

thaTEC:OS - User Manual

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March 26, 2018

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1 Installation Notes

1.1 thaTEC:framework Installer

To run thaTEC:OS or thaTEC:driver modules, runtime environments for LabView2015 as well as Sentinel LDK are required. To satisfy these requirements, please run the thaTEC:framework installer which includes all required components and installs them after checking your system status. In addition to the installation of these modules, the installer releases port 1947 for incoming and outgoing traffic. This will allow for distributing our software on PCs in the same network with just one Sentinel HL Max key. After this first step, you can install and run additional modules in any order. Furthermore, the installation includes the program *thaTEC QuickSupport* that might be used for trouble shooting (see Section 7).

1.2 Troubleshooting

If the installer shows the error message *Port release failed...*, you can manually release the port. To do so, please press the Windows key and type *cmd.exe*. Right-click on the Windows command line tool to open it as administrator. To check the status or release the port, use the commands:

- *netsh advfirewall firewall show rule name="Sentinel Port 1947" dir=in* (status for incoming traffic)
- *netsh advfirewall firewall show rule name="Sentinel Port 1947" dir=out* (status for outgoing traffic)

and

- *netsh advfirewall firewall add rule name="Sentinel Port 1947" dir=in action=allow protocol=TCP localport=1947* (release for incoming traffic)
- *netsh advfirewall firewall add rule name="Sentinel Port 1947" dir=out action=allow protocol=TCP localport=1947* (release for outgoing traffic).

If the installer shows the error message *Installation of Sentinel LDK failed...* or you cannot access <http://localhost:1947> after installation, please try to manually install the Sentinel LDK runtime *HASPUserSetup.exe* that can be found at `C:/ProgramData/THATec-HASP/`. If you cannot find the Sentinel LDK installer at the specified location, please run the thaTEC:framework installer.

1.3 thaTEC:driver Template

To allow users the development of their own device modules, we offer thaTEC:driver template. The use of this template is restricted to LabView2015 32/64bit. You cannot use the template with newer/older LabView versions. Please make sure that your systems meets this requirement.

To use the template, you need to run its installer (32 or 64 bit) first. This installers will satisfy all dependencies of the template project. If you cannot run the template project because of missing VIs, please make sure that the installer has been run. If you want to work with both versions, 32 and 64 bit, you need to run both installers.

Once the installer has been run, you can copy the template project to any location, open it and start to develop. If you want to use your new device modules on a PC without the template installer, please use the *Build* section of LabView's project explorer to create executables that satisfy all dependencies.

2 Sentinel HL Max Key

The HASP key Sentinel HL Max contains the software licenses for all the modules you purchased from the THATec Innovation GmbH. thaTEC:framework installer provides all required components to interact with your Sentinel HL Max key as well as releases the required ports. You can check the status of your key and the corresponding software licenses via the Sentinel Admin Control Center in your webbrowser at <http://localhost:1947> that is described in the next section. We recommend the creation of a bookmark to this page for future use. To use Sentinel HL Max key as a network key, please make sure that all your PCs are running in the same network.

2.1 Keys, Features, Sessions

The Sentinel Admin Control Center (<http://localhost:1947>) lists all HASP keys that are detected by your PC. You can find this list by clicking *Sentinel Keys* in the *Options* sections on the left side of the page (as shown in Fig. 1). Your key should be listed on all PCs that share the same network with the PC where the key is attached to. If you cannot find your key, please make sure the PC with the key is switched on, Sentinel LDK runtime is installed, and port 1947 is released.

To run a certain module your key needs to have the corresponding *Feature* (or license). A list of all currently available features can be found by clicking *Features* in the *Options* section on the left side of the page (see Fig. 2). In case of a license problem in one of your modules, a pop-up message will inform you about the feature of this module. Please verify that the requested feature is available on your dongle.

Some modules like thaTEC:OS allow for a limited number of parallel executions only. Therefore, each program execution of such modules is monitored by the Sentinel HL Max key. You can check the total number of potential parallel instances of your modules as well as the currently used *Logins* in the *Feature* list in the columns *Logins* and *Limit*. To find out on which of your PCs the currently active instances of your modules are executed, you can display the *Sessions* section. This section can be displayed via *Options* on the left side of the page or via the button on the right side of the feature list.

If an error during the execution of a module prevents a clean termination of the program, it might happen that the *Login* or *Session* is still registered by the Sentinel HL Max key and blocks the corresponding *Feature*. To make features available again,

