# User Guide

# Velox

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FormFactor™

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# Welcome

Welcome to the Velox User Guide. This guide contains information about operating Velox software.

**NOTE**

*Only FormFactor supplied controllers are supported. Adding third-party software or drivers, or modifying the software installed by FormFactor may void your warranty.*

## Notational Conventions

This manual uses the following conventions:

**NOTE**

*Note is used to indicate important information about the product that is not hazard related.*

**CAUTION**

*Caution is used to indicate the presence of a hazard which will or can cause minor personal injury or property damage if the warning is ignored.*

**WARNING**

*Warning is used to indicate the presence of a hazard which can cause substantial personal injury or property damage if the warning is ignored.*

**DANGER**

*Danger is used to indicate the presence of a hazard which will cause severe personal injury, death or substantial property damage if the warning is ignored.*

## Velox Licensing

The Velox software license is generated specifically for each system. The system Device ID (smallest on-board physical Ethernet address) is used as the system identifier for the license. The

Device ID and serial number are needed when upgrading a system so that the system-specific license can be generated.

The software license and options you purchase for Velox are valid for twenty-five years. Options that may be purchased include VeloxPro, ReAlign/MicroAlign, VueTrack, and the IDTools (OCR-Reader, Barcode-Reader and 2DMatrix-Reader).

Click Velox > Licensing, or Help > About to display configuration and license information.

The license information details how many days are left on your license, what features are enabled, and the expiration date.

You can also request a 30-day demo for VeloxPro and VueTrack.

## Activating Your License

Activate a System License While Online

Activate a System License While Offline

The first step in renewing your license or adding a software option is to contact your FormFactor representative. After FormFactor has generated the new license, it can be activated.

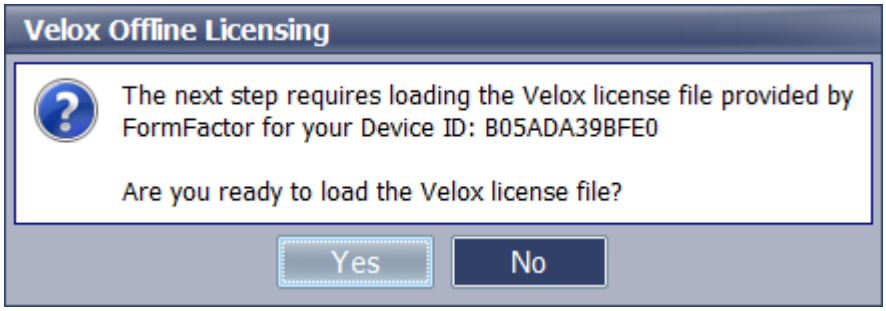
Your new license can be activated online or offline.

## Activate a System License While Online

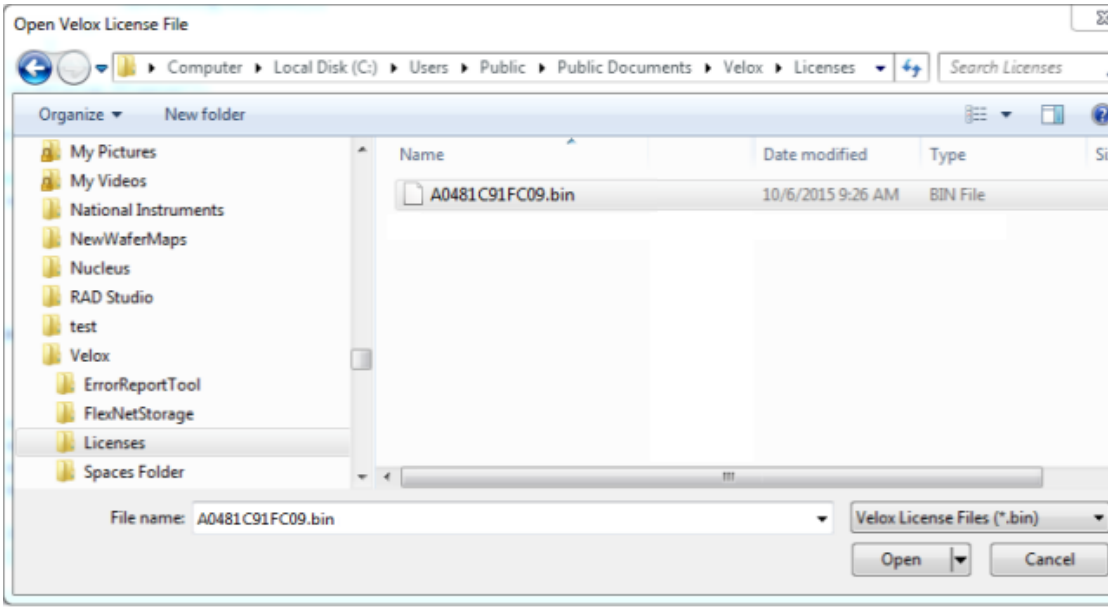
1. To activate the Velox license online, click Activate Online.
2. After reviewing Software License Agreement, click Accept License.
3. The license is retrieved from: cmicro.flexnetoperations.com.

## Activate a System License While Offline

1. To activate the Velox license offline, click Activate Offline.
2. Verify that the Velox license file for this Device ID is available to be loaded.




3. Click Yes to load the Velox license file.
4. Select the file named with your Device ID and then click Open to use the license.

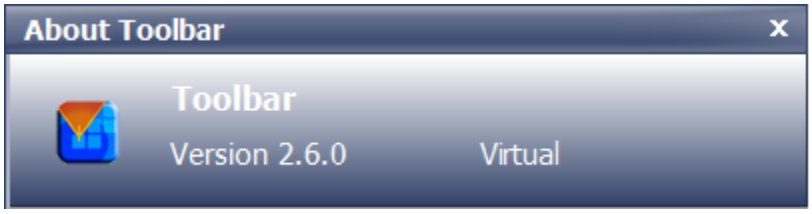



5. After reviewing Software License Agreement, click Accept License.

### Virtual Mode

If you installed Demo Minimal or Demo Full, you can run Velox in virtual mode. There is no need for a license key, but you cannot control a station in Demo mode.

To verify whether you are in Demo mode, click Help > About. If you are in Demo mode, the About Toolbar window displays Virtual at the top.




## For More Information

More information is available from these sources:

- Release Notes on the Windows Start menu > FormFactor Documentation
- www.formfactor.com

## Technical Support

If it is necessary to contact Customer Service, you can use the Error Report tool to provide the appropriate information. See Error Report Tool for details.

For immediate Sales Support or Customer Service assistance, please contact the Sales Administration Department at 1-800-550-3279 or www.formfactor.com/sales-service/product-support/cascade-rma/.

Chapter

# 1 Getting Started

Velox provides several methods of controlling and monitoring prober operation. Common routines have a system-wide effect and can be executed from different applications. All applications are notified to use the new system parameters. For instance, if a new project file is opened, every application loads its new project settings.

## Application Overview

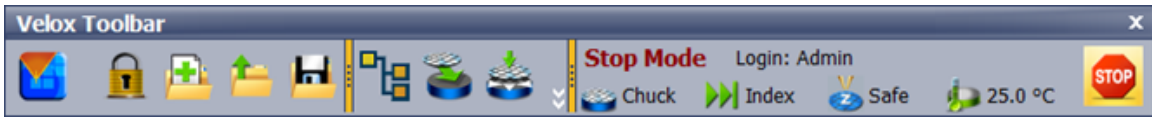
Velox software consists of a suite of applications providing several methods of controlling and monitoring prober operation. These applications share a common Project File in which all parameters, user preferences, options, and open window positions are saved. Opening a project file lets you return to the task you were working on without having to repeat prober setup. Velox applications can be started from the toolbar or Velox folder.

| | |
|---|---|
| | ControlCenter is the central program for manual prober control and prober setup. It includes prober hardware control modules like Temperature Chuck. |
| | Spectrum Vision controls the digital microscope and imaging system, and provides the interface to control the probe stations directly. |
| | Wafer Map is a graphical tool used for a wide range of applications, from manual navigation to step-and-repeat automation. All aspects of the wafer map can be changed to match the actual wafer. The WaferMap can be used to record data on other instruments for transfer to the prober. |
| | Scripting Console provides an integrated development environment for editing, executing, and debugging automation scripts. You can send commands to Velox using simple, single-line text, or you can use fully programmable automation with the Python programming language. See the Velox Remote Interface Guide for more information (on the Velox main menu, click Help > Remote Commands).<br>To access the Scripting Console from the Velox toolbar, click All applications > Tools. |
| | Optical Control tool is required when using an A-Zoom microscope and must be configured to start when Velox software starts. Optical Control is enabled in the Velox Setup window. |

## User Interface Overview

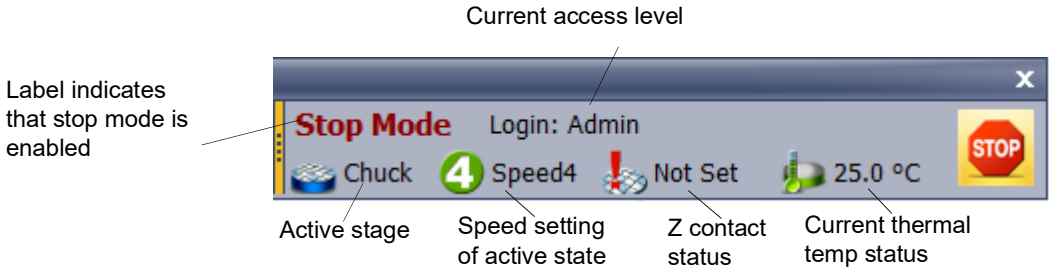
The Velox toolbar is displayed on the Windows desktop and can be docked at the top or bottom of the screen. By default, Velox has a shortcut in the startup folder.

## Velox Toolbar




| | |
|---|---|
| | Displays the Velox Main Menu. |
| | Opens Velox Login window. For information about default access levels, see Velox Login Levels.<br>For information about customizing access levels, see User Login Management. |
| | Opens a new project window and clears the current project. |
| | Opens a project from either the default location or the last saved location. |
| | Saves the current project file to the default directory, or to your selected location. |
| | Redistributes the space between the different areas of the toolbar. If an area is too small to show all buttons, an overflow button with two white arrows appears. Click for access to the hidden buttons. |

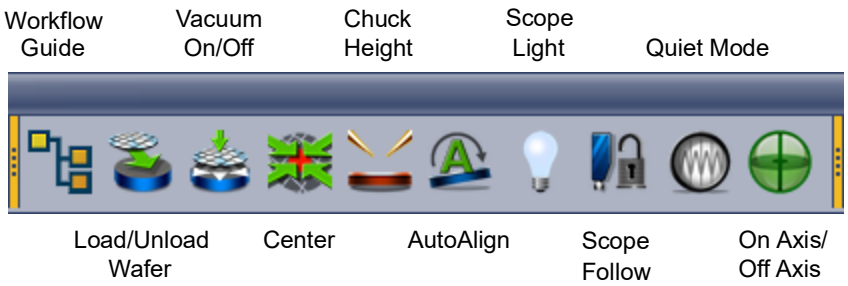
The toolbar displays status indicators pertinent to your system by default. See Status Information for more information.




| | |
|---|---|
| | Displays the current, active stage as set in the ControlCenter. Chuck stage is shown. Other stages set in the ControlCenter are Scope and Positioner. |
| | Displays the current, active speed for the active stage. Speed 4 is shown. Other speeds set the ControlCenter are Jog, Speed 2, Speed 3, and Index. |
| | Displays chuck contact status. |
| | If your system is equipped with a thermal check, either the current chuck temperature or the cooling/heating status is displayed. |
| | When enabled, all mechanical movements are stopped and the following are prevented:<br>• Movements via the user interface, remote commands, joystick, or knob interaction<br>• Heating/cooling of the thermal chuck<br>• Wafer handling jobs for the MHU<br>An error message describes the obstructed actions. |

| | |
|---|---|
| | The Stage Unlock button appears if at least one stage is locked. The button tooltip displays which stages are locked and, if available, which programs have set the locks. |

Most of these tools are available on the Velox toolbar by default, based on your system setup. For details about modifying which tools appear on the main toolbar, see Configuration Window.




| | |
|---|---|
| | See Workflow Guide and Workflow Creator for more information. |
| | See Chuck Load/Unload for details. |
| | See Chuck Vacuum On/Off for details. |
| | See Chuck/Scope Center for details. |
| | See Move to Separation Height for details. |
| | See AutoAlign for details. |
| | The Scope Light toggles the light state of the cameras. |
| | Toggles scope follow mode on and off. When enabled, the scope can follow all chuck Z movements. For more information on Scope Follow, see Configure and Calibrate Positioners . |
| | Toggles the motor power off for quiet probing.<br>• Quiet On turns off the motor power for all stages.<br>• Quiet Off turns on the motor power of all stages for subsequent movements.<br>• A move command automatically turns on the motor power for all stages.<br>The Quiet mode indicator is active only if all stages are off (chuck, scope, positioners). If only one stage is turned off, the indicator isn't active. |
| | See On-Axis and Off-Axis Mode for details about the alignment mode. |

## Velox Main Menu

Click on the toolbar to display the main menu.

| | |
|---|---|
| | Displays the menus for Programs, Tools, Interfaces, and Status. See Configuration Window for more information about displaying menus for programs and tools in your system. |

| | |
|---|---|
| | From the Projects menu, you can:.<br>• Create a new project.<br>• Open an existing project.<br>• Save the current project.<br>• Save the current project to a new project name.<br>• Create a new project from a template.<br>• Save the current project to a new template.<br><br>Velox project files are used for saving the setup parameters, user preferences, and project templates. See Project Templates for more information. |
| | The Help menu provides links to the online help and other information. |
| | Velox provides different access levels to ensure system security. See Velox Login Levels for more information. |
| | Software-only licensing encompasses all options purchased and is required to operate Velox. See Velox Licensing for details. |
| | See Configuration Window to see more information about buttons and groups. |
| | Displays the Velox Shutdown and Exit Toolbar options. See Exit Velox for details. |

## Velox Login Levels

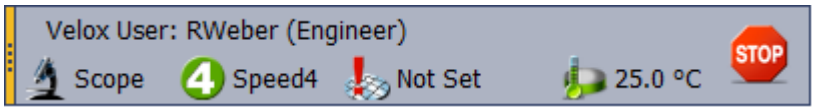
Any time you change system parameters, you should log in as Operator to prevent security problems. It is not necessary to exit an application to change the security level. If the password is correct, click the OK button to apply the new access level.

Velox applications start with the Operator security level. The following table describes user login access levels and their permissions.

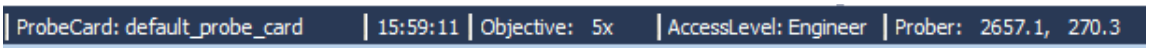
| Access Level | Permissions |
|---|---|
| Operator | Most restricted |
| Engineer | For highly-skilled users responsible for setting up the process parameters |
| Admin | Can change critical parameters; most users have Admin privileges |
| Service | Full access; Service key required |

User passwords are not case-sensitive. See Manage User Accounts for details about customizing user login IDs.

The Velox toolbar displays your user name and access level.



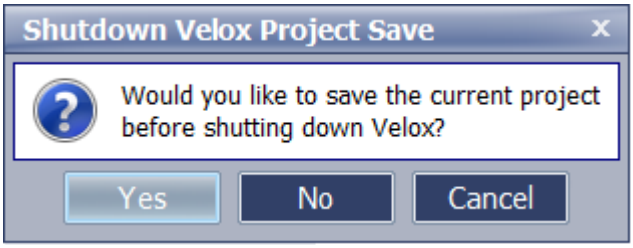

Certain applications also display your access level in the status bar.



## Exit Velox

On the Velox toolbar, click , click the Exit button, then click the Shutdown Velox button to close all Velox applications, including the Message Server running in the background.

When shutting down Velox, you can save or discard the current project.




If you select Exit Toolbar, the toolbar closes, but all open applications remain open. To display the toolbar again, click FormFactor Velox in your Windows Start menu, and click Velox Toolbar.

# Velox Project Files

**NOTE**

*Files should be saved to* C:\Users\Public\Documents\Velox.

| | |
|---|---|
| Project File (.spp) | Contains the basic setup and user preferences for all Velox applications. Saving and opening a project file can save considerable time by not having to repeatedly arrange windows, enter setup parameters, enter all parameters for working with a specific device or project, and reset personal preferences for how to use the system.<br>When opened in an application, all parameters load into all other open applications. Parameters of the open project start when you open an application.<br>Setup parameters saved in the project file include:<br>• Home position<br>• Index values<br>• Wafer diameter<br>• Z-axis contact<br>• Align and separation positions<br>Starting a new project or saving a project affects all open applications. Start, open, and save project files from the File menu of all Velox applications. Open and save project files from the Velox toolbar. |
| Spectrum Project File (_vm.xml) | Saves Spectrum project data and project settings for the trained Spectrum tools. It is loaded when you open a Velox project so that the trained tool settings are restored.<br>The Spectrum project filename is *[project_name]*_vm.xml.<br>Spectrum configuration data is in config.xml (.xpcd file for probe card data), stored in Velox\Spectrum\Config. |
| WaferMap File (.map) | Stores the wafer parameters, including wafer size, flat location, die size, testable die, and test and binning results in a .map data file for the WaferMap application. By default, the WaferMap filename for a given project is *[project_name]*._wmap.map.<br>The .map file associated with the project is loaded when you open the project. |

# Project Templates

You can create a portable project file with settings safely copied between systems. A template file contains all the relevant project settings that are safe to move between systems. However, it does not eliminate the need for retraining. Specific settings that will not be retained include:

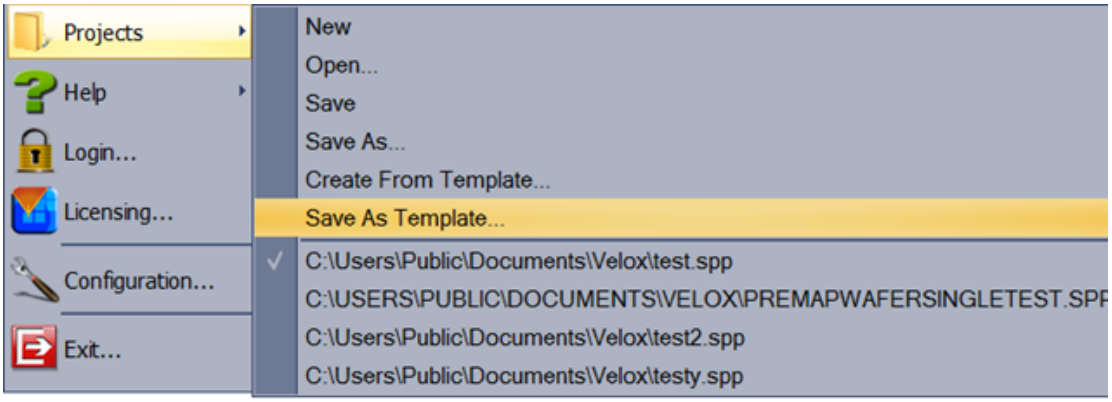
- Contact Heights
- Trained Spectrum model images and locations
- Z-heights

After you create a project from a template, you must retrain Spectrum tools before they can be used.

The project template consists of three or four project files (Project.xpcd, Project.vm, Project.spp, and optionally Project_wmap.map). These files are modified to create the project template and placed in a .zip file for easy transport. The single project template file has the ".prjtmp" extension. The WaferMap file is included if confirmed while saving the template.

## Create a Project Template

1. On the Velox toolbar, click Projects > Save As Template.

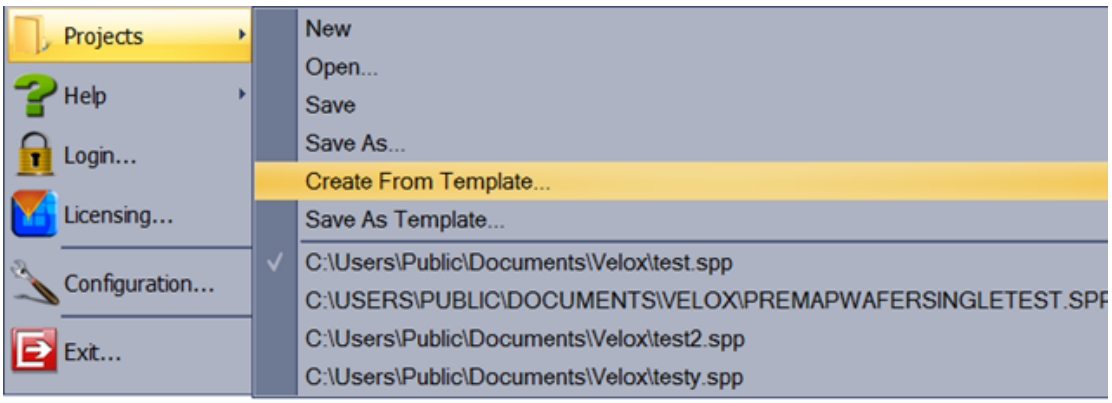



2. Enter the project template (.prjtmp) file name in the save window.

3. If the template already exists and you are overwriting, click the Yes button to include the WaferMap file in the project template.

## Create Project From Template

1. On the Velox toolbar, click Projects >Create From Template.




2. If the contact height was set in the current project, answer the prompt to retain the contact height.
3. In the open project (.prjtmp) file window, select the template file and then click the Open button.
4. In the save project window, type the name for the new project. The default is the name of the template.
5. Click the Save button. If the project exists, answer the prompt to overwrite.

   The project files are created from the project template, and the project opens.

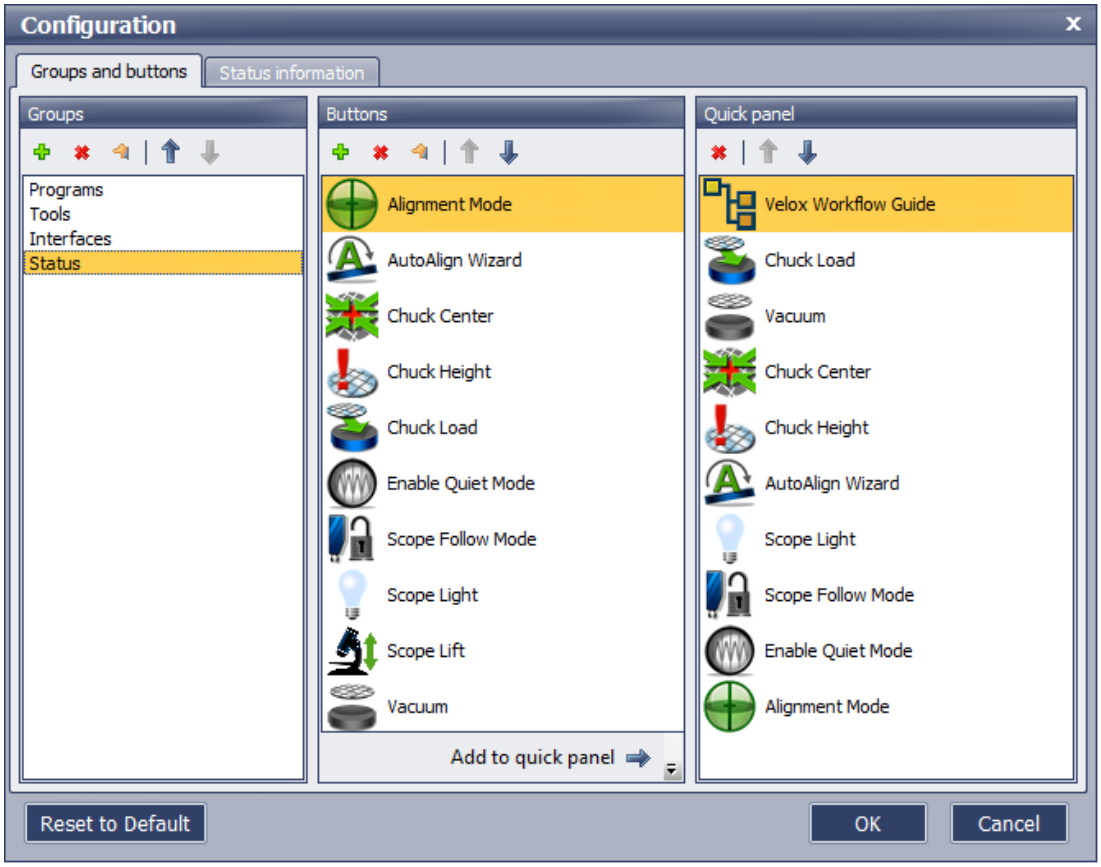
## Copy Project From One System to Another

1. On the Velox toolbar, click Projects > Save As Template.
2. Copy the template file to the Velox directory on the new system.
3. On the toolbar, click Projects > Create From Template, and then select a template.
4. Train the Spectrum tools that are required for the project. Explorer data does not need to be edited.

# Configuration Window

You can customize which buttons the Velox main menu (toolbar) displays and add new buttons in the Configuration window. In the Velox main menu, click Configuration.

Each group in the left pane displays available buttons in that group. Select a button in the center pane, then click Add to quick panel to display the tool on the Velox toolbar.




## Add New Buttons

Application Buttons

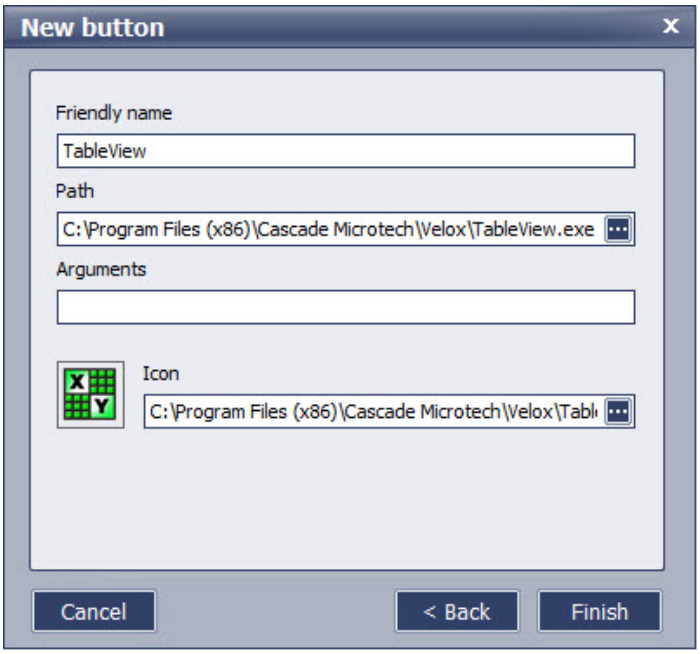
Script Buttons

Action Buttons

To create an additional button, click Add (+) in the buttons panel, then select the button type.

## Application Buttons

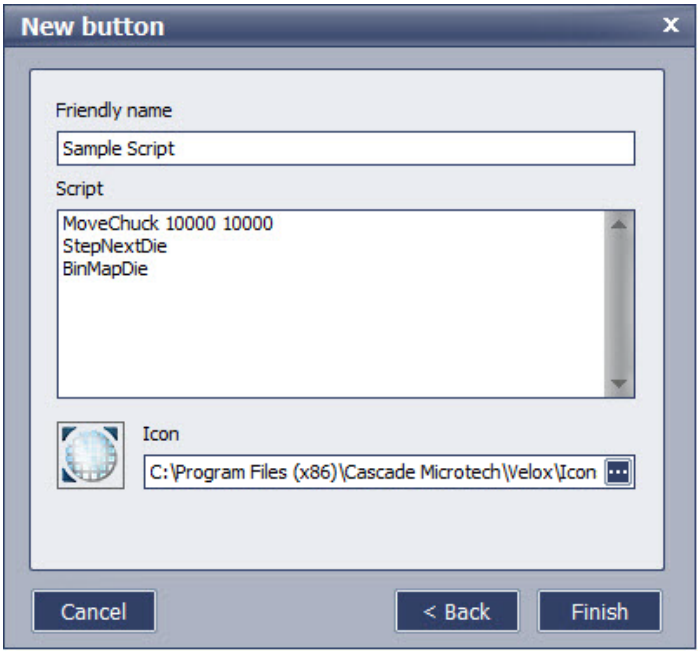
1. In the Friendly name text box, type the name to display in the menu.




2. Browse for the path to execute the command.
3. Enter the arguments to use for execution.
4. Browse to the icon for the application.

## Script Buttons

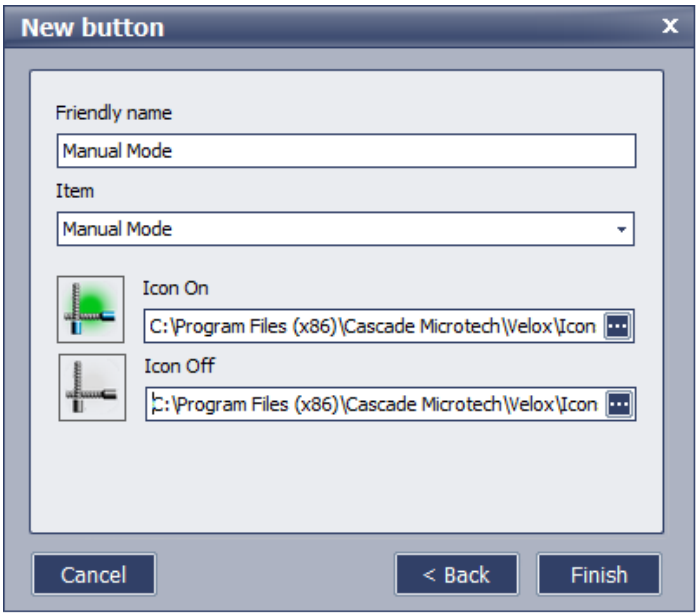
1. In the Friendly name text box, type the name to display in the menu.



2. Enter the set of remote commands to execute.
3. Browse to the icon to display for the Script.

### Action Buttons

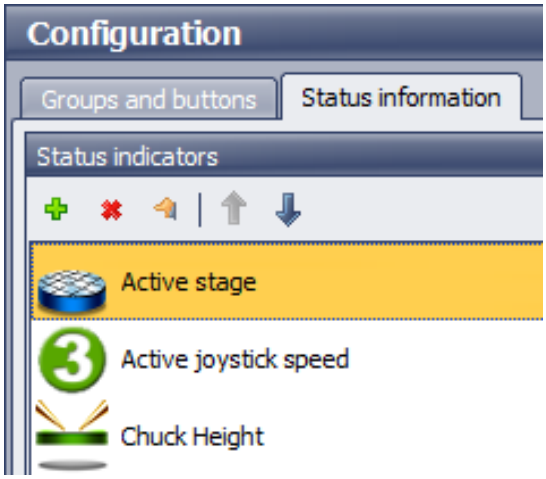
1. In the Friendly name text box, type the name to display in the menu.

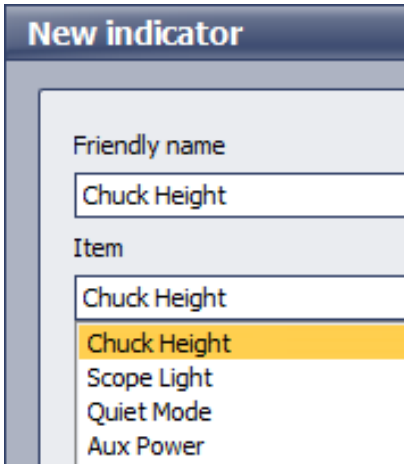



2. Enter the system parameter to control.
3. If applicable, browse to the icons to display for On and Off.

## Status Information

Different status indicators are available depending on your system setup. In the Status information window, click Add (+) to show the available selections. Move the scroll bar to see the entire list.



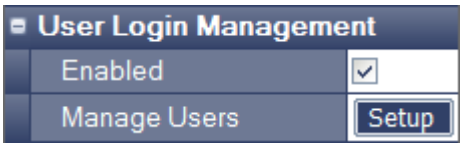



# User Login Management

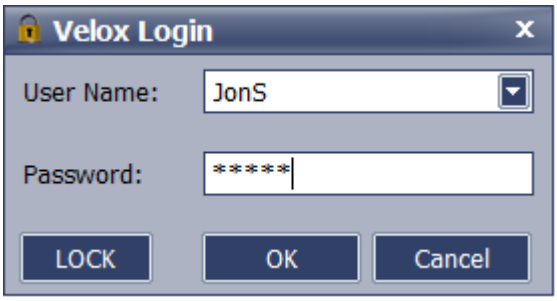
**Access Level Required:** Admin

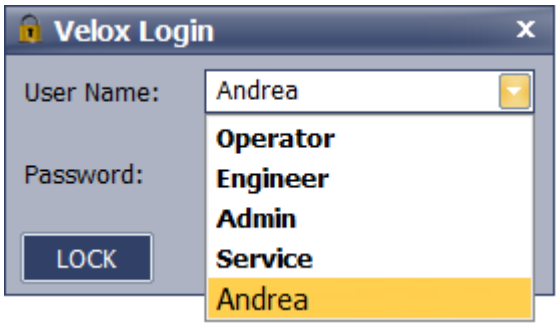
When User Login Management is enabled in ControlCenter System Setup Global Settings, you can manage user accounts in the User Management window and track who is using the station at any point in time. Usage Analyzer monitors and reports how much time a user or group of users spends on the station, and which user performed a specific action on the system.

User Login Management is disabled by default. Admin access is required for enabling Login Management in the ControlCenter System Setup Global Settings.




With User Login Management enabled, no one can use the system without logging in. It is also important to log out after your work is done to save your settings and prevent anyone else from making changes to your setup.




## Manage User Accounts

**Access Level Required:** Admin

In the User Login Management window, you can manage aspects of other Velox user accounts, including:

- Add and delete users.
- Edit user profiles.
- Reset a password for users who have Engineer- or Operator-level access.
- Change the access level for a user.

Every account user name must be unique, and every user is assigned an access level: Operator, Engineer or Admin.

The user name is displayed in the saved usage logs.

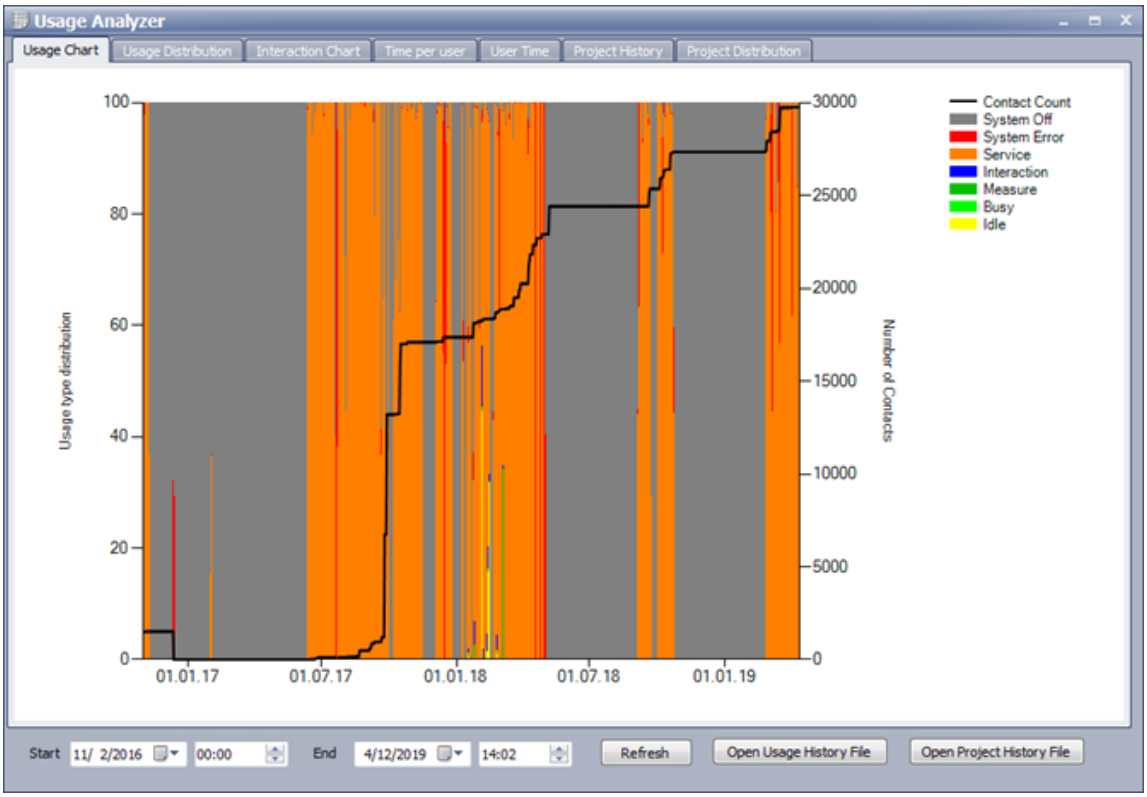
## User Login Data

Login data is stored in an encrypted file on the hard drive of the station in the Velox program data folder. The file uses the station serial number to ensure that it cannot be overwritten with a different login file. You can copy this file to a different probe station, but you must apply the new station serial number to the new file before you can use it.

## Usage Analyzer

Usage Analyzer is a monitoring program that logs the runtime of the probe station. Views depend on the system status, and date and time ranges.

To access Usage Analyzer, on the Windows Start menu, click FormFactor Velox Tools > Usage Analyzer.




Each tab shows a different view of the usage data. If applicable, each graph type provides a color legend. Project history and project distribution graphs are based on saved Velox project files.

You can set the beginning and end date and time ranges at the bottom of the window.

| Tab Name | Tab Contents |
|---|---|
| Usage Chart | Color-coded usage type distribution within the date range. Distribution range is 0–100% with number of needle contacts on the right axis of the graph. |
| Usage Distribution | Distribution of usage types during the set date range. |
| Interaction Chart | Interaction of all users on the probe station during a day in the set date range. |
| Time per user | Distribution of logged-in users by user level during the set date range. |
| User Time | Total time of logged-in users by user level during the set date range. |
| Project History | Time line of project activity within the set date range. |
| Project Distribution | Percentage of usage for projects saved on your system. |

# Velox Usage Log

Velox logs the usage and the state of the probe station. You can observe how your system is used and track usage to improve its processes. The following states are logged in order:

| | |
|---|---|
| 1. System Off | Probe station is turned off (for example, PC is off; Velox is not running) |
| 2. System Error | VeloxPro is in an error state<br>No vacuum<br>EMO button is pressed (only on stations that support this feature, such as CM300) |
| 3. Service | Service-level access requires a Service key. |
| 4. Machine User interaction | Time the system was used interactively (mouse movements or keyboard actions) |
| 5. Machine Measuring | Chuck is in contact |
| 6. Machine Busy | A stage position has changed significantly (ignores small position changes < 10µm)<br>Chuck temperature has changed (ignores small temperature changes < 5°C) |
| 7. Machine Idle | Any time the station is not in one of the other states. |

The touchdown count of the chuck stage is logged for you to track, along with the time the system was used interactively (mouse movements or keyboard actions). The station is assumed busy for 300 seconds after the last Busy event to handle the normal operation of the station.

## Logging Intervals

The system is always in one of the seven states described above, so the total time of a system is calculated by:

System Off + System Error + Service + Interaction + Measuring + Busy + Idle

The system is assumed to be used interactively for 60 seconds after the last mouse or keyboard event.

## Saving the Output

Output logs, saved in the UsageData.csv file in the Velox program data folder, can be imported into a spreadsheet application.

One log entry is generated for every 10-minute time slot. The single data fields are separated by semicolon so that the lines are easily split up in spreadsheet format.

A line looks like this:

07/09/2015 06:20:00;Default;0;0;404;196;314;21876

And is interpreted like this:

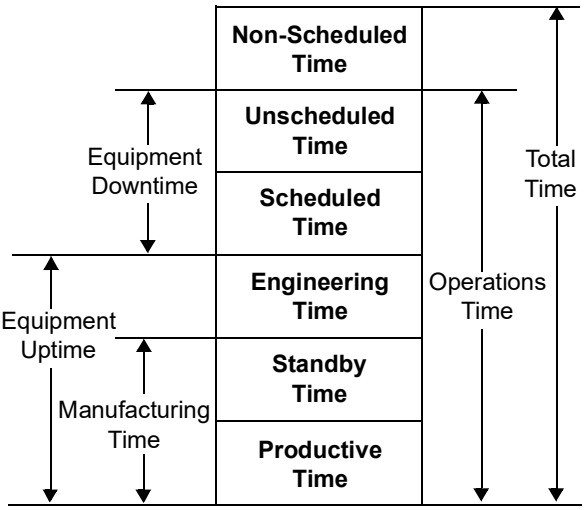
Date Time; User Name (unused); System Off; System Error; Service; Measure; Busy; Idle; Interaction; Touchdowns

To analyze the usage data file, copy UsageData.csv to a different directory and then open it in a spreadsheet to generate reports/charts.

**NOTE**

*Do not delete or write to the UsageData.csv file.*

## SEMI Standard Definitions for Usage Logging




| System status | SEMI definition |
|---|---|
| • Measure | • Productive Time (Manufacturing Time) |
| • Busy | • Productive Time (Manufacturing Time) |
| • Idle | • Standby Time (Manufacturing Time) |
| • Interaction | • Engineering Time (Equipment Uptime) |
| • Service | • Scheduled Downtime (Equipment Downtime) |
| • System Error | • Unscheduled Downtime (Equipment Downtime) |
| • System Off | • Non-scheduled Time |

Chapter

# 2 Velox Tools

Velox provides a set of tools to help you set up and use your system. To access Velox tools from the toolbar, click Velox All applications > Tools.

The Scripting Console tool is also available on the Velox Tools menu. In the Velox main menu, click Help > Remote Commands for details.

## Initialization

Initialization resets the stage positioning system by moving a stage to a specific end-limit sensor and setting the position registers to 0. Initialization is generally not needed during normal system startup or operation.

For most initialization processes, you need Engineer and Admin permissions. Some initialization functions require Service-level access. Initialization is not permitted in Operator mode.

Initialization is recommended when:

- The system has been mechanically serviced.
- A stage has been positioned by hand.
- A stage is exhibiting poor repeatability or accuracy.

The axes selected for initialization are displayed next to the selected stage and are highlighted in red while initializing. When initialization is complete, the axes are displayed in gray.

Before starting an initialization, verify that the complete movement range of all axes is free.

| | |
|---|---|
| **Initialization Menu** | The Initialization menu consists of:<br>• Read Init Configuration—reads a predefined initialization sequence for the machine.<br>• Save Init Configuration—saves the current selected initialization sequence and the initialization directions for all axes to a configuration file.<br>• Login Dialog—opens the Velox Login window.<br>• Using Initialization—opens the help topic for the Initialization window.<br>• About Initialization—displays product and license information. |
| **Start and Stop Initialization** | • To start the initialization procedure with the current parameters and settings, click the Start button. During the procedure, all controls are disabled.<br>• To stop all movements of the machine and prevent accidental damage of the equipment, click the Stop button. |
| **Position and Order** | When the Move to start position is enabled, the stages move to their start positions.<br>• Chuck start position for the XYZ axes is the load position.<br>• Chuck start position for Theta is the center position.<br>• On all other stages, the start position for the X and Y axes is the zero position and the Z axis is not moved.<br>When the Sequential Order is enabled, the selected stages are initialized sequentially. If it is disabled, the application initializes all of the stages at the same time. |
| **Status bar** | Displays the user access level and indicates the status of the initialization process. |

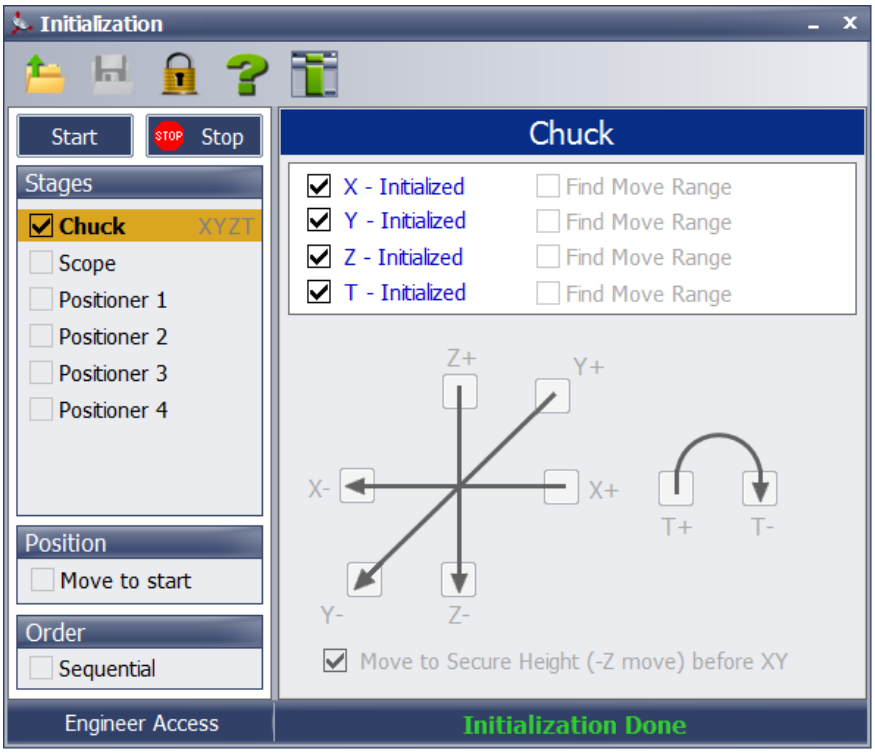
**NOTE**

*On BlueRay double-side systems, stages must be initialized in a specific order, and the chuck must be in the center position before running. Otherwise a collision may occur.*

*Elite and Summit systems require you to initialize each time before using the system. Click Init All to initialize every stage and every axis.*

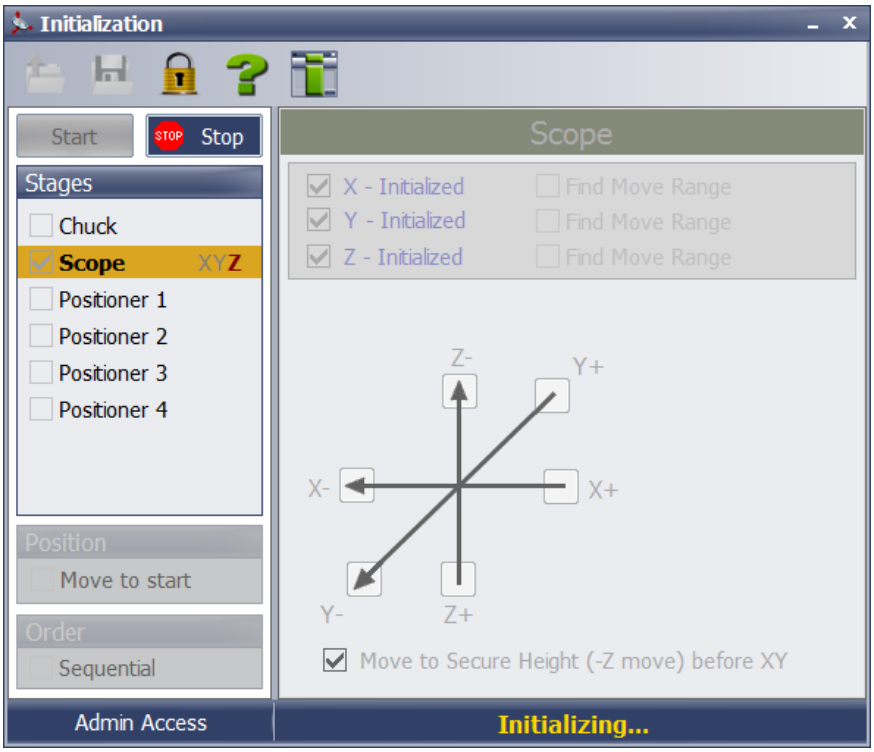
## Initialize Chuck Stage

Select Chuck in the Stages panel to begin initialization.



## Initialize Scope Stage

Select Scope in the Stages panel to begin initialization.

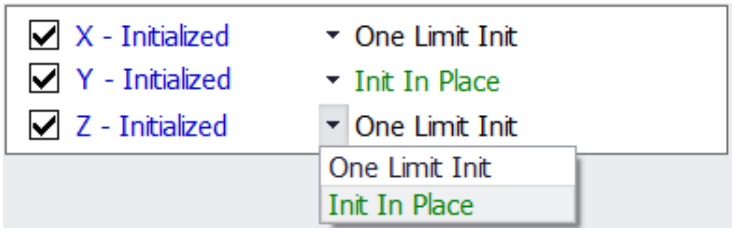



## Initialize Positioner Stage

Positioner Operating Cases

Typically, the axis must be moved in at least one direction until the electrical end switch toggles to initialize a positioner axis.

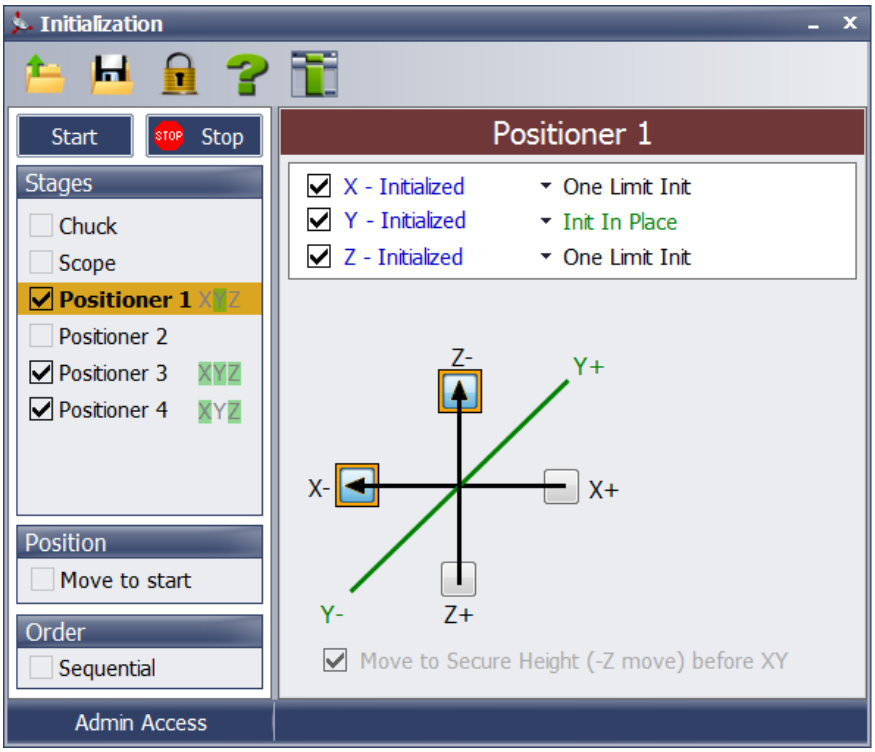
Use the Init In Place mode to initialize positioner axes without movement. For each axis, select either One Limit Init or Init In Place from the drop-down list.




Init In Place sets the current position to the center of the current movement range, and sets the Velox center position to the current position (for X and Y).

In the example below, Init In Place is set for Y.

- The green highlight signals that the init action will be safe (no movements).
- The graphic for Y does not show any arrows because no movement will be done during initialization.
- The Stages panel on the left shows all Init-In-Place axes with green background.




## Positioner Operating Cases

The operational scenario depends on the initialization state of the axis.

- You can move an initialized axis (for example, by ControlCenter).
- You cannot move an uninitialized axis.

### Previously Initialized Positioner Axis

To initialize the axis with Init-In-Place:

1. In ControlCenter, move the axis visually to center using the hand wheel.
2. In the Initialization window, set the init mode for the axis to Init-In-Place, and then set up the other axes as requested.
3. Click the Start button.

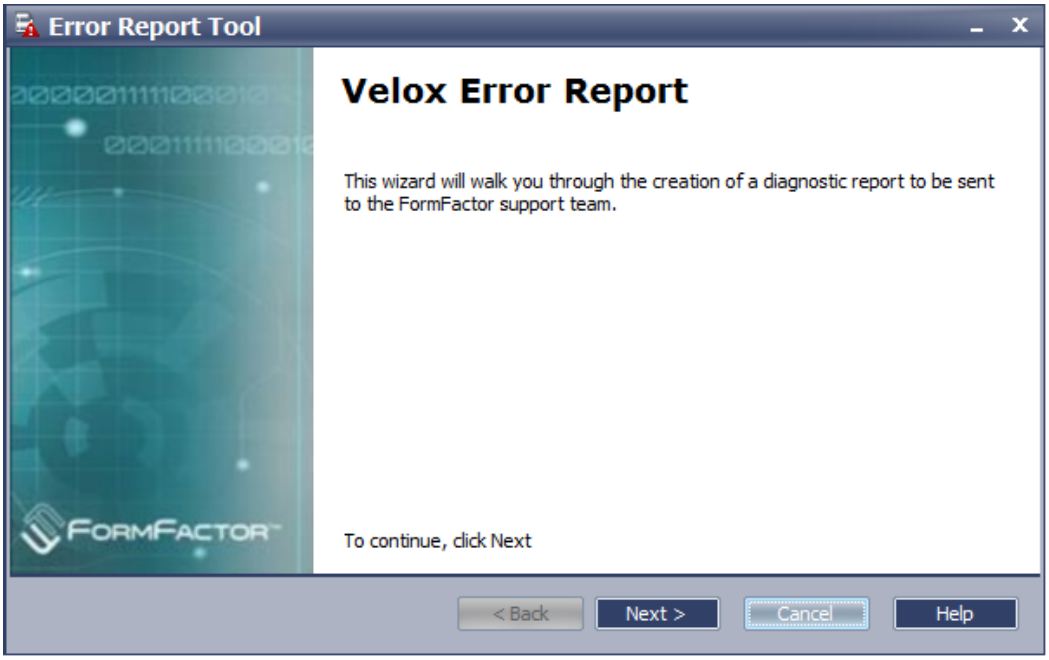
### Uninitialized Positioner Axis

To initialize the axis with Init-In-Place:

1. In the Initialization window, set the init mode for the axis to Init-In-Place, and then set up the other axes as requested.
2. Click the Start button to initialize the axis so that it can be moved.
3. In ControlCenter, try to move the axis visually to center. If you are successful, click the Start button again and initialization is complete.
4. If the move range is too small, repeat steps 2 and 3.

# Error Report Tool

The Error Report Tool analyzes an existing Velox installation for error diagnostics information when you need to contact Customer Service.




It is important to provide as much detail as possible for the support team to effectively diagnose and solve the problem.Click the Next button through each panel to add the description, capture screen shots, attach additional files, and save the report to a specified location.

## Data Collection

Velox collects data related to the system environment, as well as setup and configuration data. The data is converted into a report and compressed into a single archive to be submitted to the FormFactor Customer Service department. If you want to review the contents of the report, extract the .zip file and open the Report.html file in your browser.

Error reports are evaluated for software and hardware problems; all data is strictly confidential.

| Types of Data | Description |
|---|---|
| System data | System information, which is related to the computer running Velox, helps identify problems such as hardware conflicts or malfunctions. System data contains:<br>• All running processes and resource usage<br>• All files located in the Velox installation and data directories<br>• All hardware connected to the computer<br>• RAM and hard disk capacities<br>• Computer identification (IP-Address, computer name, login name) |
| Velox data | Velox data includes setup and configuration files, and the project that was last used. The amount of data collected depends on the Velox version and on its current state. Velox data includes:<br>• Current state of the Velox (demo mode, login level)<br>• Velox component version information<br>• Last project file and files related to this project<br>The following files are added to the report archive:<br>• Files of type .log, .xml, and .dmp<br>• Text files commands.txt, errors.txt, initialization.txt, and demoresponses.txt<br>• The kernel configuration file and kernel log files |
| User-provided data | Optionally, you can provide additional information—such as name, email address, error type, and component that caused the error—to help FormFactor analyze the problem. You can also attach screen shots and additional relevant files. |

## Error Report Directory

Error reports are data archives compressed into a .zip file. They follow a distinct naming convention:

ErrorReport_yyyymmdd_hhmm.zip

where yyyymmdd_hhmm is the date and time of the report creation. By default, error report .zip files are saved to

C:\Users\Public\Documents\Velox\ErrorReportTool

A report directory contains the following files and directories:

| **Directories** | |
|---|---|
| Report.html.files | Files for displaying the report |
| SystemEventLogs | A record of system notifications |
| VeloxData | Configuration and log files from data folder |
| VeloxInstall | Configuration from install folder |
| VeloxKernel | Kernel setup and log files |
| VeloxLastProject | The project file last used |
| VeloxScreenshots | Screen shots |
| VeloxUserFiles | Velox user-attached files |
| **Files** | |
| Report.html | Report file |
| Report.xml | Data file created by the error report tool |

# Backup and Restore

| | |
|---|---|
| **Access Level Required:** | Admin or Engineer |

You can create a backup of your Velox configuration and restore data from a backup file from the Velox Configuration Backup window.

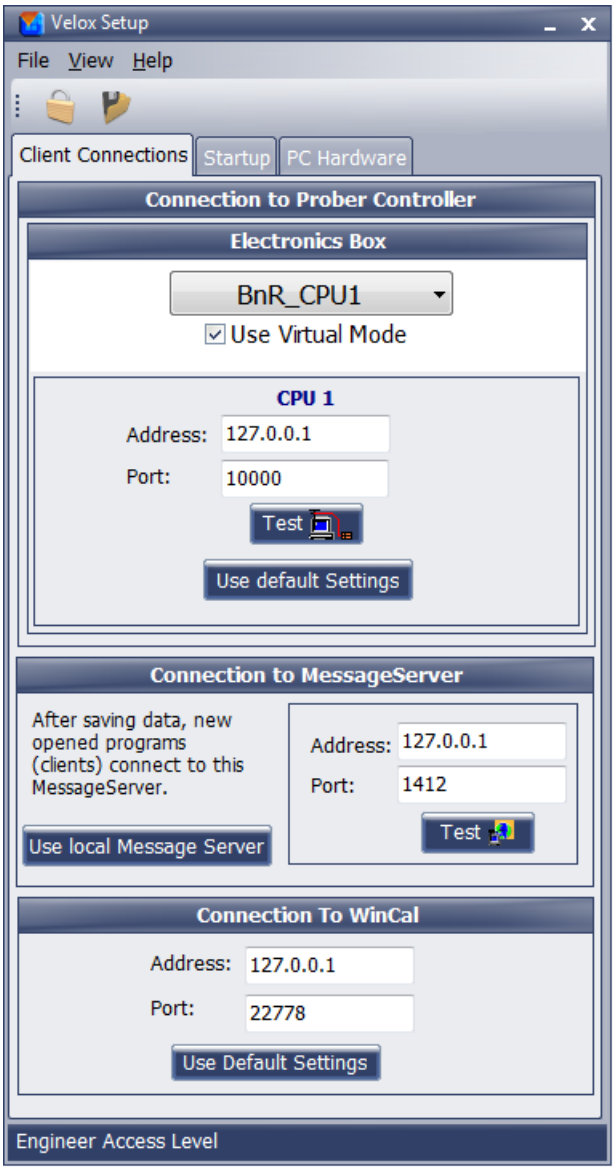
From the Velox toolbar, click All applications > Tools > Velox Backup to open the Velox Configuration Backup window.

- To create a backup file, you must have **Admin- or Engineering-level access**. Although you can customize the name of the saved file, we recommend including the backup date, which is appended in the default backup file name.
- To restore data from a backup file, **Admin-level access** is required.

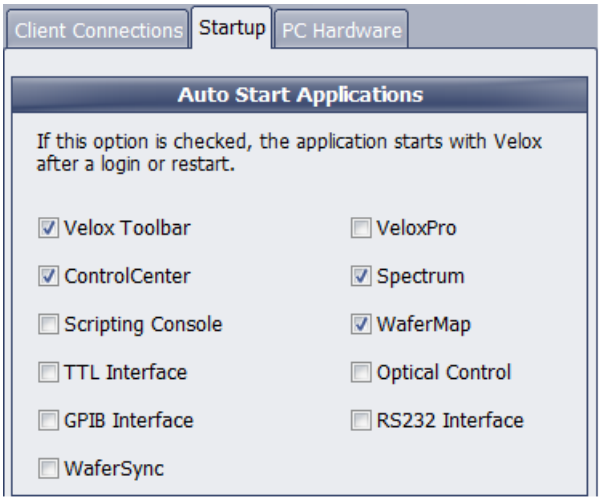
# Velox Setup

To access the Velox Setup window, from the Velox toolbar, click All applications > Tools > Velox Setup.

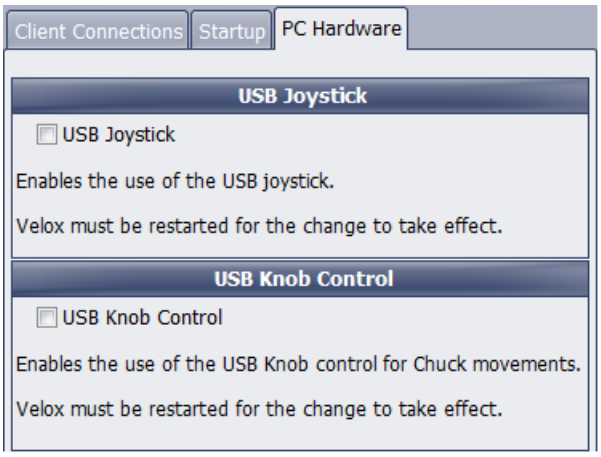
On the Client Connections tab, you can connect to the Prober Controller and MessageServer, and WinCal. Changing controller and message server connections requires Service-level access.



On the Startup tab, select the applications you want to open each time you start Velox. The example shows default startup selections.




On the PC Hardware tab, you can enable or disable the USB Joystick and the USB knob control.




# Spectrum Setup

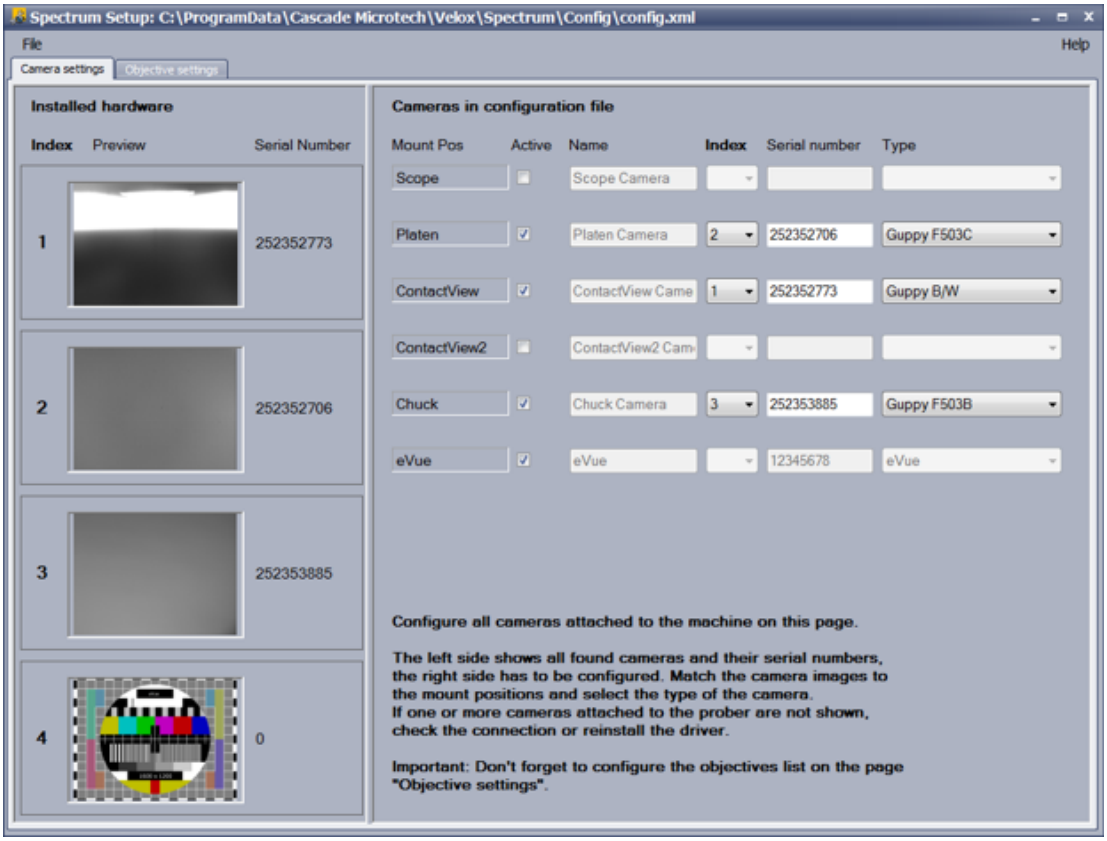
After Velox is installed on your system, you might need to adjust camera and objectives settings. Before you open Spectrum Setup, you must close the Spectrum tool. You can save the changes to the current configuration or save to a new configuration.

To open the Spectrum Setup window, on the Velox toolbar, click All applications > Tools > Spectrum Setup. The Spectrum Setup window displays all found camera images, which are loaded from C:\ProgramData\CascadeMicrotec\Velox\Spectrum\Config\config.xml (the default Spectrum folder).

## Camera Settings

To configure cameras attached to the machine, on the Camera Settings tab:

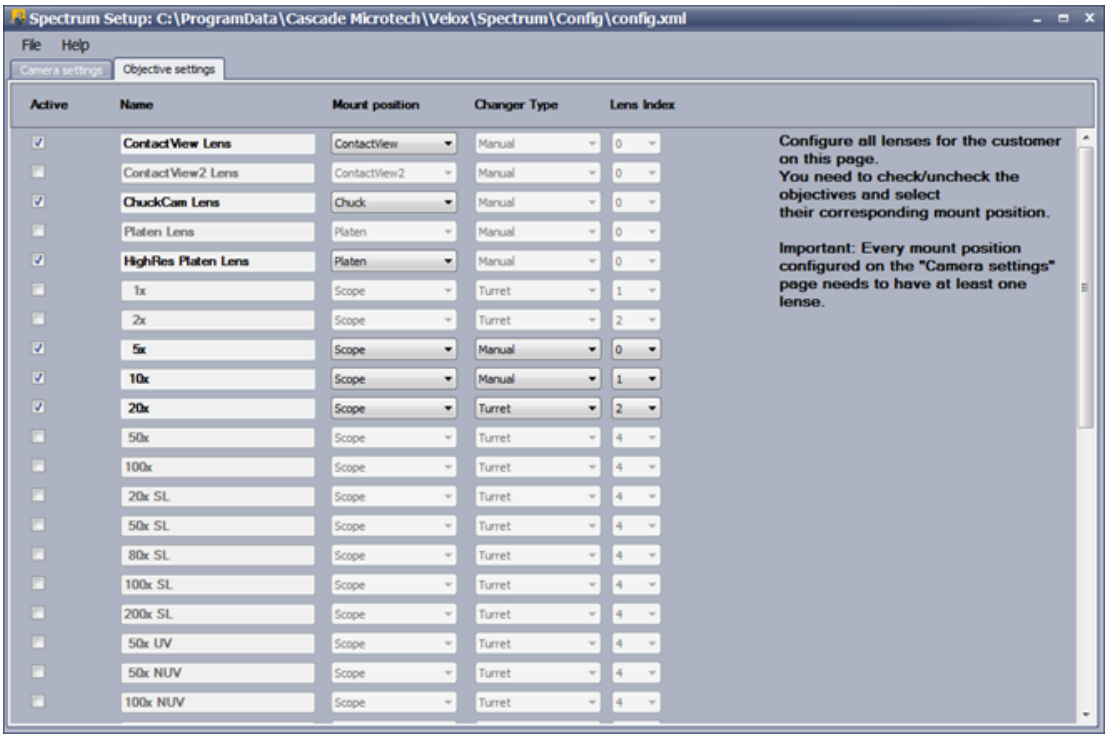
1. Set the mount positions of the available cameras as Active.
2. Select the Index of the displayed image for mount position, or enter the serial numbers manually.
3. Select the type of camera for each mount position.



## Objective Settings

To configure all lenses for the customer, on the Objective settings tab:

1. Select the objective, and select the mount position.
   - Every attached camera must have at least one lens.
   - If you use a Lens Changer, you must modify the Lens Index.
2. Save the config.xml file.




# Workflow Guide and Workflow Creator

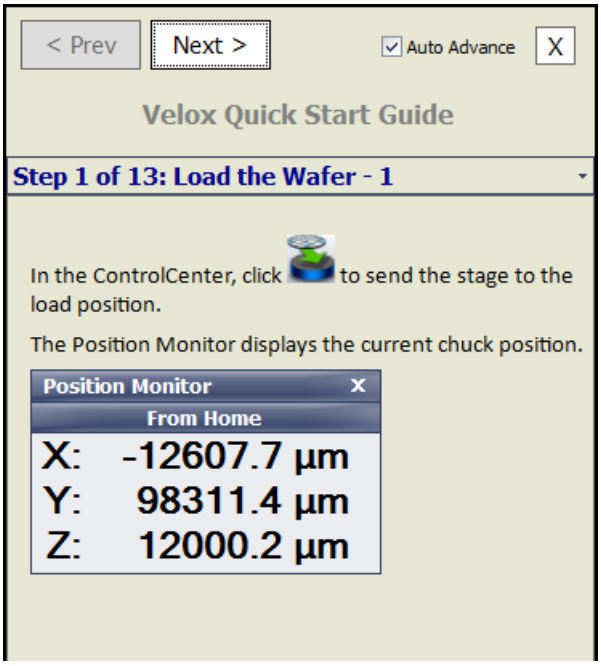
Velox includes two workflow tools to help you develop your own workflows:

- The Workflow Guide is a wizard-type tool that shows you basic steps in Velox applications as you follow along in the guide. Each step provides instruction, information, and examples with pointers showing the tool and location of the action described.
- The Velox Workflow Guide Creator is a workflow wizard that guides you through multiple standard workflows.

You can create customized workflows for your system, capture them in the Velox Workflow Guide Creator, and then use the wizard to train other users.

## Velox Workflow Guide

1. On the Velox main menu, click All applications > Tools > Workflow Guide.
2. In the Velox Workflow Guide window, select the workflow you want, then click the Start button.
   - When Auto Advance is enabled, the guide moves to the next step after you click the buttons that the guide points to in the current step. You can disable Auto Advance at any time.




- Step-related pointers stay connected to the Velox application when you move or resize windows.

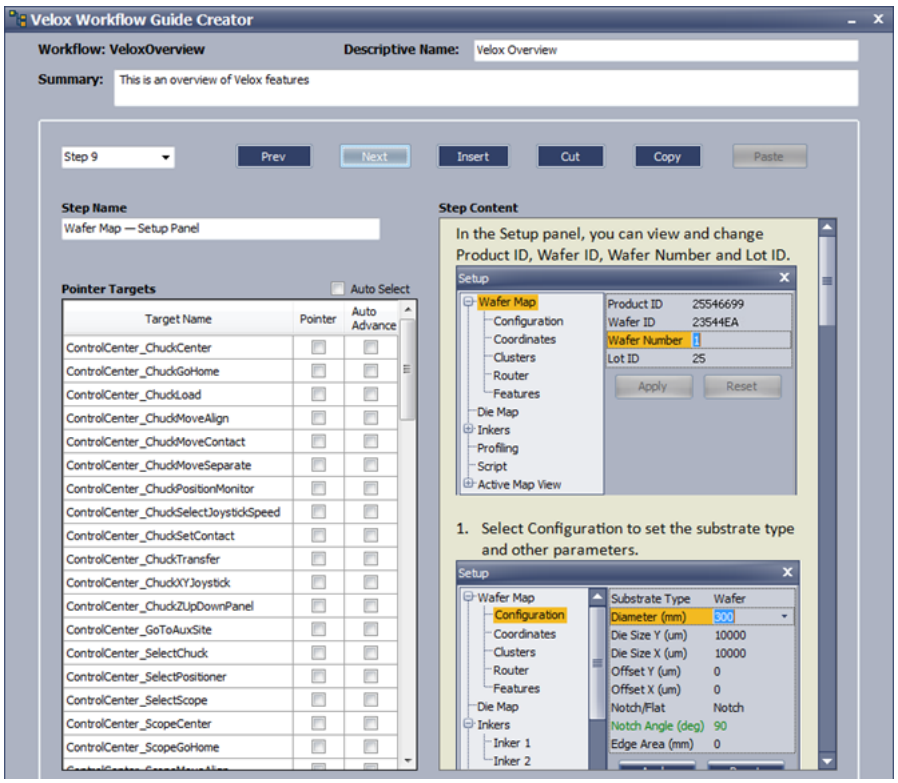
3. Proceed with each step, making settings appropriate to your probe station setup.

## Workflow Guide Creator

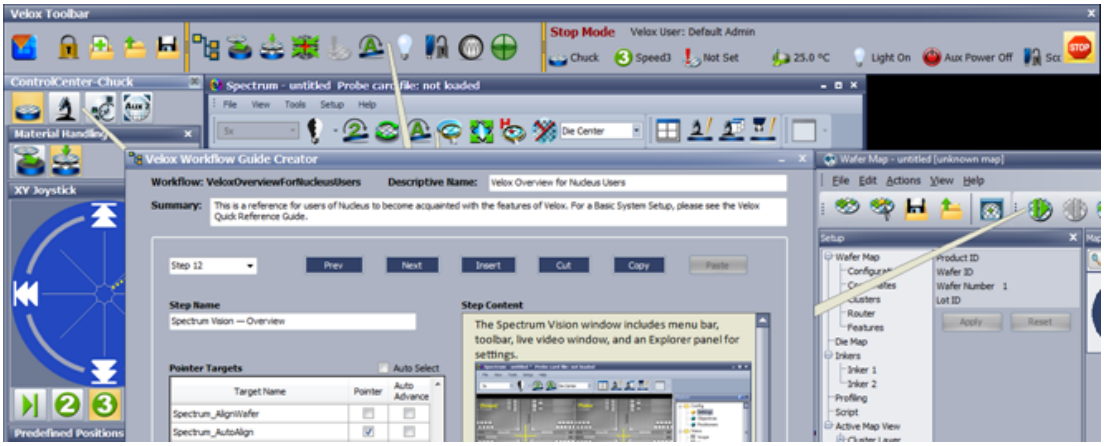
Develop your own workflows to document processes you want to reuse multiple times in the Velox Workflow Guide Creator. Create as many steps as you need for each workflow or process. Step names are optional.

1. On the Velox main menu, click All applications > Tools > Workflow Guide Creator.
2. Click the New Flow button.
3. In the New Workflow window, type a descriptive workflow name and then click the OK button.
4. Optionally, type a summary to describe the workflow.

5. In the Step Content pane:
   a. Enter exactly what you want the workflow step to display.
   b. Right-click to see a set of editing tools.
   c. You can type text directly or copy and paste text and graphics from another source. The example below shows a simple paragraph, screen capture graphics, and the first item of a list.




6. In the Pointer Targets section, specify pointers to features in the Velox applications that apply to a given instruction in the Step Content. This example shows pointers to AutoAlign in both the Velox toolbar and in the Spectrum toolbar, as well as to Select Scope, and Step Next Die.



7. Optionally, select the Auto Advance check box for individual pointers or for all pointers in the workflow.

**NOTE**

*Workflows are automatically saved to the default directory (Users\Public\Public Documents\Velox\WorkflowGuide) so that they are listed in the Velox Workflow Guide window.*

Chapter

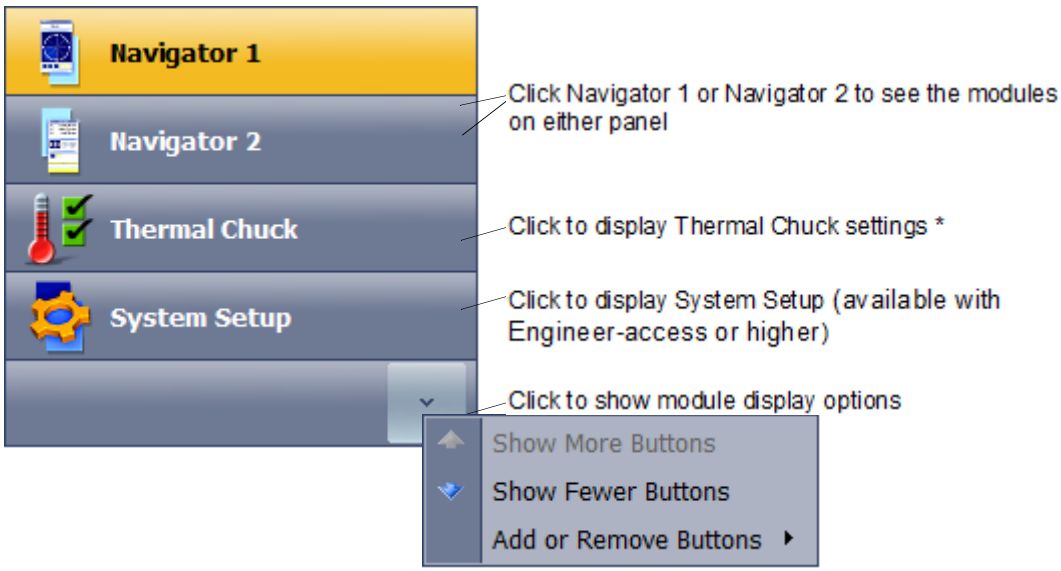
# 3 ControlCenter

Click in the Velox folder or on the Velox toolbar to open ControlCenter, or you can open it from the start up folder. For more information, see:

- Navigation
- Alignment
- Configuring XYZ
- Monitoring Position Status
- Scope Z-Fence Configuration
- System Setup
- Thermal Chuck
- Probe Cleaning
- Cleaning Manager

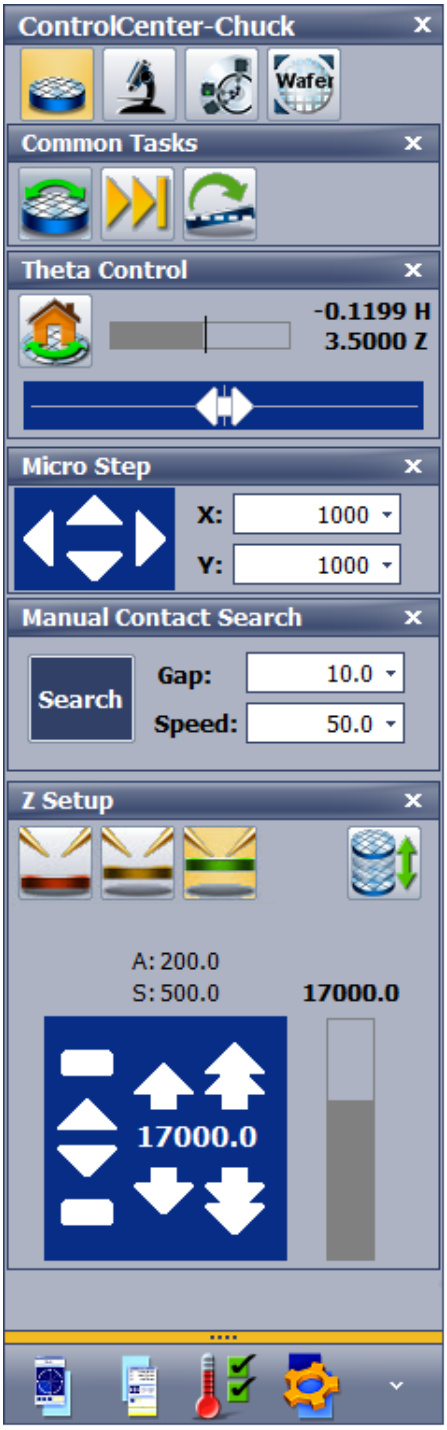
## Navigation

Use the navigator panels to control chuck and scope, system setup, and a hardware control module. They contain a set of modules for each stage to process user control and set up tasks. The module set is shared between Navigator 1 and Navigator 2.



*Thermal Chuck settings are available only if a thermal chuck is connected and enabled.

Examples of navigator panels. The display depends on your system setup and individual preferences.



Every stage has a special set of modules. Some modules have the same function in every stage, and other modules are stage-specific. The module set is shared between Navigator 1 and Navigator 2.

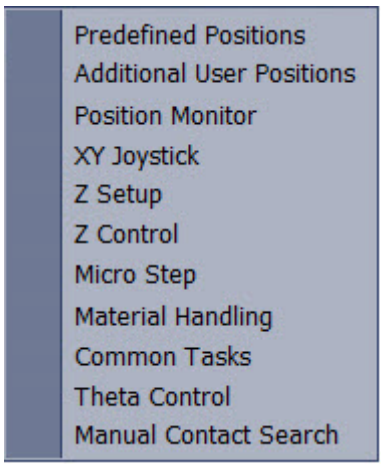
The Go to AuxSite 1 and Go to AuxSite 2 options are visible only when aux sites are enabled during system setup.

You can have up to 16 sites. Click a site to move the chuck to its position and restore the parameters of the site.

## Module Arrangement

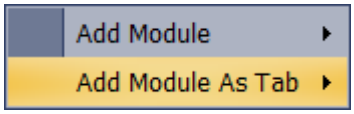
You can change how modules are arranged according to your needs and requirements. The module set is shared between Navigator 1 and Navigator 2. Every module can be on Navigator 1 or Navigator 2 or unused (hidden).

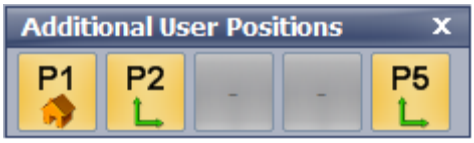
The arrangement is automatically saved when you close the program, and is available the next time you use ControlCenter.




**Add a Module**

Right-click in the navigator area or in any module title bar to display all available modules or to add a new module as a tab in the open module.



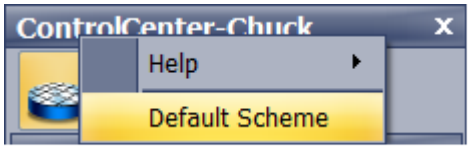



**Hide a Module**

Click X in the upper-right corner to hide the module. This can be helpful for arranging modules to suit your preferences.

**Dock a Module**

Click and drag a module title to move the module to an upper or lower position or to dock it as a tab to another module. The pop-up move controls provide a dock preview.



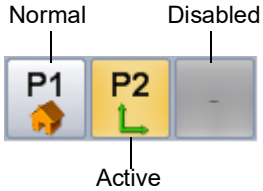

**Restore Default Module Scheme**

To reset the arrangement of all stages to the default module scheme, right-click the navigator title bar.

## Module Properties

**Disabled Modules**

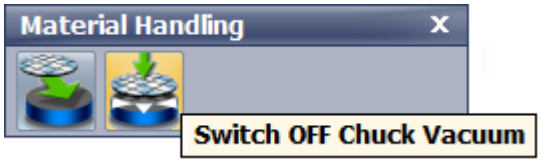
If a module is not available, it is grayed out and cross-hatched. For instance, if no edge sensor is enabled, the Manual Contact Search module is not available.




**Buttons**

Buttons can be normal, active, or disabled. For example, a Predefined Position button is:

- Normal if a position is set but the stage is not at the position.
- Active if the stage is at the position.
- Disabled if a position is not set.

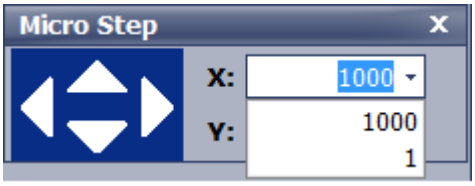



**Tooltips**

Velox displays additional information in a tooltip when you hover over a control, such as the Switch OFF Chuck Vacuum button.

**Context Menus**

When you right-click a control, Velox displays a context menu for you to choose certain values to set. For example, the user position button context menu provides options to set the current position relative to HOME, relative to ZERO, or make other edits to the button appearance and position parameters.



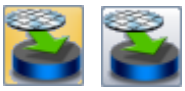
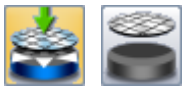
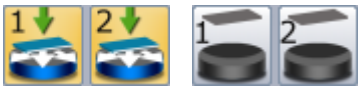
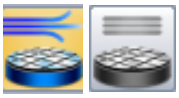

**Most Recently Used Drop-Down Lists**

After you edit and execute a parameter, such as when you move a micro step, the text box becomes a drop-down list that contains the last-used value.

When you close the program, Velox saves the list automatically and the list is available the next time you use ControlCenter.

## Material Handling (Chuck Load and Chuck Vacuum)

Use this module to load and unload wafers manually and toggle the chuck vacuum on and off.

| | |
|---|---|
|  | **Chuck Load/Unload**<br>Moves to the probe station's manual load position. The button toggles between load wafer (left icon) and unload wafer. If the current site is an aux site, the stage will automatically be switched to wafer site. |
|  | **Chuck Vacuum On/Off**<br>Toggles chuck vacuum on and off. |
|  | **Aux Chuck Vacuum (Elite 300)**<br>Toggles auxiliary chuck vacuum on and off. |
|  | **Chamber Purge On/Off (SUMMIT200)**<br>Dries the chamber to prepare for measurements and testing after other operations that might leave moisture behind. |
| | **Probe Card Purge On/Off (AP200 Tesla and SUMMIT200)**<br>Manually controls probe card air to correctly set contact height under pressure. |

## XY Joystick

The USB Joystick, implemented in ControlCenter, displays the current stage and speed. You can use the joystick to navigate in the XY plane. The pane background shows the current position graphically.

Click to select one of the preset speeds. The assigned values correspond to the joystick control box buttons.

| | |
|---|---|
| | **Continuous moves along the X axis, the Y axis, and 45° diagonal**<br>Mouse over the joystick pane to preview the navigation direction. Navigate along the yellow line; the (angle) direction is constant until the mouse is released.<br><br>**Completely free continuous moves**<br>If you right-click, the direction is not incremental and will be updated continuously until the mouse is released.<br><br>**Step moves**<br>With the Jog button selected, click one of the four white arrows to start a jog move; otherwise an index move begins.<br>Because the jog and index buttons are a button group, only one button can be selected at a time.<br><br>**Edit Jog, Set Speed, and Index**<br>Right-click a button and then click Edit to change the current step size or preset step speed setting.<br><br>**Cycle Speed**<br>Click to toggle the cycle speed on or off. |

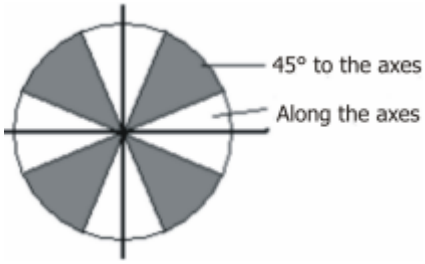
| | |
|---|---|
| | **Set Jog**<br>• Jog provides the most precise positioning capabilities.<br>• The step size is usually a few microns.<br>• Jog is typically used when at the highest magnifications. The jog motion is undetectable at lower magnifications. |
| | **Set Speed**<br>• Use Low, Medium, or High velocity for continuous moves.<br>• Defaults are .5, 5.0, and 100. |
| | **Set Index**<br>Use the index step size to step from one feature (die) to the next. |

You can use the joystick to move the stage in the X and Y axes. The plus and minus buttons set the speed of stage movement. Press the joystick button to move the stage in the Z axis.

| | |
|---|---|
| **Joystick button** | Switches between XY and Z movement. When the button is up, the joystick controls XY. When pressed, it controls Z. |
| **Left button** | Cycles through the available stage channels. |
| **Right button** | Cycles between Jog, Speed 2, Speed 3, Speed 4, and Index. |

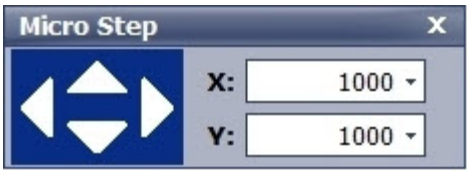
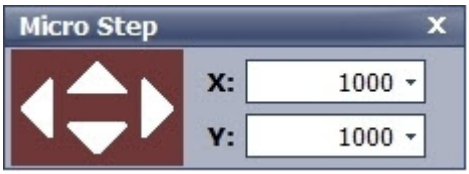
Velox immediately detects when a joystick cable is connected or disconnected. If more than one USB joystick device is connected to the system, the first detected joystick is used.

Stage and speed of USB Joystick and ControlCenter are synchronized. For example, if the current ControlCenter stage is chuck and the XY Joystick module speed is set to 4, the USB Joystick moves the chuck at speed 4.

| **Joystick Movements** | |
|---|---|
| Continuous Movements of the XY Axis | Exponential deflection behavior (with dead band):<br>Speed = k ● Deflection 5<br>Direction of movement is according to the deflection angle of the lever. |
| Index and Jog Movements of the XY Axis | • Movements are possible only along the axes or 45° (XY steps) to the axes. The deflection region is divided into sectors, as shown.<br>• The speed is always 100%.<br>• The step frequency is dependent on the deflection. For maximum deflection, the step pauses between the movements. For smaller deflection, the step frequency is exponentially lower.<br>  |
| Movements of the Z axis | • Z movement must be enabled.<br>• Continuous movement similar to the XY axis; only the Y deflection component is used.<br>• Index movement is not available (Jog movement is used instead).<br>***Note:*** *If the joystick lever is already deflected in XY direction, there is no Z movement when the Z button is pressed.* |
| **Security Functions** | |

| | |
|---|---|
| Lock the Controls | • Clicking a button has no effect when the joystick lever is not in the dead band.<br>• Releasing the Z button during a Z move stops the movement. A new movement is possible after a joystick lever zero crossing.<br>• While holding the Speed+ or Speed- button, no movement can be started. A new movement is possible after a joystick lever zero crossing. |
| Response to External Events | The following external events stop a possible movement:<br>• Stage change<br>• Speed change<br>• Disconnecting the USB cable<br>• Closing ControlCenter and shutting down the PC<br>A new movement is possible only after a joystick lever zero crossing.<br>When the lever is already deflected after detection of USB joystick device, there is no movement and a zero crossing is required. |

## Micro Step

| | | |
|---|---|---|
|  | **Micro Step (Chuck, Aux Chuck)** | The micro step module makes step moves in X or Y direction according the values in the edit fields.<br>• Chuck and aux chuck micro steps move the stage in the opposite direction.<br>• Probe micro steps move the scope so that it sees that the wafer is moved in the arrow direction. |
|  | **Micro Step (Probe)** | |

# Alignment

You can use the Common Tasks module to perform basic alignment tasks, such as align chuck, probes, or probe card.

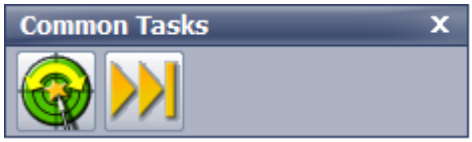
## Common Tasks

Alignment wizards simplify the process for chuck alignment, probe card alignment, probe alignment, and microscope alignment.

Probe, probe card, and scope alignment is effective only if the compensation level is technology compensation (set by Service-level personnel).

Common tasks include setup tasks, such as aligning the wafer geometry with the chuck stage, calculating the index, or aligning the probe, probe card, or scope with the chuck.

| | |
|---|---|
| **Chuck / Probe Card**<br> | • The Chuck Alignment wizard aligns the wafer geometry with the chuck stage to correct for the rotational error that is always present when a wafer is loaded.<br>• Set Index, used with index move, defines the distance the chuck moves.<br>• Probe Card Alignment virtually turns the chuck coordinate system to align the probe card if the probe card is not correctly aligned to the chuck XY coordinate system. |

| | |
|---|---|
| **Scope**<br> <br> | • Scope Alignment virtually turns the scope coordinate system to align the scope to the chuck if the scope is not correctly aligned to the chuck XY coordinate system, you can virtually turn the scope coordinate system to align the scope to the chuck.<br>• Scope Index, when used with index move, defines the distance that the chuck moves.<br>• The Microscope Z-Fences wizard defines a flexible Scope Z-Fence Configuration. |
| **Probes**<br>  <br> | • Probe Alignment virtually turns the probe coordinate system to align the probe to the chuck if the probe is not correctly aligned to the chuck XY coordinate system.<br>• Probe Index, used with index move, defines the distance the probe moves. |

## Chuck Alignment

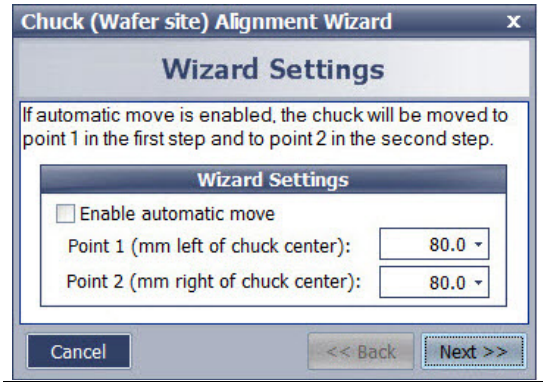
Chuck alignment is required whenever WaferMap is used, or during any other automated wafer-level test processes. Chuck alignment is recommended for any other die-to-die navigation processes.

During the chuck alignment process, you locate two points on the opposite ends of a line, typically on a wafer street line. Velox calculates the rotational error and applies a theta correction. Although this is typically performed across the entire wafer, you can use it on a single die for internal die navigation.

**NOTE**

*Do not use the theta controls during this routine; use only the XY axis controls.*

Click to open the alignment wizard. If you do not see the Wizard Settings page, click the Move to button at the top-right of ControlCenter – Chuck and then click Go to Wafer Site.



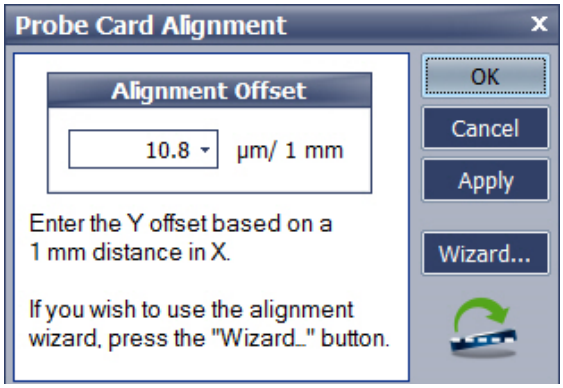

- The Point 1 and Point 2 values are the distances from center over which two-point alignment is performed. The values are typically one-half the wafer diameter less the distance from the wafer edge to a die.
- You can run this alignment at a low magnification to correct for gross misalignment, or repeat it at higher magnification for higher accuracy.

## Probe Card Alignment

If the probe card is not correctly aligned to the chuck XY coordinate system, you can virtually turn the chuck coordinate system instead of the probe card to align the probe card to the chuck.

Alignment supports the calculation of the angle between the probe card and the chuck XY coordinate system and writes the angle to the kernel. The angle is handled as Y offset based on a 1mm distance in X.

Click to edit the alignment offset or calculate it in the alignment wizard.



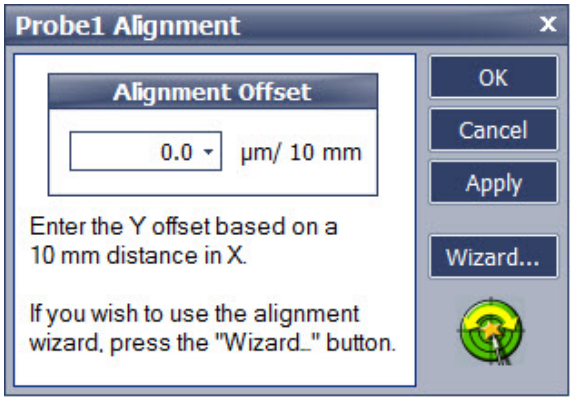

If the start alignment offset is not 0, the wizard uses the rotated coordinate system to calculate the (new) alignment offset. The offset is calculated iteratively with increasing precision.

## Probe Alignment

If the probe is not correctly aligned to the chuck XY coordinate system, you can virtually turn the probe coordinate to align the probe with the chuck.

Alignment supports the calculation of the angle between the probe and the chuck XY coordinate system and writes the angle to the kernel. For better understanding, the angle is handled as Y offset based on a 10 mm distance in X.

Click to edit the alignment offset or calculate it in the alignment wizard.

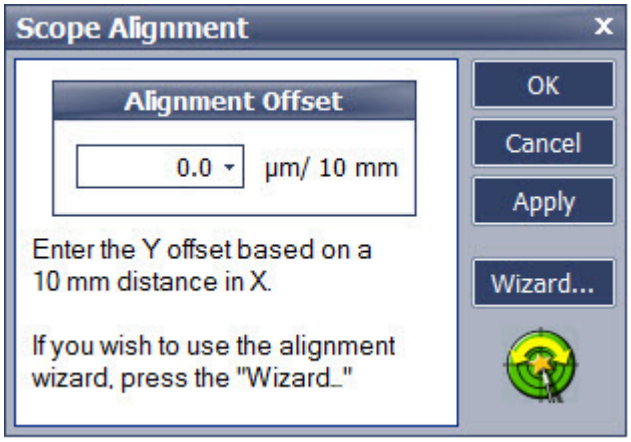



If the start alignment offset is not 0, the wizard uses the rotated probe coordinate system to calculate the (new) alignment offset. The offset is calculated iteratively, with increasing precision.

## Microscope Alignment

If the scope is not correctly aligned to the chuck XY coordinate system, you can virtually turn the scope coordinate to align the scope with the chuck. Alignment supports the calculation of the angle between the scope and the chuck XY coordinate system and writes the angle to the kernel. The angle is handled as Y offset based on a 10 mm distance in X.

Click to edit the alignment offset or calculate it in the scope alignment wizard.



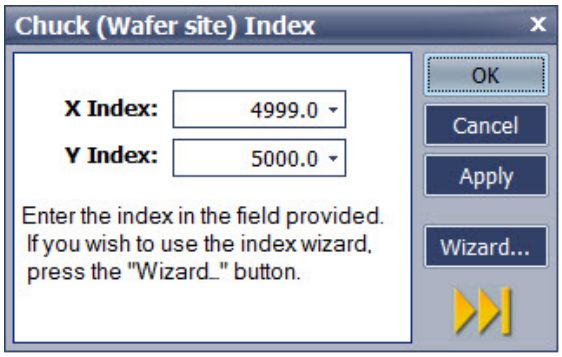

If the start alignment offset is not 0, the wizard uses the rotated scope coordinate system to calculate the (new) alignment offset.

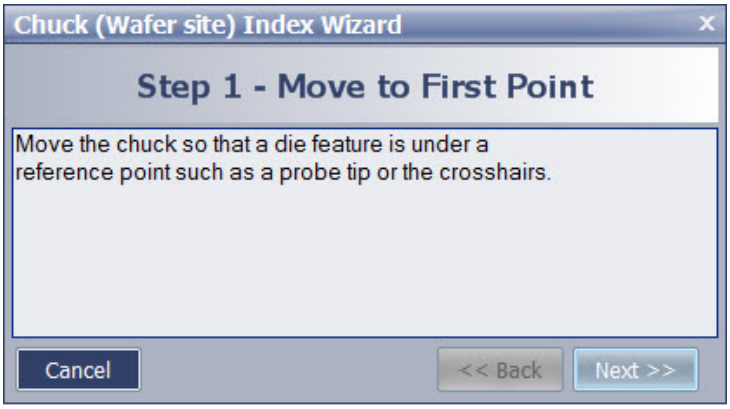
The offset is calculated iteratively, with increasing precision.

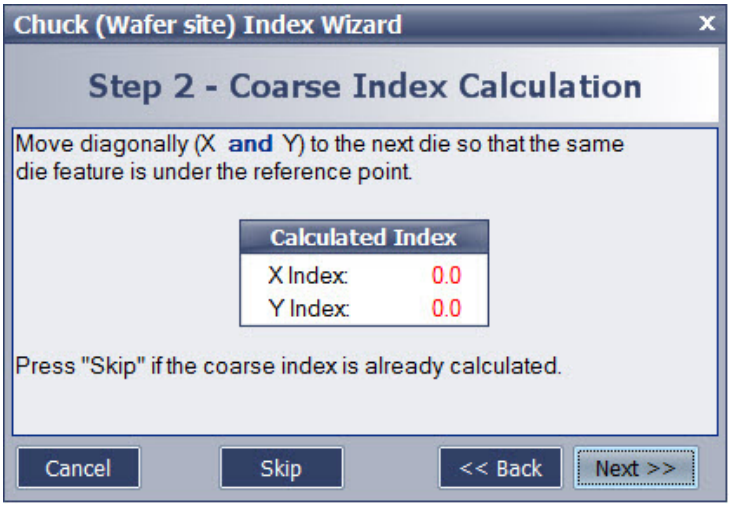
## Index Stepping

Index defines the distance that the chuck or microscope or probe moves when you use an index move. You can execute index moves from the XY Joystick module. Examples shown are for the chuck index. The scope and probe Index wizards work the same way. Typical uses are stepping from die to die on a wafer, or from cell to cell within a die.

