Hukseflux
Thermal Sensors

USER MANUAL **HUKSEFLUX SENSOR MANAGER**

Software for digital solar radiation sensors

This user manual supports Hukseflux Sensor Manager software v2424 and later

Cautionary statements

Cautionary statements are divided into four categories: danger, warning, caution and notice according to the severity of the risk.

DANGER

Failure to comply with a danger statement will lead to death or serious physical injuries.

WARNING

Failure to comply with a warning statement may lead to risk of death or serious physical injuries.

CAUTION

Failure to comply with a caution statement may lead to risk of minor or moderate physical injuries.

NOTICE

Failure to comply with a notice may lead to damage to equipment or may compromise reliable operation of the instrument.

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Introduction

Digital Hukseflux solar radiation sensors with a Modbus interface can be accessed via a PC. The communication with the sensor can be done via the user interface offered by the Hukseflux Sensor Manager software or by another Modbus testing tool. The Hukseflux Sensor Manager can be downloaded on the Hukseflux website. This manual describes the functionality of the Hukseflux Sensor Manager only.

The Hukseflux Sensor Manager software provides a user interface for communication between a PC and digital Hukseflux pyranometers and pyrheliometers with a Modbus interface. It allows the user to locate, configure and test one or more sensors and to perform simple measurements using a PC. The Hukseflux Sensor Manager's most common use is for initial functionality testing and setting the sensor's device address and serial communication settings. It is not intended for long-term continuous measurement purposes. For available software updates of the Sensor Manager, please check www.hukseflux.com/downloads. For support of the Sensor Manager software, please visit the Sensor Manager's online support page, which includes the latest user manual for installing and using the software.

This user manual supports Hukseflux Sensor Manager software v2424 and later.

NOTICE
Always use the latest version of the Hukseflux Sensor Manager.

1 Specifications

The recommended system specifications for using the Hukseflux Sensor Manager on a PC and the Hukseflux Sensor Manager specifications are shown in Table 1.1.

Table 1.1 *Specifications*

RECOMMENDED SYSTEM SPECIFICATIONS	
Operating system	Microsoft Windows 10 Microsoft Windows 11
Hardware interface	Serial port (COM port). For example: • a USB port and an appropriate USB-to-serial converter • a RS-232 port and an appropriate serial converter
HUKSEFLUX SENSOR MANAGER SPECIFICATIONS	
Software version	v2424
Supported sensors	• SR300-D1 • SR200-D1 • SR100-D1 • SRD100-D1 • SR30-M2-D1 • SR20-D2 • SR05-D1A3 • SR15-D1 • SR05-D2A2 • SR15-D2A2 • SR05-DA1 • SR05-DA2 • SR20-D1 • SR22-D2 • SR25-D1 • SR25-D2 • SR30-D1 • DR30-D1 • Generic Modbus RTU • Virtual SR300-D1 (see Appendix on the Virtual Sensor)

The appropriate serial converter depends on the sensor model and version; typically an RS-485 interface is required. Please refer to your instrument's manual.

2 Installation

The system and software requirements can be found in Table 1.1. The Hukseflux Sensor Manager can be downloaded from the Hukseflux website by downloading the *Hukseflux Sensor Manager-24.24.msi* installer. Double-click the file and follow the steps to install the software.

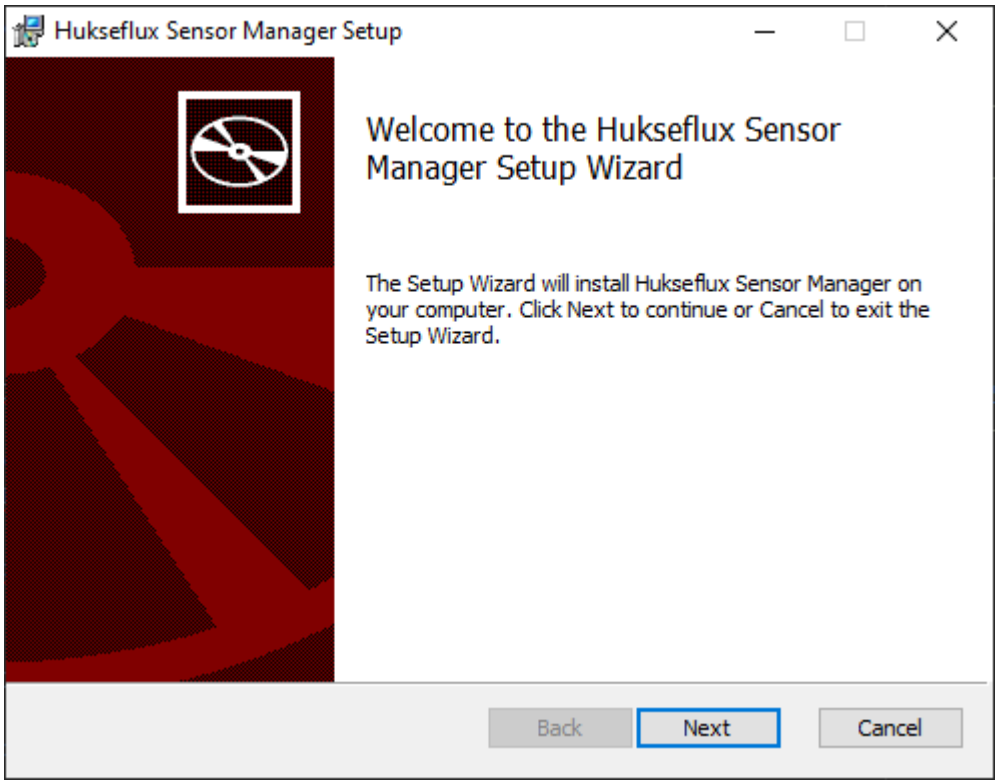


Figure 2.1: *Install window of the Sensor Manager.*

The Microsoft Windows 10 and 11 operating systems provide an additional layer of security for applications that are downloaded from the Internet. To install the Hukseflux Sensor Manager this needs to be disabled for the downloaded MSI file. Refer to the instructions provided by Microsoft in this article.

Please take note of the terms and conditions of the Hukseflux Sensor Manager and the included external libraries before installing the software. Licences of external libraries of the latest version are available after installation through the "About" menu.

NOTICE
By using this software, the user agrees with the terms and conditions of the software including the ones of the included external libraries.

For available software updates of the Sensor Manager, please check www.hukseflux.com/downloads

3 Usage

This chapter describes how to use the Hukseflux Sensor Manager to perform basic actions such as connecting to a sensor, display sensor data and logging sensor data. When the Sensor Manager is started, the main window, shown in Figure 3.1, will appear.

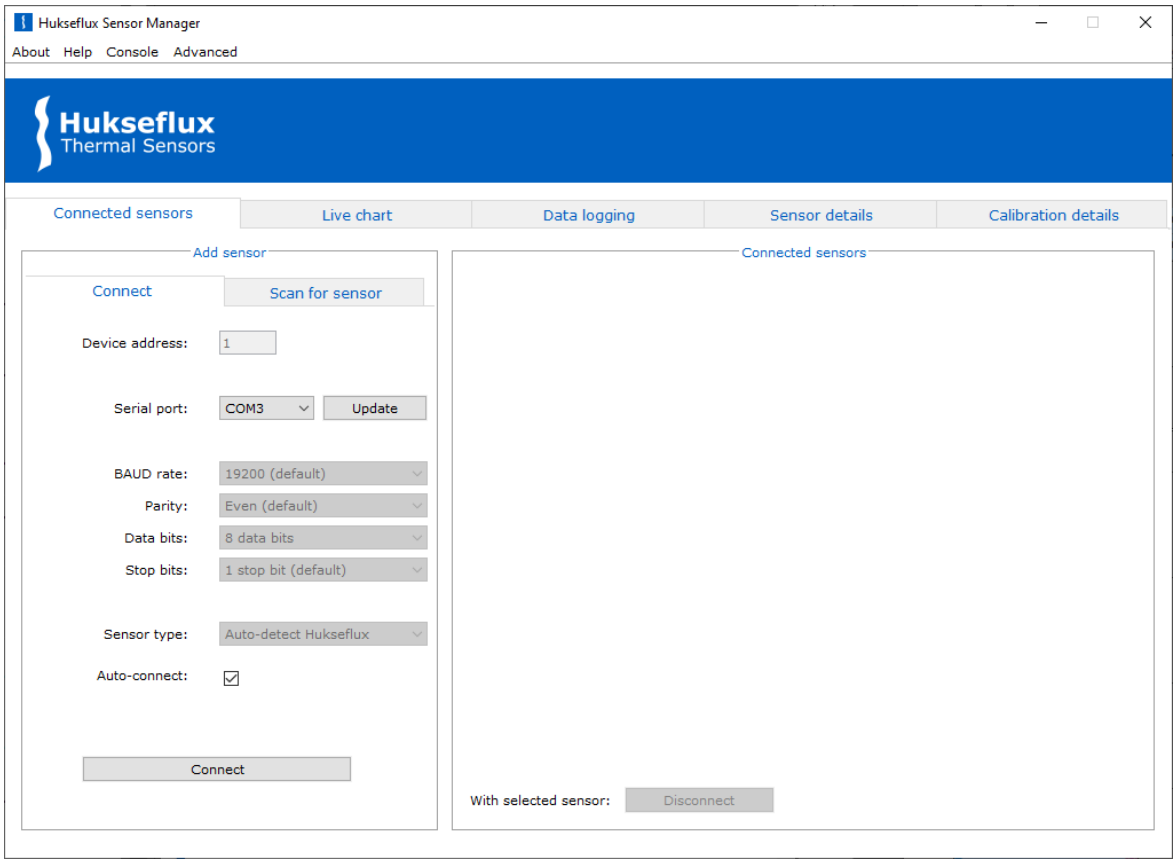


Figure 3.1 *Main window of the Sensor Manager.*

3.1 Sensor Manager information

In the top menu bar, the "About" and "Help" menu items provide information about the Sensor Manager. See Figure 3.1.1.

Figure 3.1.1 *"About" and "Help" buttons in the top menu bar.*

3.1.1 About

Clicking the "About" button in the top menu will open the "About screen", which can be used to retrieve information about the Sensor Manager such as the version and supported sensors (see Figure 3.1.1.1). By clicking on "See Licenses" an overview of all applicable software licences is shown.

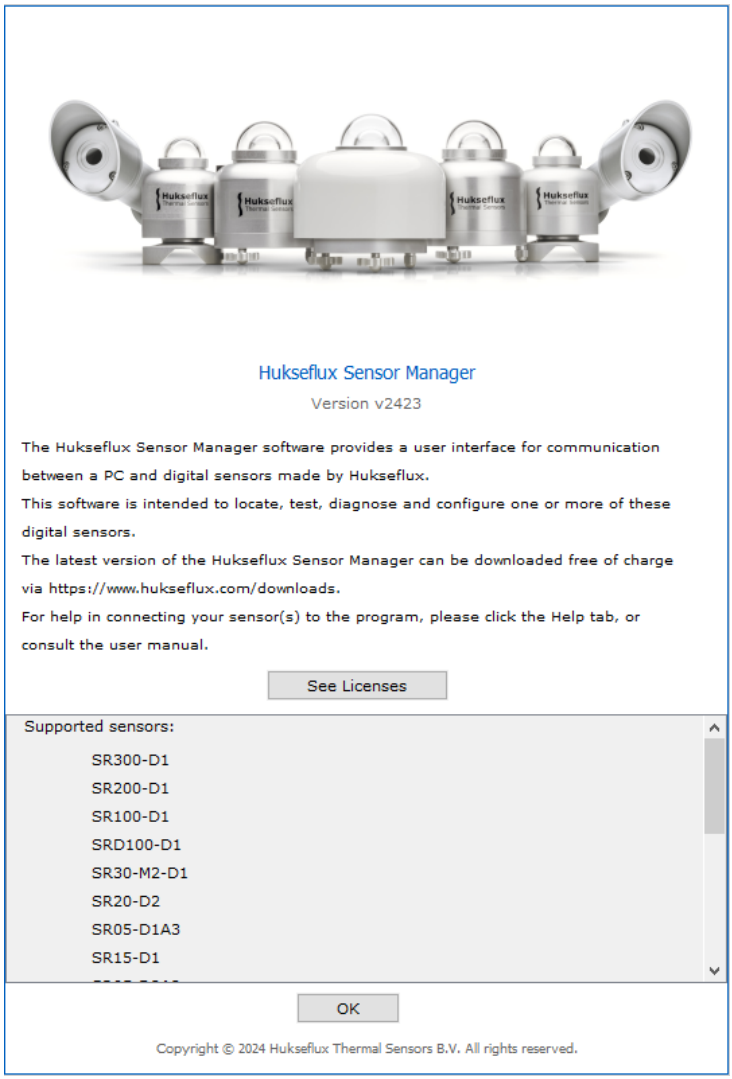


Figure 3.1.1.1 *About screen of the Sensor Manager.*

3.1.2 Help

The "Help" button in the top menu bar will open the online Sensor Manager support page in your default web browser. The user manual on that page offers help in connecting your sensor(s) to the program and in using the software.