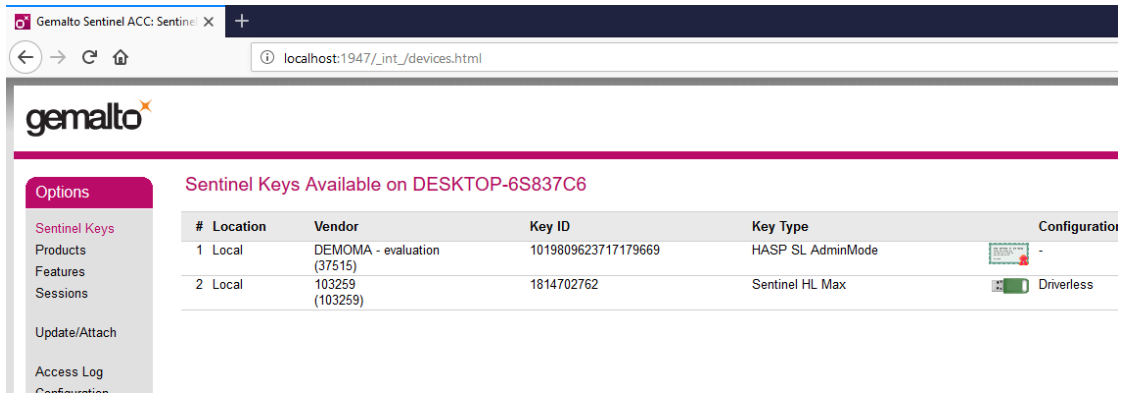


Figure 1: Sentinel Admin Control Center accessed in a web browser. The list of *Sentinel Keys* (accessed via the *Options* sections on the left side) shows a Sentinel HL Max keys (green symbol).

#	Product	Feature	Location	Access	Counting	Logins	Limit	Detached	Restrictions	Sessions	Actions
1	-	0	Local	Loc	Station	-	=	-	Perpetual	-	Sessions
2	13 thaTEC.OS + library - local use	17 Standard Library	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
3	13 thaTEC.OS + library - local use	1 thaTEC.OS	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
4	13 thaTEC.OS + library - local use	13 MCCDS	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
5	13 thaTEC.OS + library - local use	8 TFPDAS	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
6	13 thaTEC.OS + library - local use	18 template	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
7	13 thaTEC.OS + library - local use	12 FAST ComTec MSCA6	Local	Loc Display	Station	-	=	-	Perpetual	-	Sessions
8	13 thaTEC.OS + library - local use	19 TimeTagger	Local	Loc Display	Station	-	1	-	Perpetual	-	Sessions

Figure 2: *Features* available on a Sentinel HL MAX key.

Sessions on DESKTOP-6S837C6, Key 1814702762, Feature 1, Product 13

ID	Key	Location	Product	Feature	Address	User	Machine	Login Time	Timeout	Actions
00000000	1814702762	Local	13 thaTEC:OS + library - local use	1 thaTEC:OS	Local	Thomas	DESKTOP-6S837C6-11388	Mon Feb 26, 12:14:48	11:24:51	Disconnect

Figure 3: List of active *Sessions*. In addition to the option to manually close an active session (last column), this menu offers information about the PC where this session is active.

you can manually disconnect sessions in the *Sessions* menu. To disconnect the session, please click the corresponding button in the last column of this menu that is shown in Fig. 3.

2.2 Error Messages and Solutions

The following error messages are displayed in case of license problems by the corresponding module. Most modules can be run even with license errors. However, in this case, you cannot establish connections between thaTEC:drivers and thaTEC:OS and, therefore, not automatize cross-device processes.

Sentinel LDK is not available on your system. Please run the HASP installer! Visit <http://localhost:1947> to check whether Sentinel LDK is installed. If not, please try to manually install the Sentinel LDK runtime *HASPUserSetup.exe* that can be found at `C:/ProgramData/THATec-HASP/`. If you cannot find the Sentinel LDK installer at the specified location, please run thaTEC:framework installer.

Protection Key Sentinel HL Max cannot be found. Please check the availability of the dongle in your browser at <http://localhost:1947> Attach the dongle to one of the PCs in your network, start this PC, and make sure that port 1947 is released on all machines (see Section 1.2).

Feature xy is not available. Please check the availability of the feature in your browser at <http://localhost:1947>. You might have downloaded and installed a module that you have not purchased. Therefore, the dongle does not have the corresponding feature/license. Please contact us for further discussion.

Feature xy has too many concurrent user sessions. You can check and stop current sessions in your browser at <http://localhost:1947>. Licenses to some modules allow only a certain number of parallel executions. To prevent unnecessary waiting times, please make sure that all users stop the modules if they do not need them any more. Please have a look at Section 2.1 for more information about sessions.

Remark: Even though thaTEC:OS offers the option to visualize your data, it should only be used for quick checks or during measurements. Please keep in mind that a running instance of thaTEC:OS might block one of your licenses. For the evaluation of data the use of the license free *Data Inspector* is strongly recommended!

Feature xy is requested via a terminal server or remote desktop. This feature can only be used locally. Please contact us!

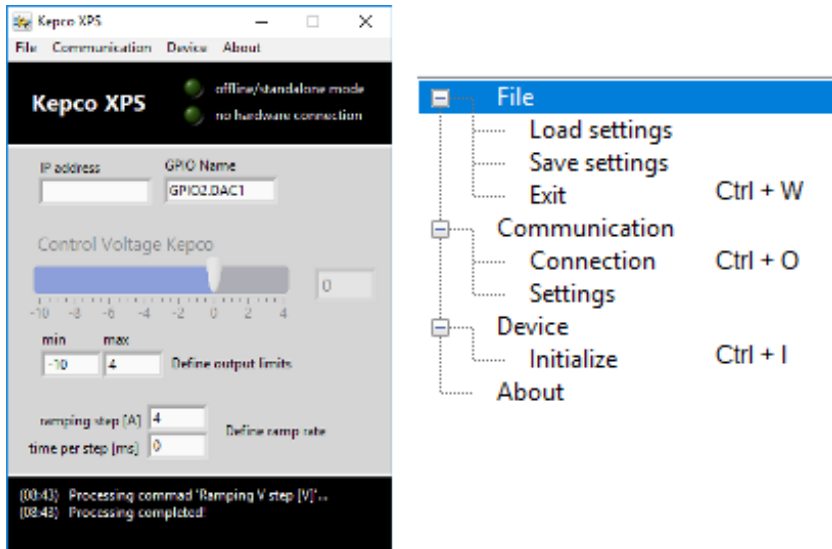


Figure 4: Example of a thaTEC-driver module and the minimal runtime-menu entries. The entries that are shown here are shared by all of modules. Depending on the functionality of the corresponding devices, the menu can be extended.

