HFPSYS06

Heat flux measurement system with 6 measurement locations

USER MANUAL

HFPSYS06 manual / version 1705

Hukseflux Thermal Sensors
http://www.hukseflux.com
e-mail: info@hukseflux.com

This manual is available free of charge via e-mail as a PDF file.

Hukseflux
Thermal Sensors

General information:

This manual is intended for explanation on use of the HFPSYS06 system only, not the functioning of the individual sensors.
For functioning of the individual sensor, user should refer to its manual.
The current manual explains working of a HFPSYS06 in combination with 6 HFP01 heat flux plates.

Contents

Introduction

HFPSYS06 is a measurement system for analysis of heat flux. In its standard configuration the system is equipped with six heat flux sensors.

Figure 1 HFPSYS06 consists of MCU Measurement and Control Unit and six heat flux sensors. Readout is performed by connecting temporarily to a PC (not included). Software for readout (Loggernet) is included.

1 Specifications of HFPSYS06 and sensors for current configuration

GENERAL SPECIFICATIONS	
Protection Class	MCU: IP63, Sensors: IP65
Measurement locations	6
Non specified measurements	Total net weight: 4,6 kg Dimensions (in cm): 32 x 14 x 16 (without sensors)
CE requirements	HFPSYS06 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 degrees 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; 10 minute and 24 hour averages
Power supply	External: Adapter included for 100 - 240 VAC, 50/60 Hz operation. Power should be supplied between 9.6 and 16 VDC to the system
Software	New software versions can be uploaded through the RS232 or USB port
Data transfer	RS-232 or USB
Control	External PC (not included)
LOGGERNET SOFTWARE SPECIFICATIONS	
Required PC	Windows XP or later, CD-ROM drive, USB port, one free COM or USB port, 100 MB hard disk space

Table 1.1 *List of HFPSYS06 specifications*

2 Delivery

The delivery is as follows:

MCU, PC cable	The MCU containing a CR1000 measurement and control module, a SC32B RS-232 interface. The PC cable is ending in a 9-pin female connector. The user is supposed to have a COM port with a 9 pin male connector. User can also use the USB interface, provided the drivers are correctly installed and a free USB port is available on the PC 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 6 sensors Type HFP01 are connected to the MCU, with 5m cable
HFPSYS06 software on a USB flash drive	The USB flash drive contains a program that is specially developed for use with HFPSYS06, as well as manuals
LoggerNet Software on CD-ROM	To be installed on the PC for communication with the MCU
SC-USB driver software on CD-ROM	The CD contains the drivers for the USB interface

Table 2.1 *Delivery: parts and their function*

3 Step 0: Before the System Arrives

It is recommended before the system arrives 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

The software is supplied with the system. It should be installed on the PC.	Make a backup of all received files. 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 rest follows automatically. The directory in which the software is installed is usually called LoggerNet. The specific "HFPSYS06" software is delivered on a separate USB flash drive. Extensions of files are: .CR1. All files on the disk should be copied to the LoggerNet directory.
Read the program and the comment in the program file.	It is recommended, in particular when receiving a new version of the software, to read the program that controls the experiment. The hfpsys06 v0901.CR1 file, as received on the USB flash drive, contains the description of the program, of operation and of the wiring schedule. The file can be opened in any text editor, or with CRBasic in LoggerNet program.

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

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 HFPSYS06 system must be connected to 12 VDC power. In a normal laboratory experiment this can be done using the Adapter.

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.

Table 6.1.1 *Powering the system*

6.2 Connecting the HFPSYS06 to the PC / defining the user interface

The HFPSYS06 now can be connected to the PC using the LoggerNet software and the "HFPSYS06" software to make contact.

Install the software as in chapter 5
Connect the RS-232 –or USB- cable of the HFPSYS06 to a COM –or USB- port of the PC.
Start the LoggerNet software

Table 6.2.1 *connection to the PC step 1*

The following figure appears:

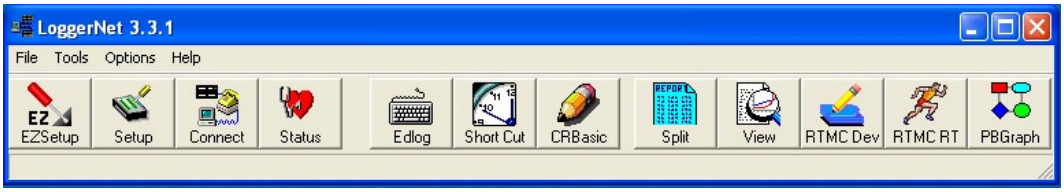

Figure 6.2.1 *The heading of the LoggerNet software. EZSetup or Setup is used during Installation only. During normal operation only Connect is used.*

