ISOMET 2114

Thermal properties analyzer

User's Guide

Version 1.59

Contents

1. Safety Considerations and Instructions

Basic safety instructions

- The unit is dedicated for hand-held operation with strictly limited conditions for connecting to circuits with non-safe potential level referring to IEC EN 61010.

- Keep the operational conditions defined in technical specification.

- Using other than supplied power adapter is not allowed.

- Operation of the power adapter is for indoor use only.

CAUTION !!

Exposing the measurement probe to increased thermal or mechanical stress can lead to its damage or permanent deviation from specified accuracy.

2. Introduction

2.1 Description

ISOMET Model 2114 - Thermal Properties Analyzer
Multifunction instrument for measurement of
- Thermal conductivity (λ) [W m^{-1} K^{-1}]
- Thermal diffusivity   (a)   [m^2 s^{-1}]
- Volume heat capacity (cρ)   [J m^{-3} K^{-1}]
- Temperature   [°C]

ISOMET 2114 is a hand-held measuring instrument for direct measurement of heat transfer properties of a wide range of isotropic materials including cellular insulating materials, plastics, glasses and minerals. It is equipped with two types of measurement probes: needle probes for soft materials, surface probes for hard materials. It applies a dynamic measurement method, which enables reducing the measurement time in comparison with steady state measurement methods.

Built-in menu system on color graphic display and the alphanumeric keypad enable effective interactive communication with the device. Measurement data are stored in the high capacity internal memory. Content of the memory is accessible through the display or it can be transferred into a PC by USB or RS-232 interface. Calibration data in internal memory ensure interchangeability of probes without affecting the measurement accuracy. Since supplied measurement probes have good long term stability through the whole measurement range, periodic calibration before measurements is not necessary. Nevertheless, calibration by means of a reference material is supported by the instrument. Calibration coefficient stated in the sense of the standard ASTM – 5334-08 may be applied to subsequent measurements automatically.

ISOMET2114 is powered by internal rechargeable batteries, which makes outdoor, in situ measurements easier.

⇨ **Applications**
- Civil Engineering
  - *Measurement of thermal transfer properties of building materials and constructions*
  - *Optimization of development of thermal insulating materials*
- Geological Investigations
  - *Indoor and outdoor measurement of thermal transfer properties of soils, sands, rocks, etc.*
  - *Optimization of development of thermal insulating materials*
- Chemical Industry
  - *Measurement of heat transfer properties of chemical substances, agents, lubricant greases, plastics, suspensions, foam, rubbers, etc.*
- Woodworking Industry
  - *Measurement of heat transfer properties of woods*
  - *Moisture measurement and drying process optimization*
- Textile Industry
  - *Optimization of textile thermal contact comfort*
  - *Textile composition and surface adjustment*
  - *Evaluation of floor plates and carpets*

2.2 PRINCIPLE OF OPERATION

Measurement is based on analysis of the temperature response of the analyzed material to heat flow impulses. Heat flow is excited by electrical heating of resistor heater inserted into the probe which is in direct heat contact with the tested specimen. Evaluation of thermal conductivity and volume heat capacity is based on periodically sampled temperature records as function of time, provided that heat propagation occurs in unlimited medium.

2.2.1 Measurement Probes

The broad measurement range of the ISOMET allows to measure variety of materials with extremely different mechanical properties. It is possible to measure solid materials ranging from soft foams to hard rocks, liquids, suspensions etc. In order to obtain the best measurement accuracy on specific materials two general probe types were developed:

> **a/**   **Needle probes**
> **b/**   **Surface probes**

Needle probes can be utilized for solid soft materials where it is possible simply to stick the needle of the probe into the measured material or it is possible to bore precise aperture for the needle. Measurement accuracy using the needle probes is not degraded even for the best low-conducting polyurethan foams but it might be significantly affected in harder materials by inaccuracy of the aperture. Expected minimal material thickness surrounding the needle probe is from 20 mm to 40 mm depending on the material's thermal diffusivity (conductivity). The sensor part of the probe begins 15 mm from the probe tip and is 50 mm long. Needle part of the probe should be fully inserted into measured material up to its handle in order to obtain the best measurement accuracy but 80 mm insertion depth is acceptable in most cases.

Needle probes are calibrated without any thermal contact improving means for soft porous materials. For hard solid non-porous materials where apertures for probe are bored silicon oil is used to fill the hole.

Surface probes are intended to use for measurement on solid and hard materials. Flat surface of at least 60 mm diameter is satisfactory for the probe. Demand for the accuracy of the surface flatness increases with increasing thermal conductivity value of the tested material. The expected minimal thickness of evaluated material is ranging from 20 mm to 40 mm depending on its diffusivity (conductivity).

Surface probes, in principle, can be utilized also for extremely low conductive foams. However, the properties of the surface layer of materials may significantly differ from the properties of the inner structure (especially in case of low-conductive gas filled foams, due to filling gas diffusion).
Surface probes are calibrated without any thermal contact improving means.

2.2.2 Accuracy Influencing Factors

Measurement of thermophysical properties by ISOMET can be, like all other measurements, influenced by conditions of measurement.

Following influencing factors might have the most significant effect on measurement:

- Quality of the thermal contact of the measurement probe and measured object
- Temperature fluctuations and drift
- Finite dimensions of the measured material sample
- Non-homogeneity of the measured material sample
- Anisotropy of the measured material sample
- Humidity of the measured material sample.

2.3 Measuring System

Measuring system of ISOMET 2114 consists of Measuring Unit, optional Needle and Surface type measurement probes supported with following accessories:

Standard Accessories	
ISOMET 2114	Measuring Unit
ISTC 2000	Transport Case
WSPA 2000	Power Adapter (100-240V)
CCU 1000	USB Communication Cable
ISCD	CD-ROM with Manual and Software

Optional Accessories	
IPN 1100	Needle Probe with one meas. range
IPS 1105	Surface Probe with one meas. range
IPNR	Additional meas. range for IPN 1100
IPSR	Additional meas. range for IPS 1105
WSCA 1000	Car Outlet Adapter (12V)
SOB	Set of Borers for Needle Probes

