THORLABS

Environmental Measurement

TSP01
Operation Manual

2015

Version: 1.3
Date: 17-Jul-2015

Contents

We aim to develop and produce the best solution for your application in the field of optical measurement technique. To help us to live up to your expectations and improve our products permanently we need your ideas and suggestions. Therefore, please let us know about possible criticism or ideas. 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 preceeded 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 these advices carefully!

1 General Information

The TSP01 is a device in the size of a USB thumb drive that can be plugged to any free 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 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 Thorlabs TSP-TH or any other NTC type sensors. The software allows to enter individual NTC parameters, such as R0 (reference resistance), T0 (reference temperature) and the B coefficient.

The data can be displayed in the GUI or can be embedded into existing software, e.g. Thorlabs Beam Profiler Software.

1.1 Safety

Attention

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.
All modules must only be operated with proper shielded connection cables.
Only with written consent from *Thorlabs* may changes to single components be carried out or components not supplied by *Thorlabs* be used.
This precision device is only serviceable if properly packed into the complete original packaging including the plastic foam sleeves. If necessary, ask for a replacement package.

1.2 Ordering Codes and Accessories

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

1.3 Requirements

1.3.1 Hardware Requirements

- CPU: 1 GHz or higher
- RAM: 512 MB or more
- Graphic card with at least 32 MB memory
- Hard disc with at least 100 MB free storage space
- Free USB2.0 port

1.3.2 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)

For operation of the TSP01, also an NI-VISA (version 5.1 or higher) is required. This NI-VISA engines comes with the Thorlabs TSP01 installation CD, but can be downloaded also from National Instruments' website www.ni.com.

2 Installation

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 and you have inspected 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, 2m
4. CD with TSP01 software and drivers
5. Quick Start Instruction

2.2 Getting Started

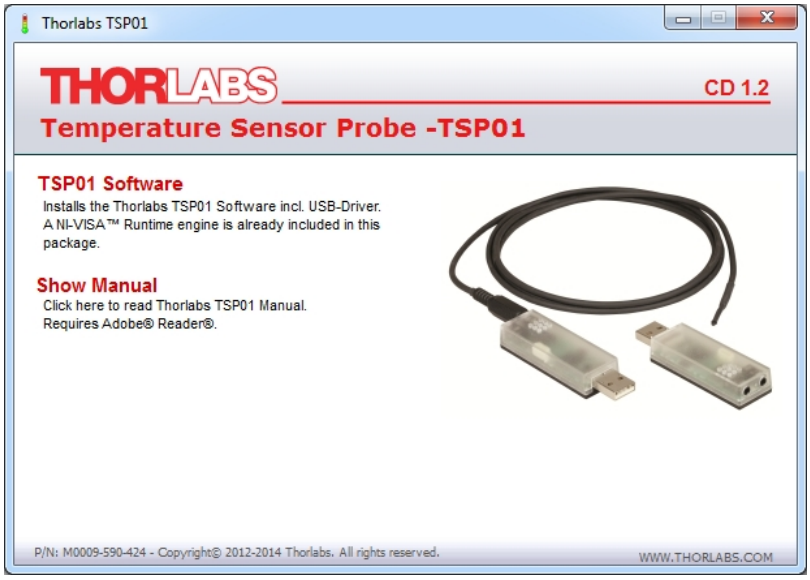
Attention

Please do not connect the TSP01 prior to install software! The probe won't be recognized correctly and will not work as intended.

2.3 Installing Software

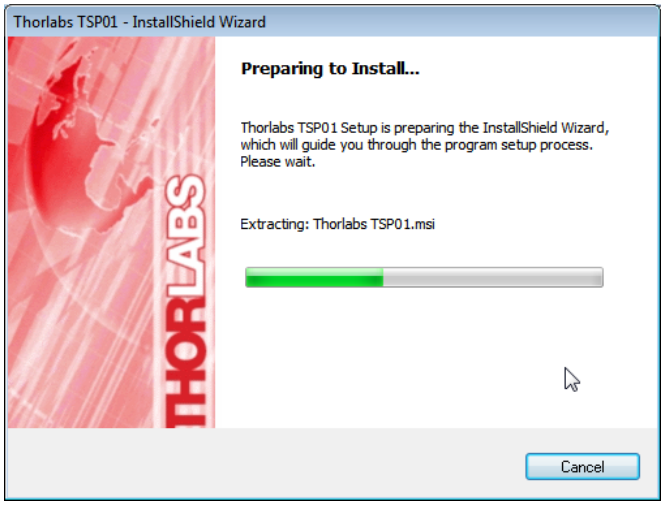
Hereinafter, the installation to Windows 7 operating system is explained.

Insert the CD and select "Install Software" from the start up panel.



If the CD does not start automatically, please start the installation manually from

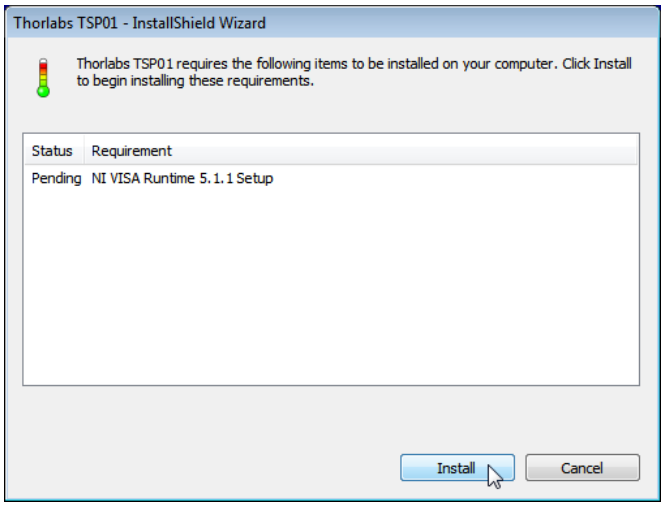
[CD Drive]:\autorun\autorun.exe



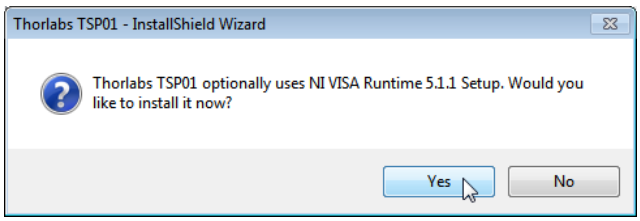
The installer verifies if a NI-VISA is already installed. If not, the installer alerts you about that and requires NI-VISA installation, otherwise it continues with TSP01 application software installation 9

Note

Please note that the NI-VISA is mandatory to operate the TSP01.