3.2 Connecting to a sensor

There are four ways to connect to a sensor:

1. **Auto-connect:** Automatically connect to a sensor (Connect tab) – *only available for the SR300-D1, SR200-D1, SR100-D1, SRD100-D1 and Generic Modbus RTU sensors*
2. **Connect manually:** Manually enter the sensor's device address and serial settings ("Connect" tab)
3. **Scan for sensor:** Scanning a range of device addresses and serial settings ("Scan for sensor" tab).
    a. This can also be used to connect multiple sensors
    b. This is advised when the sensor's serial settings and address are unknown and Auto-connect (see below) can't be used
4. **Default Modbus map:** Automatically connect to a sensor using the default Modbus mapping of that sensor (Connect tab) – *only available for the SR300-D1, SR200-D1, SR100-D1, SRD100-D1 and Generic Modbus RTU sensors*

3.2.1 Auto-connect

This option is the preferred connection method for the SR300-D1, SR200-D1, SR100-D1, SRD100-D1 and Generic Modbus RTU sensors because no information about serial connection settings of the Modbus address is needed.
In the "Connect" tab, make sure the "Auto-connect" checkbox is checked and the right COM Port is selected. Now click "Connect." The Hukseflux Sensor Manager will attempt to connect to the sensor and display updates about the process. Auto-connect allows sensors to be connected even if serial settings and Modbus address are unknown.

NOTICE
Auto-connect restarts the sensor is connected.

3.2.2 Connect manually

To manually connect to a sensor make sure that the "Auto-connect" checkbox is unchecked. All settings need to be known a to connect manually.
The "Device address" field is used to specify the device address of the sensor that is being connected. The device address can be any value from 1 to 247. The "Serial port" drop-down menu is used to select the serial port to which the sensor is connected. When the "Update" button is clicked, all currently connected sensors will be disconnected and all available serial ports will be added to the drop-down menu. This action is needed when a serial converter is physically connected or disconnected. The "Baud rate", "Parity", "Data bits" and "Stop bits" drop-down menus are used to specify the sensor's serial settings. These drop-down menus in the "Connect" tab are identical to those in the "Scan for sensor" tab (see Section 3.2.1 Scan for sensor) except that there are no "unknown" options, since the serial settings must all be known in order to connect manually.
The "Sensor type" drop-down menu can be used to specify the sensor model. If "Auto-detect" is selected the software will automatically determine the sensor model. There is

also an option to connect a "Virtual SR300-D1" sensor. This option simulates an SR300-D1 sensor for testing and demonstration purposes. For more details on this see the Appendix on the Virtual Sensor. Once all settings are made press "Enter" or click on the "Connect" button to establish the connection. A sensor entry should appear on the right side of the main window or, if the connection times out, a message will appear stating the Sensor Manager failed to connect to the sensor and advising to search for the sensor by scanning through the possible serial settings.

3.2.3 Scan for sensor

With unknown serial settings, it is not possible to manually connect to a sensor. Note that for SR100-D1, SR200-D1, SR300-D1 and SRD100-D1 the "Auto-connect" feature can be enabled in this case, and the sensor is discovered automatically. For any other sensor, a search can be performed using the "Scan for sensor" tab in the "Connected sensors" main window. A full search can be performed, but if any of the settings are known the search will be much shorted. It is recommended to select the sensor model if this is known as this will also speed up the search.
Device address range" fields are used to specify the range of device addresses to be scanned. The fields can be set to any range within 1 to 247. Upon clicking the "Scan in device address range" button, the software will scan for sensors with device addresses in the specified range.
The "Serial port" drop-down menu is used to select the serial port that is to be scanned. When the "Update" button is clicked, all currently connected sensors will be disconnected, and all available serial ports will be added to the drop-down menu.
Using the "Baud rate", "Parity" and "Stop bits" drop-down menus, the serial settings can be set to match the sensor's settings. The "Data bits" drop-down menu currently only has one setting – 8 data bits – and is therefore fixed. If any of the sensor's baud rate, parity or stop bits settings is unknown, the "unknown" option can be selected for that specific setting. In that case, all possible settings will be tried for the unknown variable.
The "Sensor type" drop-down menu has several options:

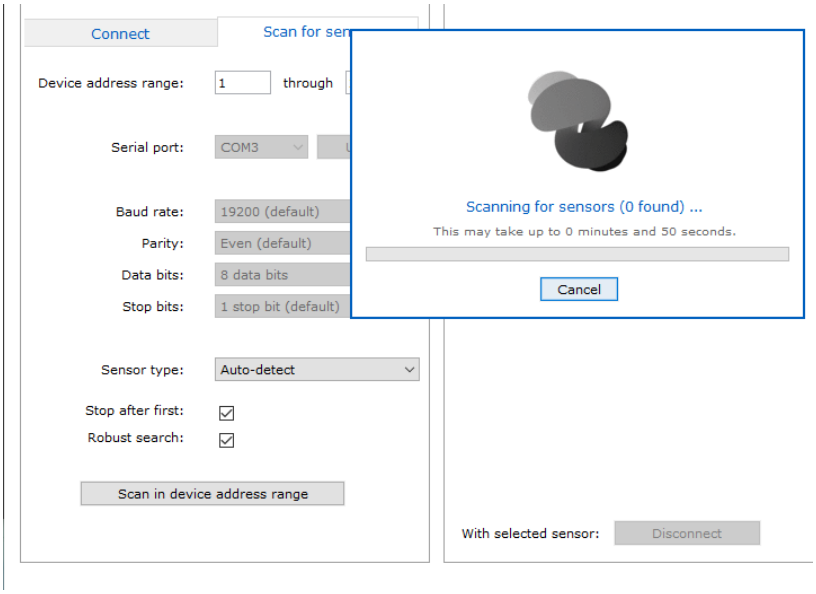
1. "Auto-detect Hukseflux", which will automatically determine the sensor type.
2. "Virtual SR300-D1" sensor, which can be used to connect a virtual sensor. This sensor simulates a physical sensor for demonstration and training purposes. For more details on this, see the Appendix on the Virtual Sensor.

After making the settings, press "Enter" to start the search or click "Scan for device in address range" to start the search. When the "Stop after first sensor" checkbox is checked, the scan will stop after the first sensor has been found. This is recommended if only one sensor is connected. When unchecked, the full range of device addresses and serial settings is scanned until a sensor is found and can be connected. A search will continue until all connected sensors are found, provided they have different (unique) Modbus addresses and the same serial settings. Since two sensors cannot communicate over an RS-485 bus with different serial settings, the search will stop once one or more sensors with a given set of serial settings in a given Modbus address range are found. Therefore, it is recommended to connect and discover the sensors one by one if the serial settings are unknown.

NOTICE
Connect a sensor on after the other if the serial settings are unknown.

3.2.3.1 Robust search

The "Scan for sensor" feature is designed for quick performance, while being as reliable as possible and not skipping over sensor. If a sensor is not found, the "Robust search" option can be enabled further enhance the reliability. This increases the timeout before for a serial configuration and executes a second attempt for the configuration which may be beneficial in case there is noise on the RS-485 bus. A robust search is much slower, but is even less likely to skip over a sensor. To activate this feature, check the "Robust search" box in the sensor manager (see Figure 3.2.3.1.1).



3.2.3.1.1 *Scan window showing robust search.*

3.2.3.2 Scan for sensor search time

When searching or *scanning* for sensors, the search time to complete the entire search depends on how many "unknown" settings are selected. An exhaustive search with "Robust search" enabled, with baud rate, parity and stop bits all set to unknown, takes approximately 10 minutes. With "Robust search" disabled, a full search takes about 2.5 minutes, but can be as short as 35 seconds when the sensor model is known. An estimation of the time to complete the entire search is displayed, as can be seen in Figure 3.2.3.2.

Tips to speed up the search:

- Select the sensor model from the menu if this is known
- Disable "Robust search" if performance is preferred over reliability
- Enable the "Stop after first" option if only one sensor is connected
- Use "Auto-connect" in the "Manual" connection tab if this is supported for the sensor (SR300-D1, SR200-D1, SR100-D1 and SRD100-D1)

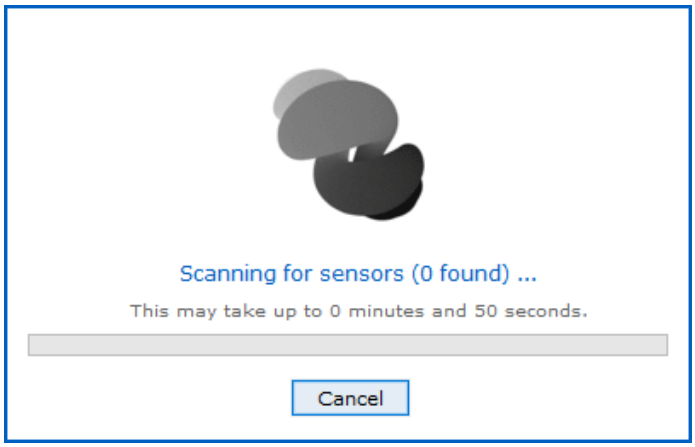


Figure 3.2.3.2.1 *Scan window showing the estimated time to complete the search.*

3.2.4 Default Modbus map

This option is only available for the SR300-D1, SR200-D1, SR100-D1, SRD100-D1 and Generic Modbus RTU sensors and is only available through the "Connect" tab.
With this option enabled, the Sensor Manager will attempt to use the default Modbus map when connecting to a sensor, without any alias mapping.

To enable the Default Modbus map option, click the "Advanced" drop-down menu in the top menu bar, hover the mouse over the "Connection Settings" submenu and click the "Default Modbus map (Connect manually only)" checkbox.

3.2.5 General

When an instrument is found, temperature and irradiance data are displayed (see Figure 3.2.5.1). Updates are performed automatically every second. Some sensors have some startup time due to a bootloader being active. During this time, signals from the sensor may show "ERR" temporarily. This may take up to 10 seconds after power-up or a soft reboot.

NOTICE
Sensor signals may show "ERR" for up to 10 seconds after power-up or a soft reboot.

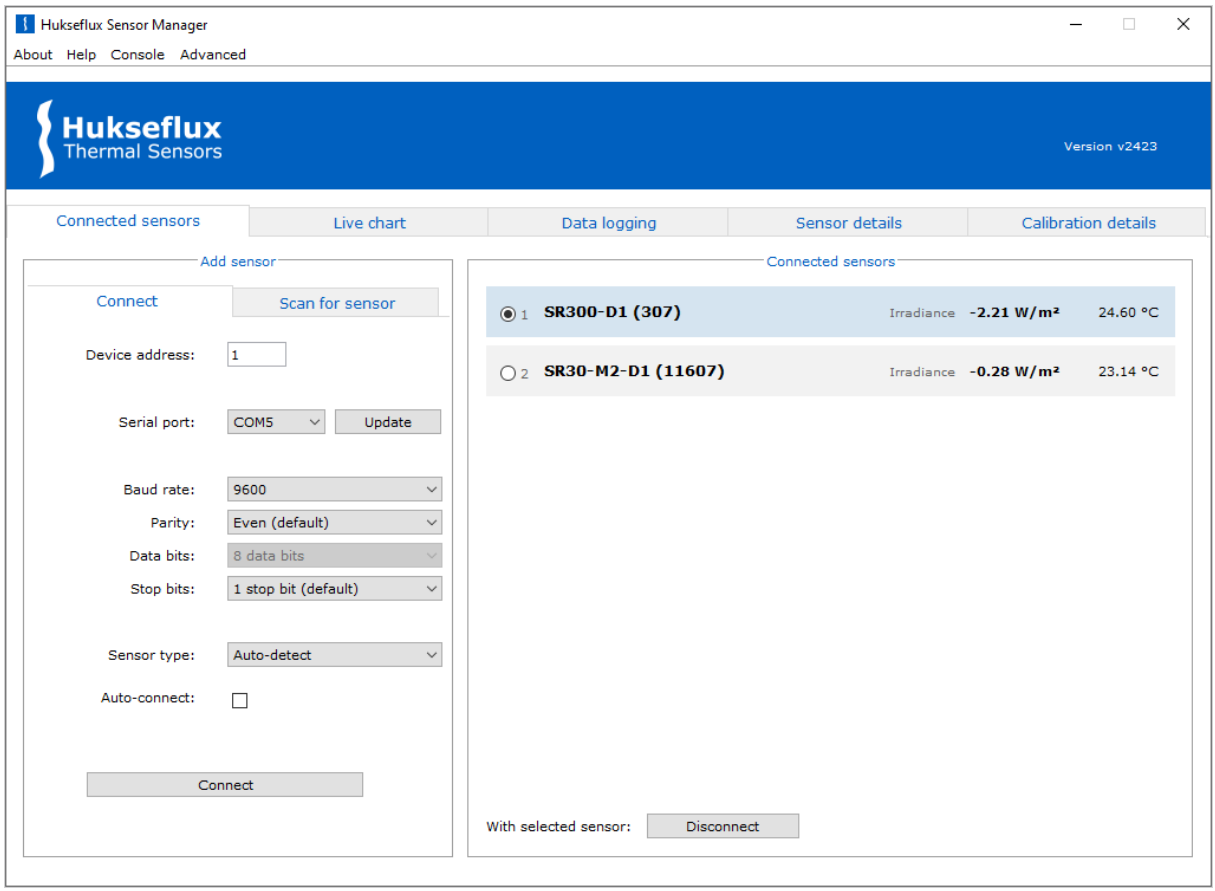


Figure 3.2.5.1 *Sensor Manager main window with two connected sensors.*

3.3 Live chart

The "Live chart" tab shown in Figure 3.3.1 can be used to display a live chart of the irradiance data from one or more sensors.

NOTICE
It is not possible to save data points using the "Live chart" functionality; only the displayed graph can be saved as an image. To save data points, use the "Data logging" functionality instead (see Section 3.4).