Keep in mind that at any time during Setup, you may ask for Help by clicking on that button

Select EZSetup
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. Set delay at 0
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. Several attempts are sometimes needed

Table 6.2.2 *Connection to the PC step 2: defining the Setup* *(continued on next page)*

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 HFPSYS06 v0901.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 HF_10min 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_HF_10min.dat
Select HF_24h 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_HF_24h.dat
Select Next
Scheduled collection Select Next
Select Finish
Close the EZSetup window

Table 6.2.2 *Connection to the PC step 2: defining the setup (started previous page)*

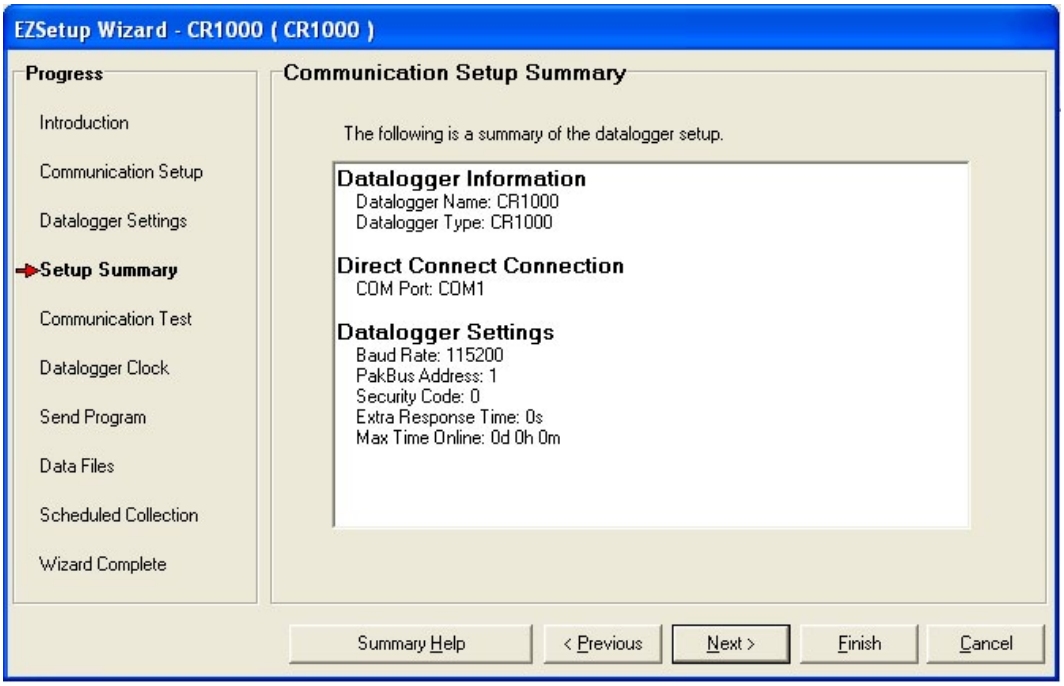

Figure 6.2.2 *Typical Setup screen*

6.3 Communicating with the HFPSYS06

The HFPSYS06 is now connected to the PC. The LoggerNet software has been instructed which port to look at.

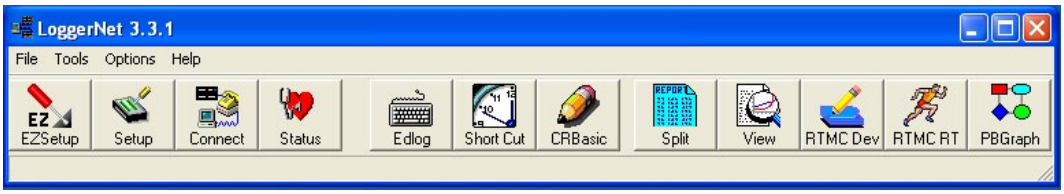

Figure 6.3.1 *The heading of the LoggerNet software.*

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

Table 6.3.1 *Activating Connect*

The following screen will appear:

