Welcome to WITec Control

Welcome to the WITec Control Measurement Software Help.

Main Window	Load/Save projects, select configuration
Video Window	Live video image, illumination, objectives, microscope control, stitching
Control Window	Manage hardware and measurement parameters
Messages Window	Shows progress and warnings or asks for user inputs
Service Monitor	Configuration of CCD Cameras, CCD/Video Device Status
COM Automation	Programming interface for WITec Control

Press the **F1 key** anywhere in the software to open the context help or browse the Help Menu to open the help contents.

Main Window

Tool Buttons

For general Tool Buttons help see WITec Project Main Window

- Auto Save Project (See Program Options - Auto Save Project)

- Stop Measurement
- Measurement buttons (depending on Configuration)
  Left Click: Start Measurement.
  Right click: Open parameter sub tree in Control Window

Main Menu

For general Main Menu help see WITec Project Main Window

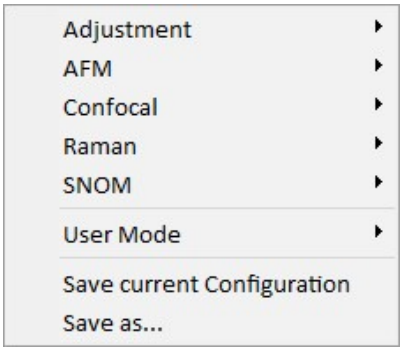
View

Point Viewer Window
Shows the Point Viewer to define automated measurements at multiple sample positions.

Options

Scantable Load Profiles
Lets you select one of the available Scantable Load Profiles. Load Profiles can be used to load e.g. scan table PI controller settings for heavy samples.

Configurations



Depending on which kind of measurement you would like to perform, you can select a configuration in this menu.
All parameters in the Control Window are stored in the configuration.
Further information about the usage of predefined configurations can be found in the operation guide.

User Mode
Here you can set the User Mode depending on the level of knowledge. This will hide or show certain parameters in the Control Window.

Beginner
Only basic parameters and functions of the configuration are available.

Expert
All parameters and functions of the configuration are available. Recommended setting.

Super User
All parameters are available like in the Default tree. Only use it if you know what you do.

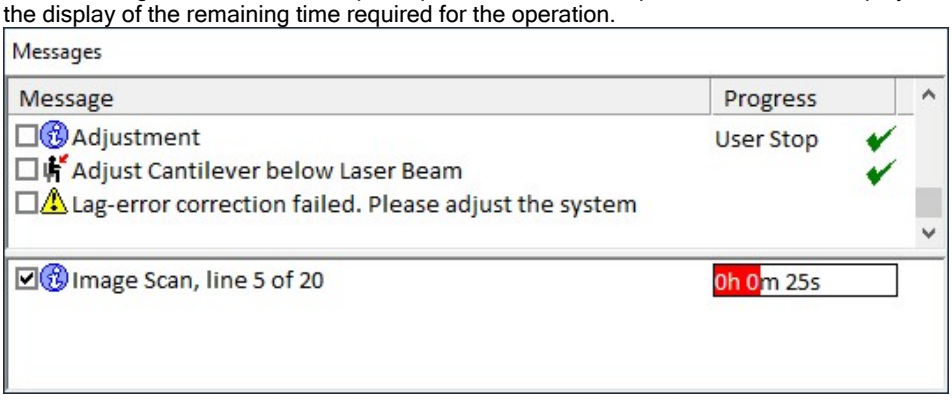
Save current Configuration
Saves and overwrites the current configuration.

Save as...
Saves the current configuration into a new file.

A configuration consists of two files. The style defines the appearance of the Control window, the other file contains all parameters.
The shown configurations are stored in %userprofile%\WITec\WITec Suite X.X\WITec Control\UserConfigurations. Upon start WITec Control copies all configurations from %allusersprofile%\WITec\WITec Suite X.X\Configs\WITec Control\UserDefaults\UserConfigurations if not existing.

Messages Window

The message window is a message interface between the controller hardware and the user. The upper part of the window is a chronological classification of past operations. The lower part of the window displays the current operation followed by the display of the remaining time required for the operation.



The nature of the message can be identified by the symbol displayed in front of the message. The following types of messages are displayed:

Information
This class of messages contains only information about ongoing processes performed by the controller. The message description next to this symbol, informs the user about the actual process.

Warnings
If a controller process fails, a warning message is displayed.

User input for an operation
Some routines of the controller are automated. Nevertheless, they cannot be completed without user inputs. Messages

which contain the user input symbol describe the action which should be accomplished by the user.

Hazard

Hazard messages indicate severe problems of the hardware. They contain information about communication errors between computer and controller or failures of the power supply.

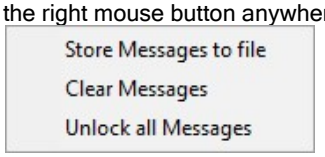
Move the mouse over a message to get a tooltip with more detailed information.

Checkboxes

Setting a checkbox locks this message in the lower part. Unsetting a checkbox unlocks the message to the upper, chronological part.

Context menu

It can be opened by clicking the right mouse button anywhere in the Messages window.



Store Messages to file

Stores the messages to the file
C:\ProgramData\WITec\WITec Suite X.X\Log Files\WITec Control\UserFeedbackLog.txt.

Clear Messages

Clears all unlocked messages of the upper part.

Unlock all Messages

Unlocks all messages of the lower and moves them to the upper part.

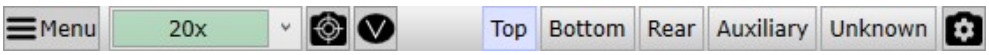
Video Control Overview

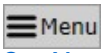
The "WITec Video Control" Window is the main user interface for

- showing the video image
- controlling the illumination
- managing objectives
- positioning of devices
- laser control
- spectrometer selection
- controlling further devices ...

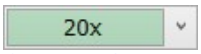
Hint: Move the mouse over a control in the running software and press F1 for context help !

Top Bar





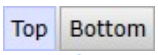
See Menu



Objective Selection

Objective Video Calibration

Vignetting Correction



Video Camera Selection

Video Camera Settings

Video Image

The video live view shows the video image of the currently selected camera.
You can zoom in and out using the mouse wheel or by holding down the control key on the keyboard and dragging a

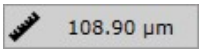
rectangle.

Right Bar

 See Illumination

Bottom Bar

Toggle Field Stop
Toggles the field stop open / focus position. Right-Click to open Field Stop / Aperture Stop Settings.



Mouse Distance
Shows the current mouse distance. You can click the left mouse button to set a reference position.

Turn off listen
In the bottom bar you might see some mouse pointer followed by a label (e.g. "Probe Position").
This means that you can click into the video image in order to set the probe position.
If you click on this Button, the mouse mode will be cleared so no software component will listen to a position anymore.

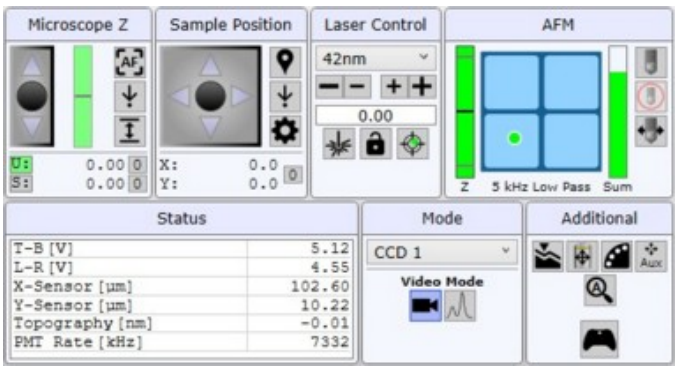
Zoom Out
The magnifier icon shows that you have zoomed into the video image. Click it to zoom out.

Video Image Acquisition
Saves the current video image in the full camera resolution as a new bitmap into the current project.

Video Measurement
Opens the **Video Measurement Window** for doing image stitching and focus stacking.

Video Movie Recording
Opens the **Video Movie Recording Window** to create movies.

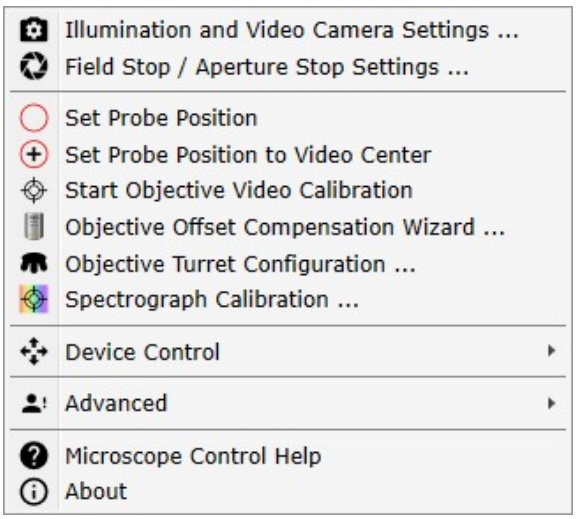
Control Boxes



- Microscope Z
- Sample Position
- Laser Control
- AFM Status / True Surface Mk3 Control
- Status Values
- Microscope Modes

- Additional Microscope Controls

Menu



Illumination and Video Camera Settings
Opens detailed settings for the illumination / smart brightness and video camera settings.

Field Stop / Aperture Stop Settings
Opens detailed settings for the automated field stop / aperture stop - if available.

Set Probe Position
Lets you click somewhere in the video image to define the new probe position.
You can turn off this mode by pressing the button again or by pressing the label in the bottom right corner of the video image.

Set Probe Position to Video Center
Sets the current Probe Position to the Video Center.

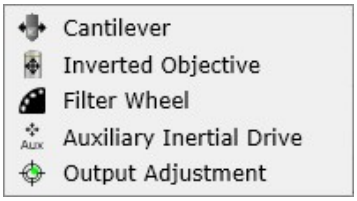
Start Objective Video Calibration
Starts the Objective Video Calibration. Each objective needs its own calibration.

Objective Offset Compensation Wizard
Opens the Objective Compensation Wizard

Objective Turret Configuration
Opens the Objective Turret Configuration

Spectrograph Calibration
Opens the Spectrograph Calibration.

Device Control



Cantilever
Shows the cantilever positioning user interface.

Inverted Objective
Shows the user interface for positioning the inverted objective.

Filter Wheel
Shows the user interface to change the filter wheel position (SNOM feature).

Auxiliary Inertial Drive
Shows the auxiliary inertial drive user interface. The name of this menu entry is dynamically set due to the configuration.

Output Adjustment
Shows the Laser Output Adjustment Window.

Advanced
Intended only for the WITec Support Team:

Spectrometer Calibration Lamp Permanently On
This will turn on the spectrometer calibration lamp, no matter which WITecControl configuration is selected.

Use Laser Filter for Raman
If checked, the laser filter is coupled during Raman measurements. Only works with automated filter couplers.

Change Laser Wavelength
Lets you change the exact laser wavelength of the currently selected laser.

Show COM Parameter
Shows all remote controllable parameters.

Set/Remove Cantilever Laser Spot Marker
Sets or removes the cantilever laser spot marker. Available in AFM Mode.

Add custom logfile entry
Allows to add a custom logfile entry/comment in case of errors or bad software behavior. This way analyzing errors might be more easy.

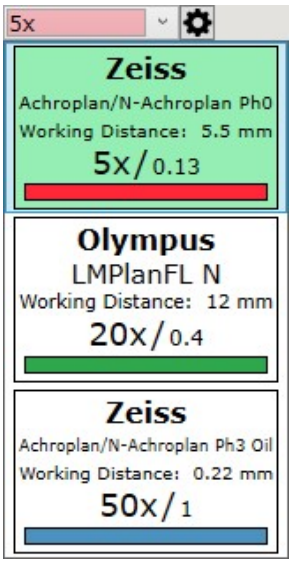
EasyLink Controller Help
Shows the EasyLink Controller Online Help (Button Assignments)

Microscope Control Help
Shows this WITec CHM Help.

About
Shows program information such as version number, license, memory consumption.

Objective Selection

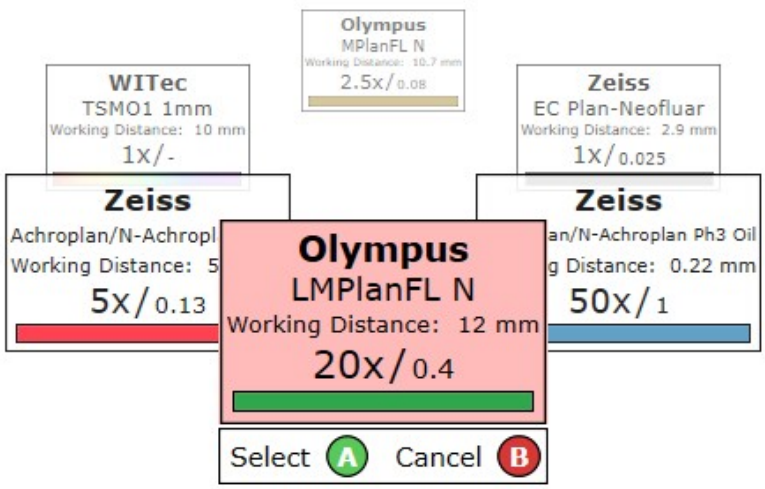
The selected objective is displayed in the top bar of the window and can be changed using the combo box:



Selecting another objective will open the Change Objective Dialog.

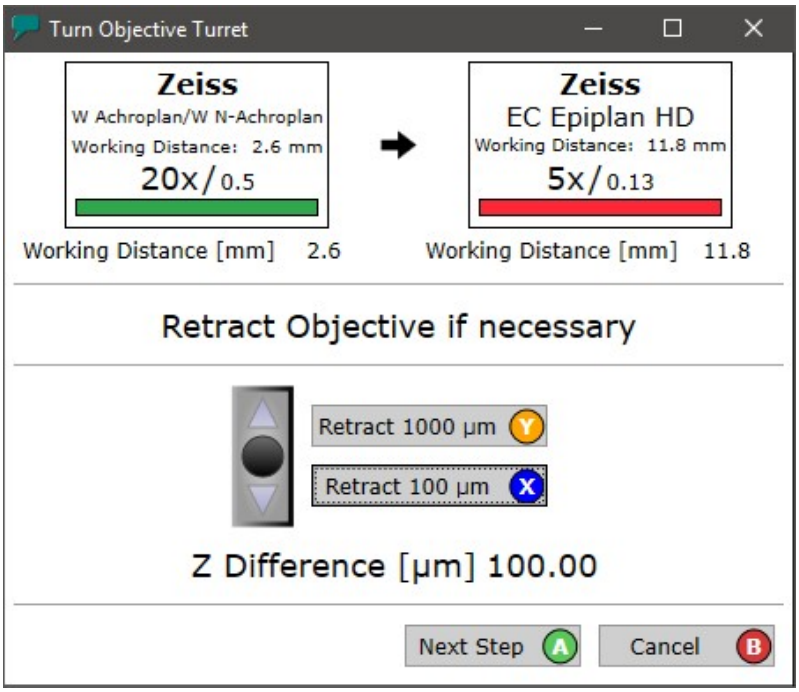
Pressing the gear icon next to the combo box will open the Objective Turret Configuration.

It's also possible to change the objective using the EasyLink Controller by pressing "A":



Change Objective Dialog

If you select another objective, the change objective dialog will open.
This dialog is an assistance for safely changing the objective:



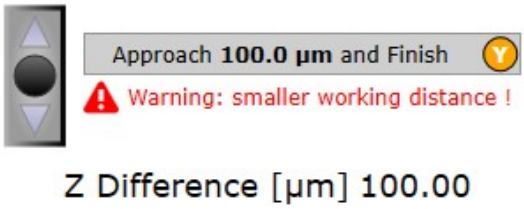
Step 1:
You can automatically retract the microscope from the sample by 100µm or 1000µm (or use it multiple times) to have enough space for a safe turret rotation. Of course you can also move the Z stage manually using the UI Joystick Control or the EasyLink Controller.

Use the X/Y/A/B Buttons on the EasyLink Controller to press the buttons on the user interface.

After moving up the microscope, you can press "Next Step".
If you have a motorized objective turret, the turret will move automatically now;
turn the manual objective turret if it's not motorized.

Step 2:
In the second step you can either manually approach the microscope and do the focus as desired or you can press the

"Approach" button which will automatically move the microscope to the same Z-Position where it was before you retracted the microscope:



If you change to an objective with a smaller working distance than the current objective, you will get a warning.
Always make sure that there is enough space around the objective !

Objective Video Calibration

Video Calibration

For image stitching and in order to have a correct spatial correlation between video images and acquired scanned images by a probe, a video calibration is necessary and can be done in different ways.
If a sample positioner or scan table is available, the video calibration will be done automatically using the table (the sample positioner will be preferred).
If no table is available, a manual calibration can be done.

Automatic Calibration

If a scan table or a sample positioner stage is available, the video calibration is done automatically if you click on the "Start Calibration" button or menu item.

The automatic calibration may fail on the following conditions:

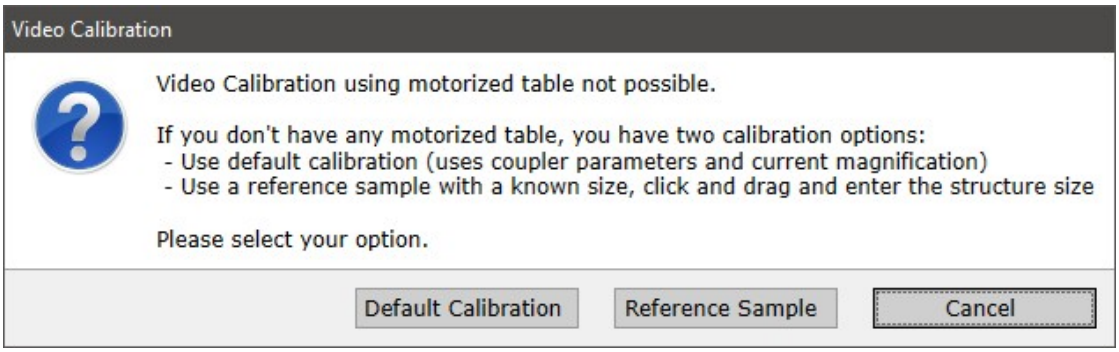
Wrong Image Content:
- No structures visible
- Periodic/Cycling structures
- Not focused
- Image too bright or too dark
- Laser spot is visible
- Light shade is visible
- Cantilever is visible

Wrong Configuration:
- Wrong objective is selected in the software
- Wrong configuration of the tube lens focal length or video chip size

Hardware Error:
- The scan table / sample positioner is not moving correctly

Manual Calibration

If the video calibration using a motorized table is not possible, you can choose between the default calibration and reference sample:



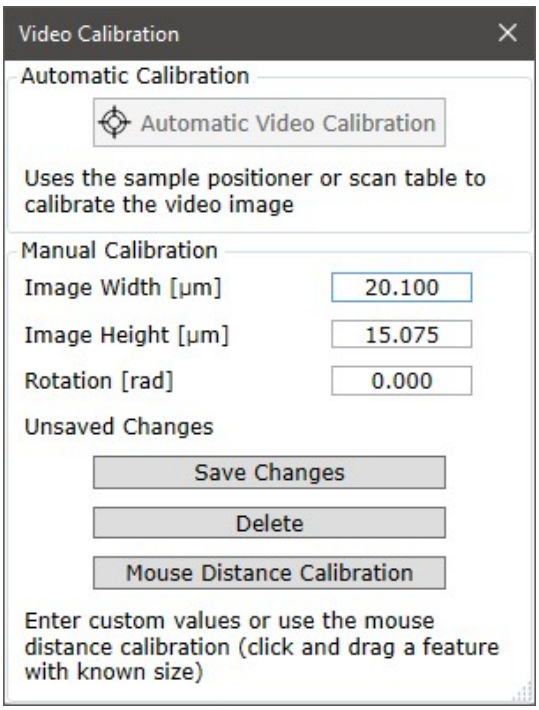
Default Calibration

Calculates a default pixel size using the current objective magnification, tube lens focal length and video chip size.

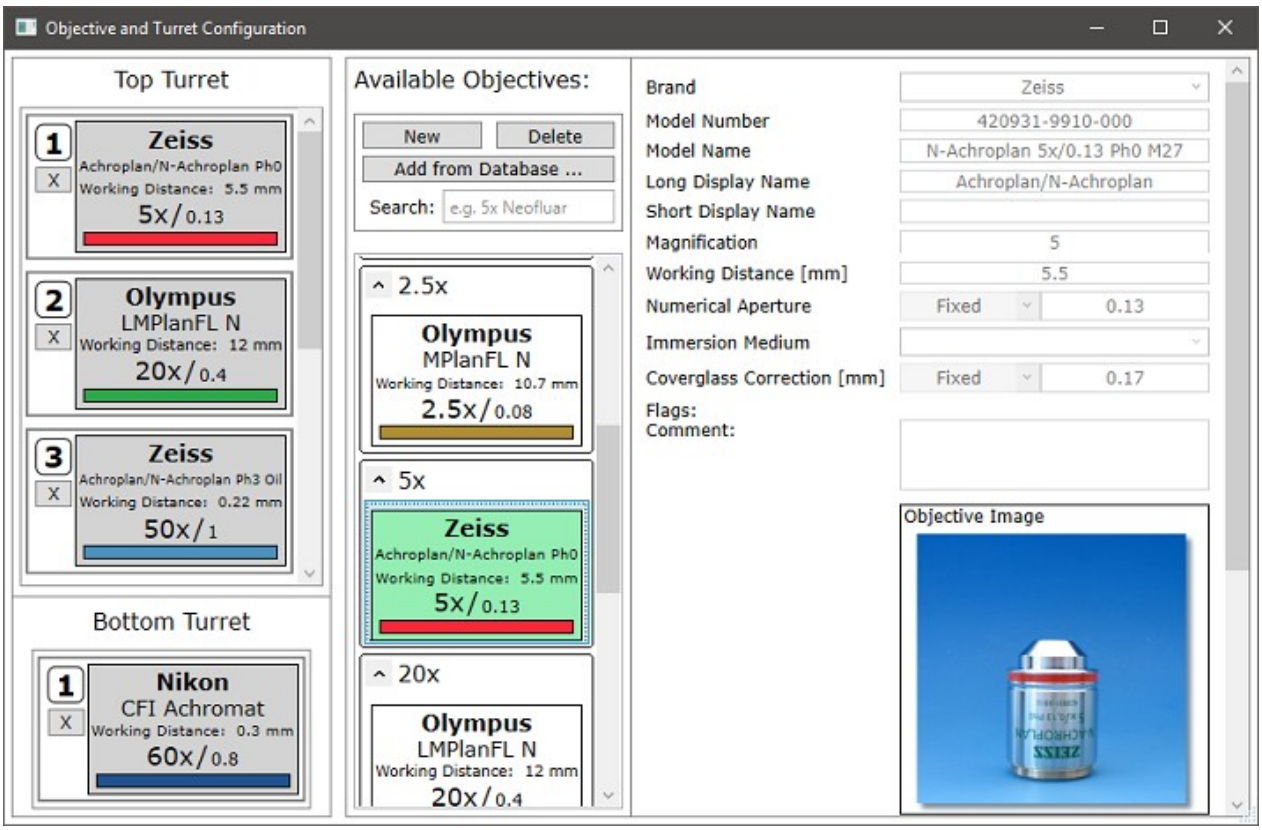
Reference Sample
Here you can drag the size of a feature with a known size in the video image and enter the size.

Advanced Video Calibration Dialog

The advanced dialog can be found in the Main menu -> Advanced Submenu.
Here you can enter custom calibration values:



Objective Turret Configuration



Available Objectives

Before assigning objectives to your turret slots, you have to add objectives to your available objective list:

Objective Database
You can add objectives to your available objective list using "Add from Database ...".
Here you can search for your objective in a large objective database.

Create new objective
If your objective is not listed, you can create a new objective using the "New" Button.
Hint: Please enter at least a correct magnification and working distance due to other software components relying on this information.

Turret Slot Assignment

You can simply drag and drop objectives from your available objective list into your turret slots.
To remove an objective from a turret slot, just press the "X" button next to the slot number.

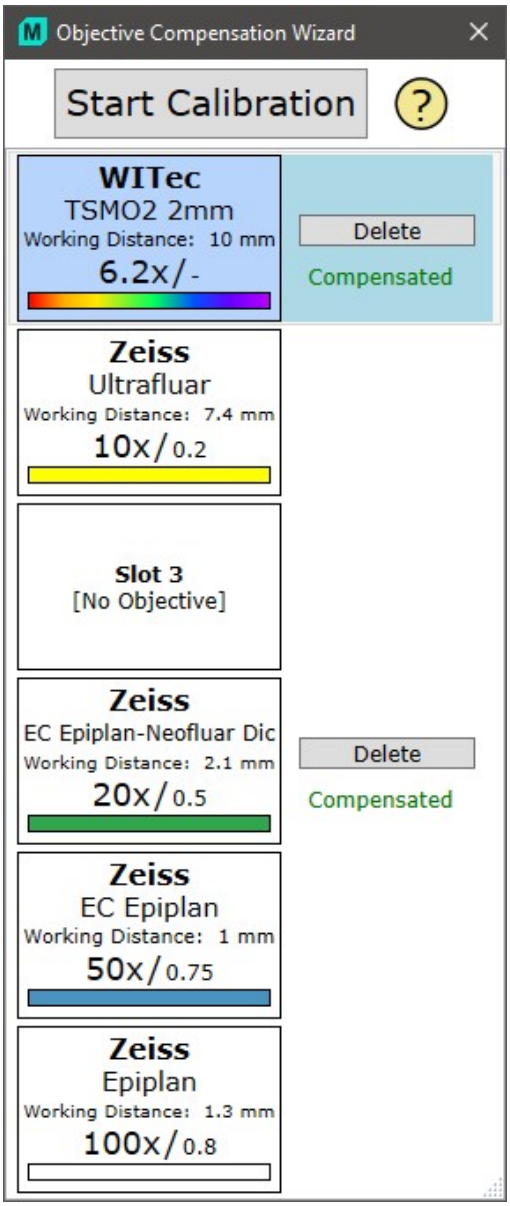
Press on the Help Button for a recommended Slot Assignment.

If you have configured a new objective, don't forget to compensate the objective offset; just open the Objective Compensation Wizard.

Objective Compensation Wizard

The Objective Compensation Wizard can be used to compensate the small displacement between different objectives. Depending on whether the X/Y Sample Positioner and the Z Stage is motorized, the compensation is done in all 3 spatial axes.

To start the Objective Compensation Wizard, open the dialog via the main menu:



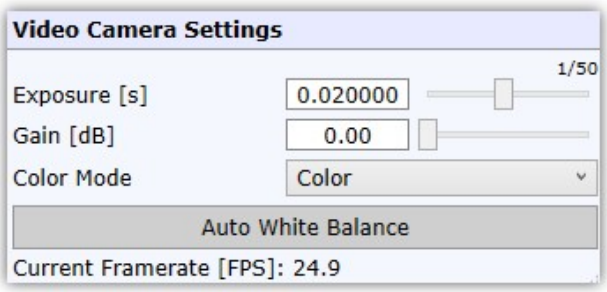
Click on the question mark to see a step by step guidance.

The Wizard shows all configured objectives. You can click on an objective to select it and move your X/Y/Z axes to a desired position (e.g. a certain feature on the sample).

Press Start Calibration to tell the software that from now on all movements should be stored for each objective. If you want to move the sample without saving the displacement, press Stop calibration first.

The compensation is automatically stored upon selecting another objective or closing the dialog.

Video Camera Settings



Exposure

Changes the exposure time of the camera. This will also change the frame rate up to a limit of 25fps (or less for a high resolution camera).

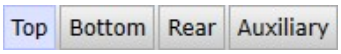
Gain
Changes the gain of the camera. Only use this, if a longer exposure time is not possible and your image is still too dark.

Color Mode
Here you can switch between color and monochrome video images.
This setting is also used for video image measurements (single bitmap, stitching, focus stacking).

Auto White Balance
Press this button once to do an automatic white balance.
A white sample is recommended, e.g. a Teflon band.

Video Camera Selection

You can change the current camera in the top bar of the video control window:

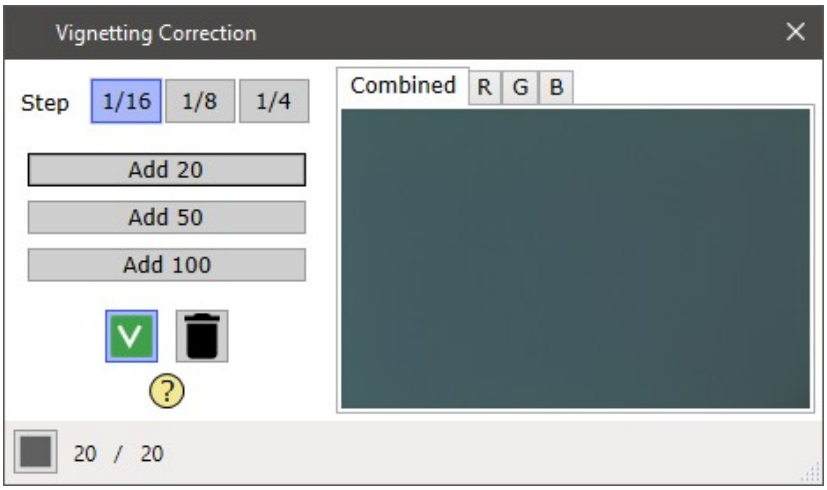


The following video cameras are possible, depending on the system configuration:

- Top: normal brightfield video camera that looks from the top through the objective turret
- Bottom: a camera that looks from below, e.g. available in a SNOM system
- Rear: a camera that looks from the backside
- Alignment: automatically selected and only used for the laser adjustment

Vignetting Correction

The vignetting correction leads to a better video image quality, especially for stitching images.



Step (1/16, 1/8, 1/4)
Defines the step size for the automatic movement (e.g. 1/16 video image size).

Add 20/50/100
Automatically moves the sample positioner and adds video images to the current Vignetting Correction.
You should add images as long as there are structures visible in the preview image on the right.

 **Toggle Use Vignetting Correction**
Lets you activate or deactivate the current Vignetting Correction.

 **Delete Vignetting Correction**
Deletes the current Vignetting Correction.

Combined / R / G / B (Image)
Shows the current Vignetting Correction image.

By switching to R/G/B you can have a look at one of the color channels red/green/blue.

 **Stop Measurement**
Stops the Vignetting Correction image measurement, if currently running.

Illumination

Right-Click anywhere on the right bar to open the Smart Brightness and Video Camera Settings.

Darkfield Mode

This button enables or disables the darkfield mode.
Only available in an automated microscope system with darkfield configuration.

Top Lamp

You can turn on or off the top illumination.
It is automatically turned on upon program start and turned off upon program shutdown.
In automated systems, the white light coupler will automatically couple in or out.

Smart Brightness / Bottom Brightness

With the upper wheel control you can change the Smart Brightness parameter.
With the lower wheel control you can change the bottom lamp brightness.

