ENERGY DISPERSION MEASURING INSTRUMENTS

DIAGNOSI ENERGETICA CARLESI
STRUMENTI DI MISURA

Smartphone Compatible

Bluetooth

MADE IN ITALY

ThermoZig Wireless

HIGH PRECISION WIRELESS HEAT FLOW METER

Thermozig

In-situ measurement of thermal transmittance of building elements

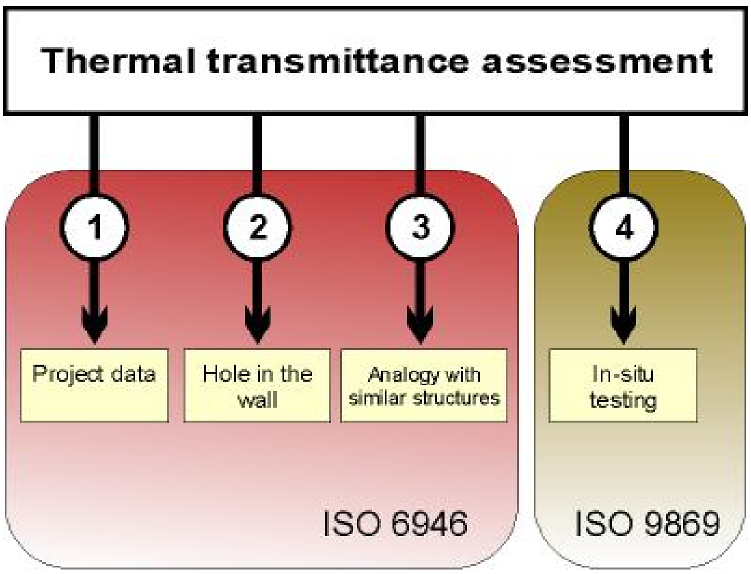
In order to estimate the energy requirements and subsequent emissions of Co2 for winter heating or summer cooling of a building, it is important to determine the thermal transmittance values of its envelope. The thermal transmittance evaluation (U-value) can generally be conducted according to one of the following 4 different scenarios:

1) The structure components are known (thickness and type of the wall material are known with certainty); the transmittance can be calculated in accordance with ISO 6946.

2) The structure components are unknown. A hole can be drilled in order to determine the material type and thickness. The hole may be small in size and the structure can be examined with an endoscope. Or, coring can be larger and the material characteristics are established directly. The technician's professional experience plays a key role here. Once the wall material has been determined, transmittance is calculated in accordance with EN ISO 6946.

3) The building is attributable to particular building types and features that are well known. It is therefore possible to act by analogy estimating the transmittance of the components.

4) The structure transmittance is measured in-situ in accordance with ISO 9869.
The following diagram summarizes the different strategies:



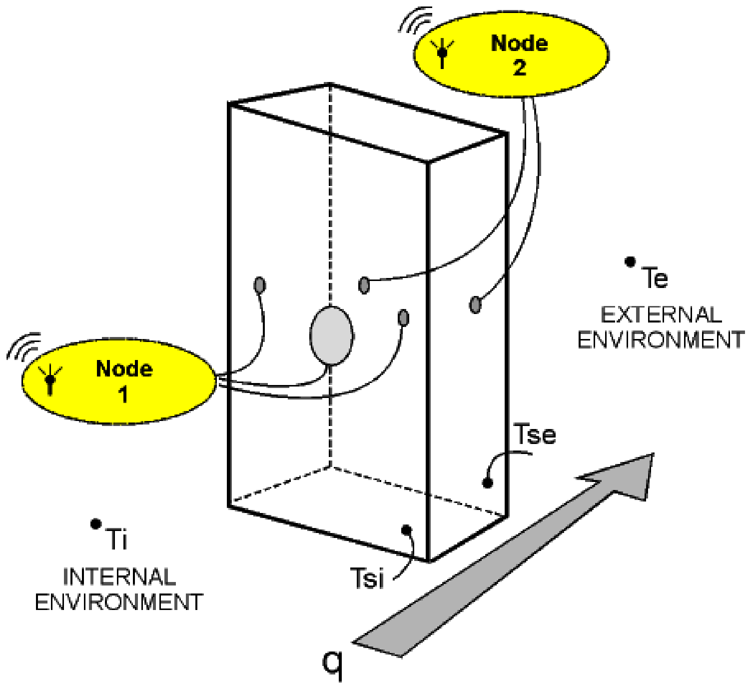
The data acquisition for an energy diagnosis of an existing building or for testing a new construction ofteninvolves considerable difficulties due to unavailability of the project drawings and non-correspondence of the project with the actual construction; for this reason it is very important to have in-situ measuringinstruments. An additional benefit of instrumental measurement is the greater correspondence with the actual values.

