Schleibinger Geräte
Building Materials Testing Systems

Schleibinger Shrinkage-Drain

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Contents

1 Introduction

This user manual contains information on the safe, trouble-free and economical use of the appliance.

This information is intended for people who carry out tasks with or in connection with the appliance.

Keep this user manual or relevant parts of it ready to hand in the immediate vicinity of the appliance.

When handing over the appliance to another person, the operator passes this user manual on to this person.

2 Safety

Read and follow the instructions.

2.1 Symbols Used

This manual contains Warning and Caution statements. This information is important for safe and efficient installation and operation. The following signal words and symbols are used in this user manual:

Caution indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

Indicates a dangerous situation which, if not obviated, may result in damage to property.

2.2 Warnings

Make sure that the input voltage and frequency correspond to the device specification. This information is printed on the type label and can be found on the device in the area of the connection cable.

Connect the power supply according to the safety regulation for electrical equipment. Do not damage the power cable. Risk of injury. Damage to or destruction of the sensor.

Disconnect the power supply before servicing.

Avoid shocks and impacts to the sensor.

Avoid contact exposure of sensor to splashes of water.

Avoid exposure of sensor to aggressive media (detergents, cooling emulsions etc).

3 Intended Use

The appliance is designed for use in industrial and laboratory applications. It is used for measuring displacement, distance, position and thickness. It is used for in-process quality control and dimensional testing.

The appliance must only be operated within the limits specified in the technical data.

The appliance must be used in such a way that no persons are endangered or machines and other material goods are damaged in the event of malfunction or total failure of the controller.

Take additional precautions for safety and damage prevention in case of safety-related applications.

The appliance is intended for use in closed rooms.

4 Description of the Appliance

Cementitious building materials change their volume during the hydration. This is a known phenomenon resulting from structural and environmental processes. The process can take up to months and years reflected in shrinkage or expansion of building materials. For the most practical applications of building materials the dimension change is very harmful and has to be minimized.

For the shrinkage of cementitious materials two distinct stages can be defined which are early and later ages. The age of 24 hours and longer refer to the later age shrinkage. This is also the kind of shrinkage which is recorded by standardized test measurements where a certain strength of the material is necessary.

The early stage is commonly defined as the first day while the cementitious materials are setting and starting to harden. The change of the consistency of the cementitious material implements high requirements for a measuring system. At the plastic state, usual physical test methods can not be applied showing difficulties in measuring of the fluid materials.

The Schleibinger **Shrinkage Drains** are suitable for continuous measuring of shrinkage and expansion of mortar or concrete for long-term determination.

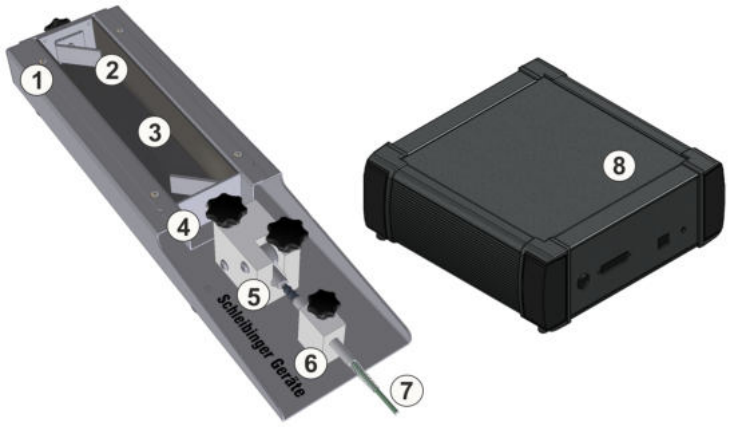
4.1 Structural Design of the Appliance

The appliance consists of a drain, sensor and data logger for the control and data logger (fig. 1).

The measurement data are recorded with the help of data logger. The measurement data can also be viewed via a web browser during the measurement.

4.1.1 Drain

For the measurement the drain (fig. 1, 1) is covered with a cellular rubber inlay (fig. 1, 2). In order to be able to use the cellular rubber inlay more often, an additional use of cling film is recommended. After the adjusting the anchors (fig. 1, 2, 4) the sample is filled into the drain.



1 drain
2 anchor
3 cellular rubber inlay
4 movable anchor
5 bearing block
6 probe support
7 digital measuring probe
8 data logger

Figure 1: Components of the Shrinkage drain equipment.

4.1.2 Anchor

Anchors are used to fix the sample and transmit the changes in length to the probe. The drain is equipped with one fixed anchor which is fixed with a screw (fig. 1, 2). After the measurement is completed, the screw is unscrewed and the anchor is removed from the sample, for example with a hammer and chisel.

4.1.3 Cellular Rubber Inlay

Cellular rubber inlay is made of compressible foam rubber and will be placed into the drain (fig. 1, 3). By using it, the wall friction is reduced and the sample is not blocked during the measurement.

4.1.4 Movable Anchor

The movable anchor serves as a transmitter of the change in length to the digital measuring probe. The anchor (fig. 1 4) is placed in the bearing block (fig. 1, 5) and remains movable during the whole measuring procedure.

4.1.5 Bearing Block

The bearing block holds the movable anchor in the measuring position (fig. 1, 5). The movable anchor is not fixed and stays movable during the measurement. The bearing block is unscrewed from the drain to remove the sample after the measurement has been completed.

4.1.6 Probe Support

The support is used for fixing the fixing stamp and later the measuring probe for the measurement (fig. 1, 6).

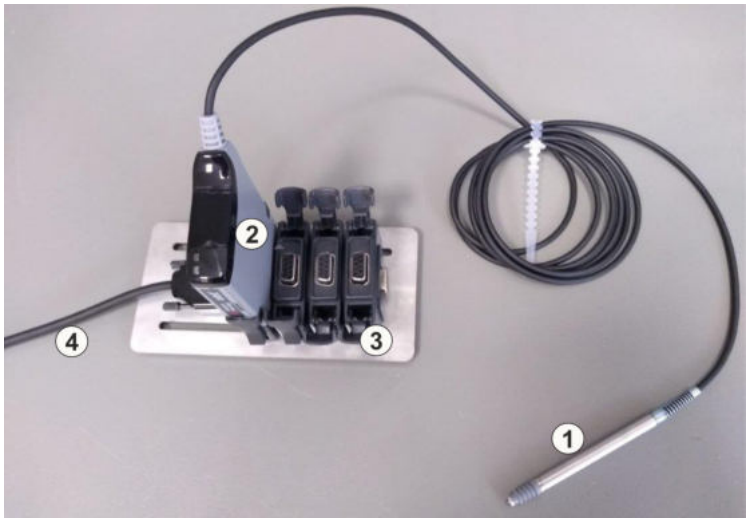
4.1.7 Digital Measuring Probe

For the measurement a digital measuring probe with spring push and 5 mm measuring range is used (fig. 1, 7). The measuring probe is a linear variable differential transformer (LVDT sensor) and shows very high resolution, excellent linearity, high data speed and very good measurement repeatability.

The measuring probe is attached to the probe support (fig. 1, 6) of the drain using a screw.

The probe is equipped with a probe interface electronics which allows the data processing and communication with the data logger. The connection with the data logger is made via T-con module (fig. 2).

The probe interface electronic is equipped with a blue LED light which is blinking every 2 seconds when the power is on and the data acquisition is running. A red LED is showing an error.



1 probe
2 probe interface electronic (PIE)
3 T-con module
4 connecting cable to the data logger

Figure 2: Digital measuring probe -LVDT sensor.

