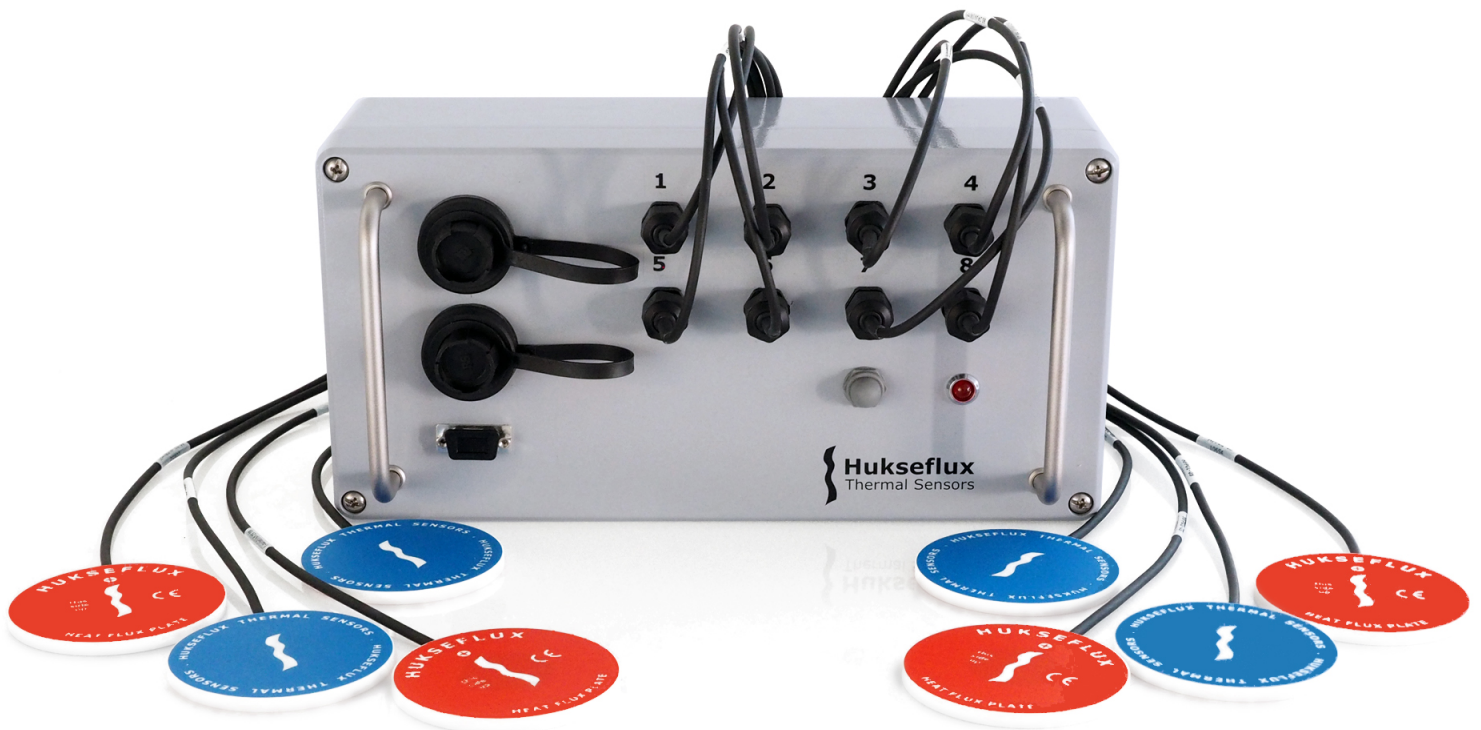


USER MANUAL **HFPSYS08**

Heat flux measurement system with eight measurement locations



General information

This user manual explains the installation and use of HFPSYS08, a measurement system for analysis of heat flux, combined with 8 HFP01 heat flux plates.

The manual is intended for explaining the HFPSYS08 system only, not the functioning of the individual sensors. For information on use and functioning of the individual sensor, the user should refer to its manual.

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Introduction

HFPSYS08 is a measurement system for analysis of heat flux. In its standard configuration the system is equipped with eight heat flux sensors.

