



USER MANUAL **HUKSEFLUX** **SENSOR MANAGER**

Software for digital solar radiation sensors

This user manual supports Hukseflux Sensor Manager software v2021 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 pyrhemometers 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 Modbus 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 v2021 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 or later
Software	Java Runtime Environment 8
Hardware interface	serial port (COM port), for example: <ul style="list-style-type: none"> • A USB port and an appropriate USB-to-serial converter • An RS-232 port and an appropriate serial converter
HUKSEFLUX SENSOR MANAGER SPECIFICATIONS	
Software version	v2021
Supported sensors	<ul style="list-style-type: none"> • SR05-DA1 • SR05-DA2 • SR05-D1A3 • SR05-D1A3-PV (non-default register mapping) • SR05-D2A2 • SR15-D1 • SR15-D2A2 • SR20-D1 • SR20-D2 • SR22-D2 • SR25-D1 • SR25-D2 • SR30-D1 • SR30-M2-D1 • DR30-D1 • Virtual SR30-D1 (see Appendix on the Virtual Sensor)

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

2 Installation

The system and software requirements can be found in Table 1.1. Running the Hukseflux Sensor Manager requires the latest version of the Java Runtime Environment 8 (JRE 8) software to be installed on the PC. If not already installed, JRE 8 may be obtained free of charge from www.java.com. Follow the installation instructions in the software to complete the JRE 8 installation. The Hukseflux Sensor Manager can be downloaded from the Hukseflux website.

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 show up.

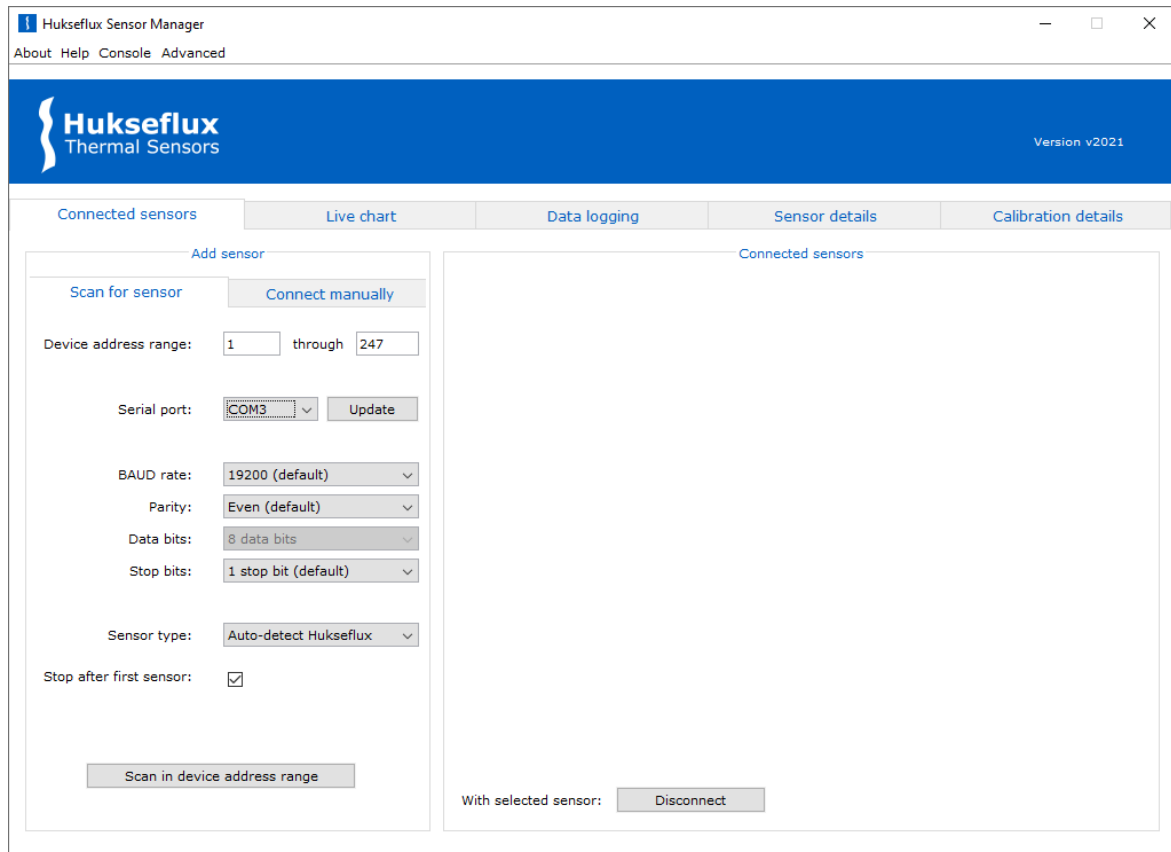


Figure 3.1: Main window of the Sensor Manager

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

3.1.1.1 About

Clicking the "About" button in the top menu will open the "About screen" and can be used to retrieve information about the Sensor Manager such as the version and supported sensors (see Figure 3.1.1.1).

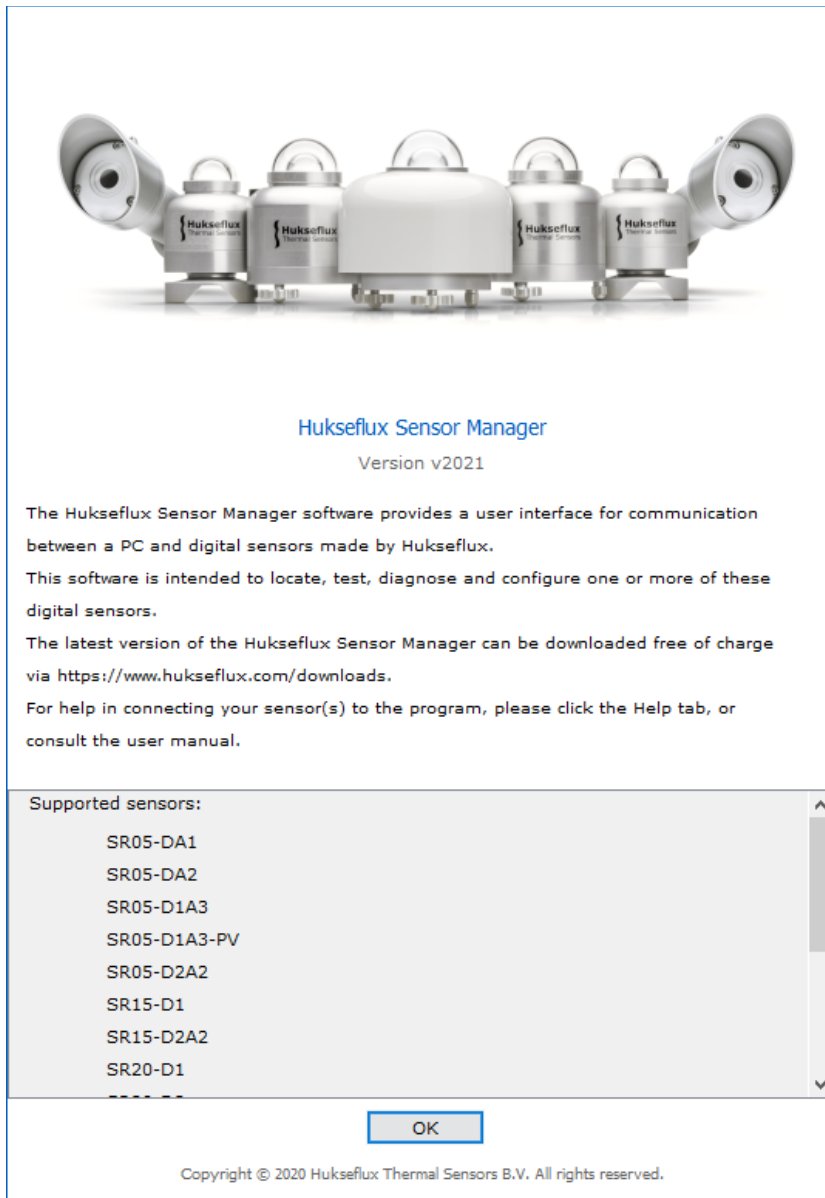


Figure 3.1.1.1 About screen of the Sensor Manager

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 two ways to connect to a sensor: either by manually entering the sensor's device address and serial settings or by scanning a range of device addresses and serial settings. If the sensor's serial settings and device address are known, the "Connect manually" tab can be used. Otherwise, the "Scan for sensor" tab is advised. The "Scan for sensor" tab can also be used to connect multiple sensors.

3.2.1 Scan for sensor

The "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 particular variable. 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 SR30-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.

When the "Stop after first sensor" checkbox is checked, the scan will stop after the first sensor has been found, which is recommended if only one sensor is connected. When unchecked, the full range of device addresses and serial settings is scanned.

3.2.2 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.

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 manually" 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 Hukseflux" is selected the software will automatically determine the sensor model. There is also an option to connect a "Virtual SR30-D1" sensor. This option simulates an

SR30-D1 sensor for testing and demonstration purposes. For more details on this see the Appendix on the Virtual Sensor.

3.2.3 Search time

When scanning for sensors, the search time to complete the entire search depends on how many “unknown” settings are selected. An exhaustive search, with BAUD rate, parity and stop bits all set to unknown, takes approximately 30 minutes.

An estimation of the time to complete the entire search is displayed, as can be seen in Figure 3.2.3.1. A search can be stopped at any time by clicking the “Cancel” button.