4.1.8 Data Logger

The data logger is supplied with the appliance (fig. 1 8). The data logger records the measurement values for several months depending on recording interval (sampling rate) and the amount of channels connected. The data sets are stored non-volatile in the data logger.

The logger is equipped with a network interface and can be connected to a computer directly or be integrated into a lab network. As user interface PC with an Internet browser e.g. Firefox, Chrome or Opera can be used. No special operating system of the computer is needed. Android or iOs based tablets can be used as well.

The computer must be equipped with an Ethernet network interface running the TCP/IP protocol. No special software is needed. During the measurement no running computer is needed. The configuration is described in section 6.1.

As soon the data logger get power, data acquisition starts. This is shown by blinking of the green LED "OK" at the front-side of the data logger and a LED from the measuring sensor lights up if connected. The PC is only required for setup, online monitoring and data export.

4.1.9 Thermocouples

A thermocouple can be used to measure the temperature development of the sample during the measurement.

A thermocouple is a temperature measuring device consisting of two dissimilar conductors that contact each other at one or more spots, where a temperature differential is experienced by the different conductors (or semiconductors). It generates a voltage when the temperature of one of the spots differs from the reference temperature at other parts of the circuit.

Thermocouples are a widely used type of temperature sensor for measurement and control. Commercial thermocouples are inexpensive, interchangeable, supplied with standard connectors, and can measure a wide range of temperatures. The main limitation of the thermocouples is their accuracy: system errors of less than one degree Celsius (°C) can be difficult to achieve.

There are different types of thermocouples on the market available. Type K (chromel / alumel) is the most common thermocouple type with a sensitivity of approximately $41\mu V/°C$ (chromel positive relative to alumel when the junction temperature is higher than the reference temperature) (Fig. 3].

The type K of thermocouple is cost-effective and available in a wide variety of probes with the temperature range from -200 °C to +1350 °C.[1]

NOTICE

Use Type K thermocouples provided with the device only. Otherwise the results will be incorrect!

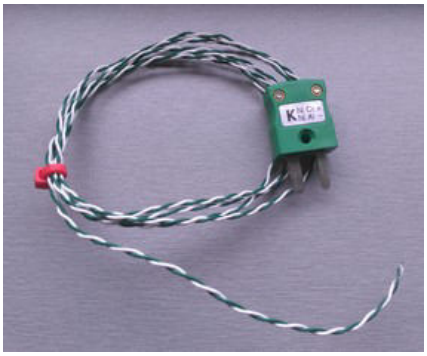


Figure 3: Thermocouple type K.

After the measurement, the thermocouple can be simply pulled out of the sample. If it is not possible, cut it off. Thermocouple can be reused by removing the insulation from the cable head and twisting the cables.

NOTICE

If no thermocouple is connected or it is broken, the temperature will still displayed. This temperature is the temperature or the cold spot at the temperature plug of the device.

[1] Text partly from: Wikipedia contributors. "Thermocouple." Wikipedia, The Free Encyclopedia. Wikipedia, The Free Encyclopedia, 31 May. 2015. Web. 5 Jun. 2015.

4.2 Technical Information

Table 1: Drain dimensions available.

mortar drain dimensions (l x w x h)	1000 x 60 x 40 mm^3 500 x 60 x 40 mm^3 250 x 60 x 40 mm^3
concrete drain dimensions (l x w x h)	1000 x 100 x 60 mm^3 500 x 100 x 60 mm^3

Table 2: Digital Measuring Probe

Measurement range	5 mm
Accuracy	0.05 % of reading
Resolution	0.05 μm
Tip force at middle of range	1mm 0.7 N
Sealing for probe	IP65

Table 3: Data Logger

dimensions (l x w x h)	24 cm x 21 cm x 6 cm
weight	approx. 1.8 kg
power supply	100 .. 240 V, 50 .. 60 Hz

Table 4: Environmental conditions for the operation of the appliance

operating temperature	0 °C to max. +50 °C
storage temperature	+5 °C ...60 °C
rel. air humidity	max. 65 %, non-condensed

5 Delivery and Installation

5.1 Delivery

After delivery, remove the appliance from the packaging.

When the packaging is no longer needed, dispose of it according to local regulations.

5.2 Installation of the Appliance

The installation should be done on the vibration free underground.

Avoid direct sunlight or other direct lights.

For the installation of the appliance proceed as following:

Shrinkage Drains should be installed in a room with a controlled air condition. The length change ratio of steel and concrete is about $12\mu m/Km$. The real working error of the complete measurement system is $< 1\mu m/K$. Mount the shrinkage drains on a table free of vibration, or place it on the wall-mounted platform.

- Plug the probe interface electronic into the T-con modules (Fig. 4). Connect the 9-pin D-Sub connector to the data logger.

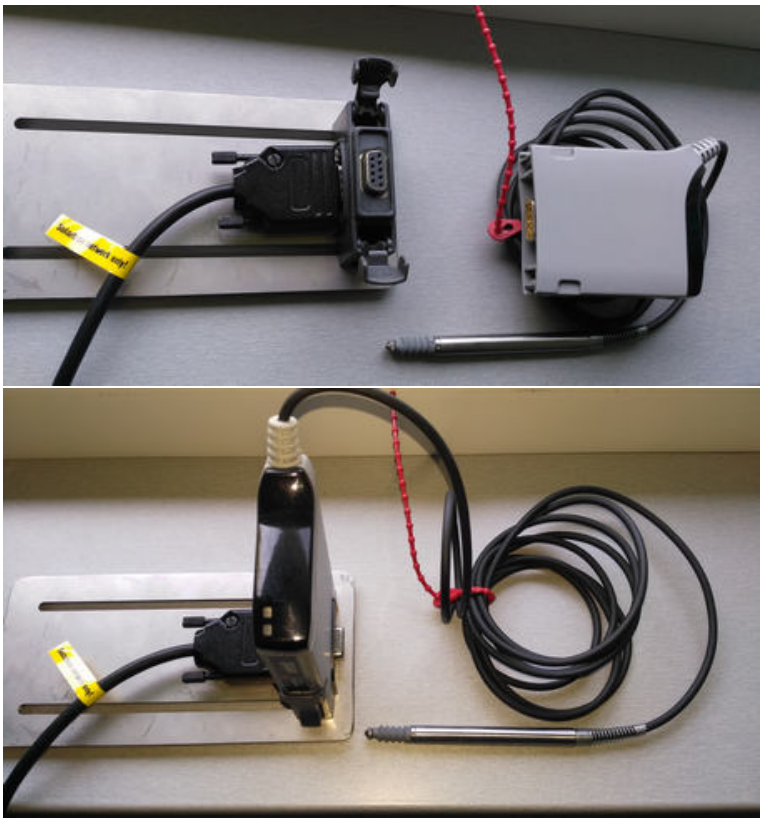


Figure 4: Connection of probe interface electronic with the T-con module.

- Connect the temperature, or temperature/humidity sensor to the connectors on the backside of the logger in an appropriate way if available.

