



Wireless NetCommunication

# Artmon

Climatic monitoring system  
for works of art

User guide

Developed in cooperation with



THE NATIONAL MUSEUM  
OF ART, ARCHITECTURE  
AND DESIGN



# Content

1	Introduction.....	3
2	Artmon components .....	3
3	The Artmon wireless sensor .....	4
3.1	Normal operation.....	5
3.2	Internal sensor .....	7
3.3	External interfaces.....	7
3.4	LED interpretation .....	7
3.5	Charging the Artmon sensor .....	8
3.5.1	Charging with external power adapter.....	8
3.5.2	Charging through USB interface .....	9
3.6	Attaching the sensor to the painting .....	10
4	Artmon configuration tool.....	11
4.1	Installing Artmon configuration tool .....	11
4.2	Artmon sensor configuration .....	11
4.3	Alarm settings .....	13
4.4	Sending test SMS:.....	15
4.5	Setting the time of day for the SMS transmission:.....	15
4.6	GSM/SMS settings: .....	16
4.7	Firmware update: .....	18
5	Artmon web application .....	19
5.1	Normal operation.....	19
5.2	Starting the web application .....	19
5.3	Create item.....	21
5.4	View/edit/delete item .....	22
5.5	Devices .....	24
5.6	Device graph .....	25

# 1 Introduction

Artmon gives you an efficient tool to monitor the climatic condition of the paintings and other works of art that are on lent to other museums or other exhibitions around the world.

The wireless Artmon sensor attaches to the respective painting and continuously reads temperature and relative humidity. On configurable intervals these measurement data are reported back to the central Artmon database through the world-wide GSM network. This enables the sensor to report measurement data both during transport and while the painting is shown in the visiting exhibition hall.

This user manual covers the installation and operation of the Artmon system. For more information about the Artmon system, please see the Artmon system description.



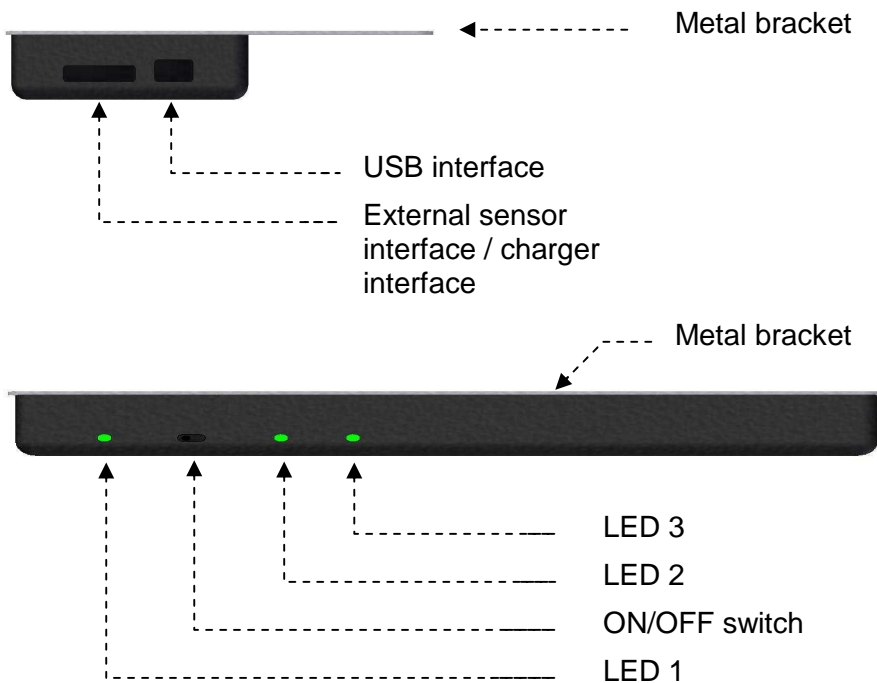
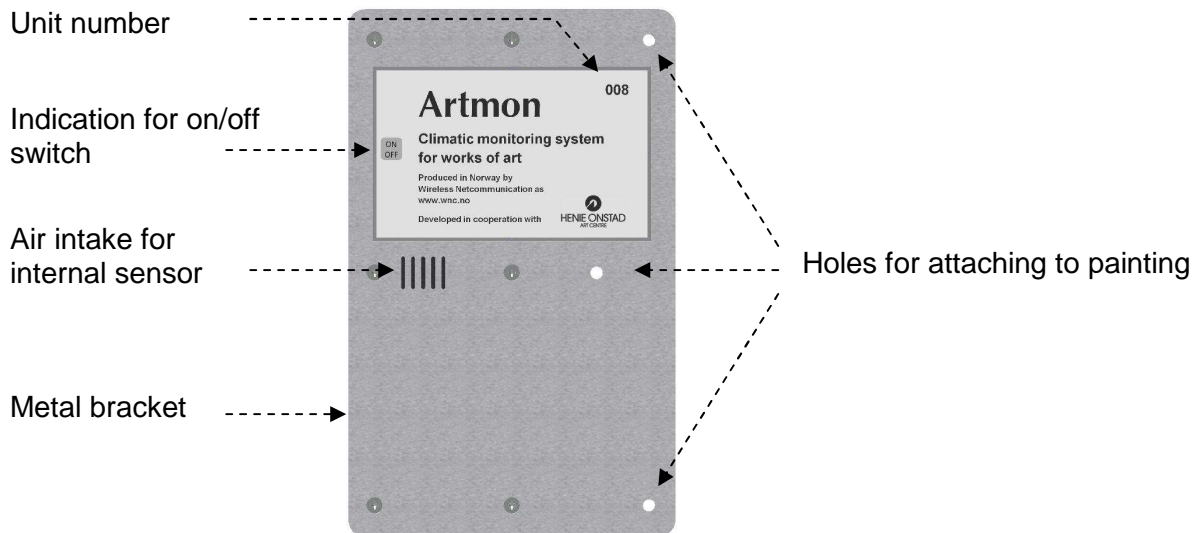
*Artmon wireless sensor*