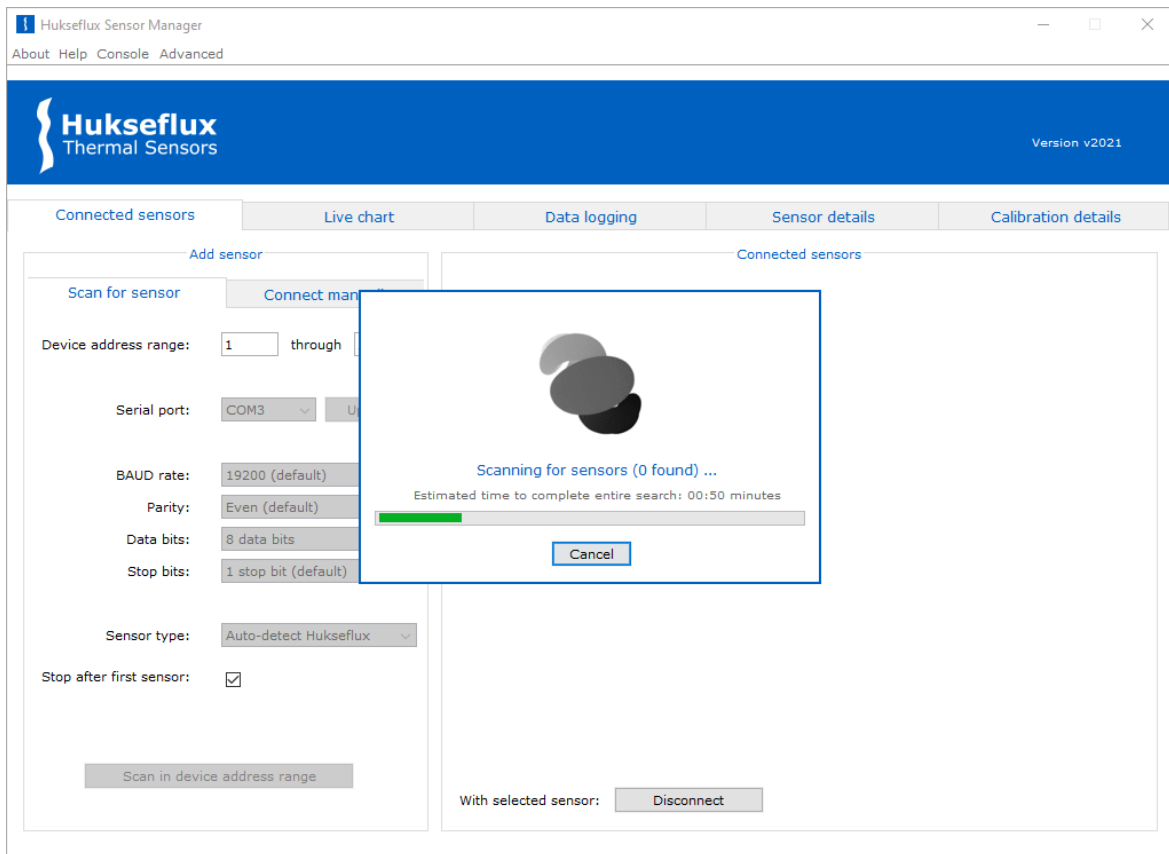


Figure 3.2.3.1 Scan window showing the estimated time to complete the search

3.2.4 General

When an instrument is found, temperature and irradiance data are displayed (see Figure 3.2.4.1). Updates are performed automatically every second.

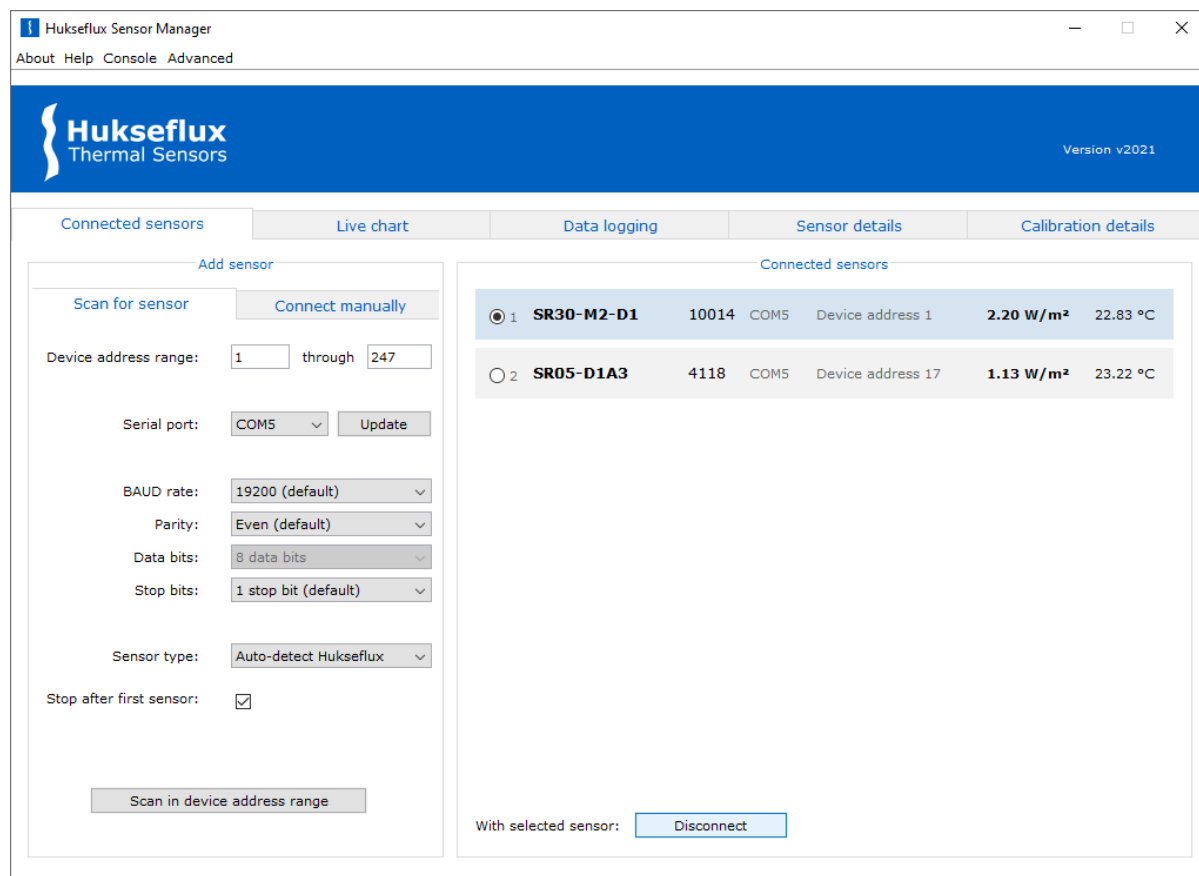


Figure 3.2.4.1 Sensor Manager main window with two connected sensors

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).

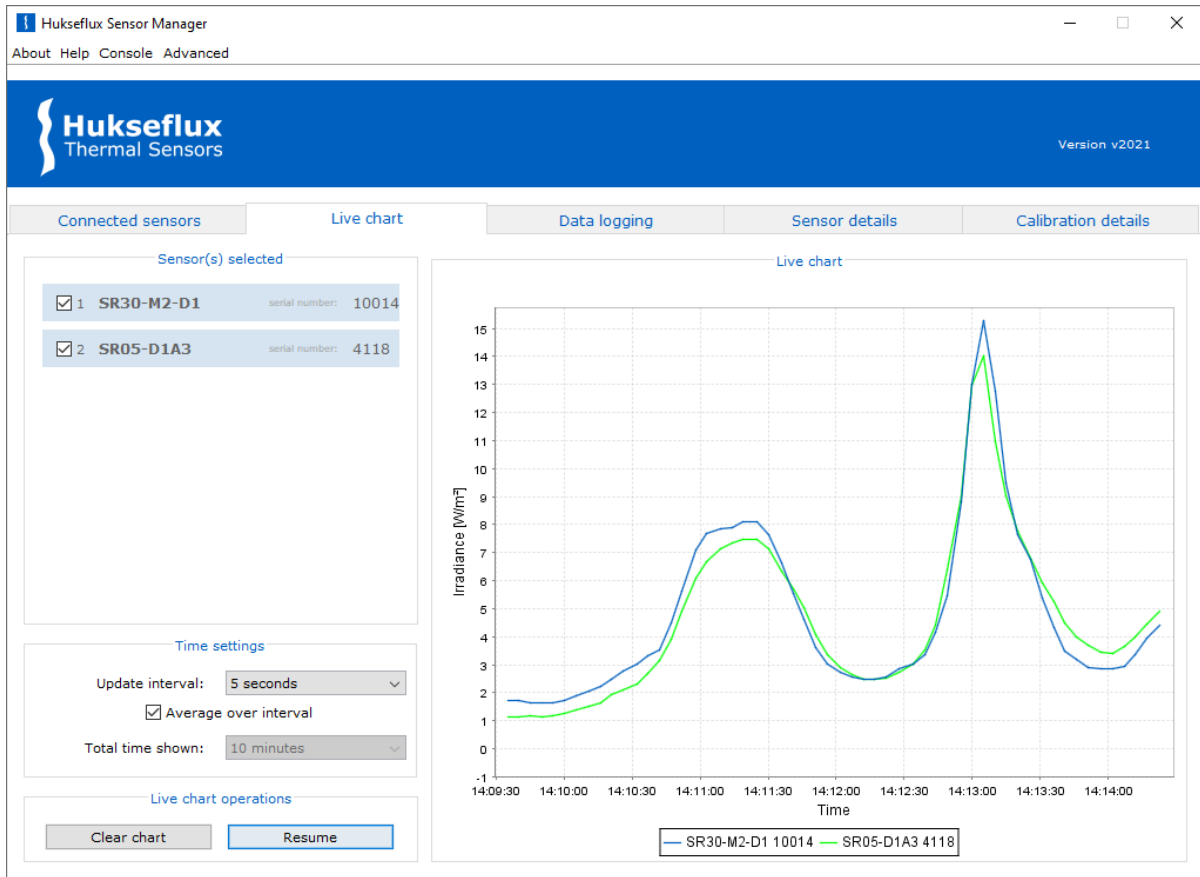


Figure 3.3.1 Live chart tab offers a live chart of irradiance data from one or more sensors

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

You can set certain properties of the live chart 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 "domain axis", change fonts of the title and of the "domain axis" and set specific colours for the background and the title and domain axis.