3. Measuring Unit

3.1 Front panel
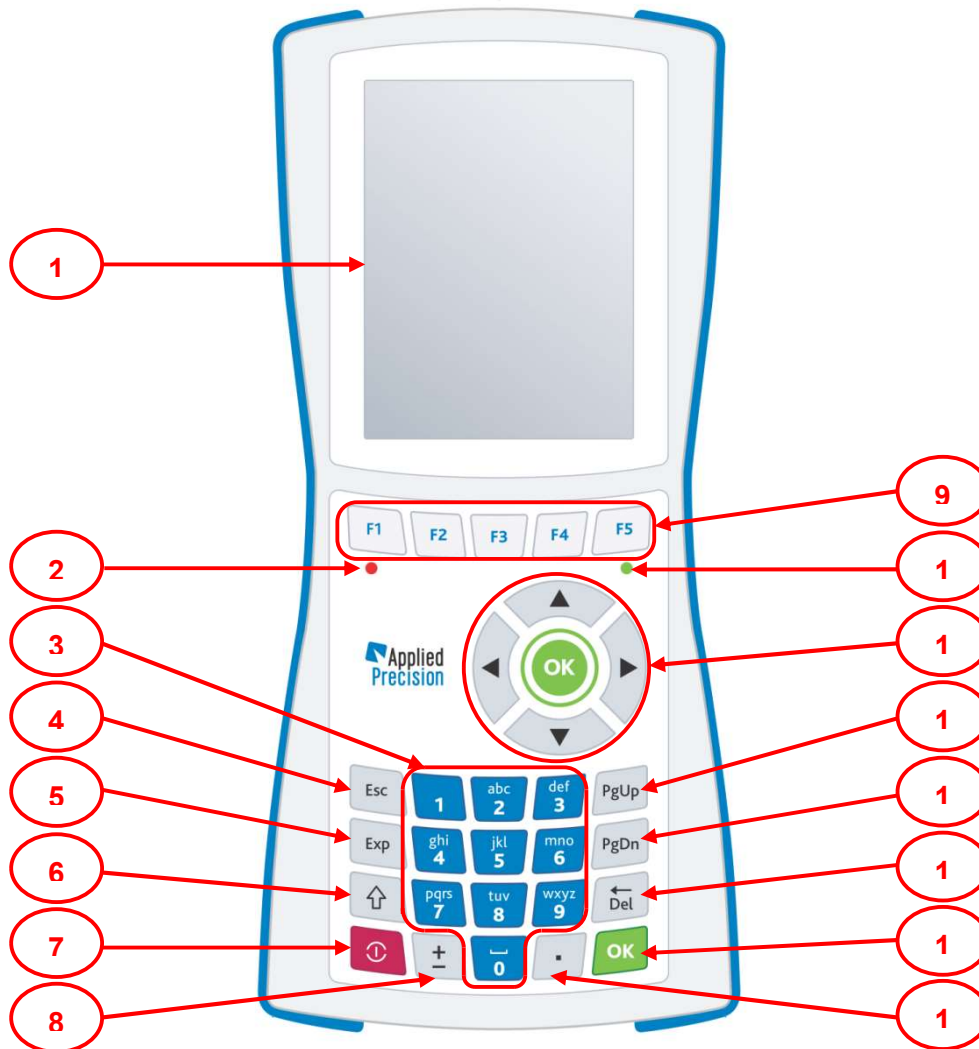
Front panel of the device

1	**Display** - colour graphical display	**9**	**Function keys** - quick access to functions
2	**LED** - indicates enabled heating	**10**	**Indicator of charging batteries** - green LED indicating charging status
3	**Alphanumeric keypad** - keys 0-9 (a-z)	**11**	**Choice keys** - arrows and OK
4	**ESC key** - termination of functions	**12**	**PgUp key** - paging upwards
5	**Exp key** - input of exponent of number	**13**	**PgDn key** - paging downwards
6	**Shift key** - switching of keys functionality	**14**	**Del key** - deleting
7	**Power key** - power on/off of the device	**15**	**OK key** - confirmation of choice
8	**Sign key** - input of plus/minus sign	**16**	**Point key** - decimal point

3.2 Rear panel

Back panel of the device

1	**Protection Rubber** - blue protection rubber
2	**Nameplate** - nameplate with serial number
3	**Accumulators box** - box for accumulators (4 x AA)
4	**Screws of accumulators box**
5	**Screws of back side of the device**

3.3 Bottom Connectors
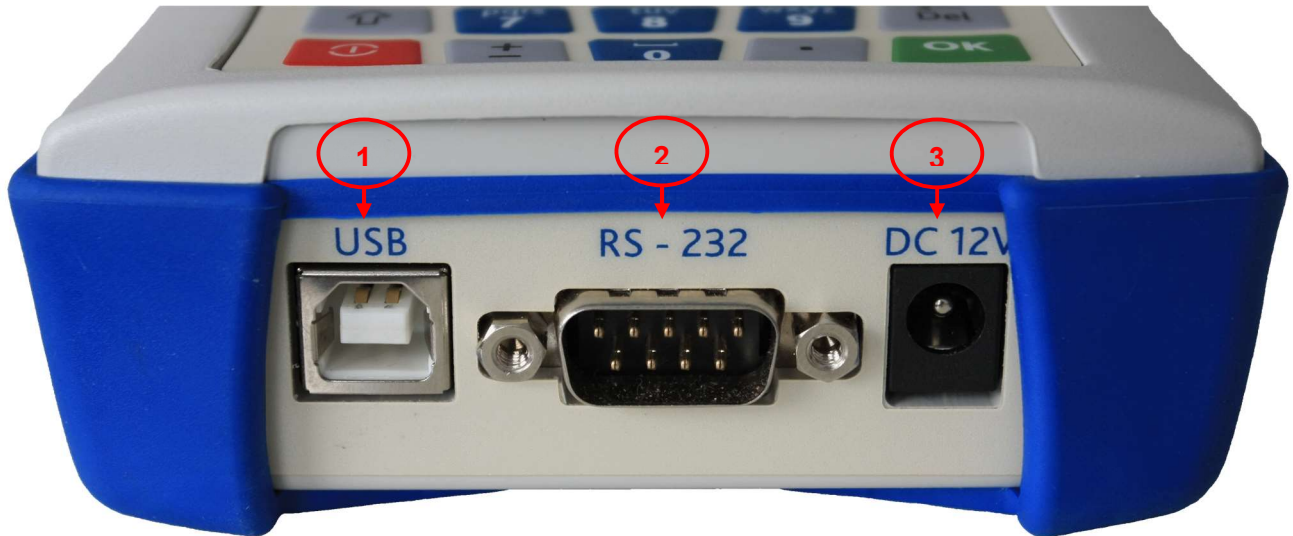
Bottom side connectors

1	**USB Connector** - communication connector USB
2	**RS-232 Connector** - communication connector RS-232
3	**Power Connector** - connector of power adapter (+12V)

3.4 Measurement Probes

ISOMET 2114 is supplied with various types of measurement probes. Calibration coefficients and further technical parameters are written into the probe nonvolatile memory, which ensure interchangeability of probes. These parameters are uploaded into the measurement unit during initialization procedure after switching the measuring unit on. Therefore the measurement probe has to be connected to the measurement unit before it is switched on or initialization may be activated by switching the measuring unit on once more. "Probe" socket for connecting measurement probes is situated on the top of the instrument.

Measurement probes are equipped with plastic cylindrical push-pull connectors with definite and safe locking mechanism for quick and easy connecting to the measuring unit.
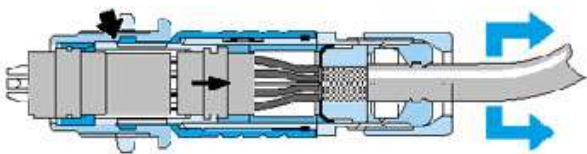

Receptacle
(socket)

Plug
on the cable of the accessory
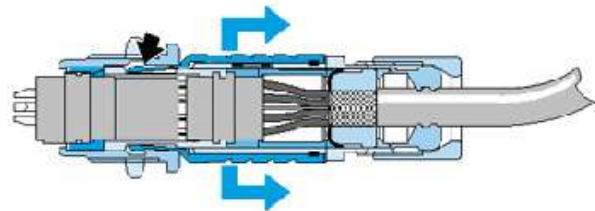
3.4.1 Locking Mechanism

Pulling on the cable or on the back nut causes the locking fingers to grip tighter into the groove inside receptacle (socket). A separation is virtually impossible.

Pulling on the outer plug housing disengages the locking fingers from the receptacle groove and the connector separates easily.

3.4.2 Cable Connecting

Connecting

Connected cable

3.4.3 Cable Disconnecting

Incorrect disconnecting

Incorrect disconnecting

Incorrect disconnecting

Correct disconnecting

3.5 Power Supply

ISOMET2114 is powered by 4 pieces of AA sized 1.2 V rechargeable batteries. Batteries are installed under the plastic cover on the rear panel of the instrument.

External power adapter with range of input voltage from 100VAC to 240V, 50-60Hz is supplied for recharging batteries.

Batteries should be recharged when measuring procedure for thermal measurements is not activated. Supplied Power adapter may be connected to the instrument also during measurement procedure to power electronic circuits of the instrument but power adapter may not supply sufficient power for taking correct thermal measurement when batteries are discharged.
It is recommended to start series of thermal measurements with fully charged batteries.

Powering Status Indicator, icon located in upper right corner of the display, indicates connection to power adapter or state of batteries when power adapter is not connected.

More precise way for checking the state of batteries is available under the item System Info in Main menu. Battery Voltage lower than 4.8 V is not sufficient for taking thermal measurement. The system aborts thermal measurement automatically, when battery voltage is lower than 4.8 V.

Batteries Charger Status is indicated by means of the green LED, situated on the front panel keyboard under key F5.

Batteries Charger Status LED has three statuses:

- no light .... power adapter (charger) not connected
- flashing .... batteries are charging
- steady light .... batteries charging has been stopped

Charging time of discharged batteries is approx. 4.5 hours.

CAUTION !!

Use power adapter supplied with the device only.

**Rechargeable batteries need periodical recharge, storing discharged batteries can cause their damage.**

*Power Adapter **WSPA 2000***

4. Operation

Measuring unit of ISOMET 2114 is equipped with color 3.5″ TFT LCD display, alpha-numeric keyboard, USB and RS232 communication ports, which ensure its simple operation.