Field experience has shown that, in general, the measured transmittance values are higher than the calculated values (even up to 20%). The reasons for this difference can be found among the following aspects:

-The construction does not comply with the design.
-The insulating performance of the materials deteriorated over time
-The environmental conditions differ from those established in the project

(e.g. moisture in the insulating layers).

The in-situ measurement using a heat flow meter (HFM) provides accurate results far superior to other strategies. Practical data reports indicate an average e rror value of less than 8-10%. Typical sensor configuration consists of a flow sensor to be positioned on the interior surface of the building element under test and by two or more temperature sensors to be positioned both on the interior and the exterior surface. The use of more temperature sensors allows averaging the values, and decreasing the error in case of insufficiently uniformed elements. The following figure demonstrates a typical sensor installation:



Where:

$$q = \frac{d\Phi}{dA}\left[\frac{W}{m^2}\right]$$ Density of heat flow rate

$$\Lambda = \frac{q}{Tsi - Tse}\left[\frac{W}{m^2K}\right]$$ Thermal conductance

$$U = \frac{q}{Ti - Te}\left[\frac{W}{m^2K}\right]$$ Thermal transmittance

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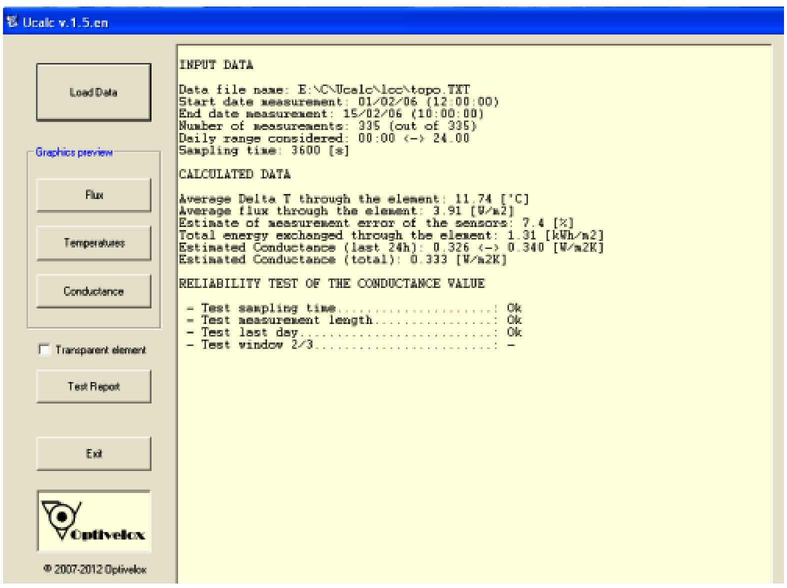
In steady thermal conditions, thermal conductance and thermal transmittance could be established experimentally simply through the instantaneous measurement of the heat flow and the indoor and outdoor temperatures. This condition can be quite easily reproduced in a laboratory, but in general, it is never being verified on the building elements on site (in-situ). In fact, buildings in their actual operating conditions are subject to highly variable conditions over time. The measurement procedures adopted in the field must therefore provide appropriate processing of the measured data in order to properly manage the transient effects (accumulation and release of thermal energy) induced in the wall by different thermal conditions.
This practically translates into using instead of the instantaneous values the corresponding average values, evaluated over a sufficiently long period of time:

In practice, it is easier and more reliable to measure the conductance of the building wall rather than the transmittance, adopting normed values for the internal and external adduction coefficients (UNI ISO 6946).