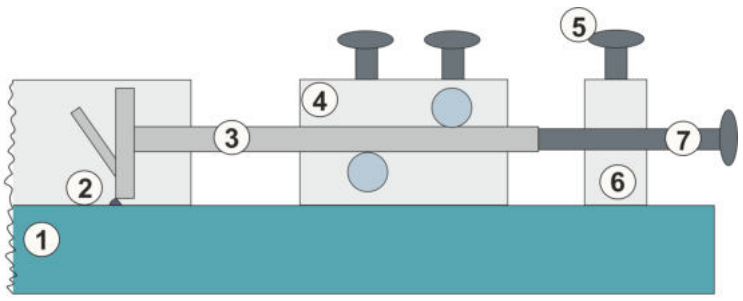
- The network cable is connected to the RJ45 plug on the front side of the data logger. If connected the green LED "Power ON" from the RJ45 socket is lighting and the yellow LED "Link" shows the connection with an active network by blinking. Configure the network interface as described in chapter 6.1.
- The data logger is delivered with a 240 V / 50 Hz power supply. Connect the power supply to the data logger. After some seconds the data logger is running and the green LED indicator "OK" should blink.
- Default set automatic IP-addressing for the data logger. The IP address can be changed by using the program Chiptool.exe for example (see also `www.schleibinger.com/chiptool`).

5.3 Preparation for Measurement

- Place the neoprene foil into the drain. You can adjust the length of the foil by stretching it a bit.
- In order to be able to use the cellular rubber inlay more often, an additional use of cling film is recommended. Place clink foil (PE foil) into the drain.
- Fix the stamp of the movable anchor on the bearing block next to probe support. Make sure the position of the stamp is equal to the marker on the drain and fix it with the **fixing stamp** at the position of the probe (Fig. 5, 6, 7).
- Close the gab between the movable anchor and the drain before filling the drain with some grease.
- Fill the drain with the fresh sample.
- After the sample is stiffened and showing some resistance remove the fixing stamp from the probe support (Fig.7) and mount the probe instead (Fig. 8). Mount the probe in the right direction. The rounded end of the probe must point towards the drain. Fix the screw with a torque of **0.25 Nm maximum** (fig. 5 (5)).

⚠ CAUTION

- **Turn on the logger after all probes have been connected!**
- Adjust each probe available at the middle of the measuring range (raw value of approx. 7000 to 8000) (see chapter 6.3.1).
- The measurement can be started (see chapter 6.3.2).



1 drain
2 grease
3 movable anchor
4 bearing block
5 fixing srcew
6 probe support
7 fixing stamp

Figure 5: Probe preparation for the measurement.

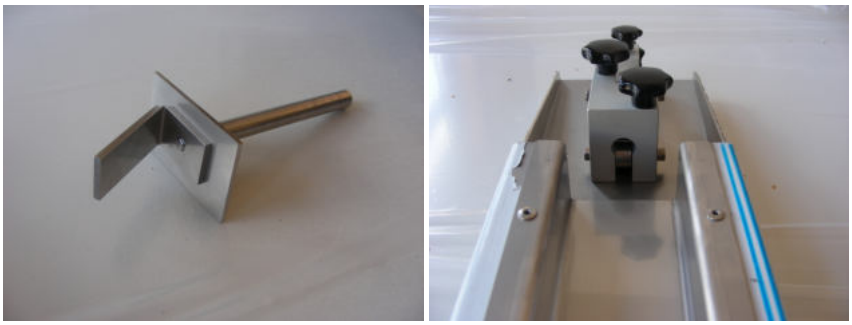


Figure 6: Movable anchor (left) and bearing block for fixing movable anchor (right)

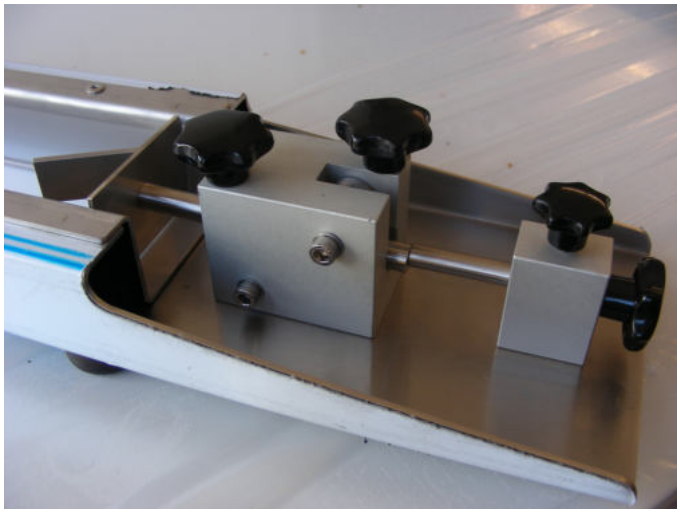


Figure 7: Fixing of the movable anchor with the fixing stamp for filling the sample.

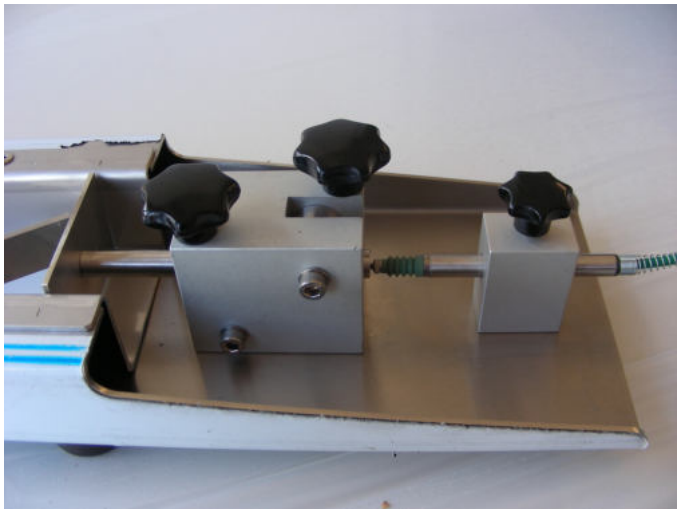


Figure 8: Fixing the measuring probe after removing the fixing stamp.

For the drain with temperature control or so called "double wall option" connect the drain to a common chiller first (Fig. 9).

⚠ CAUTION The drain with temperature control can become hot. Do not touch the hot drain!

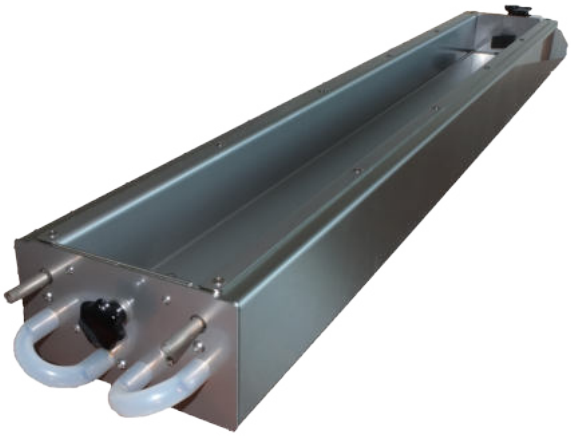


Figure 9: Shrinkage drain with the tubes for temperature control.

5.4 Running the measurement

If the drain is prepared and the measurement is started the measurement data will be collected automaticaly due to the setup was done (see also chapter 6).

The data can be displayed during the measurement graphicaly or numericaly (see also chapters 6.3.4 and 6.3.5).

5.5 Removing the Specimen

After the measurement has been finished:

- Save the data from the data logger (see chapter 6.3.5 and 6.4.5) and turn off the data logger.
- **Remove the probe first!**
- Open both screws at the bearing block and remove it.
- Open the screw at the other end of the drain.
- Remove the specimen.
- Remove the stamp from the specimen.
- Remove stubborn cement based dirt with diluted phosphoric acid if necessary. **Do not use chloride solvents!**

NOTICE Attach the bearing block in the same position as before removal!