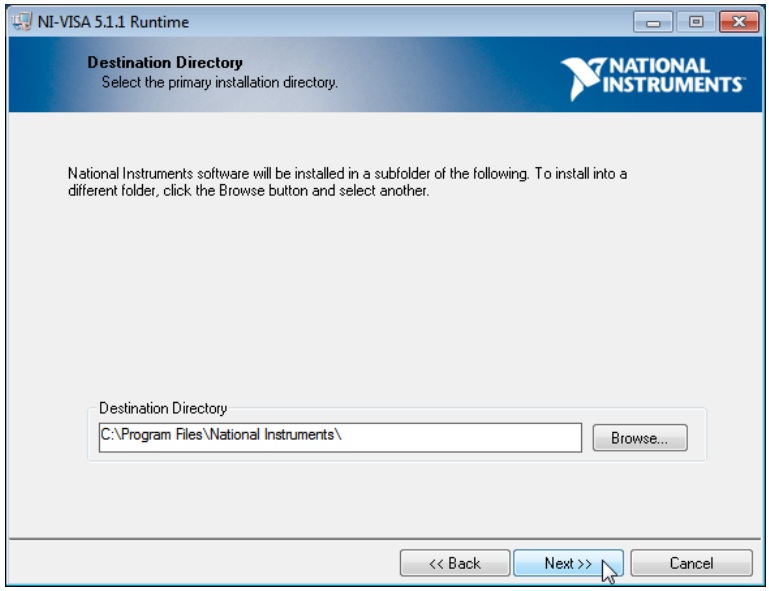


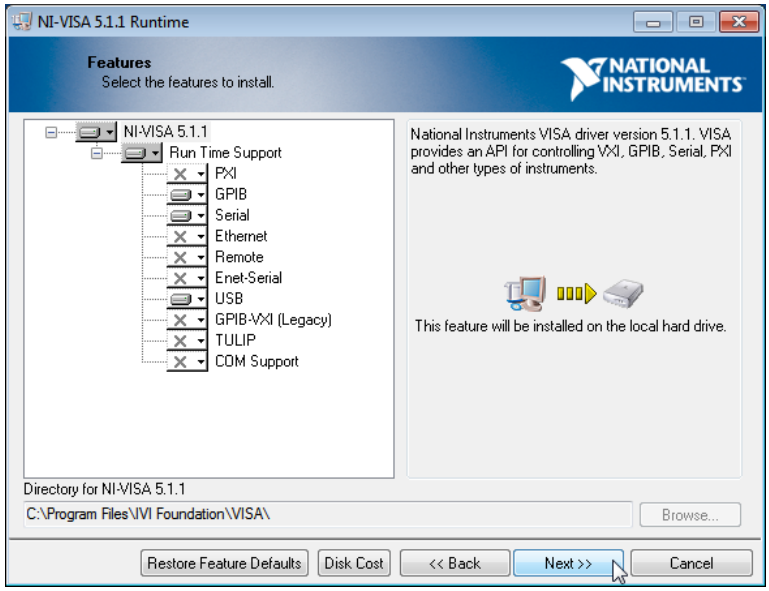
Click "Install" to continue

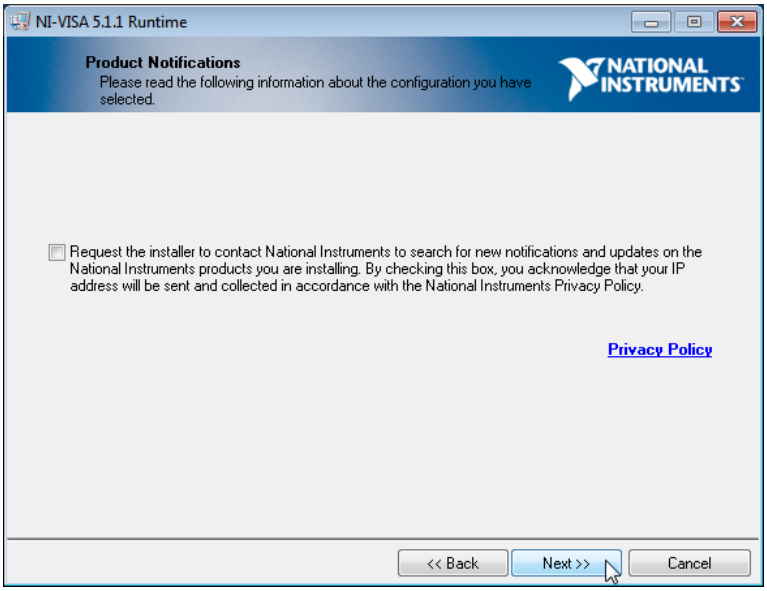


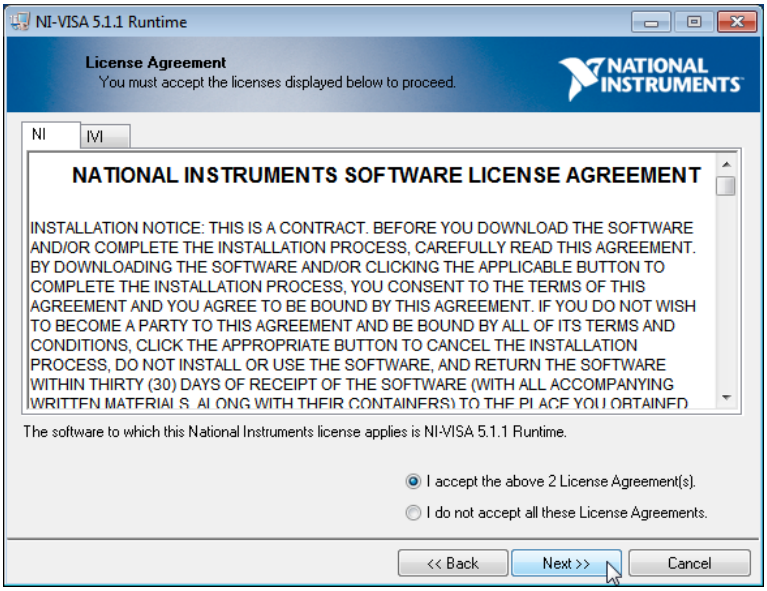
Click "Yes" to start installation, and in the next dialogs "Next" to install.


NI-VISA 5.1.1 Runtime
ni.com/visa
NI-VISA™
National Instruments VISA Software
Exit all applications before running this installer.
Disabling virus scanning applications may improve installation speed.
This program is subject to the accompanying License Agreement(s).
National Instruments Corporation is an authorized distributor of Microsoft Silverlight.
© 2011 National Instruments. All rights reserved.
NATIONAL INSTRUMENTS
<< Back
Next >>
Cancel

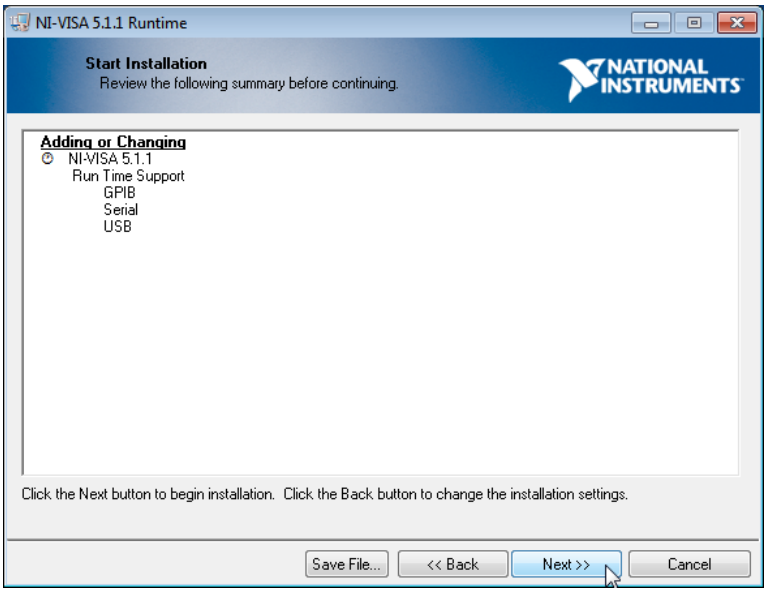

NI-VISA 5.1.1 Runtime
Destination Directory
Select the primary installation directory.
NATIONAL INSTRUMENTS
National Instruments software will be installed in a subfolder of the following. To install into a different folder, click the Browse button and select another.
Destination Directory
C:\Program Files\National Instruments\
Browse...
<< Back
Next >>
Cancel


NI-VISA 5.1.1 Runtime
Features
Select the features to install.
NATIONAL INSTRUMENTS
NI-VISA 5.1.1
Run Time Support
PXI
GPIB
Serial
Ethernet
Remote
Enet-Serial
USB
GPIB-VXI (Legacy)
TULIP
COM Support
National Instruments VISA driver version 5.1.1. VISA provides an API for controlling VXI, GPIB, Serial, PXI and other types of instruments.
This feature will be installed on the local hard drive.
Directory for NI-VISA 5.1.1
C:\Program Files\IVI Foundation\VISA\
Browse...
Restore Feature Defaults
Disk Cost
<< Back
Next >>
Cancel