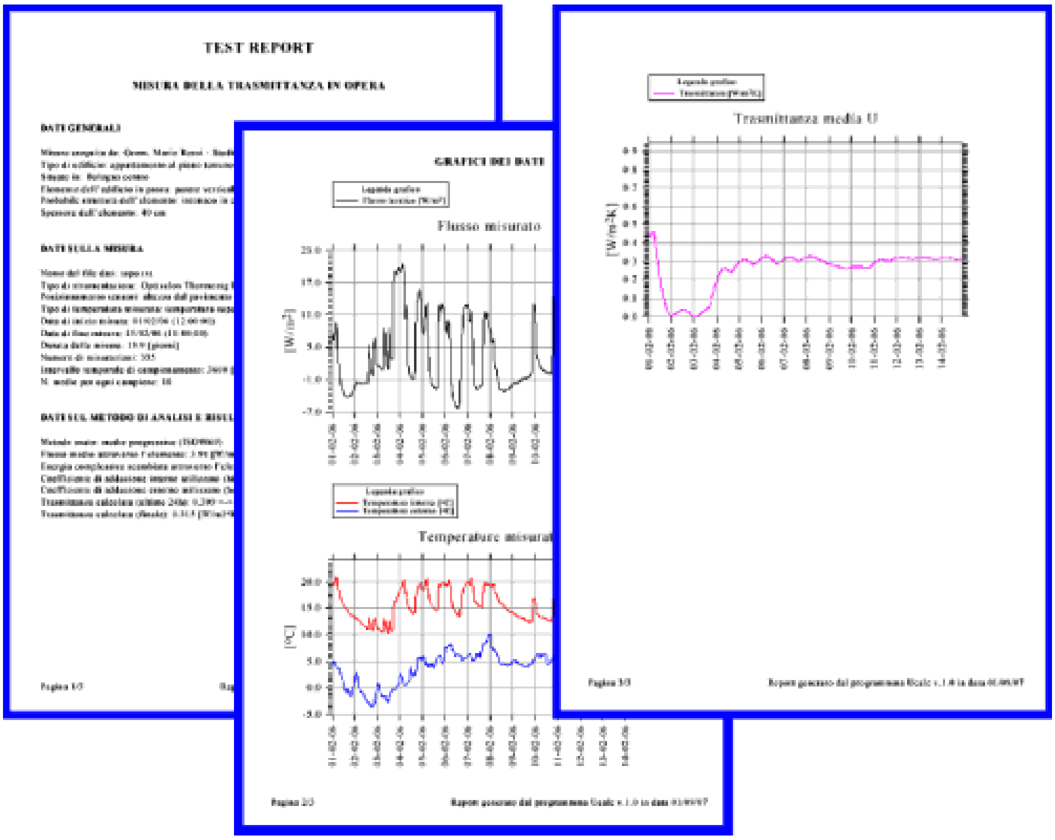
$$U = \frac{\int q\,dt}{\int (Ti - Te)\,dt} \approx \frac{\sum q_i}{\sum (Ti - Te)}$$

Ucalc program

Ucalc is a plug-in program that can be run directly from the datalogger manager program (Dataget). With Ucalc you can calculate the thermal transmittance of a wall in-situ and prepare a report containing data and graphs in PDF format.
The calculations are based on the average method suggested by ISO 9869.
The program is compatible with Windows 2000, XP, Vista or Windows7.



Ucalc allows you to display figures and graphics of the elaboration results. At the end you can save a complete report in PDF format.



The advantages of a wireless measurement system

The physical quantities that are to be monitored for the transmittance measurement are the temperature and the thermal flux. The minimal setup requires the surface temperature detection of the inner and outer wall in at least two distinct points and the measurement of the thermal flux passing through them. A first problem to be resolved is connected to the heat capacity of the element; it requires very prolonged monitoring which in some cases may be continued for several days.

The following pictures show a solution to meet these needs:

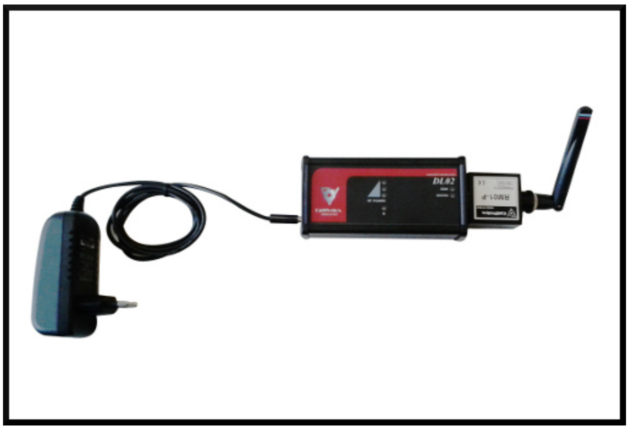
Indoor

Outdoor

The installation of the sensors and measurement nodes is facilitated by a wireless connection, it is not necessary to drill the wall or use complex cable layouts.