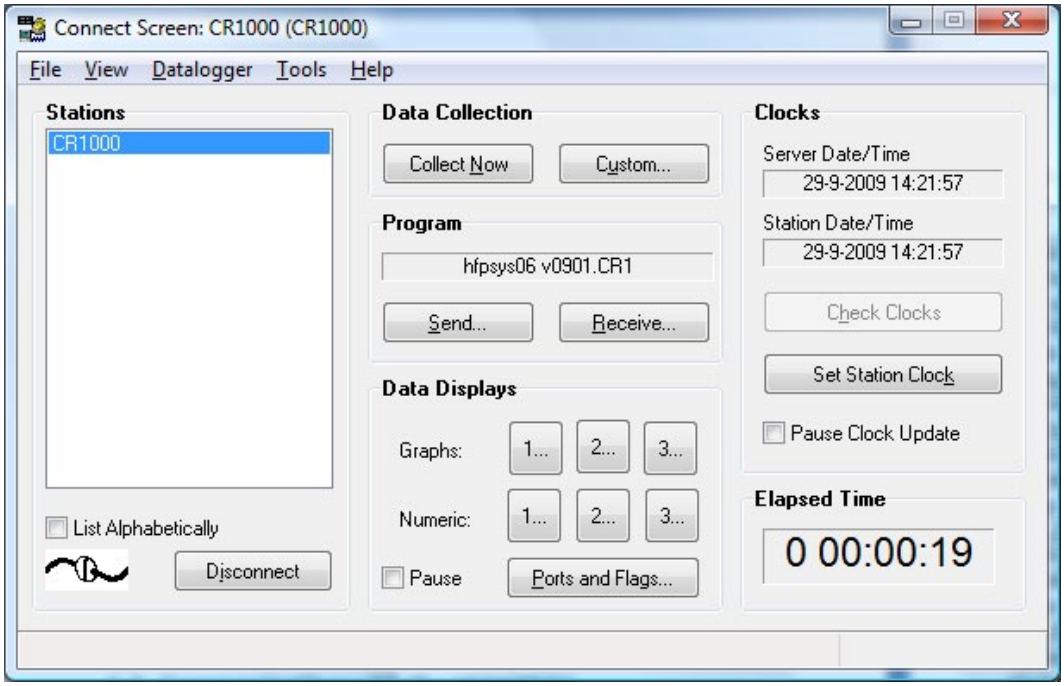

Figure 6.3.2 *The screen in Connect.*
During Normal operation the Numeric and Graphs buttons are used for on-screen data display.

Before starting operation we have to perform a few elementary functions:

When the software has made a connection to the CR1000 the lower left hand corner of the screen in Connect shows "connected", and the clock synchronisation of the upper right hand corner shows that the Datalogger time/date is running.	If not, press Connect in the lower left hand corner.
Press Set Station Clock to set it to the correct date and time.	
Select 1 at Numeric in the Data Displays window. By pressing 'Add' you can drag and drop variables from 'Public' to create a screen as in figure 6.3.3.	
Select 1 at Graphs in the Data Displays window. By pressing Add you can drag and drop variables from 'Public' to create a screen as in figure 6.3.4.	

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

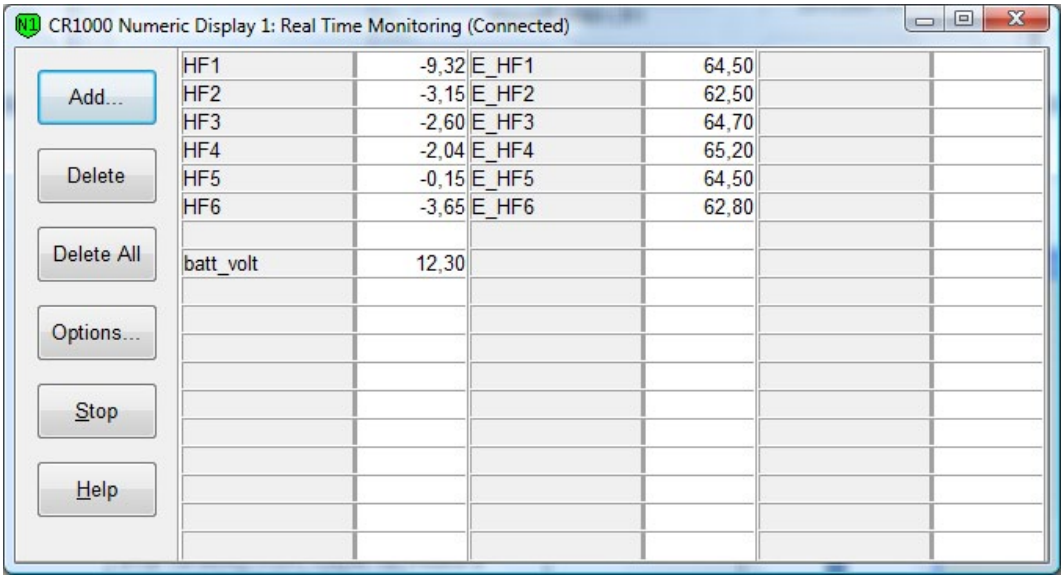

Figure 6.3.3 *A typical screen of the Numeric Display. HF1..HF6 are the heat flux of sensor 1..6 in W/m², E_HF1..E_HF6 are the sensitivities of the heat flux sensors in microvolt / W/m².*