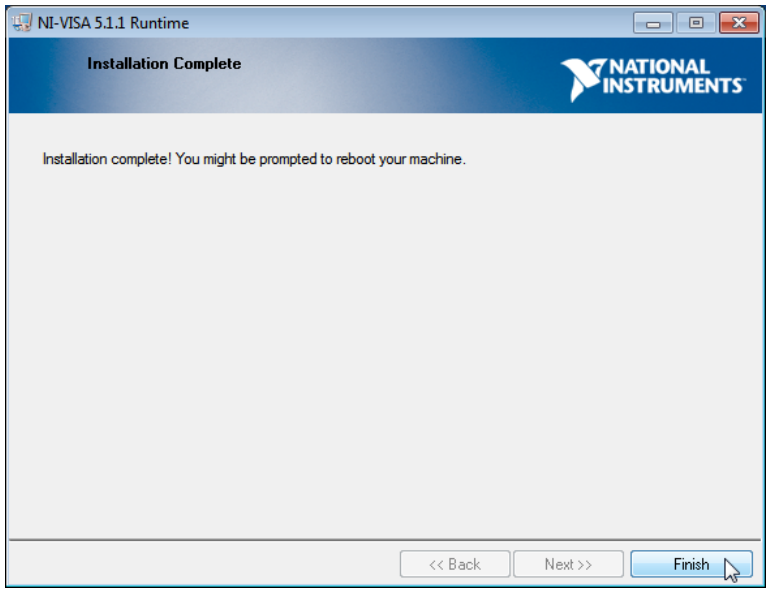




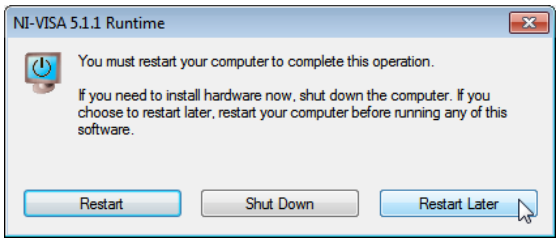
Click "I accept..." if you do so, then "Next >" to continue.



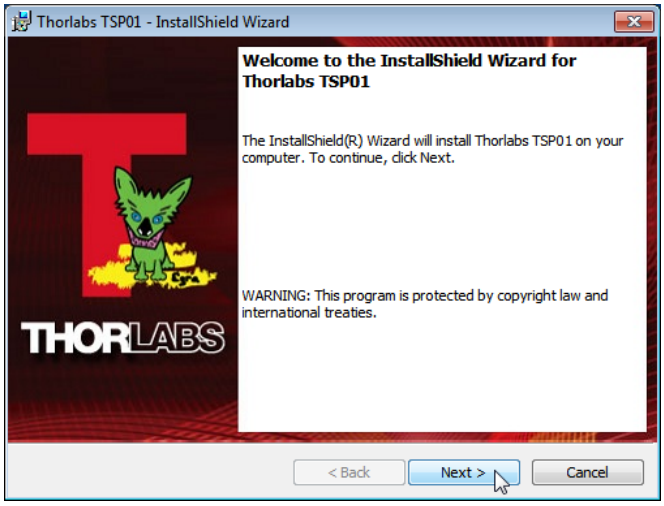
Click "Next >" to continue.



Click "Finish" to continue. You will be prompted to restart the computer.

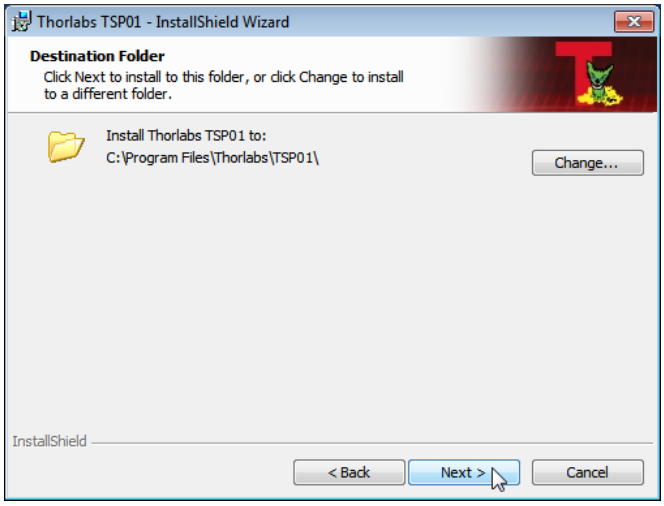


Click "Restart", leave CD in the drive. After the restart, the TSP01 software installation automatically resumes:

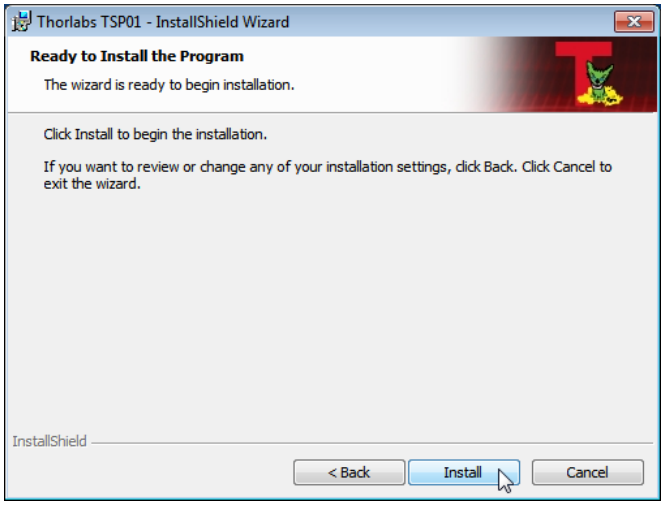


Click "Next >" to continue.

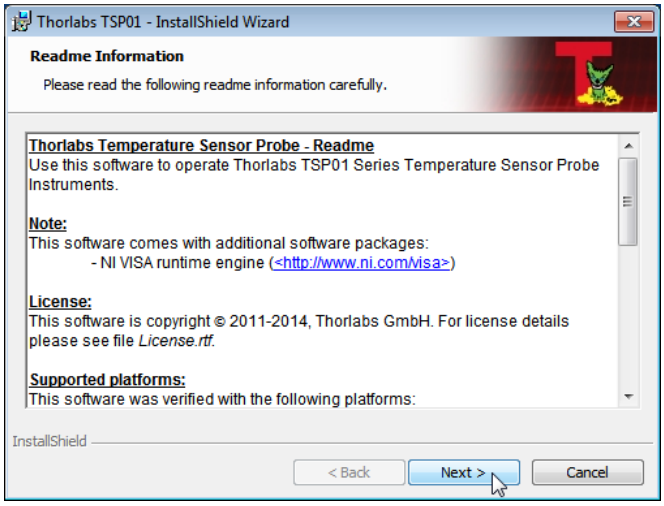
Click "I accept..." if you do so, then "Next >" to continue.

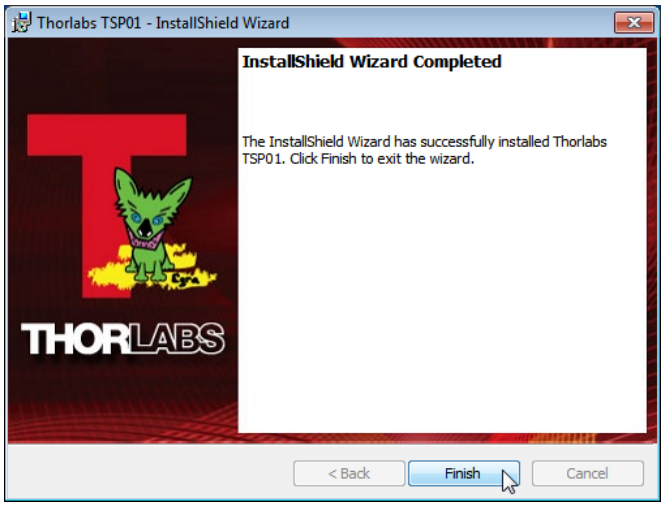


Click "Next >" to continue.



Click "Install" to continue, then "Next".