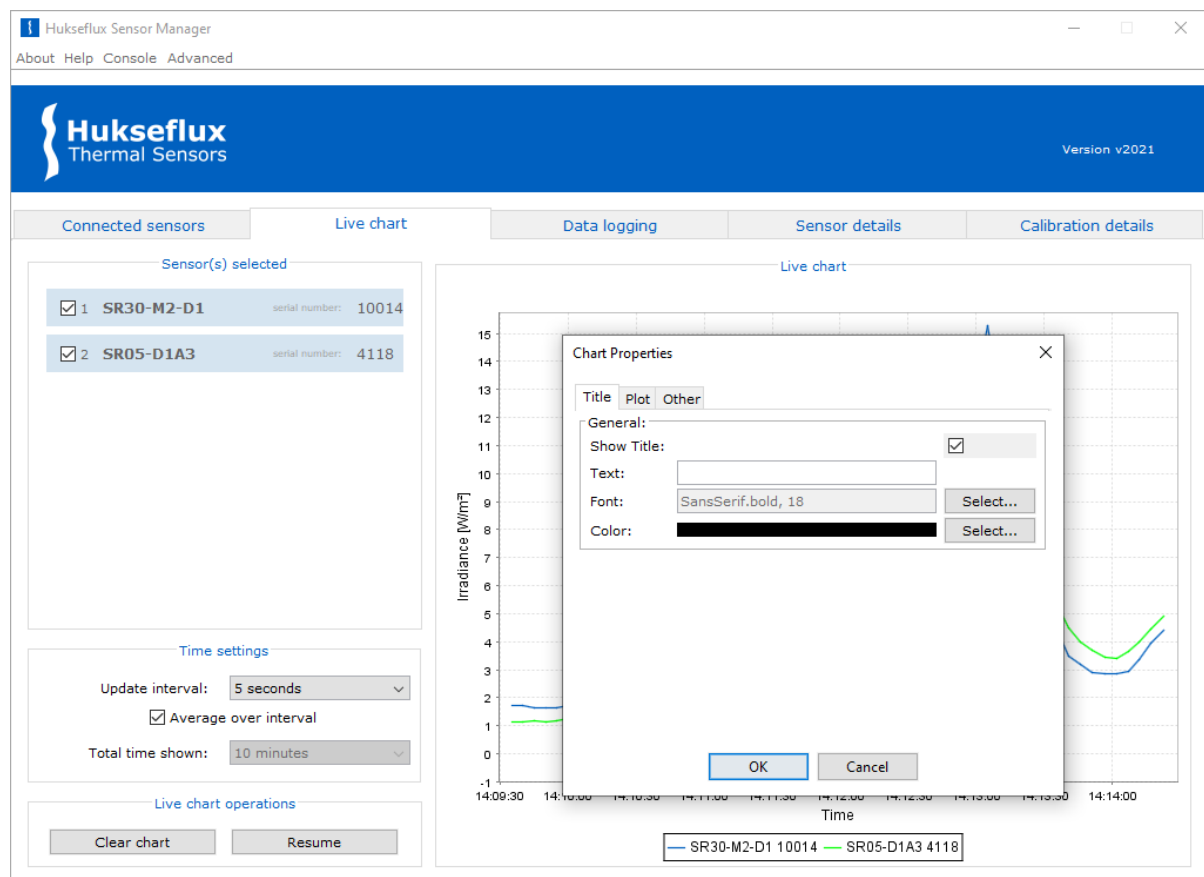


Figure 3.3.3.2.1 Setting properties of the live chart

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.

NOTICE

Although the Hukseflux Sensor Manager can in principle be used to log data for extended periods of time, it is not intended for long term data logging and may not be as reliable and robust as dedicated data logging systems. For long term datalogging Hukseflux strongly recommends using dedicated data logging systems and software.

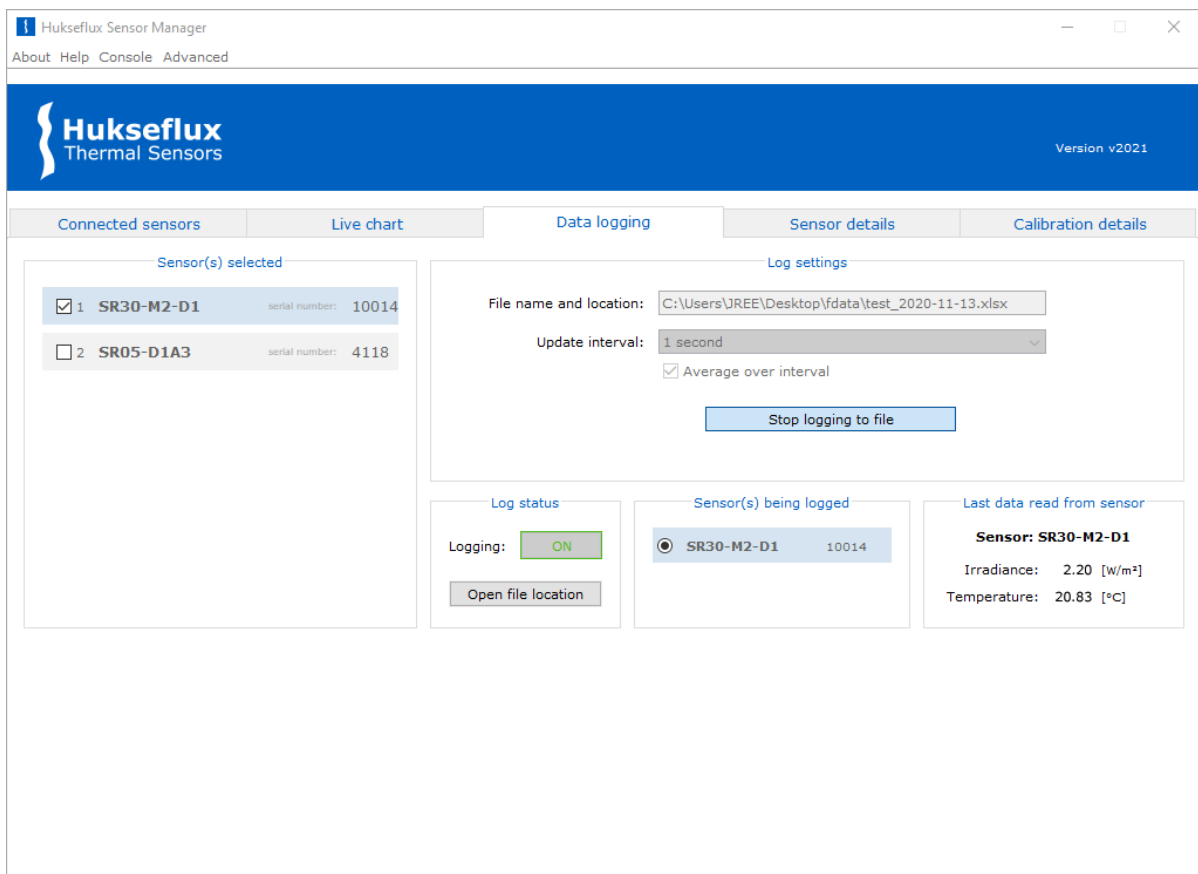


Figure 3.4.1 Data logging tab with two connected sensors

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.

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 as can be seen 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.