Auto Brightness

Click this button to trigger the automatic smart brightness using the currently selected video image and Smart Brightness settings.
If the top lamp is turned on, the auto brightness will only use the top lamp.
Otherwise it uses the bottom lamp, if available and turned on.

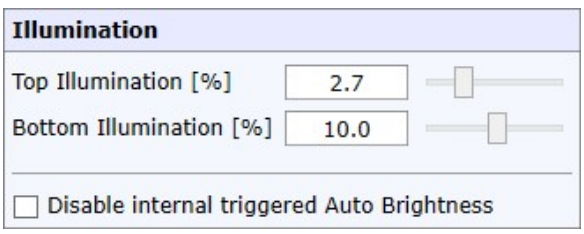
Hint: Auto Brightness is automatically performed when
- program starts up
- changing an objective
- toggling darkfield Mode
- changing Aperture Stop Position

Bottom Lamp

You can turn on or off the bottom illumination.

Hints:
The software automatically turns off the illumination when doing Raman measurements.
If a measurement has finished or a video measurement is started, the last used illumination settings are used.

Illumination Settings

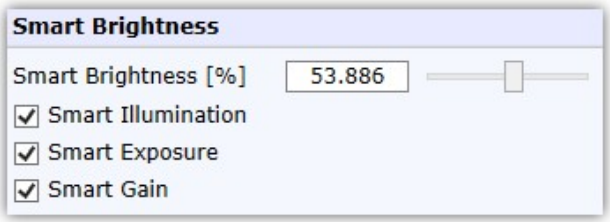


Here you can adjust the brightness of the top and bottom lamp exactly by typing a percentage or using the slider.

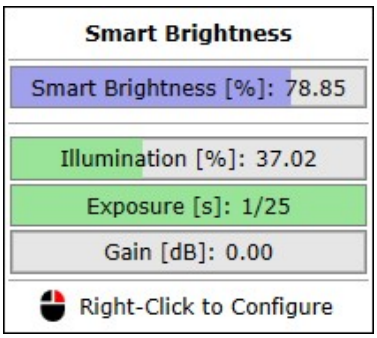
Disable internal triggered Auto Brightness
If checked, the auto brightness is NOT done when
- Changing Objective

- Toggling Dark Field Mode
- Changing Aperture Stop Position

Smart Brightness

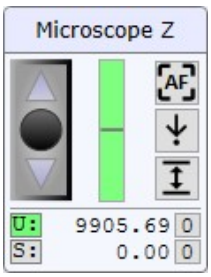


The smart brightness parameter changes the illumination as well as the video camera exposure and gain in order to increase or decrease the brightness of the video image - depending on which check boxes in the smart brightness settings are selected.
Exposure has the priority and is increased first, then the illumination, then the gain.
A little pop-up shows all changed parameters when you move the top wheel:



Microscope Z Stage

You can control the Microscope Z Stage using the UI Joystick Controls or the EasyLink Controller:



Microscope Z (Joystick Control)
Controls the Microscope Z Stage. The speed depends on the objective magnification.

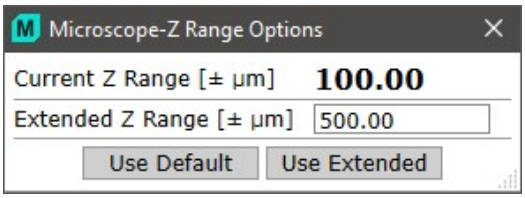
Green Bar
Shows the current position of the software controlled, limited Z axis.
If the current position is higher or lower than 95% / 5% of the complete range, the bar gets red.


Auto Focus (Button)
Press the auto focus button in the user interface or on the EasyLink Controller to do an **auto focus** using the video live image.
A rectangle is shown in the video image while the auto focus is operating. The rectangle gets green if the auto focus was successful or red if the auto focus failed.


Move to Z-Position (Button)
Opens a little pop-up where you can enter a software limited z position and move to that position.


Microscope-Z Range Options (Button)

Opens a little pop-up which allows to extend the software limited z moving range:



Use Default
Uses the default limits of plus minus 100 µm.

Use Extended
Uses the desired extended z range of e.g. plus minus 500 µm

It is the responsibility of the user to make sure that there is enough space between the sample and the objective.

User-z (Radio Button):
Shows a user controlled, unlimited Z axis position in µm.
It shows all relative movements that the Microscope Z Stage does.
The user can set this value to zero at any time, e.g. to define the focus plane.
This value is saved upon closing the application.

Click to enable the user controlled, unlimited Z axis movement.

Software-z (Radio Button):
Shows a software controlled, limited Z axis position in µm.
This position is used for automated Z Axis movements, e.g. in a depth scan or in true surface mode.

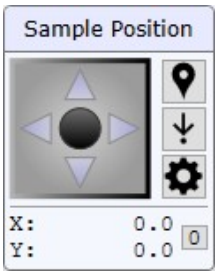
Click to enable the limited Z axis movement.

Z-coordinates used for the geometry definition of measurements are always Software-z-coordinates. This enables focusing without changing the z-coordinate of the measurement, because the Software-z remains at zero when changing the focus while User-z (U:) is selected.

Set Zero (Buttons)
The upper one sets the user controlled, unlimited Z-Coordinate to zero.
The lower one sets the software controlled, limited Z-Coordinate to zero.

Sample Positioning

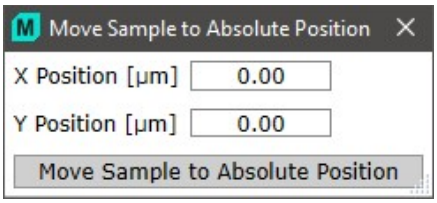
You can control the Microscope Cross Table / XY Sample Positioner using the UI Joystick Controls or the EasyLink Controller:



Cross Table (Joystick Control)
Controls the Sample Positioner. The speed depends on the objective magnification.

Move Sample to Mouse Position
If active, you can click somewhere in the video image to move the probe position to that position.
You can turn off this mode by pressing the button again or by pressing the Sample Position label in the bottom right corner of the video image.

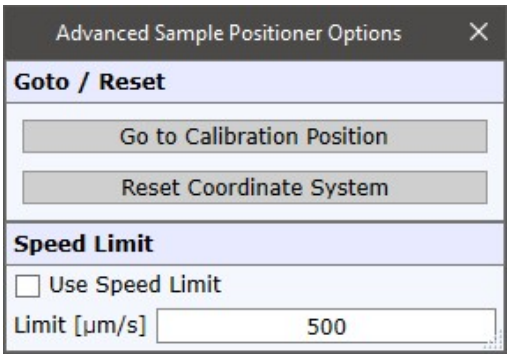
Move Sample to Absolute Position
Opens a little pop-up where you can enter an absolute XY-Coordinate and move to that position:



X/Y
Shows the current cross table position in µm.

Set Zero (Button)
Sets the XY position to zero.

Advanced Sample Positioner Options



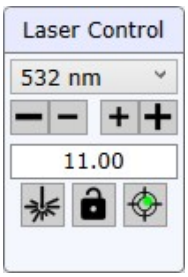
Go to Calibration Position
Moves the sample positioner to its calibration position.

Reset Coordinate System
Resets the coordinate system.

Use Speed Limit
If checked, uses the parameter "Limit [µm/s]" to limit the speed of the sample positioner for any movement (manual movement, automatic movement during measurement).

Laser Control

You can control the laser with the following user interface. If you have a TruePower Laser, also Laser Intensity and Shutter are available.



Laser Selection (Combo Box)
Here you can switch between multiple lasers. Effects of change:

- For automated microscope systems the beam path will change accordingly.
- Laser wavelength is set to calculate the Raman shift.
- Laser position (red circle in the video image) is restored (can be adjusted in the menu).

If you have multiple spectrometers, the last used laser is automatically selected for the current spectrometer.

Laser Intensity (Buttons and Edit)
You can change the laser power by either pressing the - or + buttons or by entering an intensity value in milliwatts and press <enter>. The actual reached value might slightly differ from the number you entered.
If the value can not be reached, the software will show an error. Make sure the laser is turned on and warmed up.

 **Laser Shutter (Toggle Button)**
Press on the laser button to open or close the laser shutter.

 **Laser Shutter Lock (Toggle Button)**
If this button is checked, the software will not change the laser shutter state automatically (e.g. by switching to Raman or video state).
This option is only available for AFM configurations.

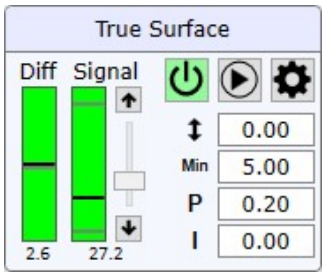
 **Laser Output Adjustment (Toggle Button)**
Opens the Laser Output Adjustment Window.
Depending on your hardware, here you can adjust the laser output in the fiber or start the automatic calibration.
Only available if an automated laser output adjustment unit is configured.

Laser Fiber Adjustment
In order to do a laser fiber adjustment, please use the True Power Laser Tool in the service monitor.

TrueSurface Mk3

The TrueSurface Mk3 device controls the position of the Z-Stage in a way that the sample surface will always have the same distance to the objective, thus leading to a stable Raman signal when scanning on rough samples. Further information can be found in the TrueSurface section of the Operation guide.

If your system has an AFM and TrueSurface Mk3, then the True Surface view is only shown if there is no AFM configuration loaded in WITec Control.



 **Turn True Surface On/Off**
Turns the device on or off. This does NOT start the Z-Stage control.
Notice that, as soon as the True Surface Mk3 device is turned on:

- The Z-Stage is locked and can not be used for other measurement modes that want to move the Z-Stage
- The Z-Stage can be moved manually by the user, as long as the TSMk3 controller is not enabled / started.
- The Z-Stage manual movement mode switches to the software limited Z mode, because the TSMk3 also can only move within this range.

 **Start**
Enables or disables the controlling of the Z-Stage.
Please stop the controlling immediately, if you hear some strange noise like oscillation of the table.

Diff
Shows the z controller difference between the desired value and the actual value.
The gray bar shows the desired value, the black bar shows the actual value.

Signal
Shows and controls the reflected laser signal strength of the True Surface Mk3 sensor.
The strength of the reflected light changes depending on the kind of sample.
Using the slider and buttons you can adjust the laser intensity and thus the measured signal.
The black bar shows the current signal strength. The gray bars show the signal limits.
If the signal goes beyond the limits, the controller does not change the z stage.

 **Focus Shift**
This parameter changes the absolute z offset in order to optimize the Raman signal.

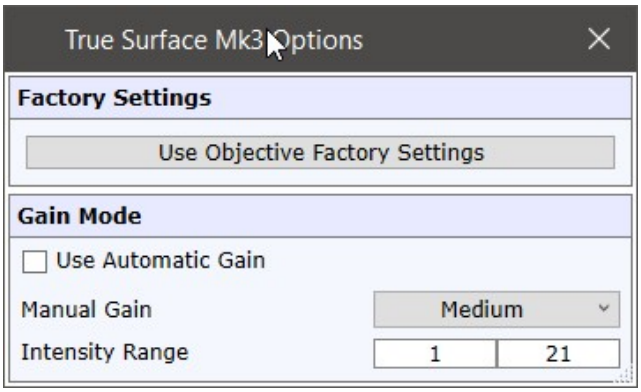
Min **Min Signal [%]**
Sets a minimum signal in percent. If the signal is weaker than this minimum, the controller does not change the z stage.

P **Feedback P-Gain**

Sets the P-Gain of the controller unit.
Decrease if the Z-Stage is oscillating. Increase if the Z-Stage is following the surface too slow.

Feedback I-Gain
Sets the I-Gain of the controller unit.

Options



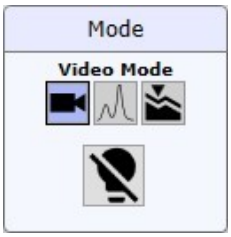
Use Objective Factory Settings
Lets you recall the default settings for the currently selected objective, if defined.
For all parameters, a default value is stored for all objectives intended for TSMk3.
WITec delivers good standard values that might be changed by the user due to changing behaviors on different samples.

Use Automatic Gain
If checked, the gain is automatically selected when changing the intensity.
If not checked, the settings below are used.

Manual gain
Defines the gain of the True Surface Mk3 Unit.

Intensity range
Defines the intensity range that is used when changing the intensity.

Microscope Modes

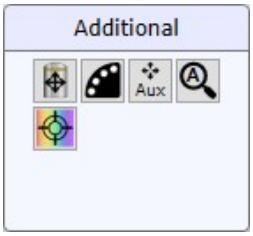


Video / Raman Mode
The Raman or video modes are selected automatically upon starting or stopping measurements in WITec Control. However, the user is able to switch between those modes at any time.
According to this state, automated microscope systems will adjust their beampath and shutters of true power lasers are closed or opened.

TrueSurface
Only available for systems with True Surface Mk2.
The TrueSurface mode is selected automatically upon starting a TrueSurface or Profilometer measurement. For automated microscope systems it sets up the beampath for TrueSurface.

Enable all Light sources
Only for SEM / RISE Users: enables all light sources.
On startup, all light sources are disabled until the user presses this button.

Additional Devices



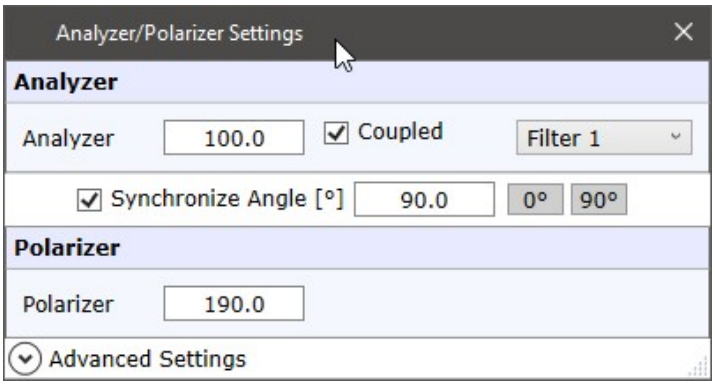
Inverted Objective Positioning
Opens the Inverted Objective Positioning Window.

Filter Wheel Position
Opens the Filter Wheel Window.

Auxiliary Inertial Drive
Opens the Auxiliary Inertial Drive Window.

Spectrograph Calibration
Here you can select a spectrograph for calibration or verification. See Spectrograph Calibration.

Analyzer / Polarizer Settings
Opens a little pop-up for controlling the automated polarizer and analyzer.



Analyzer
Angle of the analyzer.

Coupled
If activated the analyzer is in the beam path.

Filter 1/2/3
If you have more than one filter for the analyzer, select the one used when changing them. (The zero position may differ between the filters.)

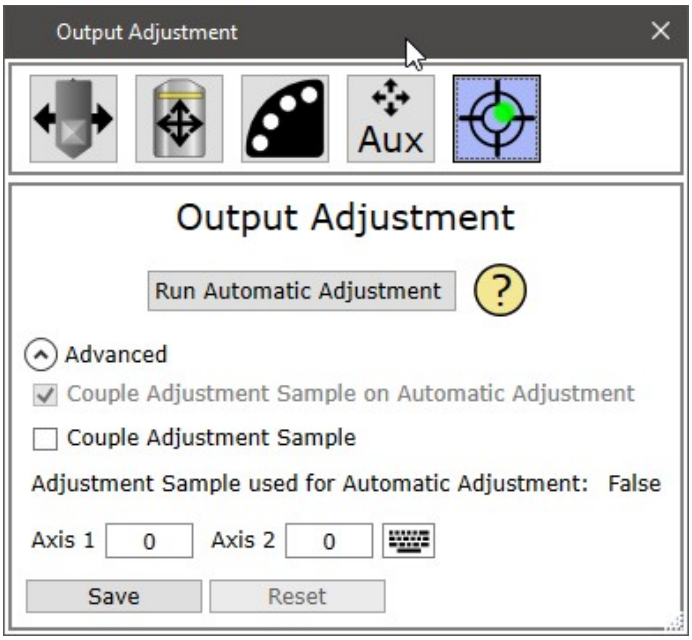
Synchronize Angle
If checked, automatically synchronizes a desired angle between the analyzer and the polarizer.

Polarizer
Angle of the polarizer.

Advanced Settings
Only use this if you know what you do.

Output Adjustment

Adjustment for AutoBeam Output Coupler



Run Automatic Adjustment
Starts the automatic adjustment sequence and tries to find the maximum output signal.
If this action is successful, the adjustment is automatically saved for the current combination of laser and output.

Advanced

Couple Adjustment Sample on Automatic Adjustment
If checked, the adjustment sample is coupled in when pressing "Run Automatic Adjustment"

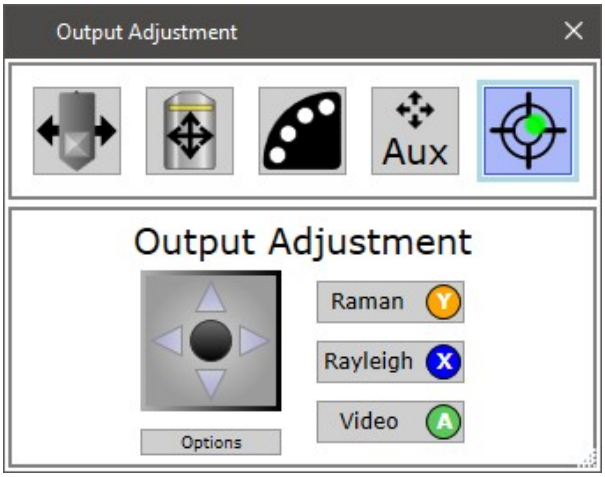
Couple Adjustment Sample
Lets you couple in or out the adjustment sample

Axis 1 / Axis 2
Lets you manually move two axes to adjust the laser output.
You can click on the  button to use the arrow keys up/down/left/right to move both axes.

Save
Saves the current output adjustment (axes positions) for the current combination of laser and output.

Reset
Resets the current output adjustment for the current combination of laser and output.

Adjustment for Output Coupler with Alignment camera



To start the laser output adjustment, first start the oscilloscope in WITec Control.
For help moving the inertial drive, see Inertial Drive Control.

Use the UI Joystick Controls or the EasyLink Controller to adjust the adjustment mirror.

The motorized laser output adjustment is only available with an automated output tower.

Raman
Sets up the beam path for Raman signal.
Use this in a first step to align your laser.
Only use single steps in all directions to optimize your signal.
If there is no signal, try using the Rayleigh adjustment.

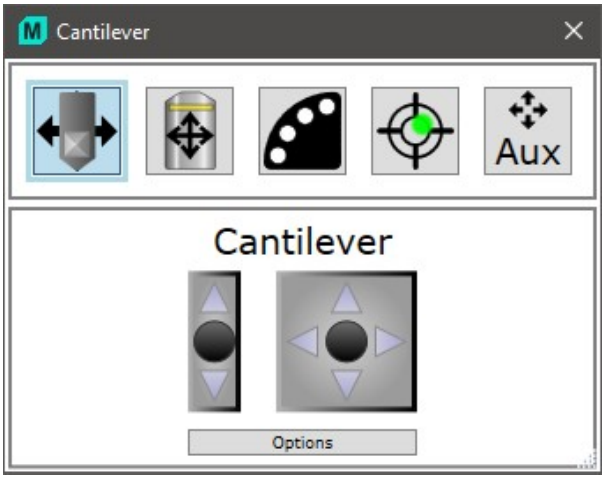
Rayleigh
Sets up the beam path for Rayleigh signal (removes the filter).
Only use single steps in all directions to optimize your signal.
If there is still no signal, use the video adjustment.
The Rayleigh adjustment mode is only available if the laser coupler has an automated filter unit.

Video
Sets up the beam path for video adjustment and switches the video live view to the adjustment video camera.
Try to move the laser spot in the red circle.
If the laser spot is far away, use the continuous movement feature.

If you have finished this task, close the window and stop the WITec Control oscilloscope.

Inertial Drive Control

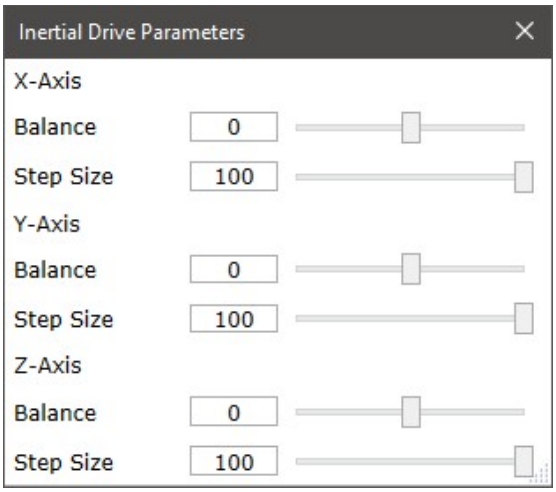
This dialog can be accessed from Additional devices or from AFM Status for Cantilever movement.



Inertial drives are used to move the cantilever, the laser output adjustment mirror or an auxiliary device.

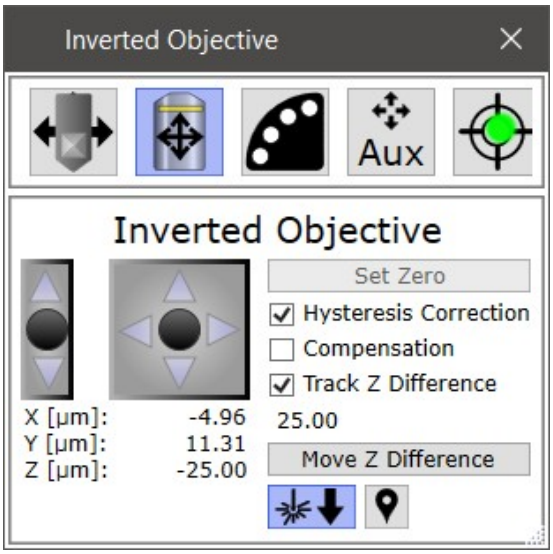
You can use the UI Joystick Controls or the EasyLink Controller to move the inertial drive.
Pressing the arrows will do a single step.

If the axes don't move symmetrically or one direction does not move at all, open the options and adjust the balance or step size:



Inverted Objective Positioning

This dialog can be accessed from Additional devices.



You can control the X/Y/Z axes using the UI Joystick Controls or the EasyLink Controller.

Set Zero
To avoid unwanted contact of the inverted objective with the scan table, the maximum allowed area of movement is limited.
Press set zero to set all values to zero and to enlarge the area of allowed movement.

Hysteresis Correction
If checked, a hysteresis correction will be done when doing single steps using the gamepad or the "arrow buttons".

Compensation
If checked, the inverted microscope compensates X-/Y-Position whenever the probe position changes:
- when changing the top turret objective
- when changing the probe (e.g. laser change)

Track Z Difference
If checked, the difference between the inverted objective Z-Position and the microscope Z-Stepper Position will be tracked.

Move Z Difference
Moves the inverted objective in Z, so that the tracked difference between the inverted objective Z-Position and the microscope Z-Stepper Position is compensated.

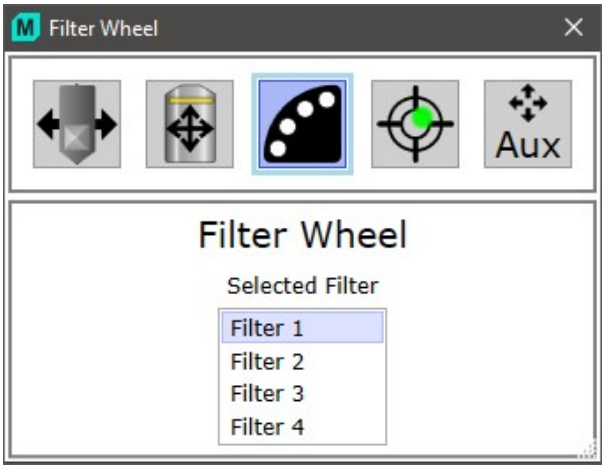

Indicates that the laser light is coming from top and the marker in bottom camera view shows the detector position.


Indicates that the laser light is coming from bottom and the marker in bottom camera view shows the laser position.


If checked, you can click into the bottom camera image in order to move the inverted microscope to the desired position.

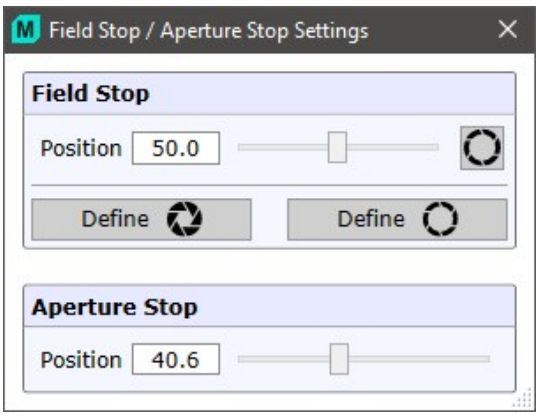
Filter Wheel

This dialog can be accessed from Additional devices.



Just select your desired filter position from the list box.
You can also push the right stick of the EasyLink Controller up and down to select a filter.

Field Stop / Aperture Stop



Field Stop

Position
Sets the position of the field stop.

Toggle Open / Focus Position
Toggles between the open and focus position.
You can define both positions with the "Define" buttons.

Define Focus Position
Defines the current position as the Focus/Close position.

Define Open Position
Defines the current position as the open position.

Aperture Stop

Position

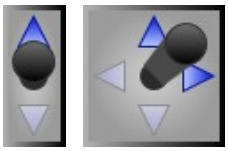
Sets the position of the aperture stop.
When changing the position, the video brightness will be automatically adjusted.

UI Joystick Control

The User Interface Joystick Control allows to control the movement of several axes such as the Microscope Z Stage, the Sample Positioner, the Inverted Microscope, the Cantilever etc.
It can be controlled using the mouse or the keyboard.

Mouse Control

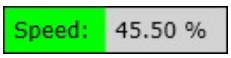
The black circle in the middle can be dragged with the mouse, which controls the direction and the speed, depending on the mouse movement distance:



The arrows can be clicked for single steps.
Hint: Hold down the control-key on the keyboard to do a continuous movement instead of single steps.

Turning the **mouse wheel** on a vertical joystick will do single steps in the desired direction.

Holding down the right mouse button will change the step size:



Keyboard Control

If the control is just clicked with the left mouse button, it gets the keyboard focus and can be controlled using the arrow keys.
Hint: Hold down the control-key on the keyboard to do a continuous movement instead of single steps.

The speed can be changed using the keys 0, ... 9:

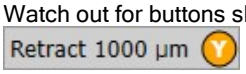
EasyLink Controller

A lot of microscope devices and some software parameters can be controlled using the WITec EasyLink Controller.

Assignment of Buttons

The assignment can change upon switching to another task in the software.
If no special task is currently in process, the default mode is active and the assignment looks like this:

If a special task is currently in process, e.g. if the change objective wizard is open, then some buttons are handled by this wizard in order to move up or down the microscope automatically.
Watch out for buttons showing the EasyLink Controller assignment, e.g.:



Continuous Movement

To move any axis **continuously**, you have to hold down one of the shoulder buttons:
The lower shoulder button will set the moving speed according to the objective magnification and video zoom.
The upper shoulder button will set the moving speed to the maximum speed ("**Turbo**") of the current moving device.
The more the joystick is moved to the boundary, the higher the moving speed.

Single Steps

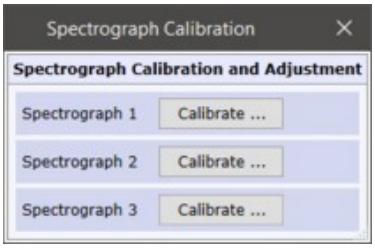
If no shoulder button is pressed, only a single step is done in the selected direction.
The single step size can be adjusted by pressing on the Joystick or by selecting a custom step size using the right mouse button on a UI joystick control.

Secondary Options

Hold down the left menu button to enable "Secondary Options", which allows to use the same controller buttons for different purposes such as laser control, auxiliary device control, video measurements etc:

Spectrograph Calibration

Further information (Operation Guide):
- Spectrograph Calibration



Let you select a Spectrograph for Calibration or Verification.
Note that automated microscope systems will automatically couple necessary devices for the calibration, e.g. the automated calibration lamp, output, etc.

Calibration (Tab)

Top Bar

Verify only (Checkbox)
If checked, you can verify the quality of the grating calibration, without changing the current calibration.

Cancel
Cancels a currently running calibration or verification.

Current Reports
Shows the latest calibration or verification report for each grating.

Export Reports
For problem analysis, you can export the latest reports into a ZIP file and send it to WITec.
Note that you can also include the latest reports when creating a Support ZIP File.

Delete Old Reports
Deletes reports older than 90 days. This might be reasonable in order to clean up unnecessary data, e.g. when you do calibrations/verifications very often.

Gratings

For each grating, you can see the Grating infos and whether it is calibrated or not.

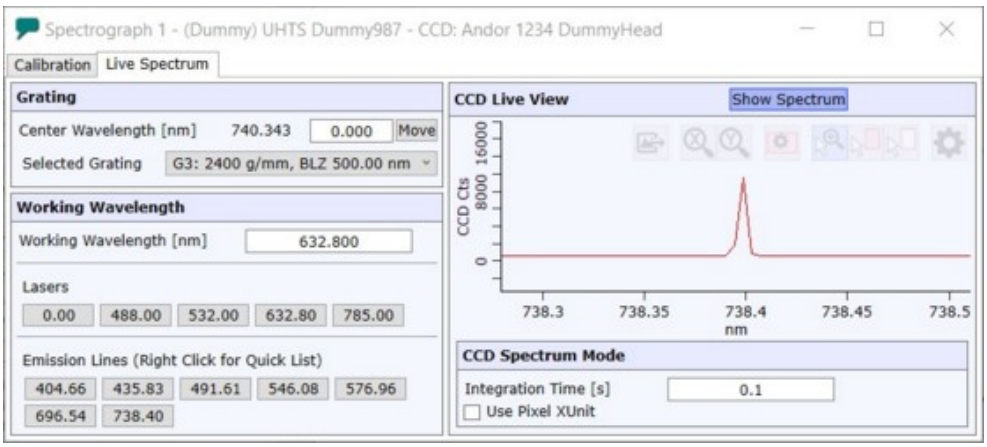
History
Opens the history of all calibration and verification reports of the current grating and lets you open and compare any of those reports.

VIS (Combobox)
Here you can select one of the "calibration groups" specified for the current spectrograph-grating-combination.

Calibrate (or Verify)
Starts the calibration or verification process.

State / Infos
Each grating shows the result of the last calibration or verification: whether it was successful or not and the min/max error values in nanometer and pixels.
At the bottom area you can see the last measured spectrum with integration time.