Switching on and switching off the device is done by pressing the red Power key for approx. 3 seconds. Pressing the Power key for shorter time toggles the display backlight only. The measuring unit should be switched on with disconnected battery charger, USB connection and with connected measurement probe. When the instrument is switched on, display backlight turns on and after initializing procedures and loading parameters from connected probes, the Stand By page appears on the display.

Stand By page like all other pages is divided into 3 zones:
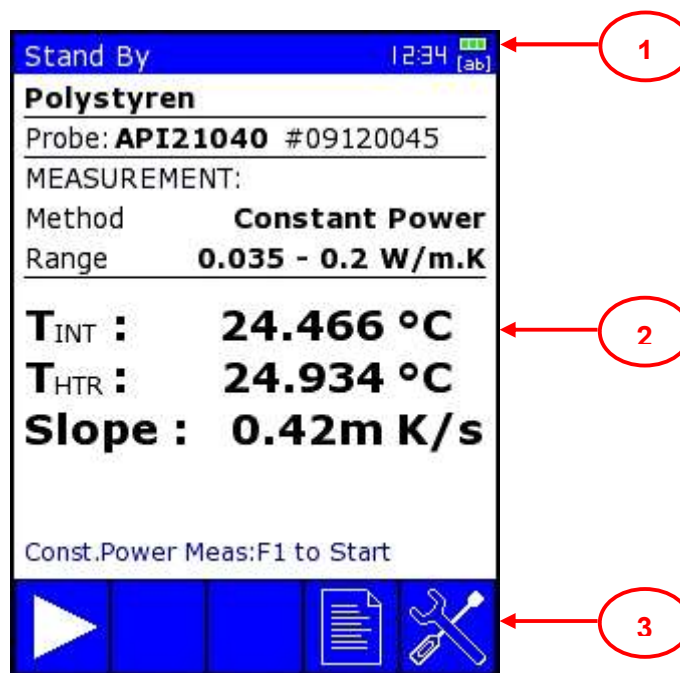
Stand By page

1	**Header** • page name • time • keyboard mode • battery status
2	**Info** - measured and calculated values, results, parameters etc.
3	**Functions** - graphical presentation of active function keys F1 – F5, various meaning of function keys is represented by different graphical representation, of function keys.

4.1 Measurement

After switching the measuring unit on and uploading parameters from the connected probe, Stand by Page containing serial number of the connected probe is shown on the display.

After short initialization procedure, continuous temperature measurement is activated by means of two temperature sensors installed in the measurement probe. Temperature values, signed as T_{HTR} and T_{INT}, are displayed with the slope of their time dependence qualifying the state of thermal equilibrium around the probe.
Further data, measurement range of the connected probe and measurement label are edited in the system menu.

Control keys on the Stand By page:

> **F1** .... start measurement
> **F4** .... review and deleting results
> **F5** .... switches to the system menu of the page where configuration of measurement and the system can be performed

Function keys without graphical presentation are not active.
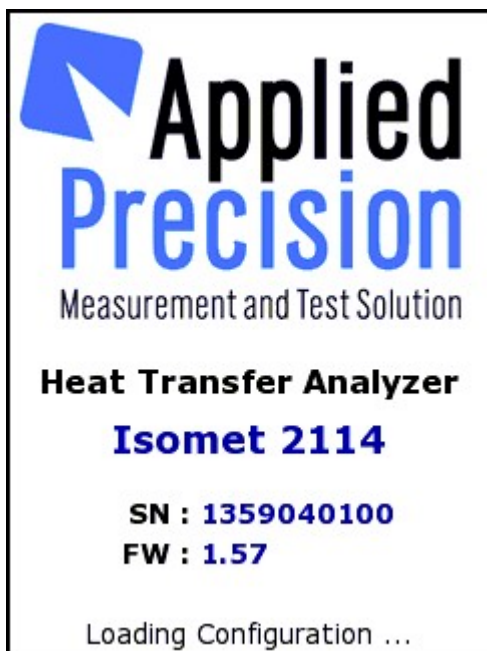
Loading parameters

Stand By page

Thermal conductivity measurement is started by pressing the key F1. After running thermal conductivity measurement, Stand By page turns to the Measurement page.

Active function keys on the Measurement page:

> **F1** .... serves for stopping thermal conductivity measurement. Pressing the key F1 displays request for stopping the measurement. The running measurement is stopped after confirmation by the key F5.
> **F4** .... displays results in the database
> **F5** .... switches to the System Menu page, where configuration of measurement and the system can be performed

Measurement page contains progress bar characterizing progress of the measurement time and number of selected measurements with number of the measurement in progress.
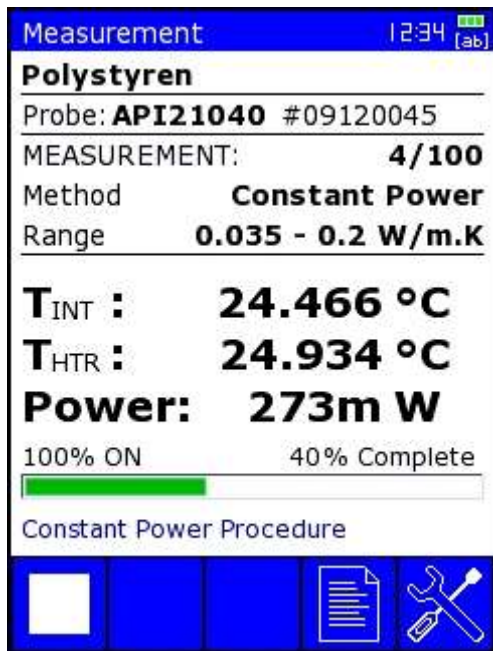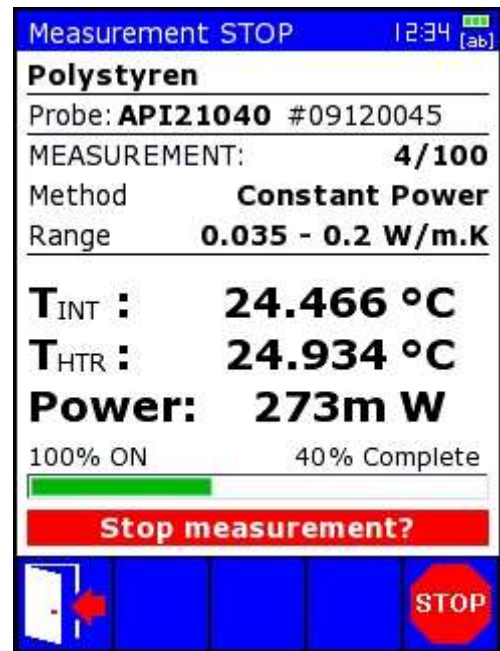
Measurement page   *Measurement STOP page*

It is recommended to configure the instrument for repeated thermal conductivity measurement. Results of completed thermal conductivity measurements are available any time also during measurement in progress. Results page for reviewing results may be activated on Measurement, Stand By or menu page by pressing the key F4. Pressing the key F4 on the Measurement or Stand By page opens the results database at the last completed measurement. Activating the Results page from Menu page opens the results database at the last reviewed result.

Control keys on the Measurement page:

ESC .... exit (return to previous page)
F1................................. stop measurement
F2................................. skip waiting for thermal equilibrium
F4................................. review or deleting results
F5 .... System Menu

4.2 Results

The database screens allow reviewing and deleting measurement results

Results page	*Deleting result record*

Control keys:

F2 .... switching to measurements of selected test
F5 .... deleting selected test results
▼▲ .... scrolling results
OK .... confirmation of selected item
ESC .... exit screen or close browsing table

Measurement results are organized in two levels. Repeated measurements on the same material are regarded as one test (series of measurements). Arrow keys enable scrolling measurement results or test results, which mean average values of measurement results taken as one series of measurement. When test results are displayed, standard deviation of the average value is also displayed. Pressing F2 enable entering into measurement results of the selected test. Returning to test results from measurement results is possible by pressing the key F1.
Pressing the key F5 enables deleting the selected measurement or test result. Deleting has to be confirmed by the key F3 or it may be discarded by means of the key F4.