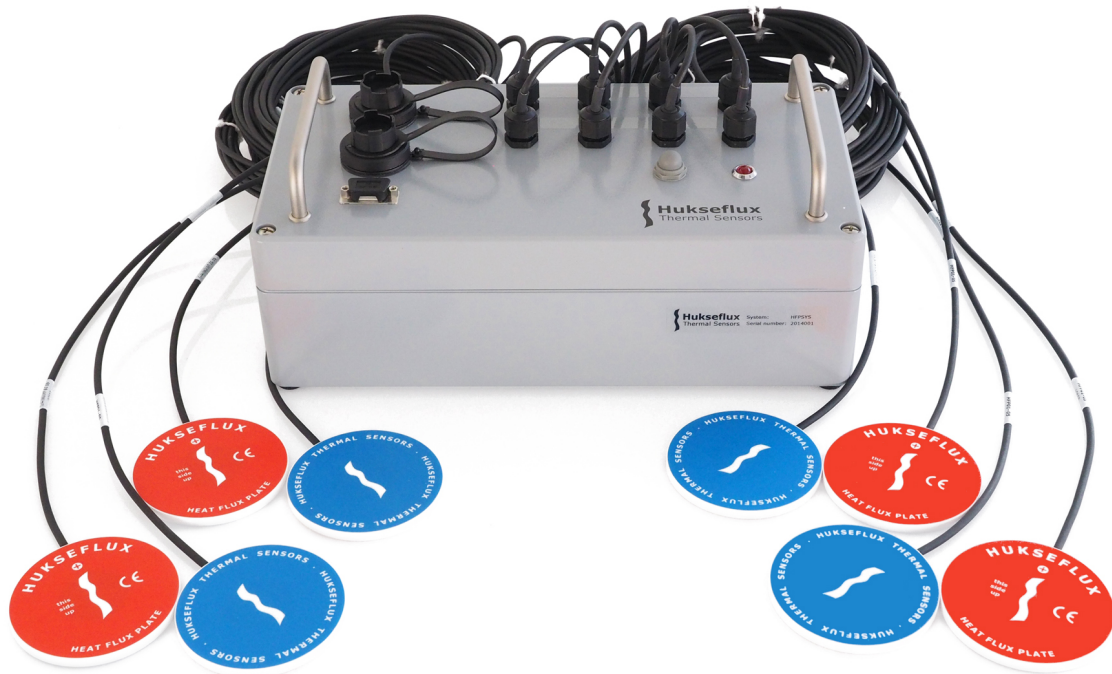


Figure 0.1 HFPSYS08 consists of the MCU Measurement and Control Unit and eight HFP01 heat flux sensors. Readout is performed by connecting temporarily to a PC (not included). Software for readout (Loggernet) is included.

1 Specifications of HFPSYS08 and sensors for current configuration

Table 1.1. *HFPSYS08 specifications*

GENERAL SPECIFICATIONS	
Protection Class	MCU: IP63, Sensors: IP65
Measurement locations	8
Non specified measurements	Total net weight: approx. 5 kg Dimensions (in cm): 32 x 14 x 16 (without sensors)
CE requirements	HFPSYS08 complies with CE directives
Data analysis	To be performed by the user: Using software on the PC, the stored data can be transmitted from the MCU to the PC and be exported to a spreadsheet (Excel) or a dedicated mathematical program
Working temperature range	Typically -20 to +50 °C
HEAT FLUX SENSOR TYPE HFP01 SPECIFICATIONS	
	See HFP01 manual
MCU MEASUREMENT AND CONTROL UNIT SPECIFICATIONS	
Measurement specifications	Voltage measurement accuracy 1 microvolt
Data Storage	At least 30 days; 5 minute averages
Power supply	External: Adapter included for 100 - 240 VAC, 50/60 Hz operation.
Software	Power should be supplied between 9.6 and 16 VDC to the system
Data transfer	New software versions can be uploaded through the USB or RS-232 port
Control	USB or RS-232
LOGGERNET SOFTWARE SPECIFICATIONS	
Minimum PC requirements	Windows XP or later, CD-ROM drive, USB port, one free COM or USB port, 100 MB hard disk space

2 Delivery

The delivery is as follows:

Table 2.1. *Delivery: HFPSYS08 components and their function*

GENERAL SPECIFICATIONS	
MCU, PC cable	The MCU containing a CR1000 measurement and control module, with a SC-USB interface. The user can use the USB interface, provided the drivers are correctly installed and a free USB port is available on the PC. The user can also connect through a RS-232 cable. The user is supposed to have a COM port available. Cable length PC to MCU: about 1 meter
Adapter 12 VDC	This adapter can be used with any mains supply form 100 to 240 VAC, 50 or 60 Hz. If possible it is recommended to use this adapter. It can be connected to the MCU directly using the plug that is connected to its cable. Cable length to MCU: about 1 meter
HFP01	In the standard configuration 8 sensors Type HFP01 are connected to the MCU, with 5m cable
HFP01 calibration certificate	Each HFP01 sensor comes with a calibration certificate
LoggerNet Software on CD-ROM	To be installed on the PC for communication with the MCU
HFPSYS08 software on a USB flash drive	Contains a program that is specially developed for use with HFPSYS08, as well as manuals
SC-USB driver software on CD-ROM	The CD contains the drivers for the USB interface

3 Step 0: Before the system arrives

Before the system arrives, it is recommended to:

1. make sure that a PC with a CD-ROM drive and a free USB port is available
2. make sure that the measurement location is prepared (power supply)
3. prepare connection of the sensors to the building element

4 Step 1: When the system arrives

When the system arrives, it is recommended to check if all is there. For a general check: see table 2.1.



5 Step 2: Software review

Table 5.1. *Software installation and review of the measurement and control program*

SOFTWARE INSTALLATION AND REVIEW	
<p>The software is delivered with the system. It should be installed on the PC.</p>	<p>Make a backup of all received files.</p> <p>Installation of LoggerNet is done by starting the Windows Explorer and double clicking the application "Autorun". The latest versions of LoggerNet are delivered on CD-ROM. The directory in which the software is installed is usually called LoggerNet.</p> <p>The specific "HFPSYS08" software is sent on a separate USB flash drive. Extensions of files are: .CR1. All files on the disk should be copied to the LoggerNet directory.</p>
<p>Read the program and the comment in the program file.</p>	<p>It is recommended, in particular when receiving a new version of the software, to read the program that controls the experiment.</p> <p>The hfpsys08 v1401.CR1 file, as received on the USB flash drive, contains the description of the program, of operation and of the wiring schedule.</p> <p>The file can be opened in any text editor program, or with CRBasic in LoggerNet program.</p>

6 Step 3: Testing PC communication and system performance

The third step is to do a system check by performing a measurement. By doing this, the system performance is checked, and the operator is trained.

6.1 Powering the system

The HFPSYS08 system must be connected to 12 VDC power. In a typical laboratory experiment this can be done using the adapter.

Table 6.1.1 *Powering the system*

POWERING THE SYSTEM	
Connect the adapter to mains power	Make sure the adapter is on 12 VDC (some adapters have a switch at both sides).
Verify that the polarity at the plug of the adapter is within specifications.	Use a multimeter, hold the red (+) pin to the interior of the plug, the black (-) pin to the exterior. The readout should show a POSITIVE value between 10 and 13 VDC.
Connect the plug to the HFPSYS	The red LED should start burning, confirming that the system is powered.

6.2 Connecting the HFPSYS08 to the PC / defining the user interface

Now the HFPSYS08 can be connected to the PC using the LoggerNet software and the "HFPSYS08" software to make contact.

Table 6.2.1 *Connection to the PC: installation*

PC connection
Install the software as in chapter 5
Connect the USB -or RS-232- cable of the HFPSYS08 to a USB -or COM- port of the PC.
Start the LoggerNet software

The following figure appears:

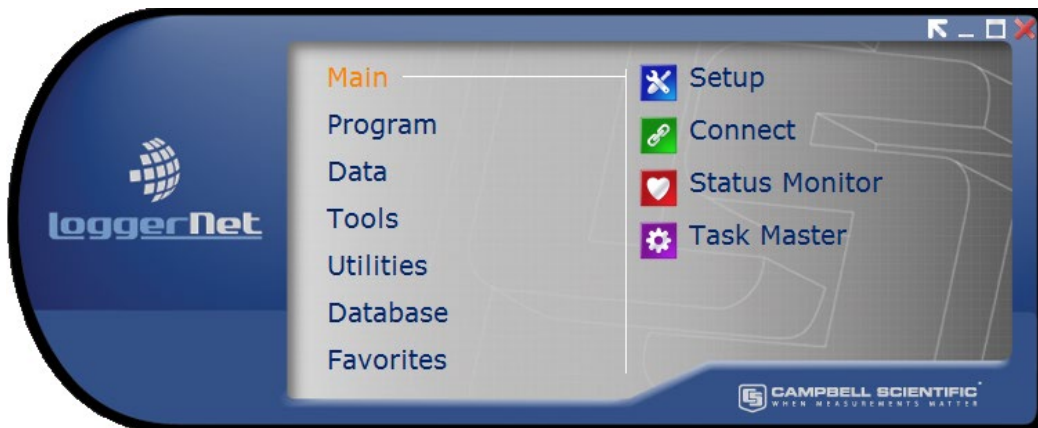


Figure 6.2.1 *The main interface of the LoggerNet software. Setup is used during Installation only. During normal operation only Connect is used.*

