KLA-Tencor

Accelerating Yield

KT Automation User Guide

9022549-000

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KT Automation User Guide

Reprint Acknowledgements

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Preface

Manual Purpose

This User Guide describes:

- Hardware components of the KT Automation™ System for KLA-Tencor instrumented test wafers

- Setting up the system for automatic missions

- Managing inventory

- Controlling the KT Automation System

- Launching user missions using SensArray® Temperature Wafers and Automation Metrology™ Wafers

Manual Structure

This manual consists of this preface, 4 sections, and a glossary. Each section is briefly described below:

Preface

Introduces the manual.

Section 1: Introduction

This section provides an introduction to the KT Automation System.

Section 2: KT Automation System Hardware Components

This section describes the functions and controls of the KT Automation System hardware components.

Section 3: KT Automation System Web UI

This section describes how to use the Web UI of the KT Automation System.

Glossary

Defines abbreviations and terms used in the manual.

Reference Documentation

The following table specifies documents referenced in this manual.

Document Number	Title
9022547-000	CPG KT Automation System Safety Manual
9022552-000	KT Automation System GEM/SECS Reference Manual

Conventions Used in this Manual

WARNING

Indicates danger to personnel.
Includes instructions needed to prevent any damage.

CAUTION

Indicates danger to Equipment.
Includes instructions needed to prevent any damage.

When either of the above symbols appear in this manual, follow the advice given. Failure to do so may endanger yourself or others, and can result in damage to the Equipment.

IMPORTANT

Indicates there is possibility for a failure.
Includes the instruction needed to prevent the failure.

NOTE

Indicates there is additional information connected with the current subject.
Includes that information.

Special terms

Special terms (dialog box names, button names and any other unique term) are in **bold**, as demonstrated in the example below:

File menu, **Start** button.

Hyperlinks

Hyperlinks to references in this document appear in blue (on screen).
Hyperlinks to web sites, or external documentation, are blue and underlined.

1.

Introduction

1.1 KT Automation System Overview

The KT Automation System provided by KLA-Tencor automates the use of instrumented wafers in a semiconductor wafer fab. The KT Automation System is used with SensArray temperature wafers and Automation Metrology motion analysis wafers to enable real-time measurement and monitoring of parameters that are critical to fab yield and productivity.

The KT Automation hardware consists of the following components:

- Battery-powered, instrumented wafers that perform the actual measurements and reside in Automation FOUPs; examples are SensArray Temperature Wafers and Automation Metrology Wafers (to measure motion and humidity)

- Battery-powered Automation FOUPs to transport and store instrumented wafers, and to provide wafer charging and data communications (see Section 2.2 for information about KT Automation FOUPs)

- KT Automation Stations that charge Automation FOUPs and provide the communication between the FOUP and the fab host (see Section 2.1 for information about KT Automation Stations)

- KT Automation Controller to control the system

1.2   KT Automation System Operation

The KT Automation System provided by KLA-Tencor is used to deploy and manage instrumented wafers in a semiconductor wafer fab to enable real-time measurement and monitoring of parameters that are critical to fab yield and productivity. Operation is completely automated (see Figure 1-1).

Figure 1-1: KT Automation System Topology
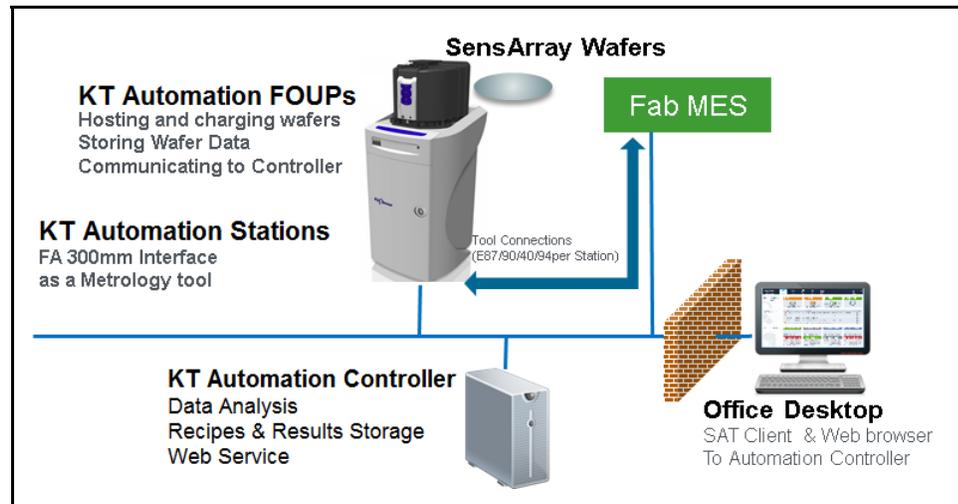
Measurement "missions" are executed automatically under control of the fab manufacturing execution system (MES). The instrumented wafers are transported by the fab OHT and automated material handling system (AMHS) to and from the tool under test. Tests are executed on process tools without removing them from full automated mode. Mission results are communicated directly to the MES, plus results can be automatically available to engineers inside and outside the fab through a web-based GUI and desktop analysis software system.

Measurements are easy to accomplish without removing the process tools from production use and without manual handling or recipe execution in the fab. This enables KT metrology wafers to be used for in-line monitoring of process and mechanical system parameters, preventing excursions that can cause yield loss, and improving tool matching performance.