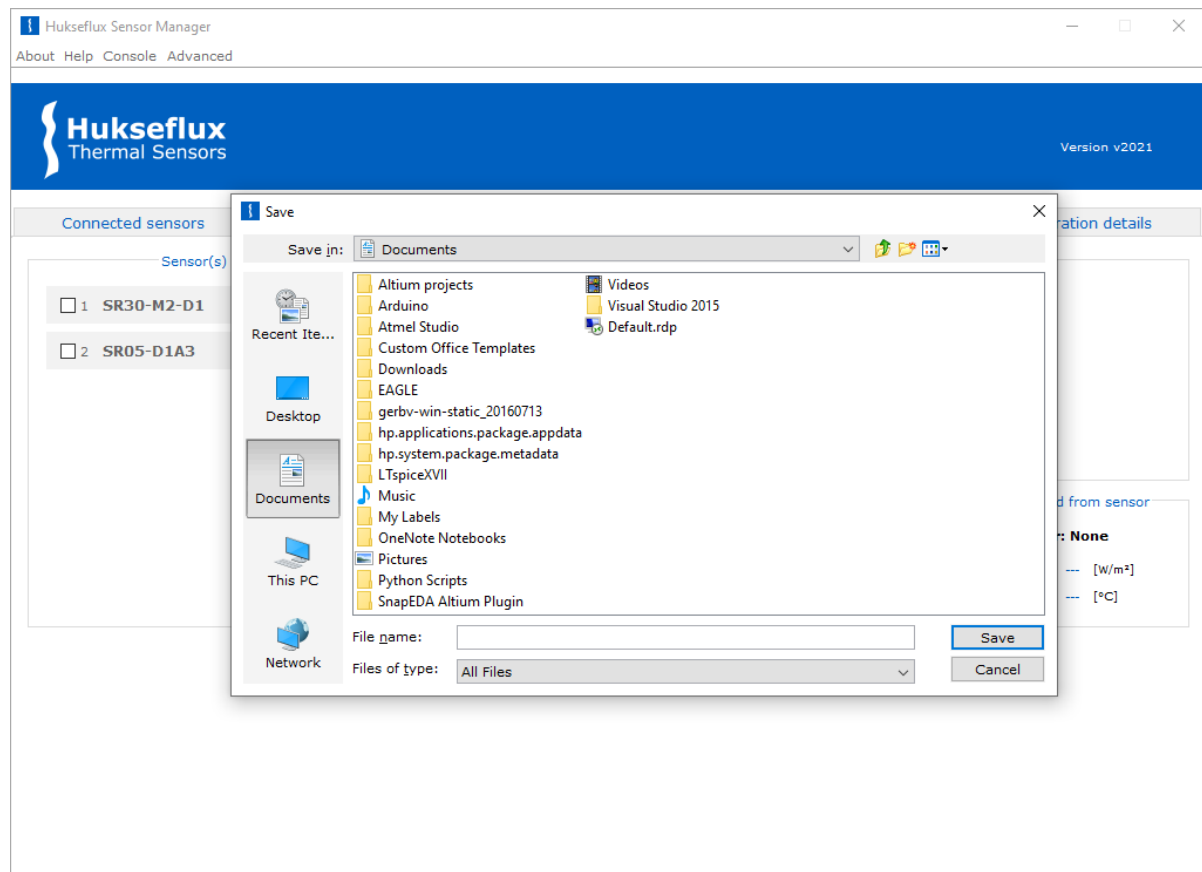


Figure 3.4.2.1 Selecting Excel Workbook format instead of CSV format

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", from which the latest irradiance and temperature readings will be displayed.

3.4.4 Recommendations

The data logging continues to function when the PC is put into sleep mode. 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 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, in order to write them to the file when this is possible again. While this error condition exist the "Irradiance" and "Temperature" fields display an "ERR" value.

NOTICE

It is not possible for the Hukseflux Sensor Manager to log data to a file when that file has been opened by another application. Therefore, care should be taken that when logging, the file is not opened anywhere on the PC.

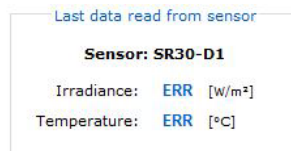


Figure 3.4.4.1 Error being displayed when a problem with writing to the file occurs

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.

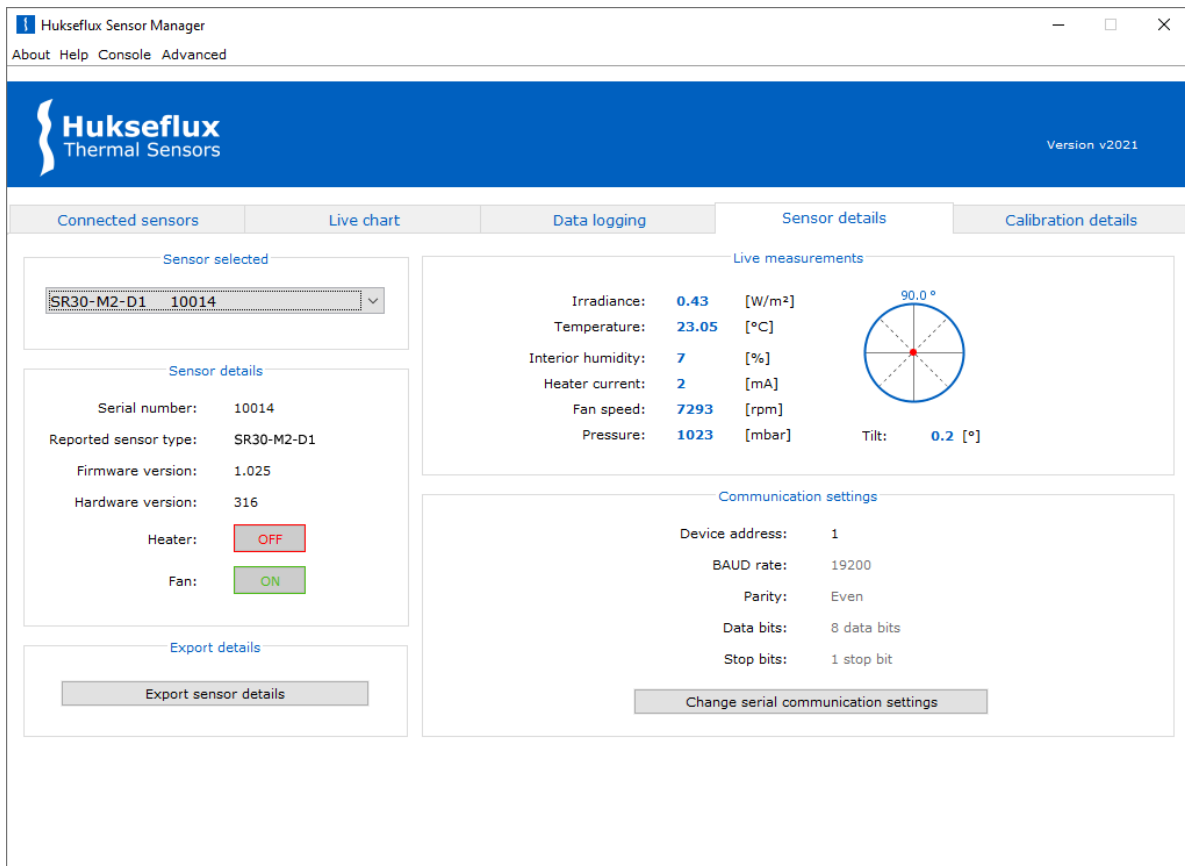


Figure 3.5.1 Sensor details window of an SR30-M2-D1 sensor

The sensor details of the selected sensor can be exported (to a .txt text-file) and consequently be viewed in the default .txt file application. The file is saved in the folder where the hsm-vxxxx.jar file is located.

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 Modbus 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 can be seen, along with the temperature characterisation coefficients (see Figure 3.6.1).

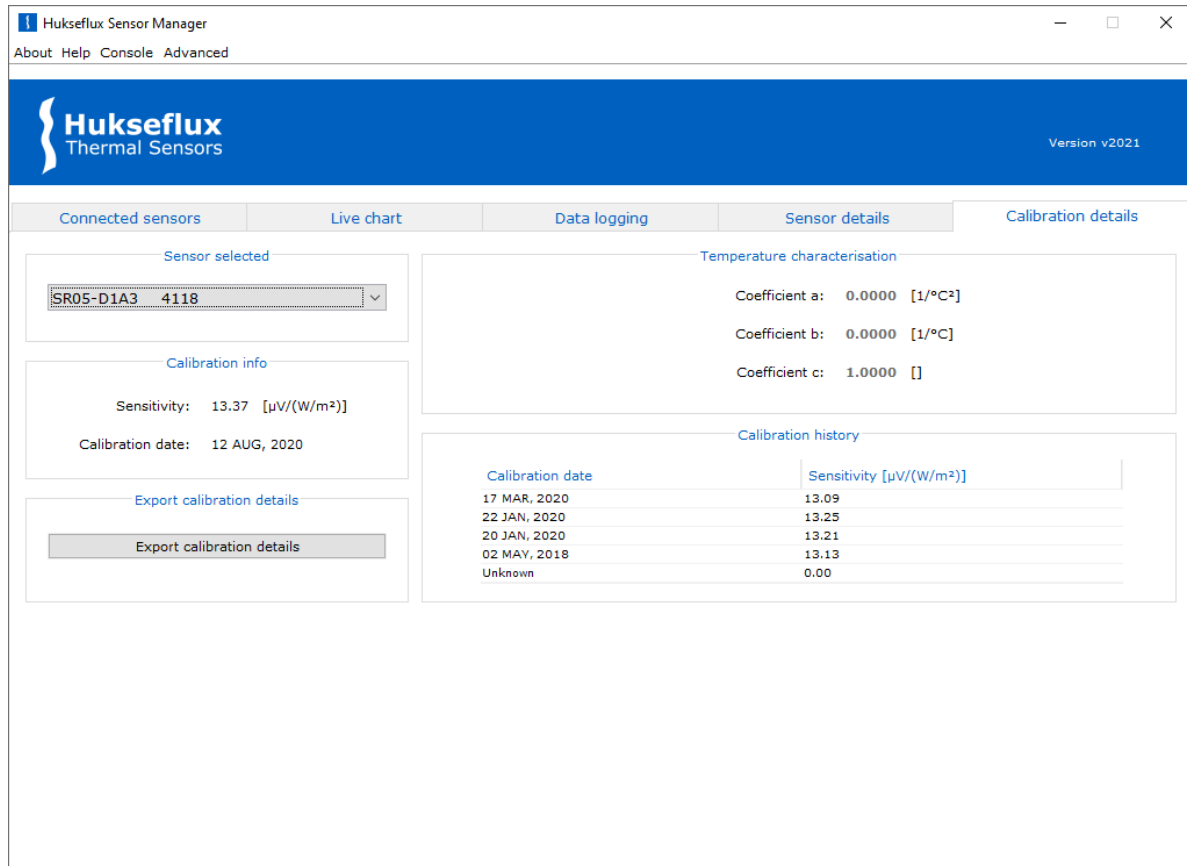


Figure 3.6.1 Calibration details window of an SR05-D1A3 sensor

The calibration details can be exported (to a .txt text-file) through the “Export calibration details” button and viewed in the default .txt file application. The file is saved in the folder where the hsm-vxxxx.jar file is located.