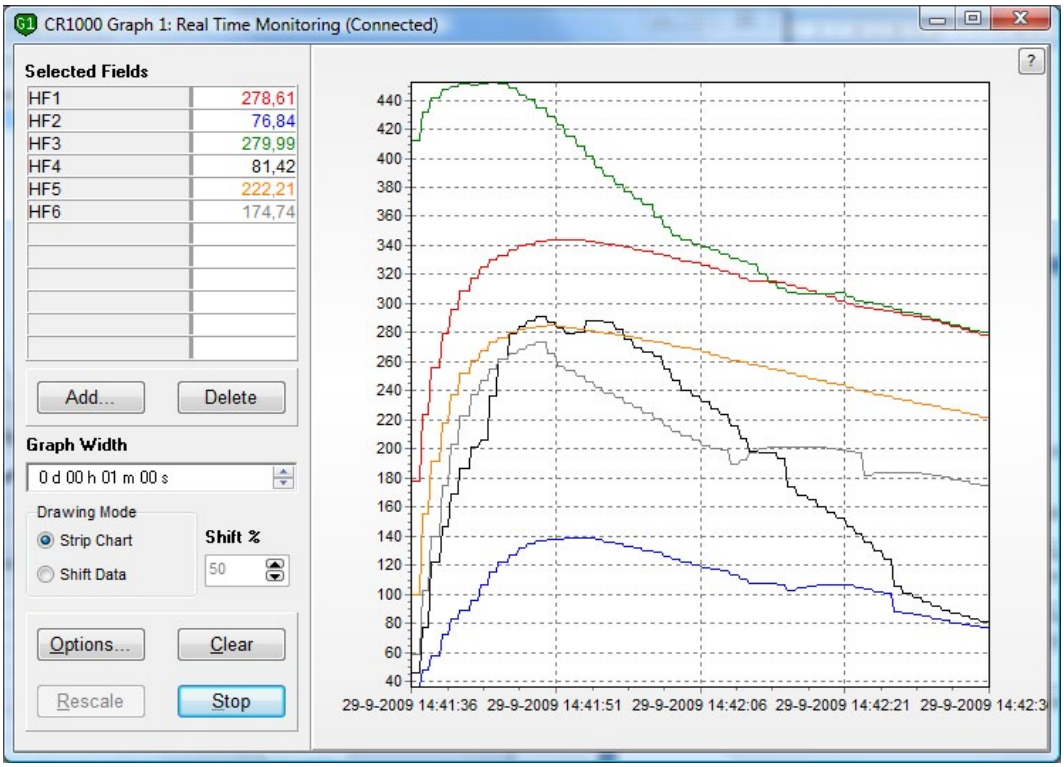

Figure 6.3.4 *Typical graphical display of the measurement process.*

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.

Have the Numeric Diplays shown from the Connect Screen	
Choose Add, then Public	
Drag and Drop E_HF1..E_HF6 into the Numeric Display	
Double-click on the value of E_HFx and change it to the value found on the cable of heat Flux sensor x	This sensitivity is stored in the 10-minute and 24-hour averages

Table 6.4.1. *Display values of E_HFx and change them to the actual individual value.*

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:

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	

Table 6.5.1 *Testing the functionality of the system*

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 HFPSYS06. Now it can be used in standard measurements.

7.1 Recommendations for the measurement location

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

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.

Table 7.1.1 *Recommendations for the measurement location*

7.2 Recommendations for installation

HFP01 are generally installed on the surface of a wall, or alternatively integrated into the wall.

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. Alternatively for short-term installation either toothpaste (1-2 days) or “DOW CORNING heat sink compound 340” can be used. Typically temporary installation is fixed using tape across the guard. The tape should be as far as possible to the edge. Independent attachment of the cable can be done to an object that can resist strain in case of accidental force.

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

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.

Note that if you upload a new version of the program, the values of E_HFx will turn back to their initial values and you will have to give them again their real value.

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

8 Step 5: Data retrieval and analysis

The measurement from HFPSYS06 must be analyzed 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.

