THORLABS

Environmental Measurement

TSP01
Operation Manual

2018

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Contents

We aim to develop and produce the best solutions for your applications in the field of optical measurement techniques. To help us to live up to your expectations and constantly improve our products, we need your ideas and suggestions. We and our international partners are looking forward to hearing from you.

Thorlabs GmbH

Warning

Sections marked by this symbol explain dangers that might result in personal injury or death. Always read the associated information carefully before performing the indicated procedure.

Attention

Paragraphs preceded by this symbol explain hazards that could damage the instrument and the connected equipment or may cause loss of data.

Note

This manual also contains "NOTES" and "HINTS" written in this form.

Please read this advice carefully!

1 General Information

The TSP01 is a device of the size of a USB thumb drive that can be plugged to any USB port for reading up to three different temperature values and relative humidity.

The combined humidity and temperature sensor is embedded into the USB stick, a second NTC temperature sensor TSP-TH is included and can be connected to the housing. A third optional temperature sensor can be plugged to the USB housing. External temperature sensors can be an additional Thorlabs TSP-TH or any other NTC type sensor. The Thorlabs TSP01 Application software allows to enter individual NTC parameters, such as R0 (reference resistance), T0 (reference temperature) and the B coefficient.

The TSP01 can be run and data can be displayed in the Thorlabs TSP01 Application software as a separate GUI. Alternatively, the TSP01 can be run from the Thorlabs' Beam Profiler Software.

Further, users have the choice to write a separate application or use a third party GUI. For this, please see the chapter Write-Your-Own-Application 19.

Attention

Please find all safety information and warnings concerning this product in the chapter Safety 33 in the Appendix.

1.1 Ordering Codes and Accessories

TSP01	Temperature and Humidity USB Sensor Probe with external temperature sensor
TSP-TH	External temperature probe for TSP01

2 Getting Started

2.1 Parts List

Inspect the shipping container for damage.

If the shipping container seems to be damaged, keep it until you have inspected the contents for completeness and tested the TSP01 mechanically and electrically.

Verify that you have received the following items within the package:

1. TSP01: Temperature and Humidity USB Sensor Probe
2. TSP-TH: External Temperature Probe for TSP01
3. USB Extension Cable, 1.8 m
4. Quick Reference

2.2 Requirements

The TSP01 is controlled and data read out is monitored through software on a connected PC.

Users have the choice to either use the Thorlabs TSP01 Application software as a separate GUI or to run the TSP01 from other Thorlabs' software such as the Beam Profiler Software.

Users are also free to write a separate application or use a third party GUI. For this, please see the chapter Write-Your-Own-Application 19.

The following are the requirements for the PC to be used for remote operation of the TSP01.

2.2.1 Hardware Requirements

CPU	1 GHz or higher
RAM	512 MB or more
Graphic Card	at least 32 MB memory
Graphic Resolution	min. 1024 x 768
Hard Disc	min. 100 MB of available disk space (32 bit) min. 100 MB of available disk space (64 bit)
Interface	free USB 2.0 port, USB cable according the USB 2.0 specification

2.2.2 Software Requirements

The TSP01 software is compatible with the following operating systems:

- Windows® XP (32-bit) SP3
- Windows® Vista (32-bit, 64-bit)
- Windows® 7 (32-bit, 64-bit)
- Windows® 8.1 (32-bit, 64-bit)
- Windows® 10 (32-bit, 64-bit)

Note

As of 12/2018, Thorlabs introduces the TSP01 revision B. These revised TSP01 devices are labeled "RevB" on the underside and use an instrument driver that no longer requires NI-VISA™. For operation of the previous version of the TSP01 without the RevB label, NI-VISA™ (version 5.1 or higher) is required for the driver.

The NI-VISA™ engine can be installed from the following sources:

- The software CD shipped with previous-revision TSP01 sensors (not labeled RevB). The installer includes NI-VISA™.
- The National Instruments' website www.ni.com

2.3 Software Installation

Please download the TSP01 Application from the software tab on the TSP01 website.

Attention

Do not connect the TSP01 to the PC during software installation! Please make sure that the installation is carried out completely, including the reboot requests.

- Save the ZIP file to your computer and unpack the archive.
- Double click the setup.exe to install Shield Wizard.
- Read and accept the End-user License Agreement.
- Note the Readme Information during the installation process:

"V 2.0: - Temperature sensor TSP01 RevB supported (includes a new library TLTSPB)

- NIVISA Runtime removed from installer. "

NI-VISA™ has been removed from the installer since it is not required for TSP01 sensors labeled "RevB". TSP01 sensors without the RevB label will require the installation of NI-VISA™ software.

3 Operating Instructions

After installation of the software connect the TSP01 to a free USB 2.0 port.

Note

The TSP01 should always be positioned away from heat and humidity sources that are not of interest for the measurement to prevent background. For this, the 1.8 m USB cable is supplied to position the TSP01 away from the PC/HUB.

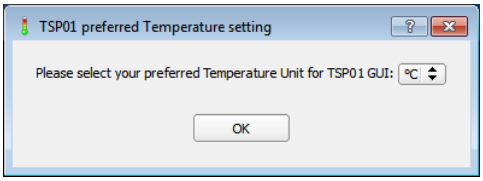
The operating system recognizes a USB device and automatically installs the device drivers.

Start the GUI from the desktop icon.

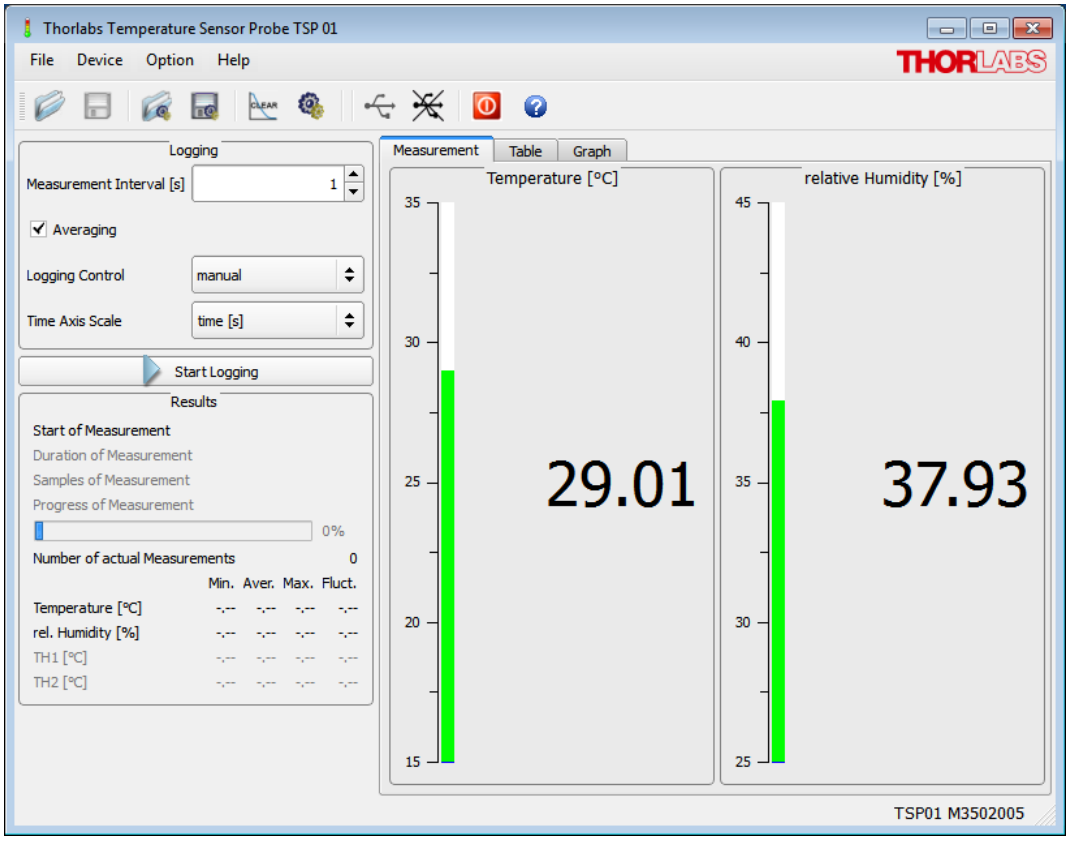
For detailed information on how to use the TSP01 Application software, please see the chapter Detailed GUI Description 11.