6 Software Handling from WEB Browser

The appliance is equipped with a network interface. An internet browser allows access to the measurement data.

The appliance can be integrated into a network or connected directly to a computer.

6.1 Configuration of the Network Access

The network configuration can be done with the program Chiptool which can be found on USB stick delivered with the equipment.

The parameters for the network settings can be found on the sticker on the device.

There are two ways to access the device:

- via local network with integrated DHCP and DNS server and automatic obtaining of an IP address.
- by specifying a static IP address.

6.1.1 Obtaining IP address automatically

To connect the system to a local network with an integrated DHCP and DNS server, proceed as follows:

- Connect the appliance to your local network with the supplied network cable and switch on the device.
- Enter the host name of the appliance in the address window of your browser (see factory settings): "**http://...**" (fig. 10).

Figure 10: Access to the appliance with the host name.

The device is assigned a free IP address via the DHCP server so that it can be reached via the host name using DNS. From time to time, the DHCP server scans the network for IP addresses and the corresponding mappings of the computers on the network. This procedure may take some time.

6.1.2 Specification of IP address

Alternatively, the device can be connected via an IP address assigned to it. Assign an IP address to the device using the program „Chiptool“ or similar. To connect the device, enter the IP address in your browser's input window instead of the host name (fig. 12).

For questions about your network, please contact your IT administrator.

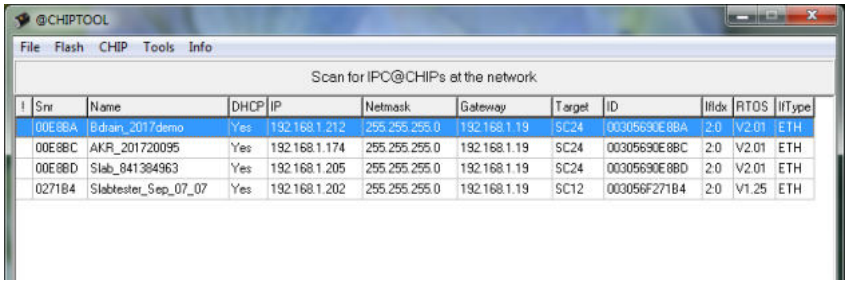


Figure 11: Reading out the IP address of the device with the Chiptool program.

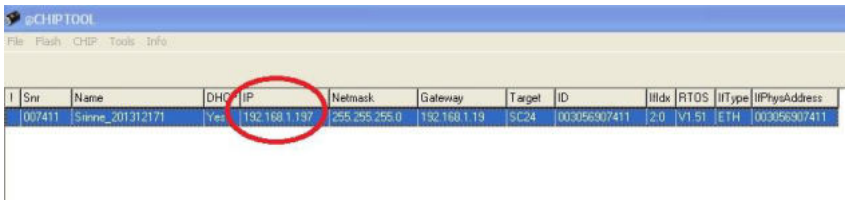


Figure 12: Access to the device with an IP address.

6.1.3 Direct connection to computer

If there is no network or it is not possible to integrate the device into a local network, the device can be connected directly to a computer as following.

1. set static IP address to the computer:

- Open `Control Panel` → `Network and Internet` → `LAN-Connection` → `Properties` (fig. 13).
- Set a static IP address from the private area e.g.: `192.168.1.1`
- Set a network mask for a local network e.g.: `255.255.255.0`.

  For Windows 10 and 11 instead of subnet-mask the subnet prefix length is required. The subnet prefix length of 24 corresponds to `255.255.255.0`. The subnet prefix length of 12 corresponds to `255.255.0.0`.
- Gateway does not have to be set.

2. set static IP address to the device:

- Use the network cable to connect the appliance to the computer on which you have just set an IP address and start the program „Chiptool“ or similar there.
- If the computer is configurated correctly, the device will appear in the program window (fig. 11).
- Highlight the entry and right-click on it. In the window select „IP Configuration“. An input window appears (fig. 14).
- deactivate there: `Use DHCP`.
- Enter a IP address from the same private range. This IP must be different from the previously assigned computer IP address e.g.. `192.168.1.184`

- Enter the same subnet mask as before for computer.
- For configuration click on `Config`.

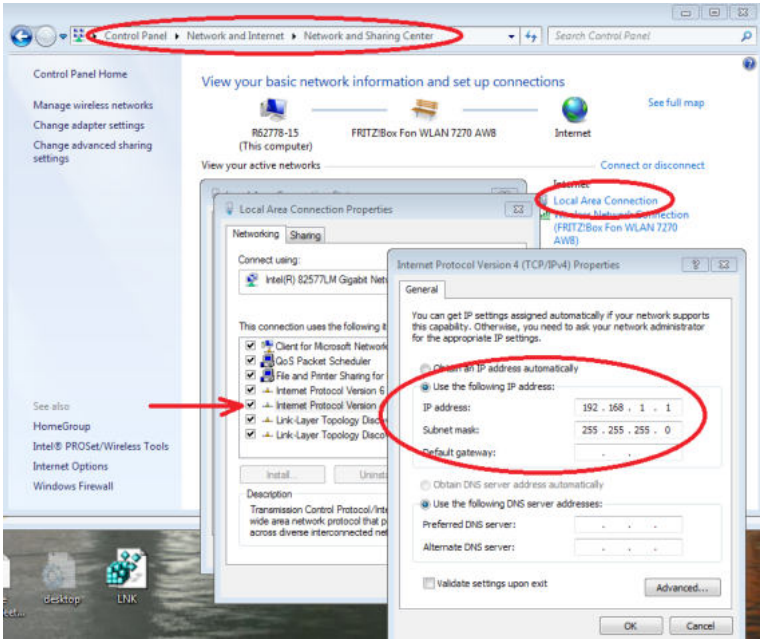


Figure 13: Computer configuration for a direct connection to the device.

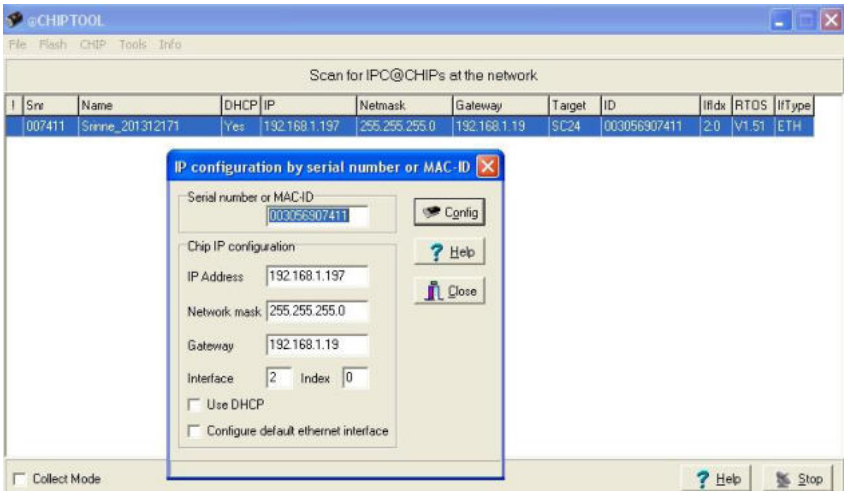


Figure 14: Device configuration for a direct connection to the computer on the program „Chiptool“.

In addition to the http protocol the file transfer protocol (ftp) can be used for readout of the data. The user name for the ftp protocol and the password are „ftp“.