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 “Advanced settings” in the top menu bar.

4.1 Changing the Modbus 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 Modbus address and serial settings (BAUD rate, parity, number of stop bits).

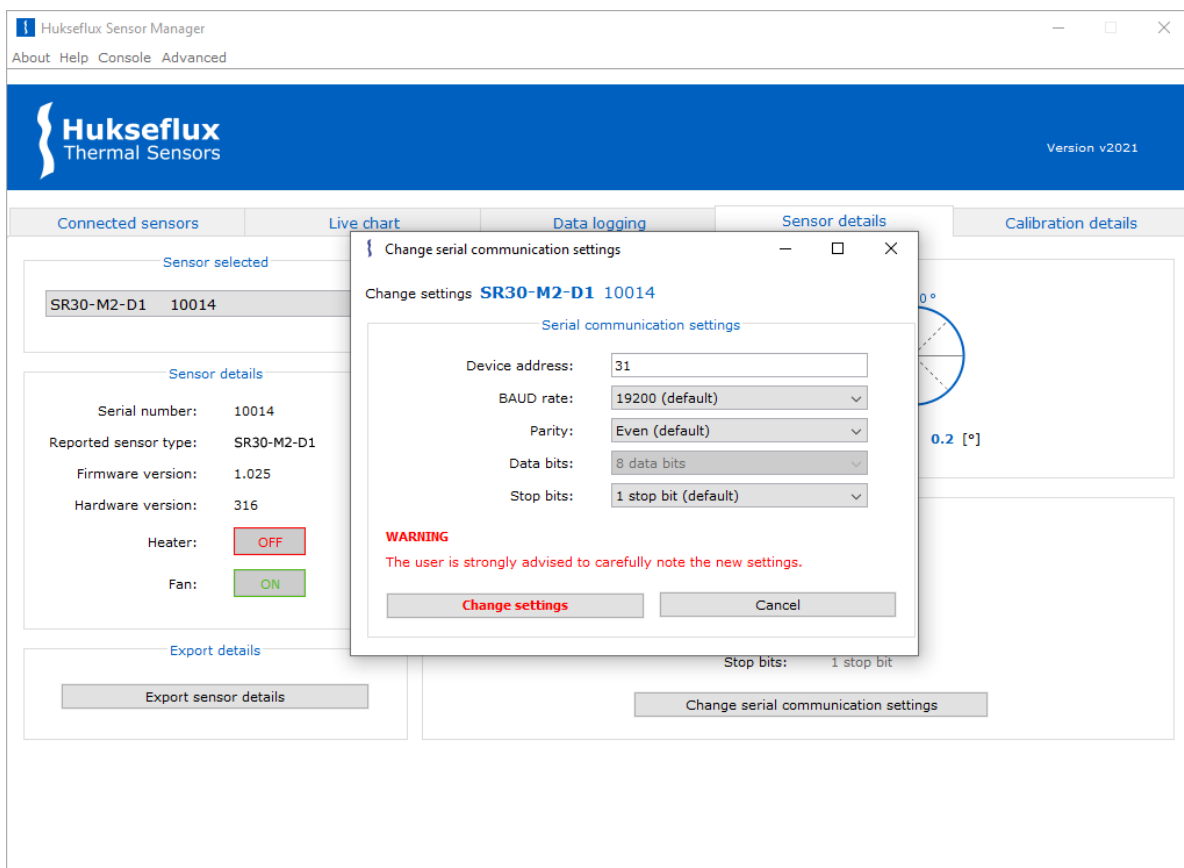


Figure 4.1.1 Change serial communication settings window

When new communication settings or a new Modbus 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 Modbus address is changed, the Sensor Manager will automatically reconnect with the instrument using the new address after restart.

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 measurements panel is shown accordingly.

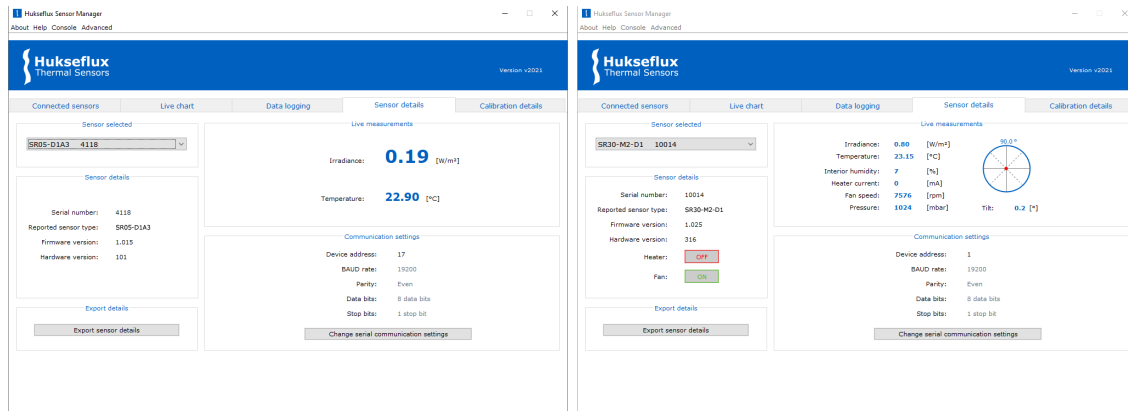


Figure 4.2.1 Example of the differences in the "Sensor details" tab between an SR05-D1A3 pyranometer (left) and an SR30-M2-D1 pyranometer (right)

4.2.1 Tilt sensor

Some pyranometers are equipped with a tilt sensor. Tilt sensors can help diagnose pyranometer alignment issues and aid in the levelling during installation. If the pyranometer is equipped with a tilt sensor, the tilt is displayed in the "Live measurements" box in the "Sensor details" tab (see Figure 4.2.1).

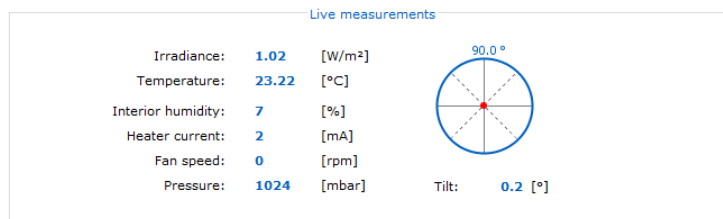


Figure 4.2.1.1 "Live measurements" box of a pyranometer equipped with a tilt sensor

Please note that, due to vibrations, the performance of the tilt sensor is best when the fan is switched OFF.

4.2.2 Heater and ventilator

Some of the pyranometers come equipped with an internal heater, a ventilator or both. See Section 4.3 Changing the heater and ventilator settings, when the heater's or ventilator's 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 ventilator settings

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

4.3.1 Temporarily switch heater and ventilator settings

If a sensor has a heater and/or ventilator, 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 ventilator setting in this manner is temporary in the sense that upon powercycling, the heater and ventilator settings will return to their default state.

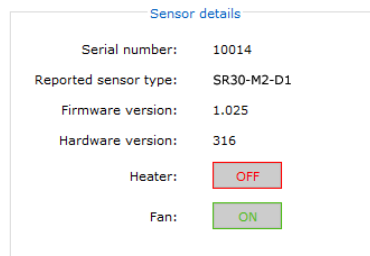


Figure 4.3.1.1 "Sensor details" box of a pyranometer equipped with an internal heater and ventilator.

NOTICE

Upon powercycling the sensor, the sensor's heater and ventilator will switch back to their default setting. To change the default heater and ventilator settings, the reader is referred to Section 4.3.2.

4.3.2 Changing the default heater and/or ventilator settings

If a sensor has a heater and/or ventilator, to change the default state of the heater and/or ventilator on power-up:

- 1) Click the "Advanced" drop-down menu in the top menu bar. In the drop-down list, "Advanced sensor settings" should be selected, which will open the "Advanced Sensor Settings" window (see Figure 4.3.2.1).

- 2) In the “Advanced settings” window select the correct sensor and set the “Heater on by default” and “Fan on by default” checkboxes to the desired state.