3.1 Quick Start

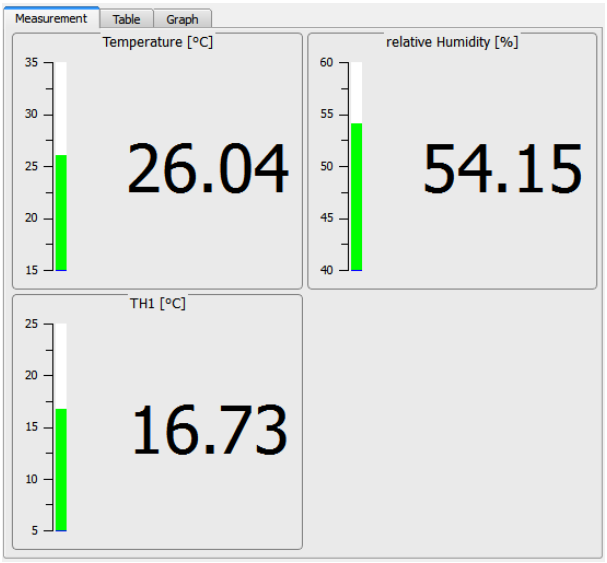
This chapter gives a short overview on how to use the TSP01 Application. A detailed description of the GUI can be found in the chapter Detailed GUI Description 11.



At the first connect, you will be prompted to select the preferred unit for temperature display. Confirm your choice with "OK". The software now automatically connects to the TSP01 and the actual temperature and relative humidity are displayed as measured on the internal sensor. If an external sensor is connected, it will be recognized and enabled automatically, and the temperature of the external sensor is now displayed.



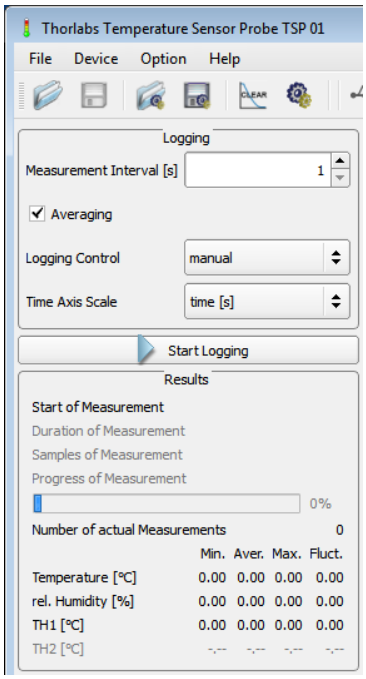
Tab Measurement



The **Measurement** tab displays the actual measurement values of all enabled sensors in numerical values and within a bar.

The bar indication range can be set individually in the Settings 12 menu. Additionally, two limits can be defined for each bar that control the bar color (blue - green - red) depending on the actual value with respect to these two limits.

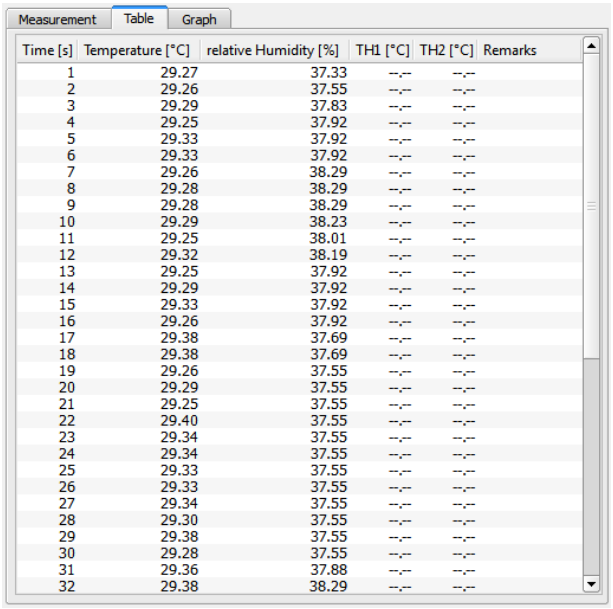
Logging Panel



- **Logging Control**: Choose between: manual start/stop, timed logging or logging of a number of samples.
- **Measurement Interval**: Set the logging interval (time between two measurements) between 1 and 10000 seconds.
- **Averaging**: Averaging unchecked: A single measured value per selected measurement interval will be logged.

  Averaging checked: All values that are measured each second within the selected measurement interval will be averaged and only this average value will be logged. Only one single value will be logged for both options.
- **Time Axis Scale**: Three selections are available: time in seconds, time in hh:mm:ss and time stamp (date and time). The complete time stamp will be displayed only in the Table Tab.
- **Start / Stop Logging:** This is a toggle button to start / stop logging.
- **Results:** In this pane logging statistics are displayed.

Tab Table



Time [s]	Temperature [°C]	relative Humidity [%]	TH1 [°C]	TH2 [°C]	Remarks
1	29.27	37.33	--.--	--.--	
2	29.26	37.55	--.--	--.--	
3	29.29	37.83	--.--	--.--	
4	29.25	37.92	--.--	--.--	
5	29.33	37.92	--.--	--.--	
6	29.33	37.92	--.--	--.--	
7	29.26	38.29	--.--	--.--	
8	29.28	38.29	--.--	--.--	
9	29.28	38.29	--.--	--.--	
10	29.29	38.23	--.--	--.--	
11	29.25	38.01	--.--	--.--	
12	29.32	38.19	--.--	--.--	
13	29.25	37.92	--.--	--.--	
14	29.29	37.92	--.--	--.--	
15	29.33	37.92	--.--	--.--	
16	29.26	37.92	--.--	--.--	
17	29.38	37.69	--.--	--.--	
18	29.38	37.69	--.--	--.--	
19	29.26	37.55	--.--	--.--	
20	29.29	37.55	--.--	--.--	
21	29.25	37.55	--.--	--.--	
22	29.40	37.55	--.--	--.--	
23	29.34	37.55	--.--	--.--	
24	29.34	37.55	--.--	--.--	
25	29.33	37.55	--.--	--.--	
26	29.33	37.55	--.--	--.--	
27	29.34	37.55	--.--	--.--	
28	29.30	37.55	--.--	--.--	
29	29.38	37.55	--.--	--.--	
30	29.28	37.55	--.--	--.--	
31	29.36	37.88	--.--	--.--	
32	29.38	38.29	--.--	--.--	

In the tab **Table** all logged data versus time are displayed numerically.

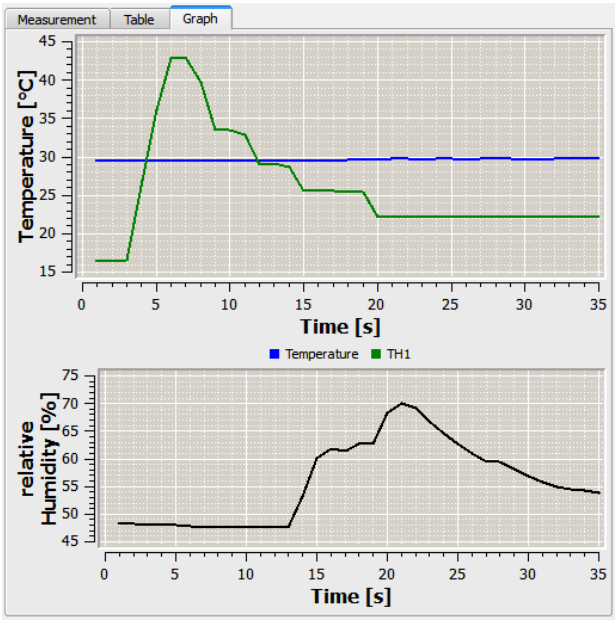
Column description:

Time: Format as selected for "Time Axis Scale"

Results: The values from all sensors are displayed. If an external sensor is not enabled or not present, the values show "--.---"

Remarks: This column is empty if no error occurred. Otherwise, an error message will be displayed.

Tab Graph

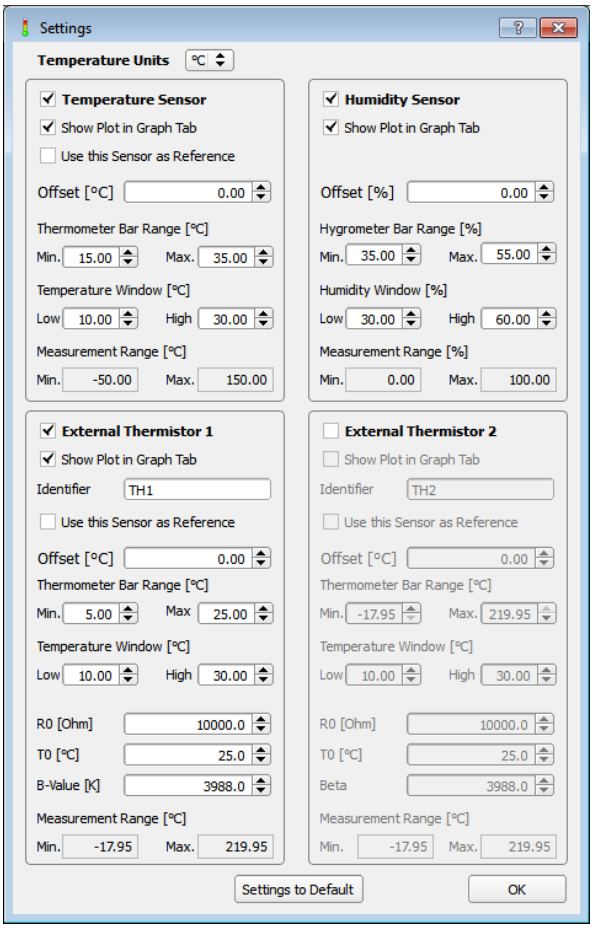


If enabled in the Settings 12 menu, the tab **Graph,** will display all logged data versus time.