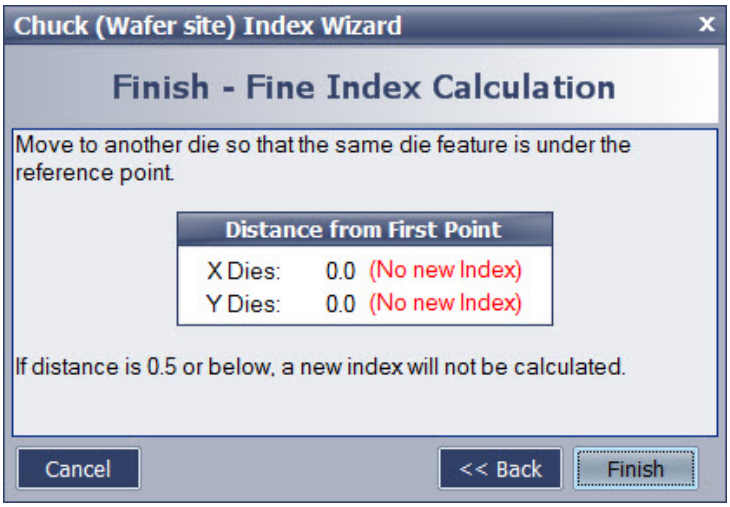
Click to edit the index or calculate it in the wizard.






The coarse index calculates from one die diagonally to the next die.




The fine index calculates from one die to a die as far distant as possible in X and Y direction.

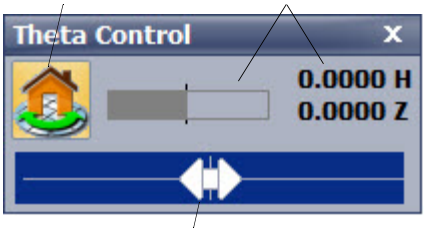
The fine index calculation uses the result from the coarse index to calculate how many dies (in X and Y) are between the fine index calculation dies.

## Theta Control (Chuck, Aux Chuck)

The Theta Control monitor represents the graphical and numerical theta position.

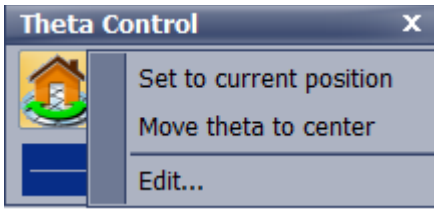
Move to Theta Home monitor

Theta position




Non-linear joystick for theta continuous moves

- The lower and upper software fences limit the bar chart. The gray-filled rectangle represents the current theta position, and the black vertical line is the theta home position.
- The value of H is the position from Theta home.
- The value of Z is the theta position from zero.



Right-click the home button to set theta to the current position, move theta to the center of the stage, or edit theta home position.

# Configuring XYZ

X and Y settings precisely indicate the chuck/scope center, scope and chuck home, and up to five user-defined positions.

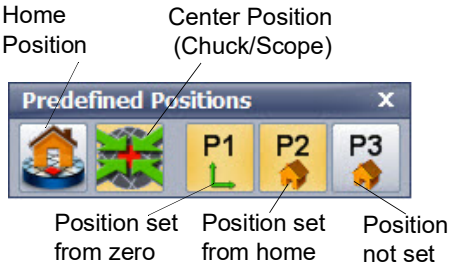
Z-Setup settings extend Z-Control settings with:

- Ability to make continuous and step moves.
- Current axis status.
- Additional user-defined speeds for up and down movements.
- A user-defined step size to step up and down.

## Set XY Positions

Use the Predefined Positions module to set XY positions and move to those positions. You can specify more positions in addition to default positions include home and center. Once defined, click the home button or user-defined button to move to the specified position.

**Predefined Positions**




The P1, P2, and P3 buttons are user-defined positions.

**Chuck/Scope Center**

Center position is approximately the middle point of the XY plane.

**Home Position (Scope and Chuck)**

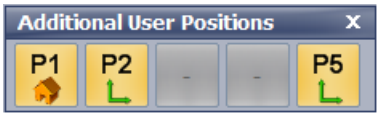
The home position is typically used as the point to which all wafer or device positions are referenced.

- Right-click the home button and click Set to current position to define the current position as the home position.
- Right-click the home button and then click Edit to set the X and Y positions for home position.

**Home Position (Positioner)**

Right-click the home button to set home to the current position or specify home by XY coordinates.

**User-Defined Positions**




You can define up to five additional positions. Right-click in the Predefined Positions module, and then click Add Module > Additional User Positions to display this module.

Right-click a user position button to set the position from zero or from home. You can also click Edit to configure the button appearance and set position parameters.

## Z Control

You can set separation, alignment, and contact heights in Z Control or Z Setup. Your station might also support the toggle lift button to toggle between the current position and the lower software fence. For additional settings and features, use Z Setup.

## Z Setup

Z Setup: Chuck, Aux Chucks, Probe

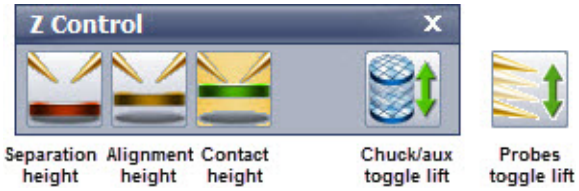
Z Setup: Microscope

Z Setup: Probes

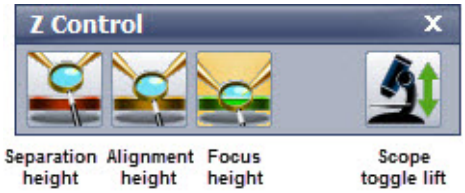
You can modify settings for Z Control in the ControlCenter Z Setup module. in Z Setup, settings are the same as those in Z Control shown below and more: Z Setup also includes step speed settings and navigation, visual positional indicators, and a quick look at separation, alignment, contact, and current position.

Use the toggle lift button on the top-right of the Z Setup or Z Control pane to quickly toggle between the current position and lower software fence. Lift buttons are not available on all stations.

Chuck, Aux Chuck Z Control Buttons




Scope Z Control Buttons




**NOTE**

*Separation height and alignment height are relative gaps to the contact height, which is an absolute coordinate. The Contact Height button is available only when the system is at the Probe Position offset compensation in Spectrum.*

**CAUTION**

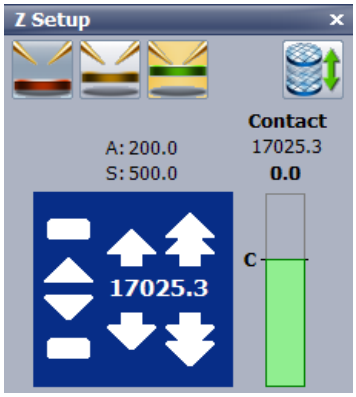
*The current contact height is lost when you reset the Message Server or controller. Make sure to reset contact height before proceeding.*

## Z Setup: Chuck, Aux Chucks, Probe

Displays the separation, alignment, and overtravel gaps.

The overtravel label is hidden unless Use Overtravel is enabled. See Edit Overtravel for details.

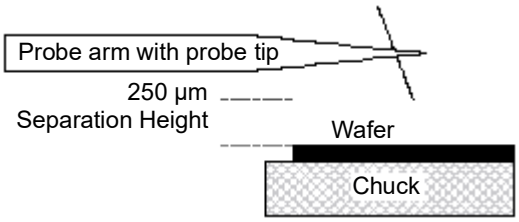
Right-click buttons to edit settings.




### Move to Separation Height

The separation height (the gap relative to contact) is the height below contact at which there is no possibility of the probe tips contacting the device under test during indexing and other coarse moves.

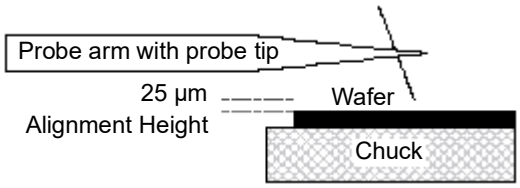
The default is 250 µ below contact.




### Move to Alignment Height

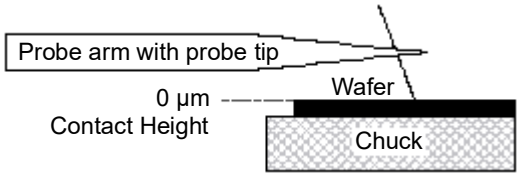
The alignment height (the gap relative to contact) is the height below contact at which the device under test and the probe tips are both in focus (at low magnification) for aligning the wafer or probe tips.

The default value is 25 µ below contact.




### Move to Contact Height

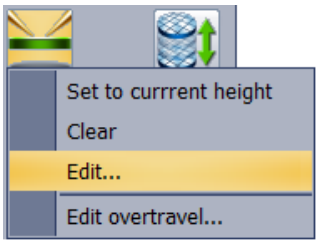
Contact refers to the chuck height at which the probe tips are in contact with the device under test. The contact height should provide adequate pressure for electrical contact integrity without damaging the device or probe tip.




When the contact height is defined, it is given the height of 0, and is the point from which all other heights are referenced. It must be defined first, before all other heights. Until it is defined, the chuck/probe height controls are disabled.

### Set Contact to Current Height

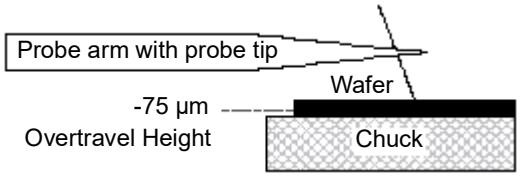
Right-click the Contact Height button, then click Set to current height.



**Z Setup: Chuck, Aux Chucks, Probe**

**Edit Overtravel**

The overtravel gap is the relative height above contact that provides additional contact pressure or scrub. It is typically used for probe cards and is set at 25-100 µ.




To enable overtravel:

1. Right-click the Contact Height button and then click Edit overtravel.
2. In the Set Overtravel Gap window, select the Use Overtravel check box.
3. Set the overtravel gap and then click the OK button.

**Toggle Lift (Chuck, Aux Chuck)**

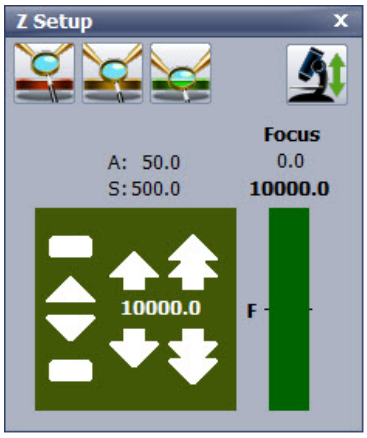
Toggles the chuck between current position and lower software fence. If contact is set, the upper lift position is not higher than separation height. If chuck is in contact, the lift toggles back to separation.

**Toggle Lift (Probe)**

Toggles the probe between current position and lower software fence. If contact is set, the upper lift position is not higher than separation height. If probe is in contact, the lift toggles back to separation.

**Z Setup: Microscope**

Displays the separation and alignment gaps.




**Move to Separation Height**

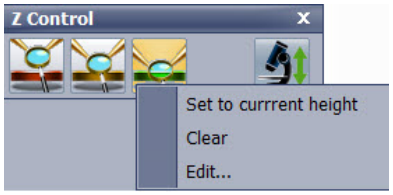
The separation height for chuck is the gap relative to contact that keeps the probe tips from contacting the device. Microscope has this height also to refocus the scope easily when the chuck moves from contact to separation. For details about chuck separation height, see Move to Separation Height in Z Setup: Chuck, Aux Chucks, Probe.

**Move to Alignment Height**

The alignment height for chuck is the height below chuck contact at which the device under test and the probe tips are both in focus, at low magnifications, for aligning the wafer or probe tips. The default value is 25 µ below contact. Microscope has this height to refocus the scope easily when the chuck moves from contact to separation.

**Move to Focus Height**

Focus height is a user-defined setting that you designate with the highest magnification objective. Use focus height to get back within the range of focus after the focus is changed so that you can focus on varying device topography heights.




This function is applicable with motorized focus drives only.

**Set Focus to Current Height**

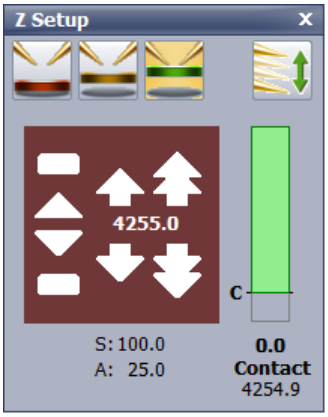
Right-click the Focus Height button, then click Set to current height.

**Toggle Lift Scope**

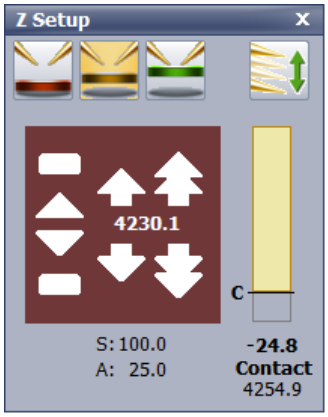
Toggles the scope between current position and upper software fence.

**Z Setup: Probes**

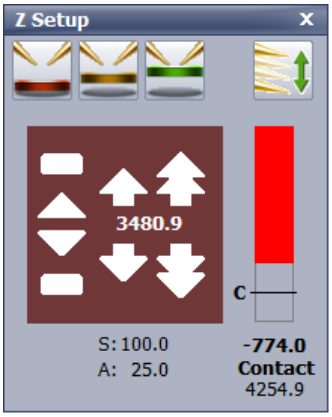
Displays the separation and alignment gaps. The probes toggle lift button, on the top-right of the pane, is not available on all stations.




Green bar indicates that Z is at contact height




Yellow bar indicates that Z is at alignment height




Red bar indicates that Z is at separation height

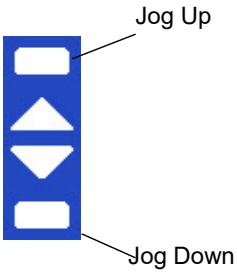
Z Setup includes a navigation control to move up and down. Three user-defined speeds and to step up and down with one user-defined step size. A height-dependent colored bar chart and numeric labels provide a quick view of the current axis status.

**Set Jog**

**Best Usage:** Small step moves.

To manually find the exact contact height in Z Setup, right-click the Jog Up control and then click Edit to set the jog value in the Set Job window.

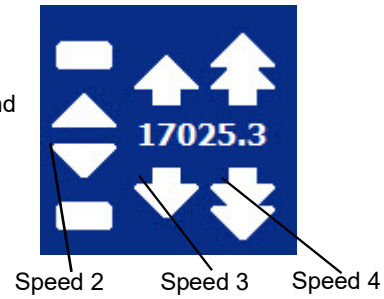
The Expert Control Panel Z buttons also use the jog value.

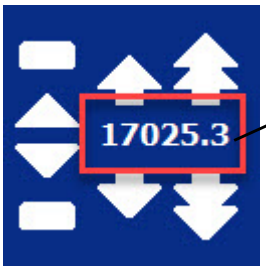



**Set Speed Arrows**

**Best Usage:** Continuous moves.

To set the speed for the Speed 2, Speed 3, or Speed 4 up and down arrows, right-click an arrow and then click Edit.



| | |
|---|---|
| **Current Position Label**<br>Displays the current Z position from zero |  |

# Monitoring Position Status

You can monitor position status using the Position Monitor module, status windows, and the Fence Monitor.

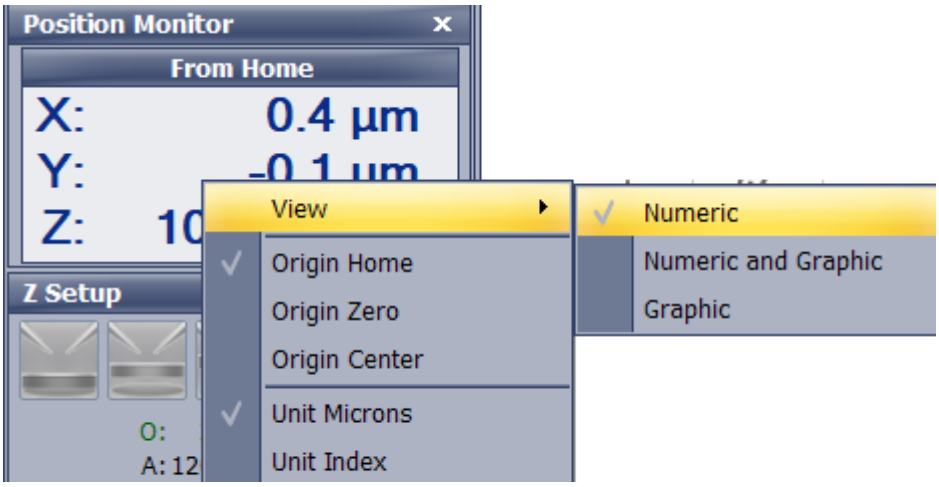
| Monitor | Where to Access |
|---|---|
| Position Monitor | Select a positioner. The Position Monitor is a module in the ControlCenter. |
| Status window | Right-click the Position Monitor pane and then click Show Status Window. |
| Fence Monitor | Right-click the Position Monitor pane and then click Show Fence Monitor. |

## Position Monitor

The Position Monitor displays the current position of motorized stages, such as the chuck, scope, and probes. You can use it to locate specific coordinates or to note coordinates for later reference.

- Microns are the unit of measure used to define the device under test.
- Index indicates the number of moves from the origin (typically used to display the number of dies from the home die).

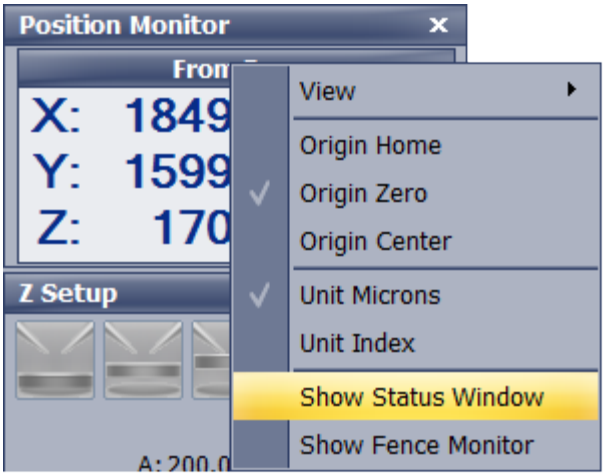
  Right-click in the From Home pane to change the view.



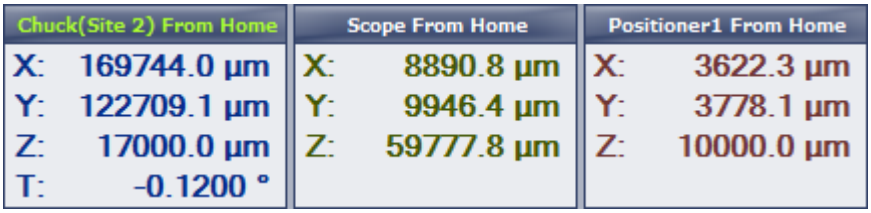
## Status Windows

Status windows for each active stage can be displayed horizontally or vertically on your desktop. By default, the chuck status window will be opened when you select Show Status Window from the Position Monitor pane.

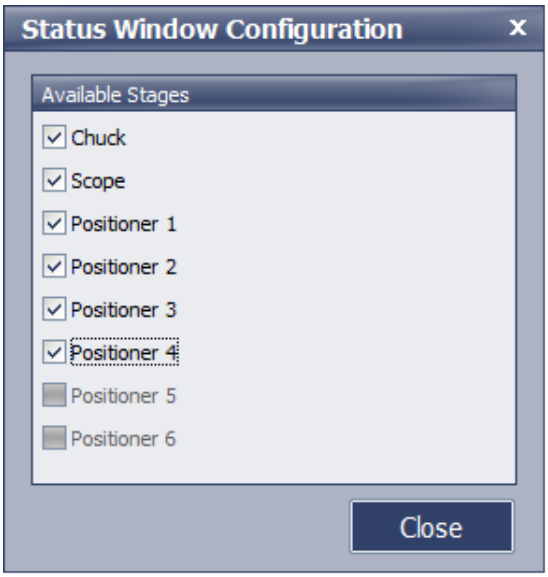
You can move the window anywhere on your desktop and it will remain topmost on the screen.



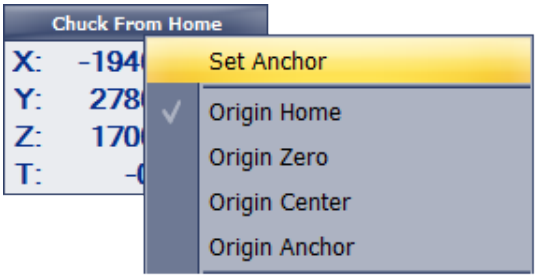

From the default status window, right-click to display an additional menu. This gives you the opportunity to configure the status window and to switch from horizontal to vertical display. For each stage, you can set the coordinate display from home, zero, center, or anchor. From the menu, select Configure Status Window.



In the configuration window, you can select all or only some of the available stages.



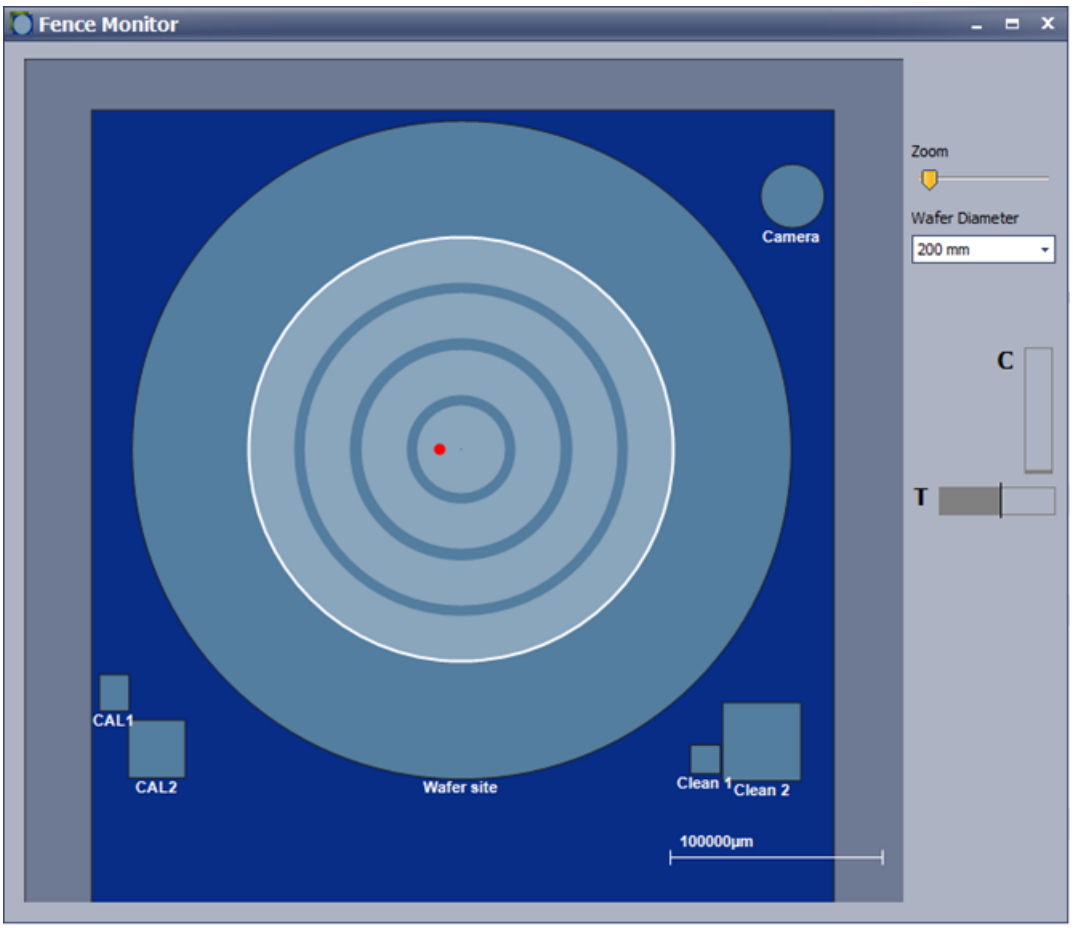

When you click the Close button, the status window settings are saved so the next time you start ControlCenter, the status window will use the previous settings.




You can define an XYZ anchor for each stage, which you can use as the reference position. Right-click in the status window and click Set Anchor.

## Fence Monitor

The Fence Monitor provides an enhanced graphical representation of the chuck and aux chuck positions and is helpful when working with aux sites. It lets you move inside the fence areas, and you can switch aux sites by double-clicking inside the fence areas. From the Position Monitor menu, click Show Fence Monitor.




# Manual Contact Search (Chuck, Aux Chuck)

The Manual Contact Search module supports user contact search by edge sensor. The corresponding edge sensor (1 or 2) must be enabled in System Setup.

# Scope Z-Fence Configuration

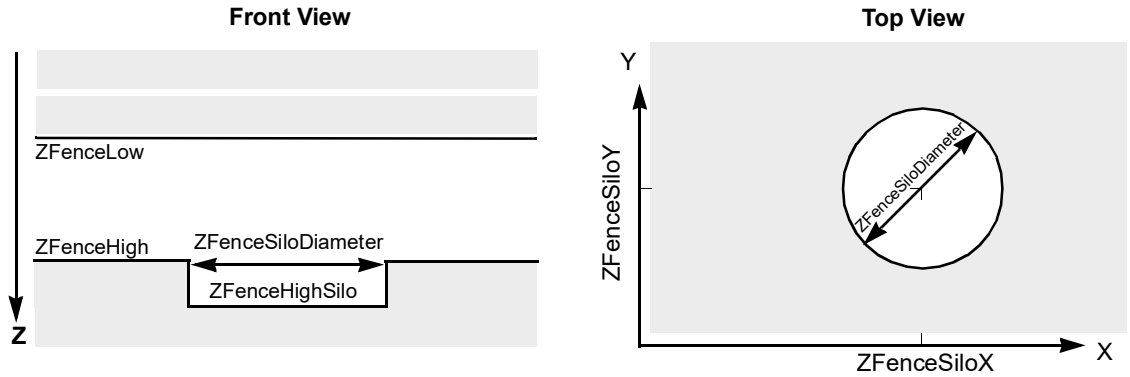
A Z-fence with silos is defined by a list of silos with XY positions, Z-height and diameter, a lower and an upper Z-fence.

Movement is considered safe:

- Between ZFenceLow and ZFenceHigh
- Inside silos between ZFenceLow and ZFenceSiloHigh

Depending on probe station type, you can define a a flexible fence configuration for the scope.

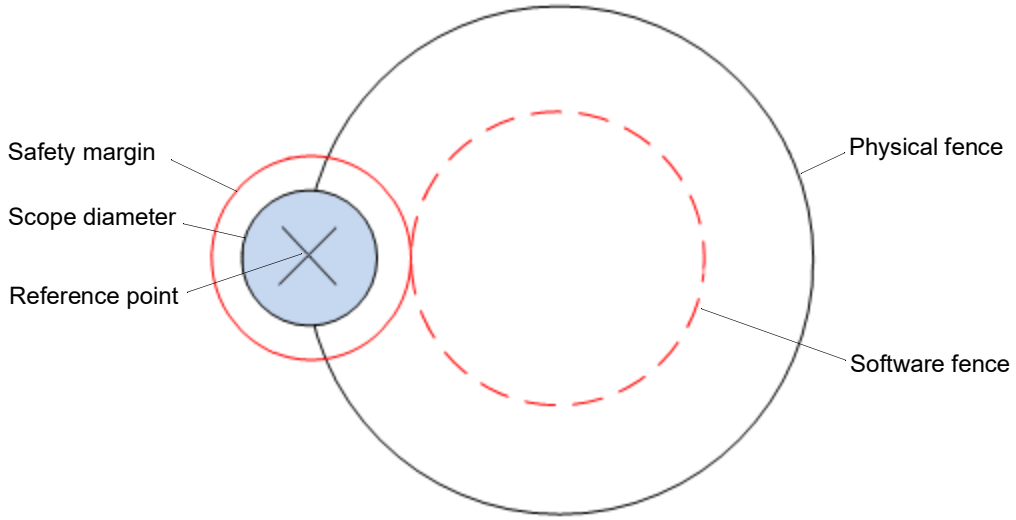
- For the Elite300, this fence is set with the Scope Silo wizard on ControlCenter.
- For CM300 and APS300, only a user with Service-level access can set the fence.




## Configuration

Admin-level users can define configuration options.

| To configure this... | Do this... |
|---|---|
| Set either two or three reference points to define a circle. | • Use three reference points to define three-point silos (default).<br>• Use two reference points to define two-point silos (safe working area that protects positioners). |
| Define how many silos must be retrained if a configuration is loaded. | • None—You can choose to accept a configuration.<br>• Two or more—You can choose to accept a configuration after retraining at least two silos.<br>• All—You cannot choose to accept a configuration; you must retrain all silos (default). |
| Use reference points. | If selected, you are prompted to define a reference position. The scope will move to the given reference position on MoveScopeSilo. The default is Disabled. |
| Define the Maximum Move speed during training. | This is the maximum allowed move speed during training. The default is 100% |
| Define the Scope Diameter and safety margin. | When a silo is trained, this value is removed from the calculated diameter. |




## Wizard Options

Disable Scope Z-Fence

Set up regular Z-Fence

Set up Z-Fence with silos

Load Z-Fence Configuration

*Two- and Three-Point Training*

To start the Z-Fence wizard:

1. In Common Tasks, click the Scope Z-Fence Wizard button.

CM300, APS300 Elite300

2. Select a configuration option.

3. Click the Next button to display the setup pages. If you click the Cancel button, the configuration is not saved.

### Disable Scope Z-Fence

Disables the Z-fence. The current high and low values are still saved.

### Set up regular Z-Fence

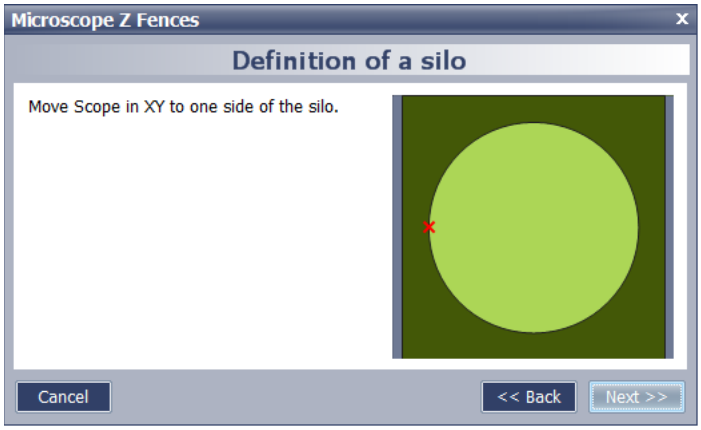
Sets up a regular Z-fence with high and low values.

### Set up Z-Fence with silos

Sets up a Z-fence with one or two silos. The first two wizard pages are the same as Regular Z-Fence, except that a lower Z-fence is mandatory.

### Two- and Three-Point Training

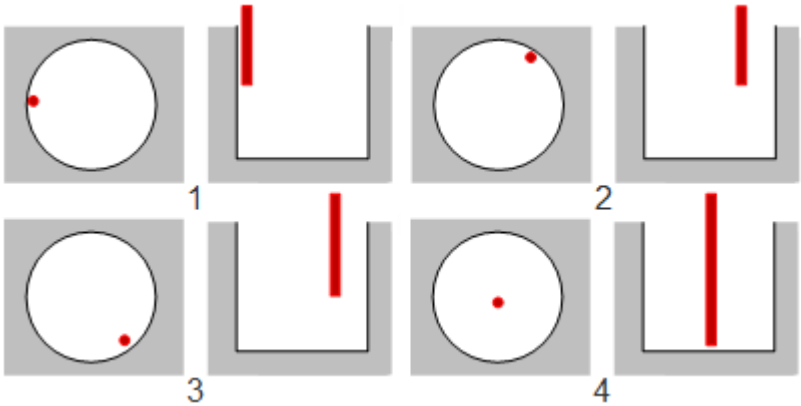
You can train a silo by either two or three reference points.




### Three-Point Training

To configure three-point silos:

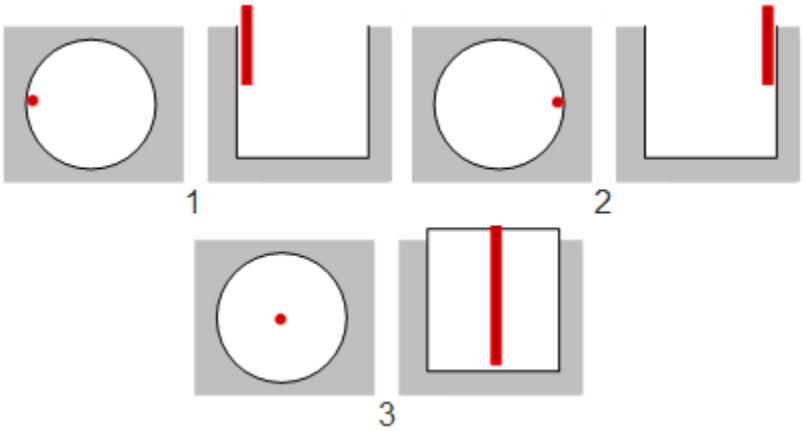
1. Move to one side of the silo and click the Next button.
2. Move to another side of the silo roughly 120° away and click the Next button.
3. Move to another side of the silo roughly 120° away and click the Next button.
4. Move down into the silo to define the Z-depth and click Next, and then click the Next button to display the Finish page
5. Click the Finish button.



### Two-Point Training

For two-point-training (to protect positioners in the scope move range):

1. Move to one side (left-most) of the cylinder-shaped silo and click the Next button.
2. Move to the other side (right-most) of the cylinder-shaped silo and click the Next button.
3. Move down into the silo to define the Z-depth and click the Next button.




4. Move to the reference point inside this silo and then click the Next button.
5. Click the Next button to display the Finish page. At this point, you can add another silo fence.
6. Click the Finish button when all selections are complete.

## Load Z-Fence Configuration

To load a saved fence configuration, select Load Z-Fence Configuration and then click the Next button.

- If there are no silos, or if you accept the configuration without changes, click the Finish button.
- If you choose to modify the configuration:
  a. Move Z to ZFenceHigh
  b. Move XY over a silo and retrain the silo
  c. If there are no more silos to retrain, click the Finish button
  d. To retrain another silo, repeat steps a and b.
- Show the difference in µm.
- You can choose to accept a configuration or continue retraining. The default is to retrain every silo.

If you save this fence configuration with the same file name, the new configuration overwrites the existing fence configuration.

# System Setup

System Setup parameters are categorized by global settings and stage-specific settings (chuck, positioner, and aux site settings).

## Global Settings

Click System Setup, and then click Global.

| | |
|---|---|
| **Contact Options** | |
| Save contact height to the project file | Used during save project and open project as follows:<br>• Save Project—If enabled, current contact height is saved; otherwise -1 is saved (contact not set).<br>• Open Project—If enabled, contact height from file is set; otherwise the contact height stays unchanged. |
| Clear contact height at load | Clears the contact height of the chuck if the chuck is moved to load. |
| **Home Position** | |
| Save Home to Project file | If enabled, the home position is restored when you load a new project. The default setting is enabled. |
| **Movement** | |
| Use auto quiet mode | If enabled, chuck stage is in auto quiet mode. |
| **Operator Handling** | |
| Set joystick to wafer orientation for:<br>X<br>Y | If enabled, X and Y joystick moves, seen from the scope, are similar for all stages: Wafer features in joystick direction are moved under the scope focus. |
| Use joystick for Z movement | If enabled, you can use the Z button that is available on some joysticks to perform Z movements of the stage using the joystick Y axis. |
| **User Login Management** | |
| Enabled | You can track:<br>• Who is using the station at any point in time.<br>• How much time each user spends on the station.<br>• Which user performed a specific action on the system. |
| Manage Users | With **Admin-level access**, you can:<br>• Add, edit, and delete users.<br>• Reset a password for users with Engineer- or Operator-level access.<br>• Change the access level for a user.<br>Every user name must be unique, and every user will be assigned access level Operator, Engineer or Admin. |
| **Thermal Chuck** | |
| Use Thermal Chuck | When disabled, Velox no longer communicates with the thermal chuck. You can disable this setting before turning off the thermal chuck. If you turn off the thermal chuck without deactivating this setting, Velox assumes the thermal chuck has lost connection and prohibits stage movements. |
| Purge on open door | If enabled, purging is activated while the chamber door is open. |
| Force purge | If enabled, bypass purge is enabled independent of all other inputs. |
| Continue purge in [s] after door closed | Continue bypass purge for so many seconds after the loader gate or chamber door is closed |

# Chuck Settings

Edge Sensor Settings

Auto Z and Auto Separation

To access chuck settings, click System Setup and then click Chuck.

| | |
|---|---|
| **Edge Sensor** | See Edge Sensor Settings for details. |
| **Contact Parameter** | Soft Touch—Percentage (0%-100%) chuck Z axis deceleration reduction for contact moves. |
| | Contact Count— |
| **Vacuum Settings**<br>Multi Line Vacuum | Values depend on probe station:<br>**CM300**—Center, 200, 300<br>**Elite300**—Center, 75, 150, 200, 300<br>**Summit200—**Center, 75, 100, 150, 200<br>**PA200BlueRay**—Ring1, Ring2, Ring3<br>**APS200Tesla**—Ring1, Ring2, Ring3, Ring4, Ring5 |
| **Manual Load** | Enable or disable Load on Pins. |
| **Auto Separation** | See Auto Z and Auto Separation for more information.<br>Distance Limit—When between contact height and separation height, the stage automatically drops to separation for commanded moves farther than the distance limit. |
| | Speed Limit—When between contact height and separation height, the stage automatically drops to separation for joystick moves faster than the speed limit. |
| **Performance Mode**<br>(Summit200 only) | Standard—For normal probing. Meets standard station specifications, with image stability after a move and medium stepping speed.<br>Accurate—Slower and more stable acceleration and deceleration. Use when throughput is not the critical factor, but hitting smaller pads is important.<br>Fast—Has faster acceleration/deceleration and reduced accuracy and image stability specifications. Use it on large pad sizes when throughput is most important. |

## Edge Sensor Settings

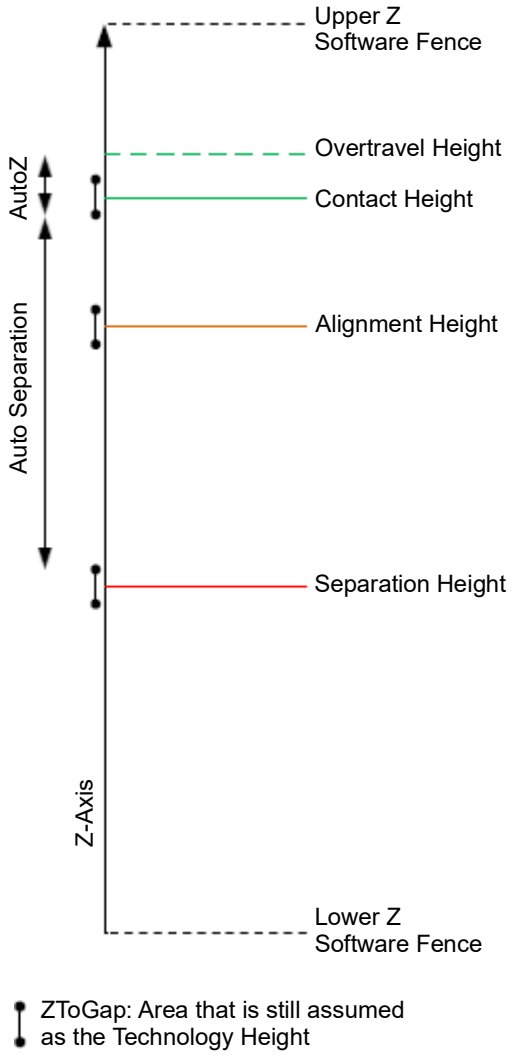
If you are using edge sensor functionality on a Summit 12K, S300, or Elite system, change the Use Sensor setting to match the type of edge sense hardware (if present) on the system.

| **Edge Sensor Functionality on Summit 12K, S300, and Elite Systems** |
|---|
| **Use Sensor**<br>• None—Defaults to None if no edge sense hardware is present on the system.<br>• Normally Closed—The edge sense switch is normally closed.<br>• Normally Open—The edge sense switch is normally open. |
| **Auto Contact Search**<br>If enabled, you can set the speed and search gap.<br>• Speed is a percentage of maximum velocity of the Z axis.<br>• Gap is the distance above and below the established contact position that the system uses to search. |

| **Edge Sensor Functionality on PA stations and SUMMIT200 systems** |
| --- |
| Use Sensor 1 / Use Sensor 2—Activates edge sensor 1 or 2. |
| **Auto Contact Search** |
| • Enabled/Disabled—If enabled, Auto Contact Search is used.<br>• Search Speed—Relative speed for search (1-100%).<br>• Search Gap—This value plus the contact height defines the search height. It is the maximal move destination for auto contact search. |

## Auto Z and Auto Separation

To avoid probe and wafer damage, Velox does not, by default, allow XY or theta moves of the chuck and positioners in contact height and above. You can adjust Auto Separation limits in the Chuck Settings panel




**AutoZ**

When a command is given for an XY or theta move in or above contact height, the stage automatically drops to separation height before doing the move.

- For positioned (known target location) X or Y moves (only from home or from zero), the stage moves back to contact after the move.
- For unpositioned movements (velocity moves, which are generated by the joystick), the stage stays at separation height and does not move back to contact after the move.

**Auto Separation**

**Positioned move**—When a command is given for a positioned (known target location) X or Y move above separation height:

- The stage automatically moves to separation height before doing the move. If the stage is above alignment height, it moves to alignment height. The stage does not move back to the original Z height after the move is done.
- If the move distance is shorter than the value specified, and the stage is at or below alignment height, the stage does not change its Z position.

**Unpositioned move**—When a command is given for an unpositioned move, and the currently-enabled speed for this stage (see Z Setup) is higher than the value specified for the speed limit:

- The stage automatically moves to separation height before doing the move.
- If the currently-enabled speed is at or below the value specified, and the stage is above alignment height, it moves to alignment height. The stage does not move back to the original Z height after the move is done.
- If the currently-enabled speed is less than or equal to the value specified, and the stage is at or below alignment height, the stage does not change its Z position.

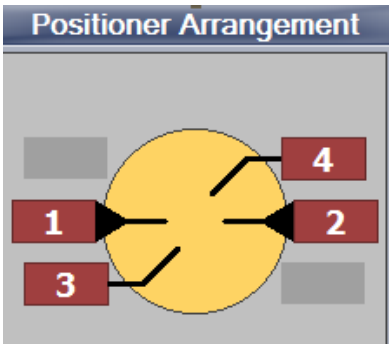
## Positioner Settings

To access positioner settings, click System Setup and then click Positioners.

**Positioner Arrangement**

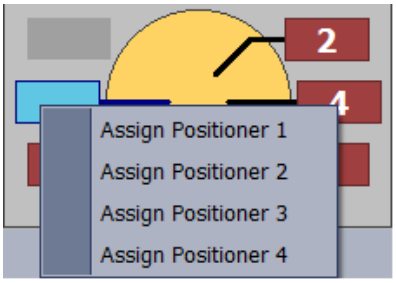
The Positioner Arrangement module provides settings for the available positioners to their places on the platen (left, right, left front, right front, left rear, right rear). You can assign more than one positioner to the left and right locations only.

You can also define whether the motorized positioner is RF or DC. RF is indicated by a black triangle on the positioner symbol.

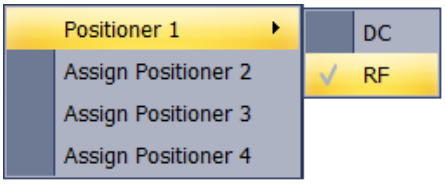



To change the placement:

1. Right-click a rectangle, and then select the positioner to assign to that location.




2. You can then right-click a positioner to select DC (default) or RF.




**Chuck Follow Mode**

When chuck contact and probe contact are set, the positioner moves to:

- Separation before chuck moves to separation.
- Contact after chuck moves to contact.

# Aux Sites

Train ISS Aux Site

To access aux site settings, click System Setup and then click Aux Sites.

| **Common Settings** | |
|---|---|
| Number of Sites | Number of additional chuck sites (0 to 16).<br>You can configure aux sites that are not physically present on the machine. |
| Warning before site move | When this setting is enabled, Velox displays a warning before every move from one site to another Move to Wafer Site and opens a wizard for setup. |
| Allow cleaning at non-ambient temperatures | When this setting is enabled, you can clean at temperatures much higher or lower than the current environment. |
| Cleaning Manager | You can combine several steps for probe cleaning and contact verification in the Cleaning Manager window. |
| Cleaning Setup Wizard | The wizard steps you through the required aux site training. |
| **Sites Settings** | |
| Setup button | The Setup button launches the appropriate wizard for the site. The wizard can set up special parameters for each site, align the substrate, set the position and shape, and set contact and home.<br>Before you run the wizard, make sure that Camera Origin is trained. Otherwise, you will get an error message “Position not trained: Camera Origin.” |
| Wafer Site | The Aux Site Wizard changes the settings for the wafer site. |
| Aux Sites 3-6 | The Aux Site Wizard changes the settings for the selected aux site. |
| Name | You can type a name for each site. |
| Type | Sets the aux site type as AuxUnknown, Wafer, CalSubstrate, ContactVerify, PadCleaner, BrushCleaner, or CleanReference. |
| Auto Align by Spectrum | This option applies to types Wafer and CalSubstrate only, and requires the optional AlignAux tool.<br>• If enabled, CCMoveAuxSite first executes MoveAuxSite, then the Spectrum command AlignAux, to automatically align the aux site.<br>• If disabled, the CCMoveAuxSite command executes only the Kernel command MoveAuxSite. |
| Cleaning | These selections apply to PadCleaner, BrushCleaner, and CleanReference types. |
| Count | Count defines the number of times the cleaning is repeated. |
| Time [ms] | Defines how many milliseconds the needles wait in cleaning position in each cleaning cycle. |
| X Index, Y Index | XY step inside the cleaner from one cleaning cycle to the next cleaning cycle to avoid multiple cleanings at the same cleaner position. |

For more information about cleaning methods, see Probe Cleaning. Write access depends on your user access level.

## Train ISS Aux Site

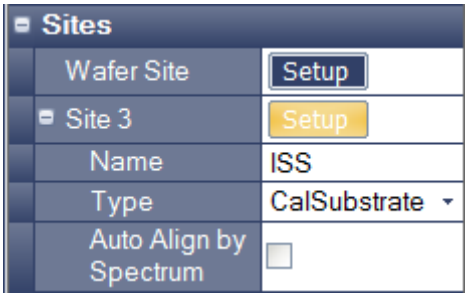
A. Make sure the ISS is installed in the correct location with vacuum turned on.

B. Move eVue to 500 µ below center of eVue travel range.

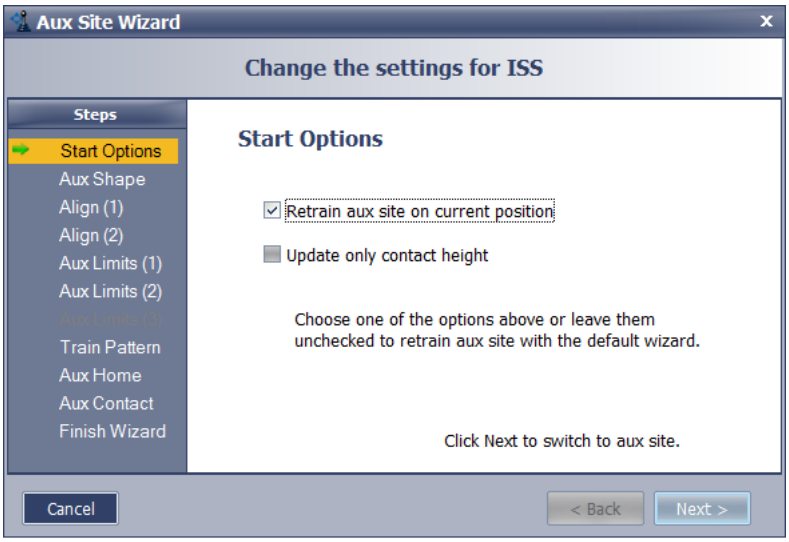
C. Move the chuck to the ISS aux site and slowly bring the chuck up to focus.

The following is an example from a 110GHz ISS. For more information on training aux sites, see Train Cleaning Reference and Clean Aux Sites.

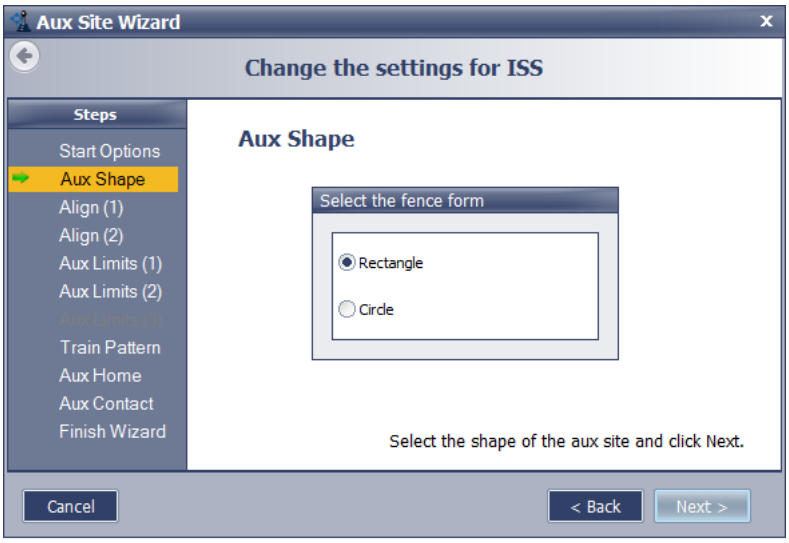
1. Click the Setup button on the ISS aux site to start the training wizard.



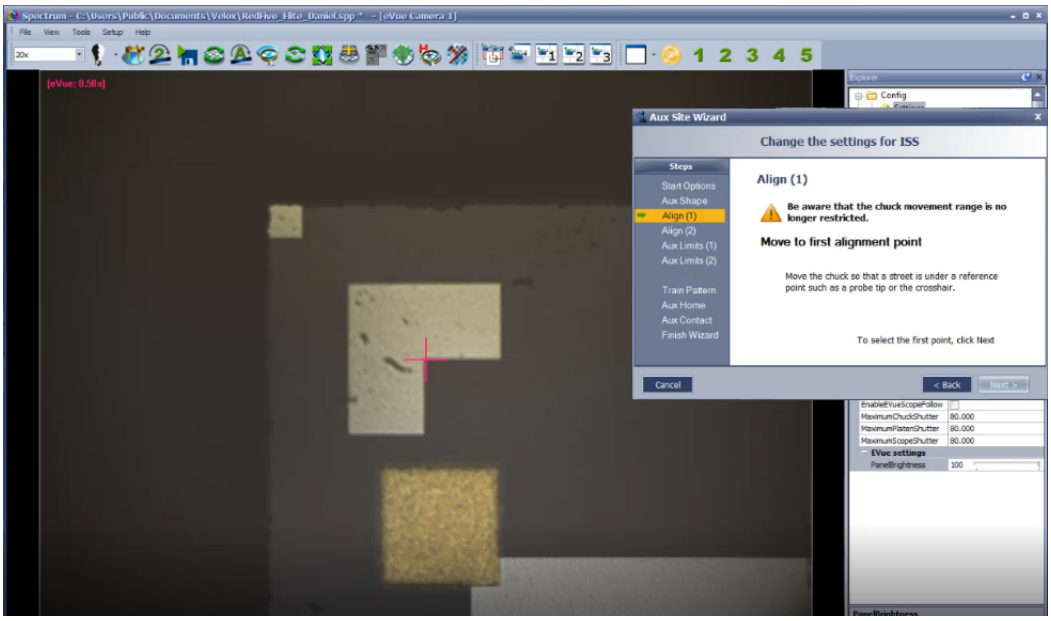

2. Select the Retrain aux site on current position check box, and then click the Next button.



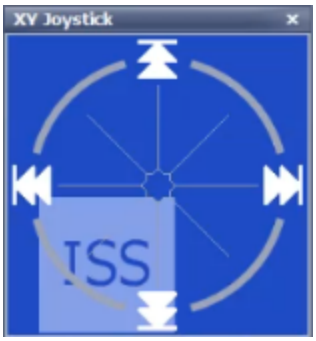

3. Select Rectangle, and then click the Next button.



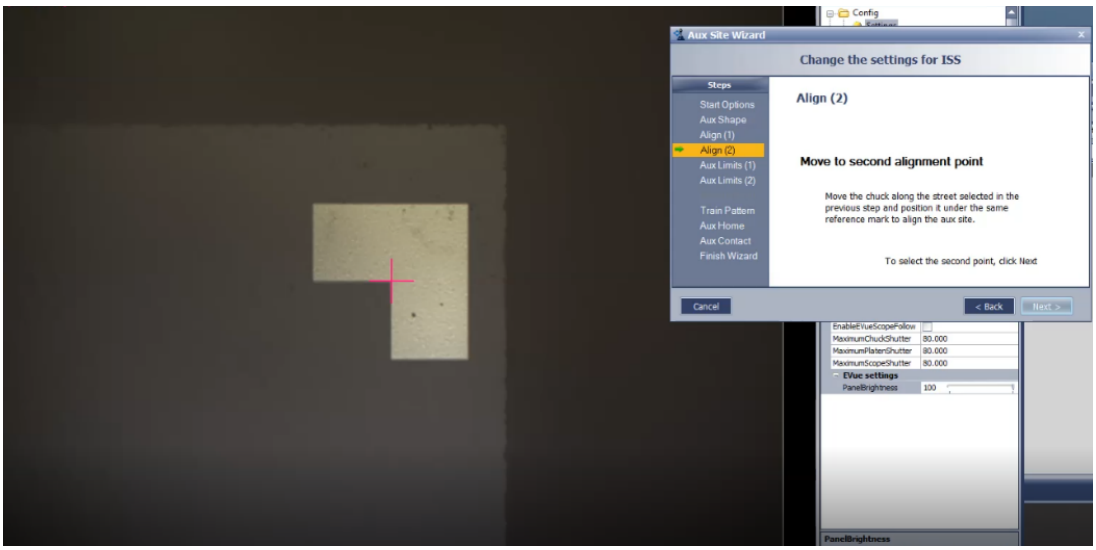
4. Move the chuck to the top-left corner, then click the Next button.



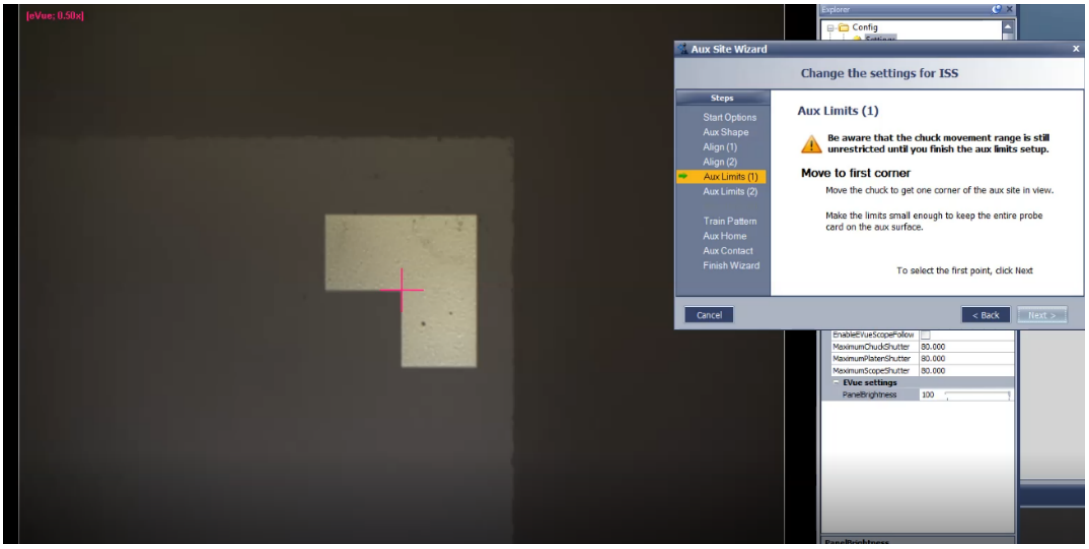

The chuck position movement corresponds to the XY Joystick in ControlCenter.



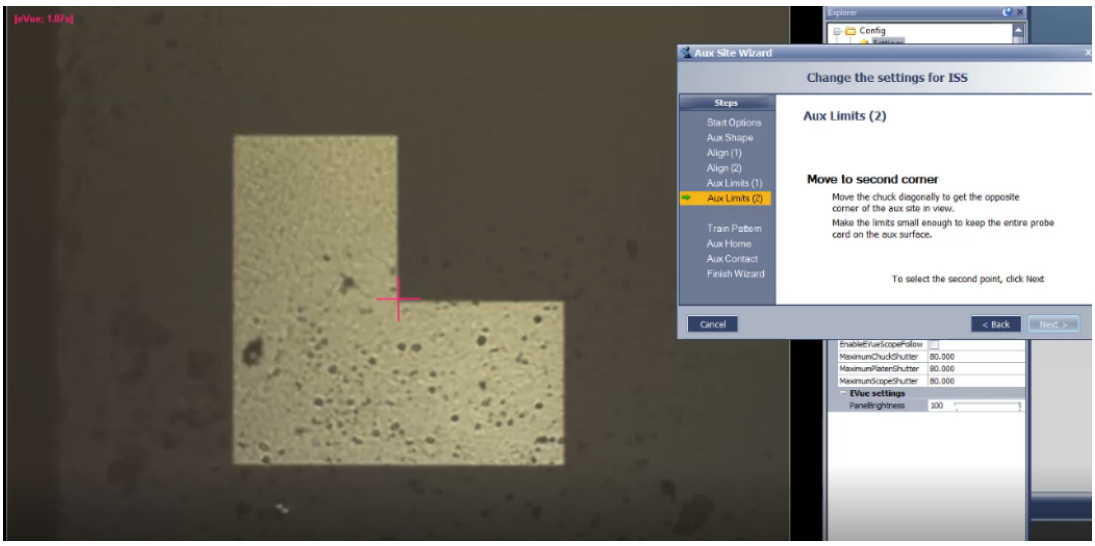

5. Move the chuck to the top-right corner, and then click the Next button. The wizard uses these two corners to align the ISS.



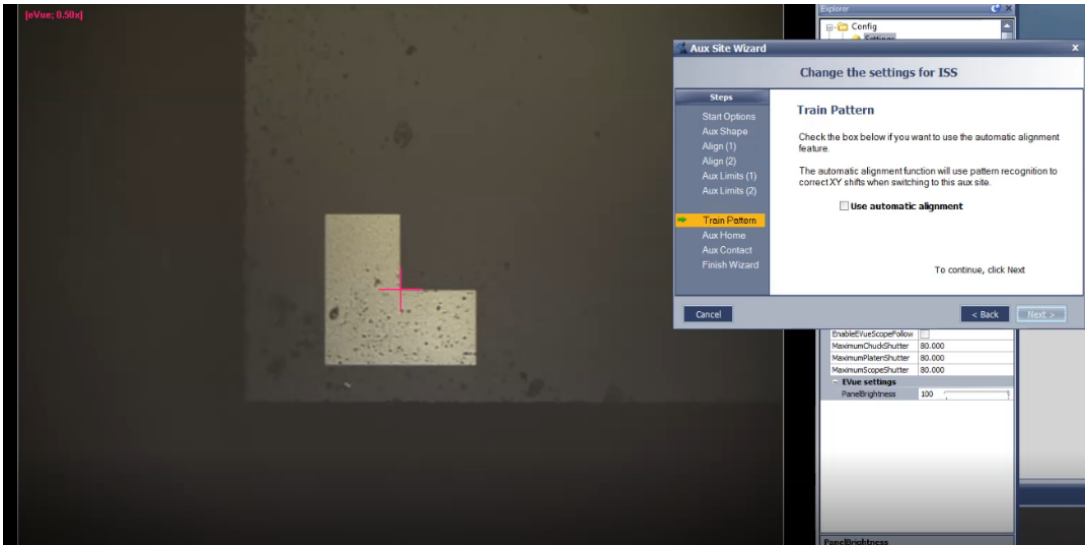

6. Choose the top-right corner again as first corner, and then click the Next button.



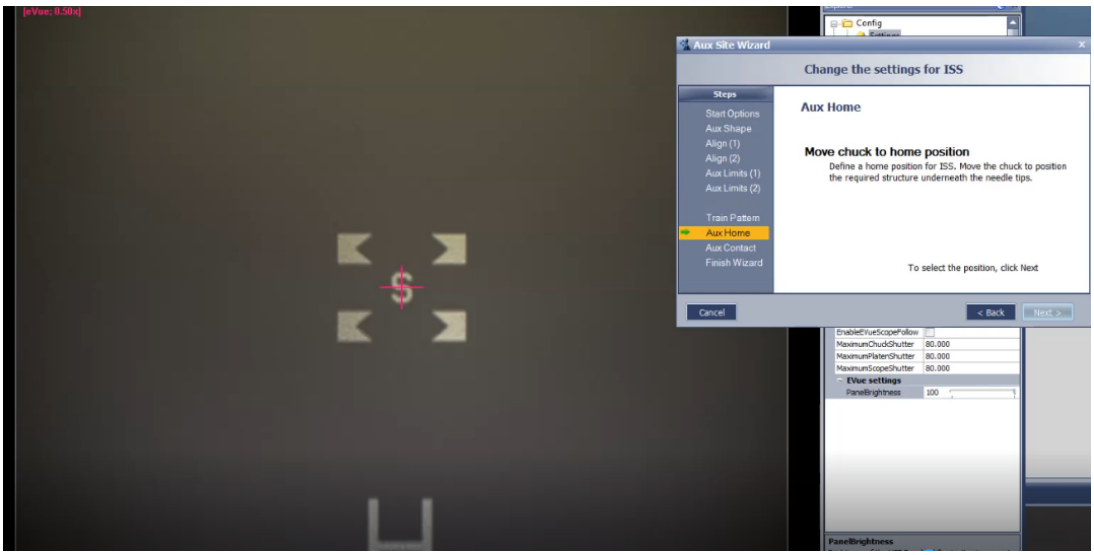

7. Move the chuck to the bottom-left corner, and then click the Next button.



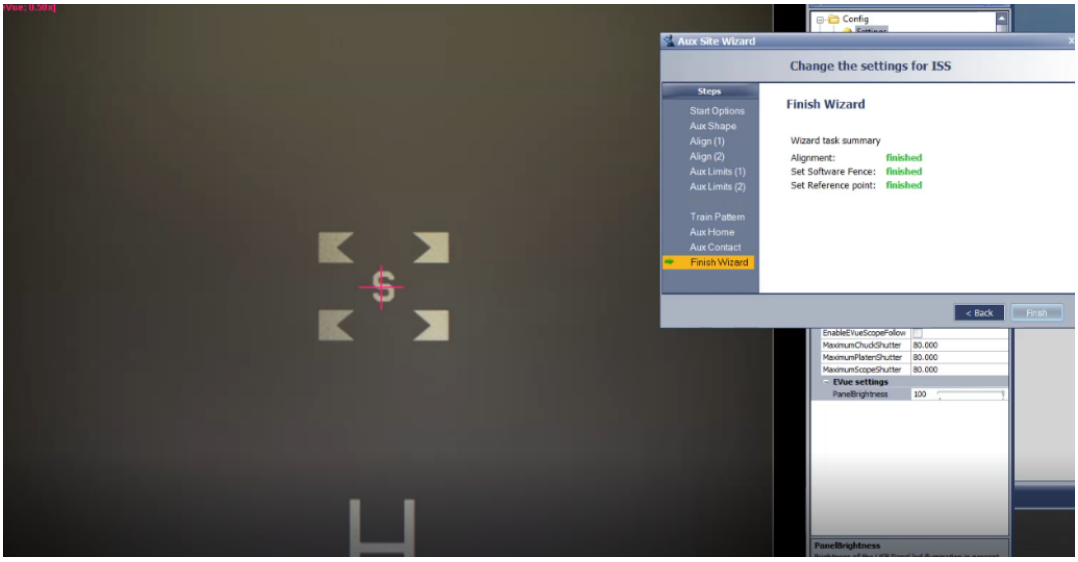

8. Clear the Use automatic alignment check box, and then click the Next button.




9. Move to one of the S patterns as home position on the ISS aux site. You can choose from rows A to H, which will match the reference in WinCal Setup later.




10. Set eVue to the center of travel. Slowly raise the ISS aux site until focused, and then click the Next button.
11. Click the Finish button to complete the ISS training.



# Thermal Chuck

Thermal Chuck Configuration

CM300 Thermal Conditioning

ECO Mode

The Thermal Chuck panel is visible only if a temperature chuck is connected and enabled.

**Temperature indicator**

This control represents the full temperature range. The colored lines show the actual temperature:

- Blue—Lower temperature
- Red—Higher temperature
- Black line—Target temperature.

**Temperature panel**

The number to the left of the Hold button is the current temperature. The Hold button toggles hold mode on or off. (Hold mode is available only if the temperature chuck device status is HoldReady. Otherwise, the button is disabled.)

The number to the left of the Set button is the target temperature. The Set button sets the target temperature to one of four presets or a custom temperature. For details about setting up the temperature options, see **Temperature Presets are set here and referenced by the target temperature Set button (see Temperature panel). You can specify up to four presets.**.

Device status messages include:

- Heating
- Cooling
- AtTemperature
- HoldReady
- HoldMode
- PowerSave
- Soaking
- Intermediate
- Unknown

The icon flashes in one of the following colors while the chuck is heating or cooling.

- Blue—Less than room temperature minimum.
- Yellow—Greater than room temperature minimum and less than room temperature maximum.
- Red—Greater than room temperature max.

**Soak Time Left and Dew Point**

Soak Time Left: 04:59
Dew Point: -5.0 °C

- Soak Time Left is the time remaining for the soak time interval. Soak time starts when the chuck has reached AtTemperature status. Soak Time Left is hidden If the device status is not soaking.
- Dew Point is visible only if the Temperature Chuck has a dew point sensor and shows the dew point temperature.

**NOTE**

*Fixed and Dynamic soak times are additive, and you can use them concurrently.*

## Thermal Chuck Configuration

**Thermal Expansion** sets the expansion coefficient in X and Y directions.

Wafer soak time [hh:mm:ss] is how long it will take, after you change the temperature, for the chuck to reach the target temperature and the test to continue.

- **Wafer Fixed Soak Time**—The amount of time after each temperature change independent of the temperature delta. Soak time starts when the chuck has reached AtTemperature status. Time is the time remaining for the soak interval.
- **Wafer Dynamic Soak Time**—The amount of time after each temperature change depending on the temperature delta. The larger the delta between old and new temperature, the longer the soak time.

You can enable fixed and dynamic wafer soak times concurrently.

Die soak time [hh:mm:ss] is the delay after moving to a new die or cluster before moving to contact height. The chuck moves from contact height to separation height, moves in X,Y to the next die/cluster, and then waits the soak time before moving to contact height again.

- **Die Fixed Soak Time**—The amount of time after each temperature change, independent of the current temperature.
- **Die Dynamic Soak Time**—The amount of time after each temperature, depending on the temperature delta. The larger the absolute delta between current and ambient (25°C) temperature, the longer the system will soak. For example, at 26°C, the station will not delay the stepping. The die soak time will only be used if the current temperature is outside the room temperature limits.

You can enable fixed and dynamic die soak times concurrently.

**Logging**

- Thermal Chuck logs to a file when logging is enabled.
- File Name—The name of the log file saved to the Velox log folder.
- File Size—The maximum log file size, in MB. If maximum size is reached, a new file is started and the old file is saved as backup. Up to four backup files are saved.
- Interval—The logging interval (between 1 second and 60 minutes).

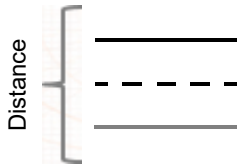
**Temperature Presets** are set here and referenced by the target temperature Set button (see Temperature panel). You can specify up to four presets.

**Contact Safety** (requires **Admin-level access**)

The contact height is temperature-dependent, changing significantly when heating or cooling the thermal chuck. For unattended testing, the contact height must be updated using either VueTrack or ReAlign for the wafer and AlignAux for the aux sites.

To prevent accidentally moving to an invalid (unsafe) contact height, Velox automatically reduces the contact height when the target temperature changes by more than 20°C.

If the chuck is above the newly set contact height, it is automatically lowered to a safe height. The contact height is lowered for the main wafer site as well as all aux sites that have contact height set.




$Z_{Contact}$ $Z_{Safe} = Z_{Contact} – Distance$

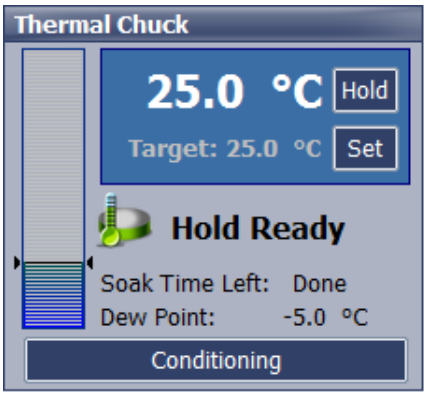
$Z_{current}$ if $(|T_{target}| > T_{current}| > + 20°C)$ then verify

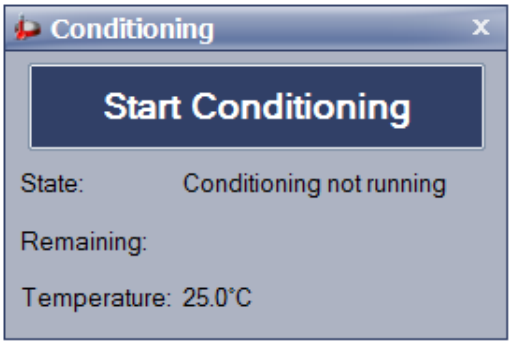
$Z_{safe}$ if $(|Z_{current} > Z_{safe})$ MoveChuckZ to $Z_{safe}$

## CM300 Thermal Conditioning

You can condition the probe station using the thermal chuck to determine ideal measurement conditions using the thermal conditioning tool.

Click the Conditioning button to open the Conditioning window. Thermal conditioning takes approximately 12 hours and requires that all doors are closed. For safety, remove the probe card and wafer from the station before you begin the conditioning process.




Thermal conditioning consists of these steps:

1. Heat chuck to 40°C; wait 1 hour.
2. Activate Chamber purge and Camera cooling. Deactivate Bypass purge.
3. Heat chuck to 80°C; wait 1 hour.
4. Heat chuck to 120°C; wait 1 hour.
5. Heat chuck to 160°C; wait 1 hour.
6. Heat chuck to 200°C; wait 4 hours.
7. Heat to the maximum allowed temperature; waits 4 hours.
8. Cools down to 25°C.

If the maximum allowed temperature (read from the station settings) is higher than 230°C, Velox prompts you to answer whether there are pins in the system. If yes, the maximum temperature is set to 230°C to avoid damaging the pins.

## ECO Mode

Velox supports the ECO mode of the ATT thermal chucks and applies to all stations with an ATT controller (software version greater than 5.0.1.5). The ECO mode reduces air consumption.

The ATT software ensures that:

- ECO mode can be enabled only if the thermal chuck is in AtTemperature state.
- ECO mode cannot be enabled if thermal chuck is below -40°C.

**NOTE**

*If the thermal chuck has been preconfigured at setup to use a forced ECO mode, you cannot deactivate the ECO mode.*

# Probe Cleaning


Set Up Cleaning Substrates

Set up a Cleaning Site

Cleaning

Probe Cleaning at Temperature


When probe tips make contact with wafers, corrosion or adherence can cause contamination that leads to a deterioration of the contact quality. To avoid contamination, clean probe tips by a method such as:

1. Contacting the needles with a gel pad or similar material.
2. Moving the needles to a vacuum nozzle.
3. Cleaning the needles with a brush.

While the second and third methods can always use the same position to clean the tips, the first method needs special handling since the position on the gel pad that was used for cleaning is consumed and must no longer be used. Instead, use a new position on the pad for the next cleaning.

Velox also supports measuring the probe tip quality through resistance measurement by moving it to a predefined verification substrate.

## Set Up Cleaning Substrates

When you use cleaning pads, place each cleaning site on a separate aux site. This ensures that there is a safe contact height for each site. The correct cleaning method is automatically performed based on the type of aux site.

The remote command CleanProbeTip is used to trigger probe tip cleaning. This command can be implemented into the test flow and automatically executes the cleaning setup.

| Aux Site Type | Symbol | Cleaning Method | Stepping |
|---|---|---|---|
| AuxUnknown | U | No cleaning possible. | – |
| Wafer | W | Several small wafers can be placed on the chuck. | |
| Cal Substrate | S | No cleaning possible. | – |

| | | | |
|---|---|---|---|
| Contact Verification | V | No cleaning possible. This parameter verifies the success of a cleaning. | – |
| Pad Cleaner Gel Cleaner | G | Needles are moved one or more times from separation to contact (+ Overtravel) and back to separation. You can specify the amount of time in contact. | Yes |
| Air Cleaner (PA stations only) | A | Needles are moved to contact (+Overtravel) one time and will be paused for a specified time. | No |
| Brush Cleaner | B | Needles are moved one or more times from separation to contact (+ Overtravel) and back to separation. | No |
| Clean Reference | R | This setting is used for alignment. No cleaning possible. | |

## Set up a Cleaning Site

ControlCenter lets you configure the Aux Sites. A wizard guides you through the following required steps:

1. Activate Aux Sites (Aux Site count needs to be set > 0).
2. Teach the type of the sites (for example, Wafer, Pad Cleaner).
3. Align the site (not necessary for gel pads, air cleaner, and brush cleaner).
4. Teach the software fence for the aux site.
5. Set the correct starting position and contact height for the cleaning substrate.

To ensure that the contact height is correct, you must set up these sites after a new substrate is assembled or the probe tips are replaced.

When using a cleaning pad, the system takes care never to contact the same position again. Therefore, the index size for this aux site must be set up correctly based on the layout of the probe tips. For example, when using a probe card with a horizontal needle configuration of 2mm length, the index should be set to 2100x100 to make sure that cleaning is always performed on a clean position.

When the gel pad is consumed, the CleanProbeTip command responds with an error message. The next time the command is sent, cleaning starts again at the first position of the pad.

## Cleaning

Stepping

The appropriate cleaning process is automatically selected based on the aux type. Velox supports three types of cleaning sites: Pad Cleaner, Brush Cleaner, and Air Cleaner.

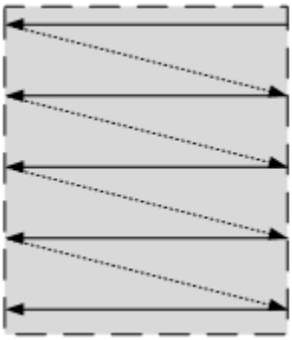
**Pad Cleaner**

The pad cleaner process begins by moving into contact height and waiting there for a configurable amount of time. The chuck then takes one index step horizontally and repeats until the configurable cleaning count is done.

The cleaning procedure uses the whole area of the aux site fence for cleaning and primarily steps horizontally but will apply a vertical step when it hits a fence.

When the stepping hits a vertical fence, the cleaning command will return an error showing that the cleaning pad is used up. The next cleaning command will then continue at the top of the substrate again, thus allowing a cleaning substrate to be used more than once.

The illustration shows the stepping pattern.



**Brush Cleaner**

The brush cleaner process begins by moving into contact height, then performing XY movements in vertical and horizontal directions by a configurable distance while in contact height at a speed of 10%. This is repeated for a specified time.

**Air Cleaner (PA stations only)**

The air cleaner process begins by moving into contact height, then activating a valve (Output 3 on PA stations) that creates an air flow to blow dust away from the probe tips.

## Stepping

You can clean with and without stepping.

- Without stepping means that the cleaning is always done at the same XYTheta position.
- With stepping, each cleaning is an index step in X direction and then in Y direction.

Stepping is always in a positive direction. When a further index step is not possible, the software displays an error message.

**Cleaning time**

Cleaning time is the delay after contact with the cleaning surface. To adjust the cleaning time, use the CleaningTime configuration parameter (type: integer, unit: ms) in Aux Sites Settings for each aux site. Set the cleaning time to:

- Clean the needles with vacuum nozzle.
- Immerse the probe tip in the cleaning gel.

**Repeat cleanings**

For gel pads, a single immersion into the gel is not always sufficient. The configuration parameter CleaningCount (type: integer) can be set to repeat the contact-per-cleaning multiple times.

CleaningCount can also be used to repeat cleanings for the brush pads.

**Use Existing Aux Site Parameters**

The following parameters must be set for installation of a cleaning pad site:

- Contact height is set at a Z height appropriate for cleaning the needles, and at the right distance from the nozzle. The gel pads must be at a proper depth. For the brush pads, the needle tips must be in contact with the brush.
- The Overtravel parameter can be set to increase or decrease contact height. This is especially useful when using gel pads.

The following parameters must be set for pads with stepping or XY movement in contact:

- The XY software fence defines the area where needles can safely be contacted. In each position within the fence, all probe card needles must contact the cleaning pad.
- The index values for X and Y specify the stepping values. For example, these variables may correspond to the XY dimensions of the probe card contact area. When cleaning with brush pads, the index size indicates how far to move the probe card in the XY directions to be in contact.
- In each case, the distance is one index step.

A cleaning pad corresponds to an aux site. Use a separate cleaning pad for each stage (aux site). Aux sites are typically used for calibration substrates.

# Probe Cleaning at Temperature

Aux Site Setup and Training

Testing Workflow (VueTrack)

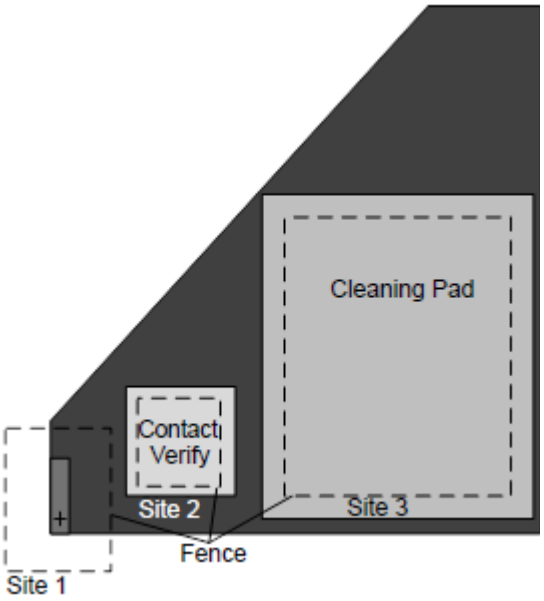
Testing Workflow (ReAlign)

Train Cleaning Reference and Clean Aux Sites

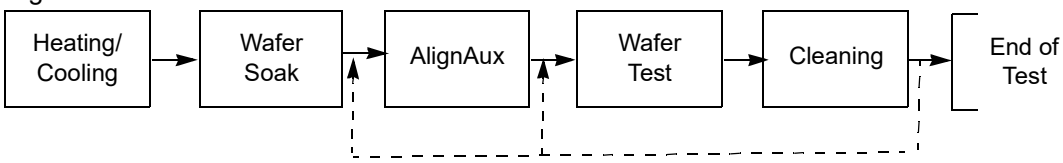
Probe cleaning at temperature requires an aux chuck with two distinct aux sites (CleanReference and PadCleaner). The reference site is used for determining the XYZ correction factors, which will then be applied to the clean/verify aux sites that are associated with the reference site.

The graphic at right is an example of setting up for over-temperature cleaning.

- Site 2 (ContactVerify) and Site 3 (Cleaning Pad) are aux sites associated with Site 1, the cleaning reference aux site (CleanReference).
- The Spectrum AlignAux tool aligns to Site 1 and updates the contact height for Sites 2 and 3.
- The Spectrum AlignAux tool calculates contact heights and applies vision-based XYZ correction to the touchdown positions on the cleaning sites.
- To do an off-axis operation, use Spectrum ReAlign > Aux Alignment.
- As vision tools are not reliable for direct use on the cleaning sites, the software generates the XYZ correction values from the alignment mark on the CleanReference aux site.
- By default, the ExecuteCleaningSequence command runs AlignAux/AlignAuxOffAxis as part of the cleaning sequence, unless the SkipAlignAux parameter is true. You can separate the aux site alignment process and the cleaning process if needed to reduce the thermal effect of the aux site alignment to the probes.



The overall testing flow looks like this:




The AlignAux/AlignAuxOffAxis command moves to the reference site and generates an XYZ offset used to update the contact, home, and fence positions on the reference, cleaner, and verify sites. It is up to your system's test flow to determine how often to run the AlignAux/AlignAuxOffAxis command to readjust the XYZ positions.

When you use the AlignAux wizard to train the CleanReference site, the wizard determines the contact height delta between the reference site and the wafer. The AlignAux wizard is also used to train the focus height delta between the clean/verify sites and the reference site. This delta is used to calculate contact height for the CleanReference and ContactVerify sites.

The Spectrum AlignAux tool works in conjunction with VueTrack Automation to calculate the contact height for the cleaning sites. The Spectrum ReAlign > Aux Alignment tool works in conjunction with ReAlign to calculate the contact height of the cleaning sites. (See ReAlign and Aux Sites for details.) As thermal expansion occurs and probe tips move during thermal transitions, VueTrack/ReAlign will adjust the wafer contact height. The information used in calculating wafer contact height is used by the AlignAux tool when calculating the contact height for the aux sites.

## Aux Site Setup and Training

1. In Aux Sites Settings, select the Allow cleaning at non ambient temperatures check box.
2. On the Velox main toolbar, click All Applications>Status>Alignment Mode to select On-Axis for scope or Off-Axis for platen camera.
3. In Spectrum, click the Automation tool, and then enable ViewTrack for Automation training. Alternatively, right-click the Spectrum ReAlign tool, select Show Tool Wizard, and then click the Train ReAlign button.
4. In System Setup, select Aux Sites and then click the Cleaning Setup Wizard Execute button to set up the PadCleaner, CleanReference, and optionally ContactVerify aux sites. It also sets the aux site limits, home, and contact.
5. In Spectrum, right-click AlignAux and then select Show Tool Wizard to finish training the focus height delta between the clean site and the reference site. The contact height of the PadCleaner site is set as part of this training.
6. In ControlCenter, click System Setup, click the Cleaning Manager Open button, and then click the Cleaning Sequences tab in the Cleaning Manager window to define the cleaning sequence. This could include just a clean site, or a clean site followed by a ContactVerify site to perform verification.
7. Use the FocusToContactOffset configuration parameter in the Cleaning Sites tab of the Cleaning Manager window to adjust the contact height from the trained focus height for a given clean aux site. A positive value causes the chuck to move closer to the probes.

## Testing Workflow (VueTrack)

1. Run StartAutomationTemperature to perform thermal ramp.
2. Run AlignAux to update the contact height of the cleaning surface.
3. Run AutomationSearchCurrentDie to move back to the wafer and perform VueTrack align with optional die soak.
4. Perform testing on the wafer.

5. Run `ExecuteCleaningSequence "" 0 1` to perform the cleaning and optionally move to the verify site if ContactVerify was defined as part of the sequence.
6. If you are doing verification, measure contact quality using external electrical equipment.
7. Run `AutomationSearchCurrentDie` to move back to the wafer and perform VueTrack align with optional die soak.
8. Continue testing.

### Testing Workflow (ReAlign)

1. Run `HeatChuck` to perform thermal ramp.
2. Wait for the system to stabilize.
3. Run `ReAlign` to update wafer contact height.
4. Run `AlignAuxOffAxis` to update XYZ locations at clean/verify aux sites.
5. Run `MoveAuxSite 0` to move back to the wafer.
6. Wait for thermal soak time.
7. Perform testing on the wafer.
8. Run `ExecuteCleaningSequence "" 0 1` to move to perform cleaning and then optionally move to the ContactVerify site and make contact.
9. If you are doing verification, measure contact quality using external electrical equipment.
10. Run `MoveAuxSite 0` to move back to the wafer.
11. Wait for thermal soak time.
12. Continue testing.

### Train Cleaning Reference and Clean Aux Sites

A. Make sure the cleaning pad is installed on the correct location with vacuum turned ON.

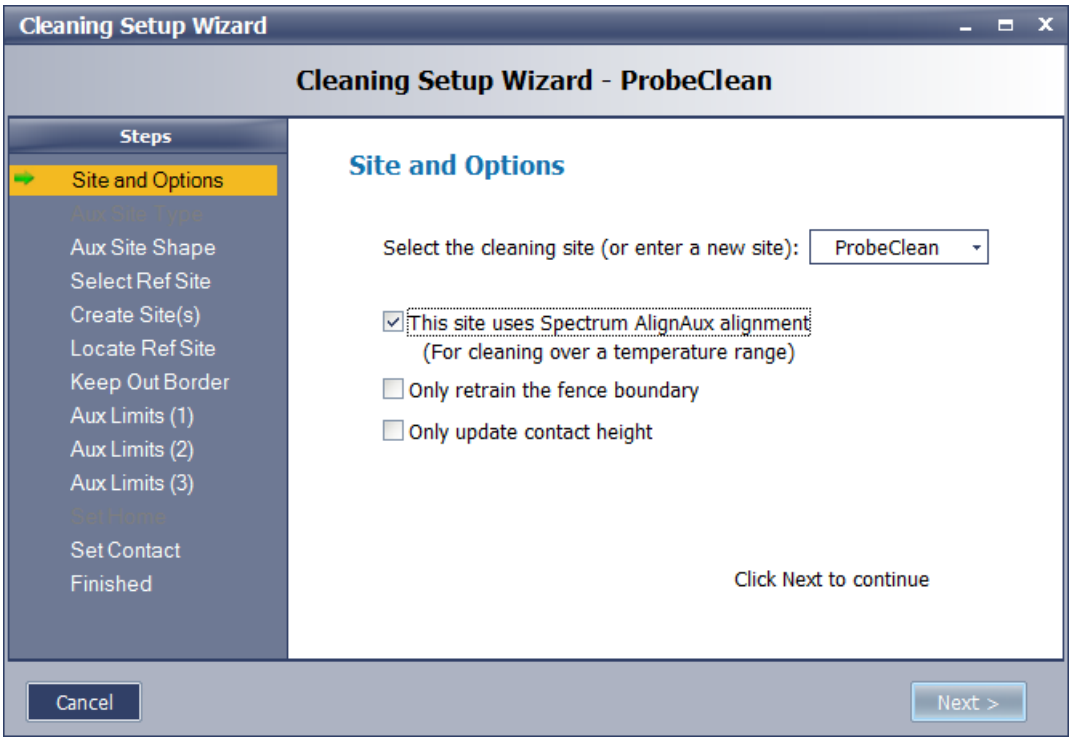
B. Make sure the fiducial fence is installed next to the PadCleaner site.

C. Move eVue to 500 µ below center of the eVue travel range.

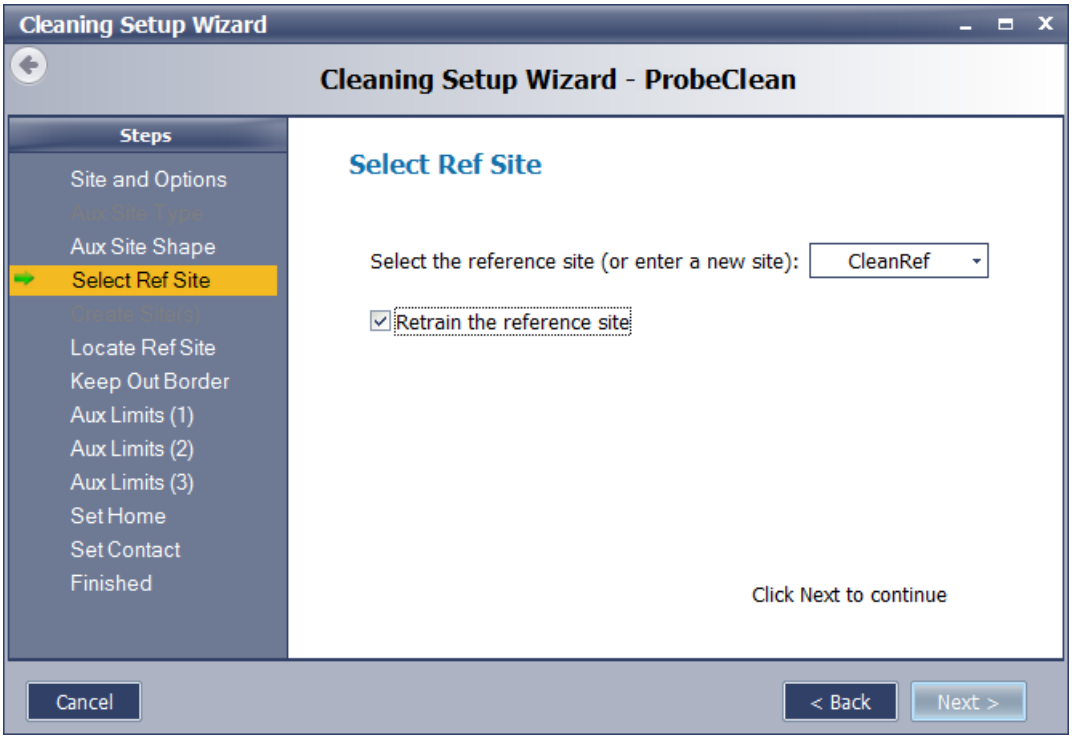
D. Move the chuck to the CleanReference aux site and slowly bring up the chuck to focus.

1. In ControlCenter, click System Setup, select Aux Sites, and then click the Cleaning Setup Wizard Execute button to start the Cleaning Setup wizard.

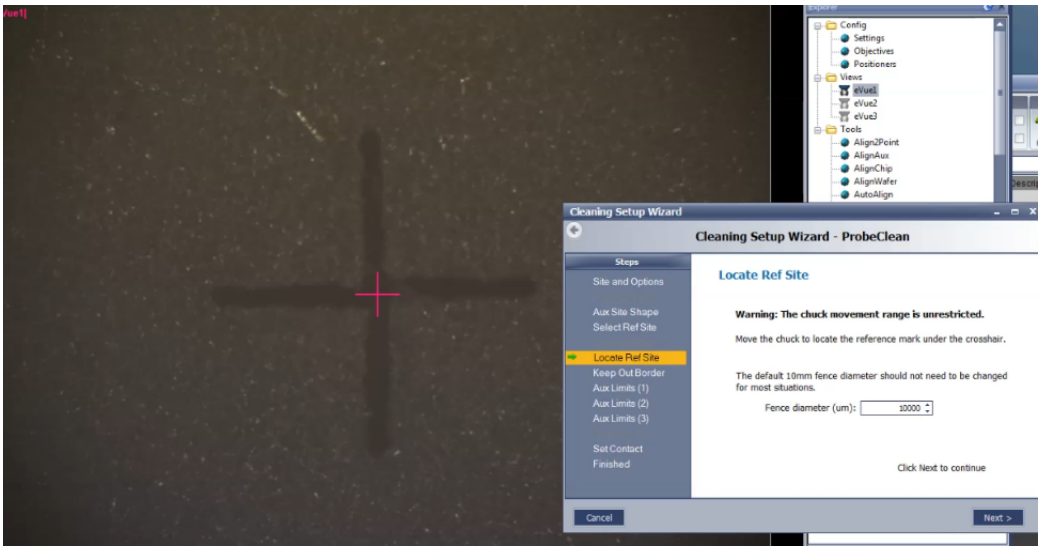
2. Select the first check box, then click the Next button.




3. Choose the aux site type, and then click the Next button.
4. Select the aux site shape and then click the Next button.
5. Select the Retrain the reference site check box, and then click the Next button.

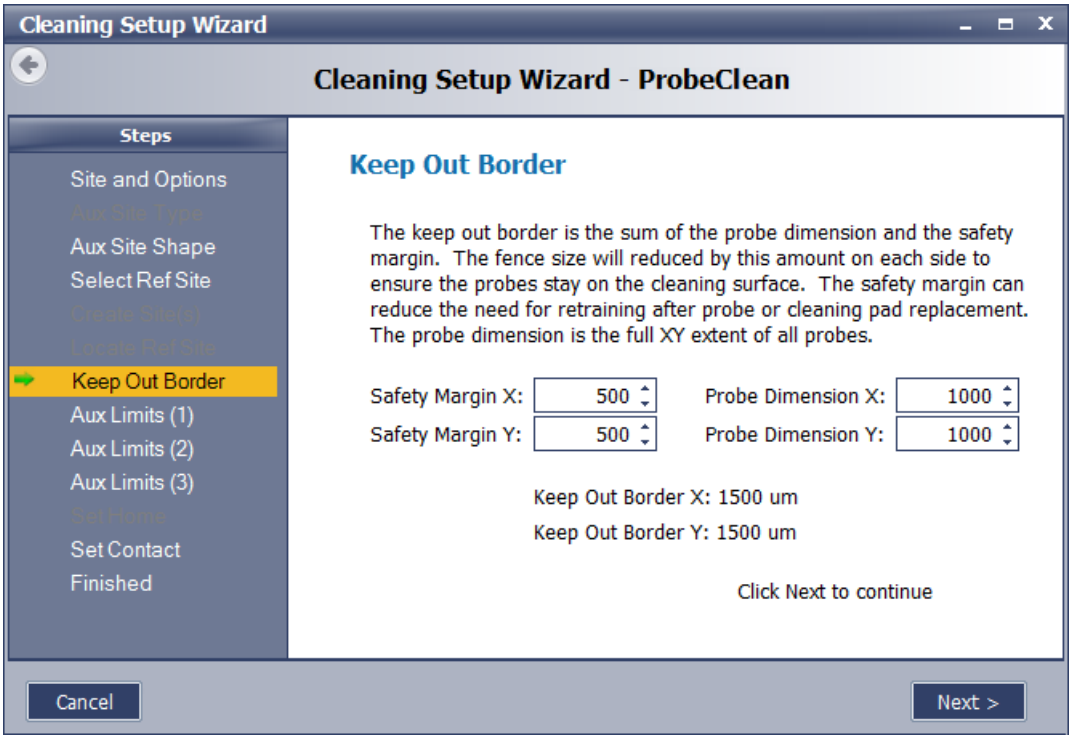


6. In Spectrum, raise the CleanReference aux site slowly until focused. Find the cross mark in the center of field of view. Click the Next button.

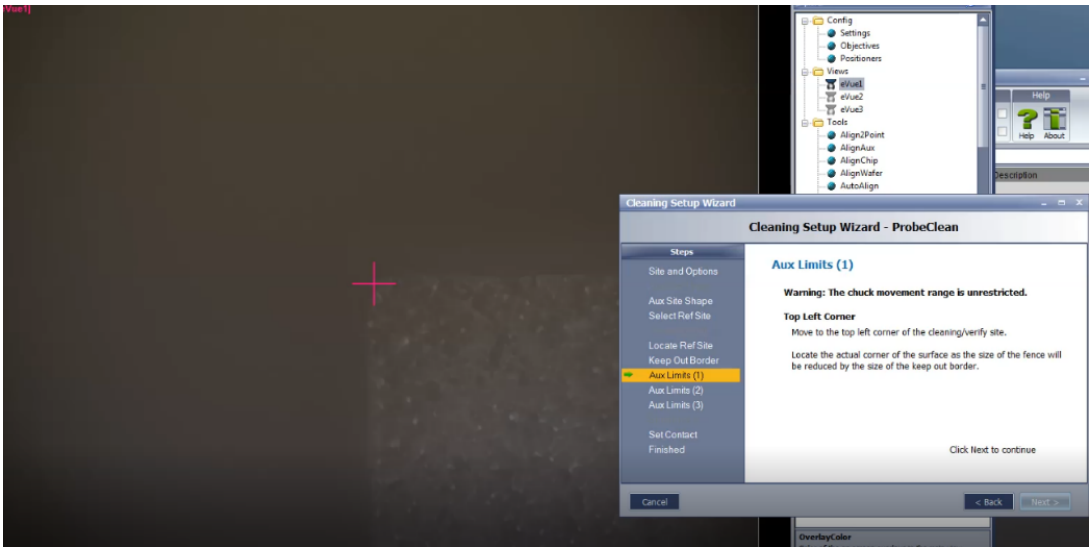



The chuck moves to the cleaning pad aux site automatically. eVue should still be 500 µ below the center of travel range. You can also change the light setup if the mark is not clear. The probe dimension X and Y can be as small as 300 µ.

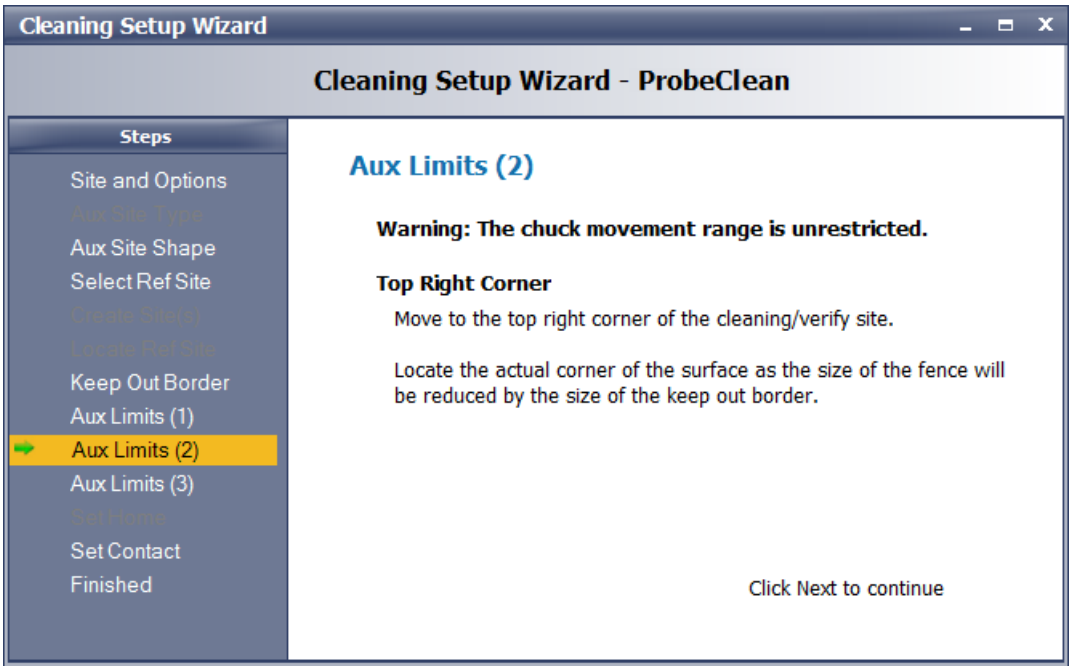
7. Click the Next button.

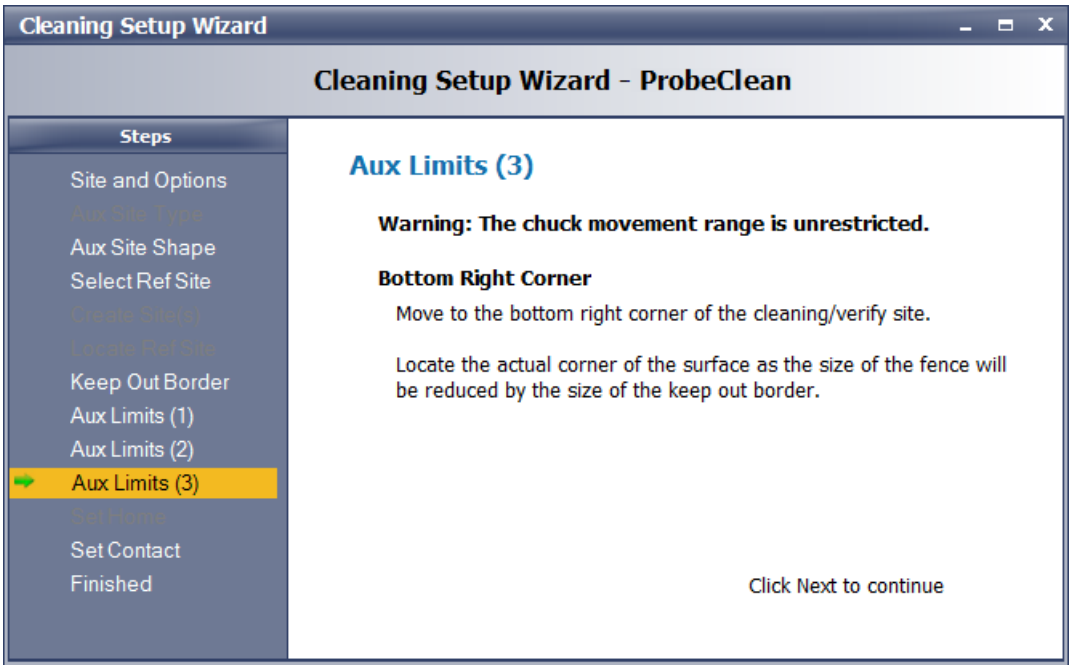


8. Raise the CleaningPad aux site slowly until focused. Move to the top-left corner of the aux site, and then click the Next button.