Thanks to the ZigBee protocol, the measurement nodes have a very high autonomy. For this type of application, the internal battery of the radio modem is capable of powering the measurement node for several months. The battery is also a rechargeable type and can be completely restored within a couple of hours.

The choice of the data logger location does not pose particular problems. In this case it was placed inside the house, at a point where it does not disturb the normal household activities.



Datalogger

In this example, only one wall has been taken into consideration and only two measurement nodes were used. The interesting note is that the datalogger is able to manage many other measurement nodes without any modification. This gives you the ability to perform multiple simultaneous measurements by simply adding more nodes on the walls.
With a multiple simultaneous measurement you can monitor a complete building in a single recording session.

FE01/02 devices with two heat flow or more temperature sensors (4 or 8) can be used when more accurate measurements are needed, especially if the walls are not very homogeneous.

The picture on the right shows another installation method of the thermal flow sensor.
The metallic structure presses the sensor against the wall to ensure a good thermal contact.
This application type has the advantage of allowing to make the measurements and remove the device without damaging the wall plaster.

Quick Learning

The use of the system has been simplified with particular care. Although the instrument is highly versatile, you can manage all phases of the in-situ measurements with a single button.
The quick start guide that comes with the user manual covers all the basic operations.

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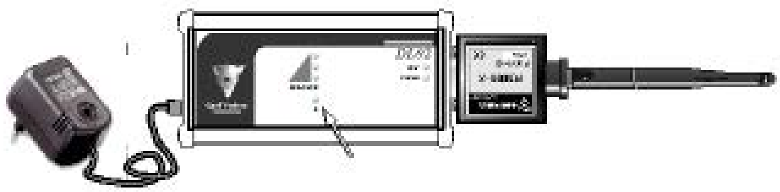
QUICK START

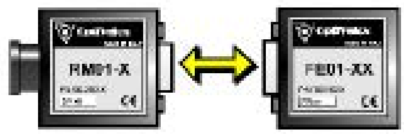
Start Measurement

1

Connect the power supply unit and make sure that the B light is lit green.

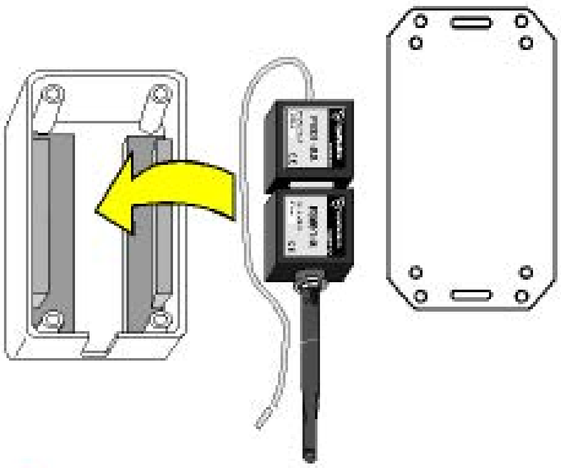


2



Activate a measurement node by checking that the datalogger simultaneously emits a beep.

3



Place the node in the protective box and fix the sensors on the wall. When finished, press the P button to control the RF signal level.

4

Repeat steps 2 and 3 for every other node to be activated.

5

Start data recording by pressing the P button until you hear two beeps (the B light turns red).

6

The measurement session can be terminated by pressing P to go into PAUSE (B light yellow) and then pressing P until you hear two beeps (B light green).

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WWW.OPTIVELOX.COM

Data Download

QUICK START

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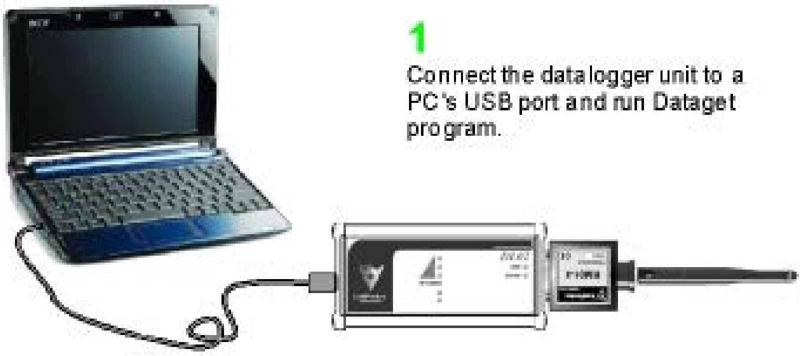
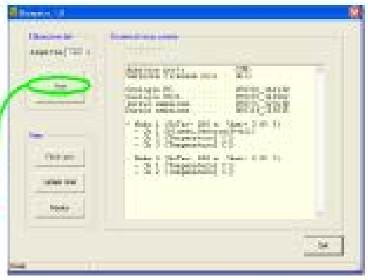