Temperature: Up to three curves can be displayed: blue for internal sensor, green for external sensor TH1 and red for external sensor TH2.

Rel. Humidity: If enabled, the relative humidity value versus time will be shown in black color.

Settings panel



To adjust settings, click to the  icon or select "Settings" from the "Option" menu.

From this panel you can adjust the appearance of the GUI, change thermistor settings and enable/disable a sensor. Tool tips appear when moving the mouse pointer over the appropriate parameter.

Detailed explanations can be found in the chapter Detailed GUI Description 11.

In the following section the functionality is described in detail.

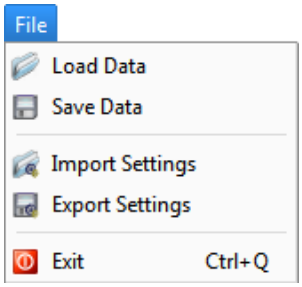
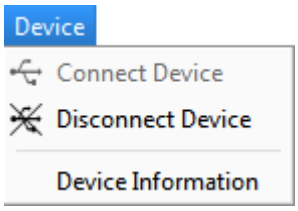
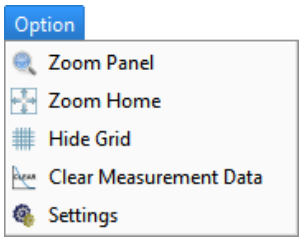
3.2 Detailed GUI Description

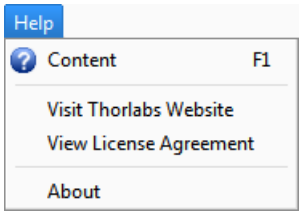
The Graphic User Interfaces automatically connects to the detected TSP01. The software starts with the most recent settings and configuration.

3.2.1 Controls

TSP01 GUI Controls

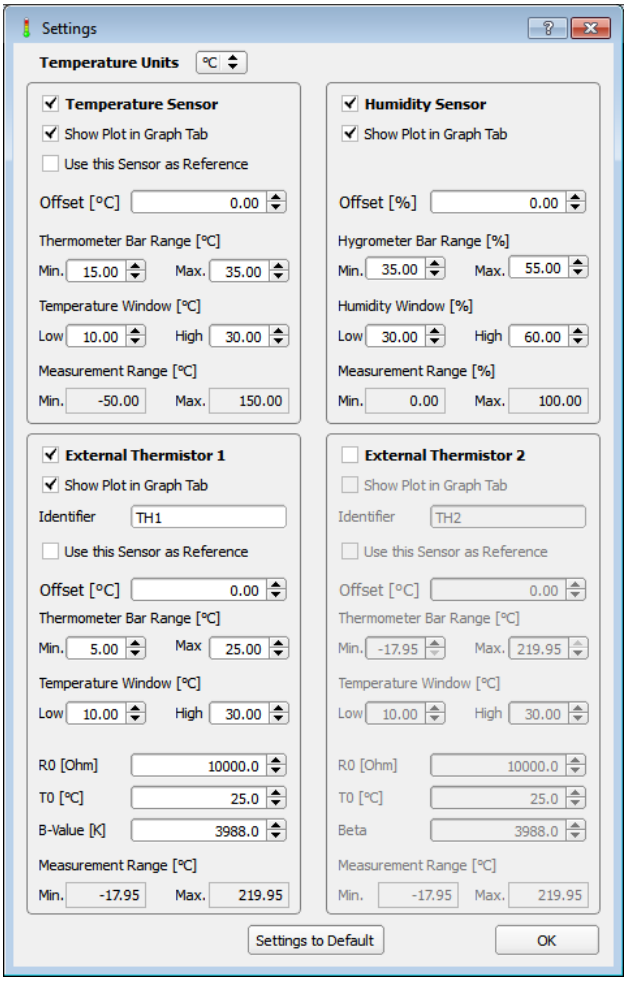
The following table summarizes the function of controls. For detailed information, click to the text in the **Function** column.

Menu	Menu Topic	Icon	Function
	Load Data		Load measurement data from a file 16
	Save Data		Save measurement data to a file 16
	Import Settings		Import configuration file 17
	Export Setting		Export configuration to a file 17
	Exit		Exit GUI
	Connect Device		
	Disconnect Device		
	Device Information	-	Recall TSP01 info 18
	Zoom Panel *)	*)	Opens Zoom Dialog panel (Graph axes) 14
	Zoom Home *)	*)	Resets zoom of Graph display 14
	Hide Grid *)	*)	Hide / show grid in Graph display 14
	Clear Measurement Data		Clears all logged data
	Settings		Opens Settings dialog panel 12

Menu	Menu Topic	Icon	Function
	Visit Thorlabs Website View License Agreement		
	About		Display info about the software 29

*) Option is displayed only when **Graph** tab is selected

3.2.2 Settings

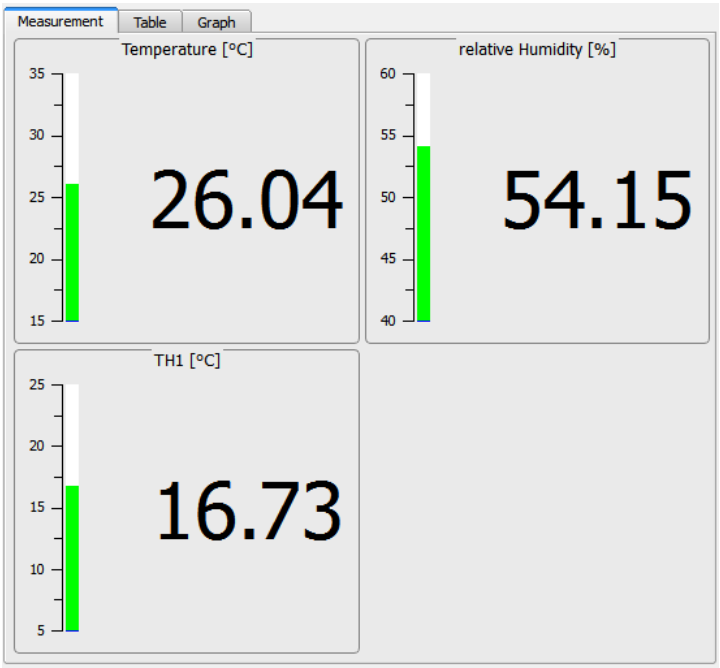


The upper two frames contain settings for the TSP01 internal sensor which combines a temperature and a humidity probe. The lower frames are related to external thermistor(s).

- **Temperature Units**: Select the required unit (°C, °F or K)
- **Temperature/Humidity Sensor**: Check the box to enable the sensor. Default settings: Internal sensors enabled, external enabled if recognized.
- **Show Plot in Graph Tab**: Enable the display of logged values for this sensor in the Graph tab.
- **Identifier**: For external thermistors, a custom identifier can be assigned (max. 25 characters).
- **Use this sensor as Reference**: When checking this box, the values of all sensors will be equalized to the value of the reference sensor by adding a positive or negative offset. This individual offset is displayed for each affected sensor. Unchecking this box returns all sensors to display of the actually measured value.
- **Offset**: For each sensor, an individual offset can be entered manually.
- **Thermometer (Hygrometer) Bar Range**: Upper and lower limits of the bar display in Measurement tab. The default value depends on the actual measured values at start of the application or connect to a TSP01.
- **Temperature (Humidity) Window**: The color of the bar displayed in the window can change depending on the actual measured value. **Low** and **High** are the thresholds for changing from blue to green or green to red, respectively.
- **Measurement Range**: This is the physical measurement range of the sensor. It is not editable. For the internal combined sensor, the ranges are fixed, for external thermistors the range is calculated based on the entered $\mathbf{R_0}$, $\mathbf{T_0}$ and **B** values.

For explanations on the Settings Dialog, please also use the tool tips which appear when moving the mouse pointer over them.

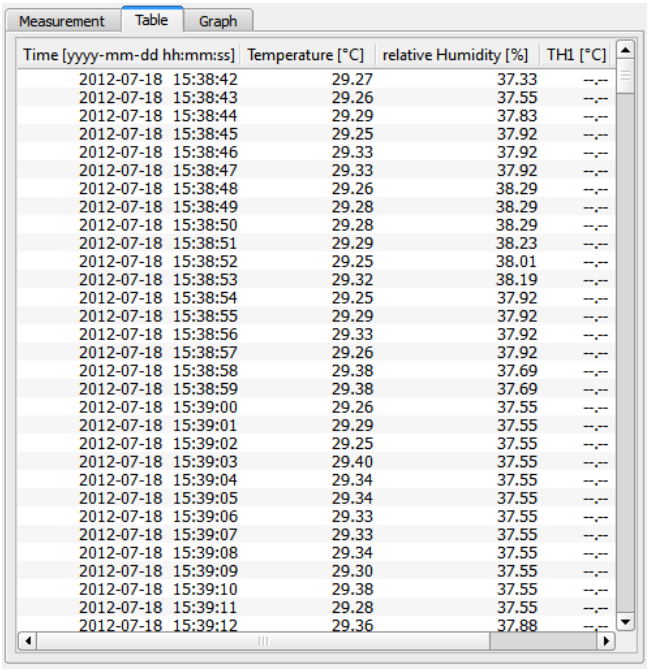
3.2.3 Tab Measurement



The tab **Measurement** displays by default the actual measurement results for internal sensors and recognized external thermistor sensors. Displayed sensors can be hidden, see Settings 12.