## 2 Artmon components

The Artmon system consists of the following component:

1. Artmon wireless sensor
2. Artmon web application
3. USB cable
4. Power adapter/charger
5. Power cable

### 3 The Artmon wireless sensor



## 3.1 Normal operation

### ***Measurement interval***

When switched on the Artmon sensor measures the air temperature and relative humidity at configurable intervals. The intervals are set by the Artmon configuration tool (see separate chapter below in this document). Following intervals are possible: 5 min, 15 min, 30 min, 1 hour, and 2 hours.

Each measurement is an average calculated from 5 samples taken between each measurement interval. For example, if the measurement interval is set to 5 minutes, the sensor will actually measure the temperature and RH every minute. After 5 minutes, an average temperature and RH is calculated and stored as a measurement in the sensor.

### ***Sending interval***

As long as the sensor is in an area with GSM coverage, the sensor will report all stored measurements at regular intervals through the SMS service in the GSM network. The sending interval is depending on the measurement interval as follows:

Measurement interval	Sending interval
5 min	4 hours
15 min	12 hours
30 minutes	24 hours
1 hour	48 hours
2 hours	96 hours

(This relation between the measurement interval and sending interval ensures that all SMSs sent are filled with measurement data, and therefore taking full advantage of the data capacity offered by the SMS service).

As soon as the mobile sensor detects that the SMS was successfully transmitted, the SMS and all respective measurement data are deleted from the sensor database.

### ***GSM subscription / SIM card***

Each Artmon sensor includes a GSM modem and needs a GSM subscription and a SIM card in order to operate (as any other mobile phone). The GSM subscription and the SIM card is provided by Wireless Netcommunication as.

### ***Forwarding alarms to a mobile phone***

It is possible to set alarm thresholds for both temperature and relative humidity on each Artmon sensor. If this function is activated, the sensor will send an SMS (to a predefined mobile phone, configurable) as soon as it detects measurements outside the predefined conditions. The following information is included in each alarm:

- Name and id of mobile sensor
- Date and time of alarm
- Alarm description (e.g. temperature is too high)

Each Artmon sensor sends maximum one alarm per day.

### ***When outside GSM coverage***

If the sensor is moved to an area outside GSM coverage (for example on ships or in basements) it will not be able to report the measurement data to the central data system at the regular sending intervals. In this situation, the sensor will act as a normal data logger and store the measurement data in the internal data memory. The internal memory allows up to 24.576 measurements. When the memory is full, the sensor will start to overwrite the oldest measurements with new measurements.

As soon as the sensor is moved to an area with GSM coverage, the sensor will start transmitting the measurement data collected during the time the sensor was without GSM connection. Since the sensor is programmed to send SMS at certain intervals, it may take several hours (and up to a few days) before all measurement data is reported in to the central database.

### ***GSM deactivated during flight transport***

The GSM modem on the sensor may be turned off during transport in airplanes. This is done by the Artmon configuration tool (see separate chapter).

As soon as the GSM modem is turned back on, the sensor will transmit all measured data that was collected during the time the modem was turned off.

### ***Battery operation***

The Artmon sensor runs on rechargeable batteries that are dimensioned for up to 1 year operation before recharging is needed. The charging interval depends on the sending interval set on the sensor as follows (estimate)

Sending interval	Estimated charging interval
4 hours	3 months
12 hours	6 months
24 hours	9 months
48 hours	12 months
96 hours	18 months

Note: These estimates will not necessarily apply if the sensor is kept outside GSM coverage for a long time. Outside GSM coverage, the sensor will attempt to connect to the GSM network at shorter intervals, and therefore shortening the charging interval.

When the battery voltage decreases to a certain level (approaching the time when recharging is needed), the sensor automatically goes into an energy saving mode where data logging continues but the GSM is turned off. This makes it possible for the sensor to act as a data logger for an extended period (estimated 3 – 6 months). These measurement data collected in this period will be retrieved as soon as the batteries have been recharged.