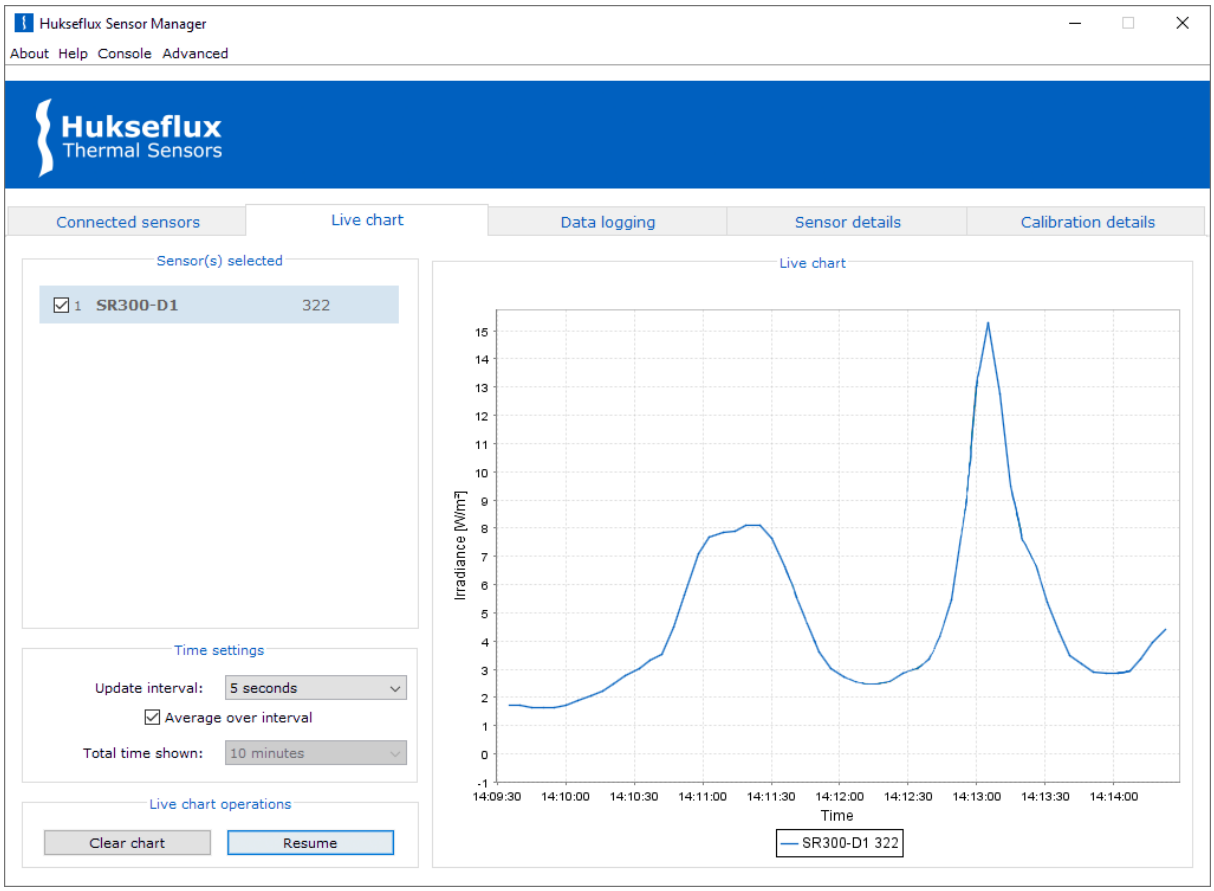


Figure 3.3.1 *Live chart tab offers a live chart of irradiance data from one or more sensors.*

3.3.1 Time settings

The update interval can be set to the desired value through the "Update interval" drop-down menu. When the "Average over interval" checkbox is checked, the average of all readings possible within the given interval – with a maximum of 100 readings – will be plotted in the Live chart plot.
The "Total time shown" drop-down menu determines how much data will be shown in the graph. For example, if the total time shown is set to one hour and there are two hours of data available, only the last hour will be shown. The time on the horizontal axis is the current time as obtained from the PC the program is running on.

3.3.2 Live chart operations

A live chart can only be started when there is no data being logged in the Data logging tab. When a live chart has been started, it is possible to pause it and resume at any other moment. Clearing the chart is done through the "Clear chart" button after a live chart has started.

3.3.3 Live chart options

The live chart has a range of options for zooming in and out, setting the auto-range, setting certain properties of the chart and for saving or printing it.

3.3.3.1 Zooming and auto-range

By right-clicking the live chart, it is possible to zoom in or out on the horizontal axis, the vertical axis or both. Alternatively, it is possible to zoom in on the live chart by holding down the left mouse button and dragging the mouse from left to right around the area on which to zoom in. Similarly, zooming out can be done by holding down the left mouse button and dragging the mouse from right to left. Auto-range can be set on both the "domain axis" as well as the "range axis", depending on the user's preferences.

3.3.3.2 Live chart properties

Certain properties of the live chart are set by right-clicking the live chart and selecting "Properties…" from the menu (see Figure 3.3.3.2.1). It is possible to set a title for the live chart, change the title of the axes, set specific colours for the background and change the title of the horizontal axis (domain axis) and vertical axis (range axis).

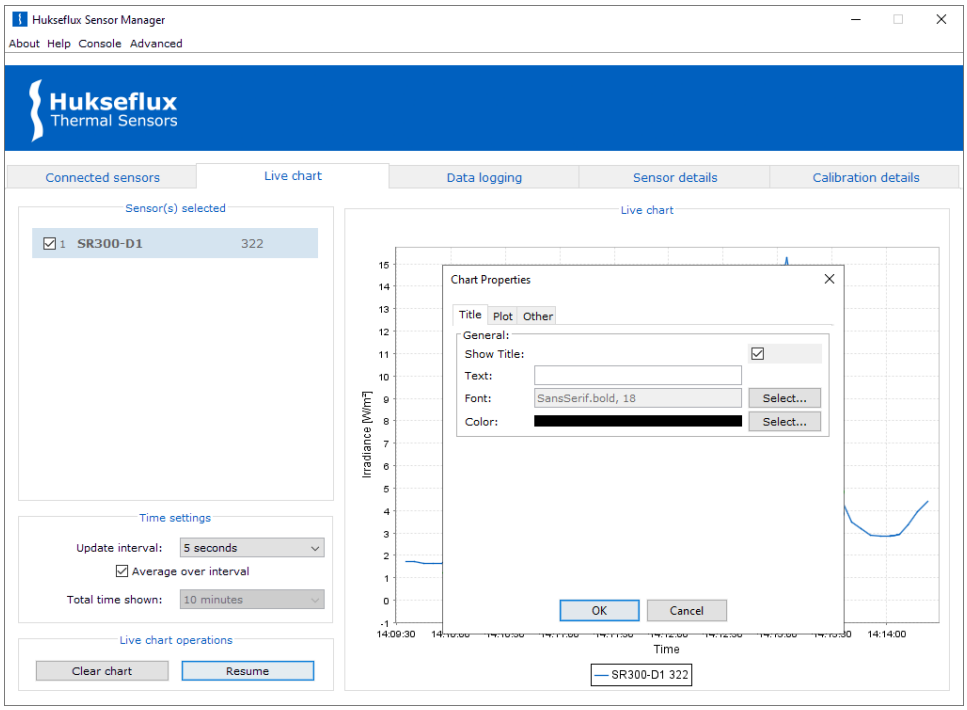


Figure 3.3.3.2.1 *Setting properties of the live chart.*

3.3.3.3 Saving or printing

The generated plot can be saved by right-clicking the plot and selecting "Save as…", after which the save location can be chosen. Printing the generated plot can be done by right-clicking the plot and selecting "Print…".

3.4 Logging data

The Hukseflux Sensor Manager is capable of logging data of sensors when no data logger is available. The data can be saved in Excel Workbook format (.xlsx) or in comma-separated values format (.csv). One or more sensors can be selected, from which the irradiance and temperature will be written to the file with an interval specified under "Update interval". See Figure 3.4.1 for the "Data logging" tab.

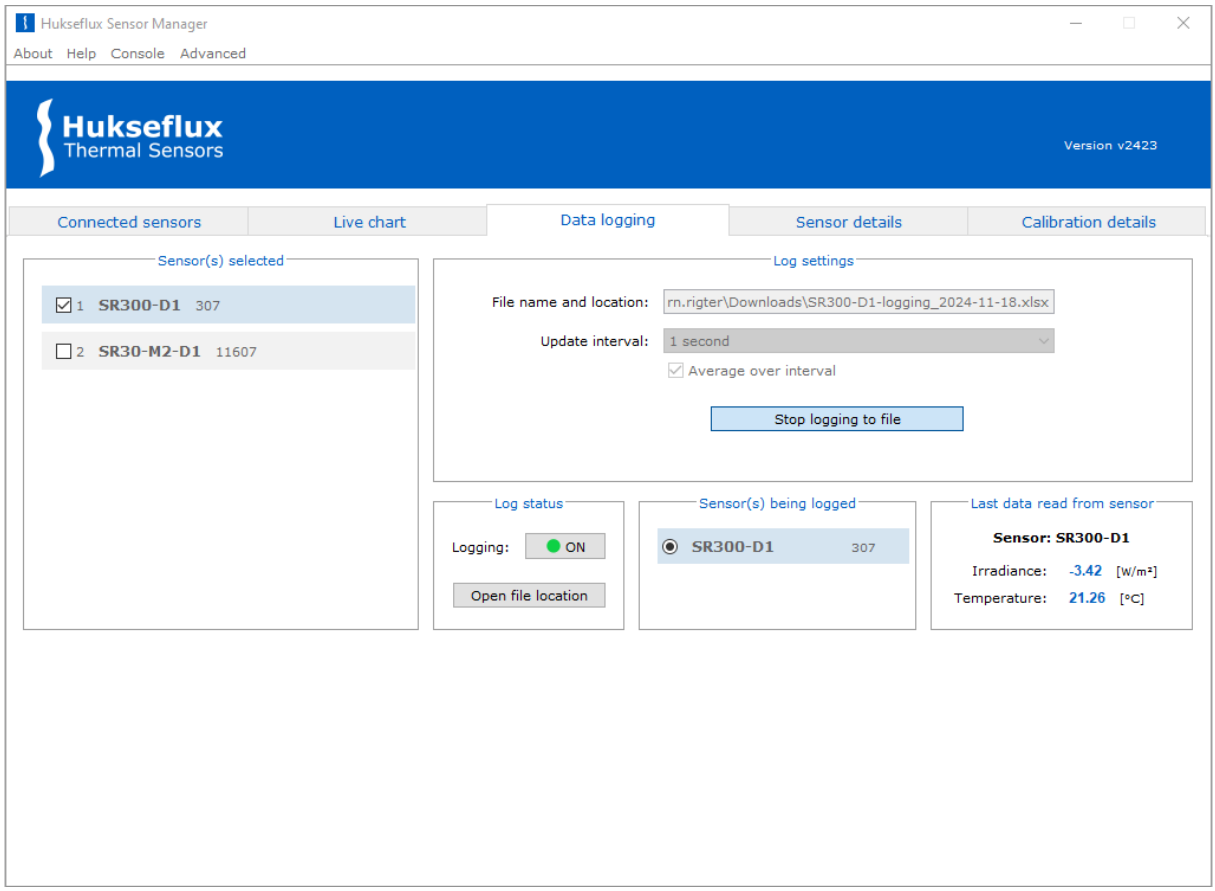


Figure 3.4.1 *Data logging tab with two connected sensors.*

3.4.1 Files

The data logging functionality of the Hukseflux Sensor Manager will start a new file each day. The filenames start with an ISO 8601 date stamp (YYYY-MM-DD). Since an Excel Workbook can hold a maximum of 1,048,576 rows, a single Excel Workbook can easily store data for an entire day at the shortest update interval of 1 second. This makes long-term datalogging possible, but the reliability depends very much on the used hardware, software and operating system. It is therefore not recommended to use this feature, as loss of data is critical.

NOTICE
The Hukseflux Sensor Manager is not intended for long-term data logging and is not as reliable as dedicated datalogging systems.

3.4.2 Log settings

The file location to which the file will be saved can be specified by clicking the file location field. The default file format is .csv (Comma Separated Values). If .xlsx format (Excel Workbook) is desired, it is possible to specify this file type as shown in Figure 3.4.2.1. The desired update interval can be set through the "Update interval" drop-down menu. When the "Average over interval" checkbox is checked, the average of all readings possible within the given interval – with a maximum of 100 readings – will be plotted in the Live chart plot.

NOTICE
Data logging with "Average over interval" enabled can only be started when there is no live chart active with averaging enabled in the Live chart tab.