Examples of instrumented metrology wafers from KT that are supported by this system are: the SensArray EtchTemp Wafer for monitoring etch temperature; and the KT Automation Metrology Wafer for monitoring AMHS FOUP and equipment front end wafer handling.

To create and launch a new mission (see Figure 1-2), the MES system sends the instrumented wafer(s) in a KT Automation FOUP to the KT Automation Station (1). The MES communicates with the KT Automation Station to initiate the mission with a Control Job/Process Job (CJ/PC). If the correct wafers for the mission are present in the FOUP with sufficient charge, the CJ/PJ is completed (2). The FOUP is transported to the target tool under test by the standard fab AMHS (3). The MES host system initiates the correct test recipe on the target tool in full auto mode. When the test is complete, the Automation FOUP is returned to the Automation Station (5). When the Automation FOUP

arrives at the Automation Station, the host executes another CJ/PJ to process the data (6). The mission results are uploaded to the KT Automation Controller and the Go/No Go results are reported to the host from the Station, per the metrology recipe in effect (7).

Figure 1-2:   KT Automation System Mission Sequence
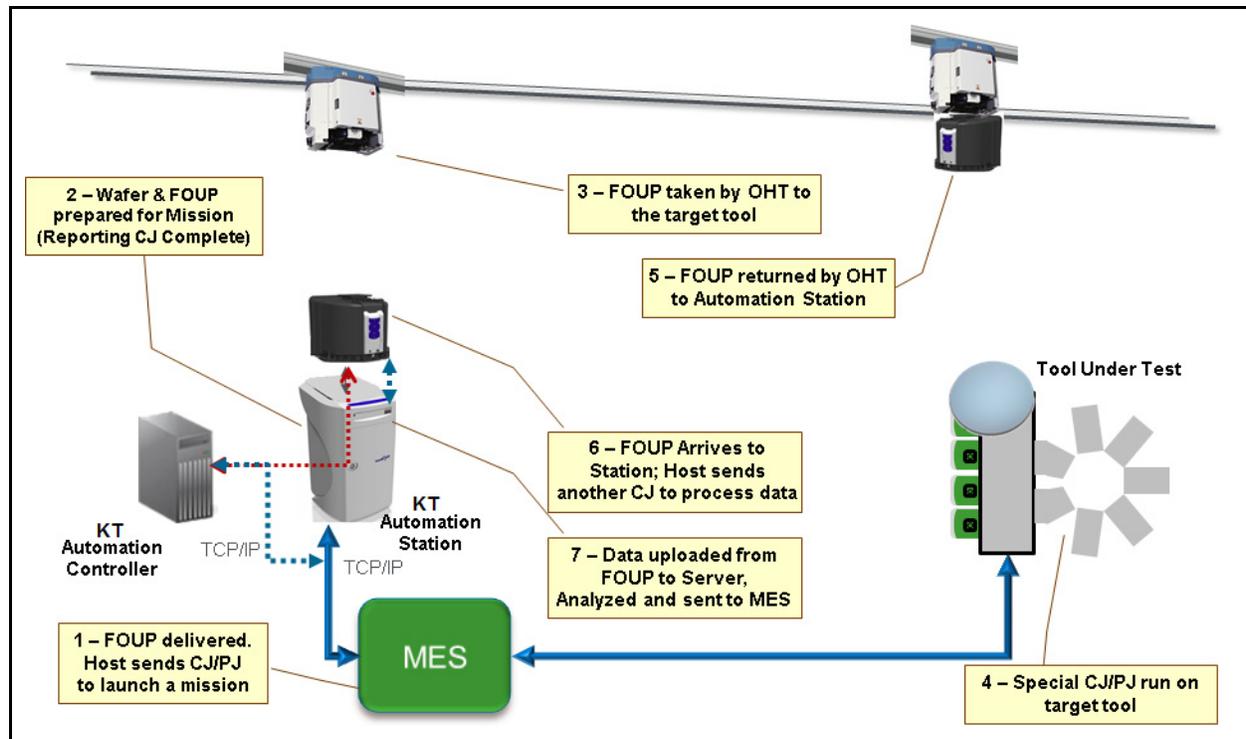
1.3   KT Automation Missions

There are 3 ways to launch and control KT Automation missions:

1. **Automatic missions:** controlled by fab MES via Factory Automation (as described above); results are reported back to the MES (see ***9022552-000, KT Automation System GEM/SECS Reference Manual***)

2. **User missions:** initiated by an operator via the KT Automation Web UI; the Automation FOUP is carried manually to the target tool and back to the station

3. **Manual missions:** initiated through the SA Tools software installed on a laptop that is directly connected to the Automation FOUP and provides all the required parameters for starting a mission; the Automation FOUP is carried manually to the target tool and the mission is manually executed on that tool

1.4   Regulatory Compliance Statements

1.4.1   Prohibitions on Modifications

Changes or modifications not expressly approved by KLA Tencor could void the user's authority to operate the equipment.

1.4.2   Class A Digital Device

Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

1.4.3   Special Accessory Installation: Manual Use Laptop/FOUP cable

1. Verify SensArray Tools software is installed before connecting cable to ensure appropriate communication settings.

2. Connect power supply to barrel connector in middle of manual use case cable.

3. Connect manual use case RJ (Ethernet) connector to Ethernet port on laptop.

4. Connect manual use case cable to FOUP magnetic connector on the back of the FOUP to the left of the power switch. The factory provided ferrite must be installed on the magnetic connector side of the manual use case cable.

