Operating instructions

Multi-functional precision thermometer, model CTR4000

EN

Multi-functional precision thermometer, model CTR4000

Further languages can be found at www.wika.com.

Prior to starting any work, read the operating instructions.
Keep for later use.

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Declarations of conformity can be found online at www.wika.com.

1. General information

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- The instrument described in the operating instructions has been designed and manufactured using state-of-the-art technology. All components are subject to stringent quality and environmental criteria during production. Our management systems are certified in accordance with ISO 9001 and ISO 14001.
- These operating instructions contain important information on handling the instrument. Working safely requires that all safety notes and work instructions are observed.
- Observe the relevant local accident prevention regulations and general safety regulations for the instrument's range of use.
- The operating instructions are part of the product and must be kept in the immediate vicinity of the instrument and readily accessible to skilled personnel at any time. Pass the operating instructions on to the next operator or owner of the instrument.
- Skilled personnel must have carefully read and understood the operating instructions prior to beginning any work.
- In case of a different interpretation of the translated and the English operating instructions, the English wording shall prevail.
- If available, the provided supplier documentation is also considered to be part of the product in addition to these operating instructions.
- The general terms and conditions contained in the sales documentation shall apply.
- Subject to technical modifications.
- Factory calibrations / DAkkS calibrations are carried out in accordance with international standards.
- Further information:

Manufacturer		Importer for Europe
	Mensor Corporation	**WIKA Alexander Wiegand SE & Co. KG**
- Address	201 Barnes Drive San Marcos, TX 78666	Alexander-Wiegand-Straße 30 D-63911 Klingenberg / Germany
- Internet address:	www.mensor.com	www.wika.de / www.wika.com
- Relevant data sheet:	CT 60.25	CT 60.25
- Contact:	Tel.: 1-512-396-4200 1-800-984-4200 (USA only)	Tel.: +49 93 72/132-5015
	sales@mensor.com	CTsales@wika.com
	techservices@mensor.com	

1.1 Abbreviations, definitions

■	Bulleted list
►	Instruction
1. ... x.	Follow the instruction step by step
⇒	Result of an instruction
→	See ... cross-references
3-wire	Two connection lines are used for the voltage supply. One connection line is used for the measurement signal.
4-wire	Two connection lines are used for the voltage supply. Two connection lines are used for the measurement signal.
(S)PRT/RTD	Resistance thermometer
TC	Thermocouple

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1.2 Explanation of symbols

DANGER!
... indicates a directly dangerous situation resulting in serious injury or death, if not avoided.

WARNING!
... indicates a potentially dangerous situation that can result in serious injury or death, if not avoided.

CAUTION!
... indicates a potentially dangerous situation that can result in light injuries or damage to property or the environment, if not avoided.

DANGER!
... identifies hazards caused by electrical current. Should the safety instructions not be observed, there is a risk of serious or fatal injury.

WARNING!
... indicates a potentially dangerous situation that can result in burns, caused by hot surfaces or liquids, if not avoided.

Note
... points out useful tips, recommendations and information for efficient and trouble-free operation.

1.3 Software license information

GPL Software
The software included in this product contains copyrighted software that is licensed under the GPL/LGPL. A copy of the license texts is included in the packaging of this product. You may obtain the complete corresponding source code from us for a period of three years after our last shipment of this product and/or spare parts therefor, which will be no earlier than 01/01/2030, for a fee of 10 €. Please use our contact form at CTServiceteam@wika.com and write „Corresponding Source for CTR4000“ in the subject line. This offer is valid to anyone in receipt of this information.

Installing modified versions of open source software components on the product will result in the loss of warranty. Also support service and software updates will be refused.
Make sure to follow the safety precautions in the operating instructions. Improper access to the instrument is likely to result in its damaging.

Disclaimer
This software from WIKA can be used at your own risk and responsibility. WIKA is not responsible for the correct entry of the values and operation of the equipment or of the software. WIKA assumes no liability for damages, either due to incorrect calculations and results or erroneous interpretation of the results. WIKA recommends that the results of the equipment or of the software calculations are reviewed for plausibility by a qualified specialist. The software installed here constitutes a non-transferable, single-user license.

For any questions please refer to your WIKA contact.

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2. Safety

2.1 Intended use

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Application

The model CTR4000 precision thermometer provides a complete measurement and control interface for users wishing to make high-accuracy temperature measurements or calibrate thermometers. It supports a wide range of thermometer types including 25 Ω SPRTs, 100 Ω PRTs, thermistors and thermocouples.
The CTR4000 is a high-accuracy instrument designed for laboratory and industrial temperature measurement and calibration applications intended to be used in a basic electromagnetic environment.

Functionality

The instrument will operate with all 3- and 4-wire (S)PRTs (25 Ω, 100 Ω) platinum resistance thermometers as well as most standard international thermocouple types and NTC thermistors.
The following temperature measurement units are selectable: °C, °F, K.
Base measuring units mV and Ω are also displayed. The temperature values will be calculated through common conversion of the base measurement. Due to the wide range of this instrument it makes individual instruments needless and makes the calibration cost-effective.

Features included:

- Unique dual capability for both thermocouple and resistance thermometer measurements
- Input channels can be expanded up to 44
- Large graphic touchscreen for temperature measurement values as well as configuration settings and statistical results
- Advanced functions include differential measurement, programmable scanning routines, programmable timer, data logging, statistical reporting
- Scan function with a live screen and graph
- Logger and log-data transfer to USB stick or communication interface
- USB and Ethernet communication interfaces available for automated monitoring and calibration applications

This instrument is not permitted to be used in hazardous areas.

Note for instruments with EMC

FCC Emission Notice: This equipment has been tested and found to comply with the limits for a class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial, Industrial or business environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his or her own expense.

CE Emission Notice: This equipment is of the emission class B, intended for operation in residential environments.

The instrument has been designed and engineered solely for the intended use described here and may only be used accordingly. The technical specifications in these operating instructions must be observed, see chapter 10 “Specifications”. It is assumed that the instrument is handled properly and within its technical specifications. Otherwise, the instrument must be taken out of service immediately and inspected by authorised WIKA service personnel.

Handle electronic precision measuring instruments with the required care (protect from moisture, impacts, strong magnetic fields, static electricity and extreme temperatures, do not insert any objects into the instrument or its openings). Male and female connectors must be protected from contamination.The manufacturer shall not be liable for claims of any type based on operation contrary to the intended use.

2.2 Improper use

- Any use beyond or different to the intended use is considered as improper use.
- Refrain from unauthorised modifications to the instrument.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

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- Do not use in safety or emergency shutdown devices.
- Do not use in hazardous areas.
- Do not use the temperature probes with abrasive or viscous media.
- Do not use in places of use that are not protected from weather influences.
- Do not use in processes with high condensation.
- Don't connect lines to this equipment that are longer than 3 m [9.84 ft].
- Do not use the CTR4000 if it is damaged.
- Use only the delivered AC adapter, see chapter 4.7.1 "Voltage supply".
- Only use the accessories specified and authorized by WIKA.

2.3 Personnel qualification

The activities described in these operating instructions may only be carried out by skilled personnel who have the qualifications described below.

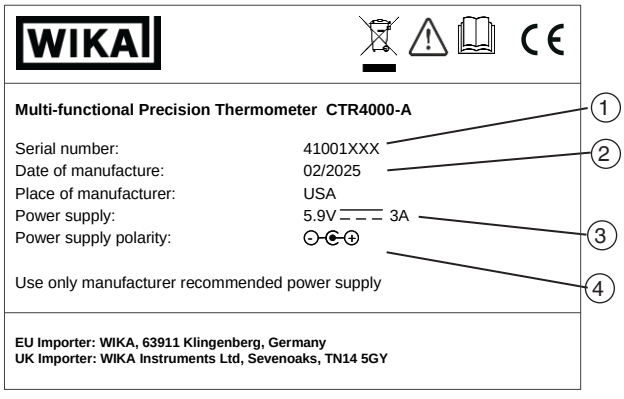
Skilled personnel
Skilled personnel, authorised by the operator, are understood to be personnel who, based on their technical training, knowledge of measurement and control technology and on their experience and knowledge of country-specific regulations, current standards and directives, are capable of carrying out the work described and independently recognising potential hazards.

Special operating conditions require further appropriate knowledge, e.g. of hazardous media.

2.4 Labelling, safety marks

The labelling, safety markings must be maintained in a legible condition.

Product label (example)
The product label is fixed on the rear of the instrument.



CTR4000-A/S label
1. Serial number
2. Date of manufacturing (month-year)
3. Power supply
4. Power supply polarity

Symbols

Before mounting and commissioning the instrument, ensure you read the operating instructions.

Do not dispose of with household waste. Ensure proper disposal in accordance with national regulations.

CE, Communauté Européenne
Instruments bearing this mark comply with the relevant European directives.

The user must read the manual before operating the equipment.

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3. Transport, packaging and storage

3.1 Transport

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CAUTION!
Damage due to improper transport
With improper transport, damage to property can occur.
- ► When unloading packed goods upon delivery as well as during internal transport, proceed carefully and observe the symbols on the packaging.
- ► With internal transport, observe the instructions in chapter 3.2 “Packaging and storage”.

Check the instrument for any damage that may have been caused.
In the event of any damage, do not commission the instrument and contact the manufacturer immediately.

If the instrument is transported from a cold into a warm environment, the formation of condensation may result in instrument malfunction. Prior to recommissioning, wait for the instrument temperature and the room temperature to equalise.
A warm up time of 1 hour is recommended. Please refer to chapter 5.3.2 “Warm up time”

3.2 Packaging and storage

Do not remove packaging until just before mounting (use).
Keep the packaging as it will provide optimum protection during transport (e.g. change in place of use, sending for repair).

Permissible conditions at the place of storage:
- Storage temperature: -20 ... +50 °C [-4 ... +122 °F]
- Humidity: 0 ... 50 % relative humidity (non-condensing)

Avoid exposure to the following factors:
- Direct sunlight or proximity to hot objects
- Mechanical vibration, mechanical shock (putting it down hard)
- Soot, vapour, dust and corrosive gases
- Hazardous environments, flammable atmospheres

Store the instrument in its original packaging in a location that fulfils the previously listed conditions. Instruments that have already been commissioned must be cleaned before storage, see chapter 8.2 “Cleaning”.

If the original packaging is not available, pack and store the instrument as described below:
1. Wrap the instrument in an anti-static plastic film.
2. Place the instrument in the packaging and evenly pad with shock-absorbent material.
3. If stored for a prolonged period of time (more than 30 days), place a bag containing a desiccant inside the packaging.

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4. Design and function

4.1 Overview

1. Model CTR4000 multi-functional precision thermometer
2. Front end USB: Upload and download function, see chapter 5.5 “Download function”.
3. User interface with touchscreen, see chapter 4.9 “User interface, touchscreen”.
4. Power on/off, see chapter 5.3.1 “Key ON/OFF”.
5. Input for thermocouples (standard miniature plug), see chapter 4.7.2 “Thermocouples”.
6. Input for resistance thermometers or thermistors (5-DIN plug), see chapter 4.7.1 “Resistance thermometers”.

4.2 Scope of delivery

- Instrument incl. AC adapter
- Test report for electrical inputs
- Calibration certificate (system calibration only if ordered with a probe)
- Choice of model CTP5000/CTP9000 temperature probes, when ordered
- Ordered accessories
- Operating instructions

Cross-check scope of delivery with delivery note.

4.3 Description

The model CTR4000 precision thermometer provides a complete measurement and control interface for users wishing to make high-accuracy temperature measurements or calibrate thermometers. It supports a wide range of thermometer types including 25 Ω SPRTs, 100 Ω PRTs, thermistors and thermocouples. The CTR4000 is offered in two versions: standard and advanced. The advanced version has increased accuracy for PRT measurements as well as selectable excitation currents.

The CTR4000 is a high-accuracy instrument designed for laboratory and industrial temperature measurement and calibration applications.

Features include:

- Unique dual capability for both thermocouple and resistance thermometer measurements
- Input channels can be expanded up to 44

1) System calibration means the calibration of a thermometer as a measuring chain with the CTR4000

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4. Design and function

- Large graphic touchscreen for temperature measurement values as well as configuration settings and statistical results
- Advanced functions include differential measurement, programmable scanning routines, programmable timer, data logging, statistical reporting
- Scan function with a live screen and graph
- Logger and log-data transfer to USB stick or communication interface
- USB and Ethernet communication interfaces available for automated monitoring and calibration applications

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The CTR4000 will operate with all 3 and 4-wire PT100 (100 Ω) platinum resistance thermometers as well as most standard international thermocouple types. Temperature measurement units are selectable by front panel operation: °C, °F, K. Base measurement units mV, Ω are also displayed.
Resistance accuracy is better than ±2 mΩ equivalent to temperature measurement precision of ±5 mK for PT100 thermometers.

Standard miniature sockets allow convenient connection for thermocouple inputs. Connection sockets incorporate integral temperature compensation sensors making high-accuracy thermocouple measurement possible without the use of an external reference junction.

4.4 Product passport

There are three ways to access the instrument-specific product passport.
- Via the QR code on the product label
- Via the instrument's product details page
- Via the link, here in the operating instructions

The product passport can be retrieved from the product page or directly from the corresponding web application.

https://productpass.wika.com/

After entering the intelligent serial number into the web application, all instrument-specific details on the manufactured version are displayed.

The following is provided:
- The most important product information such as measuring range, accuracy, process connection, date of manufacture, etc.
- Calibration certificates, certificates and test reports/records
- Documentation, such as the data sheet and the operating instructions

From this view, the required information can be printed out directly or also sent by e-mail.

A direct link to the online shop makes it easier to order additional accessories that match the instrument.

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4.5 Principles of measurement

4.5.1 PRT measurement

The CTR4000 measures the voltage (V_t) developed across the unknown sensor resistance (R_t) and the voltage (V_s) across a stable internal reference resistance (R_s) connected in series and passing the same current. The voltages are in proportion to the resistances so the thermometer resistance is derived from: $R_t = R_s \times V_t / V_s$. This technique achieves immunity from slow moving time and temperature drift in the electronics as it is not affected by voltage measurement gain variations or current source fluctuations.

In the same way that AC resistance measurement eliminates thermal EMFs, switched DC achieves a similar advantage. Switched DC works by reversing the current flow on alternate measurement cycles and taking the average value, thereby cancelling any thermal EMF offsets from the measurement.
For PRTs, the relationship between resistance and temperature varies slightly from one PRT to another. Therefore, no matter how accurately the CTR4000 measures the PRT resistance, if the relationship between resistance and temperature for a particular PRT is not known, accurate temperature measurement is not possible.

The CTR4000 uses PRT calibration data to overcome this problem and calculates temperature from temperature conversion functions stored in internal memory. This method enables the CTR4000 accurately to convert resistance to temperature, uniquely for each PRT used. It is very important therefore that a PRT is used on the correct and properly configured input channel.

4.5.2 Thermocouple measurement

As well as the PRT resistance measurement facility the CTR4000 also functions as a precision millivolt-meter. Designed for high-accuracy measurement over the EMF voltage range of all standard base and precious metal thermocouples, the CTR4000 achieves a basic voltage accuracy of better than ±0.004 % + 2 µV over the full measurement range. Thermocouple EMFs are converted to temperature using the EN 60584 linearisation functions.

The voltage input connection is specially designed to minimise the thermal gradient between the terminals. This is particularly important when the internal reference junction compensation is used, as any temperature difference at the connection junction will influence the measurement result.

4.5.3 Thermocouple reference junction compensation

The electrical connection between the thermocouple element and the CTR4000 input connector is often referred to as the internal reference junction. All standard thermocouple reference functions are defined relative to 0 °C. To eliminate the physical need to reproduce this temperature inside the CTR4000, the actual connection temperature is accurately measured with an internal PRT. This temperature is converted to an equivalent EMF and added to the actual thermocouple voltage measurement, thereby correcting for the connection temperature.

For high-precision thermocouple measurement applications, i.e. calibration, an external reference junction may be used. Using an external reference junction eliminates the uncertainties associated with reference junction compensation.

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4.6 Thermometer inputs

The CTR4000 has two resistance thermometer and two thermocouple input channels, the input sockets are located on the instruments front panel.

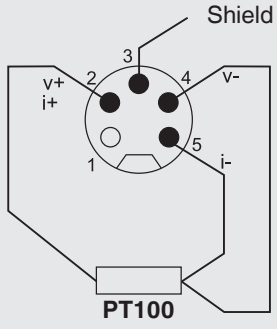
4.6.1 Resistance thermometers

PRTs are connected via the 5-pin DIN sockets as 3- or 4-wire.
Un-terminated platinum resistance thermometers may be connected through an optional adapter box or the universal multiplexer CTS3000.
This is available as an accessory, see chapter 11 “Accessories and spare parts”.

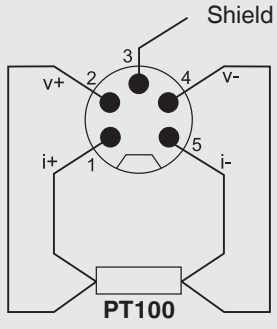
Resistance thermometer connection (5-pin DIN connector)

- Channel 1 and 2 (PRT1, PRT2)
- View towards front panel connector

3-wire PRT connection



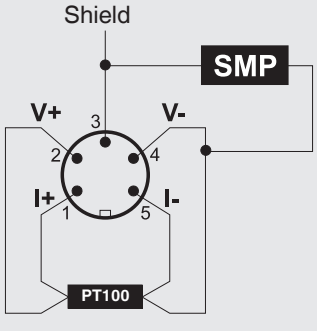
4-wire PRT connection



Options - with DIN plug or SMART plug

With the SMART connector on the probes, storing the data is needed only once - in the connector. The calibration data stays with the probe - permanently. It can even be used on another instrument without any further action.

Viewed from top panel



The SMART connector saves time and reduces error. If there are existing calibrated or uncalibrated probes, no problem, CTR4000 automatically registers if a probe is SMART or normal.

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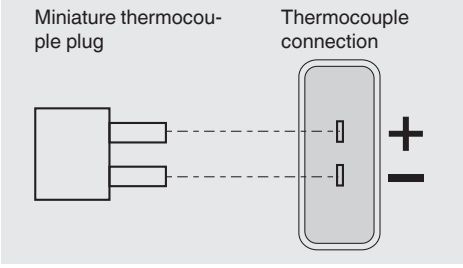
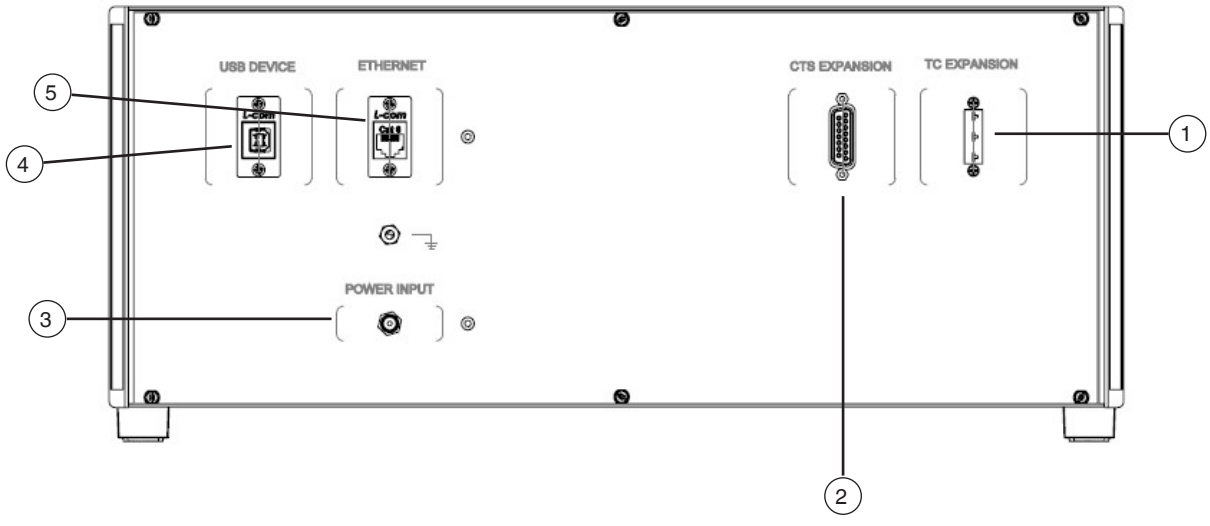
4.6.2 Thermocouples

Thermocouples may be directly connected to the CTR4000 at the standard miniature sockets. These sockets are within a temperature-compensated isothermal block which eliminates the need for an external ice point reference junction. However, the CTR4000 may also be used with an external ice point reference for high-precision measurement and calibration work.