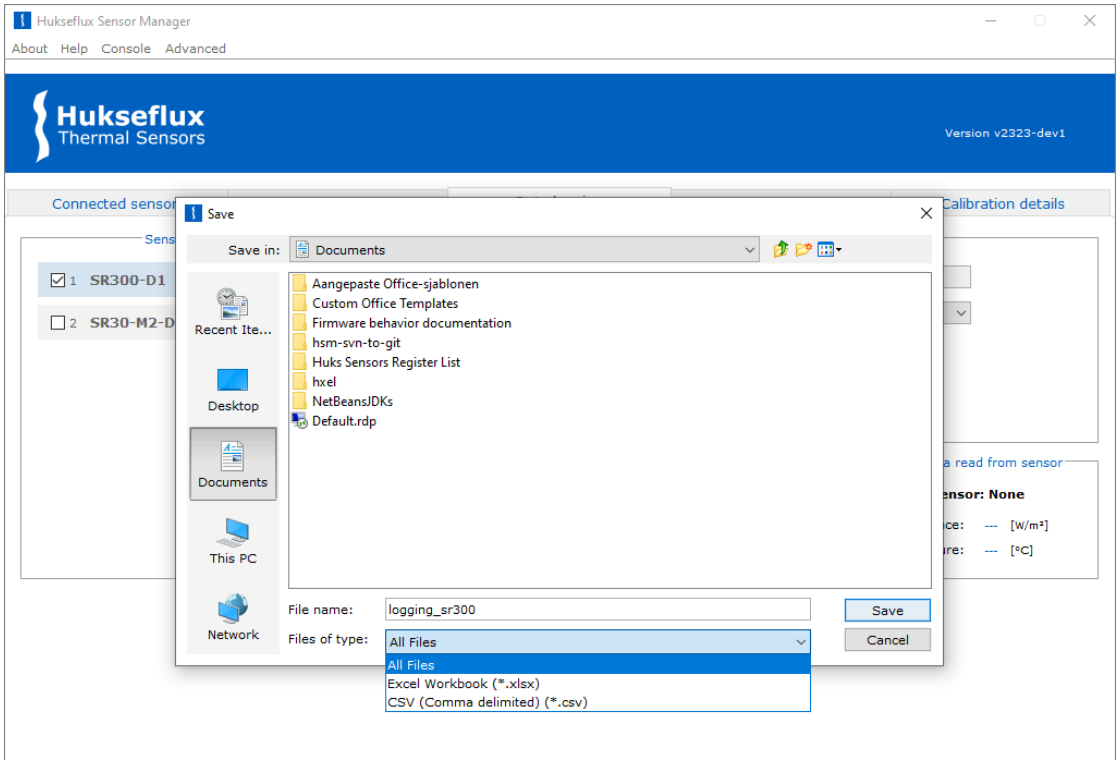


Figure 3.4.2.1 *Selecting Excel Workbook format (.xlsx) instead of the default CSV format (.csv).*

3.4.3 Sensors being logged

Once logging to a file starts, the "Sensor(s) being logged" box displays a list of sensors of which data is being logged. The selected sensor in this list will be shown under "Last data read from sensor". The latest irradiance and temperature readings will be displayed here as well.

3.4.4 Recommendations

The data logging continues to function when the PC is put into sleep mode, but it is not possible to log data to a file while the file is open. Therefore, care should be taken that when logging, the file is not opened or, in some other way, blocked from writing anywhere on the PC. When there is a problem with writing to the file, the "Last data read from sensor" will display an error message as shown in Figure 3.4.4.1. The console can be used to find the cause of the error (see Section 5.3 Console). When there is a problem with writing to the file, for example when the file is open in another application, the Sensor Manager will buffer up to 100 reads from the sensor which will be written to the file when this is possible again. While this error condition exists, the "Irradiance" and "Temperature" fields display an "ERR" value.

NOTICE
The Hukseflux Sensor Manager cannot log data to a file when that file is opened by another application.

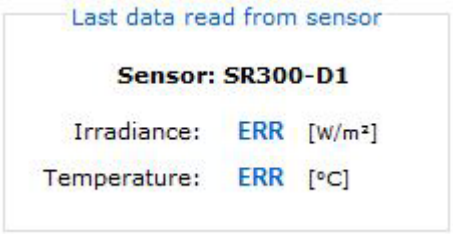


Figure 3.4.4.1 *Error being displayed when a problem with writing to the file occurs.*

3.5 Sensor details

In the "Sensor details" tab, the settings of the selected sensor from the dropdown menu can be seen, along with some live measurements specific to the sensor (see Figure 3.5.1). These measurements differ per sensor, please see Section 4.2 for the differences.

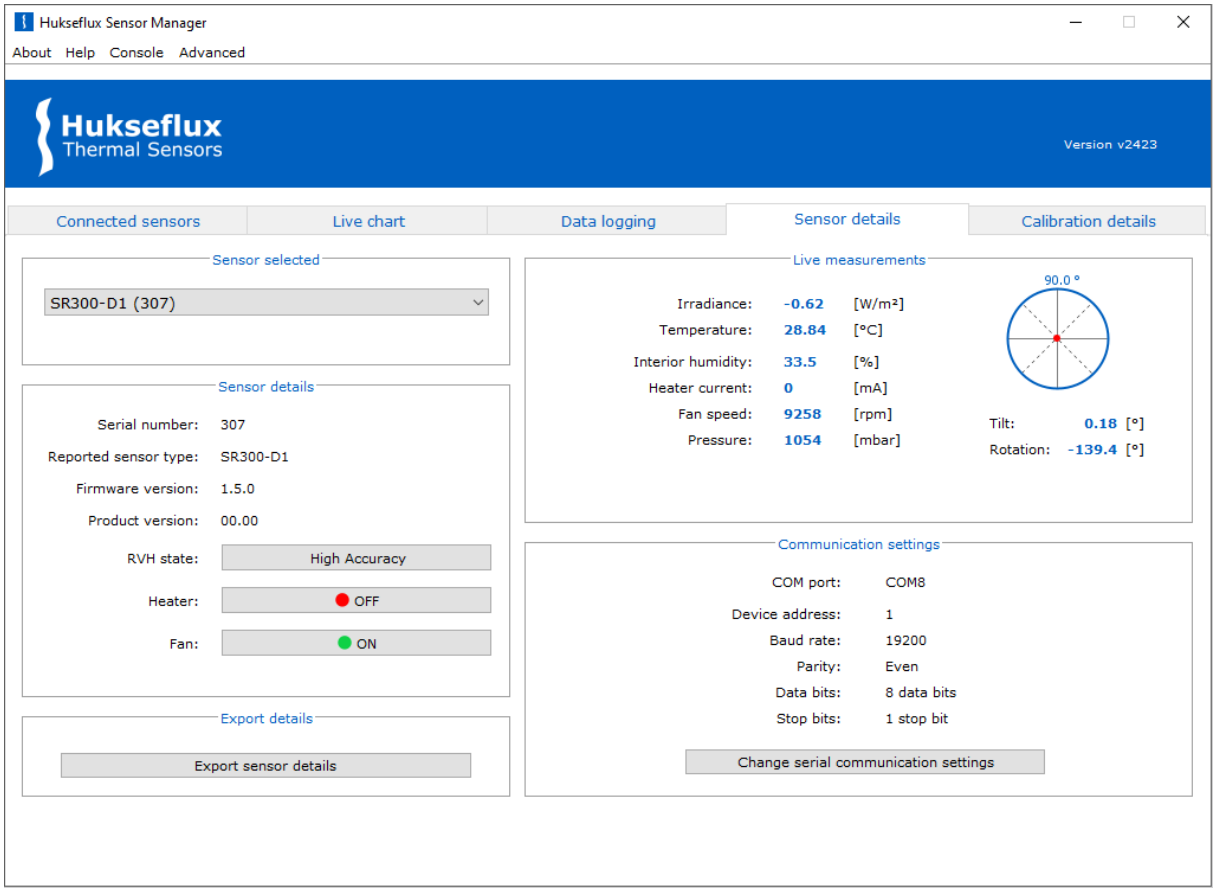


Figure 3.5.1 *Sensor details window of an SR300-D1 sensor.*

A detailed overview of all information about the sensor can be exported (to a .txt text-file) and can consequently be viewed in the default .txt file application. The stored sensor details report contains a lot of information on the current state and 'health' of the sensor and is very useful in case of a suspected problem or for reference purposes. Calibration information is excluded because it is part of a separate report.

By clicking "Change serial communication settings" a popup window will appear in which the communication settings can be changed, see Section 4.1 Changing the Device address and communication settings for details.

3.6 Calibration details

In the "Calibration details" tab, the calibration details of the selected sensor from the dropdown menu are shown, along with the temperature characterisation coefficients (see Figure 3.6.1).

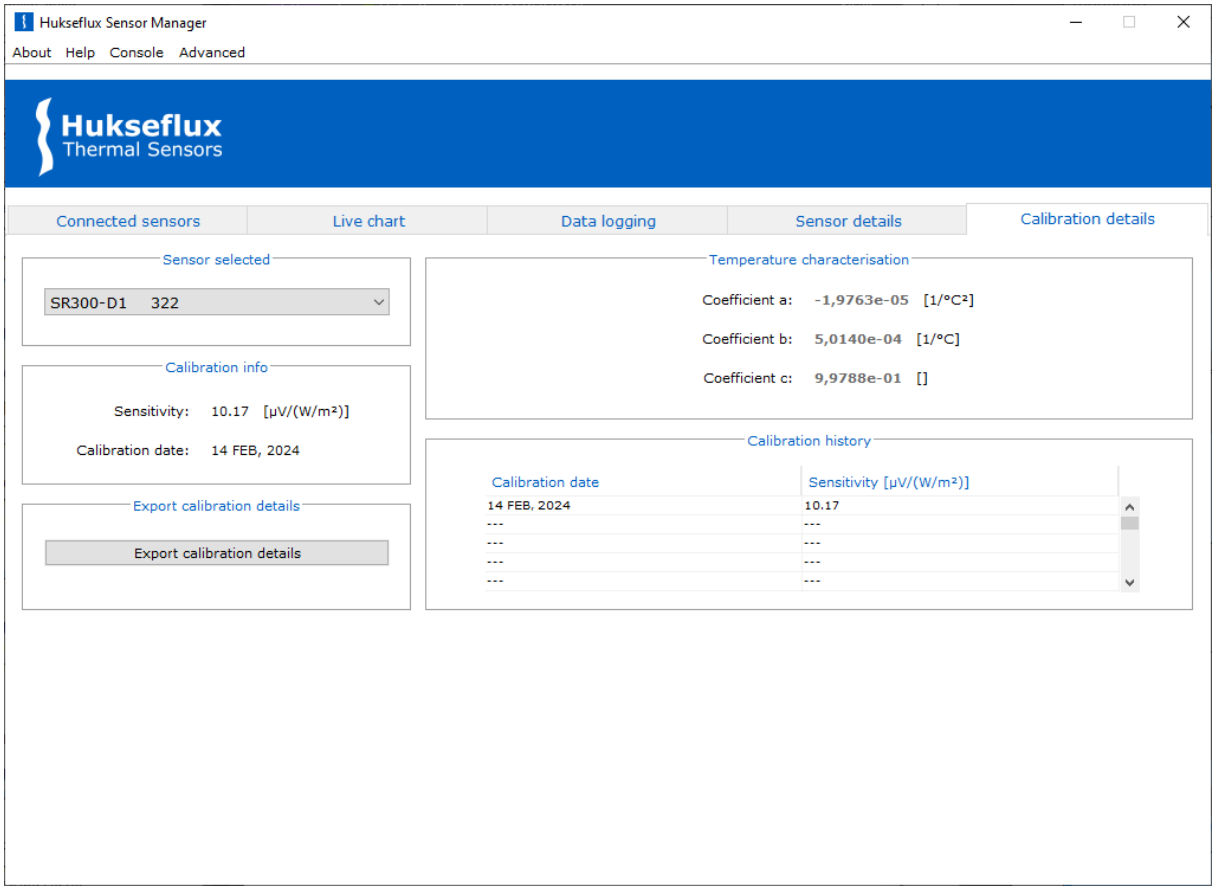


Figure 3.6.1 *Calibration details window of an SR300-D1 sensor.*

The calibration details can be exported (to a .txt text-file) through the "Export calibration details" button. After selecting the file save location and saving, the file can be viewed in the default .txt file application. The calibration details report is mainly meant for reference purposes.

4 Sensor configuration

This chapter describes how to use the Hukseflux Sensor Manager to configure the sensor and modify sensor settings. Sensor settings can be changed from the "Sensor details" window, which can be opened by clicking the "Sensor details" tab, and via the "Advanced" menu-item in the top menu bar.

4.1 Changing the Device address and communication settings

In the "Sensor details" tab, the "Change serial communication settings" button opens the "Change serial communication settings" window, as shown in Figure 4.1.1. This allows the user to change the sensor's Device address and serial settings (baud rate, parity, number of stop bits).