For debugging purposes it is possible to login with the telnet protocol. The user name and the password are „tel“.

6.2 Main menu

Start a web browser and enter the host name or IP address in the address field of the web browser. After successful connection, the start screen is displayed (fig. 15).

In the upper part of the window the menu bar is located showing different tabs. Click on the tab to open the subdirectories.

By selecting „Schleibinger“ you will be forwarded to the Schleibinger Geräte GmbH web page:

www.schleibinger.com

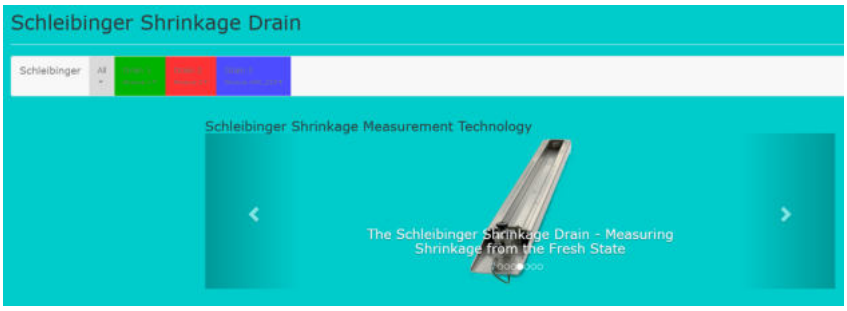


Figure 15: Start screen

In the header of the page on the left, the drop down menu **All** is shown. All channels are controlled in the same way from this menu. For example starting the measurement, set up of the real time clock, showing data from all channels numerical or graphical.

The single channels available are listed from the menu item „All“ on the right side.

6.3 Operating All Channels Simultaneously

The menu item „All“ allows to control all available channels in the same way at the same time (fig. 16).

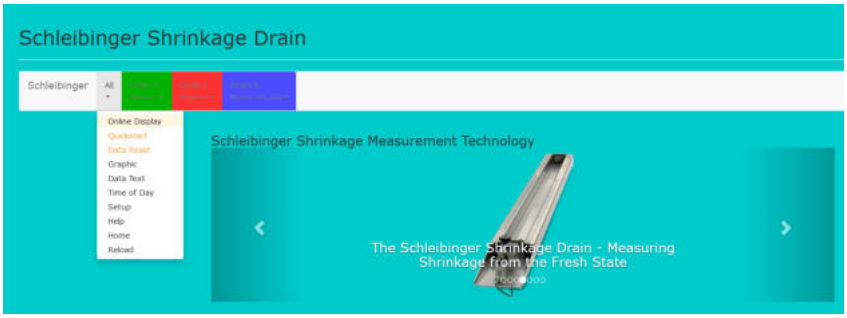


Figure 16: Main menu

6.3.1 Online Display

Using the subitem „Online Display“ the current values of all channels will be displayed in a form of a table (fig. 17).

Select the subitem „All → Online Display“ and click on „Start“. The data will be displayed and updated every 5 to 10 seconds. Select „Stop“ to stop updating the data.

Each row in the table is assigned to a sensor according to the order. The raw values are shown in the last column of the table.

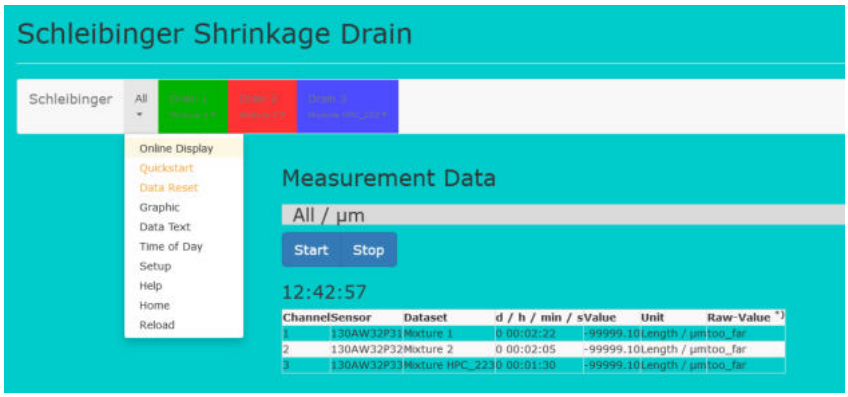


Figure 17: Main menu

Adjust the LVDT sensor of the shrinkage drain to the middle of the measuring range. Check this by displaying the raw values with: **All - Online Display** and press **Start**. The raw value should be between of 7000 and 8000.

If the probe is not connected, „too_far“ is displayed.

6.3.2 Quickstart

For starting the measurement and data acquisition, the existing data files must be deleted, an offset performed, the measurement time set to zero and the measurement itself started. All these steps for all available channels can be carried out simultaneously by using the subitem „Quickstart“ (fig. 19).

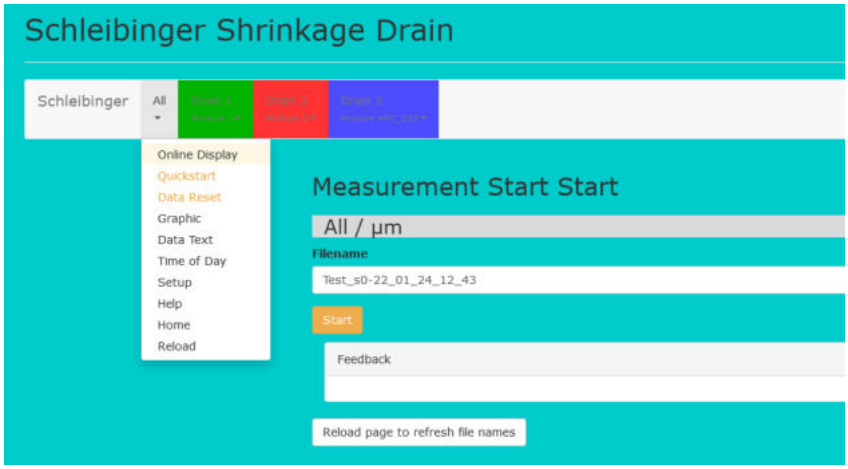


Figure 18: Main menu „Quickstart“.

NOTICE Save the measurement data first. Use of „Quickstart“ erases all data from all channels.

Select the subitem „All → Quickstart“ and click on „Start“.

Optionally, a filename can be entered. This name will appear for all channels in the main menu bar and in the table of the submenu „Online Display“ in the column „Dataset“.

6.3.3 Data Reset

With the subitem „Data Reset“ all the data of all channels will be reset at the same time.

Select the subitem „All → Data Reset“ and click on „Erase“.

6.3.4 Graphic

All the measured values will be displayed from the subitem „Graphic“.

Select the item „All → Graphic“. (fig.