Thermocouple connection (miniature connector), channel 3 and 4 (TC3, TC4)



4.7 Rear panel



(1) **TC expansion**
Input TC expansion, see chapter 5.7.1 “Input channel expansion port (CTS expansion, TC expansion)"

(2) **CTS Expansion**
Input CTS expansion, see chapter 5.7.1 “Input channel expansion port (CTS expansion, TC expansion)”.

(3) **Power Input**
Connection of the power supply over power supply unit, see chapter 4.7.1 “Voltage supply”.

(4) **USB Device**
USB interface (standard), see chapter 4.7.2 “USB interface (standard)”.

(5) **Ethernet**
Ethernet interface (standard), see chapter 4.7.3 “Ethernet interface”.

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4.7.1 Voltage supply

WARNING!
Injuries through improper use
Improper use of the instrument can lead to hazardous situations and injuries.
- ► Use only the delivered AC adapter.
- ► Dry location and indoor use only.
- ► Use only at max. height of 2,000 m [6,652 ft].
- ► Use only the delivered power cable.
- ► Observe the safety warnings and instructions of the rating label of the AC adapter.
- ► Don't connect power cable that is longer than 3 m [9.84 ft].
- ► When replacing consumable materials, if the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- ► Any external circuit connected to this instrument shall provide double or reinforced insulation between the supply mains and secondary circuits.

CAUTION!
ESD Protection required.
The proper use of grounded work surfaces and personal wrist straps are required when coming into contact with exposed circuits (printed circuit boards) to prevent static discharge to sensitive electronic components.

Power supply unit

DANGER!
Danger to life caused by electric current
Upon contact with live parts, there is a direct danger to life.
- ► Use only the delivered power cable.
- ► Only use the power supply unit from WIKA supplied with the instrument.
- ► If there is any visible damage to the case or the wiring, do not use the power supply unit.
- ► Never install nor store the power supply unit in the following locations, as this can lead to a failure in operation:
  - ■ Places where there is strong humidity or condensation
  - ■ Outdoors
- ► Disconnect the power supply unit from the mains supply when it won't be used for a longer period of time.
- ► The power supply unit is maintenance-free. It must not be opened (danger of electrical shock).
- ► Before cleaning, disconnect the power supply unit from the mains supply. Do not clean with chemical cleaning agents. Only clean with a dry cloth.
- ► The power supply unit may only be used at an ambient temperature of 0 ... 40 °C [32 ... 104 °F] (humidity: up to 90 % relative humidity, non-condensing).

4.7.2 USB interface (standard)

The USB connector is fitted as standard. Communication requires the installation of the USB driver on a PC.
The instrument can be controlled through simple SCPI commands and can transmit SCPI result data, which may be recorded using a simple terminal program.

Please refer to chapter 5.4.7 "Application [Remote]" for further details.

4.7.3 Ethernet interface

The Ethernet function allows the user to set the following by inputting a numeric value in each separate field:
- ■ IP
- ■ Netmask
- ■ Gateway
- ■ Port
- ■ DHCP settings

Set the Ethernet communication parameters as described in chapter 5.4.7 "Application [Remote]".

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4.7.4 Input channel expansion port (CTS expansion, TC expansion)

Optional input channel expansion ports.
An expansion port connector is provided on the rear panel. The CTS expansion connector enables up to four CTS3000/ CTS5000 multiplexers to be used to expand the number of input connections to provide up to 44/64 additional channels. For more information see chapter 5.7 “Working with a multiplexer”.

4.8 User interface, touchscreen

1. Display of the current menu
2. Home application
3. General settings
4. Probe settings
5. Scan settings
6. Logger settings
7. Calibration
8. Remote settings
9. Service settings
10. Unit; shortcut
11. Plus decimal place
12. Clear the peak values (min, max measured since starting the instrument)
13. Selected probe (standard or custom); shortcut
14. Freeze the display; button
15. Root 2 for sensor current PRT; button [1)]
16. Current displaying of average, stability and number of measurements
17. Peak displaying
18. Minus decimal place
19. Probe type; standard sensor or SMART sensor(s)
20. Measured value in the base unit according to probe, e.g. Ω for Pt100 and mV for TC
21. Current measured value [2)]
22. Selected channel; shortcut
23. Status bar with current application name

1) Selecting √2 current multiplier
This option increases current through the probes by √2 (double-power), to determine any probe self-heating. The best method of using this option is first to let the sensor reach a steady temperature and note the value. It may take some time to stabilise. Note the value down.
Press **[√2]** the probe will increase the heating effect on the probe, and the value displayed will represent the temperature due to the increased current. When the reading has stabilised, note the temperature and calculate the temperature change.

2) The selected input channel is interrogated before each measurement cycle, and when enabled, SMART probes are identified by ‘SMART´ appearing as (S) beside the field **[√2]**. Open circuit thermometer input channels will display nothing, the symbol “OL” displays that the measurement value is out of range.

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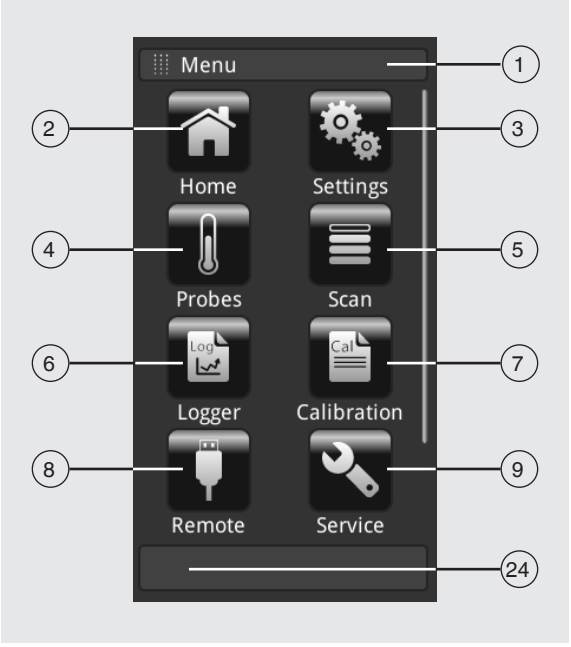
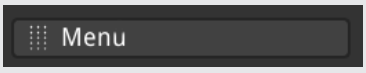
4.8.1 Menu selection



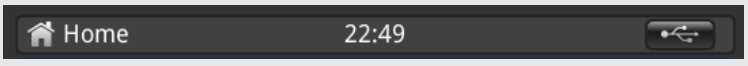
4.8.1.1 Applications (apps)

Eight applications are available on the start page:
Home, Settings, Probes, Scan, Logger, Calibration, Remote, Service and Info.
Info is hidden but visible until the menu is scrolled down.

Pos.	Application	
1		**Input title** The input bar is located at the top of the applications. The menu screen is activated
2		**Home application** Use the **[Home]** button to go to the start page. If the **[Home]** button is held pressed for more than 2.5 seconds, a screenshot with the file name "YYYYMMDD_hhmmss-Screenshot.png" will be created. This file can be readout via the front-end USB via a memory stick.
3		**General settings** Setting or changing of all instrument parameters, such as: Language, date, time, display brightness, temperature units and temperature probes. For further information, see chapter 5.4.2 "Application [Settings]".
4		**Probe settings** Create new probes or change the parameters for existing probes e.g. after recalibration. For further information, see chapter 5.4.3 "Application [Probes]".
5		**Scan settings** Scan function is the sequential measurement of each channel and temporarily shows the data on the display in the selected view. For further information, see chapter 5.4.4 "Application [Scan]".
6		**Logger settings** Opens the **[Logger]** application. For further information, see chapter 5.4.5 "Application [Logger]".
7		**Calibration settings** This application allows to calibrate thermometers automatically by changing the set point at user-defined intervals with a connected dry well CTD9100/9300 or micro calibration bath CTB9100. For further information, see chapter 5.4.6 "Application [Calibration]".

Pos.	Application	
8		**Remote settings** Display of the communication commands and parameters. For further information, see chapter 5.4.7 “Application [Remote]”.
9		**Service settings** Display of all service-relevant settings. For further information, see chapter 5.4.8 “Application [Service]”.
		**Info display** To call all information on the CTR4000, including all connected multiplexers. For further information, see chapter 5.4.9 “Application [Info]”.
24		**Menu button** Return to the application menu

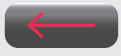
4.8.1.2 Symbols of the status bar

Pos.	Symbol
23	
	Status bar (see user interface in chapter 4.9 “User interface, touchscreen”) The status bar is located at the top of the screen. ■ Left: Display of the selected function page ■ Middle: Display of the currently set time ■ Right: Display of the activated function

Symbol	The symbol lights up on:
 **Home**	Start screen activated
 **Settings**	Application **[Settings]** activated
 **Probes**	Application **[Probes]** activated
 **Scan**	Application **[Scan]** activated
 **Logger**	Application **[Logger]** activated
 **Calibration**	Application **[Calibration]** activated
 **Remote**	Application **[Remote]** activated
 **Service**	Application **[Service]** activated
 **Info**	Application **[Info]** activated

Symbol	The symbol lights up on:
	USB memory stick plugged in
SCAN	Scanner function switched on
LOG	Logger function switched on
REM	Remote function switched on
CAL	Calibration function switched on

4.8.1.3 Further symbols

Symbol	The symbol lights up on:
	Main screen activated
	**Delete function (recycle bin)** This function deletes existing probes or other functions if they are selected in the list below. Every time the CTR4000 needs a confirmation for deleting.
	**Start to download** Data will be downloaded.
	Confirm with OK
	Abort
	Delete last input

4.8.1.4 Further definitions

[XXX]	Press button **[XXX]**
“XXX”	Menu **“XXX”** will be selected
XXX	Menu **XXX** will be displayd

4.9.1.5 Application selection and parameter inputs

The application selection area on the right side of the screen is the area where settings, probes, logger, service and other apps can be chosen. As each app is chosen, related application parameters will appear on the left of the screen along with the name of the application, and a reduced size icon in the top title chapter.

When a parameter is chosen, related selections, sliding scales or a data entry button pad will appear in the input area on the right where the application selection buttons were previously displayed.

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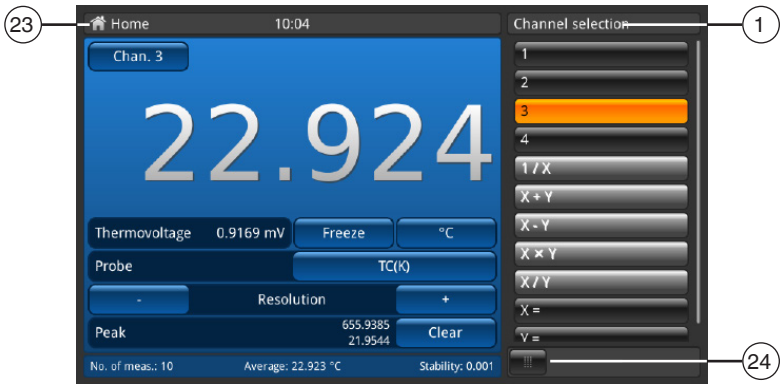
An example of each type of input is shown below. To return to the app selection menu, simply press the button (24) below the input area.

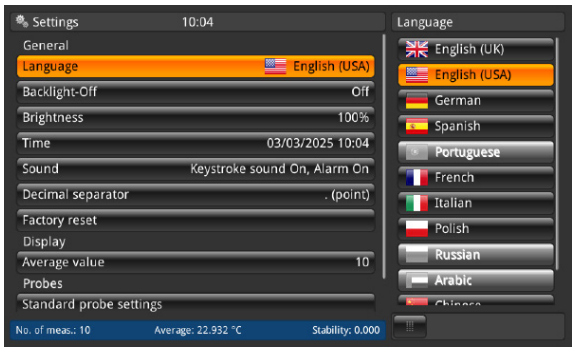


(1) Input title

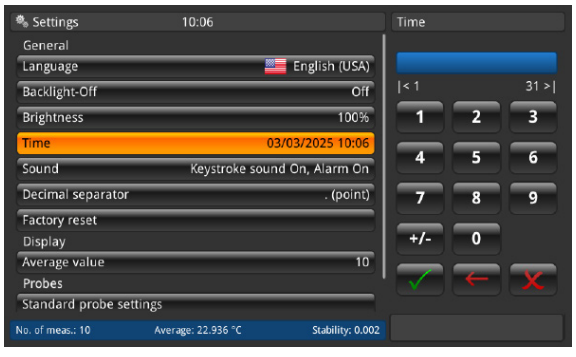
(23) Status bar

(24) To return to the main screen; simply press the menu button  .

Parameter inputs:



Related selections
The selection will be presented on the right side of the button for the input.



Data entry button pad
Confirm the values with [✓]. Min./Max. values will be indicated below the blue screen also QWERTZ keyboard is available.

Sliding scales
To set some parameters sliding scales can be used.

5. Commissioning, operation

Personnel: Skilled personnel

EN

WARNING!
Physical injuries and damage to property and the environment due to hazardous media
Upon contact with hazardous media (e.g. oxygen, acetylene, flammable or toxic substances) and harmful media (e.g. corrosive, toxic, carcinogenic, radioactive), there is a danger of physical injuries and damage to property and the environment.
Should a failure occur, hazardous media with extreme temperatures (over 55 °C [131 °F]) may be present at the instrument.
- ► For these media, in addition to all standard regulations, the appropriate existing codes or regulations must also be followed.
- ► Wear the requisite protective equipment.

Only use original parts, see chapter 11 “Accessories and spare parts”.

Check the instrument for any damage that may have been caused.
In the event of any damage, do not commission the instrument and contact the manufacturer immediately.

5.1 Electrical mounting

DANGER!
Danger to life due to electrical voltage
Upon contact with live parts, there is a direct danger to life.
- ► The instrument may only be installed and mounted by skilled personnel.
- ► If there is any visible damage to the case or the cable, do not use the power supply unit.
- ► Only use the power supply unit from WIKA supplied with the instrument.
- ► Do not expose the power supply unit to extreme moisture or condensation.
- ► Do not use or store the power supply unit outdoors.
- ► Disconnect the power supply unit from the mains supply when it won’t be used for a longer period of time.

5.2 Using the instrument with thermometers

Prior to commissioning, check the CTR4000 multi-functional precision thermometer as well as the model CTP5000/ CTP9000 temperature probes, when ordered, for integrity.

5.3 Operation

5.3.1 Key ON/OFF

To switch on the instrument, the On/Off button must be pressed. As soon as the multi-functional precision thermometer is turned on, it will go through a short self-test routine. Then the main screen appears.

Switching on
- ► To switch on the instrument, press the key On/Off.
  - ⇒ The main screen appears.
  - ⇒ The desired applications can now be started.

5.3.2 Warm up time

It is recommended that the CTR4000 be warmed up before use to stabilize the environmentally controlled components. This will ensure the best performance to the specifications.
We recommend a warm up time of 1 hour for full accuracy specifications.

The internal cold junction compensation needs up to 2 hours for performing best.

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5.4 Applications and their functions

5.4.1 Application [Home]

The app **[Home]** is the normal operation screen. This application is different from the others in that it is not used to setup the configuration but is used to monitor the temperature measurement values applied to this instrument.

5.4.1.1 Status bar

The status bar at the top end of the screen gives a description of the actual operating mode of the instrument.

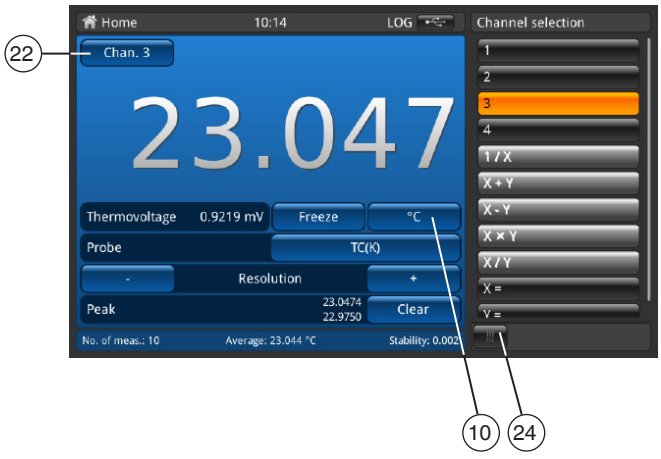
LOG	=	Logger is active
SCAN	=	Scan is running
CAL	=	Calibration is running
REM	=	Interface is active
	=	USB memory stick recognised

EN

5.4.1.2 Channel selection

By pressing button **[Chan "#"]** the menu for the channel selection opens on the right side. Back via the menu button on the bottom line.

1. Press button (22) **[Chan "#"]**.
   ⇒ The menu for the channel selection opens on the right side.
2. Select the channel.
   ⇒ The desired channel will be indicated in the button (22).
3. Return to the main screen by pressing the menu button (24).



1 = PRT 1
2 = PRT 2
3 = TC 3
4 = TC 4

All channels which are connected via a mulitplexer are named as described in the chapter 5.7 "Working with a multiplexer".

The selected channel will be indicated in the button (22) **[Chan "#"]**.

Mathematical functions

The CTR4000 can display several mathematical functions between two different channels (X, Y). The unit can be selected after the selection of the channel via button (10). If the units for these two channels do not match (like PRT and TC), the value will be displayed in a temperature unit like °C, °F, or K.

- Input necessary for X and Y
- If you click on "X=" or "Y="then a list of available channels opens on the right side
  ⇒ Only numbers for channels selectable, which are connected
  ⇒ If an invalid number is selected, an information dialogue appears.

SMART probes take time to read their stored information. The SMART probe 'read on channel change' is disabled once a difference mode is selected. To change probes, select a single channel before reselecting a difference mode with SMART probes.

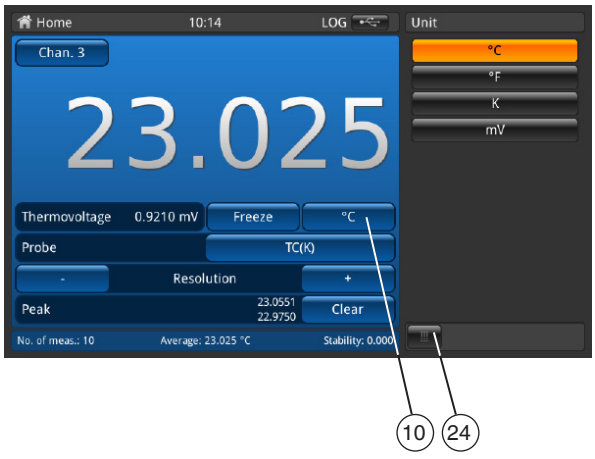
5.4.1.3 Freeze function

While clicking on the button (14) **[Freeze]** the colour turns into orange and the display freezes / holds.
This function helps the user to read more easily the values.

5.4.1.4 Unit selection

By pressing button (10) the menu for the unit selection opens on the right side. Back via the menu button on the bottom line.

1. Press button (10).
   ⇒ The menu for the unit selection opens on the right side.
2. Select the unit.
   ⇒ The desired unit will be indicated in the button (10).
3. Return to the main screen by pressing the menu button (24).



Sequence as shown right for all PRT channels.
Sequence for all PRT channels like °C, °F, K and Ω.

Beside the button **[Freeze]** on the left side the corresponding value is displayed, e.g.:

- PT100 and °C → then show Ω
- TC and mV → then show °C

Calculation and units

1 °Celsius
x °C * 1.8 + 32 = y °Fahrenheit
x °C + 273.15 = y Kelvin

Temperature units

The temperature cannot be measured. The instrument measures Ω or mV.
These electrical signals are calculated into temperature through the conversion of the probe by means of a characteristic function.