Please note that at any time during Setup, you may ask for assistance by clicking on the Help button

Table 6.2.2 *Connection to the PC: defining the setup*

Setup
Select 'Setup'
Select 'Add'
Select 'Next'
Select 'CR1000', and give it the appropriate name: 'CR1000'
Select 'Next'
Select 'Direct Connect'
Select what COM port you plugged the cable in. When connected to USB, the port is displayed: "SC-USB USB TO CS I/O ISOLATED INTERFACE (COMXX)"
Set delay at 0
Datalogger Settings: Set Baud Rate to 115200
Datalogger Settings: Select Next
Setup Summary: Select Next
Select Yes to check communication is OK
Select Next
Set Dataloggers' clock if the two clocks don't match.
Select Next
Typically, the program for the system is already installed on the logger. User should then select 'Next' and proceed to step: datalogger table output files.
If program is not present on the logger or a newer version of the program needs to be installed: press 'Select and Send Program'
Browse to where the HFPSYS08 v1401.CR1 program is situated (supplied on a USB flash drive) and click OK
Click Yes at the warning
Click OK when programs was successfully sent
Select Next
Datalogger table output files.
Select HeatFlux_5min in Tables. Make sure option Table collected during Data Collection in turned ON. Data file option should be: Append to File. Output file should be: C:\CampbellSci\LoggerNet\CR1000_HeatFlux_5min.dat
Select Next
Check box: Scheduled Collection Enabled
Select Next
Select Next
Select Finish
Close the EZSetup window

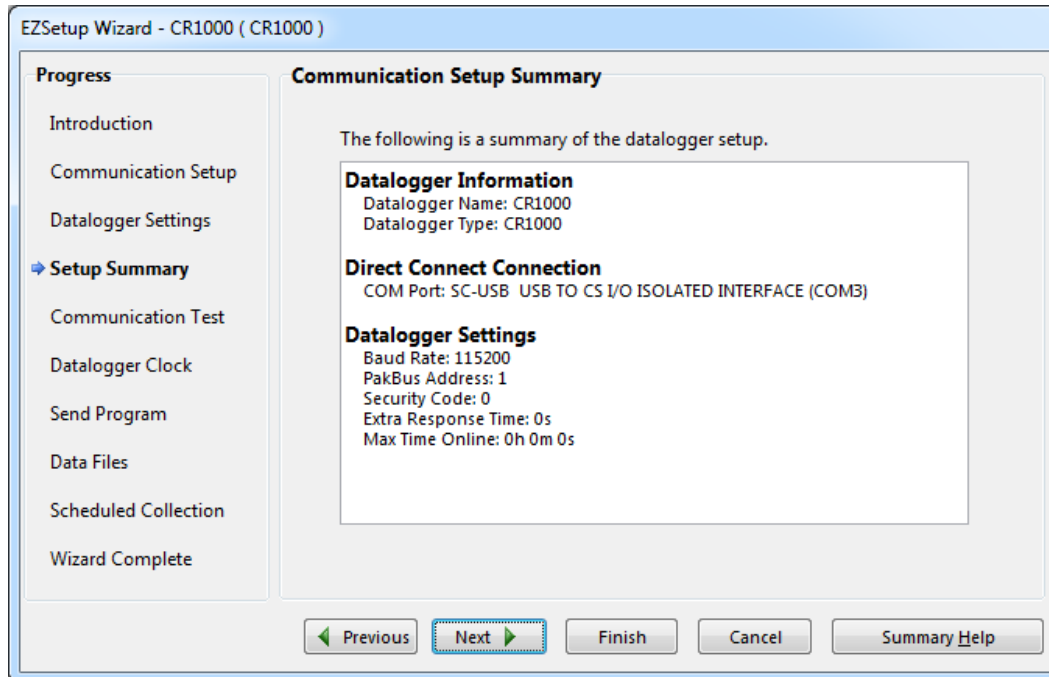


Figure 6.2.2 Typical setup screen

6.3 Communicating with the HFPSYS08

The HFPSYS08 is now connected to the PC. The LoggerNet software has been instructed which port to look at.