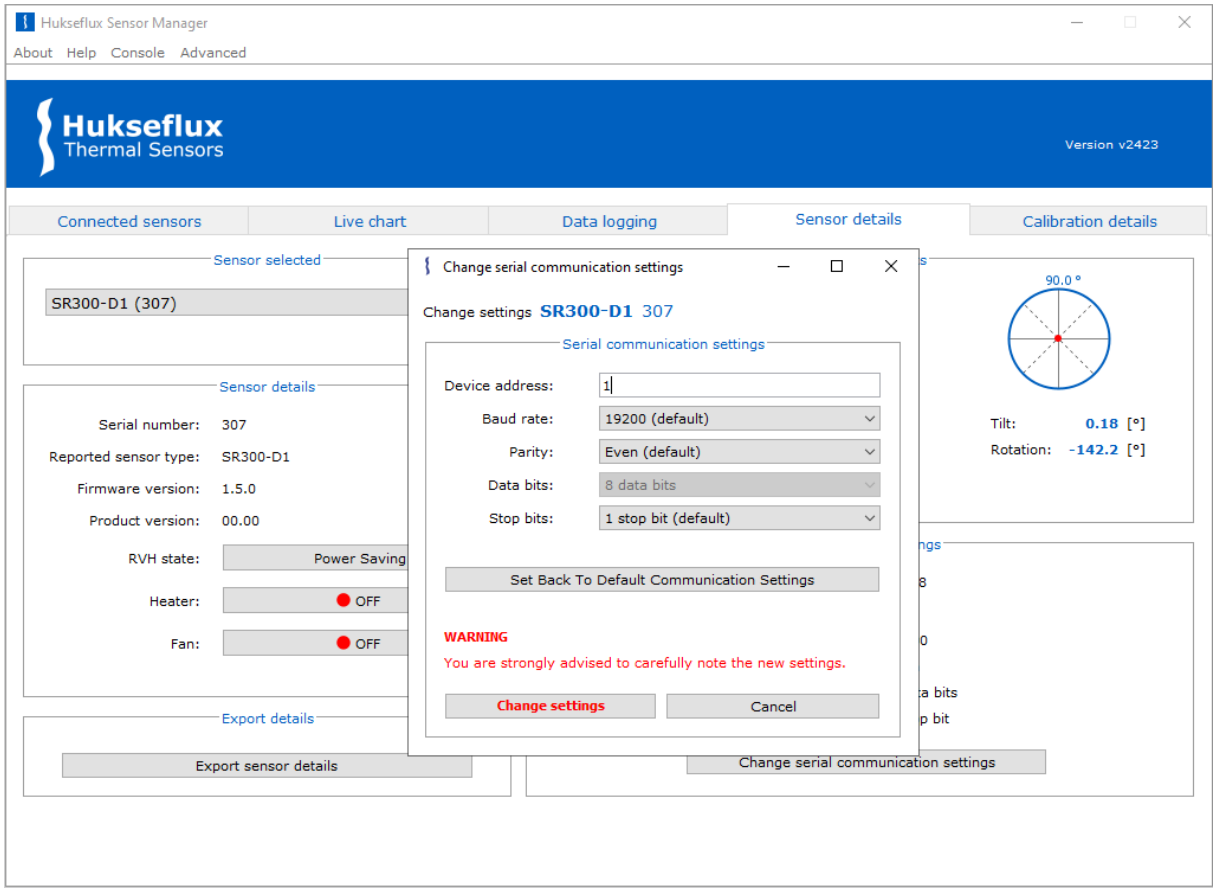


Figure 4.1.1 *Change serial communication settings window.*

When new communication settings or a new Device address is entered, these need to be confirmed by clicking the "Change settings" button. The instrument will then automatically be restarted. In case the "Change settings" button is not clicked, the original settings remain valid. If the Device address is changed, the Sensor Manager will automatically reconnect with the instrument using the new address after a restart.
The "Set Back To Default Communication Settings" button will reset the connected sensor to its factory-default serial settings (these can be found in the sensor's manual), with device address 1.

4.2 Sensor specific settings

The measurements within the Hukseflux Sensor Manager are sensor-specific, since measurement capabilities can differ per sensor (see Figure 4.2.1). The measurement capabilities of the selected sensor are recognised automatically, and the correct measurement panel is shown accordingly.

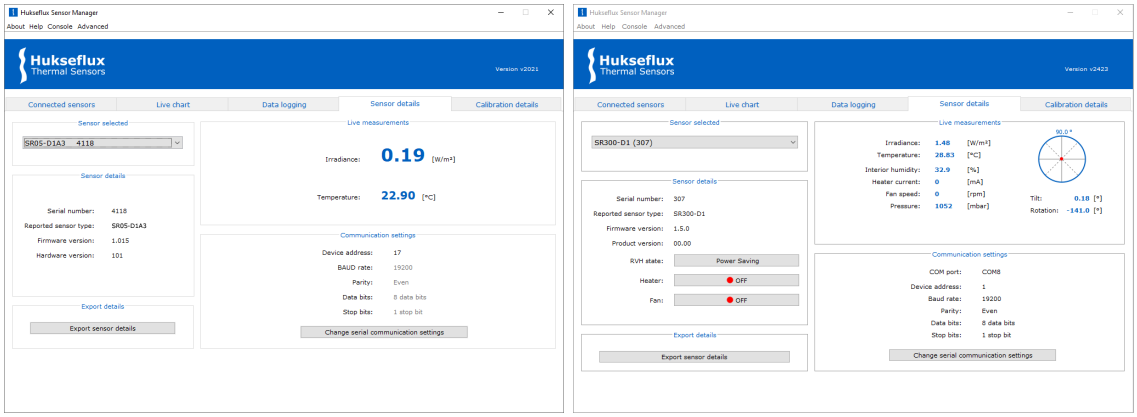


Figure 4.2.1 *Example of the differences in the "Sensor details" tab between an SR05-D1A3 pyranometer (left) and an SR300-D1 pyranometer (right).*

4.2.1 Tilt & Rotation sensor

Some pyranometers are equipped with an accelerometer and output the sensor tilt and rotation. Tilt and rotation of a sensor can help diagnose pyranometer alignment issues and aid in the levelling during installation. Please refer to the sensors' user manual for a full review of use. If the pyranometer is equipped with a tilt and rotation sensor, these values are displayed in the "Live measurements" box in the "Sensor details" tab (see Figure 4.2.1.1).

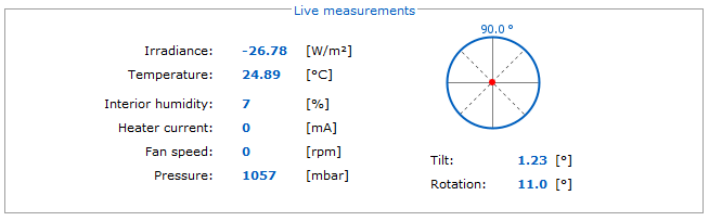


Figure 4.2.1.1 *"Live measurements" box of a pyranometer equipped with a tilt and rotation sensor.*

4.2.2 Heater and fan

Some of the pyranometers come equipped with an internal heater, a fan or both. See Section 4.3 Changing the heater and fan settings, when the heater or fan settings are to be changed.

4.2.3 Analogue output

Some pyranometers are equipped with an analogue output. The range of the analogue output can be modified. See Section 5.2 Changing the analogue output range, for a description of how to change this range.

4.3 Changing the heater and fan settings

Some digital radiation sensors are equipped with an internal heater or fan. This section describes how to change the heater and fan settings using the Hukseflux Sensor Manager.

4.3.1 Industrial Sensors (with earthing terminal)

The heater and fan settings for these sensors can be changed by clicking the "Advanced" drop-down menu in the top menu bar and selecting "Sensor Settings". The "Recirculating Ventilation Heating Mode" (see figure 4.3.1.1) combines the heater and fan settings and can be set to three modes:

- Dew & Frost Mitigation: heater and fan are both on
- High Accuracy: heater is off, fan is on
- Power Saving: heater and fan are both off

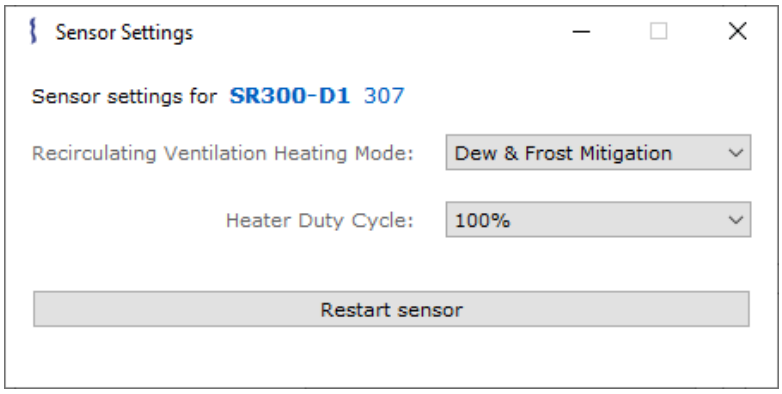


Figure 4.3.1.1 *Sensor Settings window for an SR300-D1.*

The next section discusses the power-on default heater and fan settings of SR30 sensors. Newer, industrial sensors always preserve the current heater and fan setting upon a power cycle of soft restart, no separated power-on setting is needed.

4.3.2 SR30 Sensors

SR30 sensors have some distinctive features not found in any other sensors.

4.3.2.1 Temporarily switch heater and fan settings

If a sensor has a heater or fan, they can be switched on or off in the "Sensor details" tab, in the "Sensor details" box (see Figure 4.3.1.1). Note that the switching of the heater or fan setting in this manner is temporary in the sense that upon restarting or power-cycling the sensor, the heater and fan settings will return to their default state.

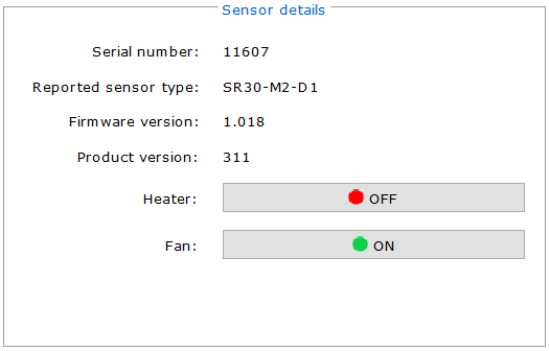


Figure 4.3.2.1 *"Sensor details" box of a pyranometer equipped with an internal heater and fan.*

NOTICE
After power-cycling or a soft reboot of the sensor, the heater and fan will switch back to their default settings.

4.3.2.2 Changing the default heater and fan settings

To change the default state of the heater and fan of an SR30 sensor on power-up:

1) Select the sensor for which you want to change the default heater or fan state
2) Click the "Advanced" drop-down menu in the top menu bar. In the drop-down list, select "Sensor Settings", which will open the "Sensor Settings" window (see Figure 4.3.2.2.1).
3) In the "Sensor Settings" window, set the preferred default mode for the heater or fan state.

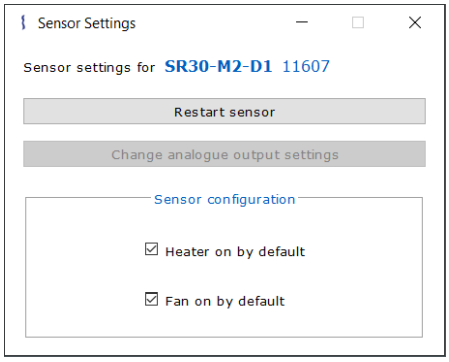


Figure 4.3.2.2.1 *"Sensor Settings" window for SR30-M2-D1.*

The heater and fan settings affect the instrument's specifications, most notably its response to thermal radiation (zero offset a). Please consult the instrument's manual for more information.

NOTICE
The heater and fan settings affect the instrument's specifications.

5 Advanced use

This chapter describes advanced features of the Hukseflux Sensor Manager, such as debugging Modbus communication and updating a sensor's calibration details.

5.1 Password-protected settings

Critical settings within the Hukseflux Sensor Manager are protected from accidental or unauthorised modifications by a password. If a modification to one of these settings is required, please contact the factory to obtain this password if needed. Along with the password, instructions on how to update settings that are critical to the measurement performance will be provided.

5.2 Adjusting sensitivity

In case the instrument is recalibrated, it is common practice that the sensitivity is adjusted, and that the latest result is added to the calibration history records. This functionality is password-protected (see 5.1 Password-protected settings).

Example: During a calibration experiment, the result might be that the pyranometer has an irradiance output in W/m^2 equal to 990, whereas the calibration reference standard indicates it should be 970. In this example, the pyranometer output is 2.06 % too high. The original sensitivity of 16.15 µV/(W/m²) ought to be changed to 16.48 µV/(W/m²). The old calibration result is recorded in the calibration history registers on the sensor and displayed in the "Calibration history" box in the "Calibration details" tab.

Updating to the new sensitivity value is done by clicking the "Advanced" drop-down menu in the top menu bar and selecting "Update Calibration Details". Carefully note whether the correct sensor is selected. After providing the correct password, the new sensitivity can be set for the sensor, as in Figure 5.1.1. After confirming the new sensitivity and calibration date, the new entry can be seen in the "Calibration details" tab.

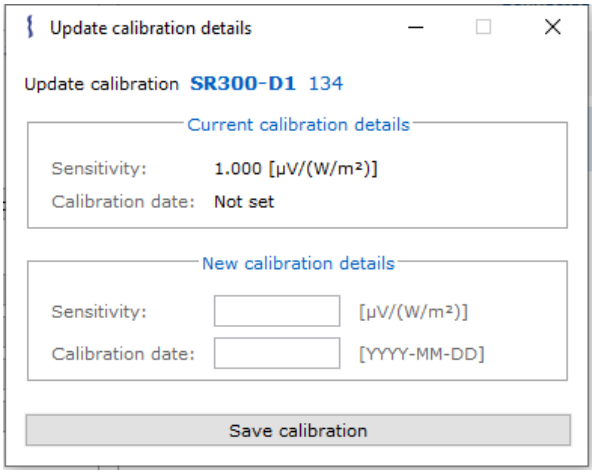


Figure 5.2.1 *Update calibration details window.*

5.3 Sensor Diagnostics

Depending on the type of sensor, the sensor may have diagnostics features, such as an uptime counter, LED Mode status, Leak Detection and Status Registers (see figure 5.3.1).