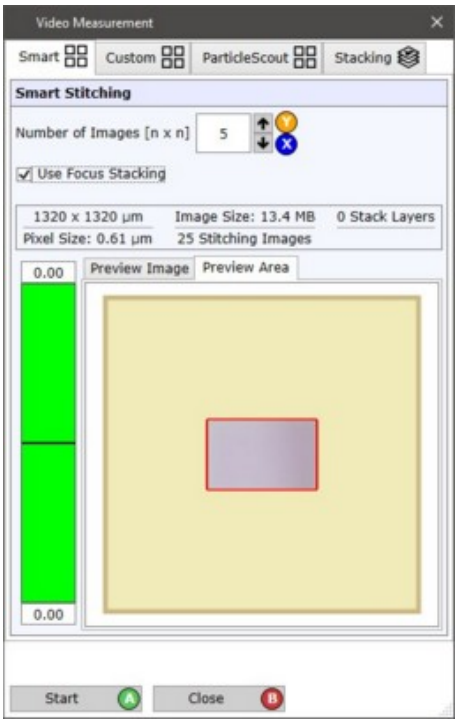
Live Spectrum (Tab)



Click on "Show Spectrum" in order to display a live spectrum, for example in order to adjust the intensity of your calibration source.
You can select a grating and adjust the center wavelength by typing a number or by clicking one of the emission line buttons.

Video Measurement Overview

The Video Measurement dialog can be used to perform image stitching and focus stacking.



Smart Stitching
See **Smart Stitching**.

Custom Stitching
See **Custom Stitching**.

ParticleScout Stitching
See ParticleScout Stitching.

Scan Table Stitching
For systems using a scan table and without any sample positioning device, the scan table stitching is available.
It just uses the total range of the scan table for the stitching.

Video Focus Stacking
See Video Focus Stacking.

Common Stitching User Interface

Stitching Information

Here you can see the current stitching information:
- Area in µm
- Size of a single pixel
- The total image size in megabytes/gigabytes
- The number of images
- The number of stack layers (if focus stacking is turned on)

Preview

Preview Image
During the video measurement process, this tab will show a preview image.
You can zoom into the image using the mouse wheel, pan the image using the mouse wheel button.

Export High Quality
Exports a the stitching image with a higher resolution to the current project.
The original resolution is an optimal resolution calculated using objective and camera parameters with a maximum of 64 mega pixels.
To prevent large projects, the exported standard resolution is about 1 Mega-Pixel.

Preview Area

Here you can see the current video area and the preview stitching area, positioned in absolute lateral space.
This gives you an overview about the relation of the stitching image position/size
compared with the current position and video image size.

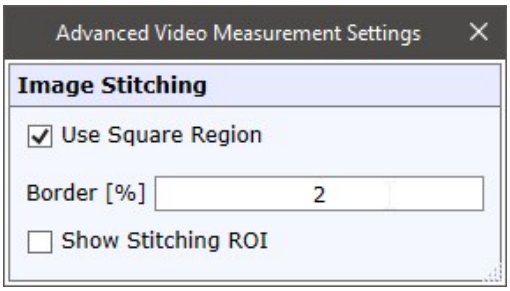
Start / Cancel / Close

Start
Starts the currently selected video measurement, depending on which tab is selected.

Cancel
Cancels the current video measurement. The preview video image is always exported to the current project (except for ParticleScout Stitching)

Close
Closes the window.

Advanced Options



Use Square Region
If checked, a quadratic area is used. Affects the size of Smart Stitching.

Border [%]
Defines how much of a full video image is used for a single stitching image.
E.g. Video Width = 1000px, Border = 10% -> the most left 100px and the most right 100px are not used.

Show Stitching ROI
If checked, the area of a single stitching image is shown in the video image.

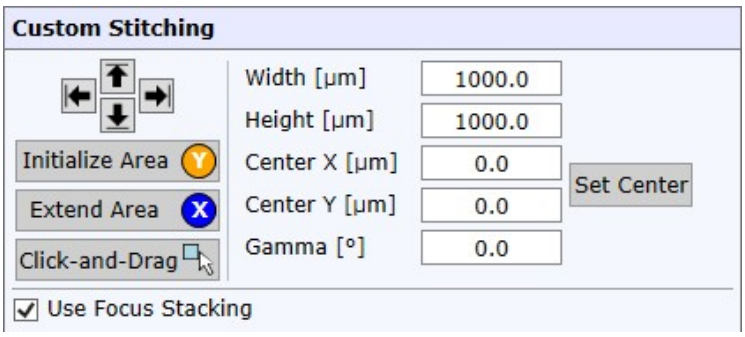
Smart Stitching

Smart Stitching can be used to measure a stitching image around the current position by simply defining a number of images.

Number of Images
Here you can set the number of images [n x n] for the stitching.
Depending on the selected objective, the number of images defines the total size of the stitching image.
You can increase or decrease the number of images using the number edit, the arrow buttons or the gamepad buttons X and Y.

Use Focus Stacking
If checked, uses the current focus stacking range in order to do a focus stacking for each single image.

Custom Stitching



Custom Stitching lets you define the stitching area exactly by setting the size and center position and a rotation.
The Area Definition Buttons will help you defining the parameters visually.

Area Definition Buttons

Arrow Buttons
Let you define the most left/top/bottom/right position for the stitching area.

Initialize Area

Sets the custom stitching area to the current video position / size.

Extend Area
Extends the current stitching area by the current position of the video image.

Click-and-Drag
Turns on the mouse listen mechanism: if turned on, you can click and drag a rectangle in an image viewer in order to define the stitching area.

Area Parameters

Width / Height
Sets the stitching width and height in microns.

Center X / Y
Sets the absolute center position of the stitching image.

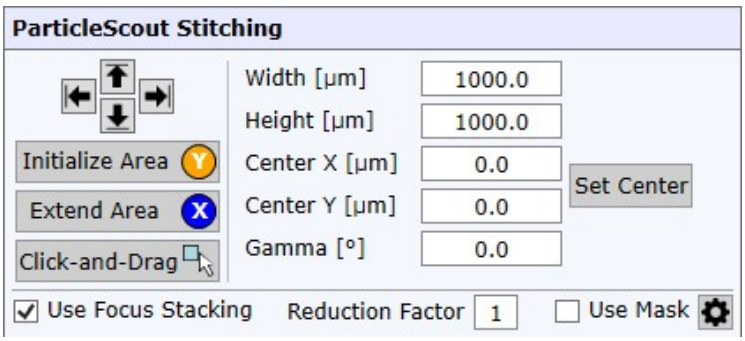
Set Center
Sets the Center X / Y parameters to the current position.

Gamma
Sets an angle in degrees for the stitching. This way you can stitch a rotated structure.

Focus Stacking

Use Focus Stacking
If checked, uses the current focus stacking range in order to do a focus stacking for each single image.
Please consider Video Focus Stacking FAQ for best results.

ParticleScout Stitching



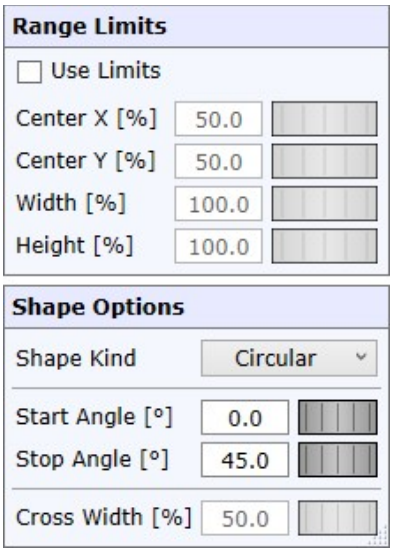
The ParticleScout Stitching will create a high resolution stitching image and open the WITec ParticleScout software after the stitching measurement has finished.

In addition to the custom stitching parameters (which define the stitching area), there are the following options:

Reduction Factor
In case of large stitching areas, the resulting stitching image may have a very large resolution and thus needs a lot of memory. If you don't need the resolution (e.g. if you only have large particles), you can reduce the image resolution by increasing the factor.
Watch the Image Size in Megabytes/Gigabytes.

Use Mask
If checked, a customizable mask will be used in order to stitch only a part of the defined stitching area, see Mask Options below.

Mask Options



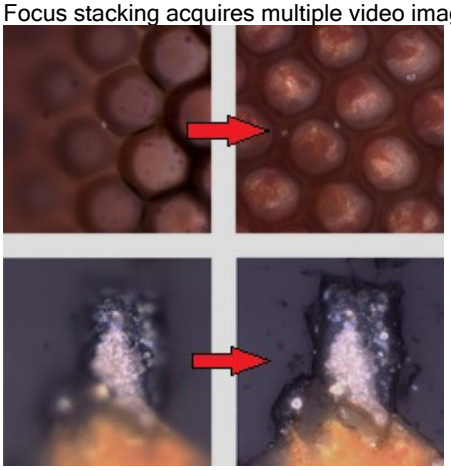
Use Limits
If checked, the defined percentages for Center and Size will be used to "shrink" the mask / to use only a part of the defined stitching area.

Center / Size
Lets you define a center position or size as a percentage relative to the original stitching area.

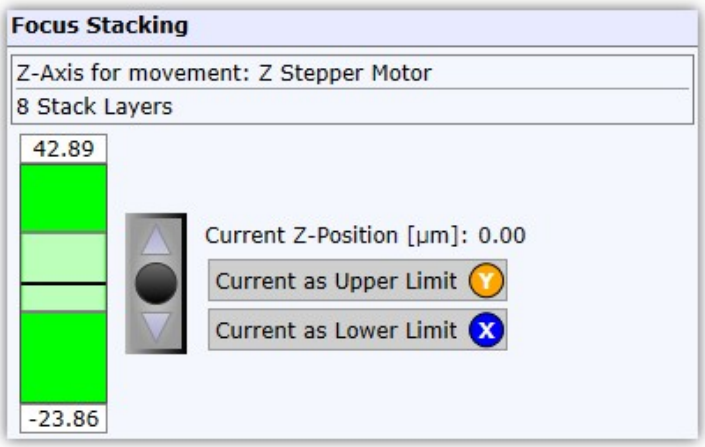
Shape Kind
- Rectangular: just uses the range limits and defines a rectangle
- Circular: creates a circle or ellipse and uses Start/Stop Angle to define a section
- Crosswise: creates a cross using the Cross Width parameter

Video Focus Stacking

Focus stacking acquires multiple video images in different z-positions to calculate a sharp result image:



Please consider Video Focus Stacking FAQ for best results.



Green Bar
Shows the maximum Z-Range that the software is able to move by its own (Default: ±100µm, see Microscope Z Stage Range Options).

The bright area shows the Z-Range which is used for the focus stacking.
The upper edit defines the upper limit, the lower edit the lower limit.

Joystick
The joystick moves the Z-Stage. Note that the software limited z coordinates are used when opening the Video Measurement Window.

Current as Upper Limit
Uses the current Z-Position as the upper limit for the focus stacking.

Current as Lower Limit
Uses the current Z-Position as the lower limit for the focus stacking.

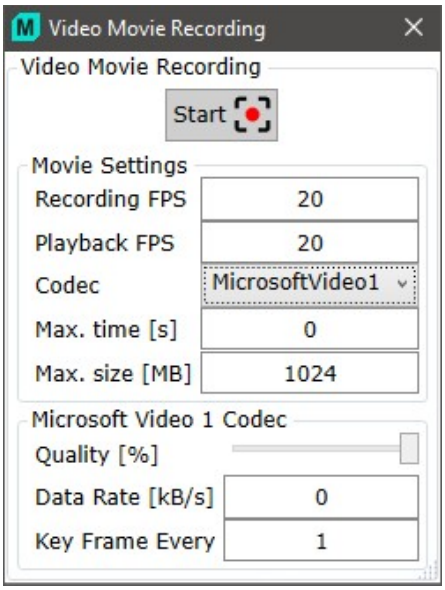
Pressing start will simple perform the focus stacking on the current position.

Video Focus Stacking FAQ

To get proper results when performing video focus stacking, please consider the following rules:

- Ensure that the aperture stop is aligned correctly
- Ensure that the image is not over saturated (too much light)
- Ensure that the used objective is NOT an AFM objective

Video Movie Recording



Start
Lets you select a file name and starts the movie recording.

Movie Settings

Recording FPS
Here you can enter a desired recording frame rate. The actual frame rate may differ because of limiting camera specifications.

Playback FPS
Here you can enter a desired playback frame rate. You can implement a slow or fast motion by setting a lower / higher playback frame rate.

Codec
Here you can select a AVI codec:

- None: Full uncompressed bitmaps will be saved. The video file will be very large.
- Microsoft Video 1: see below

Max time
Sets a maximum time for the video recording. The recording will stop automatically after this time.

Max size
Sets a maximum file size for the video file. The recording will stop automatically if the file gets larger than the max size.

Microsoft Video 1 Codec

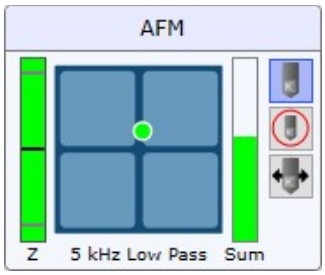
Quality
Sets the quality of the saved video images. The lower the quality, the smaller the file size.

Data Rate
The desired data rate. A data rate of 0 sets an automatic data rate.

Key Frame Every
Defines the number of key frames.

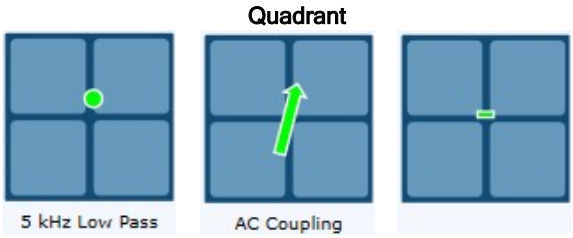
AFM Status

If your system has AFM and TrueSurface Mk3, then the AFM status view is only shown if any AFM configuration is loaded in WITec Control (AFM beam deflection laser is turned on).



Hint: If you click on the quadrant, the AFM Status opens in a separate window with freely adjustable size.

Left Bar (Z)
The left bar shows the current scan table z sensor position.



It shows the four quadrants of the beam deflection detector. The indicator changes depending on the operation mode:

- A spot visualizes the **T-B** and **R-L** Signal as position of the light spot on the four quadrant diode for Contact mode. The active low pass filter is indicated at the bottom.
- An arrow displays the **LockInR** (oscillation amplitude) as its length and LockInPhi (phase offset) as its rotation for AC mode. The note "AC coupling" at the bottom indicates that all DC voltage offsets are neglected in this representation.
- A horizontal bar represents the **FMax** signal (maximum force) for DPFM. The **R-L** Signal is not evaluated.

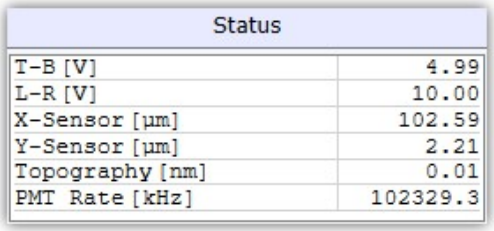
Right Bar (Sum)
The right bar shows the sum signal (total from the cantilever reflected light captured by the four quadrant detector).

 **Cantilever Active**
This button should be turned on when a cantilever is attached and in use.

 **Show Cantilever Position**
If checked, the cantilever probe position is shown in the video image instead of the laser probe position.
You can define the probe position in order to do lateral-correlated measurements.

 **Cantilever Positioning**
Opens a little pop-up for positioning the cantilever.

Status Values

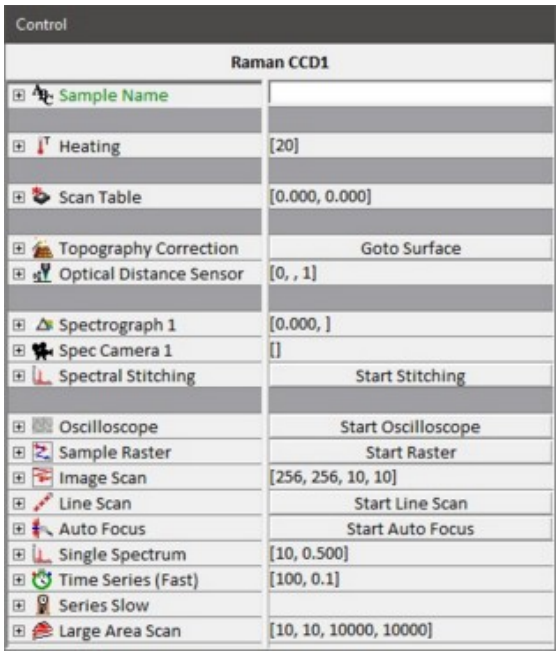


Status	
T-B [V]	4.99
L-R [V]	10.00
X-Sensor [µm]	102.59
Y-Sensor [µm]	2.21
Topography [nm]	0.01
PMT Rate [kHz]	102329.3

Shows the current status values from different hardware devices, such as scan table X/Y/Z sensors, AFM voltages, PMT rates etc. Please refer to Data Channels for further information.

Control Window Overview

Depending on the selected configuration and the installed hardware, the Control Window provides access to most of the hardware and measurement parameters:



Caption
The caption shows the selected configuration (e.g. Raman CCD1).

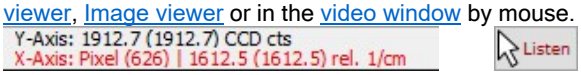
Navigation
Double-Click on a label on the left side or click on the little +/- sign to expand/collapse a sub tree or use the right/left arrow keys. It is possible to navigate through the parameters using the up/down arrow keys.

Edit values
Simply click on a row in order to edit a parameter. The value is changed by holding the Ctrl key and pressing the up/down key to increase/decrease the value. For larger increments hold Ctrl + Shift and use the up/down arrow keys.
If parameter names are shown as a **red label**, one of the parameters might be wrong, are out of range or a combination of parameters does not work.

Stop button


All Stop buttons within the Control tree will stop the currently running sequencer no matter in which subsection it is located. This applies also to the Stop button in the Main window.

Listen functions


The Listen functions within the Control tree enables to determine certain parameters like positions in a Graph viewer, Image viewer or in the video window by mouse.


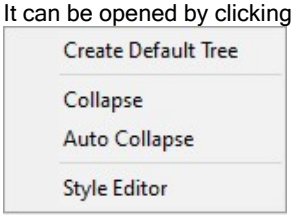
An active Listen function is indicated by the text color of the axis position turning to red in the status bar of the Graph viewer or Image viewer (left) and by a symbol in the video window (right). Clicking on the red text or on the symbol in the video window turns off the Listen function.

Never
The Listen function is switched off.

Once
The Listen function is active. It is turned off automatically after a value is selected by mouse.

Multiple
The Listen function is active until it is switched off by the user by either setting it to Never or clicking on a red line in a status bar of the Graph viewer or Image viewer.

Context menu
It can be opened by clicking the right mouse button anywhere in the Control tree.



Create Default Tree
The Default tree shows all available parameters no matter which configuration is selected.

Use Configuration Layout
Changes back from the Default tree and shows parameters as defined in the style of the selected configuration.

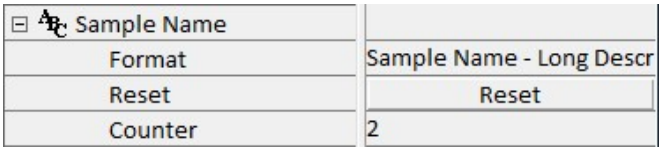
Collapse
Closes all sub-trees.
Auto Collapse
If this is selected, open sub-trees are closed as soon as a new sub-tree is opened.

Style Editor
The Style editor enables to change the style of a configuration using a graphical user interface. This is for WITec-internal use only!

Parameter groups
Here you can find information about specific parameter groups. If the parameter description is gray, the parameter is only available in the default tree.

Sample Name

The Sample Name parameter group allows to specify a sample name, which is then used in the name of new created data objects. The following configuration independent parameters are available:



Sample Name
Shows the X position of the scan table and can be increased or decreased up to the limits of the scan table. If an out of range value is entered, the scan table will move to its maximum position which will then also be displayed as the parameter value.

Format
Different predefined formats are available:
Sample Name - Long Description
A combination of the sample name and a long version of the used measurement mode is used as name for new data objects.
Sample Name - Short Description
A combination of the sample name and a short version of the used measurement mode is used as name for new data objects.
Sample Name
Only the sample name is used as name for new data objects.

Reset
The button resets the counter.

Counter
Value of the counter used as number for the next created data object.

Format
Defines the complete name format for new data objects.

Delimiter
Defines the delimiter between the name parts.

COM Automation

This parameter group controls for the remote access over the **COM interface** of WITec Control.
Further information:

- **COM Automation**

COM Automation
This button allows exclusive write access to a remote application. A window opens which blocks WITec Control user entries and enables to revoke remote access by a button.

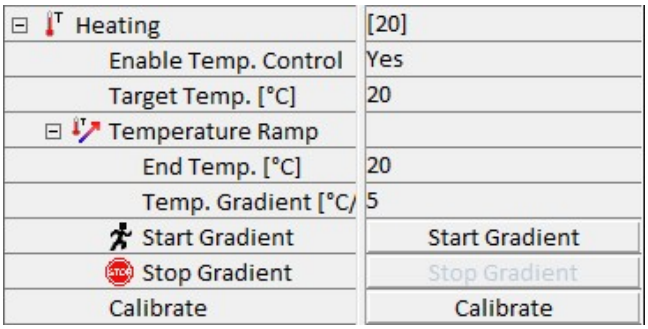
Allow Remote Read Access
It is possible to deny remote read access using this parameter.

Allow Remote Access
This button has the same function like the COM Automation button.

Revoke Remote Access
This button can revoke the remote access.

Heating

The Heating parameter group controls the WITec heating stage which is driven through the alphaControl controller. Upon start of the software, the heating stage is calibrated using the PT100 element within the stage. Information about this process is displayed in the message window. The state of the heating stage (enabled, disabled, stabilized,...) as well as the current temperature while heating is also displayed in the message window.
If the heating stage is present, the temperature determined at the start and the end of a measurement (such as an image scan) is saved in the automatically created text object describing the scan.
The following parameters allow control over the the heating stage:



Enable Temp. Control
Using this parameter the temperature control can be enabled (Yes) or disabled (No). If the temperature control is disabled, all other parameters in this group will be inactive and the target temperature is set automatically 20 °C.

Target Temp. [°C]
Here the target temperature of the stage can be entered. If it is changed, the stage will try to reach the new target temperature using the P, I and D parameters for the Proportional(P) Integral(I) Differential(D) regulating loop.

Temperature Ramp
Using this group it is possible to ramp the temperature linear to a certain target temperature. The following parameters allow this control:

End Temp. [°C]
The temperature the stage should reach at the end of the ramp.
Temp. Gradient [°C/min]
The slope of the temperature ramp in °C per minute.
Start Gradient
Starts the temperature ramp.
Stop Gradient
Stops the temperature ramp.

Calibrate

This button triggers the automatic calibration of the heating stage using the PT100 element inside the stage. (This procedure is automatically executed upon starting WITec Control.)

P-Gain
The P-gain for the PID regulating loop.

I-Gain
The I-gain for the PID regulating loop.

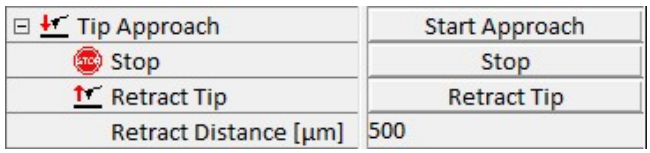
D-Gain
The D-gain for the PID regulating loop.

Get Temperature Interval [s]
This parameter determines in which time intervals the temperature is measured.

Tip Approach

This sequencer is used for the tip approach for AFM and SNOM measurements with the alphaControl. The following parameters are used to control and perform a tip approach.
Further information (Operation Guide):

- AFM Overview
- AFM Procedure



Start Approach
This button starts the tip approach procedure.
The automatic approach may fail if one of the following problems occur:

- The approach is interrupted by the user clicking on a Stop-button.
- Instability of the sum signal. If the sum-signal increases by 10 % or decreases by 20 %.
- No contact was registered after the microscope moved 2 mm down.
- The setpoint has been altered by the user during the approach.
- The setpoint has been reduced by 50 % during an AC approach.

Retract Distance [µm]
This parameter defines the upward travel distance of the microscope z stage during tip retraction.

Retract Tip
This button retracts the tip using the microscope z stage by the defined retract distance.

Out of Contact Speed [µm/s]
This parameter defines the speed of the microscope Z stage during an approach before the feedback setpoint is reached (see Section 3.4.5).

In Contact Speed [µm/s]
This parameter defines the speed of the microscope Z stage during an approach after the feedback setpoint is reached (see Section 3.4.5). As the scan table (Section 3.4.3) is completely extended in the Z-direction, the microscope Z stage travels at the in contact speed downwards, while the feedback loop retracts the scan table to its final Z position (see below).

Final Position Z [µm]
This parameter sets the z-position of the scan table at which the approach is completed.

Approach Method
The tip approach depends on the selected feedback settings. This function allows the selection of the proper approach method for the following modes:

Contact Mode
During the approach in contact mode, the tip is in contact with the surface as soon as the setpoint is reached. At this point the cantilever is bent and a force, defined by the setpoint and the spring constant of the cantilever, is acting between tip and sample. Following this the scan table retracts to its middle position while the microscope Z stage simultaneously compensated for this movement in order to keep the bending of the cantilever constant.

AC Mode
During the approach in AC mode, the cantilever is oscillating at a defined free amplitude before the sample is reached. As the tip reaches contact with the sample this amplitude is damped and the tip is in its designated position once the setpoint defined by the feedback has been reached. Due to long range forces however, the amplitude damping can begin before the tip is in physical contact with the sample. Therefore, the indication that the tip is in contact during AC approach is the change of phase shift φ when the setpoint is decreased slightly. To determine the phase shift reliably, φ is sampled

continuously during the tip approach. As soon as the final Z position is reached, the setpoint is decreased further and the standard deviation σ(φ) is determined. If σ(φ) < σmax (the maximum deviation of φ) the setpoint is decreased further while the final Z position is corrected using the microscope Z stage. The tip approach is stopped when the standard deviation σ (φ) ≥ σmax.
For safety reasons, the AC mode tip approach is also stopped if the current setpoint is smaller than half of the initial setpoint.

PFM Mode

The approach in PFM mode is similar to the approach in contact mode with the difference the the signal used for regulation is not the T-B signal (ie the signal of the constant bending of the cantilever). The signal used here is the Fmax signal determined from the PFM curve. This ensures a constant maximum force on the cantilever.
The approach in PFM mode will only be successful if the Fmax window is selected properly.

Tip Regulated Contact Mode

In this mode, the tip positioning in Z direction is regulated by the positioning piezo located in the cantilever arm instead of the Z axis of the scan table. Therefore the retracting of the tip is done to the middle position of this piezo and not of the scan table.

PhiStdDevAccums
To calculate the standard deviation σ(φ), n samples of φ are utilized. The parameter PhiStdDevAccums defines the number n of the φ samples.

Stop@PhiStdDev
This parameter defines the maximum deviation σmax at which the AC approach is stopped.

Scan Table

The Scan Table parameter group is for controlling the position of the piezo stage.

Scan Table	[0.000, 0.000]
Listen Position	Never
Position (X) [µm]	0.000
Position (Y) [µm]	0.000
Position (Z) [µm]	0.000
Position (Z, Microscope	0.000

Position(X/Y/Z)[µm]
Shows the X position of the scan table and can be increased or decreased up to the limits of the scan table. If an out of range value is entered, the scan table will move to its maximum position which will then also be displayed as the parameter value.

Position(Z, Microscope)[µm]
This has the same function like the **Move to Z-Position** button in the Video Control Window.

Listen **Position**
The listen position parameter allows the selection of coordinates for the positioning of the scan table and/or the microscope Z stage using any graph or image with position information. The X and Y coordinates can be selected using any image captured in the X-Y plane such as a 2D scan, video image or a bitmap and also graphs from cross sections or line scans. The Z axis can be altered by clicking on a depth scan for example.

Move mode
Using this drop down menu, the behavior of the Z axis can be controlled with the following options:

I Z for Feedback

This mode is typically used for SNOM or AFM measurements. Here the Z axis of the scan table is controlled through the PI controller using the feedback signal as a reference. If this mode is selected, the position of the Z axis of the scan table cannot be changed manually.

I Z by Microscope

This is the typical mode of operation when performing confocal or confocal Raman measurements, in which the microscope Z stage is used as the Z axis of the internal coordinate system. This allows depth scans greater than the piezo z range.

I Z by Scan Table

Here the Z axis of the scan table is the Z axis of the internal coordinate system. Additionally, using the Z axis of the scan table only allows for depth scans within the piezo z range.

I No Z Movement

This is selected, if no z movements are possible during a measurement.

Detection

The Detection parameter group is for controlling photon counting devices and the inverted beampath.
Further information (Operation Guide):

- Confocal

- SNOM
- StrobeLock

Detection	
Flip Mirror 1	Video Camera
PMT On	Reset / On
APD On	Reset / On
PMT2 On	Reset / On

Flip Mirror 1
This parameter controls the flip mirror in the inverted beampath (for systems build until 2015). It is possible to switch between Video Camera and Detection. This is done automatically when a measurement is started or stopped.

PMT/APD/PMT2 On
Pressing this button turns on the respective photon counting device. This is done automatically when a measurement is started.
If the count rate exceeds 4500 kHz, the photon counting device will be turned off automatically for protection. In this case the button can be used to turn on (reset) the photon counting device after reducing the light intensity.
It is the responsibility of the user to avoid exposing too high light intensity to the photon counting device.

Photon Detector Amplifier

This parameter group controls an amplifier e.g. for an analog PMT. The parameters are:

Photon Detector Amplifier	
Controlled Amplifier	PrimaryAmplifier
Gain [V/A]	10^5 (High Speed)
Bandwidth [kHz]	500.0
Coupling	DC
Control Voltage [V]	0.50
Offset [%]	0.10

Controlled Amplifier
The amplifier can be selected. In normal case only one amplifier will be available.

Gain [V/A]
This parameter defines the amplification. It is also possible to choose between low noise and high speed.

Bandwidth [kHz]
Read-only parameter, which shows the bandwidth in kHz dependent on the selected Gain.

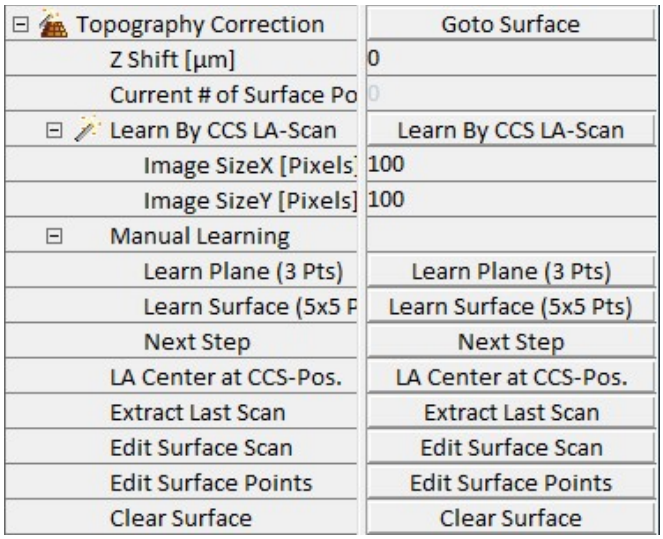
Coupling
AC or DC can be selected here dependent on the type of voltage that should be amplified. DC should be selected for the analog PMT.