### **3.2 Internal sensor**

The Artmon sensor detects temperature and relative humidity through a sensor mounted inside the unit. Air intakes both on the front and on the side ensures correct monitoring of the surrounding air at the same time as it filters out any high frequency (but non-damaging to works of art) fluctuations in temperature and humidity.

### **3.3 External interfaces**

There are two interfaces to the Artmon sensor:

1. USB interface. This interface is used to connect the sensor to a PC for configuration of the sensor. The batteries are recharged while connected to the PC through USB. It can take up to 15 hours to fully recharge the batteries through the USB interface
2. External sensor / charging interface: This interface may be used to connect an external sensor (eg. Light sensor). This function requires an SW upgrade. The same interface is used when charging the sensor batteries with power adapter (fast charging).

### **3.4 LED interpretation**

There are 3 LEDs (light emitting diodes) on the Artmon sensor. The table below summarises the interpretation of the different light signals. The positions of the three LEDs are indicated in the figure in chapter 3.

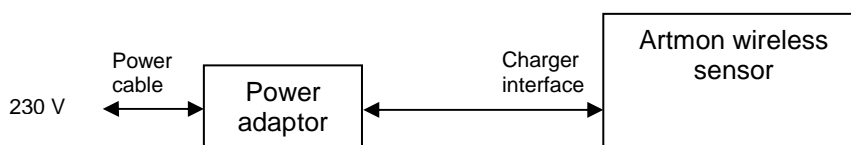
LED	Comment
LED 1 (PC connection)	Constant red light indicates that the Artmon sensor is correctly connected to PC (USB driver is installed in PC)
LED 2 (Charging status)	Blinking green when the batteries are recharging
	Constant green light when the batteries are fully recharged (and the sensor is connected to the the PC or power adapter).
	Constant red light when the temperature is below 10°C. The batteries are not recharging.
LED 3 (Activity)	One green blink when the sensor is switched on.
	One red blink when the sensor is switched off.
	Constant green light during the time the GSM modem is activated and is trying to send SMS. This normally takes 20-30 seconds.
	One long red blink following the green light indicates that the sensor failed to send SMS. (The sensor will try again 1 - 2 hours later depending on model).
	One green blink every minute indicates the Artmon sensor is activated (switch in ON position and/or the Artmon sensor is connected to PC)
	One green blink every time a measurement is made.

### 3.5 Charging the Artmon sensor

The Artmon sensor is equipped with rechargeable batteries. (Please note that it is not possible to change the batteries on the unit since the batteries are fixed permanently inside the unit). The time before the batteries needs to be recharged depends on how the unit is used. It is expected that the batteries will last one year before recharging, provided it is set to sending an SMS every 2 days.

#### 3.5.1 Charging with external power adaptor (2-3 hours)

The figure below shows how to recharge the batteries inside the Artmon sensor.



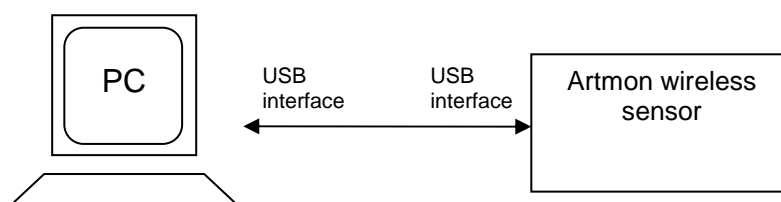
The procedure for recharging the batteries with the external power adaptor is as follows:

1. Turn off the Artmon sensor. The LED 3 should blink red for approx 1 second to indicate that the unit has been switched off.  
*Note:* The LED will not respond with a red blink if the batteries are completely empty. In this case the recharging through the power adaptor will not start correctly, and the sensor should be recharged with the USB interface (as explained in chapter 3.5.2) for approx 15 minutes until the LED 2 starts blinking green.
2. Connect the power adaptor to 230V mains. The LED on the power adaptor will give a yellow light.
3. Connect the power adaptor to the Artmon sensor. The charging of the batteries will start when the LED on the power adaptor blinks orange.
4. When the batteries are close to fully charged (after up to 2 hours), the LED on the power adaptor will start blinking more slowly and alternating between green and orange. The power adaptor will continue this process until the batteries are fully charged. This “top off” process may take up to 1 hour. However, the top-off process may be interrupted at any time without affecting the charging of the batteries very much.
5. When the top-off charging is finished, the LED on the power adaptor will give a constant green light. In this state the power adaptor will maintain the battery charge, but will not add any more charge to the batteries.  
*Note:* The power adaptor should not be connected to the Artmon sensor more than 24 hours.
6. When the power adaptor is disconnected from the Artmon sensor, the Artmon sensor can be switched on.  
*Note:* The recharging of the batteries will heat up the Artmon sensor a few degrees, which means that the sensor will show too high temperature readings and too low RH readings for a short period following the recharging.

*Note:* If the batteries have been fully discharged, the internal clock of the Artmon sensor may have stopped. In this case the internal clock needs to be reset to correct time as explained in chapter 4.2.