Figure 6.3.1 The heading of the LoggerNet software.

Table 6.3.1 Activating Connect

ACTIVATING CONNECT	
Select Connect from the heading of LoggerNet	The Connect screen will be the only screen during normal operation.

The following screen will appear:

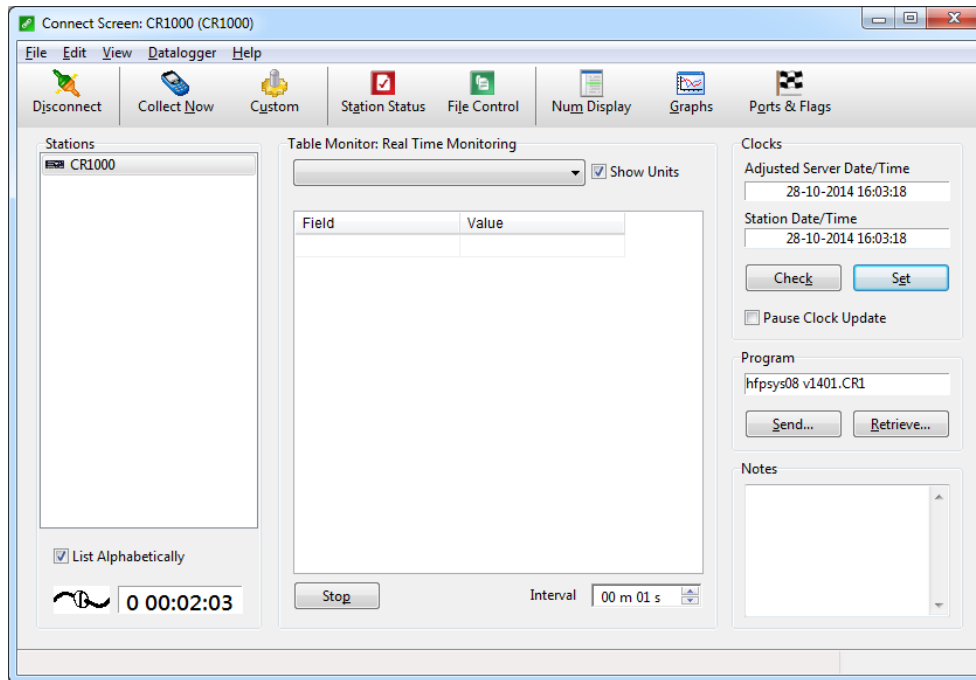


Figure 6.3.2 The screen in Connect. During normal operation the Numeric and Graphs buttons are used for on-screen data display

Before starting operation, a few elementary functions have to be performed:

Table 6.3.2 verification of contact, synchronising data and time, giving the buttons a name, creating graphic and numeric screens.

POWERING THE SYSTEM

When the software has made a connection to the CR1000 datalogger, the button in the upper lefthand corner displays two connected plugs and the text will read 'Disconnect'. In the lower lefthand corner, a timer will indicate the duration of the established connection.

If not, press 'Connect' in the upper left hand corner.

Press Set Station Clock to set the correct date and time (if needed).

Select the button 'Num display' and select 'Display 1'. By pressing 'Add' you can drag and drop variables from 'Public' to create a screen as in Figure 6.3.3.

Select the button 'Graphs' and select 'Graph 1'. By pressing the green clouded '+' symbol, you can drag and drop variables from 'Public' to create a screen as in Figure 6.3.4.