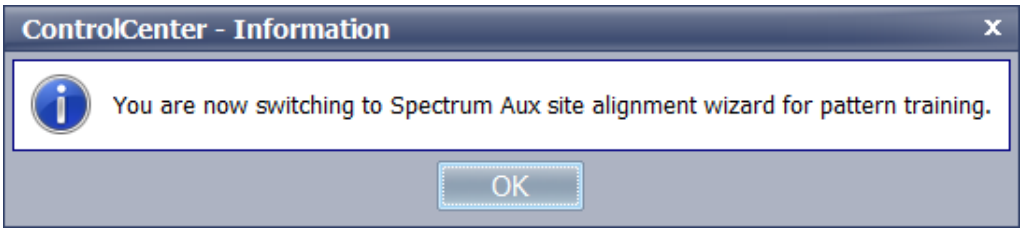

9. The next two steps are similar to step 8— find the top-right corner of the aux site, and then bottom-left corner.






10. Click the Next button.

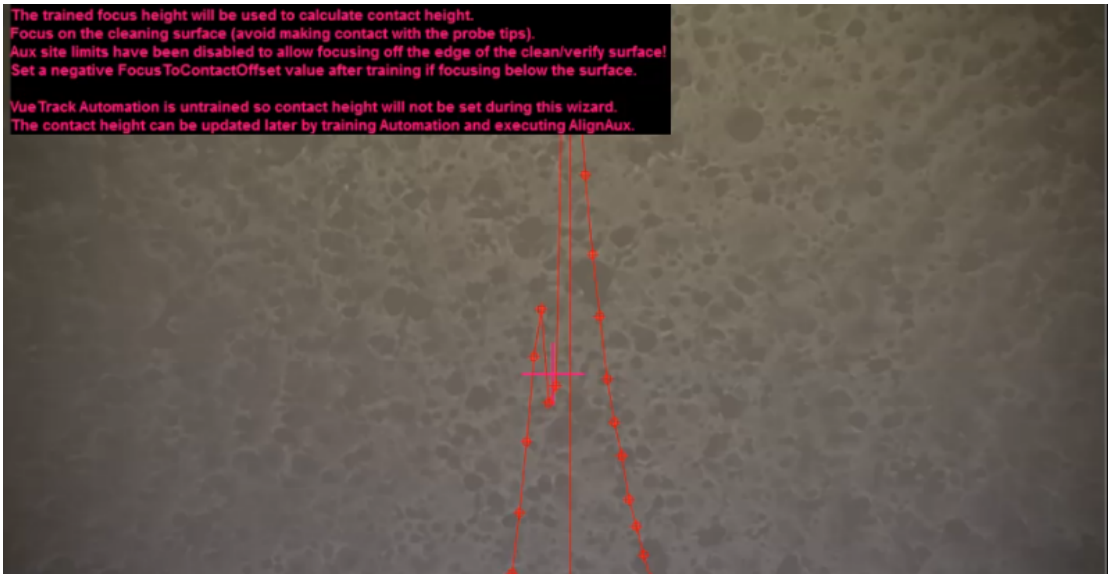
    Automation training defines the contact height of the CleaningPad aux site. See Automation Wizard or AutoRF Setup and Training for more information.



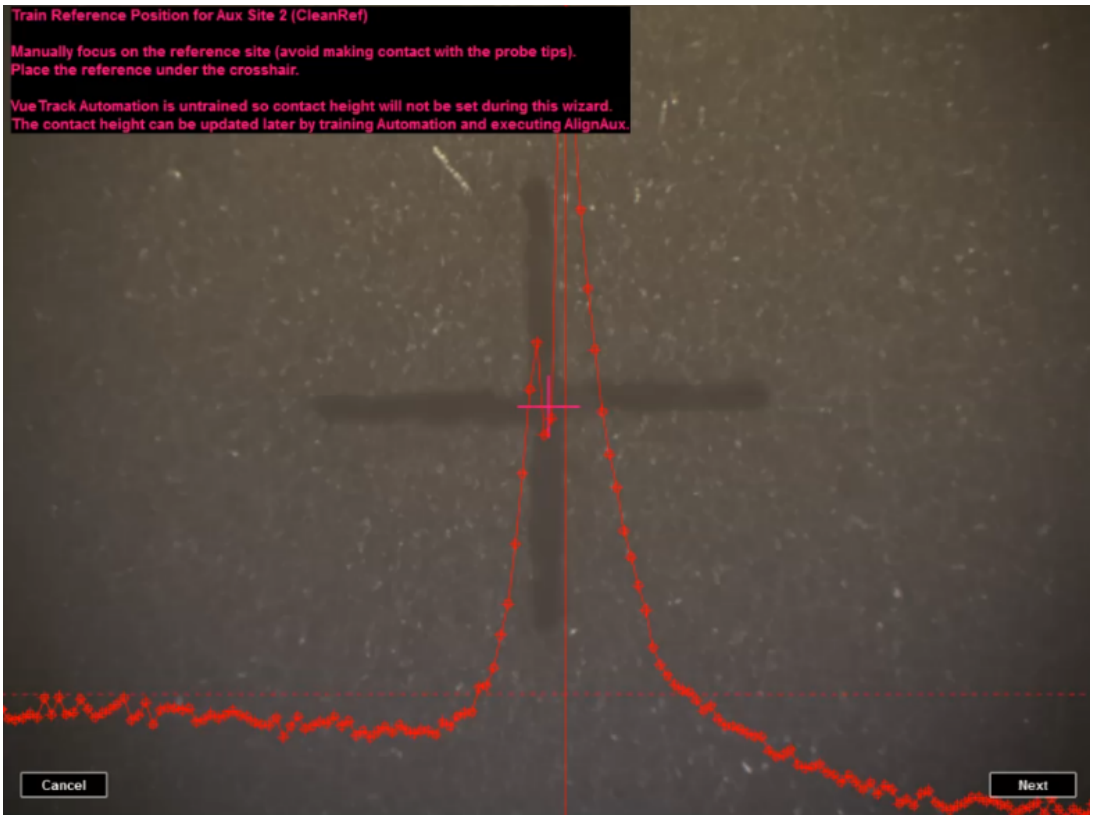

11. Click click the OK button.

12. In the Spectrum Aux Site Alignment wizard, click the Find Focus button to determine if the focus curve has a distinct peak, and then click the Next button.

    The chuck moves to the CleaningReference aux site again, near the location of the cross mark.

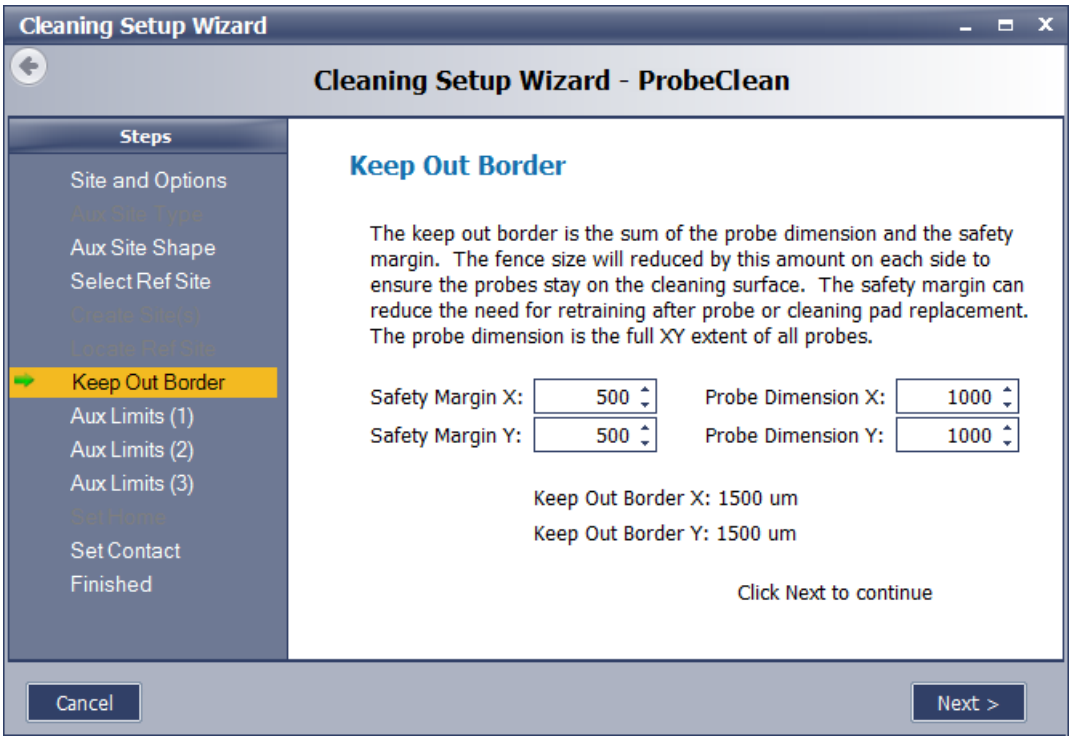



13. Raise up the CleaningReference aux site slowly until focused, and then click the Next button.



14. Resize the box to a unique feature in this field of view. Ensure that the presence of the probes in the field won't block the vision. Click the Next button.

15. Click the Finish button to complete this training.




**NOTE**

*You'll see a message that the contact height has not been set, and the height difference between Clean Reference and Cleaning Pad is less than 500. The Automation Training process will define the contact height of Cleaning Pad. See Automation Wizard (or AutoRF Setup and Training) for more information*

# Cleaning Manager

Use the Cleaning Manager window to:

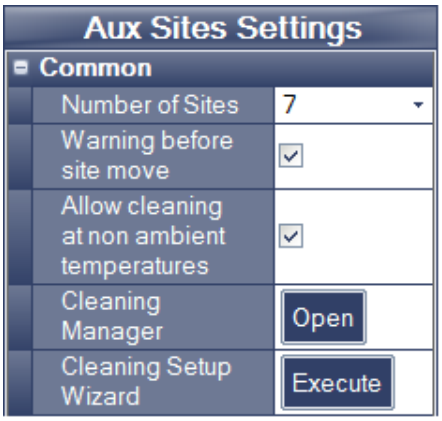
- Set up cleaning sites that need alignment (for over temperature testing) using vision-based aux site alignment provided by Spectrum.
- Set up cleaning sequences that can combine operations on multiple aux sites.
- Define multiple uniquely-named and purposed cleaning sequences.
- Define probe dimensions and update clean sites to eliminate the need for retraining.
- Access the Cleaning Setup Wizard for a a step-by-step workflow to configure aux sites for cleaning.
- Update general settings that apply to the aux site.

Commands provided include:

- **ResetCleaningPosition**—Resets the current clean position for when the clean substrate is replaced.
- **ExecuteCleaningSequence**—Execute a given cleaning sequence.

To open the Cleaning Manager window:

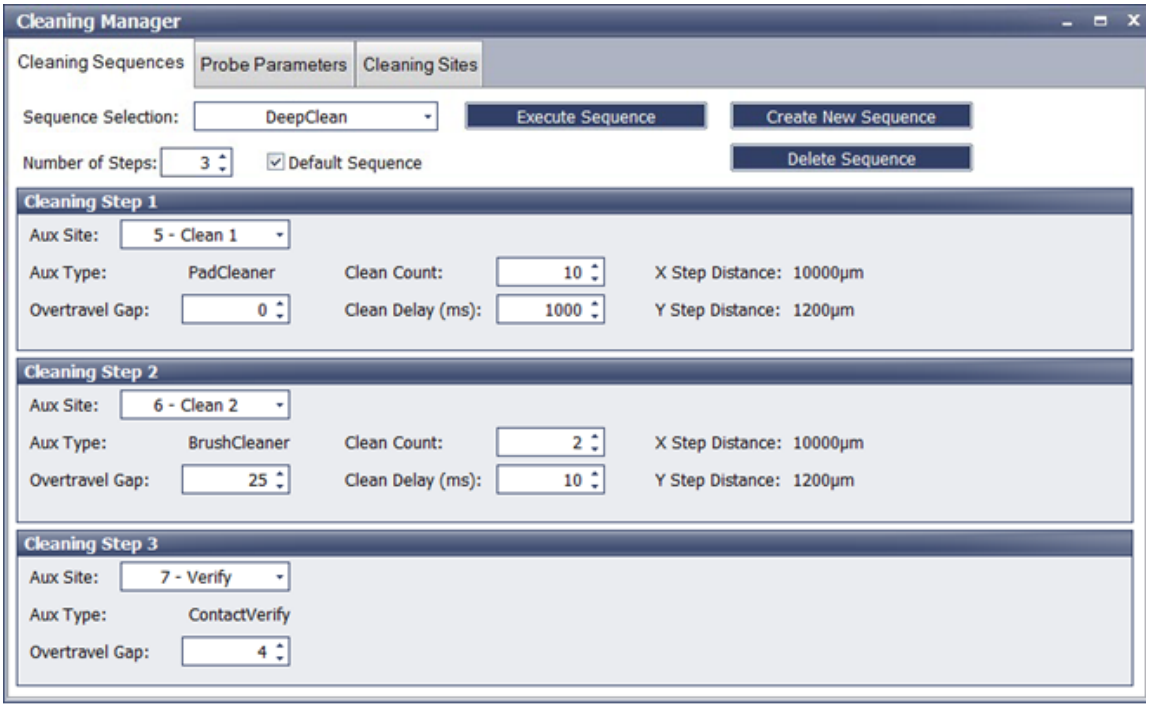
1. In ControlCenter, click System Setup and then click Aux Sites.
2. Click the Cleaning Manager Open button.




## Cleaning Sequences

Use the Cleaning Sequences tab of the Cleaning Manager to create, edit, and execute cleaning sequences. The sequence definition allows up to five steps. If a contact verification step is included, it is automatically executed as the last sequence step to ensure that the handshake with the test equipment is implemented.

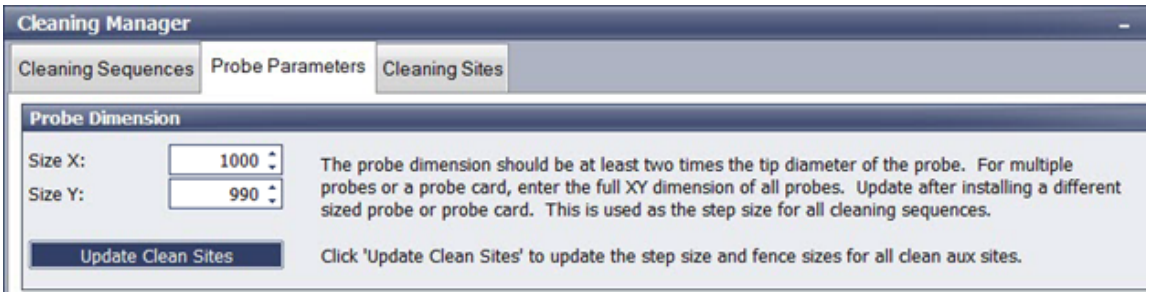
The cleaning sequence defined as the default sequence is used when the `ExecuteCleaningSequence` command is executed without parameters.




## Probe Parameters

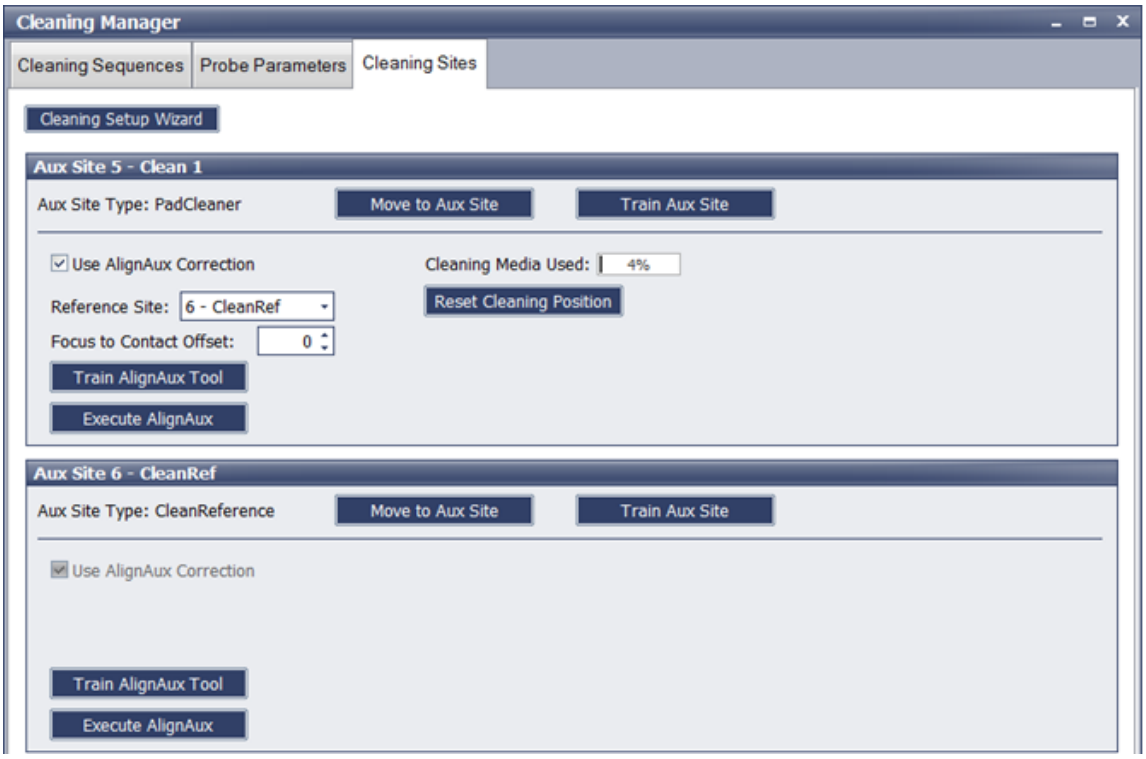
The cleaning sequences use the probe dimension size as the step size. Whenever the probes are changed, you must update the setting.

When you change the probe card dimensions, click the Update Clean Sites button to update the stepping index and fence sizes for all the cleaning aux sites. The fence size is updated based on the new probe dimension, which eliminates the need for retraining. Cleaning sequences always use the current value.



## Cleaning Sites

Use the Cleaning Sites tab to customize the configuration for all cleaning sites.




## Cleaning and Retraining Workflows

Clean Aux Site Setup Wizard (Clean Pad on Aux Chuck With AlignAux Alignment)

Clean Aux Site Setup Wizard (Clean Pad on Aux Chuck Without AlignAux Alignment)

Retraining After Replacing the Cleaning Pad

Retraining After Replacing the Probe Card (Same Size)

Replace Probe Card With Different Sized Card

Create Cleaning Sequence

Execute Cleaning Sequence

Select Default Cleaning Sequence

In ControlCenter and Spectrum, you have the option to do many tasks in various ways. These workflows provide examples of some of the ways to do your cleaning work.

In each of the following workflows, click the Next button after a step in the wizard.

### Clean Aux Site Setup Wizard (Clean Pad on Aux Chuck With AlignAux Alignment)

1. On the Velox main toolbar, click All Applications>Status>Alignment Mode to select On-Axis for scope or Off-Axis for platen camera.
2. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Setup Wizard Execute button.
3. In the Cleaning Setup Wizard, select the This site uses Spectrum AlignAux alignment check box.
4. Follow the wizard prompts.

### Clean Aux Site Setup Wizard (Clean Pad on Aux Chuck Without AlignAux Alignment)

1. On the Velox main toolbar, click All Applications>Status>Alignment Mode to select On-Axis for scope or Off-Axis for platen camera.
2. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Setup Wizard Execute button.
3. In the Cleaning Setup Wizard, select the This site does not use AlignAux alignment check box.
4. Follow the wizard prompts.
5. When you set the contact height for a:

   a. Platen camera—Focus on the surface (click the RunFindFocus button).

   b. Scope/eVue camera—Manually set contact.

### Retraining After Replacing the Cleaning Pad

If the keep-out border is generous enough that you can replace the cleaning pad without retraining, use the Cleaning Manager Cleaning Sites tab or the ResetCleaningPosition SCI command to reset the cleaning position.

If the keep-out border is not generous enough and you need to retrain:

1. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Setup Wizard Execute button.
2. Select the aux site to retrain, and then select the Only re-train the fence boundary check box.
3. On the Keep Out Border page of the wizard, enter the safety margin and probe dimension. The keep-out border is the sum of these two values. The fence dimensions are reduced by the keep-out border.
4. On the Aux Limits pages, locate the actual corners of the surface.

   Home is set to the upper right corner of a rectangular fence. Home is set at the top center of a circular fence.

### Retraining After Replacing the Probe Card (Same Size)

If the cleaning site is set up to use alignment (Spectrum AlignAux), no retraining is necessary. AlignAux updates the fence location and contact height based on where the probe card is currently placed.

If the cleaning site doesn’t use alignment and if the safety margin used when you set up the keep-out border for the cleaning site is not large enough to account for probe card placement tolerance, the fence needs to be retrained. For steps to retrain, see Retraining After Replacing the Cleaning Pad.

### Replace Probe Card With Different Sized Card

1. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Manager Open button.
2. In the Cleaning Manager Probe Parameters tab, enter X and Y dimensions.
3. Click the Update Cleaning Sites button.

   The fence sizes and index size are updated for all clean sites. The change in the dimension is calculated and used to update the fence sizes.
4. If the safety margin of the trained aux site isn't large enough to account for the placement error, retrain the fence following the steps in Retraining After Replacing the Cleaning Pad.

### Create Cleaning Sequence

1. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Manager Open button.
2. On the Cleaning Sequences tab, select Create New Sequence, and then enter the sequence name.
3. Select the PadCleaner aux site (created in Replace Probe Card With Different Sized Card).
4. Set up overtravel, clean count, and clean delay parameters.

### Execute Cleaning Sequence

1. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Manager Open button.
2. In the Cleaning Manager window, click the Cleaning Sequences tab.
3. Select the desired sequence from the drop-down menu.
4. Click the Execute Sequence button.

### Select Default Cleaning Sequence

The default cleaning sequence is used when `ExecuteCleaningSequence` runs with no sequence specified.

1. In the ControlCenter application, click System Setup, click Aux Sites, and then click the Cleaning Manager Open button.
2. In the Cleaning Manager window, click the Cleaning Sequences tab.
3. In the Sequence Selection drop-down list, select the desired default sequence.
4. Select the Default Sequence check box.

Chapter

# 4 Spectrum Vision

In Spectrum, you can use on-screen wizards for most setup actions. The wizards are displayed on live video using overlays with text and buttons.

Spectrum software can display up to four live cameras simultaneously. All cameras available for your system are listed in the Explorer Window, where you can configure each camera in the Settings pane. Semiautomatic pixel-to-micron video calibration ensures correct evaluation of the image. MultiView and MultiZoom imaging displays the full field of view. The combination of MultiView images and a contact view camera makes observing the wafer and the probe needle positions in XYZ easier and provides several zoom-in views of single-contact needles.

Spectrum provides full control of all motorized stages. With point-and-shoot navigation, you can precisely move the chuck, microscope, and up to five motorized positioners. Each positioner must be calibrated before use. See Configure and Calibrate Positioners for details.

Spectrum data is saved to .xml files. The configuration data for Vision is obtained from config.xml (stored in Velox\Spectrum\Config).

See also:

- Automation Setup
- VueTrackPro
- AutoRF Setup and Training

## Spectrum Features and Definitions

Spectrum provides multiple tools and features to set up your environment for successful testing.

| | |
|---|---|
| General Settings | Camera setup to calibrate the optical system. Admin access is required to modify these settings. |
| Objective Settings | Calibrates objectives with the selected camera. Admin access is required to modify objective settings. |
| Configure and Calibrate Positioners | Calibrates each positioner. Includes: Positioner Data, Positioner Repository, Calibration, Find Probe with Scope, Scope Follow Mode. |
| Set Up and Configure Cameras | |
| Calibrate Cameras | The Calibrate tool includes the data of all installed objectives (listed in config.xml file). Besides lens-specific data, it provides the calibration data specific to the camera where the objective is mounted. Settings include details of:<br>• Found models<br>• Search algorithm<br>• Settling time<br>• Movement |
| eVue Optical System | The eVue camera view provides a multi-path, digital optical system for micrography, inspection, and probing. |

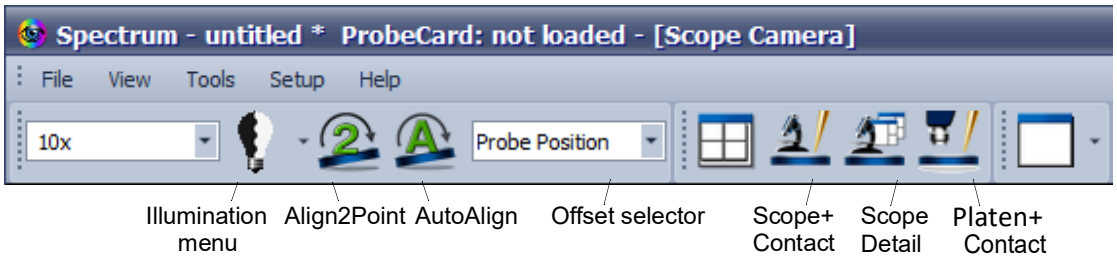
| | |
|---|---|
| Camera and Light Settings | The camera data for scope, platen, contact view, and eVue microscope is saved to the project file (.spp). The camera data for chuck is saved to the probe card file (.xpcd). |
| Main Camera Image | Provides field selectors to change the size and position of the detail views. You can zoom in and out digitally or switch the navigation function to point and shoot.<br>Spectrum displays on-screen messages for changed values and other information. You can change the crosshair size and text overlay colors in the Settings panel. |
| Multi-Camera Image | Provides the simultaneous use of multiple cameras. MultiView shows the wafer and the probe needle positions in XY as well as several zoomed-in views of single contact needles. |
| Cognex Models | A model is a saved pattern that has been trained as the ideal search structure that can be unique or found multiple times inside the region of interest. |
| PatMax Model | • Working with a sub-pixelgrid algorithm, a PatMax model trains and stores a rectangular pattern of a given structure. The search compares its pattern features with structure features in the current image.<br>• AlignModel trains the appending chuck and microscope distance to a trained position. |
| Cognex Blob Model | A blob model requires a high contrast image and objects with a closed shape. It includes a circular area in which grayscale values are binarized with the ThresholdPercent parameter. |
| NI Vision Models | National Instruments (NI) Vision model uses MatchScore, ColorPlane, and rotation angle for pattern matching. |
| NI Vision Blob Model | Background Correction, Circle Detection, and a binary threshold algorithm are used to train NI Vision blob models. |
| Probe Card Model | All single items (points) of this complex model are based on blob or PatMax models. This type of model is mainly used to detect probe card needle position shifts at temperatures other than ambient. |
| Pattern Matching | A search places the match score at the bottom of the match rectangle. |

# Spectrum Toolbar, Menus, and Windows

## Toolbar

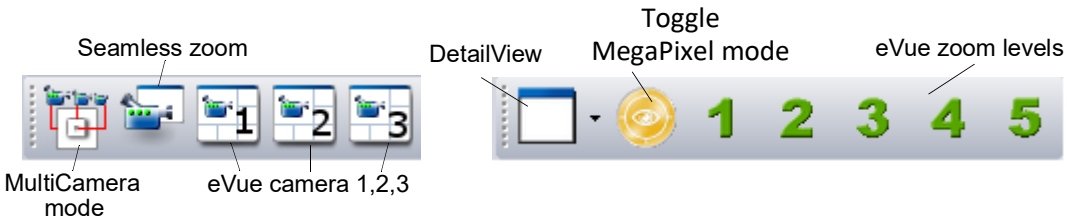
Configure Favorite Tools

The following graphic shows the default toolbar configuration for non-eVue systems.



The toolbar displays the available objectives, illumination setting, offset selection, camera view layouts, and the tools that are available for your application and enabled for display.

An eVue Optical System provides additional options such as MultiCamera mode and seamless zoom.



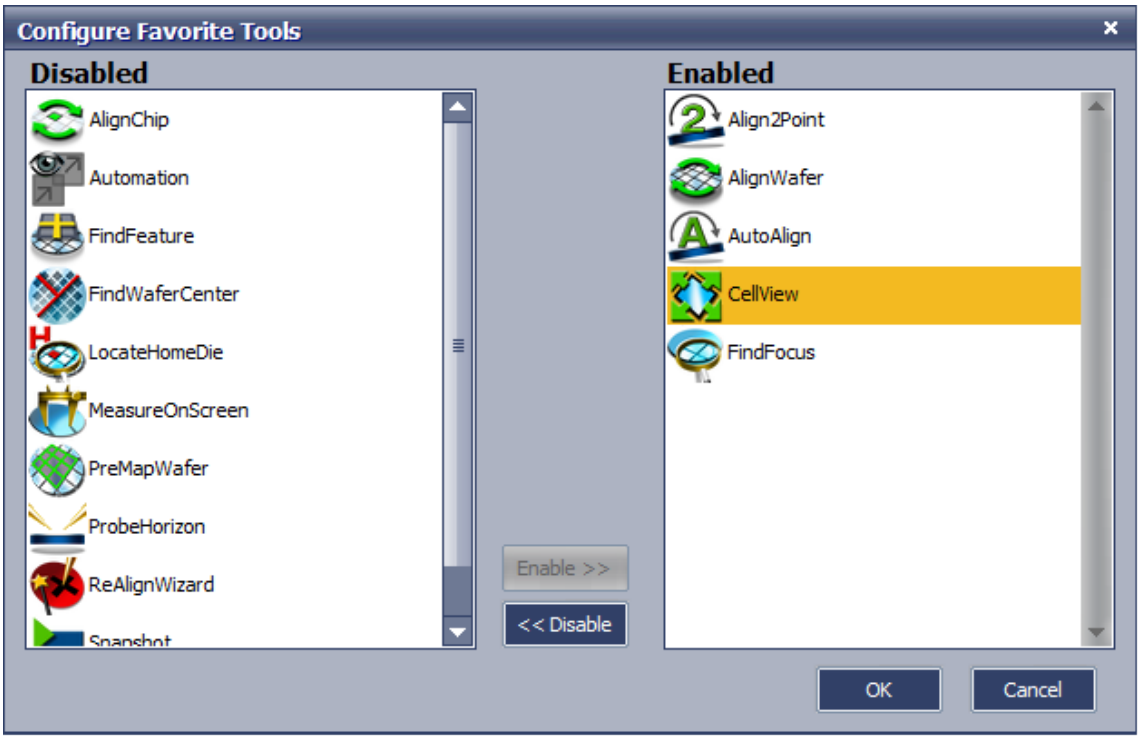

## Configure Favorite Tools

You can configure the Spectrum toolbar to display any of the tools available on your system.

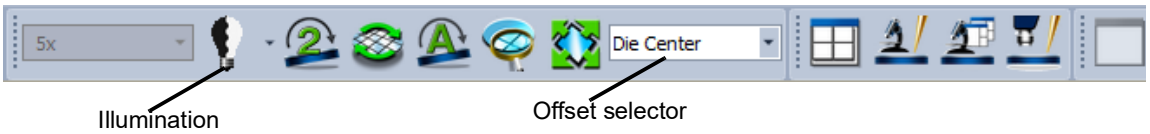
To enable the display of a tool in the Spectrum toolbar:

1. Right-click anywhere in the toolbar or click Tools > Configure Favorite Tools.
2. In the Disabled panel, click the tool you want to enable, and then click the Enable button. You can display all of the available tools, or enable only the ones you need to use frequently.

To remove a button from the toolbar, select it in the Enabled panel and then click the Disable button. You can access all tools available on your system from the Spectrum Explorer Window.



This example displays the tools as enabled above.




| | |
|---|---|
| Illumination | Adjust the sharpness, brightness, contrast, and shutter speed for the currently selected camera.<br>• Shutter speed changes frame rate.<br>• Brightness and contrast use image processing to improve image quality.<br>• Sharpness changes power level for the lamp that illuminates the currently selected camera. |
| Offset selector | Switch between coordinate systems when you use a platen camera.<br>• Probe Position – Use during probing.The offset compensation is deactivated and the chuck is below the needles.<br>• Die Center – Use for automatic calculations in the TrainReAlign wizard and the ReAlign procedure.<br>• Probe Mark 1—When the offset compensation is activated, the offset value is calculated as the distance between the first group of needles (as defined by the ProbeCardTool) and the platen camera. This setting automatically activates the overlay image of the first needle group and allows setting a home position or inspecting the probe marks at the current position.<br>• Probe Mark 2—When the offset compensation is activated, the offset value is calculated as the distance between the second group of needles (defined by the Probe Card Tool) and the platen camera. This setting is used to check if the second group of needles matches the pads or to correct the position if necessary.<br>• Probe Marks 3 and 4—You can add up to two more probe mark positions for vertical probe cards in order to view all four corners of the probe card.<br>Probe Marks 3 and 4 are for viewing only. They have no trained model and are not used in any calculations. See Add Probe Mark Positions for more information. |

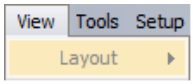
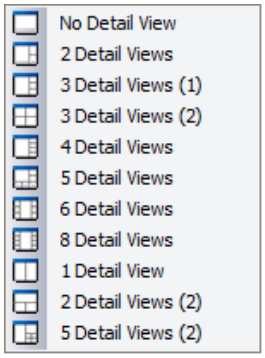
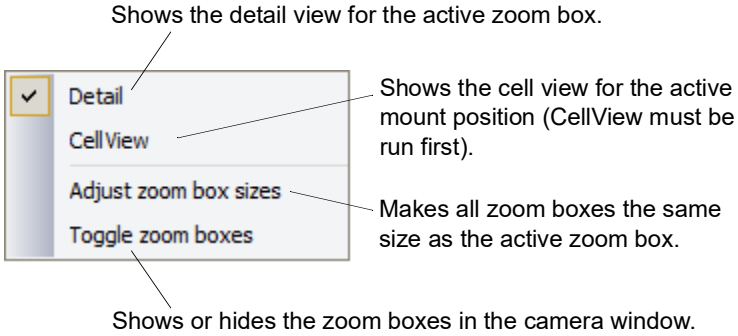
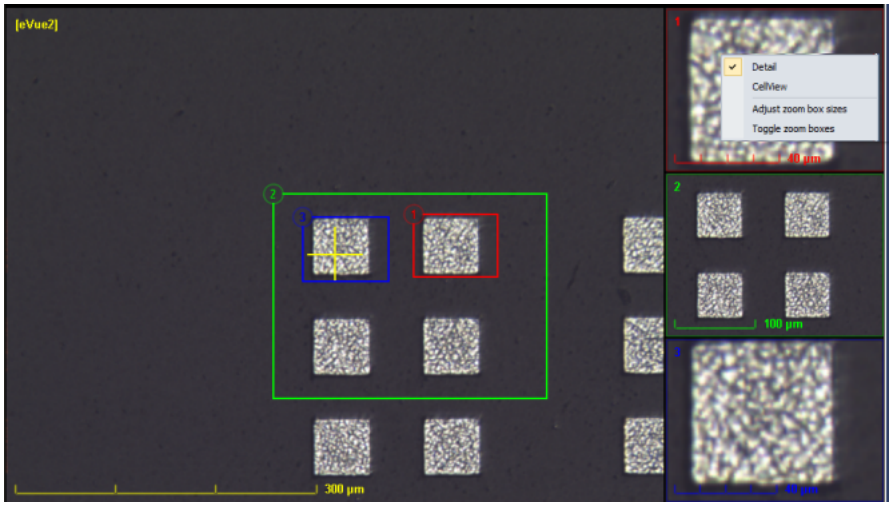
# Spectrum Menus

The following menus are available from the Spectrum application.

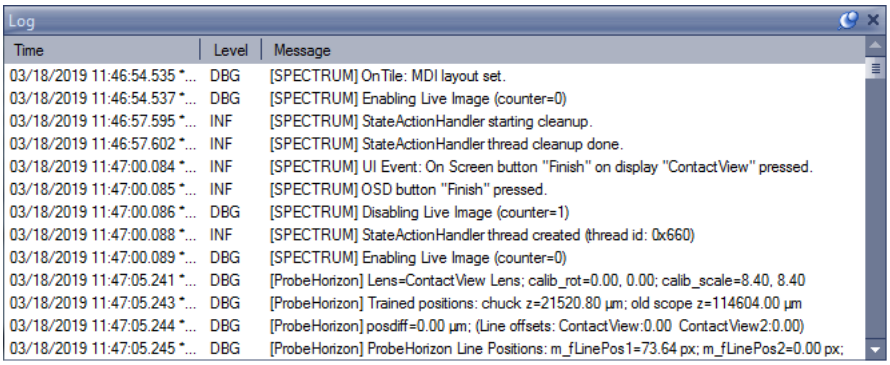
## File Menu

| | |
|---|---|
| Project | Includes the functions for managing files—New, Open, Save, and Save As—and a link to the last four project files used. Velox project files save your setup parameters and user preferences. |
| Probe Card | Saves and opens probe card data when Probe Card Tool is enabled.(The Probe Card Tool is automatically enabled when you have the ReAlign software option and you have a chuck camera configured in your setup.) |
| Login | Opens the permissions window for changing your access level. The application opens with the last used permission level. |
| Exit | Closes the application. |

## View Menu

| | |
|---|---|
| Layout | Configurable to display up to 8 detail views.<br>  <br><br>  <br> |
| Detail Views | On the Layout submenu, configure the view to display up to eight detail views. In each detail view, you can right-click and select from the following menu:<br>  <br><br>  <br> |

| | |
|---|---|
| Log Window | Shows or hides the log window. The log contains program status information. |



Log

| Time | Level | Message |
|---|---|---|
| 03/18/2019 11:46:54.535 *... | DBG | [SPECTRUM] OnTile: MDI layout set. |
| 03/18/2019 11:46:54.537 *... | DBG | [SPECTRUM] Enabling Live Image (counter=0) |
| 03/18/2019 11:46:57.595 *... | INF | [SPECTRUM] StateActionHandler starting cleanup. |
| 03/18/2019 11:46:57.602 *... | INF | [SPECTRUM] StateActionHandler thread cleanup done. |
| 03/18/2019 11:47:00.084 *... | INF | [SPECTRUM] UI Event: On Screen button "Finish" on display "ContactView" pressed. |
| 03/18/2019 11:47:00.085 *... | INF | [SPECTRUM] OSD button "Finish" pressed. |
| 03/18/2019 11:47:00.086 *... | DBG | [SPECTRUM] Disabling Live Image (counter=1) |
| 03/18/2019 11:47:00.088 *... | INF | [SPECTRUM] StateActionHandler thread created (thread id: 0x660) |
| 03/18/2019 11:47:00.089 *... | DBG | [SPECTRUM] Enabling Live Image (counter=0) |
| 03/18/2019 11:47:05.241 *... | DBG | [ProbeHorizon] Lens=ContactView Lens; calib_rot=0.00, 0.00; calib_scale=8.40, 8.40 |
| 03/18/2019 11:47:05.243 *... | DBG | [ProbeHorizon] Trained positions: chuck z=21520.80 µm; old scope z=114604.00 µm |
| 03/18/2019 11:47:05.244 *... | DBG | [ProbeHorizon] posdiff=0.00 µm; (Line offsets: ContactView:0.00 ContactView2:0.00) |
| 03/18/2019 11:47:05.245 *... | DBG | [ProbeHorizon] ProbeHorizon Line Positions: m_fLinePos1=73.64 px; m_fLinePos2=0.00 px; |

## Tools Menu

| | |
|---|---|
| Standard/Automation | Displays tools you have purchased. |
| Configure Favorite Tools... | Displays tools available on your system that you can display on the Spectrum toolbar. |

## Setup Menu

| | |
|---|---|
| **ACCESS LEVEL REQUIRED:** | Admin |

| | |
|---|---|
| Save/Read | Saves current settings as default settings used at next project startup. Select Read default Spectrum settings to restore default setting to the current project. |
| Reset GUI | Reinitializes the main menu and the toolbar according to the active set of tools. |

## Help Menu

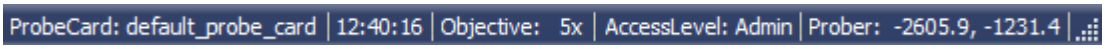
When you access Velox Help from the Spectrum Help menu, the help file opens at the beginning of the Spectrum topics.

The Remote Commands menu item opens the Velox Remote Interface Help.

About Spectrum displays important product, version, and copyright information.

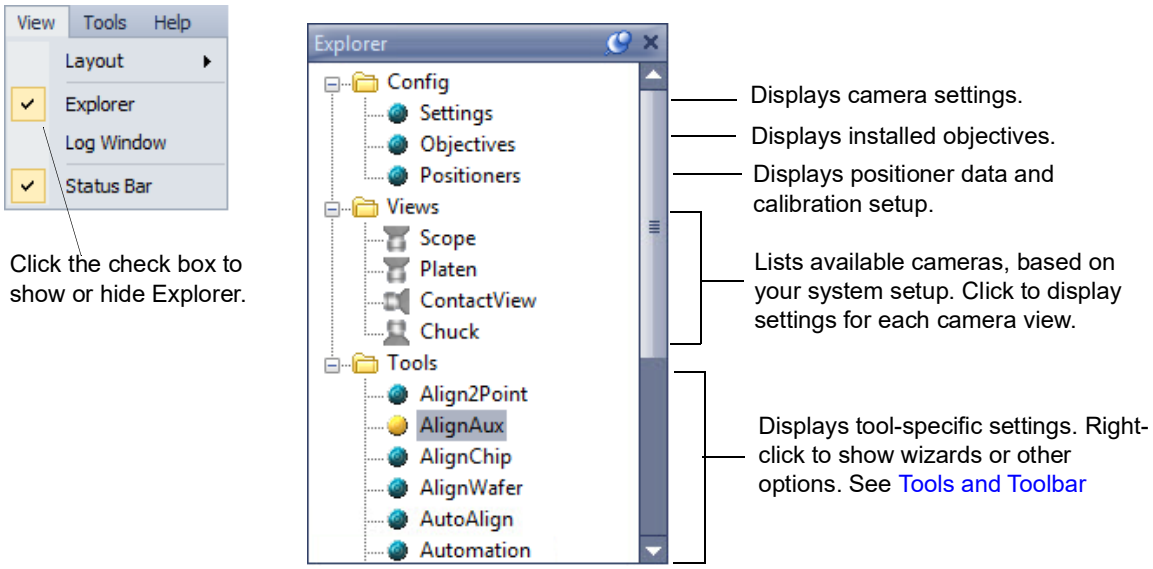
# Status Bar

Shows or hides the status bar at the button of the screen. Status details include current view, objective lens, access level, and model type.



## Explorer Window

The Spectrum Explorer window displays components, their properties, and tool wizards. If the Explorer is docked in Spectrum, you can drag it to a new position.




Spectrum tools use config data, project data, and probe card data settings, which are saved in the Explorer.

| | |
|---|---|
| ConfigData | To store default configuration settings in the Explorer, click Setup > Save default Spectrum Settings. |
| ProjectData | To save project settings in the Explorer with a project file, click File > Project > Save or Save As.<br>Project data files save to C:\Users\Public\Documents\Velox. |
| ProbeCardData | To save probe card settings in the Explorer with a probe card file, click File > Probe Card > Save or Saves.<br>Probe card data files save to C:\Users\Public\Public Documents\Velox. |

# General Settings

The optical system must be calibrated before you use Spectrum Vision. Camera setup is required for:

- Any changes to the magnification by zooming or changing objectives
- Mechanical changes to the camera or adapter
- Assembly or reassembly of the microscope

To modify general settings, in the Spectrum Explorer window, click Config > Settings. Refer to the following table for setting descriptions and access-level requirements.

.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| ShowFoundModels | If enabled, shows contour of all discovered models. | write | none |
| ShowDetails | If enabled, shows all detected features of the found models or display focus curves. | write | none |
| SettlingTimeXY | Select the settling time after XY movement in milliseconds | write | none |
| SettlingTimeZ | Select the settling time after Z movement in milliseconds | write | none |
| PointAndShootSpeed | Select the speed (percent) used for point and shoot movements. | write | none |
| Debug Mode | Select to enable Debug mode. | write | none |

# Objective Settings

You must be logged in as Admin to view objective settings. Read-only objective settings are determined by the installed objective. Once all objectives are calibrated with the selected camera, no new calibration is necessary for this camera and objective combination.

To modify objectives settings, in the Spectrum Explorer window, click Config > Objectives. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| Magnification | If enabled, shows contour of all discovered models. | read | none |
| MountPoint | If enabled, shows all detected features of the found models or display focus curves. | read | none |
| LensIdx | Select the settling time after XY movement in milliseconds | read | none |
| FindFocusParams | Select the settling time after Z movement in milliseconds | read | none |
| StepSize | Select the speed (percent) used for point and shoot movements. | write | none |

| | | | |
|---|---|---|---|
| RegionOfInterest | Determines the region of interest (ROI) settings. Use the region for model lookup and focus search.<br>You can right-click on a camera view to change the ROI (see Calibrate Cameras).<br>See also Region of Interest Data, | write | none |
| ExtensionFactor | Extends the diagonal measurement of the ROI by a multiplier, creating an extended search area that is used by AlignWafer, AlignChip, AutoAlign, and AlignAux.<br>If the ROI diagonal was 600 micrometers, applying an Extension Factor of 2.0 would create an extended search area with a diagonal of 1200 micrometers. The aspect ratio of the extended search area will match the aspect ratio of the ROI. | write | none |
| Origin | Upper left point (XY) of the Region of Interest, relative to the upper left corner of the Field of View of the camera. Units represent fraction of the FOV. For example, 0.5, 0.5 places the upper left corner of the ROI in the center of the FOV. | write | none |
| Size | ROI represented as a fraction of the Field of View. For example, 0.5, 0.5 creates an ROI that is 1/4 the area of the FOV. | write | none |

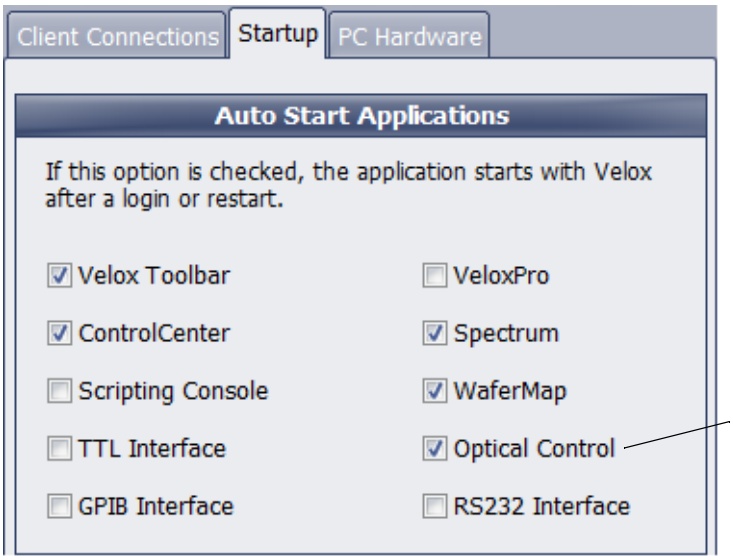
## Region of Interest Data

When you save a project, Spectrum writes the region of interest (ROI) data from each objective lens configuration to the project file. Chuck camera ROI data is stored in the probe card file. When a project is loaded, Velox transfers the ROI data from the project file or probe card file to the objective lens configuration.

## A-Zoom Objective Calibration

The Zoom Level Calibration calibrates the currently installed objective over the full zoom range of the A-Zoom microscope. This calibration allows the objective scale factor to be dynamically updated based on changes to the microscope zoom level. In turn, this enables accurate point-and-shoot movement throughout the full zoom range of the microscope.

1. The Optical Control tool must be configured to start when Velox software starts. It is required when using an A-Zoom microscope with remote control.




Enable the Optical Control tool in the Velox Setup window (in ControlCenter Tools)

2. In the Spectrum Explorer window, click Config > Settings, and then select the UseOpticalControlForZoomLevel check box.
3. Under Views, right-click Scope and then click Calibrate Camera Zoom Levels to start Zoom Level Calibration wizard. (requires Engineer login privileges).
4. To begin the calibration process, select an appropriate model by moving the chuck as instructed, and then click the Start Calibration button.

   The Zoom Level Calibration wizard begins calibrating from zoom level 0 up to 100 in 10 percent increments. s part of the calibration process, you select a new model and then go on searching if a model can't be found for a particular zoom level.
5. When you click the Finish button, the wizard saves the calibration data.

# Configure and Calibrate Positioners

Spectrum supports point-and-shoot movement for up to 6 motorized positioners. Before using this feature, each positioner must be calibrated. The calibration must be repeated every time the needle is replaced or the position of a probe relative to the prober is manually changed. Positioner data is stored in the Positioner tool.

To specify positioner settings, in the Spectrum Explorer window, click Config > Positioners. Refer to the following table for setting descriptions and access-level requirements.

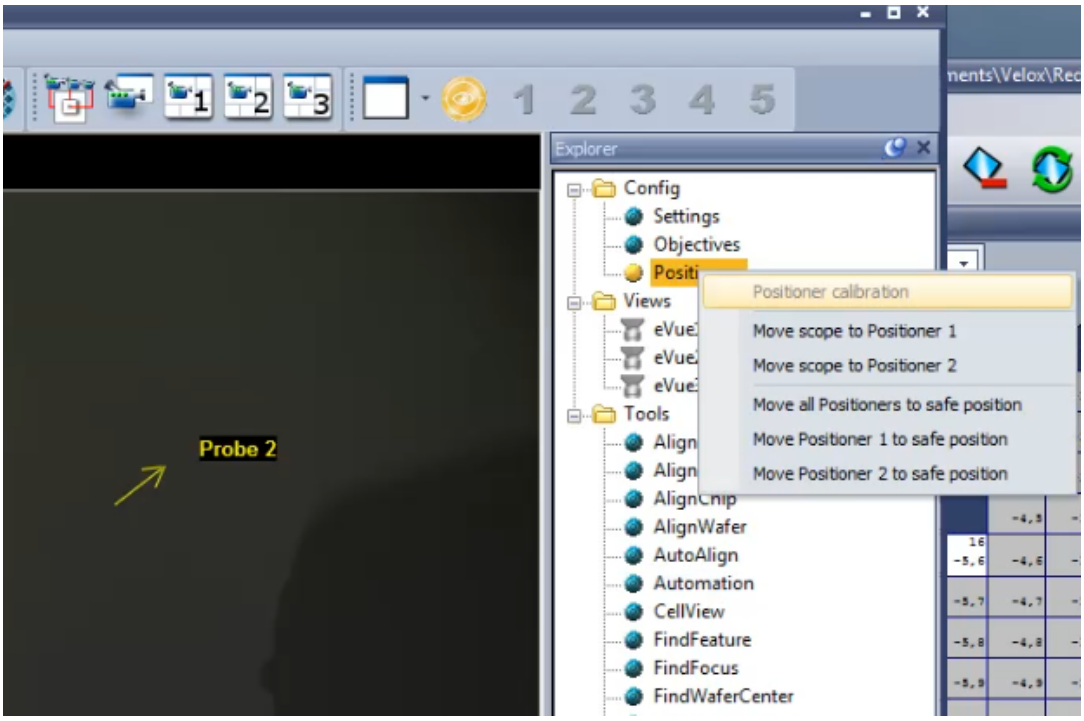
| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| EnableScopeFollow | Enables or disables Positioner Follow mode. When enabled, positioner XY follows the scope XY. | write | read |
| ShowPositioners | When enabled, shows the position of the calibrated positioners as an overlay image of the scope camera. | write | read |
| Safe Distance | Sets the distance the probes move in the direction of the safe vector (angle) for safe movement. | write | read |
| Positioner *n* | Settings are specified for each installed positioner, shown as Positioner 1, Positioner 2, etc. Click the (+) symbol to display the settings. | write | read |
| FollowScope | If Scope Follow mode is enabled, an individual positioner can be set to FollowScope. | write | read |
| SafeVector | Angle for the safe movement. | write | none |
| Overlay Color | Sets the color of the on-screen overlays in the main view. | write | write |
| Description | Enter a description to be displayed in the overlay (optional). | write | write |

## Calibrate the Positioners

Calibrated the positioners set the safe boundary on each probe. To calibrate the positioners:

1. In the Spectrum Explorer window, click Config and then right-click Positioners.

2. Click Positioner calibration.

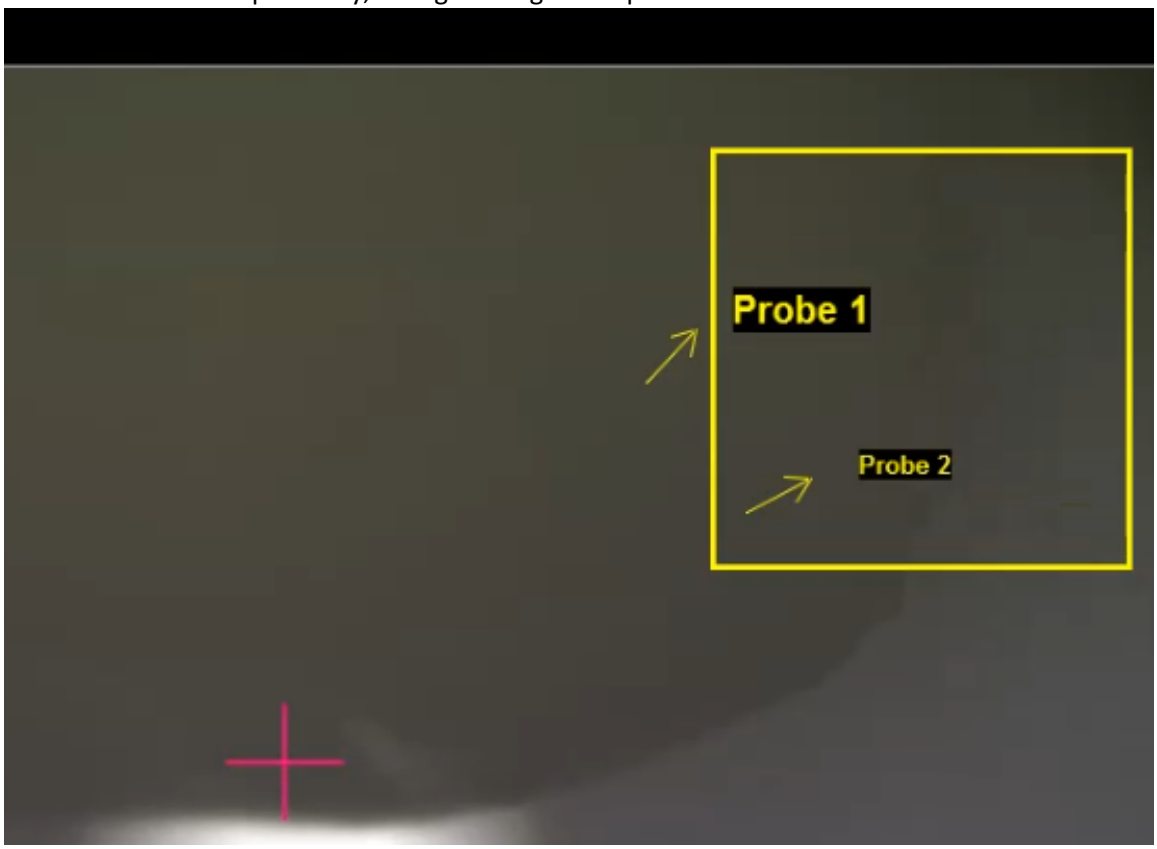



3. Manually move away Probe 2, then click the Positioner 1 button.
4. A yellow box is displayed at the bottom left corner. Manually move the Probe 1 tips inside that box, then click on one of the tips.

The box turn greens while the mouse cursor is inside the box. In this example, you click the top probe tip.

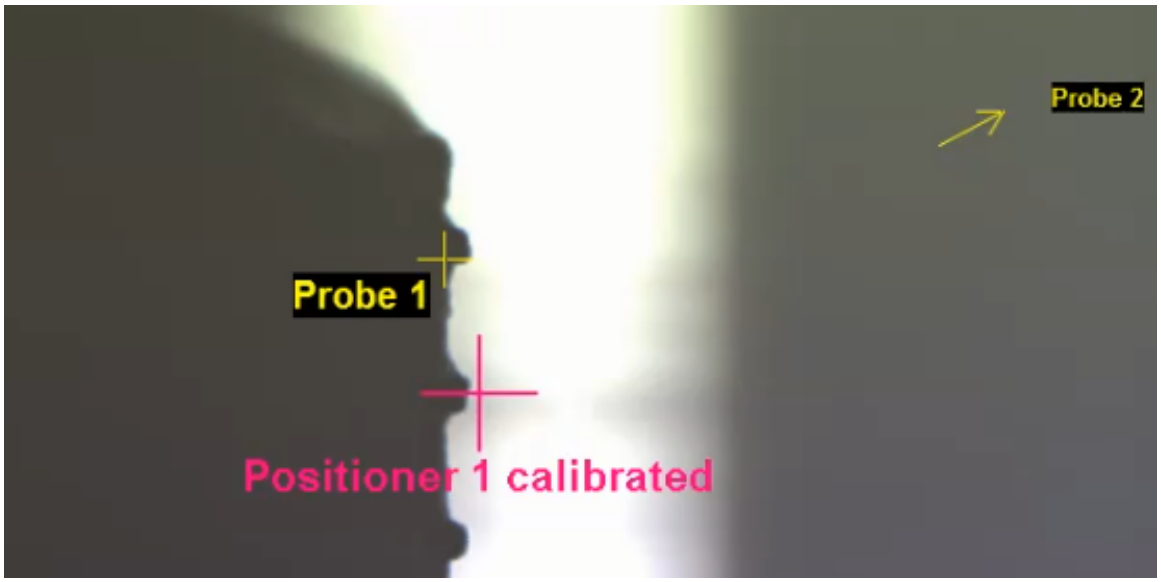
Spectrum displays the yellow box in the top-right corner.

5. Manually move the Probe 1 tips inside this second box, and then click the same tip. If you cannot see the tips clearly, change the light setup.




Positioner 1 should automatically move close to the center of the field of view. If not, you must reinitialize the probe.

6. Follow the instructions to move the probe to center, and then click the center of the probe shaft close to the edge of the field of view. The wizard shows that this positioner is calibrated.



7. Right-click Positioners, and again select Positioner calibration. Move away from Probe 1, and then choose Positioner 2 to calibrate. After both positioners are calibrated, the labels fall in the probe tips that you choose.

**NOTE**

*If you are training Automation, refer to Automation Wizard, VueTrackPro, or AutoRF Setup and Training for more information.*

**Find Probe with Scope**

Use Find Probe with Scope to locate a programmable probe that is beyond the field of view.

1. To locate a probe, the probe and the selected objective must be calibrated and the scope must have a motorized XY-axis.
2. In the Spectrum Explorer window, Config folder, right-click the Positioner tool and then click Move Scope to Positioner.
3. Select the positioner you want to see inside the scope field of view.

**Positioner Follow Mode**

You can synchronize the movement of the positioners to the movement of the scope.

1. The probe and the selected objective must be calibrated and the scope must have a motorized XY-axis.
2. In the Spectrum Explorer window, click Config > Positioners.
3. Under Positioner data, select the EnableScopeFollow check box.
4. Under Positioner repository, select the FollowScope check box.
5. Slowly navigate the scope to the desired position.
6. Make sure that all probes are positioned to allow movement to the desired movement. ScopeFollowMode is deactivated when one of the positioners moves into its software fence.
7. Move the scope very slowly—no faster than 1%—to ensure the probes don't lose track of the scope.
   - While ScopeFollowMode is activated, do not move a probe separately.
   - Collision detection is not implemented, so ensure that no positioner can collide with another probe.

## Scope Follow Mode Using eVue

When you have enabled the EnableEVueScopeFollow parameter (in the Spectrum Explorer window Config > Settings), the system uses the eVue fine focus stage for Scope Follow mode instead of the scope transport Z-stage.

| On systems with... | Scope Follow Mode defaults to... |
|---|---|
| eVue and no scope transport Z-stage | Enabled |
| Both an eVue and a scope transport Z-stage | Disabled |

The eVue fine focus stage has a small range of travel. Carefully position the stage when you enable scope follow mode so that the desired range of chuck Z motion can be tracked.

### Scope Follow Mode Workflow

1. Put the device or chuck surface into focus (move the chuck, eVue fine focus, scope transport, or any combination of these).
2. Click Scope Follow mode on the Velox toolbar.
3. Perform actions such as PTPA where probe tips are aligned in XYZ to pads after the chuck is lowered away from contact. The device surface stays in focus when the chuck moves up/down between separate/contact positions. This is especially useful when checking probe scrub marks.

If Scope Follow mode is enabled and the wafer surface is not in focus, perform the following steps to re-establish focus:

1. Disable Scope Follow mode.
2. Focus on the wafer surface using the eVue microscope or the scope transport. Ensure the current eVue microscope position is appropriate.
3. Enable Scope Follow mode.

# Set Up and Configure Cameras


Calibrate Cameras

eVue Optical System

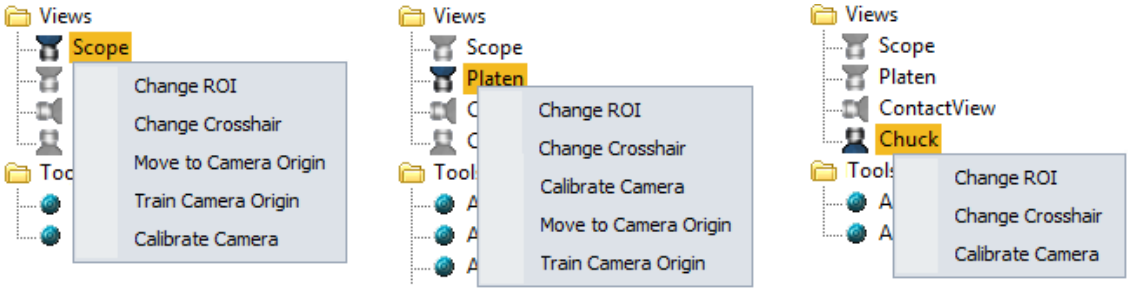
Camera and Light Settings


## Calibrate Cameras

**ACCESS LEVEL REQUIRED:** Admin

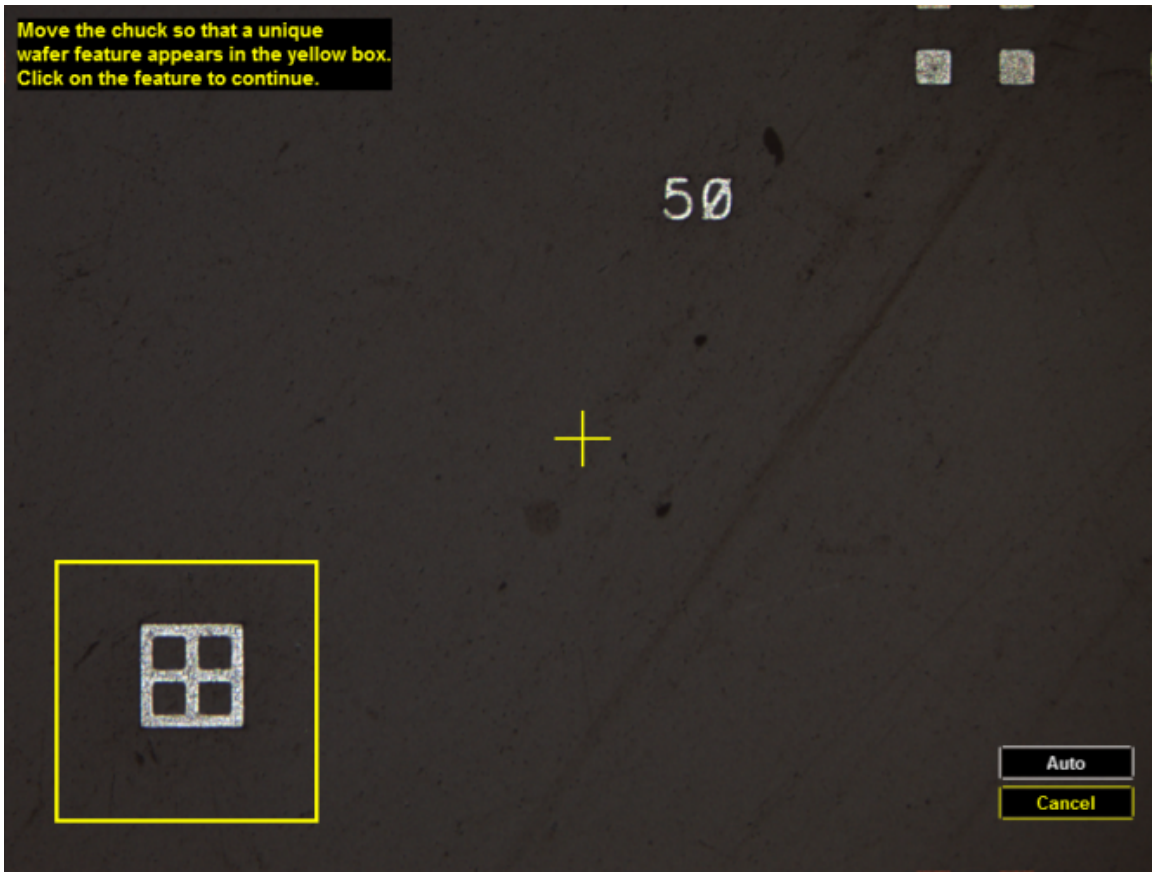
The Calibrate tool includes the data of all installed objectives. In addition to lens-specific data, it provides the calibration data specific to the camera where the objective is mounted. Microscopes make use of changeable lenses which are calibrated when selected.

Contact View, Chuck camera, and Platen camera use fixed lenses. Right-click the camera view (Scope, Platen, Chuck) to display the Calibrate Camera option.




1. In the Spectrum Explorer window, select the view to be calibrated.
2. In Camera Settings, set up the correct objective for the microscope.
3. Right-click on the view to be calibrated and choose Calibrate camera.
4. Move the chuck to get a recognizable feature inside the yellow box. Zoom in to make single pixels visible, and then click the feature.
5. Move the chuck to get the same feature inside the yellow box. Click this feature at the same pixel position.

   To determine the camera rotation, click the relation between camera pixels and microns (scale). The calibrate state changes from Guess to Calibrated. All data are written to config.xml.




## eVue Optical System

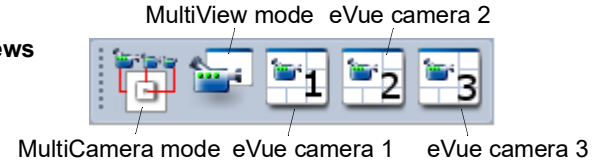
eVue Seamless Zoom

eVue Smart Lens Board

The eVue camera's multi-path, digital optical system provides multiple configurations, including 10x, 40x, 10x Pro, and 40x Pro.

- eVuePro solutions include productivity tools such as Auto Focus, MultiCamera mode, MultiView mode, and Megapixel mode.
- The eVue 40x solution has a third higher-magnification system integrated with the two 10x systems. The third path provides higher magnification as well as a third video stream for multi-stream display.

**eVue layout views**



- eVue1, eVue2, and eVue3 have unique Regions of Interest (ROI). Seamless zoom mode automatically switches between ROIs as the cameras are switched.

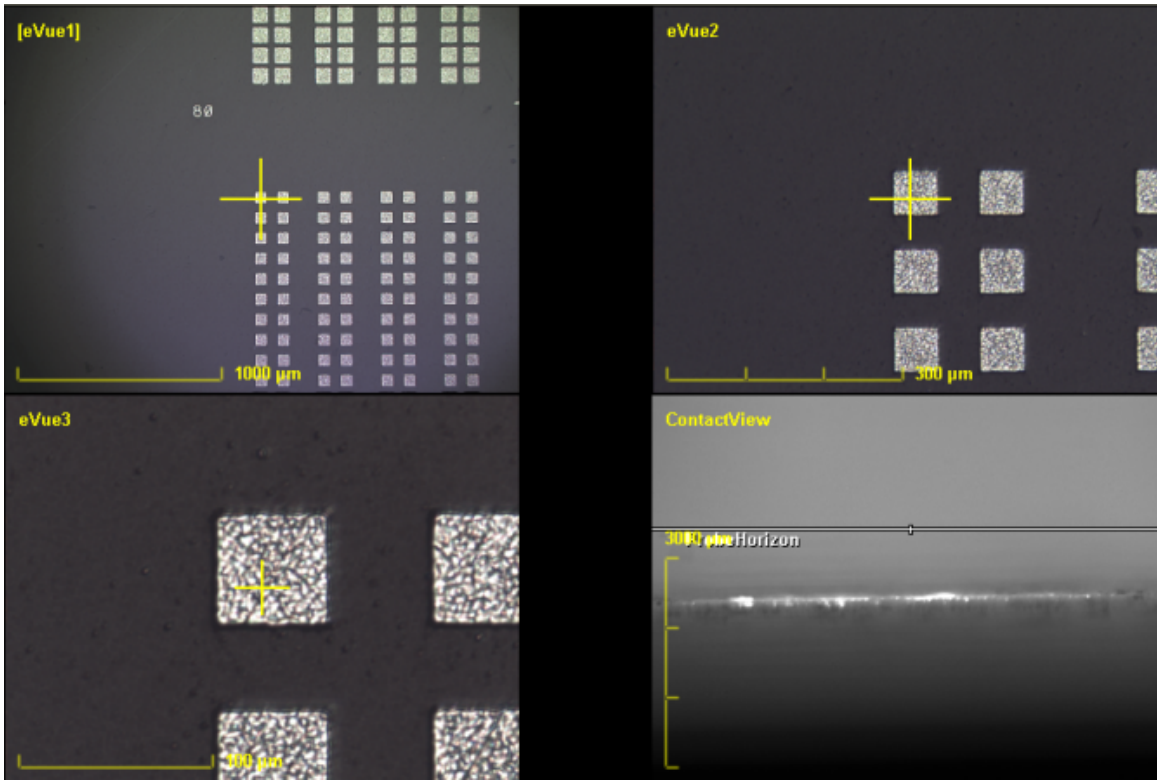
| | |
|---|---|
| MultiCamera mode | Controls multiple live video cameras configured at different zoom levels. All of the zoom windows are on axis. |
| MultiView mode | View a single live video camera in different ways, such as with altered zoom level and changed horizontal or vertical orientation. |
| MegaPixel mode | Available only on the eVue microscope in Multi-View mode. Mega Pixel mode doubles the number of pixels used as the source for the Live Video window and provides 1280x1024 of source pixels for the display. |

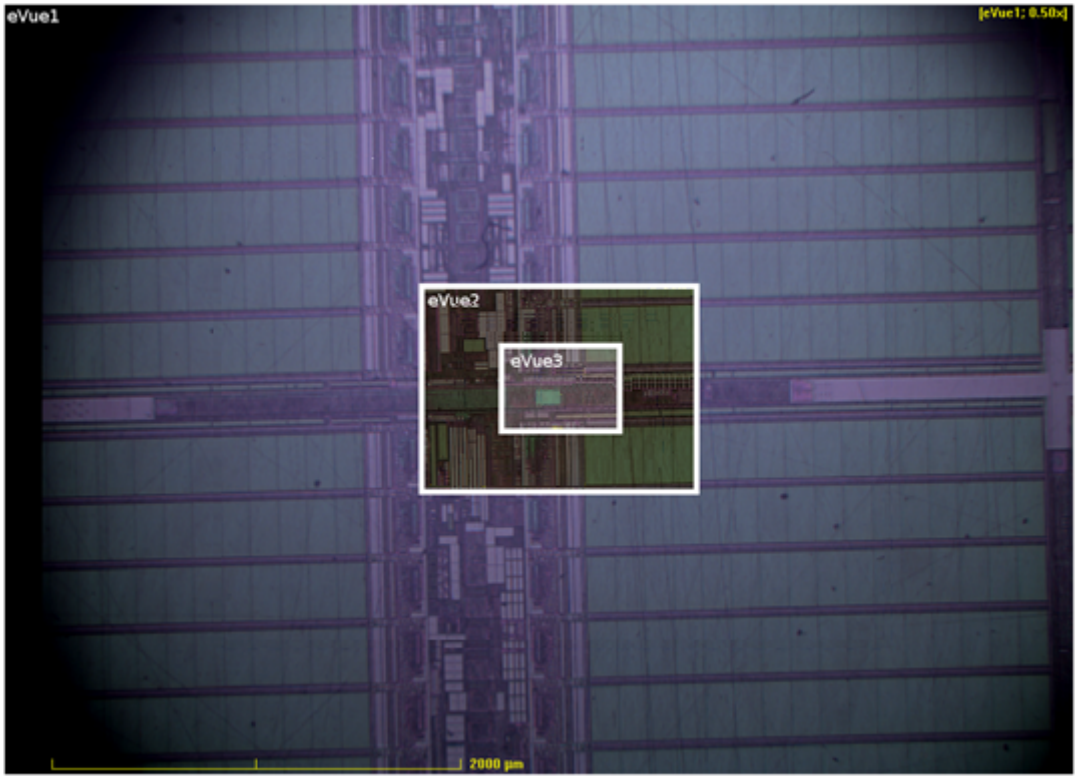
## eVue Seamless Zoom

The eVue microscope contains up to three cameras, each covering a different field of view (FOV). The seamless zoom mode dynamically adjusts the image acquisition modes and switches to higher resolution sub-camera sites when needed.

Zooming always takes place with respect to the image center. Seamless zoom mode:

- Does not support off-center zooming and panning.
- Is not available when multiple cameras are displayed.
- Is not enabled in detail views.






## eVue Smart Lens Board

**CAUTION**

*If you use the same Smart Lens mount when changing objectives on automatic or semi-automatic stations, you must change the objective settings and recalibrate the Smart Lens to ensure measurement accuracy.*

See the *eVue Digital Imaging System User Guide* for more information on setting up the Smart Lens.

### Format an Objective

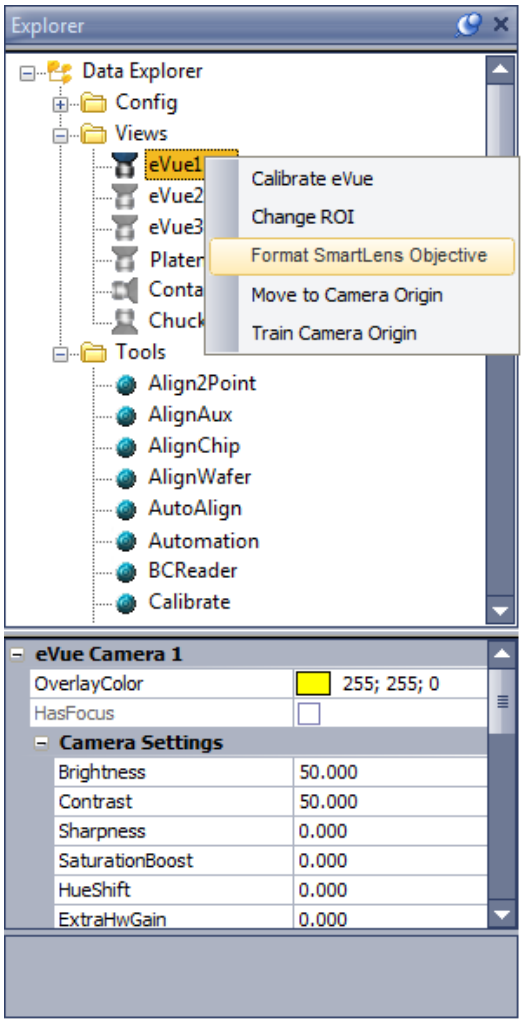
**ACCESS LEVEL REQUIRED:** Admin

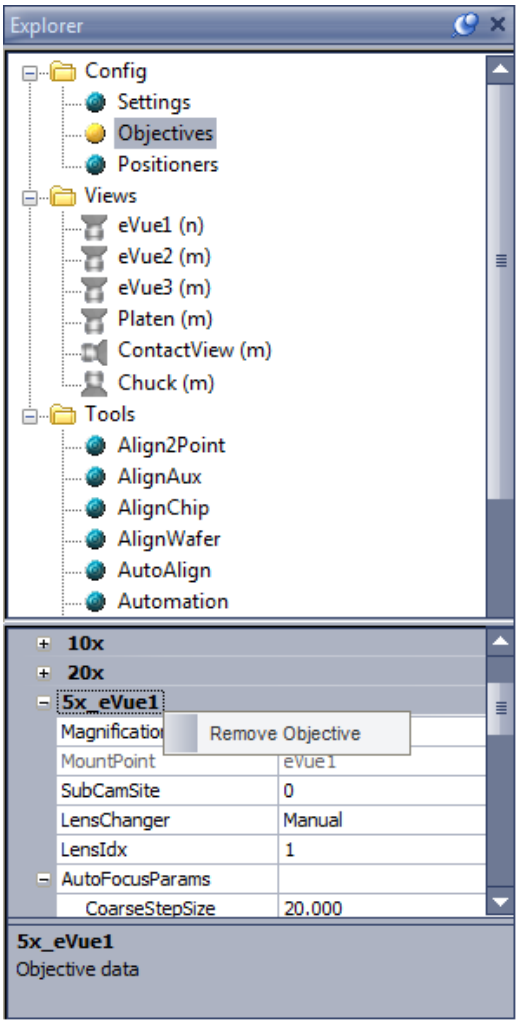
To format and calibrate the eVue microscope objectives:

1. Select the active camera live video.
2. In the Spectrum Explorer window, right-click eVue1, then click Format Smart Lens Objective to display the selection for nominal magnification (5x, 10x, 20x, 50x, etc.).

3. Click the OK button.

   Spectrum prompts you to confirm and warns that all data will be lost on the Smart Lens. The cursor changes to an hourglass until the formatting is complete.




## Select the Objective

When your Smart Lens Board is shared between objectives:

1. Move the Smart Lens Board to a different objective.
2. Place the Smart Lens Board back in the eVue microscope.
3. The objective is identified incorrectly as the prior objective.
4. Select the different objective.
5. When Spectrum asks you to overwrite the Smart Lens with the other objective's data, click the OK button.

### Remove eVue Objectives

You can remove old objectives from the eVue microscope list when they become unavailable for any reason. Right-click eVue1 to display the Remove option. The selection is disabled if the current objective is being used, which prevents the last-used eVue microscope objective from being removed or deleted.

The Remove option applies only to eVue1 objectives. Removing an eVue1 objective would remove all objective objects in the Spectrum Explorer window that apply to the same physical objective (5x_eVue2 and 5x_eVue3).

### Temporary Objectives

When you insert an unformatted Smart Lens, a temporary objective—which is not persistent across Spectrum sessions—is added. This temporary objective is visible in the Spectrum Explorer window and can be modified, but it is not saved to config.xml across sessions.

To aid diagnosis, temporary eVue Smart Lens objectives have the same names: TEMP_eVue1, TEMP_eVue2, and TEMP_eVue3.

For an unformatted Smart Lens, Spectrum status bar displays the eVue1 objective in the as:

> Objective: TEMP_eVue1 (UNFORMATTED)

When the eVue microscope is using a temporary objective, an on-screen notification displays:

> Objective set to TEMP_eVue1, Objective set to TEMP_eVue2, and Objective set to TEMP_eVue3

### Recognize an Objective

When an eVue Smart Lens is inserted, it is compared to existing eVue microscope objectives. If the name matches an existing Smart Lens objective from the config.xml file, that objective is selected and the data from config.xml is selected.

If the objective is not recognized (the Smart Lens objective name does not match any objective configured in the config.xml file), it is imported. However, the calibration data, if any, is discarded. This prevents a 5x objective from being calibrated on one system and then being used on another; although the pixel-to-micron ratios might be correct, the rotation is likely to be incorrect.

If an objective is not locally calibrated, the Spectrum status bar shows the uncalibrated state. Normally, the status bar displays the name of the objective: Objective: 5x_eVue1. If it is an eVue and is uncalibrated, it will show Objective: 5x_eVue1 (UNCALIBRATED).

The uncalibrated state exists when:

- An objective is formatted
- Does not match the saved objective data
- Calibration fails (hardware error occurs)

### Start the Calibration Wizard

Spectrum prompts you to format and calibrate when an unformatted Smart Lens board is detected. If you do not acknowledge the prompt within 10 seconds, the message box closes. The calibration wizard begins when you affirm the prompt.

If an uncalibrated or unformatted Smart Lens board is detected while a wizard is running, you must manually cancel the wizard and restart the format or calibration process.

## Camera and Light Settings

The camera data for scope, platen, contact view, and eVue microscope is saved to the project file (.spp). The chuck camera data is saved to the probe card file (.xpcd).

Camera and light settings depend on your system setup. In some cases, you can enable tool-specific light settings.

To specify camera and light settings, in the Spectrum Explorer window, Views folder, click the view (Scope, Platen, ContactView, or Chuck) for which you want to set camera properties.

| Setting | Supported Cameras | Description |
|---|---|---|
| OverlayColor | All cameras | Sets the color of text and other indicators in the main view. |
| **Camera Settings** | | |
| Light settings | Scope and Platen | • Downward-looking camera (scope and platen) light settings are stored for each auxiliary site. For example, CalSubstrate Site 3 has unique settings depending whether it is off-axis (platen) or on-axis (scope).<br>• Auxiliary sites light settings are stored in Spectrum Config data. The light values remain across projects and are global to Spectrum.<br>• Each wafer site light settings are stored in Spectrum Project data. You can have different light settings for different wafers. |
| Brightness | All | Sets the brightness value (0 is darkest,100 is brightest, 50 is default). |
| Contrast | All | Sets the contrast value (0-100, 50 is neutral). |
| Sharpness | All | Sets the sharpness value ranging from 0 to 350 (sharpest is 350, and 0 is the same as no sharpening).<br>An adjusted sharpness can make the video image seem more detailed and the edges more distinct. This can be especially useful when examining devices under high magnification. |
| Shutter | All | Sets shutter speed time (frame rate) in ms. |
| Gain | All but eVue microscope and A-Zoom | Sets the multiplier for each pixel in the image. |
| White Balance | Color cameras only | Set white balance manually or select Automatic White Balance for consistent results. The camera must be set to look on a real white surface and be out of focus.<br>Right-click White Balance or select the AutoWB check box to enable White Balance. |
| ShadingCorrection | For iVista only | Enables camera shading compensation when selected. |
| RingLight1&2 | Chuck camera | Activates special lights to optimize the lighting of the needles when seen with the upward looking (chuck) camera. (Applies only to some chuck cameras on PA stations.) |
| LightState | All | Switches light on or off. |
| **Crosshair Settings** | Scope, Platen, and Chuck cameras | Crosshair – Sets the appearance of the mark (lines, cross, window) in the middle of the camera image. |
| | | Size – Sets the size of the mark. |
| | | Thickness – Sets the thickness of mark lines. |
| **eVue-Specific Settings** | | |
| SaturationBoost | | Sets the saturation boost factor (0-100). 0 is no extra saturation. |

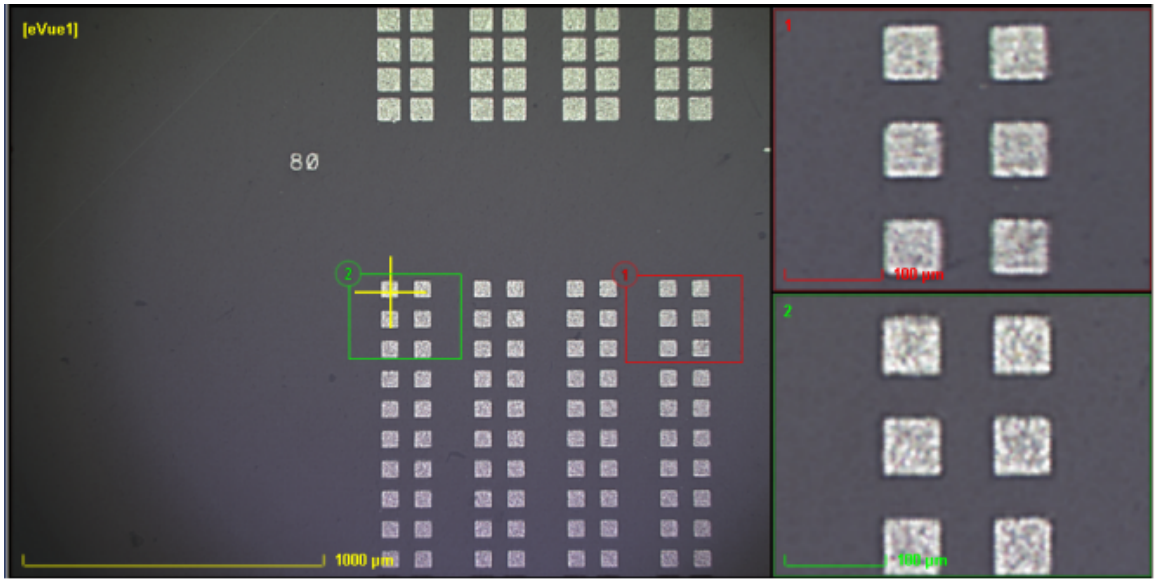
| | |
|---|---|
| Hue Shift | Sets the hue shift (0-100). |
| ExtraHwGain | ExtraHwGain (0-10, 0 is extra gain) |
| SoftWhiteBalance | When enabled, the eVue microscope automatically and continually adjusts the white balance level for a neutral color balance. This causes the video image to be processed so that no single color dominates.<br>Use this setting to improve clarity and reduce viewer fatigue when you view a scene that is predominantly one color. By default, the eVue microscope uses factory calibration against a known color standard to display colors as accurately as possible. |
| SoftAgc | When enabled, Automatic Gain Control (AGC) makes automatic exposure and contrast adjustments for optimal illumination across your image. |
| Illumination | Illumination adjustment changes the actual level of light from the eVue microscope. Possible values range from 0 to 100 by increments of 1.<br>• Full Illumination is 100.<br>• Zero illumination is equivalent to turning the illumination off,.<br>• Full illumination (100) is the same as normal illumination in prior versions.<br>When you examine devices that are very sensitive to visible light, it may be useful to change illumination levels. If you reduce illumination, be sure to increase exposure time to maintain a good view or use Auto Expose. |

# Camera Views and Images

Available camera views depend on your system setup.

## Main Camera Image

Spectrum displays on-screen messages for changed values and other information. You can change the crosshair size and text overlay colors in the Spectrum Explorer window (Config > Settings).



### On-Screen Navigation

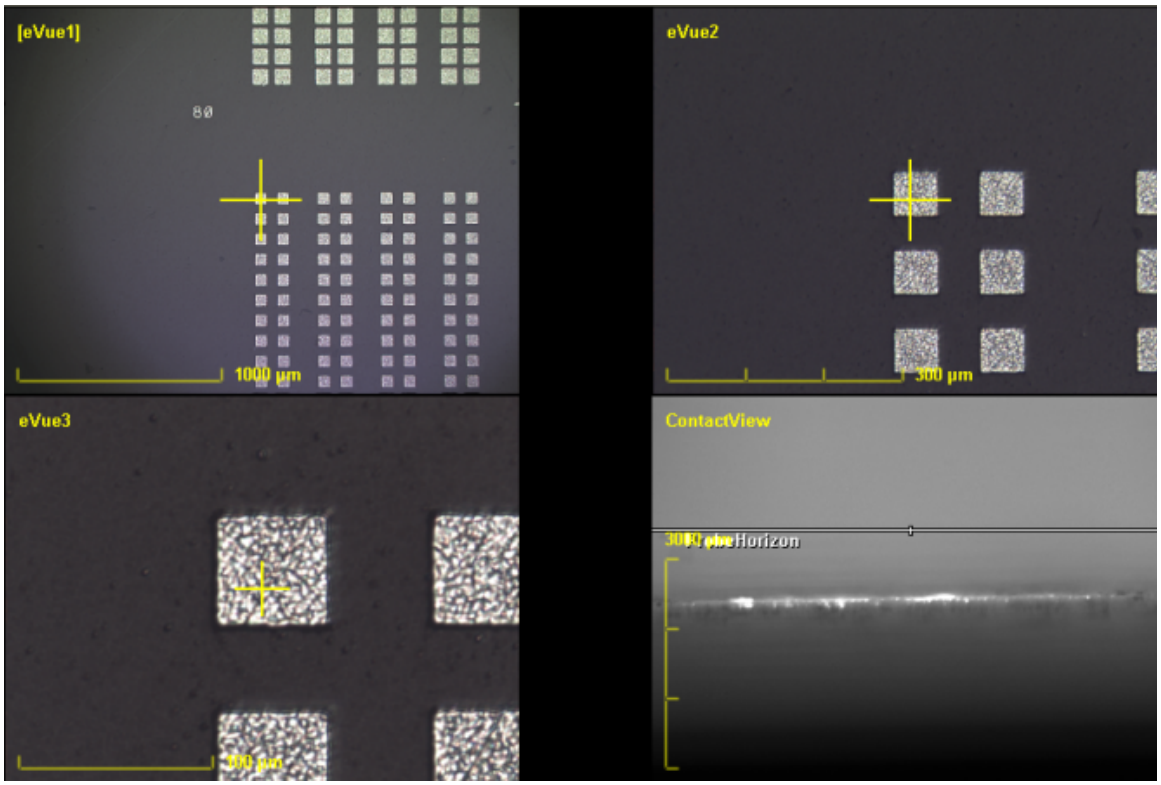
To move the chuck, microscope, or motorized positioners, use the default keyboard and mouse navigation, or the Point And Shoot mode.

You can enable or disable the modes from the Spectrum Explorer window or the video window menu. Use the ControlCenter Navigator to switch the stage.

| Keyboard and Mouse Navigation (Default) | Point and Shoot Navigation |
|---|---|
| Select chuck stage – Ctrl+C | Select Point and Shoot to select a specific feature in the middle of the video window with just one mouse click.<br>Do one of the following:<br>• Point at a structure with the mouse pointer and double-click.<br>• Hold down the Ctrl button on your keyboard while you click the mouse.<br>Depending on the stage selection, the chuck or the microscope moves. A character on the mouse cursor indicates the active stage. |
| Select scope stage – Ctrl+S | |
| Select a positioner – Ctrl+1...6 | |
| Point and Shoot to the clicked position (for scope and platen cameras) – Ctrl+click | |
| With Use Stage Drag enabled, drag the chuck or scope stage to follow the pointer – click or touchscreen<br>• For scope/eVue microscope cameras, the drag movement can move either scope or chuck.<br>• For the platen/chuck cameras, the drag movement moves only the chuck. | |
| Move the first of two selected positions to the second position – Shift+click to select positions<br>• Useful for probe-to-pad alignment.<br>• For example, select needle and click the pad to move needle to pad. | |
| Display menu inside camera window – Right-click | |
| Zoom the view and resize the detail views – Mouse wheel<br>• Panning is allowed in detail views.<br>• Panning is allowed in main view only if Use Stage Drag is disabled. | |

## Multi-Camera Image

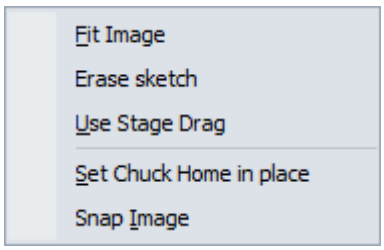
Multi-camera imaging provides the simultaneous use of multiple cameras. MultiView shows the wafer and the probe needle positions in XY as well as several zoomed-in views of single contact needles.You can check the height of the probe needles over the wafer while a contact view camera facilitates the observation in Z direction.



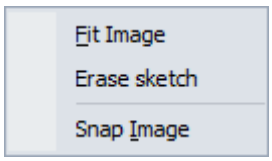

## On-Screen Camera Menus

Right-click in a camera view to display the menu.

**Scope and Platen Cameras**




**Chuck and Contact View Cameras**




- Fit Image – Resets the zoom level so that the full field of view is shown.
- Erase Sketch – Removes focus curve and found models overlays, which can be left over after running tools such as FindFocus or FindFeature.
- Use Stage Drag – Enables a dragging motion (using the left mouse button) to move the currently active stage (Chuck and Scope only)
- Set Chuck Home in place – Sets the chuck home position to the current position.
- Snap Image – Takes a snapshot of the selected view and saves it.

# Tools and Toolbar Buttons

You can find tools required for the selected configuration in the Spectrum Explorer window. You can configure these tools in the Settings pane and tool's sub settings. You must run the wizard before you start using a tool that uses pattern recognition, such as AlignWafer or ProbeCard.