### 3.5.2 Charging through USB interface (10 – 15 hours)

It is also possible to recharge the batteries while the unit is connected to the PC through the USB interface.



The batteries are recharged only if the correct USB drive is installed in the PC. The batteries will not be recharged when the PC is in hibernate mode.

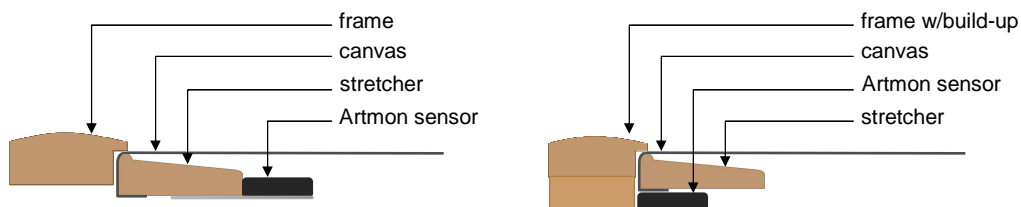
LED 2 shows the charging status. The LED is blinking green during charging. The batteries are fully charged when LED2 is showing constant green light. (See also the chapter on LED interpretation above).

### 3.6 Attaching the sensor to the painting

Before the sensor is attached to the painting, the sensor needs to be configured through the Artmon configuration program (See separate chapter below).

It is recommended that the batteries are fully charged before attaching the sensor to the painting.

The sensor is attached by using 3 appropriate screws that are screwed through the 3 holes in the metal bracket and into either the frame build-up or the canvas stretcher. The figures below show two alternative ways of attaching the sensor unit to the painting.



The figure on the right, shows the Artmon sensor attached directly to the stretcher on the back side of the painting. The metal bracket is designed to give a stable and secure attachment to the painting.



## 4 Artmon configuration tool

The Artmon configuration tool is a PC tool used to configure the different Artmon sensors.

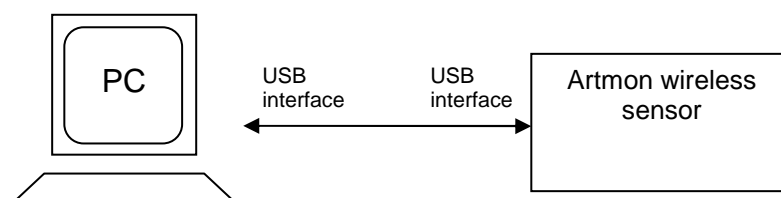
### 4.1 Installing Artmon configuration tool

The configuration tool is available at [www.artmon.no](http://www.artmon.no).

1. Log in with user id and password
2. Click on “Download Configurator”
3. Follow the instructions that are showed on the screen.

### 4.2 Artmon sensor configuration

In order to configure the Artmon sensor, the sensor needs to be connected to the PC through the USB interface. The figure below shows how to connect the Artmon sensor to the PC.



LED1 will show a red light when the Artmon sensor is correctly connected to the PC.

When the Artmon configuration tool is launched on the PC, the following window appears on the screen:



The program will automatically look for Artmon sensors connected to the PC. Press “connect” in order to establish connection between the Artmon sensor and the PC program. (It is possible to connect only one Artmon sensor to the configuration tool. However, several Artmon sensors can be connected to the PC for charging the batteries). The following window will appear:



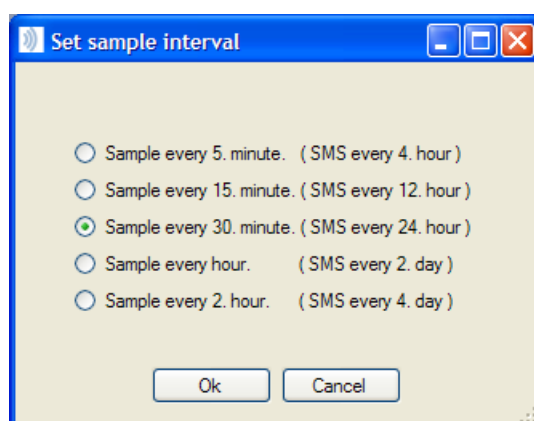
*Main window: Device information*

The following functions are available from this window:

1. Read the actual temperature and RH measurement.
2. Set sample interval. It is possible to change the time intervals between each measurement (default every 30 minutes), and the time interval between each time the unit sends SMS (default every 24 hours).
3. Set a different time periods for when the GSM modem shall be deactivated. This function is used if the unit will travel by plane.
4. Set internal clock. This function may be used if the unit is to travel to another time zone (and it is desired to read local time), or if the internal clock is incorrect due to a complete discharge of the batteries.

Note: The batteries will start recharging as soon as the sensor is connected to the PC through the USB interface. Therefore the battery voltage indicated by the configuration tool will give a higher reading and can not be used to evaluate the state of the battery.