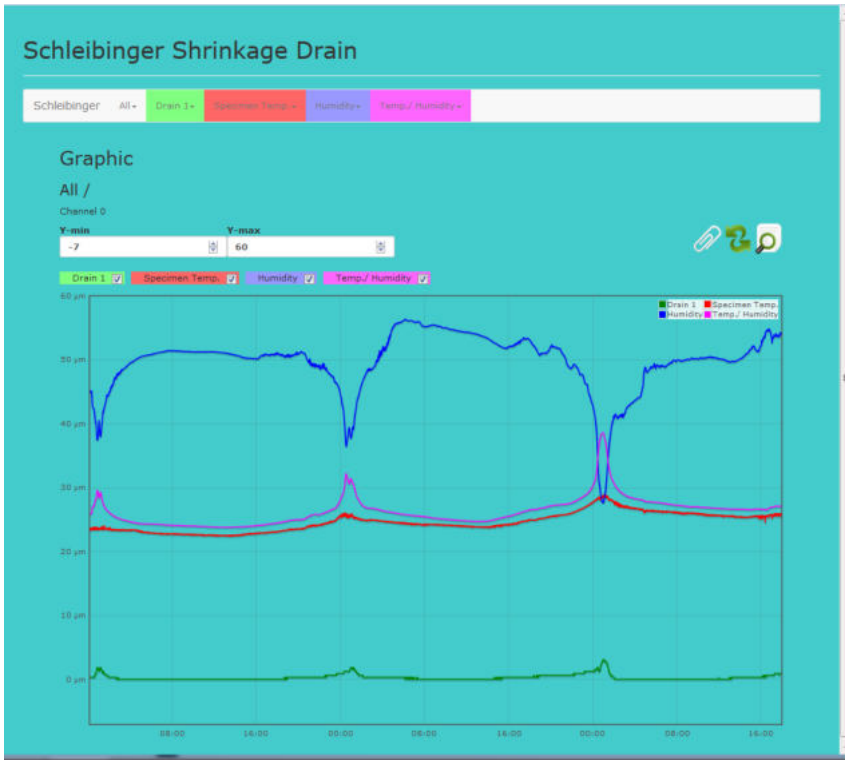


Figure 19: Submenu „Graphic“.

The graphical display can be customized. Please note, the display of the data in the web browser may vary depending on the browser.

Selection of the channel: The buttons above the graphic allow the selection of the channels to be displayed. The color of the measurement curves corresponds to the color of the respective channel. After the selection, update the graph with the icon „double-arrow“.

Selection of measuring range in the Y direction: The graph is scaled automatically. By entering in the fields **Y-min** and **Y-max** the graph can be adjusted individually in the Y-axis (temperature axis).

Selection of the measuring range in the X direction: A section on the X-axis (time axis) can be determined with the mouse. Press the left mouse button and mark the area of the graph to be displayed.

For zoom out use the icon „magnifying glass“.

Inserting text: By selecting the icon „paper clip“a text box opens in the graphic area. Comments or notes can be entered there. For closing the box select the cross on the box.

Printing the graph: Use the print function of the browser.

Firefox: Select „current frame“from the print dialogue to print the graphic without menu items.

Internet Explorer 9 and others: For the most browsers it is possible to open the print dialogue by pressing the right mouse button and thus print the graphic without menu items or to safe the graph as a pdf file.

6.3.5 Data Text

The measurement values will be stored locally on the data logger. The data remains stored even if there is no power.

Select the subitem „All → Data Text“ and click on „Load“. The measured values are displayed (fig. 20). The data file generated contains all data from all channels in tabular form.

By selecting menu item „Clear Screen“ the data is hidden and not displayed.

The data can be copied directly into an Excel sheet, Word or similar. Save the data as txt file using „Strg-S“.

Alternatively, the data can be read in Excel. Select the tab `Save Link as...`. A new window with the measured data opens. Copy the website address:

for example: `http://192.168.1.186/DATEN/DATA0.TXT`

and import the link in Excel via `Data → from the web`.

The data can also be transferred directly from the browser to desired program via copy and paste.

The measurement data are presented in tabular form and are separated by tab characters. The column assignment is listed in table 5.

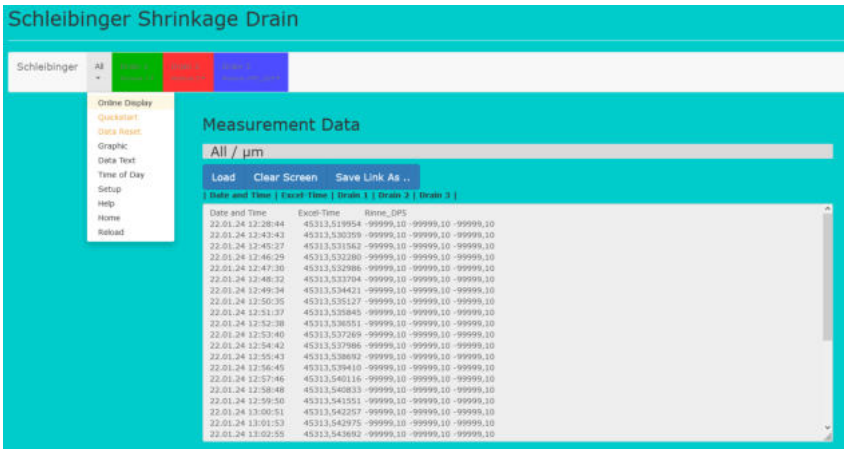


Figure 20: All channels data as text file

Table 5: Measurement data column assigment as example.

column	assigment
1	date and time
2	fracture of a day since January 1^{st}, 1900, to be formate in Data:Time
3	channel 1 - drain 1
4	channel 2 - drain 2
5	channel 3 - drain 3
6	channel 4 - temperature from the thermocouple type K

In addition to the http protocol the file transfer protocol (ftp) can be used for readout of the data. The user name for the ftp protocol and the password are „ftp“. The datasets can be found in folder:

`/httpd/htdocs/daten`

Filezilla (free software), wise-ftp or similar programs are recommended.

6.3.6 Time of Day

From the „All → Time of Day“ date and time can be adjusted (fig. 21). The data logger uses the 24-hour clock setting. The European time format is used.

day.month.year:hour:min for example `26.03.03:12:11`.

Use „Set Date and Time“ button for confirmation.

NOTICE

Do not change the time during the measurement.

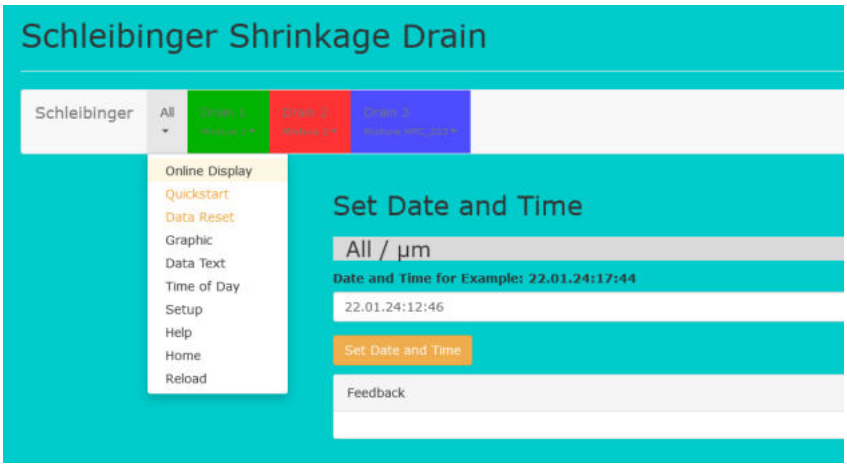


Figure 21: Setup of date and time

6.3.7 Setup

From the submenu „Setup“ the sampling rate of the comprehensive data file can be specified (fig. 22). This shows the recording rate for all channels combined in „All → Data Text “.

The values of 30 s, 1 min, 5 min, 15 min, 30 min, 1 h or 4 h can be selected (fig. 23).

