering sensors up to 200 mA. The output voltage is 12 volts DC.

5.7.4 Modem

The modem inside the SIMbox is capable of either GSM or CDMA communication, depending on the version purchased from INW. The GSM version has quad band support, so it can be used worldwide.

For selecting the proper frequency band, use the "modem settings" in the configuration menu. In most cases GPRS communication is requested, so use a GPRS enabled SIM-card to allow this operation. Consult your local telecom provider for the right SIM-Card and – settings. If GSM communication is requested, use a GSM-DATA subscription. GSM communication is suitable for modem dial in communication. We strongly advise activating this option in the SIM cards used in the logger. This is often used to re-configure a logger, remotely, or to monitor actual values. In most cases, normal GPRS communication is sufficient for the operation of the data logger.

5.8 Data Format

The SIMbox/SIMtube data format uses different records for data output. There are two types of data records:

- D-records
- S-records

Header:

In every log file, first a header is transmitted. This header contains all information about the data following in the next records. The syntax of the header is;

<'L'> <';'> [<Parameter Code> <';'> < Parameter Name > <';'> < Parameter Unit> <';'>]

This means that the line starts with an 'L' character, followed by a semicolon, then the code, name and unit of the parameter. These last 3 elements must be repeated for each logged parameter.

Example header:

```
L;RCi;Rest Capacity;%;PTi;Processor Temperature;C;Vi;Voltage;V;AVGCi;Average
Current;mA;0Ci;0perating Cycle;sec;S%;GSM Signal;%;MAXCi;Max Current;mA
```

So the header consists of these elements:

1. L
2. Parameter Code
3. Parameter Name
4. Parameter Unit
5. ;

Parameter Code:
An abbreviation of the full Parameter name. This code has a maximum of 7 characters.
All characters are allowed except a semi-colon (;), which is reserved for a separator. If the customer is running their own version of OMC-Data-Online, this code must match the code exactly as it appears in the SQL database.

Parameter Name:
The name of the logged parameter. It may be up to 31 characters long

Parameter Unit:
The unit representing the physical dimensions of the measurement. This may be up to 15 characters long.

.

5.8.1 D-Records

Most of the data is logged into D-records. D-records stands for Data records. The syntax of this record is;

<'D'> <';'>,<Timestamp> <';'> [<Parameter Code> <';'> < Parameter Value >[<Data Modifier>] <';'>]

The D-record consists of a 'D' character followed by a timestamp, and after that, one or more series of parameter code and parameter name.
Thus, the D-record consists of these elements:

1. D
2. Parameter Code
3. Parameter Value
4. Optional Data Modifier
5. ;

Parameter Code:

An abbreviation of the full Parameter name. This code has a maximum of 7 characters.
All characters are allowed except semi-colon (;), which is reserved for a separator.

Parameter value:

The numeric value of the measurement. Together with the information from the header this forms the measurement.

Example Data-record(s):

```
D;110928030200;RCi;95.8;PTi;50.1;Vi;3.6;AVGCi;71;0Ci;0.25;MAXCi;71
D;110928030300;RCi;95.8;PTi;49.3;Vi;3.6;AVGCi;71;0Ci;0.25;MAXCi;72
D;110928030400;RCi;95.8;PTi;49.5;Vi;3.6;AVGCi;72;0Ci;0.25;MAXCi;72
D;110928030500;RCi;95.8;PTi;49.1;Vi;3.6;AVGCi;72;0Ci;0.25;MAXCi;54
D;110928030600;RCi;95.8;PTi;49.1;Vi;3.6;AVGCi;54;0Ci;0.25;MAXCi;72
```

System-records

The System-records are used to log system related information. Thus, system-records do not contain normal measurements. A system-record is made when an awkward situation is encountered, for instance, when a sensor is not replying to a request from the logger. System-records are used for monitoring system-performance. The syntax of an S-record is:

<'S'> <';'>,<Timestamp> <';'> [<System Message> <';'> < Additional System Message> <';'>]

The S-record consists of an 'S' character followed by a timestamp, and after that, one or more series of parameter code and parameter name.
Thus, the S-record consists of these elements

1. S
2. System Message
3. Additional System Message
4. ;

System Message:

A short and comprehensive message to explain the type of problem encountered

Additional System Message:

Some more information on the exception

Example S-records:

```
S;110922202054;CFG_RESET
S;110922202054;CFG_CHANGED;Brasil_3002389
S;110922202124;MODEM_WDT;STATE 10
```

5.8.2 Data Modifiers

Normally a data value presented in the D-records is recorded without Data Modifiers, but in case of a malfunction, or in rare circumstances, a Data Modifier is added to the data value. See table below:

Data Modifier	Description	Remarks
*T	Timeout	The sensor did not provide the data logger with a data value, and the timeout has expired. The previous data value is recorded, with the addition of this exception.
*I	Data Invalid	The data logger, did receive a data value from the sensor, but it was out of bounds. This exception is very rare
*A	Alarm Value	The datalogger has received a value, which is outside the limits of the particular parameter.