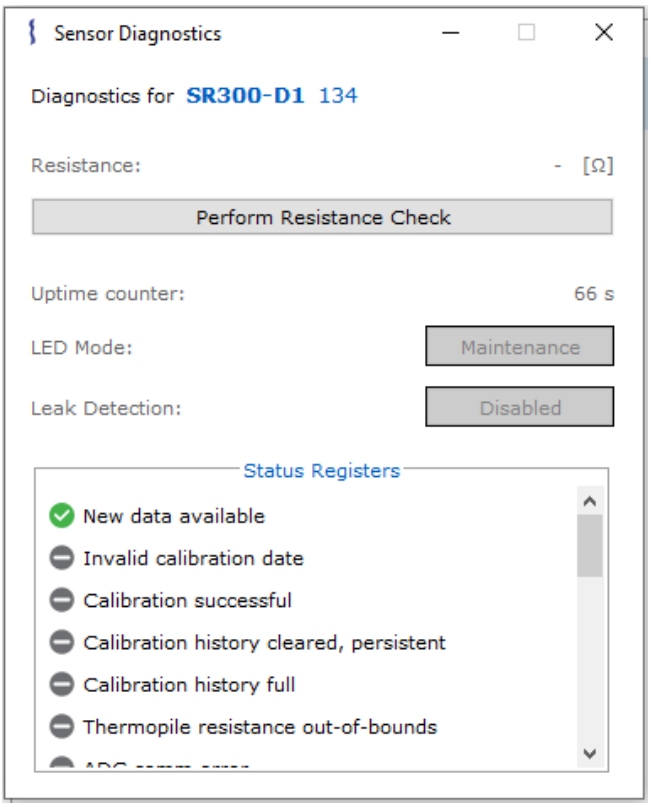


Figure 5.3.1 *Sensor Diagnostics window for an SR300-D1 sensor.*

5.3.1 Uptime counter

The uptime counter shows the number of seconds the sensor has been connected to a power source since the last power cycle or the last soft restart.

5.3.2 LED Mode

A sensor has five possible LED modes:

1. **On:** The LED is always on
2. **Off:** The LED is always off
3. **Auto (default):** Every 15 seconds the LED blinks
4. **Identify**: Blinks for 10s when a sensor is connected to a power source
5. **Maintenance**: The LED blinks 5 times every second

5.3.3 Leak Detection

Indication of the leak detection status. See 5.4 Leak Detection for more information.

5.3.4 Status Registers

Individual status registers can show the status on or off (high or low):

- When off, a grey circle is shown, as seen in Figure 5.3.1.1;
- When on and it's an error indication, the circle is red;
- When on and it's not an error indication, the circle is green.

5.4 Leak Detection

Certain sensors have a leak detection feature that allows a user to check if a potential leak is present for that sensor (see Figure 5.4.1). This feature is accessed by clicking the "Advanced" menu-item and selecting "Leak Detection" from the drop-down menu.

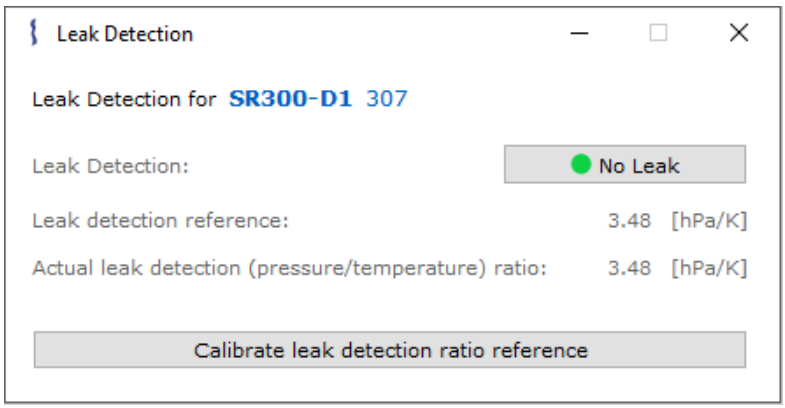


Figure 5.4.1 *Leak Detection window for an SR300-D1 sensor.*

An explanation of how leak detection is calculated can be found in the user manual of sensors that have this feature.

5.4.1 Leak Detection States

There are three possible leak detection states:

1. Disabled: the leak detection system is disabled
2. Leak detected
3. No leak detected

5.4.2 Calibrating the leak detection ratio reference

This functionality is password-protected. Please see 5.1 Password-protected settings for more information.

The leak detection system comes calibrated from the factory when the sensor is new or after it has been serviced. After years of use or when a sensor has been opened, the leak detection system may need to be calibrated again. Calibration of the leak detection system needs to be done at room temperature. Click the "Calibrate leak detection ratio reference" button in the Leak Detection window (see Figure 5.4.1) to calibrate the leak detection ratio reference. In the Calibrate Leak Detection window (see Figure 5.4.2.1), the initial value for the new internal leak detection ratio reference is set to the current actual leak detection ratio, as read out from the sensor.

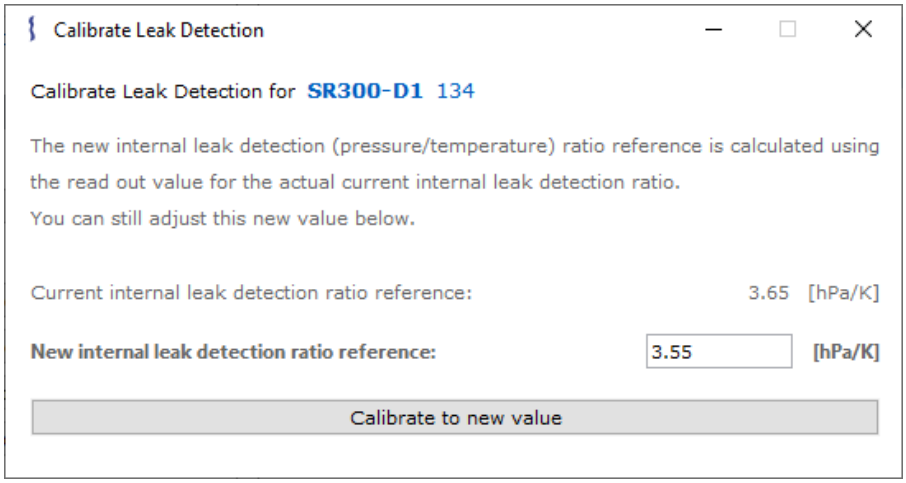


Figure 5.4.2.1 *Calibrate Leak Detection window for an SR300-D1 sensor.*

NOTICE
For accurate performance over a wide temperature range, execute the leak detection calibration at room temperature.

NOTICE
Take care when calibrating the leak detection ratio reference, since an incorrect ratio reference could falsely indicate a leak.

5.5 Tilt and Rotation Indication

Certain sensors have a tilt and rotation indication feature that allows a user to check if the tilt and rotation are within range for that sensor (see Figure 5.5.1). This feature is accessed by clicking the "Advanced" menu-item and selecting "Tilt / Rotation Indication" from the drop-down menu. The tilt and rotation indication is disabled if its reference range is set to 0.0 (see "Tilt" in Figure 5.5.1).

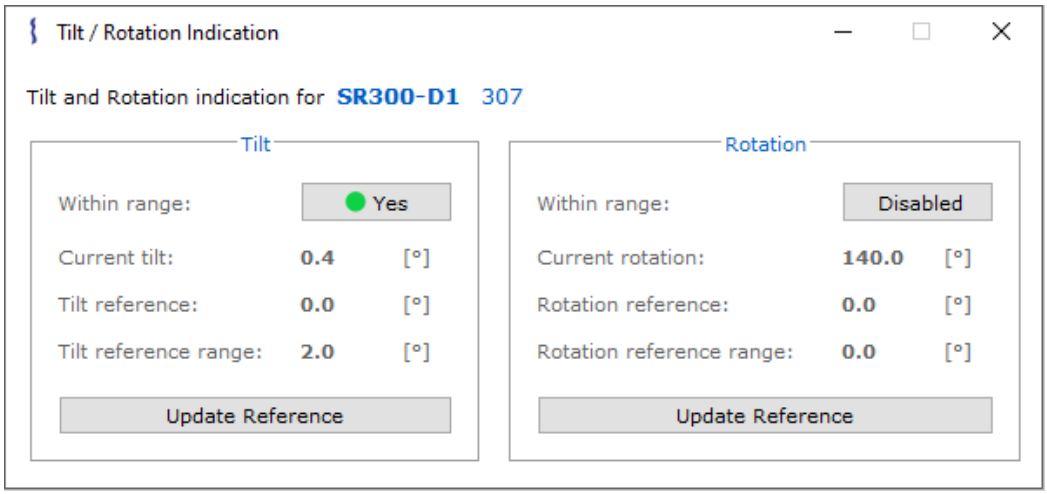


Figure 5.5.1 *Tilt / Rotation Indication window for an SR300-D1 sensor.*

The desired tilt and rotation reference values can be set by clicking "Update Reference". In the window that opens (see Figure 5.5.2), one can set the desired tilt or rotation reference and its reference range.
For example, if the required rotation is 10 ° ± 2 ° (such that the acceptable range is from 8 ° to 12 °), the rotation reference should be set to 10 ° and the rotation reference range to 2 °. The indicator will turn high when the rotation is below 8 ° or above 12 °.

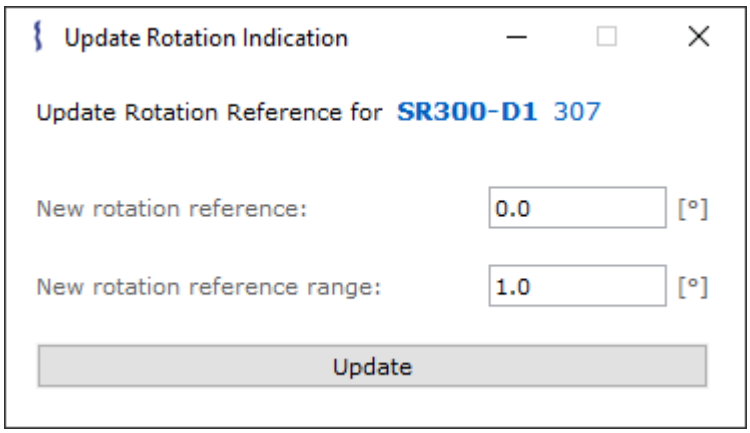


Figure 5.5.2 *Update Rotation Indication window for an SR300-D1 sensor.*

5.6 Sensor Settings

The following sensor settings can be viewed and adjusted by clicking the "Advanced" menu-item and clicking "Sensor Settings". A "Sensor Settings" window will open (see Figures 4.3.1.1 and 4.3.2.1), where these modifications can be made.

5.6.1 Restarting a sensor

You can restart a connected sensor by clicking the "Restart Sensor" button in the "Sensor Settings" window. A restart is equivalent to a power-cycle and may also be called a *soft reboot*. An automatic restart of the sensor is performed when the communication settings

of the sensor are modified, or for Industrial sensors when the "Auto-connect" feature (see 3.2.3 Auto-connect) is used when connecting to a sensor.

5.6.2 Recirculating Ventilation Heating Mode

Please see 4.3.1 SR30-M2-D1 and SR300-D1 (Changing the heater and fan settings) for the Recirculating Ventilation Heating Mode (RVH Mode) setup.

5.6.3 Heater power setting

Industrial sensors that have a built-in heater, such as SR300-D1 and SRD100-D1, allow for change of the heater power. To save on the energy consumption of the sensor, the heater power can be lowered in steps of 10 %. If energy consumption is not a concern, it is recommended to leave the power setting its default value, the maximum heater power. Only when the heater is switched on, the heater power setting can be changed. 0 % is not available as this corresponds to the heater switched off. Also, refer to section 4.3.1 Industrial Sensors (Changing the heater and fan settings) for more details.

5.6.4 Changing the analogue output range

Some digital radiation sensors are equipped with an analogue output (e.g. a 0-1 V voltage output or a 4-20 mA current output) in addition to the digital output. This section describes how to change the range of the analogue output.

This functionality is password-protected (see 5.1 Password-protected settings).

It is possible to change the analogue output range by clicking the "Change analogue output settings" button in the "Sensor Settings" window (see Figure 4.3.1.1). After entering the password, the "Analogue output settings" window will be opened (shown in Figure 5.6.4.1). Fill in the new signal at low and high levels and click the "Save settings" button to confirm the changes.

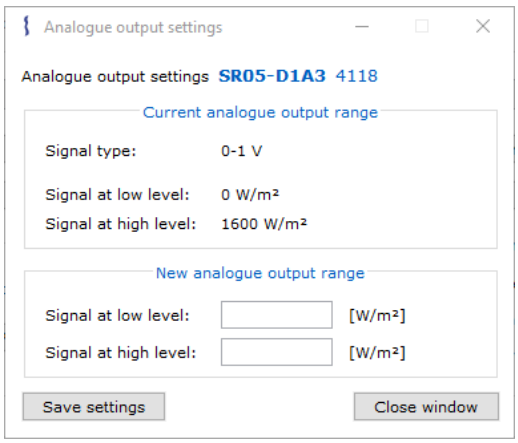


Figure 5.6.4.1 *The "Analogue output settings" window for an SR05-D1A3.*

5.7 Console

The "Console" window (see Figure 5.3.1) can be used to:

1) Monitor sensor operations
2) Monitor raw data bytes being sent and received (Modbus I/O)
3) Monitor live graph operations
4) Monitor logging details

To open the "Console" window, click the "Console" button in the top menu bar.