Offset [%]
This parameter is for compensation of the offset. This is factory defined and should only be changed if really necessary.

Control Voltage [V]
The Control voltage of the PMT changes its sensitivity. It can be adjusted between 0 V and 1.2 V.

Topography Correction

The Topography Correction parameter group is for learning a topography either manual or by using a Confocal Chromatic Sensor (CCS) for use with a Large Area Scan.
Further information (Operation Guide):
- Manual Topography Correction
- TrueSurface



Goto Surface
This will move the z-stage into the learned focus position, if the current position exists in the current surface and a z-value can be interpolated.
If the z-stage is moved by the user in while the user-z is selected in microscope z, an offset to the learned focus will be added and this button will not go to the correct focus position anymore.

Z Shift [µm]
This parameter can be used to vary define an offset to the learned focus position. This can also be done while a surface corrected large area scan is performed.

Current # of Surface Points
This will just show the number of points that define the current surface.

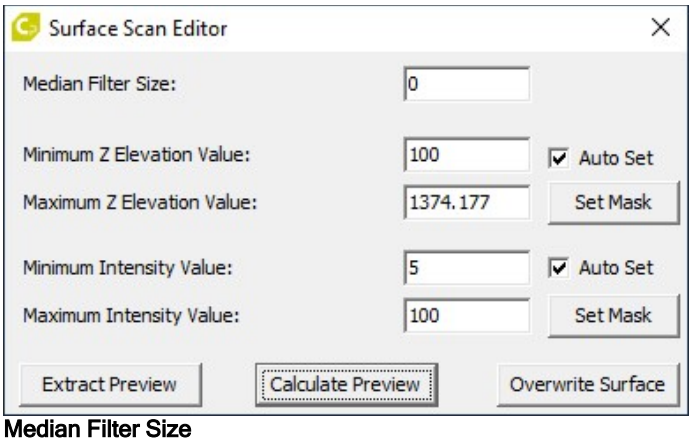
Learn By CCS LA-Scan
This will scan the defined large area scan geometry using the CCS sensor.
Image SizeX/Y [Pixels]
This will define the image pixel size of the large area scan for the CCS learning.

Manual Learning
This group of parameters enables to learn simple surface without CCS. The progress is shown in the **messages window**.
Learn Plane (3 Pts)
This will start a sequencer which will move the sample to 3 positions defined by the large area scan geometry for a tilt correction.
Learn Surface (5x5 Pts)
This will start a sequencer which will move the sample to 25 positions defined by the large area scan geometry for a simple surface correction.
Next Step
Press this button after focusing the current point to move to the next point or to finish the learning.

LA Center at CCS-Pos.
This will set the large area scan geometry center to the current x-y-position and uses the currently measured CCS-Elevation for setting the z-position.

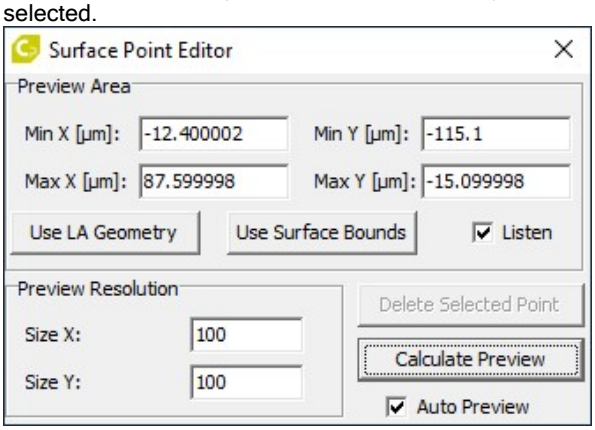
Extract Last Scan
This button enables to extract the Elevation and Intensity data of the last scan to the Project Manager.

Edit Surface Scan
When a surface was learned using the CCS, this button opens a dialog to change the current surface, e.g. mask out wrong elevation values. For this the last measured Elevation and Intensity image are also opened.



Median Filter Size
Defines the size of a median filter, which is applied on the surface.
Minimum Z Elevation/Intensity Value
Minimum allowed Z elevation/intensity value. Lower values will be added to the mask.
Maximum Z Elevation/Intensity Value
Maximum allowed Z elevation/intensity value. Higher values will be added to the mask.
Auto Set
If set, the mask in the Elevation or Intensity image will automatically update when a value is changed.
Set Mask
This button manually updates the mask in the Elevation or Intensity image.
Extract Preview
This button extracts the preview to the Project Manager.
Calculate Preview
This button recalculated the preview applying the currently selected masks and filter size.
Overwrite Surface
Pressing this button overwrites the surface by the current version with selected masks and filter applied.

Edit Surface Points
This will open a dialog to see what the surface (learned manually or by CCS) would look like when a different area is selected.



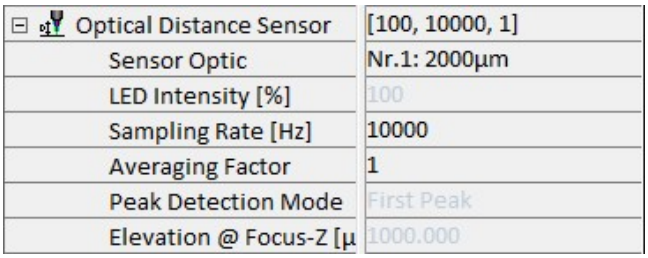
Min/Max X/Y [µm]
Bounds of the current preview.
Use LA Geometry
The bounds of the Large Area Scan are used.
Use Surface Bounds
The bound of the current surface are used.
Listen
If this is activated, the center position of the current area can be changed by clicking in an image or in the video window.
Size X/Y
Changes the resolution of the preview image by changing the number of pixels in X or Y direction.
Calculate Preview
This button will update the preview using the current values.
Auto Preview
If this is activated, the preview is updated on any change.

Clear Surface
This will clear the current surface.

Optical Distance Sensor

The Optical Distance Sensor parameter group contains parameters to control the Confocal Chromatic Sensor (CCS).

Further information (Operation Guide):
- TrueSurface
- Profilometer



Senor Optic
Using this parameter the used senor can be selected and thereby its calibration is loaded. In normal case only one sensor is installed. The sensor range is shown here.

LED Intensity [%]
Dependent on hardware a read-only value. It shows the LED Intensity of the MicroEpsilon-Controller-intern LED. Always adjust this value for the respective sample. The status section will show the current CCS intensity, this should be above 1 % and below 100 %.

Sampling Rate [Hz]
This controls the integration time of the CCS CCD chip. The highest possible sampling rate is always recommended (due to Dark Calibration errors on lower sampling rates/higher integration times).

Averaging Factor
Elevation values will just be averaged.

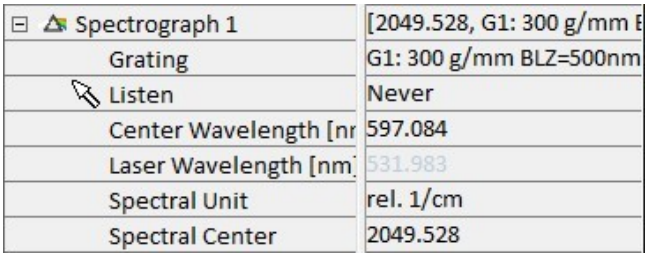
Peak Detection Mode
Dependent on hardware a read-only value. It defines how the sensor will calculate the Elevation from the spectrum.
Highest Peak
Used for opaque samples.
First Peak
Used for transparent samples. Be careful when using this mode, since the change is much higher to get a wrong value (because e.g. sometimes noise is interpreted as the first peak)

Elevation @ Focus-Z [µm]
Read-only parameter, which should show half of the sensor range.

Calibration
Parameters for the sensor calibration.
Dark Calibration
This button starts the dark calibration. Make sure that the light of the CCS is blocked before starting.

Spectrograph

For each spectrometer connected to the alphaControl one Spectrograph X parameter group will be available. The parameters described in the following provide access to the full functionality of the spectrometer including its calibration.
Further information (Operation Guide):
- Raman
- Spectrograph Calibration
- Change Laser wavelength



Grating
The grating parameter allows the selection of the gating used for spectrometry. The gratings listed in the the pull down menu depend on the individual configuration but generally have the form
[Turret number : Groove density Blaze wavelength] and an example typical for the UHTS would be
G1 : 600 g/mm BLZ=500nm.

Laser Wavelength [nm]
This parameter should contain the wavelength of the laser used for the spectral measurements. It is read-only and defined by the selected laser in the video control window.

Center Wavelength [nm]
The wavelength hitting the center of the CCD chip can be adjusted using this parameter. This wavelength will then also be the central wavelength in the spectra displayed in the software. To change the central wavelength, the software calculates the necessary rotation of the grating selected.

Spectral Center
The spectral center is identical to the center wavelength. The only difference is that the units this central position is described by are variable and adjustable using the Spectral Unit parameter (see below).

Spectral Unit
The spectral unit controls the display of the numerical value in the spectral center parameter field. If the spectral unit is changed, the entry in the spectral center parameter field will be changed accordingly. Additionally any change in the spectral unit will also change the X axis and thus the display of the hardware spectrum currently recorded. Any measurement started after changing this parameter will also use the units set with this parameter. The units available are:

- nm
- µm
- 1/cm
- rel. 1/cm
- eV
- meV
- rel. eV
- rel. meV

Listen
The Listen parameter allows the selection of a new spectral center using any spectrum. The grating will be moved so that the position clicked on in the spectrum will be the new central wavelength.

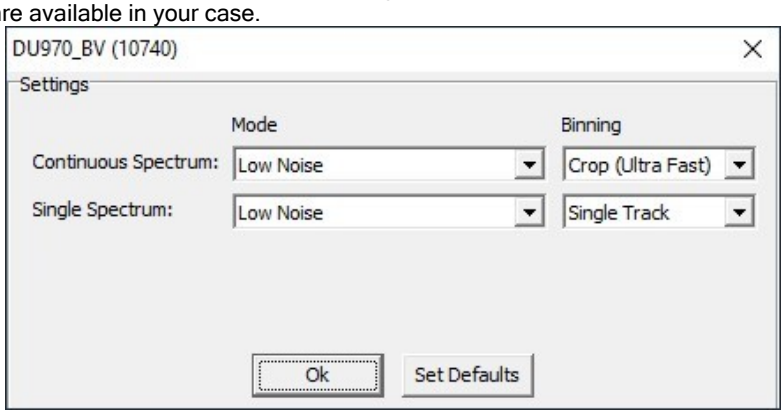
Spec Camera

For each spectral camera connected to the computer, one Spec Camera X parameter group will be available. For temperature settings and status please refer to the Service Monitor. The options enable to change readout and binning of the CCD camera.

Further information (Operation Guide):

- Camera configuration (Service monitor)
- Raman
- EMCCD
- InGaAs camera

Options
Pressing this button, open the spectral camera options dialog. The available options depend on the camera model, so maybe not all options are available in your case.



Continuous Spectrum
The settings apply to continuous spectra acquisition used for oscilloscope, fast time series, image scan and continuous modes of the large area scan.
For longer integration times > 400 ms Single Track can be used as Binning setting to reduce the number of cosmic ray events and the amount of dark current, but will result in a slightly lower signal. For integration times > 1 s Single Track is the recommended setting.
Single Spectrum
The settings apply to e.g. single spectrum, line scan and stepwise raster mode of the large area scan. For these modes speed is less important.

Mode
The mode defines readout speed and dynamic range of the camera.
Low Noise
This setting is optimized for low noise, but can limit the readout speed for very short integrations times.
High Dynamic Range
This setting offers more dynamic range for measuring higher intensities without saturating the camera.
High Dynamic Range (Fast)
This setting offers more dynamic range and also a higher readout speed.
Electron Multiplying
This setting is only available for EMCCDs. For this setting a low signal without background is required. The low signal is then amplified over the readout noise. For longer integration times thermal noise becomes significant over the readout noise and the benefit of the amplification is lost.
Binning
Binning defines the readout of the CCD chip.
Crop (Ultra Fast)
Only a small part of the CCD area is read, but the rest of the CCD is not cleaned. This is the fastest mode and reduces clock-induced charges.
Single Track
Only several lines of the CCD are used for the spectrum, the rest is discarded. This mode collects the least cosmic ray events and has less dark current. The slower readout can result in a lower signal intensity for short integration times.
FVB
For Full Vertical Binning (FVB) the whole CCD chip is binned to one line. This mode is faster than Single Track, but collects more cosmic ray events and more dark current.
None
For line cameras only. No binning possible.
Set Defaults
Sets the default settings for all measurement modes.

The following parameters are available for InGaAs cameras only.

⊟ Offset Calibration	Start
Number of Accumul	100
Enable Calibration	No
⊟ Intensity Calibration	Start
Number of Accumul	10
Enable Calibration	No
⊟ Dark Current Calibratio	Start
Max Integration Tim	0.10000
Number of Intervals	5
Number of Accumul	5
Enable Calibration	No

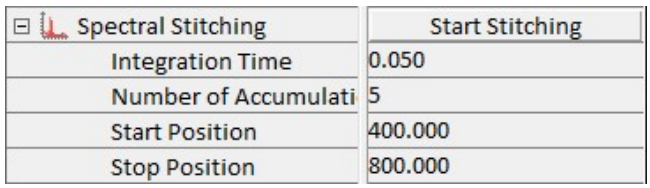
Offset Calibration
The calibration routine measures a series of spectra (accumulations adjustable by the user) with 0 s integration time and no light falling on the detector. If enabled, all measured spectra are now subtracted by the average spectrum of the acquired series. In order to get only positive values an offset of 2000 is added. Existing Intensity and dark current calibration are now invalid and therefore disabled automatically.
Intensity Calibration
In order to calibrate the gain of each pixel, a spectrum with a smooth distribution is needed. The gain of each pixel is calculated by the average intensity of its neighbor pixels. At the beginning of the algorithm an integration time is searched that gives a maximum signal of 50000. Now at 10 different integration times a series of spectra (accumulations adjustable by the user) is acquired. From this data a gain lookup table is calculated. An existing dark current calibration is now invalid and therefore disabled by the software.
Dark Current Calibration
The dark current calibration routine acquires a sequence of time series at different integration times. The user can change the maximum integration time, the number of time series and the number of accumulations. From this data the dark signal rate is calculated for each pixel. Depending on the current integration time the dark signal is subtracted from the measured spectra. For best results the proposed integration times used for the measurements need to be covered by this calibration.
Start
This button starts the calibration. Only possible for Intensity and Dark Current Calibration, if the offset calibration is valid and on. Make sure no light falls on the camera for Offset and Dark Calibration. The recorded calibration is saved in the internal settings folder.
Number of Accumulations
This parameter describes how many spectra will be accumulated.
Enable Calibration
This parameter turns the respective calibration on and off. It is set automatically to Yes, if the Calibration was successful.
Number of Intervals
The Number of Intervals determines how many different integration time steps are taken between zero and the maximum

integration time.
Max Integration Time
This parameter defines the maximum integration for the Dark Calibration.

Spectral Stitching

This parameter group allows recording of single spectra with an extended spectral range. Therefore the grating is moved to different spectral positions to cover the defined range. The data is combined to one spectrum.
Further information (Operation Guide):

- Raman



Start Stitching
Pressing this button, will start the acquisition using the current parameters.

Integration Time
This parameter defines the integration time at each spectral position.

Number of Accumulations
This parameter describes how many spectra will be accumulated at each spectral position.

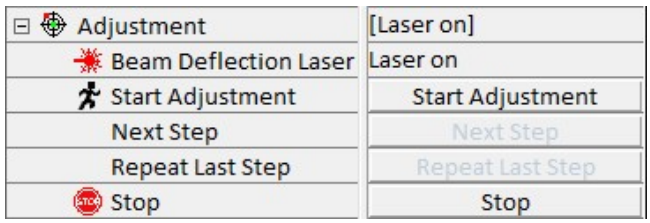
Start Position
Defines the spectral start position of the spectral range for the resulting spectrum in the spectral unit defined in the Spectrograph section.

Stop Position
Defines the spectral end position of the spectral range for the resulting spectrum in the spectral unit defined in the Spectrograph section.

Adjustment

The adjust sequencer offers software assisted step by step alignment procedures for certain measurement modes. It automatically changes the parameters required for the adjustments. If necessary, the sequencer requests user inputs and/or manual adjustments from the user via the messages window, where information about the progress of the adjustment is also displayed. The adjustment can be stopped at any time by pressing any stop button within the software.
Further information (Operation Guide):

- AFM Overview
- AFM Procedure



Beam Deflection Laser
This parameter controls whether the laser is On or Off.

Start Adjustment
Pressing this button will start the adjustment procedure using the current set of parameters.

Next Step
When executing an adjustment this button will become active. After finishing a task given to the user by the sequencer via the message window, this button should be pressed to continue the adjustment.

Repeat Last Step
This button goes back one step and allows repetition of the last task performed during the adjustment.

Adjust Method

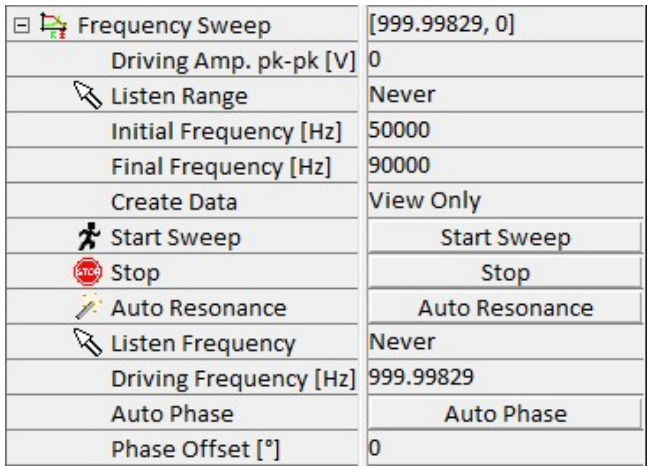
This parameter defines for which method the adjustment will be performed.

Frequency Sweep

The frequency sweep varies the frequency of the output signal of the lock-in amplifier in order to determine the response in amplitude and phase of the detected signal as a function of the excitation frequency. E.g. in AC mode this is used to find the resonance frequency of the cantilever. Amplitude and phase are represented in a graph viewer.

Further information (Operation Guide):

- AFM AC mode
- AFM AC parameters



Start Sweep
This parameter starts the frequency sweep.

Listen **Range**
From the graph which displays the frequency sweep, a frequency range can be selected and the corresponding values will automatically be entered as the initial and final frequency.

Initial Frequency [Hz]
This parameter defines the initial frequency of the frequency sweep.

Final Frequency [Hz]
This parameter defines the end frequency of the frequency sweep.

Divisions
This parameter defines the number of steps between the initial and final frequency.

Create Data
This parameter allows the user to either only view the frequency sweep or to save the frequency sweep as a graph data object in the project manager.

Auto Resonance
This button starts the auto resonance procedure. It automatically determines the resonance frequency of the cantilever for AFM AC Mode. Similar to the frequency sweep, the frequency of the output signal of the lock-in amplifier is varied and the amplitude of the cantilever is measured at every frequency. In this procedure a coarse frequency sweep is performed over a large frequency range (typically from 10 kHz up to 500 kHz). As the maximum amplitude of the cantilever is approached, a second fine frequency sweep is performed to determine the exact resonance frequency.
The graph represented in the graph viewer displays the amplitude and phase variations close to the resonance frequency. The resonance frequency is automatically set as the driving frequency and the phase offset is adjusted to zero.

Initial Start Frequency [Hz]
This parameter sets the initial start frequency for the auto resonance procedure.

Initial End Frequency [Hz]
This parameter sets the initial end frequency for the auto resonance procedure.

Driving Amp. pk-pk [V]
This parameter is used to set the output of the internal oscillator of the lock-in amplifier. This amplitude can be varied from 0-20 V and is used as the drive amplitude.

Listen **Frequency**
With the frequency cursor, the driving frequency can be set by clicking on any graph viewer linked to a frequency.

Driving Frequency [Hz]
This parameter is used to set the driving frequency of the reference oscillator.

Filter Frequency [Hz]
This parameter sets the low pass filter for the PSD outputs of the lock-in amplifier. This filter is implemented as a 3rd order IIR filter.
For AFM AC Mode measurements the default setting of this filter is $\frac{1}{10}^{th}$ of the driving frequency.

Phase Offset [°]
The measured phase can be shifted with this parameter.

Auto Phase
This button sets the phase offset in a way that the current measured phase becomes zero.

Feedback settings

The feedback settings allow access to the parameters used in conjunction with the PI control of the scan table Z axis.
Further information (Operation Guide):

- AFM Overview
- AFM Procedure

Feedback Settings	[1.5, 5, 5]
Setpoint [V]	1.5
P-Gain [%]	5
I-Gain [%]	5
PI Controlled Channel	LockIn R

Setpoint [V]
The setpoint voltage can be adjusted from -10V to +10V and is compared to the voltage measured from the PI Controlled Channel (see below).

P-Gain [%]
This parameter allows the increase or decrease of the proportional gain of the PI controller from 0 % to 100 %. It might be necessary to adjust this value to avoid oscillations due to the natural frequency of the cantilever or oscillations induced by the sample.

I-Gain [%]
This parameter allows the increase or decrease of the integral gain of the PI controller from 0 % to 100 %. It might be necessary to adjust this value to avoid oscillations due to the natural frequency of the cantilever or oscillations induced by the sample.

PI Controlled Channel
With this parameter, the channel which is compared to the setpoint can be selected. The following options are available for selection:
Top-Bottom
This signal is the difference between the electrical signal received from the top and the bottom halves of the four quadrant diode. This is the typical setting for AFM and SNOM contact measurements.
LockIn R
LockIn R is the amplitude recorded through the Lock-In amplifier. This channel is typically selected if the measurement mode is AFM AC.
Fmax
In this selection the maximum force, as determined from the peak of the pulsed force curve in DPFM, is used as the controlled variable.
off
No channel is used as an input and the PI controller is off.
Aux1
The signal read from the Aux1 input is used as the controlled variable.
Aux2
The signal read from the Aux2 input is used as the controlled variable.
Z-sensor
Using this signal, the capacitive sensor in Z direction of the scan table is used as an input and the system then acts as an active feedback controller for the Z position of the scan table.

Inverted
This variable allows the inversion of the control deviation signal. This is due to the fact that in AFM contact mode the scan table should retract if the signal is too high whereas it should move up in AFM AC mode.

HV Amp Active
During AFM measurements, the regulation of the bending of the cantilever can be achieved in two different ways. Either

the Z axis of the scan table is used or a cantilever arm with a piezo positioning element. If such a cantilever arm is used, a high voltage signal needs to be provided to the piezo. The HV Amp Active can therefore be activated (setting YES) or not (setting NO). The signal is then automatically amplified and directed to the respective hardware.
If the regulation using the cantilever with the positioning element is used, the topography readout of the scan table will not show the topography since the Z position of the table will be held constant during those measurements. Instead the feedback signal recorded can be used to derive the topography from it.

Output Limitation Active
This parameter is generally set to Yes to protect the controlling card of the scan table. This is necessary because the output of the alphaControl is ±10V which exceeds the maximum range of the controlling card of the scan table.

Output Limitation Range
Here a multiplicative factor is entered (typically 0.65) which if multiplied with the voltage output range of the alphaControl (20V) results in the correct range of the controlling card of the scan table (13V). The minimum and maximum values are 0 and 1 respectively.

Output Limitation Offset
A multiplicative factor for the offset of the signal in the range from -1 to +1 can be entered as the output limitation offset. Multiplying this factor with the positive voltage range of the controller (+10V) results in the offset necessary for the electronics of the scan table.

PFM Control

The PFM control parameter group contains the additional control parameter required for the acquisition of DPFM images.
Further information (Operation Guide):

- AFM DPFM
- AFM DPFM parameters

PFM Control	[Off, 1000]
Data Sampling	[Both]
Bandwidth Limited	Both
Max. MB/s	2.00
Max. pts/period	1000
Modulation	Off
Driving Amp. pk-pk [V]	0
Driving Frequency [Hz]	1000
Excitation Phase [°]	0
Reference Modulation	0
Listen (F max)	Never
Fmax Window Start	0
Fmax Window Widt	0
Listen (Adhesion)	Never
Adhesion Window S	0
Adhesion Window V	0
Listen (Stiffness)	Never
Stiffness Window St	0
Stiffness Window W	0

Modulation
This binary variable either turns the modulation of the cantilever On or Off.

Driving Amp. pk-pk [V]
The peak to peak voltage of the sinusoidal modulation of the cantilever can be entered as a value between 0 and 20V.

Driving Frequency [Hz]
The frequency of the cantilever oscillation can be entered as a value between 1 and 10000Hz.

Excitation Phase [°]
The excitation phase can be adjusted in order to ensure that the pulsed force curve will be displayed in the graph window in the standard way with the snap-in near the left hand side of the window, then the force increasing to the maximum force, followed by the decrease of the force up to the maximum adhesion and the free oscillation after the snap-out as shown in Fig. 1
.
Reference Modulation Phase [°]
The reference modulation phase can be adjusted to ensure that the sinusoidal reference modulation signal displays a

minimum where the DPFM curve displays a maximum. This is necessary for the proper representation of the pulsed force curves as force-distance curves.

Listen **(Fmax/Adhesion/Stiffness)**
The listen parameter allows the selection of the angular range for the determination of the maximum force/adhesion/stiffness from the displayed DPFM curve by mouse.
Fmax/Adhesion/Stiffness Window Start [°]
The start of the region in the DPFM curve where the hardware will search for the maximum force or determine the adhesion/stiffness can be defined from 0 to 360° using this parameter.
Fmax/Adhesion/Stiffness Window Width [°]
The width of the region in the DPFM curve where the hardware will search for the maximum force or determine the adhesion/stiffness can be defined from 0 to 360° using this parameter.

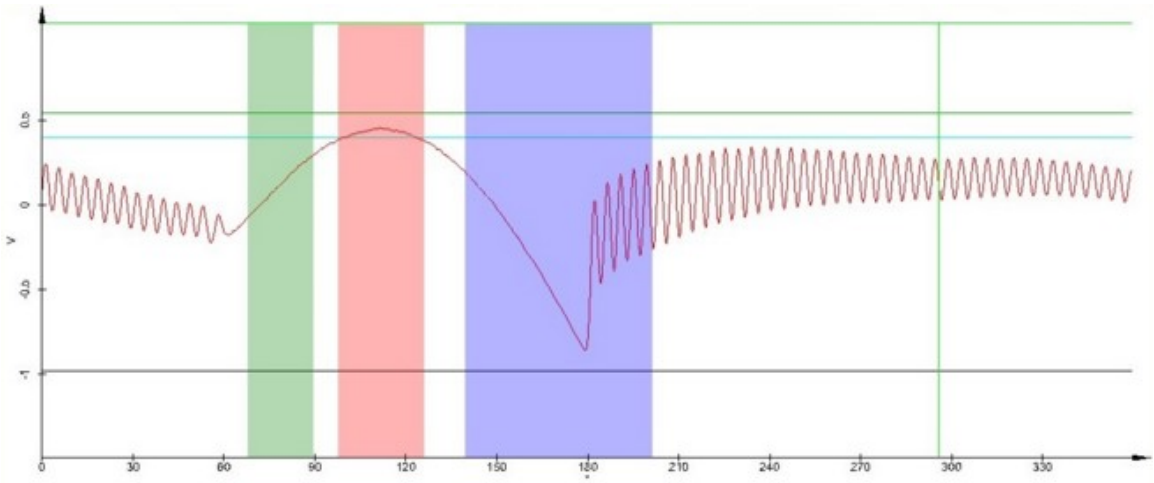


Fig. 1: The typical PFM curve with the search regions marked. (Green = Stiffness; Red = Fmax; Blue = Adhesion)

EFM Control

The EFM control parameter group enables to provide a voltage on a output of the alphaControl. This can be used for Electric Force Microscopy (EFM), to supply the cantilever tip with a voltage, or for other purpose.
Further information (Operation Guide):

- EFM Overview

EFM Control	
EFM Output	Disabled
DC Component [V]	0.000
Signal to Output	DC Only
Output DAC	Dither DAC

EFM Output
Enables or disables the output.

DC Component [V]
Adjusts the voltage supplied at the output, from -10 V to 10 V.

Signal to Output
Defines the type of voltage.
DC Only
A DC voltage is supplied. This is used in normal case.
AC Only
An AC voltage is supplied.

Output DAC
This parameter defines which output should be used.
Dither DAC
The Dither Ouput is in normal case used for the oscillation of the cantilever in AC mode.
Aux1 DAC
This is an axillary output which is used i.e. for EFM.

Kelvin Probe Control

The Kelvin Probe Control parameter group contains the advanced parameters for Kelvin Probe Force Microscopy (KPFM). The following values are initialized with default values when starting the measurement, but can be adjusted during the measurement:

Further information (Operation Guide):

- KPFM Overview

Kelvin Probe Control	[0, 0.000, 0]
VDC Driving Amp. pk-p	0
VDC Offset	0.000
VDC Driving Frequency	100
Listen (T-Bmin)	Never
T-Bmin Window Start [	120
T-Bmin Window Width	180
VAC Driving Amp. pk-p	0
Filter Frequency [Hz]	99.999832

VDC Driving Amp. pk-pk [V]
The modulation amplitude of VDC in V, which defines the voltage range for the minimum search.

VDC Offset
An Offset for VDC in V, which shifts the voltage range for the minimum search.

VDC Driving Frequency [Hz]
The Modulation frequency of VDC in Hz, which defines the search speed. **The time per pixel should be adjusted dependent on this value, i.e. 10 ms/pixel for 100 Hz.**

Listen **(T-Bmin)**
Enables the definition of the T-Bmin search window by mouse. The T-Bmin search window defines the search range for the minimum T-B signal along the x-axis.

T-Bmin Window Start [°]
Defines the starting point of the T-Bmin search window.

T-Bmin Window Width [°]
Defines the width of the T-Bmin search window.

VAC Driving Amp. pk-pk [V]
The modulation amplitude of VAC in V. The sum of VAC Driving Amp., VDC Driving Amp. and the absolute value of VDC Offset must be smaller or equal to 20 V.

Filter Frequency [Hz]
This parameter defines the amount of averaging of the T-B amplitude for the minimum search. A smaller value results in a smoother curve, but also in a greater offset between the real position of the minimum and the measured position of the minimum.

Piezoresponse Control

The Piezoresponse Control parameter group contains the parameters required for the Piezoresponse Force microscopy (PRFM).

Further information (Operation Guide):

- PRFM Overview

Piezoresponse Control	[0, 999.99829]
Driving Amp. pk-pk [V]	0
Driving Frequency [Hz]	999.99829
Filter Frequency [Hz]	3
Phase Offset [°]	0

Driving Amp. pk-pk [V]
The modulation amplitude applied to the tip in V.