5.9 Transmission of the logfile

When data is sent to the receiver (by means of ftp or tcp) the user can choose which records he wants to use as output. Thus, a user can decide to output only D-records to the data presentation-server (by means of tcp) and, for example, the system records to his private email. In this case, only in case of bad performance of the data logger, an email with system information is send. This is because S-records are written by the data logger only in case of special events. Examples of these events are: SD-Card failures, a change of configuration, a timeout of a sensor, and a retry of sending data via the modem.

Here an example of an email with S and D records;

```
L;RCi;Rest Capacity;%;PTi;Processor
Temperature;C;Vi;Voltage;V;TMP;Temperature;C;PRS;Pressure;psi
S;110922202054;CFG_RESET
S;110922202054;CFG_CHANGED;Brasil_3002389
S;110922202124;MODEM_WDT;STATE 10
D;110922203000;RCi;99;PTi;59.5;Vi;3.6;TMP;22.1;PRS;15
```

5.10 Input-drivers

Input-drivers obtain data from sensors. Various sorts of sensors can be connected to the data logger. When a sensor needs a "warm-up time" the power output switch can be used to power the sensor before the measurement is taken. The maximum time for a power delay is 5 minutes.

Note:
The Power Switch output consumes a lot of power, so try to minimize this. Consult the manual of the sensor for warm up times. A warm up time of 5 minutes is possible and can be used in rare situations, such as some types of dissolved oxygen sensors. This will shorten the battery life tremendously. In such rare cases, consult INW for a calculation of battery-life, before exploiting your data logger.

5.10.1 Analog sensors

The analog inputs are calibrated inputs which are factory-calibrated. The electrical specifications are listed below. The ADC converter is a 12 bit type and software algorithms are used to obtain the most accurate result. Note that the Voltage inputs can be used as a current-input, by adding an external parallel resistor. Contact INW for more information.

Input	Range	Accuracy	Impedance
1	0 – 20 mA	< 0.1%	150 Ohm
2	0 – 20 mA	< 0.1%	150 Ohm
3	0 – 3.3 V	< 0.1%	1 M Ohm
4	0 – 3.3 V	< 0.1 %	1 M Ohm

5.10.2 Digital sensors

Rain Gauge

Most rain gauges are based upon the "reed contact" principle. The rain gauge has an internal bucket with a very precise volume. It is constructed to tip over when it reaches a specified amount of water. The water is drained and while the bucket is turning, a magnet triggers a magnetic switch, a so called "reed contact." Thus, the rain gauge itself works like a passive switch. The data logger has a special input to trigger on these events. Even when the data logger is sleeping, the event of a tipping bucket is never missed. The data logger uses a so called "interrupt-input" to make this possible. To connect a rain-gauge, use this interrupt input and connect the other side of the rain gauge to the 3.6V output.

Note:
The rain-gauge offers the most energy-friendly measurements available. This is because the data logger is allowed to sleep most of the time and only capture the events of the tipping bucket. In the situation where only one rain gauge is used, the battery is likely to last much longer than with any other measurement. The data logger sends its data only if it is available. That means when it hasn't been raining for 3 days, no data is transmitted on those days. For safety reasons a user can include some internal measurements in the configuration to allow monitoring of the performance of the system. Those data-records are sent normally.

5.11 Power supply, power connections, backup power, power consumption & Battery Life

The SIMbox/SIMtube is designed to work on a 3.6VDC battery, but using the external Power supply cable, it is possible to work on a voltage range of 8-30 VDC.

5.11.1 Connection of 8 – 30 V power

Any voltage between 8V and 30V.
Some ripple is allowed.(<200mV p-p), e.g., 12V battery with solar panel.

Pay attention to “unloaded” Solar Panels. When you connect two solar panels (12 volts) in series, and you don’t connect the batteries, the voltage may drift above 30 Volts. For solar powered systems, we recommend using a 12 volt system.