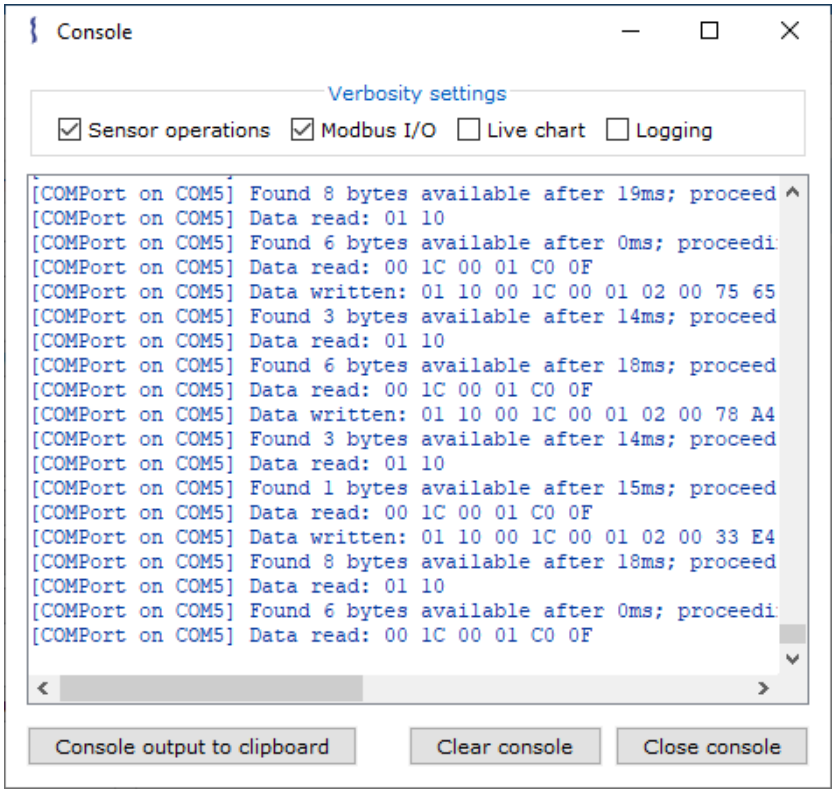


Figure 5.7.1 *Console window with "Sensor operations" and "Modbus I/O" enabled.*

The displayed content in the console can be selected and copied. Use the left mouse button to select the text. Alternatively, all text can be selected by pressing CTRL + A. The text can be copied to the clipboard using CTRL + C. Consequently, CTRL + V can be used to paste the contents elsewhere.

The **"Sensor operations"** checkbox can be checked to enable verbosity regarding sensor operations. This can be useful in identifying certain problems with a sensor, for example, when connecting to a sensor or changing its settings.
The **"Modbus I/O"** checkbox can be checked to display the individual Modbus requests made by the Sensor Manager and the responses given by the sensor. An example of this can be seen with the "[COMPort on COM4]" messages in Figure 5.3.1 and can be useful in determining problems with the Modbus communication of a sensor.
The **"Live chart"** checkbox can be checked to view the data displayed in the "Live chart" tab. This can, for example, be used to troubleshoot problems with the "Live chart."

The **"Logging"** checkbox can be checked to display the data being written to file via the "Data logging" tab. This can, for example, be used to troubleshoot problems with the "Data logging" tab.

5.8 Register Operations

For certain uses, for example for debugging or changing the irradiance or temperature scaling factors, viewing and editing a sub-set of registers of a connected sensor is possible. This can be done via the "Register list" window (see Figure 5.8.1.1). To open the "Register list" window, click the "Advanced" drop-down menu in the top menu bar and select "Registers". Operations on individual registers can be performed through the "Change register" window, by clicking a register in the "Register list" window.

NOTICE
Changing a register should be done with great care. If done improperly, it might result in unexpected sensor behaviour.

5.8.1 Register list

The "Register list" window (see Figure 5.8.1.1) can be used to read and adjust individual registers. The order of registers (sorting) can be changed using the selection menu at the top of the window.

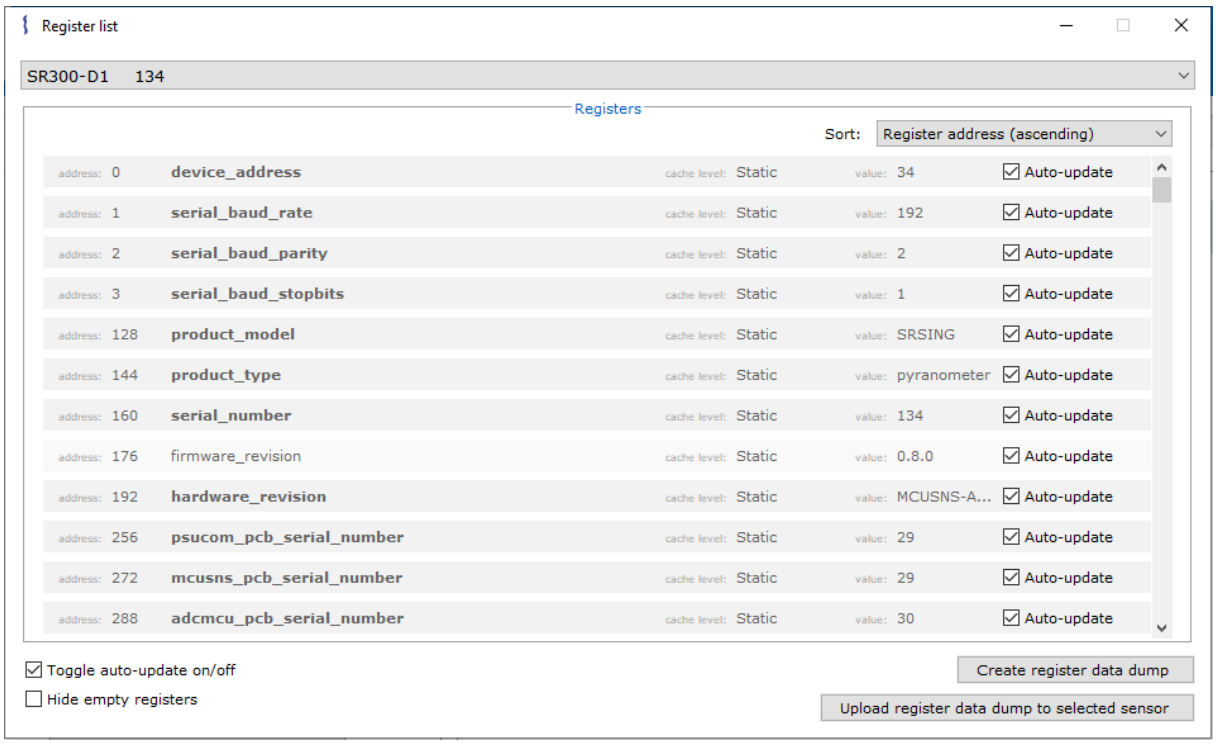


Figure 5.8.1.1 *Register list window for Industrial Sensors.*

In the "Register list" panel, the **"Toggle auto-update on/off"** checkbox will check or uncheck the **"Auto-update"** checkboxes for all registers in the register list. The automatic update of individual registers can be enabled or disabled by clicking the **"Auto-update"** checkbox on the right side of a register. The **"Hide empty registers"** checkbox will hide registers with empty values (null) when read.

The Hukseflux Sensor Manager uses a cache for efficient functioning. More information about the cache level of a register can be found in the Appendix on cache levels.

5.8.2 Change register

Changing an individual register can be achieved by clicking the register in the "Register list" window, which will open the "Change register" window (see Figure 5.8.2.1). This operation can only be performed on read/write registers, which are indicated by a darker background (see Figure 5.8.2.2). Certain registers are considered critical and are therefore password-protected. Please contact the factory to obtain this password.

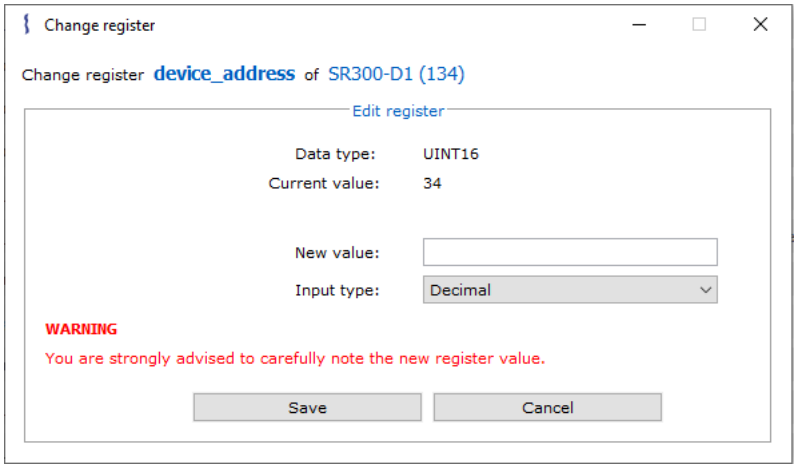


Figure 5.8.2.1 *Change register window for the modbus address register of an SR30-M2-D1 sensor.*

Figure 5.8.2.2 *Read/write registers (red) with bold name and darker background, read-only registers (green) with lighter background.*

When changing a register value, the possible **input formats** for the new value are either a decimal, hexadecimal, binary or string format. A list of example inputs is given in Table 5.8.2.1. Where possible, the input is automatically converted to the data type that is expected for the register. If no conversion is possible, the user will be informed and asked to change the entered new value.

Table 5.8.2.1 *Input examples.*

Input format	New value	Input	Explanation
Decimal	$4.56 \cdot 10^{-3}$	4.56E-3	use the E notation when inputting new values that are in scientific notation. Another option is to input its decimal format (0.00456 in this case)
Decimal	51.42	51.42	in the case of a regular decimal, simply use it as input with a dot as a decimal separator
Hexadecimal	31	1F	convert the new input value to hex first. Do not use the 0x prefix in the input. No differentiation is made between lower or capital letters in the hex input
Binary	31	11111	convert the new input value to binary first. Do not use the 0b prefix in the input
String	SR300-D1	SR300-D1	simply use the new value string as the input

5.8.3 Data dump

The "Register list" window (see Figure 5.8.1.1) can be used to create a register data dump from the selected sensor to a PC and to upload a register data dump from the PC to a selected sensor. This effectively allows the user to make a backup of sensor settings. Note that this is a partial backup, because some settings are factory-use only. Industrial pyranometers have a much more complete dump than other sensors as there are only a few maintenance settings hidden for end-users.

5.8.3.1 Creating a register data dump

Creating a register data dump can be done by clicking the "Create register data dump" button in the "Register list" window. This will create a file called "[Sensor name]_SerialNumber [Serial number]_register data dump.csv" in the user folder. The file format is in Comma Separated Values (.csv) format. A representation of the three values from Table 5.8.3.1 in .csv-format, as stored in the register data dump file, is given below.

regId,regAddress,dataType,value,valueType
modbus_address,1,U16,1,Long
sensor_type,33,HF_STRING_U16,SR30-D1,String
sensor_sensitivity,42,FLOAT,10.26,Float

Table 5.8.3.1 *Register data dump example model for SR30-D1 with device address 3.*

Register id	Register address	Data type	Value	Value type
modbus_address	1	U16	3	Long
sensor_type	33	HF_STRING_U16	SR30-D1	String
sensor_sensitivity	42	FLOAT	10.26	Float

5.8.3.2 Uploading a register data dump

Uploading an existing register data dump file to a sensor can be done by clicking the "Upload register data dump to selected sensor" button. After clicking this button, the register data dump file should be selected (see Figure 5.8.3.2.1). The Hukseflux Sensor Manager will attempt to automatically write all values from the specified file to their corresponding register for the selected sensor.
It is possible to upload register data written by the user, instead of register data generated by the Hukseflux Sensor Manager. Beware that this data should be saved exactly according to the model from the given example. For a complete model, the user can create a register data dump from the selected sensor (as explained in 5.8.3.2.1 *Creating a register data dump*). This will show the complete model, in the generated CSV file. In practice, the best way to create a file with register values is to start from a dump which was created by downloading the register contents from a sensor.

NOTICE
When uploading register data written by a user, make sure to strictly conform to the provided example's model, since other models may cause exceptions to occur.

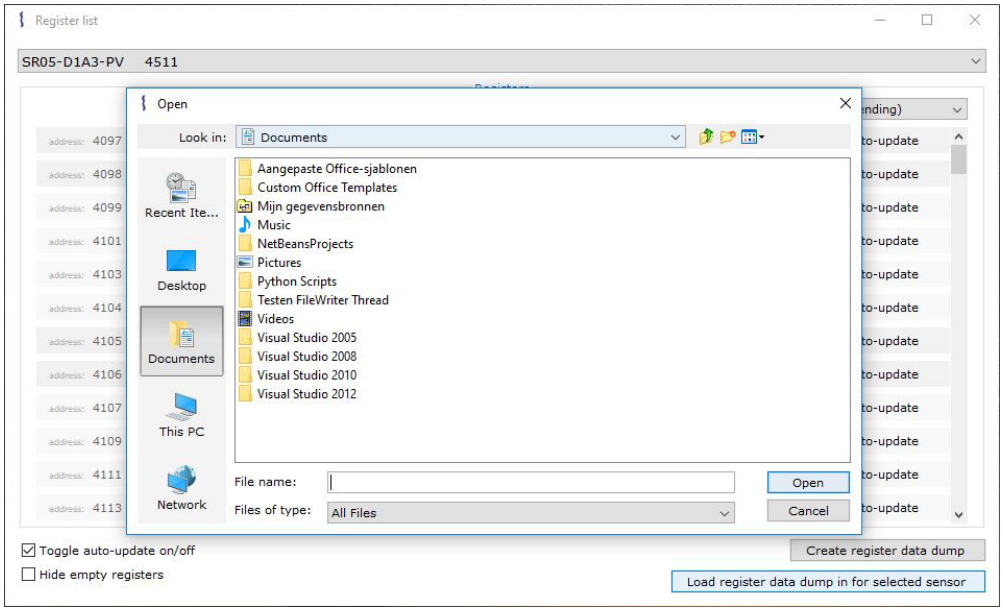


Figure 5.8.3.2.1 *"Open" window to upload a register data dump file.*

5.9 Program Settings

5.9.1 All supported sensors

The Hukseflux Sensor Manager supports certain very specific sensors which are not shown by default. To access these sensors, click the "Advanced" drop-down menu in the top menu bar, hover the mouse over the "Program Settings" submenu and click the "Show all supported sensors" checkbox (see Figure 5.9.1.1).
This functionality is password-protected (see 5.1 Password-protected settings).