Measurement results may be transferred into your PC by means of the supplied program ResReadout_I2114.exe. Measurement results are transferred as text file with file extension "csv" accepted by table processors.

4.3 Menu

Menu enables access to settings, database of measurement results, information about device and device calibration. It can be activated by pressing the key F5 on Stand By page.
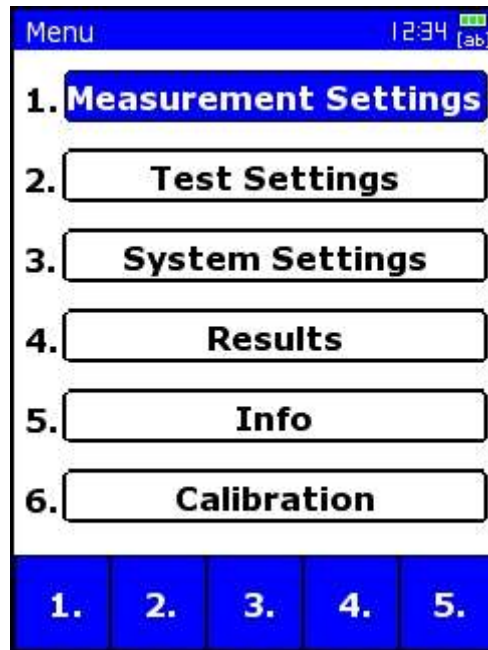
Menu page

Content:

1. **Measurement Settings** .... measurement settings
2. **Test Settings** .... test settings
3. **System Settings** .... system settings
4. **Results** .... review and deleting results
5. **Info** .... gives information about the devices
6. **Calibration** .... enables measurement calibration

Control keys (active on Menu page):

F1 or 1 .... measurement settings
F2 or 2 .... test settings
F3 or 3 .... system settings
F4 or 4 .... database
F5 or 5 .... info
6 .... calibration
▼ ▲ .... enable selecting the wished item
OK .... confirmation of selected item
ESC .... exit (return to previous page)

4.3.1 Measurement Settings

Measurement Settings page enables selection of measurement range of connected probe with more than one range.

Generally, data are entered into the system by means of combo boxes and edit boxes. First the controlling element has to be selected by means of arrows on the keyboard. Selection of a control element is signed by turning colors into their inverse color, white background into blue background and blue letters into white letters. After pressing the OK key, selected control element becomes editable, items of a combo box are scrollable and edit boxes rewritable.

For example, the combo box for selecting measurement range may become scrollable by pressing arrow down once and pressing OK key. After that, possible measurement ranges of the connected probe may be displayed in the combo box by pressing arrow keys. The selected measurement range is confirmed by OK key. By pressing the functional key F4, the selected measurement range may be stored into the memory of the measuring unit and after next initialization the stored measurement range will be selected automatically.
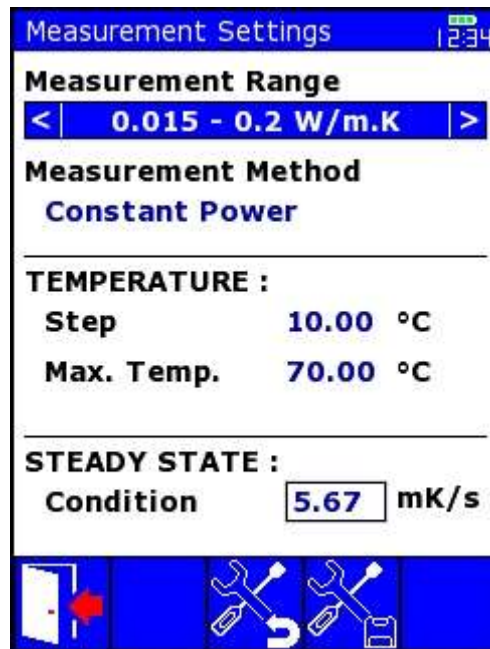
Measurement Settings screen

Measurement Settings page also enables modification of Steady state condition for starting measurement. After selection of edit box by pressing arrow and OK keys, the new value is entered into the edit box. The wished value in the edit box is confirmed by pressing OK.

There are further informative data on the Measurement Settings page: Measurement Method, Temperature Step and Max Temperature, which are not editable.

Control keys:
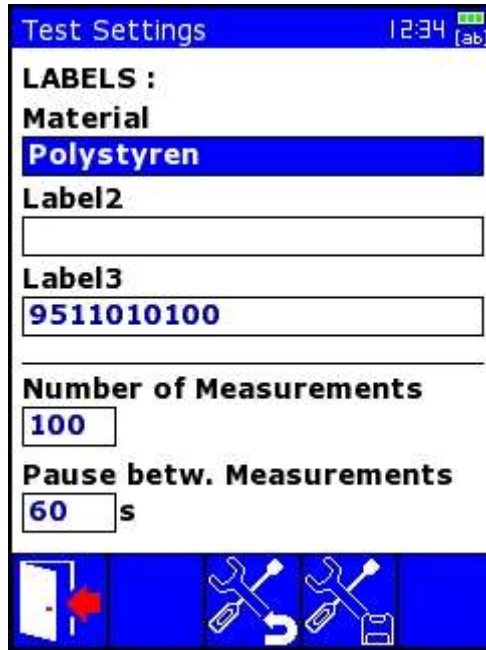
      F1, ESC .... exit (return to previous page)
      F3 .... load default (factory) settings
      F4 .... save selection of the measurement range into memory

4.3.2 Test Settings

Test Settings page enables configuring number of repeated measurement, pause between measurements and entering three measurement labels to identify the series of repeated measurements.

Editing of edit boxes is described in section 4.3.1. When any of the edit boxes is selected, keyboard mode may be modified for typing upper case letters or numbers by pressing the Shift key.

Test Settings screen

Control keys:

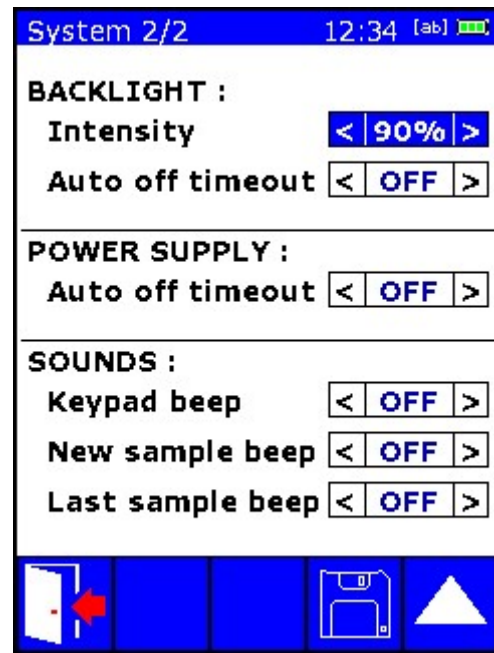   **F1, ESC** .... exit (return to previous page)
        F4 .... save all changes into memory (will be loaded after next switch on)
        F3................................ loading factory settings

4.3.3 System Settings

System Settings page contains general parameters of the system of the device.
Page is showed in two screens and switching between them is done by key **F5**.
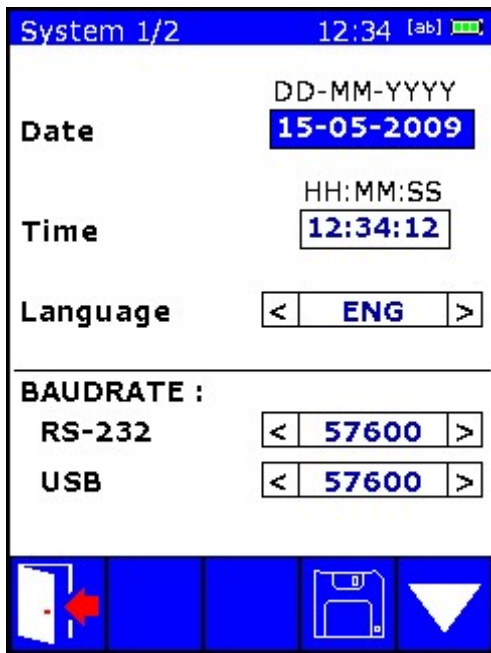
System Settings screen 1/2

System Settings screen 2/2

Content:

Date .... actual date
Time .... actual time
Language .... selection of language of devices user interface
BAUDRATE .... settings of baud rate of device communication interfaces
    RS-232 .... baud rate of RS-232 communication interface: 300, 600, 1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600 or 112000
    USB .... baud rate of USB communication interface: 300, 600, 1200, 2400, 4800, 9600, 19200, 28800, 38400, 57600 or 112000
BACKLIGHT .... settings of backlight of display
    Intensity .... backlight intensity: 10%, 20% … 90% or 100%
    Auto off timeout .... automatic backlight switch-off time: 1 / 2 / 5 / 10 / 20 / 30 min or OFF (inactive)
POWER SUPPLY .... settings of power supply
    Auto off timeout .... automatic power switch-off time: 1 / 2 / 5 / 10 / 20 / 30 min or 1 / 2 / 4 h or OFF (inactive)
SOUNDS .... settings of sounds
    Keypad beep .... acoustic indication of keys pressing: ON or OFF
    End of meas. beep ..... acoustic indication when measurement is finished: ON or OFF
    End of test beep .... acoustic indication when test is finished: ON or OFF

Control keys:

    F1, ESC .... exit (return to previous page)
    F4 .... save all changes into memory (will be loaded after next switch on)
    F5 .... switching between screens 1/2 and 2/2

4.3.4 Information Screen

Information screen shows basic information about the device and connected accessories.
Page is showed in two screens and switching between them is done by the key **F5**.

Information screen ½	*Information screen 2/2*
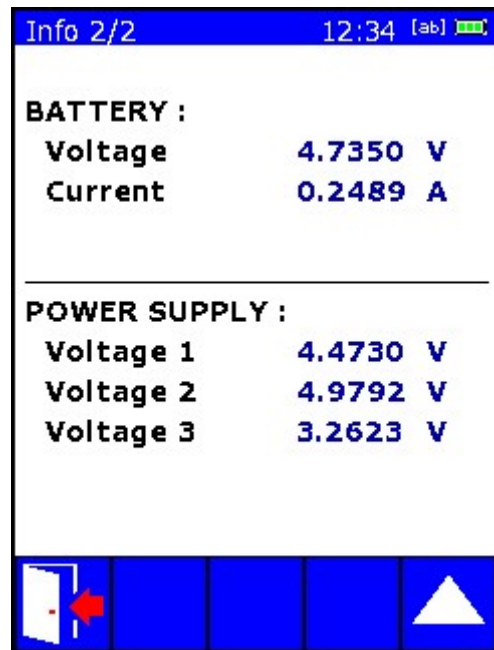
<u>Content:</u>

DEVICE .... type of the device
    Serial No. .... serial number of the device
    HW1 ver. .... hardware version of upper (high level) part of the device
    HW2 ver. .... hardware version of bottom (low level) part of the device
    FW1 ver. .... firmware version of upper (high level) part of the device
    FW2 ver. .... firmware version of bottom (low level) part of the device
    GUI ver. .... version of user interface screens (Graphical User Interface)

Probe Type .... type of the connected measurement probe
    Serial No. .... serial number of the connected measurement probe
    Range .... measurement range of the connected measurement probe

BATTERY .... parameters of internal battery
    Voltage .... voltage of the battery
    Current .... current from the battery

POWER SUPPLY .... auxiliary voltages (specified for diagnostic purposes)
    Voltage 1 .... power supply voltage 1
    Voltage 2 .... power supply voltage 2
    Voltage 3 .... power supply voltage 3

<u>Control keys:</u>

    F1, ESC .... exit (return to previous page)
    F5 .... switching between screens 1/2 and 2/2

4.3.5 Calibration

Supplied measurement probes have good long term stability through the whole measurement range. Periodic calibration before measurements is not necessary. Nevertheless, calibration by means of a reference material is supported by the instrument. Calibration coefficient k stated in sense of the standard ASTM – 5334-08 may be applied to subsequent measurements automatically. In addition, it is possible to apply an offset value q for subsequent measurements.

Calibration page is available by selecting the 6th item in the system menu or by pressing the key 6. Editing the Calibration page is protected by password. The password is 1234. Before entering the password numeric mode of the keyboard must be selected by pressing the Shift key. After successful entering the password, edit boxes for entering calibration coefficients or expected (conventionally true) thermal conductivity values became available. There are two possibilities for the user. It is possible to enter coefficients k and q, calculated according to the standard ASTM 5334-08 or linear regression, directly. It is also possible to select measurement result of one or two reference materials in the database of results and after entering the conventionally true thermal conductivity values of the reference materials, calculated calibration coefficients are displayed in the edit box. If only one reference material is used for calibration, the second calibration coefficient q must have zero value.

Applying the coefficient must be enabled in the combo box Use correction. For safety reason, the combo box is not saved. After switching the instrument on, applying calibration coefficient is disabled.
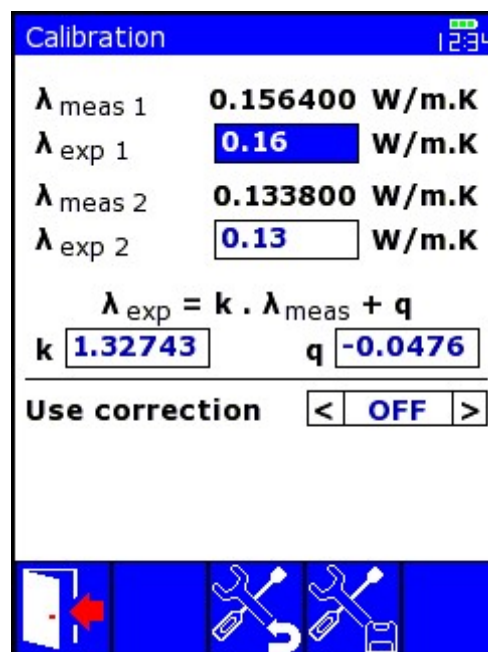
5. Software data exchange

Measurement results may be transferred from memory of the measuring unit of ISOMET2114 into a personal computer via USB communication interface. Supporting software is supplied with ISOMET2114 on USB MSD (USB key) in two application files: CDM20814_Setup.exe and ResReadout_I2114.exe.

Application ResReadout_I2114.exe enables

- Uploading results from ISOMET2114 to connected PC via USB communication interface
- Deleting all results from memory of ISOMET2114 connected to PC via USB port.

Before the first running of the application ResReadout_I2114.exe, driver for installing virtual communication port should be installed by running CDM20814_Setup.exe. For complete installation, the application CDM20814_Setup.exe must be run after finishing the first part of the installation once more.

5.1 Software Installation

Minimum System Requirements:

- processor Intel Pentium 166 MHz or higher (PII 400 MHz recommended)
- operation system Microsoft Windows XP or newer version
- operation memory 128 MB RAM (256 MB recommended)
- free hard disk space 30 MB
- USB port
- VDA Monitor and mouse or other pointing device

Procedure for installing the data transfer support

Run the application file CDM20814_Setup.exe. The installation will take approximately 10 seconds.
Run the application file CDM20814_Setup.exe once more. The additional installation will take approximately 25 sec.
Copy the file ResReadout_I2114.exe from installation USB key to the HD of your PC.