**CAUTION**

*If the operations are disrupted by resetting the Message Server or the controller, settings such as Contact Height may be lost. Be sure to check all settings before proceeding. For details, click the tool name in this table or in the contents listing.*

| | | |
|---|---|---|
| AutoAlign | | Aligns the wafer. You can determine the wafer's diameter and indices using pattern recognition algorithms. You can set up a WaferMap with the new data.<br>Use AutoAlign if:<br>• You have a unique alignment mark, repeating for every die.<br>• You need to compensate for thermal scaling.<br>• You want to calculate and update the die size.<br>You can also use the AutoAlign wizard to align an aux site as described in ISS Alignment. |
| AlignWafer | | Determines wafer angle using pattern recognition, either with single pattern alignment or two-pattern alignment.<br>Use AlignWafer if:<br>• The substrate has only two alignment marks that can be used for alignment and no repeating pattern.<br>• Alignment needs to be fast. (AlignWafer is faster in most cases.) |
| AlignChip | | Aligns single chips. You can also use AlignChip to test chips that are separated and placed on a carrier or fixed with a foil. |
| Automation | | Can be configured using AutoXY, AutoZ, and VueTrack. To run Automation Setup, you must set the home position and contact height. Use the stage and scope to find good targets for wafer pattern and auto focus location. If you start your die step at contact, Automation returns to contact when it runs.<br>• VueTrack is a purchased option used for training needles (cannot be run without AutoXY and AutoZ). See VueTrack for details.<br>• VueTrackPro is a purchased option used to set up and operate motorized positioners for Unattended Test at Multiple Temperatures. See VueTrackPro for details.<br>• AutoRF enables automated thermal transitions that maintain wafer and RF probe tip positions when the chuck temperature is changed, providing much larger volumes of measurement data between user-assisted manual interrupts. For details, see:<br>– AutoRF<br>– AutoRF Wizard Steps<br>– RF Needle Training<br>– AutoRF Setup and Training |
| Align2Point | | Select the stage where the tool camera is mounted and select the setup mode: TwoPoint, OneButton, or Quick. |
| AlignAux | | Provides automated alignment of auxiliary sites. Velox supports up to 16 aux sites that must be trained and configured. |

| | | |
|---|---|---|
| FindFocus | | Finds the optimal point of focus on the wafer surfaces. You can use it to measure different heights. |
| FindWaferCenter | | Finds the center of the wafer by using edge detection to find the wafer edge in 3 locations and triangulating to find the center. |
| LocateHomeDie | | Aligns the wafer with AutoAlign, finds the center of the wafer, and then uses the WaferMap configuration information to calculate and update the home position. Finds the center of the wafer by locating the wafer edge at three locations and then triangulating. |
| CellView | | Provides ability to navigate on parts of the wafer that are out of view, based on a pre-trained image of a die or a portion of a die. View the image in one of the detail windows and use it for point-and-click navigation. |
| PreMapWafer | | Finds the location of singulated die and then updates WaferMap with the actual die positions. After premapping, WaferMap stepping moves the chuck to the actual die location instead of using a theoretical position as defined by the WaferMap die size). |
| ProbeHorizon | | Brings wafer and probe needles into microscope focus and sets contact height using the contact view camera. |
| Measurement | | Measures the distance between two points on the live image. This measurement is not a calibrated measurement. |
| Measurement Overlays and MeasureOnScreen | | Use MeasureOnScreen wizard and measurement overlays to measure distances between two on-screen points of the live video. |
| FindFeature | | Stores up to 40 trained models. After training, you can search these models directly on screen or remotely. |
| Snapshot | | Exports high resolution images with annotations. |
| OCR Reader | | Reads simple text strings from a wafer to determine wafer IDs. |
| Barcode Reader | | Reads industrial bar codes. |
| DataMatrix Reader | | A datamatrix is a two-dimensional version of a barcode. |
| ReAlign | | Use ReAlign to make an automatic ProbeToPadAlignment and contact height calculation after thermal influences. You must successfully perform tasks in the TrainReAlign wizard at least one time before you run ReAlign.<br><br>The Train ReAlign wizard helps train the probe card and wafer. You must run it each time you change a probe card or insert a new wafer.<br><br>Probe Card training calculates home position and contact height for vertical probe cards and when using the platen camera as top camera. See Probe Card Training and Detection for more information. |

## Alignment Methods Overview

You can choose from various methods for aligning the wafer, individual die, and the probe card or probes.

| Command | X | Y | Z | Theta | Cameras | Thermal | Singulated Die | BlueTapeWafer |
|---|---|---|---|---|---|---|---|---|
| AutoAlign | | | | • | Scope/Platen | • | | |
| AlignWafer | • | • | | • | Scope/Platen | | | |
| AlignChip | • | • | | • | Scope/Platen | | • | • |
| AutoXY | • | • | • | | Scope | • | | • |
| ReAlign | • | • | • | • | Scope/Platen & Chuck | • | | |
| ReAlign @ current die | • | • | • | | Scope/Platen and Chuck | • | | • |
| VueTrack | • | • | • | | eVue | • | | • |
| Manual 2-Point Align | | | | • | None required | | | |
| PreMapWafer (multiple die FOV) | • | • | | | Scope/Platen | | • | • |
| PreMapWafer (single die FOV) | • | • | • | • | Scope/Platen | | • | • |
| LocateHomeDie | • | • | | • | Scope/Platen | | | |
| FindWaferCenter | • | • | | | Scope/Platen | | | |

| Command | Requirements | Actions and Uses |
|---|---|---|
| **AlignChip** | Downward looking camera (scope or platen camera) | Aligns an individual die in XY and theta.<br>• Use for singulated die, singulated die in trays, blue tape wafers, or shards.<br>• Options:<br>– Use one-point alignment for small die, if a second pattern is not available or if theta correction is not important.<br>– Use two-point alignment for larger die or if theta correction is important.<br>• Procedure runs only once per command issued.<br>• Extended pattern search is included in this function if trained pattern is not found in the camera's field of view. |
| **AlignWafer** | Downward looking camera (scope or platen camera) | Provides automated two-point theta alignment of the wafer with an additional XY correction of the home die position.<br>• Options during training:<br>– Single Pattern Alignment uses one alignment pattern, which must be located on the same horizontal or vertical street line, to do the theta correction. Wafer does not have to be aligned before training the tool.<br>– Two Pattern Alignment uses two separate patterns that don't need be on the same street line. You must align the wafer before training the tool. This method of alignment was developed for wafers that do not contain unique and repetitive die patterns, such as hybrid test wafers. You can use it effectively to align singulated die chip carriers.<br>• Use AlignWafer in situations where using ReAlign is not possible; for example, on the 2nd-wafer, 3rd-wafer, and so on, of a trained project. |

| Command | Requirements | Actions and Uses |
|---|---|---|
| **AutoAlign** | Downward looking camera (scope or platen camera) | Quickly theta aligns a wafer and calculates the die size.<br>• Uses a trained pattern that must repeat on every die printed.<br>• Does XY home correction when home is trained during wizard training.<br>• Use the AutoAlign wizard at ambient temperature to calculate the die size. |
| **ReAlign** | • Upward-looking/ downward-looking cameras and contact view camera<br>• Probe card supported by Velox (cantilever, pyramid, vertical)<br>• A unique pattern on each die that repeats with every die printed<br>• ReAlign software option (purchased)<br>• ReAlign is trained (TrainReAlign wizard) | Use to perform a Probe Offset alignment. You must use the Train ReAlign wizard before you can call and use ReAlign.<br>• Training is typically performed at ambient temperature.<br>• Allows testing over multiple temperatures by compensating for wafer expansion and drift in XYZ and probe card drift in XYZ.<br>• Uses the models and parameters established when training ReAlign.<br>See also ReAlign Training Steps. |
| **ReAlign @ current die** | • Upward-looking/ downward-looking cameras, and contact view camera<br>• Probe card supported by Velox (cantilever, pyramid, vertical)<br>• A unique pattern on each die that repeats with every die printed<br>• ReAlign software option (purchased)<br>• ReAlign is trained (TrainReAlign wizard) | Executes a ReAlign operation to compensate for XY positioning inaccuracy (not theta) for only the current die.<br>• Optionally exclude remeasuring the probe card and Z heights.<br>• You do not need to record a Z-profile if remeasuring die Z-height is enabled.<br>• Use if you experience your needles do not hit your pads using global wafer alignment only when using small pads at non ambient temperatures.<br>• Typically used as a remote command. |
| **AutoXY** | • Scope camera (eVue, iVista, Optem, and so on)<br>• Wafer pattern must be in field of view after chuck stepping | Finds and corrects the delta between the trained wafer and probe positions in X and Y of the current die.<br>To align theta, run AutoAlign or AlignWafer and then use AutoXY to correct X and Y per die.<br>• Integrated into die stepping with WaferMap; does not require sending separate commands.<br>• Once activated, AutoXY runs after WaferMap commands such as StepNextDie until AutoXY is turned off.<br>Uses:<br>• Standard or blue tape wafers if theta correction is not required.<br>• Irregular die sizes. |

| Command | Requirements | Actions and Uses |
|---|---|---|
| **VueTrack** | • Station configured with eVuePro<br>• VueTrack software option (purchased)<br>• Certain applications for stationary manual (or motorized) positioners with DC probes only, where:<br>– Probe tip alignment features must be visible from the downward-looking eVue camera.<br>– Probes must come from the same side of platen (cannot be opposing) | Performs over-temperature die-to-die correction using on-axis camera.<br>• Finds the delta in XYZ of the probe tips and corrects registration error.<br>• Uses the AutoXY function to correct the wafer position.<br>• To align theta, run AutoAlign or AlignWafer, and then use VueTrack to correct XYZ per die.<br>• Integrated into die stepping with WaferMap; does not require sending separate commands.<br>• Primarily used for cantilever probe card applications. |
| **Manual 2-Point Align** | • Downward looking camera (scope or platen camera)<br>• Spectrum or ControlCenter | Quickly theta-aligns a wafer or carrier by showing two alignment positions on a horizontal or vertical street line.<br>• Should be used for singulated die, shards, or to align a die carrier.<br>• Aligns theta alignment using the cursor position at two points in the live image.<br>• If Spectrum is not available, use the Chuck Alignment wizard in ControlCenter. |

| **ReAlign Training Steps** | |
|---|---|
| ProbeHorizon | Sets an initial contact height to ensure the needles are safe throughout the Train ReAlign wizard. |
| DetectWaferHeight | Measures the wafer Z location and synchronizes the downward looking camera with the upward looking camera. |
| AutoAlign | Performs theta alignment and calculates the die size. |
| Probe Card Alignment | Trains the probe tips and system-calculates probe card angle and probe card location in XY, and then defines the home die position using an overlay image of the probe tips to place them over home die pads.<br>Probe card angle is calculated using the crosshair locations that you select at PC Position 1 and Position 2 (not by the trained tip model positions). |
| **ReAlign execution steps** | |
| Probe Card Alignment | Automatically measures the probe card location in XYZ, but does not recalculate probe card theta. |
| DetectWaferHeight | Measures the wafer Z location and synchronizes the downward-looking camera with the upward-looking camera |
| AutoAlign | Performs a wafer theta alignment and measures the thermal expansion of the wafer (does not update the die size – thus AutoAlign 2). |
| Probe Offset Alignment (PTPA) | Calculates the offset between the trained wafer alignment model and the desired position of the probes over the test structures (pads) at the Home die. |
| Z-Profiling (optional) | Records a wafer profile.<br>For information about WaferMap profiling parameters, refer to Profiling. |

## FocusParameters

You can define focus parameters for the AlignAux, Automation, FindFocus, and ReAlign tools. Specific parameters and options apply to each tool.

| | |
|---|---|
| Focus Stage | Sets the focus implementation based on the stage selected (chuck or scope). |
| FocusMethod<br>Image Sharpness<br>Image Brightness<br>Pattern Score<br>Gradient Energy<br>Sobel | Specifies the method used if image is focused.<br>• Image Sharpness acquires the sharpness value of the image.<br>• Image Brightness uses the largest pixel value from the image.<br>• Pattern Score uses the score of the found model at every Z height.<br>• Gradient Energy acquires the sharpness value of the image using a different algorithm than Image Sharpness that may produce better results in some cases. The score is based on the sum of the squares of the edge gradients.<br>• Sobel algorithm assesses incoming images by computing the edge detection convolution and then computing the standard deviation of each pixel's Sobel-computed value so that the focus curve (fitness versus Z position) is less noisy and the computed focus peak is more repeatable. |
| FocusAlgorithm<br>Curve Interpolation<br>Brute Force<br>First Peak<br>Centroid | Specifies the algorithm used to calculate the focal point with the gained values based on the FocusMethod parameter.<br>• Curve Interpolation uses a correlation to determine the equation from the values and produces a curve sketch.<br>• Brute Force finds the maximum value in the curve.<br>• First Peak finds the center of mass for the first peak above the threshold with a base of at least 69 micrometers in width.<br>• Centroid algorithm finds the highest peak and includes partial data on the edges where the cutoff percentage trims the data. |
| Range | Sets scanning range, 1 µ through 3000.000 µ.<br>When you use Find Focus with a zoom tube (such as a Guppy camera), a longer range is needed—usually over 1000 µ. |
| LowerThreshold | Sets the threshold for discarding focus data (0 through 1.000). |
| LowThresholdPercent | Discards focus points below the lower threshold percentage. |
| StepSize | Sets the target distance between samples in microns for eVue scan focus. |
| TrimToPrimaryPeak | Trims focus curve data to include only the highest peak. The Brute Force focus algorithm is used to find the peak, and the edges of the trimmed data are found by looking for the first data to the left/right that has slope <=0 on the left or >=0 on the right. |
| UseMultipleFocus Areas | Activates independent focus search in every FocusArea and every AreaModel. |
| AcquireFrames | Sets the method used to acquire video frames.<br>• Move and Stop – The selected focus stage moves and then comes to a stop before acquiring each frame in range.<br>• eVue Continuous High Speed – Available only if you have an eVue microscope. The eVue focus stage moves continuously while acquiring frames at the same time. A small window of interest is used for the video frames.<br>• eVue continuous Region of Interest – The eVue microscope moves continuously grabbing frames, and can be clipped to an ROI instead of a small window of interest.<br>• External Trigger – Available only for the platen camera. Uses a hardware trigger from the kernel to signal the camera to acquire frames as the chuck stage moves simultaneously. |
| FirstPeakMinPeakWidth | Minimum peak width in microns for first peak algorithm. |

# AutoAlign

ISS Alignment

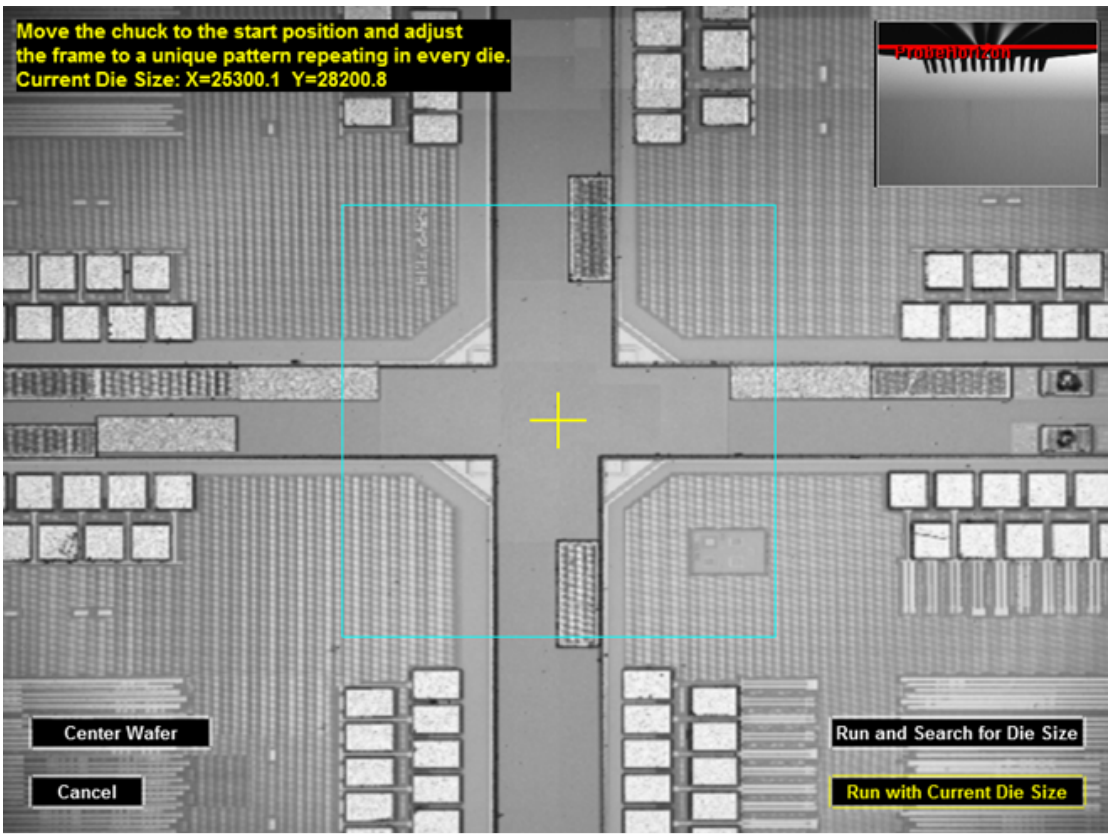
AutoAlign aligns the wafer, sets the index, optionally updates the home position, and calculates the thermal expansion. All data is project-specific.

You can use its pattern recognition algorithms to determine the wafer's diameter, and then set up a wafer map with the new data.

Specify settings for AutoAlign in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Specifies scope or platen camera for AutoAlign. | write | none |
| UseOwnLightSettings | When enabled, uses tool-specific light settings. | write | write |
| LightSettings | See Camera and Light Settings for details. | | |
| CalculateDieSize | When enabled, the WaferMap indices and InitialWizardSteps are updated with the calculated index values. | write | write |
| MoveToTrainedXYPosition | Moves the chuck and/or scope to the previously trained XY position before searching the pattern. | write | none |
| MoveToTrainedZPosition | Moves the chuck and/or scope to the previously trained Z position before searching the pattern. | write | none |
| UseAutoFocus | Uses FindFocus to focus on patterns at the wafer edge. | write | none |
| PreAlign | Before starting alignment, do an initial Theta correction based on the features in the region of interest. | write | read |
| AlignDirection | AlignmentDirection can be horizontal or vertical. | write | write |
| WaferDiameter | Optional; reduces auto alignment time when you enter the wafer diameter. If the value is equal to zero, uses the maximum achievable diameter (probe station-specific). | | |
| ChuckPosition | Fixed chuck position to start alignment. | | |
| ScopePosition | Fixed scope position to start alignment. | | |
| Model, ModelISS | Specifies the model for the alignment procedure. The pattern is temporarily stored. Changed parameters are stored in a project file. See Cognex Models for more information. | write | write |

1. Click in the Spectrum toolbar to start the AutoAlign wizard.




2. Click the Center Wafer button so that the algorithm does not start at a limited area close to the wafer border.
   - The wizard displays a search framearound the center of the camera image.
   - You must locate a unique feature used for alignment inside this frame.
   - The frame dimension can be adjusted using its handles, but you cannot shift the frame.
3. Make selections in the following steps to proceed through the wizard.

| | |
|---|---|
| Calculate die size or use current die size? | If **Run and Search for Die Size** is selected, the wafer is aligned and die size is calculated. |
| Update WaferMap diameter? | If yes, the wafer diameter is set |
| Set Home position? | If yes, move to home die. Set home position. |
| Update Home die | If yes, the home die is set in the wafer map. |

4. Click the Finish button to update and build the wafer map.

### ISS Alignment

You can use the AutoAlign wizard for the initial alignment of an aux site. The pattern that is used for the alignment is not stored and must be retrained each time you start the wizard. The alignment process is used with AlignAux, which supports an X/Y/Theta correction of the calibration substrate.

Click in the Spectrum toolbar to start the AutoAlign wizard

After you select a repeating pattern to train, you can choose to perform the alignment vertically or horizontally. In contrast to AutoAlign for wafers, the alignment is done in only one axis.

AutoAlign ISS finds features from the start position to the outside until it no longer finds features. (It does not try to move to the fence and then back in until it finds a pattern again.)

## AlignWafer

AlignWafer determines the wafer angle using pattern recognition, either with single-pattern alignment or two-pattern alignment.

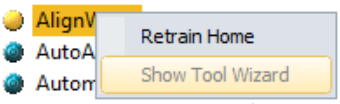
- For Single Pattern Alignment, the wafer must have distinct features or alignment marks located on a wafer street line.
- You can train Two-Pattern Alignment with multiple patterns that do not need to be located on street lines. The wafer must already be aligned before training the two-pattern alignment.

AlignWafer provides a view of the current wafer position based on the aligned mark positions. Once AlignWafer runs, it rotates a new wafer to the same position.

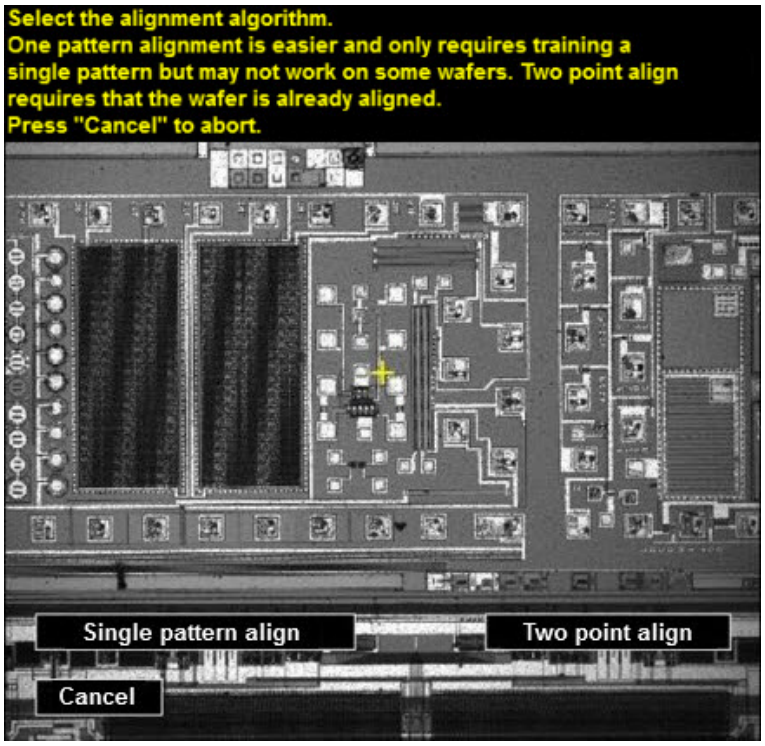
Specify settings for AlignWafer in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Select scope or platen camera to use. | write | none |
| UseOwnLightSettings | When enabled, you can configure AlignWafer with light settings that differ from the current camera light settings. | write | write |
| LightSettings | This setting is available if UseOwnLightSettings is enabled. You can adjust the shutter and gain values in a way that ensures best possible model detection.<br>See Camera and Light Settings for details. | write | write |
| MoveToZPosition | Moves to trained Z position before performing alignment. | write | write |
| Mark1 | First mark for wafer alignment. | write | write |
| Model1 | • For single-pattern alignment, this is the trained align mark pattern.<br>• For two-pattern alignment, this is the primary alignment model. Two-pattern alignment may also have alternate models (labeled Model2, Model3, and so on).<br>See Cognex Models for more information. | | |
| ChuckPosition | Original position of the chuck used to train the model. | write | none |
| ScopePosition | Original position of the scope used to train the model. | write | none |
| Mark2 | Second mark for wafer alignment. | write | write |
| PrealignSteps | Sets the number of steps used for prealign. | | |

| | |
|---|---|
| Accuracy Mode<br>Fast<br>Standard<br>High Accuracy | • Fast – Single alignment step, no verification<br>• Standard – Two alignment steps, no verification<br>• High Accuracy – Up to 10 alignment steps with result verification |




After you set the properties, right-click AlignWafer, and then select Show Tool Wizard.




**Single Pattern Alignment**

1. Click the Single pattern align button.
2. Move the chuck to the first alignment mark and train the alignment mark model.
   - The chuck moves automatically to test the model in each corner of the region of interest to determine whether the model is unique and whether it can be located easily. If it cannot be located, the wizard prompts you to set up a new model. Otherwise, click the Next button to skip this test.
   - The chuck moves along a horizontal street line to the location of the second align mark. The align mark must be in the camera's field of view.
3. Click the Next button to locate the second align mark automatically. If found, the wizard moves the chuck to the home die position.
4. Click the Next button to finish.

**Two-Pattern Alignment**

1. Click the Two point align button.
2. Move the chuck to the location of the first alignment reference point and then click the Next button.
3. If the correct alignment model is not in the camera's view, move the chuck to the model position and train the alignment model.

   The chuck moves automatically to test the model in each corner of the region of interest to determine whether the model is unique and whether it can be located easily. If it cannot be located, the wizard prompts you to set up a new model. Otherwise, click the Next button to skip this test.
4. To add models, click the Train Alternative Model button, or else click the Next button to continue with the next alignment point.
5. To train the second alignment point, move the chuck to the correct position.
6. Train the alignment model for the second align mark. If necessary, move the chuck to the model position. Use the blue model selector to select the model.
7. To test the trained model for uniqueness, click the Test button, or else click the Next button to skip testing.
8. Move the chuck to the home die position and then click the Next button to finish.

## AlignChip

AlignChip performs an alignment of single chips. Use it to test chips that are separated and placed on a carrier or fixed with a foil.

AlignChip uses either a single-point or a two-point alignment algorithm to calculate the X,Y, and theta offsets of a model from its trained position. All offsets are returned as the result of AlignChip. The theta threshold should be set to 0.05 to avoid misalignment.

Click to start the AlignChip wizard.

Specify settings for AlignChip in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Specifies a scope camera or platen camera to use for AlignChip. | write | none |
| UseOwnLightSettings | When enabled, you can configure AlignChip with light settings that differ from the current camera light settings. | write | write |
| LightSettings | Is visible only if UseOwnLightSettings is enabled. You can adjust the shutter and gain values in a way that ensures best possible model detection.<br>See Camera and Light Settings for details. | | |
| MoveToTrainedZPosition | Moves to trained Z position before performing alignment. | write | write |
| ChuckMoveToFoundPosition | Moves chuck X and Y to the location of the model after search. | write | none |

| | | | |
|---|---|---|---|
| Algorithm | Specifies to use the two-point or one-point algorithm.<br>• Two-point algorithm uses two patterns for alignment; this takes more time, but is more accurate.<br>• One-point algorithm aligns the chip using one pattern and the angle of this pattern; this is faster, but not as accurate. | write | none |
| FineAlignment | Searches for remaining XY and theta offsets after the first correction. | write | none |
| ThetaThreshold | If theta offset is below ThetaThreshold, theta does not perform a correction move. | | |
| Point1 | First point for wafer alignment. | write | write |
| Model1 | First model used for chip alignment (alternative models are possible). Modify settings such as Score Threshold and Accuracy as needed. See Cognex Models for more information. | | |
| Point2 | Second point for wafer alignment. | write | write |

| | |
|---|---|
| Set up AlignChip | 1. Place all chips on the wafer and assemble the probe needles.<br>2. Set contact height (using ProbeHorizon).<br>3. In ControlCenter Common Tasks, start the probe card alignment wizard.<br>4. In ControlCenter or Spectrum, manually theta-align the reference chip.<br>5. Using ControlCenter or WaferMap, set the chip index, which is the XY distance from one chip to the next chip so that you can use WaferMap for stepping from chip to chip.<br>6. Place the needles above the pads of the reference chip and set chuck home to the current position. |

| | |
|---|---|
| Start AlignChip Wizard | 1. In the Spectrum Explorer window, click Tools, right-click AlignChip, and then click Show Tool Wizard.<br>2. Click the Next button to store the coordinates of the chuck and scope.<br>3. Move the chuck and/or scope to a unique feature, and then click the Next button to calculate and save the offsets from the original align position.<br>4. Select the search image near the center of the field of view. (See the Cognex Models sections for detailed information on how to train a model.)<br>5. Click the Test Model button to automatically move the chuck to test the model in each corner of the region of interest.<br>This determines whether the model is unique and whether it can be located easily. If it cannot be located, Spectrum prompts you to set up a new model.<br>6. Follow the procedure used to train the first model if you need to train a second and third model.<br>7. When using two-pattern alignment, show the second alignment model.<br>8. Accept the new data (click the Finish button)<br>or<br>Exit the wizard and discard the new data (click the Cancel button).<br>9. Move back to the chuck home position.<br>The system is now ready for testing. Repeat these steps each time the needles are replaced or moved, and each time a new type of chip is tested. |
| Test single chips | 1. In WaferMap, move to the specified chip and then select AlignChip from the toolbar (or use the remote command).<br>2. Move into contact.<br>3. Test (measure) the chip. |

## Automation

Click to start Automation Setup.

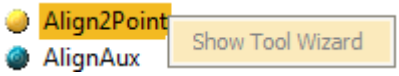
For more information, see:

- Project Data Settings
- Automation Wizard

## Align2Point

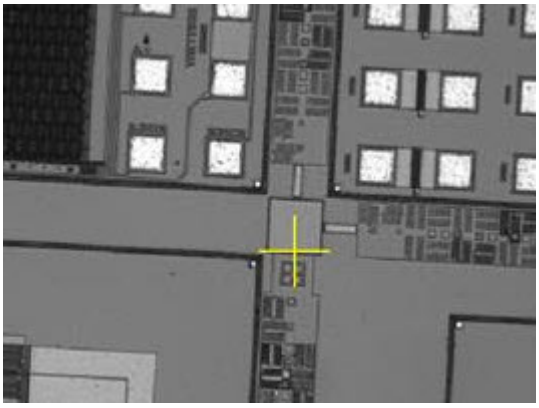
Manual 2 Point Alignment is the default mode. Click to open the manual alignment tool.

Specify settings for Align2Point in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| CameraMount | Specifies to use a scope camera or platen camera for Align2Point. |
| Mode | Specifies TwoPoint, Quick, or OneButton alignment mode. |
| TwoPoint | In the Align2Point wizard, choose a horizontal street line or feature for the first and the second reference point. Chuck theta rotates to correct the rotational error according to your selections. |
| Quick | In the Spectrum Explorer window, right-click Align2Point and then click Show Tool Wizard to start Quick alignment.   |
| OneButton | Scene Angle Finder detects the angle of the current field of view. This angle is used to move the chuck theta axis to align the wafer. |

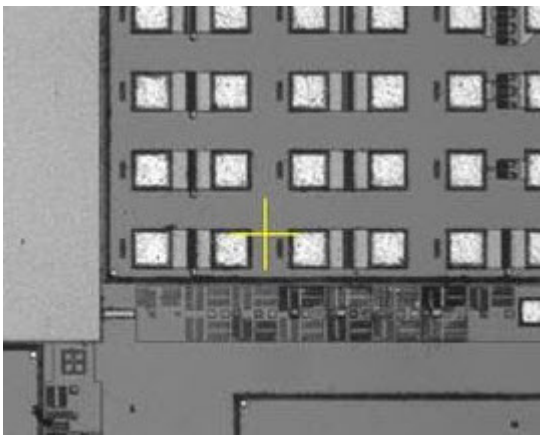
1. Set Align2Point Mode to Quick, right-click Align2Point in the Spectrum Explorer window, and then the Align2Point tool and then select the wafer diameter.
2. Move to a horizontal street line near the center of the wafer.

   The Align2Point tool automatically detects the angle of the current video image and tries to perform a raw alignment. The chuck is moved to the left edge of the wafer.

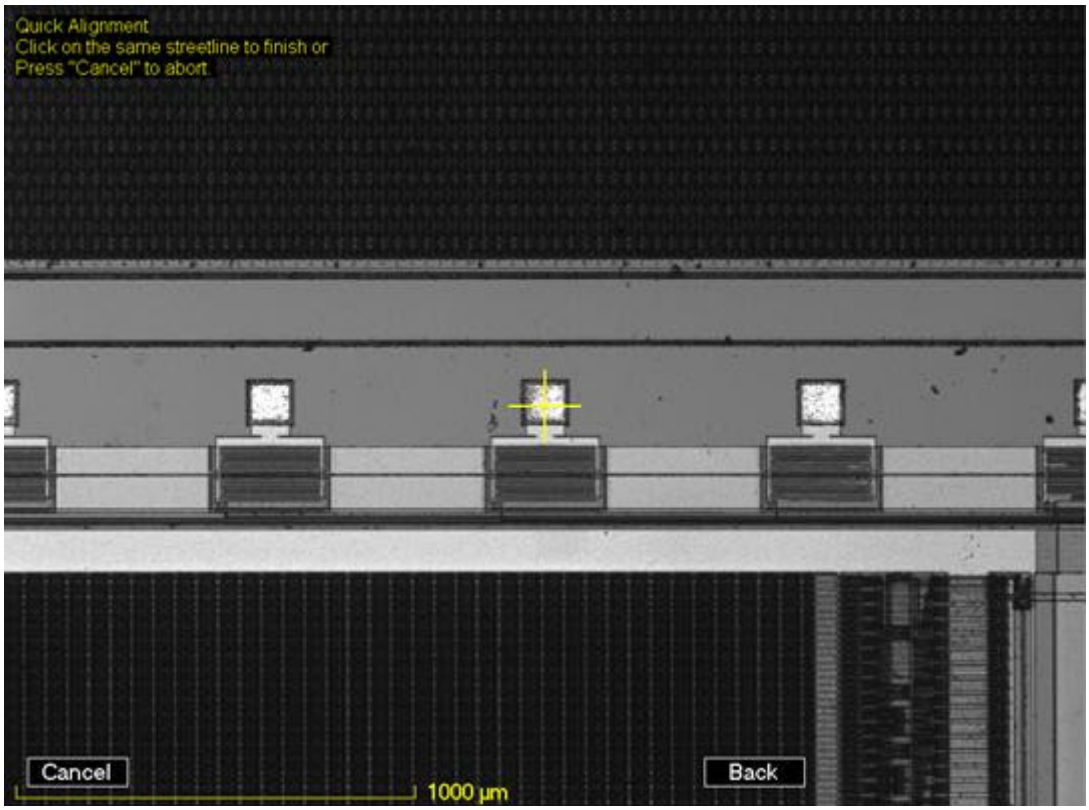
   

3. Next, click the street line.

The chuck moves to the right side of the wafer.



4. Click the same street line again.
   The wafer is automatically aligned.



## AlignAux

AlignAux provides automated alignment of auxiliary sites in Spectrum. Velox supports up to 16 sites, which must be trained and configured. The AuxSite alignment tool must be enabled in Velox before you can use it with calibration substrates or any other type that has an alignment mark.

Typically, the AuxSite tool is trained while you set up the aux site through the ControlCenter wizard, so you don't need to manually start the wizard. See Aux Site Setup and Training for more information.

Specify settings for AlignAux in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| AuxSites | List of all available aux sites on the system, including Cal 1, Cal 2, Clean 1, Clean 2. | write | read |
| FocusParameters | Parameters include the focus method, focus algorithm, range, and lower threshold. | | |
| AuxMark | The alignment mark and all the data necessary to perform the aux site alignment for a single site. | | |
| Model1 | The pattern used for detecting the XY position of the aux site. See Models for more information. | | |
| ChuckPosition | Fixed chuck position for home alignment. | write | none |
| ScopePosition | Fixed scope position for home alignment. | write | none |
| ChuckContact | Calculated contact height. | read | read |
| AuxID | Number of aux site | read | none |
| UpdateContact | Updates contact height on execute. | write | none |
| CorrectTheta | Performs an additional theta alignment. | write | none |

**Wizard Steps**

1. Select the aux site that must be trained.

   This step is not used when setting up the aux site through the ControlCenter.)
2. Train the alignment position.
3. Train the reference position for the selected aux site.

   The needles must be placed on the reference position of the site. Make sure that you set a contact height before continuing.
4. Train the model. See Cognex Models for more details.
5. Train the pattern that is used to identify the reference position. When UpdateContact is enabled, the focus height of the top camera is trained automatically.
6. Click the Finish button.

## FindWaferCenter

FindWaferCenter finds the center of the wafer by locating the wafer edge at three locations and then triangulating to find the center. This tool, used by LocateHomeDie, is trained as part of the LocateHomeDie wizard training.

After FindWaferCenter calculates the center location of the wafer, it then moves to the center.

Specify settings for FindWaferCenter in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| CameraMount | Specifies the camera (Scope, Evue1, Evue2, Evue3, Platen). |
| UseOwnLightSettings | If enabled, tool-specific light settings are used. |
| LightSettings | The light settings can be customized for each tool. See Camera and Light Settings for details. |
| MoveToTrainedZPostion | If enabled, moves chuck and scope Z to the trained positions before the search. |
| MoveToScopeXY | If enabled, moves Scope XY to the trained position before the search. |
| SearchDistanceLimit | Distance in microns to search when looking for an edge. |
| MinimumSignalStrength | Minimum strength needed for line detection. |
| SignalStrengthTuningRatio | Ratio used to calculate MinimumSignalStrength during wizard training. |
| WaferDiameter | The wafer diameter in millimeters. To use the diameter from WaferMap, set to 0. |
| ChuckWaferCenter | The XY position of the wafer center is calculated by the tool. |
| ScopePosition | The trained scope XY position. |
| ScopeZ | The trained scope Z position. |
| ChuckZ | The trained chuck Z position. |
| TrainedCameraMount | The mount where training occurred. |

# LocateHomeDie

Initial Project Training

Run a Previously Trained Project

LocateHomeDie aligns the wafer using AutoAlign, finds the center of the wafer (by locating the wafer edge at three locations and then triangulating to find the center), and then uses the WaferMap configuration information to calculate and update the home position.

The home position is the approximate location of home within the correct home die, based on the Die Reference offset location as defined by WaferMap. By default, it is the upper-left corner of the home die. The chuck is at the new home position after this tool is trained or executed.

## Initial Project Training

1. In WaferMap, create or set up a wafer.
2. In ControlCenter, move to the wafer center.
3. In WaferMap, set home to match the wafer center in ControlCenter, and then configure XY.
4. In Spectrum, click Tools > Automation > LocateHomeDie and follow steps in the wizard. The AutoAlign training wizard sets the chuck-Z/scope-Z focus height and aligns the wafer.

## Run a Previously Trained Project

1. Load a wafer.
2. Run LocateHomeDie, which:
   - Aligns the wafer.
   - Locates the wafer edge in three places.
   - Calculates and sets home position based on wafer center and WaferMap information.
   - Moves to home position.

3. Select one of the following options to set PTPA:
   - Manually set home.
   - Run AlignWafer.
   - Run VueTrackAlign.
   - Run ReAlign.

## FindFocus

FindFocus focuses the wafer surface. You can use it to measure different heights.

Standard focus finds the optimal point of focus on the wafer surfaces. The chuck or microscope Z-axis varies the distance between wafer surface and lens in a predefined range by equidistant step sizes. Image sharpness, image brightness, or pattern score value is based on FocusMethod. The better the focus, the higher the sharpness, brightness, or score value. The measurement is interpreted with FocusAlgorithm.

Click to start the FindFocus tool.

Specify settings for FindFocus in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| CameraMount | Select the camera to use for FindFocus (Scope or Platen). |
| UseOwnLightSettings | If enabled, tool-specific light settings are used.<br>See Camera and Light Settings for details. |
| MoveToTrainedChuckPosition | Move chuck to trained Z position before focus search. |
| MoveToTrainedScopePosition | Move microscope to trained Z position before focus search. |
| FocusParameters | Set parameters for focus search. |
| UseMultipleFocusAreas | Activates independent focus search in every FocusArea and every AreaModel. |
| Focus Area | Area inside the focus search. |
| AreaModel | Select model to find the focus areas. See NI Vision Models for more information. |
| UseHighestScoreModels | If there are more models than *NumToFind* found, use models with highest scores. |
| NumToFind | Set maximum number of models to find. |
| MinNumToFind | Set minimum number of models to find. |
| ZOffset | Set offset in Z from ChuckStartPosition to find models. |

To ensure FindFocus works correctly:

- The point of optimal focus must be inside the moving range.
- The curve that will be detected has only one distinct maximum.
- The moving range is not restricted by predefined limits such as contact height.

FindFocus determines the optimal focus height for every area and calculates an average focus height, which FindFocus returns as result. UseMultipleFocusAreas defines certain FocusAreas. The AreaModel is required to find the areas at every FindFocus execution.

The value for StepSize depends on the objective and is stored in the Objectives settings.

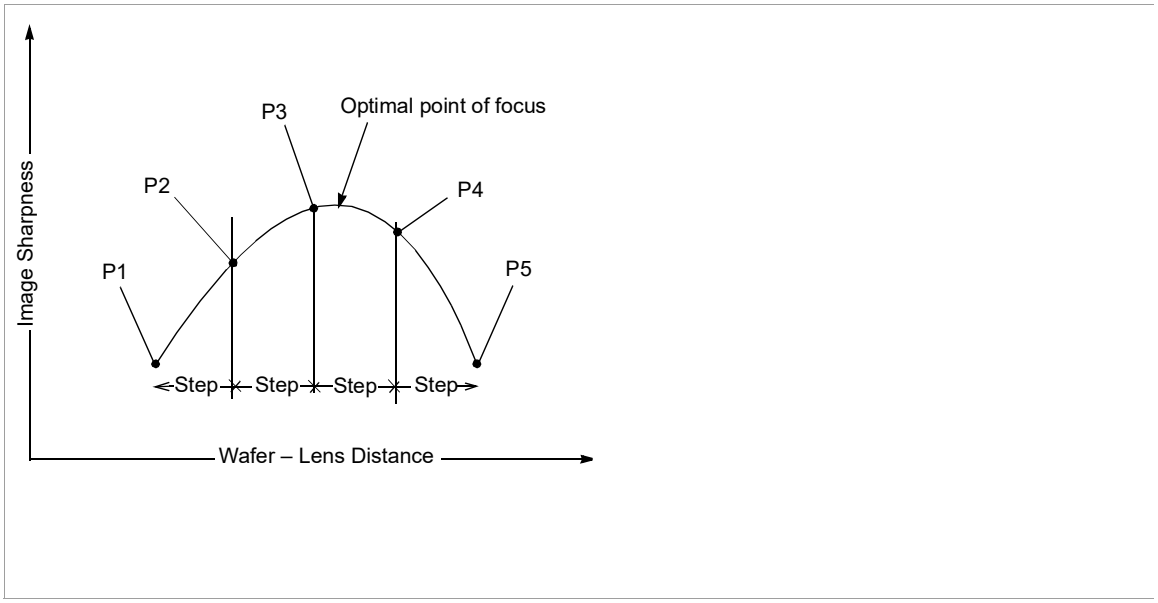
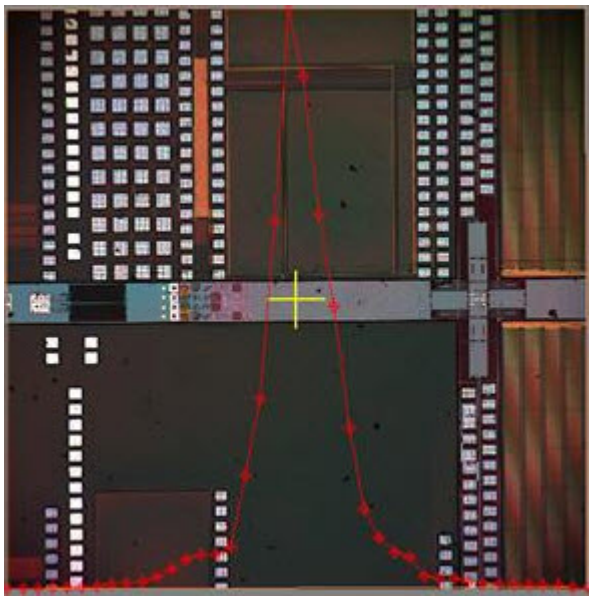


Image Sharpness
P1
P2
P3
Optimal point of focus
P4
P5
Step
Step
Step
Step
Wafer – Lens Distance



# CellView

Training

**ACCESS LEVEL REQUIRED:** Admin

Using CellView, you can navigate parts of the wafer that are out of view, based on a pretrained image of a die or a portion of a die. You can use this image, which is shown in one of the detail view windows, for point-and-click navigation.

Click a feature in the overview image to navigate the chuck to the corresponding position of the current die. CellView automatically correlates the clicked position to the position of the die currently being inspected.

CelllView is available only for eVuePro and iVista cameras, and can be used only with the scope mount position.

Specify settings for CellView in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

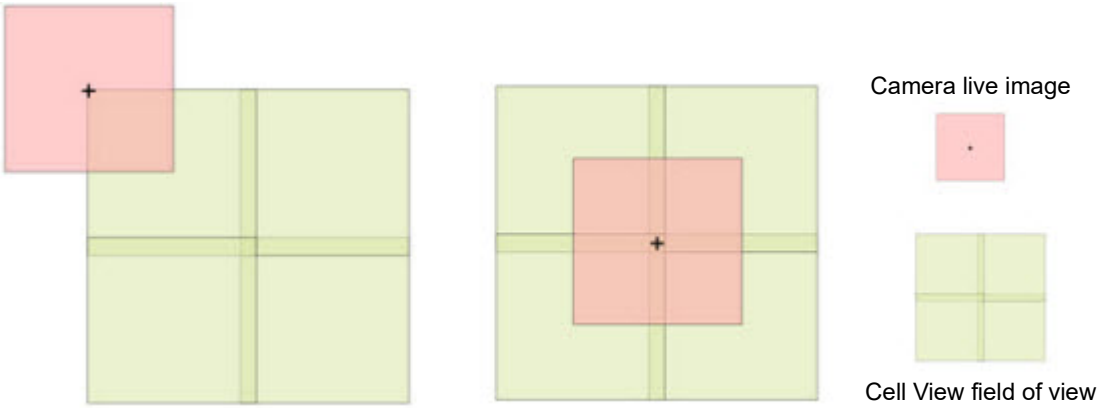
| Setting | Description |
|---|---|
| CameraMount | Stage where the CellView tool camera is mounted. |
| ColorMode | Color of the stitched image. Grayscale images have Resolution. |
| FieldOfView | Field of View (FOV) settings. |
| Origin | Sets origin to center or upper-left corner. |
| UseIndexSize | When disabled, Width and Height settings are enabled. |
| LimitMotionToDie | When enabled, moves beyond die boundaries are disabled when navigating in point and shoot mode. |
| MaxImageWidth | Maximum width (in pixels) of the cell view image. |

## Training

CellView trains overview areas of up to 50000 µm. Dies must be located on the wafer on a regular grid. Before you start the training, make sure the wafer is properly aligned and the home position is set accordingly. If it is not, start the AutoAlign tool or start a manual alignment.

Click CellView to start training automatically.

You can train the FOV with the starting position of the chuck either in the upper-left corner or the center position of the CellView image, depending on the configuration of the CellView tool.



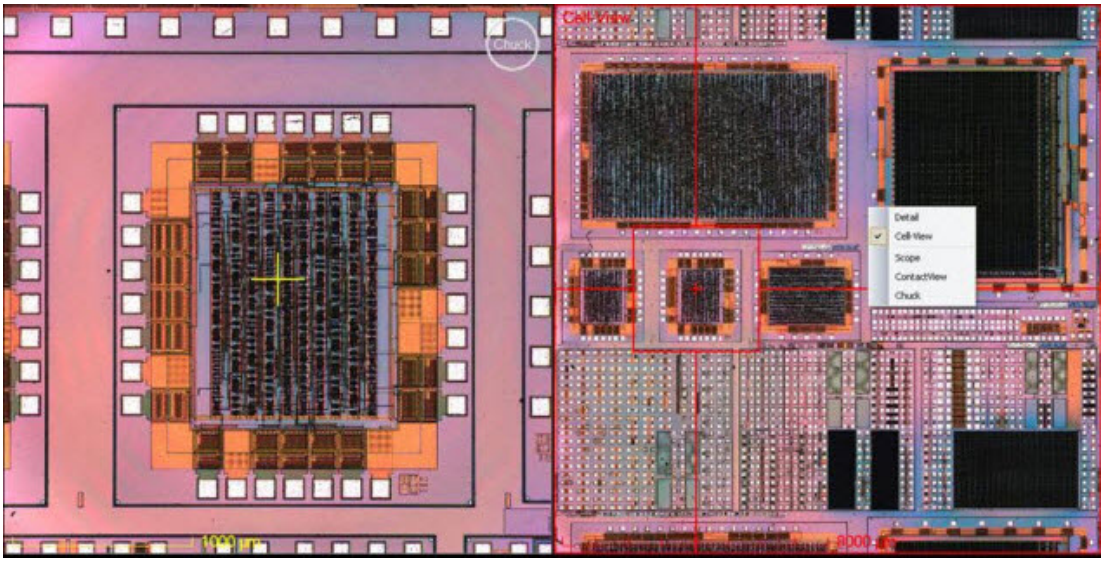

Set the size of the CellView image to match either the index step size of the wafer or custom values. Custom values for width and height are automatically adjusted to match the aspect ratio of the scope camera. This is necessary to ensure optimal use of screen space when the image is displayed in a detail view.

The maximum width or height is 30000 µm. Overview images cannot exceed this size.

When the image is trained, the overview image is ready for use. The image remains valid even after loading a new wafer of the same type. You must align the new wafer properly and set its home position.

| | |
|---|---|
| **Retraining** | Retraining is necessary when you:<br>• Exchange the probe card (probe card angle change).<br>• Switch to a different wafer type (index step size change).<br>• Change the wafer home position. |
| **Multi Layout View** | CellView requires a multi-view layout with at least one detail view. Select a layout view with at least one large detail view from the layout selector. |

1. Move the mouse to the detail view and right-click the mouse.
2. Select CellView from the popup menu to assign the CellView tool to this view.




This example shows the CellView tool being activated in a detail view window. The image tilt is the result of the probe card angle.

If the CellView tool is active, a crosshair shows the current position over the die. The crosshair moves along as you move the chuck or scope to match the current position of the scope camera over the wafer. The center part of the crosshair is a box. The size of this box corresponds to the size of the live image currently shown in the scope camera.

A dashed-line rectangle indicates the boundary of the current die. When LimitMotionToDie is enabled, CellView moves only within the boundary of the current die. Double-click outside the die boundary to move to the specified location within the current die (near the opposite edge).

Use the mouse wheel to zoom in to the overview image. While the image is zoomed in, use drag and drop to navigate inside the image. To point and shoot to the clicked position, hold the Ctrl key while you press the left mouse button. The image feature is centered by adjusting the chuck position accordingly.

| Action | Keyboard/Mouse Command |
|---|---|
| Point and shoot navigation using the chuck | Ctrl+click |
| Open context menu for switching back to a different display mode (detail view or secondary camera) | Right-mouse click |
| Zoom in or out | Mouse Wheel |
| Move around (pan) in the image (must be zoomed in) | Click and hold mouse |
| Stop panning (must be zoomed in) | Left mouse release |

# PreMapWafer

Multiple Dies in the Field of View

Single Die in the Field of View

Premapping is intended for use with singulated die, which are die that have been cut and are either placed in a carrier or adhered to a sticky medium within a wafer frame.

Premapping finds the location of each die and updates WaferMap with the actual die positions. After performing premapping, WaferMap die stepping moves the chuck to the actual die location found by the premapping operation instead of a theoretical position as defined by the WaferMap die size. WaferMap uses the actual mapped positions until a new wafer map is loaded or until premapping runs again to update the map with new actual positions.

When WaferMap is updated with the actual die positions, it switches to a blue background color to indicate that it is using actual positions. When premapping, WaferMap allows stepping only to the testable die that have been mapped.

The PreMapWafer tool supports two workflows:

- Multiple Dies in the Field of View Workflow
- Single Die in the FOV Workflow

### Start the PreMapWafer Wizard

To start the PreMapWafer wizard, do one of the following:

- Click on the Spectrum toolbar.
- From the Spectrum Tools menu, click Automation > PreMapWafer.
- In the Spectrum Explorer window, Tools folder, right-click PreMapWafer.

In the PreMapWafer wizard, select Train Single Die or Train Multiple Dies.

## Multiple Dies in the Field of View

Multiple Dies in the Field of View Workflow

Specify settings for PreMapWafer in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| Camera Mount | Specify to use a scope camera or platen camera. |
| UseOwnLIghtSettings | If enabled, tool-specific light settings are used.<br>See Camera and Light Settings for details. |
| UseAlignChip | Disable to map multiple smaller die in the FOV. |
| Die Spacing | Die spacing is calculated based on the X axis and Y axis positions. |
| WaferDiameter | Wafer diameter (in millimeters); set to 0 to use the WaferMap diameter. |
| Model | Model settings are available when UseAlignChip is disabled. See NI Vision Models for more information. |

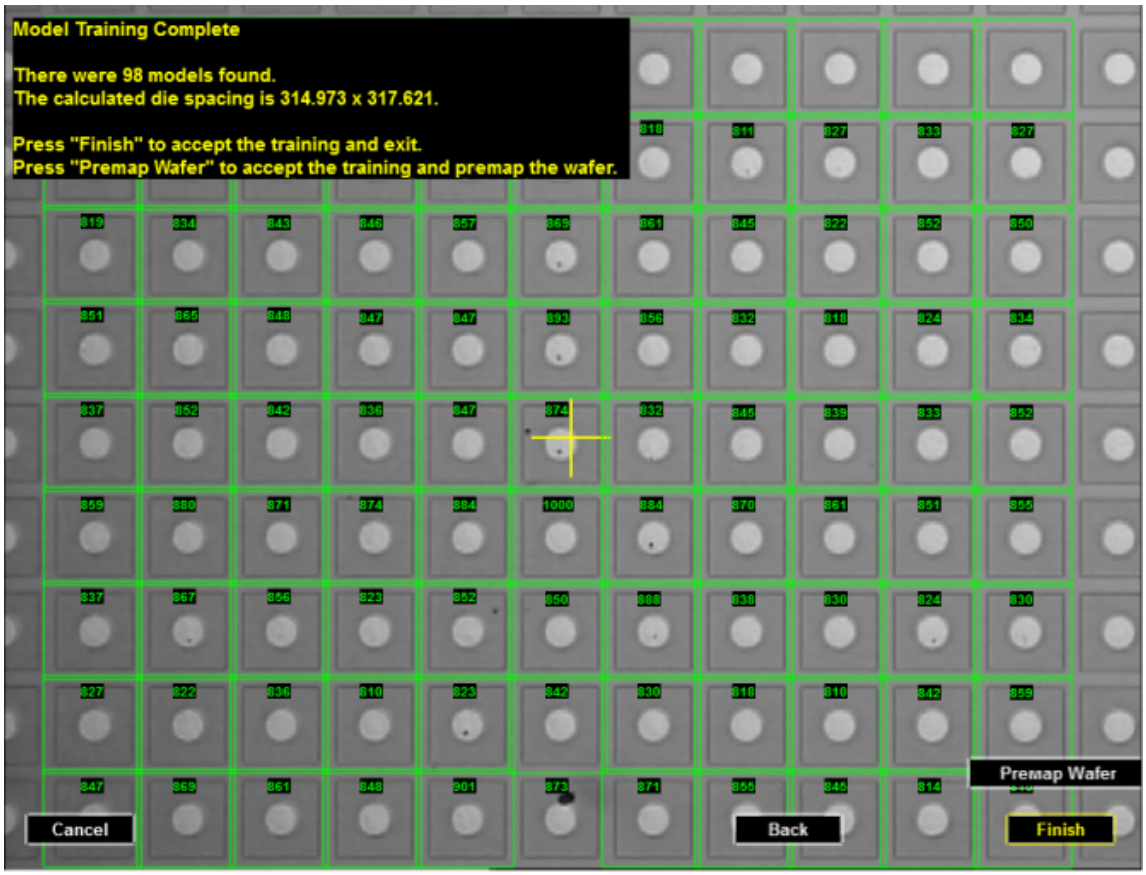
### Multiple Dies in the Field of View Workflow

This workflow maps small singulated die attached to a stretchy medium (blue-tape) so that they can be stepped to accurately. Rows and columns don't need to be perfectly straight; the algorithm that sorts the die into rows and columns allows variance across the wafer, as long as the variance is gradual.

You must configure the precut die size, precut wafer size, and the home die in WaferMap before you start the PreMapWafer wizard. The testable die do not need to be predefined by WaferMap; the premapping operation updates WaferMap with all die found and marks them as testable.

Training the PreMapWafer tool trains the pattern that is used to identify each die and find three consecutive die in XY to calculate an average die spacing. After training and execution, the tool does a serpentine stepping pattern of each camera field of view to find the XY location of each die on the wafer. WaferMap is updated with the XY location of each die found during the premapping operation, and those die are marked as testable. Die that are not found (pattern not matched) during premapping are marked as untestable.

1. Create the wafer map with precut die and wafer dimensions (just as it was before it was cut).
2. See Set Up and Use WaferMap and WaferMap Configuration for more information about setting wafer diameter and die dimensions.
3. Set the wafer map home die.
4. Start the PreMapWafer Wizard.
5. Click the Train Multiple Dies button to calculate an average die space.
6. Move to home position and click the Next button.
7. Align the rectangle on the desired feature and then click the Train Model button.
8. Click the Premap Wafer button to launch the PreMapWafer wizard. The wizard:
   - Uses wafer diameter and die size from WaferMap.
   - Moves in a serpentine path through the wafer, finding all dies in each ROI.
   - Sorts all the dies into rows and columns and updates WaferMap with the XY location of each die that was found and mapped.
   - Marks/sets all of the found/mapped die as testable in the wafer map.




## Single Die in the Field of View

Single Die in the FOV Workflow

Premap Another Wafer Using GUI

Premap Another Wafer Using Remote Command

Specify settings for PreMapWafer in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| Camera Mount | Specify to use a scope camera or platen camera |
| UseAlignChip | When enabled, uses AlignChip to map larger singulated die in the Field of View (FOV). |
| UpdateContactHeight | Enable to find focus on each die and calculate Z-offset. |
| FocusParameters | Visible when Update Contact Height is enabled.<br>Use these parameters for the focus search on the synchronization cross, and include the focus method, focus algorithm, range, and lower threshold. |

This feature uses the AlignChip tool to determine XY and theta for each die. In addition, UpdateContactHeight determines a unique contact height for each die when this parameter is enabled.

Premapping significantly improves productivity. AlignChip premaps all of the testable dies at one time while the chuck is positioned under the platen or scope camera.

During testing (while stepping die-to-die and probing), you do not need to perform any moves between probe position and the platen or scope camera.

### Single Die in the FOV Workflow

1. Create the wafer map with approximate die dimensions and wafer diameter so that moving to a particular die brings it into or near the FOV. (See WaferMap Configuration.)
2. Define which die are testable.
3. Train the PreMapWafer wizard. The AlignChip wizard training runs.
4. Click the Premap Wafer button to launch the PreMapWafer wizard. The wizard:
   – Performs AlignChip for each testable die defined by the wafer map and determines XYZ and theta.
   – Updates WaferMap with the XYZ, and theta positions for each die.

   Dies that fail AlignChip are marked as not testable in the wafer map.

### Premap Another Wafer Using GUI

1. Load and align the wafer.
2. For single die in the FOV, specify the testable die in the wafer map.
3. Start the PreMapWafer wizard from the Spectrum toolbar, or right-click in the Spectrum Explorer window.
4. Click the Run Premap Wafer button.

### Premap Another Wafer Using Remote Command

1. Load and align the wafer.
2. For single die in the FOV, specify the testable die in the wafer map.
3. Send the SCI command PreMapWafer.

## ProbeHorizon

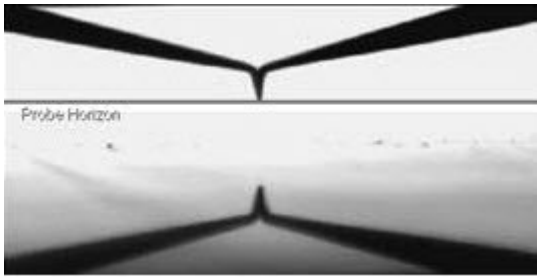
ProbeHorizon brings wafer and probe needles into microscope focus and sets contact height quickly after you load a new wafer or a change a probe card. The routine is only available for use with a contact view camera.

To start the ProbeHorizon tool, do one of the following:

- Click on the toolbar.
- Right-click the ProbeHorizon tool.
- Click Tools > Standard > ProbeHorizon.

Specify settings for ProbeHorizon in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Access Level Required |
|---|---|---|
| SafetyOffset | Sets contact height offset. Chuck is moved at contact minus SafetyOffset. | Admin-write<br>Engineer-write |
| UseWaferThickness | If enabled, Spectrum prompts you for the current wafer thickness every time the ProbeHorizon tool runs. | Admin-write |
| DynamicUpdate | Update ProbeHorizon according to contact height. | Admin-read |




1. Insert probe card and wafer.
2. Adjust the white line slightly below the probe needle tips.

   The contact heights are adjusted accordingly.
3. Move the microscope to focus the wafer surface.
   - On systems without aux sites, the chuck always moves to the XY center position and then upwards in Z to the SafetyOffset below the needle tips. From this Z position, use the ControlCenter Navigator to bring the wafer in contact and focus.
   - On systems with aux sites, the chuck performs the Z movement only if the working position offset is set to Probe Position. Otherwise, no Z movement takes place. This is to protect probe cards from colliding with thick aux site substrates.
4. Scope, if available and in probe position (see above), moves to Focus and ScopeFollowMode is activated.

## Measurement

### Measurement Overlays and MeasureOnScreen

The MeasureOnScreen tool performs a two-point measurement on the live image. When you click two points on the image, it measures the distance between the points and then displays the resulting uncalibrated measurement on the image immediately after the second click.

1. To open the MeasureOnScreen tool, do one of the following:
   - Click on the Spectrum toolbar.
   - In the Spectrum Tools menu, click Standard > 2 Point Measurement.
   - In the Spectrum Explorer window, right-click the MeasureOnScreen tool.
2. Click the first point or feature to measure from.
3. Click the second point or feature to measure to.

You can move the chuck and/or scope if the second point is beyond the field of view.

## Measurement Overlays and MeasureOnScreen

The MeasureOnScreen wizard and measurement overlays are visually similar. You can use both of them to measure distances between two on-screen points of the live video.

The following table compares the features and attributes of the MeasureOnScreen wizard and measurement overlays.

| MeasureOnScreen wizard | Measurement overlay |
|---|---|
| • Better at measuring distances | • Better at quickly showing predefined distances |
| • Better for determining feature sizes | • Better at helping you land probes an exact distance apart (such as through measurement for RF calibration) |
| • The wizard mode overlays disappear when you click the Finish button. | • Measurement overlay remains visible. |
| • You cannot use this wizard while any other wizard is running. (For example, it is not possible to use the MeasureOnScreen wizard while using the ReAlign wizard.) | • You can add predefined measurement overlays while using another wizard. |

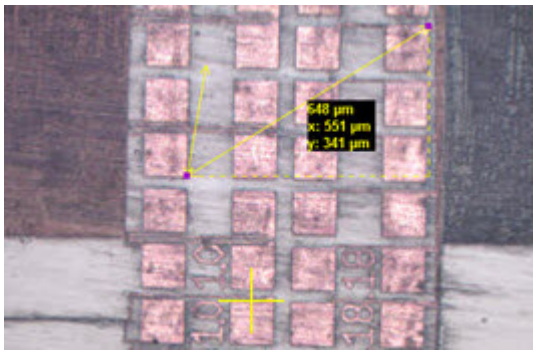
**NOTE**

*Because the MeasureOnScreen overlays look the same as the predefined measurement overlays, avoid confusion by using only one type of measurement overlay at a time.*

## Measure with the MeasureOnScreen (2 Point Measurement) Wizard

1. Start the 2 Point Measurement wizard from the Tools menu, from the toolbar, or right-click MeasureOnScreen in the Tools list in the Spectrum Explorer window.
2. Click the starting point, and then click the endpoint.
3. If needed, you can resize or move the overlay anywhere. Click and drag the handles on either end of the measurement line to the desired location. While moving the endpoint, Spectrum displays both old and new lines until you release the cursor.

   The measurement size updates dynamically.

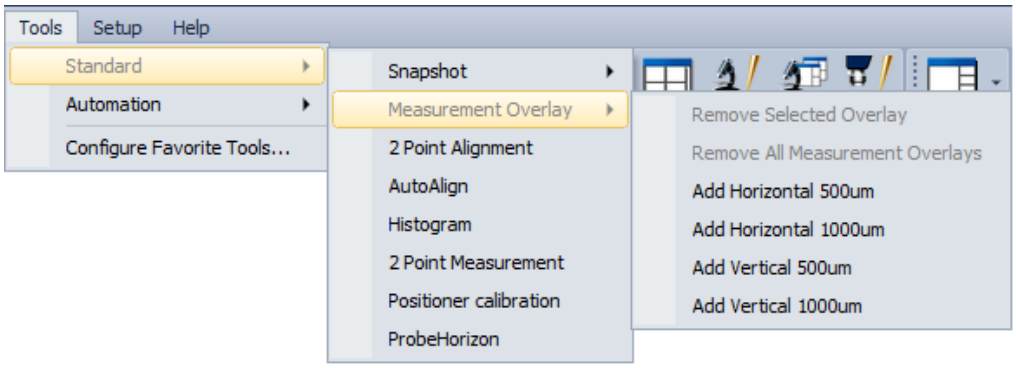


## Measure in Non-Wizard Mode

Similar to the measuring wizard, overlays help you measure between two points.

- Predefined overlays have default names, sizes, and locations, but they are completely configurable in the Spectrum Explorer window.
- Active overlays are associated with a camera view.

To access overlays, on the Tools menu, click Standard > Measurement Overlay.




**Predefined Overlays**

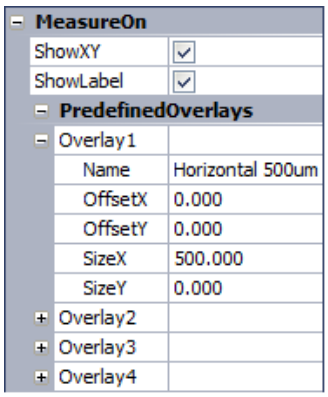
You can name and define predefined overlays in the Explorer window, and then select them from the Tools menu.

In the Overlay definitions, click in a text box to change the value.

**Active Overlays**

Measurement overlays that are added to a camera view are displayed in the Explorer window. You can also define X and Y offsets and sizes for active overlays in the Explorer window.

Customized names do not apply because each overlay is associated with a camera view.




**Name**

The name of the overlay as it is seen in the Tools > Standard > Measurement Overlay menu.

**OffsetX**

The X offset in microns from the center of the camera view of the top-left point in the overlay.

**OffsetY**

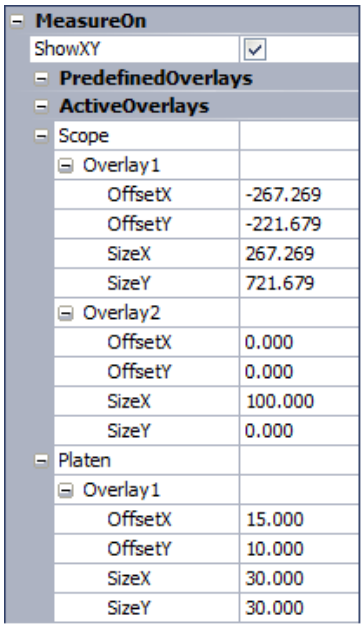
The Y offset in microns from the center of the camera view of the top-left point in the overlay.

**SizeX**

The distance in X from the top-left point to the bottom-right point. Zero if vertical. This value must be non-zero if the Y size is zero.

**SizeY**

The distance in Y from the top-left point to the bottom-right point. Zero if horizontal. This value must be non-zero if the X size is zero.



## Add or Remove an Overlay

Each predefined overlay and active overlay (for a camera view) has two context menu items:

- Add Measurement Overlay
- Remove Measurement Overlay

### Add an Overlay

1. In the Spectrum Explorer window, click the MeasureOnScreen tool.
2. Right-click an overlay and then click Add Measurement Overlay.

   or

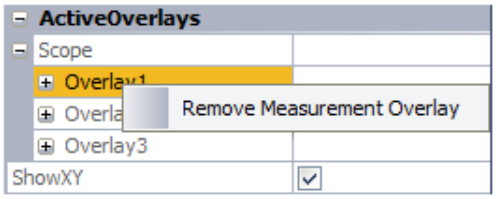
   Right-click PredefinedOverlays and then click Add Predefined Overlay.

### Remove an Active Overlay

1. In the Spectrum Explorer window, click the MeasureOnScreen tool.
2. Right-click an active overlay and then click Remove Measurement Overlay.

   or

   On the Tools menu, click Tools > Standard > Measurement Overlay > Remove All Measurement Overlays.



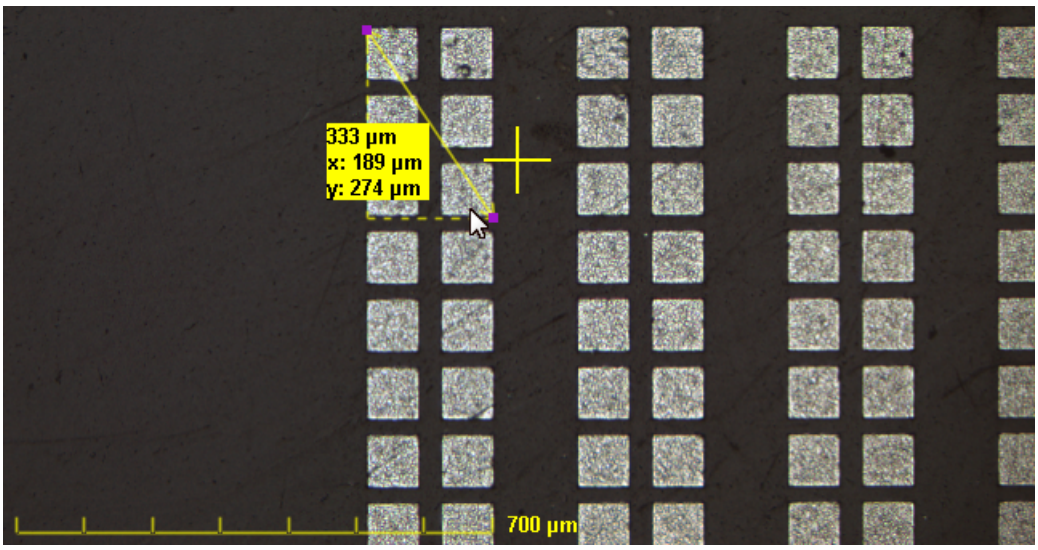

If you right-click in a camera view and select Erase sketch, all overlays except the measurement overlays are removed.

## Move an Overlay

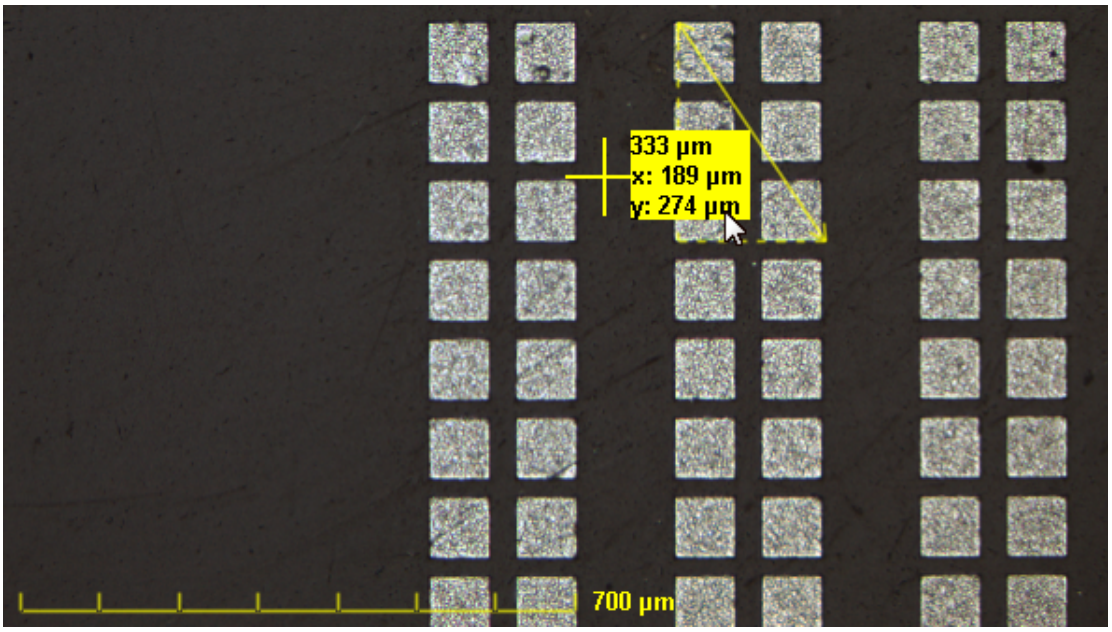
For very small adjustments, you can edit the X and Y offsets in the Active Overlays section in the Explorer window to move an overlay.

You can also drag the overlay to a new position. Click the text for the measurement overlay. The text box changes from a black background to a yellow background.

**Before Move**




**After Move**




After moving the overlay, the endpoints are checked to ensure that they are within the camera's field of view (FOV). If they are not, the measurement overlay is moved back within bounds so that each endpoint is within the camera's FOV.

### Zoom Level Changes

If you use the mouse wheel to change the current zoom level, the measurement overlay may become partially or fully invisible to the user. Zoom out to display the full view again.

**NOTE**

*When the current view is an eVue camera with seamless-zoom turned on, transitioning the measurement overlays between eVue cameras requires special handling. Zooming in from eVue1 to eVue 2 transfers the overlays (appropriately scaled). In addition, turning Megapixel Mode on/off handles the image-resize correctly.*

## FindFeature

The FindFeature tool stores up to 40 trained models. After training, you can search these models directly on screen or remotely. The remote command returns the XY positions, angle, and score value for each instance of the model found on screen.

The features are simple models that are either Cognex- or NI Vision-based. Each feature contains all of the data that can be searched on its camera mount positions.

Specify settings for FindFeature in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| Feature1 | |
| Camera Mount | Specifies the camera mount for this feature. |
| Model | |
| MatchScore | Smallest score a match can have to be considered valid. |
| ColorPlane | Color used for the model image acquisition (white, red, green, blue). |
| MinAngle | Minimum value for the rotational degree of freedom for pattern recognition. |
| MaxAngle | Maximum value for the rotational degree of freedom for pattern recognition. |
| Sensitivity | An increase in the sensitivity value makes the PatMax model less sensitive to random noise. Sensitivity value is best between 2.0 and 5.0. The higher the value, the longer the processing time. |
| Light Settings | See Camera and Light Settings for details. |

When you load legacy projects, the features are populated with data from the legacy project, including light settings defined for the feature.

You can have separate camera mount positions for each FindFeature model, and simultaneously train a pattern for the scope camera and a second pattern for the platen camera.

The FindFeature wizard initially displays what is configured for the first feature. You can select another feature for training. If the selected feature has a different mount position than the one the wizard is currently running on, you must move the wizard to the display of the selected feature.

The number of available cameras depends on your system configuration.

1. In the Spectrum Explorer window, Tools folder, right-click FindFeature and then click Show Tool Wizard.
2. Select the camera mount for this feature.

3. Drag the shape to fit around the model. Click the TrainModel button to continue training, or click the Cancel button to quit the wizard.

## Snapshot

You can use Snapshot to export high resolution images with annotations. Snapshot expands to capture images of the main view with or without detail views and save them to a file (as bmp, jpg, or .png) or copy them to the clipboard. The original captured image is always saved.

To access the Snapshot tool, on the Spectrum Tools menu, click Standard > Snapshot.

## OCR Reader

| | |
|---|---|
| **REQUIREMENT:** | IDTools software license |

The OCR Reader reads simple text strings from a wafer to determine wafer IDs. It supports a set of standard fonts and can be extended with custom fonts if needed.

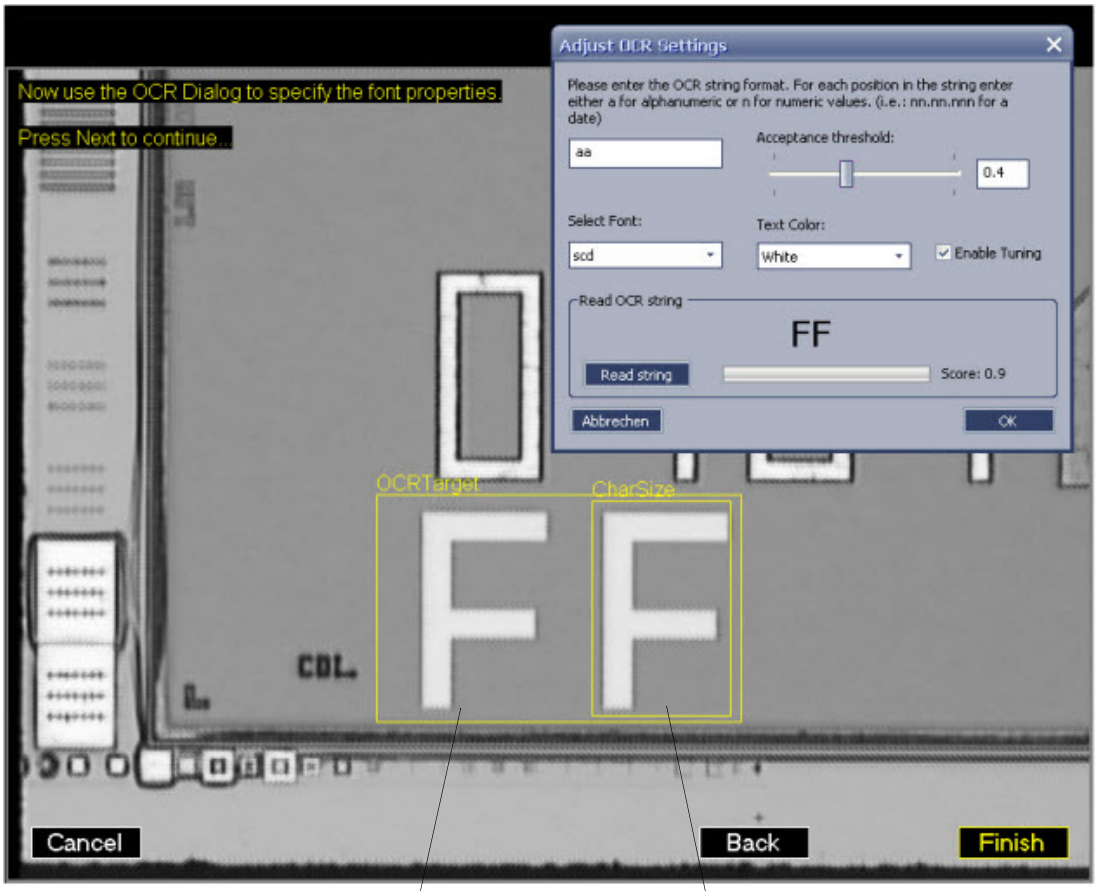
The following table lists user access levels required to use OCR Reader settings.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Specifies the camera (scope, platen, contact view, chuck) to use for the OCR Reader. | write | read |
| UseOwnLightSettings | When enabled, you can configure the OCR Reader with light settings that differ from the current camera light settings. | write | write |
| LightSettings | Visible only if UseOwnLightSettings is enabled. You can adjust the shutter and gain values in a way that ensures best possible model detection. | write | write |
| OCRFont | Specifies the text font. Spectrum supports semi, cano, trip, and ocra (OCR-A) fonts. Custom fonts are available. | write | read |
| Accept | Values between 0 and 1 (0.4 is recommended). The higher the value, the less tolerant the character recognition for noise, spots, and stains in the image. | write | write |
| Fields | Specifies the field string, which you can use to specify the OCR string in greater detail.<br>a – alphanumeric [a-z, A-Z,0-9]<br>c – characters [a-z, A-Z]<br>n – numeric [0-9]<br>? – any character<br>All other characters represent literal characters. Examples of field strings and their meaning:<br>• nnnn – Any four digit number<br>• cccc – Any string with four characters<br>• nn.nn.nnnn – Day/month/year (24.09.2009) | write | write |
| VariableLength | If enabled, the length of the OCR string is not known. The characters are matched with the field string as long as the length of the OCR string is smaller or equal to the length of the field string.<br>If the field string is shorter than the string being read, arbitrary characters can occupy positions not specified in the field string. | write | write |
| Enable Tuning | If enabled, the reading algorithm varies its parameters to improve the detection result. Use this if your text is not detected properly. | write | write |
| TextColor | Specifies text color. The OCR Reader expects either white text on black background or black text on white background. | write | write |

To use the OCR Reader:

1. Right-click OCR Reader and then click Show Tool Wizard.
2. Drag the OCR target over the string you want to read.

3. Next, drag the CharSize box over an arbitrary character in the string and adjust its size to match the character size.




OCRTarget selection box CharSize selection box

4. Click the Next button to open the wizard.
5. Adjust the parameters and test your settings.
6. When finished, click the OK button in the Adjust OCR Settings window and then click the Finish button to exit the wizard.

## Barcode Reader

| | |
|---|---|
| **REQUIREMENT:** | IDTools software license |

The Barcode Reader reads industrial bar codes.

Right-click BCReader and then click Show Tool Wizard to edit the Barcode Marker. When selecting a barcode, make sure to select only the barcode graphics and not any text associated with it.

Once you have positioned the marker box, you can read the barcode by clicking Read Barcode or click the Finish button to exit the wizard.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Specifies the camera (scope, platen, contact view, chuck) to use for BCReader. | write | read |
| UseOwnLightSettings | When enabled, you can configure BCReader with light settings that differ from the current camera light settings. | write | write |
| LightSettings | Visible if UseOwnLightSettings is enabled. You can configure the shutter and gain values to ensure best possible model detection. | write | write |
| SymbolType | Type of barcode symbol (Auto, Code 39, Code 128, BC 412 and IBM 412) | write | read |

## DataMatrix Reader

| | |
|---|---|
| **REQUIREMENT:** | IDTools software license |

A data matrix is a two-dimensional version of a barcode.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| CameraMount | Specifies the camera (scope, platen, contact view, chuck) to use for DMReader. | write | read |
| UseOwnLightSettings | When enabled, you can configure the DMReader with light settings that differ from the current camera light settings. | write | write |
| LightSettings | Visible if UseOwnLightSettings is enabled. You can configure the shutter and gain values to ensure best possible model detection. | write | write |

# ReAlign

ReAlign uses an off-axis downward-looking camera and an upward-looking camera to perform an automated probe-to-pad alignment of probe cards. Because ReAlign measures needle- and wafer-drifts, it can test unattended wafers at multiple temperatures. ReAlign requires a probe station equipped with a contact view camera, a chuck camera, and a platen camera.

ReAlign can be used with:

- Wafers that have a unique pattern that repeats in every die.
- Typical cantilever/vertical/pyramid probe cards.
- Semi- and fully-automatic use cases.

You can choose between full wafer alignment and single die alignment. A two-point pattern alignment is used for single chip alignment.

You cannot use ReAlign with single needles or probe cards with less than 3 probe tips in the field of view of the chuck camera.

## On-Axis and Off-Axis Mode

Most vision tools support either on-axis or off-axis workflows, but some are independent and can be used for both. ReAlign is an Off-Axis tool that is self-contained and does not require data or functionality from an on-axis tool, which means that you can train and use both workflows in parallel.

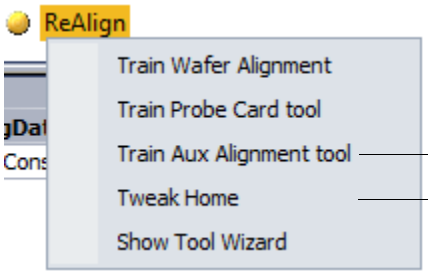
Alignment mode (On-Axis/Off-Axis) indicates how the system is currently being used. To access On-Axis/Off-Axis modes, in the Velox toolbar, click All applications > Status > Alignment Mode.

| **On Axis** | **Off Axis** |
|---|---|
| **Workflows using the scope/eVue camera:**<br>Includes all vision tools available for the microscope and that are used to align probes-to-pads while you can see the needles and the pads at the same time. | **Workflows using the platen and chuck camera:**<br>Includes all vision tools associated with ReAlign that are used to align probes-to-pads *without* the need to see the needles and the pads simultaneously. |
| AutoAlign<br>AutoXY/AutoZ<br>Align2Point<br>AlignAux<br>AlignWafer<br>AlignChip<br>CellView<br>FindFeature<br>FindFocus<br>IDTools<br>Measure<br>ProbeHorizon<br>Snapshot<br>VueTrack | Align2Point<br>FindFeature<br>Measure<br>ProbeHorizon<br>ReAlign<br>Snapshot |

## Train ReAlign

You must train ReAlign for a new project or wafer, for a new or changed probe card, and when changing the touchdown location on the home die (for example, to different pads).

To start training, click on the Spectrum toolbar, or right-click ReAlign in the Spectrum Explorer window.




See ReAlign and Aux Sites.

Correct the home die position after Probe-to-Pad alignment, then manually adjust the home die position.

The following table lists ReAlign wizard training steps and descriptions.

| | |
|---|---|
| **Train ReAlign-ProbeHorizon** | Sets a preliminary contact height for safe operation during the wizard procedure. |
| **Train ReAlign-Detect Wafer Height** | Measures wafer height and synchronizes top camera with chuck camera. |
| **Train ReAlign-Wafer Alignment** | Aligns the wafer, calculates the die size, and optionally builds a wafer map. |
| **Train ReAlign-Probe Card Alignment** | Determines probe card dimensions (XYZ), calculates the home die position, and then moves chuck to that position. |
| **Train ReAlign-Z-Profiling** | Creates a profile of the wafer and stores it in the electronics. (This step is skipped if UseZProfile is disabled.) |

After training, the wafer is aligned in theta, the index is calculated, the needles are aligned to the pads at the home die, and the contact height is set.

## Train ReAlign-ProbeHorizon

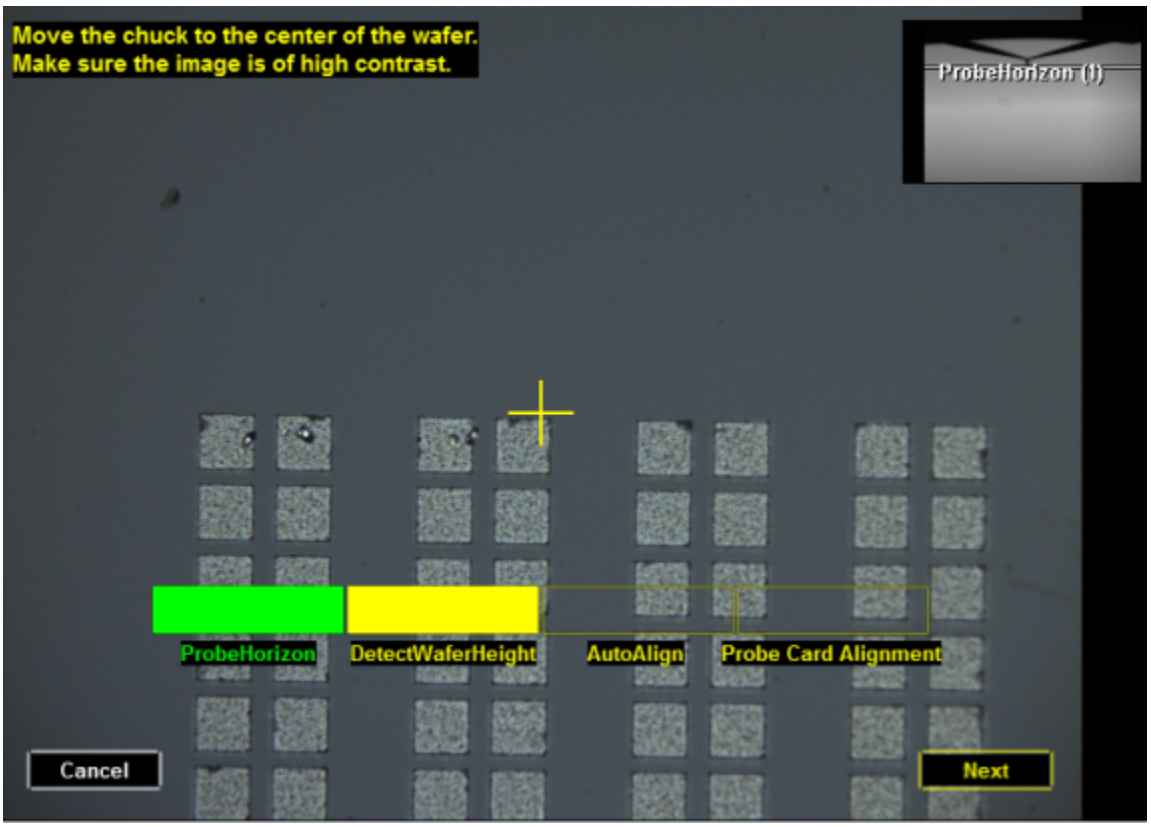
ProbeHorizon uses the contact view camera to define a preliminary contact height, which is used to ensure that none of the following steps cause any needle damage. The final contact height is calculated at the end of training ReAlign.

Drag the ProbeHorizon line at or slightly below the lowest part of the probe card. The probe card must be located in the upper third of the contact view camera. If it extends lower, the ReAlign process may run into contact height violations (for example, while focusing on the synchronization mark).

## Train ReAlign-Detect Wafer Height

DetectWaferHeight synchronizes the chuck camera (upward-looking) and the platen camera (downward-looking) using a small synchronization crosshair that is located on the housing of the chuck camera. The tool focuses on the crosshair and searches a predefined pattern to update the XYZ location of the chuck camera.

After you find the predefined pattern, the wizard prompts you to focus on the wafer surface to measure the wafer Z height, which is used in the Wafer Alignment and Probe Card Alignment steps, and for the final calculation of the contact height. When you focus on the wafer, it is important to use a surface that has good contrast and is close to the wafer center.




When you create a new project, the chuck automatically moves to the camera origin of the platen camera, which is close to the wafer center, before it prompts you to select a position for focus. When retraining an existing project, the tool moves to the last trained XY location.

The Z location used for the wizard step is calculated by:

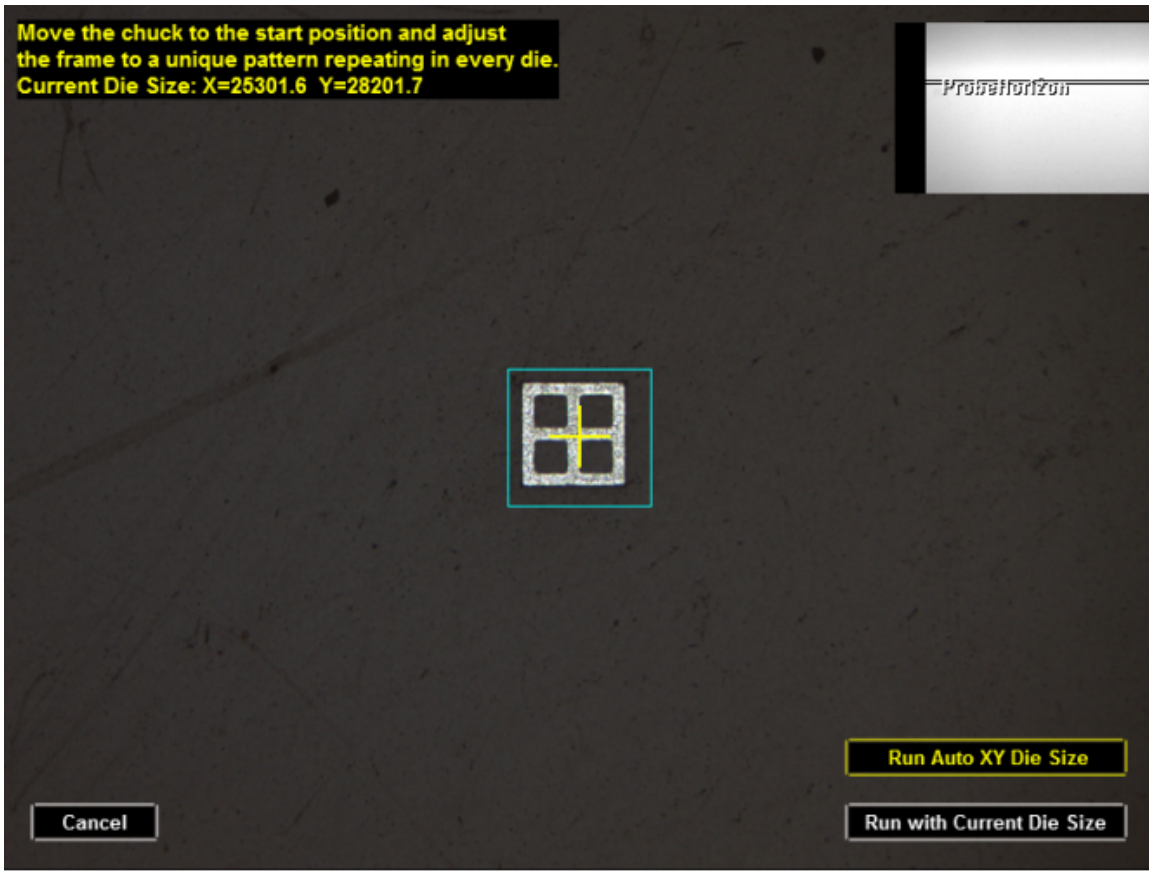
- Synchronization height of the chuck.
- Sync-chuck gap (Z gap between synchronization mark and chuck surface).
- Wafer thickness (set in the Spectrum Explorer window).

To select a good focus position, you must move the chuck in XY. You are not required to move Z.

If the chuck is not in focus in this wizard step, the wafer thickness may not be set correctly.

## Train ReAlign-Wafer Alignment

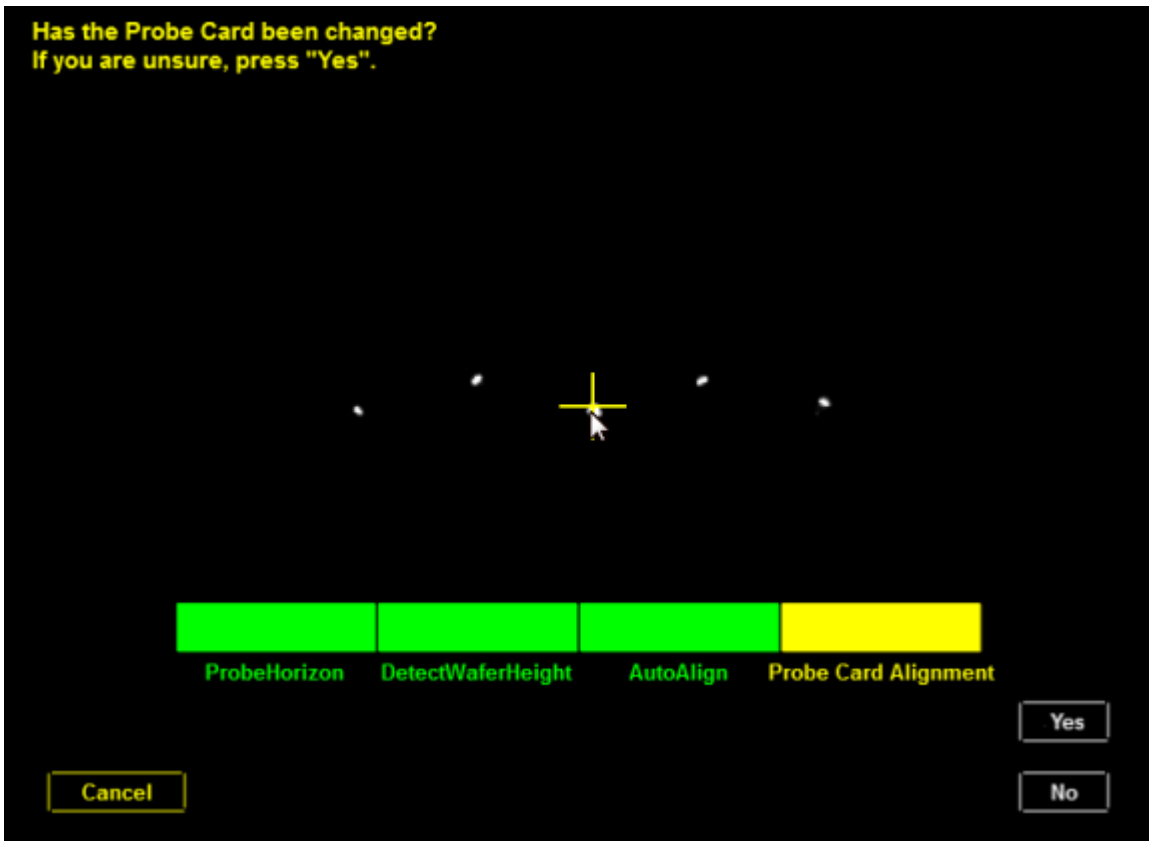
The Wafer Alignment step performs a theta alignment of the wafer and calculates the die size using pattern recognition. The wizard prompts you to train a unique pattern that repeats in every die. The trained pattern is later used by ReAlign to measure the XY location of the home die, as well as for other dies when using the ReAlign at Die functionality.




The alignment pattern should be trained close to the wafer center location, because the alignment algorithm is optimized for measuring the XY die dimensions when started from a die close to center. The wizard requires you to move the chuck in XY to the pattern. The wafer should be in focus since the previous step found the focus height.

## Train ReAlign-Probe Card Alignment

The probe card alignment step identifies the XYZ location of the probe card and performs the initial alignment of the probes to the pads. Use the chuck camera to train the probe card position, and then use the platen camera to perform the initial matching of probe tips to pads.




The chuck camera is used first so that you can move the chuck in XYZ to the position of the probe card. The chuck should already be close to the probe card position, but depending on the probe card type, the needles may not yet be in the field of view. For that, the scope is moved to the pre configured park position to prevent the scope light and objective from interfering with the probe tip detection.

After you train the probe card, the probe card angle is used to automatically align the wafer. This compensates for rotated cards and ensures that all needles hit the pads.

After you align the wafer again, the chuck moves to the home position and presents an overlay image on the platen camera. This shows you the wafer and a static image of the probe card at the same time so you can match the tips with the target pads on the home die. Using the toggle functionality, you can align two ends of the probe card to optimize the matching.

In this step, it is important that you use the WaferMap application to set the home die correctly. In WaferMap, set the home die using the black dot that represents the chuck position from Zero. (If this is not done correctly, the Z-profiling step will likely fail because of software fence errors.)

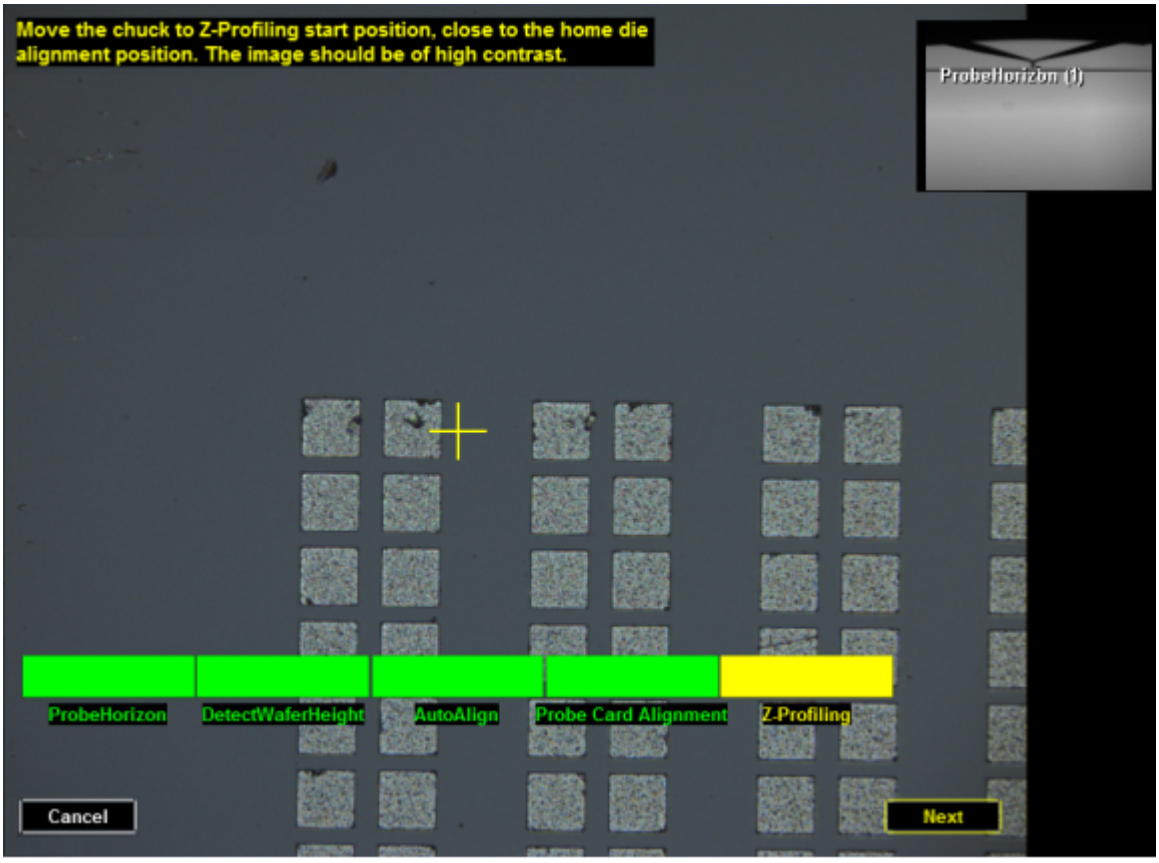
See Set Home for more information on setting the home position.

### Add Probe Mark Positions

You can add Probe Mark positions 3 and 4 for Vertical probe cards so that you can view two additional positions for probe card alignment verification. These positions are for viewing only and aren't used in any calculations.

## Train ReAlign-Z-Profiling

The Z-Profiling step is optional and is intended to measure and compensate planarity differences of the wafer surface. In the Spectrum Explorer window, enable the UseZProfile option under ConfigData. Depending on your application and wafer planarity, you should use Z-Profiling if significant variations in contact height across the wafer surface are expected (for example, caused by bowing wafers). You can also use the ReAlign at die functionality to measure each die's Z-height before going into contact.




In Z-Profiling, the wizard prompts you to select an area on the home die that has good contrast and can be used for focusing on the wafer surface. Move the chuck in XY. (Z movements are not required because the wafer focus was measured in a previous step.)

After selecting a focus position, Z-profiling runs using the WaferMap. It moves to the defined dies and measures the focus height on each die to create a height map of the wafer surface. The height profile accuracy is improved when more points are selected and profiled. This takes longer to record, but it also improves the consistency of the contact height across the wafer. When the profiling is finished, the height map is automatically saved and is then used for all subsequent moves.

## Run ReAlign

You can run ReAlign in full mode (ReAlign at Home position) or reduced mode (ReAlign at die).

| ReAlign at Home | ReAlign at Die | ReAlign for Single Die |
|---|---|---|
| ↓ | ↓ | ↓ |
| Probe Card Alignment | Probe Card Alignment | Probe Card Alignment |
| ↓ | ↓ | ↓ |
| Detect Wafer Height | Detect Wafer Height | Detect Wafer Height |
| ↓ | ↓ | ↓ |
| Wafer Alignment | Probe-to-pad Alignment | Chip Alignment |
| ↓ | ↓ | ↓ |
| Probe-to-pad Alignment | | Probe-to-pad Alignment |
| ↓ | ↓ | ↓ |
| Z-Profiling | | Z-Profiling (optional) |

| | |
|---|---|
| ReAlign at Home aligns the wafer in theta, updates the home position, calculates a new contact height, and measures and compensates for thermal drift. | ReAlign at Die updates the homeReAlign for single die updates the position and calculates a newhome position and calculates a new contact height.contact height. |

ReAlign does not need retraining:

- When you manually or automatically load the next wafer of the same kind.
- After temperature changes to compensate for needle and wafer drift.
- After moving to a new die to compensate for thermal drift caused by different chuck XY position.

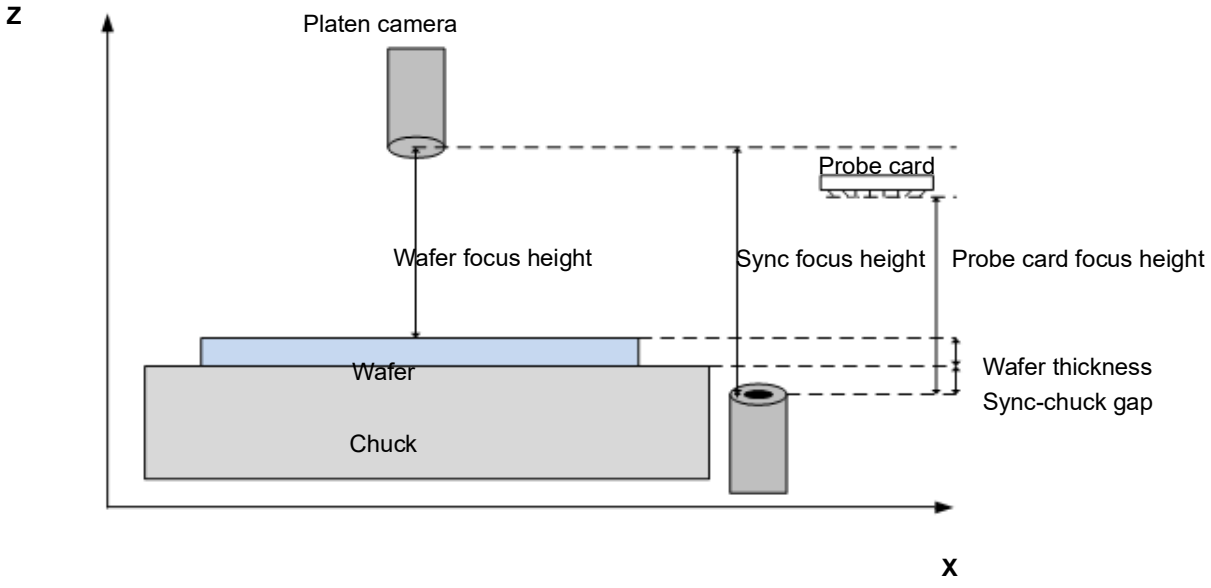
| | |
|---|---|
| **Probe Card Alignment**<br>(Full ReAlign and ReAlign at Die) | • Probe Card Alignment moves to the last known location of the probe card and searches the trained probe card pattern with the chuck camera.<br>• The scope is again moved to the park position. When DoPreFocus is enabled, the chuck tries to find the focus before searching the trained probe card in XY.<br>• When the probe card is identified in XY, the tool focuses on the first and second probe card position and calculates the needle height as an average of both.<br>• The identified XYZ location of the probe card is stored in the tool settings so that the next execution of ReAlign uses the updated position. |
| **Detect Wafer Height**<br>(Full ReAlign and ReAlign at Die) | • Detect Wafer Height moves the chuck camera below the platen camera, then focuses on the synchronization mark and searches the pre-trained pattern so that it has an up-to-date location of the mark in XYZ.<br>• After that, it moves the chuck to the trained XY location on the wafer and focuses on the wafer to determine the new focus height that will be used for Contact Height calculation. |

| | |
|---|---|
| **Wafer Alignment**<br>(Full ReAlign) | • Wafer Alignment performs a theta alignment of the wafer and re-measures the index size.<br>• The difference between the new index size and the index that is defined during ReAlign training is then used to calculate the thermal expansion factors of the chuck. ReAlign will continue using the index size but internally compensate any XY moves for the thermal expansion. |
| **Chip Alignment** | • ChipAlignment performs XY and theta alignment of the die. |
| **Probe-to-Pad Alignment**<br>(Full ReAlign and ReAlign at Die) | • Probe-to-pad alignment searches the trained wafer pattern to measure the XY drift of the home die position (or of the current die in the case of 'ReAlign at die'). This information, in combination with the probe card position, is then used to update the home position. |
| **Z-Profiling (optional)**<br>(Full ReAlign) | • The Z-Profiling step re-measures the wafer planarity to compensate for height differences across the wafer surface. Once the differences are measured, the compensation map is stored and used for all subsequent movements. |

## Contact Height Calculation

### Offset Compensation

The contact height is calculated as part of training or running ReAlign. The system calculates the correct contact height using a focus search on the synchronization crosshair, the wafer surface, and the needles.



| | |
|---|---|
| $Z_{Contact}$ | Calculated contact height |
| HeightConstant | Machine constant that is determined by factory. |
| $Z_{Synch}$ | Synchronization cross focus height |
| $Z_{Wafer}$ | Wafer focus height. The platen camera focuses on the wafer surface to determine this height. |
| $Z_{Needle}$ | Probe card focus height. The chuck camera focuses on the needle tips to determine this height |
| $Z_{RefComp}$ | Refraction error compensation, depending on temperature. |
| $Z_{Bump}$ | Configured bump height when testing on micro bumps. |

Using the values above, the Contact Height is calculated as:

$$Z_{Contact} = HeightConstant – Z_{Synch} + Z_{Wafer} + Z_{Needle} + Z_{RefComp} – Z_{Bump}$$

**Refraction Error Compensation**

A crucial part of the realign process is determining probe card heights at different temperatures. This process is based on building a Z-axis from height information that is obtained by measuring the heights of the following reference points:

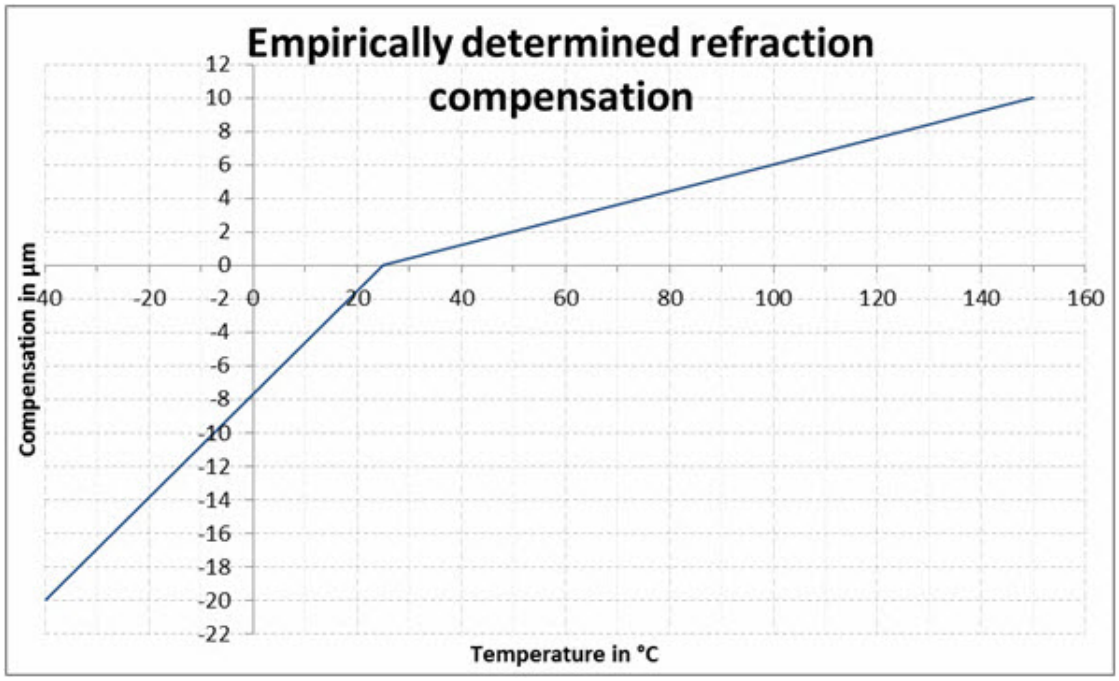
- Z-position of the probe card needles
- Z-position of the wafer (chuck)
- Z-position of the synchronization mark

While you can see some of the positions from above with the scope or platen camera, you can only see needle tips from below using the chuck camera.