For each sensor, the result is displayed numerically and on a vertical bar. The bar color changes depending on the value. The thresholds for color change as well as upper and lower limit of the bar can be adjusted in the Settings 12 panel.

3.2.4 Tab Table

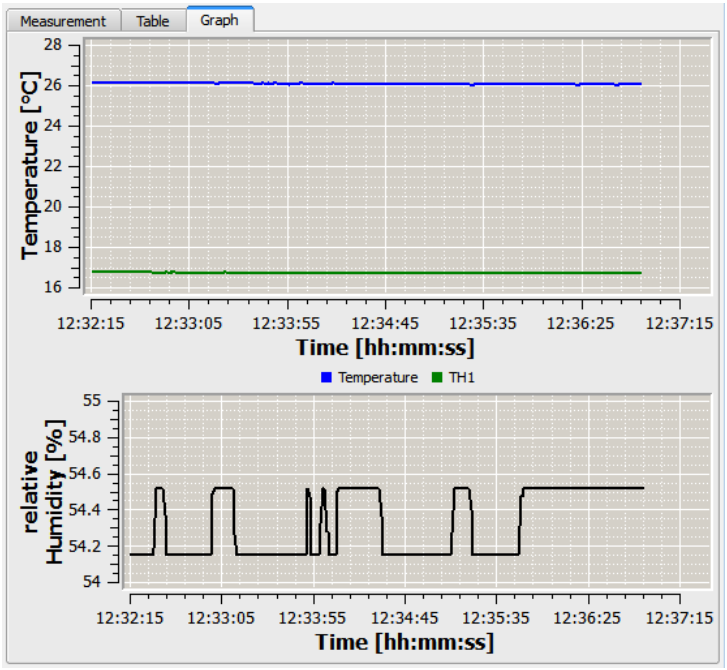


In the tab **Table** the logging results are displayed.

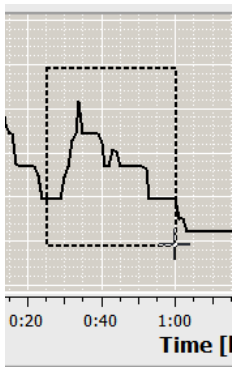
The first column contains the **time** in the format selected in the Logging panel 15 (time in seconds / days:hours:minutes:seconds or complete time stamp).

The next columns display the logged data from all sensors. If an external sensor is not recognized (not connected), its measurement values will be displayed as "--.---".

3.2.5 Tab Graph



The graph displayed in this tab shows the logged measurement values based on the data in the table of logged values. It is displayed when with the box "Show Plot in Graph Tab" in the Settings 12 panel is selected. Thus, logged data can be shown or hidden in the graphical display.



The graph display can be zoomed: move the mouse pointer into the graph - it changes to ⊕. Press and hold the left mouse button - the center of the mouse pointer changes to white color. Drag a rectangle over the area to be zoomed and release the mouse button.

In order to return to the full graphical display (auto scaling), click to the Zoom Home button.

The time axis shows time in [sec] or [hh:min:sec] formats, a complete time stamp cannot be shown.

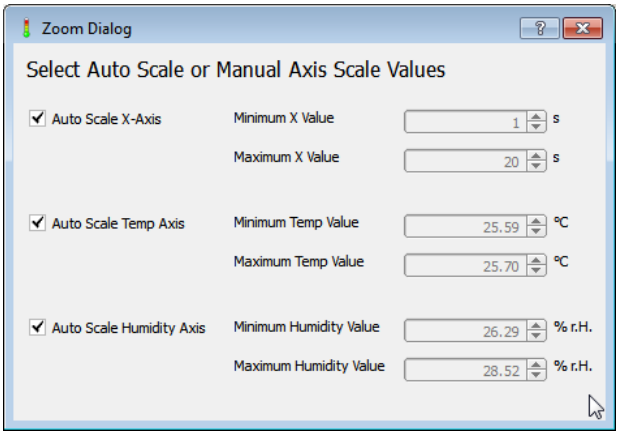
For scaling of the graph, click the Zoom Dialog 14 icon.

The grid can be toggled, see Graph Display Options 15.

3.2.6 Graph Display Option Menus

The following icons are only visible when the tab **Graph** is selected.

Zoom Panel



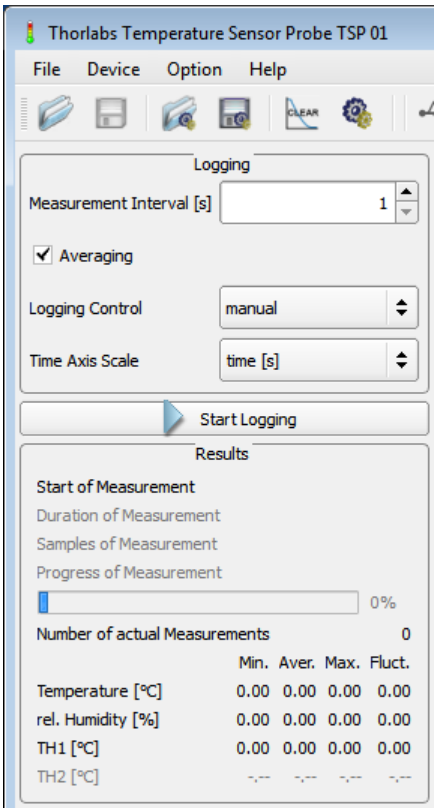
By default, Auto Scaling is enabled. By unchecking the "Auto Scale..." box, the limits of the appropriate axis can be changed.

Zoom Home: Click to this icon to display the entire graph (auto scaling).


Show / Hide Grid: This button toggles the grid of the graph display on/off.

Above functions can be reached via the **Options** drop-down menu as well.

3.2.7 Logging Panel

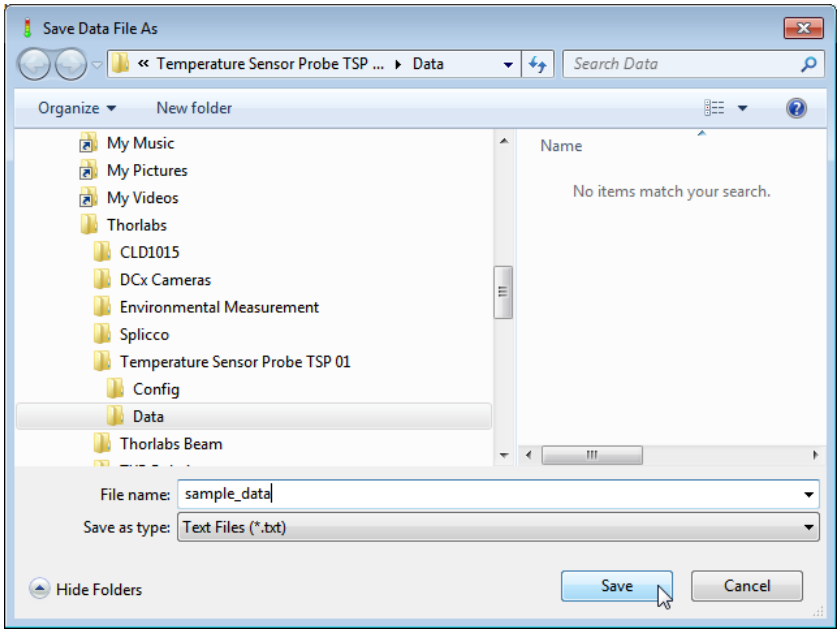


This is the control panel for recording of temperature(s) and/or humidity over time.

- **Measurement Interval**: The logging interval (time between two measurements) can be set from 1 to 10000 seconds.
- **Averaging**: When averaging is unchecked, a single measured value per selected measurement interval will be logged. By checking this box, all values that are measured each second will be averaged over the period of the selected measurement interval and only this average value will be logged. That means per measurement interval for both options one single value will be logged only.
- **Logging Control**: Three modes can be set: **manual** start/stop, **time**d logging or logging of a number of **samples**.
- **Time Axis Scale**: Three selections are available: time in seconds, time in hours:minutes:seconds and time stamp (date an time). The complete time stamp (date and time) will be displayed only in the Table tab.
- **Start / Stop Logging** This is a toggle button to start / stop logging process.
- **Results** In this pane logging statistics are displayed.
  - Start of Measurement: time in [date] hh:min:sec. The date will be displayed only, if the start date is different from the actual date.
  - Duration of measurement: a value will be displayed only in **time** or **samples** logging modes
  - Samples of measurement: a value will be displayed only in **time** or **samples** logging modes
  - Below the progress bar, numerical values (minimum, maximum, average and fluctuation). All values are updated with each new logged value. Fluctuation is the difference between Min and Max.