2.

KT Automation System Hardware Components

2.1   KT Automation Station

2.1.1   KT Automation Station Function

The KT Automation Station communicates with the KT Automation FOUP to start missions and to extract the results after the missions are completed. The KT Automation Station also recharges the KT Automation FOUP between missions.

Figure 2-1 shows the KT Automation Station (including the optional signal tower), with and without a KT Automation FOUP loaded on the station.

Figure 2-1: KT Automation Station

NOTE

If your system uses the optional signal tower, the signal tower is installed and configured at the time the rest of the system is installed.

2.1.2   KT Automation Station Indicator Panel LEDs

The indicator panel at the front of the top cover (see Figure 2-2) contains all the Automation Station LEDs, as well as the Manual/Auto control button.

Figure 2-2: KT Automation Station Indicator Panel
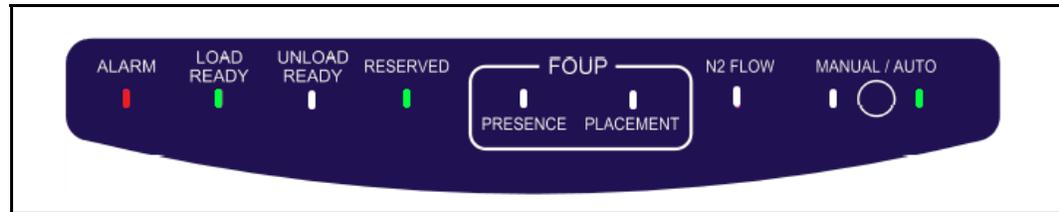
Table 2-1:   KT Automation Station Indicator Panel LEDs

LED Name	Color	Description
ALARM	Red	Indicates a critical error (for example, application has stopped working) that requires the operator to recover the Automation Station
LOAD READY	Green	Indicates the Automation Station is ready to receive a FOUP (there is currently no FOUP on the Automation Station)
UNLOAD READY	Green	Indicates the FOUP can be unloaded from the Automation Station (there is currently a FOUP loaded on the Automation Station)
RESERVED	Green	Indicates the Automation Station is reserved by the fab Host for a mission
FOUP PRESENCE	Green	Indicates a FOUP is present on the Automation Station
FOUP PLACEMENT	Green	Indicates a FOUP is fully placed on the Automation Station
Important: When a FOUP is seated properly, both the FOUP PRESENCE and the FOUP PLACEMENT LEDs are on.		
N2 FLOW		Indicates N2 is flowing from the Automation Station to the FOUP (in systems that include the N2 option)
MANUAL		*Blinking MANUAL LED* Indicates the Automation Station is in the process of initializing and is not yet ready for use *Steady MANUAL LED* Indicates the Automation Station is in Manual mode (user can manually place or remove a FOUP)
AUTO	Green	Indicates the Automation Station is in Auto mode (controlled by the fab Host and the OHT delivery system)

2.1.3   KT Automation Station Indicator Panel Manual/Auto Button

The Manual/Auto control button is located between the MANUAL and the AUTO LEDs on the KT Automation Station Indicator Panel (see Figure 2-2).

The button has two functions:

1. **Toggles between Auto mode and Manual mode**
   Press and hold the Manual/Auto control button for 5 seconds to toggle the Automation Station between Auto mode and Manual mode, indicated by the AUTO and MANUAL LEDs.

2. **Operates the Automation Station** (when the Automation station is in Manual mode)

   • When the FOUP is present on the Automation Station, press and release the button to unclamp the FOUP and switch it to the UNLOAD READY state (UNLOAD READY LED is green), which allows you to pick it up manually.

   • When the Automation Station is in the LOAD READY state (LOAD READY LED is green):

      • Manually place the FOUP on the Automation Station.

      • Press and release the Manual/Auto control button to lock the FOUP and connect it to the Automation Station.

2.2   KT Automation FOUP

2.2.1   KT Automation FOUP Function

The KT Automation FOUP transports the instrumented wafer to the equipment during missions. It also charges the wafer, stores the wafer data, and communicates the wafer data to the Automation Controller.

Figure 2-3: KT Automation FOUP

NOTE

The KT Automation FOUP configuration must be updated when:
* The CID pill is written or replaced, or
* The network configuration or server IP address has changed.
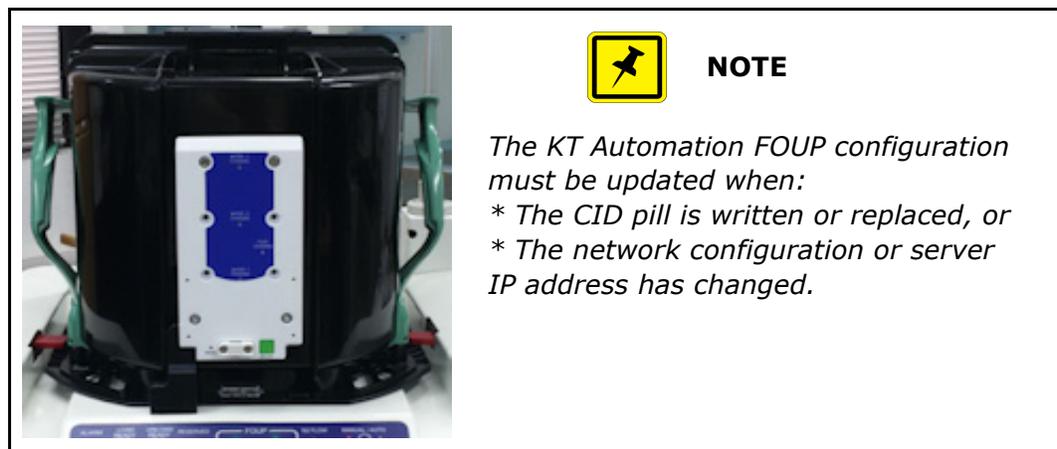
2.2.2   KT Automation FOUP Indicators and Controls

All FOUP indicators and controls are on the rear of the KT Automation FOUP (see Figure 2-4).

