TRSYS20

Building thermal resistance measuring system with two measurement locations

TRSYS20 is a high-accuracy measuring system used in determining the in-situ thermal resistance (R-value), thermal conductance (Λ-value), and thermal transmittance (U-value) of building envelope components. The system is mostly used for measurements according to standard practices of ISO 9869, ASTM C1046 and ASTM C1155. TRSYS20 is equipped with high-resolution electronics, two heat flux sensors of model HFP01 as well as two pairs of matched thermocouples for differential temperature measurements. The high-sensitivity heat flux sensors combined with the robust, high-resolution electronics ensure that TRSYS20 continues making meaningful measurements when other systems no longer perform; in particular at very low heat fluxes and low temperature differences across the wall. The matched thermocouple pairs allow measurement of temperature differences with an uncertainty better than 0.1 °C over the entire temperature range. Two measurement locations provide redundancy allowing the user to verify that the measurement results are representative for the building envelope component.

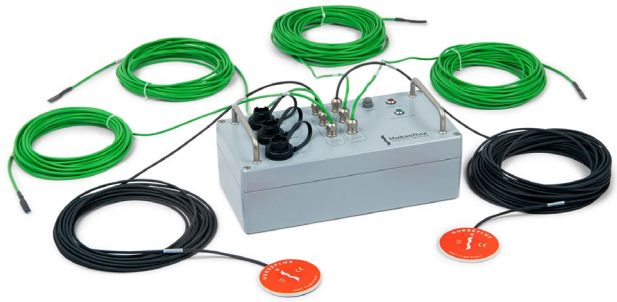

Figure 1 *TRSYS20: the measuring system consists of 2 HFP01 heat flux sensors and 2 matched thermocouple pairs (in total 4 temperature sensors) connected to the measurement and control unit (MCU).*

Figure 2 *HFP01 heat flux sensor and thermocouples mounted on a wall.*

Introduction

In-situ measurements of thermal resistance or R-value are often applied in studies of buildings. Other possibilities are to measure its inverse value, the thermal conductance which is called the Λ-value, or to measure the thermal transmittance or U-value which includes ambient air boundary layer thermal resistance. The measurements of R, are based on simultaneous time averaged measurement of heat flux Φ in W/m^2 through the wall and differential temperature ΔT in K across the wall:

$$R = \Delta T/\Phi$$

The ISO 9869, ASTM C0146 and ASTM C1115 standards give detailed directions concerning the measurement method, sensor installation and data analysis. TRSYS20 is a system for measuring the heat flux and differential temperature used in determining the thermal resistance of building envelope components.

TRSYS20 consists of two HFP01 heat flux sensors, two matched thermocouple pairs, a measurement and control unit (MCU), a power supply unit (PSU) and a carrying case. The high-sensitivity heat flux sensors in combination with the MCU's high-resolution electronics ensure that TRSYS20 continues to make meaningful measurements down to very low heat fluxes. The matched thermocouple pairs in TRSYS20 measure temperature differences across the wall with an uncertainty of better than 0.1 °C over the entire rated operating temperature range as required by ISO 9869 (paragraph 5.2).

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User interface: MCU as a web server

TRSYS20 is controlled via a PC. No software installation is required. The measurement and control unit (MCU) can be connected to a local area network (LAN) via ethernet or directly to a PC via USB. The MCU provides a graphical user interface in the form of a webpage that is accessible through a web browser. The graphical user interface allows the user to start and stop experiments; to monitor real-time heat flux, temperature and temperature difference measurement data; and to review preliminary results.

Typical measurements may last 1 to 2 weeks with a minimum of 3 days. Preliminary data analysis may be required to determine if sufficient data has been collected. To provide a quick assessment of the current dataset, the interface shows a scatter plot of the heat flux versus temperature difference, a time trace of the R-value an several data quality indicators. Using the scatter plot users can check for sufficient correlation in their data set. The time trace allows checking for convergence. The data quality indicators follow the criteria outlined in the ISO 9869 standard.