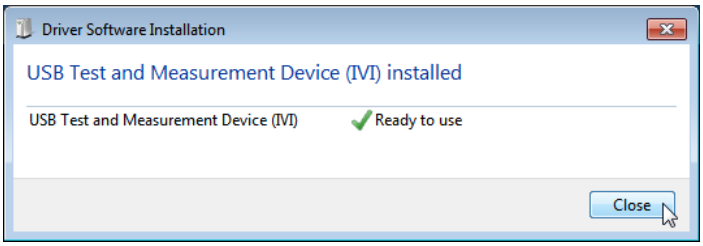




Click "Finish" to finalize installation.

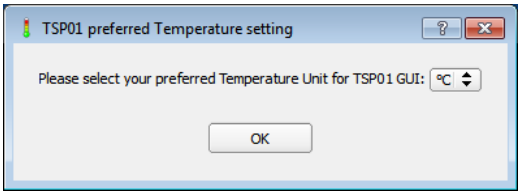
3 Operating Instruction

After installation of the software connect the TSP01 to a free USB2.0 port.

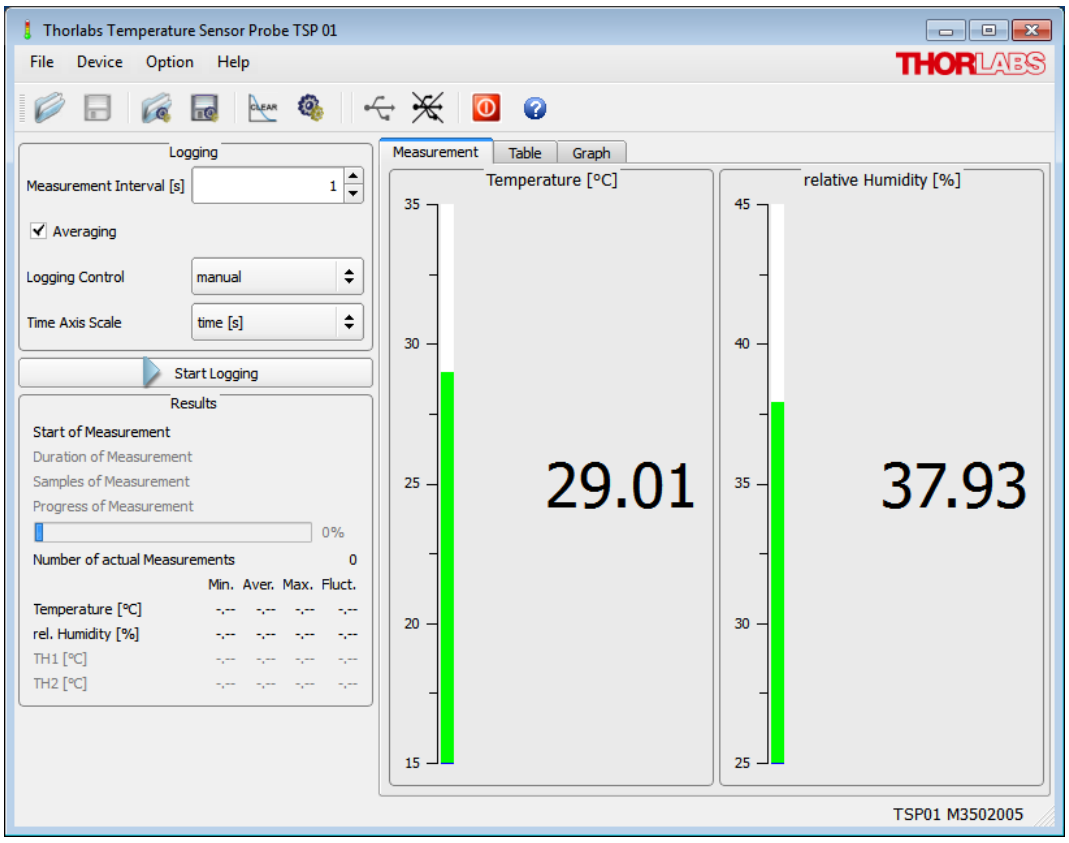


The operating system recognizes a new device and automatically installs the device drivers.

Start the GUI from the desktop icon.

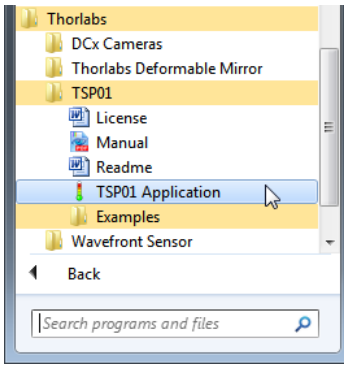


At the first connect, you will be prompted to select the preferred unit for temperature display. Click "OK" to confirm your choice. The software now automatically connects to the TSP01, and the actual temperature and relative humidity, measured on the internal sensor, are displayed. If an external sensor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

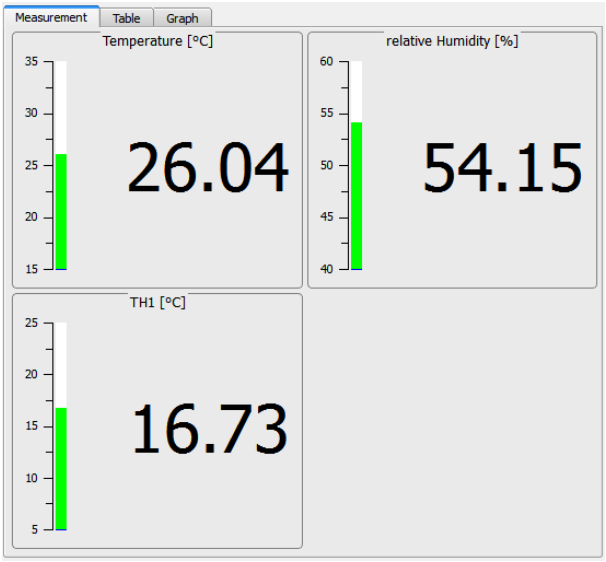


3.1 Quick Start

The Quick Start gives a short overview on how to use the TSP01 software.



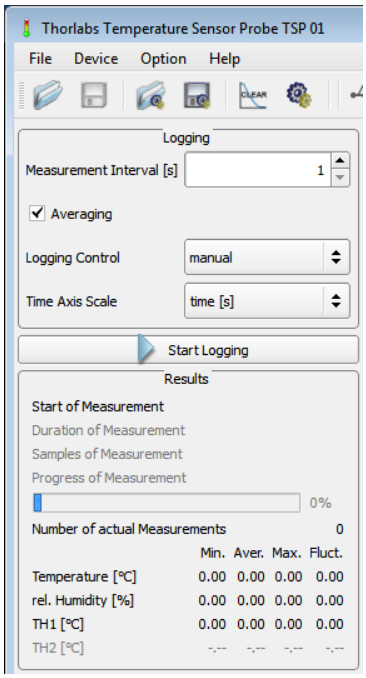
Tab Measurement



In the tab **Measurement** the actual measurement values of all enabled sensors are displayed in numerical values and within a bar.

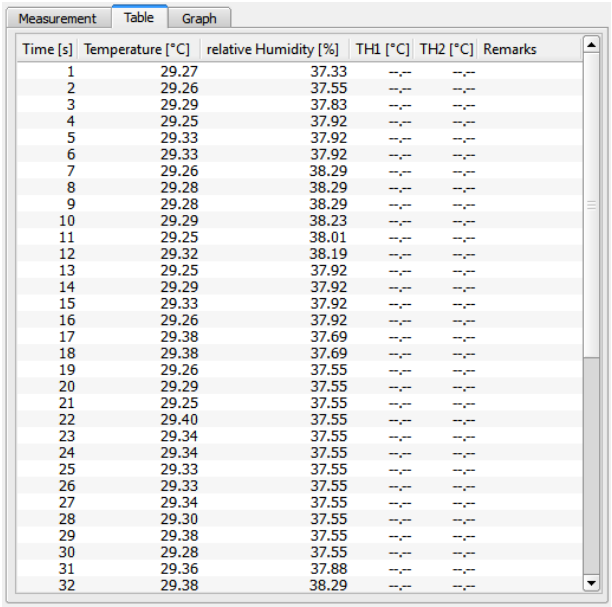
The bar indication range can be set individually in the **Settings** menu (see extended manual). Additionally, for each bar 2 limits can be defined, controlling the bar color (blue - green- red) depending on the actual value with respect to these 2 limits.