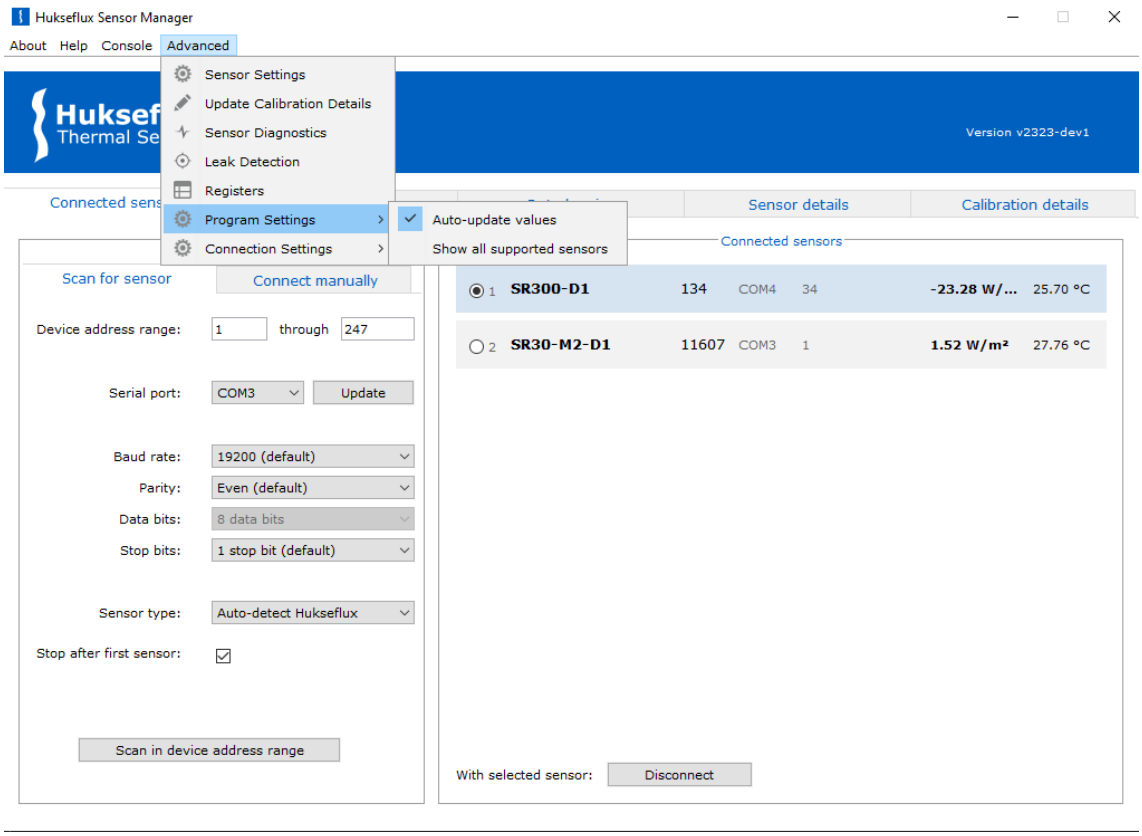


Figure 5.9.1.1 *Program Settings options.*

5.9.2 Auto-update values

The Sensor Manager automatically updates all values from connected sensors in the background. This means the many operations could clutter the Console output (see 5.6 Console). These automatic updates can be turned off by clicking the "Advanced" drop-down menu in the top menu bar, hover the mouse over the "Program Settings" submenu and click the "Auto-update values" checkbox (see Figure 5.9.1.1).

6 Appendices

6.1 Appendix on hardware setup

Connecting a sensor to a PC requires a serial port interface of an appropriate type (typically an RS-485 or TTL interface depending on the sensor type). These interfaces are usually not found on a PC. PCs are typically equipped with RS-232 or USB interfaces. When using one of these interfaces a serial converter is needed to connect the sensor to the PC. We consider two setups:

Occasionally PCs come equipped with an RS-232 interface. In that case, an appropriate serial converter is required. The RS-232 interface of the PC is connected to the serial converter input. The serial convert output is connected to the sensor. See Figure 6.1.1

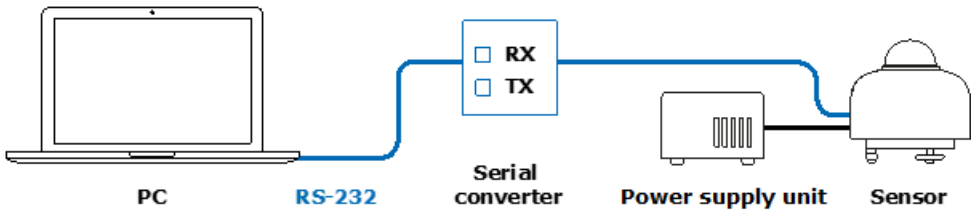


Figure 6.1.1 *A PC connected to a sensor via a serial converter.*

In most cases, PCs are not equipped with a serial interface. In that case a USB-to-serial converter is required. The converter is connected to the PC via USB. This will create a virtual COM port on the PC. The converter output is connected to the sensor. Note that an external power source needs to be connected to the sensor. See Figure 6.1.2.

For more details on how to connect the sensor to the converter please consult the manual of the sensor as well as the manual of the converter.

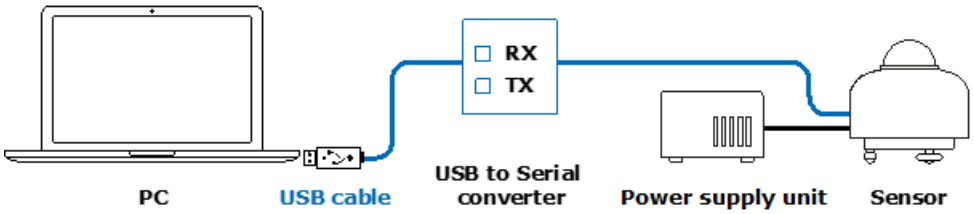


Figure 6.1.2 *A PC connected to a sensor via a USB-to-serial converter*.

6.2 Appendix on troubleshooting

For troubleshooting when problems with the Hukseflux Sensor Manager are encountered, see Table 6.2.1.

Table 6.2.1 *Troubleshooting*

Problem	Proposed solution
"Error" or "Invalid" are displayed for the "Recirculating Ventilation Heating Mode"	If this is the case, restart the sensor (see "5.4.1 Restarting a sensor"). If the "Recirculating Ventilation Heating Mode" still shows "Error" or "Invalid", physically disconnect and re-connect it. If the problem persists there may be a problem with the hardware, contact the manufacturer.
Unable to connect to a sensor	Make sure to select the correct COM port, device address and serial settings and try the connecting with "Auto-connect" enabled. If still no connection can be established, please refer to your sensor manual to verify the physical connections.
No serial ports can be found	USB-to-serial converters may require driver software to be installed before use. Check whether the correct driver software has been installed for the USB-to-serial converter (in the Control Panel under "Hardware and Sound\Devices and Printers"). If not, right-click the device and install the driver software using the "Troubleshoot" option (see Figure 6.2.1).
Software does not start after installation	In contrast to previous version of the Sensor Manager Java Runtime is packaged with the software and does not need to be installed separately.
MSI installer cannot be opened	On Windows 10 and 11 an exclusion to security settings may be needed to install the Sensor Manager after it has been downloaded from the website, please refer to this article by Microsoft for instructions.

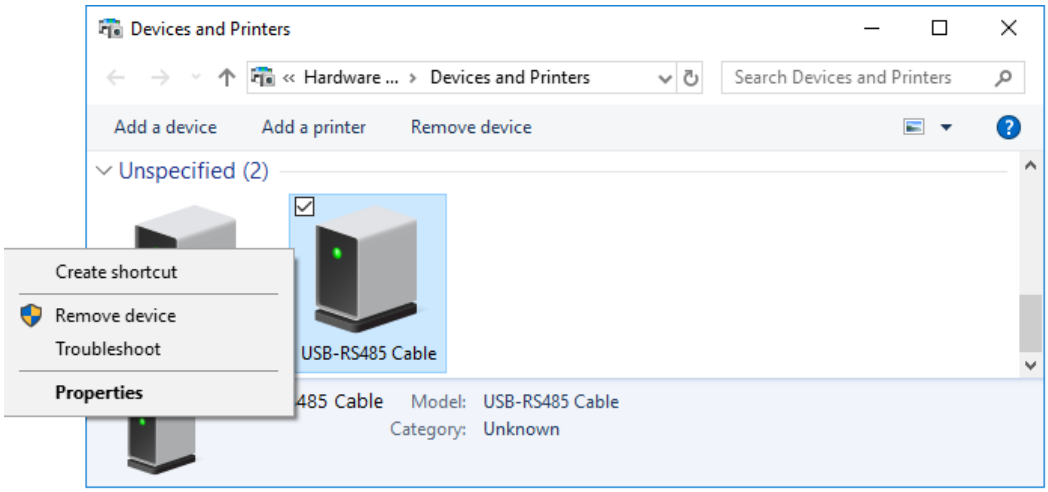


Figure 6.2.1 *Troubleshooting when no serial ports can be found. In this case, troubleshooting for a USB-RS485 USB-to-serial converter.*

6.3 Appendix on cache levels

All registers have a defined cache level. The Hukseflux Sensor Manager has a cache for storing values that are read from registers. This cache is implemented to avoid reading values that are essentially static repeatedly and will thereby reduce the number of I/O operations and time needed to perform these.

A list of possible cache levels for registers can be found in Table 6.3.1. Depending on the cache level of a request and the cache level of the register, as well as the availability of a cached value, the register value may either be requested from the sensor or returned from cache.

Table 6.3.1 *Possible cache levels.*

Cache Name	Level	Explanation
Force-read	0	always request register value from the sensor (forced read, overwrites the old cache).
Static (default)	1	reads register value from the sensor once, returns cached register value whenever a cached value is available

6.4 Appendix on the Virtual Sensor

In the Hukseflux Sensor Manager, a Virtual SR300-D1 sensor can be used to explore the Hukseflux Sensor Manager without having a physical sensor connected. This sensor can be used like any physical sensor. However, the user must be aware that the displayed values do not correspond to actual measurements.

NOTICE
The values of the Virtual SR300-D1 are randomly chosen constant values and do not correspond to actual measurements.

6.4.1 Connecting a Virtual Sensor

Connecting a virtual sensor can be done in both the "Scan for sensor" and "Connect" manually tabs. In order to connect the sensor, you select the Virtual SR300-D1 from the "Sensor type" dropdown menu (see Figure 6.4.1.1). The sensor does not need a COM port to establish a virtual connection.
When using "Scan for sensor", the device address from the first input field will be used as the device address for the virtual sensor. Note that setting the baud rate, parity and stop bits will have no effect on the serial settings of the virtual sensor itself – it will always be connected with default, preset serial settings.

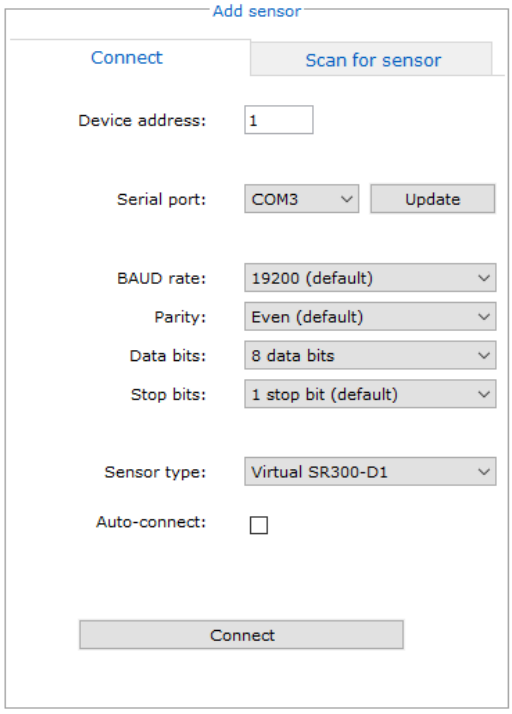


Figure 6.4.1.1 *Connecting a virtual sensor.*

6.4.2 Capabilities

The capabilities of the Virtual SR300-D1 are like a regular SR300-D1. However, most sensor readings are static and will not change.

6.4.2.1 Live Chart with Virtual SR300-D1

In the Live Chart, random values are used to mock the irradiance readings of the Virtual SR300-D1. This is done for demonstration purposes, and one can set the time settings to an Update interval of 30 seconds with averaging enabled to get somewhat realistic-looking results.

6.4.2.2 Data logging with Virtual SR300-D1

The same simulated values as used in the Live Chart are used for logging the values of a Virtual SR300-D1 to a file.

6.4.2.3 Changing settings

A Virtual SR300-D1 could be used to try out changes to settings. For example, trying out how to change the serial communication settings (see Section 4.1 Changing the Device address and communication settings) could be done with a virtual sensor, without the risk of unintentionally changing the settings of a real instrument.

6.5 Appendix on why Default Modbus map prevents restarting

When connecting a sensor using the default Modbus map (see 3.2.4 Default Modbus map), the sensor cannot be restarted. This is because the sensor is connected through its "default settings" mode, where the sensor communicates through specific dedicated communication settings. Restarting the sensor would reset this and, with that, overwrite the default Modbus map setting.