2.3 Updates of your License

If you purchase new modules, it might be required to update your license on the Sentinel HL Max key. For this purpose, we need a *Customer-to-Vendor* file that can be created with your key. To do so, please click on the button *C2V* in the *Sentinel Keys* menu in the row that is showing your key (see Fig. 1). Download the *C2V* file to any location you like and send us the file by mail (contact@thatec-innovation.com).

With your *C2V* file, we will create a *Vendor-to-Customer* file and send it to you. To apply this *V2C* file, go to the *Update/Attach* menu (via *Options* on the left side of the page), choose the *V2C* file that you received and press the *Apply File* button. If your dongle is attached to the PC, a message should inform you about the successful update of your license.

3 thaTEC:drivers

thaTEC:driver modules are standalone programs for the control of specific devices. Even though they offer completely different functionality (based on the devices they are created for), they all share a set of common functions.

Fig. 4 shows the user interface of a typical driver module with its name, indicators for the device status as well as the connection status to thaTEC:OS, and a status bar displaying information about the currently processed command. Most of the drivers do also have controls to specify the hardware address of the corresponding device (IP address, GPIB number, COM port, ...). In the runtime-menu of the drivers you will

always find the common entries shown in Fig. 4. More information about these entries can be found in the next sections.

3.1 Device Initialization

To start working with your device, specify the correct hardware address (if needed) and use the runtime menu entry *Device* → *Initialize* or the corresponding shortcut *Ctrl+I*.

For most devices which use the VISA communication protocol, the address can be automatically detected by the *refresh* function of the address field. For devices that are not automatically detected and listed in the address field, please have a look at the description of the syntax for VISA addresses that can be found here: NI-VISA Online Help. For instance, if you want to connect to your device via Ethernet you have to specify the address in the following format: `TCPIP0::address::INSTR` where *address* is the IP address or the network name of the device.

If the initialization fails, please check the hardware status and the hardware address you specified. If there is software from the manufacturer shipped together with the hardware, please make sure that all required components and drivers are installed on your system and that this software is working with the device properly. This is a crucial pre-condition to use thaTEC:driver modules.

If you still cannot initialize the device, please also check if the device is already in remote mode and does not allow for initialization because of an already existing connection. If so, close this connection from the corresponding program or restart the device and try to initialize again.

If *National Instruments Measurement & Automation Explorer* (NI MAX) is available on your system, you might also check the connectivity of the device with it.

3.2 Connection to thaTEC:OS

thaTEC:drivers are standalone programs. However, if you want to automatize cross-device measurements and processes you have to connect them to thaTEC:OS. To do so, please specify the IP address and port number of thaTEC:OS via the runtime menu entry *Communication* → *Settings* first (see Fig. 5, IP and port number can be found on the user interface of thaTEC:OS). Set up the actual connection via *Communication* → *Connection* or the corresponding shortcut *Ctrl+O*. The connection settings are automatically loaded/saved at the start/end of the program execution. As long as IP and port number of thaTEC:OS stay the same, you do not need to edit these settings.

If the connection fails, please check the connection settings specified in thaTEC:driver as well as the firewall settings of your system. Please make sure that all thaTEC:drivers and thaTEC:OS are run on PCs in the same network.

4 thaTEC:OS

thaTEC:OS is the central interface to control devices, automatize cross-device measurements and processes, and visualize measurement data. **Remark:** Even though

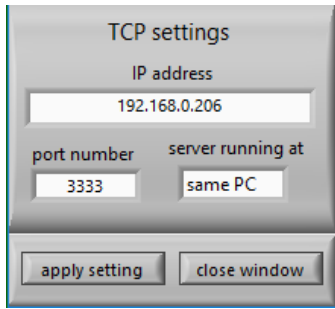


Figure 5: Connection settings to thaTEC:OS. Specify IP address and port number of thaTEC:OS that can be found on its user interface. Via the control *server running at* you can choose pre-defined IP addresses.

thaTEC:OS offers the option to visualize your data, it should only be used for quick checks or during measurements. Please keep in mind that a running instance of thaTEC:OS might block one of your licenses. For the evaluation of data the use of the license free *Data Inspector* is strongly recommended!

4.1 Settings

4.1.1 Email Notifier

thaTEC:OS offers email notifications that inform about successfully finished processes or errors that might occur during automatized processes. To set up these notifications, please specify the server and account settings of a valid email address via *Settings* → *Email notifier*. Please verify correct settings by sending a test message!