To change the sample interval, select “Change”. The following window appears:



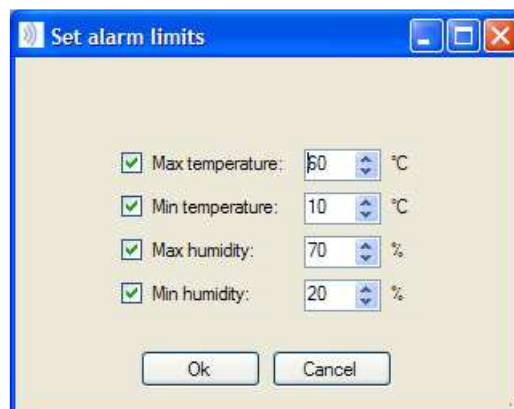
*Set time interval*

### 4.3 Alarm settings

The Artmon system can be set to generate an alarm if measurements fall outside user-defined threshold values. The user decides which threshold values to apply (both upper and lower limits). As soon as the temperature or relative humidity is outside of the defined range, the system generates an alarm that is sent to a mobile phone as an SMS.



The threshold values are set by choosing “Change alarm limits”. The following window appears:



The alarm limits are deactivated by hocking off the respective limits.

The alarms are sent to the mobile phone as defined by the user in “Change alarm number” in the alarm settings window.



#### 4.4 Sending test SMS:

In order to see if the unit is functioning correctly, it is possible to send a test SMS by choosing “Send test SMS”. The SMS will immediately be sent to the same mobile phone as defined for receiving alarms.

When selecting “Send test SMS”, the following window will appear:

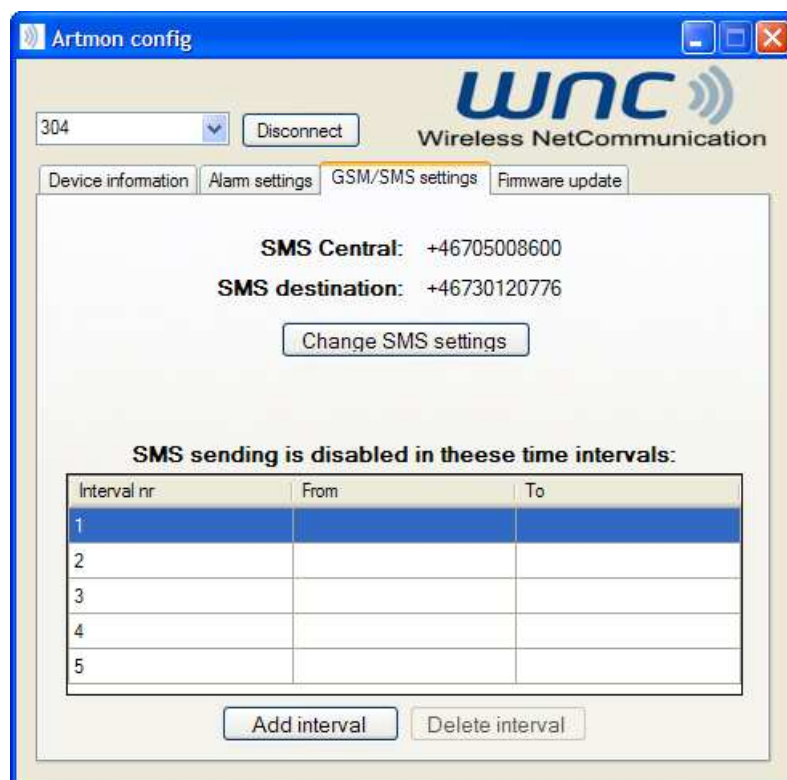


#### 4.5 Setting the time of day for the SMS transmission:

The Wireless sensor sends the SMS only on the hour (for example at 11:00 every 24 hours). In the Artmon 1b version it is not possible to define which hour the SMS will be sent. However, it is possible to influence this by using the on/off switch on the wireless sensor. Turn off the unit for a few minutes and then turn it back on at the approximate time of the day you want the unit to send the SMS.