To calculate the correct contact height position of the needs, the height information of the needle tips (as measured with the chuck camera) and the height information (measured from above with the platen or scope camera) must be unified into a single Z-axis value.

The heights are first trained at ambient temperature and later revised to working temperature (-40 to 200°C). Measure the reference points at working temperature to compensate all temperature-related effects, provided all of the three reference points are measured under identical environmental conditions. This is not always possible, as some machines may experience problems of undertravel and overtravel related to incorrectly determined contact heights.

Changes in the optical parameters (index of refractivity) of air due to temperature differences may cause problems. Although all reference heights are determined with the chuck at working temperature, temperature differences may still occur due to the chuck being moved to a different XY position inside the probe chamber in order to travel to the Z-axis reference points. The ReAlign wizard uses an empirical approach to deal with these effects based on a bilinear compensation curve.




The result of this measurement is added to the contact height. The bilinear curve is constructed by connecting three points: Low, Ambient, and High.

Each point consists of a value pair containing a temperature (in °C) as well as an offset value (in µm). The data is stored as part of the ReAlign config data. Plausibility checks are performed to ensure the correct order of the reference points.

$T_{Low} < T_{Ambient} < T_{High}$

To view refraction compensation data, see the Spectrum Explorer window, ReAlign tool.

| | |
|---|---|
| **ReAlign** | |
| **ConfigData** | |
| HeightConstant | 3525.000 |
| UseZProfile | ☐ |
| AlignProbeCard | ☑ |
| CorrectZ | ☑ |
| RefErrComp | |
| Enabled | ☑ |
| Low | -40;0;0;0 |
| Ambient | 25;0;0;0 |
| Temperature | 25.000 |
| OffsetX | 0.000 |
| OffsetY | 0.000 |
| OffsetZ | 0.000 |
| High | 150;0;0;0 |

The compensation offset is added to the contact height that ReAlign calculated. Spectrum logs the original contact height as well as the compensated contact height. The implementation is subject to the following limitations:

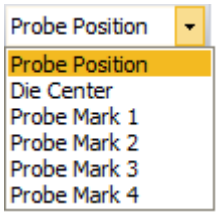
- The compensation is applied only to contact heights calculated in ReAlignWizard. No other tools or process are affected.
- The compensation is not applied to AuxSite chuck contact heights.
- ReAlignWizard stores a single set of compensation data that can represent data that is valid for either the platen or scope camera.
- Temperature values are restricted to values between -100 and 300°C.
- Offset values are restricted to values between -100 and 100µm.

### Offset Compensation

A probe station with ReAlign has two separate working areas that share technical parameters. Under the platen camera, you can access the wafer optically and teach alignment and software fences. The other working area is under the probe needles (approximately 20 cm).

Offset compensation is used to improve transparency. This compensation lets you switch between both areas while keeping all references and orientations (such as home position and WaferMap). This provides easy navigation and orientation while the wafer is below the platen camera.

To access offset options, expand the drop-down list in the middle of the Spectrum toolbar.




| | |
|---|---|
| Probe Position | The offset compensation is deactivated and the chuck is below the needles. Use this setting during probing. |
| Die Center | When the offset compensation is activated, the offset value is set during machine setup and only users with **Service-level access** can change it. This offset is calculated by the distance of the machine-probe center to the platen camera and is fixed. This setting is used for automatic calculations during the Train ReAlign wizard and ReAlign procedure. |
| Probe Mark 1 | When the offset compensation is activated, the offset value is calculated as the distance between the first group of needles (as defined by the ProbeCardTool) and the platen camera. This setting automatically activates the overlay image of the first needle group and lets you set a home position or inspect the probe marks at the current position. |
| Probe Mark 2 | When the offset compensation is activated, the offset value is calculated as the distance between the second group of needles (as defined by the ProbeCardTool) and the platen camera. This setting is used to check whether the second group of needles matches the pads or to correct the position if necessary. |
| Probe Mark 3/4 | Probe Marks 3 and 4 are for viewing only. They have no trained model and are not used in any calculations. See Add Probe Mark Positions for more information. |

## Probe Card Training and Detection

Probe Card Inspection

Probe Card Angle

Cantilever and Vertical Probe Cards

Pyramid Probe Cards

### Probe Card Inspection

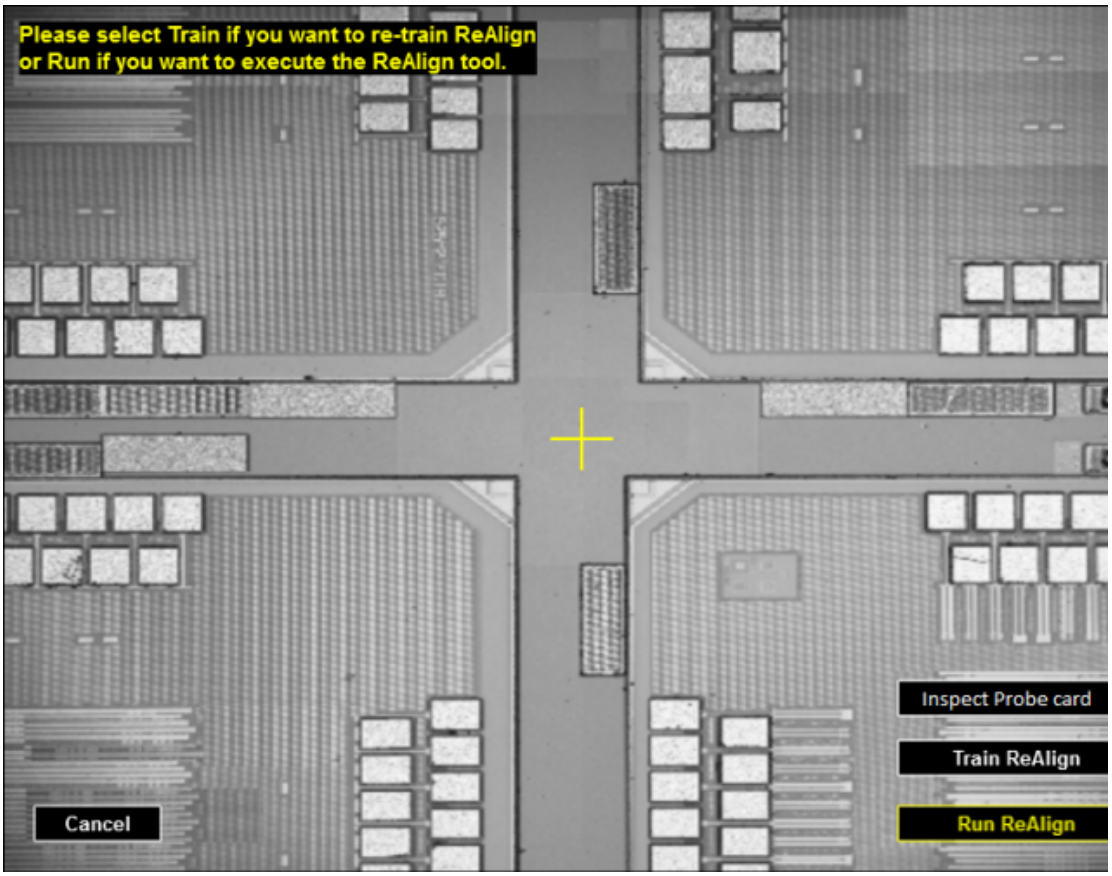
ReAlign includes steps to inspect the probe card and gives you the ability to:

- Inspect probe tip quality.
- Optimize needle detection parameters.
- Optimize light settings to improve reliability of needle detection.
- Focus search and light optimization for probe cards that have not yet been trained.

- Automatically perform an inspection after a certain number of touchdowns to ensure that the probe card still has a good quality that provides the expected contact quality.
- Ensure that a probe card is properly planarized to the chuck to provide comparable probing forces/touchdown for the whole needle layout.

1. In the Spectrum Explorer window, Tools folder, right-click ReAlign and select Train Probe Card tool.

   Spectrum starts the Train Probe Card wizard.



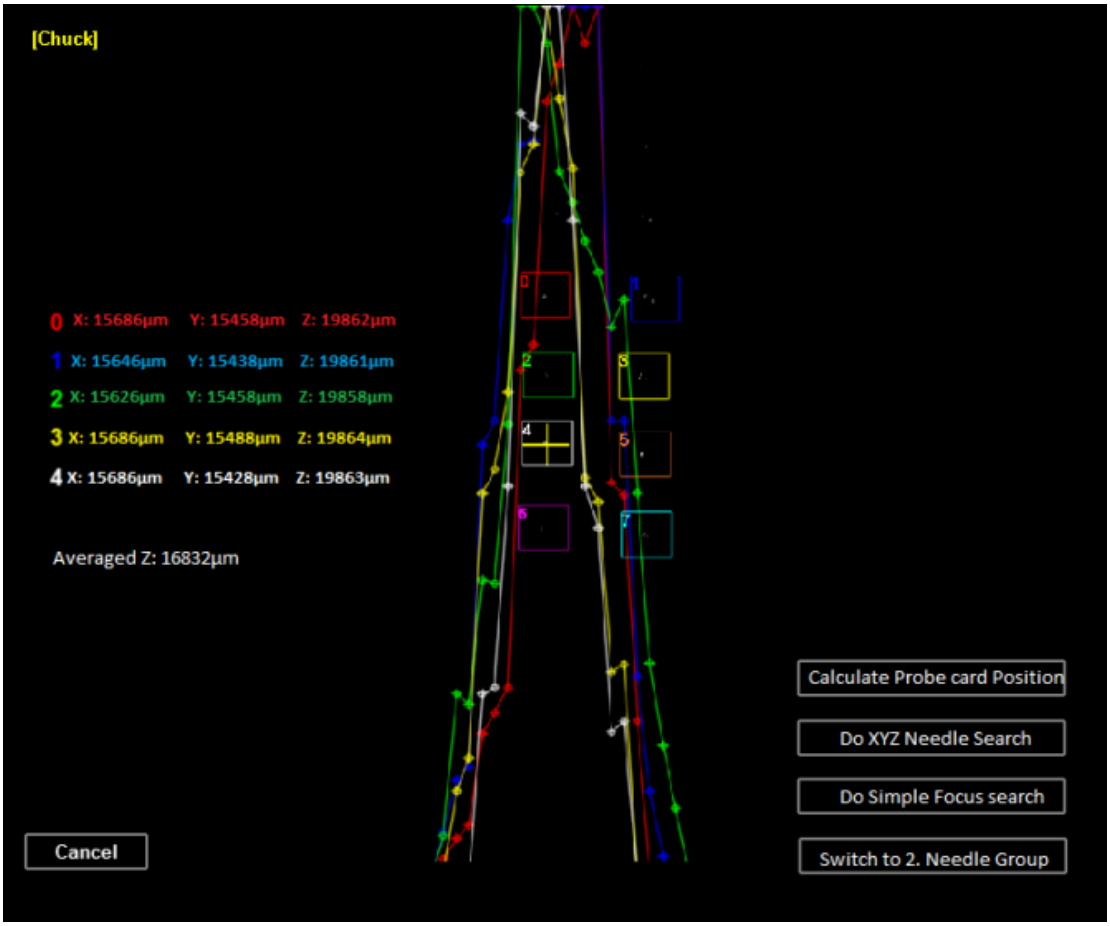

2. Click the Inspect Probe card button to begin probe card inspection.

   You can:

   - Modify the light settings and the focus options for probe card detection while in the wizard.
   - Do a simple focus search when the probe card has not yet been trained to check or adjust the planarity before training the card.
   - Do a FindFocus search on the full field of view using the focus options configured for the probe card detection.

- Do an XYZ needle search to output the information on-screen about the found needle XYZ location for either the first or second group

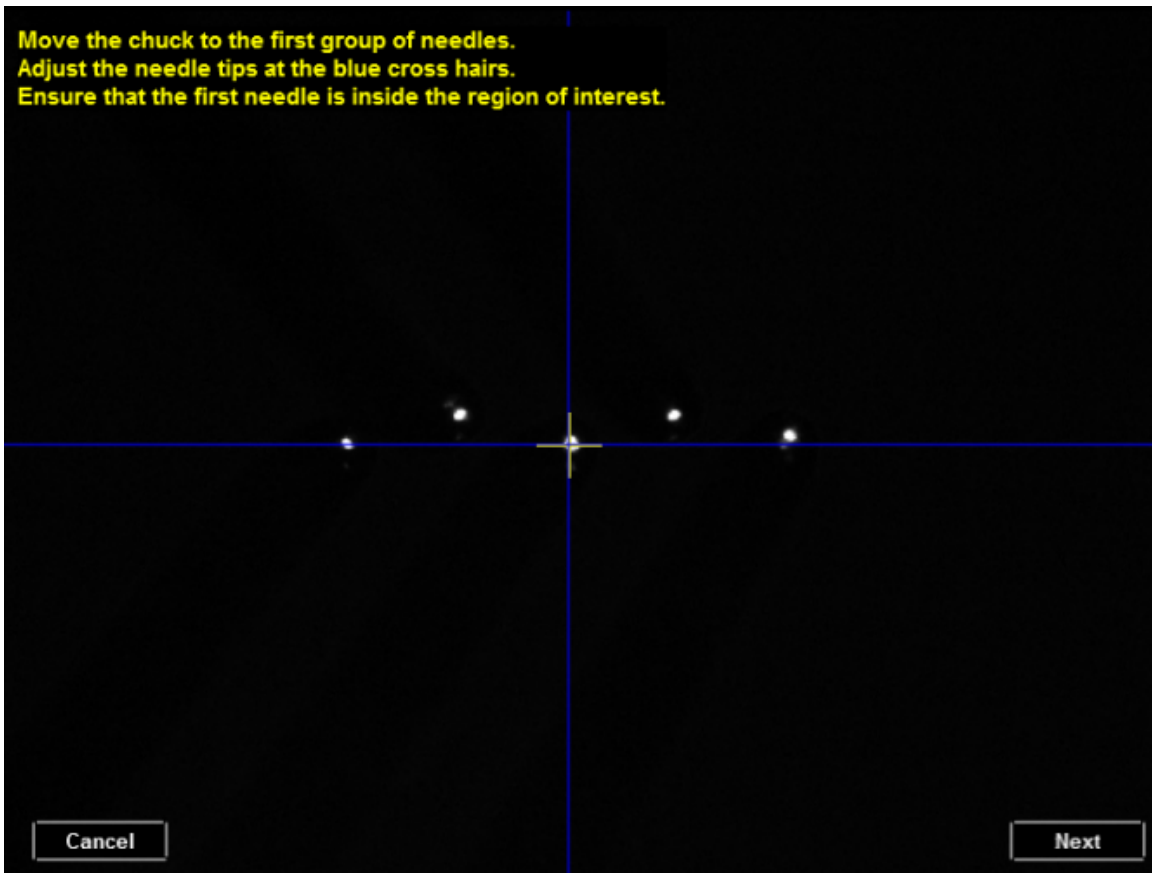
.



3. Calculate the probe card position to run the probe card tool and output the values for the two focus heights of needle groups 1 and 2, as well as the delta and averaged Z height.

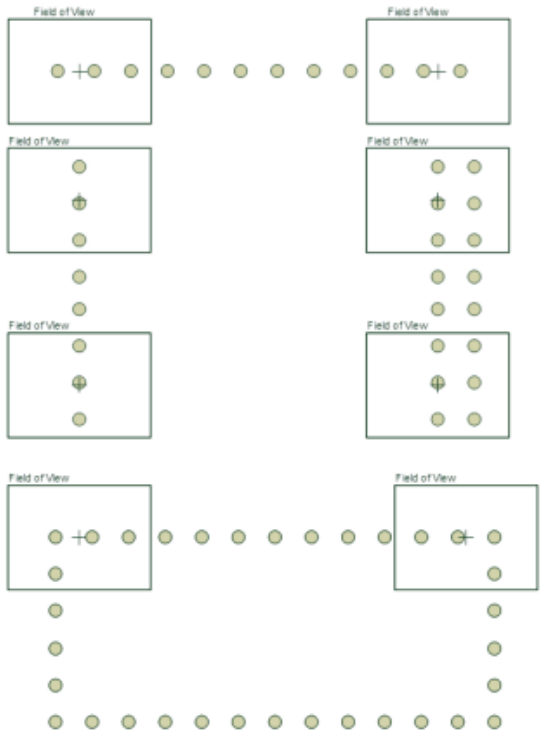
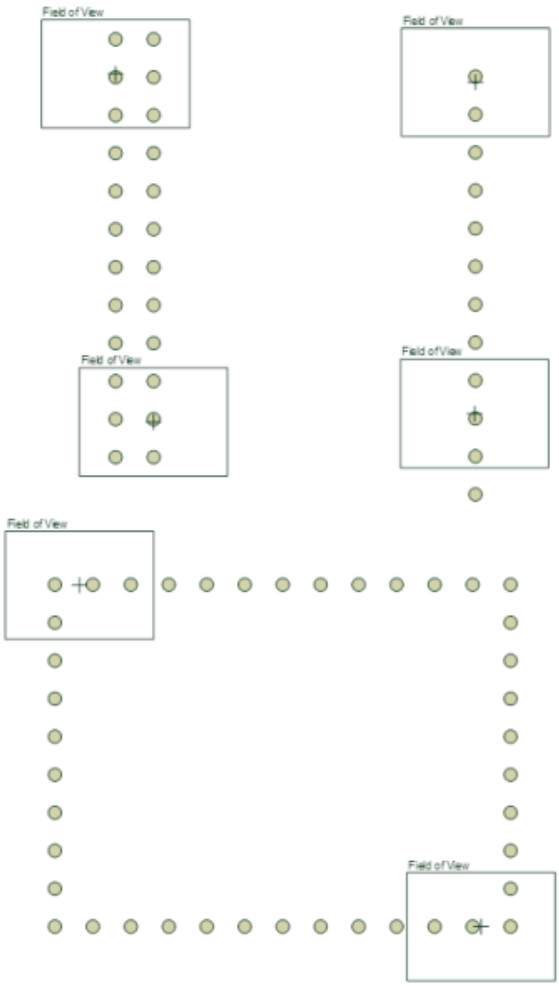
## Probe Card Angle

To train the probe card angle, place a blue crosshair overlay over the needles on two outermost groups of the probe card, either X or Y.




Because ReAlign doesn't support training a rectangular probe array, you must train either X or Y of the array. Do the angle training carefully to ensure that the system does not calculate an incorrect angle, which would result in a bad probe-to-pad alignment. When you select the needle positions, it is also very important to have the outermost probe tips in the field of view as probe card detection relies on knowing the dimension of the trained probe card.

### Trained Probe Card Examples

| Correctly-Trained Probe Cards | Incorrectly-Trained Probe Cards |
|---|---|
| The crosshair was placed on the same needle lines, resulting in a proper angle calculation. The outermost needles are in the field of view. The lower example shows how to train a rectangular probe array. | The top left example shows that the first (upper) crosshair was trained on the left needle line whereas the second (lower) crosshair was placed on the right needle line. This causes the calculation of a probe card angle which will be incorrect. The top right example shows that the second (lower) crosshair was placed so that the lowest probe tip is not in the field of view and can't be trained which will cause errors with probe card detection. This example shows how *not* to train a rectangular probe array |
|  |  |

## Cantilever and Vertical Probe Cards

Velox uses a combination of algorithms for training and detecting probe tips of vertical- and cantilever-type probe cards.

First, it searches for all possible instances of the trained needles. With cantilever cards, the identified blobs do not necessarily represent real needles; they might be dirt or part of the shaft.

After the instances are found, Velox uses a point-to-point matching algorithm to filter out instances that can't be matched with the trained probe card. Then, the first two steps are then repeated for the second probe card position.

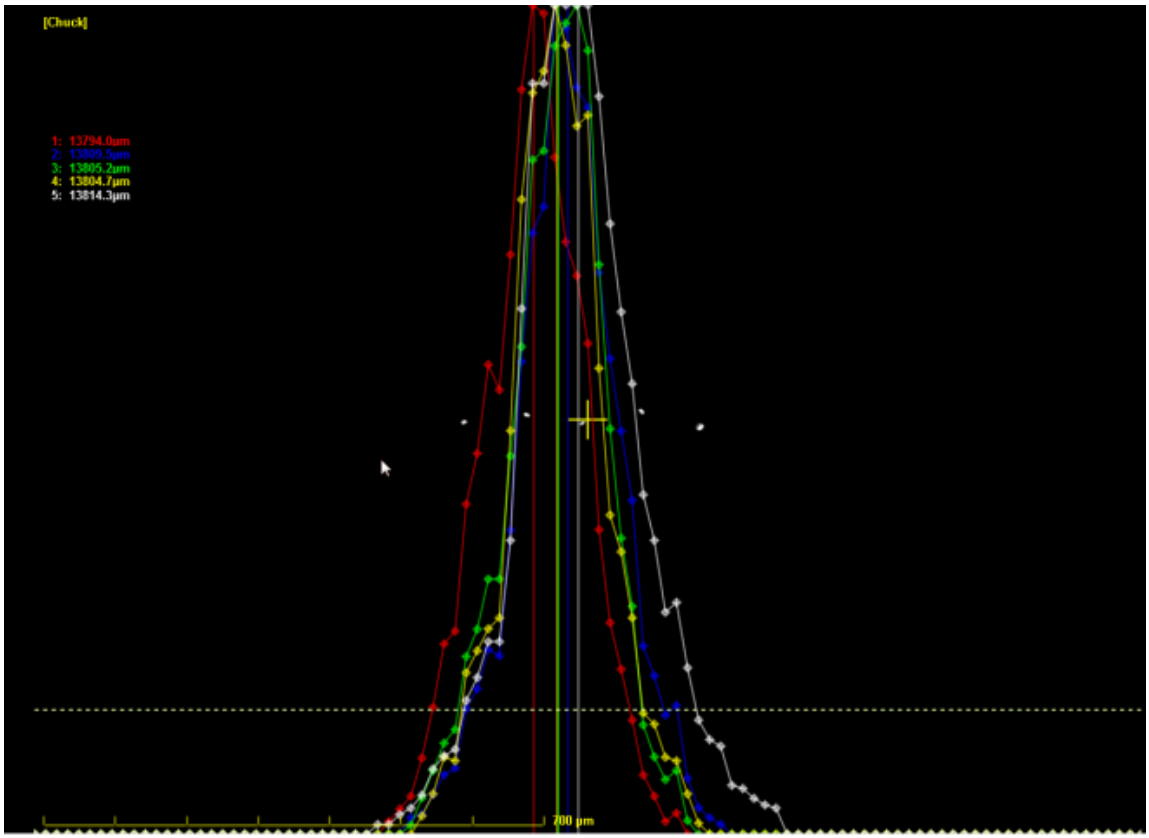
After matching needle instances are identified, Velox matches the first instances against the second instances to identify which pair is the one that represents what you trained.

This algorithm requires that at least three needle instances for the first probe card and three needle instances for the second probe card position can be trained. The outermost needles must also be trained so that the tool can check the dimension of the trained needle row/column.

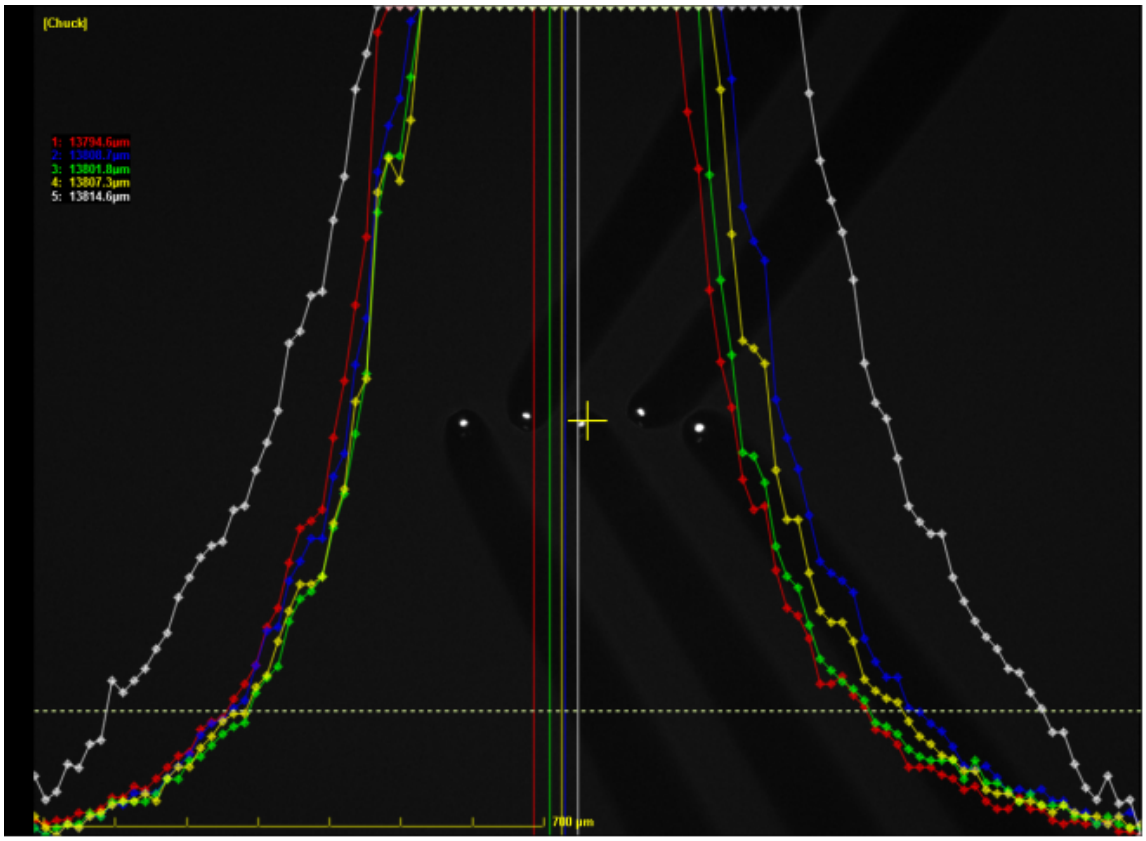
As long as the outermost needles can be identified, the XY location can be determined.

### Probe Card Focus (Especially for Cantilever)

The following is an example of good focus curves (no big plateau in focus height).



- The following is an example of bad focus curves (big plateau in focus height). To improve, reduce the focus light factor.




## Pyramid Probe Cards

Probe card detection for pyramid-style probe cards is different from cantilever or vertical because pyramid cards provide alignment marks that are used to find the XY location.

| | |
|---|---|
| **ProbeCardData** | |
| NeedleFocusParams | |
| ProbeCardType | Pyramid |
| FocusLightFactor | 0.500 |
| TipDistance | 20.000 |
| ProbeCardModel | |
| ReferenceOffset | 0;0 |
| FocusArea1 | |
| FocusArea2 | |
| Position1 | 15253.10, 3726 |
| X | 15253.100 |
| Y | 37267.600 |
| Z | 16500.000 |
| Position2 | 15253.10, 3656 |
| Position3 | 0.00, 0.00, 0.00 |
| Position4 | 0.00, 0.00, 0.00 |
| ReferenceModel | |
| MatchScore | 700 |
| ColorPlane | White |
| MinAngle | -5.000 |
| MaxAngle | 5.000 |

Use TipDistance to set the Z height distance between the beam and the actual tip.

The wizard prompts you to train the reference pattern and then train the probe card angle by placing the blue crosshairs at two outermost tips on the same line in either X or Y.

For detecting the Z height of the tips, ReAlign focuses on the beam of the pyramid needle as the tip itself is too tiny.

You can configure the Z height distance between beam and actual tip using the TipDistance parameter in the Spectrum Explorer window.

Following is the routine for detecting a pyramid probe card:

1. Chuck moves to the XYZ position of alignment mark.
2. Focuses on the surface of card (whole field of view).
3. Searches alignment mark and correct XY position of probe tips.
4. Moves to position of the first probe tip.
5. Focuses on the trained area.
6. Moves to position of last probe tip.
7. Focuses on the second trained area.
8. Calculates the average of both focus results and updates Z position on probe tips.

## Thermal Ramping (Unattended Test)

When you do unattended testing at multiple temperatures, a test executive can implement ReAlign in either of the following ways:

- ReAlign after temperature change.
- Continuously run ReAlign while changing temperature.

When the probe card is not drifting significantly, it is sufficient to use the HeatChuck command to change the temperature and then run ReAlign after soaking is done.

To improve reliability of ReAlign after temperature changes, Velox supports a thermal transition function that runs ReAlign in fixed intervals while the chuck is heating or cooling and during soaking. The chuck can stay closer to the needles during the transition, allowing the probe card and station platen to completely soak.

The ramping function runs remotely using the StartReAlignTemperature command, which is similar to the StartAutomationTemperature command.

The temperature transition function soaks the chuck at Separation Height. Between ReAlign executions, the ramping tool will wait for two minutes at separation.

The tool can also run a full ReAlign once the transition and soak is complete, and optionally move to Contact Height when finished.

## Soak Times

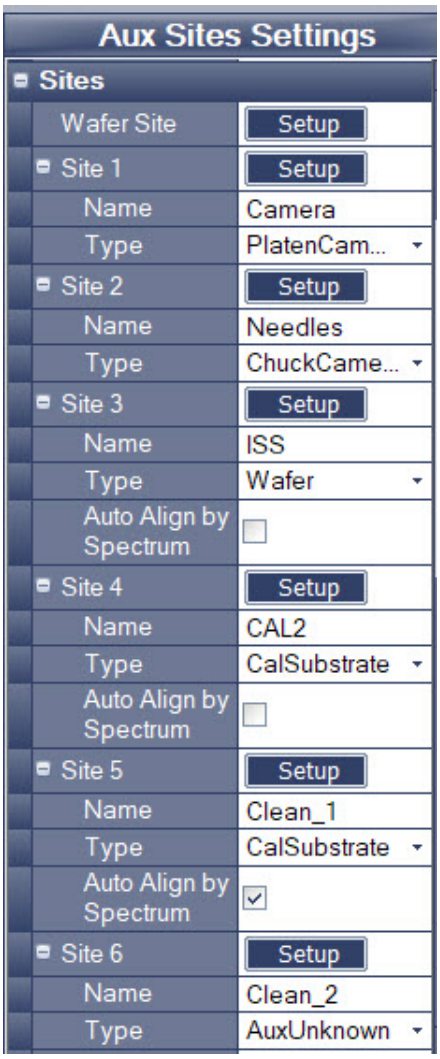
For testing wafers at non-ambient temperatures, use soak times to ensure that the system is thermally stable enough to achieve proper contact quality and stability. For more information about setting soak times, see Thermal Chuck Configuration.

| | |
|---|---|
| Die Soak | When the system moves from one die to another die, it should wait a set die soak time before moving into contact or before measuring the needle/wafer position at the new die. This is because the thermal chuck is positioned differently below the platen and thus causes a change in drifts of platen and probe card.<br>You can use the built-in die soak time when you use WaferMap. The die soak time causes all step commands that cross a die boundary to wait for the specified time. Velox supports both a fixed die soak time and a dynamic die soak time that depends on the temperature difference to ambient (for example, 10s / ΔT). |
| Wafer Soak | After changing the chuck temperature, the system should also be soaked before the wafer test can continue to ensure that the chuck stack, the platen, and the probe card temperature is stable and they no longer significantly drift in XY. The reason for this is that the thermal chuck reaches its new target temperature much quicker than the surrounding objects (probe card, platen) reach a stable temperature. A typical value for the wafer soak is 1.5 minutes per Kelvin change of temperature.<br>Velox provides a fixed wafer soak (for example, 1h) and a dynamic wafer soak (for example, 1.5 minutes / ΔT). Both can be used concurrently. When using the command HeatChuck or ReAlign ramping, the command is finished when the soak time is done. The wafer soak time starts when the chuck reaches its new target temperature. |

| | |
|---|---|
| Load Soak | When loading a wafer at a non-ambient temperature (for example, through the handling system), the system should also soak before starting the test.<br>The wafer itself must reach the temperature of the chuck. This should happen quickly due to the thermal mass of the wafer, but the chuck and probe card also must be soaked again as the thermal chuck is moved away for several minutes during the wafer load operation.<br>Because Velox does not have a built-in load soak time, a test executive must implement a load soak time. A typical load soak time is 15 minutes. |
| Cleaning Soak | Since probe cleaning moves the chuck away from the probe card and causes the tips to cool down/heat up, the probe card must be soaked before the test can continue.<br>Velox has no built-in cleaning soak time, so you can either rely on the die soak that occurs after going to the next die, or have the test executive wait some time after cleaning and then move the chuck back to separation on the wafer. |
| Post ReAlign Soak | During ReAlign, the chuck is away from the probe card most of the time and the needles drift due to the temperature change. Therefore, the system should be soaked after ReAlign runs. Velox has no built-in soak time after ReAlign, so you can have the test executive implement a soak time of 5-10 minutes. |

## ReAlign and Aux Sites

Before you use the ReAlign tool, you must configure the probe station with two fixed aux sites for training and execution of ReAlign. These are required because the chuck camera and platen camera are outside of the allowed movement range of the wafer site (Aux Site 0). You cannot remove or reconfigure these sites. You can define additional aux sites, as needed.




Aux Site 1 and Site 2 are pre configured by default:

Site 1 – Configured with the Type PlatenCamera; used when synchronizing the platen and the chuck camera.

Site 2 – Configured with the type ChuckCamera; used when looking at the probe tips using the chuck camera.

When training and executing ReAlign, the software handles movement between these two pre configured aux sites.

For cleaning, contact verification, and calibration, you can use the ReAlign aux site alignment functionality. It is very similar to the On-Axis AlignAux tool; you can train alignment marks and focus heights for these sites, which enables cleaning at hot temperatures by automatically correcting for XYZ drifts of aux chucks and probe tips.

In Off-Axis alignment mode, training is integrated into ControlCenter. To compensate for thermal drift on the aux site, a test executive must call AlignAuxOffAxis after running ReAlign.

# ReAlign Settings in the Explorer Window

Config Data

Project Data

Probe Card Data

You can access all settings related to the ReAlign tool in the Spectrum Explorer window. ReAlign also uses light settings, global settings and objective settings.

## Config Data

Specify settings for ReAlign ConfigData in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| HeightConstant | A machine constant that is used to calculate the Contact Height.<br>You can adjust this parameter if the Contact Height calculation is consistently incorrect. If the Contact Height of a single project is not sufficient, use overtravel (see Edit Overtravel). | write | none |
| UseZProfile | Enables the Z-Profiling step in ReAlign training and execution. This step measures and compensates the wafer planarity.<br>Use Z-Profiling if you expect wafer planarity to have contact quality issues. Alternatively, you can measure the height for each die when using ReAlign at Die.<br>Combining ReAlign at Die and Z-Profiling makes sense only for large dies where the contact height varies significantly within a die. | write | none |
| AlignProbeCard | Defines the default action for re-measuring the probe card location when doing a ReAlign at Die. The default parameters of the `ReAlign 2 C` command use AlignProbeCard as configured in the Explorer window. You can also use the command to override AlignProbeCard. | write | none |
| CorrectZ | Defines the default action for re-measuring the contact height when you run ReAlign at Die. The default parameters of the `ReAlign 2 C` command use CorrectZ as configured in the Explorer window. Alternatively, you can use the command to override CorrectZ. | write | none |
| RefErrComp | Uses the refraction compensation to compensate consistent XYZ offsets at specific temperatures. The values must be determined empirically by analyzing the touchdown locations of several ReAlign executions at lower and higher temperatures. For example, you could use RefErrComp if the scrub marks at ambient temperature are good, but are too big at hot temperatures and too small at cold temperatures. | write | none |
| SynchronizeCamera | | | |

| | | | |
|---|---|---|---|
| LightSettings | Defines the light for the platen camera when synchronizing the platen camera and the chuck camera. See Camera and Light Settings for details. | write | none |
| FocusParameters | Used for the focus search on the synchronization cross, these parameters include the focus method, focus algorithm, range, and lower threshold. | write | none |
| XYCalibration | A machine constant that is used to calculate the home position for the probe-to-pad alignment. You can adjust this parameter if the scrub marks are repeatedly offset from where the overlay image was placed. | write | none |
| AuxSiteAlignment | This data is used to perform an off-axis aux site alignment for cleaning and calibration sites. See AuxSites below for details. | | none |
| **AuxSites** | Lists each available aux site. | | |
| FocusParameters | Used for the focus search on the synchronization cross, these parameters include the focus method, focus algorithm, range, and lower threshold. | write | read |
| AuxMark | The alignment mark and all the data necessary to perform the aux site alignment for a single site. | write | write |
| Model | The pattern used for detecting the XY position of the aux site. | write | write |
| MatchScore | The smallest score a match can have to be considered valid. | write | write |
| ColorPlane | Color is used for the model image acquisition (white, red, green, blue). | write | none |
| MinAngle | Minimum value for the rotational degree of freedom for pattern recognition. | write | none |
| MaxAngle | Maximum value for the rotational degree of freedom for pattern recognition. | write | none |
| ChuckPosition | Fixed chuck position for home alignment. | write | none |
| ChuckContact | Calculated contact height. | read | read |

## Project Data

To specify settings for ReAlign ProjectData, click ReAlign in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| UseBumpHeight | Enables use of a Z offset between the measured wafer height and the actual bump height in microns. Use when testing on micro bumps. | write | none |
| HomeReferenceModel (Wafer Alignment type) | Defines the wafer pattern used for the probe to pad alignment. Normally the pattern trained during AlignWafer is reused, so you do not need to train this pattern separately. | write | none |
| WaferFocusParams | Used for the focus search on the wafer surface. See FocusParameters for details. | write | none |
| WaferThickness | Defines the thickness of the wafer so that the tool can calculate the rough focus height as sync height + sync-chuck gap + wafer thickness. | write | write |
| AlignmentType | Specifies the type of substrate alignment for your application (Wafer, SingleDie, or Manual). | write | write |
| SoakHeight | Chuck Z height used for temperature transition soak. | write | write |

| | | | |
|---|---|---|---|
| WaferAlignment | (Visible only when AlignmentType is Wafer.)<br>Used for the wafer alignment functionality. The parameters behave the same as the AutoAlign tool settings. | write | write |
| AlignDirection | Specify Horizontal or Vertical. | write | write |
| WaferDiameter | Enter the wafer diameter to reduce auto alignment time. If value is equal to zero, the maximum achievable diameter is used (probe station-specific). | write | none |
| PreAlign | Before starting alignment, sets an initial theta correction based on the features in the region of interest. | write | none |
| ChuckPosition | Fixed chuck position to start alignment. | write | none |
| Model | Selects the model for the alignment procedure and temporarily stores the pattern. Changed parameters are stored in a project file. See Cognex Models for more information. | write | write |
| ChipAlignment | (Visible only when Alignment Type is SingleDie.)<br>You must set up the model for each point. | write | none |
| Point1 | First point for wafer alignment. | write | none |
| Model1 | First model used for chip alignment (alternative models are possible). Modify settings as needed. | write | none |
| Point2 | Second point for wafer alignment. | write | none |

## Probe Card Data

To specify settings for ReAlign ProbeCardData, click ReAlign in the Spectrum Explorer window, Tools folder. Refer to the following table for setting descriptions and access-level requirements.

| Setting | Description | Admin Access | Engineer Access |
|---|---|---|---|
| NeedleFocusParams | Used for the focus search on the probe card. | write | write |
| ProbeCardType | Specifies the type of the probe card that is used (vertical, cantilever or pyramid).<br>• Vertical style cards – The probe card tool prompts you to train a pattern of one needle.<br>• Cantilever style cards – The tool uses the blob model search.<br>• Pyramid style cards – The prompts you to train a reference pattern instead of a single needle instance. | write | write |
| FocusLightFactor | Used with cantilever type probe cards. The focus search is done using a search for the brightest state of the probe tips.<br>For the XY search, the light should be set up so that the needle tips are clearly visible and have a good contrast to the background.<br>For the focus operation, you can use this factor to reduce the light. This multiplies the configured Shutter and Gain to set a focus light, which is darker, to avoid large plateaus that negatively affect the needle focus accuracy. | write | none |
| ProbeCardModel | The trained pattern of the probe card and the position of the needles. | write | none |

| | | | |
|---|---|---|---|
| Position1 | The first trained XYZ location of the probe card, which is used to calculate the home and contact position. This position is automatically updated when you run ReAlign. | write | none |
| Position *n* | The next trained XYZ location of the probe card. This position is not used for home or contact calculation, but it is needed to identify the probe card. | write | none |
| Model1 | The trained instance of the first needle group with the location of all selected probe tips and the trained pattern/blob of a single needle. | write | none |
| NeedleModel | Relative position of the needle instance from Position1. See Probe Card Model for more information. | write | none |

# Models


Cognex Models

NI Vision Models

Probe Card Model

Training

Pattern Matching


A pattern is a trained geometric description of an object you want to find in run-time images. A model is a saved pattern that has been trained as the ideal search structure that can be unique or found multiple times inside the region of interest.

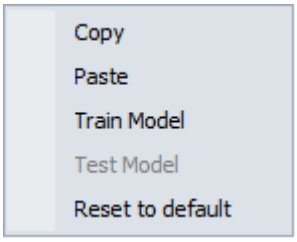
When you search for the model at another wafer position or another time, such as after temperature change, Velox compares the trained pattern with the structure found in the current camera image. When Spectrum finds a pattern, it provides information about the trained pattern position and the found pattern position in the camera image. The difference between the positions can be used to make corrective movements with the chuck or microscope stage.

- Spectrum provides two basic model types (from the Cognex Vision Library): the PatMax Model and . More complex model types in Spectrum include AlignModel (based on PatMax) and PolygonModel, which uses PatMax and Blob. A model can be trained, tested, copied, and pasted, and its values can be reset to default. Blob models also support a histogram.
- A Probe Card Model is based on Cognex Blob or PatMax model and is used to detect probe card needle position shifts at temperatures other than ambient.

Spectrum also supports pattern matching with National Instrument (NI) Vision. See NI Vision Models and NI Vision Blob Model for more information.

To access commands in the table below in the Spectrum Explorer window, click a tool , click AuxSiteAlignment > AuxSites > [aux_site] > AuxMark, and then right-click a model.

- To start a model search, click Test Model.
- To launch the model wizard, click Train Model.




| Command | Description |
|---|---|
| Copy and Paste models | Copies or pastes a mode. Be sure you want to replace an existing mode before you paste; there is no Undo function and all data will be replaced.<br>• Only trained models can be copied.<br>• Models can be pasted only in tools providing the same type of model. |
| Train Model | The model wizard is tool-independent for the specific model type. It trains only model-specific features, like pattern or area. |
| Test Model | Starts the model search on the current image. It can be used to evaluate model parameters. |
| Reset to default | Deletes all trained features of the model and resets all parameters to default values. Be sure you want to reset; there is no Undo and all data will be lost. |
| Show Histogram<br>(blob models only) | Shows the histogram of the current camera image. The histogram displays the gray value and intensity distribution within the model limits. Use the histogram to evaluate Blob model parameters, such as ThresholdPercent. |

See also Set Up and Configure Cameras.

# Cognex Models

PatMax Model

## PatMax Model

Working with a sub-pixelgrid algorithm, a PatMax model trains and stores a rectangular pattern of a given structure. The search compares its pattern features with structure features in the current image.You can rotate, scale, or stretch the structure in the search image. PatMax is tolerant of illumination changes, depending on thresholds that include or exclude search results and parameters:

- ScoreThreshold – includes
- SearchScoreThreshold – excludes

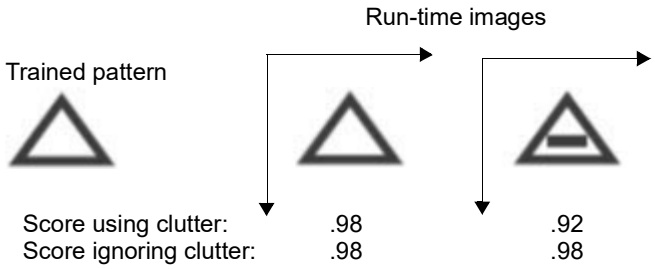
The PatMax algorithm runs with the low SearchScoreThreshold and accepts a number of structures as valid. Next, all results below the ScoreThreshold are discarded. This makes the search more robust than searching directly with ScoreThreshold and increases the reliability of the model search.

AlignModel sets the appending chuck and microscope distance to a trained position. Search uses this to bring the model structure into view. It also provides an extended search using the ExtentionFactor of RegionOfInterest parameter.

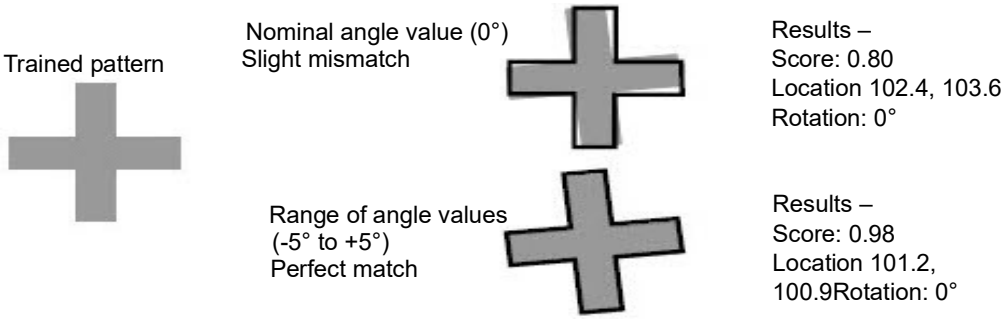
Some vision tools provide alternative models at different chuck or microscope positions. In this case, a parameter called ModelContainer is provided. You can train up to three models in different positions with varying patterns. This feature improves the reliability of the system when the first model cannot be found at its location. The chuck or microscope is moved to the location of the second model, and the model search is performed there.

| Model | |
|---|---|
| ColorPlane | White |
| ScoreThreshold | 0.750 |
| SearchScoreThreshold | 0.600 |
| ContrastThreshold | 10.000 |
| UseClutter | ☐ |
| IgnorePolarity | ☐ |
| MinAngle | -5.000 |
| MaxAngle | 5.000 |
| MinScale | 1.000 |
| MaxScale | 1.000 |
| AutoSelectGrainLimits | ☑ |
| CoarseGranularity | 4.000 |
| FineGranularity | 1.000 |
| Elasticity | 0.000 |
| UseHighSensitivity | ☐ |

| Setting | Default | Min. | Max. | Description |
|---|---|---|---|---|
| ScoreThreshold | 0.75 | 0 | 1.0 | Found patterns that receive scores greater than or equal to this value are accepted. Use ScoreThreshold to sort results after you use the PatMax search algorithm. |
| SearchScore Threshold | 0.6 | 0 | 1.0 | This is the ScoreThreshold given to the Patmax search algorithm. To reduce the time required to perform a search increase the value of SearchScoreThreshold. |
| ContrastThreshold | 10 | 0 | 255 | PatMax considers patterns where the average difference in pixel values across all feature boundaries exceeds the ContrastThreshold value.<br>The Scene Angle Finder tool considers only pixels in the edge angle image that correspond to edge magnitudes greater than your specified threshold. |
| UseClutter | disabled | disabled | enabled | Set to enabled to consider extraneous features (clutter) when computing the score of a pattern instance. |




| | | | | |
|---|---|---|---|---|
| MinAngle | 0 | -180 | 0 | Minimum value for the rotational degree of freedom for pattern recognition. |
| MaxAngle | 0 | 0 | 180 | Maximum value for the rotational degree of freedom for pattern recognition. |




Entering nonzero values enables the rotational degree of freedom during the PatMax search. If the rotational degree of freedom is enabled, PatMax will find pattern instances that are rotated and return the angle of the found pattern instance.

If MinAngle=MaxAngle, the angular degree of freedom is deactivated. Due to the limited theta movement range of the probe station, the recommended values are between –5 and +5 degrees.

| | | | | |
|---|---|---|---|---|
| MinScale | 1.00 | 0.10 | 1.00 | Minimum value for the scale degree of freedom for pattern recognition. |

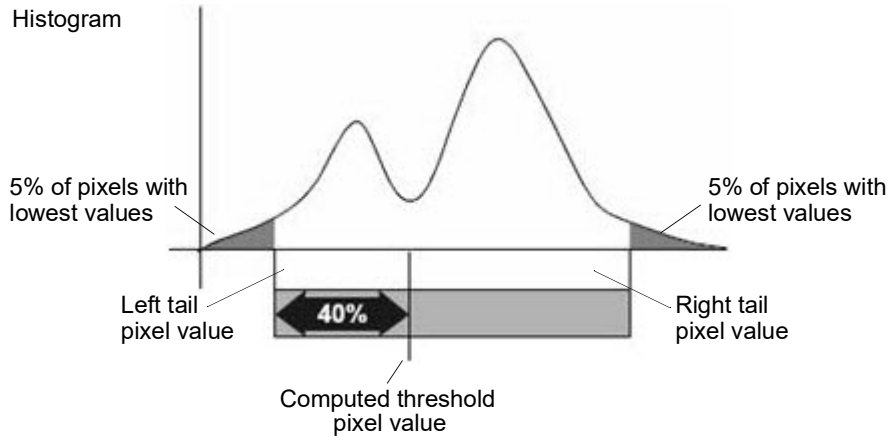
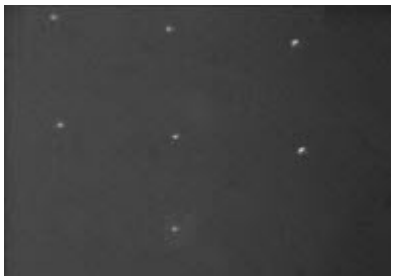
| | | | | |
|---|---|---|---|---|
| MaxScale | 1.00 | 0.10 | 1.00 | Maximum value for the scale degree of freedom for pattern recognition. |
| Entering nonzero values enables the scale degree of freedom during PatMax search. If the scale degree of freedom is enabled, PatMax will find pattern instances that are slightly scaled without lower score and return the scale value of the found pattern instance. | | | | |
| Granularity | Granularity is expressed as the radius of interest, in pixels, within which features are detected. Grain limits use large features to perform the initial coarse scan of the image, and uses small features to determine the precise location of the model. | | | |
| AutoSelectGrain Limits | enabled | disabled | enabled | If enabled, PatMax automatically selects the granularity limits at training time. If disabled, PatMax uses granularity limits you specify. |
| CoarseGranularity | 4.0 | 1.0 | 25.5 | Set the coarse granularity limit used for feature detection during pattern training. |
| FineGranularity | 1.0 | 1.0 | 25.5 | Set the fine granularity limit used for feature detection during pattern training. FineGranularity must be a smaller value than CoarseGranularity. |
| Elasticity | 0 | 0 | >10 | The elasticity value is the amount of feature variance, in pixels. Setting a nonzero value forces PatMax to find pattern instances with nonlinear geometric variation. |
| HighSensitivity | disabled | enabled | disabled | High sensitivity mode improves performance for noisy images or patterns with extremely low contrast, but will require more training and execution time.<br>If enabled, high sensitivity mode is enabled.<br>If disabled, the default standard or 'normal' mode is operational. |
| Sensitivity | 2.0 | 1.0 | 10.0 | Increase the sensitivity value to make PatMax less sensitive to random noise. Sensitivity value is best between 2.0 and 5.0. The higher the value, the longer the processing time. |
| ChuckOffset | 0 | * | * | The chuck offset in microns (set during tool training). |
| ScopeOffset | 0 | * | * | The microscope offset in microns (set during tool training). |

## Cognex Blob Model

A blob model requires a high contrast image and objects with a closed shape. It includes a circular area in which grayscale values are binarized with the ThresholdPercent parameter.This threshold tells the model which pixel is counted as white or black pixel. Based on this data, objects can be recognized in the search image. The blob model does not tolerate size changes of objects to be found. The blob model is able to handle non-circular objects with Min/MaxAcircularity parameters.

| NeedleModel | |
|---|---|
| MountPosition | Chuck |
| SubCameraSite | 0 |
| BlobColor | White |
| ThresholdPercent | 20 |
| LowTailPercent | 0 |
| HighTailPercent | 0 |
| MinArea | 5 |
| MaxArea | 1000 |
| SetAcircularityFilter | ☐ |
| UseMorphing | ☑ |
| MinAcircularity | 0.200 |
| MaxAcircularity | 2.500 |
| Range | 0.200 |
| Coverage | 0.600 |
| Position | Undefined |

| Setting | Default | Min. | Max. | Description |
|---|---|---|---|---|
| BlobColor | White | White | Black | Defines whether white or black objects shall be found. |
| ThresholdPercent | 50 | 0 | 100 | Threshold to take a pixel value as either object or background. |
| LowTailPercent | 0 | 0 | 100 | Percentage of pixels that are low (left) tail pixels; these have the lowest pixel values. |
| HighTailPercent | 0 | 0 | 100 | Percentage of pixels that are high (right) tail pixels; these have the highest pixel values. |
| MinArea | -1 | 0 | | Minimum number of connected pixels interpreted as one object. |
| MaxArea | -1 | 0 | | Maximum number of connected pixels interpreted as one object. |
| SetAcircularity Filter | enabled | enabled | disabled | Use the Acircularity filter. |
| UseMorphing | | | | |
| MinAcircularity | 0.2 | | | Minimum value for a non-circular object. |
| MaxAcircularity | 1.5 | | | Maximum value for a non-circular object. |

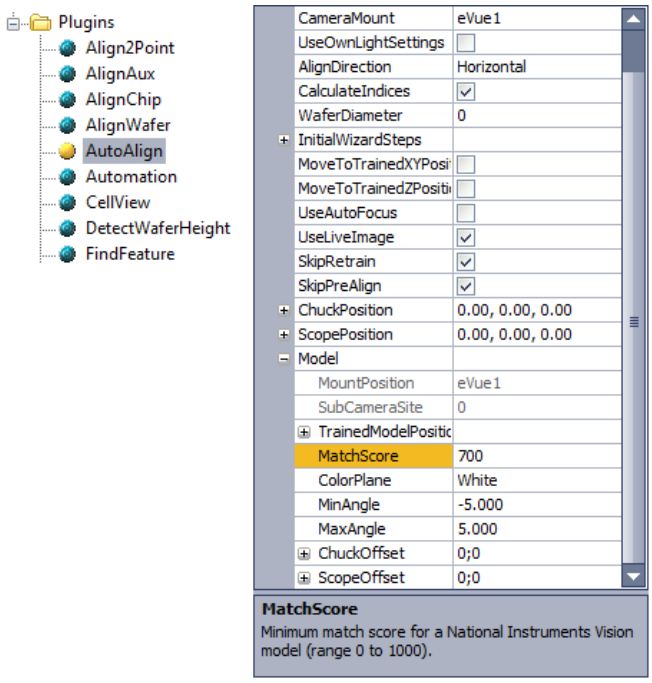
| | |
|---|---|
| **Tail Percent and Threshold Percent** |  <br>Example –<br>LowTailPercent and HighTailPercent = 5%<br>ThresholdPercent = 40%<br>The computed threshold pixel value (between 0 and 255) depends on the relation of background-to-object pixel values. |
| **Training** | For best results, observe the following guidelines when you select a training image:<br>• Use a high-contrast image.<br>• Select objects that have distinct gray values that are different than the background.<br>• Select a training image that is free of noise.<br>Both of the images below are good images.<br> <br>Background is clearly different from blobs<br>  <br>Background could be more black |
| **Searching the Model** | Before you start the model search, place the structure inside the region of interest (ROI) either manually (move the chuck and/or microscope) or by executing the search tool. Then, run the blob algorithm inside the ROI. It makes no pattern comparison; it looks for all grayscale objects that meet the given parameters, such as BlobColor, ThresholdPercent, Min/MaxArea, and Acircularity.<br>**NOTE**<br>*It is very important to have the same illumination conditions as used for training.*<br>After a successful search, the mass center of each found object is returned and can be used for further calculations. |

# NI Vision Models

NI Vision Blob Model

The National Instruments (NI) Vision Assistant is used when you set up your system for NI Vision pattern matching and blob models. NI Vision uses MatchScore, ColorPlane, and rotation angle for pattern matching.

In the Spectrum Explorer window, Tools folder, click AutoAlign.




| Setting | Default | Min. | Max. | Description |
|---|---|---|---|---|
| MatchScore | 700 | 0 | 1000 | The smallest score a match can have to be considered valid. |
| ColorPlane | | | | The color used for the model image acquisition (white, red, green, blue). |
| MinAngle | 0 | -180 | 0 | Minimum value for the rotational degree of freedom for pattern recognition. |
| MaxAngle | 0 | 0 | 180 | Maximum value for the rotational degree of freedom for pattern recognition. |
| ChuckOffset | 0 | * | * | The chuck offset in microns; set during tool training. |
| ScopeOffset | 0 | * | * | The microscope offset in microns; set during tool training. |

## NI Vision Blob Model

NI Vision blob model parameters include:

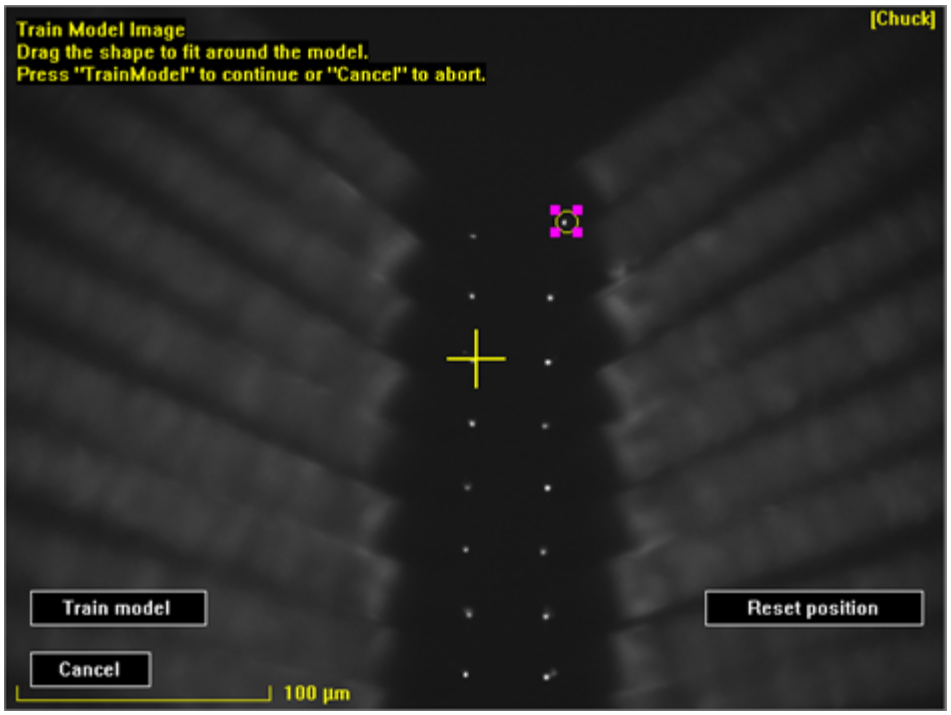
- Background Correction searches for bright objects with a radius less than or equal to the radius of the training circle.

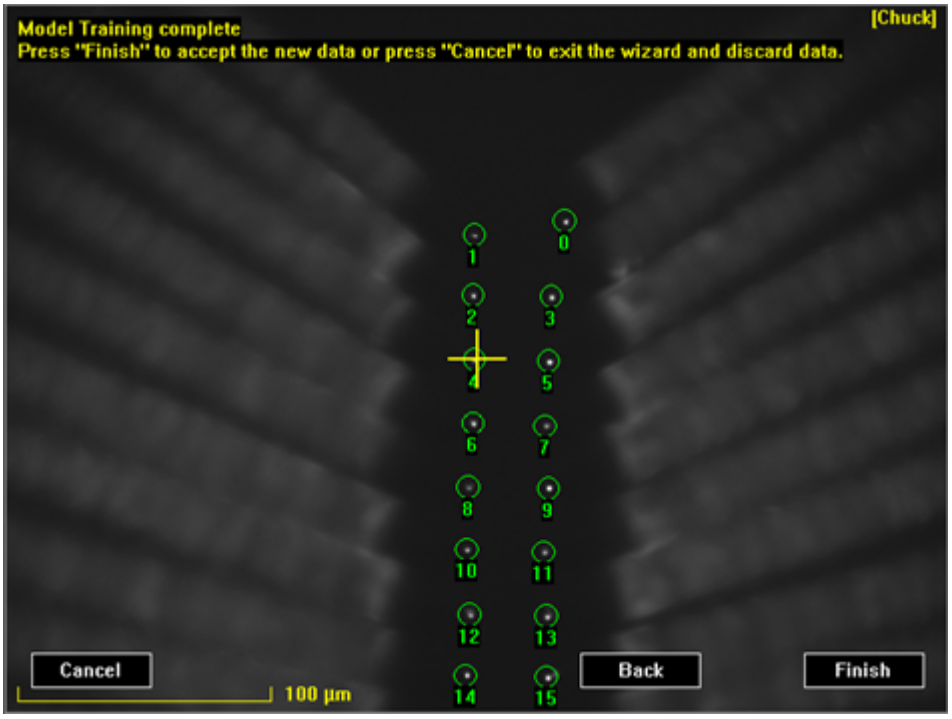
- Circle Detection is performed to detect circles with a radius less than or equal to the radius of the training circle.

NI Vision uses the Otsu threshold algorithm to calculate binary threshold. The Otsu method involves iterating through all possible threshold values and calculating a measure of spread for the pixel levels on each side of the threshold (the pixels that fall in either the foreground or the background).

| NeedleModel | |
|---|---|
| MountPosition | Chuck |
| SubCameraSite | 0 |
| IsTrained | ☑ |
| ⊞ TrainedModelPosition | |
| BlobColor | White |

| Name | Default | Min. | Max. | Description |
|---|---|---|---|---|
| IsTrained | | | | |
| TrainedModelPosition | | | | |
| BlobColor | White | White | Black | Defines whether white or black objects shall be found. |






| NeedleModel Parameters | Description |
|---|---|
| TrainingCircleRadius | Training circle radius (µm). Set when blob training is performed. You can adjust it manually in the Spectrum Explorer window after the initial training, or use the wizard to retrain. |
| MaxRadius | Maximum blob radius (µm). Set when blob training is performed, and adjustable thereafter (µm). |
| MinRadius | Minimum blob radius (µm). Set when blob training is performed, and adjustable thereafter. |
| KernelSizeMultiplier | Size of the neighborhood around each pixel used to compute the mean value in the interclass variance thresholding algorithm. Increase this parameter as necessary to eliminate false positives on blobs in extremely close proximity to one another. (Default 700%.) |

## Probe Card Model

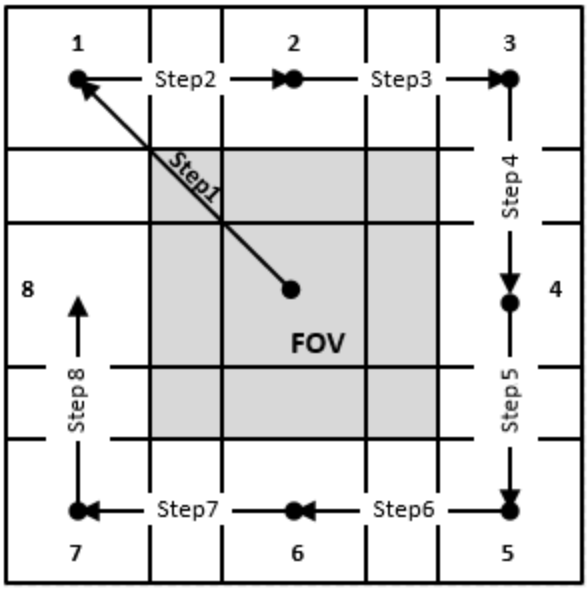
A Probe Card model is a special kind of a model. All single items (points) of this complex model are based on blob or PatMax models. This type of model is mainly used to detect probe card needle position shifts at temperatures other than ambient. This type of model is mainly used to detect probe card needle position shifts at temperatures other than ambient.

During training, the positions of all selected instances are saved. The model is searched by recognizing all single items in the region of interest (ROI). A point-matching algorithm is used within all found models. The size of the found probe card is compared to the trained one.

| Setting | Position | Description |
|---|---|---|
| ProbeCardModel | 0;0 | Physical dimension (the two outermost trained needles) of the probe card. |
| Position1 | 0;0;0 | Position of the first needle group. |

| | | |
|---|---|---|
| Position *n* | 0;0;0 | Position of the nth needle group. |
| Model1: Needle 1…x | 0;0 | Relative position of the needle instance from Position1. |
| NeedleModel | | The PatMax or blob model used to train and search single models of the polygon.<br>See NeedleModel Parameters for details. |
| Range | 0.2 | Range factor (0.0 – 0.5) is the area in which the PointMatcher tool must search for matching needles. The factor is used with NeedlePitch.<br>Distance = Range * NeedlePitch |
| AutoGridSize | | Uses automatic grid size calculation for PointMatcher. |
| ColorAvgFilter | | Filters the blobs before running the point matcher. |
| Coverage | | Percent of needles to be found (0.0 to 1). |
| Position | | Position of the needle group. |

ProbeCard model searching always starts at Position1. At this position, an ExtendedFind is started.




At each step, you can perform a PreFocus scan before the tool searches for an instance of the first needle group.

If the first group was detected, the tool performs a relative movement to the second needle group position (Position2) and tries to locate an instance of the second needle group.

After an instance of the second group is found, the tool checks the size of the found probe card instance with the trained one and updates the positions.

# Training

Search the Model

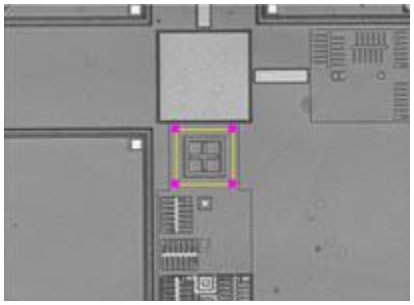
Extended Region of Interest

Avoid including features in the training image that will not be present in the search image. Training a pattern from a pattern training image requires that the image has distinguishable features. A model can be trained with its own tool or with the Start Model wizard.

For best results, observe the following guidelines when you select a training image:

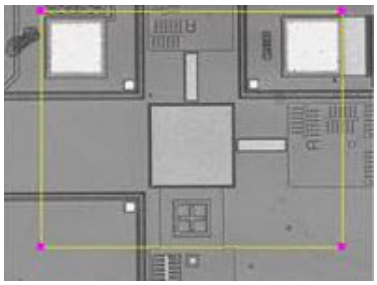
- Training image is free of noise.
- Model size is as large as possible.
- Horizontal and vertical features that are relevant (makes the search fast and reliable).
- The pattern location is near the center of the region of interest (ROI) to compensate for prealigner deviations. Ensure the pattern is inside the field of view (FOV).

**Good model sample**

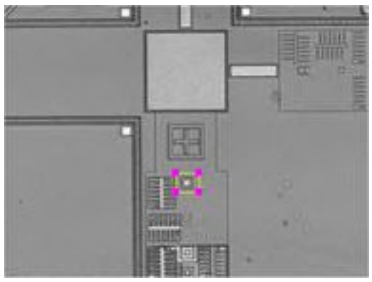


This model sample is unique, centered, and has many features in the FOV

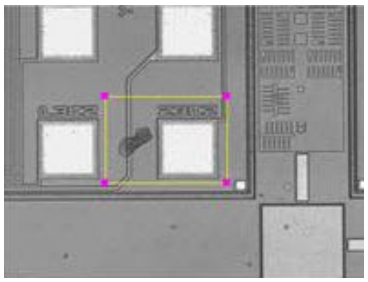
**Bad model samples**



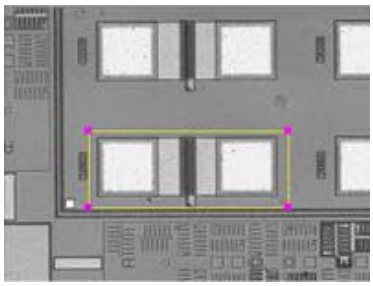
Training image is too large



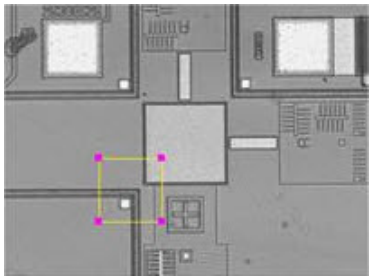
Training image is too small and has too few features



Training image contains noise



Two instances of the pattern in the field of view



Three possible instances and the pattern is not centered

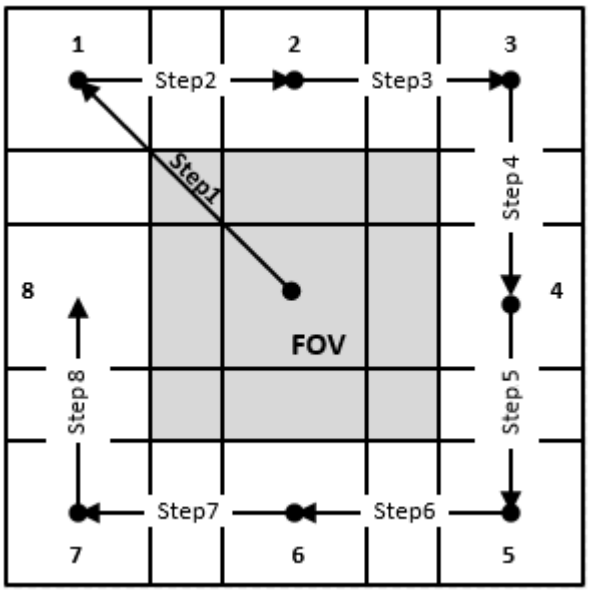
## Search the Model

Before you start the model search, place the structure inside the region of interest (ROI) either manually (move the chuck and/or microscope) or by executing the search tool. The trained pattern and the structure in the ROI are compared. The search result is influenced mainly by the SearchScore parameter. If the search structure is rotated or stretched in comparison to the trained image, also use the Min/Max Angle and Min/Max Scale parameters. For instance, AlignWafer tool model works with a Min/MaxAngle of ±5 degrees by default.

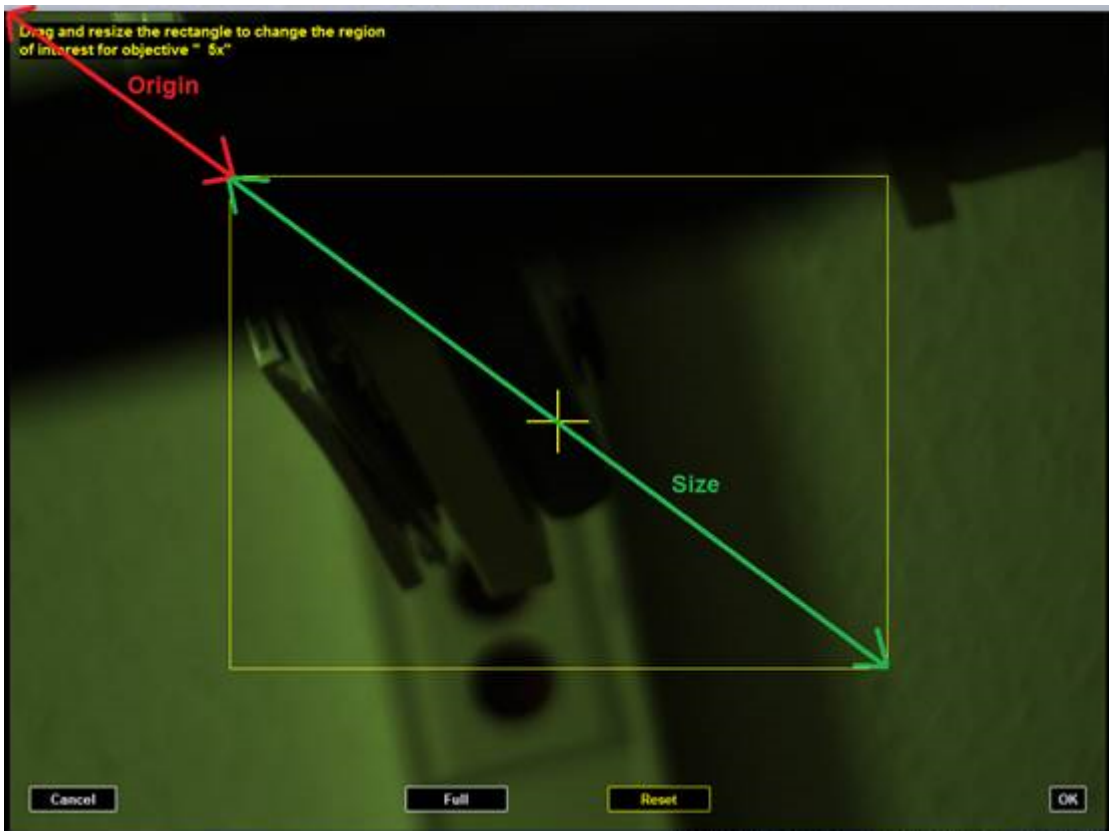
After a successful search, the model returns the offset between its trained position and the position of the found structure.

## Extended Region of Interest

A special feature of AlignModel is the extended search, which improves system reliability. If the ideal model could not be found at its position, the chuck steps in circles around the first search position until the ideal model is found or until it reaches the maximum size of the extended region of interest (ROI). Step size is calculated so that each new ROI overlaps the previous one by the size of the model to ensure that the model is not missed due to overlapped images.

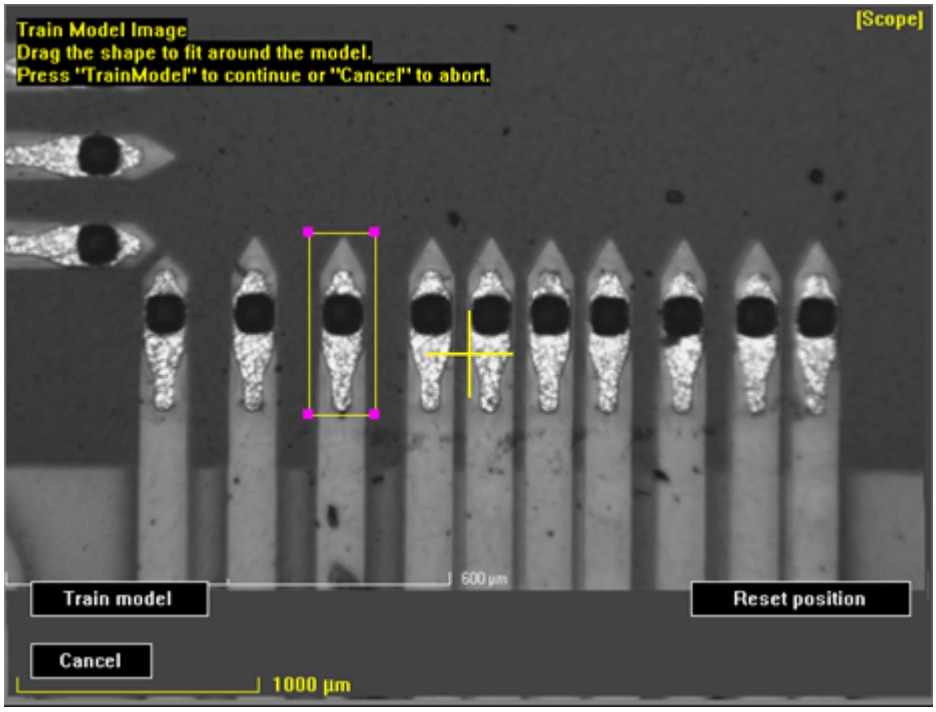


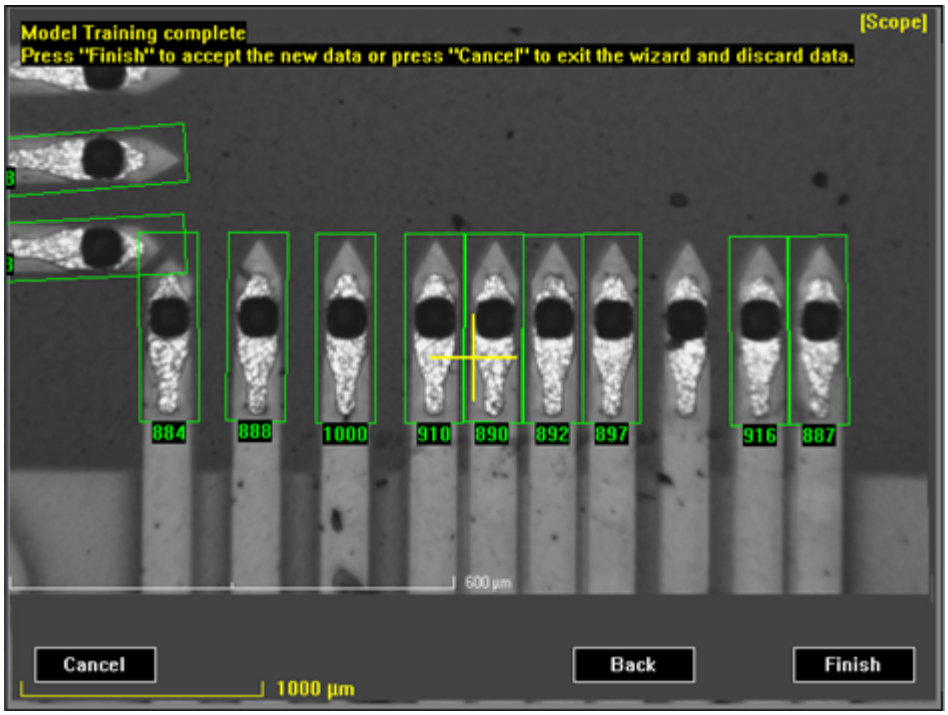

The extended search uses the pattern size to calculate the correct move distance. Compared to a small pattern, a very large model displays a large overlap when stepping around.



## Pattern Matching

A search places the match score at the bottom of the match rectangle.



Chapter

# 5 Automation

You can configure the Automation tool using AutoXY, AutoZ, VueTrack, and AutoRF.

- AutoXY is for adjusting wafer touchdown position based on a vision model during StepNextDie operations.
- AutoZ is for dynamically adjusting the Z contact position of the wafer during StepNextDie operations.
- VueTrack (available as a purchased option) is for training needles You cannot run VueTrack without AutoXY and Z.
- VueTrackPro (available as a purchased option) is used to set up and operate motorized positioners for Unattended Test at Multiple Temperatures with DC probes. You can also use ScrubAlign to define pad boundaries. See Scrub Mark Alignment Wizard for details.
- AutoRF (available as a purchased item) can be used to setup RF measurements for Unattended RF Test at Multiple Temperatures.

These combinations are valid:

- AutoXY
- AutoXY, AutoZ
- AutoZ
- AutoXY, AutoZ, VueTrack
- AutoXY, AutoZ, VueTrack, AutoRF

With a special hardware setup, Automation supports an option that enables finding needle locations and wafer targets across multiple tiles. See Configure Automation for Multiple Sites for more information.

The Automation tool allows use of the same target for AutoXY and AutoZ when training. Alternatively, you can set the wizard to perform AutoXY and AutoZ on different wizard steps if you need to use a different magnification for AutoXY and AutoZ targets. The AutoZ target must still be in the same field of view as AutoXY, but it can be on a different imager. CombineAutoXYZ is enabled by default.

# Automation Setup

Project Data Settings

Automation Wizard

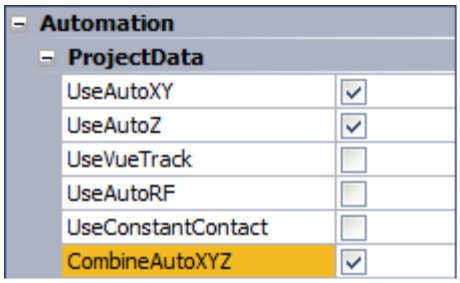
Scrub Mark Alignment Wizard

Configure Motorized Positioners with VueTrackPro

Configure Automation for Multiple Sites

You can set up Automation to your specifications in the ProjectData settings, using the Automation wizard and the Scrub Mark Alignment wizard, and configuring motorized positioners and automation for multiple sites.

# Project Data Settings




Before you run the Automation Setup, you must set the home position and contact height. Use the stage and scope to find good targets for wafer pattern and auto focus location. If you start your die step at contact, when Automation runs, it will return to contact.

In the Spectrum Explorer window, Tools folder, click Automation. Refer to the following table for setting descriptions.

| Setting | Description |
|---|---|
| UseAutoXY | Corrects for minor errors in XY stage movement by looking for a repeating target on the wafer and adjusting the chuck XY position based upon any difference in actual versus expected location. |
| UseAutoZ | Adjusts for variations in the height of the wafer as temperature changes cause growth or shrinkage of the chuck and device material. |
| UseVueTrack | Uses the VueTrack function for probe tip tracking. (Requires VueTrack license.) |
| UseConstantContact | Uses AutoXY/AutoZ trained targets to make adjustments when Constant Contact mode is active.<br>Customizes the automation wizard for Constant Contact Mode, including limitations when training AutoXY(Z). When UseConstantContact is enabled, UseAutoXY and UseAutoZ are also enabled. |
| UseAutoRF | Uses automated RF operations during die stepping and thermal transitions. |
| CombineAutoXYZ | Uses the same model for both AutoXY and AutoZ. |

| | |
|---|---|
| AutoLightSwitching | Enables the automatic control of light switching for AutoXY/AutoZ. If enabled:<br>• DelayAfterLightOn — Sets the wait time after turning light on before performing vision functions.<br>• DelayAfterLightOff — Sets the wait time after turning light off before vision function is deemed complete. |
| SubsiteVisionAdjust | Defines whether automation uses vision to search and adjust when subsite stepping.<br>If enabled, every die/subsite is adjusted.<br>If disabled, only die moves are adjusted, not subsite. Only die moves trigger thermal soak. |
| SoakHeight | Sets the chuck Z height used during automation soak. Possible values are Align or Separate. |

## AutoXY

To access the AutoXY settings, in Spectrum Explorer window, Tools folder, click Automation and then select the AutoXY check box. Refer to the following table for AutoXY setting descriptions.

| Setting | Description |
|---|---|
| AutoXY | Spectrum data items used for AutoXY setup. |
| ChuckData | Chuck model information used for wafer-trained target. |
| ScopeReference | ScopeReference contains the XYZ coordinates of the motorized microscope bridge when the chuck target is trained. This value is not visible for systems without a motorized scope. The values are in the Zero position reference. |
| LightSettings | See Camera and Light Settings for details. |
| ChuckData | Pattern for the trained target. |
| MatchScore | MatchScore is the smallest score a match can have to be considered valid. |
| ColorPlane | Color used for the model image acquisition (white, red, green, blue). |
| MinAngle | Minimum value for the rotational degree of freedom for pattern recognition. |
| MaxAngle | Maximum value for the rotational degree of freedom for pattern recognition. |
| AutoXYModelMatchScore | Match score that is used for AutoXY models (0.0 to 1.0). |

## AutoZ

To access the AutoZ settings, in Spectrum Explorer window, Tools folder, click Automation and then select the AutoZ check box. Refer to the following table for AutoZ setting descriptions.

| Setting | Description |
|---|---|
| AutoZ | Spectrum data items used for AutoZ. |
| AutoZData | |
| LastZOffset | The last calculated Z offset distance for the wafer target. Read only. |
| GuardBand | Tolerable amount of error between auto-focus operations to prevent damaging probes during AutoFocus. |
| FocusParameters | Parameters used for search needle tip Z locations. See FocusParameters for details. |

## VueTrack

To access the VueTrack settings, in Spectrum Explorer window, Tools folder, click Automation and then select the VueTrack check box. Refer to the following table for VueTrack setting descriptions.

| Setting | Description |
|---|---|
| VueTrack | Spectrum data items used for VueTrack setup. |
| PadSizeX | Probe card pad size (X). |
| PadSizeY | Probe card pad size (Y). |
| TipSize | Probe card tip size (XY). |
| TipMaxDeltaZ | Probe tip max delta Z. |
| UseFiducialTarget | Use a fiducial target instead of the probe needles for establishing XYZ offsets. |
| ChuckDistanceFromSeparation | Chuck separation gap during Automation needle search in addition to separation gap in Control Center. Used to reduce illumination variability from wafer reflections. |
| ProbeModelMatchScore | Threshold used in needle focus curve to identify focus peak. |
| UseScrubMarkAlign | When selected, enables the Scrub Mark Alignment wizard steps during Automation training. These steps are performed before probe needle training. |
| FocusParameters | Parameters used for search needle tip Z locations. |
| VueTrackFeatures | Needle tip training data used by VueTrack. |
| NeedleCount | Total number of trained needles. Read only. |

## ConstantContact

ConstantContact mode is always active and you cannot change it, but you can change ConstantContact settings.

To access the ConstantContact settings, in Spectrum Explorer window, Tools folder, click Automation and then select the ConstantContact check box. Refer to the following table for ConstantContact setting descriptions.

| Setting | Description |
|---|---|
| ModelsActive | ModelsActive mode is on when enabled. |
| UpdateIntervalAtContact | Interval for readjusting the chuck position when at contact. Range is 1-3600. Default is 15 seconds. |
| UpdateIntervalAtSeparati on | Interval for readjusting the chuck position when at separate height. Range is 1-7200. Default is 300 seconds. |
| XYChangeLimitAtContact | Maximum X or Y correction (in microns) allowed during each interval at contact. Range is 1-5000. Default is 10 µm. |
| ZChangeLimitAtContact | Maximum Z correction (in microns) allowed during each interval. Range is 1-5000. Default is 15 µm. |

### Constant Contact Mode

In Constant Contact mode, you can perform testing with continuous probe tip contact across a temperature range and keep a specific wafer feature in the same position, relative to the scope, while the chuck is at contact or separation. Due to thermal expansion and contraction of materials

when temperature varies, periodic corrections to chuck position in three dimensions are required so that you can continuously acquire data during temperature transitions.

To activate Constant Contact mode, enable UseAutoXY, UseAutoZ, and UseConstantContact, and initiate Automation training.

While the mode is active, it periodically measures the current chuck XYZ offset and adjusts the chuck position. Constant Contact mode does not measure and adjust for changes in the probe tip position relative to the wafer.

Your test control logic is responsible for commanding thermal changes, such as HeatChuck, and waiting for thermal stability as required by the test you are performing. Constant Contact mode is responsible only for correcting the chuck XYZ position during these transitions.

To use Constant Contact mode on multiple wafers, the VueTrackAlign command is required when aligning a new wafer so that Automation knows about the wafer alignment. While the mode is active, any chuck move other than a Constant Contact correction disables the mode.

For test scenarios where a thermal transition occurs at separation followed by a thermal transition that occurs at contact, Constant Contact mode should be disabled before moving the chuck between separation and contact and then re-enabled.

## AutoRF

To access the AutoRF settings, in Spectrum Explorer window, Tools folder, click Automation and then select the AutoRF check box. Refer to the following table for AutoRF setting descriptions.

| Setting | Description |
|---|---|
| AutoXYISS | Contains information for the chuck model on the ISS (auxiliary chuck). |
| ScopeReference | ScopeReference contains the XYZ coordinates of the motorized microscope bridge when the chuck target is trained. This value is not visible for systems without a motorized scope. The values are in the Zero position reference. |
| LightSettings | See Camera and Light Settings for details. |
| AutoXYISS | The pattern matching model used on the ISS. |
| MatchScore | The smallest score a match can have to be considered valid. |
| ColorPlane | Color used for the model image acquisition (white, red, green, blue). |
| MinAngle | Minimum value for the rotational degree of freedom for pattern recognition. |
| MaxAngle | Maximum value for the rotational degree of freedom for pattern recognition. |
| Sensitivity | To make PatMax less sensitive to random noise, increase the Sensitivity value. The best value is between 2.0 and 5.0. The higher the value, the longer the processing time. |
| AutoZISS | Contains information for the chuck AutoZ focus region at the ISS. |
| LastZOffset | The last calculated Z height offset. |
| GaurdBandRF | Amount of error between auto focus operations on the ISS during AutoRF. |
| AutoCleanProbe | Triggers a cleaning operation prior to RF calibration. |
| CleanSequenceName | Name of the cleaning sequence to use for probe clean. An empty string specifies to use the default cleaning sequence. |
| RetryAttempts | Number of AutoRF sequence attempts to retry on failure. |
| MonitorDieInterval | Number of die steps between calls to WinCal Monitor, incremented with a call to StepFirstDie or StepNextDie. |
| MonitorTimeInterval | Hours between calls to WinCal Monitor, referenced to the last execution of AutoCal or Monitor. |
| StabilityCheckInterval | Number of minutes to wait between RF stability checks. |
| StabilityCheckTimeout | Total number of minutes to wait for stability before a timeout error occurs. |

| | |
|---|---|
| TipSpacingSeparation | Ideal distance between probe tips at separation when aligned to ISS alignment structure. |
| TipSpacingContact | Ideal distance between probe tips in contact when aligned to ISS alignment structure. |
| TipLength | Distance signal probe extends from probe body in field of view (FOV), used for blob analysis. |
| SkateRatio | Distance probe skates across FOV for a given change in Z overtravel. Default is 2; allowable range is 0.5-5.<br>Not visible to Operator- or Engineer-level users. |
| FocusParameters | Parameters used for search needle tip Z locations. |
| ProbeBinaryThreshold | Binary threshold intended to separate probe outline from background in images of ISS alignment structure. |
| ISSBinaryThreshold | Binary threshold intended to separate ISS alignment target from substrate and probes in images of ISS alignment structure. |

# Automation Wizard

The following steps describe the Automation wizard sequence. Start the Automation wizard from the:

- Spectrum Tools menu (click Tools > Automation > Automation).
- Spectrum Explorer window (in the Tools folder, right-click Automation and then click Show Tool Wizard).

When you start the Automation wizard, you can choose to train a new Automation setup or enable a previously-trained setup. New Automation setups must be trained before you use the Automation wizard.

1. Click the Train button to start a new Automation setup.
2. Select one or more training options.

   Valid combinations are enforced during selection. When AutoRF is selected, Velox determines if WinCal is running.
3. Click the Next button to move to the home position and perform setup.

   If you are already at the home position, the wizard skips this step.
4. Verify that the contact height is set correctly.

   If the chuck is already at contact, the wizard skips this step.
5. When you are on the home die and have set an initial contact, focus the needle tips and chuck surface in the live video window using the focus block.
6. When the wafer and probe tips are in focus, Click the Next button.
7. If VueTrack is enabled, continue the wizard with the needle training sequence (Train VueTrack).

   If you are using the scrub mark tool, see Scrub Mark Alignment Wizard for a description of the wizard steps. The Scrub Mark wizard returns you to the VueTrack training tasks described in Train VueTrack.
8. If VueTrack is not configured, AutoXY and AutoZ steps are next. For steps to train Auto XY and Auto Z, see:
   - Train AutoXY and AutoZ Using the Same Target
   - Train AutoXY and AutoZ When Not Using the Same Target

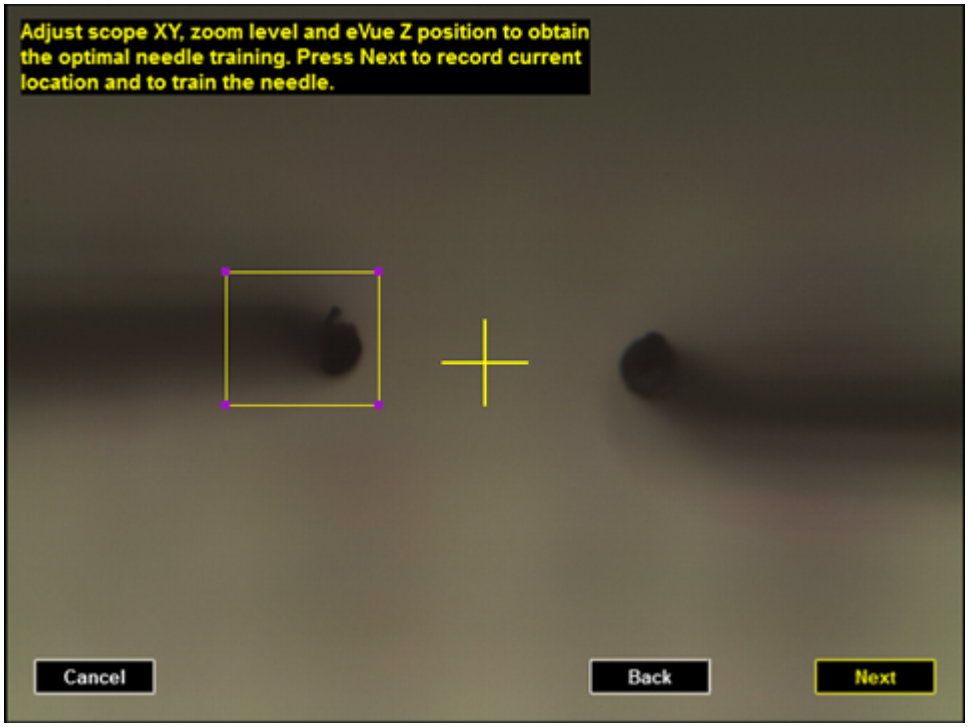
## Train VueTrack

To train VueTrack:

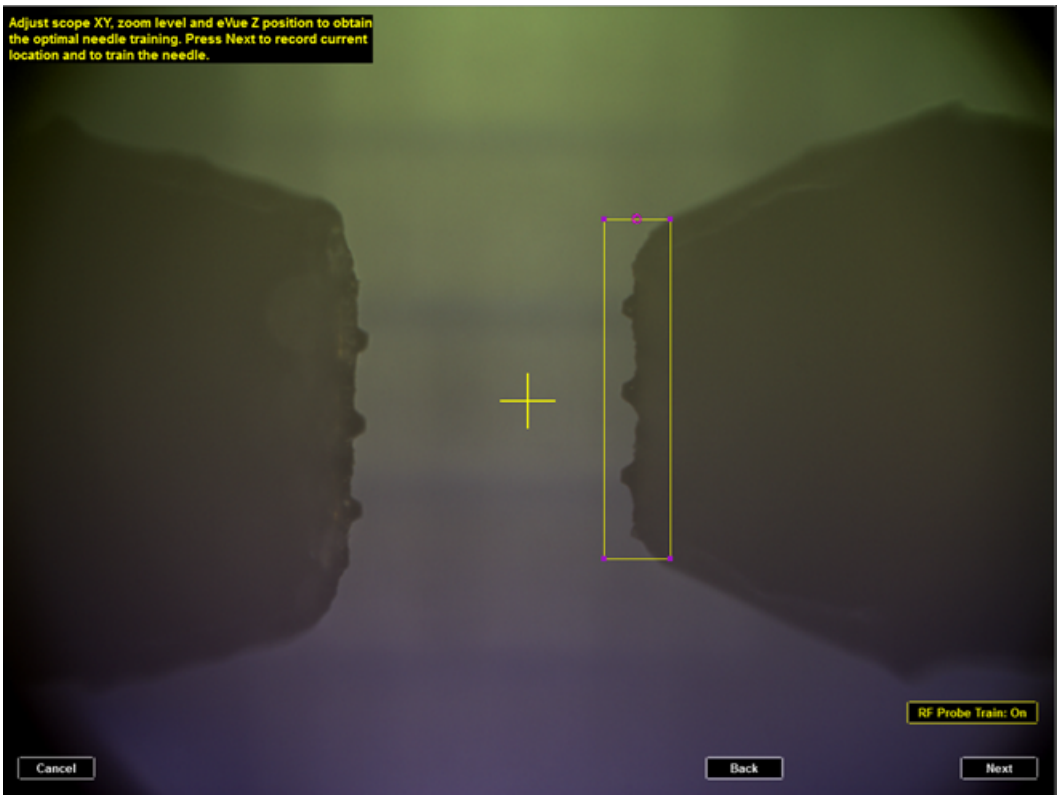
1. When the needles are visible and in focus, move the XY transport and change the zoom level to obtain optimal needle training.

   Click the Train new fixed Needle button to begin the needle training sequence. (If you have motorized positioners, additional Train buttons are visible. See Configure Motorized Positioners with VueTrackPro for more information.)

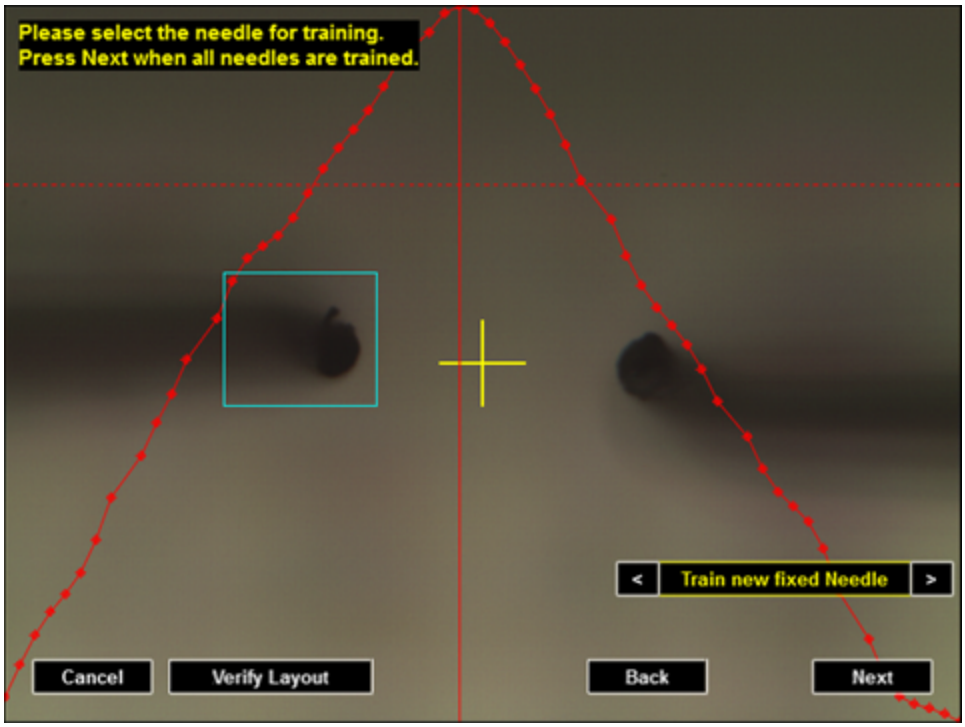
   A trained model adjustment rectangle is visible on the screen.