Figure 3 *TRSYS20 graphical user interface, accessible through a web browser.*

The system generates a data file, containing the measurement time, heat flux, temperature and temperature difference for the two measurement locations. The data file is stored in the MCU and can be downloaded through the graphical user interface. The user is responsible for the data analysis, calculating the R-, Λ- or U-value of the building envelope according to the ISO 9869 or ASTM C1155 standards.

TRSYS20 specifications

Measurand	heat flux (2 x)
Uncertainty of calibration	±3 % (k = 2)
Measurement resolution	0.02 W/m^2
Guard width to thickness ratio	5 m/m (as required by ISO 9869 D.3.1)
Measurand	temperature difference (2 x)
Accuracy	< ± 0.1 °C (as required by ISO 9869, paragraph 5.2)
Measurement resolution	0.02 °C
Measurand	temperature (4 x)
Thermocouple type	IEC 60584-3:2007 type KX
Tolerance class	Class II
Required data analysis to determine building R-value and U-value	to be performed by the user according to ISO and ASTM standard practices
Standards governing use:	ISO 9869 ASTM C1046 ASTM C1155
Number of measurement locations	2
Cable length per location	location 1: 10 m location 2: 20 m
Rated operating temperature range HFP01 and TC	-30 to +70 °C
Measurement duration range	> 3 days
Data storage capacity	> 30 days

MCU specifications

Connection	to local area network (LAN) via ethernet or directly to PC via USB
Graphical user interface	web page via web browser
Supported web browsers	Chrome 10 Firefox 4 Internet Explorer 9 Opera 11 Safari 5 or later
Rated operating voltage MCU	10 to 16 VDC
Ingress protection class	IP54

PSU specifications

Input voltage	110-220 VAC, 50 / 60 Hz
Ingress protection class	IP22

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TRSYS20 advantages

- **Robust and stable.** Equipped with heavy-duty components, TRSYS20 is a robust and stable system. Its sensors survive repeated installation necessary in this application where measuring systems are typically used at multiple locations over time. The sensors are water- (rated IP67) and corrosion proof.
- **Ethernet or USB.** TRSYS20 MCU can either be connected to a local area network (LAN) via its ethernet port or it can be connected directly to a PC or laptop via USB.
- **Intuitive and easy to use graphical user interface.** The MCU provides a user interface in the form of a webpage, accessible through a webbrowser. No software installation is required. The graphical user interface provides an intuitive and easy way of controlling and reviewing experiments.
- **Simultaneous measurements on two locations.** The two measurement locations either provide redundancy, allowing the user to check that the measured values are representative for the wall, or the option to measure two different walls in parallel, saving time.
- **High-resolution and high-sensitivity.** High-resolution electronics and high-sensitivity heat flux sensors allow TRSYS20 to measure very small heat fluxes through the wall. Sensor cable shielding ensures that the system is insensitive to electrical disturbances as found in industrial environments.

Suggested use

- Heat flux and differential temperature measurement for building R-value, Λ-value or U-value determination.

Calibration & conformity assessment

Calibration of TRSYS20 components is traceable to international standards. TRSYS20 is provided with formally traceable calibration certificates. HFP01 heat flux sensors are calibrated in accordance with ASTM C1130. Temperature difference sensors are "individually" tested as matched pairs.

Figure 4 *The robust and stable TRSYS20 system is supplied in a rugged carrying case for transportation and storage of the system.*

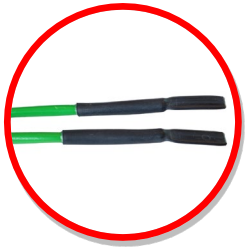
About Hukseflux

Hukseflux is the leading expert in measurement of energy transfer. We design and manufacture sensors and measuring systems that support the energy transition. We are market leaders in solar radiation- and heat flux measurement. Customers are served through the main office in the Netherlands, and locally owned representations in the USA, Brazil, India, China, Southeast Asia and Japan.