5.4.1.5 √2 current multiplier

This option increases current through the probes by √2 (double-power), to determine any probe self-heating. The best method of using this option is first to let the sensor reach a steady temperature and note the value. It may take some time to stabilize.

1. Press button **[√2]**.
   ⇒ Immediately the increased current through the probe will increase the heating effect on the probe.
   ⇒ The displayed value will represent the temperature change due to the increased current.
2. When the measured value has stabilized, note the temperature change.

The result is the actual temperature with the effect of probe self-heating eliminated.

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5.4.1.6 Probe selection

By pressing button (13) the menu for the probe selection opens on the right side. Back via the menu button on the bottom line.

1. Press button (13).
   ⇒ The menu for the probe selection opens on the right side.
2. Select the probe.
   ⇒ The desired probe will be indicated in the button (13).
3. Return to the main screen by pressing the menu button (24).

Standard probes, default

Probes for all PRT channels		
3w PRT (PT100)	PT100, 3w, DIN conversion, internal 100 Ω, keep warm current off	3W-PT100
4w PRT (PT100)	PT100, 4w, DIN conversion, internal 100 Ω, keep warm current off	4W-PT100
SPRT (PT25)	PT25, 4w, DIN conversion, intern 25 Ω	4W-PT25
Thermistor	500 kΩ, no temperature conversion	THERMISTOR

Probes for all TC channels	
Thermocouple	TC K, internal reference cold junction

Stored probes

- List of all configured probes in the menu **“Probe”**.
- With **[+]** allows the user to configure a new probe and the user is directly linked to the menu **“Probe”** (details in chapter 5.4.3 “Application [Probes]”).
- Sequence of the listed probes acc. ABC.

A probe can only be assigned to one channel at a time, so it is not possible to e.g. assign stored probe **PRT1** to channel 1 and 2 at the same time. This means that if a probe, which is currently assigned to a channel, is assigned to another channel, it is no longer assigned to the first channel. If no probe is explicitly assigned to a channel, the default probe for the channel type will be used. For PRT channels, this is 4W-PT100, for TC channels TC(K).

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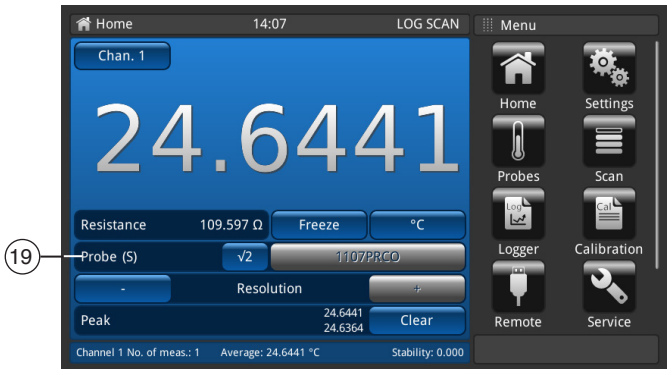
Easy access to probe settings:
Holding the button of the stored probes (in the main screen) > 2 s opens the probe menu for editing the selected probe. Please find more details how to edit/change probes in chapter 5.4.3 “Application [Probes]”.



If a SMART probe is connected to a channel this function is invalid. Probe selection list will not show up, button is disabled. The SMART probes identifier is shown in the field (19); the label shows “Probe (S)” to indicate the SMART probe.

5.4.1.7 Resolution “+/-” function

By pressing buttons (11) and (18) the resolution will be higher/lower. Means the numbers of decimal places are configured.

By pressing **[+]** a digit after the point/comma will be added, by pressing **[-]** a digit after the point/comma will be deleted.
The buttons will turn inactive if the maximum or minimum setting is reached.
By changing the unit the numbers of the settable decimal places will change.

Minimum = 0 (no comma/point)
Maximum = 0.0001 K/°C/°F / 0.00001 Ω (PRT) / 0.00001 mV (TC)

EN

5.4.1.8 Peak “clear” function

The peak function (Min./Max.) shows the maximum and minimum value for the actual recorded measurement in the unit displayed in the button (10).

The **Peak** field (17) shows in the first line peak **Max.** and in the second line peak **Min.**

By pressing the button (12) **[Clear]** the values will be deleted and the values are refreshed.

Resolution fixed at 4 respectively 5 decimal places, only depending on unit selection.
- Temperature selected → 4 places
- Base value selected → 5 places

So only a change of the unit causes change of peak values.

5.4.1.9 Information bar

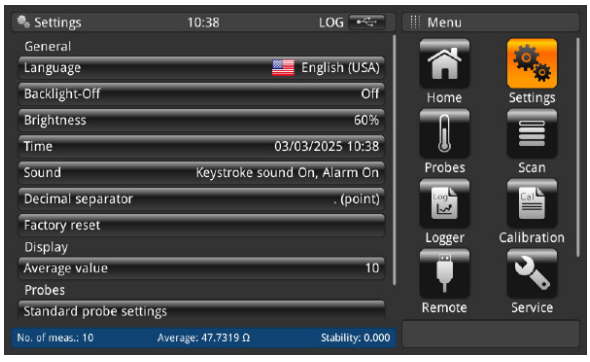
The information bar, field (16), displays relevant measurements which help you to have an easier calibration documentation.

Values	
Number of measurements	Setting in **[Settings] / [Display] / [Average value]**
Average	Average value over the last xy values, displayed in the selected unit on the main screen
Stability	Shows the standard deviation
Difference	Displays the difference between the reference (first probe marked as reference) and the test item (all other channels); displayed in the unit of the test item (only shown in scan mode when the selected view is calibration, please refer to chapter 5.4.4 “Application [Scan]”)

Information bar has the same colour as the corresponding channel selection on the main screen (blue, green, red and orange). If channels are displayed in a list or no channel relevant information is displayed the information bar will be displayed in grey.

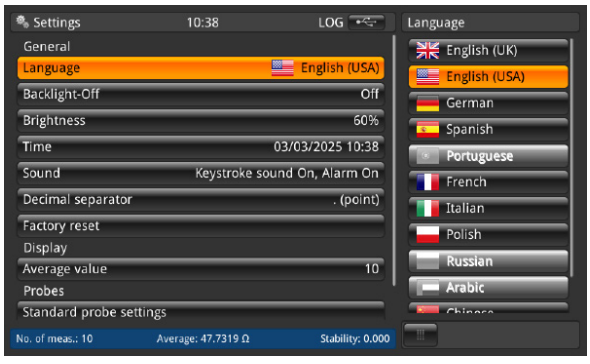
5.4.2 Application [Settings]

General settings can be done in this menu in the following categories: general, display and probes.
Pressing on the main screen the button **[Settings]** guides the user into the sub-menu. This will open on the left side. For every entry settings can be done by pressing the button.
The settings menu opens on the right side.



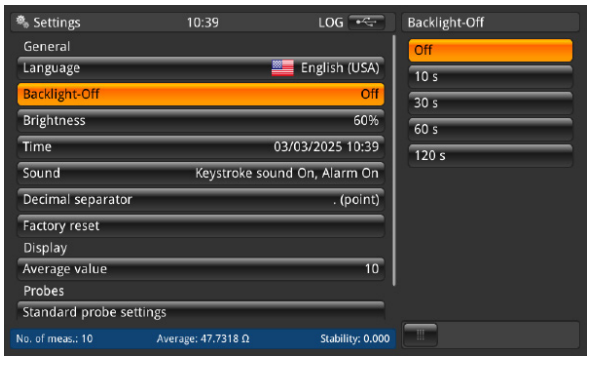
5.4.2.1 Language

The language parameter provides a selection of different languages. Once a language is chosen all words within all menus will appear in the chosen language. This will not affect the decimal separator.
The set language and country flag will be indicated in the button **[Language]** on the right side.



5.4.2.2 Backlight-Off

This setting will mean that the backlight will switch off, if no button is pressed for the set time.
The following can be selected: 10 s, 30 s, 60 s and 120 s.
When setting is **Off**, the backlight remains on permanently, i.e. it does not turn off.
The set backlight will be indicated in the button **[Backlight-Off]** on the right side.



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5.4.2.3 Brightness

The brightness setting provides a sliding scale to increment the screen brightness in all screens. Sliding your finger along the bar graph or touching anywhere in the bar graph will change the brightness of the screen. After the setting is made and your finger is removed from the screen the menu will show the brightness percent selected and revert back to the main settings menu.

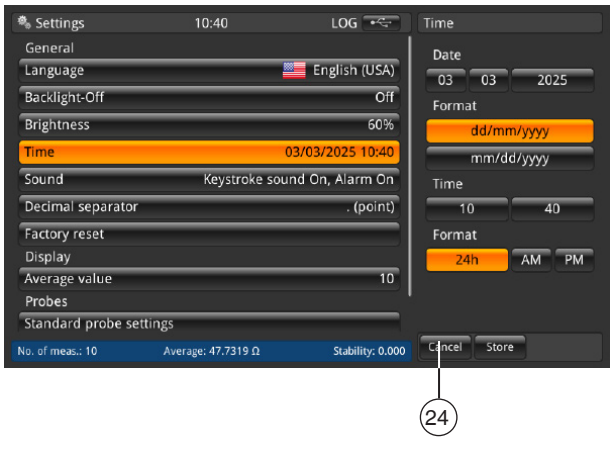
The set brightness in % will be indicated in the button **[Brightness]** on the right side.

5.4.2.4 Time and date

This setting ensures the correct time and date for your country. Different time and date formats are available.

Time changes on the main screen e.g. home view according to this setting. Date changes affect the stored calculation of the recalibration date.

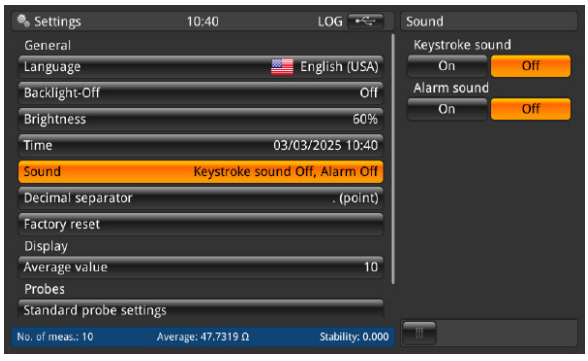
1. Press button **[Time]**.
   ⇒ The menu for the time correction opens on the right side.
2. Select the desired date format.
3. Select the desired time format.
4. Confirm the changes with button **[Store]**.
5. Return to the sub menu **Settings** by pressing the menu button (24).
   ⇒ The changing of the time and date will be indicated in the button **[Time]** on the right side.



Instrument has to restart after date or time change due to technical reasons. The instrument has no internal battery for the clock. This means that when the instrument remains powered off for several days, it loses the date and time setting.

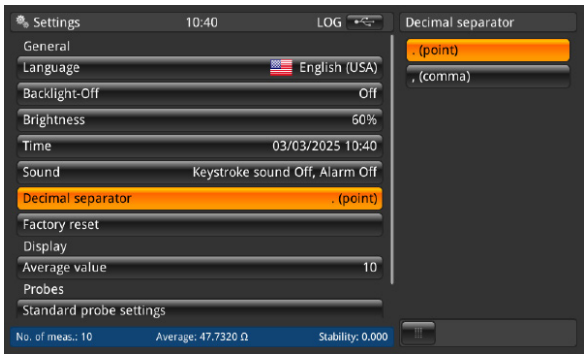
5.4.2.5 Sound

The setting enables/disables the keystroke sound and the alarm sound.
The set sound for keystroke and alarm will be indicated in the button **[Sound]** on the right side.



5.4.2.6 Decimal separator

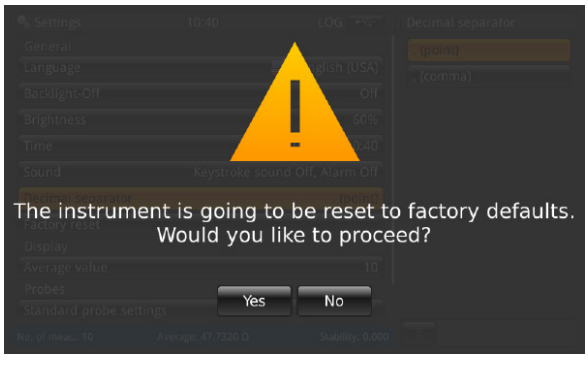
The setting of the decimal mark can be done from a dot (.) to a comma (,) or vice versa.
The set data separator will be indicated in the button **[Decimal separator]** on the right side.



The data separator of the CTR4000 must match that of any connected PC.
This is also important for downloading various files.

5.4.2.7 Factory reset

This function resets all values to their standard. Defined user probes won't be deleted. Factory reset overwrites the user calibration data with the factory calibration data.
The following dialogue will follow by pressing the button **[Factory reset]**.
Confirm with **[Yes]** will reset the values to the default values.
By pressing **[No]** the process will be cancelled.



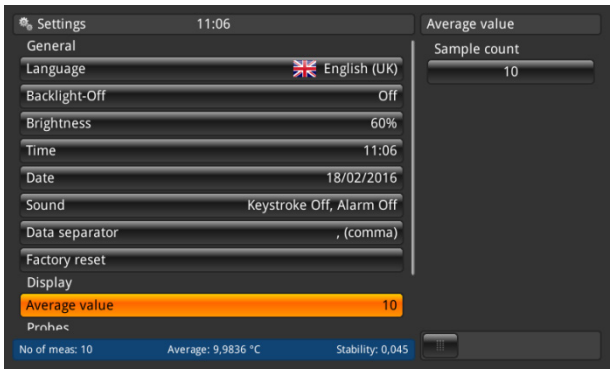
EN

5.4.2.8 Display – Average value

The average value is stated in the information bar on the home screen or other measuring screens.
Definition: Average value = arithmetic average over the last measurements.

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2}$$

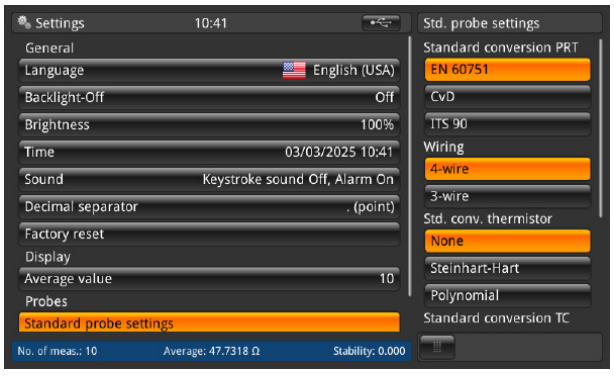
The setting defines the “n” value for the formula above.
When clicking on the button below **[Sample count]** the numpad opens. The number of measured values for the average value calculation can then be entered here.
The set average value will be indicated in the button **[Average value]** on the right side.

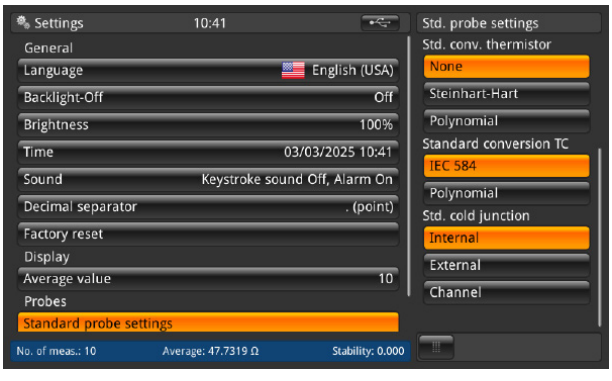


5.4.2.9 Probes – Standard probe settings

After pressing the button **[Standard probe settings]** on the left side, the sub menu opens on the right. This function helps to store a new probe, because the standard settings are pre-configured. Repeating types of thermometers can be easily pre-configured in this way.

For each chapter (standard conversion PRT, standard internal resistor, standard conversion TC and standard reference junction) one selection is necessary. For more details refer to chapter 5.4.3 “Application [Probes]”.





Standard settings are marked in orange.

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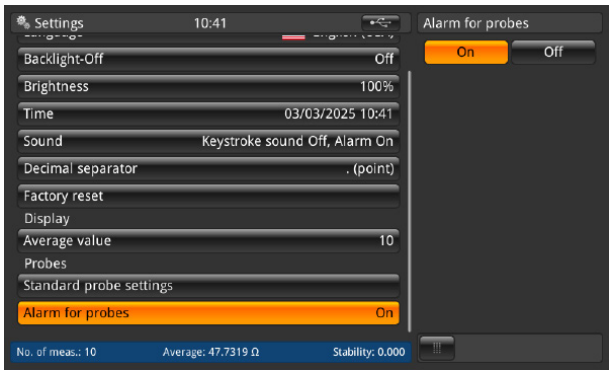
5.4.2.10 Probes – Alarm for probes

After pressing the button **[Alarm for probes]** on the left side, the sub menu opens on the right.
The option is between having an alarm for probes or not.

If **On** selected, then the measured temperature is compared with T_{max} (set under probes). If T_{max} < measured temperature, then an error appears. An exclamation mark appears to the left beside the button (13).
The set alarm setting will be indicated in the button **[Alarm for probes]** on the right side.



5.4.3 Application [Probes]

Higher accuracy measurements can be made using calibrated thermometers whose characteristics have been determined. Before being used, the thermometer and its calibration details must be entered into the CTR4000.

For this, press the button **[Probes]** on the main screen. The sub-menu on the left side opens.
All necessary settings can be made here.

- For each new thermometer the coefficients can be entered.
- For already existing probes the settings can be changed.
- Thermometers can be deleted via the recycle bin.
- Thermometers can be found quickly using the button **[Search...]** button.

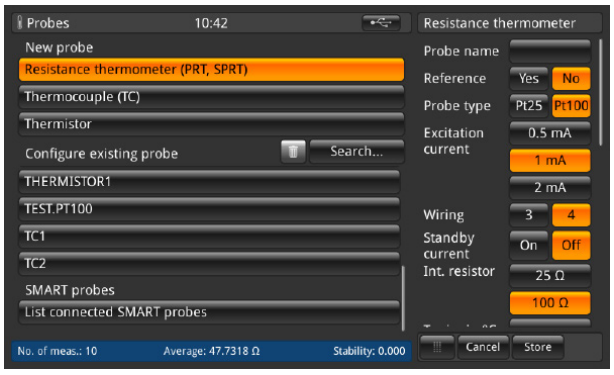
All the thermometers will appear in the list below **"Configure existing probes".**

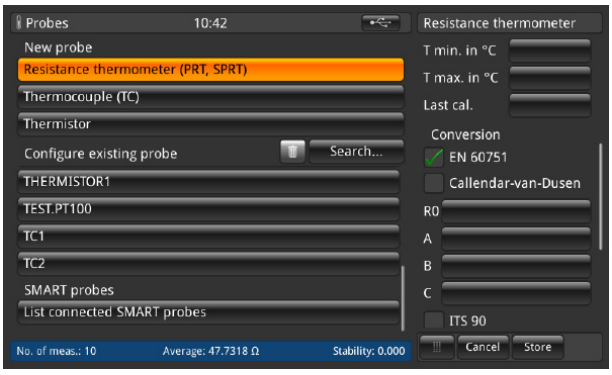
The maximum cable length of a temperature probe is 2 m.

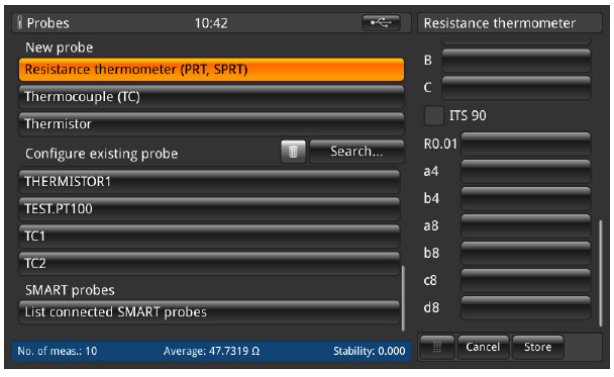
EN

5.4.3.1 New probe [Resistance thermometers]

1. To configure a new resistance thermometer press the button **[Resistance thermometer (PRT, SPRT)]**.
   ⇒ The menu with all settings opens on the right.
2. Enter the desired settings.
3. Confirm with button **[Store]**.