Driving Frequency [Hz]
The modulation frequency applied to the tip in Hz.

Filter Frequency [Hz]
This parameter defines the amount of averaging on the measured signal. A smaller value delivers smoother results, but also makes edges less sharp.

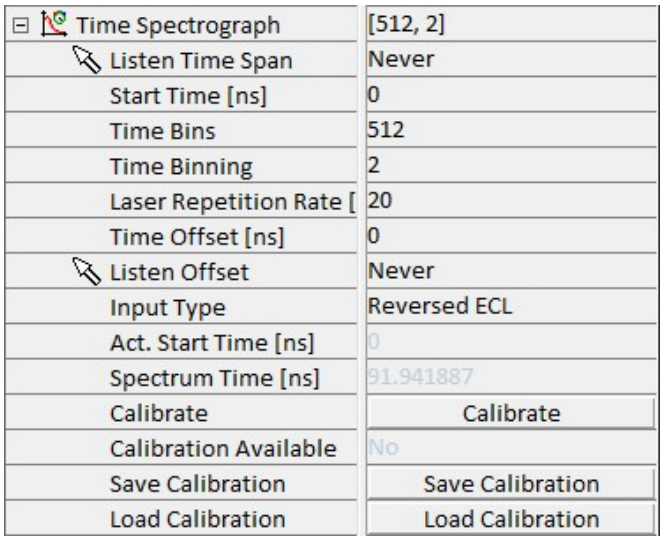
Phase Offset [°]
This parameter defines the phase offset.

Time Spectrograph

The Time Spectrograph parameter group contains the parameters required for the time-resolved spectroscopy.

Further information (Operation Guide):

- StrobeLock



Listen Time Span
If this is activated, the time span can be selected by mouse in a time spectrum.

Start Time [ns]
This parameter shifts the time spectrum to the left.

Time Bins
This parameter defines how many time bins are recorded per spectrum. One bin is the smallest time difference the controller can detect, which is slightly below 30 ps.

Time Binning
This parameter is used to combine selected number of bins into one pixel on the time axis. Higher values improve the signal-to-noise ratio, but reduce the resolution.

Laser Repetition Rate [MHz]
The Laser Repetition Rate parameter has to exactly match the repetition rate of the excitation laser.

Time Offset [ns]
Time Offset can be used to shift the x-axis until the time 0 corresponds to the real starting time marked by the steep increase at the beginning of a typical time-spectrum.

Listen Offset
If this is activated, the offset can be selected by mouse in a time spectrum.

Input Type
ECL
Not recommended. Uses the NIM inputs of the TDC card. The laser pulse acts as Start signal, the APD acts as Stop signal.
TTL
Only for testing. Uses the TTL inputs of the TDC card. The laser pulse acts as Start signal, the APD acts as Stop signal.
Reversed ECL
This is the default setting. Uses the NIM inputs of the TDC card. The APD acts as Start signal and the laser pulse as Stop signal.
Reversed TTL
Only for testing. Uses the TTL inputs of the TDC card. The APD acts as Start signal and the laser pulse as Stop signal.

Act. Start Time [ns]

Shows the currently used Start Time.

Spectrum Time [ns]
Shows the current timespan of one spectrum.

Calibrate
Starts the calibration process..

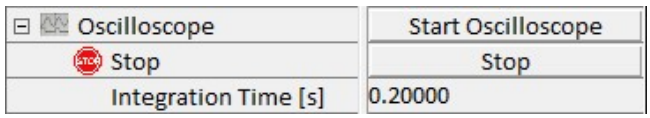
Calibration Available
Shows whether a calibration is available.

Save Calibration
Saves the current calibration to a file.

Load Calibration
Loads a previously recorded calibration.

Oscilloscope

The oscilloscope sequencer allows the user to display measured values in a similar way as is done through an oscilloscope. The measured values which are displayed are set by the configurations.
If single value signals such as the counter output of a photomultiplier are displayed, the signal will be integrated for the set time and the recorded value will then be displayed. The currently displayed values will shift to the left in the oscilloscope window with each new value recorded and the total time displayed is adjustable as well. If the recorded signal is a spectrum, the CCD camera will integrate the signal for the set amount of time and then refresh the entire oscilloscope window using the new spectrum. The following parameters are adjustable within the oscilloscope parameter group.



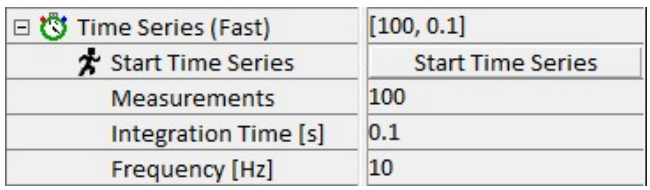
Start Oscilloscope
Pressing this button will start the oscilloscope using the current set of parameters.

Displayed Time [s]
This parameter sets the total time displayed within the oscilloscope window.

Integration Time [s]
This parameter sets the integration time per point measured. This is the counting time for a photon counting device or the integration time in the cases where spectra are recorded.

Time Series (Fast)

The time series (fast) sequencer allows the acquisition of data sources (e.g. spectra or count rates) at a fixed position as a function of time. In this mode changes to the sample over time can for example be observed. The fast time series was developed for maximum speed and therefore does not allow pauses between the measurements. The following parameters can be adjusted to control the time series:



Start Time Series
Pressing this button will start the time series using the current set of parameters.

Measurements
This parameter determines how many measurements will be performed. It can be adjusted between 1 and 217 (=131072).

Integration Time [s]
Using this parameter, the integration time per measurement can be set between 0.1 ms and 10 s. Changes to this parameter will automatically also change the frequency parameter. If the integration time entered is shorter than the fastest possible by the device (e.g. the CCD camera), the time will automatically set to the fastest possible by the device.

Frequency [Hz]
Using this parameter, the frequency of the measurements can be set between 0.1 Hz and 10 kHz. Changes to this

parameter will automatically also change the integration time parameter. If the frequency entered is higher than the highest possible by the device (e.g. the CCD camera), the frequency will automatically set to the highest possible by the device.

Single Spectrum

This parameter group allows recording of single spectra using a CCD camera connected to the system. A single spectrum acquisition stores only one spectrum. This spectrum can be an accumulation of several spectra, which can either be added or the average spectrum can be calculated. The single spectrum acquisition is controlled by the following parameters:

Single Spectrum	[10, 0.500]
Acc. Single Spectrum	Acc. Single Spectrum
Stop	Stop
Integration Time [s]	0.500
Accumulations	10
Infinite Accumulation	No

Acc. Single Spectrum
Pressing this button, will start the acquisition using the current set of parameters.

Accumulations
This parameter describes how many spectra will be accumulated using the integration time for each of them.

Integration Time [s]
This parameter defines the integration time for one spectrum. The minimum and maximum integration times depend on the CCD camera used.

Infinite Accumulation
If this option is selected (Yes) the CCD camera will continuously record spectra using the integration time and the software will accumulate them until the measurement is interrupted by the user by pressing any of the stop trigger buttons.

Accumulation Mode
Here the mode of accumulation can be switched between accumulate and average. If average is selected, only the average spectra will be displayed whereas if accumulate is selected, the spectra are added and displayed as the sum of all spectra recorded.

Distance Curve

Distance curves are used to study phenomena which occur at a defined sample position if a probe is approached to and retracted from the sample by using the z-scan of the scan table. The probe can be for instance a cantilever tip in AFM and SNOM measurements, where the tip-sample interactions are examined. In these experiments the cantilever tip is approached to and retracted from the sample. The recorded signals as a function of distance are:

- the T-B signal of the beam deflection system if the AFM is operated in contact mode. The resulting curve displayed in the graph viewer is a force-distance curve.
- the variation of the amplitude if the AFM is operated in AC mode. The resulting curve displayed in the graph viewer is an amplitude-distance curve.

Typically, distance curves are recorded when the tip is already in contact with the sample and its position is controlled by the feedback loop. In addition to studies of tip-sample interactions, the probe can also be a light source, in which case the light intensity is recorded as a function of distance from the sample. The parameters required to measure a force-distance curve are listed below.

Further information (Operation Guide):

- AFM Overview

Distance Curve	[1000, 0.3, 0.05]
Start	Start
Stop	Stop
Pull [µm]	0.3
Push [µm]	0.05
Speed [µm/s]	1
Start Position	Current
Absolute Start Position	0
Sample Points	1000

Start

This parameter starts the distance curve.

Sample Points
This parameter defines the number of points recorded in a distance curve.

Pull [µm]
This parameter defines the distance the probe will be lifted off the sample before and after recording a distance curve.

Push [µm]
This parameter defines the distance the probe will be moved downwards into the sample. As reference for the downwards movement is the start position (see below).

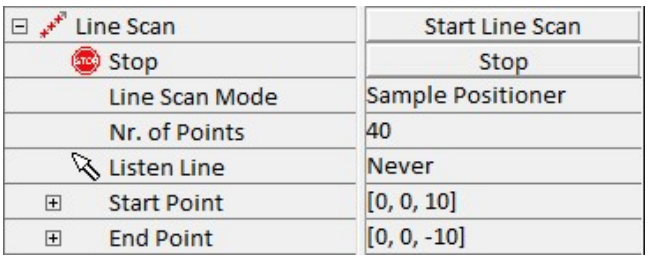
Speed [µm/s]
This parameter defines the speed of movement in the z-direction of the scan table during the complete distance curve.

Start Position
This parameter defines the reference point within the internal coordinate system for the pull and push parameters described above. This parameter can either be set to current or absolute. If absolute is chosen, the Absolute Start Position parameter (see below) is used as the start position.

Absolute Start Position [µm]
This parameter defines the start position in terms of the absolute position along the z-axis of the scan table.

Line Scan

The line scan parameter group allows the adjustment of all parameters necessary for the collection of data along a definable straight line. It allows the collection of single spectra or distance curves along the line. Adjust the parameters for either of them in the respective section. The behavior of the line scan can be defined using the following parameters.



Start Line Scan
Pressing this button starts the line scan and the data acquisition using the parameters currently entered.

Line Scan Mode
Scan Table
This mode uses the piezo stage for the movement.
Sample Positioner
This mode uses the motorized stage for the movement.
Sample Pos. + Topo. Cor.
This mode uses the motorized stage for the movement in combination with a recorded topography for the z position. Refer to Topography Correction.

Nr. of Points
This parameter defines the number of equidistant points at which measurements will be performed along the line.

Listen **Line**
With this a line can be drawn on the images and the start and end points of this line are then used as the start and end points of the line scan. The respective coordinates will automatically be entered as the corresponding position parameters.

Start Point
This parameter group contains the parameters for the three coordinates X, Y and Z (in µm) of the starting point for the line scan. Note that the scan table performs the line scan.

End Point
This parameter group contains the parameters for the three coordinates X, Y and Z (in µm) of the end point for the line scan.

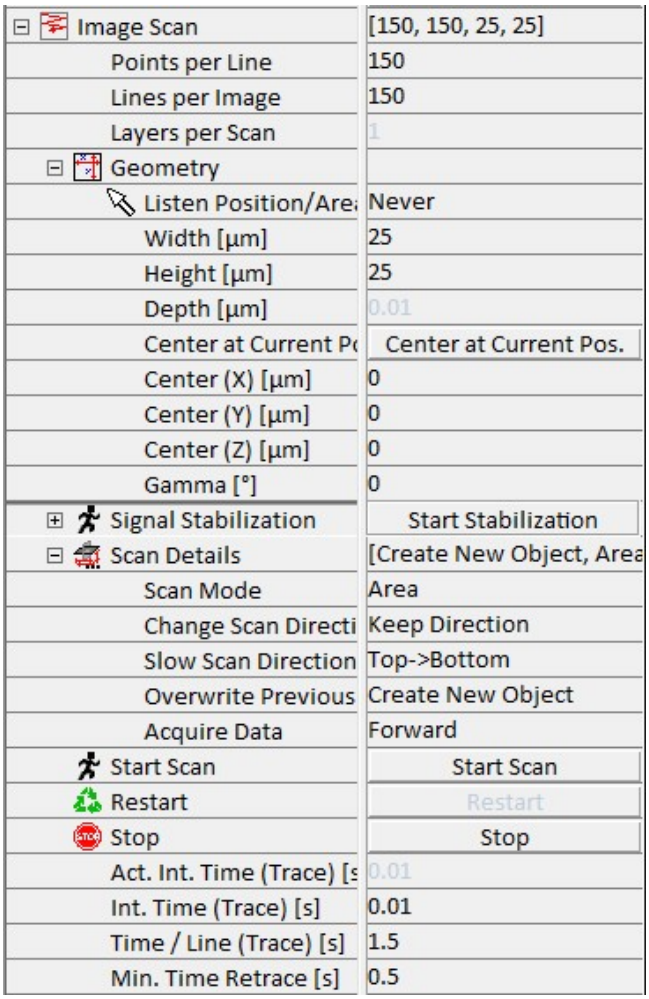
At Every Point
Here the user can define which actions should be performed at every point. Distance Curve and Single Spectrum can be selected (Yes or No selection). If any of these are selected, the parameter values set in the corresponding parameter groups are used for the respective task. If both of the tasks are selected they will be performed sequentially.

Image Scan

In the Image Scan parameter group, all parameters necessary for the capture of a two or three dimensional data set can be defined. Parameters such as the geometry of the scan or the scan speed can be adjusted in this parameter group.

Further information (Operation Guide):

- AFM Overview
- Raman Image scan
- SNOM Overview



Start Scan

Pressing this button starts the scan and the data acquisition using the parameters currently entered.

Restart

This trigger button causes the scan to restart using the parameters currently entered.
WITec Control allows most parameters within the image scan parameter group to be changed during the scan. This allows optimization of the scan parameters while scanning.
The data of the currently collected data set will be lost.

Points per Line

This parameter allows the user to change the number of pixels, data points or spectra per line.

Lines per Image

Lines per image allows the user to select the number of lines scanned inside the selected scan area (see below).

Layers per Scan

This parameter defines how many layers are recorded in a stack scan (confocal mode only). It does not have an effect on other modes.

Geometry

The geometry parameter group allows the selection of the desired scan area where the coordinates are given in the internal coordinate system (see Fig. 3.2). Since the scan table performs the movement, the selectable geometry is limited by the scan range of the scan table. The following parameters can be adjusted:

Listen **Position/Area**
Upon clicking onto a position in an image, the position clicked will be marked as the new center position for the scan or it allows the selection of the desired scan area or a line for a depth scan.
Width [µm]
The width sets the size of the box scan. It is always the size of the fast scan direction (length of one line).
Height [µm]
The height is always the size of the slow scan direction (height of the rectangular) of the box scan. This parameter will not have any effect if a depth scan is performed.
Depth [µm]
The depth parameter is used not only in conjunction with the width for depth scans, but also in conjunction with both width and height for stack scans. In depth scans, it is the dimension of the slow scan direction and in stack scans, the distance from the uppermost to the lowest stack scanned.
Center at Current Pos.
Clicking this button causes the current coordinates within the internal coordinate system to be copied into the respective fields for the center position of the scan.
Center (X/Y/Z) [µm]
The X, Y and Z coordinate of the central position about which the scan will be performed.
Alpha [°]
Alpha identifies the rotation of the scan area about the X axis and is measured relative to the Y axis.
Beta [°]
Beta identifies the rotation of the scan area about the Y axis and is measured relative to the X axis.
Gamma [°]
Gamma identifies the rotation of the scan area about the Z axis and is measured relative to the X axis.
Entering a positive value for one of the angles will rotate the scan in the mathematically positive direction. Since, however, the recording device (e.g. AFM tip) remains stationary, the resulting image will appear rotated in the mathematically negative direction. For the determination of the position of the scan area when using a rotated scan, the rotation about the X axis is applied first. Then the rotation about the Y axis is performed relative to the rotated plane. Last, the rotation about Z is applied which is again performed within the rotated/tilted plane.

Signal Stabilization
Please refer to the Signal Stabilization section.

Scan Mode
Using this parameter, the scan mode can be selected from the following options.
Area
Using this selection a single scan is performed on the plane defined through the angles Alpha, Beta and Gamma (typically the X-Y plane if Alpha = Beta = 0◦) using the width and height entered. The scan table will remain in the final position of the scan upon completion.
Area Loop
In this mode the scan will be performed as in the single setting. However, it will automatically be repeated upon completion using the exact same settings. Change Scan Direction and Overwrite Previous (see below) are additional parameters defining the behavior of this scan mode.
Depth
Using this selection, a single depth scan is performed perpendicular to the plane defined through the angles Alpha, Beta and Gamma (typically the X-Z plane if Alpha = Gamma = 0◦) using the width and depth entered. The scan table will remain in the final position of the scan upon completion.
Depth Loop
In this mode the scan will be performed as in the depth setting. However, it will automatically be repeated upon completion using the exact same settings. Change Scan Direction and Overwrite Previous (see below) are additional parameters defining the behavior of this scan mode.
Stack
A stack scan is a collection of single scans which are performed at different depths. The number of scans performed depends on the Layers per Scan parameter and the different depth levels on the combination of Layers per Scan and the Depth parameters. The individual scans are labeled automatically with incremented numbers.

Change Scan Direction
This parameter takes effect for Loop or Stack scans and has the following options:
Keep Direction
In this setting each scan will start in the direction defined by the Slow Scan Direction.
Alternate
This setting will cause the Slow Scan Direction to alternate with each scan. Therefore if a scan, which had started at the upper left hand corner of the scan area, has finished, the next scan will start at the bottom left hand corner.

Slow Scan Direction
This parameter sets the scan direction.

Overwrite Previous
This parameter takes effect for continuous or stack scans and can be set to Create New Object and Overwrite. If Create New Object is selected a new data object will be created for each scan. If the option Overwrite is selected the second scan will overwrite the first one.

Speed Defined By
This parameter can be set to Integration Time or Time per Line. Both of these parameters can be entered and are

described as
[Time per Line] = [Integration Time] * [Points per Line]
Speed Defined By determines which variable will remain unchanged if the Points per Line parameter is changed.

Act. Int. Time (Trace) [s]
Read only value, which shows the adjusted cycle time (integration time + readout time) of the CCD camera after the measurement started.

Int. Time (Trace) [s]
The integration time in the forward scan direction defines the time for one pixel, data point or spectrum. Changing this time will automatically change the Time / Line (Trace) [s] parameter.

Int. Time (Retrace) [s]
The integration time in the backward scan direction also defines the time for one pixel, data point or spectrum. If no data is recorded in this scan direction this time basically defines the backward motion speed of the scan table. Changing this time will automatically change the Time / Line (Retrace) [s] parameter.

Time / Line (Trace) [s]
The time required for one line of the scan in the forward direction can be altered here. Changing this parameter will automatically change the Int. Time (Trace) [s] parameter.

Time / Line (Retrace) [s]
The time required for one line of the scan in the backward direction can be altered here. Changing this parameter will automatically change the Int. Time (Retrace) [s] parameter.
If no data is recorded in the backward direction this time can be shortened significantly. However, if the time is selected too short, the sample might move due to the impact upon turnaround if the sample is not fixed properly.

Min. Time Retrace [s]
This parameter defines the time for one line in the backward direction, if no data is recorded and if its value is smaller than the needed time per line in the forward direction.

Acquire Data
This parameter determines whether or not data is recorded in only the Forward scan direction or in both the Forward and Backward scan directions.

Store PFM Data
If this is activated the DPFM curves (T-B signal) will be saved to a separate file. The software will prompt for the file location after clicking Start Scan.

PFM File Name
Shows the path for saving the DPFM curves.

Pre/Post Pixels
This parameter defines how many pixel triggers will be output before and after each line. This might be necessary if certain external devices are triggered through the alphaControl.

Slow Turnaround [%]
The slow turnaround reduces the impact caused by the change of direction of the scan table. If the slow turnaround is activated the scan table will be accelerated to the final scan speed and slowed down from the final scan speed upon turnaround. The distance taken for this acceleration can be altered with this parameter. The reference used with this percentage is the scan width and half of this distance will be used on each side of the line scanned. WITec Control sets this parameter automatically and it is dependent on the mode of measurement.

Linear Overscan [%]
The linear overscan is an extension of the scan width which is used in combination with the TrueScan mode implemented within the alphaControl. The reference used with this percentage is the scan width and half of this distance will be used on each side of the line scanned. WITec Control sets this parameter automatically and it is dependent on the mode of measurement.

Signal Routing

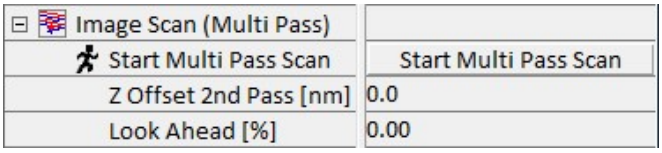
Trig 1/2/3 Out
The Trigger Outputs can be set to Pixel Clock or Line Clock.

Image Scan (Multi Pass)

In the Image Scan (Multi Pass) parameter group, parameters necessary for a two pass lift mode scan can be defined. Parameters such as the geometry of the scan or the scan speed can be adjusted in the Image Scan parameter group. Further information can be found in the Lift Mode and KPFM section of the Operation guide.

Further information (Operation Guide):

- AFM AC Lift mode
- KPFM



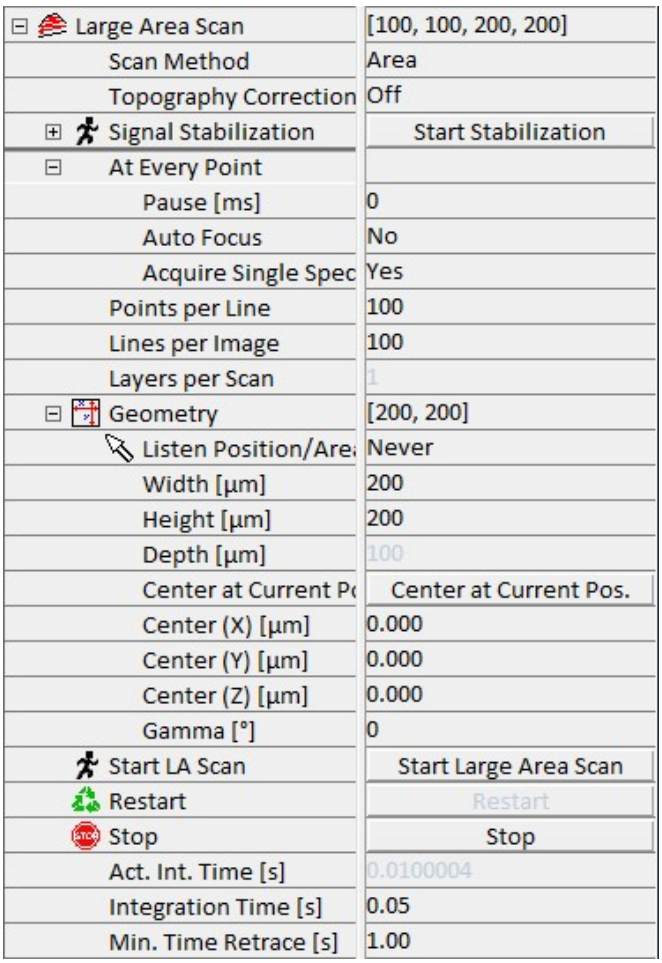
Start Multi Pass Scan
Pressing this button starts the multi pass scan and the data acquisition using the parameters currently entered here and in the Image Scan section.

Z Offset 2nd Pass [nm]
This parameter defines the height of the second pass relative to the topography recorded in the first pass.

Look Ahead [%]
Defines an offset in % between first and second pass along the moving direction.

Large Area Scan

In the Large Area scan parameter group, all parameters necessary for the capture of a two or three dimensional data set can be defined. Parameters such as the geometry of the scan or the scan speed can be adjusted in this parameter group.
Further information (Operation Guide):
- Raman Large Area Scan



Start Large Area Scan
Pressing this button starts the scan and the data acquisition using the parameters currently entered.

Restart
This trigger button causes the scan to restart using the parameters currently entered.
The data of the currently collected data set will be lost.

Points per Line
This parameter allows the user to change the number of pixels, data points or spectra per line.

Lines per Image
Lines per image allows the user to select the number of lines scanned inside the selected scan area (see below).

Layers per Scan
This parameter defines how many layers are recorded in a stack scan (confocal mode only). It does not have an effect on other modes.

Geometry
The geometry parameter group allows the selection of the desired scan area where the coordinates are given in the internal coordinate system (see Fig. 3.2). Since the scan table performs the movement, the selectable geometry is limited by the scan range of the scan table. The following parameters can be adjusted:

Listen **Position/Area**
Upon clicking onto a position in a image, the position clicked will be marked as the new center position for the scan or it allows the selection of the desired scan area or a line for a depth scan.

Width [µm]
The width sets the size of the box scan. It is always the size of the fast scan direction (length of one line).

Height [µm]
The height is always the size of the slow scan direction (height of the rectangular) of the box scan. This parameter will not have any effect if a depth scan is performed.

Depth [µm]
The depth parameter is used not only in conjunction with the width for depth scans, but also in conjunction with both width and height for stack scans. In depth scans, it is the dimension of the slow scan direction and in stack scans, the distance from the uppermost to the lowest stack scanned.

Center at Current Pos.
Clicking this button causes the current coordinates within the internal coordinate system to be copied into the respective fields for the center position of the scan.

Center (X/Y/Z) [µm]
The X, Y and Z coordinate of the central position about which the scan will be performed.

Gamma [°]
Gamma identifies the rotation of the scan area about the Z axis and is measured relative to the X axis.
Entering a positive value for the angles will rotate the scan in the mathematically positive direction. The resulting image will appear rotated in the mathematically negative direction.

Scan Mode
Using this parameter, the scan mode can be selected from the following options.

Stepwise Raster
This mode is an Intermittent area scan. The movement will stop before performing the tasks defined in At Every Point parameter group (see below) and will go to next point afterwards.

Area
Using this selection a scan is performed on the plane defined through the angle Gamma and the width and height entered (typically the X-Y plane). The sample positioner will remain in the final position of the scan upon completion.

Depth
Using this selection, a single depth scan is performed perpendicular to the plane defined through the angle Gamma and the width and depth entered (typically the X-Z plane). The sample positioner will remain in the final position of the scan upon completion.

Stack
A stack scan is a collection of single scans which are performed at different depths. The number of scans performed depends on the Layers per Scan parameter and the different depth levels on the combination of Layers per Scan and the Depth parameters. The individual scans are labeled automatically with incremented numbers.

At Every Point
This parameter group defines the actions performed at every point in the stepwise raster mode.

Pause [ms]
A pause can be defined before performing the next tasks at each point.

Auto Focus
A spectral autofocus can be performed at each point. The parameters can be defined in Auto Focus.

Single Spectrum
If this parameter is set to Yes a single spectrum is performed at each point. The parameters can be defined in Single Spectrum.

Topography Correction
Set this to On to follow a recorded surface in z direction during the scan. The surface can be defined in Topography correction.

Signal Stabilization
Please refer to the Signal Stabilization section.

Act. Int. Time (Trace) [s]
Read only value, which shows the recalculated time per pixel after the measurement started. This can be due to the minimum cycle time (integration time + readout time) of the CCD camera or the topography correction. (Only for continuous modes, not for Stepwise Raster)

Integration Time [s]

The integration time defines the time for one pixel, data point or spectrum. (Only for continuous modes, not for Stepwise Raster)

Min. Time Retrace [s]
This parameter defines the time for one line in the backward direction, if its value is smaller than the needed time per line in the forward direction.

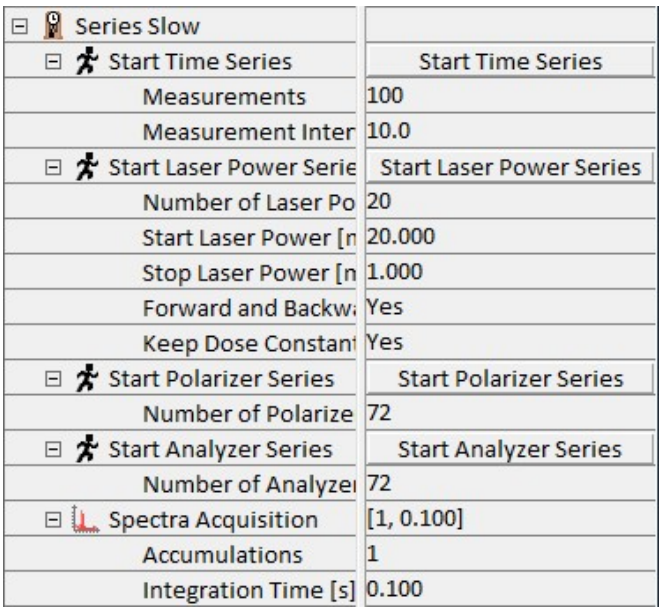
Signal Routing

Trig 1/2/3 Out
The Trigger Outputs can be set to Sampling Clock or Stop & Go Clock.
T1/2/3 Duty Cycle
Sets the duty cycle in percent.
T1/2/3 Idle State
The idle state can be set to Don't Care, Low or High.

Series Slow

The slow series allows intermittent (slow) time series, laser power series, polarizer and analyzer series and externally triggered series including to record user data channels.
Further information (Operation Guide):

- Raman Slow series



Start Time Series
Starts a slow time series.
Measurements
This parameter determines how many measurements will be performed.
Measurements Interval [s]
The measurement interval defines the time between two data points.

Start Laser Power Series
Starts a laser power series. This only available for TruePower lasers.
Number of Laser Power Steps
This parameter determines how many measurements will be performed.
Start Laser Power [mW]
Defines the laser power of the first data point.
Stop Laser Power [mW]
Defines the laser power of the last data point.
Forward and Backward
If yes is selected, the series will run to the stop laser power and then back to the start laser power.
Keep Dose Constant
If yes is selected, the integration time is adjusted to compensate the intensity change of the spectrum due to the change of the laser power. The integration time parameter is defined for the lowest laser power and is therefore the maximum integration time.

Start Polarizer/Analyzer Series
Starts a Polarizer/Analyzer series. This only available for an automated Polarizer/Analyzer.
Number of Polarizer/Analyzer Steps
This parameter determines how many measurements will be performed along a full rotation of the laser polarization or

analyzer.

Spectra Acquisition
The spectral acquisition parameters for all kinds of series.

Accumulations
This parameter describes how many spectra will be accumulated.

Integration Time [s]
This parameter defines the integration time.

Measurement Mode
This parameter determines which mode will be used for the slow time series.

Manual
Each next measurement point is triggered by the Next Measurement Button. This can be used for an external or manual triggered series.

Timed
The series is triggered Measurement Intervall parameter.