4.1.2 Memory Usage

For the visualization of your experimental data thaTEC:OS has access to the currently acquired data during automated measurements or after loading an existing data file. You have two options to define how thaTEC:OS accesses the data: the data can be loaded into memory completely (option *memory and file*) or directly read from file on demand (option *file only*). You can switch between these options via *Settings* → *Data stored in*.

In general, the option *memory and file* is recommended because it allows for faster processing of the data for visualization. However, if you acquire a lot of data in a single measurement, the memory usage can increase drastically. Therefore, we recommend to switch to the option *file only* if you start or load a measurement with more than 1GB data.

4.1.3 Communication

To start working with thaTEC:OS you need to connect thaTEC:drivers (see Section 3.2). The current IP address and port number of thaTEC:OS are displayed in the upper right

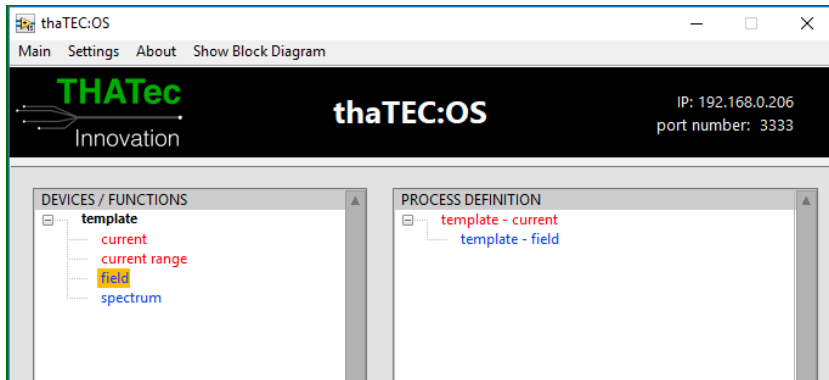


Figure 6: thaTEC:OS running on IP address 192.168.0.206 and port number 3333 (see upper right corner) with thaTEC:driver *template* connected. The driver and its functions are displayed in the tree on the left. To define a process or measurement, the tree on the right is filled by drag&drop.

corner of the user interface (see Fig. 6). The default port number is 3333. If this port is already used, thaTEC:OS will automatically switch to another port. The current IP address of your system will be automatically obtained. If (and only if) you are working on just one PC with all thaTEC:drivers and thaTEC:OS, you might switch to the option *localhost* via the menu entry *Settings* → *Server running on*. This method prevents potential problems with firewall settings. However, the use of the option *network IP* is encouraged. Switching between these options requires restarting of thaTEC:OS.

4.2 Devices and their Functions

Once you connected thaTEC:drivers to thaTEC:OS they show up in the DEVICES/FUNCTIONS tree on the left side of the user interface. Functions that need input or start an action at the device are shown in red and are called *controls*, while functions that acquire and provide data are blue and are called *indicators*. You have access to these functions by double-click or right-click.

4.3 Process Definition

With the functions displayed in the DEVICES/FUNCTIONS tree you can fill the PROCESS DEFINITION tree by drag&drop. For controls shown in red you can define the values that are set during the automation by double-click or via the right-click menu entry *Set parameter*. You cannot set any values for indicators.

The position and indentation of items in the process tree can be changed with the arrow keys. All functions in the tree are processed subsequently. Indentations define loops: If you want to detect a magnet field for all currents on an electromagnet that you defined, *field* needs to be below *current* and needs to have higher indentation (as shown in Fig. 6).

There are three functions that can be used in process definitions that are completely independent from devices. These functions *waiting time*, *user interaction*, and *user-specified value* can be accessed by right click in the process definition tree. *waiting time* allows to define a time in milliseconds that has to pass until the process continues with the next element, whereas *user interaction* stops the process until the user presses a button in a pop-up dialog. The function *user-specified value* requires user input every time, it is called in the process. It can be used for parameters that are changed manually during the automation and cannot be accessed by thaTEC:OS. During the process definition, the user can change the name of the *user-specified value* by double clicking on it.

You can load old process definitions via the menu *Main* → *Load data file* to repeat the same measurement again or to edit the process definition. If you edit a loaded process definition, the file is not changed. The edited process and any other process definition will be saved to file as soon as you start the process.

4.4 Start a Process

Once a process definition is set up and the button *start process* is pressed, a dialog pops up that allows you to specify a file path and meta data of your measurement, see Fig. 7. All settings but the filename are optional, but the use of at least the values in the section *Measurement Info* is strongly encouraged!

Measurement Info: In this part of the window on the upper left you can define general measurement meta data. If you are using a *measurement database*, you can fill in the field *Operator*, *Sample*, *Lab/Setup* with existing entries from previous measurements with right click.

File path: Here you specify the file name for your measurement and choose the folder to save the file to. After choosing the folder with a file dialog window, previous measurements are listed in the display below. You can reload meta data from a previous measurement by double clicking on it.

Optional:

- GUI pictures: At the start of a measurement, you can save pictures of the user interfaces of thaTEC:drivers to the data file. This is of particular interest if you work with the microscopy module to save the current view of the sample. The picture can be displayed in the *Data Inspector* (or in an MS Word lab book or opened from file if you used an ASCII lab book).
- Additional Parameters: This table can be filled with values that cannot be acquired or changed automatically by thaTEC:OS but are influencing the measurement. Examples might be the position of a polarizer in the optical path or the setting of a manual rf power attenuator. The values are displayed in the *Data Inspector* and in external lab book files.
- Comments: Free text field displayed in the *Data Inspector* and in external lab book files.