- Probe name
  A unique name (e.g. certificate number or serial number) must be entered for the new thermometer.
  This name is also shown later under the existing probes and for this name a search can be done. The input can be done via the QWERTZ keyboard.

- Reference
  Please mark the thermometer as reference or not. This is important for the scan mode - see chapter 5.4.6 “Application [Calibration]” because the difference between the first reference and the test item will be calculated and displayed in the information bar.

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- Probe type
  Is the thermometer a Pt25 or Pt100?

- Wiring
  Will be the connection a 3-wire or 4-wire?

- Keep warm current
  The instrument has the facility to drive deselected resistors or PRTs from a constant DC current source. This allows them to be kept at their normal working temperature, and so decrease settling time for each channel.
  The keep warm current is user selectable as ON/OFF. If set on, the CTR4000 automatically adjusts the PRT current (from 1 mA for the 100 Ω reference) to 2 mA for the 25 Ω reference.

- Int. resistor
  The CTR4000 allows the choice between two internal reference resistors (25 Ω and 100 Ω) or the Auto-function. The 25 Ω resistor should only be used when a 25 Ω PRT (or lower) is used. Use the 100 Ω reference resistor for all probes with R0 values above 25 Ω.
  The menu allows the use of Auto selection. The auto selection looks at the R0 value of the probe. If R0 is below 50 Ω, the 25 Ω reference is selected; any R0 value equal to or above 50 Ω will use the 100 Ω reference.
  The CTR4000 automatically adjusts the PRT current (from 1 mA for the 100 Ω reference) to 2 mA for the 25 Ω reference.

- T_{min}
  Probes may have a minimum temperature set for them (positive or negative). When the probe is assigned to a channel, the probe temperature is checked against the set minimum and a range error (exclamation mark left beside the button (13)) issued if the minimum temperature is exceeded.

- T_{max}
  Probes may have a maximum temperature set for them (positive or negative). When the probe is measured and active on a channel, the probe temperature is checked against the set maximum and a range error (exclamation mark left beside the button (13)) issued if the maximum temperature is exceeded.

- Last cal date
  Please enter the last calibration date of the thermometer.
  If the system date = last cal date + 1 year then a pop up is coming up which reminds that the probe is due to recalibration.

The recalibration cycle depends mainly on the thermal stress on the thermometer. The calibration time can only be estimated and is decided by the user. Therefore check the calibration system at the triple point or freezing point of water on a regular basis (independent of the recalibration cycle). Recommendation is a calibration once a year.

- Conversion
  PRTs and SPRTs can be calibrated individually (resistance-temperature characteristics determined) in order to achieve low uncertainties. There are two algorithms used to represent the thermometer's characteristic (the Callendar-van-Dusen equation and the ITS-90 equations). The Callendar-van-Dusen equation was developed first and was used as the primary conversion algorithm for all PRTs up until 1990. It is still applicable for PRTs and SPRT, although better uncertainty can be achieved by using the ITS-90 equations (particularly important when using higher accuracy SPRTs).

  In 1990, the International Temperature Scale was revised and a new set of equations were defined for converting the resistance of a PRT to temperature. These equations (commonly referred to as ITS-90) comprise a nominal conversion that represents the average conversion characteristic and deviation functions that provide the adjustment for the characteristics of the individual thermometer. They are intended for use with high-purity platinum and provide a better fit than can be achieved with the older Callendar-van-Dusen equation.
  The ITS-90 equations are sometimes also used with industrial PRTs made using the lower sensitivity 0.00385 K^{-1} wire and can provide a small improvement in uncertainty compared with the Callendar-van-Dusen equation.

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a. *EN 60751 as defined in the standard*
Generic EN 60751 conversion can be used with PRTs that are made with a grade of wire that meets the requirements of the standard. The measurement uncertainty will depend on the class of thermometer and its temperature.

Standard coefficients:

$R_0 = 100\ \Omega$
$A = 3.9083 \times 10^{-3}\ °C^{-1}$
$B = -5.775 \times 10^{-7}\ °C^{-2}$
$C = -4.183 \times 10^{-12}\ °C^{-4}$

b. *Callendar-van-Dusen like specified in the calibration certificate: R_0, A, B and C*
This follows the formula:

$R_t = R_0 [1 + A_t + B_t^2 + C (t - 100\ °C)\ t^3]$
$(C = 0, \text{if } t > 0\ °C)$

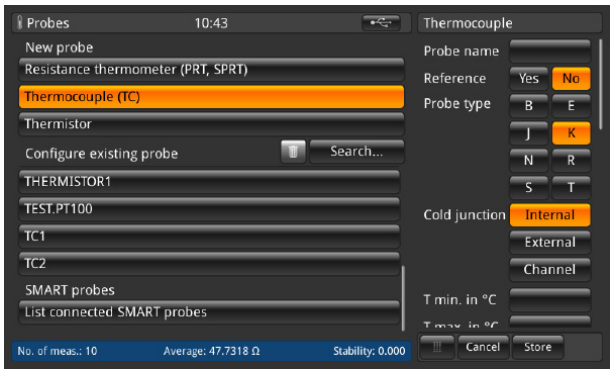
c. *ITS-90 as specified in the calibration certificate: R_0.01, an, bn, ap, bp, cp, dp*

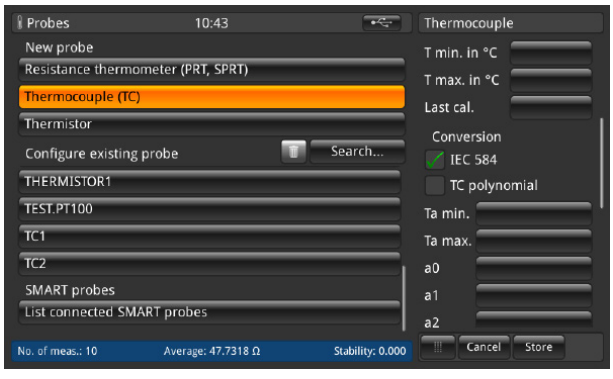
Make sure using the correct calibration parameters for the thermometer, since incorrect calibration parameters lead to erroneous results. The coefficients can be found in the calibration certificate while ordered a calculation.

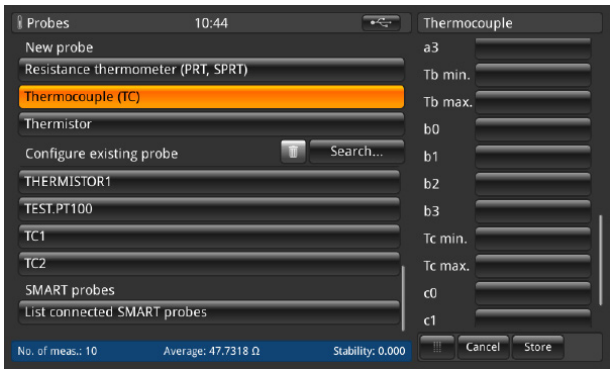
If you order a CTR4000 with a resistance thermometer and a system calibration with calculation of the coefficients, the probe will be stored under the serial number and will be calibrated with the normal sensor current. No root 2.

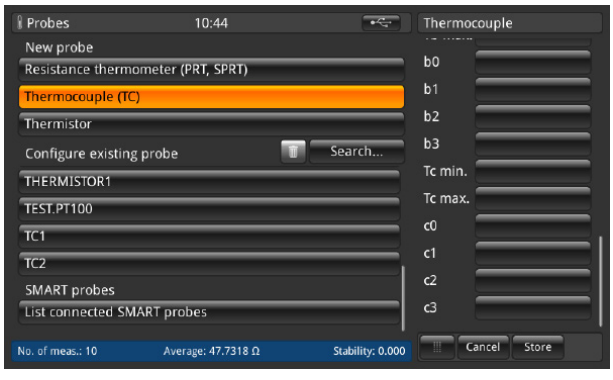
5.4.3.2 New probe [Thermocouples]

1. To configure a new thermocouple press the button **[Thermocouple (TC)]**.
   ⇒ The menu with all settings opens on the right.
2. Enter the desired settings.
3. Confirm with button **[Store]**.









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5. Commissioning and operation

The CTR4000 can be used with any thermocouple (calibrated or uncalibrated) fitted with a standard miniature thermocouple connector. Connect your thermocouple to either of the miniature thermocouple connectors on the front panel.

- Probe name
  A unique name (e.g. certificate number or serial number) must be entered for the new thermometer.
  This name is also shown later under the existing probes and for this name a search can be done. The input can be done via the QWERTZ keyboard.

- Reference
  Please mark the thermometer as reference or not. This is important for the scan mode - see chapter 5.4.6 "Application [Calibration]" because the difference between the first reference and the test item will be calculated and displayed in the information bar.

- Probe type
  Is this thermocouple type B, C, D, E, J, K, N, R, S or T?

- Cold junction
  Three selections can be done: internal, external, channel
  The selected issue turns into orange. If a channel is selected then the numpad opens to define the channel. The number of the channel is right-aligned showed left to the button **[Channel]**. Below the button **[Channel]** the name of the probe is displayed.

  a. **Internal**
  Internal reference junction compensation using the internal temperature-compensated copper isothermal junction. This is the default mode.
  - For direct temperature connection with no external reference junction.
  - High-accuracy measurement, requiring additional connection reference junctions.

  b. **External**
  No reference junction compensation applied to the measurement. All measurements are made with respect to 0 °C.
  - Used with an external ice point reference junction.
  - Suitable for highest precision measurement.

  c. **Channel**
  External reference junction compensation using PRT measurement of reference junction. No measurement channels are lost as the reference channel PRT uses the corresponding input channel.
  For temperature-controlled or ovenised reference junctions.

- T_{min}
  Probes may have a minimum temperature set for them (positive or negative). When the probe is assigned to a channel, the probe temperature is checked against the set minimum and a range error (exclamation mark left beside the button (13)) issued if the minimum temperature is exceeded.

- T_{max}
  Probes may have a maximum temperature set for them (positive or negative). When the probe is measured and active on a channel, the probe temperature is checked against the set maximum and a range error (exclamation mark left beside the button (13)) issued if the maximum temperature is exceeded.

- Last cal.
  Please enter the last calibration date of the thermometer.
  If the system date = last cal date + 1 year then a pop up is coming up which reminds that the probe is due to recalibration.

The recalibration cycle depends mainly on the thermal stress on the thermometer. The calibration time can only be estimated and is decided on by the user. Therefore check the calibration system at the triple point or freezing point of water on a regular basis (independent of the recalibration cycle). Recommendation is a calibration once a year.

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- Conversion
  The EMF-temperature characteristics of thermocouples are non-linear and the CTR4000 uses standard algorithms (from IEC584) to convert the measured EMF to a temperature. Thermocouples can be calibrated individually to achieve better measurement uncertainty. The calibration is presented as a deviation function polynomial.

  a. *IEC 584 as defined in the standard*

  b. *TC polynomial like specified in the calibration certificate where t is the temperature in °C and ΔV is the correction in millivolts.*
  $\Delta V = C_0 + C_1 t + C_2 t^2 + C_3 t^3$

Thermocouples are standardised, and the reference function for the most common thermocouple types is defined in IEC 584. The characteristic of individual thermocouples is usually close to the reference function. Therefore it is recommended to determine the deviation function from the reference function for the thermocouple under test in up to three temperature ranges, which must be indicated.

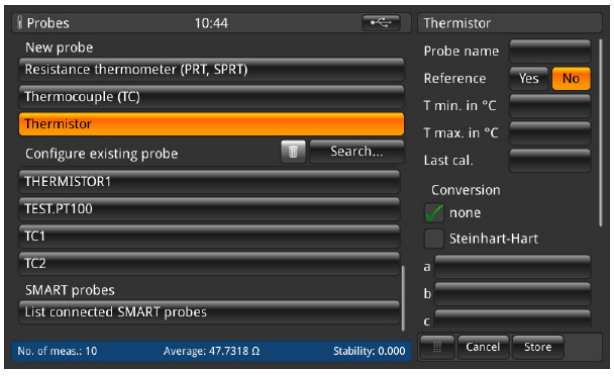
Make sure using the correct calibration parameters for the thermometer, since incorrect calibration parameters lead to erroneous results. The coefficients can be found in the calibration certificate while ordered a calculation.

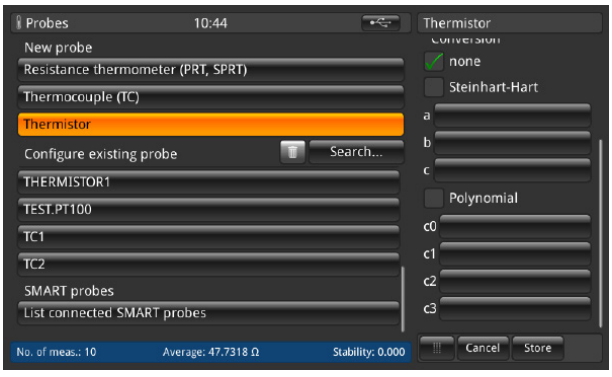
When entering the coefficients, please note:
- Until the firmware update 1.3.8.80845:
  The coefficients of the calibration certificate have to be inserted inverse in the CTR4000.
- From the firmware update 1.4.2.85671:
  The coefficients of the calibration certificate have to be inserted directly in the CTR4000.

This makes the calculation of the mV-signal in temperature values correct.

5.4.3.3 New probe [Thermistor]

1. To configure a new thermistor press the button **[Thermistor]**.
   ⇒ The menu with all settings opens on the right.
2. Enter the desired settings.
3. Confirm with button **[Store]**.





The CTR4000 can be used with thermistors. These are typically NTCs (negative temperature coefficient). Compared with PRTs/SPRTs, thermistors have a much higher resistance (typically measured in tens of kΩ), operate over a more limited temperature range (typically < 150 °C [302 °F]) and are highly non-linear (essentially logarithmic).

- Probe name
  Please enter an unique name (e.g. certificate number or serial number) for the new thermometer. This name is also shown later under the existing probes and for this name a search can be done.

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- Reference
  Please mark the thermometer as reference or not. This is important for the scan mode - see chapter 5.4.6 “Application [Calibration]” because the difference between the first reference and the test item will be calculated and displayed in the information bar.

- T_{min}
  Probes may have a minimum temperature set for them (positive or negative). When the probe is assigned to a channel, the probe temperature is checked against the set minimum and a range error (exclamation mark left beside the button (13) issued if the minimum temperature is exceeded.

- T_{max}
  Probes may have a maximum temperature set for them (positive or negative). When the probe is measured and active on a channel, the probe temperature is checked against the set maximum and a range error (exclamation mark left beside the button (13)) issued if the maximum temperature is exceeded.

- Last cal date
  Please enter the last calibration date of the thermometer.
  If the system date = last cal date + 1 year then a pop up is coming up which reminds that the probe is due to recalibration.

The recalibration cycle depends mainly on the thermal stress on the thermometer. The calibration time can only be estimated and is decided on by the user. Therefore check the calibration system at the triple point or freezing point of water on a regular basis (independent of the recalibration cycle). Recommendation is a calibration once a year.

- Conversion

  a. *None, only the resistance is displayed*

  b. *Steinhart-Hart like specified in the calibration certificate: a, b, and c*

     The Steinhart-Hart equation is commonly used to convert the measured resistance to temperature.

     $1/T = a + b \cdot \ln(R) + c \cdot \ln^3(R)$

  c. *Polynomial like specified in the calibration certificate; c0, c1, c2 and c3*

     $1/T = c_0 + c_1 \cdot \ln(R) + c_2 \cdot \ln^2(R) + c_3 \cdot \ln^3(R)$

Make sure using the correct calibration parameters for the thermometer, since incorrect calibration parameters lead to erroneous results. The coefficients can be found in the calibration certificate while ordered a calculation.

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5.4.3.4 Configure existing probes

Under the menu chapter **“Configure existing probe”** existing standard or user-defined probes can be changed or updated e.g. with new calibration data.
As soon as you click on a probe on the left side, all parameters depending on the probe type (resistance thermometer, thermocouple or thermistor) will open on the right side.

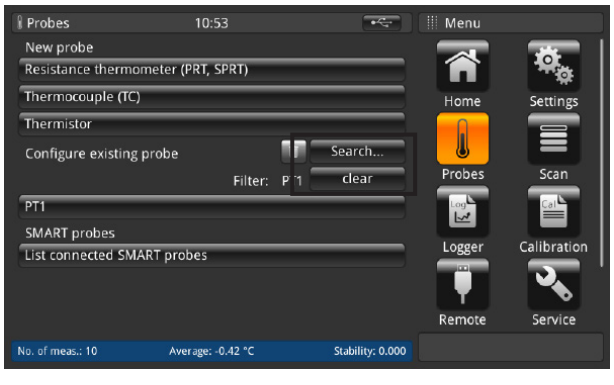
For the standard probes 3W-PT100, 4W-PT100, 4W-PT25, Thermistor and TC (K) only a few changes can be done. All other user-defined probes can be configured as needed.

Clear

The recycle bin has been placed on the left side of the search field. This function deletes existing probes if they are selected in the list below. Every time the CTR4000 needs a confirmation for deleting probes.

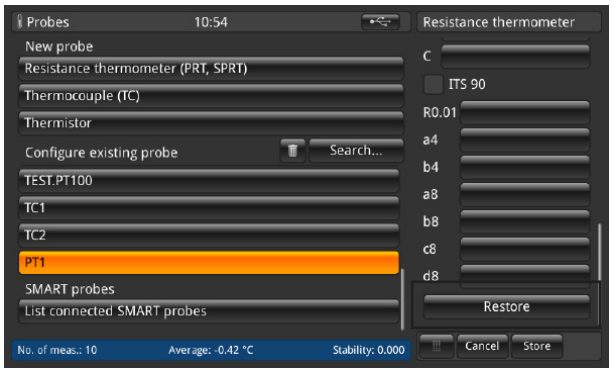
Search

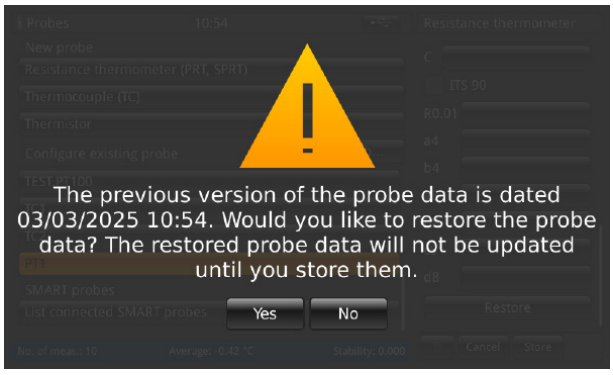
After pressing the button **[Search]** on the left side, the text pad opens. There you are able to search after the probe name and the search button allows filtering the thermometer list, which is helpful to find thermometers within a large list. The character * can be used as wildcard to show all thermometers matching a name pattern. Found results are displayed then on the left side under the menu chapter **“Configure existing probe”**.



To get all existing probes again displayed please press the button **[clear]** beside the filter.

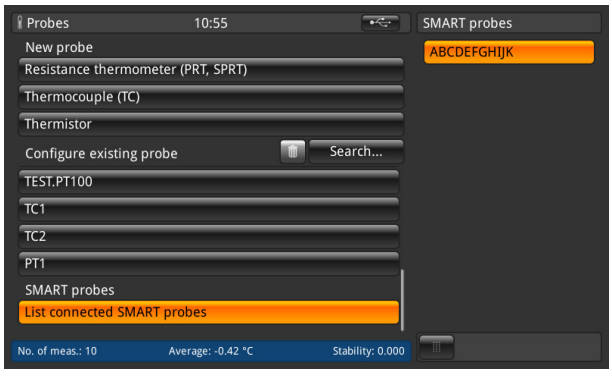
Whenever you have changed the settings of your user-defined probe, you are able to restore the last configuration over the button **[Restore]** at the end of the setting dialogue. The CTR4000 wants to have a confirmation for restoring the last probe data over the button **[Yes]** or **[No]**. And then again the button **[Store]** must be pressed as a confirmation.