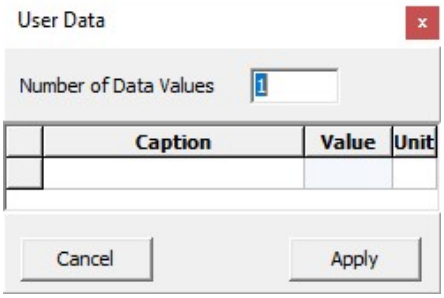
As Fast As Possible
The measurement points are processed subsequently without pause.

Timing Mode
This parameter defines the whether the measurement interval is measured between two Starts or between the Stop and the Start which takes also the time of the measurement itself into account.

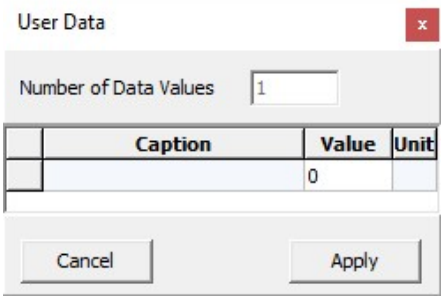
User Data Channels
Enables the definition and data input of data channels defined by the user.

Include User Data
If this is activated, the user data is stored in the project.

Define Data Channels
Clicking this button opens a new window for definition of number of user data channels and their captions and units.



Enter User Data
Clicking this button opens a new window for entering of the values for each data channel for the next measurement.



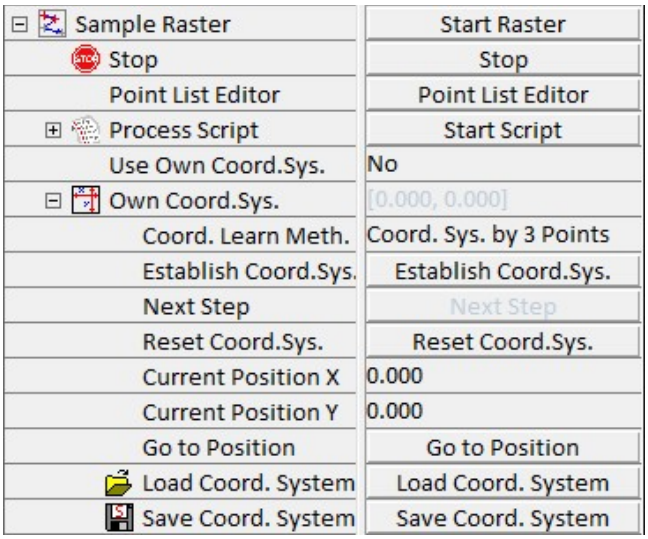
Next Measurement
Triggers the next data point, if Manual is the selected measurement mode.

Index of next Measurement
Read-only parameter which shows the index of the following measurement.

Sample Raster

This parameter group is used in combination with the Point Viewer. In the Point Viewer up to thousand points on the sample can be defined where automated measurements can be performed. The Sample Raster parameter group is used to define the script that should be executed on the defined points. Also, the execution of the raster is started from this parameter group and the Point Viewer can be opened.

Further information (Operation Guide):
- Raman Sample Raster



Start Raster
This trigger button starts the execution of the currently defined raster (= the point list as defined in the Point Viewer).

Point List Editor
This button opens the Point Viewer window. In this window the points of which the raster consists can be defined.

Process Script
Please refer to the Process script section.

Use Own Cood.Sys.
Set this to On to enable the use of the user-defined coordinate system.

Own Cood.Sys.
Enables to use a user-defined coordinate system for the raster.

Process Script

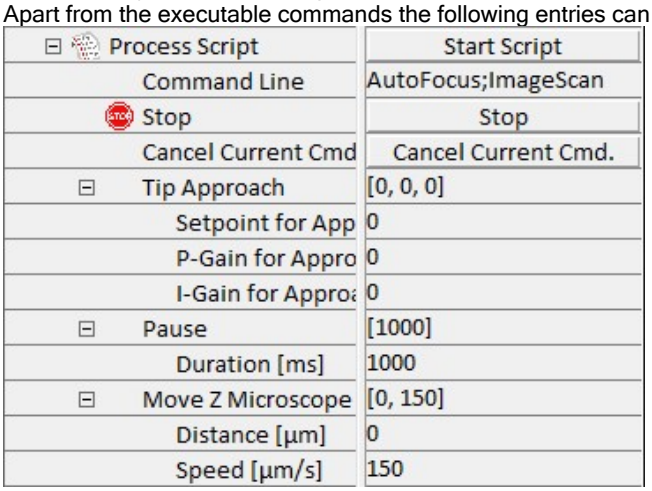
The Process Script parameter group allows the definition of script based command lines for the automatic execution of several consecutive tasks. Each task that can be included in the script is shown in this parameter group. Tasks, which are fully defined in their respective parameter groups (such as Image Scan or Auto Focus) use the parameters set in their respective parameter groups. These tasks will nevertheless be shown in the Process Script parameter group, but without any parameters. Some additional tasks are included in the Process Script parameter group and their parameters can be adjusted herein. Table 1 shows the tasks available and their parameters.

Table 1: The tasks usable in the Process Script sequencer. New parameters are described and the location of the parameters defined in other parameter groups are indicated.

Task Name	Command Line	Parameter	Parameter Description
Pause	pause	Duration [ms]	The duration of the pause at this point
Move Z Microscope	movezmicroscope	Distance [µm]	The distance the microscope Z stage should move (+ = increase; - = decrease in objective- sample distance)
		Speed [µm/s]	The speed of the microscope Z stage during the movement
Auto-Focus	autofocus	Uses the parameters in Auto Focus.	
Tip-Approach	tipapproach	Setpoint for A.	The feedback setpoint used for the Approach
		P-Gain for A.	Feedback gains for the Approach
		I-Gain for A.	
Single Spectrum	singlespectrum	Uses the parameters in Single Spectrum.	
Image Scan	imagescan	Uses the parameters in Image Scan.	
Save Project	saveproject	Uses the parameters in the program options.	

During the execution of one scrip, the parameters remain constant. If, for example, several Move Z Microscope commands are included in the script, all of them will be executed with the same speed and distance.
The script itself can contain the various commands separated by semicolons. An example for a script is given below:
pause ; autofocus ; singlespectrum ; imagescan ; saveproject ; movezmicroscope

In this example, the microscope will first pause for the defined duration before performing the auto focus function. Then a single spectrum will be recorded before an image scan is performed. Following the completion of this image scan, the project will be saved and the microscope will move the defined distance in Z.
Scripts can be executed by pressing the Start Script button (see below) or through a raster as defined in the point editor.
Once the execution of a script is triggered, it is first checked for syntax errors. Should the script contain any error, the execution will not be started and a corresponding message identifying the number of the command where the error occurs will be displayed in the message window. The erroneous command will also be displayed.
Apart from the executable commands the following entries can be found in the Process Script parameter group:



Start Script
Using this button the execution of the script can be started.

Cancel Current Cmd.
This trigger button cancels the current command. The next command in the command line will automatically be executed. In the example of the command line shown above, pressing the Cancel Current Cmd. button while the image scan is executed will cancel this execution and the saveproject function will automatically be executed.

Command Line
The command for the script function as shown in an example above can be entered here.

Command Parameters
This group contains all tasks which can be executed through the script and which have been explained in Table 1.

Using the Save As function in the Configurations menu, the current script as well as all parameters set in the individual parameter groups can be saved for later usage. This would essentially then represent another configuration, based on a standard one, but with the predefined parameters for the script execution.

Point Viewer

The Point Viewer (see Fig. 1) is used to define the points for the use with the sample raster. At the points defined in the point list, the process script sequencer can be executed before the system automatically moves the sample to the next point in the list. The points can be edited manually or imported from .CSV files or SP1 KLARF 1.2 files. Please contact WITec should you require import functions for different file formats.

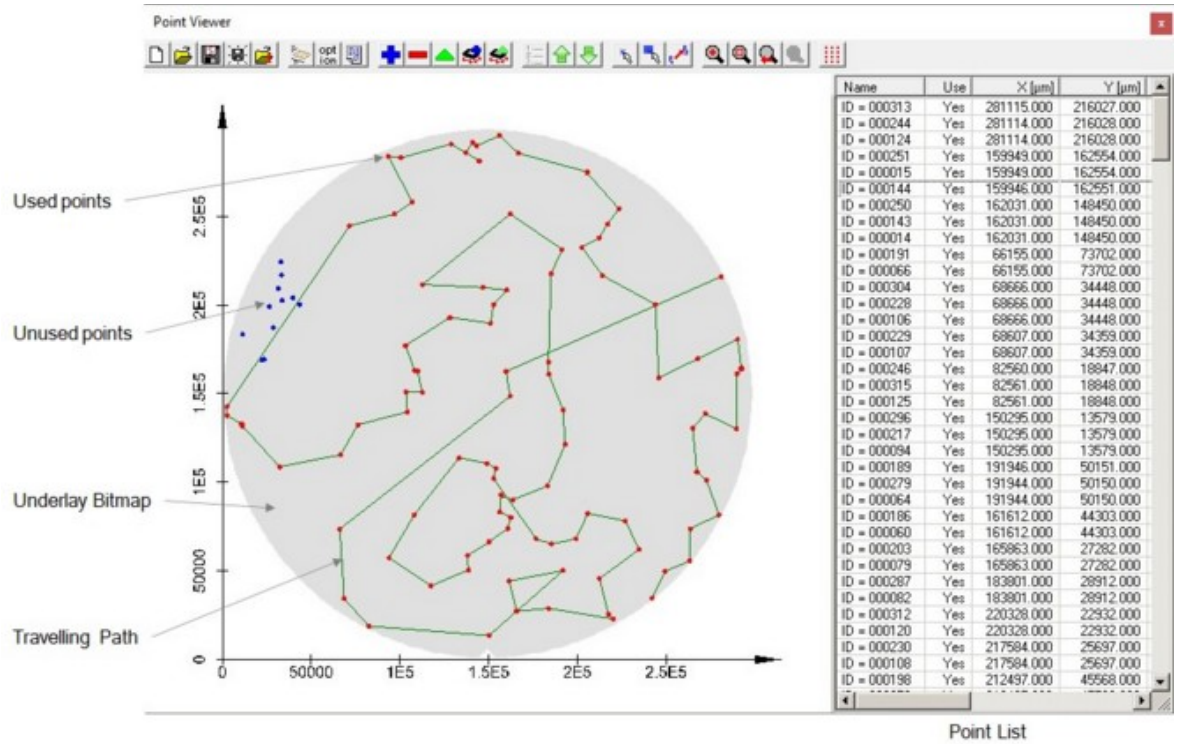


Fig. 1: The Point Viewer window showing the menu bar, the sample area and the point list. Some functions of the window are labeled.

In the following, the menu bar and the functions of the speed buttons will be described before the sample area is outlined. The point list and the context menu will then be described.

Speed Buttons

The following speed buttons are available in the menu bar of the Point Viewer window:

 **New point list**

By pressing this speed button a new point list is created. The existing point list will be deleted.

 **Open Point List**

This function starts the Windows R standard open-dialog for WITec Point List files (*.wpt). Using this dialog, a saved point list can be opened. The saved point list file also contains the bitmap underlay and the sample and bitmap coordinates. Previously opened point lists will be closed.

 **Save Point List**

This menu function allows a Point List to be saved. If it is a new list, the save file as-dialog will be opened.

 **Save Point List As**

This function is similar to the save point list function, while offering the possibility to change the filename.

 **Import SP1 KLARF 1.2 File**

This function allows the import of data saved in the SP1 KLARF 1.2 file format. Previously opened point lists will be closed. The bitmap underlay as well as the sample and bitmap size are defined internally and set automatically for the import filter.

 **Define Sample Size and Underlay Bitmap**

This speed button opens the sample size and bitmap underlay dialogs as shown in Fig. 2.
This dialog can be used to load a bitmap (in .BMP format) which is used as a background in the sample area of the Point Viewer window. The dialog allows the definition of the sample area and the size and position of the bitmap therein. In Fig. 2, a sample area of 200 µm x 200 µm was defined and the bitmap was defined in the upper left-hand corner of the sample area as can be seen in the point viewer in the background of Fig. 2.
The bitmaps should, if possible, be located in the directory C:\ProgramData\WITec\WITec Suite X.X\Configs\WITec Control\PointViewerBackgrounds because this is the standard directory where the bitmaps are searched for.

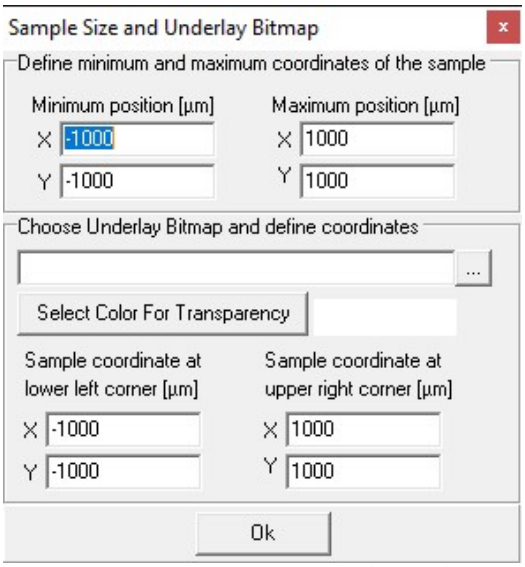


Fig. 2: The Sample Size and Bitmap Underlay dialog window

The following entries can be modified in this window:

Minimum Position [µm] X/Y

The minimum position of the sample within the coordinate system should be entered here. Following a change to the values entered here, the corresponding fields for the bitmap coordinates in the lower left hand corner are changed to the same value.

Maximum Position [µm] X/Y

The maximum position of the sample within the coordinate system should be entered here. Following a change to the values entered here, the corresponding fields for the bitmap coordinates in the upper right hand corner are changed to the same value.

Underlay Bitmap

The file containing the underlying bitmap should be entered here or selected by the ... button.

Select Color for Transparency

This trigger button opens the color selection dialog from which the transparency color for the bitmap can be selected. This color will not be displayed in the sample area. The currently selected color is shown to the right of the trigger button.

Sample coordinate at lower left corner [µm] X/Y

These fields are automatically filled in following a change to the minimum sample position field, but can also be changed manually. The coordinates of the bitmap at the lower left corner can be entered here. See Fig. 2 for an illustration of the effects of the coordinates entered. Here the underlying bitmap is shown at the coordinates as entered in the Define Sample Size and Underlay Bitmap dialog shown.

Sample coordinate at upper right corner [µm] X/Y

These fields are automatically filled in following a change to the maximum sample position field, but can also be changed manually. The coordinates of the bitmap at the upper right corner can be entered here. See Fig. 2 for an illustration of the effects of the coordinates entered. Here the underlying bitmap is shown at the coordinates as entered in the Define Sample Size and Underlay Bitmap dialog shown.

Options

In the options dialog, which is shown in Fig. 3, the export parameters for the export and graphic representation of the point list, as well as for the ASCII export of the list itself, are given.

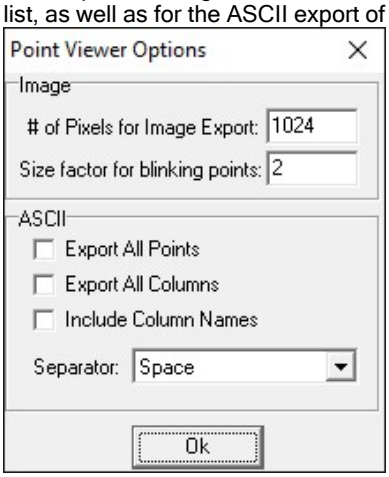


Fig. 3: The options dialog for the point viewer.

For the export of an image representing the points as shown in the sample area, the number of pixels in the larger dimension of the bitmap can be entered. The dimension of the smaller side of the exported image will be determined by the aspect ratio of the current view.

The actual number of pixels may vary due to an automatic crop function, which cuts off excess white borders.

The Size factor for blinking points is the factor by which the points are enlarged and then reduced again when blinking. The blinking in the sample area indicates that the points are selected.

For the export of the point list in ASCII format, the following options are available:

Export All Points
If this check box is selected, all points will be exported regardless of their Usage status (see below). If it is unchecked, only points with the usage set to Yes or Used will be exported.

Export All Colmns
If this checkbox is selected all columns will be exported. Otherwise only those selected through the context menu (see below) are included in the export.

Include Column Names
This selection allows the column names to be included with the exported ASCII file.

Separator
The following separators for the ASCII export are selectable:

- Space
- Tab
- Semicolon

Add Point
This speed button is only active if the point list is not imported from a KLARF file but is defined manually as a four column table. If active, it opens the edit point dialog as shown in Fig. 4.

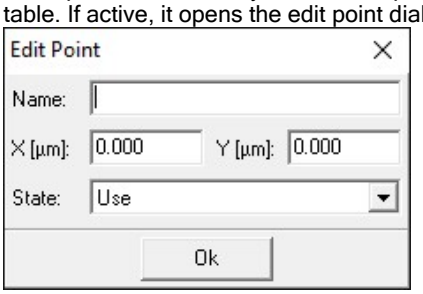


Fig. 4: The edit point dialog.

The name for the point, the X and Y coordinates in µm and the state can be selected here. The states are explained in the context menu section.

Delete Point [Del]
This button is only active if points are selected (highlighted in the point list). Pressing this speed button deletes the selected points.

Edit Point
This button is only active if a single point, which has been defined manually, is selected. Upon activating this speed button, the system opens the edit point dialog as shown in Fig. 4 and described with the Add Point speed button above.

Add Current position to point list
Takes the current position of the sample positioner as new point.

Replace Point by current postition
Replaces the position of the selected point by the current position of the sample positioner.

Sort by order
This button sorts the points in the order that they to be are executed. The display order may be changed by, for example, displaying them sorted by their name, usage or coordinates.
Upon defining the points, or upon opening or importing a point list, the order of the points is defined. Resorting the points by their name, coordinates or usage will only change the appearance of the points and NOT the order in which they are executed. This speed button displays the points again in the order of execution.

Move Selection Up [Ctrl + U]
This button causes the selected points to be moved up in the list. It is only active if the list is displayed in the way it is processed.
This changes the order of execution.

Move Selection Down [Ctrl + D]
This button causes the selected points to be moved down in the list. It is only active if the list is displayed in the way it is processed.
This changes the order of execution.

Select Single Point
If this button is activated, single points from the point list can be selected by clicking on them in the sample area. The selected point will blink in the sample area and will be highlighted in the point list. Holding Ctrl allows the selection of multiple points. Holding Shift causes this point to be deselected. This function will remain active until de-activated (though clicking onto the button again) or until a different mouse function is activated.

Select Multiple Points
If this button is selected, multiple points from the point list can be selected by drawing a rectangle around them in the sample area. The selected points will blink in the sample area and be highlighted in the point list. Holding Ctrl allows the selection of multiple points. Holding Shift causes this point to be deselected. This function will remain active until deactivated (by clicking onto the button again) or until a different mouse function is activated.

Immediately move to selected Point
This button allows the immediate movement of the sample to the selected point. This point will only be active if the sample positioning system is present. Once activated, the system will move the sample to the point selected by the mouse. The

point can either be selected by clicking onto the graphic representation in the sample area or by selecting it from the point list. This function will remain active until deactivated (by clicking onto the button again) or until a different mouse function is activated.

Zoom in

If this button is selected an area for zooming-in can be selected from the sample area. This function will remain active until de-activated (by clicking onto the button again) or until a different mouse function is activated.

Zoom to fit all

Pressing this button causes the entire sample area to be displayed. This is the standard view when defining the underlay bitmap and the sample size as well as after loading new point lists.

Zoom to previous

This button returns to the last zoomed view.

Zoom to next

This button moves one step forward (if available) in the list of zoomed views.

Create Point Array

With this dialog a periodic point distribution can be created.

Create Point Array

Number of Points X	5
Number of Points Y	5
Distance of Points X	200
Distance of Points Y	200
Start Position X	0
Start Position Y	0
Start Position Anchor	Middle - Middle
Horizontal Direction	From left to right
Vertical Direction	From top to bottom
Meander	No
Walking Direction	Horizontal
Overwrite current list	No
Create on Parameter change	No
Create Array	Create Array

Sample Area

The sample area can be seen at the left in Fig. 1. Here the bitmap underlay is shown as well as the points. Additionally, the traveling path of the microscope can be displayed through the context menu (see below).

The visible parts in the sample area are:

Coordinate System

The coordinate system is scaled according to the sample size as defined by the Define Sample Size and Underlay Bitmap dialog (see Fig. 2).

Underlay Bitmap

The bitmap chosen through the Define Sample Size and Underlay Bitmap dialog (see Fig. 2) is displayed at the corresponding coordinates.

Points

The points displayed are either red if set to Yes or Used or blue if set to No.

Selected points blink in the sample area.

Points defined outside the sample area are not displayed.

Traveling Path

The traveling path of the instrument is shown in green, connecting the points in the order they will be processed in. Only points set to Yes are connected.

The traveling path can be optimized through the context menu (see below).

Current Position

The current position of the instrument is indicated by green crosshairs.

Point List

The point list set up is similar to a spreadsheet, with each row representing a point. The number of columns may vary depending on the import filter used. However, manually defined point lists as well as point lists imported from .CSV files have only four columns:

Name | Use | X [µm] | Y [µm]

These columns are also the first four in other imported point lists. The columns displayed can be selected through the context menu (see at the bottom). By clicking on the column headers, the list is sorted by these columns (i.e. by name or usage).

This will not change the order in which the points are handled, but only their representation in the list. Use the Move Selection Up or Move Selection Down speed buttons to change the order in which the points are processed.

If points are selected, they will be marked along the entire row.

Context Menu

The context menu, which can be seen in Fig. 5, can be opened by a right click within the point viewer window.

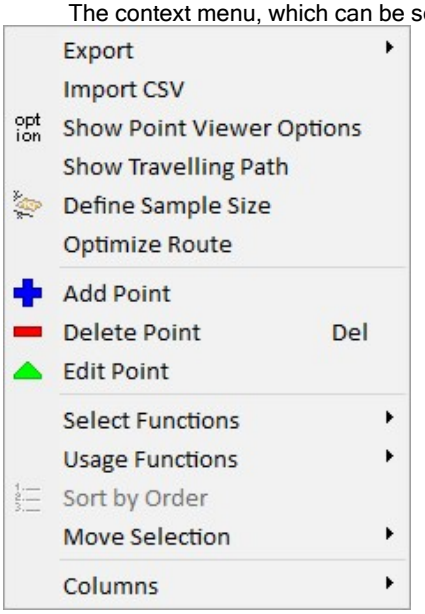


Fig. 5: The Point Viewer context menu.

The commands available through the context menu are:

Export

The export menu point allows the export of the sample area as a bitmap as well as the ASCII export of the point list. The exported bitmap will be copied to the Graphic Export window. The exported ASCII data will be copied to the clipboard, from which it can then be pasted into the desired document. The export functions use the settings set in the options dialog (see above).

Import CSV

Using this menu, comma separated value data (.CSV) can be imported. The data must be a three column CSV file with the first column containing the name of the point, the second the X coordinate in µm and the third the Y coordinate in µm. (The format of the name has to be alphanumerical without spaces and special characters. The X and Y coordinates may have a + or - as a leading sign, a dot as the decimal separator and an optional 'e' or 'E' indicating an exponent followed by a signed integer. The strings may not have a thousands separator.)

The usage state for all points imported is initially set to Yes.

Show point viewer options

This menu point opens the same dialog as the options speed button (see above).

Show Traveling Path

Using this menu entry, the display of the traveling path can be turned on and off.

Define Sample Size

This menu entry opens the Define Sample Size and Underlay Bitmap dialog (see above).

Optimize Route

This menu entry automatically optimizes the traveling route in order to minimize the travel length and thus the traveling time. A window will inform the user about the change in traveling distance due to the reordering of the points.

This procedure is not recommended while performing a measurement because it can require substantial processing power. If the point list contains more than 2000 points the software prompts the user for a confirmation of the task due to the considerable amount of time it might take.

Add Point

This menu point has the same functionality as the Add Point speed button (see above).

Delete Point

This menu point has the same functionality as the Delete Point speed button (see above).

Edit Point

This menu point has the same functionality as the Edit Point speed button (see above).

Select Functions

This menu point allows the selection of all points as well as the inversion of the current selection.

Usage Function

The usage of the currently selected points can be edited here. The possible choices are:

Use

At this point the process script sequencer is executed once the point list is carried out.

Do not use

The system will, upon execution of the raster, ignore this point and the system will not drive to it.

Used

The system automatically sets points with the label Yes to Used once the process script has been executed at this position.

Used -> Use

This function changes all points marked Used in the current selection to Yes.

Points marked No in the current selection are not changed.

Sort by Order

This menu point has the same functionality as the Sort by Order speed button (see above).

Move Selection

This menu entry contains the two entries Move Selection Up and Move Selection Down, which are identical to the

corresponding speed buttons (see above).

Columns

This menu entry contains all columns of the point list. Activating them in this menu entry will show them in the point list editor.

Spectral Auto Focus

The Spectral Auto Focus Component automatically finds the Z-Axis position with the best Raman signal. This is especially useful for automated measurements like in a Process script or in the ParticleScout.

Auto Focus	Start Auto Focus
Mode	Find Peak
Max. Search Range [µm]	100
Center [µm]	0
Step Size Multiplier	1.00000
Min. Integration Time [s]	0.0099999998
Listen Mask	Never
Mask	250;4000

Mode

- Find Peak: finds the maximum total signal with high accuracy
- Find Raman Signal: uses fluorescence subtraction and finds the maximum Raman signal fast

Max. Search Range (Z-Axis Range)

The maximum search range for the Autofocus.

Center

The Autofocus is performed around the center position using half of the Max. Search Range up and down.

Step Size Multiplier

Only used in Autofocus Mode "Find Raman Signal".
Lets you influence the accuracy and speed of the autofocus.
Typical Range: 0.5 - 2.0
A larger value leads to larger steps -> less accuracy -> faster.
The actual step size depends on the objective magnification.

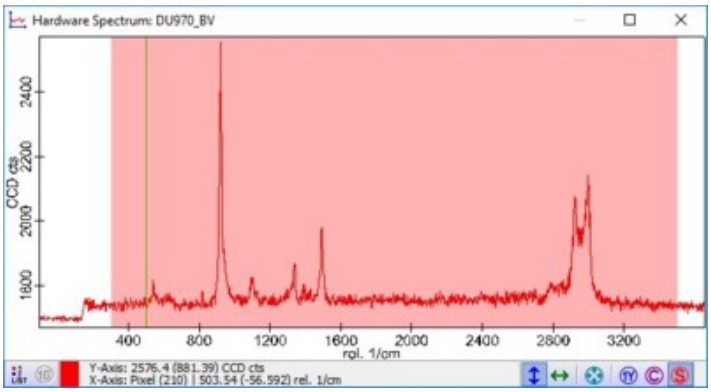
Min. Integration Time

The minimum integration time for each spectrum that is acquired for finding the best focus position.
Can be larger if Z-stage is slower.

Listen Mask

The mask determines which spectral region is used to search the maximum signal.
It is defined using value-pairs separated by semicolon:
"250;300;500;550": The mask is set from 250 to 300 and from 500 to 550.

Preview / Listen



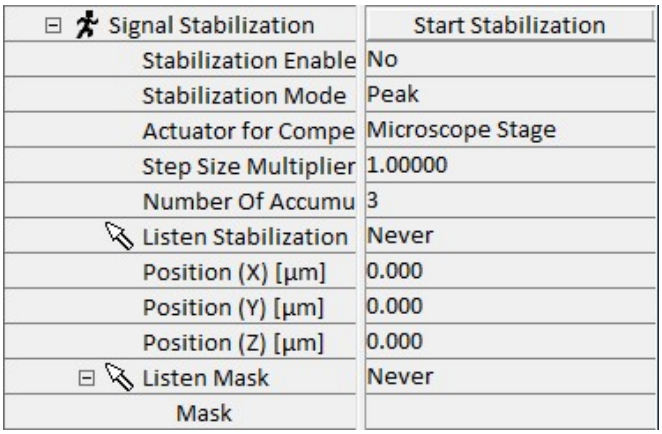
The mask is visible in the hardware spectrum viewer of the selected CCD camera. If the mask listen mode is turned on, you can edit the mask in the spectrum viewer.

Signal Stabilization

The Signal Stabilization is a feature to compensate thermal drift in the z-direction by defining a reference point, which is checked after each line of the measurement. This can be used either in the Image Scan or the Large Area Scan.

Further information (Operation Guide):

- Signal Stabilization (Raman)



Start Stabilization
This button starts the signal stabilization to test the parameters.

Stabilization Enable
This parameter turns the signal stabilization on and off also during the measurement. It is set automatically to Yes if Start Stabilization was successful.

Stabilization Mode
The Stabilization Mode defines the type of surface.

Peak
Used for a sample which only delivers intensity directly at the surface.
Positive Edge
This is for using the upper surface of a volume sample, which delivers signal also below the surface.
Negative Edge
This is for using the lower surface of a volume sample, which delivers signal also above the surface.

Actuator for Compensation
Microscope Stage or Scan Table can be selected here to compensate the drift in the z-direction. The Scan table should be preferred because of the better linearity.

Step Size Multiplier
This parameter can be used to adjust if the intensity peak delivered from the surface, is broader or narrower than normal.

Number of Accumulations
This parameter defines how many spectra will be accumulated at each step.

Listen Stabilization
If this is activated, the position of the reference point for the stabilization can be defined by clicking into an image or the video window.

Position (X/Y/Z) [µm]
These parameters define the position of the reference point for the stabilization. For an Image Scan the values have to be within the scan table range.

Listen Mask
If this is activated, the mask determining the spectral region can be selected by mouse.

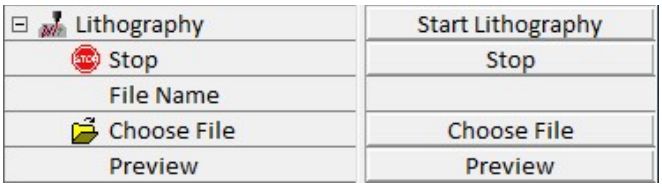
Mask
The mask determines which spectral region is used for the compensation. Refer to Spectral Auto Focus.

Lithography

In the Lithography parameter group, a Lithography file can be selected, previewed and processed. Samples can be found in the default lithography folder which opens by clicking the Choose File button. All commands are described under Lithography commands.