Measurement Info

Measurement Info	File path
Operator: <input type="text" value="Thomas"/>	Filename: <input type="text"/>
Sample: <input type="text" value="general testing"/>	Folder: <input type="text" value="C:\Users\Thomas\Desktop\test"/>
Lab/Setup: <input type="text" value="one PC with source"/>	Previous measurements: <input type="text" value="M15.tha"/> ▲ <input type="text" value="M16.tha"/> ▲ <input type="text" value="M17.tha"/> ▲ <input type="text" value="M18.tha"/> ▼
Structure: <input type="text"/>	
Date and Time: <input type="text" value="2018-03-15, 08:33"/>	

O P T I O N A L	GUI pictures mark entries to store picture in lab book <input type="text"/> ▲ <input type="text"/> ▼	Additional Parameters list of parameters not accessible by the TEC:OS <table border="1"> <thead> <tr> <th>Name</th> <th>Value</th> </tr> </thead> <tbody> <tr> <td><input type="text"/></td> <td><input type="text"/></td> </tr> <tr> <td><input type="text"/></td> <td><input type="text"/></td> </tr> </tbody> </table>	Name	Value	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
	Name	Value						
	<input type="text"/>	<input type="text"/>						
<input type="text"/>	<input type="text"/>							
Comments <input type="text"/>								
Path to external lab book - append to existing or write to new file / leave blank to generate external lab book file later <input type="text"/>								
Path to measurement database - append to existing or write to new database / leave blank not to generate an entry <input type="text" value="C:\Users\Thomas\Desktop\test\measurement.db"/>								

Figure 7: Measurement Info dialog.

- Path to external lab book: You can save the measurement meta data that you have defined in this dialog as well as the process definition in external lab book files directly at the start of the measurement. You can choose between MS Word (doc/docx) or ASCII (txt) format. Please make sure MS Office is installed on your system, if you want to use a Word lab book.

New data is appended, if you choose a path to an existing file. If you choose a new file, it will be created and filled with the new data. In case of ASCII lab books, pictures will be stored to file. If you leave the file path empty, no external lab book will be created.

Please note, that all information is in any case contained in the **.tha* data file that is created when you start the measurement. You can export all information at any point in time from this file via the *Data Inspector* to external lab book files.

- Path to measurement data base: Please define the path to your measurement data base here. For details please read the following Section 4.5

4.5 Measurement Data Base

A measurement data base contains a list of all your measurements you started with the path to this data base file. We recommend to use just one data base per setup (or even for all your setups). You can append the current measurement to an existing data base by choosing an existing data base file, create a new data base by choosing a new file, or work without data base if you leave the path open (for instance, for quick tests that you do not intend to store for later use).

Data bases can be used in the *Data Inspector* to browse all contained measurements by *Operator*, *Sample*, *Lab/Setup* and *Date and Time* as defined at the start of each measurement (see Section 4.4). For details on how to work with the measurement data bases see Section 5.

Remark: The measurement data base stores the *absolute* paths to the **.tha* data files and to optional external lab book files. Therefore, it can lead to problems, if these files are copied to other locations or another PC. To avoid these problems, the *Data Inspector* can search for these files on paths *relative* to the path of the measurement data base. To profit from this search procedure, **.tha* data file should be stored in the same folder or subfolders as the measurement data base and the relative position of the files should not be changed. For instance, *data files 1 to 3* can still be found, if the entire *data folder* is copied to another location or PC.

```
../data folder/measurement database.db
../data folder/data file 1.tha
../data folder/BLS-1/data file 2.tha
../data folder/2018-03-16/data file 3.tha
```

4.6 Data files: *.tha

As soon as you start an automatized process or measurement from the dialog described in the previous section, a *.tha data file will be created. At the start of the measurement it already contains the process definition and all meta data you specified. You can reload and edit existing process definitions at any time.

In addition, thaTEC:OS stores a list of all variables of thaTEC:drivers that are part of your process in the data file - even if the corresponding functions are not specifically used in the process definition. This list is displayed in the *Data Inspector* and can be searched for particular settings that might influence the measurement and might have been set by the user manually but not in the automated process. For details see Section 5.

As soon as data is acquired by thaTEC:drivers, thaTEC:OS stores the data itself with a time stamp to the data file. Even in case of unwanted or user-specified abortion of the current automation (or even of thaTEC:OS) the data acquired up to this point is stored to file and can be accessed at any time - no data is lost.

In summary, the data file contains all information (that is accessible by thaTEC:OS) that is required to document the entire measurement: process definition with all parameters, additional hardware settings, user-specified meta data, and the acquired data.

5 Data Inspector

The *Data Inspector* is a license free standalone program for the visualization of the information stored in *.tha data files. Since it is not copy protected, it can be shared freely. To run it, the run-time environment of LabView 2015 64bit is required ([Download link](#)).

Even though thaTEC:OS offers some functionality to visualize data, it is strongly recommended to use the *Data Inspector* to visualize completed measurements and restrict the use of thaTEC:OS to the inspection of running measurements to avoid license problems.