2. Follow the wizard prompts.
   - If you are training a manual positioner, select to train it as an RF needle or DC needle. (Click the Probe Train button to toggle between DC and RF training.)
   - If you are training a motorized positioner, the type is automatically applied from the positioner arrangement defined in ControlCenter.




3. Click Next to train the needle.
   After training, a focus curve establishes how to find focus on the needle.



4. To train more needles, navigate to another needle and then click the Train new fixed Needle button.

   You can train up to 25 needles.

   a. To Retrain a fixed needle, click the Back button or the Next button, and then click the Retrain Needle button.
   b. When you are finished training needles, click the Next button to continue.

## Configure Motorized Positioners with VueTrackPro

If your system is configured with motorized positioners and UseVueTrack is enabled, the tool prompts you to select a needle for training for either motorized or fixed positioners. Overlay labels of the motorized positioners appear in the field of view (FOV) to help you identify the correct needle to train.

The wizard calculates the positioners angle relative to the chuck stage and stores the positioners tip location compared to the scope camera. The wizard guides you to define a safe vector for each probe to ensure the probes are retracted in the course of thermal transitions. The safe vectors are used to retract the positioners before moving to the next layout.

If a needle is not trained, it won't be compensated for drift during die-to-die stepping.

1. Select Needle for Training
   a. Determine how many and which fixed and motorized positioners you want to train.
   b. Navigate with the scope (manually) and use eVue Seamless Zoom to change magnification on each needle to be trained.
   c. Define the order of training.

If no motorized positioners are configured, this selection changes to Train Needle.

Click Verify Layout to cycle through all of the trained needles.

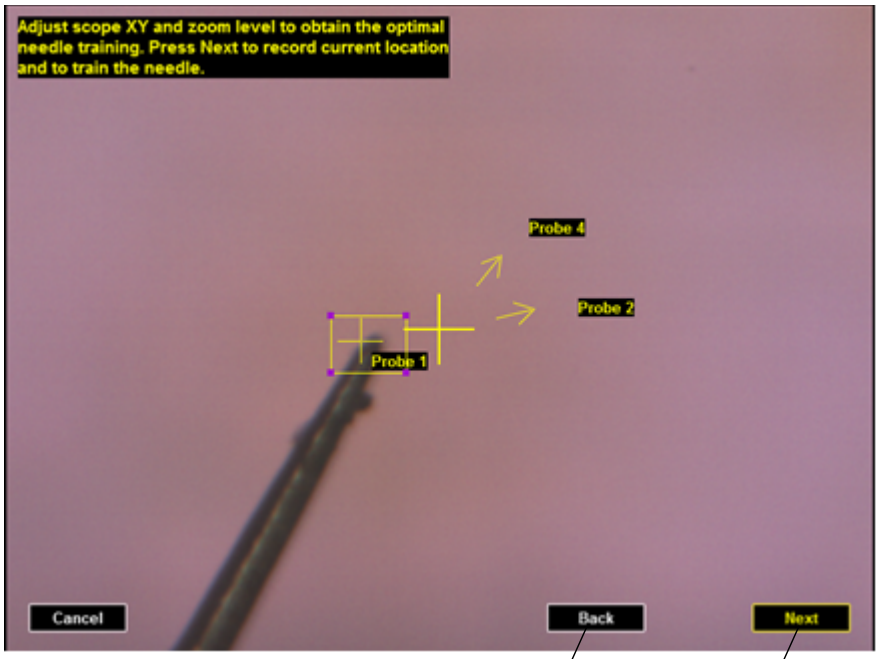
After a fixed needle has been trained, the wizard displays arrow buttons that you can use to cycle through all fixed needles that have been trained.

The caption changes as you click the arrow buttons to let you retrain a fixed needle.

When you click Train new fixed needle or Train Positioner *n*, a training rectangle appears on the screen.

2. Train the selected needle.

3. Navigate the scope in XY and zoom to a correct position for training on that needle.




Click Back to return to the VueTrack wizard step without training the needle.

Click Next to train the selected needle and return to the VueTrack wizard step. If it is a motorized positioner, the button changes to Retrain Positioner *n*.

4. Click the Verify Layout button to cycle through all of the trained needles, moving the scope to the correct position searching for the needle in XYZ. Ensure that every needle is found before you finish the VueTrack wizard step.

   With a mixture of fixed and motorized positioners, you must determine the offsets of all the fixed needles before you can find the offsets of the motorized needles. Search sequence is as follows:

   a. The nearest fixed needle is searched, and then all of the other fixed needles are searched using the nearest neighbor.
   b. A best fit XYZ offset is generated, and then all motorized needles are searched using nearest neighbor.
   c. The motorized needles are driven to the best fit XYZ fixed offset.

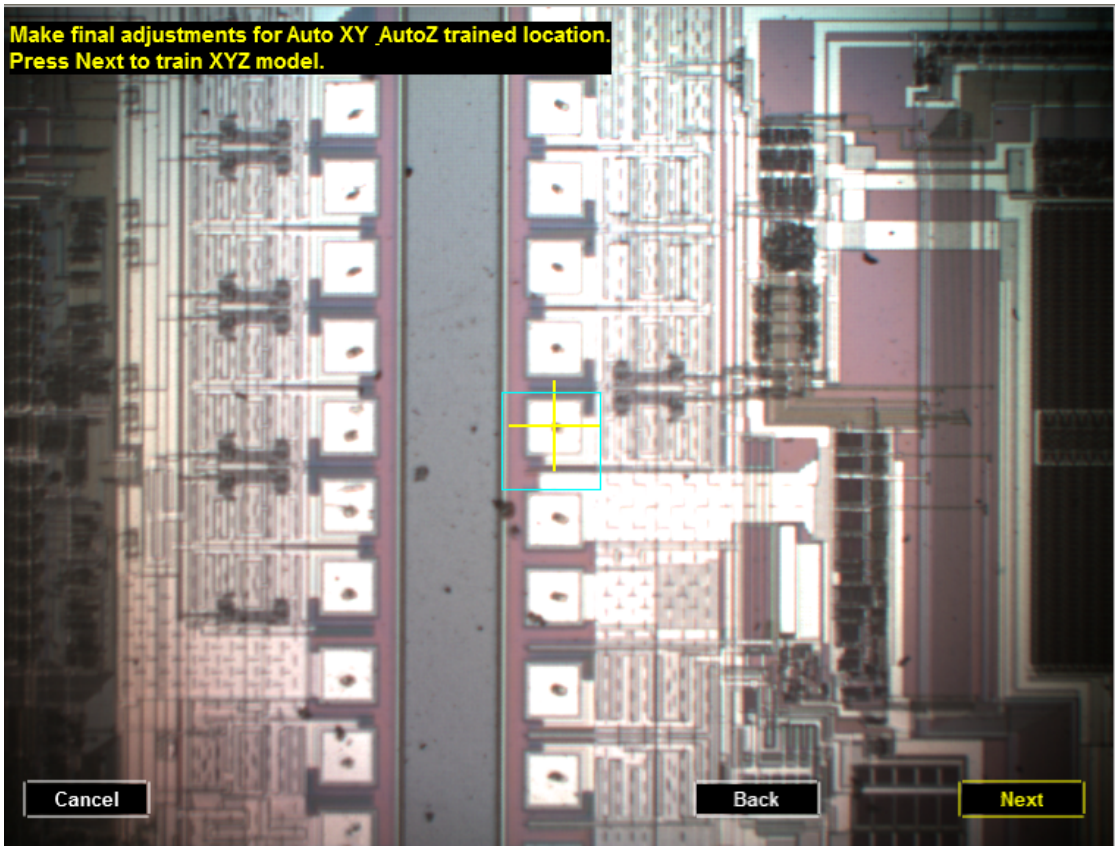
5. When your needles are trained, return to Train VueTrack of the wizard to train AutoZ.

**NOTE**

*If you are setting up Velox for WLEM, skip step 5 and continue to Configure Automation for Multiple Sites for details.*

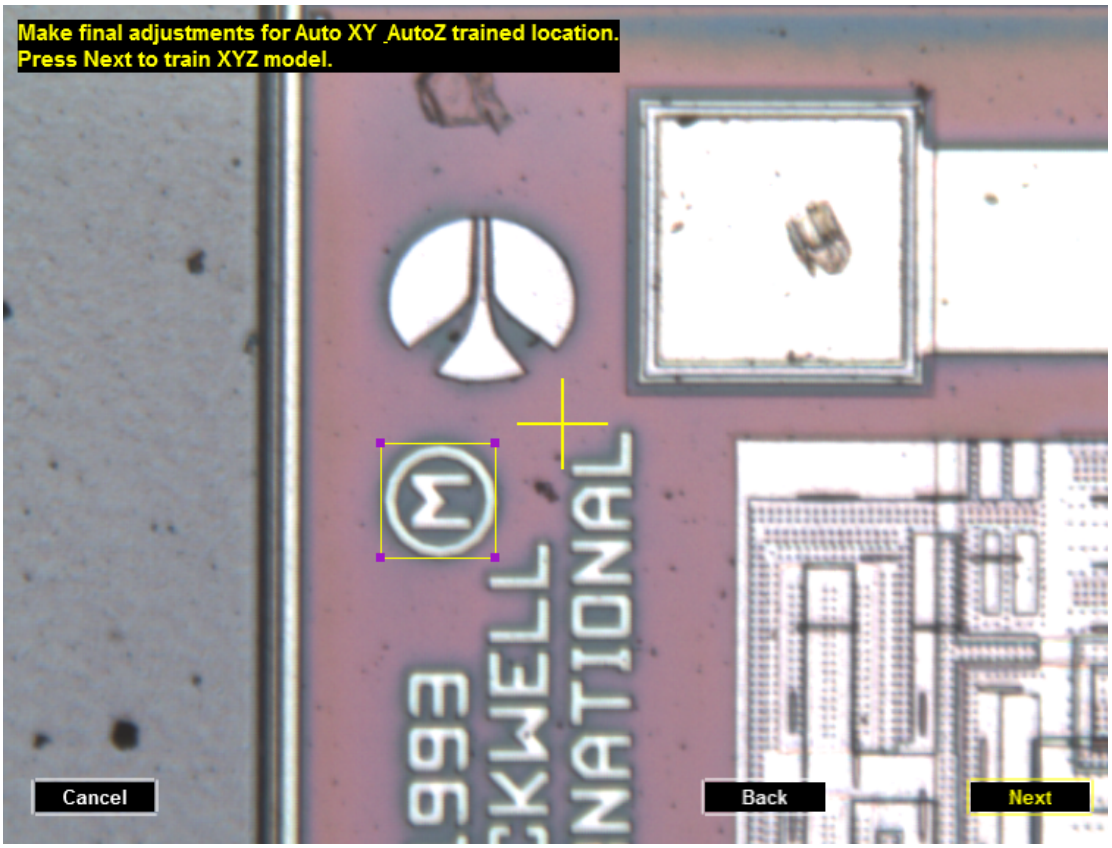
## Train AutoXY and AutoZ Using the Same Target

When CombineAutoXYZ is enabled, the combined AutoXY/AutoZ wizard displays an adjustable model rectangle.



In this example, the field of view doesn't have any good AutoXY model regions, but it has plenty of good AutoZ focus regions.

1. Move the chuck to the street intersection (because the model doesn't have any good AutoXY regions).
2. Zoom in to 2.0 with eVue to get a better target. Adjust the model region around a unique target that repeats on every die, and press Next.



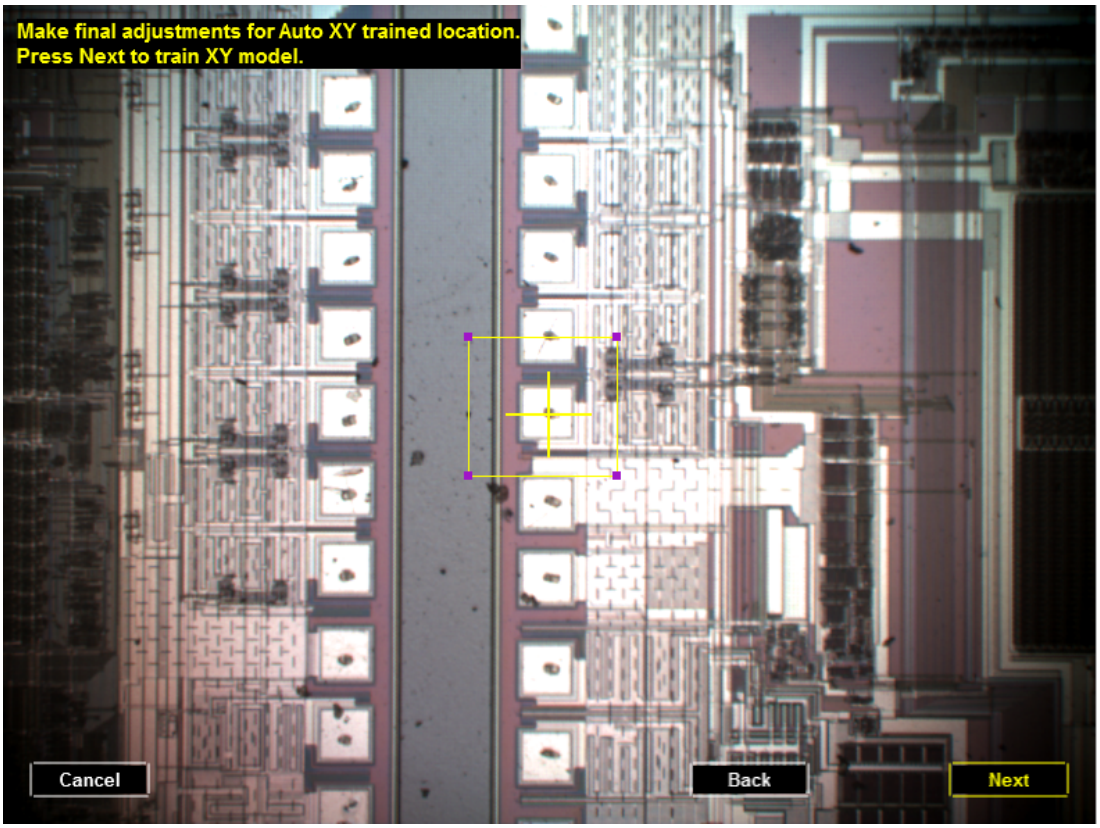

3. The Spectrum Automation wizard sets the AutoXY and AutoZ model regions. Motorized tips keep alignment. The wizard performs a focus operation to establish the trained AutoZ focus height, then the AutoXY model is trained. This region represents the AutoZ and AutoXY model.

4. Click Finish on the final automation wizard step.

## Train AutoXY and AutoZ When Not Using the Same Target

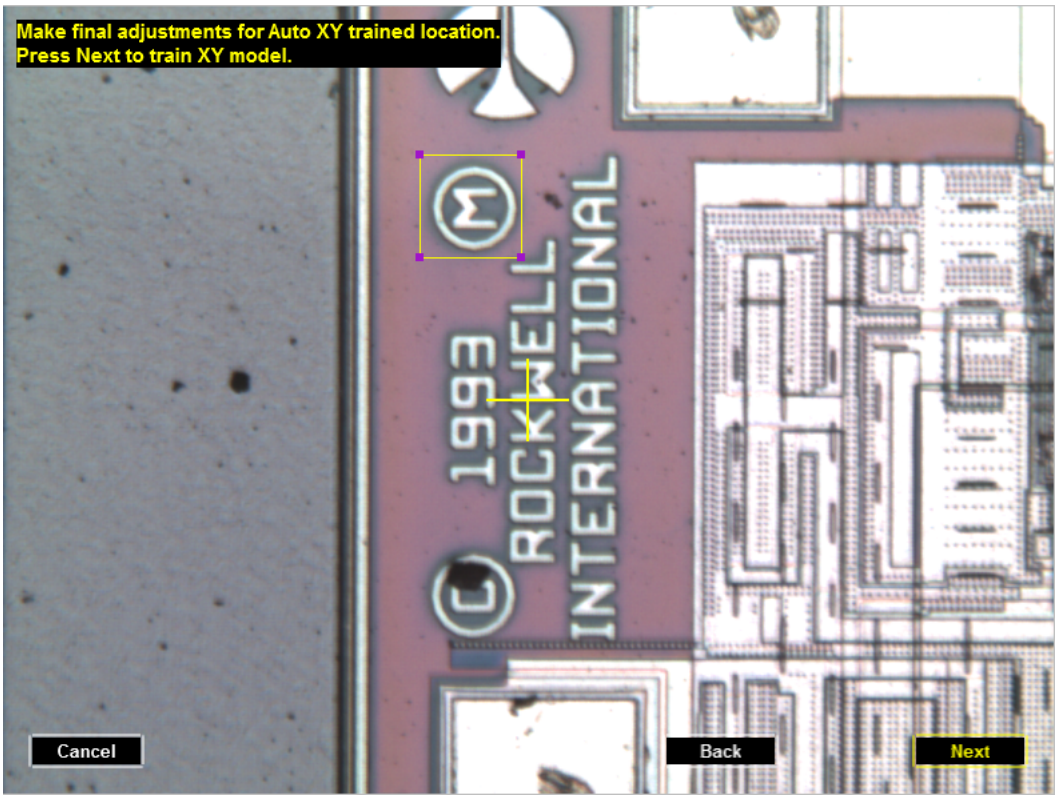
When CombineAutoXYZ is disabled, Spectrum presents the standard AutoXY wizard step with an adjustable model rectangle.

1. If you don't see any good AutoXY regions, move the chuck to the street intersection.

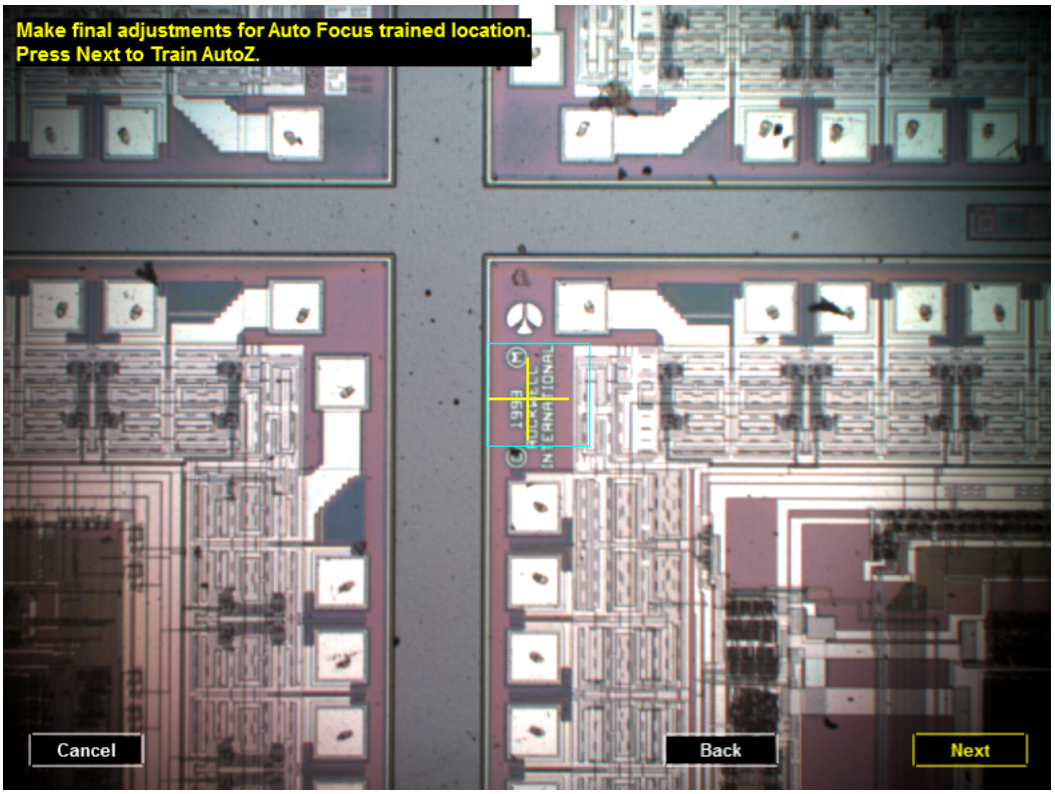



2. Zoom in to 2.0 with eVue to get a better target.
3. Adjust the model region around a unique target that repeats on every die, and then click the Next button.

   The AutoXY model is trained.




4. Next, the software presents the AutoZ wizard step and displays the fixed 128x128 model region rectangle. You can now change the magnification and use a different eVue imager than the AutoXY.
5. To train AutoZ, change to magnification 0.5.




6. Click the Next button and a focus operation is performed to establish the best focus.

   The AutoXY model is automatically retrained at the new focus height. In this case, it switches back to magnification 2.0 and retrains AutoXY.
7. Click the Finish button on the final Automation wizard step.

**NOTE**

*If AutoRF is selected, skip the last step and proceed to AutoRF Wizard Steps.*

## AutoRF Wizard Steps

Train ISS Model

Set Up Threshold at Separate

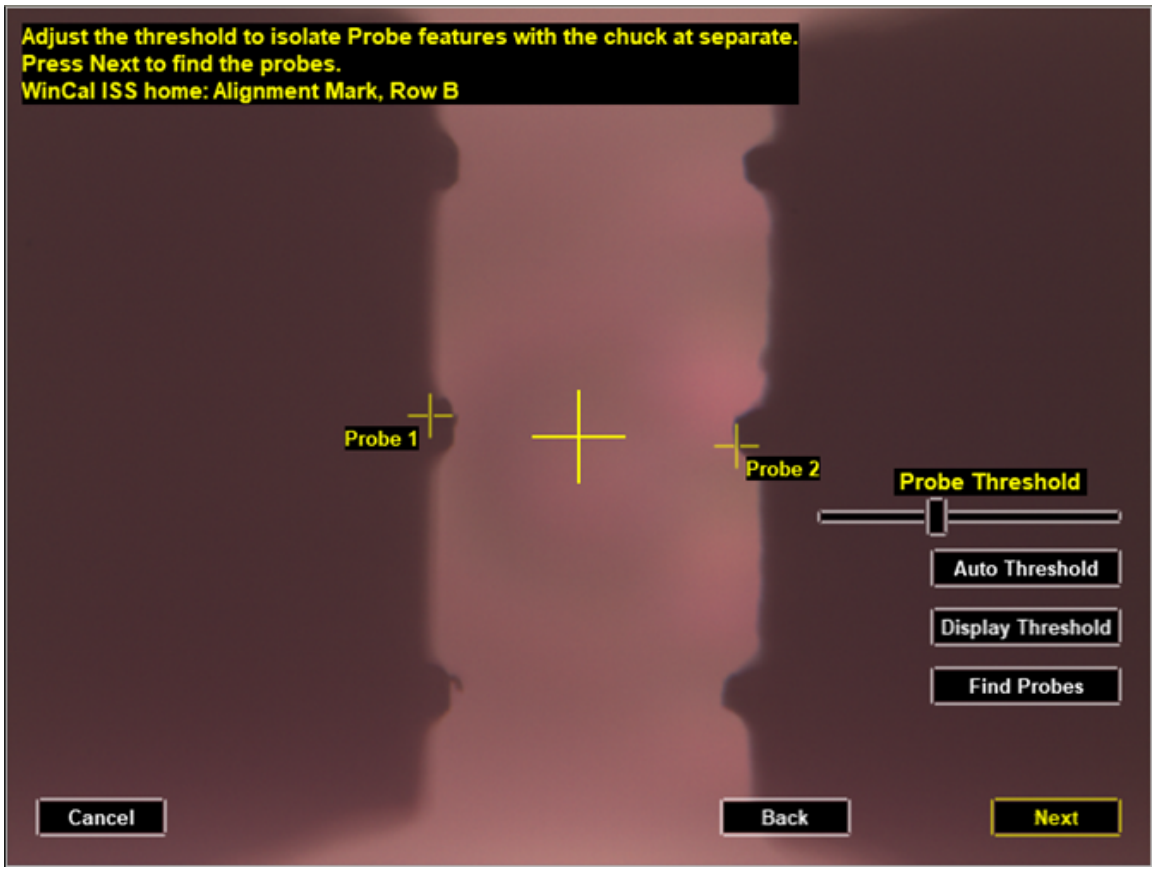
Set Up Threshold at Contact

### Train ISS Model

1. The chuck moves to the designated auxiliary chuck for the ISS, as defined in ControlCenter.
2. When the vision training box appears, you must move the chuck in XY and Z to train a model that represents the center of the ISS alignment structure.
3. The wizard then checks the eVue microscope to make sure it hasn't been used for focusing. Only the chuck Z can be moved to focus on the ISS for the purpose of defining a rough contact height. (Rough contact height is based on the probe tip focus from the initial wizard step and current chuck height.) This location is used for the XY model and focus location for the ISS.
4. Click Next.

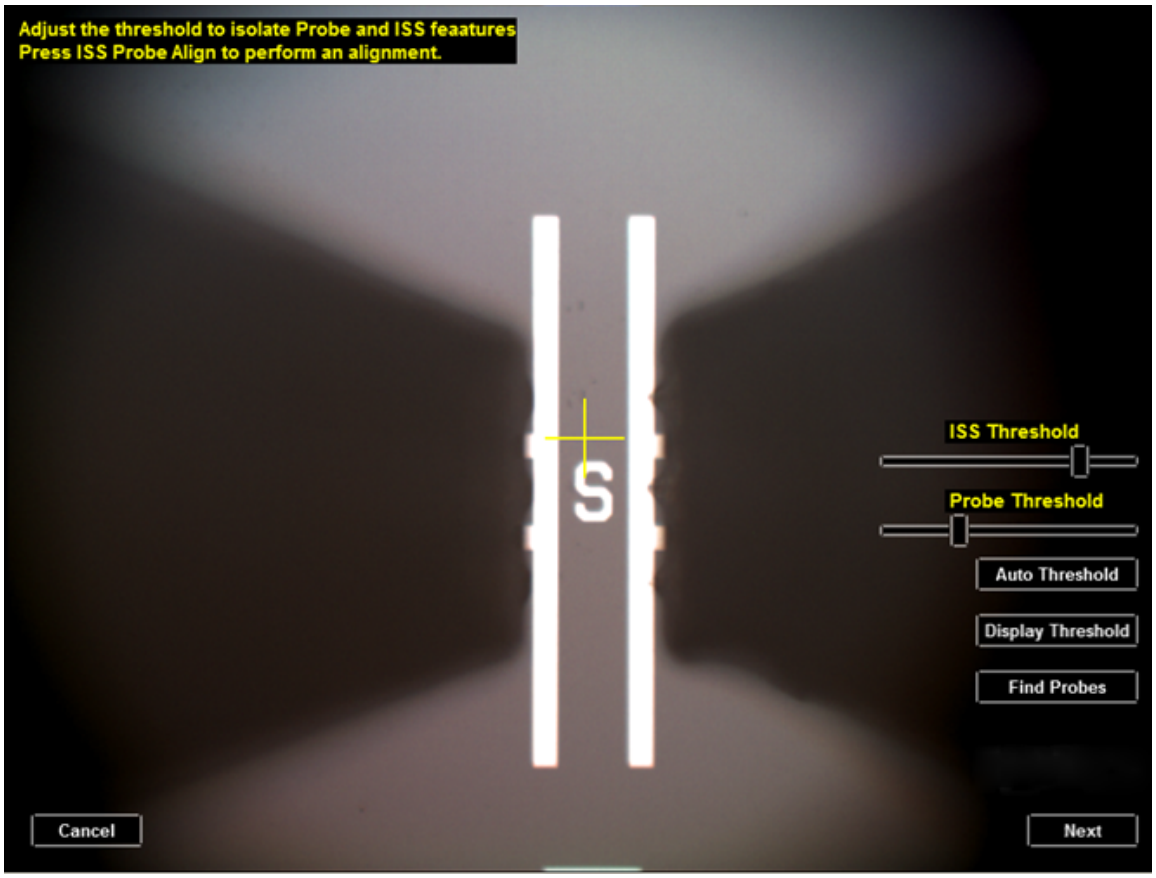
## Set Up Threshold at Separate

After the ISS model has been trained, a rough contact height is established. The eVue moves up to focus on the needles while leaving the chuck at separate. When the chuck is at separate and contact, different threshold values for the probes are used. Once the probe threshold has been adjusted, click the Next button to accept the value.

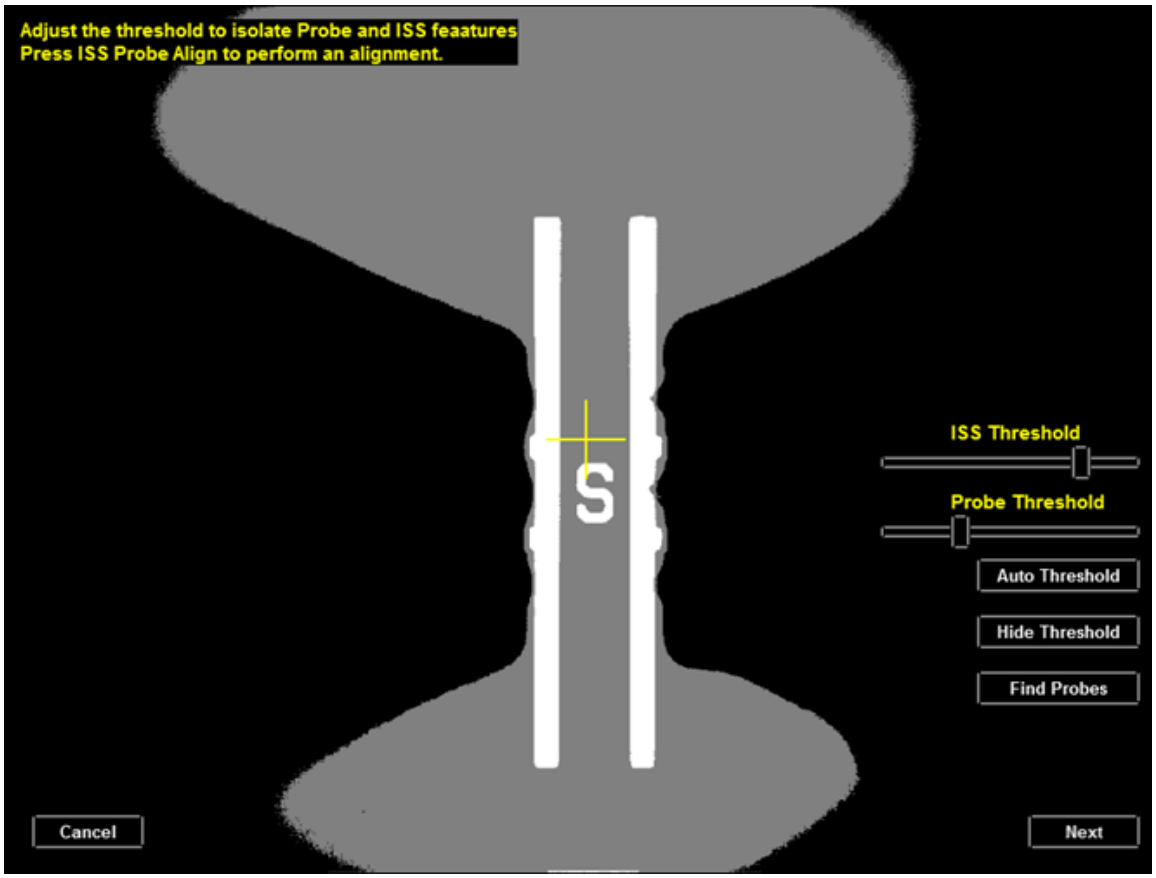



## Set Up Threshold at Contact

The chuck moves up into contact with the probes and eVue moves into focus.

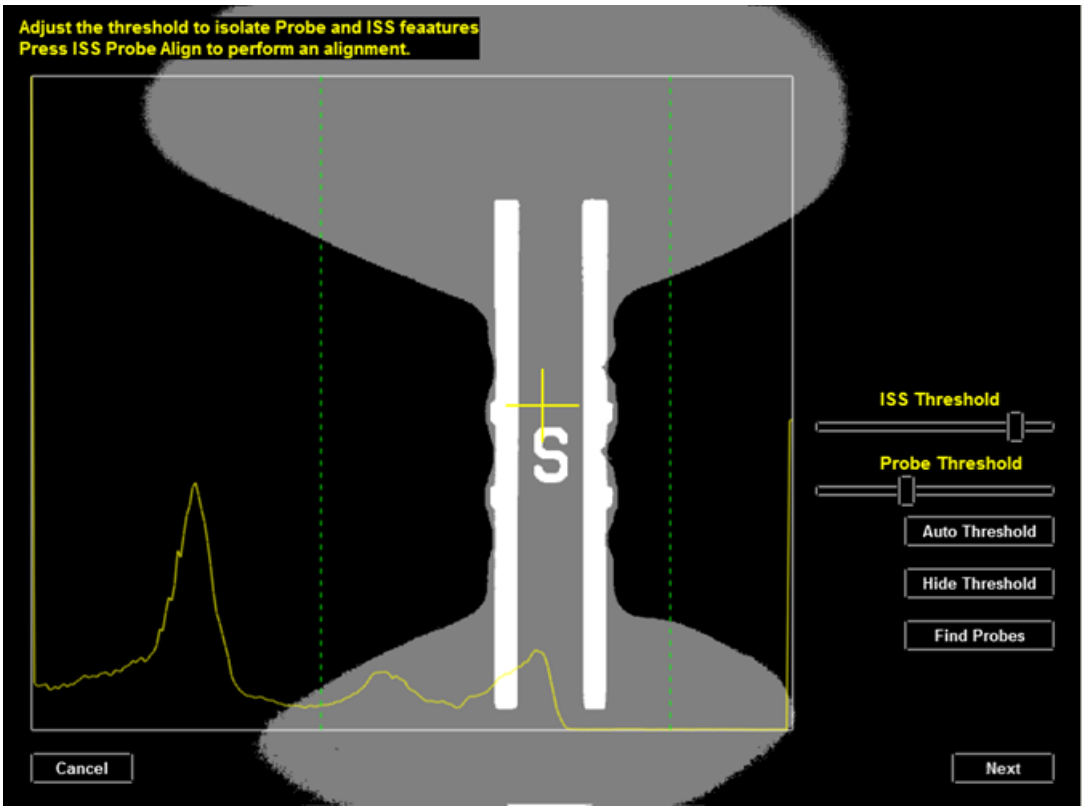



- Use the ISS Threshold and Probe Threshold sliders to adjust the binary threshold values used for the ISS and Probes in real time. When the slider is adjusted, the live video changes to display that particular threshold effect and updates as the slider is moved. This provides real-time feedback during the selection process.
  - ISS Threshold defines the level used to extract the bright pixels that represent the alignment structure.
  - Probe Threshold defines the dark pixels of the probes at contact.
- Use Auto Threshold to automatically generate ISS and Probe threshold values based on the current live video scene and update the sliders to the correct positions.
- Use Display/Hide Threshold to change the display to show the effect of the threshold values.

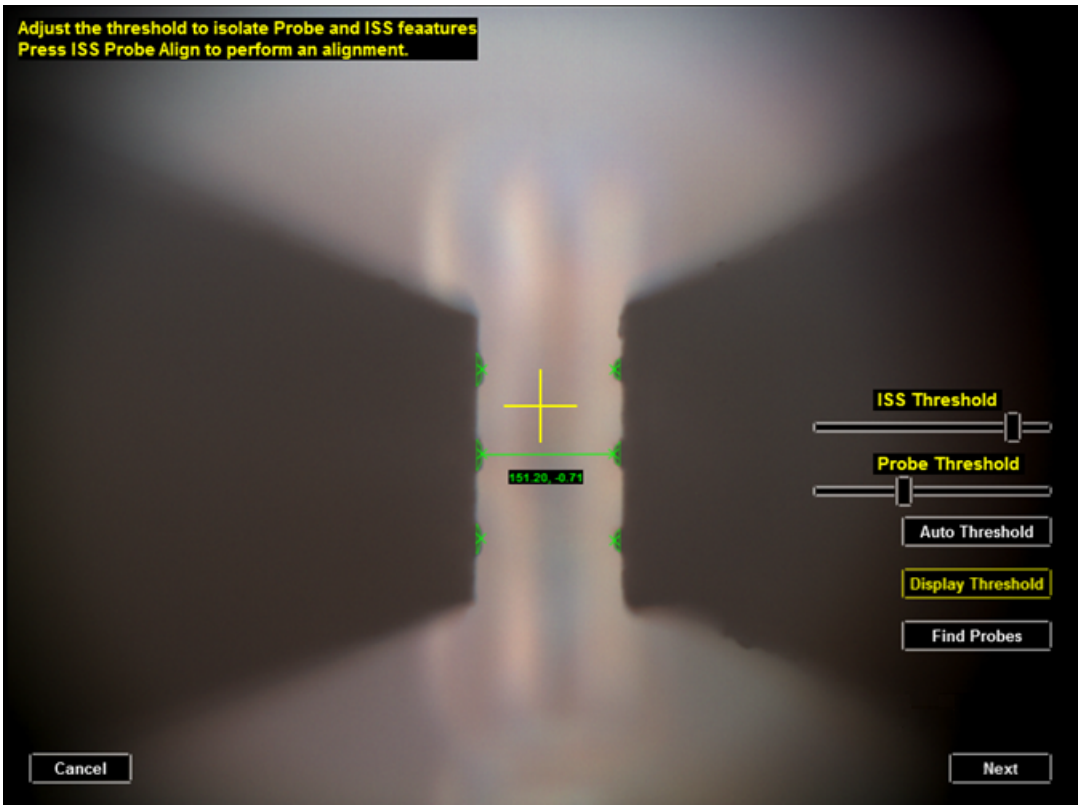



- The image is live video, but shows pixels grouped into three different categories.
  - Black pixels represent the probes.
  - Gray pixels are ignored.
  - White pixels represent the ISS structure.
- As the sliders change, the pixels are updated in real time.

5. Click the Auto Threshold button to display a histogram of all the pixels and the slider locations.




6. Click the Find Probes button to quickly locate the probe tips and display the spacing so that you can verify that the thresholds are working correctly.



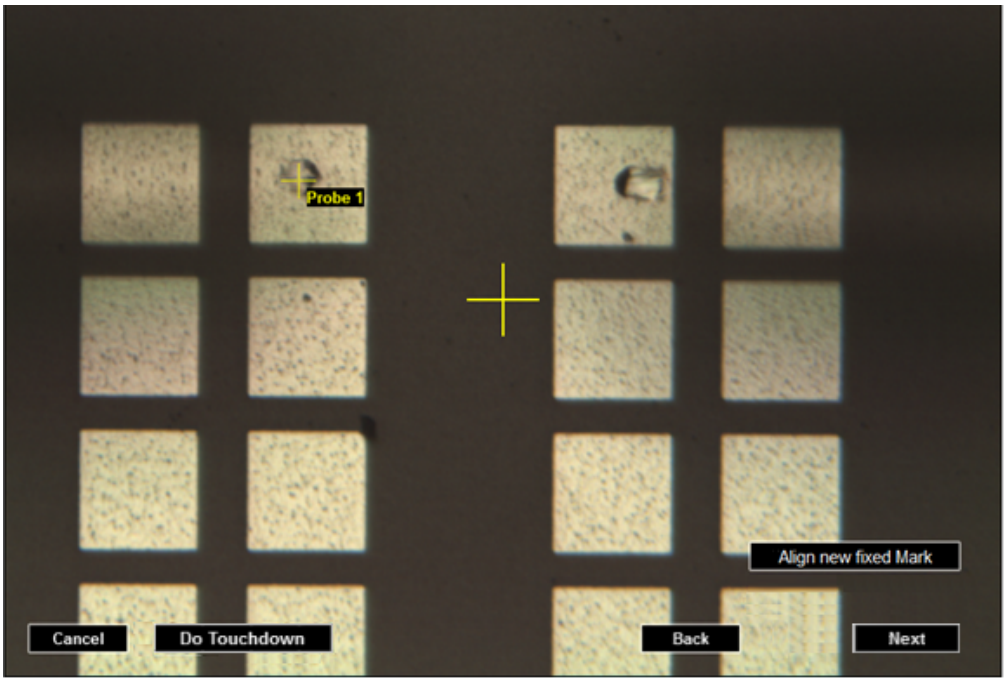

7. When you have finished setting up the probe and ISS threshold levels, click the Next button to execute an automatic probe to ISS alignment touchdown using the configured thresholds. This is the full probe-to-pad contact alignment and is the same as the runtime sequence.
   - The locations of the positioners, chuck, and scope are recorded.
   - Home is set in WinCal for the ISS.
8. On the AutoCal wizard page, click the Next button to perform an auto-calibration using the setup from WinCal.
9. Click the Finish button on the final step.

   The chuck moves back to the wafer and the positioners are restored to their spacing as defined on the wafer during AutoXY/AutoZ/VueTrack setup.

## Scrub Mark Alignment Wizard

ScrubAlign is used in conjunction with VueTrackPro to align scrub marks for unattended testing at multiple temperatures.To use this feature as part of the Automation wizard, enable UseScrubMarkAlign in the Spectrum Explorer window (Automation > VueTrack > UseScrubMarkAlign).

1. Align Fixed Scrub Mark. Perform an action from the table below.

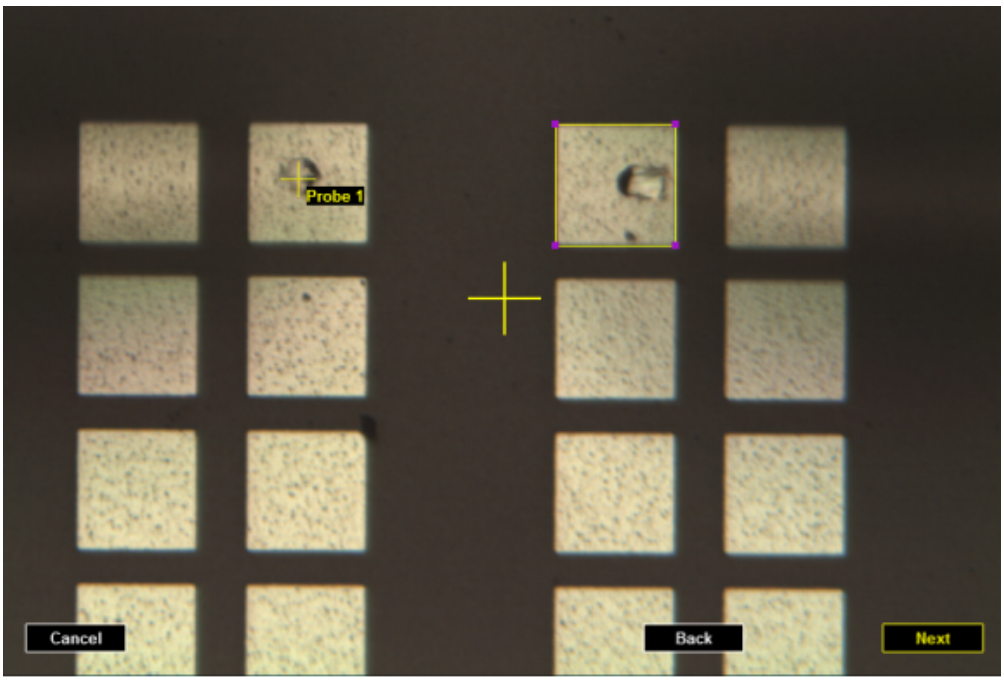



| | |
|---|---|
| Align new fixed Mark | When selected, advances to the Define Pad Boundary step.<br>• Use the Back and Next buttons to cycle through previously-trained scrub mark offsets. If the scope was moved to locate the pad, that scope location is restored when cycling through the pads.<br>• You can align as many fixed needle scrub marks as you want. If you have a probe card, you can choose to align as many needles as you want. In this step, you can align all of them or two at the top and two at the bottom. |
| Do Touchdown | Makes contact with the needles to verify that the current XY offsets for fixed probes are good and the scrub is correct. You must input the chuck Z offset amount, which is used to adjust the chuck overtravel height. All of the offsets for fixed needles are used to generate a best-fit chuck position for a new home position.<br>If motorized probes are present:<br>• They must be adjusted by the offset amount because the chuck home and overtravel have changed.<br>• They are moved to separate to avoid extra scrub marks. |
| Back | Returns to step 5 of the Automation Wizard. Disregards any offset calculations that were in progress. |
| Next | • If motorized probes are present, the wizard advances to the motorized probe sequence.<br>• If no motorized probes are present, the wizard advances to the VueTrack train needle sequence. |

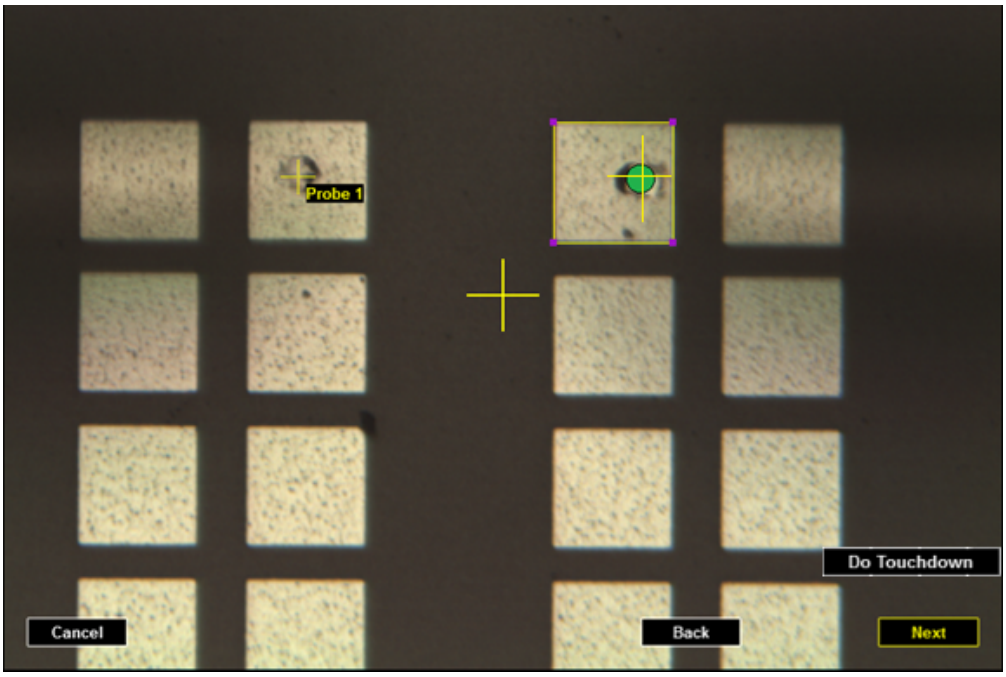
2. Define Pad Boundary.

   This step defines the outline of the pad and is used for both motorized and fixed probe calculations.

   - A sizable and movable bounding rectangle is visible on the screen. You can change the zoom level using eVue seamless zoom.
   - The chuck or scope can be moved as needed. If you move the chuck it returns to the home position (plus calculated offset) upon completion of the wizard. This is useful if a non-motorized scope is present.



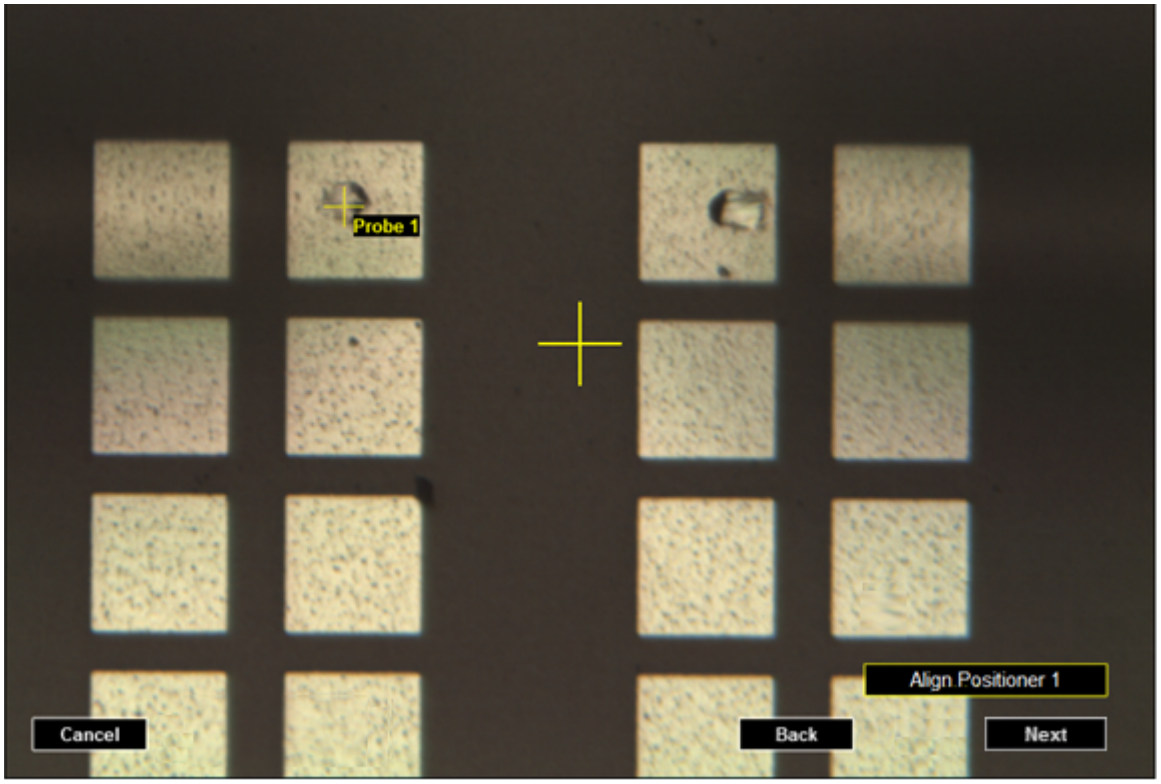
3. Define Scrub Mark Location. Perform an action from the table below.




| | |
|---|---|
| Define the scrub mark location | Place the crosshair at the location that best represents the scrub mark on the pad. The software interprets the relationship between the rectangle (pad) and the location of crosshair that you have positioned.<br>• When you click anywhere on the screen, a typical crosshair overlay appears at that location.<br>• Click a new location to move the crosshair to the new position.<br>• The Do Touchdown button is only available for motorized positioners; it is automatically performed for all fixed probes. |
| Back | Returns to the Define Pad Boundary step. |
| Next | • For motorized positioners, click Do Touchdown before you click Next.<br>• For fixed positioner.<br>– The pad boundary rectangle and the location of the scrub marker are used to generate an offset that places the crosshair in the center of the rectangle, defining the pad.<br>– The offset is stored for the final calculation when all fixed scrub marks have been defined.<br>– All calculations of offsets are based on the pixel-to-micron ratio of the objective.<br>– Wizard sequence returns to the Align Fixed Scrub Mark step. |
| Do Touchdown | For motorized positioners.<br>• Input the amount of overtravel.<br>• A relative move of the motorized probe is based on the XY offset of the crosshair and rectangle. This is the new home position for the probe.<br>• The amount of overtravel for the motorized probe is adjusted by Z and is moved to that location.<br>• The chuck moves up to make contact with the probe, and then returns to separation.<br>• You can redo Z and XY offsets as needed, then click the Next button when you are satisfied with the location. |

| | |
|---|---|
| Next (motorized positioner) | For motorized positioners, the wizard sequence advances to the Motorized Probe Mark Alignment step. |

4. Motorized Probe Mark Alignment.




The wizard displays individual buttons for each configured positioner: Align Positioner 1, Align Positioner 2, and so on.

| | |
|---|---|
| Align Positioner | Returns to the Define Pad Boundary step. This step aligns the selected motorized positioner's offset. |
| Back | Returns to Fixed Probe Scrub Alignment step. |
| Next | Advances to VueTrack needle training Train VueTrack. |

## Configure Automation for Multiple Sites

Train Tiles

Example: Training Preliminary Setup

Example: AutoXY, AutoZ, VueTrack Training

Calculations

WLEM supports multiple tiles contained within a large probe card coming into contact with the wafer at the same time. The Automation tool finds needle locations and wafer targets across many

different tiles using the scope stage. The scope stage navigates to different tile sites with Z–XY–Z motion.

Scope silos must be configured before you can train and set up multi-site Automation. See Scope Z-Fence Configuration for details.

You can repeat the Automation wizard steps for VueTrack, AutoXY, and AutoZ on as many tile locations as you want. The software records the scope silo location associated with the tile during training, so it can revisit the silo during the search operation.

You can train as many needles as you want for a tile. Each needle training records the current scope silo ID and chuck and scope positions.

## Train Tiles

The final task for setting up multi-site Automation is training tiles. You can train as many or as few tile locations as you want, but you must train the first.

You can see which tile locations have been trained as you cycle through each of the scope silos that have been defined. If a probe card has been trained, the button displays Retrain Tile *n*.

1. Click the Train Tile button to move the scope to the desired silo location.

   Automation returns to the VueTrack wizard step.

   The button selection appears at the end of the first tile location training. The first tile trained is the default tile location used during Automation temperature transitions.

2. Click the Finish button to move the chuck back up into contact.

   The scope moves back to the default tile; Automation setup is complete.

### Example: Training Preliminary Setup

1. Train scope silo locations.
2. Set home position, contact height, and probe-to-pad alignment on all tiles.

   VueTrack recreates the alignments over other temperatures and wafers.
3. Train AutoAlign and AlignWafer.
4. Set nano chamber state to Fine Align.

### Example: AutoXY, AutoZ, VueTrack Training

1. In the Spectrum Explorer window, define Automation parameters such as pad size, probe tip diameter, guard band, and so on.
2. Start Automation wizard.

   If silos are configured, Automation follows multi-site setup; otherwise, single-site probe card setup is used.
3. Move chuck to the home position.
4. Locate the scope position with a silo so that the needles in contact with the wafer are visible. The default silo should be located as close to the center of the wafer as possible.
5. When contact is established and the chamber is in the Fine Align state, adjust the chamber seal as needed.
6. Adjust proper focus at the default silo location with scope Z.

   Chuck moves to separation and eVue scope remains focused on needle tips.
   - Train as many needles as you want with the VueTrack wizard. Navigate with the scope as much as possible.
   - During needle training, the scope silo ID is recorded for each target automatically.
7. Click the Next button on the needle training step when finished.

   eVue scope moves to focus on the wafer surface. With the chamber sealed, the chuck XY can move only by the amount defined for WLEM fences.
8. Navigate with scope XY to find the target for AutoZ, and then click the Next button when you are finished.
9. Navigate with scope XY for AutoXY target. It can be the same location.
10. Click the Next button to train.
11. On the last Automation wizard step, click the Train Tile button.

    The scope moves to the corresponding silo.
12. Go to step step 6 and train the next silo. Repeat for each silo.
13. On the last wizard step, click the Finish button to complete automation training.

    Scope returns to the default tile location and chuck moves back into contact.

### Calculations

| | |
|---|---|
| Theta Correction | At the start of a thermal transition, the wafer target locations for each silo are recorded and compared to the wafer target locations at the end. The difference in angles of each silo determines the move to the optimal theta location. |
| Best fit | After a search is performed, a best-fit algorithm calculates the correct offsets in XYZ for each tile, and then all tile offsets are used to calculate a final touchdown. |
| Error checking | During the best-fit calculation, error checking of offsets is performed based on customized input values.<br>The pad size and probe tip size provide XY error thresholds to verify that each needle can hit the pads. An error results if one needle is found beyond the correct pad dimension.<br>To determine how much height difference between tips is tolerable, set the Tip Max Delta Z value. This provides a threshold if one tip is erroneously found in Z.<br>Guard Band is used as a threshold to verify the difference between all subsequent searches. |

# VueTrackPro

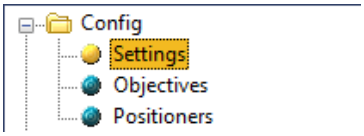
The Unattended Test at Multiple Temperatures feature comprises VueTrackPro software and motorized positioner hardware. The procedures described here include configuring the software, and executing an automated wafer probing test with optimum probing performance.

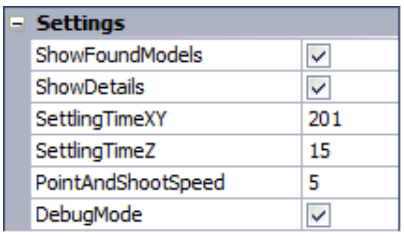
## Spectrum Configuration

You can set alignment mode (on-Axis/off-Axis) on the main Velox toolbar to indicate how the system is currently used. This determines the behavior of several functions, including Automation, ReAlign, and moving between aux sites. For Automation to function properly, Alignment Mode must be set to On-Axis (see On-Axis and Off-Axis Mode for details).

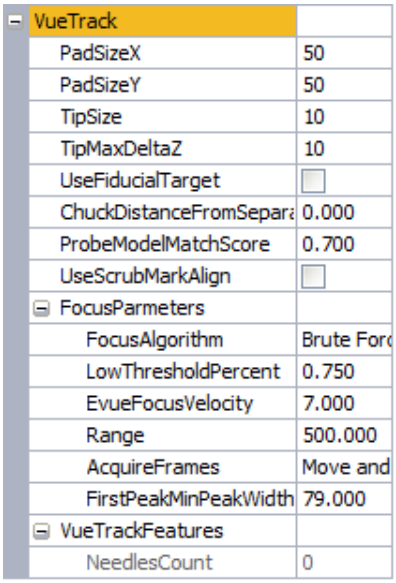
The recommended values for Spectrum global parameters and the recommended settings for VueTrack/VueTrackPro parameters are shown in the following graphics.

In Explorer, click Config > Settings.




In the Tools folder, click Automation, then click VueTrack to display the parameters.




# Positioner Setup

Positioner Initialization

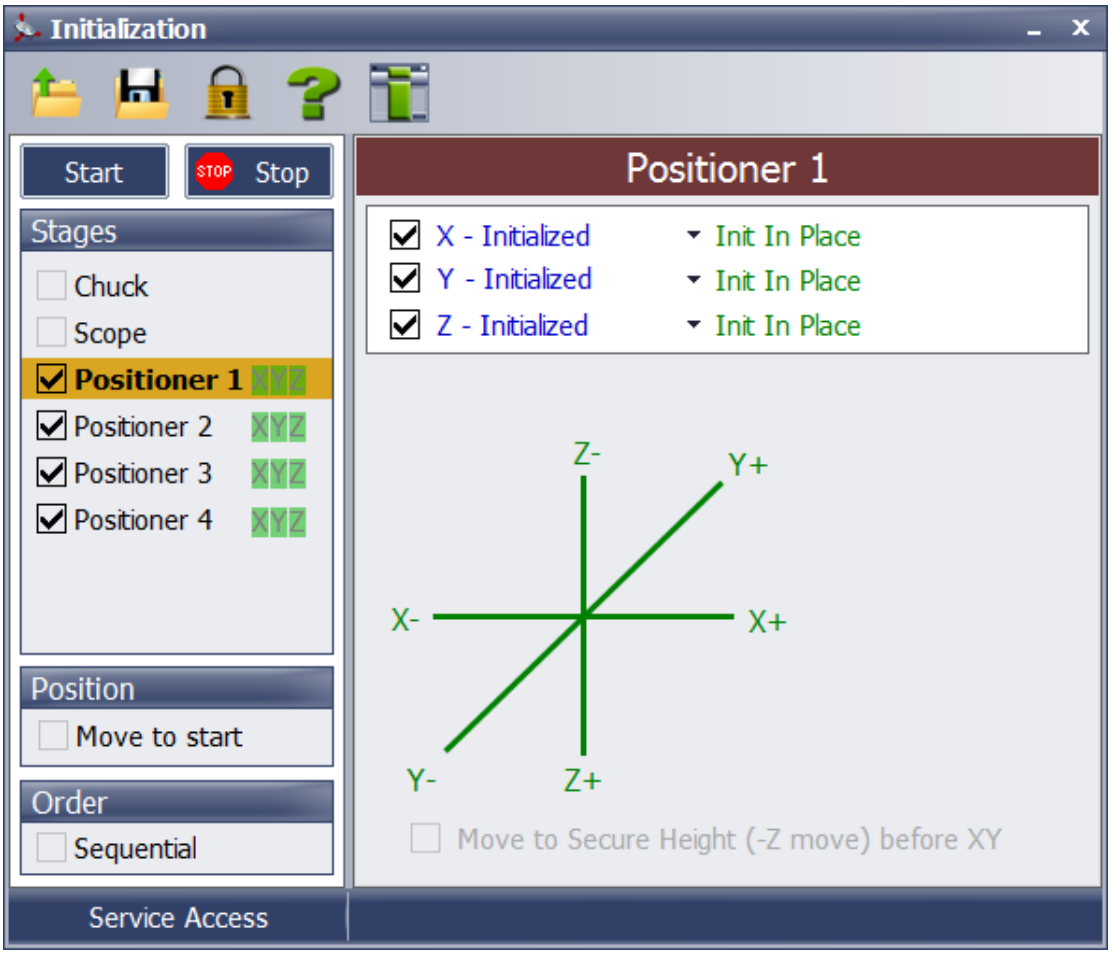
Positioner Arrangement

Positioner Calibration

## Positioner Initialization

The recommended procedure for Positioner Initialization with VueTrackPro is to select the Init In Place option.

1. Move the chuck to center position.
2. In the ControlCenter application, lower the chuck to the bottom of travel and raise the scope.
3. Using manual knobs on the positioners, adjust each of the axes until they are in the center of travel.
4. From the Velox toolbar, click All applications > Tools to open the Initialization window.

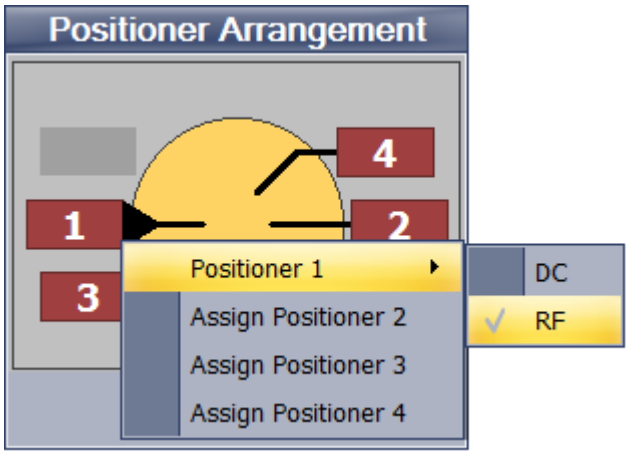



5. Select Positioner 1 from the list of stages.
   a. Check the Initialized boxes for XYZ.
   b. From the corresponding drop-down list, select Init In Place.
   c. Clear the Move to Start check box.
   d. Click Start to begin initialization.
   e. Insert a probe tip into tip holder.
   f. Lower the positioner Z to 5000 in Zero coordinates.
   g. Slide the positioner within its base such that the probe tip is centered below the eVue microscope and within 3mm of the other probe tips as viewed with the naked eye.
   h. Tighten the three screws attaching the positioner to its mounting plate.
6. Repeat these steps for remaining positioners.

### Positioner Arrangement

1. In ControlCenter, click System Setup.
2. In the System Setup pane, click Positioners.
3. For each positioner, right-click on the number icon in the Positioner Arrangement pane that corresponds to the positioner's location on the platen.

4. Move the mouse over the positioner icon and then click RF or DC for type of probe tips. Automation uses the positioner type to select the correct needle training.



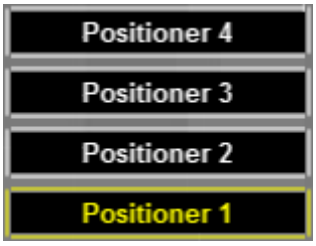

See Positioner Settings for more information.

## Positioner Calibration

After you have configured positioner arrangement in ControlCenter, you must calibrate positioners in Spectrum. Calibration is required so that joystick controls perform the proper rotation transforms for correct XY motion in chuck coordinates.

1. Using the scope transport, locate all of the probe tips with the scope and move them to a common focal plane and field of view (FOV) so that all tips can be seen by eVue at once.
2. Move all positioners except the positioner to be calibrated to the edge of the field of view to avoid collisions during calibration.
3. In the Spectrum Explorer window:
   a. Click Config, and then right-click Positioners.
   b. Click Positioner calibration.

4. In the lower-right corner of the video window, click the Positioner button indicating the positioner to be calibrated.



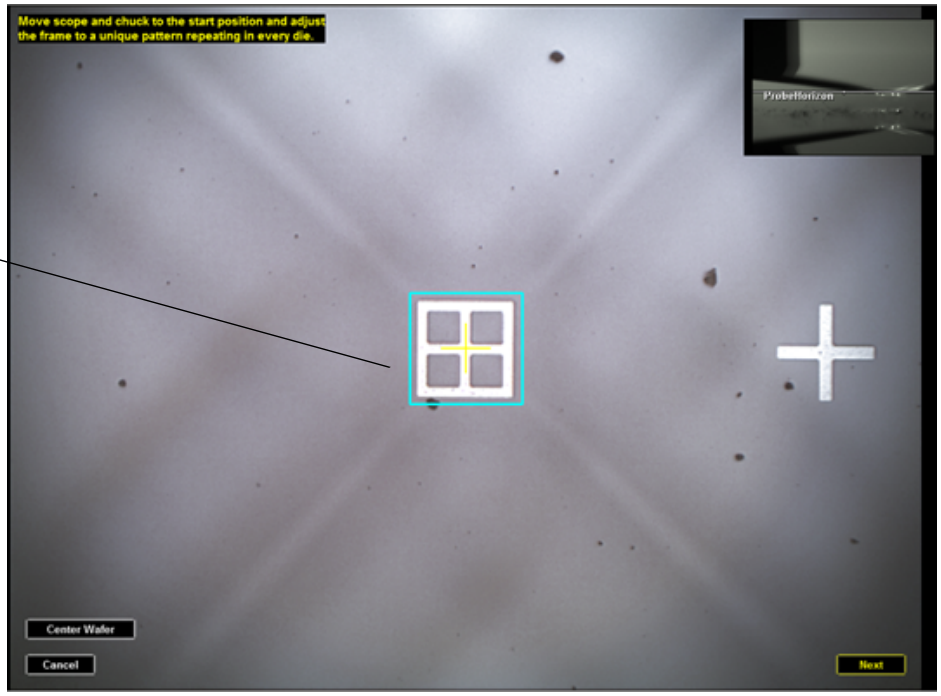

A large yellow box appears in the lower-left corner of the screen.

5. Use the joystick to move the positioner into the approximate center of the box. (It may be necessary to move the joystick in a different direction than the box to achieve the desired motion in the field of view.)
6. Click the center of the probe tip. Then, if calibrating an RF probe, click the middle probe tip. The first yellow box disappears and another yellow box appears in the top-right corner of the screen.
7. Use the joystick to move the positioner into the approximate center of the box.
8. Click the center of the probe tip. The yellow box disappears.
9. Click the center of the shaft at the edge of the screen farthest from the probe tip to define the safe vector for the positioner.

## AutoAlign

The AutoAlign wizard makes corrections for wafer rotation in theta, measures die size, and establishes thermal scaling factors.

1. Raise each positioner to the top of its travel in Z.




2. Press the eVue Home button on the joystick control to center eVue fine focus within its range of travel.
3. Raise chuck Z to between 19500 and 20000 in zero coordinates and set contact height.
4. Move scope Z to focus on the wafer, and set scope focus height.
5. On the Velox toolbar, click All applications > Scope Follow Mode or click .
6. Move chuck to separation height.
   Scope should follow and remain in focus.
7. Click Auto Align on the Spectrum toolbar.

8. Click Train on the video window.
9. Navigate to the fiducial on the wafer nearest to the center.
10. Save the Center fiducial position of the wafer as a place mark in ControlCenter to make returning to this position easier in the future.
11. Adjust the blue box to train the fiducial as a vision model.
12. Click Next to run the alignment.
13. Click Finish when AutoAlign is done.

## Select Die for Probing

When the wafer is aligned, open the WaferMap application, set the Home Die, and select the die to be probed. See Wafer Map for more information.

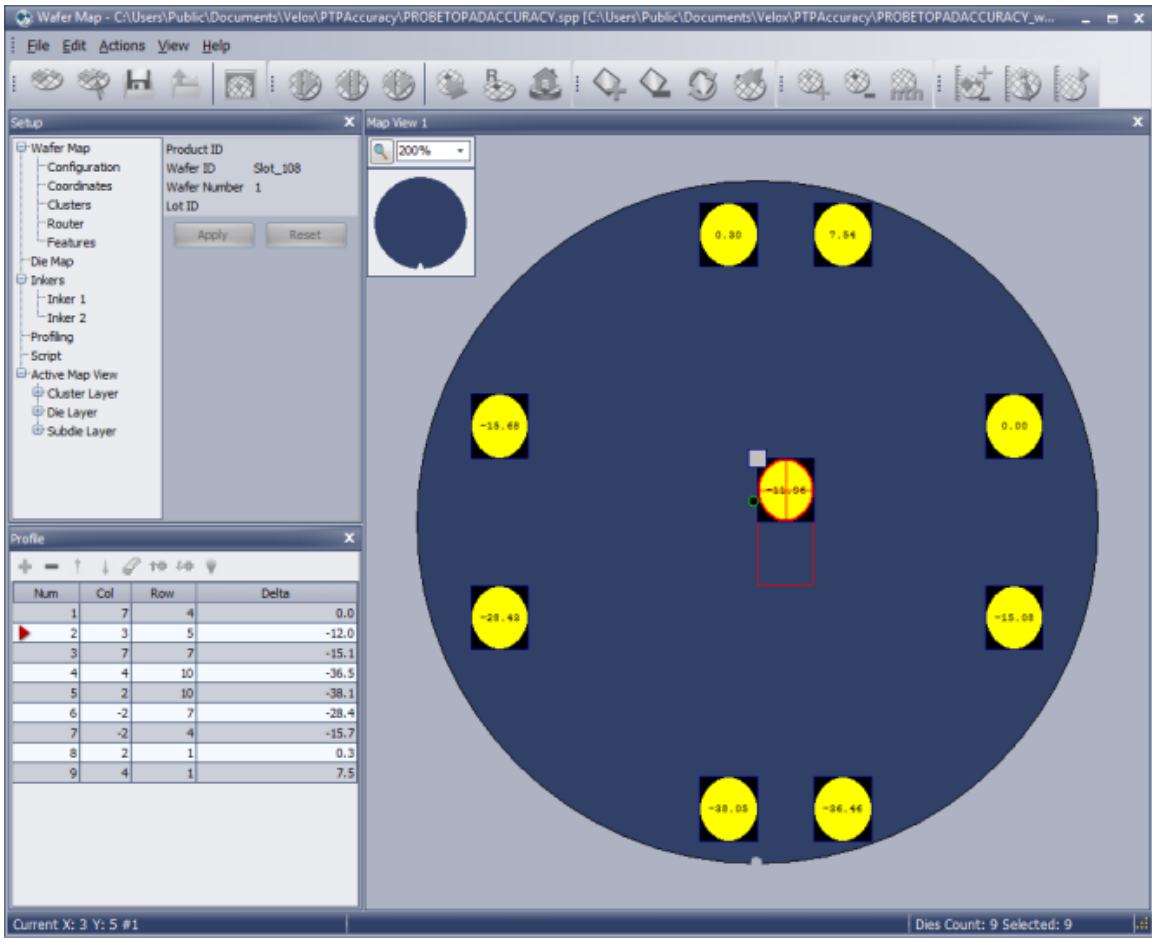
## Wafer Profiling

When the wafer is aligned, you can optionally use the wafer profiling function in the WaferMap application to compensate chuck planarity. We recommend that you run wafer profiling immediately after wafer alignment. See Profiling in the WaferMap chapter for more information.

1. In WaferMap, select Actions > Profiling > Mark/Unmark to Profile .
2. When you click the die to be profiled, it turns black with a yellow circle.
3. Select Actions > Profiling > Run Profiling .

**NOTE**

*To confirm planarity is less than 30 µm, observe the range of Z that is measured across the wafer.*




## Wafer and Die Soak Time

ControlCenter provides four soak time parameters that you can use to configure soak times after a thermal transition (wafer soak) or after a die step (die soak).

Optimum soak time is a complex function of chuck set point temperature, chuck temperature history, chuck position, and chuck position history.

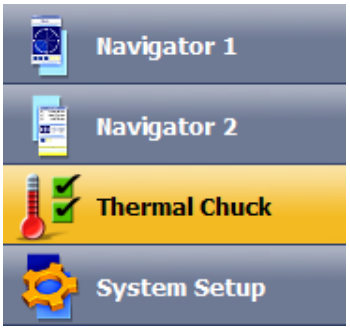
Recommended soak times are:

Wafer Soak Time = 3 hours

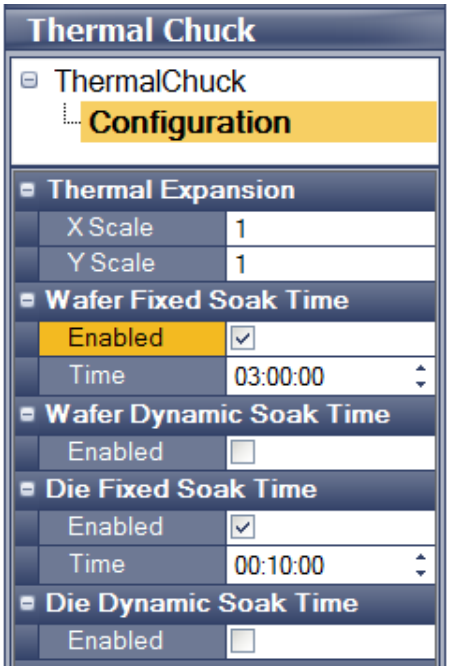
Die Soak Time = 10 minutes.

To specify soak time:

1. In ControlCenter, click Thermal Chuck.




2. In the Thermal Chuck pane, click Configuration, and then configure the Thermal Chuck settings as shown.

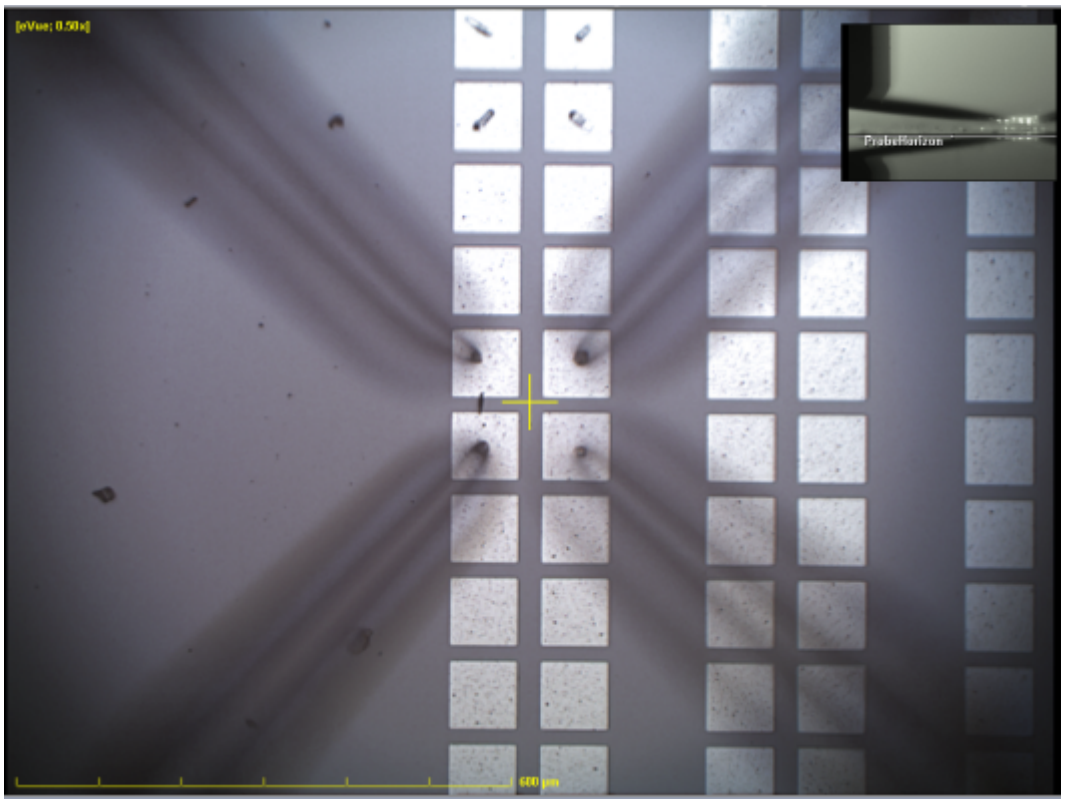



## Coarse Probe Alignment

The purpose of coarse probe alignment is to:

- Get all probe tips in focus under the eVue camera, in one field of view (FOV), at a single scope position if possible.
- Establish initial probe-to-pad contact.

This is a typical eVue FOV after coarse probe alignment:



1. Ensure that the chuck is at home position and at contact height.
2. Get the wafer in focus, and make sure that the scope is at home position and at focus height.
3. Set coarse alignment for each positioner.

a. In ControlCenter, select Positioner 1.

b. In the XY Joystick pane, click 3 to set speed to medium.

c. Using the joystick for XY and ControlCenter for Z, guide the probe into contact on the desired pad.

   Move slowly to avoid excessive overtravel. Stop when the probe skates horizontally 10-20 µm across pad. At this point, it is not critical to precisely set the scrub length or XY position within the pad; only that a detectable scrub mark has been made.

d. Set home and contact height for this positioner.

e. Repeat coarse alignment for each of the remaining positioners.

4. With Scope Follow mode still enabled, move chuck to separation to confirm that the scrub marks landed within the pads.
5. Move chuck back into contact height.
6. Verify that:
   - Chuck is still at home and at contact height.
   - eVue is still in center of travel.
   - Scope is still at home and at Focus height.

## Automation Training

Probe Mark Alignment

Needle Training

DC Needle Training

RF Needle Training

Wafer Reference Training

The final step for setting up VueTrackPro is Automation training, where a vision model is trained on each probe tip and a single wafer reference target at the alignment positions. The XYZ positions of the eVue, scope, and chuck are captured at focus positions during training, then subsequently used to maintain correct probe-to-pad spacing when probing over temperature.

**WARNING**

*Move positioners slowly when approaching contact. Do not use high-speed positioner Z control; wafer collision and damage is likely to occur.*

### Probe Mark Alignment

The purpose of probe mark alignment (also referred to as scrub mark alignment) is to train XYZ probe-to-pad positions that create optimized scrub marks in terms of both scrub length and XY placement within the pads. Scrub mark alignment requires making a witness mark on contact pads with the probes. Prior to scrub mark alignment, the wafer must be aligned to the chuck in the wafer alignment steps described in AutoAlign and the probes coarsely aligned to the pads as described in Coarse Probe Alignment.

During fine (scrub mark) alignment, the chuck is moved out of contact to reveal the scrub mark at separation height. You must draw a box around the pad in the video image and then pick the scrub

mark. The software then makes a correction move with the motorized positioner to optimize scrub placement within the pad.

Testing has shown that a 15-20 µm scrub length is optimal to minimize both contact resistance and pad size.

More than any other factor, scrub mark alignment is a critical step in the needle training process that determines whether the performance specifications are met during unattended testing at multiple temperatures.

For more information about the ScrubAlign settings and wizard steps, see Scrub Mark Alignment Wizard.

## Needle Training

Automated PTP alignment with VueTrackPro relies on vision-based measurements of the XYZ position of probe tips over temperature with the eVue camera. It first measures Z with a focus scan, then XY with a pattern match. During needle training, VueTrackPro captures a vision model of each probe tip at a specific eVue Z height is captured and stored in the project.

Later, when calling the StepNextDie command, the models are used to identify the XYZ position of each probe tip using a pattern-matching algorithm. Then the models use the motorized positioners to move individual needles back to the original trained position relative to the trained wafer reference prior to thermal drift.

During needle training, your choice of vision models determine the performance of unattended probe positioning, and must meet performance specifications.

## DC Needle Training

DC Needle Training Options

DC Needle Training Vision Models

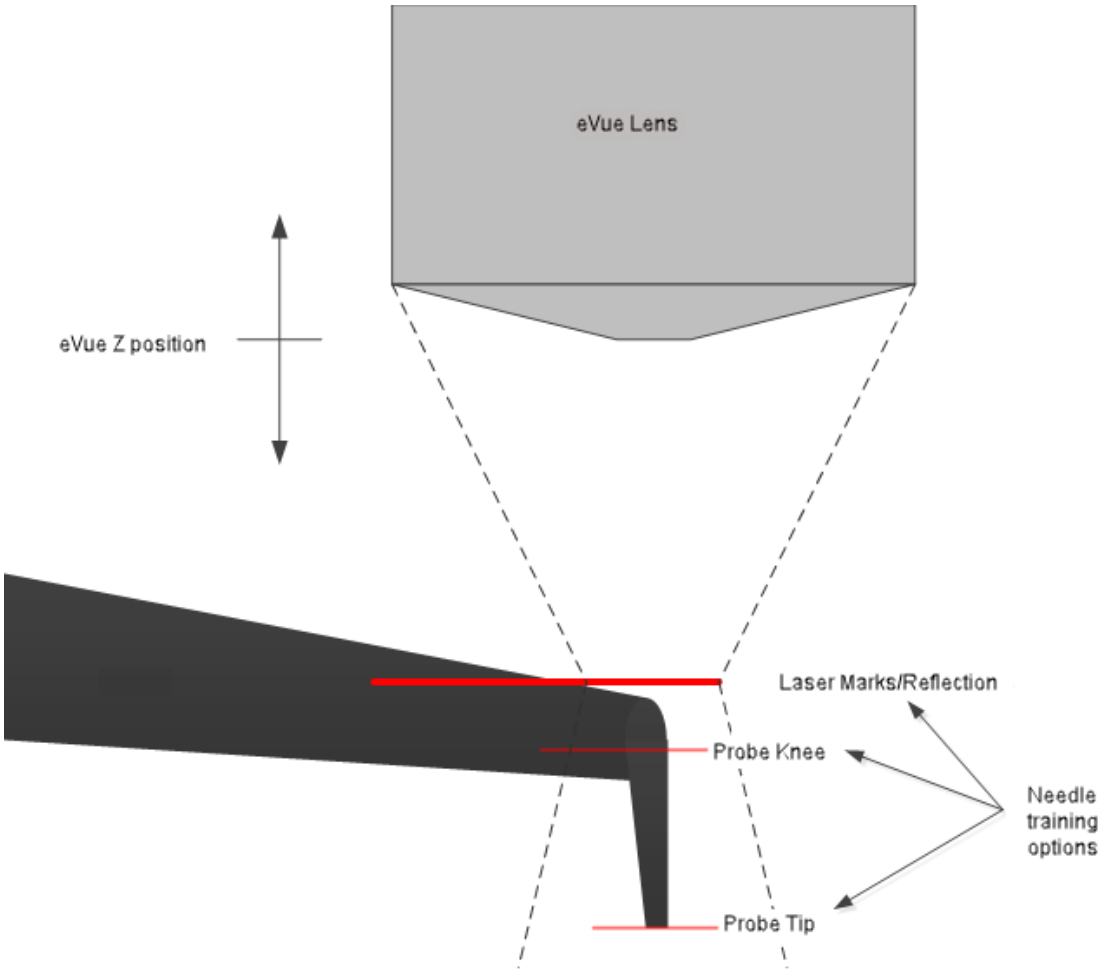
Laser Mark Image Processing

DC Needle Training Recommendations

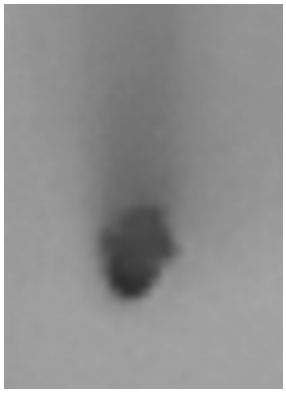
For best results, mark the probe tips with a laser across the width of the needle at intervals along the shaft to create non-reflective bands on the reflective upper edge. The alternating reflective/non-reflective pattern along the shaft creates high contrast dark/light edges in two dimensions across the image, which is then used as a fiducial for needle training.

Laser marks on pixel intensity along the needle shaft enable more repeatable focusing and pattern matching than non-marked tips.

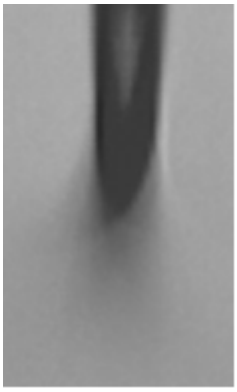
## DC Needle Training Options



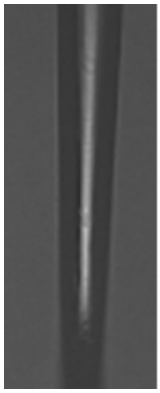

DC Needle Training Vision Models



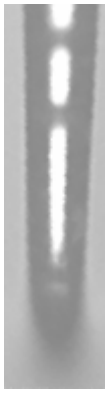
Tip



Knee



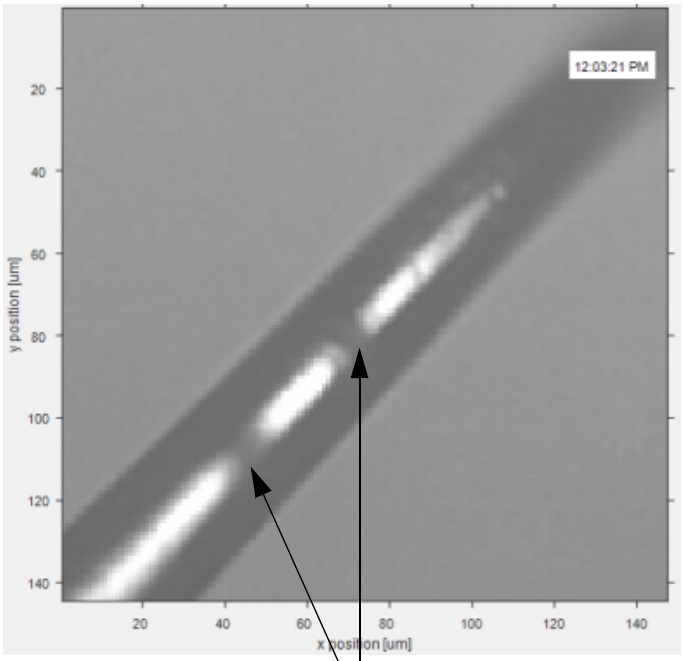
Reflection



Laser marks

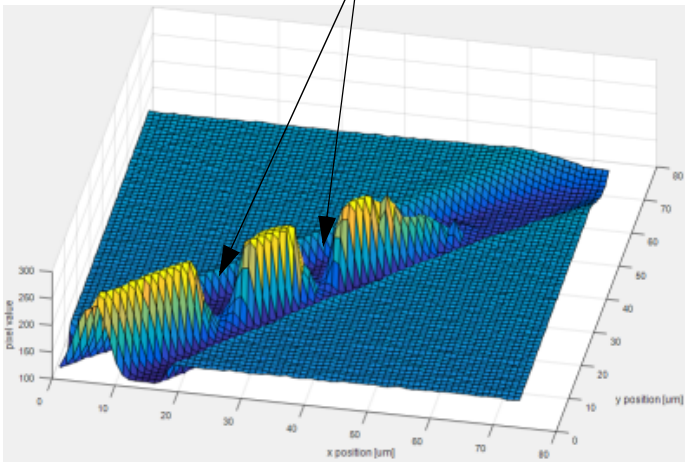
Laser Mark Image Processing

Vision Model




Laser marks provide axial contrast along tip

Vision Model Intensity



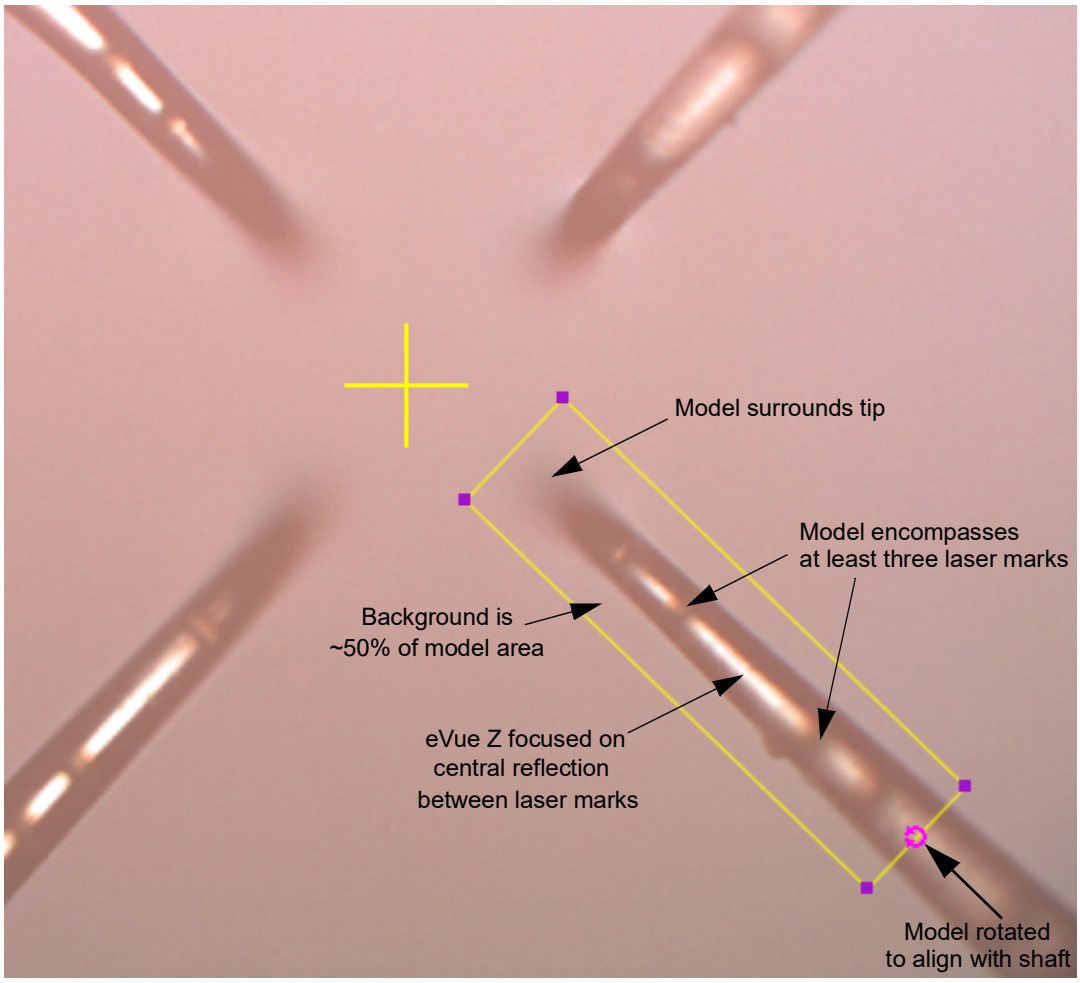

Using the recommended settings, a focus scan may take up to 60 seconds.

The chuck should be at least 5 mm below the needles during both needle training and needle searching to reduce the influence of variable reflected light from patterns on the wafer. The ChuckDistanceFromSeparation setting manages this extra separation gap (see the Automation Wizard for details).

### DC Needle Training Recommendations

1. From the Spectrum toolbar, select Automation .
2. Select Next.
3. Select Train Positioner 1.
4. From the illumination controls, adjust Shutter and Illumination to maximum.
5. Use the focus wheel on the eVue controls to focus on the reflections with laser marks.
6. Drag the model training box to center on the tip.
7. Rotate the model training box to align with the shaft of the needle.
8. Stretch the model training box to surround at least three laser marks.
9. Include ~50 percent of the model area as background.
10. Repeat for the other positioners.

Needle training is extremely important for probing accuracy, second only to scrub mark alignment. In addition to scrub mark alignment, the quality of focus curves during needle training determine the accuracy of unattended probing on the CM300.

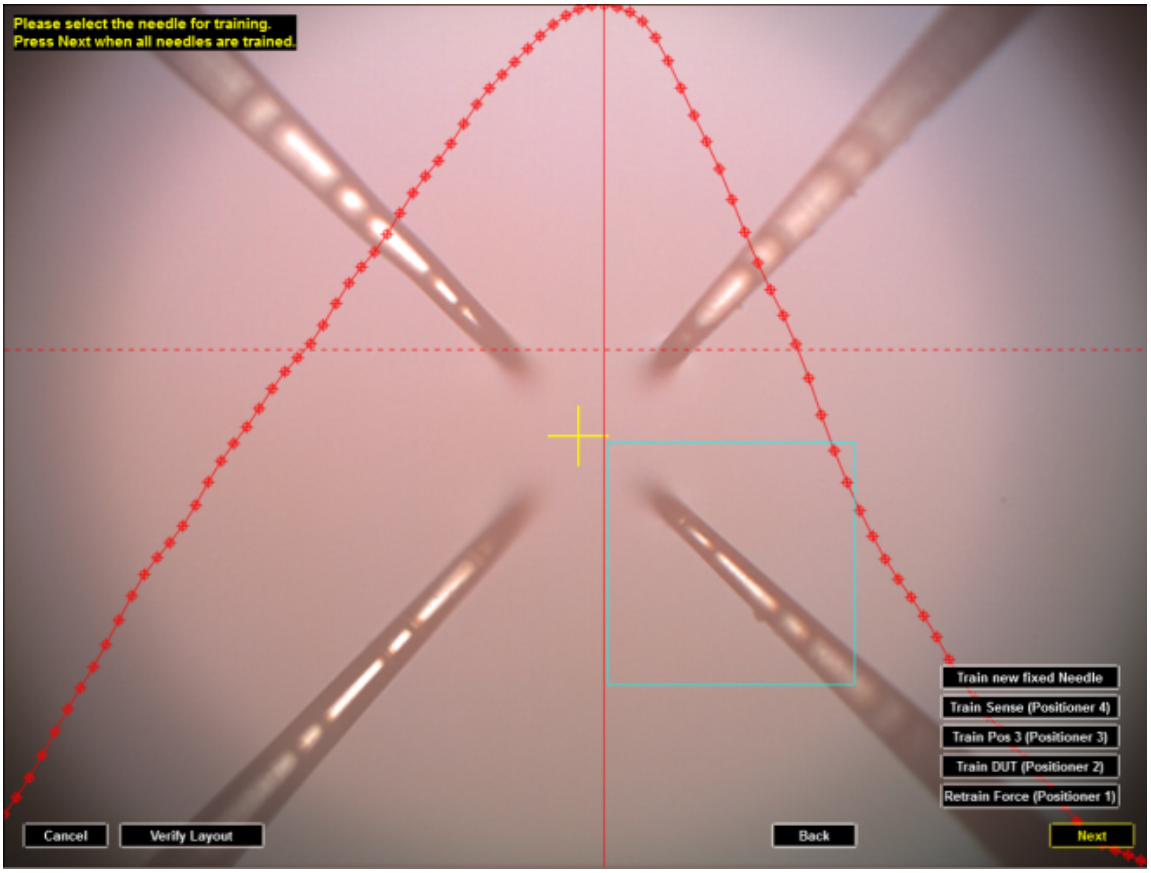


Focus curves on needle tips should have the following qualitative properties:

- Single peak above the threshold
- Smooth, Gaussian-like shape
- Exactly two threshold crossings, one on either side of the peak
- No discontinuities or large vertical jumps in score
- No high-frequency noise

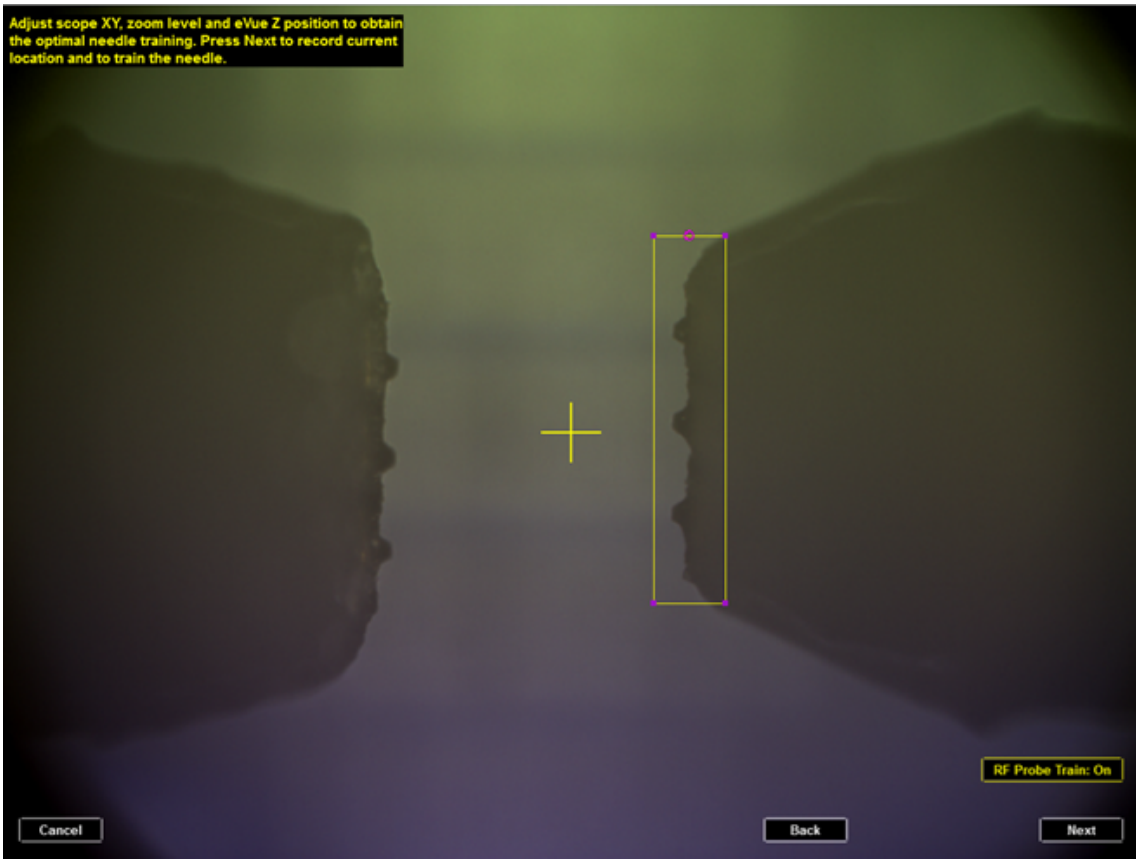
Lacking a simple way to get a good focus curve, you need to develop a sense of focus curve quality during this step of setup to prevent a needle training that results in excessive scrub length variation due to low-quality focus curves.

The example of a good focus curve shown below was obtained from the needle training steps described above.