NOTICE

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

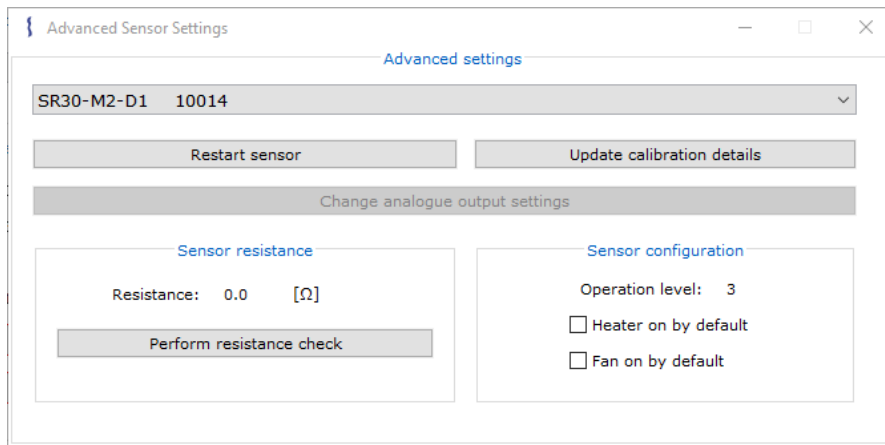


Figure 4.3.2.1 *Advanced Sensor Settings window for an SR30-M2-D1*

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 Adjusting sensitivity

Critical settings within the Hukseflux Sensor Manager are protected from accidental or unauthorised modifications by a password. 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 can be done after obtaining a password. Please contact the factory to obtain this password.

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 $16.15 \mu V/(W/m^2)$ ought to be changed to $16.48 \mu V/(W/m^2)$. 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 "Update calibration details" button within the "Advanced settings" window. 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.

The screenshot shows a software window titled "Update calibration details". At the top, it says "Update calibration SR30-M2-D1 10014". Below this, there are two sections: "Current calibration details" and "New calibration details".

Current calibration details:

- Sensitivity: 0.00 [$\mu V/(W/m^2)$]
- Calibration date: Unknown

New calibration details:

- Sensitivity: [$\mu V/(W/m^2)$]
- Calibration date: [YYYY-MM-DD]

At the bottom of the window, there are two buttons: "Save calibration" and "Close window".

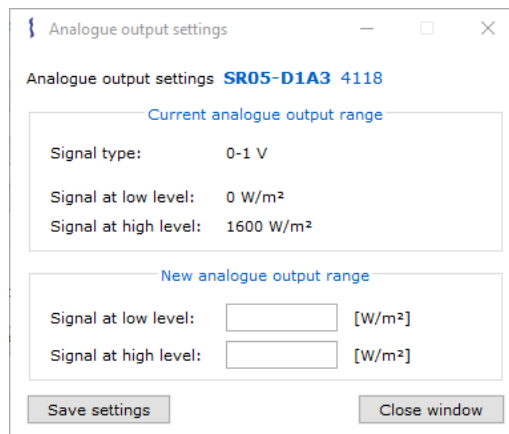
Figure 5.1.1 Update calibration details window

5.2 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.

Critical settings within the Hukseflux Sensor Manager are protected from accidental or unauthorized modifications by a password. The analogue output settings are considered critical and changing them can be done after obtaining a password. Please contact the factory to obtain this password.

It is possible to change the analogue output range by clicking the "Change analogue output settings" button in the "Advanced settings" window. After entering the password, the "Analogue output settings" window will be opened (shown in Figure 5.2.1). Fill in the new signal at low and high level and click the "Save settings" button to confirm the changes.



The screenshot shows a window titled "Analogue output settings" for sensor "SR05-D1A3 4118". It is divided into two sections: "Current analogue output range" and "New analogue output range".

Field	Current Value	New Value
Signal type	0-1 V	
Signal at low level	0 W/m ²	[input] [W/m ²]
Signal at high level	1600 W/m ²	[input] [W/m ²]

Buttons: Save settings, Close window

Figure 5.2.1 The "Analogue output settings" window for an SR05-D1A3

5.3 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.

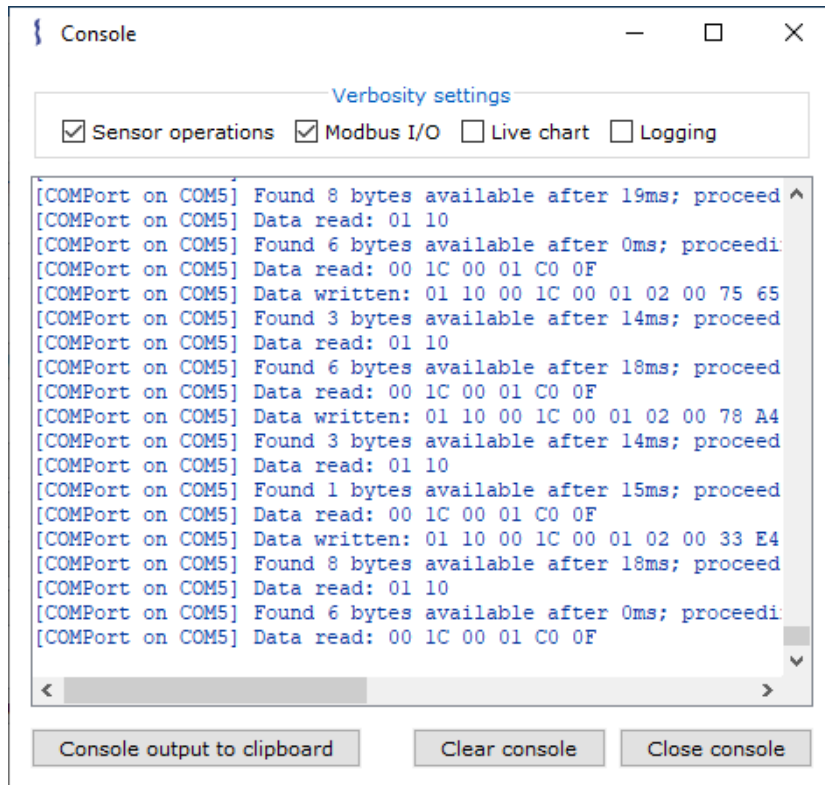


Figure 5.3.1 Console window with "Sensor operations" and "Modbus I/O" enabled

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 with regards to sensor operations. This can be useful in identifying certain problems with a sensor, for example when connecting to a sensor or changing a sensor's 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 that is being displayed in the "Live chart" tab. This can for example be used to troubleshoot problems regarding the "Live chart".

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

5.4 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 5.4.1.1). 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 behaviour of a sensor.

5.4.1 Register list

The “Register list” window (see figure 5.4.1.1) can be used to read and adjust individual registers.

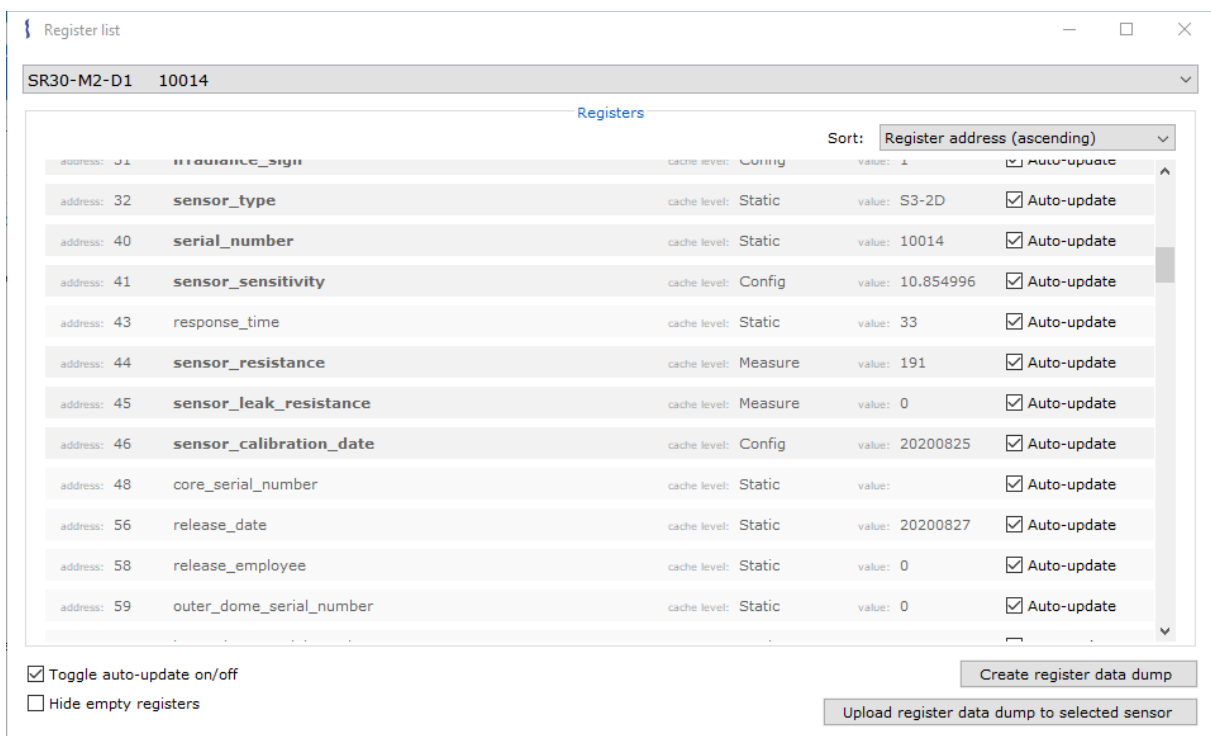


Figure 5.4.1.1 Register list window for an SR30-M2-D1 sensor

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.