The *Data Inspector* can be used to visualize single measurements or the entries of a measurement data base. These options are described in the next sections.

5.1 Single Measurement

If the Tab *Single Measurement* is active, the *Data Inspector* shows the PROCESS DEFINITION, a list of all variables of the individual DEVICES, and the meta data MEASUREMENT INFO of the current measurement (see Fig. 8).

The items in the process definition tree can be accessed by double click to inspect the control (red) settings in the measurement or to visualize the data acquired by the indicators (blue).

The list of all controls/indicators in the center of the user interface can be searched by typing in the text field below. Entries that fit the search string are emphasized by

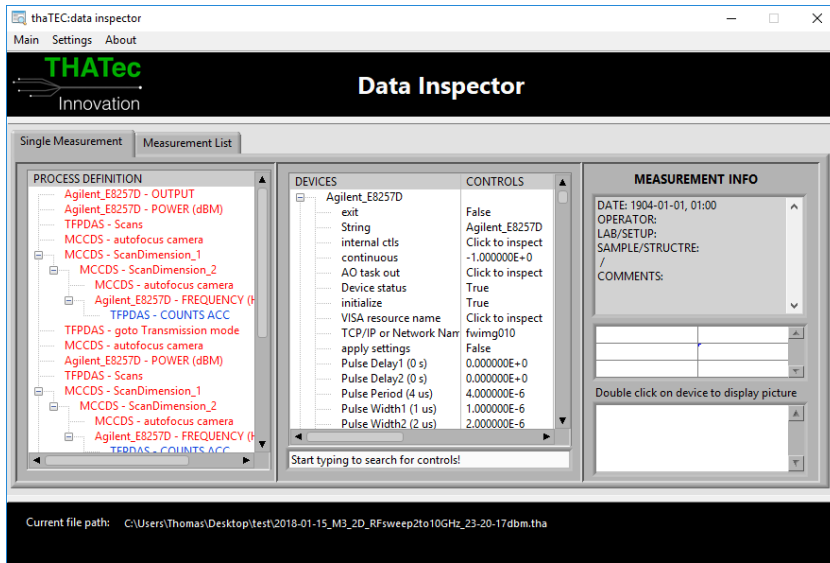


Figure 8: Data Inspector. Display of a single measurement.

color. The value of the corresponding control/indicator is displayed in the right column of the DEVICES tree for basic data types. For complex data, please click to inspect.

The measurement meta data is listed in the right part of the window. If user interfaces of devices have been stored as pictures, these are available by double click on the corresponding entry in the list box in the lower right.

Data files can be loaded via the menu *Main* → *Load data file*, with the corresponding shortcut *Ctrl+L*, or via the Tab *Measurement DB* as described in the following section.

To open an existing or create a new external lab book file, please use the menu *Main* → *Export to Lab Book*. Choosing a new file will create a completely new external lab book, while choosing an existing file will append the current meta data.

5.2 Measurement Data Base

If the Tab *Measurement DB* is active, the *Data Inspector* shows a list of all measurements stored in the current measurement data base as shown in Fig. 9. Data base files can be loaded via the menu *Main* → *Load Measurement DB*.

The list of measurements can be filtered by adjusting the fields *Date*, *Operator*, *Lab/Setup* and *Sample*. A right click on a certain measurement in this list offers the option to load the corresponding data file for display in the *Single Measurement* Tab, or to open an external lab book file (if one exists).

6 Visualization

Acquired data can be visualized during automatized processes or if existing *.tha files are loaded by thaTEC:OS or the *Data Inspector*. The data to be displayed in a graph

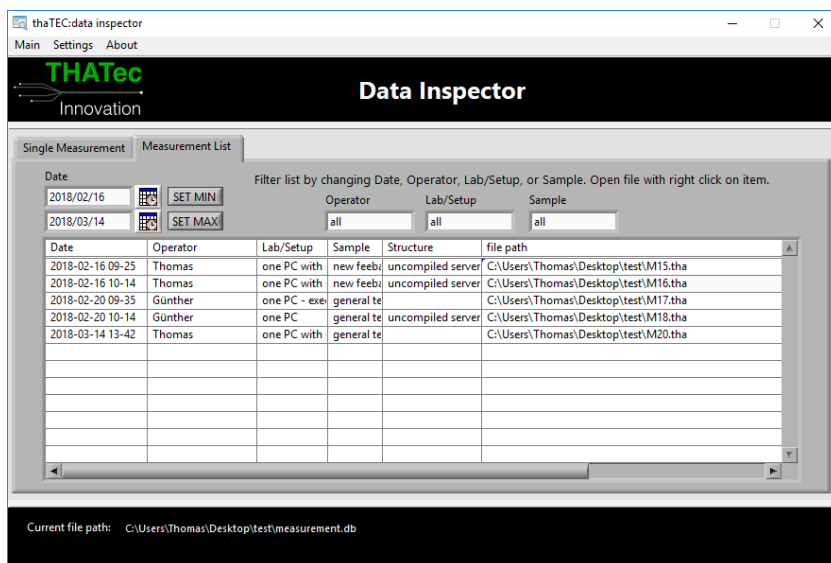


Figure 9: Data Inspector. Display of a measurement data base.

is chosen via the right-click menu or a double click on an indicator (blue color) in the PROCESS DEFINITION tree.