## RF Needle Training

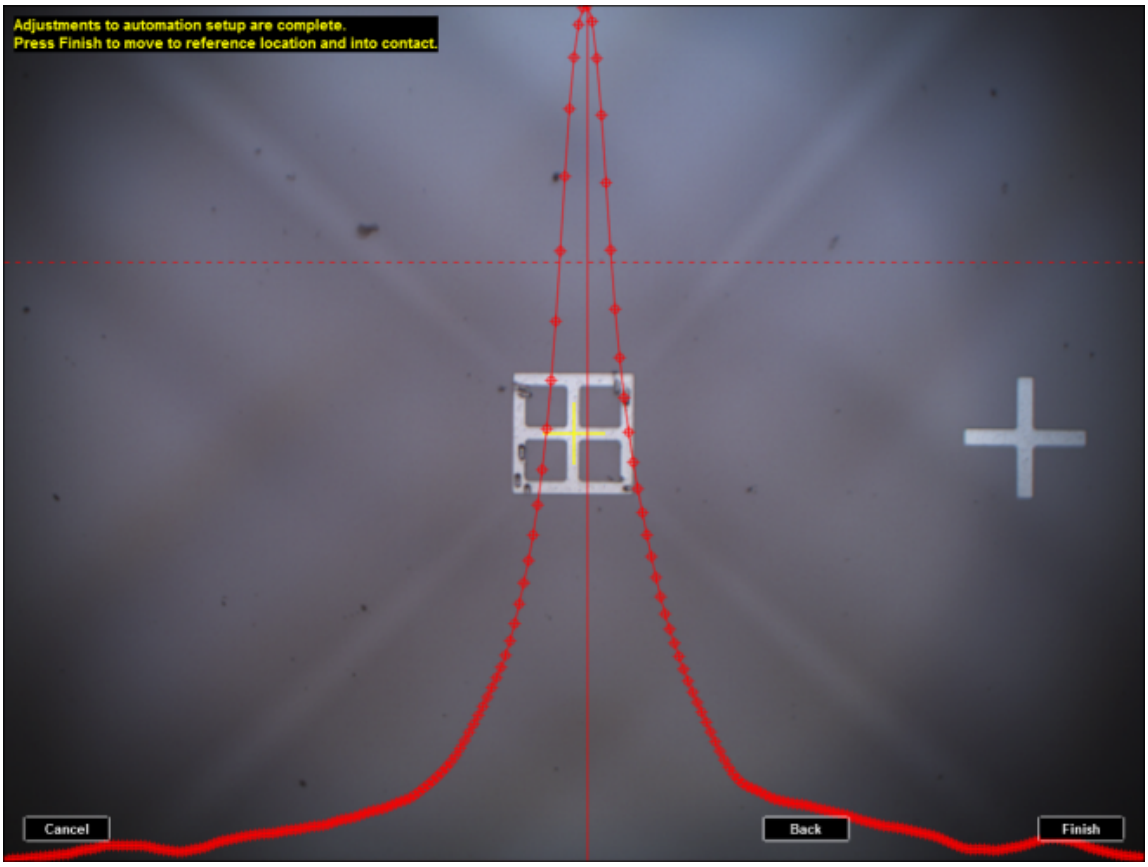
For RF needle training, place the training rectangle around the three probe tips covering some of the RF probe body and background of the wafer as shown:




For more information, see AutoRF Setup and Training.

## Wafer Reference Training

In the Automation wizard, wafer reference training follows needle training. You select a common reference on the wafer, then the system focuses on the target, and chuck and scope positions are captured for use as the die reference.




1. When all needles have been trained, click Next.
2. In the ControlCenter System Setup, click Chuck.

   The scope may also be used to navigate to and train the wafer reference; however, the chuck is recommended due to its superior repeatability and scaling compensation over temperature.
3. From the illumination controls, adjust Shutter and Illumination to approximately 50 percent.
4. Navigate to the nearest fiducial associated with the current die.
5. Train the AutoZ position that FindFocus will run.
6. Train the AutoXY model.
7. Click Finish when complete to return the chuck to probing position on the pads.

## Probing

Thermal Transitions

Wafer Realignment

Die Stepping & Probe Alignment

When wafer alignment, soak times, and automation training are complete, the probe station is ready for probing. The test executive can send the following sequence of commands through the remote interface.

For each temperature:

- Call `StartAutomationTemperature <Temp(i)>`.
- Call `GetAutomationTemperatureStatus` and wait for wafer soak timer to expire.
- Call `VueTrackAlign` to align the wafer and probes at the new temperature.
- For each die:
  - Call `StepNextDie`.
  - Measure die with SMU, or VNA for RF applications.
- End die loop.
- End temperature loop.

## Thermal Transitions

Transitions between chuck temperatures are controlled with the command `StartAutomationTemperature`, with the new set point temperature as the only argument. Once called, the thermal chuck ramps to the new set point temperature, then soaks at that temperature, depending on soak times configured in ControlCenter.

During both thermal ramping and soaking, Automation measures the XYZ position of the wafer reference and each needle tip, and uses the measurements to adjust chuck and needle spacing back to the offsets established during Automation training. The measure-and-adjust function executes approximately every two minutes.

When the wafer soak timer expires, `GetAutomationTemperatureStatus` returns COMPLETE and the wafer is considered soaked and ready for alignment at the new temperature.

## Wafer Realignment

The command `VueTrackAlign` is used to align wafers either after a wafer load or after a thermal transition with VueTrackPro. Note that the AutoAlign command alone is insufficient to update the alignment offsets of the wafer reference and needle tips in the Automation tool and should not be called. The purpose of `VueTrackAlign` is to unify data between tools, and is required to run after every wafer load and/or thermal transition for successful probing.

## Die Stepping & Probe Alignment

When Automation training is complete, the automation function is left in an enabled state. Any call to `StepFirstDie` or `StepNextDie`, or when you click on a die in WaferMap, triggers a die soak (if configured), followed by an execution of VueTrack.

If motorized positioners have been trained using VueTrackPro, individual needle correction and chuck position correction are performed. During this process, the wafer and needle positions are measured and adjusted similarly to the automation temperature process (Thermal Transitions).

Whenever VueTrackPro executes with motorized positioners, each probe tip is adjusted independently as follows.

1. For each positioner:
   a. Perform a focus scan on the probe tip using the trained probe tip vision model with the pattern-matching algorithm to find the probe tip in Z.
   b. Perform a feature recognition of the probe tip vision model at the new focal plane to find the probe tip in XY.
   c. Compute the XYZ offset of the current probe tip position relative to the position where it was trained.
   d. If the XYZ offset is greater than the CorrectionTolerance parameter in µm, send a correction move to the positioner controller to correct the measured probe tip offset.

e. Repeat probe tip correction steps until all three XYZ dimensions are within the *CorrectionTolerance*, or until the *MaxIterations* parameter has been exceeded
f. Repeat for all positioners.

2. Perform a focus scan on the wafer reference at the wafer reference position (AutoZ) to find the wafer reference in Z.
3. Perform a feature recognition of the wafer reference at the new focal plane (AutoXY) to find the wafer reference in XY.
4. Send a correction move command to the chuck to correct the measured wafer reference offset.
5. Move chuck to the updated XY probing position.
6. If `StepNextDie` was called with the chuck in contact, return the chuck to contact height on the new die; otherwise, leave the chuck at separation height.

On the Spectrum toolbar, click to enable or disable Automation.

# AutoRF Setup and Training


Train ISS Aux Site

Train Cleaning Reference and Clean Aux Sites

Define Cleaning Sequence

Cleaning Manager

Planarize and Initialize the Positioners

Calibrate the Positioners

Calibrate the Motorized Positioners

Train Automation


AutoRF setup and training requires you to train aux sites (ISS, Cleaning Reference and Cleaning Pad) and define cleaning sequences.

1. In ControlCenter, train the ISS aux site.
2. Train the cleaning reference and clean the aux sites.
3. Define the cleaning sequence.
4. Next, planarize and initialize the positioners.
5. In Spectrum, calibrate the positioners.
6. Proceed to the Automation training wizard.

## Define Cleaning Sequence

1. In ControlCenter System Setup, Aux Sites Settings, click the Cleaning Manager Open button.
2. Click the Create New Sequence button, then enter a name for the cleaning sequence. Click OK.

3. Select parameter values for the number of touchdowns each time (Clean Count), the delay time of each touch down (Clean Delay), and the overtravel distance per touch down.
4. Close the Cleaning Manager to save the values.

# Planarize and Initialize the Positioners

Planarize the Positioners

Initializing Motorized Positioners

## Planarize the Positioners

1. Planarize the probes on ISS (if not yet done).
   a. Use the manual knobs on the motorized positioners to adjust the angle until all tips in one probe are creating equal scratch marks on the ISS metal surface.
   b. Make sure the chuck vacuum is turned on.
   c. Before using thermal chuck, set the purge level to Auto in the Thermal Chuck tab in ControlCenter. This is important when the test needs to go to a low temperature.
2. Execute wafer auto-alignment (if not done yet on this wafer), and create the wafer map. Choose either 200 mm or 300 mm dimension for the wafer map. Choose the home die on the wafer map and set home position and contact height on the probing target in home die.

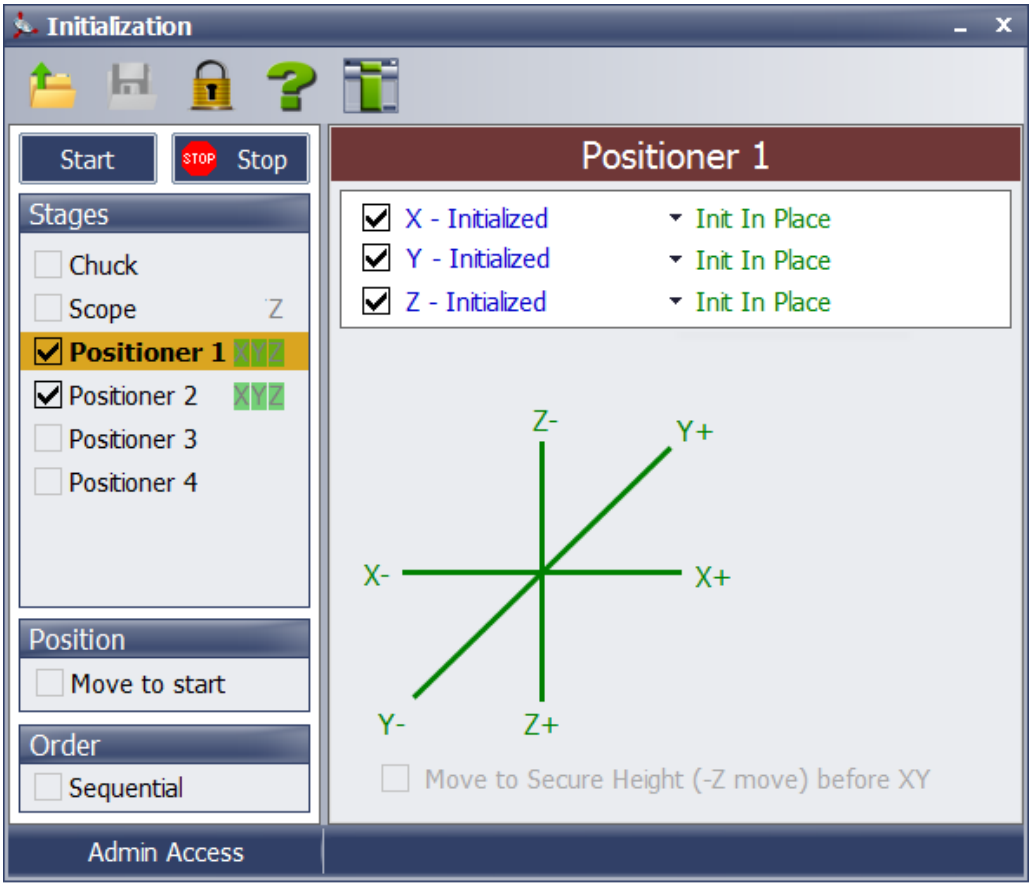
## Initializing Motorized Positioners

**CAUTION**

*You must initialize each positioner axis with Init in Place. Any other setting will cause damage.*

1. In the Velox main menu, click All applications > Tools > Initialization. Make sure that Chuck is not selected.

2. For the first motorized positioner, select Init In Place from the drop-down list for each axis, then click Start, and wait for initialization to finish.




3. Repeat for each motorized positioner.

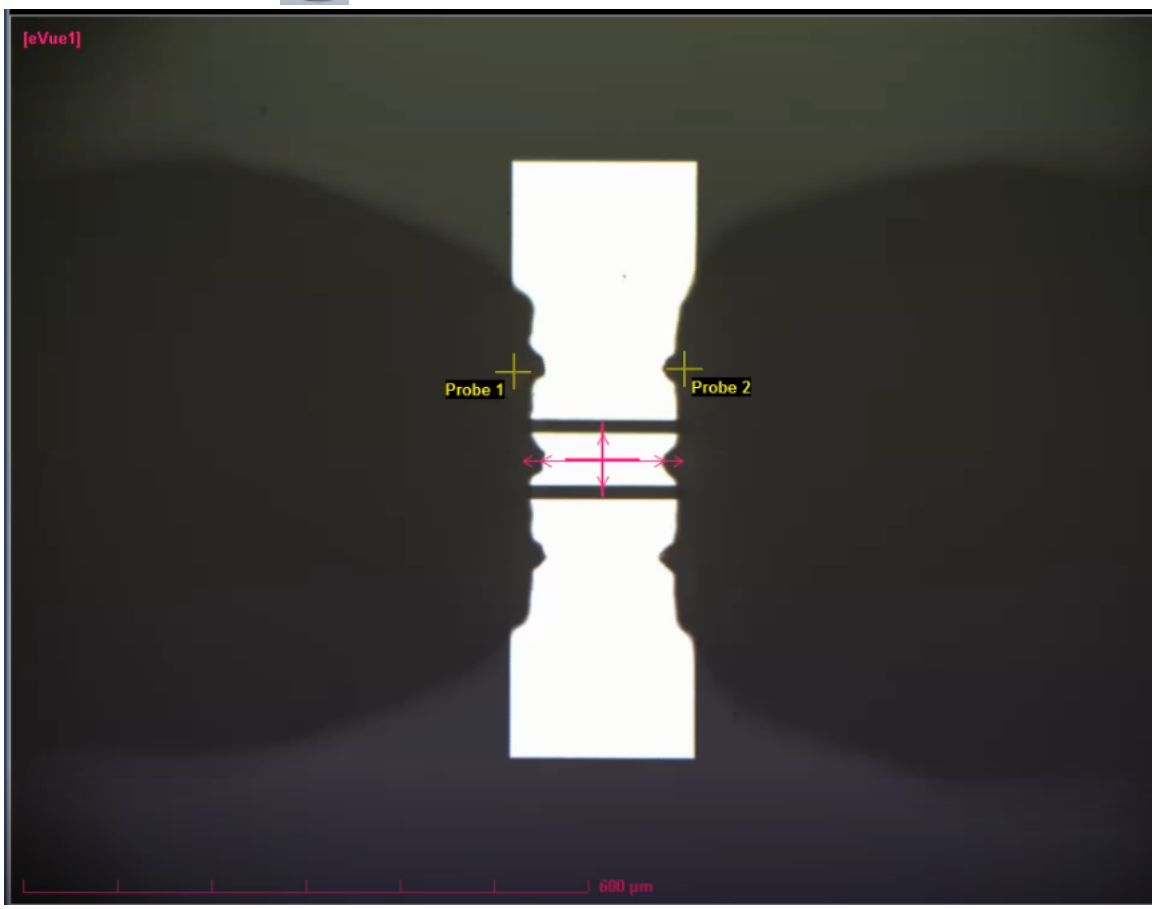
## Calibrate the Motorized Positioners

For details on calibrating positioners, see Configure and Calibrate Positioners. After completing the steps, finish the calibration process for motorized positioners.

1. Park the probes on the probing target with some overtravel.

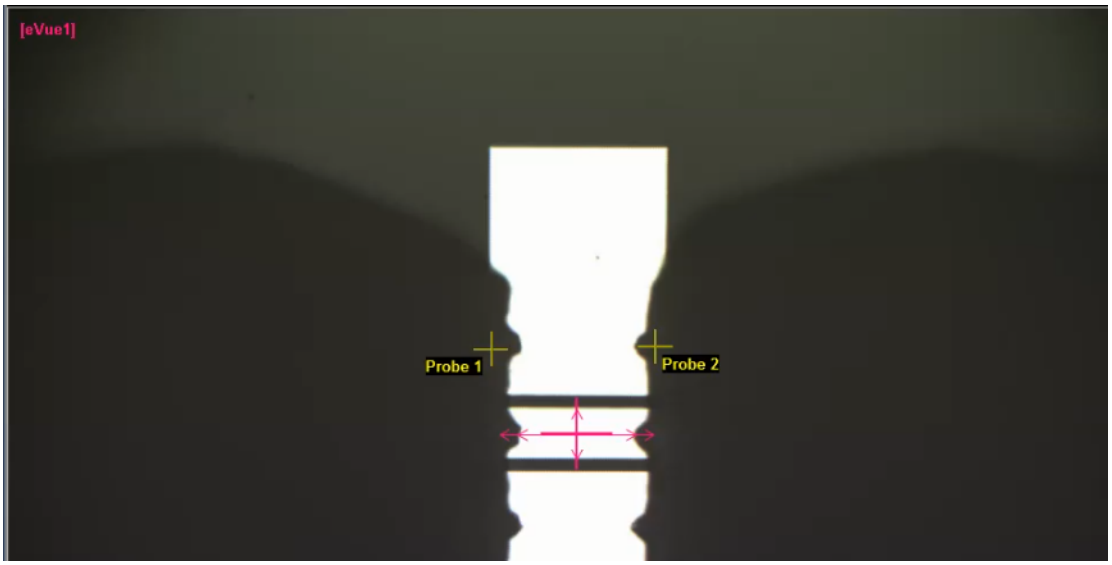
2. Set home positions and contact heights of the positioners.

Use MeasureOnScreen , to create overlays to identify the spacing while probing on the target.



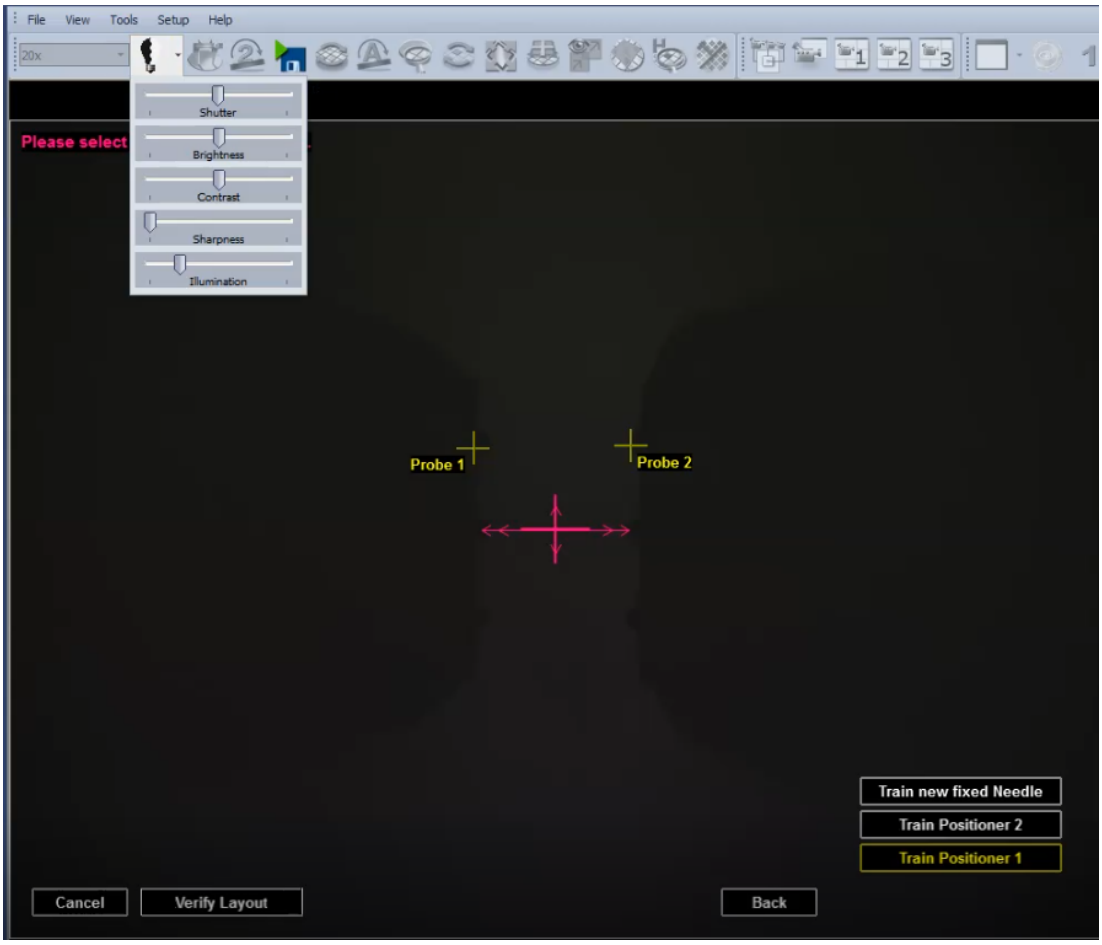

## Train Automation

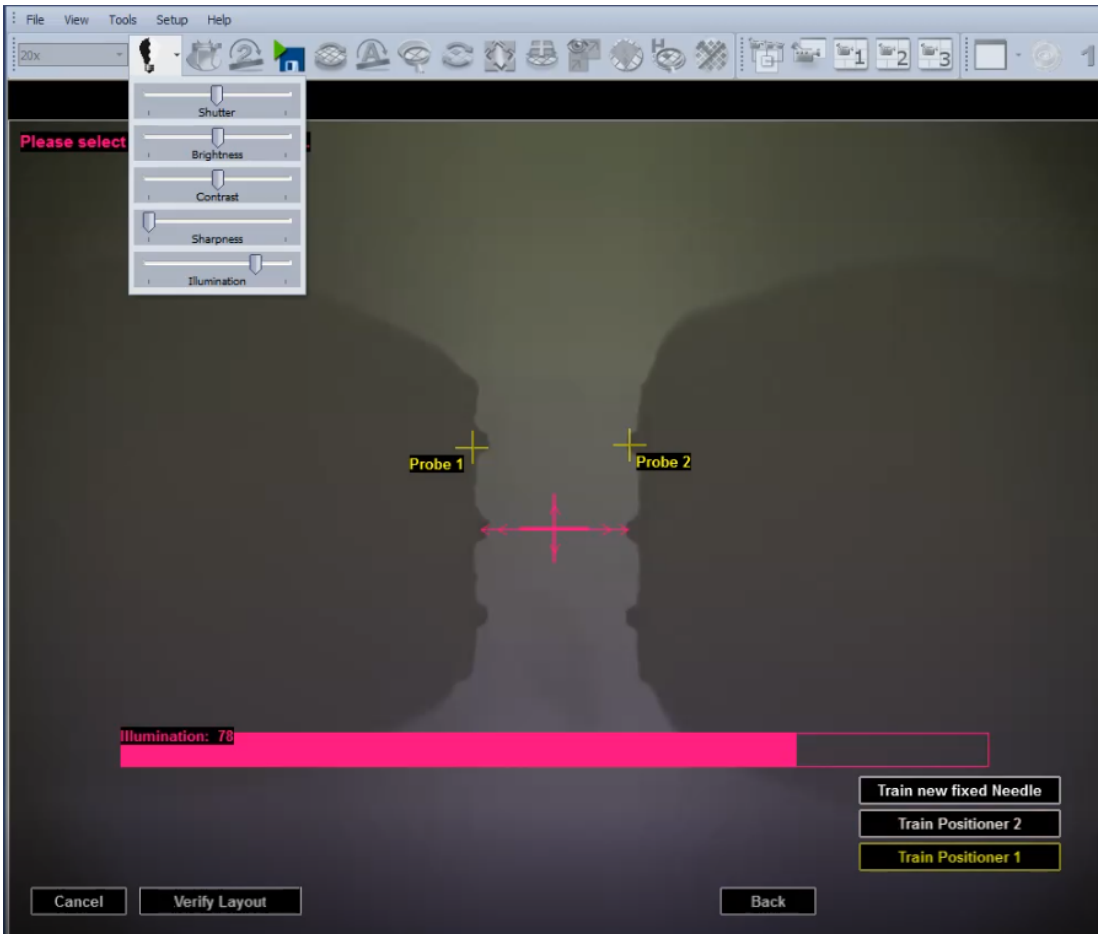
1. Verify that:
   - Wafer chuck, camera, and positioners are set to home and contact positions.
   - eVue is at center position.
   - WinCal is on.
2. Start the training wizard for Automation.
   This example is with 20x lens.



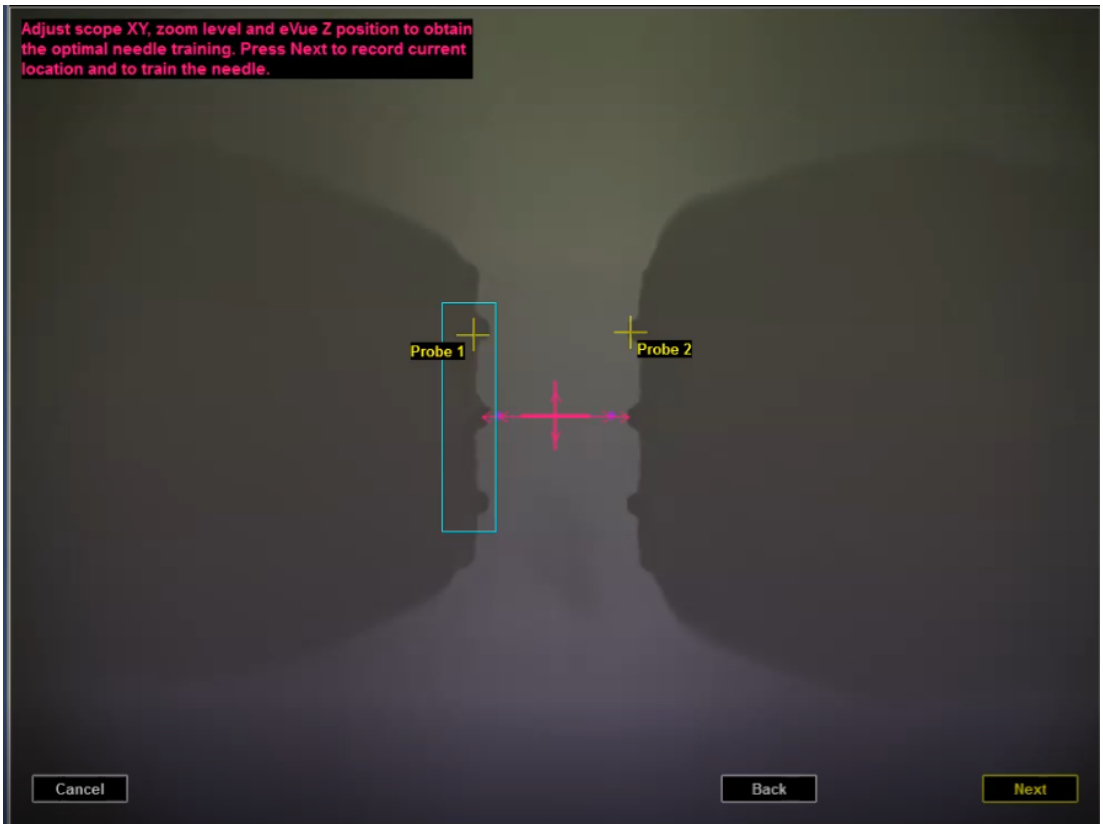

3. For AutoRF, enable all four boxes, then click Next. The wafer chuck drops to a safe height.

4. If needed, adjust the light setup, then click Train Positioner 1.


File
View
Tools
Setup
Help
20x
Shutter
Brightness
Contrast
Sharpness
Illumination
Please select
Probe 1
Probe 2
Train new fixed Needle
Train Positioner 2
Train Positioner 1
Cancel
Verify Layout
Back

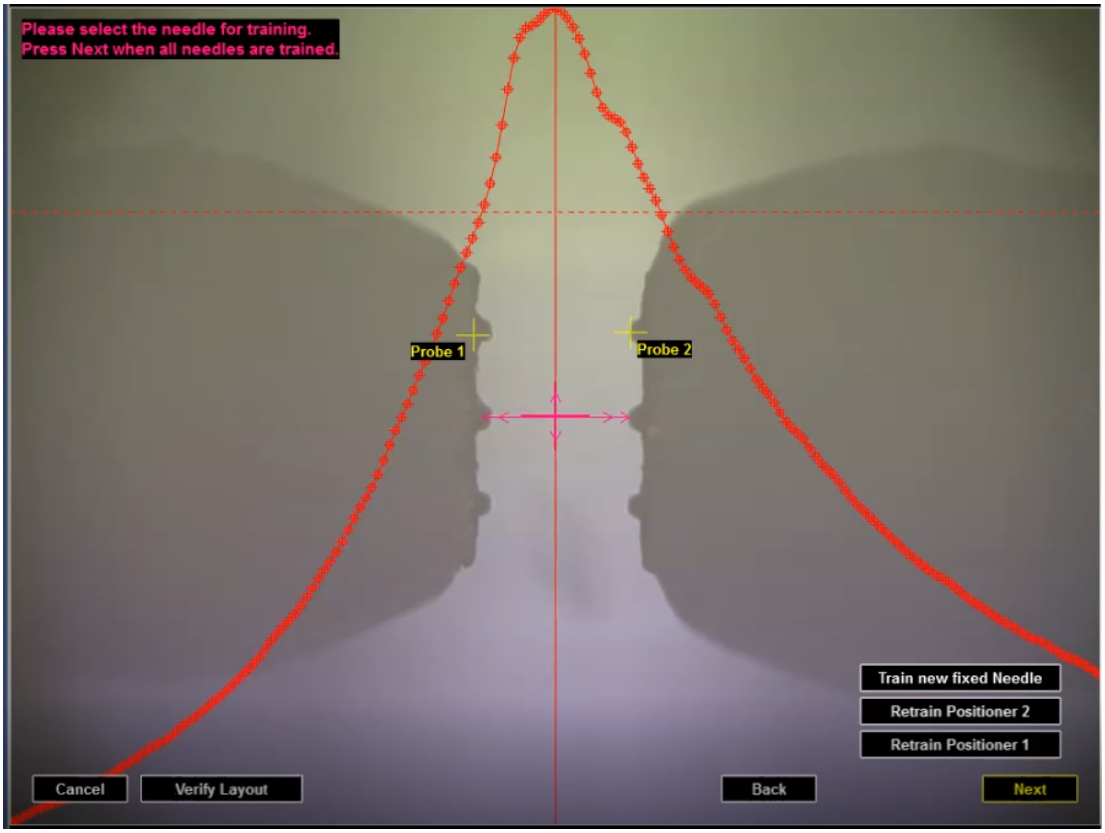



5. Resize the box to fit all Positioner 1 probe tips, and then click Next to see the focus curve.
   - If the focus curve is acceptable, click Next.
   - If not, click retrain Positioner 1.


Adjust scope XY, zoom level and eVue Z position to obtain the optimal needle training. Press Next to record current location and to train the needle.
Probe 1
Probe 2
Cancel
Back
Next

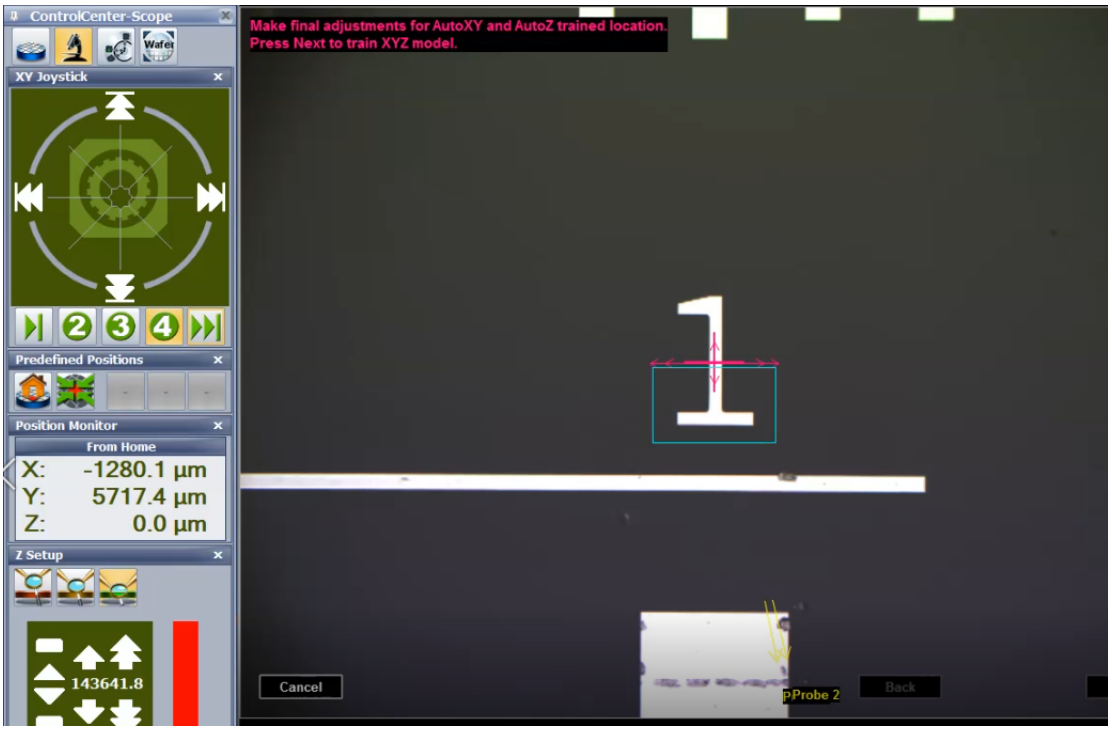
6. Click Train Positioner 2, adjust light, and retrain Positioner 2. Make small adjustments until a good focus curve is achieved, then click Next.

eVue automatically drops to 500 microns below its center of travel.




7. Adjust the light setup and find the unique die target.
8. Resize the box to fit the target, then click Next.

   This example uses scope transport to find the target. You can also choose to move the wafer to locate the target instead




- The wizard executes the default cleaning route saved in the Cleaning Manager window. The cleaning route automatically moves the chuck to the clean reference aux site (pre-trained), cleans the probe tips on the clean pad aux site (pre-trained), then moves to ISS aux site. The DC probes (if any) are moved to a safe location.
- The ISS aux site is initially at the lowest height.

9. Slowly bring up the ISS aux site until you see the ISS surface.
10. Change the light setup if needed.

    The S pattern should be within the field of view.

    Set the S pattern to the center of the field of view, then resize the box to fit. Click Next.

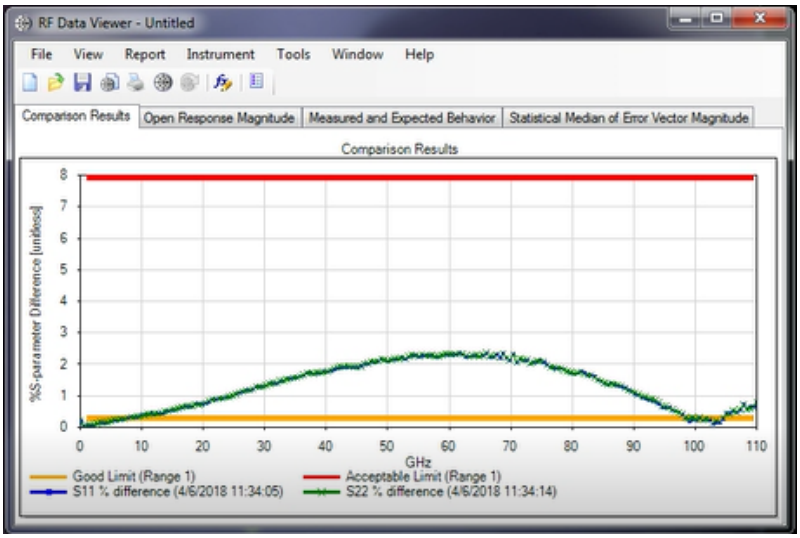
Move Chuck in XYZ to locate ISS model location.
Press Next to train ISS model.
Probe 1
Probe 2
Cancel
Back

11. Click Find Probes to locate the tips of RF probes.

The wizard recognizes probes on the tips when the ISS chuck is at Separate height and at Contact height.

12. Click Next. The wizard starts probe tip alignment with the S pattern in the center, then sets the home location.

13. Click the Next button to run AutoCal from WinCal. The wizard steps through the ISS structures and measurements.




14. After the validation pass, click Finish and the wizard returns the home location on the wafer.

**NOTE**

*When using 20x lens, stay in eVue camera 1 to locate this S pattern on ISS.*

*When using 10x lens, the field of view is wider and the pixels per unit area are fewer. You will need to switch to eVue camera 2 by clicking on the button on the eVue remote, so the wizard can recognize the S pattern.*

15. Click the Finish button to complete the training.
    The next step is to run your customized test or script.
16. Before running the test, verify the following:
    a. Chuck vacuum, ISS aux site vacuum, and cleaning pad vacuum are turned on.
    b. Purge level is set to Auto while using thermal chuck.
    c. Automation is trained and turned on to enable AutoRF and VueTrack function.
    d. AutoRF license is valid.
    e. The contact heights and home positions of chuck, scope and positioners are set.
    f. eVue is calibrated and the lens is set to correct magnification.
    g. Positioners are calibrated. If not, the positioner labels will be off from the tips.
    h. Probes are configured to the correct probe types.
    i. Motorized positioners move in the correct direction.

Chapter

# 6 Wafer Map

User Interface Controls

Set Up and Use WaferMap

View Menu

Map View Menu

Viewing and Defining Die Parameters

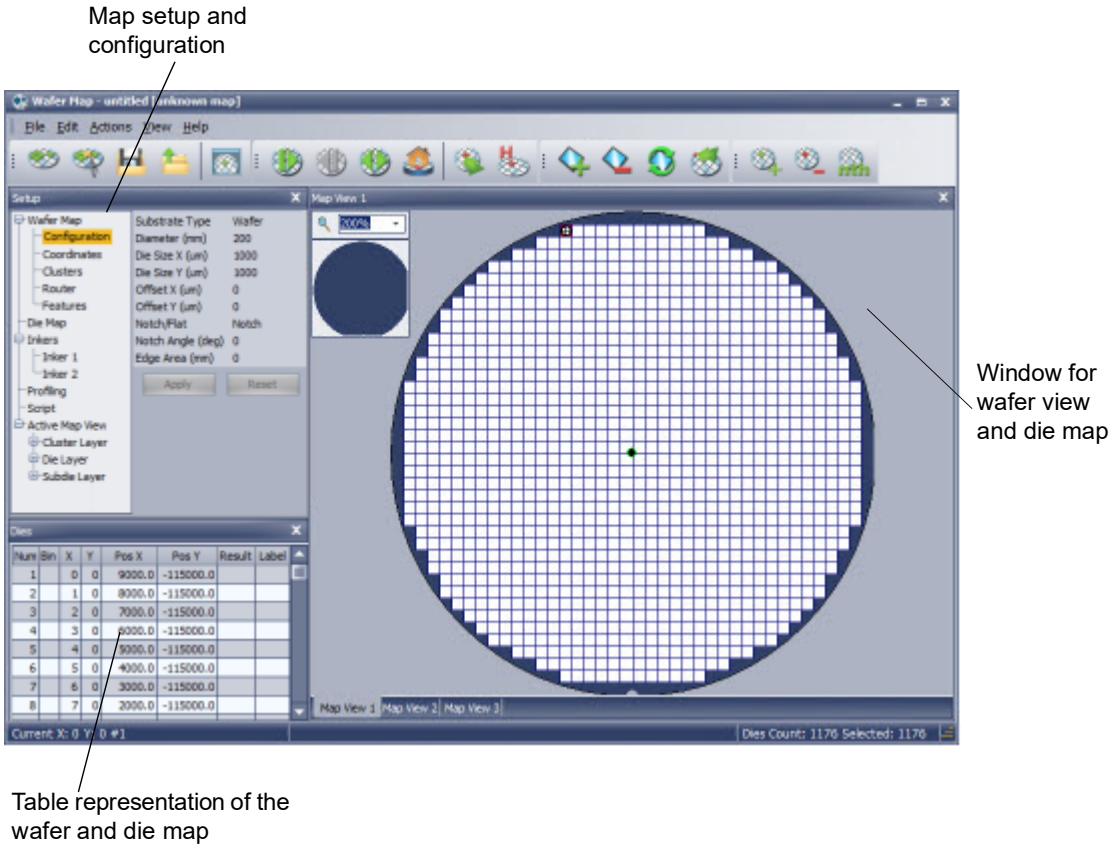
Viewing and Defining Subdie Parameters

Inking

Using Bins

File Formats

WaferMap is a graphical application used to probe regularly-spaced die arrays on a circular wafer or rectangular substrate. Once it is configured, WaferMap can move the chuck stage to any given die on the wafer. WaferMap stores a wafer's configuration, die selections, and bin information in a map file.



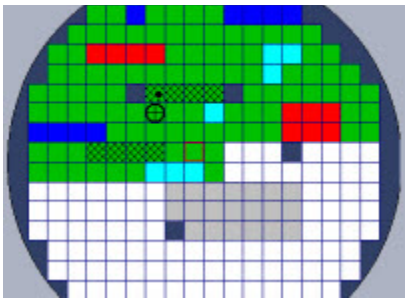

A die map is used for intra-die, or subsite, probing. After teaching a set of subsites, you can visit any subsite in any die. Click the die in the Wafer Map window, and click the subsite in the Die Map window.

In WaferMap, you can assign a test result to each die and use bins for the test results. Different bin values are typically displayed in different colors. After the measurement, the result is stored as a string that can handle any data you want. (Use the vertical bar character (|) to split the tested data into separate lines.)

The Dies and Subdies tables, Die Info pane, and Bin Auto Selection window display measurement results.

**Uses and Definitions**

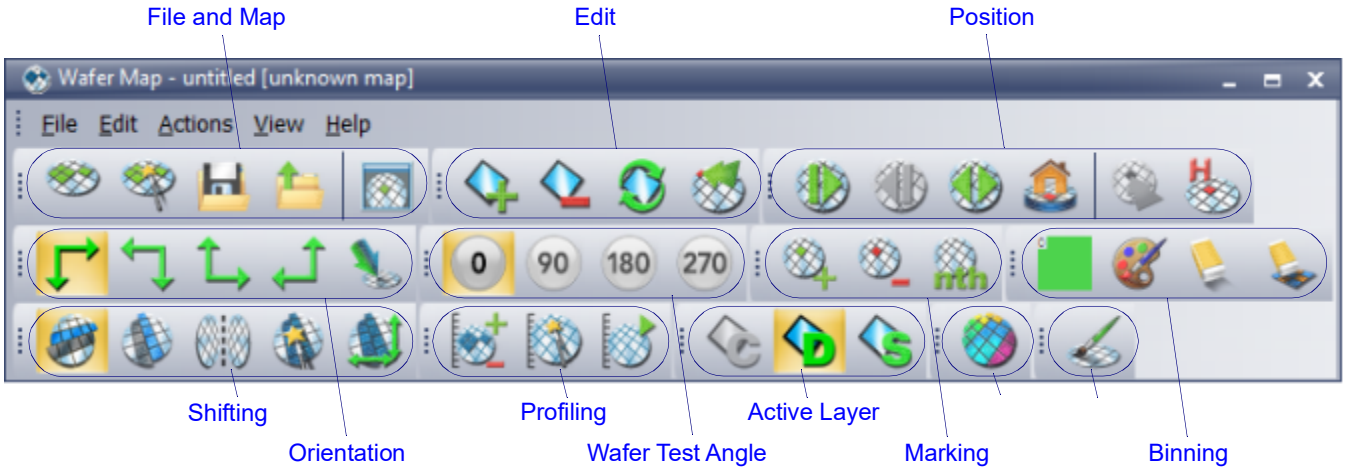
| | |
|---|---|
| Die | A rectangular test element is described by its size. All dies are arranged on the substrate in the grid. Each die has its own coordinate: X (column) and Y (row). Any die can include subdies. |
| Subdie | A subdie is a point test element that has no size and is described by its coordinates only. |
| Set Up and Use WaferMap | For wafer substrate, set the wafer diameter, die sizes, offset, and other parameters.<br>For rectangular substrate, set die sizes (in millimeters) and numbers of dies horizontally and vertically. |
| WaferMap IDs | |

| | |
|---|---|
| WaferMap Configuration | The default wafer has a diameter of 300 millimeters. Service-level access is required to change the allowable diameter size.<br>During wafer creation, WaferMap calculates how many full dies could be placed on the described wafer shape in X and in Y. Then it creates the grid and places it into the center of the wafer. Use the offset parameters to shift the grid up to the size of one die. |
| Coordinate System | Select the origin and orientation, home coordinates, and alpha coordinates. |
| Route Configuration (Test Sequence Stepping) | Select the type of route and stepping. |
| Profiling<br>Profile Table Data | Use Z-profiling to set Fine Focus, Edge Sensor, or Auto Focus as the Height Detection sensor. The Z-Profile table displays all dies added to the profile, and you can edit a value or move a die position. |
| Script | Enter a set of commands. Each line represents one command. |
| Statistics | Displays values such as time of wafer creation, number of all dies, and number of binned dies. Histograms provide bar chart and graph views. |
| Active Layers | Each Wafer View window has its own settings that you can define separately for each layer: dies, subdies, and clusters. Work with a cluster of dies the same way you work with one die. See also Clusters, Die Layer Stepping, and Subdie Layer Stepping. |
| View Menu<br>Map View Menu | Customize the display of the Map View window. |
| Overview | Displays a wafer map shape, notch (if needed), and a zoomed area. |
| Zoom Bar<br>XY Axis Key | In Zoom Bar, you can click the magnifier icon to switch the zoom mode on or off and select a new scale factor in percentage. |
| Controls Position | Set to top left, top right, bottom left, or bottom right. |
| WaferMap Position Indicator | Displays current position (relative to home) as a green circle with a black border. The current chuck position relative to the chuck center is represented as a black circle with a green border. |
| Viewing and Defining Die Parameters | You can choose to display a variety of parameters in the Map View window: bin color, die number, die coordinates, bin number, bin state, etc. By default, only bin color and die borders are enabled. |
| Dies View mode | To define which die parameters can be drawn in the current Map View window, click View > Map View > Dies. |
| Dies table data | To display the Dies table, which shows the dies that are marked to probe, click View > Dies Table. |
| Die Info window | To display die number, die coordinates, bin data, and measurement result for a specific die, click View > Dies Info. |
| Wafer substrate representation | Color representation information for current and inactive windows. |
| Die representation | Every visible die on the wafer map is drawn as a rectangle, which may be:<br>• White (marked to probe)<br>• Gray (marked to skip)<br>• Filled by the designated bin color.<br>Patterns include diagonal crosshatching (inked dies and binned dies that are marked to skip) and yellow circles on black (dies marked for profiling).<br>  <br>The home die is bordered in red. The current die is marked by a circle-cross mark. |

| | |
|---|---|
| Viewing and Defining Subdie Parameters | By default, all subdie properties except bin information and results are common for all dies. Every subdie of every die can be binned by different bins. The chuck coordinate system is used for the subdie coordinates. |
| Subdies View | To define which subdie parameters can be drawn in the current Map View window, click View > Map View > Subdies. |
| Subdies Table Data | To view and configure the subdie parameters, click View > Subdies Table. |
| Die Map Setup | To display the Setup window, click View > Setup, then select Die Map. |
| Inking | Structures can be inked independently or together with a test process. Each time a structure is binned by a bin with connected inkers, the structure is inked immediately. |
| Using Bins | The bin is a marker that groups the tested elements by similar characteristics |
| Bins View | To display the binned element, click View > Bins. |
| Features (Bin Setup) | To set bin table size and a flag to enable binning, click View > Setup > Features. |
| Bin Auto Selection | To set up automatic binning, click View > Bin Auto Selection. |
| Set Up Bin Rules | Use Bin Rules to check the test values from the measurement result string and define which bin to use. |
| Conditions Window | Conditions can be applied to the bin rules. |
| Bin and Bin Distance | If a rule includes a range condition, define the first and last bins to set the bin distance |
| Bin Rule Examples | To mark with bin, select the current bin, and then clear all bins or selected bins, click Actions > Marking. |

# User Interface Controls

You can customize the toolbar to suit your needs. The example below displays all possible toolbars. To toggle the display of a particular toolbar, click View > Toolbars. You can access most of the settings on the toolbars from the Actions menu or other menus.



# File and Map

| Toolbar | |
|---|---|
| | **New Map**<br>Creates a new wafer with default parameters. The new default wafer map uses the same die sizes as the last map used.<br>Click View > Map View to open a New Map View window. |
| | **New Map with Wizard**<br>Creates a map |
| | **Save map**<br>Saves the current map to the directory you select. |
| | **Open map**<br>Opens a map from a directory you select. |
| | **New Map View Window**<br>Creates a new Map View window and corresponding tab. |

| File Menus | |
|---|---|
| Project | Includes the typical functions for managing files: New, Open, Save, and Save as.<br>WaferMap uses Velox Project files for saving the setup parameters and user preferences. |
| Map | You can add, open, and save maps, and display a list of the last files used (up to four). See Map Files. |
| Subdies | You can open and save files for storing subdie table information (.stv files). You can also open legacy subsite .csv files. |
| Bins | You can open and save Bin Code Table (.bct files) that store bin configuration. |
| Print | Opens a special print window for printing the wafer configuration and wafer view, using the picture in the active Wafer Map window. You can select printing information for wafer map, bins, and die table. Use standard Print Setup to set printing parameters. |
| Login | Opens the permissions window for changing your access level. The application opens with the last used permission level. |
| Exit | Closes the WaferMap application. |

**Map Files**

Map (.map) files contain the test and binning results for a wafer and the wafer configuration data, subdie, table and bin configuration. Like project files, map files are text files that follow the Windows INI file format of sections, keys, and values. Only the WaferMap application uses .map files. You can create a new wafer map using the Design Wizard.

Map files and KLA Results (.kla) files provide a common format for test results storing from KLA Tencor that you can open and save. Also, you can save dies to a .csv file format. You can also open special die portion (.dpt) files where the first line indicates which die is stored inside (skip or probe). All other lines represent two coordinates of the die.

## Edit Menu

| | |
|---|---|
| | **Copy To Clipboard**<br>Copies the picture of the active Map View window to the clipboard. |
| | **Add**<br>Adds individual dies or a selection of them. Click Add and then click a die or area of dies. |
| | **Remove**<br>Removes individual dies or a selection of them. Click Remove and then click an individual die or select an area where all dies in the area are to be removed. |
| | **Invert**<br>Inverts individual dies or a selection of them. This command combines Add and Remove functions, with one difference: This feature is similar to add/remove, but adds only dies that were previously on the wafer. Click Invert, and then click a die or area of dies. |
| | **Map Edge Dies**<br>When Map Edge Dies is active, the subdies (subsites) that lie on edge dies and that are completely on the wafer shape are enabled for test. This position is calculated from the subdies width and height. All edge dies that include such a subdie are marked for probing, too. When Map Edge Dies is inactive, functionality is disabled for all edge dies of the wafer.<br>Each edge die that is marked for probing has a unique set of subdies that are enabled (based on the location and size of the subdie). To view which subdies are enabled for a given edge die, select the edge die and then view the Subdie Table. You can also modify which subdies are enabled for the selected edge die. |

# Actions Menu and Toolbars


Position

Orientation

Wafer Test Angle

Marking

Shifting

Profiling

Active Layer

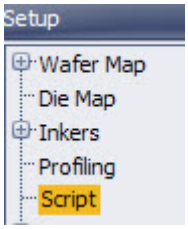
Show Demo

Inking

Binning


The Select, Set Home, Click Home, Step Next, Step Prev, Go To, and Script actions position the wafer.

## Position

| | |
|---|---|
| | **Select**<br>Enables or disables a mode in which you can click to select any die. In the selection mode, two tool windows, Subdies and Die Info, work with the currently-selected die instead of the current die. |
| | **Set Home**<br>Coordinates the wafer map with the actual wafer, if both are positioned on the same die. This is the most critical step when setting up the wafer map; an error here identifies test results with the wrong die.<br>Click Set Home, then click on the die or subdie to use as the home die of the wafer, based on the active layer. |
| | **Home**<br>Moves the chuck to the home position. The chuck moves to the home die or subdie, based on the active layer. |
| | **Step Next, Step Prev, Go To**<br>Move the chuck between clusters, dies, or subdies for the current active layer.<br>After you click Go To, click on the layer (cluster, die, or subdie) where you want the chuck is to move. |
|  | **Script**<br>You can create a script in the WaferMap Scripting pane, apply it to the WaferMap toolbar, and then run Go To with Script. See Script for more information. |

## Orientation

Define the coordinate system for the wafer map and for the selection mode.

When Select Origin mode is active, you can click on any die to select the origin of the coordinate system.

## Wafer Test Angle

Use this option to set the wafer test angle to 0, 90, 180, or 270 degrees while maintaining the XY coordinates, the route, the die home location, die, subdie, and data stored within the WaferMap (on a per-die basis). This is useful when loading wafers onto the chuck at different angles.

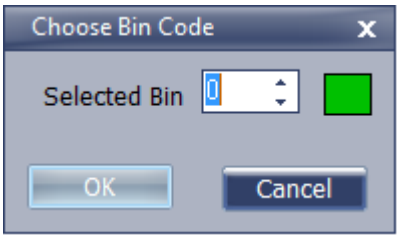
By default, the Wafer Test Angle is set to 0 when a new map is created. All rotations are clockwise.

## Marking

| | |
|---|---|
| | Mark To Probe<br>Starts a mode in which you click a die (subdie) or select a number of dies on the wafer map to mark to probe. |
| | Mark To Skip<br>Starts a mode in which you can click on a die (subdie) or select a number of dies to mark to skip. |
| | Probe Nth Element<br>Marks every Nth element on the wafer map to be probed. You select a value for *n*. |

## Binning

See also Using Bins.

| | |
|---|---|
| | **Mark With Bin**<br>Starts a mode in which you can click a die or select a number of dies on the wafer map to bin dies. Also indicates the current bin. The color and number (code) of the current bin are shown on the button. |
| | **Current Bin**<br>If the number of the current bin is selected, the green color to the right of the bin number indicates that it is the current bin.<br>  |
| | **Clear Selected Bin**<br>Starts a mode where you can click on a die or select a number of dies to clear the die bin or bins. |
| | **Clear All Bins**<br>Clears all bins on all dies in the wafer map. |

## Shifting

| | |
|---|---|
| | **Row Shifting**<br>Switches to shift lines mode. |
| | **Column Shifting**<br>Switches to shift columns mode. |

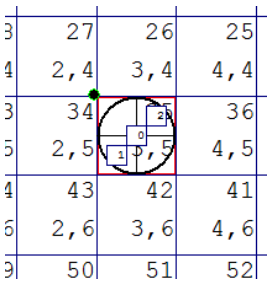
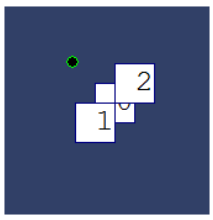
| | |
|---|---|
| | **Mirrored Wafer**<br>Enables or disables mirrored mode for the wafer in which all shifted lines (columns) are mirrored after a center of the wafer. |
| | **Set Shift Value**<br>Sets a shift value for interactive shifting. |
| | **Mark to Shift**<br>Enables or disables a mode in which you can mark lines (columns) to shift on selected shift value by clicking on them or by selecting the number of them. |

## Profiling

| | |
|---|---|
| | **Mark/Unmark to profile**<br>Click a die or click and drag to mark/unmark multiple dies to profile. |
| | **Define a Profile**<br>Manually set the die to be tested. To enable the Define a Profile mode:<br>1. Click Profiling in the Setup pane and clear the 'Use Global Settings check box.<br>2. Click in the toolbar or Actions > Profiling > Define a profile to open the Mark dies to profile window. |
| | **Run Profiling**<br>Starts or stops the Z-profiling process. You must set contact height before starting.<br>If the profiling is started before all points have been profiled, WaferMap prompts you to continue the previous profiling or start it again. |

## Active Layer

The active layer (cluster, die, or subdie) applies to the Wafer View window and certain movement and marking commands. If some interface features (sites and/or clusters) are disabled, not all layers will be active. See Active Layers for more information.

| | |
|---|---|
| | **Cluster Layer**<br>Switches the active layer to Cluster layer. |
| | **Die Layer**<br>Switches the active layer to Die layer.<br>  |
| | **Subdie Layer**<br>Switches the active layer to Subdie layer.<br>  |

### Show Demo

Starts or stops a demonstration.

### Inking

Starts or stops the inking process. See Inking for more information.

## View Menu

Toolbars Menu

| | |
|---|---|
| Map View | Customize your Map View windows. See Map View Menu for details. |
| Setup | Shows or hides the Setup tool window. |
| Bins | Shows or hides the Bin Code tool window. |
| Statistics | Shows or hides the Statistics window. Select a Standard, Histogram 1, or Histogram 2 view. |
| Dies Table | Shows or hides the Dies window. |
| Subdies Table | Shows or hides the Subdies window. |
| Clusters Table | Shows or hides the Clusters window. |
| Die Map | Shows or hides the Die Map window. For easier viewing, display the Die Map view when you set up subdies.<br><br>See Viewing and Defining Subdie Parameters for more details. |
| Die Info | Shows or hides the Die Info window. |
| Bin Auto Selection | Displays the Bin Auto Selection window. You can automatically bin elements (dies or subdies) when a result is assigned to the element. |
| Profile Table | Shows or hides the Profile window. |
| Toolbars | Select toolbars to show or hide. |

## Toolbars Menu

Click View > Toolbars to display or hide any of the toolbars in the Wafer Map window.

| | |
|---|---|
| **Edit** | Includes buttons for adding, removing, inverting, and enabling subdies. |
| **Map** | Provides standard actions with maps. |
| **Position** | Includes buttons for chuck movement and working with wafer home. |
| **Binning** | Includes buttons for binning. |
| **Marking** | Includes buttons for marking dies to probe and to skip. |
| **Demonstration** | Starts or stops the demonstration. |
| **Inking** | Starts or stops the inking process. |
| **Active Layer** | Includes buttons for working with the active layer. |
| **Orientation** | Includes the buttons to define the coordinate system for the wafer map and for the selection mode. |
| **Wafer Test Angle** | Includes the buttons you can use to set the Wafer Test Angle to 0, 90, 180, or 270 degrees while maintaining the XY coordinates, the route, die home location, die, subdie, and stored data. |
| **Shifting** | Includes buttons for shifting dies to probe and to skip. |
| **Profiling** | Includes buttons for profiling process. |

# Map View Menu

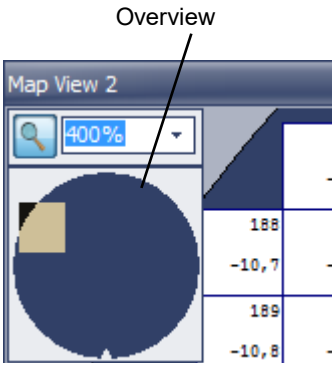
MapView Context Menu

To access the Map View menu, click View > Map View. Features described below must be enabled in the View menu to be visible.

The Controls Position setting determines which corners the Overview and XY axis key are displayed (top-left, top-right, bottom-left, bottom-right).

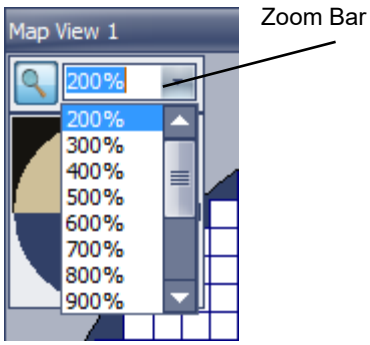
**New Window**

Displays a new Map View window. You can display different sets of information, a zoomed view, and so on for each new window. Click a tab at the bottom of the Map View window to view a specific map view.




**Overview**

Shows or hides a wafer shape, a notch (if selected), and a zoomed area. You can click inside the overview pane and drag the rectangle to the desired location on the wafer map.



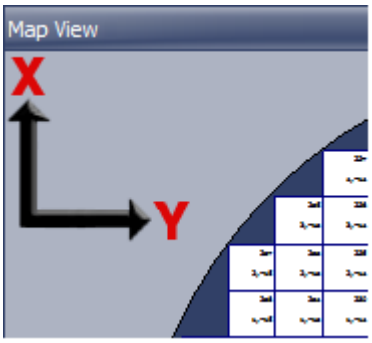

**Zoom Bar**

Appears in the top-left corner of the Map View window.

- Zoom button toggles between zoomed and regular views.
- Zoom scale drop-down list specifies a zoom scale factor. When you change the scale factor or status of the zoom mode, the Map View window saves the previous position and displays only a specified part of the wafer map.
- Zooming in/out scale factor increases/decreases to the nearest bigger/smaller number divisible by 100.

**Zoom In/Zoom Out**

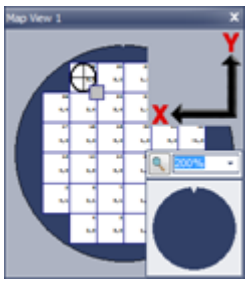
Zooms in/zooms out in the picture in the current Map View window.




**XY Axis Key**

Shows or hides the XY axis key.

See also Orientation and Wafer Test Angle for more information.

| | |
|---|---|
| Overview controls top-left position | **Controls Position**<br>Moves the Overview pane to any of the four corners of the Map View window. When the XY Axis Key is also enabled, it moves in relationship to the Overview pane. |
|  Overview controls bottom-right position | |
| | **Dies**<br>Use the Dies menu group define which die parameters can be drawn in the current Map View window. |
| **Show** | Shows or hides dies. |
| **Border** | Shows or hides die borders. |
| **Number** | Shows or hides the die numbers inside the dies. |
| **Coordinates** | Shows or hides the die coordinates inside the dies. |
| **Results on Die** | Shows or hides the measurement results for the die. If enabled, all other symbolic data on the die, Die Number, Die Coordinates, Bin Number, Bin Chars and Bin State are disabled. (If the measurements result string is too long, the last part is replaced by "…".) |
| **Bin Color** | Shows or hides a bin color on the dies. |
| **Bin Number** | Shows or hides the bin numbers (codes) inside the dies. |
| **Bin Chars** | Shows or hides the bin letters inside the dies. |
| **Bin State** | Shows or hides the bin state inside the dies. |
| | **Subdies**<br>Use the Subdies menu group to define which subdie parameters can be drawn in the current Map View window. |
| **Show** | Shows or hides subdies. |
| **Use Small Size** | Displays subdies in a small size. |
| **Border** | Shows or hides subdie borders. |
| **Number** | Shows or hides the subdie numbers inside the subdies. |
| **Bin Color** | Shows or hides a bin color on the subdies. |
| **Bin Number** | Shows or hides the bin numbers (codes) inside the subdies. |
| **Bin Chars** | Shows or hides the bin letters inside the subdies. |
| **Bin State** | Shows or hides the bin state inside the subdies. |
| **Follow Mode** | View the current die during the chuck moving. When enabled, the View window tries to center the current die in the window automatically after each movement. |
| **Show Hint** | Shows or hides the data for the any item as hints. |
| **Chuck Position from Home** | Displays the chuck position relative to the home position. |

### MapView Context Menu

Right-click anywhere in Map View for a menu that includes the option to copy the Map View picture to the clipboard.

## WaferMap Help Menu

When you access Velox Help from the WaferMap Help menu, the help file opens at the beginning of the WaferMap topics.

The Remote Commands menu item opens the Velox Remote Interface Help.

About WaferMap displays important product, version, and copyright information.

# Set Up and Use WaferMap


WaferMap IDs

WaferMap Configuration

Coordinate System

Clusters

Route Configuration (Test Sequence Stepping)

Features (Bin Setup)

Die Map

Inking

Profiling

Script

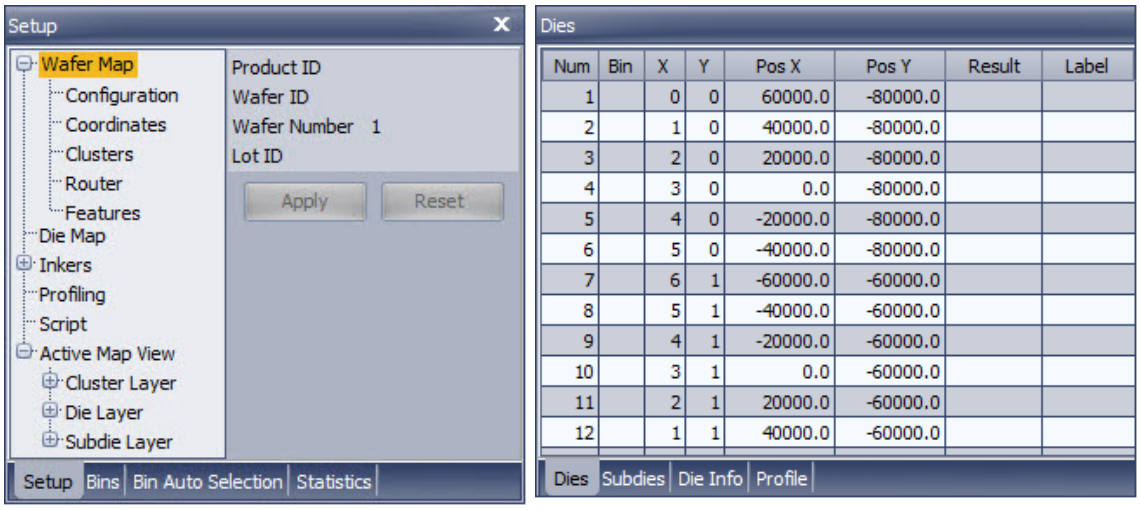
Statistics

Active Layers

Die Layer Stepping

Subdie Layer Stepping


Click a tab at the bottom of the pane to access an enabled view. All of the views below are enabled from the Views menu.



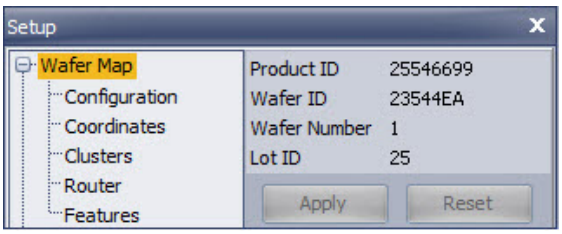

Use Setup to change parameters. It uses different font colors for different parameter states:

- Black is the default font.
- Green indicates a changed parameter before you click the Apply button to save it.
- Red indicates parameter is incorrect.

**NOTE**

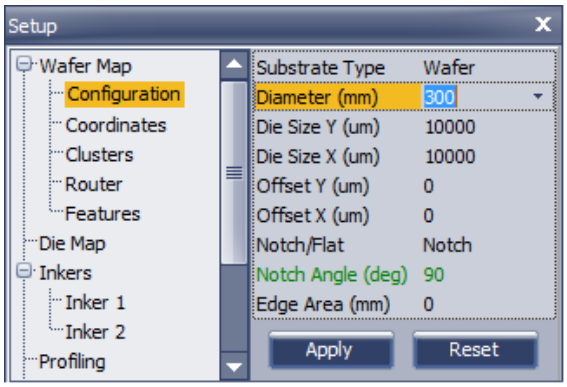
*Apply and Reset buttons are activated if you have changed at least one of the parameters.*

## WaferMap IDs




In the Wafer Map node, you can view and change wafer IDs (Product ID, Wafer ID, Wafer Number and Lot ID).

## WaferMap Configuration




Substrate Type: Wafer (circular) substrates and rectangle substrates have different configuration parameters.

For circular (wafer) substrates, define the following:

- diameter (in millimeters)
- die size X, die size Y (in microns)
- offset X, offset Y (in microns)
- flat angle (in degrees) and flat length (mm)
- a notch angle (in degrees)
- an edge area (in millimeters)

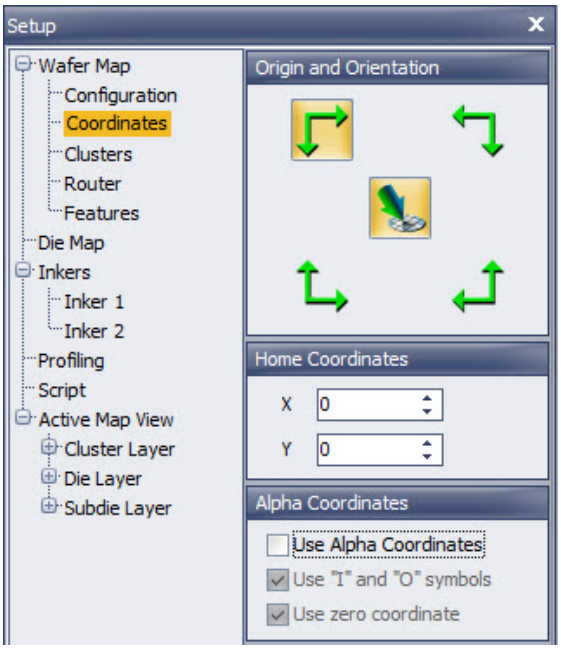
A circular wafer can have a flat cut. The flat angle describes where this flat part is placed on the wafer: at bottom (0°), at left (90°), at top (180°) and at right (270°). The flat length describes the length of the flat cut. The flat length will be changed automatically based on the selected diameter, but it can also be changed later.

For rectangle substrates, set die sizes (in millimeters) and numbers of dies horizontally and vertically. By default the die size is the same as the probe station index. When you edit the die size and apply the changes, the probe station index is automatically updated.

Click Apply to implement changes. When wafer parameters are changed, the wafer map will be rebuilt. Some data may be lost (if new wafer is smaller than old one).

Click Reset to restore the last settings applied.

## Coordinate System




This mode lets you change the coordinate settings.

Origin and Orientation—The selected corner button determines the current directions for the coordinate system. The arrows determine the directions in which an X or Y coordinate will increase.

When you select an origin for the coordinate system, the center button turns the mode on or off. A coordinate grid will be drawn in the WaferMap view, and you can select any cell as an origin (this cell has (0, 0) coordinates).

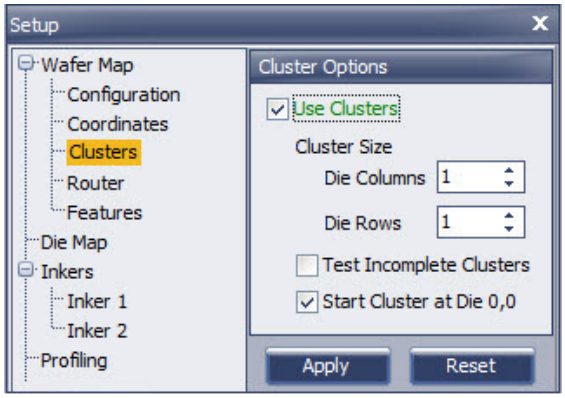
Home Coordinates—Shows the coordinates of the home die and lets you manually edit the values for this die

Alpha Coordinates—Because the Latin symbols I and O are similar to digits, they could be eliminated from the coordinates unintentionally.

Enable Use Alpha Coordinates check box to replace all column coordinates by alpha characters: 0 is A, 1 is B, -1 is -A, and so on.

## Clusters

A cluster is a group of dies. The cluster is described by its size in dies in X and in Y. For example, a 2x3 cluster means that the cluster has 3 rows of dies where each row has 2 dies. The cluster grid always starts from the home die (the leftmost and topmost die of the cluster).

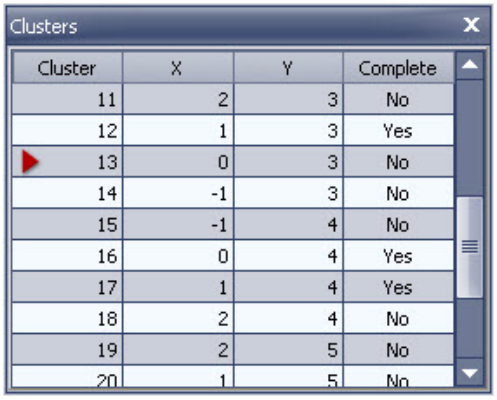



Clusters let you work with a group of dies the same way as one die. By default, a wafer map has no clusters.

If Use Clusters is enabled, a cluster size can be set in dies. In the Map View, cluster borders are represented as orange lines. Like dies, the clusters have coordinates. The cluster with (0, 0) coordinate starts from the origin. The top left die of this cluster is the die with (0, 0) coordinates.

Test Incomplete Clusters: a cluster is incomplete if it includes holes (does not have all dies). For example, if the cluster is 5x4, it should include 20 dies. If the cluster consists of a smaller number of dies, it is an incomplete cluster.

If Use Clusters is enabled, the chuck will move to incomplete clusters, otherwise it will test only full clusters.



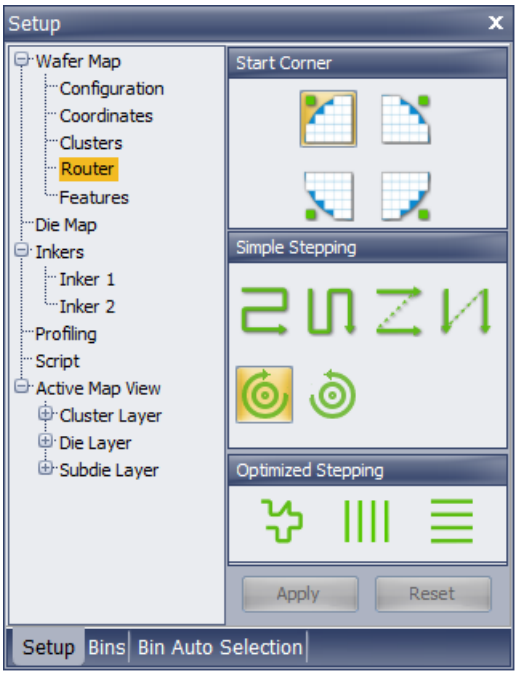

| Cluster | X | Y | Complete |
|---|---|---|---|
| 11 | 2 | 3 | No |
| 12 | 1 | 3 | Yes |
| 13 | 0 | 3 | No |
| 14 | -1 | 3 | No |
| 15 | -1 | 4 | No |
| 16 | 0 | 4 | Yes |
| 17 | 1 | 4 | Yes |
| 18 | 2 | 4 | No |
| 19 | 2 | 5 | No |
| 20 | 1 | 5 | No |

**Cluster table data**

The Clusters table displays the cluster number according to the route parameters, cluster coordinates (a column and a row), and a flag that indicates if this cluster is complete or not.

The current cluster is marked by a red arrow in the cluster number column.

## Route Configuration (Test Sequence Stepping)




Sets the properties of the die probing route.

Start Corner—Select one of the possible routes to start from. This route determines the order in which the dies will be probed. This order also determines die numbers.

Simple Stepping can include horizontal and vertical routes (bidirectional or unidirectional), or spiral routes (clockwise and counterclockwise).

Select a subtype for a simple route:

- Horizontal bidirectional
- Vertical bidirectional
- Horizontal unidirectional
- Vertical unidirectional
- Spiral clockwise (center-outwards)
- Spiral counterclockwise (center-outwards)

For each type of horizontal or vertical stepping, a start die can be designated by selecting the start corner of the wafer. If a vertical bidirectional route is selected, dies will be probed in columns from right to left, starting from the right bottom corner. Each odd column will be probed from bottom to top and each even one from top to bottom.

Optimized Stepping—An optimized route will reduce ineffective movement between dies. Optimized routes can minimize movements in X and Y directions, in X direction only, or in Y direction only. For a route that minimizes movements in one direction only, you can set a start point using a column only (for the X minimization) or a row only (for Y minimization). Another starting coordinate is automatically calculated for the best quality.

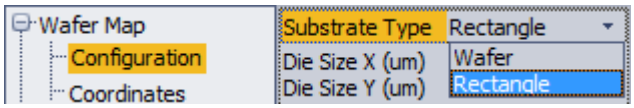
# Profiling

Global Settings

Profile Table Data

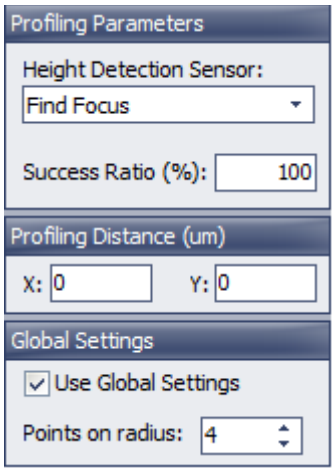
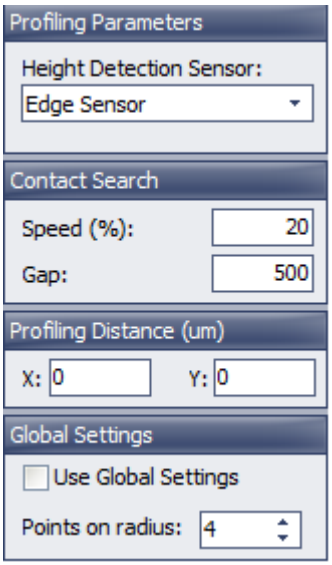
Profiling parameters determine how the profiling will be performed (Find Focus or Edge Detection).

The profiling options differ depending on the substrate type (Wafer or Rectangle) selected in Configuration.




See also Global Settings and Profile Table Data.

| | |
|---|---|
| **Rectangle profile** | For Rectangle profile, define two (2) parameters for the rectangle profile: dies in X and dies in Y. |
| **Wafer profile** | Define one (1) parameter for the wafer profile: Points on radius.<br>The wafer profile can be described by a diameter, a number of points on a radius, its flat angle and flat length and an edge area. The wafer profile is created in the following way:<br>• A start point is placed in the start position, which can be selected in the Start Position group: center or one of four positions on the wafer border.<br>• The radius is calculated as a (diameter – 2 * (edge area))<br>• A radius is divided into a number of equal parts. The number of parts is equal to the Points on radius value minus 1.<br>The result is some points along the radius. The circle close to the center consists of 6 points, the next circle consists of 12 points, the third of 18, and so on.<br>The flat angle and the flat length are used during this creation. |
| **Height Detection Sensor** | Defines a method to use for height detection: FindFocus or Edge Sensor. |
| **Success Ratio % (Find Focus)** | Set the percentage of successfully profiled dies to establish that the profiling process itself is successful. (Not used for Edge Sensor.) |
| **Contact Search (Edge Sensor)** | Set the chuck movement speed and gap. |
| **Profiling Distance** | Enter the X/Y value to add to the profile point during the profiling. |

| | |
|---|---|
| **Circular Wafers** |   |

| | | |
|---|---|---|
| **Rectangular Substrates** | Profiling Parameters<br>Height Detection Sensor:<br>Find Focus<br>Success Ratio (%): 100<br>Profiling Distance (um)<br>X: 0 Y: 0<br>Global Settings<br>☐ Use Global Settings<br>Dies in X: 5<br>Dies in Y: 5 | Profiling Parameters<br>Height Detection Sensor:<br>Edge Sensor<br>Contact Search<br>Speed (%): 20<br>Gap: 500<br>Profiling Distance (um)<br>X: 0 Y: 0<br>Global Settings<br>☑ Use Global Settings<br>Dies in X: 5<br>Dies in Y: 5 |

## Global Settings

The Use Global Settings profiling flag affects whether the die locations to perform profiling are automatically selected or whether you manually select the die to be tested. This flag also has an effect on what occurs when a wafer map file is loaded and what occurs when a new wafer is loaded. The Z-profile data in the Kernel is not changed when a new project or wafer map is loaded.

If the Use Global Settings flag in WaferMap is disabled, the profile data from the wafer map file is loaded into the wafer map application and can be viewed in the profile table, but it is not automatically downloaded to the Kernel. For a new wafer map you must define the dies in the profile table manually before performing the profiling operation.

If the Use Global Settings flag is enabled, the profile data is not loaded from the wafer map file and a default profile table is created when a wafer map is loaded.

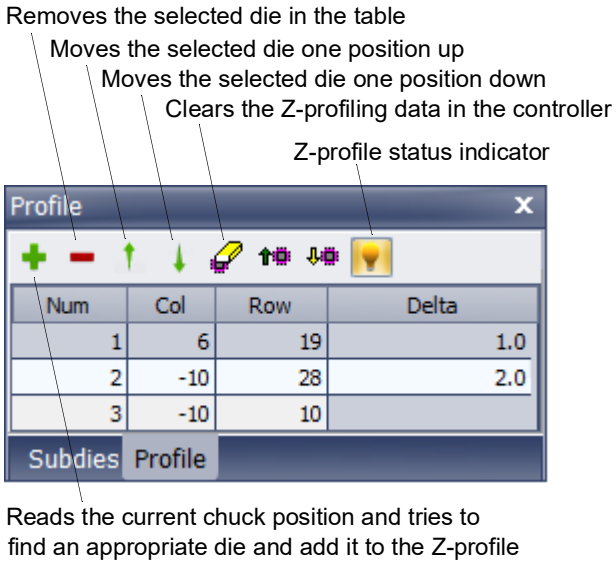
You can reuse a Z-profile table that has been saved in the wafer map data file by disabling the Use Global Settings flag, loading the wafer map, and then downloading the profile table to the Kernel.

When Z-profiling is performed, it fills in the Profile table, downloads it to the Kernel, and enables it. The Z-profile tables in WaferMap and the Kernel are now matched.

### Profile Table Data

Profile table displays all dies added to the profile. The Delta shows a detected height difference. You can edit this value manually. Dies where the sensor failed to detect a height are marked as “<Failed>”.

The chuck can be moved to specified die from the profile (double-click in the number cell). The current die is marked by a red arrow in the die number column.




Clears the current profile, reads the profiling points from Velox. For each point, the application tries to find an appropriate die and add it into the Z-profile.

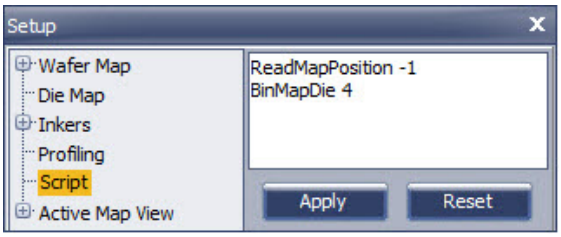
Clears the Z-profiling data in Velox and downloads the successfully-tested dies from the current profile to Velox.

Indicates profile loaded and enabled.

Indicates profile loaded and disabled.

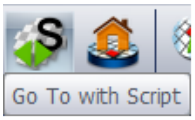
Indicates profile not loaded.

## Script

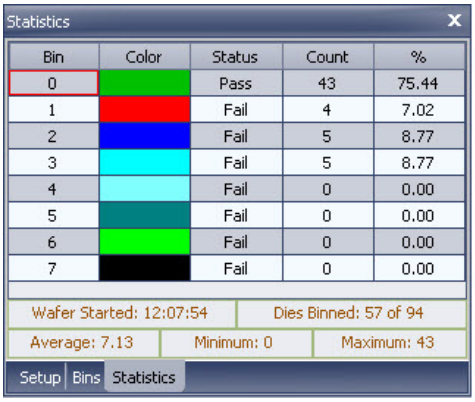



Each line of the script represents one command. Click Apply to save to the WaferMap toolbar.

For details, see the Velox Remote Interface Help (click Help > Remote Commands). WaferMap commands are in the Application Commands section.

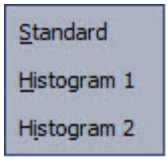


# Statistics




| Bin | Color | Status | Count | % |
|---|---|---|---|---|
| 0 | | Pass | 43 | 75.44 |
| 1 | | Fail | 4 | 7.02 |
| 2 | | Fail | 5 | 8.77 |
| 3 | | Fail | 5 | 8.77 |
| 4 | | Fail | 0 | 0.00 |
| 5 | | Fail | 0 | 0.00 |
| 6 | | Fail | 0 | 0.00 |
| 7 | | Fail | 0 | 0.00 |

Right-click to select a view: Standard, Histogram 1 and Histogram 2.




Each view displays the information panel: time of wafer creation, number of all dies (marked to probe), number of binned dies, and statistical values (average, minimum, and maximum).

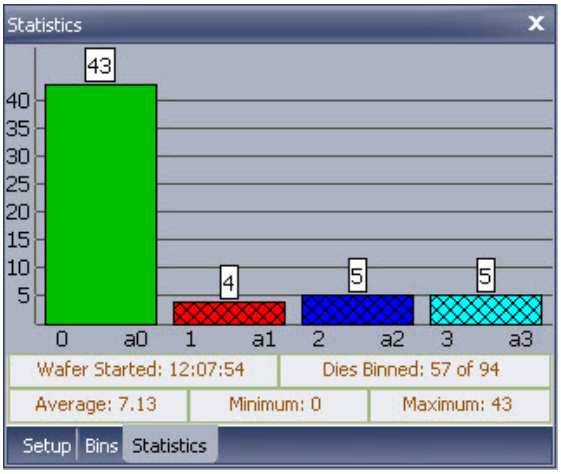
**Standard**

All bins can be seen with their main parameters and the quantity of dies binned by every bin (as a number and as a percentage).

To select the current bin for manual binning, double-click on the bin number cell. The current bin is marked with the red border around the bin number cell.

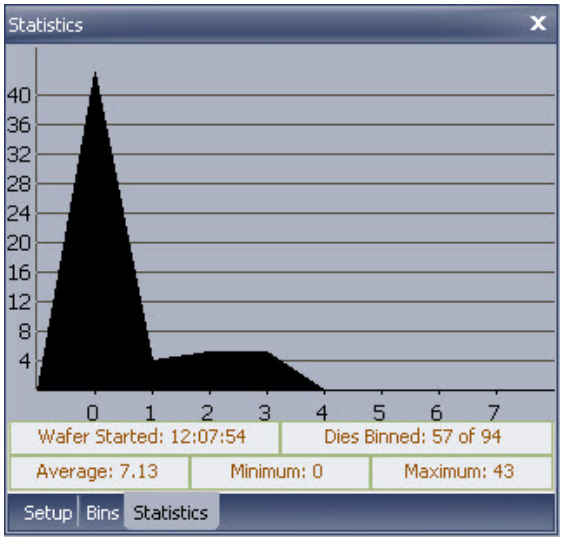
**Histogram 1**

The number of binned dies is displayed over the bar. The bars with failed status are displayed with a zigzag pattern. The bin code and bin chars are displayed under the bar.




**Histogram 2**

Values on the y-axis show the number of binned dies, Values on the x-axis show bin codes.



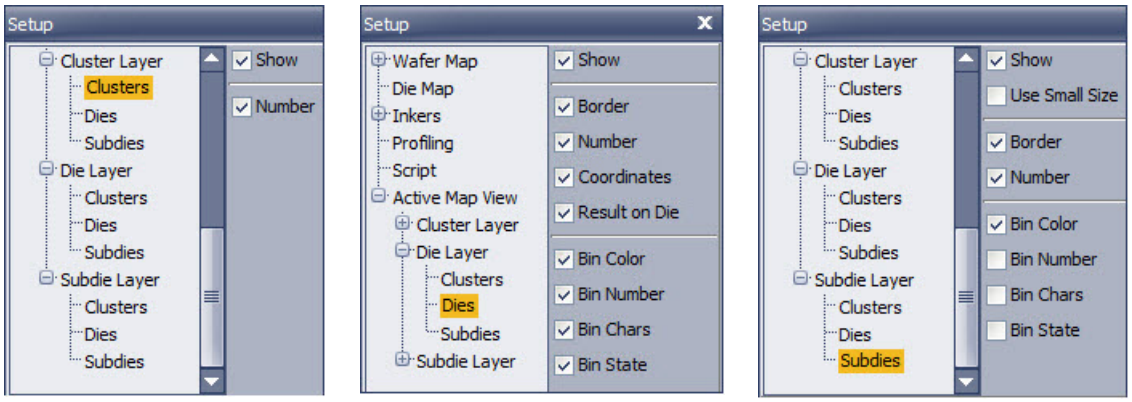
## Active Layers

Die Layer Stepping

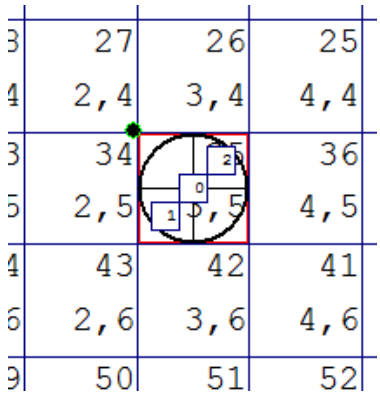
Subdie Layer Stepping

| | |
|---|---|
| **Actions Which Depend on a Layer** | The movement commands (Go To, Step Next, Step Previous) work with elements of the current layer only. For example, Step Next command will move the chuck:<br>• To the next die for the die layer<br>• To the next subdie for the subdie layer<br>• To the next cluster for the cluster layer |
| **Map View** | Each Wafer View window has its own settings which are defined separately for each layer.<br>The Map View context menus lets you change the settings for the active layer only. If you wish to define all settings for all layers without changing the active layer, use the Setup window. In the Active Map View section of the setup directory, you can see the three nodes which correspond to all layers (cluster, die and subdie).<br>The DieMap feature is used for intra-die probing or subsite probing. After teaching a set of subsites, you can visit any subsite in any die by clicking on the die in the Wafer Map window and clicking on the subsite in the DieMap window. |
| **Active Map View** | The Active Map View settings let you define the view for the currently active Map View window. Each subnode represents parameters for the specific items. Any change is applied immediately. |

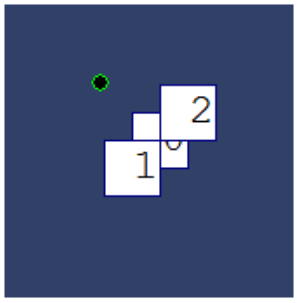
**Setup Windows**



**Die Layer**



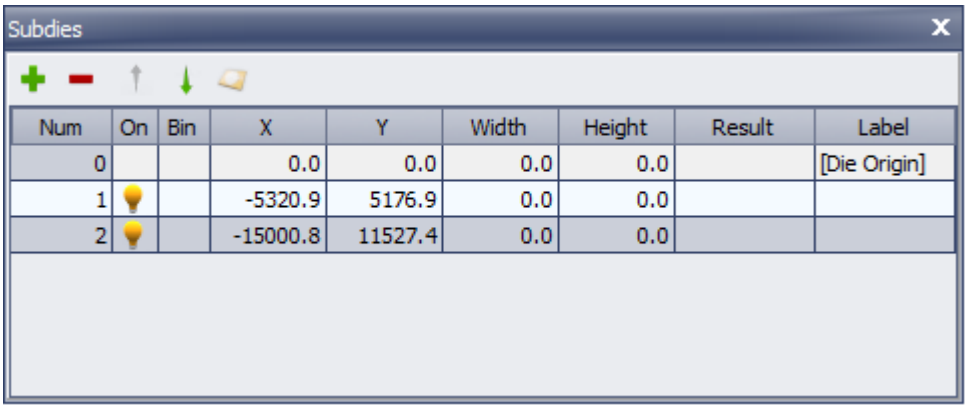

**Subdie Layer**




## Die Layer Stepping

This Subdies table is used in all of the following examples:

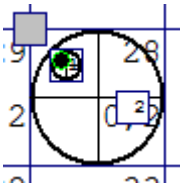
Stepping is based on the active layer. For Die Layer stepping , stepping to the next or previous die will step to the first testable subdie of the target die. If there are no testable subdie, movement is to the target die origin.



Subdies

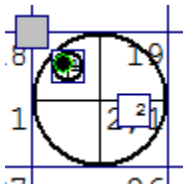
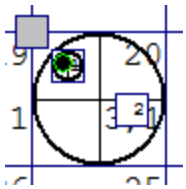
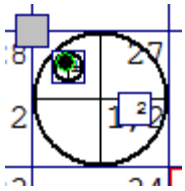
| Num | On | Bin | X | Y | Width | Height | Result | Label |
|---|---|---|---|---|---|---|---|---|
| 0 | | | 0.0 | 0.0 | 0.0 | 0.0 | | [Die Origin] |
| 1 | | | -5320.9 | 5176.9 | 0.0 | 0.0 | | |
| 2 | | | -15000.8 | 11527.4 | 0.0 | 0.0 | | |

In all examples below, the subdie at the die origin is not On. The Subdies table above is used in the examples:



**Double-click on Die**

Double-clicking on die #28 moves to the first subdie that is On (die #28).

| | |
|---|---|
|  | **Single-click with Go To** **selected**<br>When GoTo is selected, clicking die #19 moves to the first subdie that is On (that is, the first testable subdie, die #19). |
|  | **Step Next (PgDn)** <br>When on die #19, clicking Step Next moves to the first testable subdie of die #20. |
|  | **Step Prev (PgUp)** <br>When on die #28, clicking Step Prev moves to the first testable subdie of die #27. |
| | **Step to Testable Subdie**<br>The stepping moves to the first testable subdie of the target die. The behavior is like that of the StepNextDie SCI command. |
| | **No Testable Subdie**<br>When there are no testable subdie, the chuck moves to the die origin of the target die. This is the case when no subdie are defined, or when none of the subdie are On. |

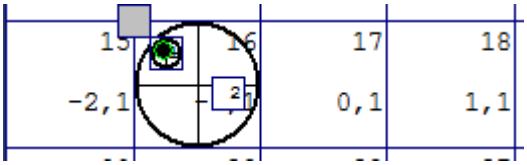
## Subdie Layer Stepping

For comparison, the stepping behavior for Step Next of the subdie layer is shown below.

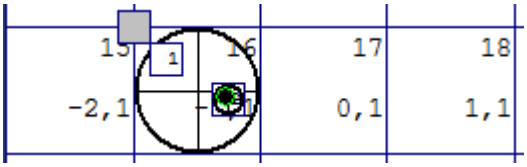
(The stepping behavior for Step Prev of the subdie layer is the same as described below, except in reverse.)

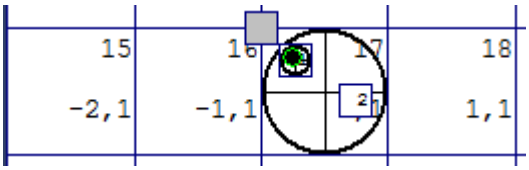
For these examples, the active layer is Subdie Layer .

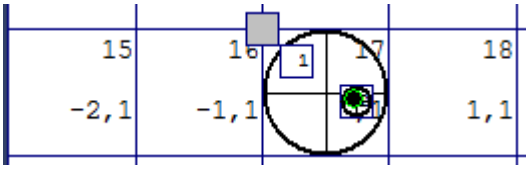
**Given this Wafer Map**

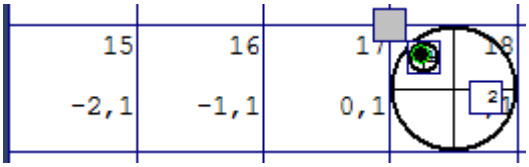



a. clicking results in:



b. clicking results in: 

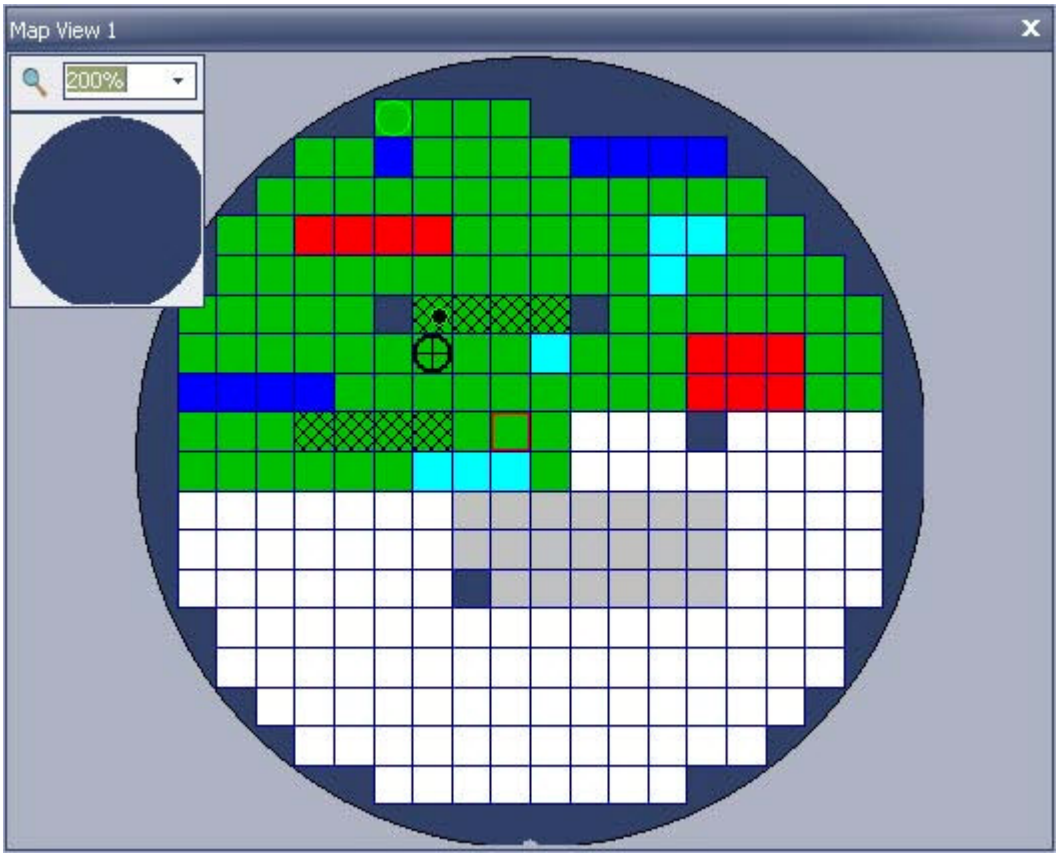

c. clicking results in: 


d. clicking results in: 


# Map View

The Map View displays the current state of the wafer map. Operations with bins and dies are also processed in this window.

See the Die Map sections for more information on Map View.



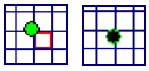
# WaferMap Position Indicator

Chuck Position from Center

Chuck Position from Home

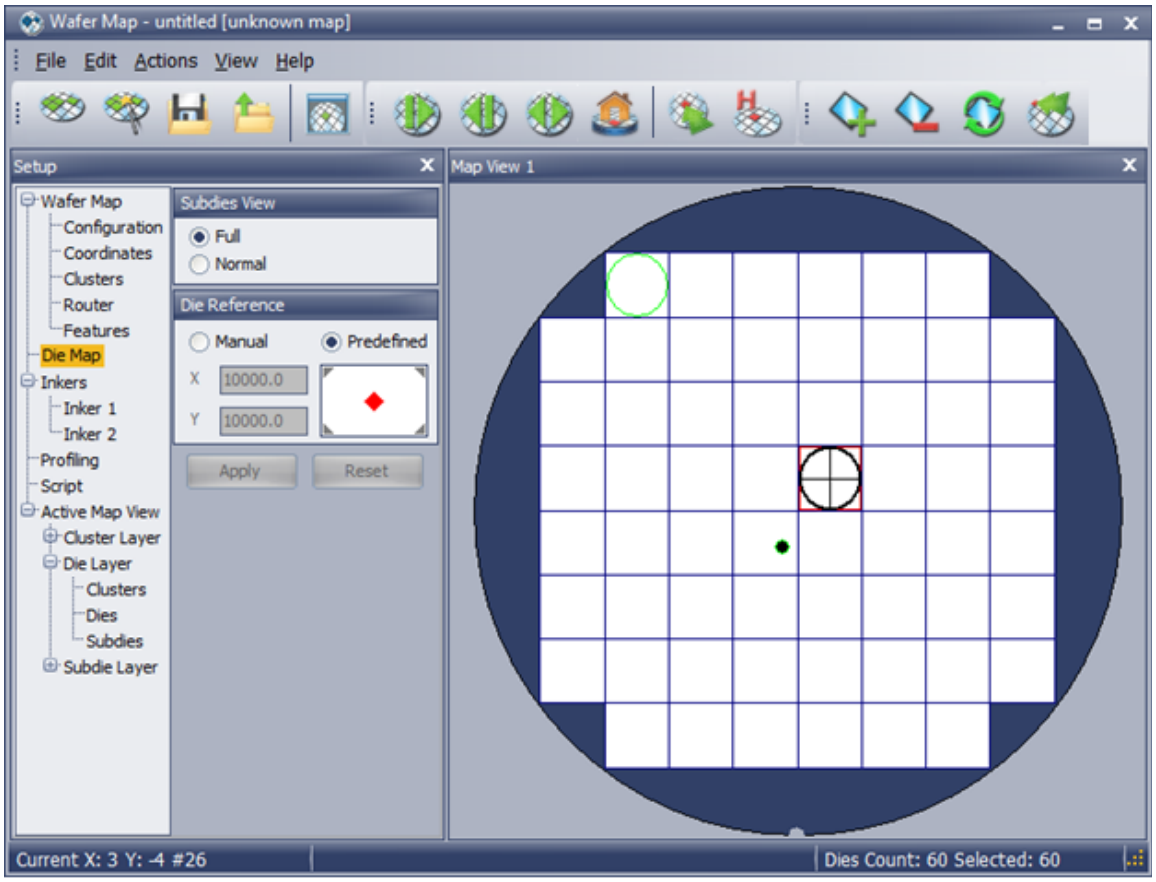
Change the Position Indicator

WaferMap shows the current chuck position as a small green or black circle over the wafer.