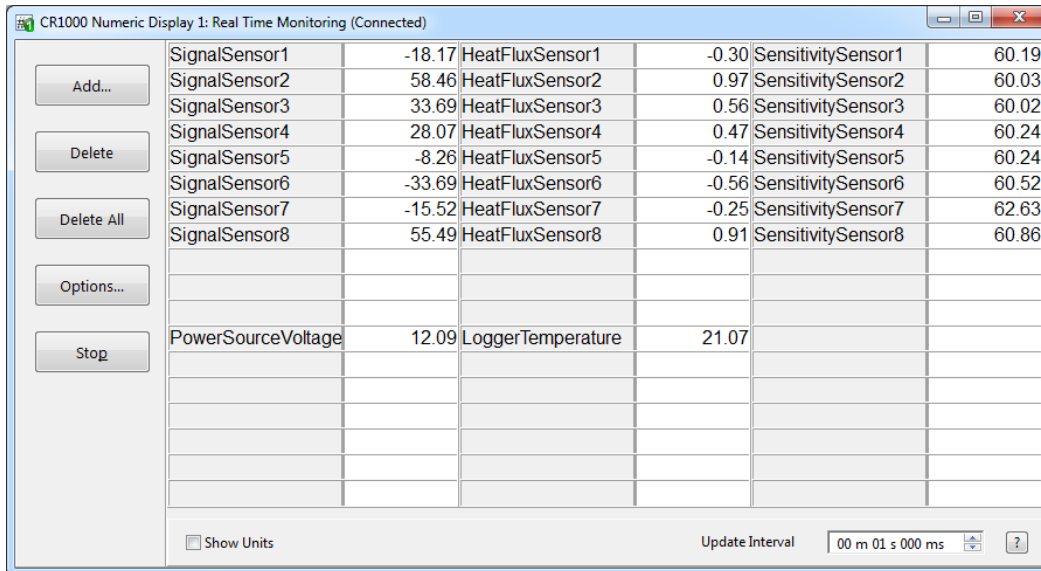


Figure 6.3.3 A typical screen of the Numeric Display. SignalSensor1...SignalSensor8 are the raw signals in microvolts, HeatFluxSensor1...HeatFluxSensor8 are the heat flux of sensor 1..8 in W/m^2 , SensitivitySensor1...SensitivitySensor8 are the sensitivities of the heat flux sensors in microvolt / W/m^2

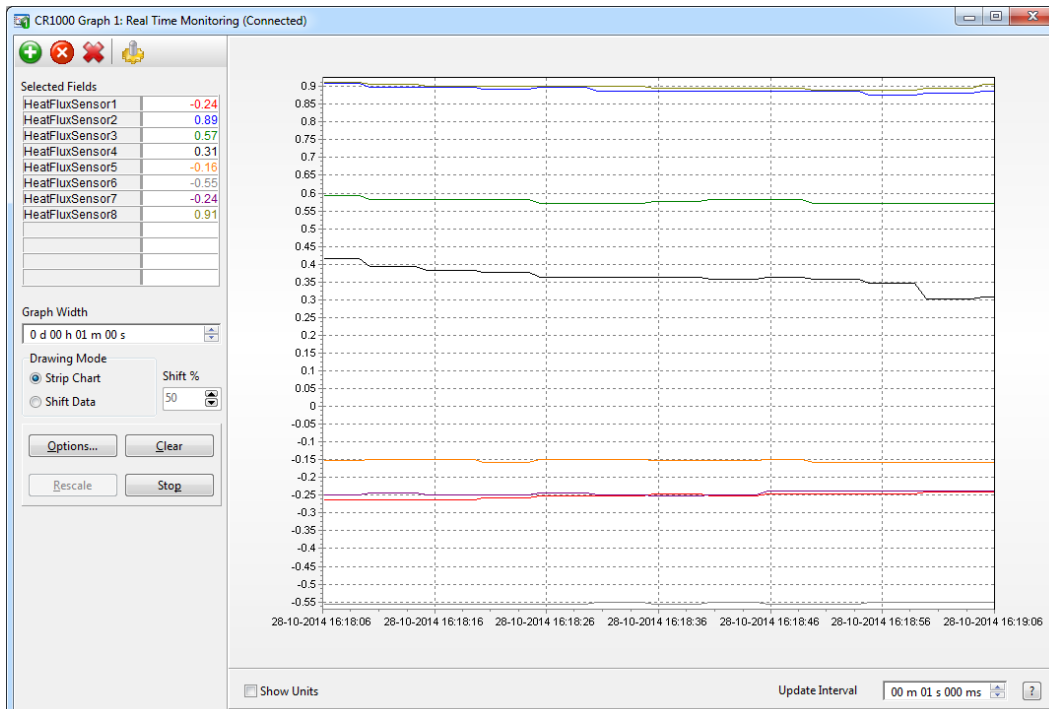


Figure 6.3.4 Typical graphical display of the measurement process

6.4 Changing the heat flux sensor calibration factors

Heat flux sensors are individually calibrated and have individual sensitivities. The sensitivity value of the sensor can typically be found on a cable marker attached to the sensor. The sensitivities are programmed in the datalogger.

6.5 Performing a test

Having followed the directions of 6.3 and 6.4, the system is now ready for a measurement.