6.1 Choose axes

The following pop-up dialog shown in Fig. 10 allows to configure the graph that will be displayed. Depending on the dimension of the indicator data (scalar, 1D, or 2D), and the number of numeric parent controls in the process definition, one can choose to display an intensity or an xy graph. The acquired data will always be displayed on the z or y axis, respectively. The user can choose what will be displayed on the x and y axes (intensity graph) or on the x axis (xy graph). For multidimensional data, not only control values but also the axes of the data itself can be used as the axes of the new graph. To display, for instance, an acquired spectrum (1D data), one would have to choose xy graph with *data x-axis* on the x axis. Control values and the axes of multidimensional indicators that are not displayed on any axis of the new graph are called free parameters.

6.2 Choose parameters values

Fig. 11 shows the data of the same indicator (1D spectrum) displayed in an intensity and a xy graph. In the intensity graph, the x axis of the data is used as the y axis of the graph, while the values of the control *FREQUENCY* are used to define the x axis. The xy graph shows the spectrum itself (data x-axis is used as the x axis in the graph). In these examples, there are free parameters (the scan dimensions, which are scan positions in a scanning microscope, and *FREQUENCY*) that are not displayed on any axis and can, therefore, be set to display data acquired for a specific position (scan dimensions)

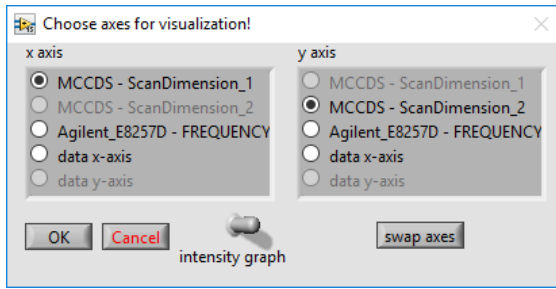


Figure 10: *Choose axes* dialog. This dialog allows to open an intensity or a xy graph and to choose what will be displayed on the axes.

or FREQUENCY that has been used in the measurement.

To define the values for a free parameter right click on it in the list of parameters in the lower right of the user interface and choose *define values*. As a result, the *value picker* windows shows up. On the left side of this new window that is shown in Fig. 12, there is a list of all parameters value that have been used in the measurement. The values that are used for the current display of data in the graph have blue background. Please use the control and/or shift button to select multiple values.

In the center of the window, there is a graph showing the parameter values that are available (line) and the values that are chosen for the display (red square). The cursors in this graph can be used to *add* or *subtract* value regions to the current selection or to *pick* a new set of values - depending on the buttons on the right of the graph.

In the *repetitions* list below these buttons, the user can choose which repetition is displayed or use the *sum* button to display the summation over all repetitions.

The option to display the summation over all values of a parameter can be accessed directly from the graph window. For this operation it is not needed to open a value picker. The summation can be chosen with the *integrate values* entry in the right-click menu in the parameter list.

6.3 GRAPH settings

The run-time menu *GRAPH* gives access to the autoscaling and normal/log-scale options for intensity and xy graphs.

For intensity graphs it is also possible to normalize each row (*GRAPH* → *normalize along x*) or column (*GRAPH* → *normalize along y*).

xy graphs allow for the display of multiple plots. This option can be switched on and off via *GRAPH* → *add plots*. The entries *GRAPH* → *clear graph* and *GRAPH* → *remove plot* deletes all plots or just the active one, respectively. The active plot can be chosen by moving one of the cursor onto the plot, or by changing the *active plot* control.

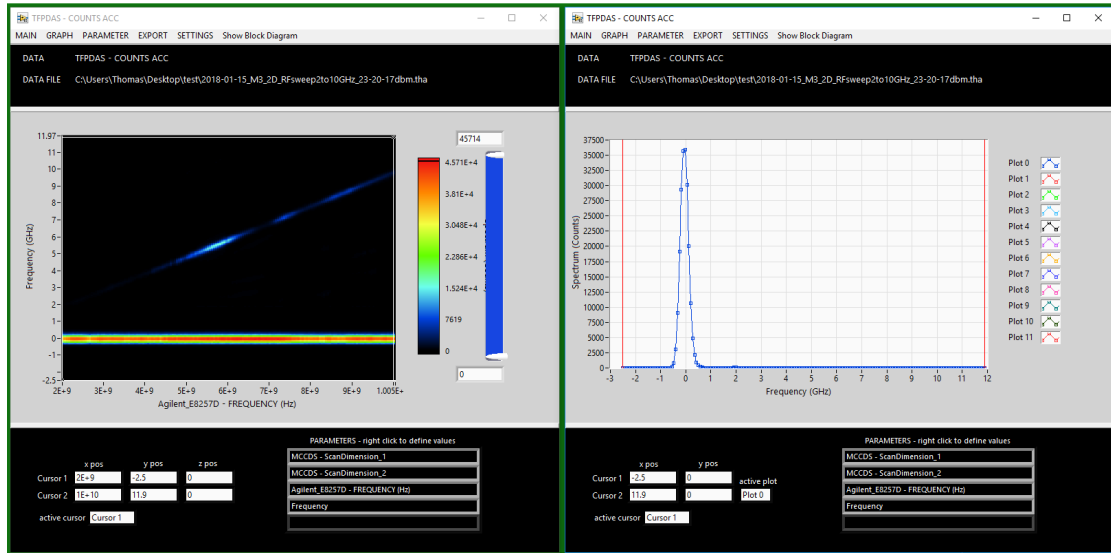


Figure 11: Intensity and xy graph.

