Chapter 8.62

Keyence VHX-7000 Digital Microscope

(keyence7000) (380)

1.0 Equipment Purpose

1.1 The Keyence VHX-7000 is a high speed, CMOS image sensor digital microscope, capable of 4K resolution. Key features include Automatic Focusing, Multi-Lighting, and 2D/3D stitching. The Fully-Integrated Objective Head makes for automatic transition between objectives while the fully motorized XYZ stage allows for smooth movement and focusing.

2.0 Material Controls & Compatibility

2.1 No wet samples are allowed on the keyence stage.

3.0 Training Procedure & Applicable Documents

3.1 Exam Tool

3.1.1 This tool requires an online exam before qualification.

3.1.2 Timeline (estimated time to completion: 1 week)

3.1.2.1 Get trained by any qualified member.

3.1.2.2 Take the online test

3.1.2.3 Arrange a qualification session with a superuser to show competency on the tool.

3.1.3 Superusers and staff qualify members on this tool.

3.2 Manufacturer's Manual

4.0 Definitions & Process Terminology

4.1 The following are buttons and their actions on the keyence7000 controller:

4.1.1 Fine/Coarse Focus Dial: Raises or lowers the Z-axis for the camera to adjust focus.

4.1.2 Scale: Toggles the scale display between on and off.

4.1.3 Anti-vibration: allows for observation without vibration

4.1.4 Split screen: Displays the observation window as split screens

4.1.5 Multi lighting: object is illuminated from several directions

4.1.6 Live Depth Up: automatically scan through the height of a sample

4.1.7 Home button: Return to default imaging settings and back to easy mode

4.1.8 Navigation: Display the navigation window

4.1.9 Origin: Move the XYθ stage to the origin (center)

4.1.10 Joystick: Move the position of XYθ stage

4.1.11 Remove reflection: suppresses glare on highly reflective surfaces

4.1.12 Image stitch: image stitching menu appears

4.1.13 Increase resolution: Improves visibility of the images with methods of HDR

4.1.14 Opt-SEM: Optical Shadow Effect Mode

4.1.15 Auto Focus: An area specified with the focus area automatically comes into focus

4.1.16 Depth Composition & 3D: Performs depth composition and displays 3D images

4.1.17 Rec: Stores images on screen to the hard drive

4.1.18 Pause: temporarily pauses the screen. Press again to release paused image

4.1.19 White Balance: adjust white balance

4.1.20 Light: Turn lamp on or off

4.1.21 Light Shift: Changes orientation of light to emphasize height differences

4.1.22 Brightness: Adjusts the brightness of the image by adjusting the shutter speed

4.1.23 XY stage: moves the stage

4.1.23.1 LED blinking: stage initialization not complete

4.1.23.2 LED Solid: stage initialization complete

4.1.24 Magnification: Changes the magnification level automatically using fully-integrated head

5.0 Safety

5.1 Be aware at all times where the lens is with respect to the stage or your sample. **Do not contact the objective lens with the sample or stage.**

5.2 No wet samples are allowed to be observed with this system. Do not attempt to put any sample with liquid on the stage.

6.0 Process Data

6.1.1 This tool is not regularly monitored by staff.

7.0 Available Processes, Gases, Materials. Process Notes

7.1 Observing targets with automatic zoom control 20x - 2500x mag

7.2 Freezing, recording and measuring images

7.3 Image enhancement

7.4 Reflection/glare removal

7.5 Real time Focus view/assisting

7.6 Anti vibration modes

7.7 Real time depth composition (multiple focal plane integration)

7.8 3-D profile measurement

7.9 2D/3D Stitching

7.10 Opt-SEM (Optical Shadow Effect Mode)

8.0 ***Equipment Operation***

8.1 Enable the tool: **keyence7000**

8.2 Verify the stage, camera, light and monitor are on.

8.2.1 Stage and camera should have a blue light illuminated. On the controller, the light button should be toggled on. Monitor should be open to the software screen.

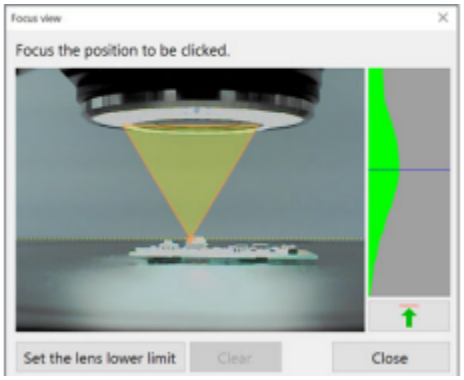
8.3 Initialize the stage if prompted

8.3.1 Stage initialization (for XY) is only needed if the stage was not left at the origin position previously

8.4 **Double check wafers/samples for cleanliness before placing onto the stage. Place a technicloth over the glass before placing a sample, if needed.**

8.5 Use the XY knob on the controller to center the area of interest under the objective

8.6 Bring sample into focus by raising the stage in the Z direction. Be sure to use the focusing triangle on the screen to avoid moving the stage and sample too high.



8.7 Manually tune focus knobs for stage and camera until sample is in focus or use “Auto Focus” on the controller

8.7.1 Sample stage must be high enough to perform auto focus. Auto focus only adjusts the location of the camera relative to the stage. It does not move the sample stage.