Figure 2-4: KT Automation FOUP Indicators and Controls
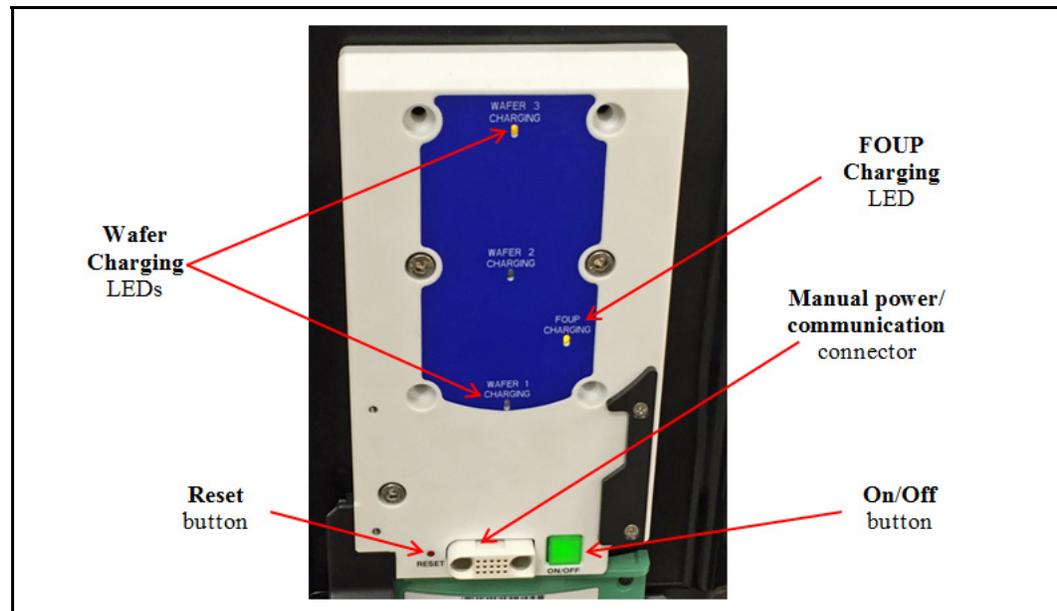
Table 2-2:   KT Automation FOUP Indicators and Controls

Control or Indicator	Color	Comments
Wafer Charging LED	Green	Blinks when the applicable Wafer is charging
		Steady when the applicable Wafer is present but not charging (Wafer is fully charged)
	Orange	Steady when the applicable Wafer is absent
FOUP Charging LED	Green	Blinks when the FOUP is charging
		Steady when the FOUP is powered On and at the Station but not charging (FOUP is fully charged)
	Orange	Steady when the FOUP is powered On but is not at the Station
Reset button	n/a	To press the Reset button, insert a thin stylus or pen tip into the hole
Important: Reset the FOUP **only** if it is an error state.		
Manual power/ communication connector	n/a	Used to connect a laptop to the FOUP in order to perform manual missions, or provide power to a FOUP that has not been at the Station for a long time
ON/OFF button	n/a	To power down the FOUP, press and hold the ON/OFF button until the **FOUP Charging LED** turns off

2.2.3   KT Automation FOUP Data Storage and Transfer

- When the Wafer is back in the Automation FOUP, it automatically transmits the data it collected during the mission to the Automation FOUP.

- When the Automation FOUP is placed on the Automation Station, the Automation FOUP automatically transmits the data to the Automation Controller to be stored in the centralized database.

- An Automation FOUP can store up to 10 hours of data.

2.2.4   KT Automation FOUP Battery

- When an Automation FOUP's charge level goes down to 35%, an alarm is sent to the host.

- The Automation FOUP goes into power-save mode:

  - When the charge level goes down to 20%

  - If it is not on a mission and has not been charged for 30 minutes

- When in power-save mode, the Automation FOUP can maintain its charge for 6 months.

- To charge an Automation FOUP, place it on the FOUP Station and make sure it is **clamped (not in LOAD READY state)**, or use the manual power/communication cable to connect it to a laptop.

NOTE

If the Automation FOUP was powered off, placing it on the Automation Station and clamping it will power it on automatically.

- When powered off, the Automation FOUP can maintain its charge for 12 months.

NOTE

If the Automation FOUP loses its charge completely, please ask your KT service representative to change the battery.

2.2.5   Option: Emulating Occupied KT Automation FOUP Slots

An available KT Automation FOUP option is a set of emulation fins for slots that contain any electronics boxes. The fins cause load port wafer mappers to identify those slots as occupied.