3.2.8 Save Data

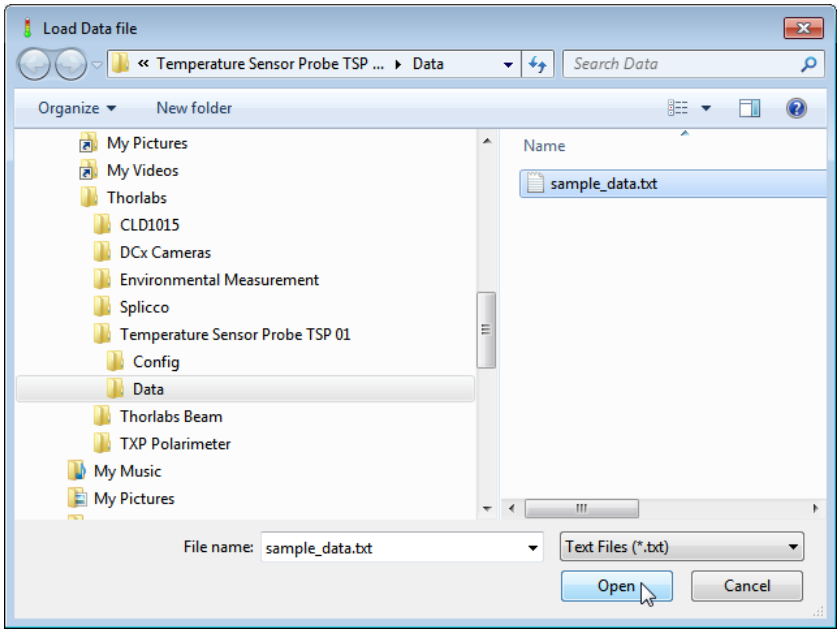
Logged data can be saved to a tab separated *.txt file. Click to the  icon or select from the menu **File** the **Save Data** item. A dialog opens:



Type in a file name and click "Save". The file includes a header with sensor and software information, application settings and the logged measurement data.

3.2.9 Load Data

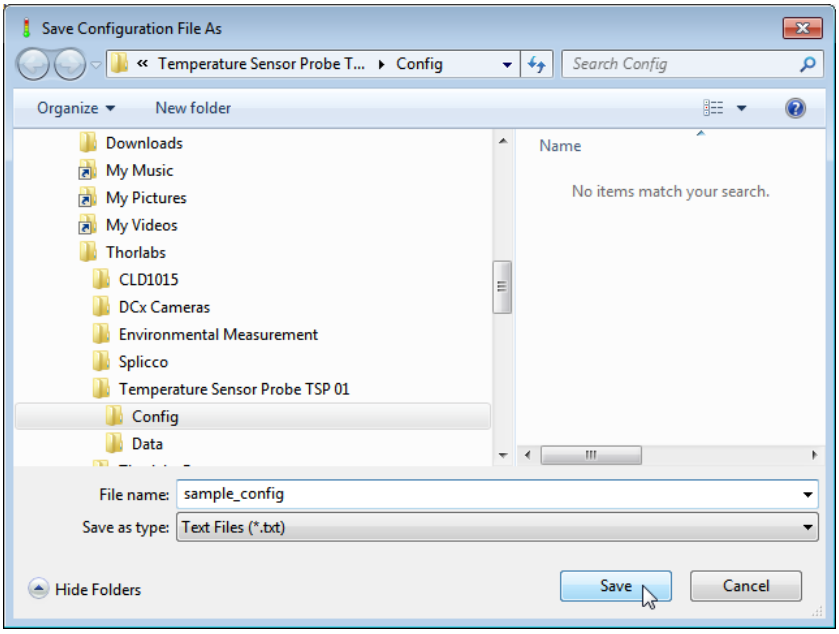
Saved data can be loaded into the GUI. Click to the  icon or select from the menu **File** the **Load Data** item. A dialog opens:



Select the desired file and click "Open". The file is loaded into the GUI and will be displayed with all appropriate application settings, as saved in the file header.

3.2.10 Export Settings

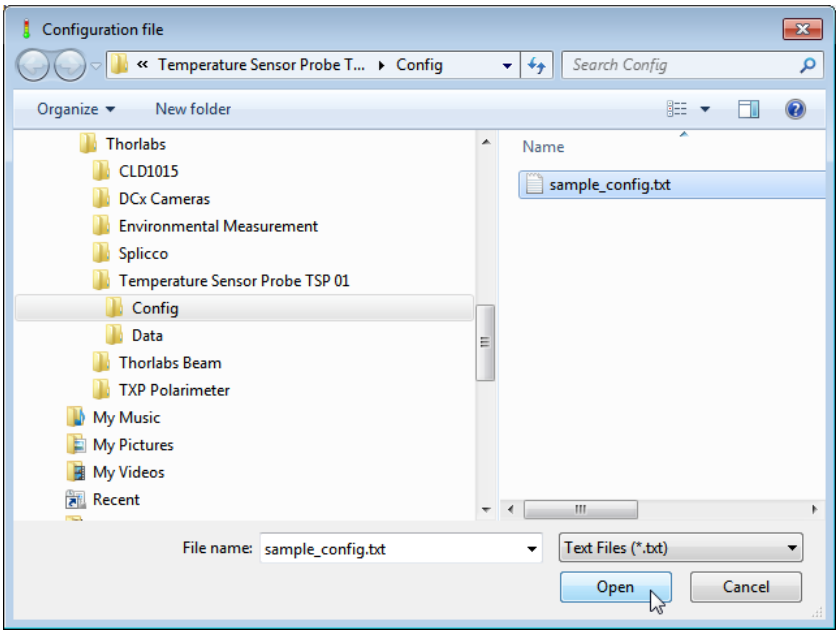
The complete GUI settings can be saved to a *.txt file. Click to the  icon or select from the menu **File** the **Export Settings** item. A dialog opens:



Type in a file name and click "Save". The file includes the sensor and software information and the application settings.

3.2.11 Import Settings

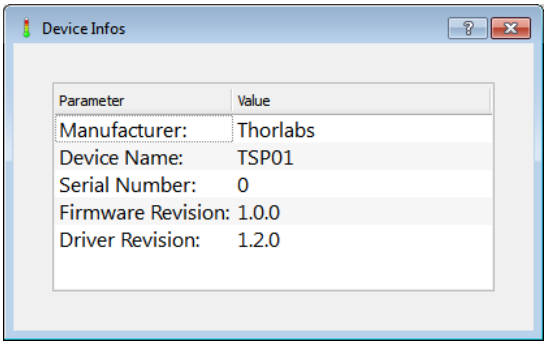
Saved settings can be loaded into the GUI. Click to the  icon or select from the menu **File** the **Import Settings** item. A dialog opens:



Select the desired file and click "Open".

3.2.12 Device Information

The Device Information menu retrieves information on the connected TSP01:



4 Write Your Own Application

Please refer to the correct chapter, depending on the Version of TSP01 you are using.

4.1 WYOA for TSP01 RevB Sensors

This section provides information on writing your own application for TSP01 sensors labeled RevB. Previous-revision TSP01 sensors require the installation of NI-VISA™ and the use of different drivers. For more information on previous-revision sensors, please refer to section 4.2: "Write Your Own Application for Previous-Revision Sensors 22".

In order to write your own application, you need a specific instrument driver and some tools for use in different programming environments. The driver and tools are installed to your computer during software installation.

Note

TSP01 software and drivers are 32 bit applications. As for this reason, in 32 bit systems, they are installed to

"C:\Program Files"

while in 64 bit systems - to

"C:\Program Files (x86)"

In the table below you will find a summary of the files needed for specific programming environments. Section 4.2 specifies the locations of these files.

Programming environment	Necessary files
C, C++, CVI	*.h (header file) *.lib (static library)
C#	.net wrapper dll
Visual Studio	*.h (header file) *.lib (static library) or .net wrapper dll
LabView™	*.fp (function panel) Beside that, LabVIEW™ driver vi's are provided with the *.llb container file

In the next section the location of above files for all hardware, supported by TSP01 RevB drivers, is described in detail.

4.1.1 Driver Installation and Location for TSP01 RevB Sensors

This section describes the driver installation for TSP01 RevB sensors.

Note

For instructions on the driver installation for previous-revision TSP01 sensors, please refer to the instruction in the chapter "Write Your Own Application for Previous-Revision Sensors 22".

NI-VISA™ Instrument driver:

```
C:\Program Files\IVI Foundation\VISA\WinNT\Bin\TLTSPB_32.dll
C:\Program Files\IVI Foundation\VISA\WinNT\Bin\TLTSPB_64.dll
```

Note

This instrument driver is required for all development environments!