5.4.2 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 5.4.2.1). This operation can only be performed on read/write registers, which are indicated by a darker background (see figure 5.4.2.2). Certain registers are considered critical and are therefore password-protected. Please contact the factory to obtain this password.

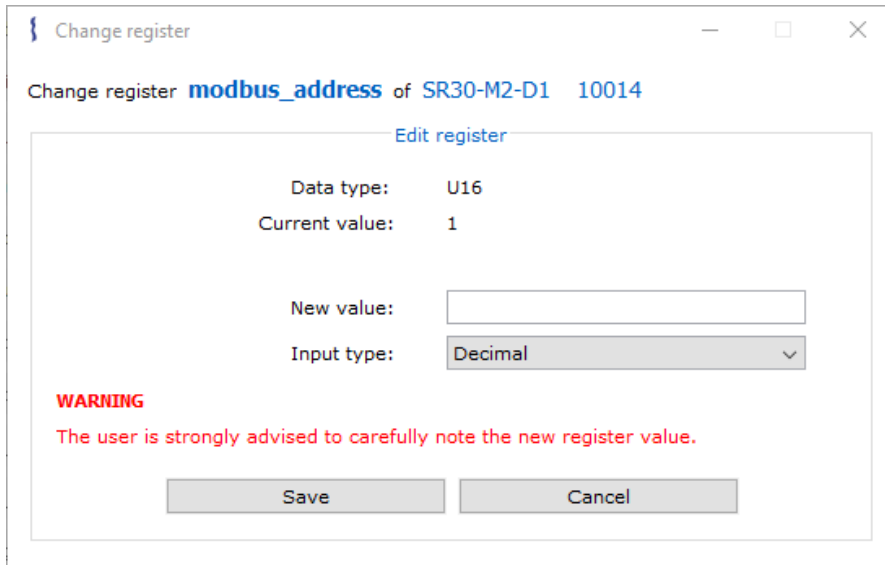


Figure 5.4.2.1 Change register window for the `modbus_address` register of an SR30-M2-D1 sensor

address: 1	modbus_address	cache level: Config	value: 1	<input checked="" type="checkbox"/> Auto-update
address: 2	serial_settings	cache level: Config	value: 5	<input checked="" type="checkbox"/> Auto-update
address: 3	temperature_compensated_signal	cache level: Measure	value: 414	<input checked="" type="checkbox"/> Auto-update
address: 5	uncompensated_signal	cache level: Measure	value: 414	<input checked="" type="checkbox"/> Auto-update

Figure 5.4.2.2 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 5.4.2.1. 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 5.4.2.1 *Input examples*

Input format	New value	Input	Explanation
Decimal	4.56·10 ⁻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	When you have a normal decimal, simply use it as input.
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	SR30-D1	SR30-D1	Simply use the new value String as the input.

5.4.3 Data dump

The “Register list” window (see Figure 5.4.1.1) 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.

5.4.3.1 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 folder where the Hukseflux Sensor Manager is stored. The file format is in Comma Separated Values (.csv) format. A representation of the three values from Table 5.4.3.1 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 5.4.3.1 *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

5.4.3.2 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 5.4.3.1). 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 [5.4.3.1 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.

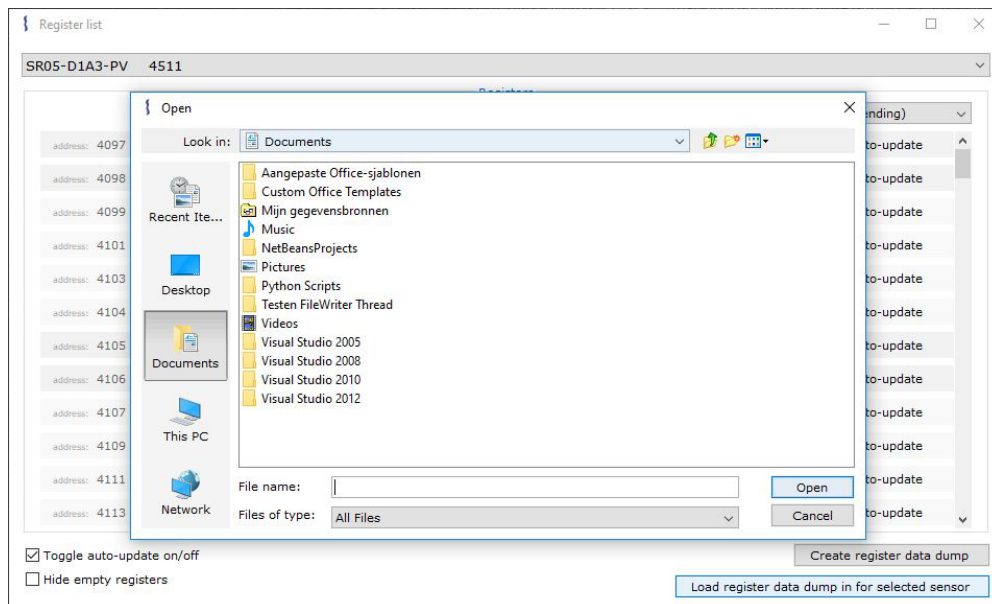


Figure 5.4.3.1 “Open” window to upload a register data dump file

5.5 All supported sensors

The Hukseflux Sensor Manager supports certain very specific sensors which are not shown by default. In order 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 5.5.1). This functionality is password-protected. Please contact the factory to obtain the password.

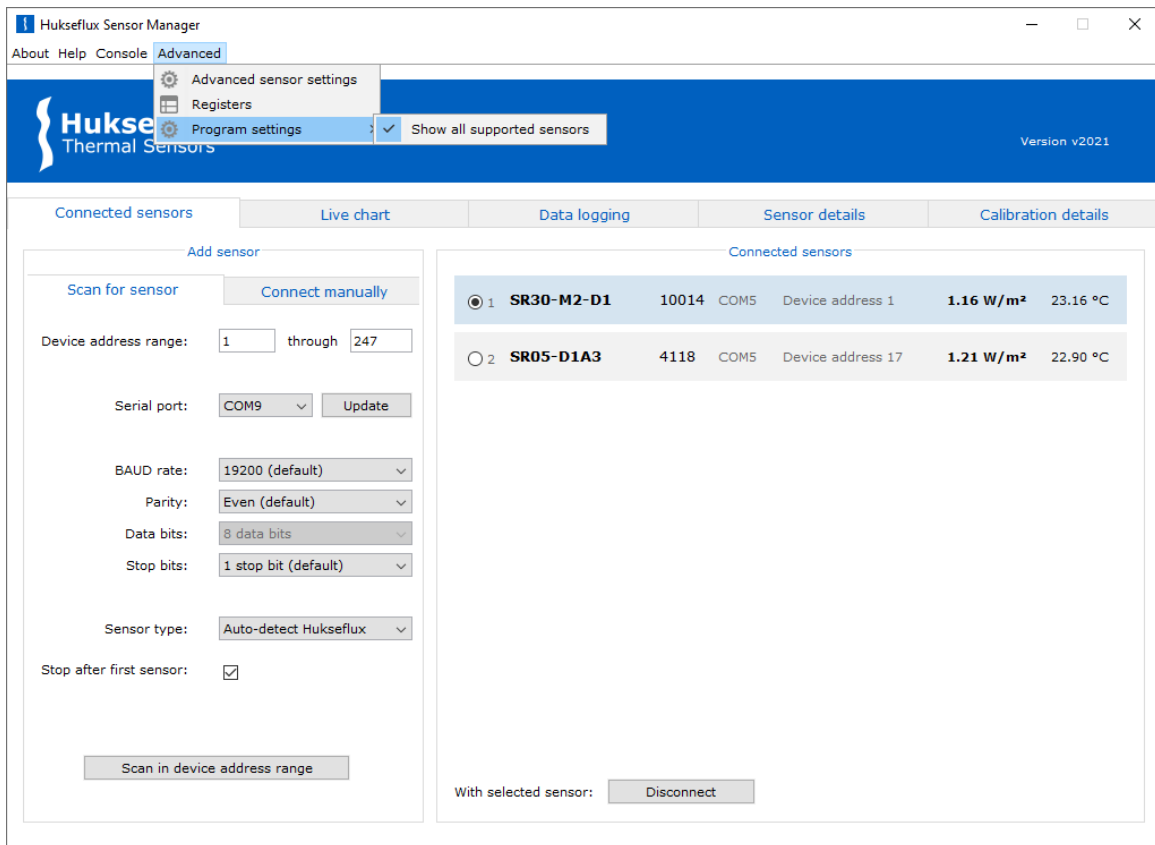


Figure 5.5.1 Show all supported sensors option

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

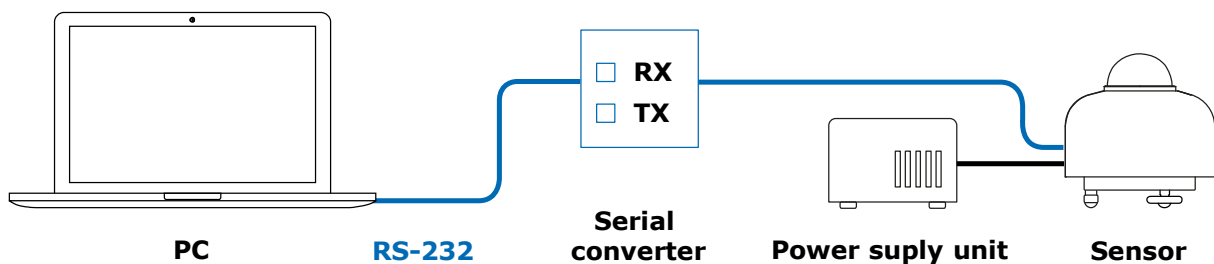


Figure 6.1.1 A PC connected to a sensor via a serial converter

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.