Further information (Operation Guide):

- Lithography

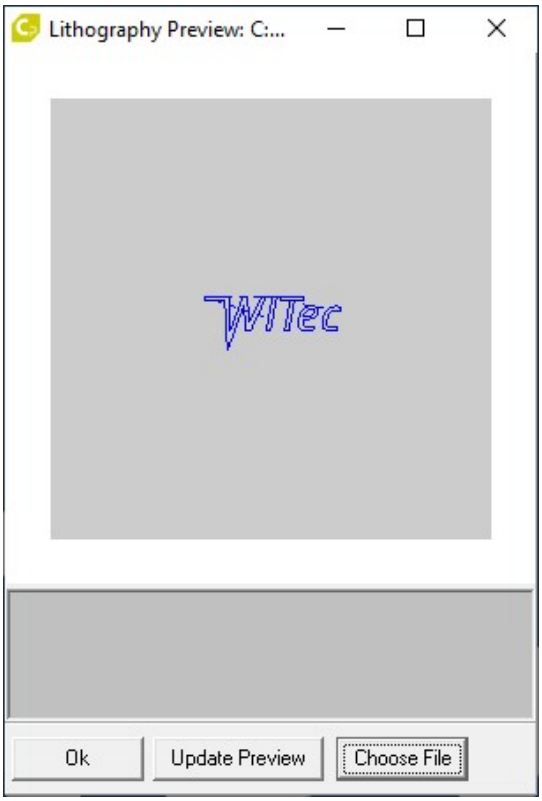


Start Lithography
Pressing this button starts the lithography process using the selected file.

File Name
Shows the path of the currently selected file.

Choose File
Opens a dialog to select the file.

Preview
Pressing this button opens a preview of the selected file shown below.



Lithography Commands

With the setup of the software several example scripts are delivered. It is highly recommended to look at these scripts in order to learn how the following commands can be used in combination.

General

Syntax

Each command must have brackets and end with a semicolon.
Example: TestCommand ();

Long and Short Command Names

All commands have a long and a short name. The command MovingSpeed(10) is equal to MS(10). In the following description the short names are shown in square brackets after the long name.
The commands are not case sensitive.

Comments

For commenting a single line out, "//" can be used at line start. For a complete block the signs "/*" and "*/" can be used to mark the beginning and the ending of a text block.

Include

With the directive #include a sub script could be added to the script. This helps to reuse parts in other scripts.

Commands

MovingSpeed [ms] (v)
Sets the speed for subsequent moves. The value of the speed v must be set in the unit [µm/s]. The speed must be in the range from 0.1 to 1000.
Example: MovingSpeed (20);

Sleep [sl] (t)
The processing of the lithography script is paused for t milliseconds. The parameter may be omitted, in this case the sleep duration is 100ms.
Example: Sleep (500);

MoveZMicroscope [mz] (z)
The stepper motor is driven that way, that the distance between objective and sample increases by the value of z. The distance must be set in the unit [µm]. If the distance between objective and sample would exceeds the software range the script will not start.
Example: MoveZMicroscope (-10);

SetTrigger [st] (T1, T2, T3)
Using this command you can set, reset and toggle up to three independent trigger signals. T1, T2 and T3 can be one of: DontChange, Off, On or Invert. The output connector of the trigger signals can be set using the signal routing device. The trigger signal defined with T1 is output on Trig 2 Out by default. All three parameters may be omitted.
Example: SetTrigger (On);

DisplayMessage [dm] (MessageText)
Displays the message specified in MessageText in the Message Window.
Example: DisplayMessage ("I'm drawing now");

Setpoint [sp] (S)
Sets the setpoint of the P-I controller subsystem to the value of S [V]. If the P-I controller is not included in the system this command is not available.
Example: Setpoint (0.5);

Snapshot [snap] (FileBaseName, C)
Makes a snapshot with the video camera and stores the image to a Bitmap file. The file name is named FileBaseName-xxxx.bmp, where xxxx is a counter value, starting from 0000, how many files in the current script have been stored. To specify if you want color or B/W images, set parameter C to 1 for color, 0 for monochrome.
Example: Snapshot("ImageName", 0);

SetLaserShutter [sls] (State)
Using this command you can open or close the shutter of the current used Laser. The laser must be a True Power Laser equipped with a Laser shutter. State can be "Open" or "Close".
Example: SetLaserShutter (Open);

Commands relating to the Piezo Scan Stage
These commands are only available if the microscope is equipped with a piezo scan stage.

PushTransformation [pusht] ()
Every coordinate P(x,y,z) you specify (for the piezo stage) gets transformed with a so called transformation-matrix M before being sent to the scan table.

T = M * P

To 'save' a copy of the current transformation-matrix, you use the PushTransformation() command. Transformations get stored on a stack one after another, so that you can store multiple transformations, and recall them in reverse order.

PopTransformation [popt] ()
To recall the last 'pushed' transformation from the stack. Calling PopTransformation() more often than having called PushTransformation() results in an error.

Rotate [rot] (Alpha, Beta, Gamma)
The current transformation matrix is multiplied with a rotation matrix resulting out of the three angles Alpha, Beta and Gamma. Alpha rotates the coordinates about the X-Axis, Beta rotates coordinates about the Y-Axis, Gamma rotates coordinates about the Z-Axis. All parameters may be omitted.

Scale [sc] (Sx , Sy , Sz)
The current transformation matrix is multplied with a scaling matrix resulting out of the three scaling factors Sx, Sy and Sz . All parameters may be omitted.

SetOrigin [so] (Ox , Oy , Oz)
The current transformation matrix is multiplied with a translation matrix resulting out of the three origin coordinates Ox, Oy and Oz. All parameters may be omitted, in this case the current position of the scan table is used as (0,0,0) position within the current transformation.

MoveRelative [mr] (Dx , Dy , Dz)
Moves the scan table to the new position

T = T + M * D
If the new position is outside of the scan range, the script will not start. All parameters may be omitted.

MoveAbsolute [ma] (Px, Py, Pz)
Moves the scan table to the new position

T = M * P
If the new position is outside of the scan range, the script will not start. All parameters may be omitted.

JumpRelative [jr] (Dx, Dy, Dz)
Same as MoveRelative except that the new position is driven to at a (nominal) speed of 1000 µm/s.

JumpAbsolute [ja] (Px , Py, Pz)
Same as MoveAbsolute except that the new position is driven to at a (nominal) speed of 1000 µm/s.

WaitForStablePosition [wpos] ()
The processing of the lithography script is paused as long as the position of the scan table is not stabilised. If the position has not stabilised after 2000 times querying it, the script will continue anyway.

Commands relating to the stepper motor driven Sample Positioner
These commands are only available,

- if the microscope is equipped with a sample positioner driven by stepper motors
- if the alphaControl is of generation Marvin 3a (serial number 120-1200-XXX) (with Firmware 1.016) or newer

SetOriginSamplePos [so_sp] ()
The current position of the sample positioner is treated as the origin of the sample-positioning coordinate system (0/0). Absolute positioning commands for the sample positioner are interpreted relative to this origin.
This command is automatically executed once when the script is started.

MoveRelativeSamplePos [mr_sp] (Dx, Dy)
Moves the sample positioner relative to the current position. All parameters may be omitted.

MoveAbsoluteSamplePos [ma_sp] (Px , Py)
Moves the sample positioner to the absolute position (relative to the last set origin). All parameters may be omitted.

JumpRelativeSamplePos [jr_sp] (Dx , Dy)
Same as MoveRelativeSamplePos except that the new position is driven to as fast as possible. The X- and Y-axis may be at the final position at different times.

JumpAbsoluteSamplePos [ja_sp] (Px, Py)
Same as MoveAbsoluteSamplePos except that the new position is driven to as fast as possible. The X- and Y-axis may be at the final position at different times.

Auto Save

Deprecated! The new **Autosave settings** are located in the Program options.
This auto save parameter group is still available for use with the COM interface e.g. LabView. The autosave can be triggered through the Store Project button. The parameters available for the autosave function are described below:

Auto Save	
Store Project	Store Project
Start Directory	c:\users\demouser\WITec
Extra Directory	Data
File Name	Sample
File Number	1
Next File	c:\users\demouser\WITec
Directory Mode	Extra Directory
Store Mode	Store and Clear
Overwrite Mode	Add Extra Suffix

If directories defined for the auto saving procedure do not exist, they will be created by the software upon saving.

Store Project
This button stores the project using the current settings.

Start Directory
In this field the starting directory can be defined. The full path where the file will be stored will be explained below.

Extra Directory

An additional directory for saving the project can be defined using this field. The full path where the file will be stored will be explained below.

File Name
The first part of the file name can be defined using this field. The composition of the full file name is described in the next point.

File Number
Here a number for the file saved can be assigned. This will automatically be incremented with each saving cycle and the number is automatically expanded to four digits. If for example the number entered is 2 the number used will be 0002.
The total file name will then be:
[File Name] [File Number].WIP

Next File
This field is for information purposes only and displays the path and filename of the next file that will be saved.

Directory Mode
Various modes can be selected here. Below the resulting file path for all methods will be shown.
No Extra Directory
[Start Directory]\
Extra Directory
[Start Directory]\[Extra Directory]\
Date
[Start Directory]\YYYYMMDD\
Here YYYY identifies the year, MM the month and DD the day.
Extra Directory + Date
[Start Directory]\[Extra Directory]\YYYYMMDD\
Date + Extra Directory
[Start Directory]\YYYYMMDD\[Extra Directory]\

Store Mode
Store and Store and Clear can be selected for this parameter. The difference is that Store and Clear will clear the project after saving it.

Overwrite Mode
This parameter will only be of importance if the file which is about to be saved exists already. If Overwrite is chosen, the existing file will be overwritten. If Add Extra Suffix is selected the file name shown above will be changed to:
[File Name] [File Number] YYYYMMDD HHMMSSmmm.WIP
Here YYYY denotes the year, MM the month, DD the day, HH the hour, MM the minute, SS the second and mmm the milliseconds of the moment when the file is saved.

Calibrate Scan Table

This sequencer is executed upon each startup of WITec Control but generally remains hidden from the user.
Only advanced users should alter the settings herein.
When executed, the scan table will be driven to two different positions per axis at which the output of the capacitive sensors are measured. Using these values a lead and an offset error are calculated for each axis. These values are then used to correct the stationary positioning of the scan table during its use. A text data object named Calibration Information is added to the project tree for information purposes.
This file should also be checked if the calibration of the scan table fails. This may occur if the offset potentiometers for the scan table on the alphaControl are not set to their minimum positions.
The following parameters are available to set the calibration routine:

Start Calibration
This trigger button starts the calibration sequencer.

CalibrateXAxis (CalibrateYAxis, CalibrateZAxis)
This parameter determines if the X (Y,Z) axis is calibrated (Yes) or not (No).

XAxisPos1/2 (YAxisPos1/2 ZAxisPos1/2) [µm]
Using these parameters the two target positions for the calibration of the X (Y,Z) axis can be entered. Entering an out of range value will cause the software to automatically enter the maximum/minimum value possible.

Calibrate Relative To Current Position
If this option is selected (Yes), the scan table will move not to the position entered in e.g. XAxisPos1 but to ([Current X-Axis Position] + XAxisPos1). Similarly it will move to ([Current X-Axis Position] + XAxisPos2) instead of XAxisPos2.

Data Channels

The following output channels are available depending on the system configuration.

X/Y-Sensor
The X/Y-sensor output is the signal collected from the capacitive sensor measuring the X/Y-axis position of the scan table. Its unit is µm. This signal is used to determine the precise position of the scan table.
Z-Sensor (Topography)
The Z-sensor output is the signal collected from the capacitive sensor measuring the Z-axis position of the scan table. Its unit is typically µm. This signal is used to represent the topography of a surface during AFM and SNOM measurements. For confocal measurements the z-sensor output reads the precise z position of the scan table.
Feedback
The feedback output is the setpoint position of the z-axis of the scan table. Its unit is typically µm* (proportional to µm), but without the linear corrections induced by the sensor. This signal is used in AFM and SNOM measurements especially if the surface topography varies by less than 1 nm.
T-B
The T-B output is the difference in the electrical signals collected from the top and the bottom halves of the four quadrant photo diode of the beam deflection system. Its unit is V. This output is used to monitor the feedback during contact mode measurements.
L-R
The L-R output is the difference in the electrical signals collected from the left and right halves of the four quadrant photo diode of the beam deflection system. Its unit is V. This output is used to monitor the torsion of the cantilever during contact mode measurements.
Sum
The Sum output is the total electrical signal collected from the four quadrant photo diode of the beam deflection system. Its unit is V.
Lock-In R
The Lock-In R output signal of the lock-in amplifier is the signal amplitude. Its unit is V and it is used to monitor the feedback during AC mode measurements.
Lock-In Phi
The Lock-In Phi output signal of the lock-in amplifier is the phase φ. Its unit is ° and it is used to monitor the phase shift during AC mode measurements.
F max.
The F max. output is the maximum of the PFM curve as evaluated by the controller hardware. Its unit is V and it is mainly used as the PI controlled channel in PFM measurements.
Adhesion
The adhesion is measured in V and is determined by the controller based on the adhesion search window from the PFM curve. Variations in the adhesion of a sample can be determined using this signal.
Stiffness
The stiffness is measured in V and is evaluated by the controller based on the stiffness search window from the PFM curve. Variations in the stiffness of a sample can be determined using this signal.
Aux 1 and Aux 2
Aux 1 and Aux 2 are the auxiliary channels of the alphaControl system. The unit of these signals is V .
Ext. AD 1/2/3/4
Ext. 1 to Ext. 4 are the auxiliary channels of the alphaControl system. The unit of these signals is V .
PMT, APD and other photon counting devices
Several photon counting devices can be added to an alpha system. Typically, the first photon counter is a PMT and the second counter an APD. The output of the counters is the actual counter reading of how many photons were counted during the last pixel. Its unit is cts (counts).
Count Rate of photon counting devices
The Count Rate output is the counter reading divided by the time required to record the pixel. Its unit is Hz (counts /second).
Sample Pos. X/Y
The Sample Pos. X/Y is the X/Y position of the sample positioning stage in the currently active coordinate system. Its unit is µm.
Microscope Z
The microscope Z output is the relative position of the microscope z-stage. Its unit is µm.
Inv. Mic. X/Y/Z
The inverted microscope X/Y/Z output is the relative position of the inverted microscope in the X/Y/Z-direction. Its unit is µm.
CCS Elevation
The CCS Elevation measures the height at the current position within range of the CCS in µm.
CCS Intensity
The CCS Intensity measures intensity of the CCS signal in %.
Heating Stage Temperature
The heating stage temperature contains the temperature as determined through the calibrated PT100 element in the heating stage.

Fast Stream Channels

Fast stream channels can be transferred with higher speed (5 MHz) from the controller to the PC. There is a limited number of channels available for this fast transfer (T-B, L-R, Aux1 and Aux2). The T-B in fast streaming mode is used e.g. in DPFM measurements.

Spectral Channels

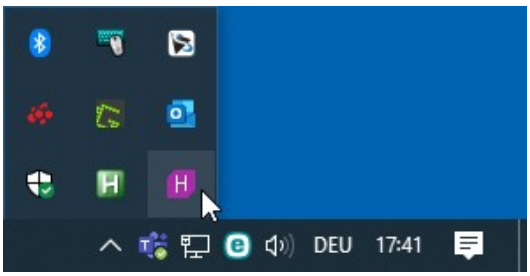
This category of data sources contains the outputs of the spectral cameras connected to the system. Up to three spectral cameras can be added. In this case, one measuring point describes a set of measured data (e.g. a full spectrum).

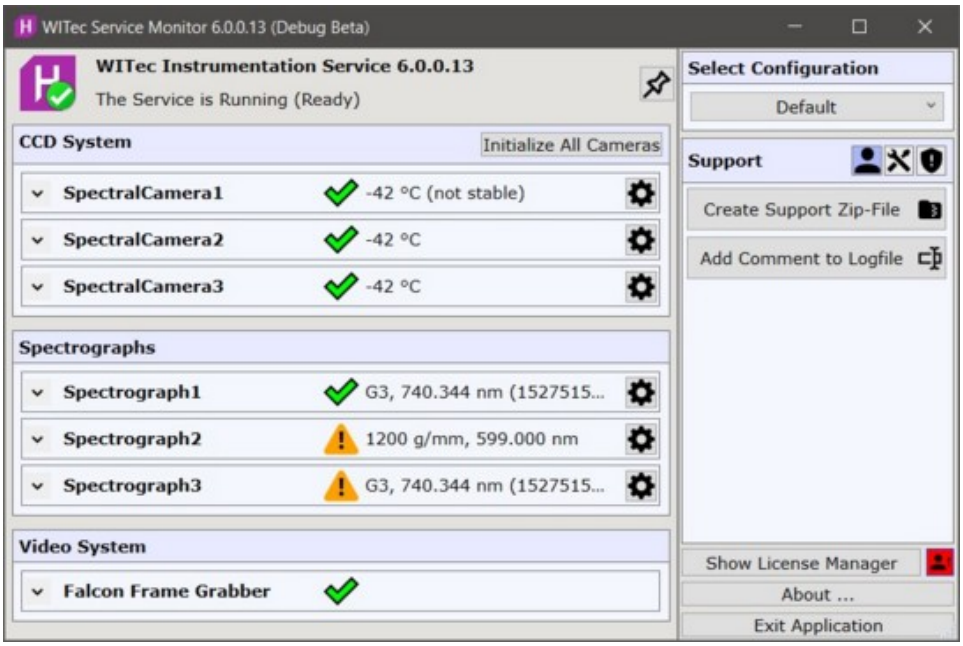
WITec Service Monitor Overview

The WITec Service Monitor is automatically installed with the WITec Suite Complete Setup / WITec Instrumentation Service Setup and automatically starts upon logging on.

It shows the status of the instrumentation service, the microscope controller, the Spectroscopy System - including CCD Cameras and Spectrographs - and all Video Cameras.
Additionally, it provides several configuration capabilities for the WITec Support Team.

You can open the Service Monitor in the windows task icon bar in the bottom right corner of the main screen by clicking on the "H" Icon:





Device List
A green check mark indicates that the device is connected and working as expected.
You can click on a device name to extend the view and see more information.

Microscope Controller
This will show the connected microscope controller unit with its serial number and firmware version.

CCD System
Shows all configured spectral cameras and the current temperature of all connected/powered cameras.

Initialize All Cameras
Disconnects and (re-)initializes ALL spectral cameras.
This allows to use cameras that were plugged in or powered after the WITec Software started.
Please do not click this button during any measurement!

Configure CCD Camera
See CCD Camera Configuration.

Spectrographs
Shows all configured spectrographs and the current grating with position.

If a warning icon is displayed, the spectrograph might not be calibrated.
See Spectrograph Calibration.

Video System
Shows all configured video cameras (or for older systems: the frame grabber).

Menu

Select Configuration
Lets you select between different microscope configurations.
This feature is only used for special microscopes having multiple optic / sensor combinations.

Create Support ZIP-File
Opens the Create Support ZIP-File Dialog.
See How to Create Support ZIP File.

Add Comment to Logfile
Allows to add comments in case of errors or bad behavior of the software, so WITec can analyze the log files and know at which time something happened.

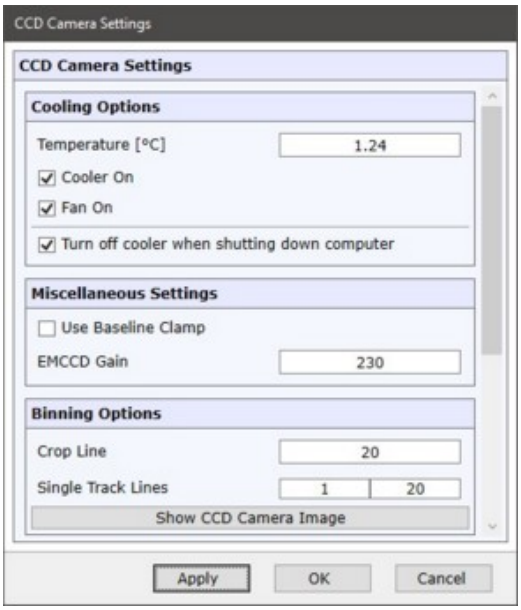
Show License Manager
Opens the WITec License Manager Application

Support

Those tools are intended to be used only by WITec Support members.

The True Power Laser Tool allows you to perform a Laser Fiber Adjustment.

CCD Camera Configuration



Cooling Options

Temperature
Sets the temperature of the CCD chip cooling unit.

Cooler On
Tuns the cooling unit on or off.

Fan On
Turns the cooler fan on or off.

Turn off cooler when shutting down computer
If checked, the cooler is turned off upon shutting down the computer.
Otherwise the camera keeps cooling and can be used immediately after a computer start.

Miscellaneous Settings

Use Baseline Clamp
Only for cameras supporting baseline clamp.
If checked, the A/D converter offset will be stabilized. The maximum possible number of spectra per second will be reduced.

EMCCD Gain
Only for cameras supporting EMCCD amplification.
Sets the gain for the EMCCD mode.

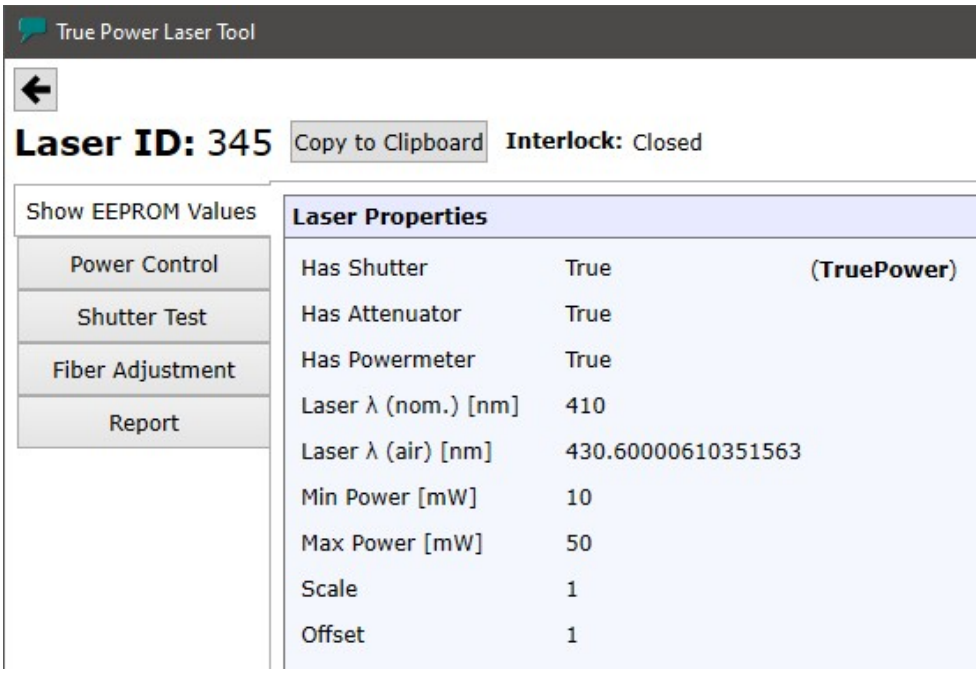
Binning options
The binning options are used for the crop and single track measurement modes.
Please set the parameters in a way that for all used gratings and spectral positions, the signal is on the configured crop line or within the range of the configured single track lines. Use a calibration light source and the CCD Camera Image to check the parameters.

Crop Line
Defines which CCD line should be used in crop measurement mode.

Single Track Lines
Defines which lines should be used in single track measurement mode.

Show CCD Camera Image
Shows the CCD camera image, intended to set up binning options and to check the position of the signal on the camera. Intended only for a system responsible person.

True Power Laser Tool



Show EEPROM Values
Shows the current laser properties.

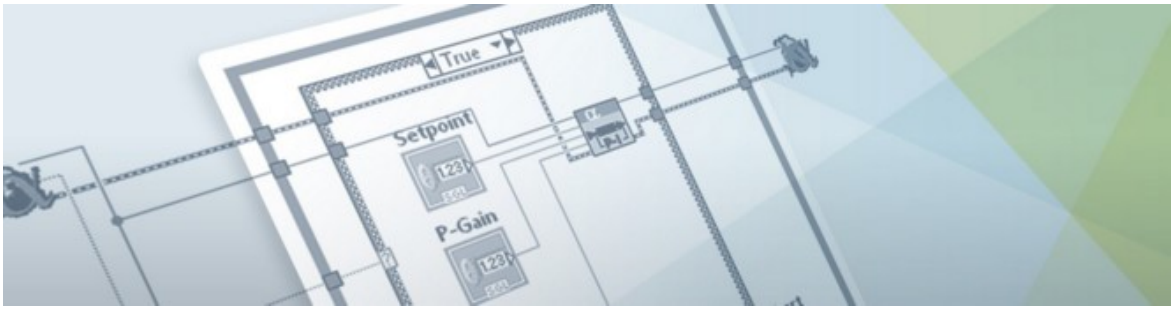
Power Control
Allows to change the laser power and to close the attenuator.

Shutter Test
Here you can check whether the laser shutter is working correctly.

Fiber Adjustment
Shows the current laser power to adjust the laser fiber.

Report
Only for support team:
Runs a self-test and creates an automatic report.

COM Automation Overview



The COM Automation feature enables remote control of WITec Control. It is possible to read and write all parameters and to press buttons in the Control window. Also many feature in the Video window are accessible.

License requirements:
- COM Automation

(Please contact WITec if you would like a quotation for your system.)

What is COM?
Component Object Model (COM) is a technique for inter-process communication developed by Microsoft. It can be used in a large range of programming languages.

What is LabVIEW?
Laboratory Virtual Instrument Engineering Workbench (LabVIEW) is a visual programming language developed by National Instruments. It is commonly used for data acquisition, instrument control and automation.

What is offered by WITec?

The COM Automation bundle includes:

- Read and write access to the COM interface of WITec Control accessible by various programming languages
- LabVIEW driver including some documented examples

Although the COM interface can be accessed by various programming languages, WITec offers completely documented examples for LabVIEW only. These examples are a good starting point to learn how to use the interface with other languages too. General information about the structure of the COM interface are documented in the interface section. Some basic C# examples can be found in the regarding section.

COM Server and Classes	Describes the COM server and its available classes.
COM Interfaces	Describes the available interfaces.
COM Subsystems	Describes the different types of parameters and how to find them.
Remote access	Describes how to access the COM interface remotely by a computer which is not the one of the microscope.
LabView	Explains how to install the LabVIEW driver.
C#	Basic example code for C# which is a good starting point also for other programming languages.
Python	Basic example code for Python.
MATLAB	Some remarks about using MATLAB and why it is not recommended.

Allow write access to WITec Control

Read access to all parameters is granted by default. To set parameters or trigger actions write access to WITec Control has to be allowed. Click **COM Automation** in the COM Automation section of the control tree. This opens a Window which blocks user entries in WITec Control until **Revoke** is clicked.
The correct functionality of the WITec Control COM Interface can be checked by starting WITec Control and running the test program “WITec Control COM Connection Tester” which is installed with the WITec Control.

Please note, that WITec will of course assist you with errors or problems caused by WITec Control or the WITec LabVIEW driver. However, WITec will not test or correct userwritten code. The correct functionality of these is solely the user’s responsibility.

COM Server and Classes

COM Server

The COM server consist of a DLL and a type library. Both is by default installed with WITec Control.

It can be used as local or out-process server over its class ID (clsid) **C45E77CE-3D66-489A-B5E2-159F443BD1AA**. There is no program ID (progid) defined. For the use as remote server refer to remote access. The use as in-process server is not possible.

The name of the type library is BasicUniversalCOMServerLib.tlb. The help string (shown in OLE/COM viewer or LabVIEW) is **Basic Universal COM Server Library**.

Implemented Classes

This section lists all available classes that are offered by the DLL. Each class has implemented one or more interfaces. The naming of all classes starts with **CBUCS** (**C**lass **B**asic **U**niversal **C**OM **S**erver).

CBUCSCore

Interfaces: IBUCSCore, IBUCSAccess

Each client should create one entity of this class to create all subsequent objects with the IBUCSCore interface functions.

CBUCSSubSystemList

Interfaces: IBUCSSubSystemList

This object is created by the GetSubSystemsList() function of the IBUCSCore interface. The object contains the available subsystems and their respective interface GUIDs. Objects of this class are no subsystem itself.

CBUCSSubSystem

Interfaces: IBUCSAccess, IBUCSSubSystemInfo

All subsystem classes are derived from this class. This class is not created by the client.

CBUCSSingleValue

Interfaces: IBUCSSingleValue **(+ interfaces of** CBUCSSubSystem**)**

All classes for single values are derived from this class. This class is not created by the client.

CBUCSIntSingleValueMinMax

Interfaces: IBUCSInt, IBUCSSingleValueHasLimits, IBCUSIntMinMaxValues **(+ interfaces of** CBUCSSingleValue**)**

This class implements all interfaces necessary to modify an integer value. The default interface is IBUCSInt. All other

interfaces of this class can be cast to this interface.

CBUCSFloatSingleValueMinMax

Interfaces: IBUCSFloat, IBUCSSingleValueHasLimits, IBUCSFloatMinMaxValues **(+ interfaces of** CBUCSSingleValue**)**

This class implements all interfaces necessary to modify an floating point value. The default interface is IBUCSFloat. All other interfaces of this class can be cast to this interface.

CBUCSStringSingleValue

Interfaces: IBUCSString **(+ interfaces of** CBUCSSingleValue**)**

This class is for modifying an string values of any desired length. The default interface is IBUCSString.

CBUCSBoolSingleValue

Interfaces: IBUCSBool **(+ interfaces of** CBUCSSingleValue**)**

This class is for modifying a boolean value. The default interface is IBUCSBool.

CBUCSEnumSingleValue

Interfaces: IBUCSEnum **(+ interfaces of** CBUCSSingleValue**)**

This class is for modifying a list or enumeration value. The default interface is IBUCSEnum.

CBUCSTrigger

Interfaces: IBUCSTrigger **(+ interfaces of** CBUCSSubSystem**)**

This class is to trigger an action. The default interface is IBUCSTrigger.

CBUCSStatusContainer

Interfaces: IBUCSStatusContainer, IBUCSFillStatusContainer **(+ interfaces of** CBUCSSubSystem**)**

This class is for reading status data. The default interface is IBUCSStatusContainer.

COM Interfaces

This sections lists all available interfaces and their respective methods. The classes implementing theses interfaces are described in the **classes section**.

The naming of all interfaces starts with **IBUCS** (**I**nterface **B**asic **U**niversal **C**OM **S**erver). All interfaces derive from IDispatch.

IBUCSCore

Reads available subsystem objects in their hierachic structure.

GetSubSystemsList(in Name : BSTR, in SubSystemDepth : int) : IBUCSSubSystemList

Description: List all subsystems starting from a defined subsystem and returns them as list.

Parameters: Name: Path to the starting subsystem. Use an empty string to start at the root.
SubSystemsDepth: Defines the number of levels that should be listed. If it is 0 only one level is listed (the subsystems of the defined subsystem).

Return: Creates a CBUCSSubSystemsList object and returns the IBUCSSubSystemsList pointer.

GetSubSystem(in Name : BSTR, in refid : IID) : IUnknown

Description: Creates a subsystem object and uses the specified interface.

Parameters: Name: Path to the subsystem.
refid: GUID of the interface that should be used for the subsystem. It should be implemented for the requested subsystem.

Return: If the path to the subsystem is valid and the interface is implemented, it returns the defined interface as IUnknown*. It needs to be cast to the interface according to the specified IId.

GetSubSystemEx(in Name : BSTR, in InterfaceName : BSTR) : IUnknown

Description: Creates a subsystem object but accepts the interface GUID as string.