8.8 Using the controller:

8.8.1 Navigate in X and Y using XY knob

8.8.2 Change brightness and magnification using their respective knobs

8.8.2.1 The tool will not allow software input during objective changing. Wait a couple seconds for objective change to be complete before proceeding.

8.9 The software options are on the right side of the screen:

8.9.1 **Easy Mode**: Convenient location for simple commands like Focus, Contrast, removing reflections, opening saved images, and standard measuring

8.9.2 **Lighting/Brightness**: Select which illumination type is active for lighting and adjust brightness. Brightness can also be changed by the brightness knob on the controller.

8.9.3 **View**: Allows split screen for multi-image viewing

8.9.3.1 Once a different image viewing method is selected, you must select the image area you want to be active in. All other areas will freeze until clicked on/selected.

8.9.3.2 Ex. Split screen: The left side is active, the right side is dark. Clicking on the right side will now allow you to create a new image while freezing the left side.

8.9.4 **Measure**: opens plane measurement and scale options

8.9.5 **Increase Image Quality**: opens options for Opt-SEM, remove reflection, increase resolution and multi lighting

8.9.6 **Depth Up**: depth composition mode

8.9.7 **Serial Recording**: Stitching

8.9.7.1 Process for stitching defined in Appendices

8.9.8 **Album/Side album**: Opens the VHX album

8.10 Use **Pause** to freeze the image on screen, use **REC** to save the image

8.11 **Final Steps**: once imaging is completed, do the following:

8.11.1 Lower magnification to 20x

8.11.2 Lower the stage away from the objectives

8.11.3 Remove sample

8.11.4 Press the origin button on the controller to bring the stage back to home (XY) position

8.11.5 Press the home button on the controller and click “OK” in the software

8.11.6 Turn brightness knob down (counter clockwise) and toggle light off on the controller

8.11.7 Disable the tool

9.0 ***Troubleshooting Guidelines***

9.1 **Home Button:** Undo all imaging settings and go back into easy mode

9.2 Possible issues that may occur:

9.2.1 Stage not moving: verify enable in mercury and stage power is on (blue light on base of stage)

9.2.2 Stage not at correct location upon start up: stage needs to be initialized. Initialize the stage using the prompt on software. If no prompt comes up, disable and enable the tool again. If the software still does not prompt for the stage to be initialized, software may need to be restarted.

9.2.3 Light not on: light button on controller needs to be toggled on. If controller button is on, then in software, check “lighting and brightness” that light is selected and on

9.2.4 Auto focus does not work: auto focus only works by moving the camera head up and down, not the sample stage. The sample stage needs to be high enough and in range to allow the camera to autofocus. Bring the stage to the correct position first, then click auto focus.

10.0 Study Guide

10.1 What should you check for after enabling the tool?

10.2 How high should you raise the sample stage in the Z direction? What should you look for on the screen?

10.3 What does the HOME button do? What does the ORIGIN button do?

11.0 Appendices, Figures & Schematics

11.1 2D Stitching Procedure:

11.1.1 Go to serial recording and click on “2D Image Stitching”

11.1.2 There are three ways to create a stitched image:

11.1.2.1 Method 1: Center of the FOV

11.1.2.1.1 This method will stitch images together in a spiral pattern around the current position. You can specify the number of images to stitch together.

11.1.2.2 Method 2: End point

11.1.2.2.1 This method illustrates a rectangle that is created by user defined positions.

11.1.2.2.2 This method allows you to check the area you will be stitching. Click the “check the area” box to navigate to the four corners of the stitching area as well as the center.

11.1.2.3 Method 3: XY length

11.1.2.3.1 This method stitches an area specified by length. Set a starting point and then input X and Y values to stitch based on the starting point.

11.1.3 Once all this has been done, click “Start stitching”. The tool will create a stitched image and update in real time.

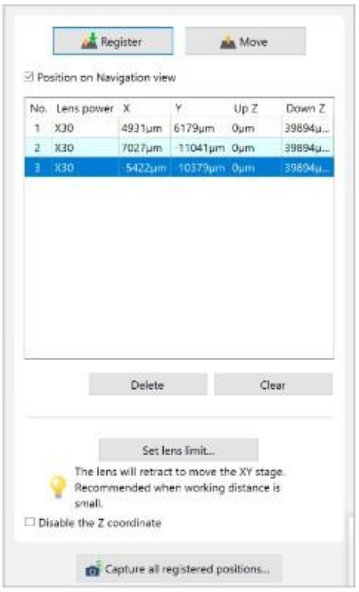
11.1.4 You may choose to complete the stitching before the software end point by selecting “complete” in the dialog box during a scan. You may also resume by clicking “resume stitching”

11.2 Register Stage position for measurements:

11.2.1 This capture method is particularly useful when taking pictures of the same positions on the wafer multiple times (ex. Before and after etch)

11.2.2 Go to serial recording and click “Register the Stage Position”

11.2.3 From this screen, you can use the “register” button to register positions to the software.



11.2.3.1 This includes the Z height for the stage and lens magnification. Set up each position as if you were going to capture it normally (in focus, correct magnification, correct lighting, etc.)

11.2.3.2 Once set up for that particular location has been completed, hit “register”. This location is now saved in the table to be captured later.

11.2.4 Once all desired locations have been registered, you can click “Capture all registered positions”

11.2.4.1 The stage will move automatically to those positions and capture pictures

11.2.5 Follow the onscreen instructions to complete the capture