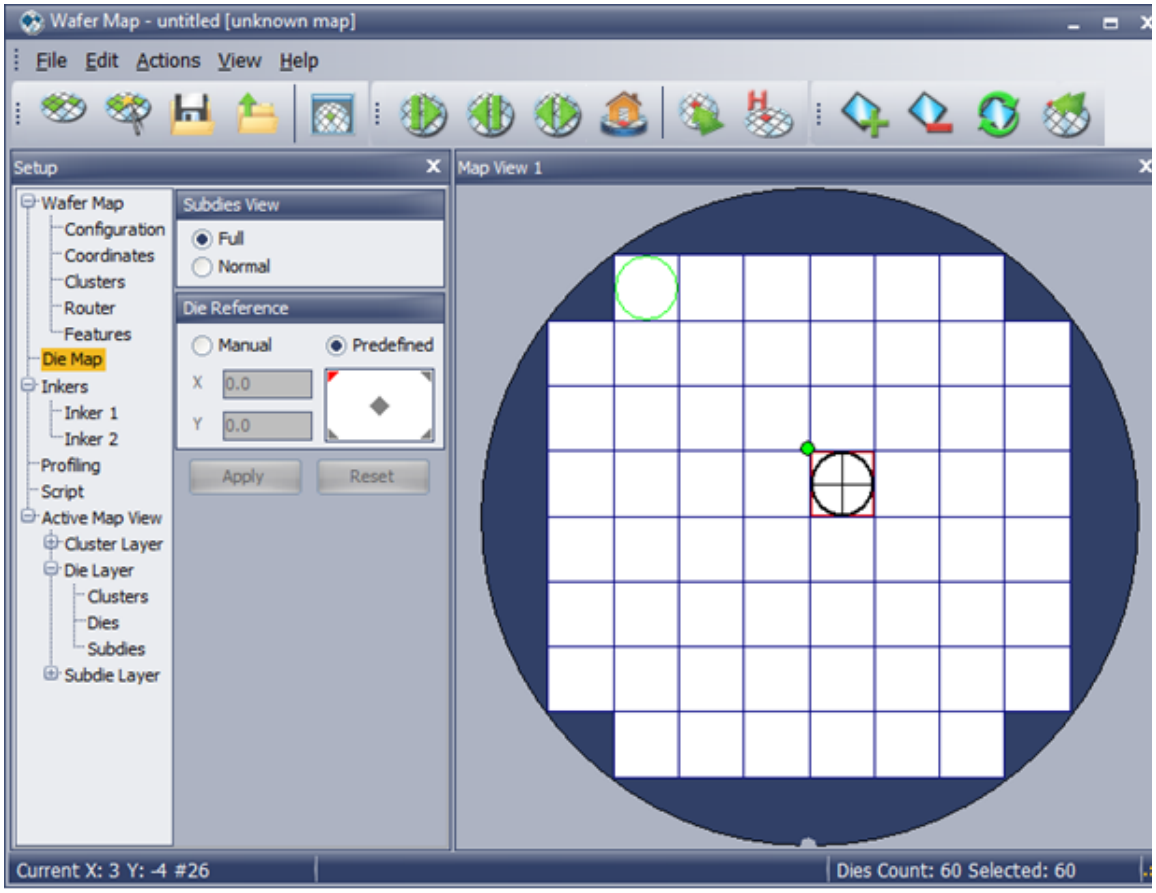
## Chuck Position from Center

The black circle with a green border indicates the current chuck position relative to the chuck stage Center. When the black circle is at the center of the wafer the chuck is at the center of travel in X and Y. The black circle is not relative to the home location.



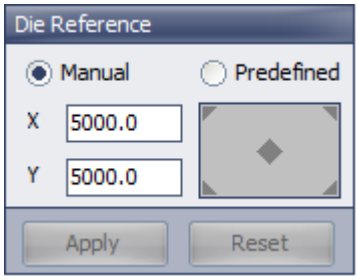
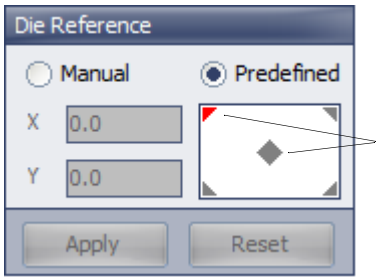
## Chuck Position from Home

The green circle with a black border ● indicates the current chuck position relative to the home position (0,0). When the chuck is at the home position, the green circle will be located on the home die. The location of the green circle within the home die is determined by the Die Map Setup > Die Reference location which defaults to the upper left corner.




When using Chuck Position from Home, you can adjust the indicator to be more representative of the actual location within the die.

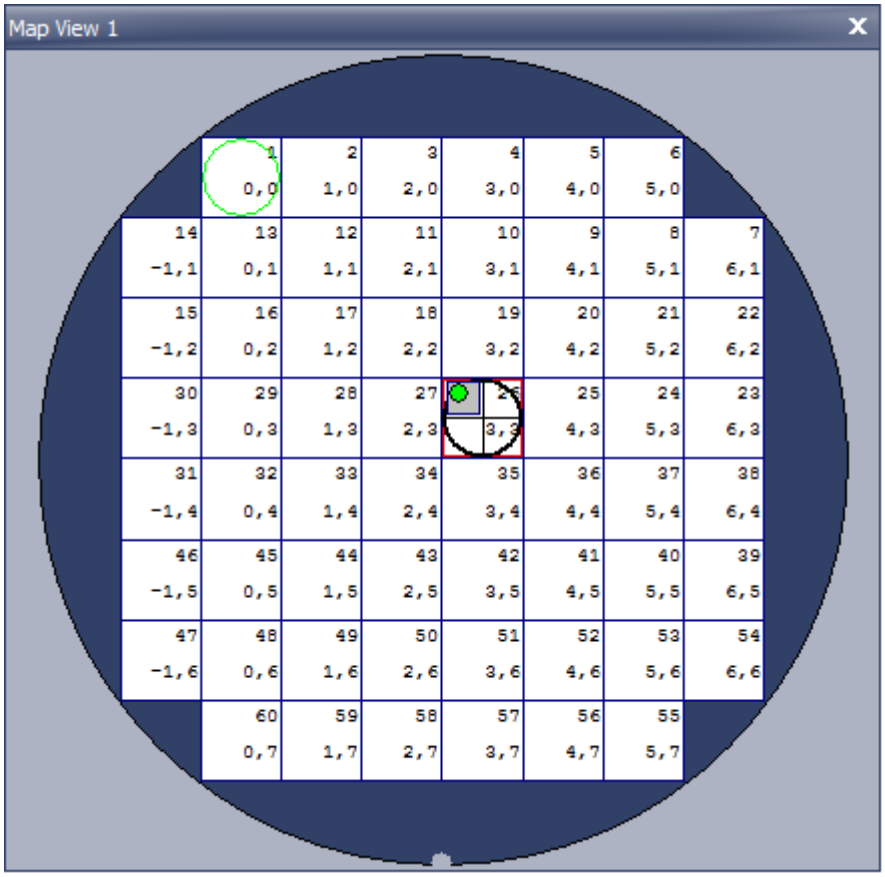
In the Die Map setup, select Manual or Predefined as the die reference.

| | | |
|---|---|---|
| Die Reference:<br>**Manual** |  | Manual adjustment allows you to define the exact location of the home position within the die. 0, 0 is defined as the upper left corner of the die and runs more positive to the right and down. |
| Die Reference:<br>**Predefined** |  | Predefined locations can be used by clicking on the markers located in the corners or middle of the graphic. |

### Change the Position Indicator

There are three ways to change the style of the indicator. You can double-click on the indicator, right-click on the wafer map display and select ‘Chuck Position from Home’ from the context menu, or select View > Map View > Chuck Position from Home.

In this example, the die size is 20000 x 20000 µm and the home position from the top left corner of the die is 5000 x 5000 µm. The chuck position marker now represents the actual location within the die.




# Viewing and Defining Die Parameters

Select View > Map View > Dies to define which die parameters can be drawn in the current Map View window.

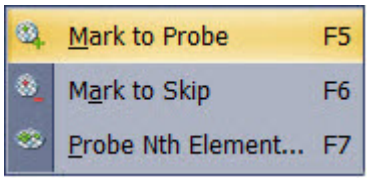
Select View > Dies Table to display the Dies data in table format.

Select View > Dies Info to display the Dies information in multi-line format.

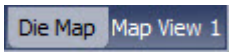
See Wafer substrate representation for information on color representation for current and inactive windows.

See Die representation for more information on the graphical depiction for each state.

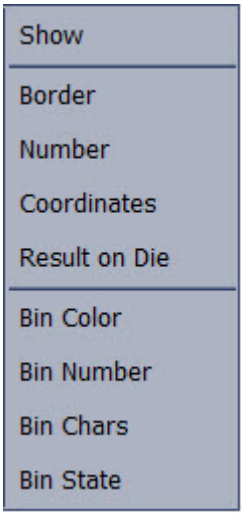
Select Actions > Marking to mark dies for probing, skipping, or probing the Nth element.




Select View > Die Map to display the Die Map in the Map View window.




**Dies View mode**




You can choose a number of parameters to draw in the Map View window: bin color, die number, die coordinates, bin number, bin letters, etc.

You can also show measurement results two ways: on the die and as a hint. If you choose to show it on the die, all other symbolic data on the die will be hidden.

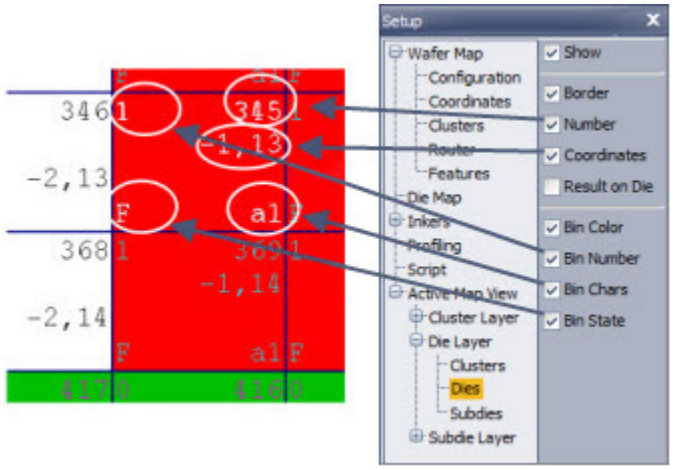
Each of these parameters can be enabled or disabled using the main menu or context menu, or special group in the Setup tool window. By default, only bin color and die borders are enabled.

Additional information can be enabled:

- Die Number is shown in top right corner of the die.
- Die Coordinates are shown in top right corner of the die or under the die number, if it is enabled.
- Bin Number is shown in top left corner of the die.
- Bin Chars is shown in bottom right corner of the die.
- Bin State is shown in bottom left corner of the die (P for passed bins and F for the failed bins).
- Measurement results are (Result on Die) shown when the value exists for the die.

**NOTE**

*Some data (like a die number, die coordinates, a bin number, and others) will only be shown if the visible size of the area for it is big enough.*



**Dies table data**

Dies

| Num | Bin | X | Y | Result | Label |
|---|---|---|---|---|---|
| 8 | 0 | 3 | 2 | 0.5 | NormDie |
| 9 | 0 | 2 | 2 | 0.58 | |
| 10 | 0 | 1 | 2 | 0.22 | |
| 11 | 2 | 0 | 2 | 0.97 | |
| 12 | 2 | -1 | 2 | 0.88 | |
| 13 | 0 | -2 | 3 | 0.58 | |
| 14 | 3 | 5 | 3 | 0.35 | |
| 15 | 3 | 6 | 3 | 0.89 | |
| 16 | 3 | 7 | 3 | 0.78 | |
| 17 | 3 | 7 | 4 | | |

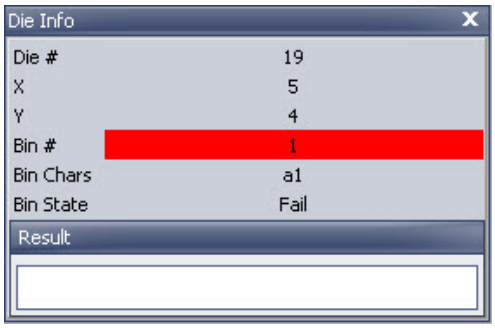
The Dies table shows the dies that are marked to probe in one table. The die number, die coordinates, bin and measurement results are displayed.

You cannot see all dies in the window, only the dies marked to probe. The current die is marked by a red arrow in the die number column.

To move the chuck to the specified die, double-click its number in the cell.

Click in the label cell and type in a label for the die.

**Die Info window**

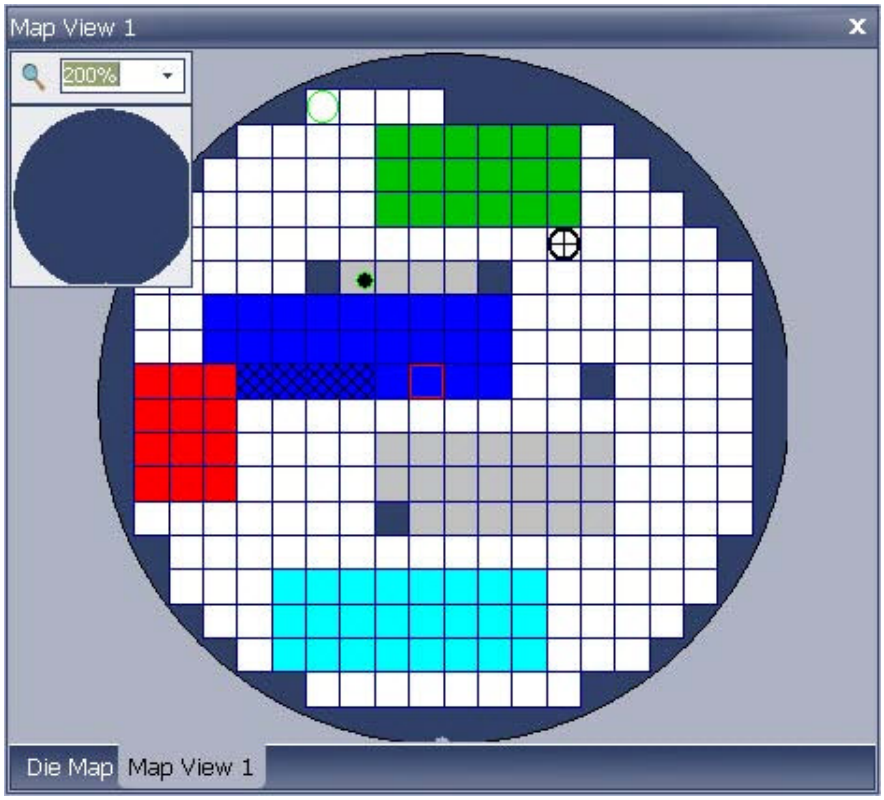
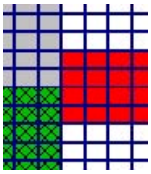


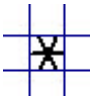
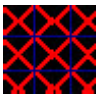
Die Info

| | |
|---|---|
| Die # | 19 |
| X | 5 |
| Y | 4 |
| Bin # | 1 |
| Bin Chars | a1 |
| Bin State | Fail |

Result

The Die Info window displays the die number, die coordinates, bin data, and measurement result for a specific die. This window shows the result in multi-line style.

| | |
|---|---|
| **Wafer substrate representation** | By default, the wafer substrate is represented as a dark blue shape. All dies are painted on this substrate. The color of the wafer substrate is used to represent current and inactive Map View . A substrate of an inactive window is painted by inverted substrate color.<br>  <br> |
| **Die representation**<br>  | The wafer map consists of number of dies. Some dies are invisible. (By default all edge dies are invisible.)windows<br>Every visible die on the wafer map is drawn as a rectangle. Every visible die has a state: a die to probe, a die to skip. Each of these dies is represented differently. |
| | Dies marked to probe are usually represented as white rectangles. If these dies are binned and the showing of the bin color is enabled (see below) they are represented as rectangles filled by the bin color (like the green and red dies in the figure). |
| | Dies marked to skip are usually represented as gray rectangles. But if such dies are binned and the showing of the bin color is enabled they are represented as rectangles filled by the bin color and using a cross-diagonal pattern. There are also some special kinds of dies. All special symbols are painted over the standard die representation. |
| | Borders of the wafer map home die are red. |
| | The current die is marked by a cross and circle. |

| | |
|---|---|
|  | During the inking process all inked dies are marked by cross-diagonal lines. |
|  | In the selection mode, or when changing wafer map origin, one die is called Pointer. The pointer die is displayed with horizontal and diagonal lines. |
| | In the profile marking mode, or during profiling, all dies marked for profiling display a yellow circle pattern on a black background. Successfully profiled dies display filled circles, failed dies display cross-diagonal lines. |

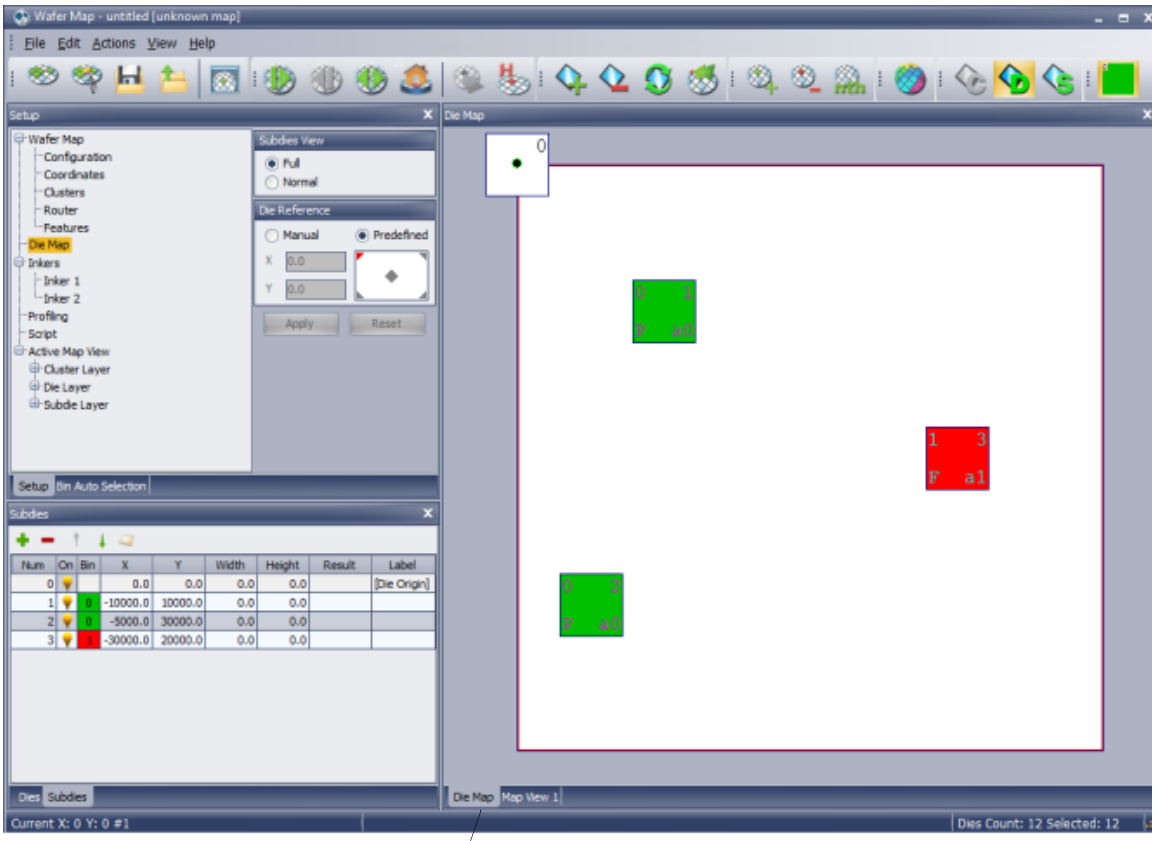
**NOTE**

*One die can be the home die and the current die at the same time. The corresponding graphics are superimposed over the die.*

# Viewing and Defining Subdie Parameters

To add a subdie at the current position, move to the desired position and then add the subdie. The current coordinates will be used. The Die Map view provides better visibility of subdies.

Select View > Die Map to display the Die Map in the Map View window.




Click the **Die Map** tab to toggle from the Map View.

Select File > Subdies to open a saved subdie TableView file (.stv).

Select **View** > **Map View** > **Subdies** to define which subdie parameters can be drawn in the current Map View window. See Subdies View.

Select View > Setup to display the Setup window, then select Die Map for setup parameters.

Select **View** > **Subdies Table**. See Subdies Table Data.

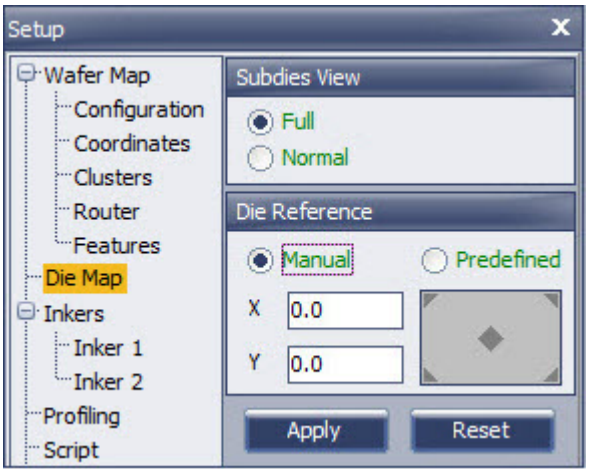
# Die Map Setup

Subdies View

Die Reference

Subdies Table Data

Die Map




Click Apply to apply changes to settings.

## Subdies View

Subdies View lets you choose how subdies will look.

- In Normal mode, subdies are shown as small rectangles without any additional information inside.
- In Full mode, there is additional information about the subdie inside it.

## Die Reference

The Wafer Map home position is set by setting the Home Die (see Set Home). This sets the chuck coordinates, for the home die, to (0,0). The Die Reference position is used to set where the home position is (e.g., 0, 0) relative to the die boundary. That is, it specifies where on the die the home position is, relative to the upper left hand corner of the die.

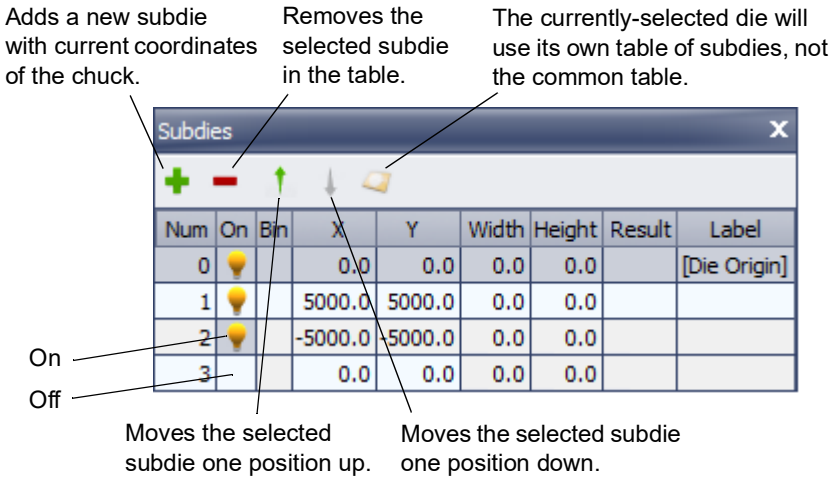
The Die Reference position is specified in microns, from the upper left hand corner of the die, where X is positive from left to right, and Y is positive from top to bottom. This position may be set explicitly by clicking on the Manual radio button, and entering the X and Y coordinates. This position may also be set by selecting the Predefined radio button, and then clicking on one of the predefined positions (top left corner, top right corner, lower left corner, lower right corner, or center of the die).

The Chuck Position from Home Wafer Map Position Indicator (green circle) is displayed at the specified Die Reference position when the chuck is at home (0, 0). Setting the Die Reference causes the position indicator to be an accurate indication of where the chuck is relative to the current die boundary as the chuck is moved within a die and stepped from die to die.

For more information on this topic, see WaferMap Position Indicator.

## Subdies Table Data

The Subdies table lets you view and organize the subdie parameters. By default, all subdie properties (except bin information and results) are common for all dies. Every subdie of every die can be binned by different bins. The chuck coordinate system is used for the subdie coordinates.




- Click the label cell to add a label.
- Double-click in the number cell to move the chuck to specified subdie.
- Click in the 'On' column to enable or disable a subdie.

## Die Map

The Die Map window represents subdies. Each die can include a number of subdies where the chuck can be moved.

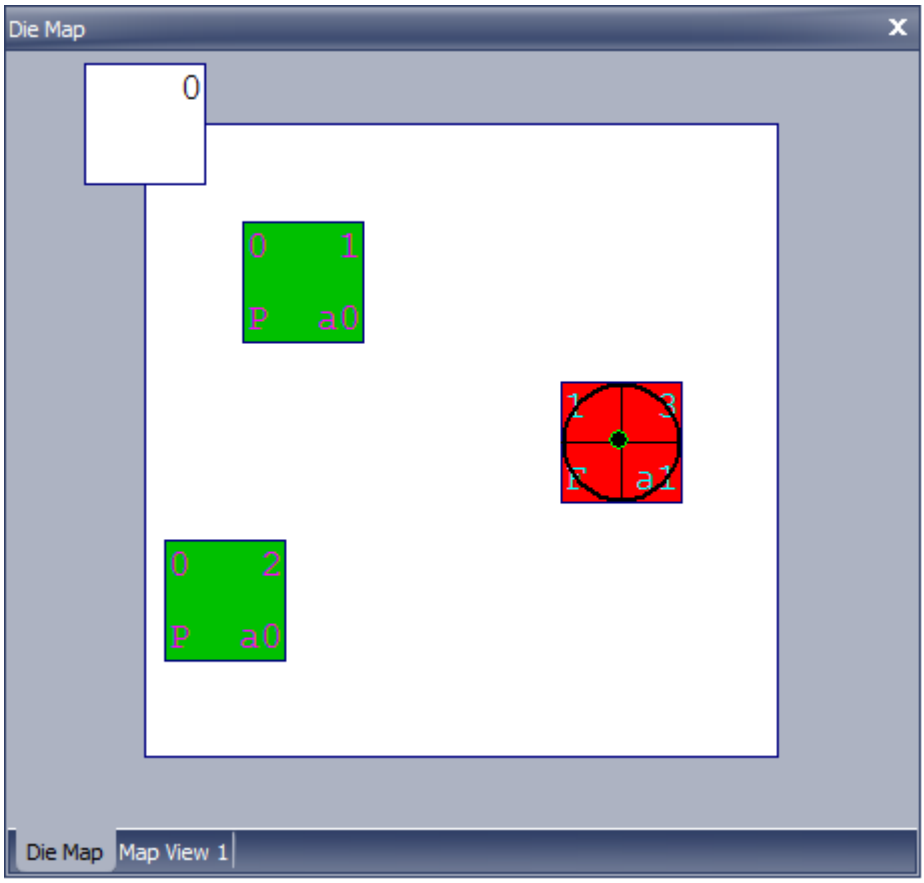
Each subdie can be binned like a die. Subdie can be a point inside or outside the die. The Die Map window shows the current die.

Additional information displayed:

- Subdie Number in the right top corner
- Bin Number in the left top corner
- Bin Chars in the right bottom corner
- Bin State in the left bottom corner

The chuck will be positioned to every subdie by default during the moving process. Some subdies can be disabled. Such subdies look like skipped dies in the picture.

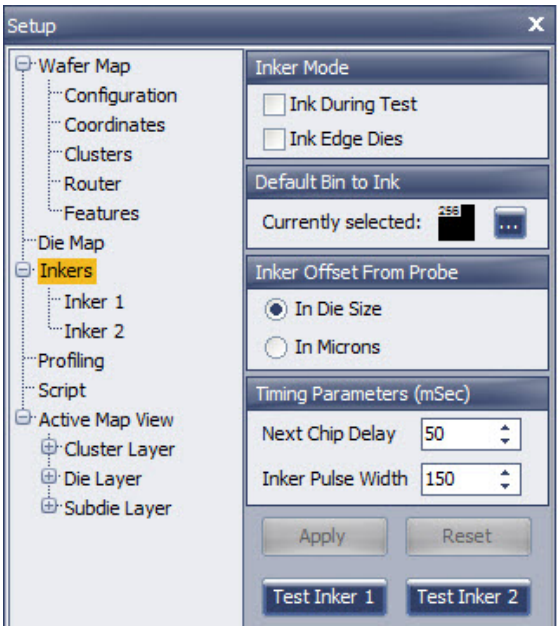
Die Map window can be toggled to the simple mode by enabling “Use Small Size” flag (in the menu or in the Setup window).



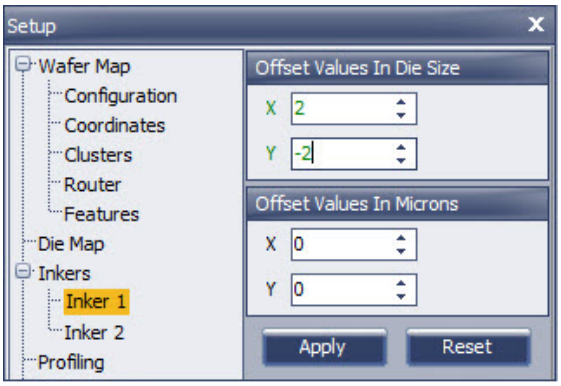

# Inking

Structures can be inked (usually defect dies) independently or together with a test process. When inking independently, click Run Inking to start the inking process. WaferMap detects all structures which should be inked and goes from one to another inking them. When using the test process, switch on the special flag Ink During Test. Each time the structure is binned by a bin with connected inkers, the structure will be inked immediately.

Click Run Inking in the Actions Menu, or click in the toolbar to start and stop inking process.




| | |
|---|---|
| Inker Mode | Ink During Test<br>When enabled, every time a die is binned during the test it will be inked too. |
| | Ink Edge Dies<br>When enabled, all edge dies will be marked with ink bin. |
| Default Bin to Ink | You can connect inkers to specific bins or use a default bin. The default bin is typically the last bin in the bin table. Use the controls to configure the default bin. |
| Inker Offset From Probe | Before every inking, the chuck is moved using specified offset values. Each inker has its own offset values.<br>When the application must ink using the offsets, it moves from the die position the given offset distance and only then sends the inker a command to make a spot of ink. This allows making colored spots in different spaces for the same structure. |
| | Inker 1/Inker 2 Offset Values<br>Offsets can be set in die size and in microns. Only one type of offset (die size or microns) can be used at a time. |
| Timing Parameters | Next Chip Delay<br>Set a time in milliseconds that the application should wait before moving to the next chip (die, subdie). |
| | Inker Pulse Width<br>Set a time in milliseconds that the application should turn on the inker during inking the die.<br>The appearance of the ink spot depends on the inker pulse width. The bigger this value, the bigger a spot. Sometimes it is necessary to have a delay between inking chips. |



# Using Bins

The bin is a marker that groups the tested elements by similar characteristics.

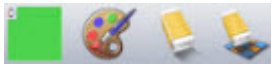
Select File > Bins to open a saved Bins Code Table (.bct).

Select View > Setup > Features to set bin table size and a flag to enable binning. See Features (Bin Setup).

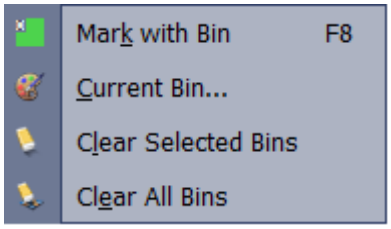
Select View > Bins to display the binned elements. See Bins View.

Select View > Bin Auto Selection to automatically bin elements. See Bin Auto Selection and Example Setup.

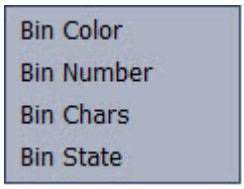
Select View > Toolbars to display the Binning toolbar on the main toolbar. The same selections are available on the Actions > Marking menu.



Select Actions > Marking to Mark with Bin, select Current Bin, and clear selected or all bins.

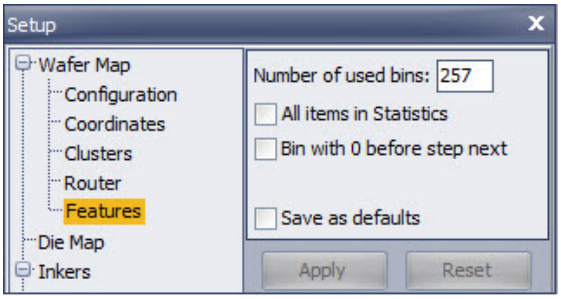
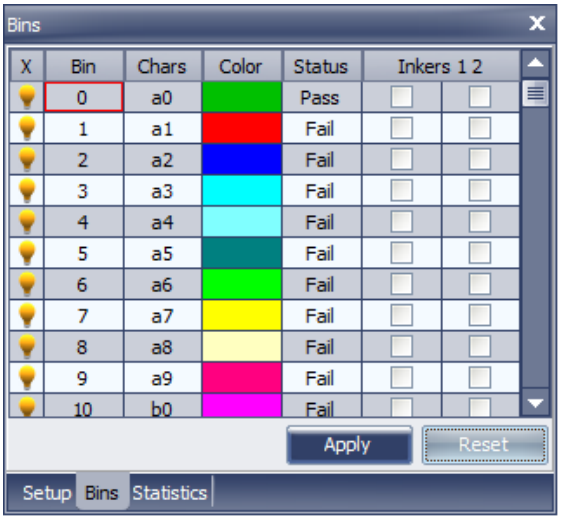



Select **View** > **Map View** > **Subdies** or **Dies** to display bin color, bin number, bin chars, or bin state in the Map View and Die Map.



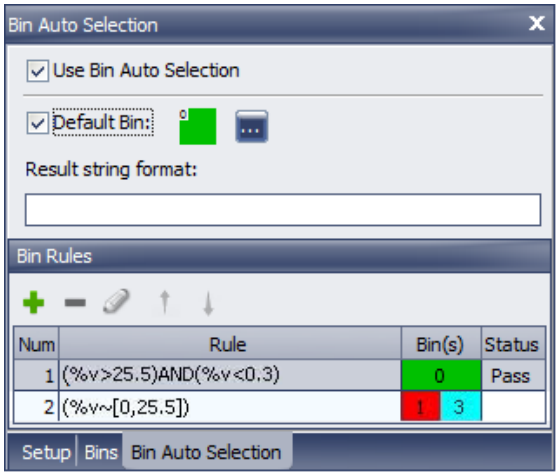

See also:

- Set Up Bin Rules
- Conditions Window
- Bin and Bin Distance
- Bin Rule Examples
- Default Bin to Ink

| | | |
|---|---|---|
| | **Features (Bin Setup)** | |
|  | Number of Used Bins | Set the bin table size. This number will be used in the Bins and Statistics windows. |
| | All items in Statistics | By default, you will see information about dies marked to probe in the Statistics window. All binned dies can be enabled by using All items in Statistics. |
| | Bin with 0 before step next | By default, when using the StepNextDie remote command, the current die isn't marked by any bin before stepping to next die. But here you can set a special flag that enables a binning by bin 0. It means the current die will be marked by bin 0 before the step to the next one. |
| | **Bins View** | |
|  | When the measurement result string stores data, the bin will group the tested elements by similar characteristics. The bin is just a marker. You can decide which bin to use based on the measurements. WaferMap allows up to 257 different bins for the wafer. Each bin is described by its index in the bin table. It has a visibility state, status, color, literal representation, and a number of connected inkers. | |
| | Visibility | If the visibility is disabled, you can use the bin, but it will not show in the wafer map representation. |
| | Status | Describes the status of the measurement: Pass (tested element is good), Fail (tested element is bad). |
| | Color | The color representation defines the bin color displayed in the wafer map. |
| | Chars | Defines a literal bin representation. You can define one or two characters for the bin |
| | Inkers | Connect inkers to the bin. Marking with bins lets you logically process the test results. |

# Bin Auto Selection

Example Setup




You can automatically bin elements (dies or subdies) when you assign a result for them. WaferMap stores the measurement result as a string. There are no limits to what you store in the bin. But this means that there is no link between the real measurement result and the bin used for it.

- Define a format of the custom measurement result string and define where the test parameters are within such strings.
- Define the rules. Each rule has one or more conditions with test values from the result string and each has a corresponding bin to use.
- When the measurement result string is assigned to an element, the application automatically tries to get test values from the string and checks all rules. The first rule where all conditions are True is used. The application gets a bin of this rule and uses it to bin the element.

If there are no accepted rules for the result string, either the default bin will be used or the element will not be binned at all.

**Bin Auto Selection Controls**

You can enable or disable the bin that will be used if no rule is accepted. Click to open the selection window.

**Result string format**

The result string format lets you define how the real result string should look and where the test values will be. To define the test values, use the following format: “%”<value name> (the % sign precedes the test value name).

There are no limitations for the test value type. It could be any string, numeric or not. Leading and trailing spaces in the result string format are ignored.

If you have a percent sign inside the result string, you could describe it by using “%%” string. %% means that one percent sign is inside the result string.

*You can define any number of test values inside the format string. Restrictions include:*

- The value name can consist only of alphabetical symbols, digits, and “_” sign.
- All test values have unique names (a string such as “v=%v and d=%v” cannot be used).
- If the result format string is incorrect it will be red-highlighted and all rules will be disabled in the Bin Auto Selection window.
- If some rules are incorrect they will also be highlighted. The incorrect rules will be ignored during the rule verification process.

**Set Up Bin Rules**

Bin Rules let you check the test values from the measurement result string and define which bin to use. The Bin Rules table displays the following data:

- The rule index (Num).
- The rule itself in the special mnemonic form.
- The bin to use for the rule.
- The bin status.
- Use the Bin Rules buttons to manipulate the rules.

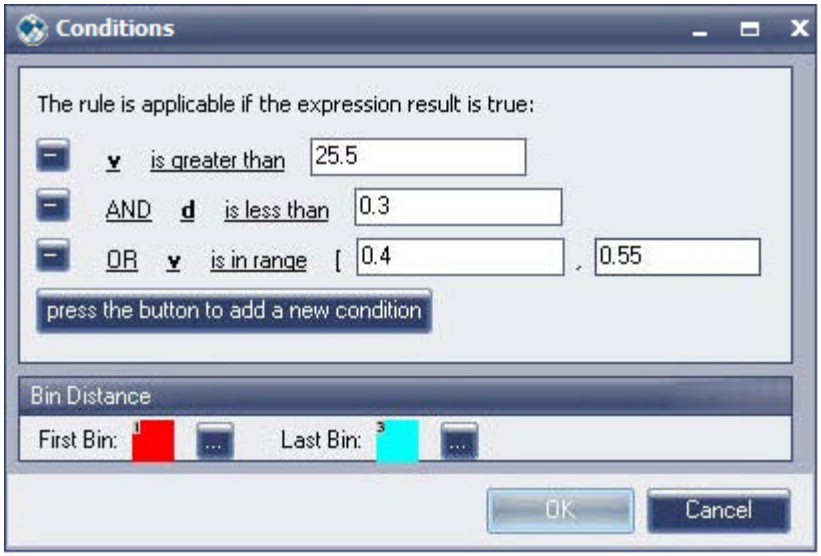
The currently-selected rule is highlighted by a blue background in the table. The order of rules can be important because the application checks them one-by-one, and if a rule is accepted no other rule is checked. If a rule is incorrect (for example, if the rule uses test values which do not exist anymore in the result format string) that rule is highlighted in red and will not be used during the rule checking process.

A rule is a number of conditions combined by logical operations AND and OR. These operations are calculated in the order they are defined in the rule. For example:

“(2<3)OR(5<3)AND(6<4)” is false because it is calculated as ((2<3)OR(5<3))AND (6<4)

But the rule “(5<3)AND(6<4)OR(2<3)” is true because it is calculated ((5<3)AND(6<4))OR(2<3)

**Conditions Window**




**Bin and Bin Distance**

The main goal of each rule is to bin die automatically. If a rule is valid, it determines which bin to use. The simplest case is when the rule defines one bin to use.

But if the rule includes the “in range” condition it allows you to use a Bin Distance instead of one bin. A rule includes only one “is in range” condition. The condition describes two limits for the value. If the given value is within these limits (including them) the condition is correct. You can describe bin distance by defining the first and the last bins. Then you have a distance of values and the corresponding distance of bins to use.

**Send SetDieResult or SetDieMapResult Command**

To return measurement results, the rules must be described and the Bin Auto Selection must be enabled.

Each time you send the SetDieResult or SetDieMapResult remote command, the application updates the result string and checks the rules to find an appropriate bin to immediately bin the element. Leading and trailing spaces in the measurement result string are automatically ignored.

In the mnemonic form of the rule, all conditions have the following notations:

“>” is greater than Example: “%v>5”

“<” is less than Example: “%v<2.3”

“=” is equal to Example: “%v=1.7”

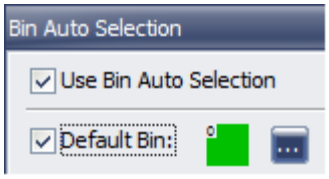
“!=” does not equal Example: “%v!=4”

“~[<val1>,<val2>]” is in the range from <val1> to <val2>

Example: “%v~[2,4.5]” means the value v is in the 2 to 4.5 range.

## Example Setup

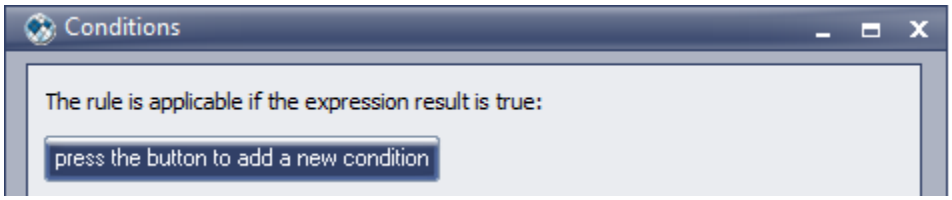
1. To set up Bin Auto Selection, check mark (enable) the Use Bin Auto Selection and Default Bin options.



2. Type a format string into the Result string format box. Example: val1=%a,val2=%b

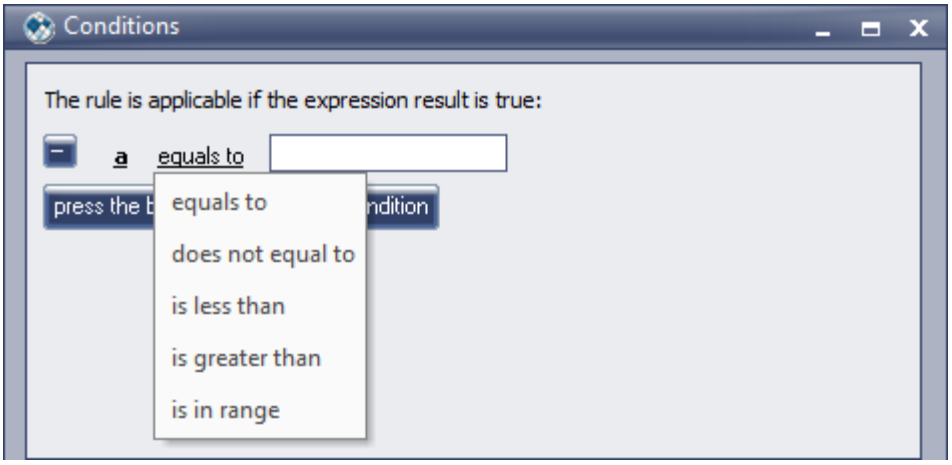
3. Click on the add button

to display the conditions window, then click “press the button to add a new condition.”




4. Click on “a”; then select a.

5. Click on “equals to” and select “is less than.”




6. Click into next cell, and enter a value; enter 100.0.

7. Select the Bin to use by clicking on the button.

8. Click OK.
9. Rule Num 1 has now been added to the Bin Rules table.

| Num | Rule | Bin(s) | Status |
|---|---|---|---|
| 1 | (%a=100.0) | 0 | Pass |

## Bin Rule Examples

| | | |
|---|---|---|
| Here are some examples of rules and how they work, using the mnemonic form. | | |
| **Example 1**: Default Bin = 2, result string format = “%v” | | |
| Rule: | | |
| 1 | (%v<4) | Use bin 1 |
| If SetDieResult commands are sent with the following measurement result strings: | | |
| | Measurement result string: | |
| | 3.8 | Bin 1 is used (rule 1 is true) |
| | 5.3 | Rule 1 is false. Bin 2 is used because it was defined as a default bin |
| **Example 2**: Default Bin = 4, result string format = “d=%d, v=%v” | | |
| Rule: | | |
| 1 | (%d<3.4) | Use bin 1 |
| 2 | (%d=3.4)OR(%d>3.4)AND(%v=220) | Use bin 2 |
| 3 | (%v<220) | Use bin 3 |
| If SetDieResult commands are sent with the following measurement result strings: | | |
| | Measurement result string: | |
| | d=2.1, v=110 | Bin 1 is used (rule 1 is true and it is checked before the rule 3 which could be true also) |
| | d=8, v=220 | Bin 2 is used |
| | d=3.5, v=360 | All rules are false. Bin 4 is used because it was defined as default bin |
| | d=77, v=0 | Bin 3 is used |
| **Example 3:** To get the same results as in the Example 2, but using different rules | | |
| Rule: | | |
| 1 | (%d<3.4) | Use bin 1 |
| 2 | (%v=220) | Use bin 2 |
| 3 | (%v<220) | Use bin 3 |
| The only change is that two conditions are eliminated from rule 2. Actually they are unnecessary because if%d is less than 3.4, such die will always be binned with bin 1. This shows why the order of rules is important. | | |
| **Example 4**: Use bin distance, result string format = “%v” | | |
| Rule: | | |
| 1 | (%v~[1,20]) | Use bin distance: the first bin is 1, the last bin is 10. |
| This rule means that if value v is in 1 to 20 range, bins from 1 to 10 will be used. For each value from the value range, the application takes an appropriate bin value from the bin range. In this case it means that if v=1 or v=2 the bin will be 1. If v=3 or v=4 the bin will be 2. And so on. For v=19 or v=20 the bin will be 10. | | |

| | | |
|---|---|---|
| **Example 5**: Default bin is disabled; result string format = “Status is %status and value is %value” | | |
| 1 | (%status!=”correct”) | Use bin 2 |
| 2 | (%value<3)AND(%value>7) | Use bin 4 |
| If SetDieResult commands are sent with the following measurement result strings: | | |
| | Status is “correct” and value is undefined | Bin 2 is used (rule 1 is true) |
| | Status is “incorrect” and value is 5 | Bin 4 is used |
| | Status is undefined and value is 6 | Bin 4 is used |
| | Status is correct and value is 123 | The die will not be binned because all rules are false and the default bin is disabled |

# File Formats

The WaferMap application can open the following file types:

- WaferMap Files (.map file extension)
- TableView Files (.stv file extension)
- Bin Code Tables (.bct file extension)
- KLA Result Files (.kla file extension)
- Die Portion Files (.dpt file extension)

**NOTE**

*Velox does not support .wfd files natively, but does support the conversion of .wfd files to .map using the WaferMapConverter program.*

All files are divided into two groups: Map files (WaferMap File Formats) and Map Portion Files.

Map files include data about the entire wafer map. Two types of files (.map, .kla) are supported. When WaferMap opens any map file, it deletes the current wafer and gets all data from the specified file.

**NOTE**

*WaferMap files should be saved to* C:\Users\Public\Documents\Velox.

See also Map File Format Example.

## Map Portion Files

Map Portion files (.stv, .bct, and .dpt) include data about one or some parts of the wafer.

| | | |
|---|---|---|
| TableView Files | The TableView file stores die map (subdies) data. The WaferMap tool lets you create different die maps for different dies, but this file does not support that feature.<br>When the application opens a TableView file, it deletes all existing die maps and replaces them with the die map loaded from the selected file. | |
| Bin Code Tables | Bin Code Table stores data about used bins. When the application opens such file it just replaces the current bin table by new one loaded from the given file. | |
| | File Structure | The Bin Code Table file is a normal ini-file. |
| | [Header] | This section describes the file version. |

| | | | |
|---|---|---|---|
| | | Description | Description of file, always equals to “Bin Code Table” |
| | | Version | Version of the current Bin Code Table file. The only supported version is “1.0” now. |
| | [Bins] | This section defines the bin information. All lines are in the same format: [BinNumber]=[Visible],[Chars],[Color],[Pass/Fail],[Ink1],[Ink2],[Ink3],[Ink4] | |
| | | [Visible] | Indicates should be this bin shown on a wafer (1) or not (0). |
| | | [Chars] | Are two ASCII characters that represent the bin. |
| | | [Color] | Is the MS Windows color representation of the bin in hexadecimal. |
| | | [Pass/Fail] | Indicates a pass/fail result (**1** means passed, **0** means failed). |
| | | [Ink1],[Ink2],[Ink3],[Ink4] | Is a 4-bit array of **0**s and **1**s. **1** means this inker is set. |
| | | For example: 24=1,c4,40C080,0,1,0,1,0 means bin 24 is visible (1), has character representation of c4, color representation of 40C080, indicates a fail result (0), and has inker 1 and inker 3 set.<br>The number of bins in this file describes a size of Bin Table. | |
| Die Portion Files | Die Portion file includes a list of dies with the same status (marked to probe or marked to skip). When the application opens such file firstly it gets the status from the file and secondly sets such status for all dies listed in the Die Portion file. | | |
| | File Structure | The file stores all data in strings. The first string describes which dies are stored in the file. | |
| | | PROBE | The dies in file are dies to probe. |
| | | SKIP | The dies in file are dies to skip. |
| | | All next string have the following format:<br><x>,<y><br>Where (x,y) are the relative die coordinates. If the file describes dies to probe all other dies will be marked to skip. Otherwise all visible dies will be marked to probe except dies described in the file. | |

# WaferMap File Formats

## Map File Format Example

Map files are ini-based files. The map file contains all of the information required to recreate the wafer, including wafer parameters, bin configuration parameters, and the test results. The WaferMap file format is similar to a Windows ini-file. It is divided into sections, which are denoted by a header line in brackets. Each line within a section contains the name of a parameter and its value, separated by an equal sign. For example the diameter of a wafer is shown by: Diameter=150

Lines beginning with a semicolon are comments.

| | | |
|---|---|---|
| [Header] | This section describes the file version. | |
| | Description | Description of file is always “Wafer Map File“ |
| | Version | Version of the current wafer map file. |
| [Wafer] | This section describes the physical layout of the wafer: shape, size, die index, flat, etc. | |
| | Revision | This field is included only for compatibility with previous versions of the WaferMap applications. It is always 0.0. |

| | |
|---|---|
| Diameter | For a wafer the diameter in millimeters |
| FlatLength | For a wafer the flat length in millimeters |
| FlatAngle | For a wafer the degree of rotation. Legal values: 0 – the flat is at the bottom, 90 – the flat is on the right, 180 – the flat is at the top, 270 – the flat is on the left |
| EdgeArea | For a wafer the edge area in millimeters |
| Xindex | X axis periodicity or pitch of the dies in microns |
| Xoffset | A user-defined distance of the X index, measured in microns, that the first die is from the wafer edge. Used to shift the pattern on the wafer |
| Yindex | Y axis periodicity or pitch of the dies in microns |
| Yoffset | A user-defined distance of the Y index, measured in microns, that the first die is from the wafer edge. Used to shift the pattern on the wafer |
| Shape | Defines the shape as a Wafer or Rectangle |
| DieInX | For a rectangle the number of dies found on the X axis |
| DieInY | For a rectangle the number of dies found on the Y axis |
| Origin | Identifies the orientation of the coordinate system used to define die locations. Dies from the origin will be positive from the designated origin. Legal values are UL upper left, UR upper right, LL lower left and LR lower right. For example, UL means X will increase left to right and Y will increase top to bottom |
| HomeDie | Coordinates of the home die on an absolute scale, default is X = 0, Y = 0. The default location of the home die is the leftmost and the topmost die from the origin, marked to probe. The line format is [X],[Y] |
| RefDieOffset | The offset of the origin from the home die. Given a RefDieOffset of X = 0 and Y = 0 the origin is the home die |
| UseClusters | Using of clusters. 1 is true, 0 is false |
| ClusterSizeX | For cluster a width of a cluster in dies |
| ClusterSizeY | For cluster a height of a cluster in dies |
| TestIncomplete | For clusters indicates which clusters should be tested. 1 means that all cluster with at least one die should be tested, 0 means that only full clusters will be tested. |
| RouterStartColumn | Defines the column of the first die to probe (or to ink during an inking process). Legal values: Left and Right |
| RouterStartRow | Defines the row of the first die to probe (or to ink during an inking process). Legal values: Top and Bottom |
| RouterType | Defines the type of the router, i.e. the procedure of die enumeration from the first die defined by RouterStartRow and RouterStartColumn parameters. Legal values include:<br>• HorBiDir (dice are enumerated horizontally bidirectional)<br>• VerBiDir (dice are enumerated vertically bidirectional)<br>• HorSingleDir (dice are enumerated horizontally single-directional)<br>• VerSingleDir (dice are enumerated vertically single-directional)<br>• CWSpiral<br>• CCWSpiral<br>• XYOptimized (dice in an optimized order to minimize horizontal and vertical movements)<br>• XOptimized (dice are enumerated in an optimized order to minimize horizontal movements)<br>• YOptimized (dice are enumerated in an optimized order to minimize vertical movements). |

| | | |
|---|---|---|
| | GUI | Defines disabled features as bit flags:<br>1 – subdies probing is disabled<br>2 – clusters probing is disabled<br>4 – hardware inking is disabled<br>For example, if this value is 7 it means all three features are disabled |
| | UsedBinsNumber | Defines a number of used bins |
| | StatAllDies | Defines which dies to show in the Statistics tool window. 0 means you will see information about dies marked to probe. 1 means you will see all binned dies. |
| | BinInStepNext | Defines how the application should process the StepNextDie remote command. 0 means it will not mark the current die by any bin before step to next die. 1 means the application will mark the current die by bin 0 before the step to the next one. |
| [FixedGrid] | If the wafer map was built from not-native file (old version or KLA, for example), sometimes such wafer use different algorithm of die grid placing. For such cases it's necessary to store additional data about the grid in the map-file. [FixedGridX] and [FixedGridY] describe one node of this grid. Do not change these values manually. | |
| [Bin] | This section defines the bin information. There are 256 lines labeled from 0 to 255 corresponding to each of the 256 possible bin numbers. All lines are in the same format:<br>[BinNumber]=[Visible],[Chars],[Color],[Pass/Fail],[Ink1],[Ink2],[Ink3],[Ink4] | |
| | [Visible] | Indicates should be this bin shown on a wafer (1) or not (0). |
| | [Chars] | Are two ASCII characters that represent the bin. |
| | [Color] | Is the MS Windows color representation of the bin in hexadecimal. |
| | [Pass/Fail] | Indicates a pass/fail result (1 means passed, 0 means failed). |
| | [Ink1],[Ink2],[Ink3],[Ink4] | Is a 4-bit array of 0s and 1s. 1 means this inker is set. |
| | For example: 24=1,c4,40C080,0,1,0,1,0 means bin 24 is visible (1), has character representation of c4, color representation of 40C080, indicates a fail result (0), and has inker 1 and inker 3 set. | |
| [ShiftParams] | This section describes the shifting rules for lines or columns on the wafer. | |
| | ShiftElement | Describes which elements on the wafer are shifted. Line means lines and Column means columns. |
| | Mirrored | Describes is the wafer shifting mirrored or no (1 is yes). |
| [ShiftValues] | The key for shifted elements on the wafer is the number of an element and the shifting value in microns. | |
| [Die] | This section defines all die on the wafer. Like the Bin section, all lines have the same format. Order of the lines is not important. Some dice or all can be not presented in this section. In this case such die has default status (i.e. such status that have the corresponding die in the default wafer with given parameters).<br>[DieNumber]=[X],[Y],[Status],[Result] | |
| | [DieNumber] | This is the number of the die when dies are enumerated from top to bottom and from left to right. |
| | [X] and [Y] | These are the die coordinates. |

| | | |
|---|---|---|
| | [Status) | Status can have one of the following values:<br>XThe die is invalid or die is invisible on the wafer representation.<br>PThe die is to be probed.<br>IThe die is to be inked only and not probed.<br>VThe die is valid but should not be probed.<br>0 to 255Denotes the die was probed and has the designated bin value. |
| | [Result] | This is the string (maybe in quotes) that indicates the result of probing. This parameter is optional (with a preceding comma). |
| | For example: 356=5,3,6, 0.43 means that die number 356 has (5,3) coordinates, it was probed, marked with 6th bin and has a measurement result of 0.43. | |
| [SubDie] | This section defines the structures of subdies for the dice belonging to the global subdie map. Dies which have no own subdie map use the global subdie map automatically. Each line has the following format:<br>[SubDieNumber]=[XOffset],[YOffset],[Width],[Height],[Enabled],[Label] | |
| | [SubDieNumber] | Number of the subdie structure. |
| | [XOffset] | Offset of the subdie from die reference point of the die in µm in X direction. |
| | [YOffset] | Offset of the subdie from die reference point of the die in µm in Y direction. |
| | [Width] | Width (size in X direction) of the subdie structure in µm. The structure is spanned from the offset position. The direction depends on the actual die reference position. |
| | [Height] | Height (size in Y direction) of the subdie structure in µm. The structure is spanned from the offset position. The direction depends on the actual die reference position. |
| | [Enabled] | Indicates if this subdie is enabled (1) or disabled (0) to probe. |
| | [Label] | Label of the subdie as string value.For example: 3=-10.0,5.0,100.0,100.0,1,Test means that subdie number 3 has X-offset of –10.0, Y-offset of 5.0, has a size of 100x100µm, it enabled and has a Test label. |
| [SubDieData] | This section stores information about probed subdies, which belong to the global subdie map, which is described in [SubDie]. Each line has the following format:<br>[Number]=[DieNumber],[SubDieNumber],[Bin],[Result] | |
| | [Number] | Number of the section line. It enumerates the lines in this section. |
| | [DieNumber] | Number of the die which subdie is probed. |
| | [SubDieNumber] | Number of the subdie structure (see SubDie section) that is probed. |
| | [Bin] | Number of the bin that is used to mark this subdie. |
| | [Result] | Result of the subdie probing as string value. |
| [SubDieMultiData] | This section stores information about structure as well as binning of subdies, which belong to own subdie maps. Each line has the following format:<br>[Number]=[DieNumber],[SubDieNumber],[XOffset],[YOffset],[Width],[Height],[Enabled],[Bin],[Label],[Result] | |
| | [Number] | Number of the section line. It enumerates the lines in this section. |
| | [DieNumber] | Number of the die which subdie is described. If a die occurs here, it means that it has an own subdie map. Values from global subdie map are ignored on this die. |
| | [SubDieNumber] | Number of the subdie. |
| | [XOffset] | Offset of the subdie from die reference point of the die in µm in X direction. |

| | | |
|---|---|---|
| | [YOffset] | Offset of the subdie from die reference point of the die in µm in Y direction. |
| | [Width] | Width (size in X direction) of the subdie structure in µm. The structure is spanned from the offset position. The direction depends on the actual die reference position. |
| | [Height] | Height (size in Y direction) of the subdie structure in µm. The structure is spanned from the offset position. The direction depends on the actual die reference position. |
| | [Enabled] | Indicates if this subdie is enabled (1) or disabled (0) to probe. |
| | [Bin] | Number of the bin that is used to mark this subdie. |
| | [Label] | Label of the subdie as string value. |
| | [Result] | Result of the subdie probing as string value. |
| [Process] | This section contains any extra information about this wafer pertaining to the process. | |
| | WaferID | Identifies the wafer |
| | ProductID | Identifies the product ID |
| | LotID | Identifies the lot ID |
| | WaferNum | Identifies the wafer number |
| [Script] | This section defines the script. Like the Die section, all lines have the same format. Order of the lines is not important but counting in the Key part is very important. [ScriptCommandNumber]=[Command]<br>[ScriptCommandNumber] is a string ScriptCommand ended with a real number of this command. It is very important to have correct numbers here: if this section includes 4 lines, for example, it should have commands with numbers from 0 to 3.<br>For example: ScriptCommand3=ReadMapPosition -1 means that the script consists of at least 4 commands and its fourth command is ReadMapPosition -1. | |
| [AutoBin] | This section defines the properties and rules for “Auto Bin” process. | |
| | UseAutoBin | Defines should the application use “Auto Bin” functionality (1) or not (0). |
| | UseDefaultBin | 1 means that if no one rule are accepted the default bin will be used. 0 means do not bin if no one rule are accepted. |
| | DefaultBin | Is a number of the bin that is used in a default case. |
| | ResultFormat | Is a string that describes a format of the result string. |
| | Also this section includes rules to choose a bin. Each rule is define d by one of the following strings:<br>[RuleNumber]=[Bin],[Rule]<br>[RuleNumber]=[Bin1]..[Bin2],[Rule]<br>[RuleNumber] is a string Rule ended with a real number of this command. It is very important to have correct numbers here: if this section includes 4 lines, for example, it should have commands with numbers from 0 to 3.<br>[Rule] is a string that defines a test rule.<br>The first format uses one value [Bin] that defines one bin to use if this rule is accepted.<br>The second format uses two values ([Bin1] and [Bin2]). These values define a bin distance from Bin1 to Bin2 to use if the rule is accepted. | |
| [Profiling] | This section defines the properties of the Z-profiling process. | |
| | AutoMethod | Defines a method of Z detection: FindFocus (use the Vision module FindFocus command), EdgeSensor (use the edge sensor) or AutoFocus (use the Spectrum module AutoFocus command). |
| | ContactSearchSpeed | Defines a speed (in percents) of the contact search process in case of the edge sensor used. |

| | | |
|---|---|---|
| | ContactSearchGap | Defines a gap (in microns) of the contact search process in case of the edge sensor used. |
| | SuccessRatio | Defines a percentage of the successfully profiled dies to determine the Z-profiling process successfully. |
| | Distance | Defines a shifting (dx,dy) in format “[dx],[dy]” in microns to use during the profiling process. Actually when the application goes to the profile die it moves the chuck to the position (x+dx,y+dy) where (x,y) is the profile die coordinate on the chuck, and (dx,dy) is a profiling distance. |
| [ProfDies] | This section defines a set of the dies for the Z-profiling process. All lines have the same format. [DieNumber]=[X],[Y],[Tested],[Delta] | |
| | [DieNumber] | Is a number of the profile die. |
| | [X] and [Y] | Die coordinates. |
| | Tested] | 1 means this die was profiled already, 0 – not profiled. |
| | [Delta] | Is a delta value (result of the profiling) for the die. |
| [DieReference] | This section defines the die reference values used in the map. | |
| | DieRefPos | Defines a die reference position. Legal values are Manual (the position is defined manually by the DieRefPoint key in this section), LeftTop for the left top corner of the die, LeftBottom for lower left corner, RightTop for the right top corner, RightBottom for the lower right corner and Center for the center of the die. |
| | DieRefPoint | Defines a die reference position within the die. Has sense if DieRefPos key is manual only. Otherwise the position is calculated automatically. The value has a form of “[X],[Y]” and defines a point within the die starting from left top corner. X grows from left to right, Y grows from top to bottom. For example, “0,0” is a left top corner, “5000,4000” is a right bottom corner if the die size is 5000 by 4000 microns. |

## Map File Format Example

| | |
|---|---|
| [Header] | Description=Wafer Map File |
| | Version=1.9 |
| [Wafer] | Revision=0.0 |
| | Diameter=25 |
| | FlatLength=0 |
| | FlatAngle=0 |
| | EdgeArea=0 |
| | XIndex=5000 |
| | XOffset=0 |
| | YIndex=5000 |
| | YOffset=0 |
| | Shape=Wafer |
| | DieInX=6 |
| | DieInY=6 |
| | Origin=UL |
| | UseAlphaCoords=0 |
| | UseIOAlphas=1 |
| | UseZeroCoord=1 |
| | HomeDie=1,2 |
| | RefDieOffset=1,1 |
| | UseClusters=0 |
| | ClusterSizeX=1 |
| | ClusterSizeY=1 |
| | TestIncomplete=0 |
| | RouterStartColumn=Left |
| | RouterStartRow=Top |
| | RouterType=HorBiDir |
| | GUI=7 |
| | UsedBinsNumber=16 |
| | StatAllDies=0 |
| | BinInStepNext=0 |
| [FixedGrid] | FixedGridX=-5000.00000000001 |
| | FixedGridY=-5000.00000000001 |
| [DieReference] | DieRefPos=RightTop DieRefPoint=5000,0 |

| | |
|---|---|
| [Bin] | 0=1,a0,00C000,1,0,0,0,0 |
| | 1=1,a1,0000FF,0,0,0,0,0 |
| | 2=1,a2,FF0000,0,1,0,0,0 |
| | 3=1,a3,FFFF00,0,0,0,0,0 |
| | 4=1,a4,FFFF80,0,0,0,0,0 |
| | 5=1,a5,808000,0,0,0,0,0 |
| | 6=1,a6,00FF00,0,0,0,0,0 |
| | 7=1,a7,00FFFF,0,0,0,0,0 |
| | 8=1,a8,C0FFFF,0,0,0,0,0 |
| | 9=1,a9,8000FF,0,0,0,0,0 |
| | 10=1,b0,FF00FF,0,0,0,0,0 |
| | 11=1,b1,800080,0,0,0,0,0 |
| | 12=1,b2,FF0080,0,0,0,0,0 |
| | 13=1,b3,008080,0,0,0,0,0 |
| | 14=1,b4,000080,0,0,0,0,0 |
| | 15=1,x0,000000,0,1,0,0,0 |
| [ShiftParams] | ShiftElement=Line |
| | Mirrored=0 |

| | |
|---|---|
| [Die] | 0=0,-1,X<br>1=1,-1,X<br>2=2,-1,X<br>3=3,-1,X<br>4=-1,0,X<br>5=0,0,X<br>6=1,0,2<br>7=2,0,2<br>8=3,0,X<br>9=4,0,X<br>10=-1,1,X<br>11=0,1,P<br>12=1,1,15<br>13=2,1,15<br>14=3,1,P<br>15=4,1,X<br>16=-1,2,X<br>17=0,2,P<br>18=1,2,15<br>19=2,2,15<br>20=3,2,P<br>21=4,2,X<br>22=-1,3,X<br>23=0,3,X<br>24=1,3,X<br>25=2,3,X<br>26=3,3,X<br>27=4,3,X<br>28=0,4,X<br>29=1,4,X<br>30=2,4,X<br>31=3,4,X |
| [SubDie] | 0=3500.0,3500.0,-1500.0,-3000.0,1,<br>1=2750.0,5000.0,0.0,0.0,0,<br>2=4250.0,2000.0,0.0,0.0,0, |
| [SubDieData] | 0=11,0,0,<br>5=17,0,0, |

| | |
|---|---|
| [SubDieMultiData] | 1=12,0,3500.0,3500.0,-1500.0,-3000.0,1,2 |
| | 2=13,0,3000.0,3500.0,-1500.0,-3000.0,1,2 |
| | 3=13,1,2250.0,5000.0,0.0,0.0,0,0 |
| | 4=13,2,3750.0,2000.0,0.0,0.0,0,2 |
| | 6=18,0,3300.0,3500.0,-1500.0,-3000.0,1,0 |
| | 7=18,1,2550.0,5000.0,0.0,0.0,1,511 |
| | 8=18,2,4050.0,2000.0,0.0,0.0,1,2 |
| | 9=19,0,3500.0,3500.0,-1500.0,-3000.0,0,511 |
| [Process] | WaferID= |
| | ProductID= |
| | LotID= |
| | WaferNum=1 |
| [Script] | ScriptCommand0=ReadMapPosition -1 |
| | ScriptCommand2=BinMapDie 4 |
| [AutoBin] | UseAutoBin=1 |
| | UseDefaultBin=1 |
| | DefaultBin=2 |
| | ResultFormat=%d, %v |
| | Rule0=0,(%d<5) |
| | Rule1=1..10,(%v~[5,25]) |
| [Profiling] | AutoMethod=FindFocus |
| | ContactSearchSpeed=20 |
| | ContactSearchGap=500 |
| | SuccessRatio=75 |
| | Distance=0,0 |
| | UseGlobal=0 |

Appendix

# G Optical Control

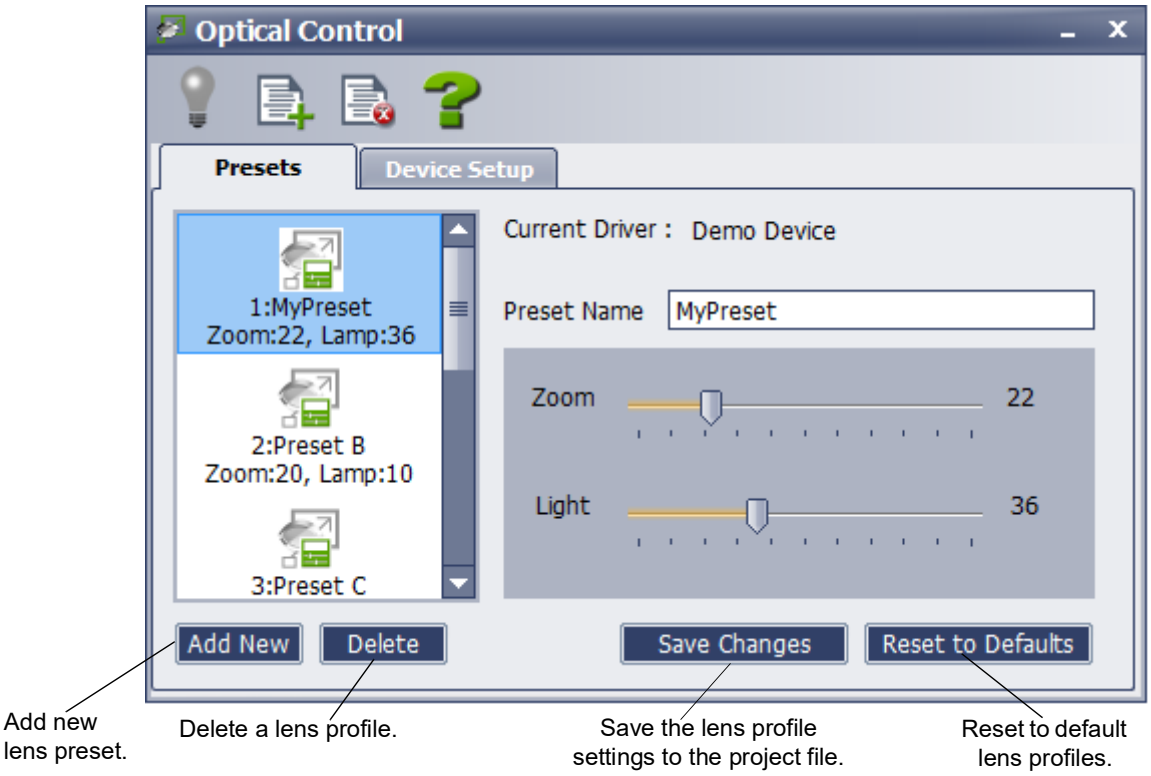
Optical Control is required when using certain microscopes and lamp sources such as A-Zoom, JE-Zoom, IntraLed 2000, and Microlight). The software provides support for control of zoom levels and lamp brightness settings.

Zoom and Lamp settings may be saved to the project file using the Save Changes button on the Presets Tab of the Optical Control application.

Open Optical Control from the Windows Start menu under FormFactor Velox Tools.

## Define Lamp and Zoom Presets

The defined presets indicate the zoom and lamp settings and are identified by the preset name. You can use the supplied default name or create a new preset name, up to 40 characters. Add, remove, and modify presets as needed.



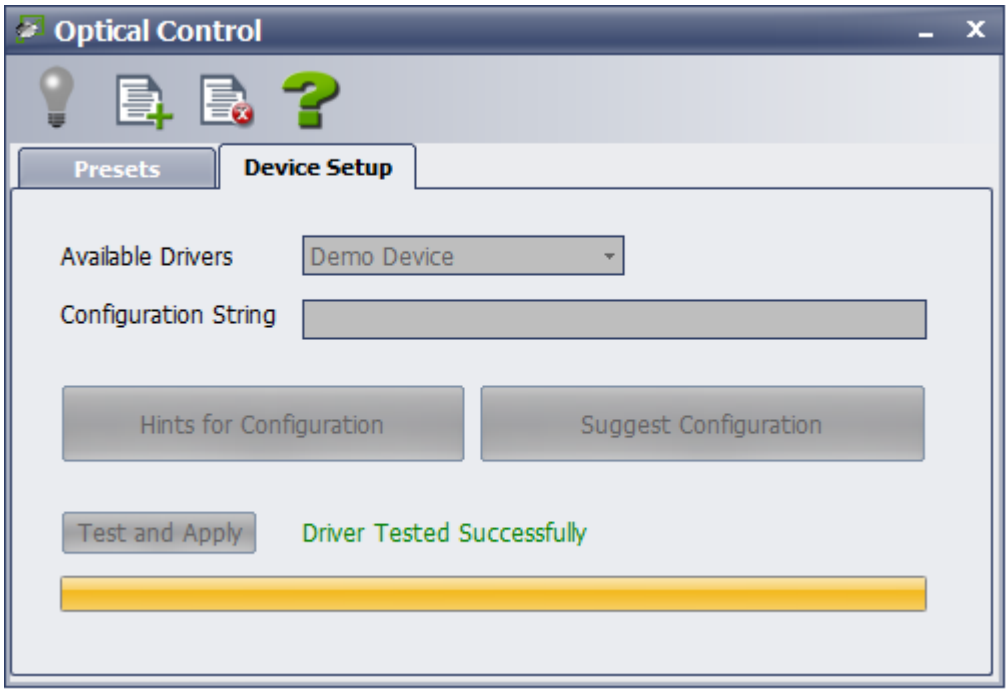
# Toolbar Buttons

These controls are available to all access levels.

| | |
|---|---|
| | Toggle the lamp on and off. |
| | Click to toggle the display of the message log. By default, this is hidden at start up. |
| | Clear the contents of the message log. |
| | Open the help documentation for Optical Control. |

# Device Setup

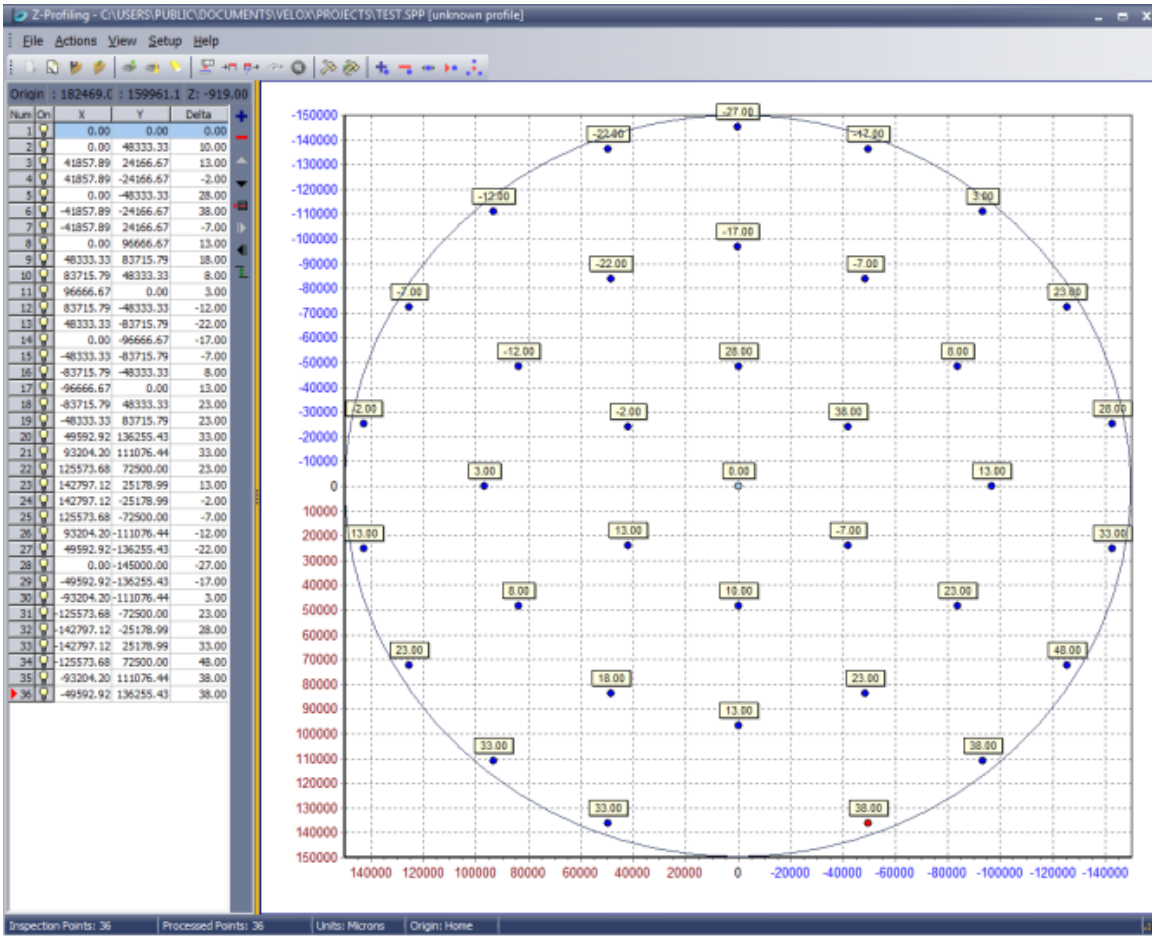
The COM Port setting can be changed by an Admin-level user. All other settings must be made by a user with Service-level access.



# H Z-Profiling

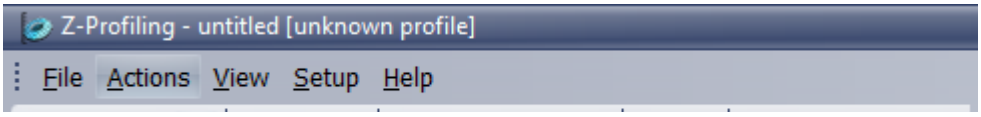
Z-profiling calibrates contact heights for non-planar wafers. The calibration can be made automatically or semi-automatically, using the edge sensor and microscope, and selecting or rejecting Z-profile points for calibration. Z-profiling calculates a delta value, which is the difference between the reference height and the real contact height of each profile point.

The Z-Profile is a list of XY-position related offsets of the Z-axis. A profile is always wafer specific. It is deleted automatically, when the chuck moves to load position.



# Toolbar

To access the toolbar from the Windows Start menu, click FormFactor Velox > Velox Toolbar.

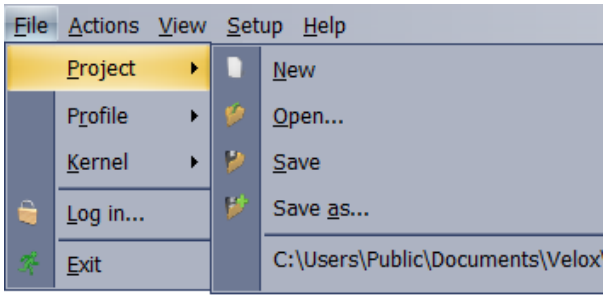



| | | |
|---|---|---|
| | New empty profile | Creates a new Z-profile. |
| | New profile with a Wizard | Opens a wizard window where a new Z-profile can be created interactively. |
| | Save | Saves the current Z-profile.<br>Profiles should be saved to: C:\Users\Public\Documents\Velox. |
| | Open | Opens the Load window to load a Z-profile from a file. |
| | Read profile points from kernel | Downloads a Z-profile from the kernel. |
| | Write profile points to kernel | Uploads the current Z-profile to the kernel. Enabled points will be stored in the kernel only. |
| | Clear kernel profiling data | Clears all the Z-profiling data in the kernel. |
| | Edit Origin | Opens a window to edit the Z-profile origin. All the points in the Z-profile are relative to its origin. |
| | Start | The Start button changes according to its state. It transitions to Next, then Finish.<br>The Start button has different behavior in the semiautomatic and in the automatic mode. In both modes, it starts the Z-profiling process by moving the chuck to the start profile point. In the automatic mode, it will be disabled until the process is finished. In the semiautomatic mode, it will change its name and picture and take the appropriate action. |
| | Next | After moving to the start point, Z-profiling is paused and the Start button becomes Next.<br>Adjust a height before clicking Next. It will be interpreted as a contact height for the current point. Next reads the current height.<br>If current point is the start point, it stores this value as a zero level, otherwise it calculates the value for the current point. Afterwards, this command moves the chuck to the next enabled point in the Z-profile. |
| | Finish | If the current point is last in the Z-profile, click the Finish button. Finish works like Next except that it does not move the chuck. After calculating the delta, it finishes the Z-profiling process. |
| | Validate the profile | Repeats the Z-profiling process and compares old values with new ones. After this operation, a window displays information about valid, invalid, and failed points. (Used in automatic mode only.) |
| | Skip | Skip the current point during the Z-profiling process. Since the delta value is not calculated for the point, this point will be disabled in the Z-profile. |
| | Stop | Cancels the Z-profiling process |

| | | |
|---|---|---|
| | Profiling | Opens the Z-profiling window to set the Z-profiling settings. |
| | Units | Opens the Units window to set the units. |
| | Add Point | Lets you add new points to the Z-profile by clicking on the point in the map view. |
| | Delete Point | Lets you delete points from the Z-profile by clicking on the point in the map view. |
| | Move Point | Lets you move any point from the Z-profile in the map view. Click first on the point, then click on new position. |
| | Go to Point | Enables a mode when the user can move the chuck to any point from the Z-profile by clicking on it in the View window. |
| | Add new center points to the triangles as tested points | Adds new points to the Z-profile to make it more precise. The rule is simple: all points are covered by triangles, each vertex of the triangle is a point of the Z-profile. The centers of the triangles are new points of the Z-profile. If all three vertexes of the triangle are tested points, the new point will be marked as tested and has Z value equal to average Z of all three vertexes. Otherwise the new point will be marked as untested. |

# Menus

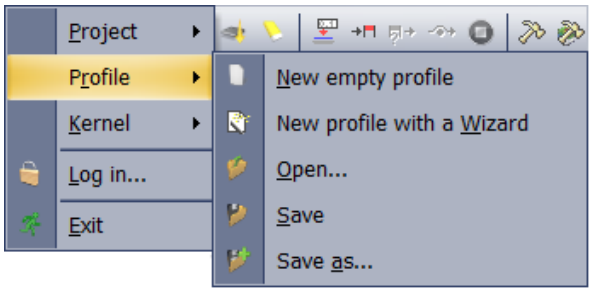
## File Menu




**Project Menu**

The most recent files are displayed (up to four) and use the .spp extension. These project files contain saved setup parameters and user preferences.

Project files should be saved to: C:\Users\Public\Documents\Velox.




**Profile Menu**

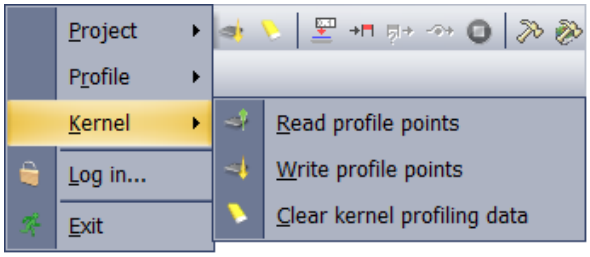
You can create a new Z-profile by entering values in setup or with the New Profile wizard.

The most recent files are displayed (up to four) and use the .prf extension. These contain all Z-profile points and their settings, and include:

- Active status (test this point or not)
- Test status (is this point tested or not)
- Delta value

Z-profile files are text files, where each line represents one point with all its parameters. Unlike Project files, Z-profile files are not used by any Velox application other than Z-profiling.

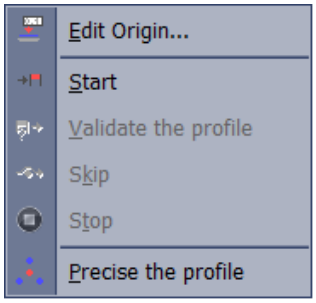
Save files to: C:\Users\Public\Documents\Velox.




**Kernel Menu**

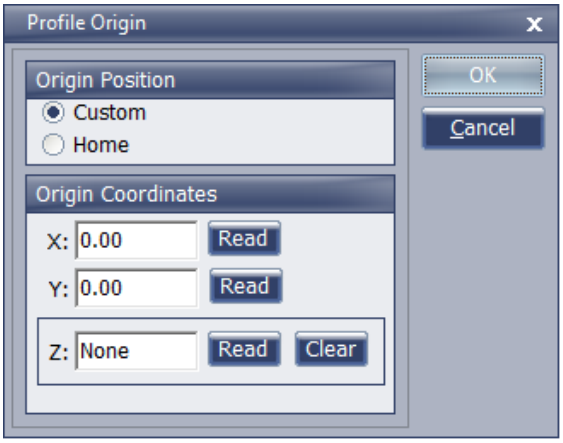
This menu lets you use, store, or clear data in the kernel. Only enabled points are stored in the kernel.

## Actions Menu




| | |
|---|---|
| Edit Origin | Click Edit Origin to display and modify the current values in Profile. |
| Start | Z-profiling process starts by moving the chuck to the Start profile point.<br>• Semiautomatic mode: changes its name and picture and takes the appropriate action.<br>• Automatic mode: disabled until the process is finished. |
| Validate the profile | (Automatic Mode only.) Repeats the Z-profiling process and compares old and new values. Displays a window with information about valid, invalid, and failed points. |
| Skip | Semiautomatic mode: skips the current point during the Z-profiling process, so the delta value is not calculated for the point. This point will be disabled in the Z-profile. |
| Stop | Cancels the Z-profiling process. |
| | Adds new points to the Z-profile to make it more precise. |

**Profile Origin**

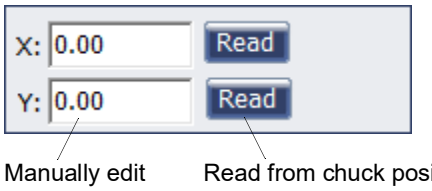



**Origin Position**

To define the origin position, select custom values or select the chuck home position.

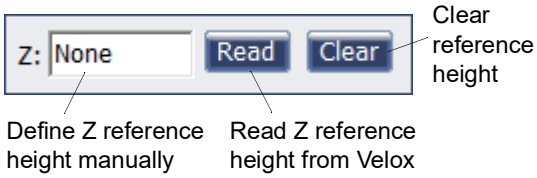
**Custom X and Y Coordinates**

You can manually edit the X and Y coordinates, or read the X and Y coordinates from the chuck position after moving the chuck to the appropriate point.

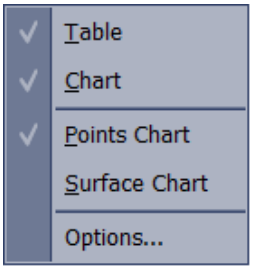



**Custom Z Reference Height**

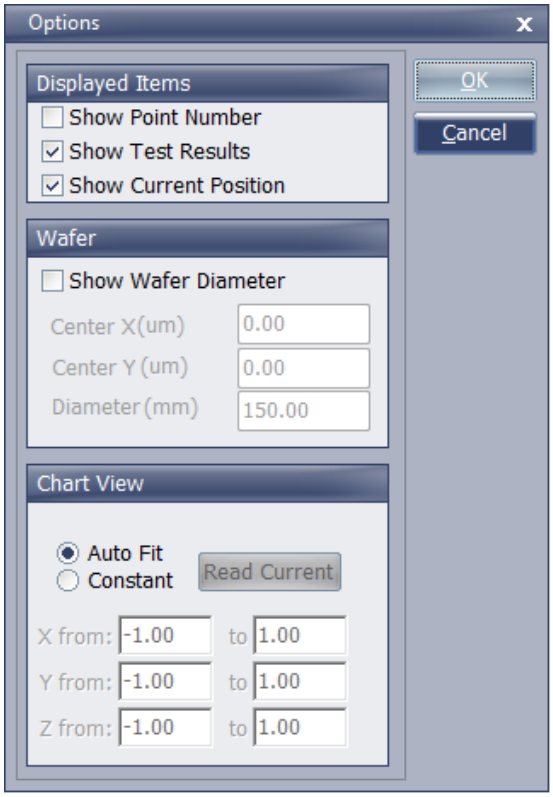
The reference height value is used to assess the wafer surface. Once the reference height is defined, it can be used for different Z-profiling processes. If the reference height is not defined, the value is calculated automatically as the contact height of the first Z-profile point.



## View Menu

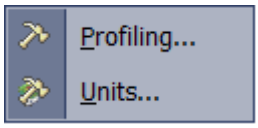


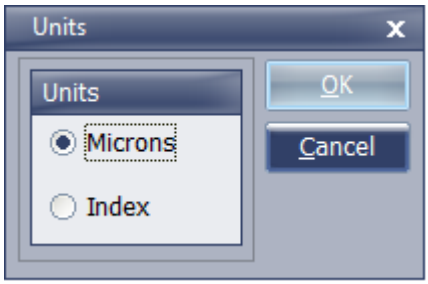

| | |
|---|---|
| Table | Switches the Table view on and off. |
| Chart | Switches the Chart view on and off. |
| Points Chart | Changes the view to a Points Chart (flat view). |
| Surface Chart | Changes the view to 3D Surface Chart. |
| **Options** | Opens Options window to define the settings for the Z-profiling process. |



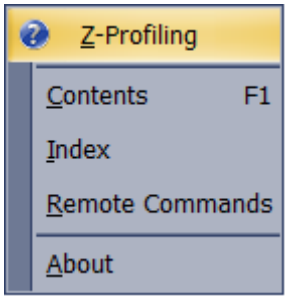

| | |
|---|---|
| Displayed Items<br>• Show Point Number<br>• Show Test Results<br>• Show Current Position | • Show/Hide point data in the view window.<br>• Show/Hide test results.<br>• Show/Hide current position. |
| Show Wafer Diameter | Click Show Wafer Diameter to set center X, center Y, and diameter. |
| Chart View | Modify settings for the Chart views.<br>Auto Fit automatically calculates the size of the chart to fit the window. |

## Setup Menu




| | |
|---|---|
| Profiling | Accesses the Settings. |
| Units | Lets you assign the X,Y coordinate units, either microns or index.   |

## Help Menu




| | |
|---|---|
| Contents | Opens the Help file to the Contents page for an overall view of the help topics. |
| Index | Opens the Help file to the Index page for a complete listing of topics and key words. |
| Remote Commands | Opens the Help file to the Contents page of Z Profiling Commands. |
| About | Opens the About dialog box with important product, version and copyright information. |

## Status Bar

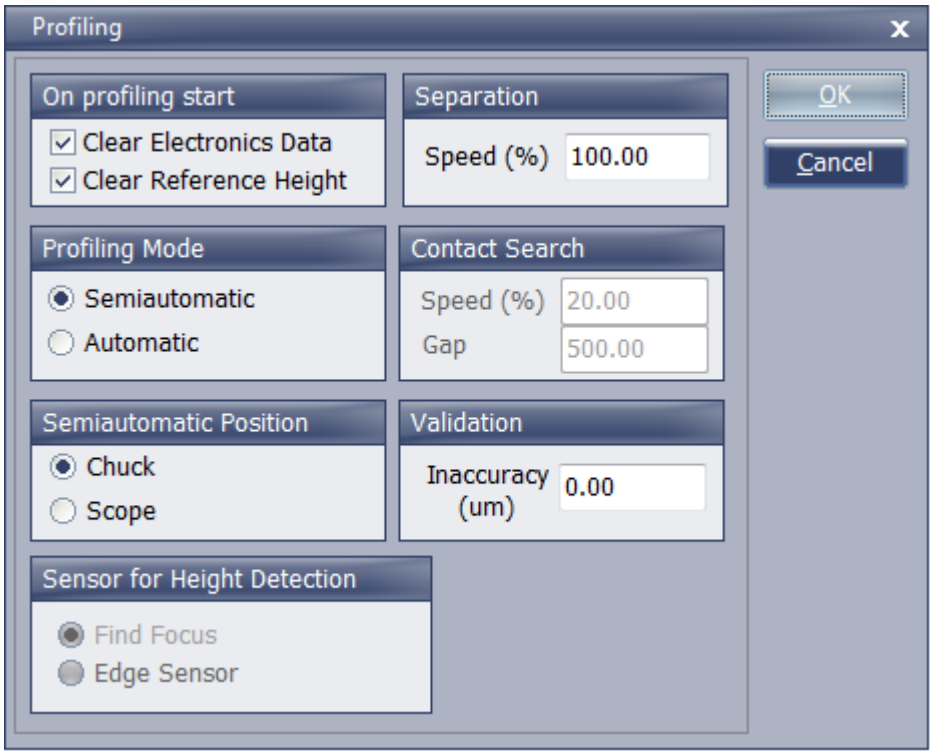
| | |
|---|---|
| Inspection Points | Displays the number of enabled points in the Z-profile. |
| Processed Points | Processed points (the points that were tested and have a delta value calculated) |
| Units | Displays the Z-profile's unit of measure. |
| Origin | Displays the Z-profile's origin: custom or home position. |
| Status area | Displays the current status of the application. |

# Z-Profile Setup

Position and Contact Height of the Z-profile points will be scanned automatically. To detect correct heights, Z-profiling can use these sensors:

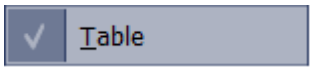
- FindFocus (Spectrum). The Z coordinate of the focus stage (for example, Chuck) is used to calculate a delta.
- Edge Sensor. The contact position must be detected by using a Velox command which reads the Z coordinate of the chuck and calculates a delta.
- Additional parameters such as Gap and Search Speed may be defined.

## Settings




| | |
|---|---|
| On profiling start | You can choose to clear all data in the Velox kernel and to clear the reference height for the Z-profile.<br>All Z-profile deltas refer to the reference height. If a value exists during the Z-profiling process, it is used to calculate delta values. Otherwise, it is calculated as a contact height for the first point in the Z-profile. |
| Profiling Mode | Select Semiautomatic or Automatic mode,<br>• In Semiautomatic mode, the contact height for points must be adjusted manually, for each step. The current height is read before moving to the next point.<br>• In Automatic mode, all points are automatically tested step-by-step. The contact height is found for each point, using either the microscope and Vision or using an edge sensor. |
| Sensor for Height Detection | Select the required sensor for height detection. |
| Separation | Set the speed of the chuck movement to the separation height. |
| Validation | During the validation process, old and new delta values are compared.<br>Select the value for the maximum possible difference to determine the valid point value. |
| Semiautomatic Position | Select the chuck stage or the microscope stage. |
| Contact Search | In Automatic mode, an edge sensor adjusts the parameters of the contact search. Select the gap and the speed of the chuck movement. |
| Combine Mode | The Combine mode is available when the height detection sensor is Auto Focus (Spectrum). The Combine mode lets you use both AutoFocus and FindFocus methods simultaneously. In this case, the primary method is AutoFocus, but if it fails to detect a delta, FindFocus can be used for the same point. |

## Z-Profile Data Table

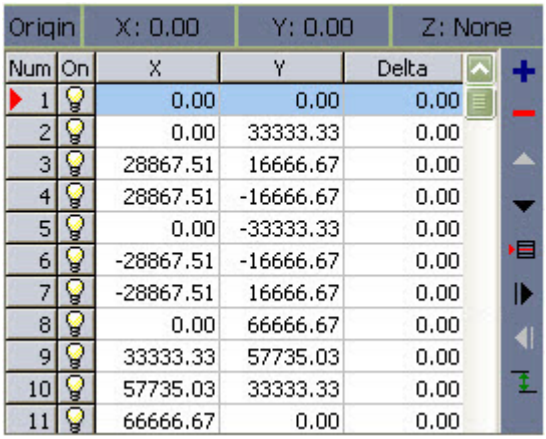
From the View menu, click the Table check mark 

to display the table data. (This is enabled by default.)

The table displays the current Z-profile as a table, which can be edited. The Z-profile point X,Y coordinates use the chuck coordinate system. If the Z-profiling process is not running, you can add any cells in the grid.

| | |
|---|---|
| Num | The red arrow marks the current point. Double-click a number to move the chuck to a point in the Z-profile. The first point in the table is the start point of the Z-profile. |
| On | Click to enable or disable. If enabled, this point will be tested during Z-profiling and stored in the kernel. |
| X | The X coordinate is displayed. |
| Y | The Y coordinate is displayed. |
| Delta | The delta value is displayed. |

The current Z-profile origin coordinates in microns are shown across the top of the window



| Origin | X: 0.00 | Y: 0.00 | Z: None |
|---|---|---|---|

| Num | On | X | Y | Delta |
|---|---|---|---|---|
| 1 | | 0.00 | 0.00 | 0.00 |
| 2 | | 0.00 | 33333.33 | 0.00 |
| 3 | | 28867.51 | 16666.67 | 0.00 |
| 4 | | 28867.51 | -16666.67 | 0.00 |
| 5 | | 0.00 | -33333.33 | 0.00 |
| 6 | | -28867.51 | -16666.67 | 0.00 |
| 7 | | -28867.51 | 16666.67 | 0.00 |
| 8 | | 0.00 | 66666.67 | 0.00 |
| 9 | | 33333.33 | 57735.03 | 0.00 |
| 10 | | 57735.03 | 33333.33 | 0.00 |
| 11 | | 66666.67 | 0.00 | 0.00 |

Adds a new point with current coordinates of the chuck

Removes the selected point

Moves the selected point up in the list

Moves the selected point down in the list

Moves the chuck to the selected point

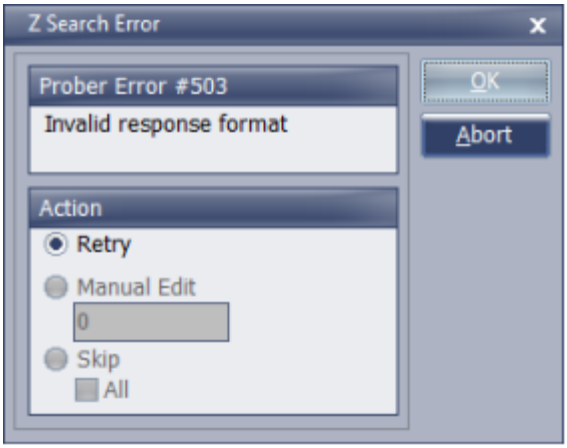
Moves the chuck to the next point

Moves the chuck to the previous point

Reads current height and calculates a delta value for the current (not for the selected) point

# Z-Search Error

In Automatic mode, all points are automatically tested step-by-step. The contact height is found for each point, using either the microscope and Vision or using an edge sensor. If an error occurs during profiling, the error and its description are displayed.




| | |
|---|---|
| Retry | If an error occurs on the Start point, only Retry or Skip All options are possible. |
| Manual Edit | Click to edit the Delta value for the point. |
| Skip | Click to select Skip for this point. |
| Skip All | Click All to skip all problem points, and abort the profiling process. |

# Remote Profiling

You can use remote commands for Z-profiling with either full Z-profiling or step-by-step.

| | |
|---|---|
| Synchronous mode | Synchronous Z-profiling will be started by the ZProfileWafer command. It starts the Z-profiling and returns a result after all points are scanned completely. Other commands will not be accepted before the Z-profiling is finished. |
| Asynchronous mode | Asynchronous Z-profiling is started or canceled by sending StartZProfiling or StopZProfiling. You can check the current state at any time by sending GetZProfilingStatus. It returns a logical 1 during Z-profiling and 0 when finished. |

1. StepFirstZProfilePoint
   a. Starts the profiling process.
   b. Goes to the first enabled profile point (in separation if necessary).
   c. Detects the contact height.
   d. Calculates a delta.
   e. Pauses the process (or stops if there are no next points).
2. StepNextZProfilePoint
   a. Goes to the next enabled profile point (in separation if necessary).
   b. Detects the contact height.
   c. Calculates a delta.
   d. Pauses the process (or stops if there are no next points).

# Z-Profiling File Format

Profiles are saved with the .prf extension. The file contains all the information required to recreate the profile, including status of profile points.

The Z-profiling file format is similar to a Windows ini-file. The file is divided into sections, which are denoted by a header line in brackets. Each line within a section contains the name of a parameter and its value, separated by an equal sign. For example the diameter of a wafer is shown by:

Diameter=150

Lines beginning with a semicolon are comments.

## [Header]

| | |
|---|---|
| Description | Description of file. |
| Version | Version of the current profile file. The current version is 1.1 |

## [Profile]

| | |
|---|---|
| RefHeight | A reference height in microns to calculate point deltas. If the profile does not have a reference height it will be calculated during the profiling process as a height of the first profile point. |
| Origin | Micron coordinates of the profile origin point. Each profile point is relative to the origin point. The line format is [X],[Y] |
| Units | Each profile point is described by its (X,Y) coordinates. Values are “Mils” for mils, “Microns” for microns and “Index” for indices. |

## [Points]

This section defines all points of the profile. All lines have the same format. Order of the lines is not important.

[LineNumber]=[X],[Y],[Delta],[Enabled],[Tested]

| | |
|---|---|
| X | X coordinate of the point |
| Y | Y coordinate of the point |
| Delta | Delta value for the point |
| Enabled | If 0 this point is disabled, otherwise – enabled |
| Tested | If 0 this point isn’t tested, otherwise – tested |

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