Interested in this product?
E-mail us at: info@hukseflux.com

TRSYS20 outperforms other models and complies with ISO and ASTM standards: how?

TRSYS20 is the world's highest accuracy measuring system for building envelope component thermal resistance measurement. It is one of the few systems with true out-of-the-box compliance to ISO 9869. Purchasing a TRSYS20 is a good investment in accurate and stable measurement. TRSYS20 complies with the acceptance interval of the temperature difference measurement specified by ISO 9869 of ± 0.1 °C.

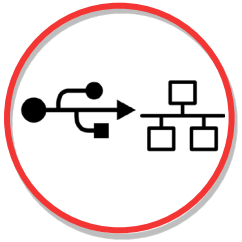


Temperature difference sensors: tested for 0.1 °C accuracy requirements

TRSYS20 matched thermocouple pairs and electronics are tested for 0.1 °C accuracy over the -10 to 50 °C temperature range as required by ISO 9869.

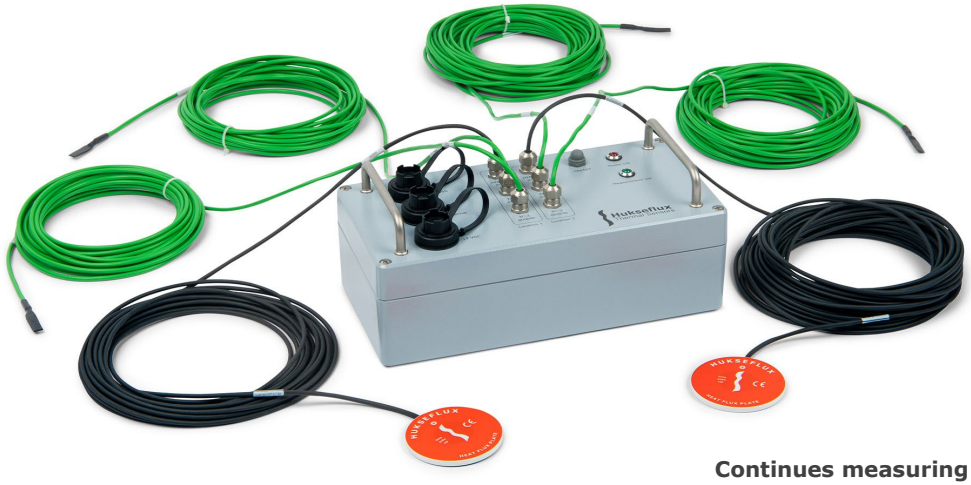
Ethernet or USB connection

TRSYS20 measurement and control unit (MCU) can be connected to a local area network (LAN) via ethernet or directly to a PC or laptop via USB. An easy to use and intuitive graphical user interface is accessible through a web browser and does not require software installation.



High sensitivity HFP01 heat flux sensor

TRSYS20's high-sensitivity HFP01 heat flux sensors in combination with the MCU's high-resolution electronics, allows meaningful measurements down to very small heat fluxes through walls. HFP01 is a robust heat flux sensor with an integrated passive guard and thermal spreader.



Best paperwork

Hukseflux has the paperwork covered. TRSYS20 is provided with formally traceable calibration certificates. HFP01 heat flux sensors are calibrated in accordance with ASTM C1130. Temperature difference sensors are "individually" tested as matched pairs.

Robust and durable

TRSYS20's durable sensors can withstand the rough handling and repeated setup and tear down typical for building applications. The heat flux sensors and thermocouples are water- (IP67) and corrosion proof.

Continues measuring when others give up: high-resolution AD converter + high-sensitivity sensors

The high-accuracy of the heat flux sensors and temperature difference measurements, ensure that TRSYS20 continues measuring when other systems no longer perform; in particular at very low temperature differences across the wall.

Voltage measurement accuracy within 1 µV