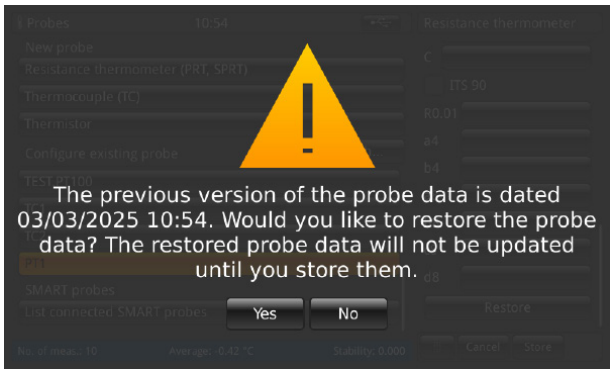




5.4.3.5 SMART probes

Under the menu chapter **"SMART probes"** you can disable SMART probes. When a SMART probe is disabled for a channel, the instrument uses the probe settings assigned to the channel.





By clicking on the button **[List connected smart probes]** all connected SMART probes will be listed on the right side with their probe name. Every probe highlighted in orange is enabled/active and all others not. Press on the button of an active SMART probe means that this will be disabled. This setting has to be confirmed with **[Yes]** or **[No]**.

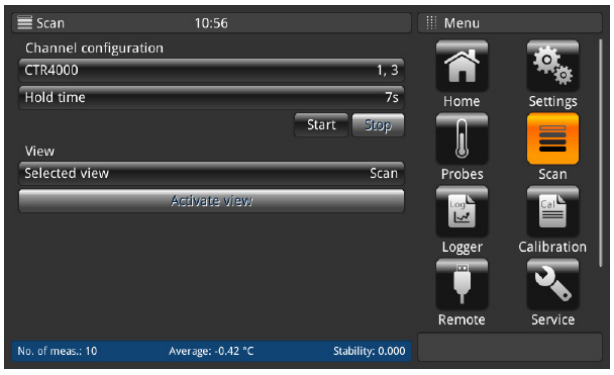
When SMART probe disabled for a channel, the instrument uses the probe settings assigned to the channel.

The scan of listed smart probes cannot be done while a scan is active.

EN

5.4.4 Application [Scan]

The application **[Scan]** describes the function of this instrument that sequentially measures each channel and either temporarily shows the data on the display in the selected view. Scans are started manually by the user. To scan a channel, the CTR4000 sequentially cycles through the channels that are selected and makes measurements. Therefore this function allows the user to see more channels on the screen and to have a more or less automatic measurement of several channels.

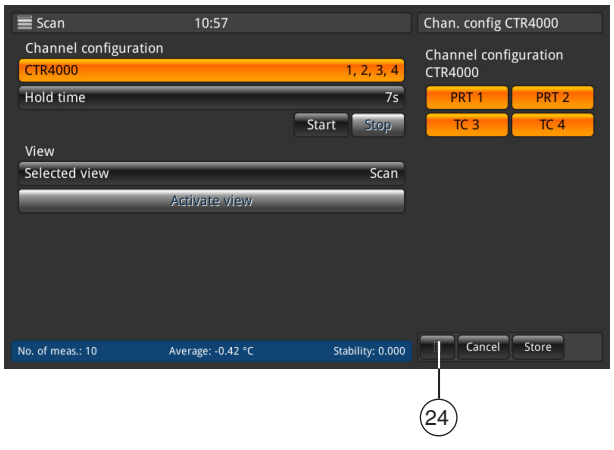


Modules are only available and selectable if these are connected.

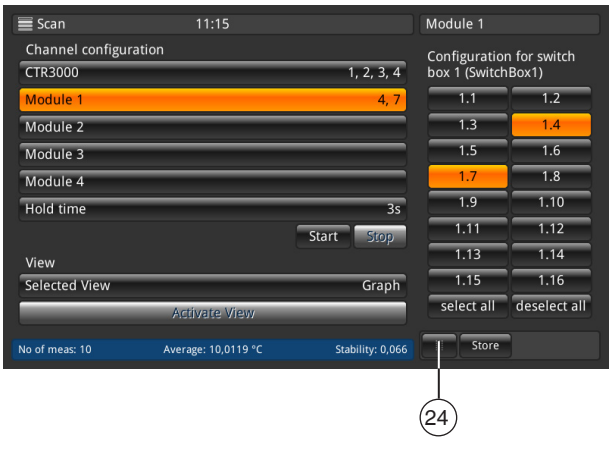
5.4.4.1 Configuring a scan

Under the menu chapter **"Channel configuration"** all or user-defined channels can be selected for the scan routine. Same procedure as for all other inputs:

1. Press desired button on the left side.
   ⇒ The input options will open on the right side.
2. Enter the settings.
3. Confirm with **[Store]**.
4. Return by pressing the button (24).



Select the channels you want to measure and then store the configuration by pressing the button **[Store]**.



Select the channels you want to measure and then store the configuration by pressing the button **[Store]**. By pressing the buttons **[select all]** / **[deselect all]** the selection is easier by choosing all or nothing with one click.

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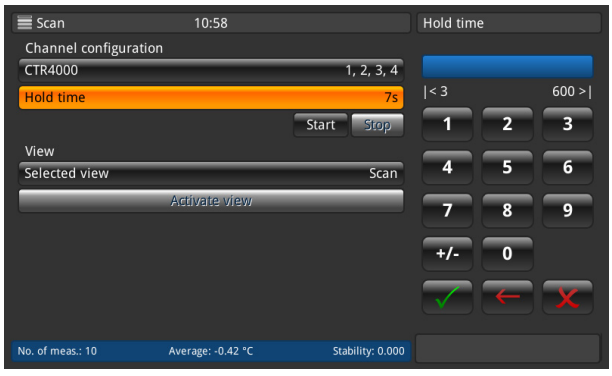
Ensure that for all configured resistance thermometers the keep warm current is **[ON]**. This allows quicker and more accurate measurements.

To set up a proper scan a hold time is needed. This value means how long the instrument stays at one channel before it switches to the next channel. The input of the value is via the numpad on the right side.

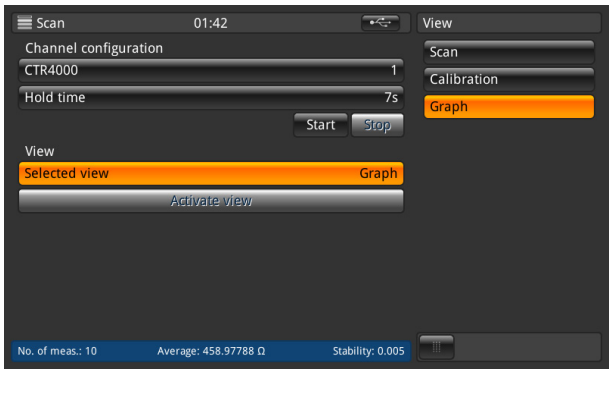


Valid values: 3 … 600 s
Means the quickest changing between the channels is 3 s.

After all settings are done start the scan via the button **[Start]**. Also in this menu the scan routine can be stopped, by pressing the button **[Stop]**. This button is active if the scan is already started.
Vice versa the start button is only active if the scan is stopped.

5.4.4.2 View

By pressing the button **[Selected View]** the sub menu opens on the right side. Scan or calibration view means that you see all channels you selected on the screens. According to the numbers of selected channels the view changes a little bit. Details see below. The graph view shows a graphic version with all selected channels.
To activate the selected view press the button **[Activate View]** (only active if the scan is started), this action guides to the selected scan view.



While changing from the scan application to the home application, please note that the scan is still active. This will be seen status and information bar.

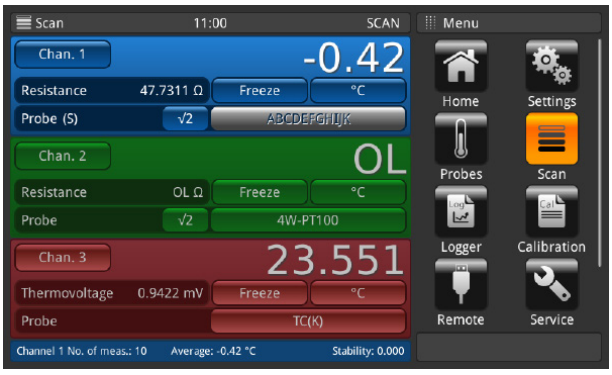
EN

Scan/Calibration view

The difference between these two views is the information bar at the bottom of the instrument. In this a difference for the calibration view is displayed. The difference is the difference between the reference (probe marked as reference and listed first) and the test item (all other channels), displayed in the unit of the test item.

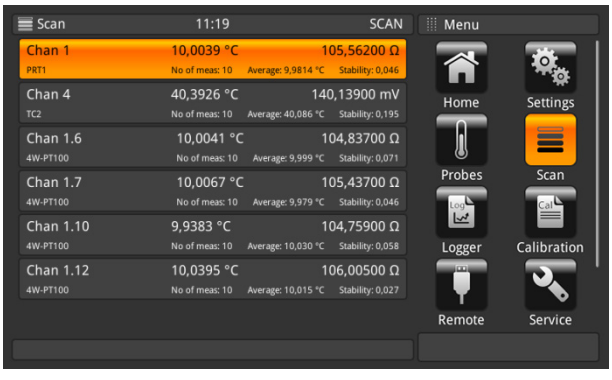
The buttons and their behaviour are known from the home application.

Scan/Calibration view: 2 channels selected



Scan/Calibration view: 3 channels selected

Scan/Calibration view: 4 channels selected



Scan/Calibration view: more than 4 channels selected

Pressing again the application **[Scan]**, during seeing the different views of the scan, guides into the application **[Scan]** menu, where all settings can be done and the scan can be stopped. Please refer to chapter 5.4.4.1 “Configuring a scan”.

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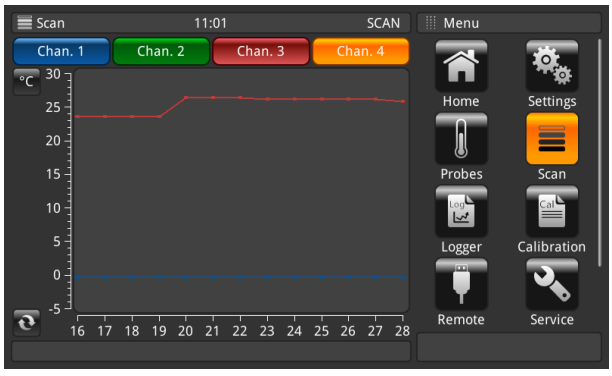
Graph view

With the graphic feature, channel measurement data for up to ten channels can be plotted and viewed on the display.
A probe must be assigned to a channel before on the main screen or via the button in the graphic view itself. Also the unit must be chosen via the button, which is indicated at the top of the y-axis.
Only the same units can be displayed. E.g. Chan PRT1 = Ω, Chan 8.1 = mV → displaying the graph in °C/°F/K is possible, but not in Ω/mV.
If the unit changes the y-axis is switched to auto scale.



The x-axis shows the numbers of measurement. This is scrollable from the left to the right and vice versa.
Re-fresh button go to the actual measurement point in the graph.

The y-axis shows the measuring values.

Pressing again the application **[Scan]**, during seeing the different views of the scan, guides the user into the application **[Scan]** menu, where all settings can be done and the scan can be stopped. Please refer to chapter 5.4.4.1 “Configuring a scan”.

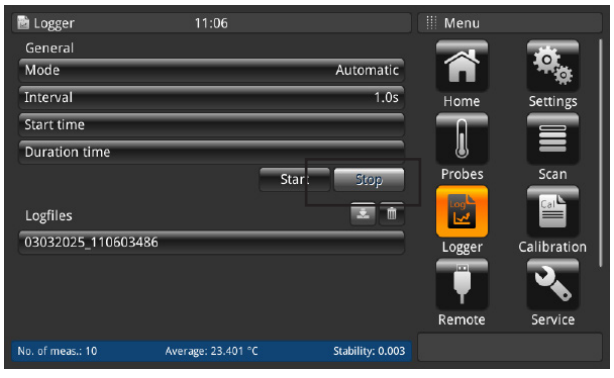
Adjustment of the graph

By pressing the button **Unit**, in this case **[°C]**, a sub menu opens where the unit and the scale can be adjusted.
Make sure that the right values for the customised scale in **Min** and **Max** are set, so that all measured values are displayed in the graph. The division will be chosen automatically. The closer Min/Max the better the resolution. Please confirm all inputs by pressing the button **[Store]**.

5.4.5 Application [Logger]

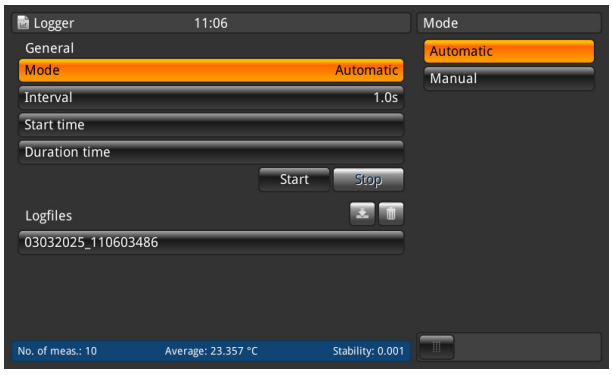
The application **[Logger]** describes the function of this instrument that logs all data which is displayed on the **Home** or **Scan** application. If a scan is active the actual channel will be logged. The different possible settings are explained in the following chapters.

1. Press the button **[Start]**.
   ⇒ Logger with the preferred settings (as described below) starts.
   ⇒ The **LOG** appears in the status line, which shows that the logger is active.
2. Press the button **[Stop]**.
   ⇒ The logger is stopped and the **LOG** disappears in the status line.



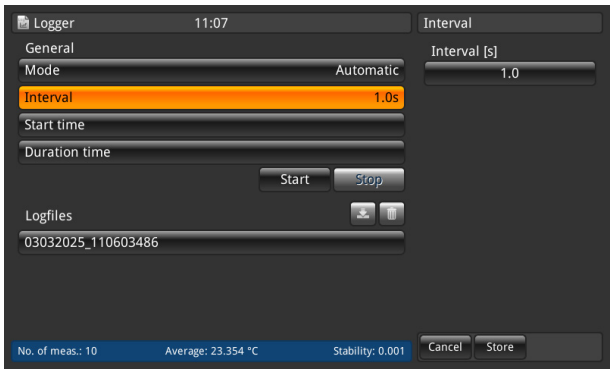
While the logger is active, please do not change the probe configuration, including plugging or unplugging of SMART probes.

5.4.5.1 General



After pressing the button **[Mode]** and two options are visible on the right side: Automatic and manual.

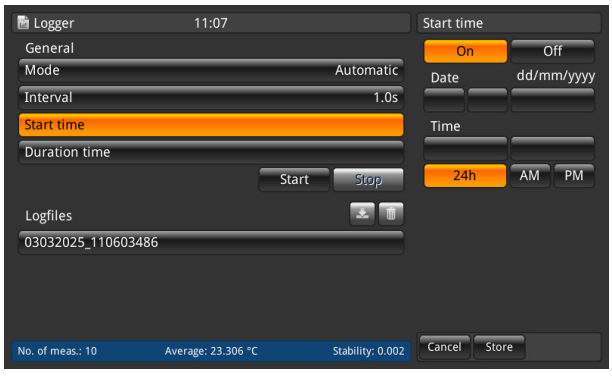
- Automatic mode requires the setting **Interval**
- Manual mode: A value is taken while pressing the **[Log]** button 3 s long, when being in the application **Home**



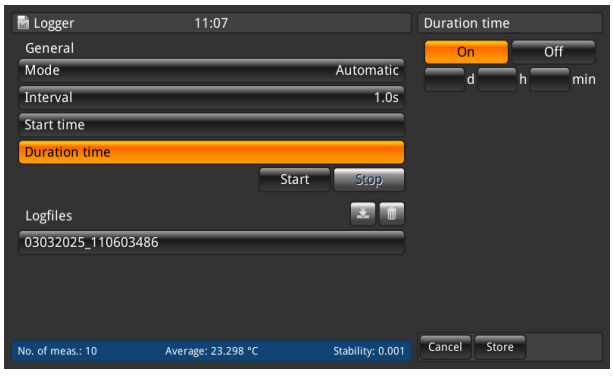
The interval describes the time when the instrument takes automatically a value from the measurement. Clicking on the button on the right side under the capture **Interval [s]** opens a num pad.
Settable values:

- Minimum 0.5 s
- Maximum 3.600 s
- Step 0.5
- Standard value = 1 s

The settings must be saved with the button **[Store]**.



Start time describes the time, when the log starts. A date and a time have to be defined.
The settings must be saved with the button **[Store]**.



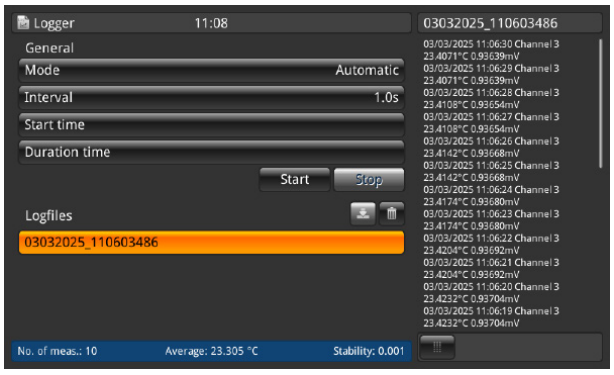
Duration time describes the time, when the log ends after starting. A setting in days, hours or minutes has to be done.
The settings must be saved with the button **[Store]**.

Ensure that the date and time is set correctly under **[Settings]**.

EN

5.4.5.2 Log files

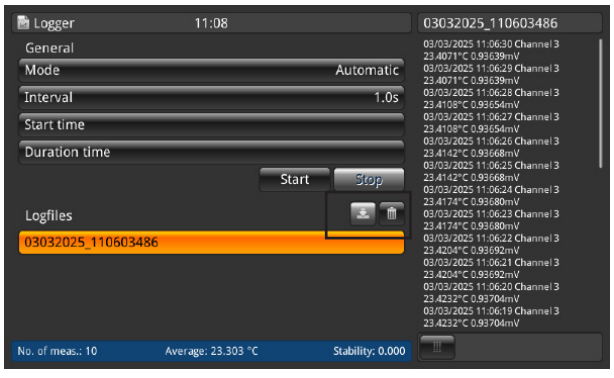
The instrument itself has a capability of approx. 1.4 Mio values. If the storage is full, no log files will be overwritten. An error log rises up and requests to delete data from the instrument.



By pressing the button **[Start]** a new log is created and named under log files with a time/date stamp according to the set time/date format. If a start or duration time is selected the button displays also the time until the log starts and then shows the remaining time until it stops.
While clicking on the created log file in the list, the log data will be viewed on the right side and will be updated after every recorded value (the values will be added on the top, that the newest value is always visible).

By pressing the button **[Stop]** the log is done and stored completely under log files.

Delete, download function of log files



By clicking on an existing log file the values appear on the right side. The head line displays the name of the log file.
In addition the buttons and are active.

An active log file cannot be downloaded and deleted.

1. Press the log file you want to edit.
2. Then press the button or .

⇒ For download, make sure that a USB memory stick is inserted in the front end USB. When the download is completed, please ensure that you eject the USB memory stick properly via the button in the status line. More details in chapter 5.5 “Download function”

If the instrument cannot detect a memory stick, the button is inactive.

⇒ If the button is pressed, a dialogue pops up which needs again a confirmation.

Stored log data

Via a USB memory stick in the front end USB the log data can be downloaded and can be viewed in e.g. Excel.

► Open Excel and import the file. Please take care that the data format is chosen with UTF-8.

Please ensure that the decimal separator setting on the instrument match to your setting on the PC.

Data which is displayed on the screen will be logged. E.g. scan is activated for 2 channels -> 2 channels will be logged.