Before this, testing the system is suggested:

Table 6.5.1 *Testing the functionality of the system*

SYSTEM FUNCTIONALITY TEST	
Touch a heat flux sensor with your hand. Look at the numeric screen	See if the heat flux sensor signal reacts.
Touch the other side of the same sensor	See if the polarity of the signal changes (+ should go to -)
Repeat the test for the other heat flux sensors	

7 Step 4: Performing standard measurements

It is now assumed that the user has installed the software and has tested the functionality of the equipment in an indoor test. The user is now supposed to be familiar with the working principles of the HFPSYS08. Now the system can be used for standard measurements.

7.1 Recommendations for the measurement location

It is recommended to pay attention to the following aspects of the measurement:

Table 7.1.1 *Recommendations for the measurement location*

MEASUREMENT LOCATION RECOMMENDATIONS

Location with exposure to direct solar radiation should be avoided as much as possible. In the northern hemisphere, north-facing walls are preferred.

When installing on a wall surface, in case of exposure to strong radiation (for instance direct beam solar radiation), the spectral properties of the sensor surface must be adapted to match those of the wall. This can be done by covering the sensor with paint or sheet material of the same colour.

The location of installation preferably should be a large wall section which is relatively homogeneous. Areas with local thermal bridges should be avoided.

7.2 Recommendations for installation

HFP01s are generally installed on the surface of a wall, or alternatively integrated into the wall.

Table 7.2.1 *General recommendations for installation of sensors onto building elements*

SENSOR INSTALLATION

The more even the surface on which HFP01 is placed the better. The optimal configuration is the heater in the same plane as the surrounding surface of the object.

Any air gaps should be filled as much as possible.

Permanent installation is preferred. It is recommended to fix the location of the sensor by gluing with silicone glue.

7.3 Further programming

The system does not need any additional switching on and off. If the power is on, it will automatically start collecting data.

Users can make their own adapted program by consulting the CR1000 manual.

8 Step 5: Data retrieval and analysis

The measurement from HFPSYS08 must be analysed by the user. The exact data analysis is the user's responsibility.

The measurement data is stored in the CR1000. This data can be retrieved for further analysis.

Table 8.1 *Retrieval of measurement data*

DATA RETREIVAL
Detailed measurement data can be retrieved using Collect Now in the Connect Screen.
When retrieving data, immediately make a backup, e.g. on a USB flash drive, external hard disk or CD-ROM
Details regarding data analysis can be found in the manual of the sensor.

The data averaged every 5 minutes are saved in the file:
C:\CampbellSci\LoggerNet\CR1000_HeatFlux_5min.dat

The files are comma separated ASCII. They can easily be imported in Excel if the user follows the following procedure:

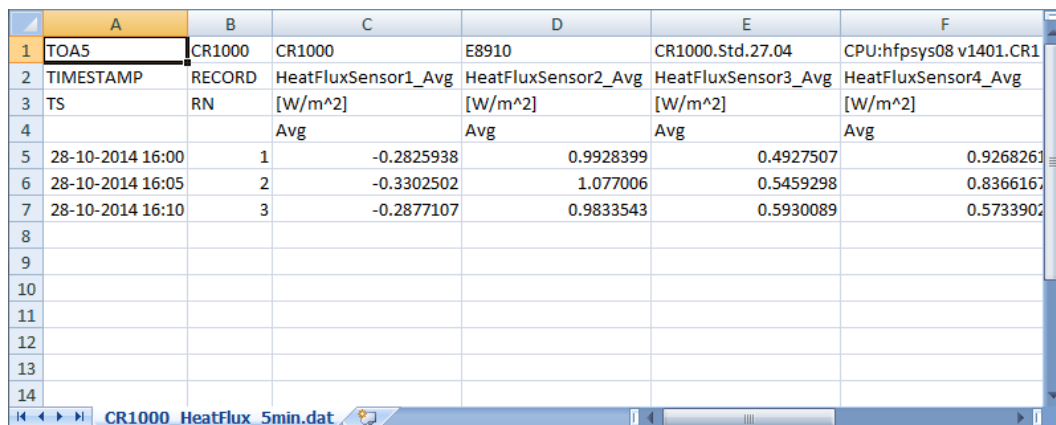
Table 8.2 *Procedure for getting the ASCII-data in an Excel file*

DATA EXPORT TO EXCEL	
Open Excel	
Choose Open file and select the desired data file	
Choose Seperated in Step 1 and select Next	
Select Comma at Separation Signs and uncheck Tabs in Step 2 then select Next	
Select Advanced	Only if you if you have the comma assigned as the decimal separator
Choose '.' (dot) as decimal and ',' (comma) as thousands separator. Select OK	Only if you if you have the comma assigned as the decimal separator
Select Finish	