Header file

```
C:\Program Files\IVI Foundation\VISA\WinNT\include\TLTSPB.h
C:\Program Files\IVI Foundation\VISA\WinNT\include\TLTSP_Defines.h
```

Static Library

```
C:\Program Files\IVI Foundation\VISA\WinNT\lib\TLTSPB_32.lib
C:\Program Files\IVI Foundation\VISA\WinNT\lib_x64\TLTSPB_64.lib
```

Function Panel

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSPB\TLTSPB.fp
```

Online Help for Instrument driver:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSPB\Manual
```

NI LabVIEW™ driver

```
C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\TLTSPB…
…\TLTSPB.llb
```

(LabVIEW container file with driver vi's and an example. "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

.net wrapper dll

```
C:\Program Files\Microsoft.NET\Primary Interop Assemblies…
…\Thorlabs.TLTSP01B_32.Interop.dll

C:\Program Files\IVI Foundation\VISA\VisaCom\Primary Interop Assem-
blies…
…\Thorlabs.TLTSP01B_32.Interop.dll

C:\Program Files\IVI Foundation\VISA\VisaCom64\Primary Interop Assem-
blies…
…\Thorlabs.TLTSP01B_64.Interop.dll
```

Example for C

Source file:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSPB\Examples\C\…
…Sample.c
```

Example for C#

Solution file:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSPB\Examples…
…\MS.NET_CS\Thorlabs.TLTSP01B.Sample.sln
```

Project file:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSPB\Examples…
…\MS.NET_CS\ASmple\Thorlabs.TLTSP01B.Sample.csproj
```

Example for LabView™

```
C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\TLTSPB…
…\TLTSPB.llb
```

(LabVIEW™ container file with driver vi's and an example. "LabVIEW xxxx" stands for actual LabVIEW™ installation folder.)

4.1.2 Changing the Driver for TSP01 RevB

Note

With the transition from TSP01 to TSP01 RevB at the end of 2018, the driver changed. TSP01 sensors without the RevB label require the installation of NI-VISA™, while TSP01 RevB sensors do not.

The NI-VISA™ engine can be installed from the following sources:

- The software CD shipped with previous-revision TSP01 sensors (not labeled RevB). The installer includes NI-VISA™.
- The National Instruments' website www.ni.com

For customers who wrote their own application for the old driver, using the C-library TLTSP_32.dll or TLTSP_64.dll and want to integrate the new **TLTSPB** temperature and humidity logger into their application, please follow the instructions below:

1. Include the new Header file into the project

```
#include "TLTSPB.h"
```

2. Copy all functions of the TLTSP and change the prefix TLTSP by TLTSP**B** for all of the copied functions.

```
TLTSP_init →TLTSPB_init
```

3. The prototype of some functions changed according to the unification to all other new Thorlabs drivers.

```
TLTSP_getDeviceCount → TLTSPB_findRsrc

TLTSP_getDeviceResourceString → TLTSPB_getRsrcName
```

4. Add the library TLTSPB_32.lib to the project

In the project settings add “TLTSPB_32.lib” to the project.

5. Be sure that the library “TLTSPB_32.dll” is either beside the application, in the VXIPNPPATH or PATH or in the system folder. Use the same location of the TLTSP_32.dll.
6. The TLTSPB uses a communication server ThorFrameServer.exe which can be found in the hidden folder COMMONAPPDATA (“C:\ProgramData\Thorlabs\ThorFrame”).

4.2 WYOA for Previous-Revision Sensors

This chapter provides information on how to write your own application for previous-revision TSP01 sensors which can be identified by the lack of a "RevB" label.

Note

For TSP01 sensors labeled "RevB", please refer to the instructions in the section 4.1. " Write Your Own Application for TSP01 RevB Sensors 19". TSP01 RevB devices run with a new driver that does not require NI-VISA™.

In order to write your own application for TSP01, you need a specific instrument driver and some tools for use in different programming environments. The driver and tools are being installed to your computer during software installation and cannot be found on the installation CD.

Note

TSP01 software and drivers are 32 bit applications. As for this reason, in 32 bit systems, they are installed to

“C:\Program Files”

while in 64 bit systems - to

“C:\Program Files (x86)”

In the table below you will find a summary of the files needed for specific programming environments. Section 4.2.1 specifies the locations of these files.

Programming environment	Necessary files
C, C++, CVI	*.h (header file) *.lib (static library)
C#	.net wrapper dll
Visual Studio	*.h (header file) *.lib (static library) or .net wrapper dll
LabView™	*.fp (function panel) and NI-VISA™ instrument driver Beside that, LabVIEW™ driver vi's are provided with the *.llb container file

Note

Each of the above environments also requires the NI VISA™ instrument driver DLL.

The next section provides the locations of the above files.

4.2.1 Driver Installation and Location for Previous-Revision TSP01 sensors

This section describes the driver installation for previous-revision TSP01 sensors which can be identified by the lack of a "RevB" label.

Note

TSP01 versions labeled "RevB" do not require NI-VISA™. For instructions on driver installation and location for the TSP01 RevB, please refer to the section "Write Your Own Application for TSP01 RevB Sensors 19".

NI-VISA™ Instrument driver:

```
C:\Program Files\IVI Foundation\VISA\WinNT\Bin\TLTSP_32.dll
C:\Program Files\IVI Foundation\VISA\WinNT\Bin\TLTSP_64.dll
```

Note

This instrument driver is required for all development environments!

Source file

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\TLTSP.c
```

Header file

```
C:\Program Files\IVI Foundation\VISA\WinNT\include\TLTSP.h
```

Static Library

```
C:\Program Files\IVI Foundation\VISA\WinNT\lib\msc\TLTSP_32.lib
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\TLTSP_32.lib
C:\Program Files\IVI Foundation\VISA\WinNT\Lib_x64\MS\TLTSP_64.lib
```

Function Panel

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\TLTSP.fp
```

Online Help for NI-VISA™ Instrument driver:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Manual
```

NI LabVIEW™ driver

```
C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\TLTSP…
…\TLTSP.llb
```

(LabVIEW container file with driver vi's and an example. "LabVIEW xxxx" stands for actual LabVIEW installation folder.)

.net wrapper dll

```
C:\Program Files\Microsoft.NET\Primary Interop Assemblies…
…\Thorlabs.TSP.dll
```

Example for C

Project file (NI-LabWindows™/CVI 2010):

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Examples\CVI_C\…
…sample.prj
```

Source file:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Examples\CVI_C\…
…sample.c
```

Executable sample demo:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Examples\CVI_C\…
…sample.exe
```

Example for C++

Solution file:

```
C:\Program Files\IVI Foundation \visa\WinNT\TLTSP01\Examples\…
…MS_VISUALCPP\TSP01_CPP_Sample.sln
```

Project file:

```
C:\Program Files\IVI Foundation \visa\WinNT\TLTSP01\Examples\…
…MS_VISUALCPP\TSP01_CPP_Sample\TSP01_CPP_Sample.vcxproj
```

Executable sample demo:

```
C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Examples\…
…\MS_VISUALCPP\Output\TSP01_CPP_Sample.exe
```

Example for DotNet

Example for C#

Solution file:

```
C:\Program Files\IVI Foundation \visa\WinNT\TLTSP01\Examples…
…\MS.NET_CS\TSP01_CSharp_Sample.sln
```

Project file:

```
C:\Program Files\IVI Foundation \visa\WinNT\TLTSP01\Examples…
…\MS.NET_CS\TSP01_CSharp_Sample\TSP01_CSharp_Sample.csproj
```

Executable sample demo:

`C:\Program Files\IVI Foundation\VISA\WinNT\TLTSP01\Examples…`

`…\MS.NET_CS\Output\TSP01_CSharp_Sample.exe`

Example for LabView™

`C:\Program Files\National Instruments\LabVIEW xxxx\Instr.lib\TLTSP…`

`…\TLTSP.llb`

(LabVIEW™ container file with driver vi's and an example. "LabVIEW xxxx" stands for actual LabVIEW™ installation folder.)

4.2.2 Command Reference

Note

This command reference is only applicable when writing you own applications for previous-revision TSP01 sensors without the RevB label on the bottom.

4.2.2.1 IEEE488.2 Common Commands

Common commands are device commands that are common to all devices according to the IEEE488.2 standard. These commands are designed and defined by this standard. Most of the commands are described in detail in this section. The following common commands associated with the status structure are covered in the "Status Structure" section: *CLS, *ESE, *ESE?, *ESR?, *SRE, *SRE?, *STB?

Command summary

Mnemonic	Name	Description
***CLS**	Clear status	Clears all event registers and Error Queue
***ESE <NRf>**	Event enable command	Sets the Standard Event Enable Register
***ESE?**	Event enable query	Returns the Standard Event Enable Register
***ESR?**	Event status register query	Returns and clear the Standard Event Register
***IDN?**	Identification query	Returns the unit's identification string
***OPC**	Operation complete command	Sets the Operation Complete bit in the Standard Event Register
***OPC?**	Operation complete query	Places a "1" into the output queue when all device operations have been completed
***RST**	Reset command	Returns the unit to the *RST default condition
***SRE <NRf>**	Service request enable command	Sets the Service Request Enable Register
***SRE?**	Service request enable query	Returns the Service Request Enable Register
***STB?**	Status byte query	Returns the Status Byte Register
***TST?**	Self-test query	Performs the unit's self-test and returns the result.
***WAI**	Wait-to-continue command	Waits until all previous commands are executed

Command reference

1. *IDN? – identification query - read identification code

The identification code includes the manufacturer, model code, serial number, and firmware revision levels and is sent in the following format: `THORLABS,MMM,SSS,X.X.X`

Where: `MMM` is the model code
`SSS` is the serial number
`X.X.X` is the instrument firmware revision level

2. *OPC – operation complete - set OPC bit

3. *OPC? – operation complete query – places a “1” in output queue

When *OPC is sent, the OPC bit in the Standard Event Register will set after all pending command operations are complete. When *OPC? is sent, an ASCII “1” is placed in the Output Queue after all pending command operations are complete.
Typically, either one of these commands is sent after the INITiate command. The INITiate command is used to take the instrument out of idle in order to perform measurements. While operating within the trigger model layers, many sent commands will not execute. After all programmed operations are completed, the instrument returns to the idle state at which time all pending commands (including *OPC and/or *OPC?) are executed. After the last pending command is executed, the OPC bit and/or an ASCII “1” is placed in the Output Queue.

4. *RST – reset – return instrument to defaults

When the *RST command is sent, the instrument performs the following operations:

- Cancels all pending commands.
- Cancels response to any previously received *OPC and *OPC? commands.

5. *TST? – self-test query – run self test and read result

Use this query command to perform the instrument self-test routine. The command places the coded result in the Output Queue. A returned value of zero (0) indicates that the test passed, other values indicate that the test failed.

6. *WAI – wait-to-continue – wait until previous commands are completed

The *WAI command is a no operation command for the instrument and thus, does not need to be used. It is there for conformance to IEEE488.2.

4.2.2.2 SCPI Command Reference

SYSTem subsystem commands

Command	Description	SCPI
SYSTem	Path to SYSTem subsystem	☑
:ERRor		☑
[:NEXT]?	Returns the latest error code and message	☑
:VERSion?	Returns level of SCPI standard (1999.0)	☑

STATus subsystem commands

Command	Description	SCPI
STATus		☑
:OPERation	Path to control operation event registers	☑
[:EVENt]?	Returns the event register	☑
:CONDition?	Returns the condition register	☑
:ENABle <value>	Sets the enable register	☑
:ENABle?	Returns the enable register	☑
:QUEStionable	Path to control questionable event registers	☑
[:EVENt]?	Returns the event register	☑
:CONDition?	Returns the condition register	☑
:ENABle <value>	Sets the enable register	☑
:ENABle?	Returns the enable register	☑
:PRESet	Set status registers to default states.	☑

CALibration subsystem commands

Command	Description	SCPI
CALibration :STRing?	Returns the calibration string	☑

[SENSe] subsystem commands

Command	Description	SCPI
SENSe[1]	**Path to temperature sensing, internal**	☑
[:TEMPerature]		☑
:DATA? [MIN|MAX]	Returns the temperature (internal sensor)	
:OFFSet {MIN|MAX|DEF|<value>}	Set temperature offset (internal sensor)	
:OFFSet? [{MIN|MAX|DEF}]	Query temperature offset (internal sensor)	
SENSe2	**Path to humidity sensing**	
[:HUMidity]		
:DATA? [MIN|MAX]	Returns the humidity in %r.h.	☑
:OFFSet {MIN|MAX|DEF|<value>}	Set humidity offset in %r.h.	
:OFFSet? [{MIN|MAX|DEF}]	Query humidity offset in %r.h.	
SENSe3	**Path to temperature sensing, ext. Therm. 1**	
[:TEMPerature]		
[:THERMistor]		
:METHod {EXPonential|SHH}	Set temperature calculating method	
:METHod?	Query temperature calculating method	
[:SHH]		
:A {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter A	
:A? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter A	
:B {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter B	
:B? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter A	
:C {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter C	
:C? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter C	
:EXPonential		
:R0 {MIN|MAX|DEF|<value>}	Set parameter R_0 for exponential RT calc.	
:R0? [{MIN|MAX|DEF}]	Query parameter R_0 for exponential RT calc.	
:T0 {MIN|MAX|DEF|<value>}	Set parameter T_0 for exponential RT calc.	
:T0? [{MIN|MAX|DEF}]	Query parameter T_0 for exponential RT calc.	
:BETA {MIN|MAX|DEF|<value>}	Set parameter Beta for exponential RT calc.	
:BETA? [{MIN|MAX|DEF}]	Query parameter Beta for exponential RT calc.	
:DATA? [{MIN|MAX}]	Query temperature	
:OFFSet {MIN|MAX|DEF|<value>}	Set temperature offset, thermistor 1	
:OFFSet? [{MIN|MAX|DEF}]	Query temperature offset, thermistor 1	
:RESistance		☑
[:DATA]? [{MIN|MAX}]	Query resistance of thermistor 1	
SENSe4	**Path to temperature sensing, ext. Therm. 2**	
[:TEMPerature]		
[:THERMistor]		
:METHod {EXPonential|SHH}	Set temperature calculating method	
:METHod?	Query temperature calculating method	
[:SHH]		
:A {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter A	
:A? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter A	
:B {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter B	
:B? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter A	
:C {MIN|MAX|DEF|<value>}	Set Steinhart-Hart parameter C	
:C? [{MIN|MAX|DEF}]	Query Steinhart-Hart parameter C	
:EXPonential		
:R0 {MIN|MAX|DEF|<value>}	Set parameter R_0 for exponential RT calc.	

Command	Description	SCPI
:R0? [{MIN|MAX|DEF}]	Query parameter R_0 for exponential RT calc.	
:T0 {MIN|MAX|DEF|<value>}	Set parameter T_0 for exponential RT calc.	
:T0? [{MIN|MAX|DEF}]	Query parameter T_0 for exponential RT calc.	
:BETA {MIN|MAX|DEF|<value>}	Set parameter Beta for exponential RT calc.	
:BETA? [{MIN|MAX|DEF}]	Query parameter Beta for exponential RT calc.	
:DATA? [{MIN|MAX}]	Query temperature	
:OFFSet {MIN|MAX|DEF|<value>}	Set temperature offset, thermistor 2	
:OFFSet? [{MIN|MAX|DEF}]	Query temperature offset, thermistor 2	
:RESistance		☑
[:DATA]? [{MIN|MAX}]	Query resistance of thermistor 2	

Note: All temperature and temperature offset values are in °C.

Measurement commands

Command	Description	SCPI
INITiate[:IMMediate]	Start measurement	☑
ABORt	Cancel measurement	☑
CONFigure		☑
[:SCALar]		
:TEMPerature[1]	Configure device for temperature measurement on internal sensor	
:HUMidity	Configure device for humidity measurement	
:TEMPerature2	Configure device for temperature measurement on external thermistor sensor 1	
:TEMPerature3	Configure device for temperature measurement on external thermistor sensor 2	
CONFigure?	Query device's measurement configuration	☑
FETCh?	Fetch measurement value	☑
FETCh		
[:SCALar]		
:TEMPerature[1]?	Fetch measurement value for temperature measurement on internal sensor	
:HUMidity?	Fetch measurement value for humidity measurement	
:TEMPerature2?	Fetch measurement value of temperature measurement on external thermistor sensor 1	
:TEMPerature3?	Fetch measurement value of temperature measurement on external thermistor sensor 2	
READ?	Read value	☑
MEASure		☑
[:SCALar]		
[:TEMPerature][1]?	Measure temperature on internal sensor	
:HUMidity?	Measure humidity	
:TEMPerature2?	Measure temperature on external thermistor 1	
:TEMPerature3?	Measure temperature on external thermistor 2	

5 Maintenance and Service

Protect the TSP01 from adverse weather conditions. The TSP01 is not water resistant.

The unit does not need a regular maintenance by the user. There are no serviceable parts in the TSP01.

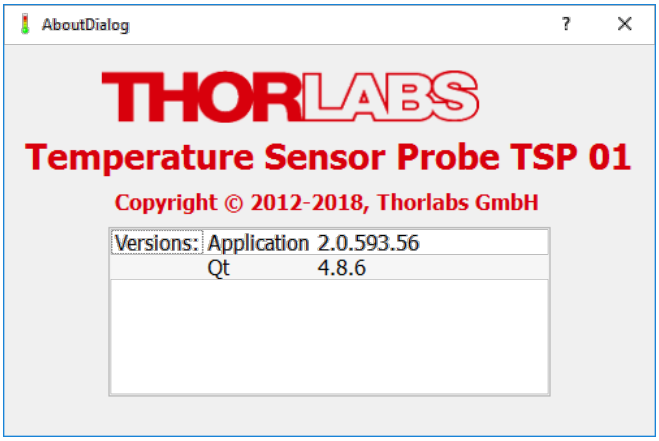
If you suspect a problem with your TSP01, please read the section Safety 33 and contact Thorlabs 36 tech support and an engineer will be happy to assist you.

Attention

To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

5.1 Version Information

Information on the software version can be retrieved via the menu **Help** -> **About**:



Please keep this information ready when contacting Thorlabs 36.