Logging panel



- **Logging Control**: Three modes can be set: manual start/stop, timed logging or logging of a number of samples.
- **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.
- **Time Axis Scale**: 3 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.

Tab Table



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

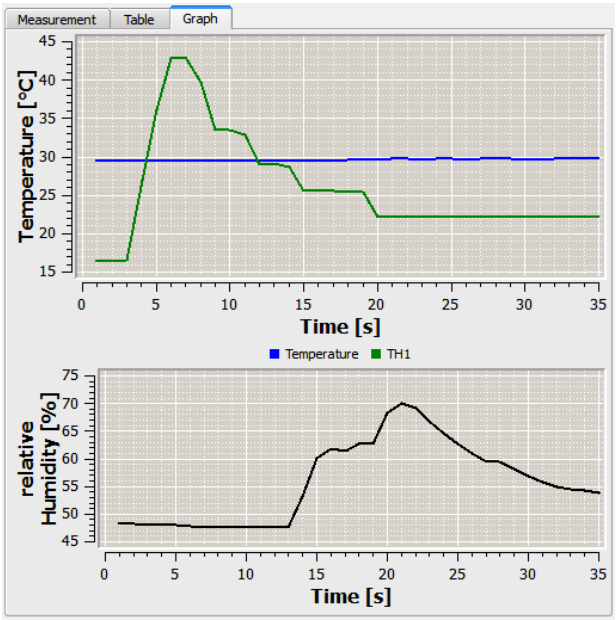
Column description:

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: empty if no error occurred, otherwise an error message will be displayed

Tab Graph

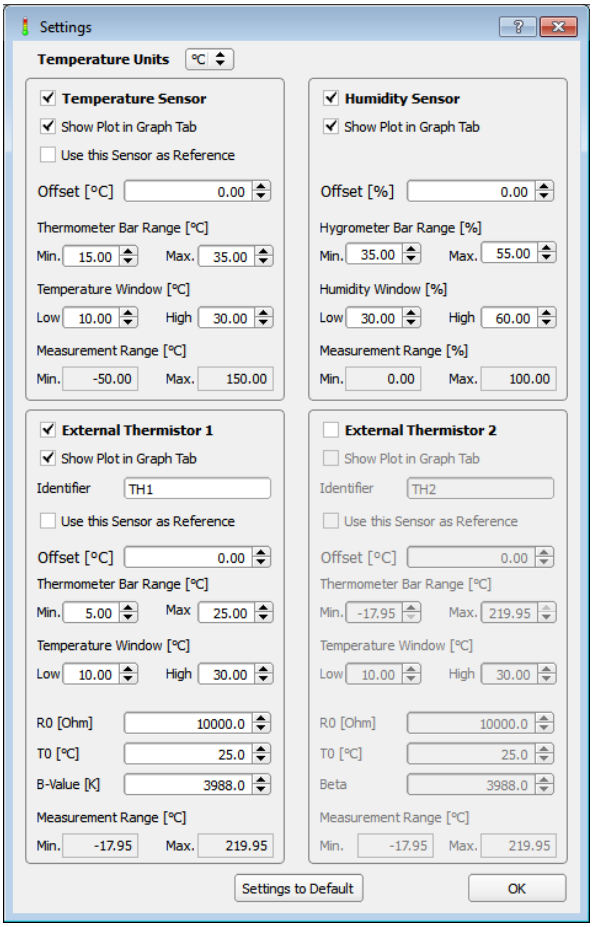


In the **Graph** all logged data vs. time are displayed, if enabled (**Show Plot** in Settings menu)

Temperature: up to 3 curves can be displayed: blue for internal sensor, green for external sensor TH1 and red for external sensor TH2.

Rel. Humidity: If enabled (**Show Plot** in Settings menu) it will show in black color the rel. humidity value vs. time.

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 sensor. Tool tips appear when moving the mouse pointer over the appropriate parameter.

In the following section the functionality is described in detail.

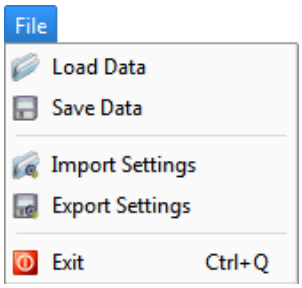
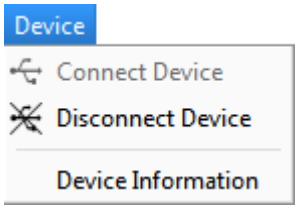
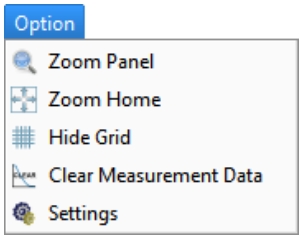
3.2 Detailed GUI Description

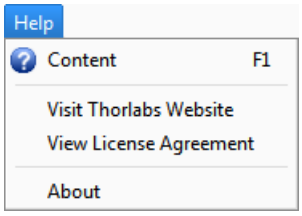
The Graphic User Interfaces automatically connects to the detected TSP01. The software starts with the most recent settings and configuration.

3.2.1 Controls

TSP01 GUI Controls

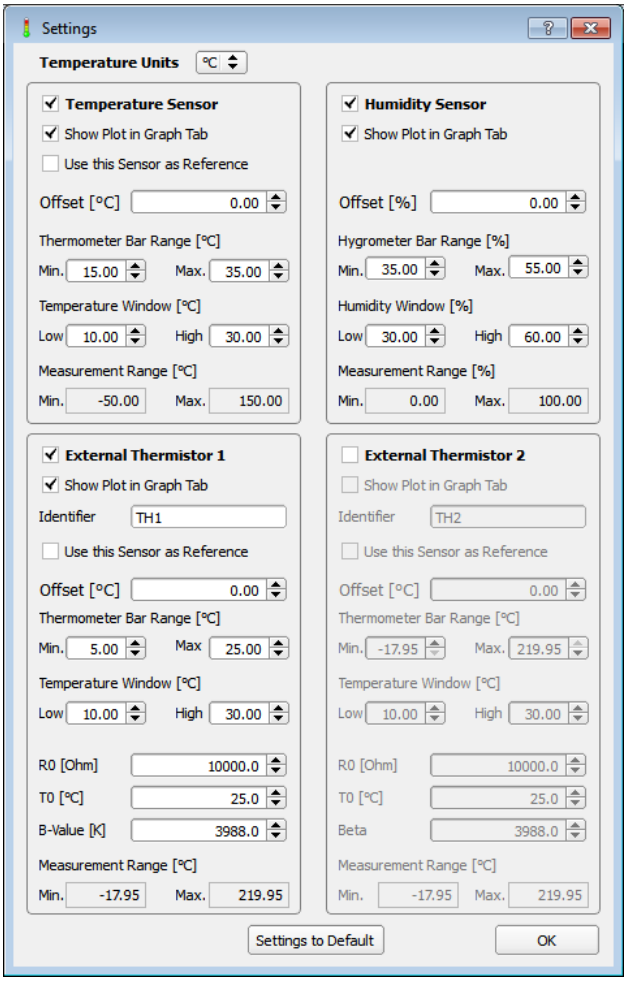
The following table summarizes the function of controls. For detailed information, click to the text in the **Function** column.