5.11.2 Internal RTC backup battery

The SIMbox/SIMtube contains an internal battery to keep the internal real-time-clock running. The lifetime of the battery is at least 10-20 years, so this battery requires no exchange during the lifetime of the data logger. The battery is a coin cell and is soldered to the printed circuit board.

5.11.3 Power consumption & Battery Life

The SIMbox/SIMtube is equipped with an internal power monitor. During the active mode of the data logger, this power monitor keeps track of the power consumption of the device. When the device is going into sleep-mode, a fixed value is used to calculate the power consumption. Both are calculated and offer a fairly accurate measurement of the power consumption. Unfortunately, the behaviour of batteries is, in practice, much more complicated than the calculation made inside the data logger. Thus, the capacity written on the back of the battery is only a typical value. Things such as shelf life, ambient temperature, current draw, and peak current draw affect the performance of the battery.

Therefore, we strongly recommend using the measurements regarding battery life as an indication only. We also recommend replacing the battery when it reaches10%.

5.12 Pin Description

5.12.1 Analog Current Inputs AIN1 & AIN2

These are current-inputs, with an input impedance of 150 ohms. The range is 0-20 mA. The circuits are equipped with over current-protection. To use these inputs, connect a current source between the input and ground.

Analog Voltage Inputs AIN3 & AIN4

These are voltage-inputs, with an input impedance of 1 M ohms. The range is 0- 3.3 Volts. The circuits are protected with over-voltage protection. To use the inputs, connect a voltage source between these inputs and ground.

5.12.2 Ground

There are some terminals which hold ground level, this provides both sensor-ground and battery ground. For your convenience, these terminals are connected to multiple pads on the connector PCB, because every single sensor will need its own ground. You can connect multiple sensors. When more connections are needed, just connect a wire and put the additional connections in parallel.

5.12.3 RS 485 A & B

These are the pins for RS485 communication. Use these pins together with a ground signal. These signals are ESD-protected by the driver-circuit. The signal levels are according to the TIA/*EIA-485* Standard.

5.12.4 Power Switch

This is an output to drive one or more sensors. It holds a level of 12 volts and is capable of driving up to 200 mA. For your convenience this signal is available on multiple pads.

5.12.5 VBAT +

This is the main power supply input for the board. There are two terminals for this signal, for better performance. The voltage is 3.6 Volts.

Note: This signal is NOT the same as the internal 3.6 volts level. The power-supply circuit converts this level to the fixed, internal, 3.6 Volts level. This voltage level is allowed to be between 0.8 volts and 5 Volts. We strongly recommend using a 3.6 Volts Power source only. The actual voltage on this pin is monitored by the firmware. It is called “Primary input Voltage.” Also the current, flowing through the 2 wires, is monitored and is called “Primary input Current.”

5.12.6 RX & TX COM 1 & Com 3

These are the pins for RS232 communications. Use these pins together with ground. All pins are protected against ESD. Voltage levels are according RS232 standard.

5.12.7 RX3 & TX3

These are pins for serial communications with an option-module. These pins are NOT protected for ESD, and may NOT be used for connection to outside sensors. The voltage levels are TTL and not RS232. (0-5 Volts) The logical levels are NOT inverted, like the RS232 ones, so a logical level is directly interpreted by the microcontroller. These signals are for future use, with option-modules. We recommend NOT using them yet.

5.12.8 SDI-12 Hi

This is the in/out terminal for SDI-12 communication. It is protected against overvoltage. Use this terminal together with ground. See www.sdi-12.org for more information.

5.12.9 Digital input

This is an interrupt-driven input with an internal pull-down resistor. To use it, connect a switch between the 3.6V and this terminal. It is suitable for energy meters, water meters, and rain-gauges.

5.12.10 +3V6

This is a power output. It is used to power external sensors or a potentiometer. It has a voltage of 3.6 volts and is capable of driving up to 100 mA.

5.12.11 RTC 512 / ON OFF EXT

At the factory this terminal is used for calibration of the RTC. For the user it is used to drive an option-module. This terminal is not capable of actually driving a module, but it is used for signalling the on/off state of the module. This terminal is for “internal” use.

Digital input:

This is an interrupt driven input.

5.12.12 Antenna placement and field strength

An antenna is required for modem operation. Normally you will require a dual-band antenna suitable for 900 MHz and 1800 MHz.