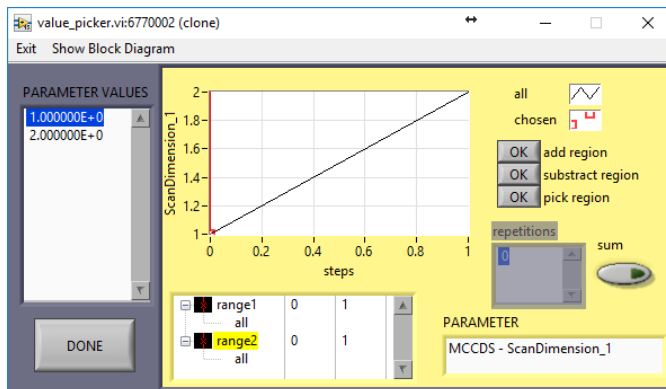


Figure 12: Value picker to set the values of a free parameters that are used to display data in the graph.

6.4 PARAMETER settings

In addition to the possibility to set the parameter values via the *value picker* window, it is also possible to define a set of parameter values for graph A by changing the cursor positions in graph B. To activate this behavior, the corresponding parameter has to be chosen by checking its entry in the *PARAMETER* run-time menu of graph B. In order to affect graph A, this parameter has to be one of the free parameters of graph A. If activated, the parameter values in graph A will be set to the values between the two cursors in graph B every time a cursor is moved with the mouse or the arrow keys.

There is a second option to control the data displayed in xy graphs from intensity graphs: *PARAMETER* \rightarrow *extract diagonal*. If this option is chosen, a pop-up dialog allows for the definition of a diagonal line in the intensity graphs with the cursors. The data points on this line can be plotted versus the data displayed on the x/y axis of the intensity graph (options *along x* or *along y*, respectively). The variable *extract values* defines how many data points will be summed up in x/y direction for plots along y/x axis, respectively. In order for this option to become active, an xy graph with the corresponding x

6.5 EXPORT options

The graph window offers export functions for the

- displayed data in binary or ASCII format
- currently displayed graph to the clipboard or to file (png format).

In addition to the format (binary or ASCII), it is possible to choose between the export of the currently displayed data or the export of all data sets that are available by varying all free parameters.

When choosing one of the options *EXPORT* \rightarrow *export current ...*, a file dialog pops up to define the *name* of the output file. In addition to the *name.txt* or *name.dat* data file that lists the acquired data without axes of the plot, two other files are created: *name.meta* and *name.index*. The meta file contains information about

- **data:** name, dimensions and axes (for multidimensional data)
- **parameters:** name, value definition used in the measurement
- **axes:** are indicated by the tag *on axis*

The index file lists the indices and values of all parameters that have been used for the exported graph. The information in these two files can be used to reconstruct the exported graph.

When choosing one of the options *EXPORT* \rightarrow *export all ...*, a file dialog pops up to define the output directory. In this output directory all plots are exported that can be created by varying the free parameters as well as meta and index files that are

described above described above. The names of these output files specify the indices of the parameters (*repX*: repetition index, *paramX*: parameter index) value used to export the corresponding data set:

```
general: rep1_param1_rep2_param2_rep3_param3.txt
example: 0000_on-x_0000_on-y_0000_0014.txt
```

To plot the data in the example file, an intensity plot has to be created with the first two parameters in the scan on the x and y axis, respectively (as indicated by the tags *on-x* and *on-y*). Since these two parameters are displayed on the axes of the graph, they are no free parameters and cannot be varied. However, it is still required to define the repetitions used in the plot (\rightarrow 0000, first repetition). For the third parameter in the measurement the first repetition and the 15th value (index (\rightarrow 0014) were used.

7 Support

You can contact our support via the mail address contact@thatec-innovation.com.

Remark: For errors regarding the installation of *thaTEC:framework*, your licenses and HASP key, or the hardware connectivity of *thaTEC:driver* modules, please consult the Sections 1.2, 2.2, or 3 before you contact us.

A thorough description of the problem is a decisive factor regarding the time needed to fix bugs. An error report should include:

- name and compilation date of the module and version of *thaTEC:driver* (as given in the *About* menu in all our modules)
- the action or circumstances that led to the error (user interaction or automation, standalone use or control via *thaTEC:OS*, ...)
- reproducibility and commonness of occurrence
- screenshots of error messages in pop-up windows or in the status bar of the corresponding module

If a certain error requires remote access to your machine, we will inform you about this requirement and contact you concerning an appointment for the remote support session. To prepare this session, please make sure that all instances of *TeamViewer* that might run on your PC are closed and start the program *thaTEC QuickSupport* shortly before our appointment starts (via the Windows Start Menu entry *thaTEC-framework 32/64bit* \rightarrow *thaTEC-QuickSupport*). The session will start as soon as we connect to your PC via the *QuickSupport* module.