Note

For Information on the TSP01 device version number, please see the bottom of the device for the serial number.

6 Troubleshooting

Problem: The TSP01 is not recognized with the TSP01 software.

- **Solution 1:** Update the Application to the latest version. The new TSP01 RevB is not compatible with software versions below 2.0.
- **Solution 2:** The TSP01 sensor might be a previous revision device and is not labeled "RevB" in which case it will require installation of the NI-VISA™ software. Please download NI-VISA™ or, in case you used your own application, please adjust the driver. Alternatively, install the previous software version. Please check the website for archived TSP01 software versions, or contact Thorlabs 36.
- **Reason:** TSP01 sensors labeled RevB use an instrument driver that was redesigned such that NI-VISA™ is no longer required. However, previous-revision TSP01 devices still need NI-VISA™.

7 Appendix

7.1 Technical Data

Internal Combined Sensor		
	Temperature Measurement	Rel. Humidity Measurement
Range	-20 °C to + 70 °C (Module) [1)2)]	0 % to 100 % RH
Units	°C, K, °F	% RH
Accuracy	±1 °C (-10 to +70 °C) ±0.5 °C (25 °C)	± 2 % RH (20% to 80 % RH) ± 4 % RH (0-20% and 80-100 % RH)
Resolution	0.05 °C	0.1 %
External Sensor, included		
Type	EPCOS NTC M861 (R0 = 10 kΩ @ T0 = 25 °C, B = 3988 K)	
Measurement Range	-15 °C to 200 °C	
Accuracy	± 0.5 °C (25 °C)	
Resolution	0.05 °C	
External Sensors		
Number of channels	2	
Connector	2.5 mm earphone jack	
Supported Sensor Type	NTC	
Units	°C, K, °F	
Measurement Range	200 Ω to 80 kΩ	
Interface and Power Supply		
Interface	USB2.0 (HID Device)	
Power Supply	5 V DC, 20 mA via USB	
Measurement Update Rate	max. 1/sec	
General		
Operating Temperature Range [1)]	-20 °C to + 70 °C	
Storage Temperature Range	-40 °C to 70 °C	
Dimensions (W x H x D)	69.5 mm x 20.0 mm x 12.0 mm	
Weight	50 g (w/o external sensor)	

1) non-condensing

2) Limited by the operating temperature range of the USB thumb drive.

7.2 List of Acronyms

The following acronyms and abbreviations are used in this manual:

GUI	Graphic User Interface
NTC	Resistor with Negative Temperature Coefficient (aka Thermistor)
RH	Relative Humidity
SCPI	Standard Commands for Programmable Instruments
USB	Universal Serial Bus

7.3 Safety

Attention

The safety of any system incorporating the equipment is the responsibility of the assembler of the system.

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly as it was designed for.

The TSP01 must not be operated in explosion endangered environments!

Do not obstruct the air ventilation slots in the housing! Do not remove covers or open the cabinet. There are no user-serviceable parts inside!

This precision device is only serviceable if returned and properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for replacement packaging. Refer servicing to qualified personnel!

Changes to this device cannot be made nor may components not supplied by Thorlabs be used without written consent from Thorlabs.

Attention

The following statement applies to the products covered in this manual, unless otherwise specified herein. The statement for other products will appear in the respective accompanying documentation.

Note

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules and meets all requirements of the Canadian Interference-Causing Equipment Standard ICES-003 for digital apparatus. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/T.V. technician for help.

Users that change or modify the product described in this manual in a way not expressly approved by Thorlabs (party responsible for compliance) could void the user's authority to operate the equipment.

Thorlabs GmbH is not responsible for any radio television interference caused by modifications of this equipment or the substitution or attachment of connecting cables and equipment other than those specified by Thorlabs. The correction of interference caused by such unauthorized modification, substitution or attachment will be the responsibility of the user.

The use of shielded I/O cables is required when connecting this equipment to any and all optional peripheral or host devices. Failure to do so may violate FCC and ICES rules.

Attention

Mobile telephones, cellular phones or other radio transmitters are not to be used within the range of three meters of this unit since the electromagnetic field intensity may then exceed the maximum allowed disturbance values according to IEC 61326-1.

This product has been tested and found to comply with the limits according to IEC 61326-1 for using connection cables shorter than 3 meters (9.8 feet).

7.4 Certifications and Compliances

EU Declaration of Conformity

in accordance with EN ISO 17050-1:2010

We: Thorlabs GmbH

Of: Hans-Boeckler-Str. 6, 85221 Dachau/München, Deutschland

in accordance with the following Directive(s):

2014/30/EU	Electromagnetic Compatibility (EMC) Directive
2011/65/EU	Restriction of Use of Certain Hazardous Substances (RoHS)

hereby declare that:

Model: ***TSP01***

Equipment: ***USB Temperature and Humidity Logger***

is in conformity with the applicable requirements of the following documents:

EN 61326-1	Electrical Equipment for Measurement, Control and Laboratory Use - EMC Requirements	2013

and which, issued under the sole responsibility of Thorlabs, is in conformity with Directive 2011/65/EU of the European Parliament and of the Council of 8th June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment, for the reason stated below:

does not contain substances in excess of the maximum concentration values tolerated by weight in homogenous materials as listed in Annex II of the Directive

I hereby declare that the equipment named has been designed to comply with the relevant sections of the above referenced specifications, and complies with all applicable Essential Requirements of the Directives.

Signed: *On:* 29 September 2017

Name: Bruno Gross

Position: General Manager

EDC - TSP01 -2017-09-29

CE

7.5 Warranty

Thorlabs warrants material and production of the TSP01 for a period of 24 months starting with the date of shipment. During this warranty period Thorlabs will see to defaults by repair or by exchange if these are entitled to warranty.

For warranty repairs or service the unit must be sent back to Thorlabs. The customer will carry the shipping costs to Thorlabs, in case of warranty repairs Thorlabs will carry the shipping costs back to the customer.

If no warranty repair is applicable the customer also has to carry the costs for back shipment.

In case of shipment from outside EU duties, taxes etc. which should arise have to be carried by the customer.

Thorlabs warrants the hard- and/or software determined by Thorlabs for this unit to operate fault-free provided that they are handled according to our requirements. However, Thorlabs does not warrant a fault free and uninterrupted operation of the unit, of the software or firmware for special applications nor this instruction manual to be error free. Thorlabs is not liable for consequential damages.

Restriction of Warranty

The warranty mentioned before does not cover errors and defects being the result of improper treatment, software or interface not supplied by us, modification, misuse or operation outside the defined ambient stated by us or unauthorized maintenance.

Further claims will not be consented to and will not be acknowledged. Thorlabs does explicitly not warrant the usability or the economical use for certain cases of application.

Thorlabs reserves the right to change this instruction manual or the technical data of the described unit at any time.

7.6 Copyright and Exclusion of Reliability

Thorlabs has taken every possible care in preparing this document. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this document is regularly updated and adapted to reflect the current status of the hardware and/or software. We furthermore do not guarantee that this product will function without errors, even if the stated specifications are adhered to.

Under no circumstances can we guarantee that a particular objective can be achieved with the purchase of this product.

Insofar as permitted under statutory regulations, we assume no liability for direct damage, indirect damage or damages suffered by third parties resulting from the purchase of this product. In no event shall any liability exceed the purchase price of the product.

Please note that the content of this document is neither part of any previous or existing agreement, promise, representation or legal relationship, nor an alteration or amendment thereof. All obligations of *Thorlabs* result from the respective contract of sale, which also includes the complete and exclusively applicable warranty regulations. These contractual warranty regulations are neither extended nor limited by the information contained in this document. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the document, please contact your local *Thorlabs* dealer or system installer.

7.7 Thorlabs Worldwide Contacts

US

A, Canada, and South America

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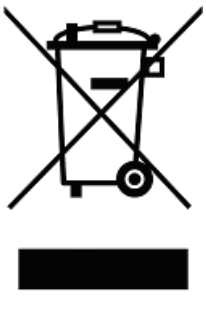

Thorlabs verifies our compliance with the WEEE (Waste Electrical and Electronic Equipment) directive of the European Community and the corresponding national laws. Accordingly, all end users in the EC may return “end of life” Annex I category electrical and electronic equipment sold after August 13, 2005 to Thorlabs, without incurring disposal charges. Eligible units are marked with the crossed out “wheelie bin” logo (see right), were sold to and are currently owned by a company or institute within the EC, and are not dissembled or contaminated. Contact Thorlabs for more information. Waste treatment is your own responsibility. “End of life” units must be returned to Thorlabs or handed to a company specializing in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

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