Transferring data into PC

Before running the application file ResReadout_I2114.exe, connect the measuring unit to a PC USB port, by means of the supplied USB interconnection cable and turn it on.
After running the exe file ResReadout_I2114.exe, the following window will be displayed on the screen.
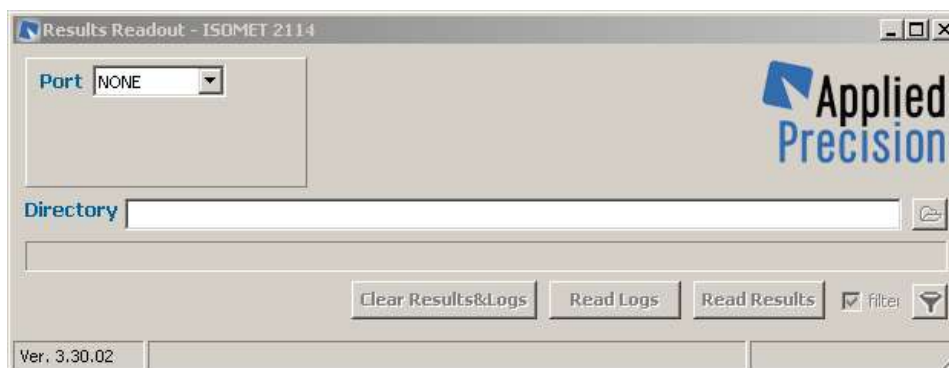
After selecting the proper communication port the window will change as follows
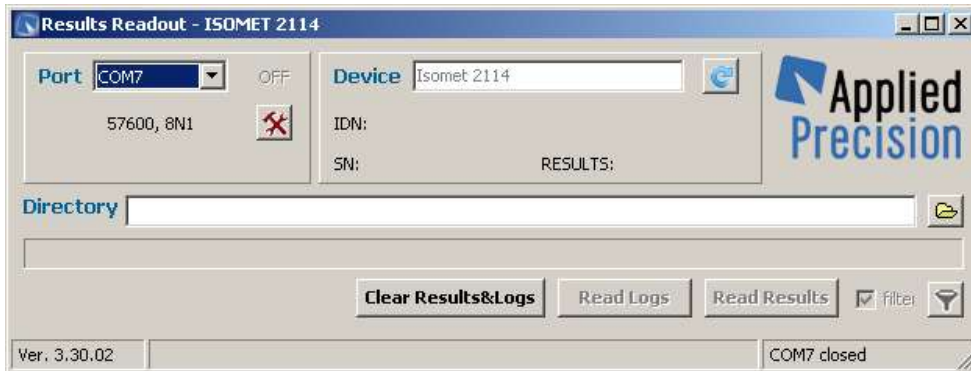
Proper communication between the PC and the measuring unit Isomet2114 may be checked by clicking on the blue circle arrow, which will upload and display type and serial number of the connected measuring unit with number of detected test results.

Before transferring results into the PC, proper directory for saving results has to be selected by clicking on the icon the Directory row. Directory for saving results should have to be selected in the Select Directory window.
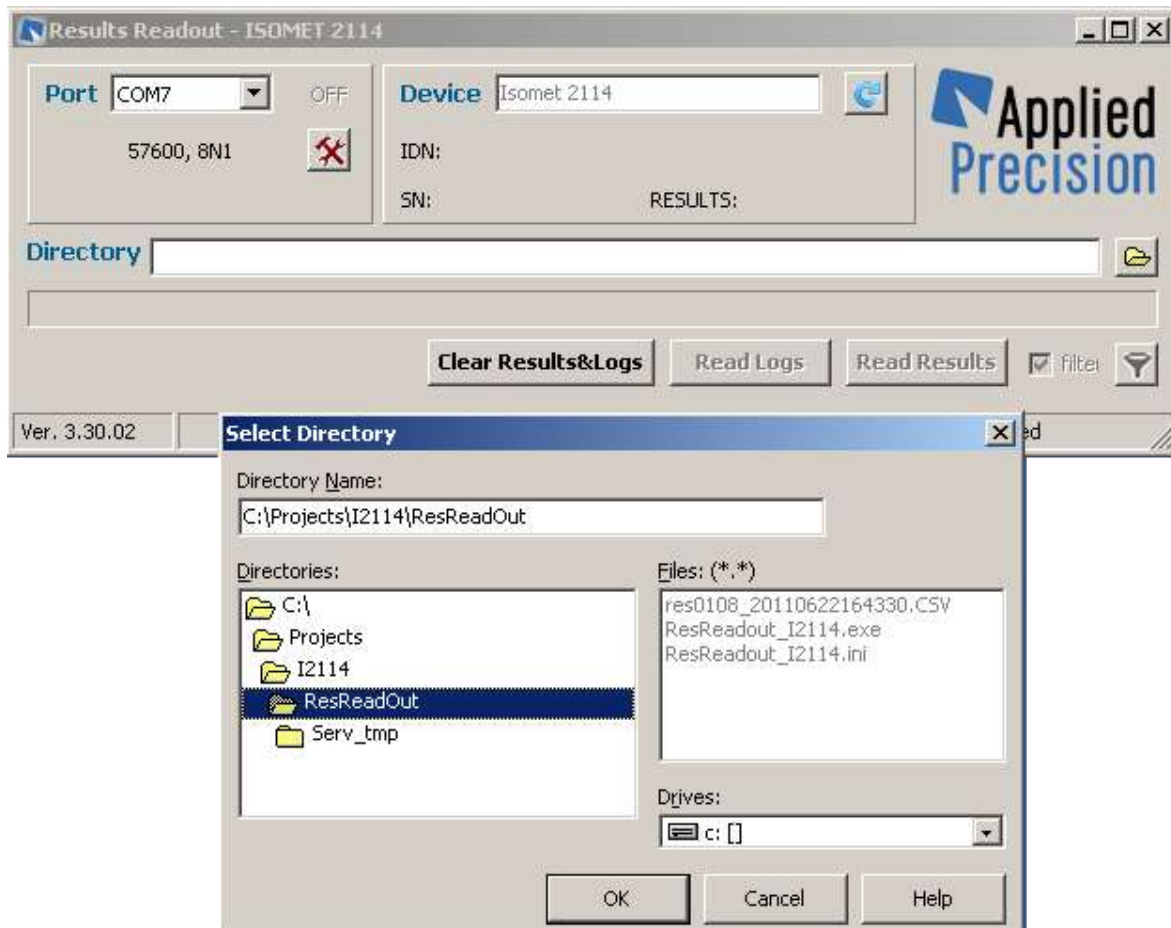
After confirming the directory by clicking on the OK Key, stored measurement results may be transferred from the measuring unit into the connected PC by clicking on the button Read Results.
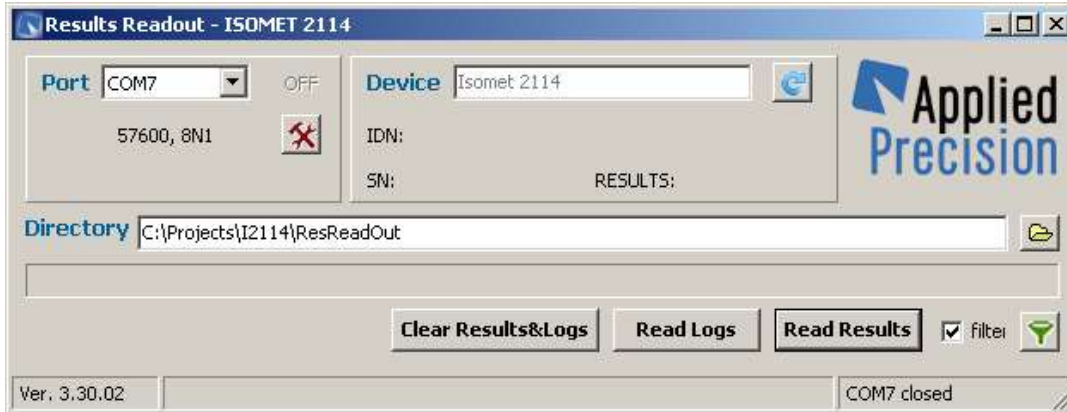
One complete measurement record has 45 items. Since most of these items are for diagnostics purposes only, the supplied program ResReadout_I2114.exe enables to filter out not wished items from measurement records by using the "filter" check box and key. After clicking on the "filter" key, Filter Settings window will be opened with names of all 45 items. The most important 16 items are checked after the first run of the program. Further items, meant for diagnostics only, are suggested to leave unselected. Selected items are confirmed by clicking on the OK button. Filtering unselected items of measurement records is switched on by checking the "filter" check box.