An example of a datafile is shown below, in Table 8.4. In the example, the data structure is as follows (columns instead of rows):

Table 8.3 Values found in exported data table

DATA TABLE VALUES	
TimeStamp	Date and time of record
Record	Number of the measurement record
HeatFluxSensor1_Avg	Heatflux of sensor 1 in [W/m ²]
HeatFluxSensor2_Avg	Heatflux of sensor 2 in [W/m ²]
HeatFluxSensor3_Avg	Heatflux of sensor 3 in [W/m ²]
HeatFluxSensor4_Avg	Heatflux of sensor 4 in [W/m ²]
HeatFluxSensor5_Avg	Heatflux of sensor 5 in [W/m ²]
HeatFluxSensor6_Avg	Heatflux of sensor 6 in [W/m ²]
PowerSourceVoltage_Min	Minimum voltage from the power source
LoggerTemperature	Temperature of the datalogger



	A	B	C	D	E	F
1	TOA5	CR1000	CR1000	E8910	CR1000.Std.27.04	CPU:hfpsys08 v1401.CR1
2	TIMESTAMP	RECORD	HeatFluxSensor1_Avg	HeatFluxSensor2_Avg	HeatFluxSensor3_Avg	HeatFluxSensor4_Avg
3	TS	RN	[W/m ²]	[W/m ²]	[W/m ²]	[W/m ²]
4			Avg	Avg	Avg	Avg
5	28-10-2014 16:00	1	-0.2825938	0.9928399	0.4927507	0.9268261
6	28-10-2014 16:05	2	-0.3302502	1.077006	0.5459298	0.8366167
7	28-10-2014 16:10	3	-0.2877107	0.9833543	0.5930089	0.5733902
8						
9						
10						
11						
12						
13						
14						

Table 8.4 Example of the structure of a datafile in Excel (not all columns are shown)

9 Appendices

9.1 Appendix on power supply

When supplied without battery pack, HFPSYS08 must be powered from a DC source supplying between 10 and 13 VDC at 0.5 Watt. Preferably the Adapter (part of the delivery) is used as power supply. This adapter can be connected to mains power. This can be 100-240 VAC, 50/60 Hz. Alternatively other sources can be used, like normal batteries or car batteries. In case of using car batteries, it is suggested to put the motor or generator off while using HFPSYS08.

In case the system is supplied with a battery pack, the voltage can usually be put on a higher level in order to have optimal battery loading. Please consult the battery manual.

Table 9.1.1 *Powering the system from a battery*

POWERING THE SYSTEM FROM A BATTERY	
Connect the adapter to mains power or connect the cable that normally leads from the adapter to the HFPSYS08 to an alternative power source like a car battery	
Verify that the polarity at the plug of the adapter or cable	Use the multimeter in the correct DC range, hold the red (+) pin to the interior of the plug, the black (-) pin to the exterior. The readout should show a POSITIVE value between 10 and 13 VDC
Connect the plug to the HFPSYS08	The red lamp should start burning, confirming that the system is powered

9.2 Appendix on the serial numbers of the equipment

The serial number of the CR1000 can be found on its side on a sticker. The serial number and sensitivity of the heat flux sensors can be found on a label sticker on the wire of every single sensor.

9.3 Appendix on HFPSYS08 wiring diagram

A wiring diagram can be found in the HFPSYS08 v1401.CR1 file. This file can be opened in the Program mode of the LoggerNet or in any text editor.

9.4 EC declaration of conformity



We, Hukseflux Thermal Sensors B.V.
Delftechpark 31
2628 XJ Delft
The Netherlands

in accordance with the requirements of the following directive:

2004/108/EC The Electromagnetic Compatibility Directive

hereby declare under our sole responsibility that:

Product model: HFPSYS08
Type: Heat flux measuring system

has been designed to comply and is in conformity with the relevant sections and applicable requirements of the following standards:

Emissions: Radiated EN 55022: 1987 Class A
Conducted EN 55022: 1987 Class B

Immunity: ESD IEC 801-2; 1984 8kV air discharge
RF IEC 808-3; 1984 3 V/m, 27-500 MHz
EFT IEC 801-4; 1988 1 kV mains, 500V other



Kees VAN DEN BOS
Director
Delft
October 20, 2014