General data

- Instrument name
- Serial number, Firmware
- Per channel the probe data (what probe and all settings)
- Start date
- Start time

Log data

- Time/date stamp
- Channel
- Measurement value in °C (or other set standard unit)
- Measurement raw data / electrical value

If one channel is marked as reference, then for all other channels the difference is calculated:

- Difference in °C (or other set standard unit)
- Difference in raw data / electrical value

Differences can only be calculated, if the units match.

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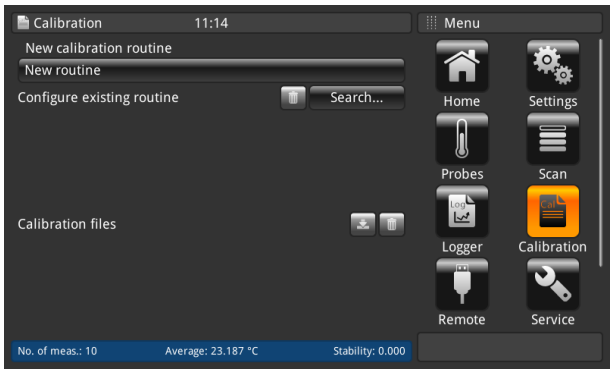
5.4.6 Application [Calibration]

This application **[Calibration]** allows to calibrate thermometers automatically by changing the set point at user-defined intervals with a connected CTD9100/9300 dry-well calibrator or micro calibration bath. With the calibration application users can create a new routine, which is stored for further similar calibrations, can change existing routines and can see all calibration results.



In this configuration the CTR4000 communicates the set point to the calibrator and a calibration can run automatically with user-defined criteria. The CTR4000 compares the performance of temperature probes against a calibrated reference probe.

When the measurement from the reference temperature probe that is wired to the CTR4000 meets all the user-defined criteria (please refer to chapter 5.4.6.1 “New calibration routine”) of the set point, the CTR4000 measures all temperature probes, logs the data and automatically communicates the next set point. This sequence repeats until all set points are complete.

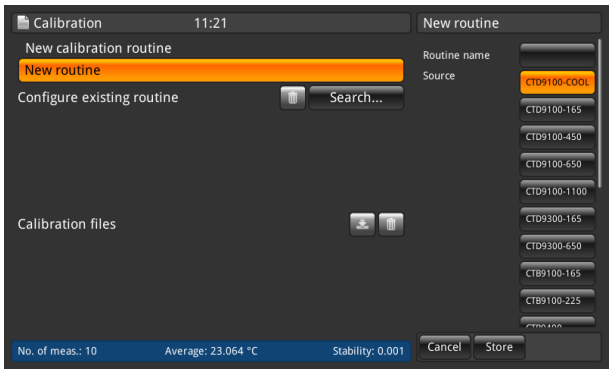
For a proper connection and a connection to the calibrator the CTR4000 has to be restarted with the lead connected and the calibrator CTx9x00 powered on to establish a connection.

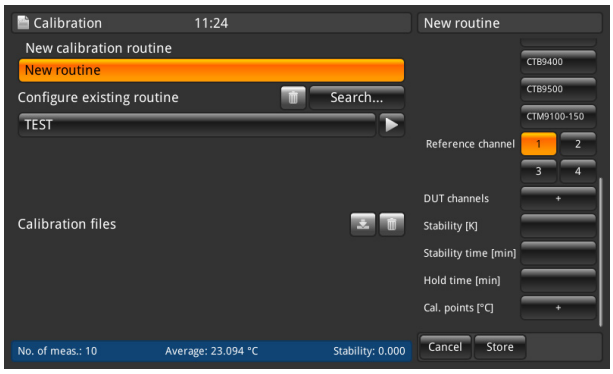
Set up with a reference

5.4.6.1 New calibration routine

To start a calibration you first have to create a new routine.

1. Press the button **[New routine]**.
2. Fill out all necessary information:
   ⇒ For the corresponding entries, either the QWERTZ keyboard or a numeric input block opens.





3. Routine name
   ⇒ Enter a name
4. Source
   ⇒ Select used CTx9x00
5. Reference channel
   ⇒ Select used channel for reference
6. DUT channels
   ⇒ Add via **[+]** the used channels for DUT (test item)
7. Stability
   ⇒ Value in [K]
8. Stability time
   ⇒ Value in [min]
9. Hold time
   ⇒ Value in [min]
10. Cal points
    ⇒ Enter via **[+]** the calibration points [°C]

Stability is the value which describes in which tolerance band the reference can float, therefore in which tolerance the value for the test item can be taken.
The stability time describes the time, that in this time frame the values are taken (first in, first out) and the difference between the minimum and maximum value is always calculated. Once this difference is smaller than the stability value, then the hold time starts. If the stability criteria is still valid, then the values will be taken after the hold time.

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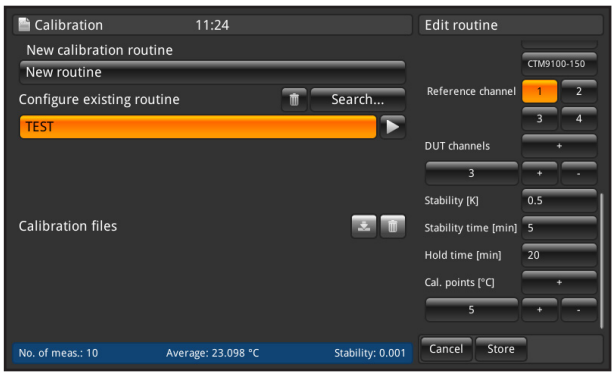
5.4.6.2 Configure existing routines

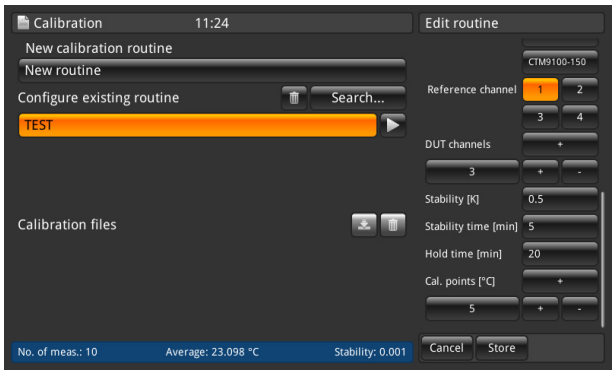
While pressing on a created routine on the left side under the menu item **[Configure existing routine]** all settings are shown on the right side. There changes can be done as described in chapter 5.4.6.1 “New calibration routine” and stored for the future.



5.4.6.3 Start the routine

To start the calibration routine only press the button **[►]** on the right side of the selected calibration routine.
Before starting the programme ensure the following points:

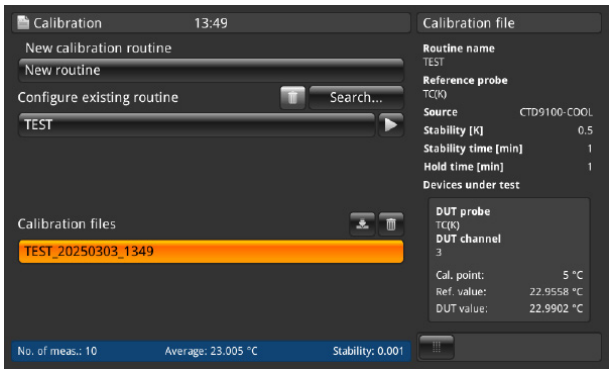
1. The calibrator is connected to the CTR4000 via the front-end USB before switching on the CTR4000.
   ⇒ Please use the delivered interface cables from WIKA. Otherwise we cannot guarantee the functionality.
2. The calibrator is switched on and is running.
3. The CTR4000 is switched now.



Please ensure that the right probes are assigned to the channels due, the CTR4000 is reading the probe information of each channel during the calibration.

5.4.6.4 Calibration files

By pressing on a file under the section **Calibration files** on the right side a summary of this calibration is shown. First of all, all of the general parameters are listed. After these the calibration result is displayed.



Delete, download function of calibration files

After pressing the button on an existing calibration file the results appear on the right side.

In addition the buttons and are active.

1. Press on the calibration file you want to edit.
2. Then press the button or .

⇒ For download, make sure that a USB memory stick is inserted in the front end USB. When the download is completed, please ensure that you eject the USB memory stick properly via the button in the status line. More details in chapter 5.5 “Download function”

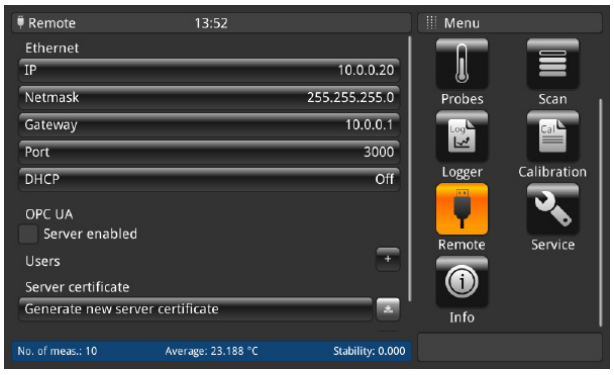
⇒ If the button is pressed, a dialogue pops up which needs again a confirmation.

If the instrument cannot detect a memory stick, the download button is inactive.

EN

5.4.7 Application [Remote]

This application **[Remote]** allows to operate the instrument with SCPI commands (command set available in a separate document) over a rear panel USB / Ethernet connection.
With the **Remote Settings** application the remote command set for all interfaces can be selected.
The Ethernet network parameters and serial parameters can also be set here.



USB

The USB PC interface will be installed as a virtual COM driver. The communication protocol is:

- Bits per second 9600
- Data bits 8
- Stop bits 1
- Parity none
- Flow control none

Ethernet

The Ethernet function allows the user to set the following by inputting a numeric value in each separate field:

- IP
- Netmask
- Gateway
- Port
- DHCP settings

The Ethernet communication parameters are set as a default.
Before using Ethernet communication, four parameters must be set up: IP, Netmask, Gateway, and Port.

Please contact the network administrator for proper settings.

Please consult the computer resources department prior to connecting this instrument to your network to verify there are no conflicts with existing IP addresses.

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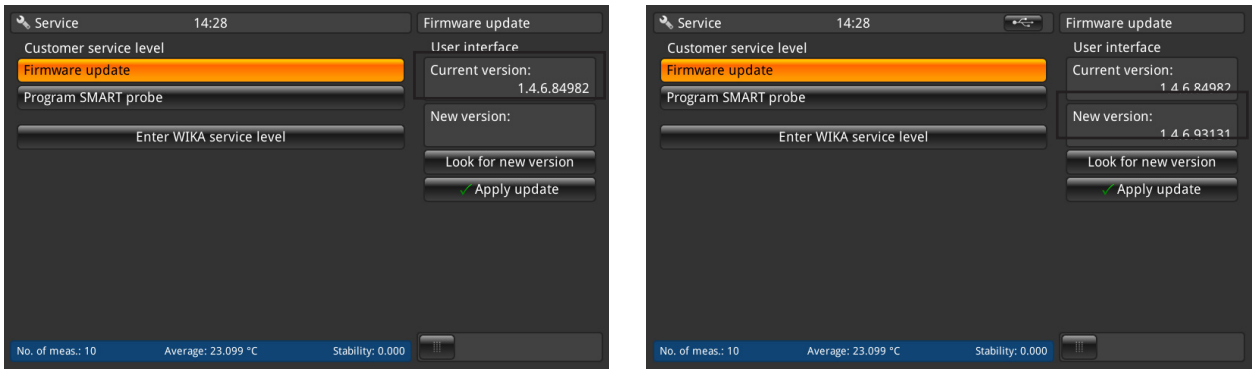
5.4.8 Application [Service]

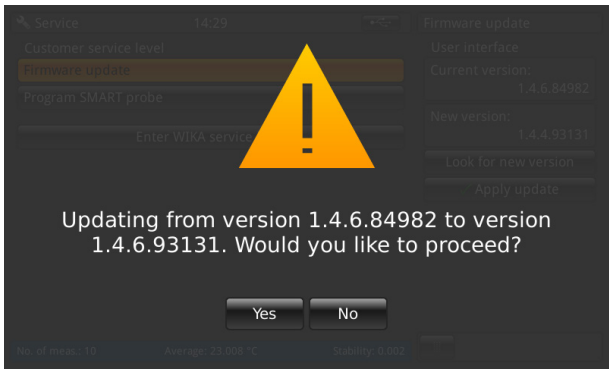
5.4.8.1 Firmware update

By pressing the button **[Firmware update]** in the application **[Service]** a firmware update can be done under the customer-specific service level. The menu opens on the right side.



Please ensure that a USB/memory stick with the folder “CTR4000” and the suitable file is inserted. Otherwise the CTR4000 will not recognize the new version.

1. USB stick is inserted.
2. Press on the button **[Look for a new version]**.
   ⇒ The instrument searches for a suitable file on the USB stick.
   ⇒ If one is found the new version number is shown in the field **New version**.
3. Press the button **[Apply update]**.
   ⇒ A warning message appears.



4. With **[Yes]** confirm to update the instrument with the new firmware.
   ⇒ The answer will be **“Firmware update ok”**.
   ⇒ New version will be installed.

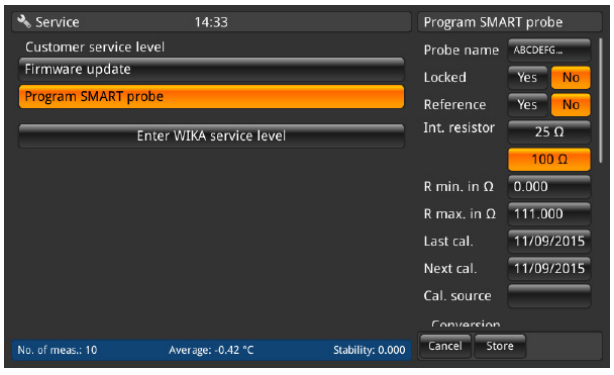
If the file cannot be found, an error log is raised.

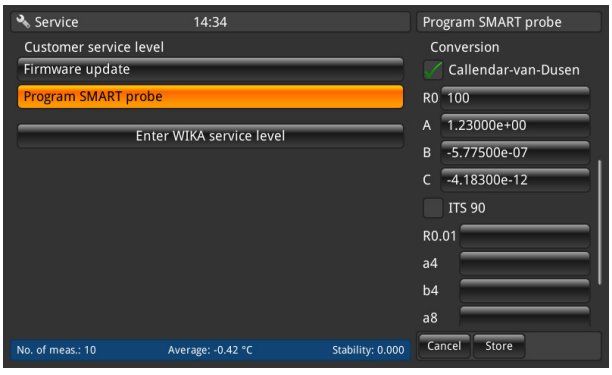
The firmware update does not delete the settings, probes and log files.

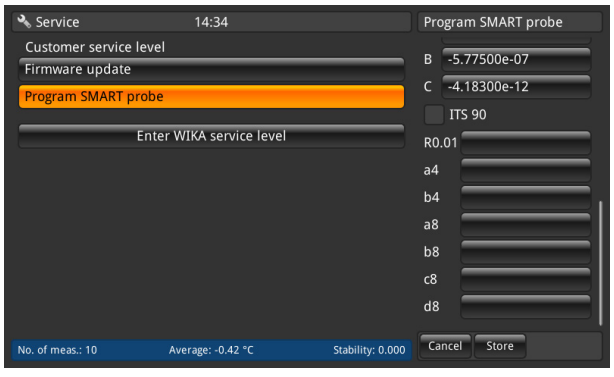
EN

5.4.8.2 Program SMART probe

By pressing the button **[Program SMART probe]** in the application **[Service]**, the SMART probes can be programmed under the customer-specific service level. The menu opens on the right side.



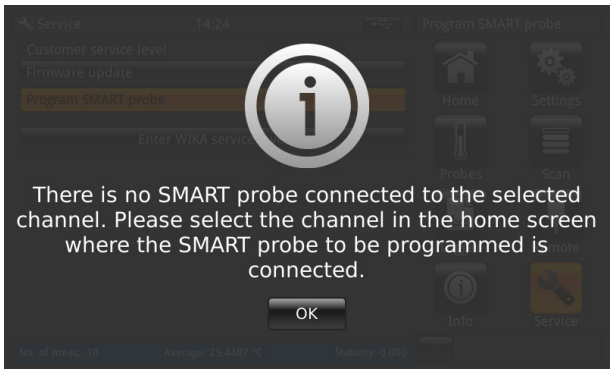




Here all settings can be done which are stored on the EEPROM on this SMART probe. Similar to the settings for new probes. Please refer to chapter 5.4.3.1 “New probe [Resistance thermometers]” to understand the meaning of these settings.

No history is stored on the memory.

This can only be done while a SMART probe is connected and on the main screen, the channel is selected where the SMART probe is connected. Otherwise an error log is raised.



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5.4.8.3 WIKA service level

Only accessible with a password.
Only for authorized users.

5.4.9 Application [Info]

The Information application displays information about the instrument, including:

- WIKA address
- Model number, serial number and manufacturing date
- Measuring system serial number and firmware version
- User interface serial number and user interface software version
- Used storage

5.5 Download function

The CTR4000 first stores all data on the instrument, which can be downloaded later on to a USB memory drive. A direct storing process on the USB memory drive is not possible. To enter the download function the instrument must detect an USB memory stick. Then the button ⇢ appears in the status bar. Press the button ⇢ to access to this function.

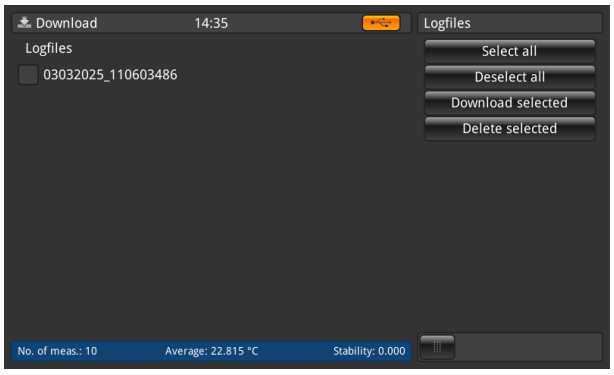
Please ensure that you eject the USB drive every time when you are ready via the button **[Eject USB stick]**. This is the only way, to ensure that all data are saved.

All downloaded data will be stored in the directory “CTR4000” in the USB stick file system root. The directory will be created, if it does not exist.

EN

5.5.1 Log files

By pressing the button **[Logfiles]** a dialogue opens on the right side. All created log files are listed there then on the left side.
To select or delete these please use the right button.



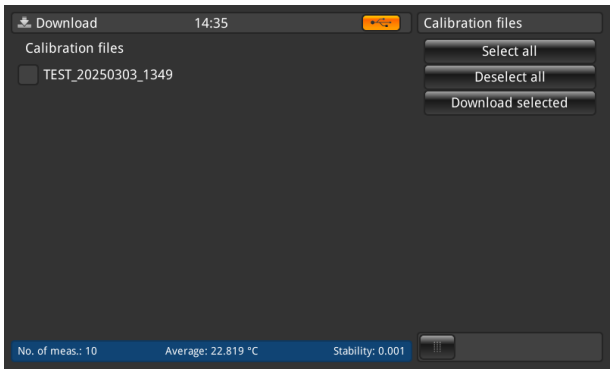
Button	Result
Select all	Ticks all log files with a **[✓]** in the box in front of the logfile name
Deselect all	Removes the **[✓]** in the box in front of the logfile name
Download selected	Downloads all log files marked with a **[✓]** to the USB memory stick
Delete selected	Deletes all log files marked with a **[✓]** from the instrument

The downloaded log file is a file in the format *.txt, which can be easily opened in e.g. EXCEL.

Name of a log file in the directory *CTR4000 \Logfiles:
Ddmmyyyy_hhmmss
The set time and data format can change according on the programming in the application **[Settings]**.
More information about the content of the downloaded log file see chapter 5.4.5.2 “Log files”.