Figure 2-5: KT Automation System Topology

3.
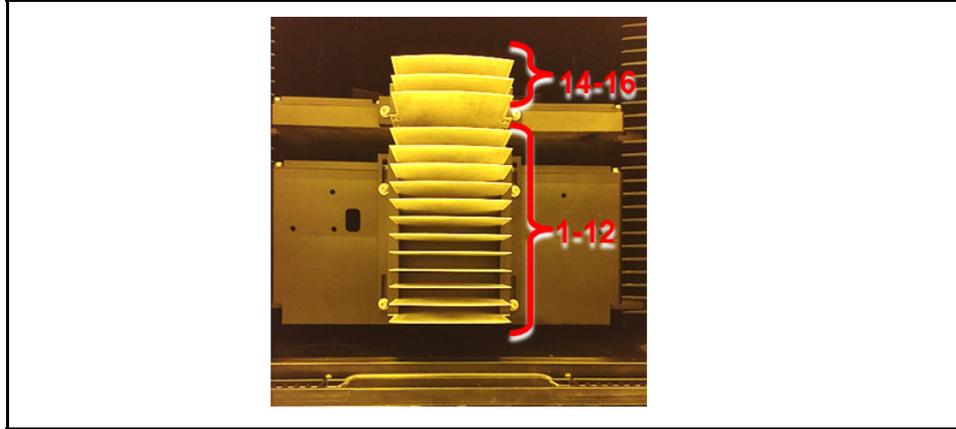
KT Automation Web UI

3.1 Logging In

1. At the KT Automation login page, select your role (in this example, **Administrator** is selected).

2. Enter your password.

3. Click **Start** to log in and go to the Home page (see Section 3.3).
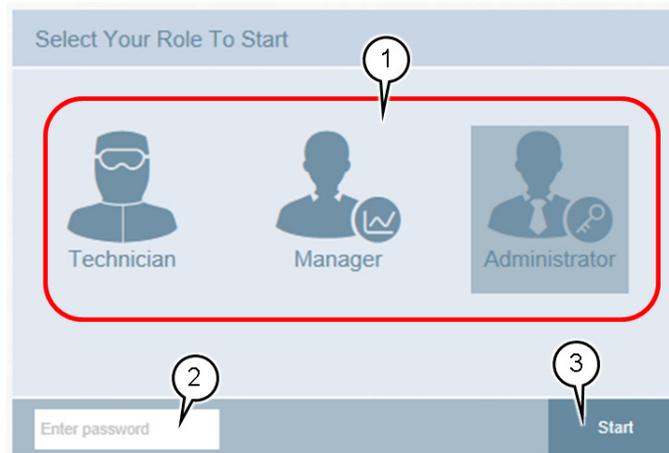
3.2 Logging Out

1. From any page in the KT Automation Web UI, click **Logout**.

   The display returns to the KT Automation login page.
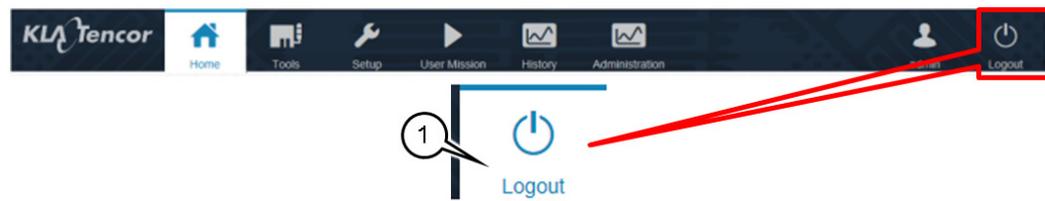
3.3   KT Automation Home Page

The **Home** page summarizes the current status of all KT Automation System components, usage, and recent mission alerts. It is the first page that you see after you log on.

1. To return to the **Home** page from any other KT Automation page, click **Home**.

3.3.1   Equipment Coverage and Usage

The **Equipment Coverage & Usage** area allows you to view information about the Tools, KT Automation FOUPs, KT Wafers, and KT Automation Stations in the system.

The color of the header for each equipment type shows the extent of usage:

• Green:High usage (>80%)

• Orange:Low usage

• Red:Not used

1. To select the time period for which you want to see coverage and usage information, select the time period from the drop-down list in the top right-hand corner.

2. To view the statistics for the equipment type, hover the cursor over the image.
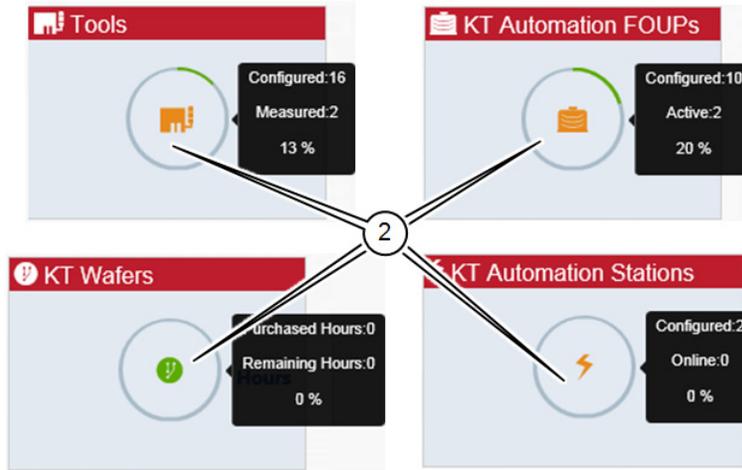
Equipment	Statistics Provided
Tools	• How many configured • How many online (as number) • How many online (as percentage)
KT Automation FOUPs	
KT Automation Stations	
KT Wafers	• How many hours purchased • How many hours used (as number) • How many hours used (as percentage)

3.3.2   Tool Mission Alarms

The **Tool Mission Alarms** area lists error messages and alerts received during recent missions.