## 4.6 GSM/SMS settings:

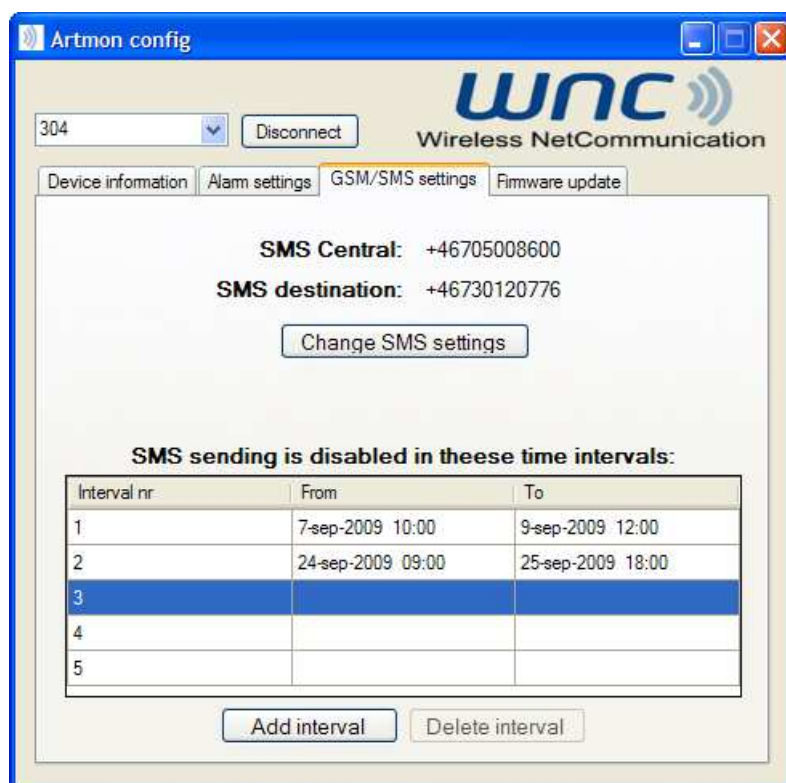
All SMS from the Artmon sensor are sent to a dedicated server that is defined by two different phone numbers. These two phone numbers are indicated in the “GSM/SMS settings” window. The user should not alter these numbers unless asked by Wireless Netcommunication as.



In the same window it is possible to define several periods when the GSM modem will be deactivated. The main purpose of this function is to have the GSM modem deactivated during the time the sensor is on a plane. These time periods are defined by selecting “Add interval”. The following window will appear:



After having selected the wanted time periods when the GSM modem should be deactivated, the window may look as follows:



## 4.7 Firmware update:

The last window in the Artmon configuration tools shows the version of the installed software.



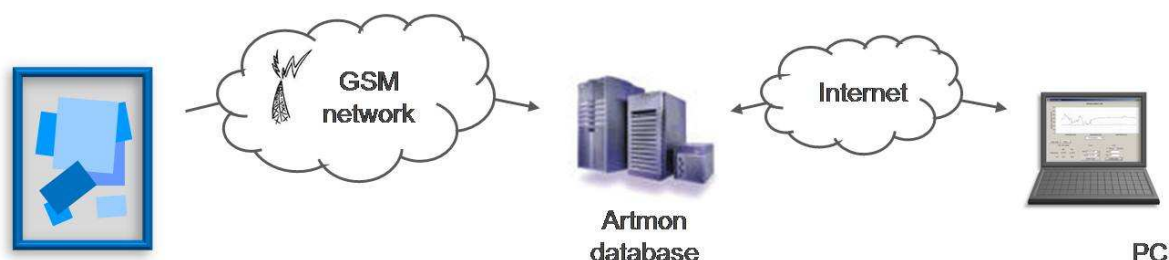
The user should not alter any data on this window unless asked by Wireless Netcommunication as.

## 5 Artmon web application

### 5.1 Normal operation

Each mobile sensor sends in the measurement data through the SMS service in the GSM network. Each SMS contains the following information:

- Mobile sensor id
- Measurement data
- Battery status (voltage)
- Date and time of each measurements



The central database will store all the SMS messages that are received from the different mobile sensors. The messages are stored in the database for several years and are available for the Artmon web application (through Internet).

The Artmon web application is available at any PC connected to Internet, provided correct user id and password.

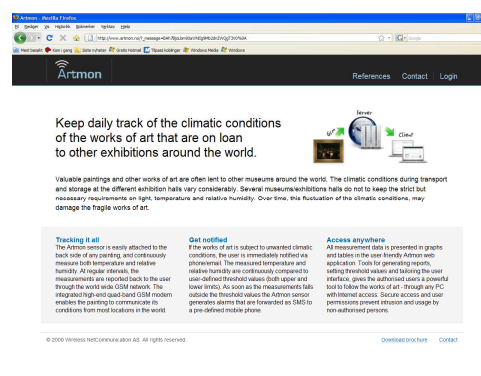
### 5.2 Starting the web application

The Artmon web application is available from the Artmon homepage

[www.artmon.no](http://www.artmon.no)

To enter the web application, select “Login” at the top right corner of the Artmon homepage.

Enter user name and password. (Contact Wireless Netcommunication as if user name and/or password is missing or incorrect)



When having entered the correct user name and password, the following page will appear:

The screenshot displays the Artmon web application interface. At the top, there is a navigation bar with the Artmon logo and menu items: Items, Devices, and Help. Below the navigation bar is a search field for items and an 'Add new item' button. The main content area is divided into two sections. The first section, 'Available measurement devices', shows three devices (301, 302, 304) with green battery status indicators. The second section is a table of monitored items, each with a small line graph showing temperature and relative humidity trends. The footer contains copyright information, user status, and links for configuration and logout.