Depending on local field strength a simple whip antenna direct connected to the SIMbox/SIMtube will work. However, some applications may require a specialized, high-gain antenna.

5.12.13 Field strength

You can monitor the actual field strength through the configuration software (menu). The field strength may vary on atmospheric conditions, so we recommend you to make sure that it is maximized at installation.
The field strength may also vary with the growth of vegetation (trees tend to block the signal). We also recommend configuring the SIMbox in such a way that the GPRS field strength is recorded. In this way you can get an early warning when the field strength gets low.

What to do to get a better field strength signal;

- Make sure the antenna is mounted in accordance with the manufacturer's instructions. Note there are antennas (whip antennas) that require a metal surface below the antenna; others (dipole antennas) do not.
- Make sure that all connectors on the antenna and antenna cable are tightened and free of moisture.
- Make sure the antenna is in vertical position. The GSM and GPRS radio signals are vertically polarized, thus, the antenna should be vertically positioned for maximum performance.
- Do not place the antenna near metal surfaces or structures. Be aware that various building structures contain metal (e.g. steel mesh as reinforcement for concrete).
- Place the antenna outdoors.
- Identify the nearest GSM tower for your provider. Place the antenna in a location that provides a free line-of-sight to the tower.
- If you cannot identify the nearest GSM tower for your provider, place the antenna in a high position; generally, higher is better.
- Use good quality (low-loss) antenna cables. Generally, the thicker the cable, the better.
- Avoid unnecessary adaptors and connectors in the antenna cable, as every "joint" causes a significant signal loss (0.5 to 1 dB).
- Use an antenna with a higher antenna gain. (Simple stubby antennas can have a gain of -9db, a rod antenna can have an antenna gain of 0 or 4 dB or higher. Note that the allowed radio power is limited to 1W/2W. An antenna with a higher gain is only allowed when this only compensates for the cable and connector losses). Directional antennas can have a very high gain in just one direction, and are normally not allowed.
- Seal your antenna-connector with vulcanising tape, to prevent oxidation

5.12.14 SIM card Compatibility

Make sure the SIM you intend to use is compatible with your network and the pin code protection is disabled.

6 Safety

6.1 Power supply

The data logger is protected against reversed polarity of the power. For the 1-5 volt connection there is an easily accessible fuse. When the fuse melts it needs to be replaced with a “4A T 230 V mini” type.

6.2 ESD

The SIMbox data logger is equipped with an ESD (Electronic Static Discharge) protection on all “outside world” leads, i.e., comports and analog inputs, etc. Though it is designed to withstand a certain amount of electrical discharge (human body model) it is strongly advised to take precautions while operating or servicing the data logger.

7 Maintenance and Repair

7.1 RTC Lithium Battery replacement

The battery of the SIMbox data logger is designed to last for the lifetime of the instrument. It should not be necessary to replace this battery. If, for some reason, it has to be replaced, it has to be performed by INW at the factory.

7.2 3.6V Lithium Battery replacement

Replacement of the 3.6V Lithium battery must be done in a clean & dry environment. It is recommended to replace the desiccant bag at the same time.
When replacing the battery, reset the battery counter for a correct battery indication (see chapter 4.1).

```
Internal sensors

[0] Exit
[1] Name                    >> Internal
[2] Sample interval         >> Normal 00:00:01; Alarm Not Used
[3] Battery Capacity (mAh)  >> 13000
[4] Battery replaced        >> Yes
[5] Rest Capacity           >> Rest Capacity
[6] Rest Power              >> Not Used
[7] Processor Temperature   >> Processor Temperature
[8] Voltage                 >> Voltage
[9] Current                 >> Not Used
[A] Max Current             >> Not Used
[B] Min Current             >> Not Used
[C] Average Current         >> Not Used
[D] Free Disk Space         >> Not Used
[E] Operating Cycle         >> Not Used
[R] Remove
>
```

7.3 Recalibration

Calibration of the data logger has been performed during manufacturing. INW guarantees the calibration for at least two years. However, in most cases, the calibration will last for the lifetime of the instrument.
Calibration is important for high accuracy measurements and in situations where time stamping is very important. The logger has a NTP-time-synchronize option, which is selectable by the user (see chapter 4.1).
The parts of the data logger that could need re-calibration are:

- Analog inputs
- Real time clock

For most applications, the analog inputs are sufficiently accurate and need no re-calibration for the lifetime of the instrument. In special cases, however, where the user demands a high precision measurement, the analog interface may be re-calibrated after that period. High temperature deviations and harsh environments

are factors that needed to be considered. Please contact your local supplier for more information on recalibration needs and support.
The real time clock is also calibrated during the manufacturing process, and has very good long life stability (see spec. sheet).