5.5.2 Calibration files

By pressing the button **[Calibration files]** a dialogue opens on the right side. All created calibration files are listed there then on the left side.
To select or delete these please use the right button.



Button	Result
Select all	Ticks all calibration files with a **[✓]** in the box in front of the calibration files name
Deselect all	Removes the **[✓]** in the box in front of the calibration files name
Download selected	Downloads all log files marked with a **[✓]** to the USB memory stick

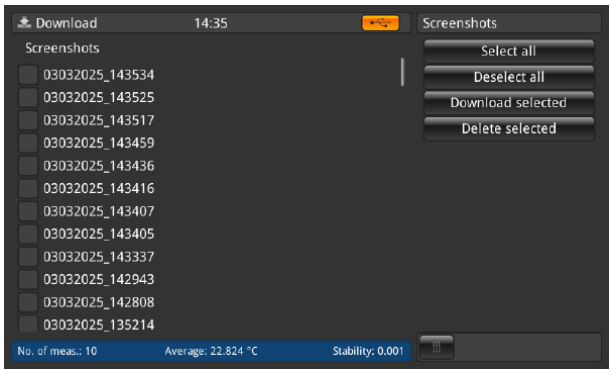
The downloaded calibration file is a file in the format *.xml and also *.csv.

Following information is stored in the file in the directory *CTR4000\CalibrationFiles:
- Routine name
- Start and end time
- Stability criteria
- Used equipment
- Calibration results: set value, reference value, reference stability, DUT value, DUT raw value

Name of a screenshot in the directory *CTR4000\CalibrationFiles:
Routine_Ddmmyyyy_hhmm
The set time and data format can change according on the programming in the application **[Settings]**.
More information about the content of the downloaded calibration file see chapter 5.4.6.3 “Start the routine”.

5.5.3 Screenshot

By pressing the button **[Screenshots]** a dialogue opens on the right side. All created screenshots are listed there then on the left side.
To select or delete these please use the right button.



Button	Result
Select all	Ticks all screenshots with a [✓] in the box in front of the screenshots name
Deselect all	Removes the [✓] in the box in front of the screenshots name
Download selected	Downloads all screenshots marked with a [✓] to the USB memory stick
Delete selected	Deletes all screenshots marked with a [✓] from the instrument

The downloaded screenshot is a file in the format *.png.

Name of a screenshot in the directory *CTR4000\Screenshots:
Ddmmyyyy_hhmmss
The set time and data format can change according on the programming in the application **[Settings]**.

5.5.4 Measured probes

By pressing the button **[Measured probes]** downloads all details into a *.txt file on the USB memory stick. Only the assigned probes are downloaded.

A window pops up which shows that the download is complete.

Following information is stored in the file in the directory *CTR4000\measured probes:

- Probe name
- Probe type
- Reference probe
- T min.
- T max.
- Last calibration:
  - ► Thermocouple type (only for thermocouples)
  - ► Cold junction compensation (only for thermocouples)
  - ► PRT type (only for resistance thermometers)
  - ► Wiring (only for resistance thermometers)
  - ► Internal resistor (only for resistance thermometers)
  - ► Standby current (only for resistance thermometers)
  - ► Conversion

5.5.5 SMART probes

By pressing the button **[SMART probes]** downloads all details into a *.txt file on the USB memory stick. Only the connected SMART probes are downloaded. SMART probes are only available as resistance thermometers.

A window pops up which shows that the download is complete.

Following information is stored in the file in the directory *CTR4000\SMART probes:

- Probe name
- Probe type
- Reference probe
- Last calibration
- Next calibration
- Calibration source
- Internal resistor
- Conversion
- [Conversion coefficients according to selected conversion]
- Working range
- Locked

5.5.6 All probes

By pressing the button **[All probes]** downloads all details into a *.txt file on the USB memory stick. All probes which are configured on the instrument are downloaded.

A window pops up which shows that the download is complete.

Following information is stored in the file in the directory *CTR4000\all probes:

- Probe name
- Probe type
- Reference probe
- T min.
- T max.
- Last calibration:
  - ► Thermocouple type (only for thermocouples)
  - ► Cold junction compensation (only for thermocouples)

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- PRT type (only for resistance thermometers)
- Wiring (only for resistance thermometers)
- Internal resistor (only for resistance thermometers)
- Standby current (only for resistance thermometers)
- Conversion

5.5.7 Instrument details

By pressing the button **[Instrument details]** downloads all details into a *.txt file on the USB memory stick.

A window pops up which shows that the download is complete.

Following information is stored in the file in the directory *CTR4000\instrument_details:

- Model
- Instrument serial number
- Measuring serial number
- User interface serial number
- User interface version
- Firmware version

5.5.8 Download probe coefficients

By pressing the button **[Download probe coefficients]** downloads all details into a *.txt file on the USB memory stick.

A window pops up which shows that the download is complete.

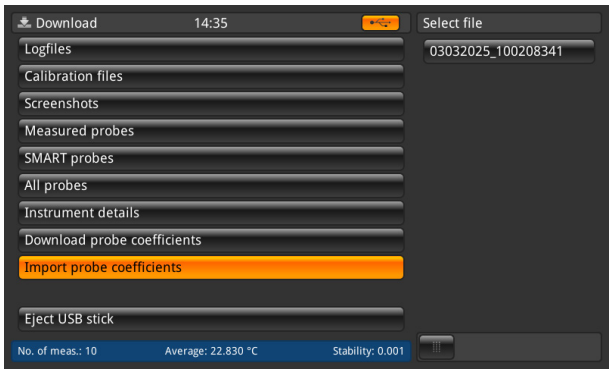
Following information is stored in the file in the directory *CTR4000\probe_coefficients:

- Probe name
- Probe type
- T min.
- T max.
- Coefficients (according to the used linearisation)

We recommend due to technical reasons to open and change the file with an appropriate csv editor and save this in the same format as downloaded.
We normally use following: https://www.ronsplace.eu/products/ronseditor

5.5.9 Import probe coefficients

By pressing the button **[Import probe coefficients]** uploads all details stored in the selected file in the directory *CTR4000\probe_coefficients.



By selecting the file on the right side, this updates automatically all changes in the probes. Only the lines which are changed or added are uploaded:
The following main screen shows that there was no update done. Only a new probe was created. Moreover it gives the information that for 3 probes the coefficients are missing.

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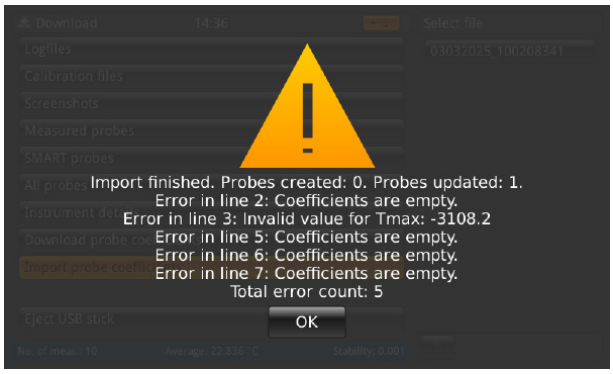
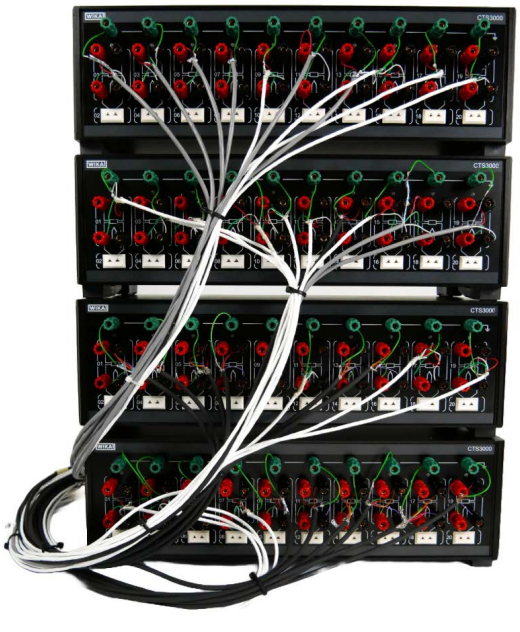


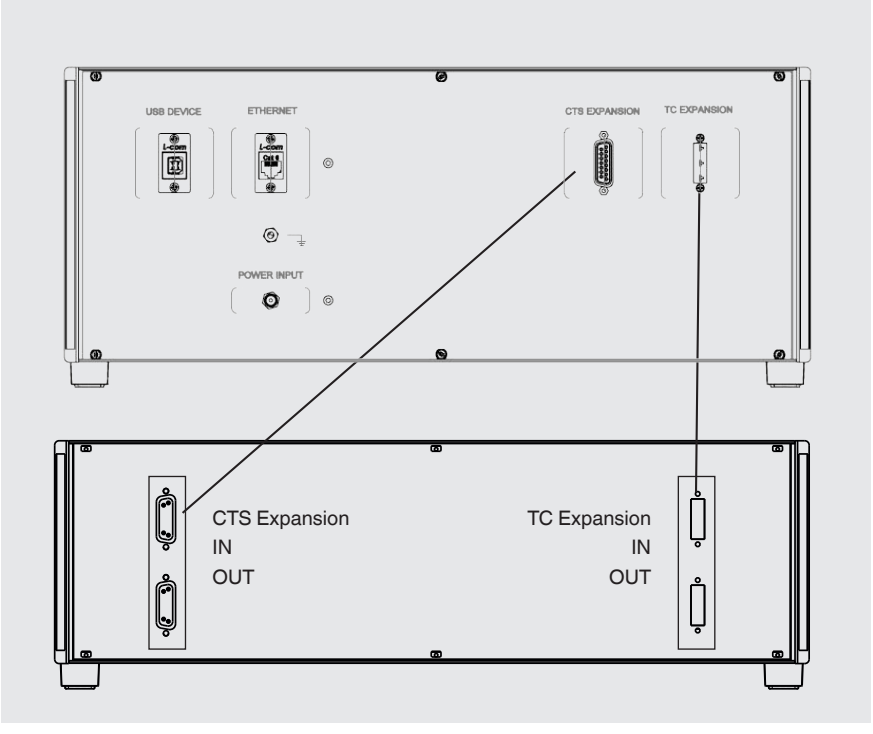
5.7 Working with a multiplexer

5.7.1 Multiplexer model CTS3000

Set up

Multiplexers are detected at power-on and are daisy-chained. Addresses are assigned in order, so the first multiplexer connected to the CTR4000 will start with the lowest address.
An expansion port connector is provided on the rear panel at the CTR4000 itself. Here you have to connect the CTS expansion and TC expansion port with the delivered cables.
The CTS connector is a (1:1) 15-way socket for signal, power and data connection to the CTS3000. The TC expansion cable is a 3-pin TC connector.





It is not compatible with any other connection. A 0.5 m [1.64 ft] lead is supplied as standard. Longer lengths may be used, but

system accuracy and the noise specification may be compromised.

Up to 40 channels may be added with the addition of external CTS3000 multiplexers.

Two models are available:
- Model CTS3000, desktop version
- Model CTS3000, rack version

Multiplexer channels are selected by their channel numbers:

Multiplexer	Channel number
1	1.1 to 1.20
2	2.1 to 2.20
3	3.1 to 3.20
4	4.1 to 4.20

If you use a fully equipped CTR4000 with 4 multiplexer and 40 probes, please ensure to secure the set up against down falling or overturning.
It is not possible to use two channels in one line. Means channel 1+2/3+4/5+6 etc. cannot be used at the same time.

Specifications
Additional errors have to be added to the accuracy of the CTR4000

- 3-wire ±50 mΩ
- TC (Temperature Coefficient) ±2 µV
- Thermistor +0.01 % of measurement value

At extremely low probe temperatures (≤ -110 °C [-166 °F]) and when using more than two CTS3000 and high channels (e.g. 4.19), the measured values may, depending on the probe, exceed the specified measurement accuracy.

6. Technical information about temperature

6.1 Measurement uncertainty and traceability

Measurement is usually made on the assumption that there is a true value. Whenever a measurement is performed it is unlikely that the measured value will equal the true value. The difference between the two values is the measurement error which will lie within the specified limits of uncertainty. Uncertainty is defined as an estimate characterising the range of values within which the true value lies.

By taking a statistically significant number of measurement samples, a distribution of results will emerge. Confidence in the distribution increases as more measurements are made. Using statistical methods, the distribution may be described in terms of mean, variance and standard deviation. The uncertainty or precision limit of a particular measurement is characterised by this distribution.

Traceability is defined as the property of a measurement that may be related to appropriate reference standards through an unbroken chain of comparisons. Through traceability it is possible to demonstrate the accuracy of a measurement in terms of SI units.

6.2 International temperature scale

The purpose of the International Temperature Scale is to define procedures by which certain specified practical thermometers including PRTs and thermocouples of the required quality can be calibrated. The values of temperature obtained from them can be precise and reproducible, matching at the same time the corresponding thermodynamic values as closely as current technology permits.

Since 1968 when the International Practical Temperature Scale of 1968 (IPTS-68) was adopted, there have been significant advances in the techniques employed in establishing temperature standards and in the measurement of thermodynamic temperature. The International Temperature Scale of 1990 (ITS-90) gives practical effect to these improvements. Particular features are:

- ITS-90 specifies the use of the PRT up to the freezing point of silver, 961.78 °C [1,763.2 °F / 1,234.93 K]. The platinum 10 % rhodium/platinum thermocouple is no longer specified for use in the scale, though it and other noble metal thermocouples will continue to be used as secondary standards.

- New, more precise, fixed points have been introduced and mathematical procedures for calculating resistance temperature equivalents have been revised so as to reduce the 'non-uniqueness' of the scale: that is, to reduce the differences which occur between different, identically calibrated PRTs. In particular, the calibration of a PRT can no longer be extrapolated beyond the freezing point of zinc, 419.527 °C [787.149 °F / 692.677 K], but requires a measurement at the freezing point of aluminium, 660.323 °C [1,220.581°F / 993.473 K].

- Alternative definitions are permitted in certain sub-ranges; the calibration of a PRT can be terminated at almost any fixed point. This allows primary calibrations to be carried out with suitable PRTs over reduced ranges, and will be of special importance to metrology standards departments which need to make precise measurements at ambient temperatures.

- The part of the ITS-90 scale which may be measured by PRTs extends from -189.3442 °C [-308.8196 °F / 83.8058 K] to +961.78 °C [+1,763.2 °F / 1,234.93 K]. The CTR4000 is specified to measure temperature over the range -200 ... +962 °C [-328 ... +1,764 °F / 73.15 ... 1,235.15 K]. The actual range of temperatures which may be measured depends on the type and range of the PRT.

The ITS-90 scale has much improved continuity, precision and reproducibility compared with IPTS-68. The implementation of the ITS-90 scale according to its definition calls for changes in equipment and procedure compared with IPTS-68, but lower uncertainties of calibration are achievable in all parts of the range. However, the instruments and equipment needed to implement the ITS-90 scale in calibration laboratories will be substantially the same.

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6.3 Measurement

6.3.1 Thermocouple

6.3.1.1 Introduction

Very broadly the thermoelectric effect occurs when an electrical circuit consisting of dissimilar metal conductors is subjected to a temperature gradient. An electric potential or voltage is developed along the conductors. This voltage potential varies proportionally with temperature and provides a means by which to measure temperature.

There are two categories of thermocouple:

- Rare metal, Platinum based types
  Rare metal, platinum types are mostly used for high-temperature precision thermometry. Maximum temperatures of 1,700 °C [3,092 °F / 1,973.15 K] and measurement uncertainties of up to 0.4 °C are possible. The sensitivity of platinum-based thermocouples is usually in the region of 10 µV / °C, which means that high-accuracy, high resolution measurements require sensitive instruments such as the CTR4000.

- Base metal, Nickel based
  Base metal thermocouples operate over a wide temperature range with high-temperature types designed for use up to 1,600 °C [2,912 °F / 1,873.15 K] . Temperatures above 2,300 °C [4,172 °F / 2,573.15 K] are possible with new high-temperature tungsten rhenium types. Typical sensitivity figures of > 30 µV / °C characterise most of the base metal thermocouple family.
  These are easily affected by contamination effects which results in recalibration and drift. This is especially pronounced at high temperatures where drift figures of the order of 10 °C [50 °F / 283.15 K] are possible. It is important to be aware of the particular contamination effects and to select the correct thermocouple for the measurement environment. The type N thermocouple offers the best performance in terms of reproducibility and measurement uncertainty, operating up to 1,250 °C [2,282 °F / 1,523.15 K]. It is the best choice for most general measurement applications, calling for accuracy with low time and temperature drift.

6.3.1.2 Connection

Thermocouples measure temperature difference. As all practical thermocouples consist of at least 2 junctions, it is important when performing absolute temperature measurement that one of the junctions is referenced to a known temperature.

The reference junction and voltage measurement precision significantly influence the overall temperature measurement accuracy. Intermediate connection junctions such as connectors and extension cables between the measurement thermocouple and the CTR4000 also influence the measurement result.

6.3.2 Resistance thermometer

The CTR4000 will operate with a range of 3- and 4-wire 25/100 Ω PRTs. The best performance will be achieved only where good quality PRTs are used from reputable, proven sources. As with any measured parameter, the performance of a measurement system depends upon its stability and repeatability. Low quality PRTs are likely to reduce system performance.

The relationship between temperature and resistance depends on several factors, including the alpha value and the PRT calibration. Consequently more than one equation is required for resistance to temperature conversion. Calibration data for the PRTs takes the form of Callendar-van-Dusen coefficients.

WIKA provides a range of proven PRTs of the series CTP5000 especially for use with the CTR4000, as well as offering a service to provide customised PRTs to meet individual customers' requirements.

High "alpha" PRTs:
The best possible system accuracy is achieved using high "alpha" (***α***) PRTs, or more correctly, PRTs using high ***α*** (high purity) platinum wire.

Low "alpha" PRTs:
Low ***α*** PRTs contain a higher level of impurities in the platinum resistance wire used. This affects the resistance value at a given temperature (the temperature coefficient). As impurities already exist in the platinum resistance wire, additional contamination has a reduced effect and hence low ***α*** PRTs are more immune to contamination and are therefore better for industrial applications. To ensure a robust PRT, the detector within the PRT is contained within materials, which can

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themselves be the source of contamination at elevated temperatures. The PRTs supplied by WIKA have been optimised for the temperature ranges for which they are specified and, when calibrated, are temperature cycled to enhance stability in use. PRTs which are used outside their design and/or calibration temperature range, especially at higher temperatures, risk irreversible alteration to their calibration either by induced thermal stresses or by contamination.

6.3.2.1 Linearisation functions for resistance thermometers

The CTR4000 provides one standard and 2 user definable algorithms for converting resistance to temperature. The choice will depend on the type of PRT and its calibration.

Standard: EN 60751 (2009):

Used for un-calibrated industrial PRTs with 0.003851 “alpha” value, to provide a conversion of resistance to temperature in accordance with the EN 60751 (ITS-90) standard.
Selecting EN 60751 from the standard menu selects the standard coefficients from BS EN 60751 based on ITS-90.

The coefficients for EN 60751 are as follows:

R_0= 100 Ω
A = 3.9083 x 10^{-3} °C^{-1}
B = -5.775 x 10^{-7} °C^{-2}
C = -4.183 x 10^{-12} °C^{-4}

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7. Faults

Personnel: Skilled personnel

EN

WARNING!
Physical injuries and damage to property and the environment due to hazardous media
Upon contact with hazardous media (e.g. oxygen, acetylene, flammable or toxic substances) and harmful media (e.g. corrosive, toxic, carcinogenic, radioactive), there is a danger of physical injuries and damage to property and the environment.
Should a failure occur, hazardous media with extreme temperatures (over 55 °C [131 °F]) may be present at the instrument.

- ► For these media, in addition to all standard regulations, the appropriate existing codes or regulations must also be followed.
- ► Wear the requisite protective equipment..

If faults cannot be eliminated by means of the listed measures, take the instrument out of operation immediately.

- ► Contact the manufacturer.
- ► If a return is needed, please follow the instructions given in chapter 9.2 “Return”.

For contact details, see chapter 1 “General information” or the back page of the operating instructions.