Item	Last measurement	Temperature	Relative humidity	Device
Barcelona 1	08. Sep, 08:00	23.5C	45.0% RH	307
Barcelona 2	08. Sep, 09:35	26.0C	39.0% RH	303
Chicago	08. Sep, 08:00	23.2C	44.0% RH	310
Girl on Chair	29. May, 00:00	20.5C	46.0% RH	
New York	23. Aug, 10:00	20.2C	55.0% RH	305
Old painting test	08. Sep, 10:00	20.2C	54.0% RH	308
Shine on you 45	08. Sep, 09:35	20.2C	49.0% RH	306
Tree on hill	08. Sep, 10:00	20.2C	55.0% RH	309

This page shows all the items (objects, paintings) being monitored and which devices (representing the Artmon sensors) that are used for the respective items.

Devices (Artmon sensors) that are not currently attached to an item will appear in the field marked "Available measurement devices" just above the list of items.

The following functions are available from this page:

- Add new item
- View last measurements
- View battery status (green fill).

There will be no items the first time the Artmon web application is started. The user must define the items and attach the sensor to the item.

### 5.3 Create item

When an Artmon sensor is attached to a works of art (e.g. painting), this painting should be created in the Artmon web application as an item, and the corresponding device (Artmon sensor) should be attached to it.

For example, the user wants to monitor a painting that will be sent to an exhibition in Barcelona, and attaches Artmon sensor number 307 to the painting. The user should do the following steps in the Artmon web application:

1. Select “add new item”
2. Chose a name of the new item (for example “Barcelona 2”)
3. Write a short description (optional)
4. Press the icon “Add item”

The new item will now appear in the list of items.

5. Attach the corresponding sensor (device 307) by drag and drop the device from the “Available measurement devices” onto the new item in the list.

The corresponding device will now appear to the right of the corresponding item as shown in the list of items in the figure above.

All measurements made by the corresponding sensor (device 307 in this example) will now show up under the new item. Until then it will say “No measurement” in the column marked “Last measurement”

## 5.4 View/edit/delete item

The user can view the measurement in a graph by selecting the item in the list. The following page will appear:



The following functions are available from this page:

- View graph
- Select time period of graph (top left on the page); 7 days, 30days, 90 days or Custom. When selecting “custom”, please note that two dates must be selected in the same calendar window before the new graph will appear.
- Zoom in on graph by drag and drop with the mouse
- Zoom out by double click
- View temperature measurements below 0°C by selecting “Toggle axis” at the top left of the graph. Please note that after having selected “Toggle axis”, the two y-axis will show different scales; the one to the left will give the temperature (-50°C to +50°C) and the one to the right will give the relative humidity (0% to 100%).

- Read the measurements from any given time by pointing at the corresponding point on the graph.
- Add a comment to any point in the graph by a double click on the desired point in the graph. The comment may be edited/deleted by selecting “Edit comment” at the bottom right of the page.
- Edit the time period which the device has been connected to the item by selecting “Edit attachment” at the bottom right of the page.
- Edit name and/or comment of each item by selecting “Edit item” at the top right of the page.
- Deleting item by selecting “edit item” and then selecting “delete item”
- Exporting the measurement data to Excel file by selecting “Export” at the top right of the page. Please note that the data exported will correspond to the time period shown on the graph. If a different period is desired for the exported data, the user should first select time period by the icons on the top left of the page (as explained above).
- Creating a report in pdf by selecting “Print” at the top right of the page. The report will include a graph and any comments made to the graph. The report will cover the same time period as is shown in the graph when selecting “Print”. If a different period is desired for the report, the user should first select time period by the icons on the top left of the page (as explained above).
- Printing graph by first selecting “Print” and then print the pdf document that is created.
- Go back to the list of all items by selecting “Back to list” on the top right of the page.

## 5.5 Devices

The devices in the Artmon web application represent the Artmon sensors. All devices belonging to the user should be represented by a device in the web application. If this is not the case, please contact Wireless Netcommunication as.

It is possible to get an overview of all the devices by selecting “Devices” on top right of the page. The following page will appear:

The screenshot shows the Artmon web application interface. At the top, there is a navigation bar with the Artmon logo and links for 'Items', 'Devices', and 'Help'. Below the navigation bar is a table listing various devices. Each row in the table contains the following information: Device ID, Attached to (location), Last measurement (date and time), Temperature (with a small line graph), Relative humidity (with a small line graph), and Battery (voltage). The table lists devices 301 through 310. Device 301 is marked as 'Available' and has no measurements. Other devices show their last measurement date and time, along with their current temperature and relative humidity. The battery status is also provided for each device.

Device ID	Attached to	Last measurement	Temperature	Relative humidity	Battery
Device 301	Available	No measurements			
Device 302	Available	30. Jun, 13:00	17.0C	51.0% RH	3.769V
Device 303	Barcelona 2	08. Sep, 09:35	26.0C	39.0% RH	4.192V
Device 304	Available	07. Sep, 07:00	22.5C	41.0% RH	4.026V
Device 305	New York	23. Aug, 10:00	20.2C	55.0% RH	3.802V
Device 306	Shine on you 45	07. Sep, 07:15	24.5C	39.0% RH	4.19V
Device 307	Barcelona 1	07. Sep, 13:00	25.8C	36.0% RH	4.201V
Device 308	Old painting test	08. Sep, 10:00	20.2C	54.0% RH	3.799V
Device 309	Tree on hill	08. Sep, 10:00	20.2C	55.0% RH	3.8V
Device 310	Chicago	07. Sep, 11:00	24.8C	40.0% RH	4.131V