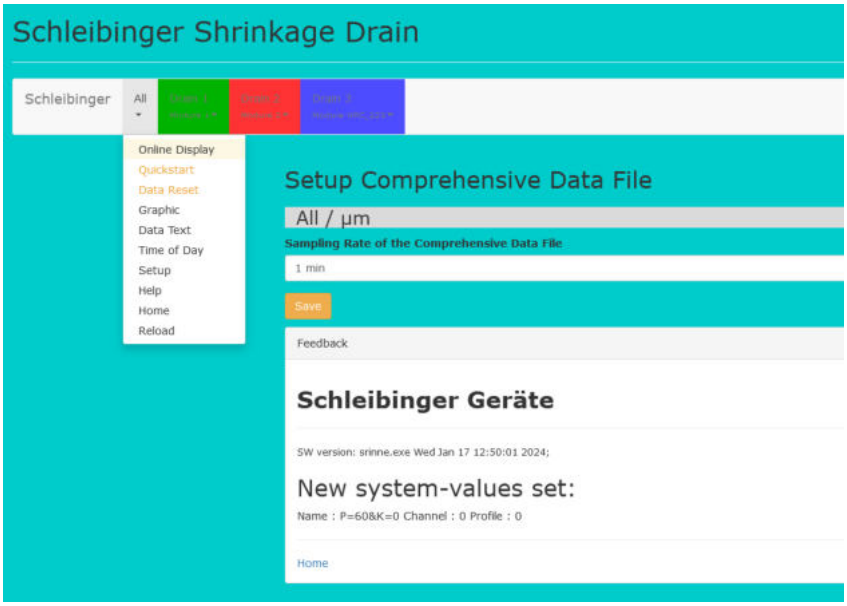


Figure 22: Setup for the comprehensive data file.

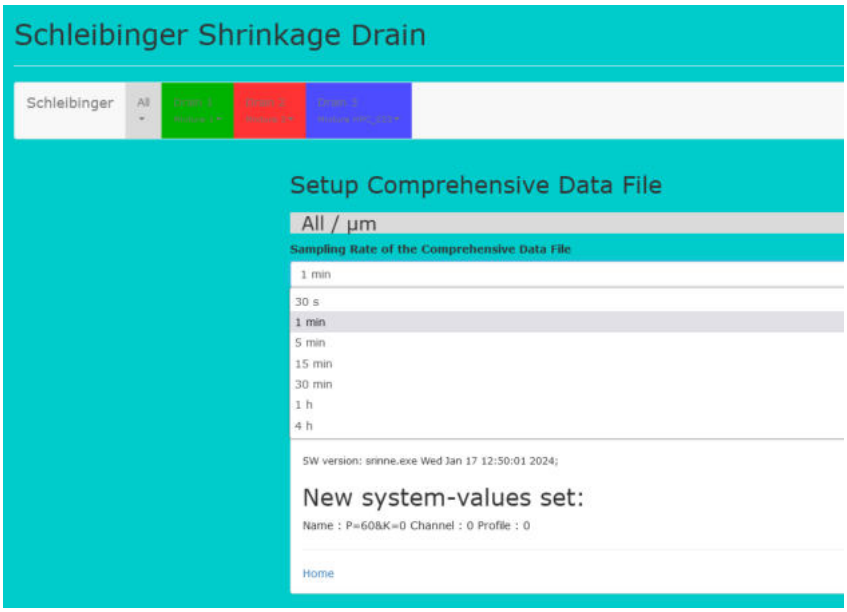


Figure 23: Sampling rate values for the comprehensive data file.

6.3.8 Help, Home and Reload

Use the subitem „Help“ to get the user manual in pdf format.

Use the subitem „Home“ to go back to the main menu.

Use the subitem („Reload“) to reload the website view.

6.4 Operating Single Channel separately

The operation of a single channel (sensor) can be done separately. This is particularly interesting when there are several identical sensors (channels) that should be started independently of each other.

6.4.1 Offset

To record relative changes in the measured values, an offset should be carried out before starting the measurement. To do this, proceed as follows:

- Select the channel in the main menu bar.
- Select the submenu item „Offset“.
- Click on „Value=0“ (fig. 24). The current measured value will be set to offset value and will be automatically subtracted from all measured values.

NOTICE

This function is not available for the thermocouple and the combined humidity and temperature sensor.

6.4.2 Start

The start setting can be carried out for each individual channel separately or for all channels together (see chapter 6.3.2).

Starting the measurement of the individual channel requires the usage of the submenu item „Start“ from the designed channel (sensor).

Figure 24: Offset zero

Figure 25: Measurement start

- Select the channel from the main menu bar.
- Select submenu item „Start“ (fig. 25).
- If needed, insert the name of the measurement.
- Click on „Start“

6.4.3 Data Reset

The measured values are continuously recorded by all connected sensors once connected to power. For each individual measurement, the previously recorded values for individual channel (sensor) can be deleted separately.

Use the submenu item „Data Reset“ from the designed channel (sensor) to emptying the data file.

- Select the channel from the main menu bar.
- Select submenu item „Data Reset“.
- Click on „Erase“

6.4.4 Graphic

The measured values from the individual channel is displayed from the subitem „Graphic“.

The graphical display can be customized (see also chapter 6.3.4). Please note, the display of the data in the web browser may vary depending on the web browser.

6.4.5 Data Text Single Channel

For each channel text data file is available. For the first channel **data1.txt**, for the second channel **data2.txt** and for the following channel *n* **data*n*.txt** accordingly will be generated.

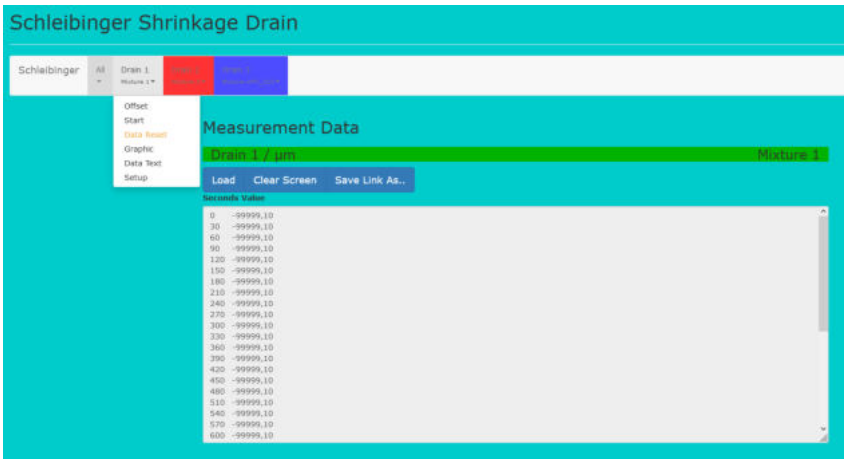


Figure 26: Measurement values of single channel as text file

- Select the desired channel from the main menu bar.
- Select „Data Text“ and use „Load“ for displaying the data of the selected channel (fig. 26).
- In the first column seconds since start of the measurement are shown. In the second column the measured values are displayed. The unit of the measured values corresponds to the channel was used and is shown under the header line.
- All columns are separated by tabs.

By selecting menu item „Clear Screen“ the data is hidden and not displayed.

The data can be copied directly into an Excel sheet, Word or similar. Save the data as txt file using „Strg-S“.

Alternatively, the data can be read in Excel. Select the tab `Save Link as...`. A new window with the measured data opens. Copy the website address:

for example: `http://192.168.1.186/DATEN/DATA1.TXT`

and import the link in Excel via `Data` → `from the web`.

The data can also be transferred directly from the browser to desired program via copy and paste.