Transferring measurement results is started by clicking on "Read Results" button
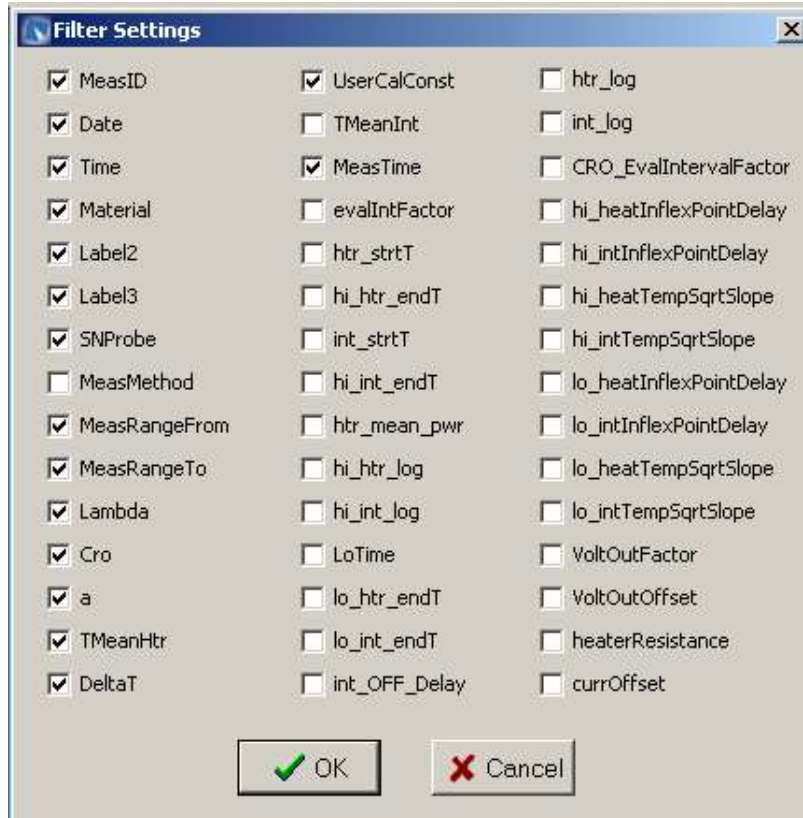
Transferring results is completed after clicking on the OK button in the Information window with the message "Data successfully loaded"

Transferred results are saved in the text file "resNNNN_YYYYMMDDHHMMSS,csv", in the selected directory. Symbols in the filename are:

NNNN – the last four digits in the serial number,
YYYY – year,
MM – month,
DD – day,
HH – hours
MM – minutes and
SS – seconds.

Data structure in the file "resNNNN_YYYYMMDDHHMMSS,csv"

CSV extension of the results file serves to open the file in standard spreadsheets and data analysis software. Measurement results are recorded in rows. Items of a measurement record are organized in columns. Symbols and abbreviations in the header row are as follows:

Meas ID	Test identification number
Date	Date of the mesurement
Time	Time of the mesurement
Material	Material entered by the user
Label2	Label2 entered by the user
Label3	Label3 entered by the user
SNProbe	Serial Number of the probe
MeasMethod	Measurement method
MeasRangeFrom	Measurement range of the probe – Lower limit
MeasRangeTo	Measurement range of the probe – Higher limit
Lambda	Thermal conductivtity (W/m.K)
Cro	Volume heat capacity(MJ/m3.K)
A	Thermal diffusuvity(1E-6 m2/s)
TMeanHtr	Mean temperature T(htr)
DeltaT	Temperature rise
UserCalConstK	Calibration constant – k
UserCalConstQ	Calibration constant – q
MeasTime	Period of measurement whith heater ON

Measured thermal conductivity values in units W/m.K are in the column Lambda and volume heat capacity values in units MJ/m^3.K are in the column Cro.

6. Remote Communication

Device control, results readout and measured values collection remotely is performed using device commands compatible with SCPI standard (Standard Commands for Programmable Instruments).

Main rules of SCPI standard:

- parentheses { } restrict parameter in the command strain
- parentheses [ ] restrict optional parameters or parts of commands
- parentheses < > restrict parameter, which is due to be replaced by the value
- perpendicular line (|) separate options, from which exactly one has to be chosen
- character case in the command is optional (command SYST:VERS? is identical with sYsT:VeRs?)

You can use the USB interface as well as the RS232 interface to send the commands. Each command must be ended with <CR><LF> resp. <EOL> (\r\n) signs (e.g. ***IDN?**<CR><LF>), otherwise the device does not respond! The default port setting values are following: BaudRate – 57600, DataBit – 8, Parity – None, StopBit – 1. For sending the SCPI commands you can use any terminal utility including AP servicing utility "Terminal" available from this link:

http://www.appliedp.com/download/software/servicer/terminal/terminal_sw.zip
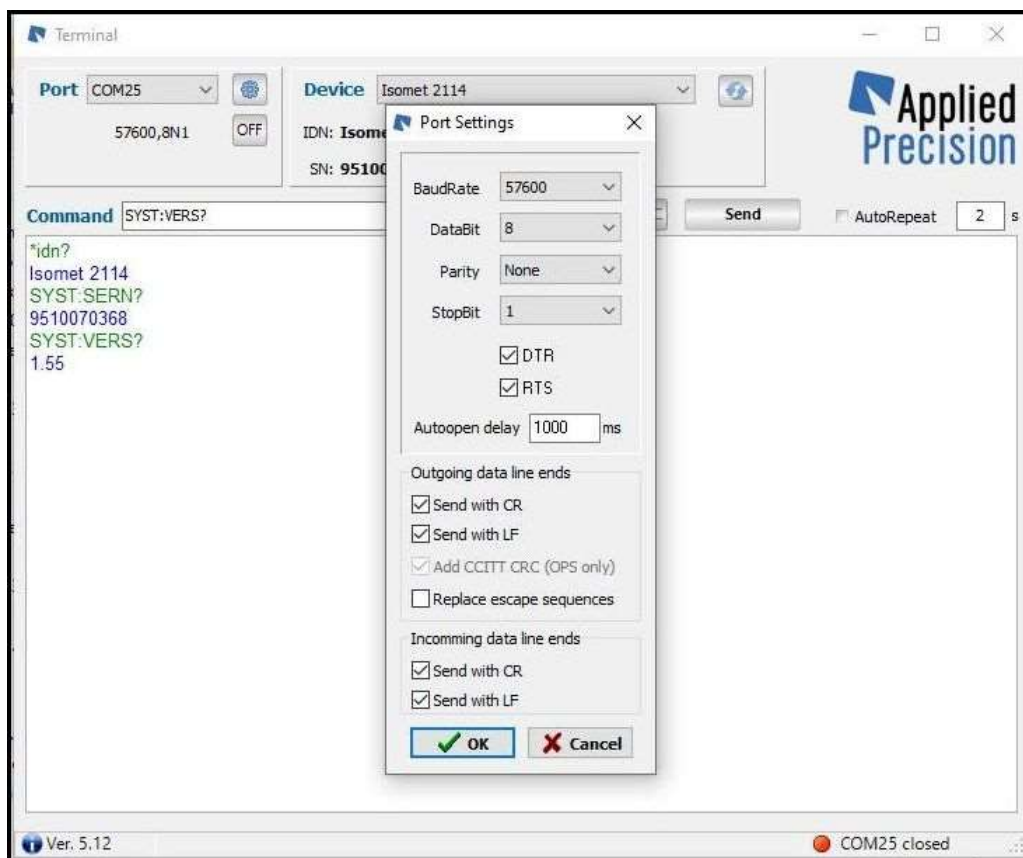
Terminal utility

6.1 Commands Description

6.1.1 System Related Commands

*IDN?
Request for the device identification string.

*RST
Device reset.

SYST:VERS?
Request for the device firmware version.

SYST:VGUI?
Request for the device GUI version.

SYST:TIM?
Request for device's date & time.

SYST:TIM:BEG?
Request for the last switch-on (or reset) time of the device. Reply is in the format of text string
"YYYY-MM-DD hh:mm:ss.xx", while it defines date and time. Example: "1996-05-20 17:23:19.04730"
Meanings of format parts:

YYYY..... year (4 digits)	**hh**...... hour (2 digits)	**xx**..... fraction of second (max. 5 dec. digits)
MM .... month (2 digits)	**mm**.... minutes (2 digits)	
DD .... day (2 digits)	**ss** ...... seconds (2 digits)	

SYST:SERN?
Request for the device serial number.

SYST:VHW1?
Request for the device hardware version (HW1).

SYST:VHW2?
Request for the device hardware version (HW2).

SYST:BATT?
Request for the battery status of the device. Reply is:
0 - 3 … different voltage level of batteries, 4 … battery charger connected.

SYST:PROB:SERN?
Request for the serial number of measurement Probe.