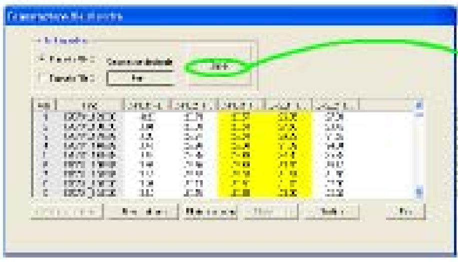
1

Connect the datalogger unit to a PC's USB port and run Dataget program.

2

Download the data by pressing the Start button.





3

Reduce the data to only three columns:

1) Heat flow
2) Internal surface temp.
3) External surface temp.

then press the Save button.

4

Select the folder where to save the file containing the measurement data.

5

If present, run the program for calculating transmittance (Ucalc) pressing the relative button, otherwise terminate Dataget and use an external program to elaborate the data file.

Available Systems
Thermozig

The standard ThermoZig system has a single measuring point (2 nodes), any additional measuring points can be purchased separately. The system can handle up to 15 measuring points (30 nodes).

ThermoZig includes:

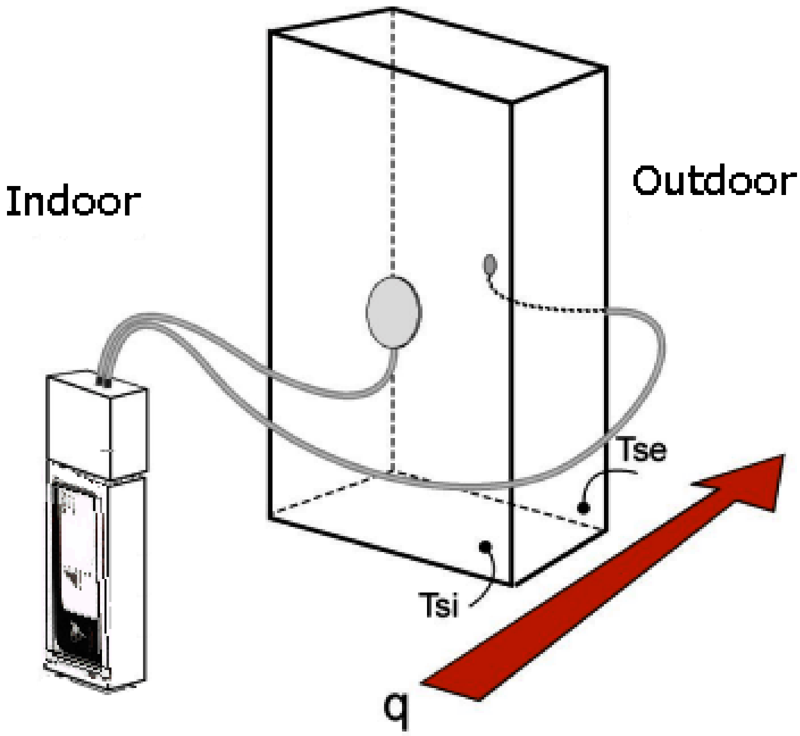
- 1x Datalogger DL02 (complete with manual, software and PC interface cable) - 1x Front End FE01-2A (with two temperature probes)
- 1x Front End FE01-3B (with a HFM + two temperature probes)
- 3x Radio Modem RM01-P (with internal rechargeable battery)
- 2x Node Box (for the protection and securing of a node)
- 1x Datalogger power supply
- 1x Clip for mounting sensors to the wall
- 1x Carrying case

Thermozig LT

The Thermozig LT system is the most economical system for measuring transmittance in-situ. It differs from the standard Thermozig system for having wired connections and a single

measurement node. This configuration allows you to approach the world of professional thermoflux meters at a very low cost without any compromise regarding the quality of the measurement sensors.