3.3.3   Connected FOUPs

The **Connected FOUPs** area displays all KT Automation FOUPs (carriers) in the system and their statuses.

For each FOUP, the following information is displayed:

1. Carrier ID

2. Carrier status

3. Wafer IDs

4. Battery level of KT Automation FOUP
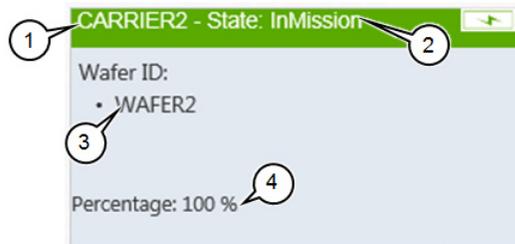
3.4   Tools Page

The **Tools** page displays information about all the tools that were set up in the system (as described in Section 3.5.1 through Section 3.5.4).

To view the **Tools** page, click **Tools**.

NOTE

- shows that the last mission that ran on this tool was successful
- shows that the last mission that ran on this tool indicated a problem

1. You can group tools by:

- Tool Type

- Tool Location

- Mission Time (mission run date and time)
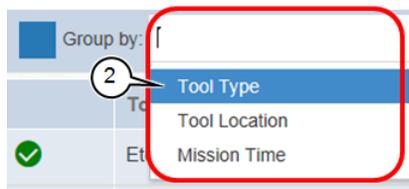
3.5   Setup Page

Use the **Setup** page to add new or edit existing tools and mission recipes.

IMPORTANT

Mission recipes are added or edited for Automation Metrology Wafers only. See Section 3.8.1 for details of adding or editing recipes.

1. To view the **Setup** page, click **Setup**.
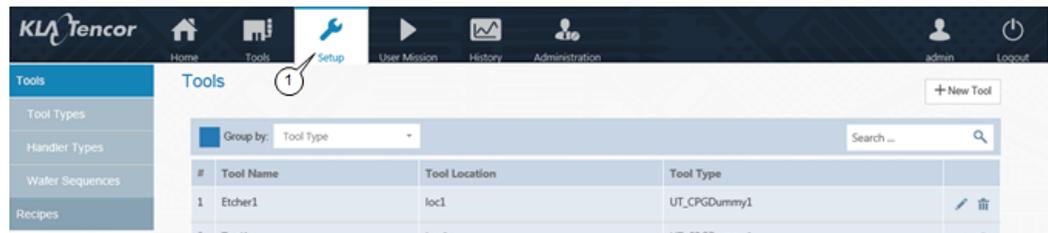
3.5.1   Edit or Add Tool

IMPORTANT

Before you can add a new tool, the applicable tool type and handler type must have been defined in the system (see Section 3.5.2 and Section 3.5.3).

1. In the **Setup** page, make sure **Tools** is selected (the default selection when the **Setup** page opens).

2. Continue as follows:

    • To edit an existing tool, click the Edit icon for the tool.

    • To add a new tool, click **+ New Tool**.

    In either case, the **Edit Tool** window opens.
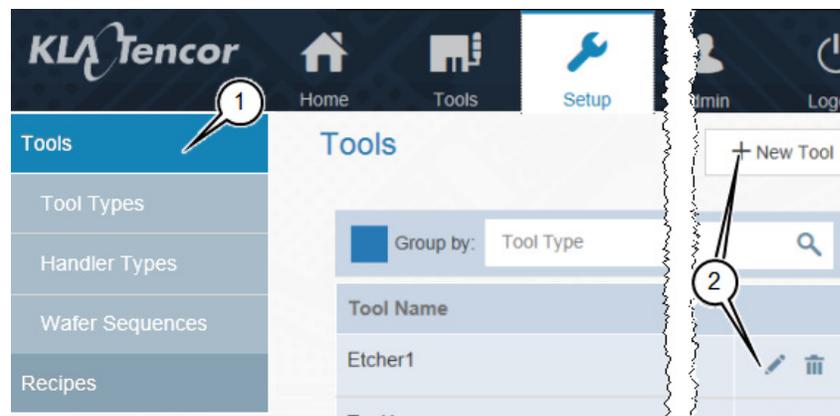
3. In the **Edit Tool** window, enter or select a value for every field.

3

NOTE

If you are editing an existing tool, enter or select new values only for those fields that you need to update.

4. Click **Save** to save the values and close the **Edit Tool** window.

3.5.2   Edit or Add Tool Type

1. In the **Setup** page, click **Tool Type**.

2. Continue as follows:

   • To edit an existing tool type, click the Edit icon for the tool type.

   • To add a new tool, click **+ New Tool Type**.

   In either case, the **Tool Type Edit** window opens.

NOTE

If you are editing an existing tool type, enter or select new values only for those fields that you need to update.

3. In the **Tool Type Edit** window, type a **Tool Type Name**.

IMPORTANT

Use an informative name that includes information that will be important for operators to know about the tool.

4. Select the **Tool Type Recipe**.

5. Continue as follows:

If you want to...	Then continue with...
Create a new **Tool Type Sequence**	step 6
Modify an existing **Tool Type Sequence**	step 11

6. To create a new **Tool Type Sequence** from scratch, click **+ New**.

NOTE

Each location that wafers visit within a tool is called a tool station.