SYST:PROB:TYPE?
Request for the type of measurement Probe.

6.1.2 Measurement Commands

MEAS:STAR:?
Request for the status of Measurement.
0 ... not measuring, 1 … measuring in process

MEAS:STAR
Command for START of Measurement.

MEAS:STOP
Command for STOP of Measurement.

MEAS:TINT?
Request for temperature of $T_{INT.}$ Internal temperature meter for temperature compensation.

MEAS:THTR?
Request for temperature of $T_{HTR.}$ Temperature of heater unit.

MEAS:STAT?
Request for progress of measurement in %. Range is from 0% - 100%.

MEAS:POW?
Request for Power applied to heater unit.

MEAS:LAB:MAT?
Request for name of Material.

MEAS:LAB:MAT {xxx}
Settings the name of Material. Text size max. 39 characters.

MEAS:LAB:LAB2?
Request for name of Label2.

MEAS:LAB:LAB2 {xxx}
Settings the name of Label2. Text size max. 39 characters.

MEAS:LAB:LAB3?
Request for name of Label3.

MEAS:LAB:LAB3 {xxx}
Settings the name of Label3. Text size max. 39 characters.

MEAS:NUMB?
Request for value Number of Measurements.

MEAS:NUMB {xxx}
Settings the Number of Measurements. Number (0-500).

MEAS:PAUS?
Request for of Pause between Measurements. Answer is seconds.

MEAS:PAUS{xxx}

Settings the Pause between Measurements. Value is in seconds.

MEAS:VAL?

Request for integrated response, which returns values in a single response separated by a comma. The data is the same as the returns: MEAS:TINT?, MEAS:THTR?, MEAS:POW?, MEAS:STAR?, MEAS:STAT?

After input of new values, changes are applied and confirmed immediately and automatically. After the restart of device, values are displayed previous stored values. If we want to have after restart of device displayed last actual values, new values must be stored to SD card by command **SYST:CONF:SAV**

7. Quick reference for making the first measurement

1. Connect the measuring unit ISOMET2114 to the supplied adapter and connect the adapter to proper mains, according to technical data on the label of the power adapter.
2. The green LED indicator for charging batteries will start flashing continuously.
3. After a certain time, depending on state of the batteries, flashing will stop and the green LED will light continuously. Steady light of the green LED means, that charging batteries has been stopped.
4. Disconnect the adapter
5. Connect measurement probe to the measuring unit. At connecting the measurement probe, follow the instructions in the chapter 3.4 Measurement Probes.
6. Insert the needle probe into the measured material or place the surface probe on the smooth surface of the measured material.
7. Switch on the measuring unit by pressing the red Power key for approx. 3 seconds. For further reference see the chapter 4 Operation.
8. After switching the instrument on, the Stand By window will be shown on the display. After switching the instrument on, the instrument may be connected to the adapter at laboratory applications or it may be fully powered from rechargeable batteries at outdoor applications.
9. At this stage, continuous measurement of thermal conductivity may be started by pressing the key **F1** on the Stand by page.
10. After running the thermal conductivity measurement, the Stand By page will be changed to Measurement page and the measurement progress will be indicated by the progress bar on the bottom of the page.
11. Measurement results are available by pressing the key **F4** or by transferring results into the PC according to instructions in the chapter 5.
12. Transferring results into the PC interrupts the measurement progress.
13. Measurement in progress may be stopped by pressing the key **F1** on the Measurement page and confirming the request for stopping by pressing the key **F5**. (Further reference in chapter 4.1 Measurement).
14. The switched ON measuring unit is switched OFF by pressing red Power key for approx. 3 seconds. After switching the instrument OFF the display will get dark. The green LED for indicating battery charger function will light further, if power adapter is connected to the instrument.

Note:

At certain states of rechargeable internal batteries, if the measuring unit is switched on with connected power adapter or USB connection with PC, pressing the red Power for 3 seconds may not switch on the instrument successfully. In this case, the instrument display remains black and the red LED will be lighting continuously. Such state may be overcome by disconnecting the power adapter and the USB connection and turning the instrument off by pressing the red Power key for approximately 10 seconds, while the red LED will switch of. Therefore it is suggested to switch the instrument on with disconnected power adapter and USB connection.

TECHNICAL SPECIFICATION

Measured Quantities		
λ - **Thermal conductivity** (W / m·K)	$c\rho$ - **Volume heat capacity** (J / m^3·K)	
a - **Thermal diffusivity** (m^2 / s)	T - **Temperature** (°C)	

Measurement Ranges		Thermal Conductivity	Volume Heat Capacity	Temperature
Needle Probe **IPN 1100**	/0.015-0.05	0.015 .. 0.05 W/m·K	4.0.10^4 .. 1.5.10^6 J/m^3·K	-20 .. +70 °C
	/0.035-0.2	0.035 .. 0.20 W/m·K	4.0.10^4 .. 1.5.10^6 J/m^3·K	
	/0.20-1.0	0.20 .. 1.0 W/m·K	1.5.10^6 .. 3.0.10^6 J/m^3·K	
	/1.0-2.0	1.0 .. 2.0 W/m·K	1.5.10^6 .. 3.0.10^6 J/m^3·K	
Surface Probe **IPS 1105**	/0.04-0.3	0.04 .. 0.3 W/m·K	4.0.10^4 .. 1.5.10^6 J/m^3·K	-15 .. +50 °C
	/0.3-3.0	0.30 .. 3.0 W/m·K	1.5.10^6 .. 3.0.10^6 J/m^3·K	
	/3.0-6.0	3.0 .. 6.0 W/m·K	1.5.10^6 .. 3.0.10^6 J/m^3·K	

Measurement Accuracy	Measurement Range	Accuracy
Thermal Conductivity	0.015 .. 0.70 W/m·K	5 % of reading + 0.001 W/m·K
	0.70 .. 6.0 W/m·K	10 % of reading
Volume Heat Capacity	4.0.10^4 .. 3.0.10^6 J/m^3·K	15 % of reading+1.10^3 J/m^3·K
Temperature	-20 .. +70 °C	1°C

Measurement Reproducibility	
Thermal Conductivity	3 % of reading + 0.001 W/m·K
Volume Heat Capacity	3 % of reading + 1.10^3 J/m^3·K

General Parameters	
Communication Interfaces	USB
Display	3.5" / 320 x 240 pixels / 256 colors
Internal Memory for Data	min. 2 GB (>1000 results)
Operation Temperature	0 .. +40 °C
Storage Temperature	-25 .. +60 °C
Power Consumption	approx. 1.5 W
Power Supply	from internal rechargeable accumulators (4xNiMH, AA size) from Power Adapter (100 - 240 V$_{AC}$ / 12 V$_{DC}$)
Degree of Protection	IP-42 *(measuring device)* IP-67 *(transport case)*
Dimensions *(L x W x H)*	210 x 105 x 40 mm *(measuring device)* 406 x 330 x 174 mm *(transport case)*
Weight *(approx.)*	0.5 kg *(measuring device)* 5 kg *(standard setup with one needle and one surface probe in transport case)*

DECLARATION OF CONFORMITY

Manufacturer's Name: APPLIED PRECISION s.r.o.

Manufacturer's Address: Stavitelska 1
831 04 Bratislava
SLOVAKIA

Declares, that the product

Product Name: Isomet
Model Number(s):   ISOMET 2114
inclusive Needle Probe Model IPN 1100 and/or
Surface Probe Model IPS 1105

Product Option(s):   all options of the above product

Conforms with the following European Directives:

Low Voltage Directive: 2014/35EU

EMC Directive: 2014/30/EU

Conforms with the following product standards:
Safety: Isomet is powered by safe voltage (12V DC)
according to EN 61010-1:2010/A1:2019
Power Adaptor Model EMSA120150 comply with standards
mentioned in its Declaration of Conformity (enclosed)

EMC: EN 61326:2013

Product is safe under conditions of standard application and carries the CE marking

$$C\,E$$

Signed for: APPLIED PRECISION s.r.o.
Place and date of issue: Bratislava, 21.11.2023

APPLIED PRECISION s.r.o.
Staviteľská 1
831 04 BRATISLAVA
www.appliedp.com
IČO: 31327257
IČ DPH: SK 2020297301

Roland BIELČIK
General Director