7.4 XRAY

In the uncommon event of exposure to XRAY, extra precautions are needed. When the device is shipped many times, and is scanned for a security check, the analog input calibration will be harmed. Although the level of radiation is very low, the data logger can be harmed if the number of times that it is exposed to radiation exceeds 10. What will happen is that the analog interface will drift outside its spec's. As a precaution the user can shield his device, with a metal can, to prevent from damage.
Normally, the impact of these security-scans is very low and causes no problems.

8 Environment and disposal

The SIMbox/SIMtube is manufactured in compliance with the RoHS directive (Reduction of Hazardous Substances) EU directive 2002/95/EC, which means in popular terms that the product is "lead-free".

When the SIMbox/SIMtube is taken out of service, dispose it in accordance to the local regulations at the time the product is disposed.

Regulations for disposal of batteries may be different. Remove the batteries and dispose of them in accordance to the local regulations for batteries

9 Specifications

Protection	Power reverse polarity protection				
Input Range	0.8 ~ 5 Vdc				
Type of Power	Battery				
Power Consumption *	Sleep mode		Operating mode		Send mode
	360 uW	< 100 uA @ 3.6 Volts	180 mW	50 mA @3.6 Volts	~1 Watt	~ 300 mA @ 3.6 Volts
General Enviroment					
Temperature	Operating: -30 ~ + 75 °C; Storage -40 ~ +85 °C				
Humidity	5 ~ 100 % RH				
IP Protection	IP 65				
Operation					
Batterylife	up to 4 years; consult user manual for more information				
Configuration Programming	Via USB port ; no special software needed; uses hyperterminal or other terminal program				
Data Retrieval	Manually exchange micro SD-card; Automatic via GPRS (Email / FTP / Native protocol) Via USB-Connection by means of a Computer (Windows)				
Alarming	On pre-defined thresholds of measurements; Via SMS, Email				
PowerSwitch	Internal voltage convertor for supplying remote sensors ; 200 mA @ 12 Volts				
System					
CPU	ARM Cortex M3				
Clock Frequency	72 Mhz				
Watchdog	Yes				
RTC(Real Time Clock)	Yes, internally calibrated; accuracy < 100 ppm; Battery Backuped				
FLASH Memory	512 KB				
SRAM	64 KB				
NVRAM	84 bytes , battery backup, data valid up to 20 years				
Analog inputs	12 bits				
Temperature sensor	Yes				
Power Sensor	Yes, Monitors power consumption, rest-capacity of battery				
Expansion Bus	One, for optional modules. Extra I/O, GPS, future functionality				
USB port	USB 2.0 full speed interface				
Sample Frequency	max 4 Hz				
Datalog Frequency	max 4 Hz				
Rohs Compliant	Yes				
Analog Inputs					
Number of Channels	4				
Resolution	12 bits				
Input type	0 ~ 20 mA (Channel 1 & 2); 0 ~ 3.3 V (Channel 3 & 4)				
Memory Card					
Type	micro-SD				
Capacity	2 GB				
Filesystem	FAT 32				
Communication Ports					
SER1	RS232; TxD, RxD; Non-isolated;Enhanced ESD Specification: ±15kV Human Body Model;				
	Speed: 115200 bps max. (230kbps on request)				
	RS485				
	SDI12				
SER2	RS232; TxD, RxD; Non-isolated;Enhanced ESD Specification: ±15kV Human Body Model;				
	Speed: 115200 bps max. (230kbps on request)				
Counter input					
Type	One Digital input 0 ~ 3.6 Volts; Internal pull up; 50 Hz max. storage of value in Non Volatile Ram, even after battery replacement				
GPRS / GSM Modem					
Frequency Range	Quad Band EGSM 850 / 900 / 1800 / 1900 MHz				
Capabilities	GPRS / GSM / FTP / EMAIL / SMS				
GPS					
GPS Option Module	Option: not included . See manual				
Dimensions					
D x H	40 X 400 mm				
Weight					
Netto Weight	320 Grams (including battery)				

* The Power consumption in sleep mode is when data logger is idle, and no tasks performing. Only the RTC is running