7. From the list of available stations, select the first station in the sequence.

8. Continue clicking **+ New** and selecting stations until you have selected every station in the sequence.
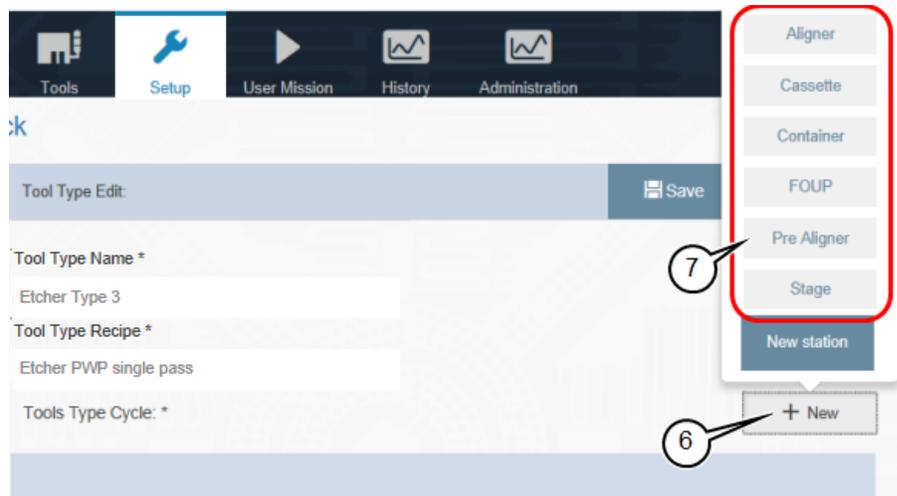
9. For the last station in the sequence (in this example, **FOUP**), click **Finish here** to select that station and remove the option to select from the other stations.
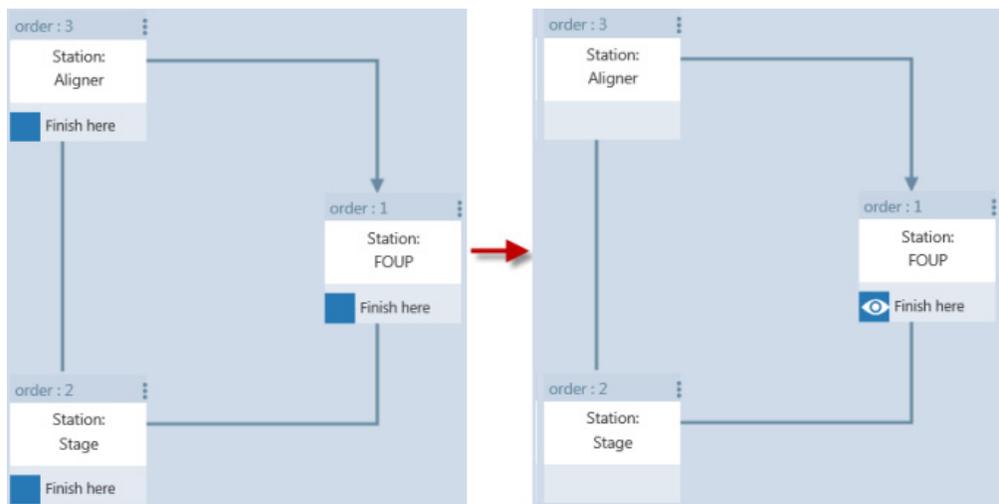
10. Click **Save** to save the new tool type and close the **Tool Type Edit** window.

11. You can modify an existing **Tool Type Sequence** in any of the following ways:

- Change the station where the sequence finishes

- Delete a station from the sequence or replace it with a different station

- Add another station to the sequence

12. To change the station where the sequence finishes:

- Click [icon Finish here] to deselect the station.

  Every station in the sequence then displays the option to select it.

- Click **Finish here** to select the new station where the sequence finishes.
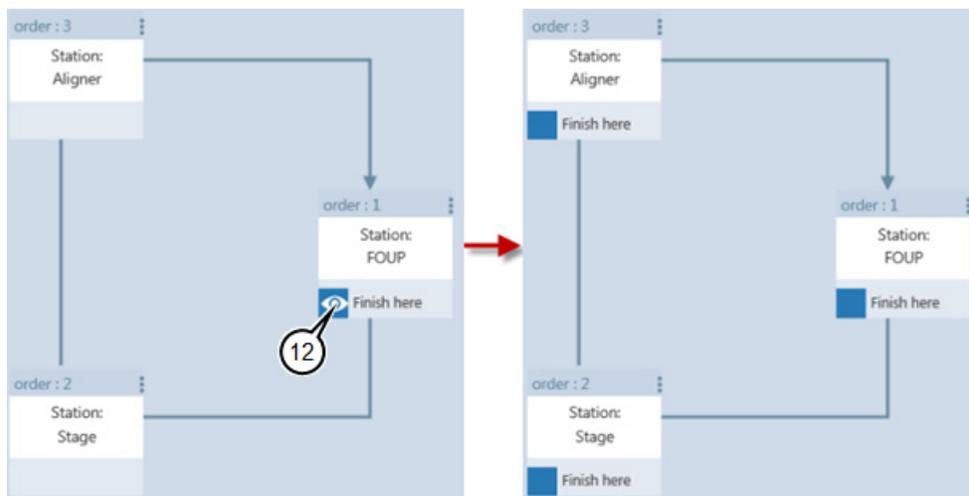
13. To delete a station from the sequence or replace it with a different station:

- Click ⋮ for that station.