The measurement data are presented in tabular form and are separated by tab characters. The column assignment is listed as following:

- first column: seconds since reset according to sampling rate.
- second column: measured value

6.4.6 Setup Single Channel

The configuration of each single channel can be done from the submenu item „Setup“ (fig. 27). Select the desired channel from the main menu and click on „Setup“. Following settings are possible:

- The sampling rate can be adjusted from the „Sampling Rate“ in the range of 10 seconds to 4 hours. The corresponding measurement values are recorded according to the set interval.

- The limit value for each channel from the „Limit“ can be specified. If the limit is set to ∞ the data will be collected according to the set recording interval of the sampling rate. If the limit is set to for example to n=5 the data logger will record the additional data where the difference of the measured value between two measurement points bigger than 5. This gives the possibility to record the changes in the measured value independent from the set recording interval. The unit of the limit value is due to the channel selected.
- From the „Time Format“ the format of the recording interval can be set. Two possibilities are available: „Time/s“ and „n · sampling rate/s“.

  With „Time/s“ the sampling interval may vary for ± 1 second due to small deviations in the response time of the several software processes running on data logger.

  With „n · sampling rate/s“ the actual measuring time is rounded down to the interval of the sampling rate.

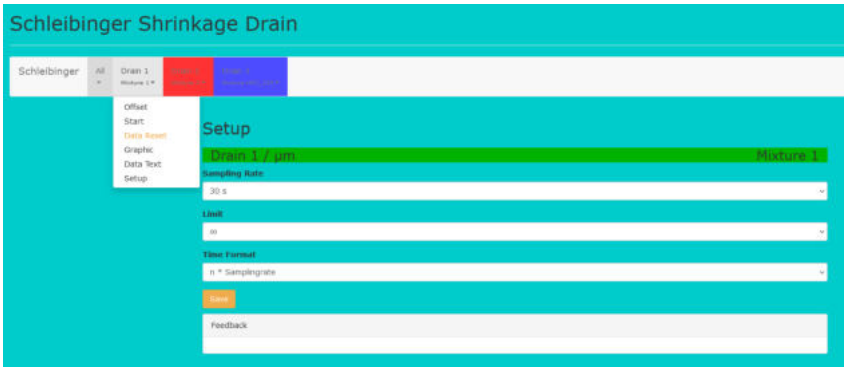


Figure 27: Channel setup

7 Service Hints and Maintenance

7.1 Cleaning the Appliance

Keep the appliance and individual components clean.

⚠ CAUTION Before cleaning always switch off the appliance.

The cleaning of the appliance and individual components must be carried out by the user after each use.

Use a commercially available mild cleaning agent.

Use a lint-free cloth or sponge to clean.

Handle the probe with care!

NOTICE Do not use abrasive sponges or scourers. Do not use concentrated cleaning agent and never use cleaning agents containing sand, chloride or acid of chemical solvents, as these would damage the surfaces and could cause corrosion.

7.2 Probe Check

The probe (also sensor) is calibrated from the manufacturer. User can not calibrate the probe. However, the user can and should check the probe regularly.

The usage of gauge blocks with different heights is recommended. The height of the gauge blocks must be within the measuring range of the probe.

For the check of the measured values proceed as following:

- Place the gauge block under the sensor.
- Adjust the sensor as for the measurement.
- Perform offset - the value is set to zero.
- Remove the gauge block.
- Read the value from the „Online Display“. The value should correspond to the height of the gauge block.
- Log the value if necessary.
- Repeat the procedure for an other gauge block.

Define a reasonable tolerance range for the measurement data. If the values deviate significantly from the specified values of the gauge blocks, contact the manufacturer of the appliance.

For the check of the long-term stability of the measuring value proceed as following:

- Make sure the appliance is stable and vibration-free.
- Place the gauge block under the sensor. Other materials that do not change over time and temperature and have a very smooth surface can also be used.
- Adjust the sensor as for the measurement.
- Perform „Quickstart“
- Let the measurement run for some hours or days.

- Check the curve from the submenu item „Graphic“.
- Log the curve if necessary.
- compare the results with the previous measurements.

The readings may drift over time. Define a reasonable tolerance range for the measurement data. If the values deviate significantly, contact the manufacturer of the appliance.

8 Decommissioning and Disposal

For the decommissioning clean up all parts of the appliance. To protect against rust, the appliance can be rubbed with a lint-free cloth soaked in oil.

The appliance can be stored at temperatures from +5 °C to +60 °C, non-condensing.

The appliance contains valuable materials and must be collected separately from unsorted municipal waste. The disposal of disused appliance must be carried out professionally and properly in accordance with the locally applicable regulations and laws.

Information about proper disposal can be obtained from the city or local authority or a waste disposal company.

The company Schleibinger Geräte GmbH will take the appliance back free of charge. The user bears the costs for an environmentally friendly delivery.

9 Additional Informations

9.1 Theory of Operation

Using the Schleibinger Shrinkage Drain measuring of the volume change during the hydration of cementitious materials or similar can be done. The shrinkage drain mould is filled with fresh sample. A length change sensor is adjusted on the mold. For this purpose at least one side of the mould is movable. Figure 28 shows the Shrinkage Drain with a length of 25 cm.

The common length of the mould is one meter. Other length are available upon request.

The volume change of building materials is done three-dimensionally and is not absolutely isotropic. To avoid the blockage which can occur due to non-isotropic behaviors inside the mould a non sucking but compressible rubber sheet (about 1..2 mm) is placed. In order to ensure a free movement in the y and z directions the movable anchor is not fixed. For this reason a gap between the anchor plate and the wall of the drain is necessary. This gab can be easily sealed with some elastic materials like ordinary grease. The anchors itself show some kind of elasticity regarding to the length changes between the start and the end point of the anchor.

The sensor has an accuracy of about ±2 µm at a stroke of 5 mm.

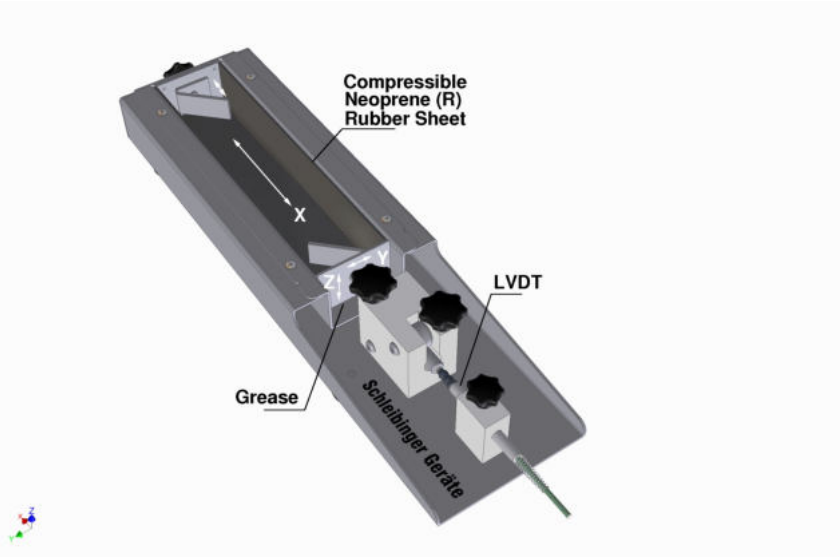


Figure 28: Shrinkage Drain with Neoprene sheet

9.2 Interpretation of the Results for Further Analysis

For the interpretation of the results please note:

- increasing values of the length means expansion of the sample.
- decreasing values of the length means shrinkage of the sample.

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