Menu	Menu Topic	Icon	Function
	Load Data		Loading measurement data from a file 21
	Save Data		Saving measurement data to a file 21
	Import Settings		Import configuration file 22
	Export Setting		Export configuration to a file 22
	Exit		Exit GUI
	Connect Device		
	Disconnect Device		
	Device Information	-	Recalls TSP01 info 23
	Zoom Panel *)	 *)	Opens Zoom Dialog panel (Graph axes) 19
	Zoom Home *)	 *)	Resets zoom of Graph display 19
	Hide Grid *)	 *)	Hide /show grid in Graph display 19
	Clear Measurement Data		Clears all logged data
	Settings		Opens Settings dialog panel 17

Menu	Menu Topic	Icon	Function
	Visit Thorlabs Website View License Agreement		
	About		Displays info on the software 32

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

3.2.2 Settings

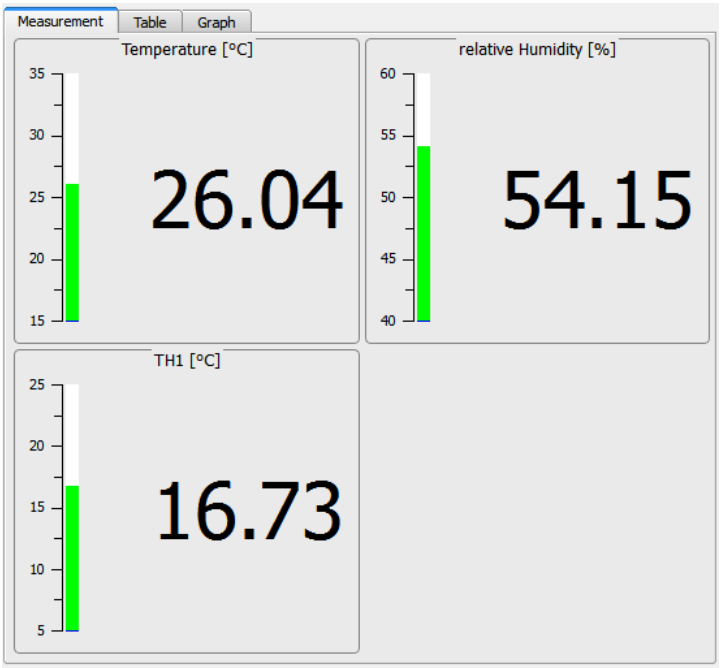


The **Settings** dialog is almost self explaining, please note the tool tips which appear when moving the mouse pointer over an item.

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

- **Temperature Units**: Select the required unit (°C, °F or K)
- Enable a sensor: Check the box at the **bold** sensor description. Default settings: Internal sensors enabled, external enabled if recognized.
- **Show Plot in Graph Tab**: Check this box to enable display of logged values in graph tab.
- **Identifier**: For external thermistors, a custom identifier can be assigned (max. 25 characters).
- **Use this sensor as Reference**: When checking this box, all sensors' values 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 real temperature.
- **Offset**: Additionally, 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 display 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 range of the sensor, it's not editable. For the internal combined sensor, the ranges are fixed, for external thermistors the range is calculated from entered $\mathbf{R_0}$, $\mathbf{T_0}$ and **B** values.

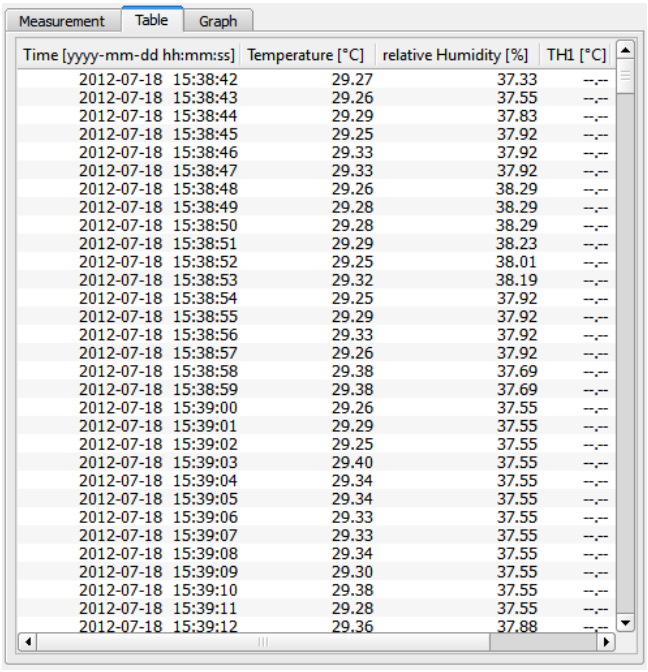
3.2.3 Tab Measurement



Tab **Measurement** displays by default the actual measurement results for internal sensors and recognized external thermistor sensors. Displayed sensors can be hidden, see Settings 17.

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 17 panel.

3.2.4 Tab Table

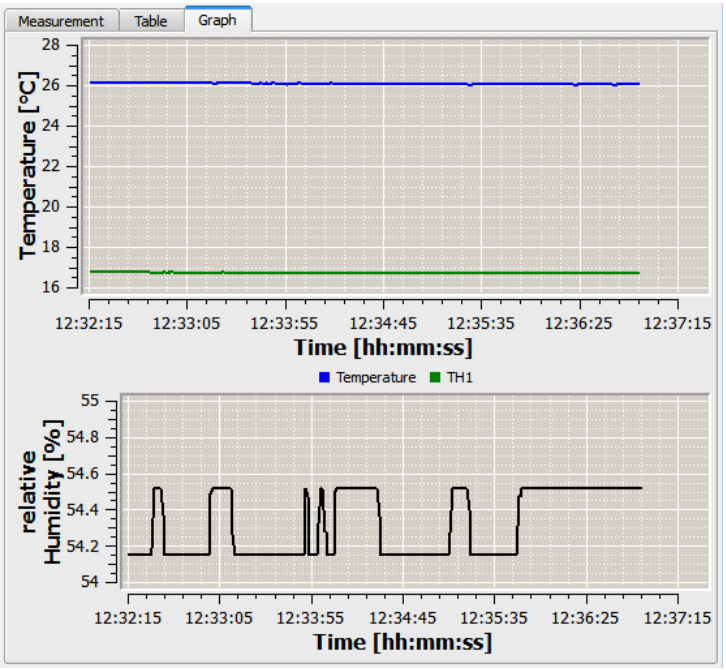


In the tab **Table** the logging results are displayed.

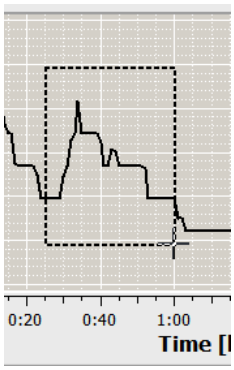
The first column contains the **time** in the format as selected in the Logging panel 20 (time in seconds / days:hours:minutes:seconds or complete time stamp).

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

3.2.5 Tab Graph



The tab **Graph** displays the logged measurement values. Data base is the table of logged values, it is linked with the box "Show Plot in Graph Tab" in the Settings 17 panel. Thus, logged data can be toggled in graphical display.



The graph display can easily 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.

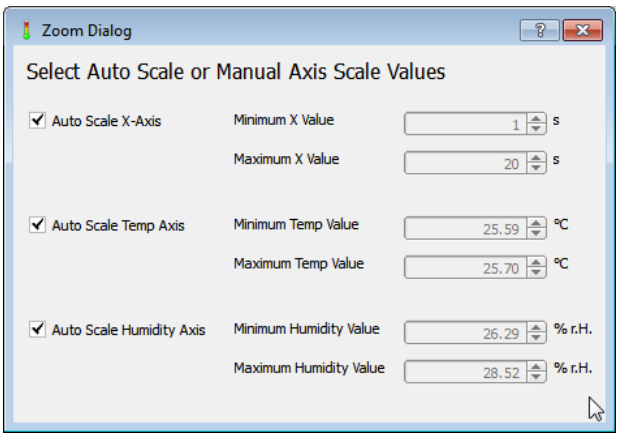
For scaling of the graph, click the Zoom Dialog 19 icon.

The grid can be toggled, see Graph Display Options 20.