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

Table 8.1 *Retrieval of measurement data*

The data averaged every 10 minutes is saved in the file
C:\CampbellSci\LoggerNet\CR1000_HF_10min.dat
The data averaged every 24 hours is saved in the file
C:\CampbellSci\LoggerNet\CR1000_HF_24h.dat
The files are comma separated ASCII. They can easily be imported in Excel if you use the following procedure:

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	

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

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

Date and time	timestamp
Number of the record	record
Sensitivity of sensor HFP1	E_HF1
Sensitivity of sensor HFP2	E_HF2
Sensitivity of sensor HFP3	E_HF3
Sensitivity of sensor HFP4	E_HF4
Sensitivity of sensor HFP5	E_HF5
Sensitivity of sensor HFP6	E_HF6
HFP1 heat flux in W/m^2	HF1_Avg in W/m2
HFP2 heat flux in W/m^2	HF2_Avg in W/m2
HFP3 heat flux in W/m^2	HF3_Avg in W/m2
HFP4 heat flux in W/m^2	HF4_Avg in W/m2
HFP5 heat flux in W/m^2	HF5_Avg in W/m2
HFP6 heat flux in W/m^2	HF6_Avg in W/m2
Panel temperature	PTemp in deg C

Table 8.3 *Values found in exported data table*

TOA5	CR1000	CR1000	21638	CR1000.Std.	CPU:hfpsys(	24062	HF_10min	
TIMESTAMP	RECORD	E_HF1	E_HF2	E_HF3	E_HF4	E_HF5	E_HF6	HF1_Avg
TS	RN	uV/(W/m^2	uV/(W/m^2	uV/(W/m^2	uV/(W/m^2	uV/(W/m^2	uV/(W/m^2	W/m^2
		Smp	Smp	Smp	Smp	Smp	Smp	Avg
9-9-2009 18:10	0	70	80	60	60	60	60	-0,01
29-9-2009 13:40	1	64,5	62,5	64,7	65,2	64,5	62,8	8,3
29-9-2009 13:50	2	64,5	62,5	64,7	65,2	64,5	62,8	6,737
29-9-2009 14:00	3	64,5	62,5	64,7	65,2	64,5	62,8	4,541
29-9-2009 14:10	4	64,5	62,5	64,7	65,2	64,5	62,8	3,783
29-9-2009 14:20	5	64,5	62,5	64,7	65,2	64,5	62,8	4,138
29-9-2009 14:30	6	64,5	62,5	64,7	65,2	64,5	62,8	6,392
29-9-2009 14:40	7	64,5	62,5	64,7	65,2	64,5	62,8	-8,43
29-9-2009 14:50	8	64,5	62,5	64,7	65,2	64,5	62,8	31,36
29-9-2009 15:00	9	64,5	62,5	64,7	65,2	64,5	62,8	-10,63
29-9-2009 15:10	10	64,5	62,5	64,7	65,2	64,5	62,8	-9,47
29-9-2009 15:20	11	64,5	62,5	64,7	65,2	64,5	62,8	-8,75
29-9-2009 15:30	12	64,5	62,5	64,7	65,2	64,5	62,8	-9,01
29-9-2009 15:40	13	64,5	62,5	64,7	65,2	64,5	62,8	-7,924
29-9-2009 15:50	14	64,5	62,5	64,7	65,2	64,5	62,8	-7,917
29-9-2009 16:00	15	64,5	62,5	64,7	65,2	64,5	62,8	-7,842
29-9-2009 16:10	16	64,5	62,5	64,7	65,2	64,5	62,8	-5,818
29-9-2009 16:20	17	64,5	62,5	64,7	65,2	64,5	62,8	-7,152
29-9-2009 16:30	18	64,5	62,5	64,7	65,2	64,5	62,8	-6,984
29-9-2009 16:40	19	64,5	62,5	64,7	65,2	64,5	62,8	-7,99
29-9-2009 16:50	20	64,5	62,5	64,7	65,2	64,5	62,8	-9,6

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, HFPSYS06 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 HFPSYS.

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.

Connect the Adapter to mains power or connect the cable that normally leads from the Adapter to the HFPSYS06 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 40V 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 HFPSYS	The red lamp should start burning, confirming that the system is powered.

Table 9.1.1 *Powering the system from a battery*

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 of the heat flux sensors and the individual figure heat flux sensor sensitivity, can be found on a sticker on every single sensor.

9.3 Appendix on HFPSYS06 wiring diagram

A wiring diagram can be found in the HFPSYS0 v0901.CR1 file. This file can be opened in the Program mode of the LoggerNet or in any text editor.

9.4 CE Declaration of Conformity

We: Hukseflux Thermal Sensors

Declare that the product: HFPSYS06

Is in conformity with 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

Delft,

October 2009