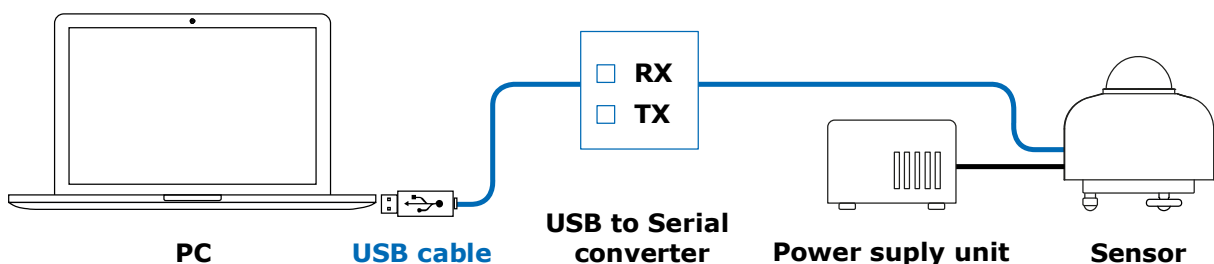


Figure 6.1.2 A PC connected to a sensor via a USB-to-serial converter

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
A Windows message comes up, displaying "the file "hsm-vxxxx.jar" could not be opened"	Check if the Java Runtime Environment has been installed. If not, install Java Runtime Environment version 8 on the PC and try again.
Cannot connect to sensor	Make sure to select the correct COM port, Modbus address and serial settings. If still no connection can be established, please refer to your sensor manual to verify the physical connections.
Unable to install communication library	Make sure that the application has writing rights.
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).

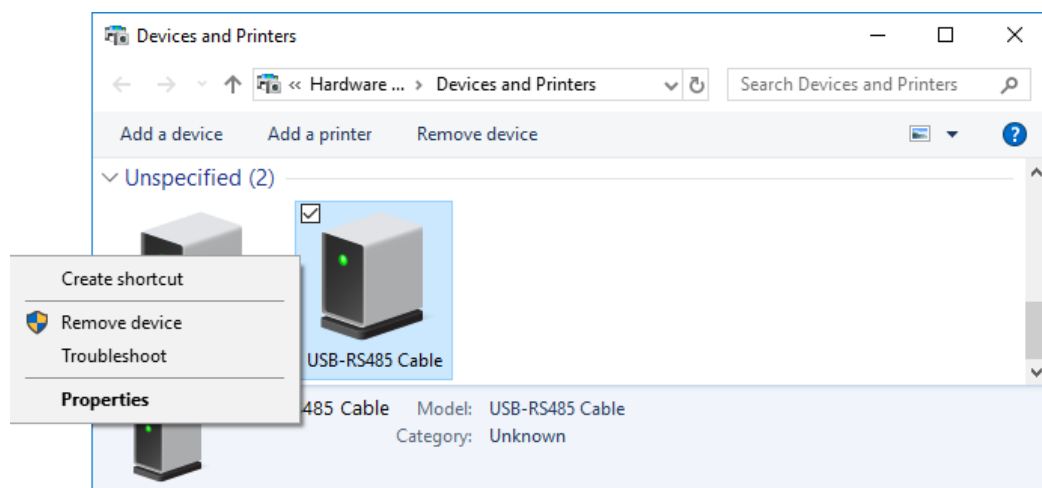


Figure 6.2.1 *Troubleshooting when no serial ports can be found. In this case, troubleshooting for a USB-RS485 USB-to-serial converter*

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. For certain registers, reading in the register value once is sufficient, after which the cached value can be returned. This will prevent time-consuming I/O operations.

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
Measure	0	Always request register value from sensor (forced read, overwrites the old cache).
Config (default)	1	Reads register value from sensor once, returns cached register value whenever cache level is greater than or equal to 1 and a cached value is available
Static	2	Reads register value from sensor once, returns cached register value whenever cache level is greater than or equal to 2 and a cached value is available
Never cache	3	Never caches (stores) the value that is read

6.3.1 Process

When the Hukseflux Sensor Manager reads in a register, a different cache level is passed along with the read-in operation. This given cache level indicates whether to read the register, or to return the value from the cache (if a value exists in the cache). In the case where the value is read from the register, the given cache level also indicates whether to store the value in the cache. A flow diagram of this process can be seen in Figure 6.3.1.1. In most cases, `readCacheLvl` and `regCacheLvl` as seen in the figure will be of the same cache level. See the example below for an illustration of this process.

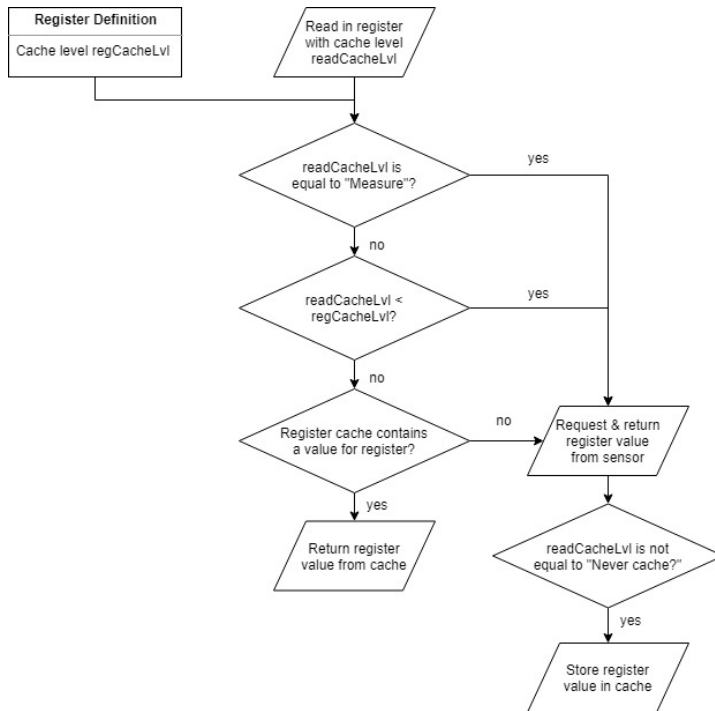


Figure 6.3.1.1 Flow diagram of cache level functionality when reading in a register

6.3.2 Example

An example to illustrate the process is reading in the sensor’s device address. The device address has a “Config” cache level, since it has to be read once, after which the cached value will suffice. This will prevent time-consuming I/O operations. In normal circumstances, the readCacheLvl as seen in Figure 6.3.1 will have the same cache level as the register has, in this example the “Config” cache level.

When trying to read the register’s value for the first time:

- The readCacheLvl is not equal to “Measure”;
- The readCacheLvl is not smaller than the register definition’s regCacheLvl (it’s the same);
- The register cache does not contain a value for the device address;

Therefore, the register is read. Since the readCacheLvl is not equal to “Never cache”, we store the value in the cache.

When trying to read the register’s value any consecutive time with readCacheLvl equal to “Config”, the register cache now *will* contain a value for the device address. Therefore, in these cases the cached value will be returned.

A special circumstance occurs when the device address is changed by the user. The cached value needs to be overwritten if the correct value is to be returned. In such circumstances, the “Measure” cache level will be passed along once as readCacheLvl when reading in a value. This will ensure that the register’s value is read and returned. Also, it will ensure this new value is stored in the cache.

6.4 Appendix on the Virtual Sensor

In the Hukseflux Sensor Manager, a Virtual SR30-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 SR30-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 SR30-D1 from the "Sensor type" dropdown menu (see Figure 6.4.1.1). The sensor does need a COM port to establish a virtual connection - any of the available COM ports will suffice. 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.

The screenshot shows a window titled "Add sensor" with two tabs: "Scan for sensor" (selected) and "Connect manually". Under "Scan for sensor", there are several fields and a button:

- Device address range: 1 through 247
- Serial Port: COM1 (dropdown) with an "Update" button
- BAUD rate: 19200 (default) (dropdown)
- Parity: Even (default) (dropdown)
- Data bits: 8 data bits (dropdown)
- Stop bits: 1 stop bit (default) (dropdown)
- Sensor type: Virtual SR30-D1 (dropdown)
- Stop after first sensor:
- Scan in device address range (button)

Figure 6.4.1.1 Connecting a virtual sensor

6.4.2 Capabilities

The capabilities of the Virtual SR30-D1 are like a regular SR30-D1. However, the irradiance, temperature and other sensor readings are static and will not change, except for the Live Chart tab.

6.4.2.1 Live Chart with Virtual SR30-D1

In the Live Chart, random values in a range from 0 to 1 are used to mock the irradiance readings of the Virtual SR30-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 realistically looking results.

6.4.2.2 Data logging with Virtual SR30-D1

Data logging is possible, but will use the static values of the sensor, so all sensor values being logged will be the same.

6.4.2.3 Changing settings

A Virtual SR30-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 Modbus address and communication settings) could be done with a virtual sensor, without the risk of unintentionally changing the settings of a real instrument.

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