3.2.6 Graph Display Option Menues

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

Zoom Panel



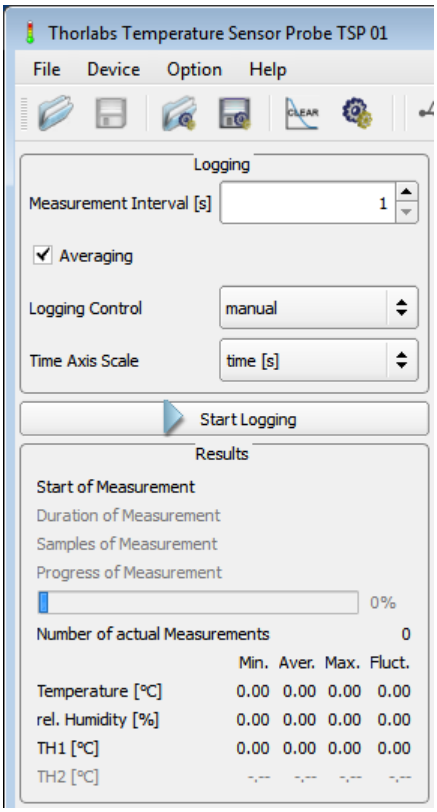
By default, Auto Scaling is enabled. By unchecking the "Auto Scale..." box, the limits of the appropriate axis can be changed.

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

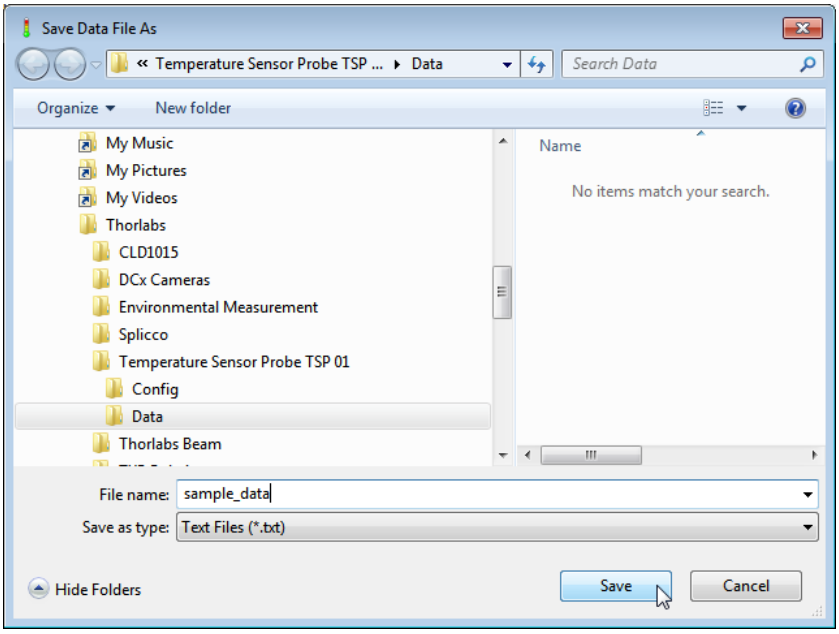


This is the control panel for recording of temperature(s) and/ or humidity over time.

- **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**: 3 modes can be set: **manual** start/ stop, **time**d logging or logging of a number of **samples**.
- **Time Axis Scale**: 3 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

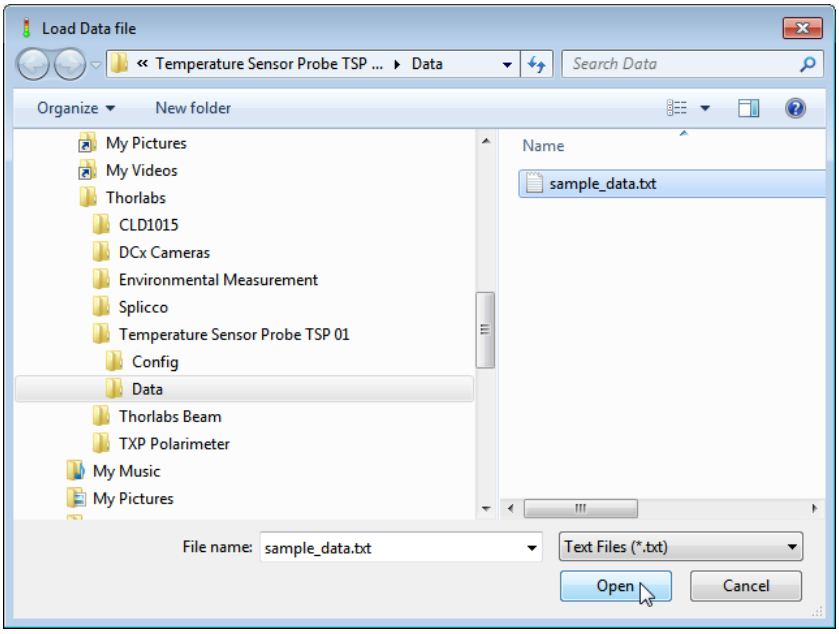
Logged data can be saved to a tab separated *.txt file. Click to the  icon or select from the menu **File** the **Save Data** item. A dialog opens:



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

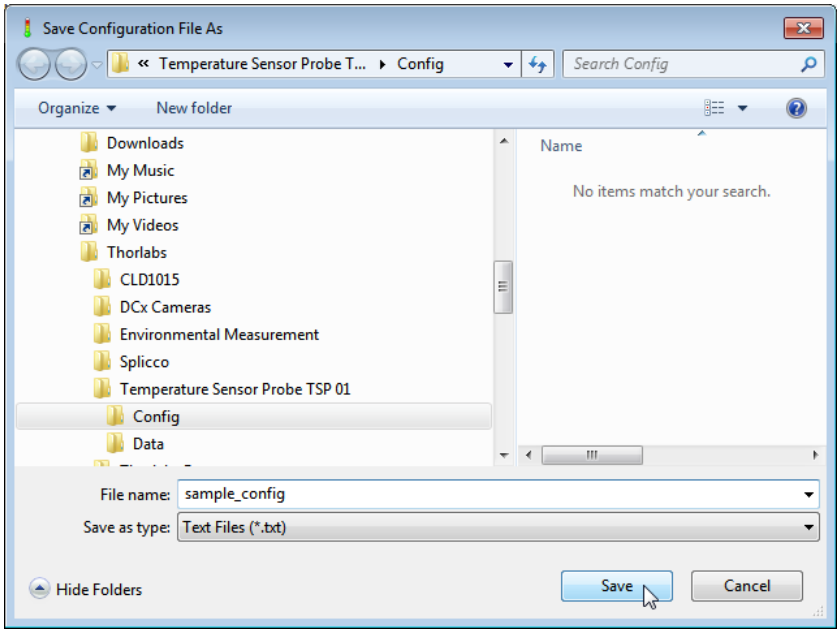
Saved data can be loaded into the GUI. Click to the  icon or select from the menu **File** the **Load Data** item. A dialog opens:



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

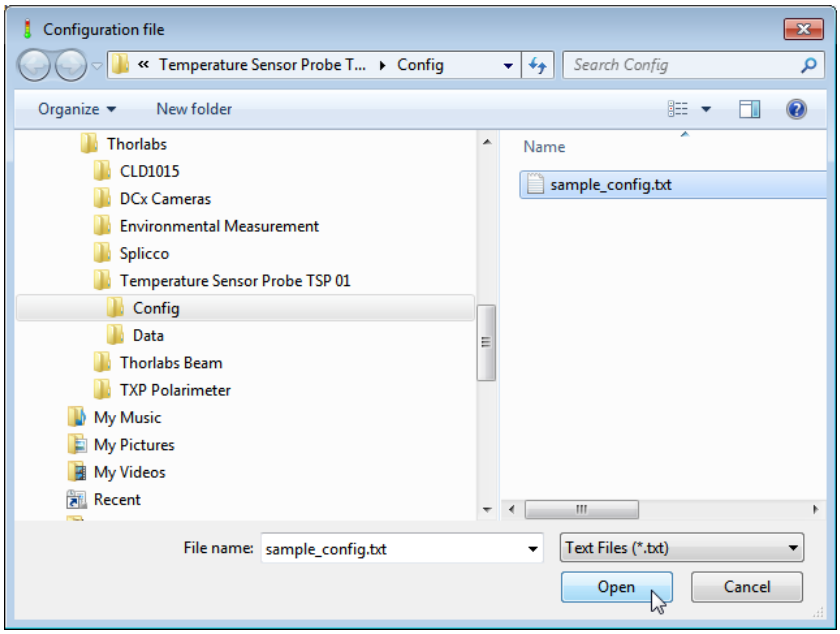
The complete GUI settings can be saved to a *.txt file. Click to the  icon or select from the menu **File** the **Export Settings** item. A dialog opens:



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

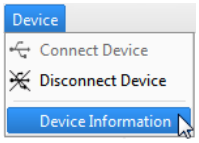
3.2.11 Import Settings

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:

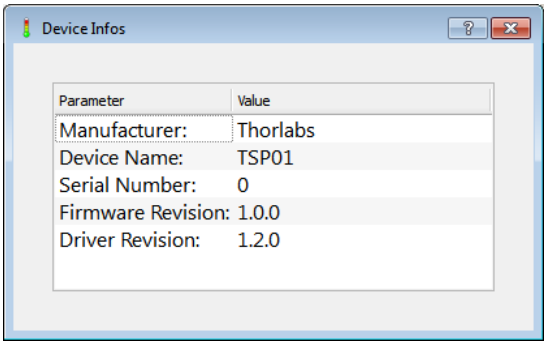


Select the desired file and click "Open".

3.2.12 Device Information



The Device Information menu retrieves information on the connected TSP01:



4 Write Your Own Application

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 being installed to your computer during software installation and cannot be found on the installation CD.

In this section the location of drivers and files, required for programming in different environments, are given for installation under Windows XP (32 bit) and Windows 7 (32 and 64 bit).

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 what files you need for particular programming environments.

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

All above environments require also the NI VISA instrument driver dll !

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

4.1 Driver Installation and Location

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 Command Reference

4.2.1 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 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]		

Command	Description	SCPI
[: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.	
: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.

Attention

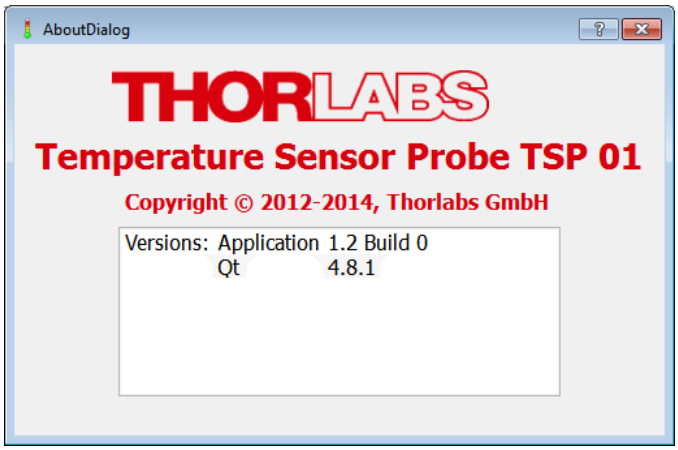
To avoid damage to the instrument, do not expose it to spray, liquids or solvents!

The unit does not need a regular maintenance by the user. It does not contain any modules and/or components that could be repaired by the user himself. If a malfunction occurs, please contact Thorlabs 39 for return instructions.

Do not remove covers!

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 39 .

6 Appendix

6.1 Technical Data

Internal Combined Sensor		
	Temperature Measurement	Rel. Humidity Measurement
Range	-40 °C to +125 °C [1])	0 % to 100 % RH
Units	°C, K, °F	% RH
Accuracy	±1 °C (-10 to +70 °C) ± 0.3°C (25 °C)	± 1 % RH (20% to 80 % RH) ± 3 % 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	0.1 °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 (Test & Measurement Device)	
Power Supply	5 V DC, 20 mA via USB	
Measurement Update Rate	max. 1/sec	
General		
Operating Temperature Range [2])	-10 °C to +70 °C	
Storage Temperature Range	-40 °C to 70 °C	
Dimensions (W x H x D)	69.5mm x 20.5mm x 12.0mm	
Weight	< 50 g (w/o external sensor)	

[1]) This specification is for the temperature range of the sensor inside the USB thumb drive. The actual temperature range of the TSP01 internal sensor is limited by the operating temperature range of the USB thumb drive, which is -10 to 70 °C.

[2]) non-condensing

All technical data are valid at (23 ± 5) °C and (45 ± 15) % rel. humidity (non condensing)

6.2 Certifications and Compliances

Category	Standards or description	
EC Declaration of Conformity - EMC	Meets intent of Directive 2004/108/EC [1] for Electromagnetic Compatibility. Compliance was demonstrated to the following specifications as listed in the Official Journal of the European Communities:	
	EN 61326-1:2006	Electrical equipment for measurement, control and laboratory use – EMC requirements: Immunity: complies with basic immunity test requirements [2]. Emission: complies with EN 55011 Class B Limits [2,4], IEC 610003-2 and IEC 61000-3-3.
	IEC 61000-4-2	Electrostatic Discharge Immunity (Performance Criterion B)
	IEC 61000-4-3	Radiated RF Electromagnetic Field Immunity (Performance Criterion A)
	IEC 61000-4-4	Electrical Fast Transient / Burst Immunity (Performance Criterion B)
	IEC 61000-4-6	Conducted RF Immunity (Performance Criterion A)
FCC EMC Compliance	Emissions comply with the Class B Limits of FCC Code of Federal Regulations 47, Part 15, Subpart B [2,4].	
EC Declaration of Conformity - Low Voltage	Compliance was demonstrated to the following specification as listed in the Official Journal of the European Communities: Low Voltage Directive 2006/95/EC [7]	
	EN 61010-1:2001	Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use - Part 1: General Requirements
U.S. Nationally Recognized Testing Laboratory Listing	UL 61010-1 2nd ed.	
	ISA-82:02.01 2nd ed.	
Canadian Certification	CAN/CSA C22.2 No. 61010-1 2nd ed.	
Additional Compliance	IEC 61010-1:2001	
Equipment Type	Test and Measuring	
Safety Class	Class I equipment (as defined in IEC 60950-1:2001)	

[1] Replaces 89/336/EEC.

[2] Compliance demonstrated using high-quality shielded interface cables shorter than or equal to 3 meters.

[4] Emissions, which exceed the levels required by these standards, may occur when this equipment is connected to a test object.

[7] Replaces 73/23/EEC, amended by 93/68/EEC

6.3 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

6.4 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 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.

6.5 Copyright and Exclusion of Reliability

Thorlabs has taken every possible care in preparing this Operation Manual. We however assume no liability for the content, completeness or quality of the information contained therein. The content of this manual is regularly updated and adapted to reflect the current status of the 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 User Manual 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 User Manual. Should you require further information on this product, or encounter specific problems that are not discussed in sufficient detail in the User Manual, please contact your local *Thorlabs* dealer or system installer.

6.6 Thorlabs 'End of Life' Policy (WEEE)

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

This offer is valid for Thorlabs electrical and electronic equipment

- sold after August 13th 2005
- marked correspondingly with the crossed out “wheelie bin” logo (see figure below)
- sold to a company or institute within the EC
- currently owned by a company or institute within the EC
- still complete, not disassembled and not contaminated

As the WEEE directive applies to self contained operational electrical and electronic products, this “end of life” take back service does not refer to other Thorlabs products, such as

- pure OEM products, that means assemblies to be built into a unit by the user (e. g. OEM laser driver cards)
- components
- mechanics and optics
- left over parts of units disassembled by the user (PCB’s, housings etc.).

Waste treatment on your own responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

WEEE Number (Germany) : DE97581288

Ecological background

It is well known that waste treatment pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS Directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE Directive is to enforce the recycling of WEEE. A controlled recycling of end-of-life products will thereby avoid negative impacts on the environment.

Crossed out
"Wheelie Bin" symbol

6.7 Thorlabs Worldwide Contacts

USA, Canada, and South America

Thorlabs, Inc.
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