Parameters: Name: Path to the subsystem.
InterfaceName: GUID of the interface that should be used for the subsystem as string (format like in the **table at the end**). It should be implemented for the requested subsystem.

Return: If the path to the subsystem is valid and the interface is implemented, it returns the defined interface as IUnknown*. It needs to be cast to the interface according to the specified IId.

GetSubSystemDefaultInterface(in Name : BSTR) : IUnknown

Description: Creates a subsystem object and uses the default interface.

Parameters: Name: Path to the subsystem.

Return: If the path to the subsystem is valid, it returns the default interface (according to the IDL definition) as IUnknown*. It needs to be cast to the default interface.

IBUCSSubSystemsList

The interface for **CBUCSSubSystemsList** which contains a list of subsystems.

GetNumberOfSystems() : int

Description: Gives the number of elements in the list.

Parameters: -

Return: Number of subsystems in the list.

GetBaseName() : BSTR

Description: Retrieves the base name of all subsystems.

Parameters: -

Return Path of all subsystems in the list. (The path was used to create the list.)

GetSubSystemName(in SystemIndex : int) : BSTR

Description Returns the name of the subsystem specified by SystemIndex.

Parameters SystemIndex: Index of the subsystem. Must be >= 0 and < than the number of subsystems (GetNumberOfSystems() - 1)

Return String containing the name of the subsystem.

GetSystemSubSystemsList(in SystemIndex : int) : IBUCSSubSystemList

Description Creates a list of subsystems below the subsystem specified by SystemIndex.

Parameters SystemIndex: Index of the subsystem. Must be >= 0 and < than the number of subsystems (GetNumberOfSystems() - 1)

Return Creates a CBUCSSubSystemsList object containing the subsystems below the specified subsystem and returns the IBUCSSubSystemsList pointer to it.

GetSubSystemNameAndIId(in SystemIndex : int, out SystemName : BSTR, out DefaultInterfaceId : BSTR) : HRESULT

Description Returns the name and the GUID string of the subsystem specified by SystemIndex.

Parameters SystemIndex: Index of the subsystem. Must be >= 0 and < than the number of subsystems (GetNumberOfSystems() - 1)
SystemName: A string pointer which is filled with name of the subsystem
DefaultInterfaceId: A string pointer which is filled with GUID of the default of the subsystem

Return Returns true if it was successful.

IBUCSAccess

This interface controls the access of the client(s) to the server.

HasReadAccess() : bool

Description Determines whether the client has read access.

Parameters -

Return Returns true if the object has read access on the server.

HasWriteAccess() : bool

Description Determines whether the client has write access.

Parameters -

Return Returns true if the object has write access on the server. If one object of an application has write access on the server, all objects creates by this application have write access.

RequestWriteAccess(in WantWriteAccess : bool) : HRESULT

Description Requests write access for the client.

Parameters WantWriteAccess: IndexTrue if the client wants to gain write access and false if the client wants to drop the write access. The server takes that only one application has write access.

Return Returns true if the object has write access on the server after the call.

IBUCSSubSystemInfo

This interface retrieves information about a subsystem.

GetName() : BSTR

Parameters -

Return Complete path including the name of the subsystem.

GetEnabled() : bool

Parameters -

Return Returns true if the subsystem is enabled and can be used.

IBUCSSingleValue

Can be used to retrieve information about a changeable value (parameter). Only implement this interface for parameters which value can be converted to a string.

GetDisplayName() : BSTR

Parameters -

Return Returns the caption (label) of the parameter in the host application (WITec Control). This description may contain white spaces and special characters.

GetValueAsString() : BSTR

Parameters -

Return Current value of the parameter as string.

IBUCSSingleValueHasLimits

This interface can request whether the parameter has a upper or lower limit different from the one given by its data type. It can not be used to retrieve the values of the upper or lower limit.

HasMinimum() : bool

Parameters -

Return True if the parameter has programmatic lower limit.

HasMaximum() : bool

Parameters -

Return True if the parameter has programmatic upper limit.

IBUCSInt/IBUCSFloat/IBUCSBool/IBUCSString

These interfaces allow access to a parameter with regard to its type.

GetValue() : int/float/bool/BSTR

Parameters -

Return The value of the parameter as respective type.

SetValue(in Value : int/float/bool/BSTR) : HRESULT

Parameters Value: The new value of the parameter as respective type. Only possible if write access on the server is granted. The host application needs to take care that the value is within the possible range. The server dll will not check for it.

Return Returns true if it was successful.

IBUCSIntMinMaxValues/IBUCSFloatMinMaxValues

These interfaces retrieve the upper or lower limit of a parameter due to its type.

GetMinimum() : int/float

Parameters -

Return The lower limit of the parameter due to its type.

GetMaximum() : int/float

Parameters -

Return The upper limit of the parameter due to its type.

IBUCSEnum

This interface can be used to change or read a list or enumeration parameter. List parameters have a respective string for each numerical value.

GetAvailableValues(out NumericalValues : SAFEARRAY, out StringValues : SAFEARRAY) : int

Parameters NumericalValues: Array pointer, which is filled with the numerical values of this parameter.
String Values: Array pointer, which is filled the strings for the respective numerical values.

Return Returns the number of available values.

C/C++/C#: After using this function it is necessary to call SafeArrayDestroy() for NumericalValues and StringValues!

GetValue(out ValueString : BSTR) : int

Parameters ValueString: A string pointer which is filled with the respective string of the current selected value by the server.

Return The current numerical value of the parameter.

SetValueNumeric(in Value : int) : HRESULT

Parameters Value: The numerical value that should be set for the parameter. The host application needs to take care that the value is within the possible range. The server dll will not check for it.

Return Returns true if it was successful.

SetValueString(in Value : BSTR) : HRESULT

Parameters Value: The string respective to value that should be set for the parameter. The host application needs to take care that the value is valid. The server dll will not check for it.

Return Returns true if it was successful.

IBUCSTrigger

This interface can trigger an action.

OperateTrigger() : HRESULT

Parameters -

Return Returns true if the action started successful.

IBUCSStatusContainer

A interface to retrieve status information from the server. This could be a single value of different types or an array of one or more dimensions.

Update() : HRESULT

Updates the status of the container.

Parameters -

Return Returns true if it was successful.

GetSingleValueAsString(out StringValue : BSTR) : bool

Parameters StringValue: Pointer to a string which is filled with the string of the current status of the container. The status is not allowed to be an array.

Return Returns true if it was successful.

GetSingleValueAsInt(out IntValue : int) : bool

Parameters IntValue: Pointer to a Int value which is filled with the value of the current status of the container. The status is not allowed to be an array.

Return Returns true if it was successful.

GetSingleValueAsDouble(out DoubleValue : double) : bool

Parameters DoubleValue: Pointer to a double value which is filled with the value of the current status of the container. The status is not allowed to be an array.

Return Returns true if it was successful.

GetStatusArray(out Dimensions : int, out DimensionExtents : SAFEARRAY, out StatusArray : SAFEARRAY) : bool

Parameters Dimensions: Pointer to an Int value which contains the number of dimensions of the status array after the call.
DimensionsExtents: Pointer to an array which contains a one-dimensional array with the extent for each dimension after the call.
Status Array: Pointer to an array which contains the complete status array after the call. Take care for consistent indexing.

Return Returns true if the status array is valid.
C/C++/C#: After using this function it is necessary to call SafeArrayDestroy() for DimensionExtents and StatusArray!

GetStatusProperties(out Caption : BSTR, out Unit : BSTR) : bool

Parameters Caption: Pointer to a string which is filled with the description of the current status value.
Unit: Pointer to a string which is filled with the unit of the current status value.
Return Returns true if the status is valid.

IBUCSFillStatusContainer

An interface to transfer a one-dimensional data array to the server.

FillDataArray(in DataArray : SAFEARRAY) : HRESULT

Parameters DataArray: The array with data (variant SAFEARRAY).
Return Returns true if the array was transfered successful.
C/C++/C#: The server calls VariantClear() for the passed DataArray.

Table of interface GUIDs

With the method GetSubSystemNameAndIId() of IBUCSSubSystemsList it is possible to determine the GUID of the default interface of an object. The following table gives an overview about the available interfaces and their respective GUID (IId).

Interface Name	Interface GUID (IId)
IBUCSSubSystemsList	512E8C62-F2C9-4840-8C5C-746E7FCE3B5B
IBUCSCore	78D9E3C8-7E0A-4788-B4D8-EF22365D3648
IBUCSAccess	594ACBE6-938A-411F-A62E-E06FE6DBD35C
IBUCSSubSystemInfo	A548CB11-959F-46C0-BACD-C813837CB9C4
IBUCSSingleValue	A75ED3DF-D774-412C-8DF3-B7640EAE0551
IBUCSSingleValueHasLimits	5C4AF664-B397-4D35-8D98-8E2AE222A8EB
IBUCSInt	EFAE9411-A8E0-461D-A5F4-4887595AA830
IBUCSIntMinMaxValues	67B7266A-9EC3-4417-A900-7FCE26FD3AD6
IBUCSFloat	3EBB7227-74F9-4A0D-9AC9-7E3327AB5221
IBUCSFloatMinMaxValues	3D750FA2-17AB-4D75-AAFA-8D6DD5717289
IBUCSString	90C0EA65-0483-46BB-80FD-B1B536D73FC4
IBUCSBool	08862E7F-BE29-4DCF-B2FC-55A3DFAE33F7
IBUCSTrigger	923FC802-04D3-4BEE-AE63-A349051FE2E8
IBUCSEnum	CC1BD98A-2D74-4242-B5F9-0288FC58E339
IBUCSStatusContainer	5CAF623C-976F-46DC-9624-2F685B00D293
IBUCSFillDataArray	EC6F2072-5998-4318-8B49-6F4E995407E6

COM Subsystems

In WITec Control all available parameters, actions and status information are organized in a hierarchic structure of subsystems and their respective objects. Each subsystem may contain several subsystems, but not every subsystem is a discrete object. Some subsystems just group other subsystems below them without being an object (like a parameter, action or status) itself.
To create an object its complete path must be known. The path is comparable to a path in a file system. A pipe (|) is used as delimiter. A path can be i.e. A|B|C|X.
All objects belong to one of the four main groups that build the first part of the path: UserParameters, MultiComm, Status and ApplicationControl. They are further explained in the following.
All available parameters can be listed by executing the LabView vi “Get Available Subsystems.vi” or by using the method GetSubSystemsList() of IBUCSCore. The availability of single parameters depends on the microscope configuration.

Application Control	ApplicationControl	Actions of the main menu
User parameters	UserParameters	Parameters of the Control tree
Status container	Status	Retrieves status information or sends data
Additional parameters	MultiComm	Parameters of the video control window

Application Control

Selected actions found in the main menu of WITec Control are implemented as distinct subsystems. These subsystems have **ApplicationControl|** at the beginning of the path.

Name	Type	Description
LoadConfiguration	String	Retrieves or changes the current selected configuration. Retrieves/expects the name of the configuration (without file extension) and its path relative to the configurations folder i.e. "AFM\AFM AC".
UpdateHardware	Trigger	Apllies changes of the user parameters to the hardware and updates the status data afterwards.

ExitApplication	Trigger	Closes WITec Control.
FileNameToAppendToProject	String	Writing the filename of a WIP-file to this parameter will append the project to the current project.
NewProject	Trigger	Deletes the current project and creates a new project

For saving a project refer to the **Auto save** group in the default tree.

User parameters

Most of the parameters that can be found in the **Control tree** in WITec Control are organized in the UserParameters group. Select the left column of the regarding parameter in the **Control tree** and press Ctrl + C to copy its path to the clipboard. To create a complete path to the respective parameter the part **UserParameters|** has to be added at the beginning. The following types of parameters can be found:

- Integer parameters are objects of the type **CBUCSIntSingleValueMinMax**.
- Parameters using numbers with radix point are objects of the type **CBUCSFloatSingleValueMinMax**.
- String parameters are objects of the type **CBUCSStringSingleValue**.
- Parameters using a dropdown list are objects of the type **CBUCSEnumSingleValue**.
- Boolean parameter are objects of the type **CBUCSBoolSingleValue**. The difference between a list parameter with only two possibilities and a boolean parameter is not obvious.
- Buttons starting an action are objects of the type **CBUCSTrigger**.

If a client tries to create an object for a not implemented parameter the server raises an error and returns a null pointer.

Additional parameters

There are additional parameters in most cases related to the **Video Control window** that have **MultiComm|** at the beginning of the path. A list of available parameters can be found in the **Menu** of the Video Control window in the Advanced section.

Status Container

The status container is used to C to WITec Control. All status container have **Status|** at the beginning of the path and are implemented as CBUCSStatusContainer. If a non-implememted status is updated the application returns E_NOTIMPL. If not stated different the direction of data is from server to client.

Application status

Path Status|Software|Application|ProgramVersion
Type single value, string
Description The name, version and ,if existing, build version of the application.
Path Status|Software|Application|MemoryStatus|PhysicalMemory
Status|Software|Application|MemoryStatus|PageFile
Status|Software|Application|MemoryStatus|AddressSpace
Type single value, integer
Description The available space in % of the respective value.
Path Status|Software|Application|CurrentFileName
Type single value, string
Description The name of the project file, if existing.

Sequencer status

Path Status|Software|Sequencers|IsASequencerActive
Type single value, bool
Description Return true if a sequencer is active.
Path Status|Software|Sequencers|ActiveSequencer|Name
Type single value, string
Description The name of the active sequencer. If no sequencer is active it returns E_ACCESSDENIED.
Path Status|Software|Sequencers|ActiveSequencer|CurrentActivity
Type single value, string
Description The current activity of the sequencer (refer to the tables at the end of the page for more detailed information). If there is no specific action, it returns Sequence Busy. If no sequencer is active it returns E_ACCESSDENIED.
Path Status|Software|Sequencers|SequencerTimeSeriesSlow|UserDataCaptions
Type 1-dimensional array, string
Description The description of the external user data channels.
Direction Client → Server
Path Status|Software|Sequencers|SequencerTimeSeriesSlow|UserDataUnits
Type 1-dimensional array, string
Description The units of the external user data channels.
Direction Client → Server
Path Status|Software|Sequencers|SequencerTimeSeriesSlow|UserDataValues
Type 1-dimensional array, float
Description The values of the external user data channels.
Direction Client → Server

Data channel status

Path	Status|Hardware|Controller|DataChannels|[name of the data channel]
Type	single value, float
Description	The current value of this data channel (scale and offset are taken into account). The available data channels depend on the hardware configuration and can be readout by using the method GetSubSystemsList() of IBUCSCore.

COM subsystem status

Path	Status|Software|COMAutomation|AcceptsRemoteConnection
Type	single value, bool
Description	Returns true if the server allows write access.
Path	Software|COMAutomation|COMCallPerformance
Type	1-dimensional array with 2 values, long
Description	Index 0: Tic frequency of the host systems (low dword) Index 1: Tic count of the host systems (low dword) Used to measure the time between to COM calls.

Sequence activity strings for all sequencers

The status container Status|Software|Sequencers|ActiveSequencer|CurrentActivity retrieves the current action of a sequencer. If not stated different it can deliver one of the following strings for the current activity. (It is not possible to retrieve the numeric value.)

Sequence Activity String	Numeric value
Sequence Busy	0
Sequence not Active	-1
Cleaning up after Sequence End	-2
Unknown Sequence Activity (n)	n

The following sequencers retrieve specific activity strings.

SequencerAutoFocus

Auto Focus Activity String	Numeric value
Preparing Data-Channels and Microscope	1
Searching for Focus-Position Iteration #n	2
Moving Microscope to Focus-Position	3

SequencerScanImage

Image Scan Activity String	Numeric value
Preparing Data Objects and Scan Path	1
Scanning Image	2
Restarting	3
Collecting data	4
Moving to next Depth-Scan Line	5
Waiting for User to Continue Scan manually	6

SequencerTimeSeriesSlow

Slow Time Series Activity String	Numeric value
Preparing Data Objects	1
Waiting for next Measurement	2
Executing Sub-Sequencer	3
Acquiring Spectral Data	4
Acquiring Data Channels	5

Remote access

It is possible to access WITec Control (server) over network from a different PC (client) over DCOM (Distributed COM). It should be done only if really necessary. Reasons for doing so:

- Combined control of the WITec system and another device connected to the other computer
- no LabVIEW license available on the microscope PC

Instructions

- Both PCs (client and server) must be in the same network domain
- Install the COM Add-on on the client PC by executing “WITec Control COM AddOn.msi”.
- Install the LabVIEW driver on the client PC, if LabVIEW should be used.
- The user that wants to access from the client PC must be logged on and must have administrator rights on the server PC on which WITec Control is running. (WITec Control doesn’t need to be executed with administrator rights)

Remarks

- The users that want to use the remote access need to be member of the same windows domain. Creating users with the same user name on both computers will not work.
- The Windows-DCOM-service must run on both computers.
- If NetBIOS is used, the computer name has to be not longer than 15 characters.
- Configure the DCOM service using the Component services tool (dcomcnfg.exe) on the server PC (Fig. 1):
  - Open Properties of My Computer over the context menu (right-click) and go to the tab COM security click on both Edit Default buttons.
  - Make sure the local administrators have local and remote access, launch and activation rights.
- Search for BUCS Application in the DCOM Config folder and open the properties of it on the server and the client
  - Security tab: Deny local and remote launch, allow local and remote activation, Access and configuration should be on Default.
  - General tab: Authentication level should be on Default
  - (Only Server) Identity tab: Interactive user should be used
- Refer to the allow write access section for testing the connection.

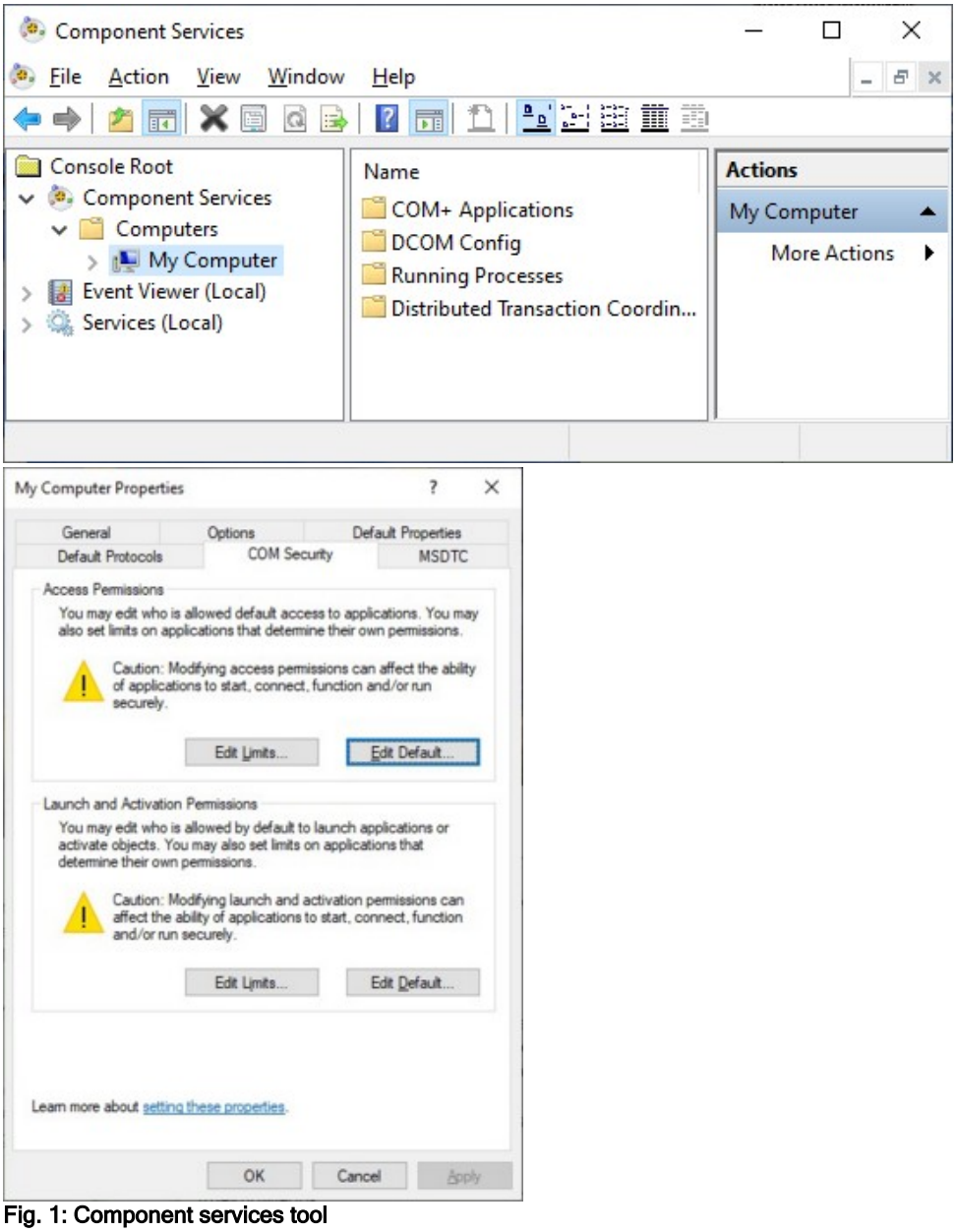


Fig. 1: Component services tool

LabVIEW Driver

Functional blocks in LabVIEW are called Virtual Instruments (VIs) and are implemented for most control functions offered by WITec Control.
This document describes the installation of LabVIEW software components related to WITec products as well as verification of successful installation. A short description of the examples delivered with the interface is also included. These are additionally described in greater detail in separate documents.

For common questions and troubleshooting, the customer is referred to the FAQ (frequently asked questions) document which is also included.
Assistance with writing LabVIEW code can be obtained and training purchased from National Instruments.

Preconditions

Before installing the WITec Control LabVIEW driver, LabVIEW must be installed:

- LabVIEW version 8.5 (or higher)

Installation

- Install the WITec Control LabVIEW driver by running the Program “WITec Control LabVIEW Driver Setup.msi”.
- Select the correct LabVIEW instr.lib directory of your LabVIEW installation as the installation directory.

After the installation, the WITec Control LabVIEW driver is available in LabVIEW in the folder “Instrument IO/Instrument Drivers” as shown in Fig. 1.

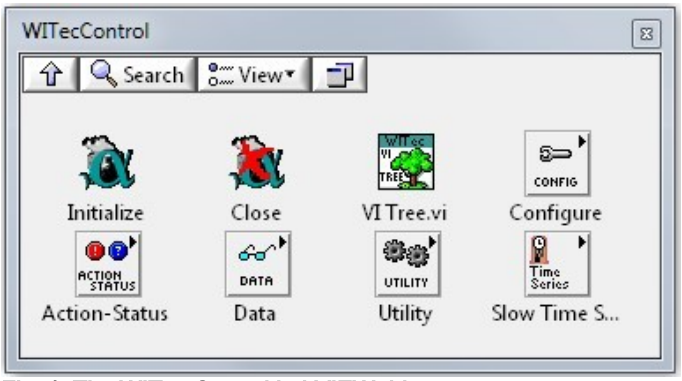


Fig. 1: The WITec Control LabVIEW drivers.

Examples

The WITec Control LabVIEW driver project contains a few additional examples to assist in understanding this interface. These examples and the corresponding detailed descriptions are located in the LabVIEW driver directory and its subdirectory “Examples”. The first example (Slow Time Series) is documented in the most detailed way including block diagrams to facilitate the understanding for the user.

- Slow Time series (EFM license and ADC + DAC boards needed)
- Fast Time series (EFM license and ADC + DAC boards needed)
- Image Stack (Piezo stage needed)

It is recommended that the users familiarize themselves with these examples prior to initiating their own project.

Test the connection

Run the example LabVIEW VI “QueryReadWrite” which is included in the WITec LabVIEW driver.
(If you use remotly access the microscope PC, enter its network name as server name in the corresponding field as shown in Fig. 2.)

After starting the VI, the “HasReadAccess” indicator should be green. After pressing “WantWriteAccess” the “HasWriteAccess” indicator should also be green as shown in Fig. 2 (if the write access is granted in WITec Control).

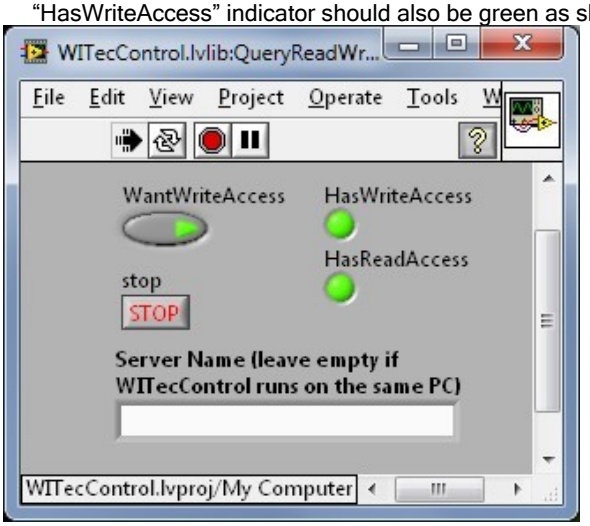


Fig. 2: Testing the Read and Write access of LabVIEW for WITec Control.

C#

An example Visual Studio Solution can be found in
C:\Program Data\WITec\WITec Suite X.X\Common Files\WITec.SDK

Example code using the SDK:

```
using (WITecSDK witecSDK = new WITecSDK())
{
  witecSDK.Connect();

  using (VideoImageAcquisition videoImageAcquisition = witecSDK.CreateVideoImageAcquisition())
  {
    Bitmap videoImage = videoImageAcquisition.AcquireVideoImage().GetAwaiter().GetResult();
  }
}
```

Example code without SDK:

```
// PreCondition: Add a reference to “BasicUniversalCOMServerLib” (Referecnes -> Add -> COM ->
BasicUniversalCOMServerLib)
static void Main(string[] args)
{
   // Connect to WITec Control
   string serverName = Environment.MachineName;
   Guid bucsCoreGuid = new Guid("C45E77CE-3D66-489A-B5E2-159F443BD1AA");

   Type bucsCoreType = Type.GetTypeFromCLSID(bucsCoreGuid, serverName, true);
   IBUCSCore wcCoreInterface = Activator.CreateInstance(bucsCoreType) as IBUCSCore;


   // Get a parameter modifier
   IBUCSFloat parameterModifier = wcCoreInterface.GetSubSystemDefaultInterface
("UserParameters|SequencerAsTimeGoesBy|IntegrationTime");

   // Read the value of a float parameter
   float value = parameterModifier.GetValue();
   Console.WriteLine("Float Value of parameter: " + value);

   // Request Write Access
   // Precondition: WITec Control must allow Remote Write Access (Control-Form, Parameter: COM Automation -> Allow
Remote Access)
   ((IBUCSAccess)wcCoreInterface).RequestWriteAccess(true);

   // Write the value of a float parameter
   parameterModifier.SetValue(0.42f);


   // Get a list of all available SubSystems
   CBUCSSubSystemsList subSystemNameList = wcCoreInterface.GetSubSystemsList(null, 0);
   for (int i = 0; i < subSystemNameList.GetNumberOfSystems(); i++)
   {
      Console.WriteLine("Subsystem Name: " + subSystemNameList.GetSubSystemName(i));
      var subSystemName = subSystemNameList.GetSubSystemName(i);

      var subSystemParameterList = wcCoreInterface.GetSubSystemsList(subSystemName, 10);
      for (int j = 0; j < subSystemParameterList.GetNumberOfSystems(); j++)
      {
         Console.WriteLine("Parameter Name: " + subSystemParameterList.GetSubSystemName(j));
      }
   }
}
```

Python

Example pseudocode:

```
import os
import sys
import pythoncom
import win32com.client

from socket import gethostname

# Connect to WITec Control
hostname = gethostname()
CLSID = "{C45E77CE-3D66-489A-B5E2-159F443BD1AA}"

IBUCSAccess = win32com.client.DispatchEx(CLSID, machine=hostname,
```

```
clsctx=pythoncom.CLSCTX_REMOTE_SERVER)
IBUCSCore = win32com.client.CastTo(IBUCSAccess, 'IBUCSCore')

# Get a parameter modifier
parameterModifier = IBUCSCore.GetSubSystemDefaultInterface
("UserParameters|SequencerAsTimeGoesBy|IntegrationTime")
parameterModifierFloat = win32com.client.CastTo(parameterModifier, 'IBUCSFloat')

# Read the value of a float parameter
value = parameterModifierFloat.GetValue()
print(value)

# Request Write Access
# Precondition: WITec Control must allow Remote Write Access (Control-Form, Parameter: COM Automation -> Allow
Remote Access)
IBUCSAccess.RequestWriteAccess(True)

# Write the value of a float parameter
newval = 0.42
parameterModifierFloat.SetValue(newval)
```

There are open source Python projects of customers available in the internet. Please contact us for further information.

MATLAB

It is possible to use MATLAB with the COM automation of WITec Control, but there are several issues.

1. MATLAB needs a ProgID to connect to the COM server. It is not set by default. Add the following entries in the registry:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Classes\Witec.COMAutomation]

[HKEY_LOCAL_MACHINE\SOFTWARE\Classes\Witec.COMAutomation\CLSID]
@="{C45E77CE-3D66-489A-B5E2-159F443BD1AA}"

[HKEY_LOCAL_MACHINE\SOFTWARE\Classes\WOW6432Node\CLSID\{C45E77CE-3D66-489A-B5E2-
159F443BD1AA}\ProgID]
@="Witec.COMAutomation"
```

2. The COM interface returns IUnknown interfaces and it is necessary to cast them to an appropriate interface. This is only possible in 32-bit versions of MATLAB. The last version available in 32-bit was R2015b. In a 64-bit MATLAB the last line in the example code will throw an error, so working with subsystems is not possible. (Refer to the help of actxserver: 64-bit MATLAB does not support custom interfaces.)
3. It is not possible to define the server type when connecting. By default MATLAB will connect as in-process server, but it needs to be connected as out-process server.
    - For 32-bit MATLAB: Delete the following registry entry and restore it after MATLAB is connected.

```
HKEY_CLASSES_ROOT\WOW6432Node\CLSID\{C45E77CE-3D66-489A-B5E2-159F443BD1AA}\InprocServer32
```

    - For 64-bit MATLAB: This is not a problem, because it is not able to load the 32-bit DLL as in-process server and is using it as out-process server instead.

For these reasons it is not recommended to use MATLAB directly. One solution is to create i.e. a C wrapper for implementing the functions to MATLAB.

Example code:

```
witeccom = actxserver('Witec.COMAutomation')
witeccom.RequestWriteAccess(true)
witeccom.HasWriteAccess
witeccore = invoke(witeccom, 'IBUCSCore')
subsyslist = witeccore.GetSubSystemsList('',0)
inttime = witeccore.GetSubSystemDefaultInterface('UserParameters|SequencerAsTimeGoesBy|IntegrationTime')
inttimefloat = inttime.invoke('IBUCSFloat')
```