Thermozig LT, however, can be upgraded to the standard version by buying the missing parts (3 radio modems and an additional FE01/02) separately.



ThermoZig LT includes:

- 1x Datalogger DL02(complete with manual, software and PC interface cable) - 1x Front End FE01-3C (with a HFM + two temperature probes) - 1x INT08 adapter (adapter DL02 <-> FE0x)
- 1x Datalogger power supply
- 1x Clip for mounting sensors to the wall
- 1x Carrying case

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GMS Remote Control

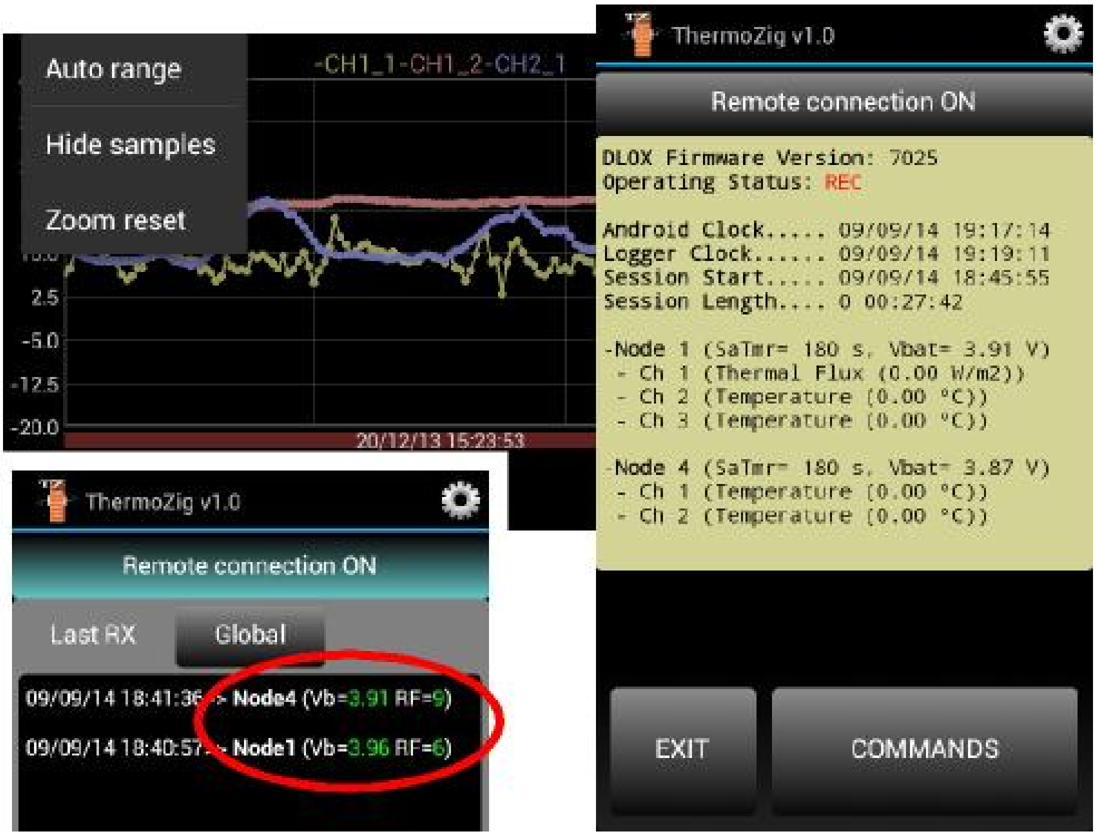
The measurement of in-situ transmittance can last for an extensive period of time, especially if the building has elements with considerable thermal mass. When the test is conducted in not easily accessible sites, it can be useful to have a remote connection that allows to download the partial measurement data in order to check the progress and determine when the session can be considered concluded.

Thanks to the new DL02 datalogger it is now possible to have a remote GSM connection through which the entire measuring process up to the final report can be controlled remotely from your office.

Bluetooth Remote Control

For Android devices there now is a ThermoZig app. It allows you to connect to the DL02 datalogger via Bluetooth and use the following functions:

- Thermal transmittance display (in real time or resulting from a previous measurement session).
- Battery level and radio signal monitoring received by each node in the measurement network.
- Display in numerical and graphical format for all channel signals recorded by the system



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