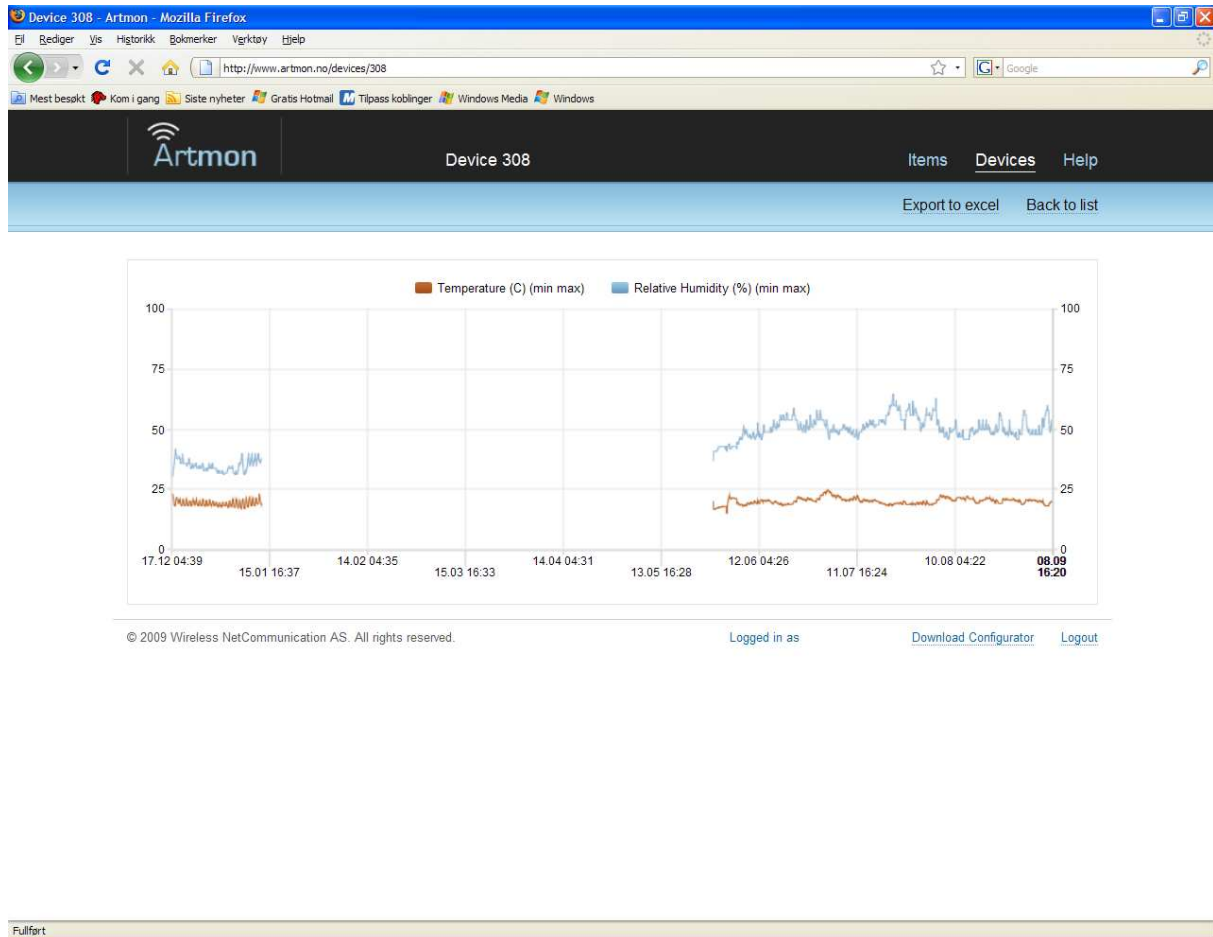
© 2009 Wireless NetCommunication AS. All rights reserved. [Logged in as](#) [Download Configurator](#) [Logout](#)

The following functions are available from this page:

- View graph for each device by selecting device.
- View graph for each item by selecting item in the column “Attached to”.
- View which item the different devices are attached to. The devices that are not attached to a certain item are marked as “Available”.
- View battery status (in voltage). The GSM modem will be turned off when the voltage decreases to 3.5V.

## 5.6 Device graph

The user can view the measurement (graph) from a certain device by selecting the device in the list. The following page will appear:



This page shows all the measurements made by the respective sensor (device) since the sensor was registered in the system. There will be gaps in the graph corresponding to the periods the sensor has been turned off. The following functions are available from this page:

- View graph
- Zoom in on graph by drag and drop with the mouse
- Zoom out by double click
- Exporting the measurement data to Excel file by selecting “Export” at the top right of the page. Please note that the data exported will correspond to the time period shown on the graph. If a different period is desired for the exported data, the user should first select time period by the icons on the top left of the page (as explained above).