Current Consumption @ Vbat 3.6 Volt

subject	value	remarks
Data logger Low power	< 100 uA	
Modem sleep	2 mA	Needs good GSM signal
Data logger Active	65 mA	
FTP Mail Transfer	300 mA	Needs Good GPRS signal

10 Pinconfiguration USB

Molex connector 4 way	Function	Description	WireColor	Name	Comments
1	+5V	VCC	Red	X3	
2	D-	Data negative	White	X3	
3	D+	Data positive	Green	X3	
4	GND	Ground	Black	X3	Pin 4 is next to J1

11 Supported serial sensors

Sensorname	Brand	Parameter	Type	Remarks
GPS	Standard	Position	RS232	
ML 250	Isomag	Flow	RS232	
NEP 39x	Mc Van	Turbidity	RS232	
NMEA DBT	Standard		RS232	
NMEA HDG	Standard	Coarse over ground	RS232	
NMEA MWV	Standard		RS232	
AWAC Current	Nortek	see manual	RS232	
AWAC Wave	Nortek	see manual	RS232	
Thalimedes	OTT	Waterlevel	RS232/SDI12	
Serial String	Standard	multifunctional	RS232	
Sontek	Sontek	see manual	RS232	
YSI 600 series	YSI	see manual	RS232	
CT2X	INW	Conductivity	RS485	
PT2X	INW	Waterlevel	RS485	
PT12	INW	Waterlevel	RS485/SDI12	
Temphion	INW	see manual	RS485	
OMC506	Observator	see manual	RS485	
WPD40	Sensus	Water Quantity	Mbus	a special mbus converter is needed

12 Troubleshooting

If you encounter problems with the data logger, you can start checking the following.

- First try to set up a connection, via USB, and use the program, OMC-040-terminal, to communicate with it.
- If that doesn't work, you have to check the battery-power, so you have to open the case. Do this in a dry and clean environment, NOT in the field. Normally a flat battery is preceded by an alarm-message.
- Check the fuse.

Most parts of the data logger are tested at startup. To monitor the messages which are issued at startup, you have to connect a PC/terminal to the debug port.

Attention*:*

The default DEBUG port is serial port 1, but when a sensor is connected to this port, the DEBUG port becomes SER 1. If both ports are in use, you can use the USB port as the debug port, but you won't be able to see startup-messages. In this case it is advised to remove a sensor from the configuration, temporarily.

```
OMC-040 Logger Version 0.2 Build 4
<12:20:05>
2011/10/07 12:20:05
Init User Interface
Init Modem Interface
Init SD Card
File system OK
Init System Monitor
Start up from Power on
POWER_ON;System log...done
SYS_START;System log...done
Init NTP Time update task
Init Sensors Internal
Init Sensor GSM signal
Init Email
Init TCP
Running
```

These are typical start up messages:

Explanation:
The data logger starts and initializes its peripherals. First, an overview of the firmware version is given, and then a timestamp. This timestamp should be accurate – carefully check the timestamp. If it is slightly wrong, it must be adjusted. If it is totally out of date, it designates a RTC-problem. There should be NO errors on this startup. If there are errors contact your local SIMbox-dealer. A screen dump of the startup messages will help to solve the problem.

An example of a defective data logger is given below. This data logger does not have its micro SD card installed. You can clearly notice the problem by looking at the startup messages.

```
OMC-040 Logger Version 0.2 Build 4
<12:29:21>
2011/10/07 12:29:21
Init User Interface
Init Modem Interface
Init SD Card
File system error
Init System Monitor
Start up from Power on
POWER_ON;System log...File system
error
SYS_START;System log...File system
error
Init NTP Time update task
Init Sensors Internal
Init Sensor GSM signal
Init Email
Init TCP
Running
```

When there is no debug output visible at all, contact INW.

Attention:

Always connect the USB-cable to the PC, even when you are connected to the serial port for debug output. When the data logger is NOT connected by USB, it will switch into low power mode (Auto Sleep), and you won't get any debug data.

13 Transport and Storage

The following requirements are applicable for transport and storage of the SIMbox/SIMtube.

Storage:

Humidity	< 95% (Non condensing)
Temp	10 – 30 °C

Transport:

Humidity	< 95% (Non condensing)
Temp	10 – 30 °C

The SIMbox is delivered in a protecting case. It is strongly recommended to use this case for all transportation until the final location of operation. This case is especially designed to protect the data logger from being damaged.

For Sales and Service, please contact:

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www.inwusa.com
800-776-9355 or 425-822-4434

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