In the event of any faults, first check whether the instrument is mounted correctly, mechanically and electrically.

Faults	Causes	Measures
OL	No reading	Check if probe is properly connected.
Sensor break	External reference sensor not plugged in correctly.	Check the connection and insert it properly.
	Cable break or short-circuit	Send in for repair.
Instrument and touchscreen are no longer responding	The instrument has found itself in an undefined state.	Switch off the instrument, wait a few minutes and then switch on again.
Display does not respond to touch	Malfunction during operation	Switch off the instrument, wait a few minutes and then switch on again.
	Electrostatic discharges on the screen However, the instrument continues to operate properly. Data will still be transmitted	Switch off the instrument, wait a few minutes and then switch on again.
No display	The controller is defective.	Contact the manufacturer.
No function - the instrument cannot be switched on	The voltage supply is not established correctly.	Check voltage supply.
No measurement(s) are displayed on the screen. **The entire area of the screen is dark.**	The instrument has not initialised after switching on.	Switch off the instrument and switch on again after approx. 5 seconds.
	After switching on again, the screen still remains dark	Check that the power cord is connected properly.
		Have authorised technical staff check that the auxiliary power is correct.
No measured value transmission	USB cable not connected	Connect USB interface cable

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8. Maintenance, cleaning and calibration

Personnel: Skilled personnel

For contact details, see chapter 1 “General information” or the back page of the operating instructions.

8.1 Maintenance

This instrument is maintenance-free.

Repairs must only be carried out by the manufacturer.
Only use original parts, see chapter 11 “Accessories and spare parts”.

8.2 Cleaning

CAUTION!

Physical injuries and damage to property and the environment

Residual media can result in a risk to persons, the environment and equipment.

- ► Wear the requisite protective equipment.
- ► Carry out the cleaning process in accordance with the manufacturer’s instructions.

CAUTION!

Damage to property due to improper cleaning

Improper cleaning may lead to damage to the instrument.

- ► Do not use any aggressive cleaning agents.
- ► Do not use any hard or pointed objects for cleaning.
- ► Do not use any abrasive cloths or sponges.

1. Before cleaning, correctly disconnect the thermometer from the temperature heater, switch the instrument off and disconnect it from the mains.
2. Clean the instrument with a moist cloth.
   Do not expose the electrical connections to moisture.
3. Clean the dismounted instrument, in order to protect persons and the environment from exposure to residual media.

8.3 Calibration

DAkkS calibration certificate or official certificates:
It is recommended having the instrument regularly calibrated by the manufacturer, with time intervals of approx. 12 months. The settings will be corrected if necessary.

If a RTD or TC simulator is connected to one of the instrument’s channels and both the simulator and the CTR4000 are connected to the same computer via USB, please use a USB isolator between the simulator and the computer. Otherwise there is a chance that the measurement value is affected.

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9. Dismounting, return and disposal

Personnel: Skilled personnel

EN

DANGER!
Danger to life due to electrical voltage
Upon contact with live parts, there is a direct danger to life.
- ► The dismounting of the instrument may only be carried out by skilled personnel.
- ► Remove the instrument once the system has been deenergised.

WARNING!
Physical injury
When dismounting, there is a danger from hazardous media and high pressures.
- ► Wear the requisite protective equipment.
- ► Observe the information in the material safety data sheet for the corresponding medium.
- ► Clean the dismounted instrument (following operation), in order to protect persons and the environment from exposure to residual media.

WARNING!
Risk of burns
During dismounting there is a risk of dangerously hot media escaping.
- ► Wear the requisite protective equipment.
- ► Let the instrument/thermometer cool down sufficiently before dismounting it.

WARNING!
Physical injuries and damage to property and the environment due to hazardous media
Upon contact with hazardous media (e.g. oxygen, acetylene, flammable or toxic substances) and harmful media (e.g. corrosive, toxic, carcinogenic, radioactive), there is a danger of physical injuries and damage to property and the environment.
Should a failure occur, hazardous media with extreme temperatures (over 55 °C [131 °F]) may be present at the instrument.
- ► For these media, in addition to all standard regulations, the appropriate existing codes or regulations must also be followed.
- ► Wear the requisite protective equipment.

9.1 Dismounting

Only disconnect the measuring assembly/test and calibration installations once the system has been disconnected from the power.

9.2 Return

Strictly observe the following when shipping the instrument:
- All instruments delivered to WIKA must be free from any kind of hazardous substances (acids, bases, solutions, etc.) and must therefore be cleaned before being returned, see chapter 8.2 “Cleaning”.
- When returning the instrument, use the original packaging or a suitable transport packaging.

With hazardous substances, include the material safety data sheet for the corresponding medium.

To avoid damage:
1. Wrap the instrument in an anti-static plastic film.
2. Place the instrument in the packaging and evenly pad with shock-absorbent material.
3. If possible, place a bag containing a desiccant inside the packaging.

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4. Label the shipment as transport of a highly sensitive measuring instrument.

Notes on returns can be found under the heading “Service” on our local website (return application).

9.3 Disposal

Incorrect disposal can put the environment at risk.
Dispose of instrument components and packaging materials in an environmentally compatible way and in accordance with the country-specific waste disposal regulations.

Disposal of electrical equipment

This instrument is labelled in accordance with the EU Waste Electrical and Electronic Equipment (WEEE) directive. This instrument must not be disposed of with household waste.

- Hand in old instruments for environmentally friendly disposal at a designated collection point for the disposal of electrical and electronic equipment.
- Ensure proper disposal in accordance with national regulations and observe the currently applicable regulations.

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10. Specifications

10.1 Specifications to multi-functional precision thermometer

EN

Multi-functional precision thermometer	
Input	
Input channels	4
Channel 1 + 2	Resistance thermometers with 5-pin DIN connector
Channel 3 + 4	Thermocouple with standard miniature 2-pin thermocouple plug
Scanner box	Up to 4 modules
	Max. 44 channels (in total)
	Each module has 10 channels
Input connections	5-pin DIN connector or bare cable ends (resistance thermometer or thermistor)
	Standard miniature 2-pin thermocouple plug or bare cable ends (thermocouple)
Data entry format	ITS-90 and CvD for calibrated resistance thermometers; or EN 60751 standard conversion for uncalibrated resistance thermometers
	TC polynomial for calibrated thermocouples; or EN 60584 standard conversion for uncalibrated thermocouple
	Steinhart and Hart for NTC thermistors
Display update rate	500 ms
Measuring range	
PRT/SPRT	Measuring range 0 ... 500 Ω
	-200 … +962 °C [-328 ... +1,764 °F]
	3- and 4-wire measurement
Thermocouple	Measuring range -9.8 ... +76.4 mV corresponding to the range of the thermocouple E
	-270 ... +1,820 °C [-454 ... +3,308 °F]
	Types B, E, J, K, N, R, S, T in accordance with EN 60584
Thermistor	0 ... 500 kΩ
Digital display	
Display	Colour TFT display including projective capacitive touchscreen with a resolution of 800 x 480 pixels
Resolution	0.0001 K / 0.00001 Ω / 0.00001 mV
Display units	°C, °F, K, mV and Ω
Functions	
Real-time clock	Integrated clock with date
Case	
Weight	6 kg [13.2 lbs]

10.2 Accuracies

Accuracies [1)]		
Resistance thermometers		
Temperature accuracy	4-wire	Accuracy (CTR4000-A): 3.75 mK Accuracy (CTR4000-S): 5 mK
	3-wire	Accuracy (CTR4000-A): 0.03 K Accuracy (CTR4000-S): 0.03 K
Temperature conversions	Standard EN 60751, CvD, ITS-90	
Sensor currents	CTR4000-A: 0.5 mA, 1 mA, 2 mA, √2 CTR4000-S: -PT25: 2 mA, √2, -PT100: 1 mA, √2	

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10. Specifications

Accuracies [1]			
Standby currents	R_0 < 50 Ω	0 ... 125 Ω	2 mA
	R_0 ≥ 50 Ω	0 ... 500 Ω	1 mA
Measuring time	3 seconds refresh rate		
Thermocouple			
Base measurement [2]	±% of reading + µV		
	±0.004 % + 2 µV		
Temperature accuracy	Type B	±0.09 °C + ±0.025 % of reading	
	Type C	±0.57 °C + ±0.057 % of reading	
	Type D	±0.60 °C + ±0.059 % of reading	
	Type E	±0.05 °C + ±0.031 % of reading	
	Type J	±0.07 °C + ±0.030 % of reading	
	Type K	±0.09 °C + ±0.035 % of reading	
	Type N	±0.08 °C + ±0.035 % of reading	
	Type R	±0.27 °C + ±0.020 % of reading	
	Type S	±0.27 °C + ±0.020 % of reading	
	Type T	±0.09 °C + ±0.025 % of reading	
Temperature conversions	Standard EN 60584, polynomial		
Measuring time	3 seconds refresh rate		
Cold junction compensation	Internal, external or channel Accuracy internal cold junction compensation ±0.15 K		
Thermistor			
Accuracies	0 ... 400 Ω	±0.006 Ω	
	400 Ω ... 50 kΩ	±0.01 % of reading	
	50 ... 500 kΩ	±0.02 % of reading	
Temperature conversions	Steinhart-Hart, polynomial		
Sensor currents	0 ... 450 Ω	1 mA	
	400 Ω ... 45 kΩ	10 µA	
	40 ... 500 kΩ	3 µA	
Measuring time	3 seconds refresh rate		

1) The accuracy in K defines the deviation between the measured value and the reference value. (Only valid for indicating instruments.)
2) In a range of -20 ... +100 mV

10.3 Specific data for thermocouples

Specifications for thermocouples			
Types	**Working range "Temperature"**		**Working range "Voltage"**
	[°C]	**[°F]**	**[mV]**
B	250 ... 1,820	482 ... 3,308	0.291 ... 13.820
C	0...2320	-32...4208	0...+37.107
D	0...2400	-32....4352	0...+40.792
E	-200 ... +1,000	-328 ... +1,832	-8.825 ... +76.373
J	-210 ... +1,200	-346 ... +2,192	-8.095 ... +69.553
K	-200 ... +1,372	-328 ... +2,502	-5.891 ... +54.886
N	-200 ... +1,300	-328 ... +2,372	-3.990 ... +47.513
R	-50 ... +1,768	-58 ... +3,214	-0.226 ... +21.103
S	-50 ... +1,768	-58 ... +3,214	-0.235 ... +18.693
T	-200 ... +400	-328 ... +752	-5.603 ... +20.872

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10. Specifications

The maximum cable length of all attached cables e.g. temperature probe or interface cables is 2 m [6.56 ft].

To reach the maximal accuracy an ambient temperature between 17 °C and 23 °C [63 °F and 73 °F] must be fulfilled.

This instrument is intended to be used in a basic electromagnetic environment, e.g. light-industrial locations, workshops, service centres etc.

To avoid possible inferences do not install the instrument near to strong radio transmitters.

10.4 Communication

Communication	
Interface	■ Ethernet ■ USB
Command sets	■ IP ■ Netmask ■ Gateway ■ Port ■ DHCP ■ Others on request

10.5 Voltage supply and performance data

Voltage supply and performance data	
Power Supply	DC 5.9V/3A via Mensor supplied power supply model: Input: FOX30-X: AC 100-120 /200-240 V; 50/60 Hz; 0.6A

10.6 Operating conditions

Operating conditions	
Place of use	Indoor Not for wet locations
Operating temperature	0 to +45 °C [32 to 113 F]
	Maximum achievable accuracy within 17 ... 23 °C [63 ... 73 °F]
Storage temperature range	-20 ... +50 °C [-4 ... +122 °F]
Humidity	0 ... 70 % relative humidity (non-condensing)
Altitude	2000 Meters
Overvoltage Category	I
Pollution Degree	Degree 2
Wet Location	Not Applicable
Ingress Protection	IP20

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10. Specifications

10.7 Approvals

Logo	Description	Country
CE	**EU declaration of conformity**	European Union
	EMC directive EN 61326 emission (group 1, class B) and immunity (basic environments)	
	RoHS directive	

EN

10.8 Certificates

Certificate	
Calibration	■ Test report for electrical inputs ■ 3.1 calibration certificate per DIN EN 10204 (only system calibration) 1) ■ DKD/DAkkS calibration certificate for electrical inputs ■ DKD/DAkkS calibration certificate (only system calibration) 1)
Recommended recalibration interval	1 year (dependent on conditions of use)

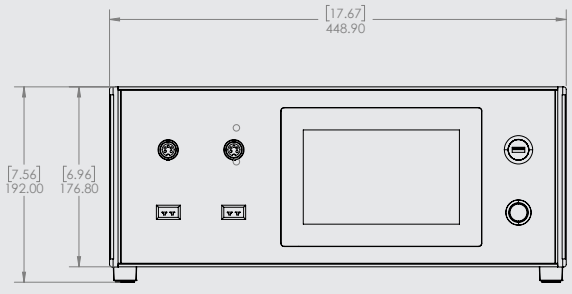
1) System calibration means the calibration of a thermometer as a measuring chain with the CTR4000

For further specifications see WIKA data sheet CT 60.25 and the order documentation.

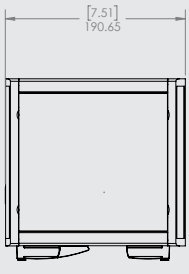
10.9 Dimensions in mm [in]

Desktop Version

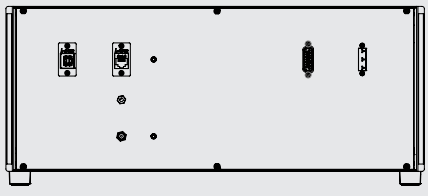
Front view



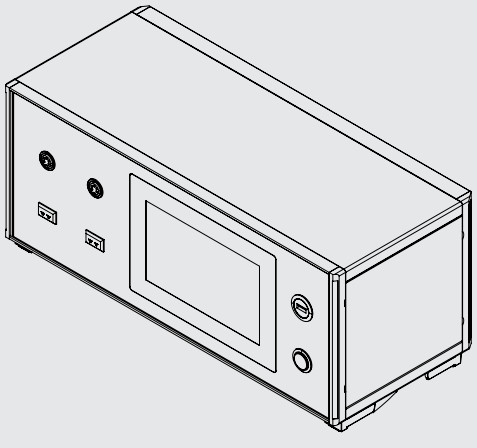
Side view (left)



Rear view

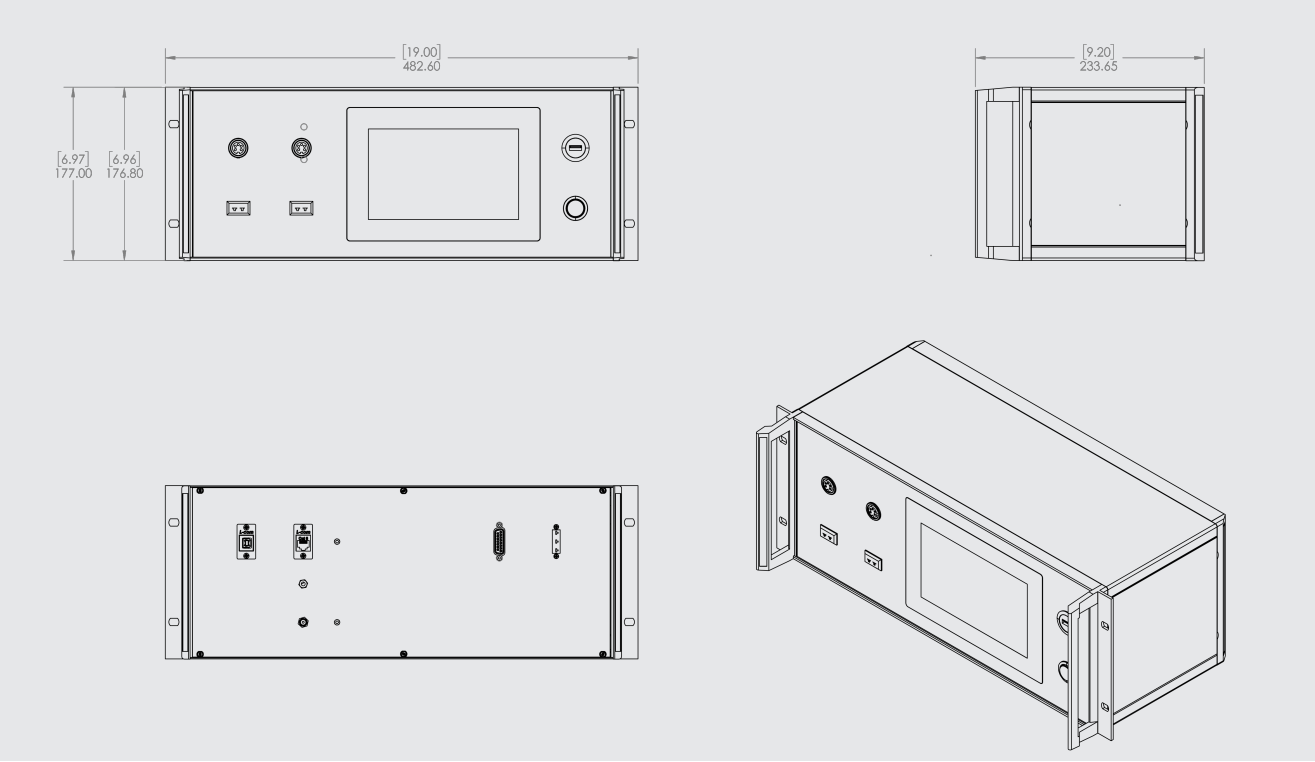


Isometric view



10. Specifications

Rack Version



5.8 Rackmount Installation Instructions:

5.8.1 Safety Precautions

- Read the full operating manual before installation.
- Ensure the device is powered off and unplugged before mounting.
- Use ESD protection when handling the device.
- Installation should be performed by qualified personnel.

5.8.2 Tools and Materials Needed

- Screwdriver
- Anti-static wrist strap (recommended)
- Measuring tape or ruler

5.8.3 Preparing the rack

- Ensure the rack is 19 inches wide, standard for rackmount equipment.
- Confirm the rack is stable and grounded.
- 5.8.4 Mounting the CTR4000

5.8.4.1 Position the Unit:

- Carefully slide the CTR4000 into the allocated rack space.

5.8.4.2 Secure to Rack:

- Align the rack ears with the rack's vertical rails.
- Use rack screws to fasten the unit securely.

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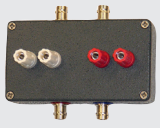
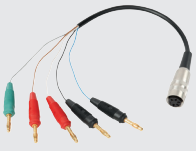
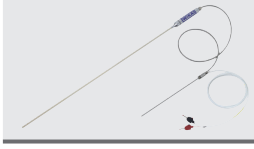
11. Accessories and spare parts

	Description	Order code
		CTX-A-A1
	**Case** Transport case, robust	-T1-
	**Multiplexer model CTS3000** 10-channel multiplexer as desktop case For resistance thermometers and thermocouples (maximum of 4 multiplexers per CTR4000)	-CD-
	**Multiplexer model CTS3000** 10-channel multiplexer with built-in case for 19" rack For resistance thermometers and thermocouples (maximum of 4 multiplexers per CTR4000)	-CR-
	**Adapter** To connect a thermometer with bare cable ends	-AD-
	**Adapter cable CTS3000** 5 x 4 mm banana plug to 5-pin DIN socket	A3
	**Adapter cable CTR4000** 5 x 4 mm banana socket to 5-pin DIN connector	AE
	**15-pin interface cable** For resistance thermometers Length: 0.75 m [2.5 ft]	I5
	**TC interface cable** For thermocouples Length: 0.75 m [2.5 ft]	I6
	Ordering information for your enquiry:	
	1. Order code: CTX-A-A1 **2. Option:**	⇓ **[ ]**

	Description	Order code
	**Temperature probe model CTP5000** Immersion probe	CTP5000
	**Thermocouple model CTP9000** Immersion probe type S With or without cold junction	CTP9000

WIKA accessories can be found online at www.wika.com.

WIKA subsidiaries worldwide can be found online at www.wika.com.

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