- Click **Replace station**.

- To delete the station, click **Delete station**.

- To replace the station, click the station from the list of available station.

NOTE

The list contains those stations that are set up in the KT Automation System but are not currently used in this Tool Type Sequence.
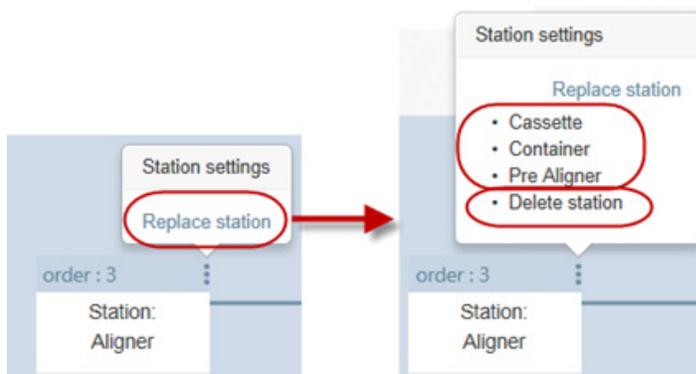
14. When you have made all the required changes to the **Tool Type Sequence**, click **Save** to save the changes and close the **Tool Type Edit** window.

3.5.3   Edit or Add Handler Type

NOTE

*The only parameter that is entered for a **Handler Type** is the **Name**.*

1. In the **Setup** page, click **Handler Types**.

2. Continue as follows:

    •   To edit an existing handler type, click the Edit icon for the handler type.

    •   To add a new handler type, click **+ New**.
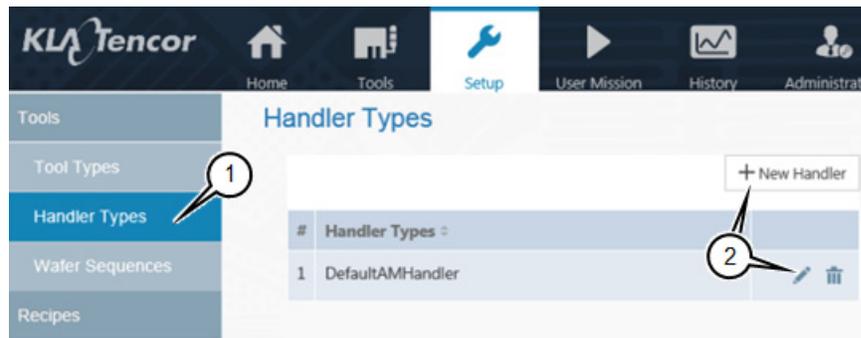
3. Type the **Name** for the handler type.

IMPORTANT

Use an informative name that shows the robot type, the number of load ports, and any other information that will be important for operators to know about the handler type.

4. Click ✓ to save.
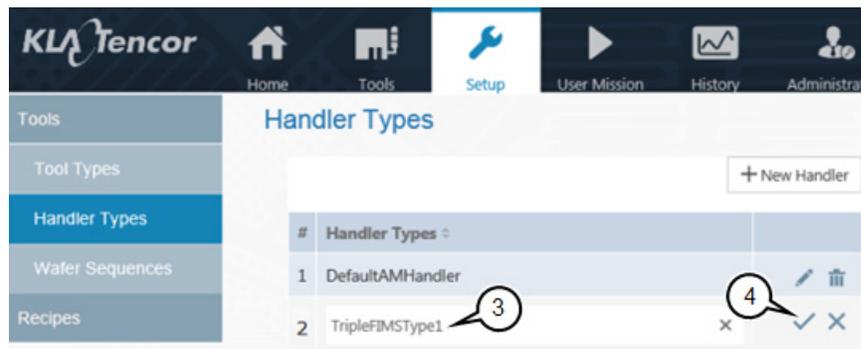
3.5.4   Edit or Add Wafer Sequence

NOTE

*The only parameter that is entered for a **Chamber** or **Station** is the **Name**.*

1. In the **Setup** page, click **Wafer Sequence**.

2. Continue as follows:

    •   To edit an existing chamber or station, click the Edit icon for the
        chamber or station.

    •   To add a new chamber, click **+ New Chamber**.

    •   To add a new location, click **+ New Station**.
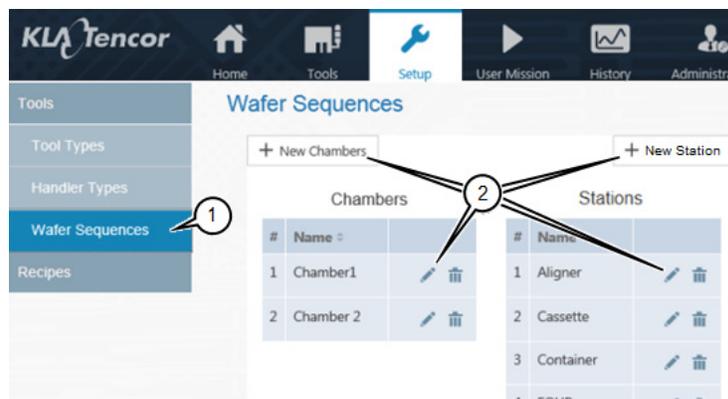
3. Type the **Name** for the chamber or station.

IMPORTANT

*Use an informative name that includes information that will be important for
operators to know about the chamber or station.*

4. Click ✓ to save.
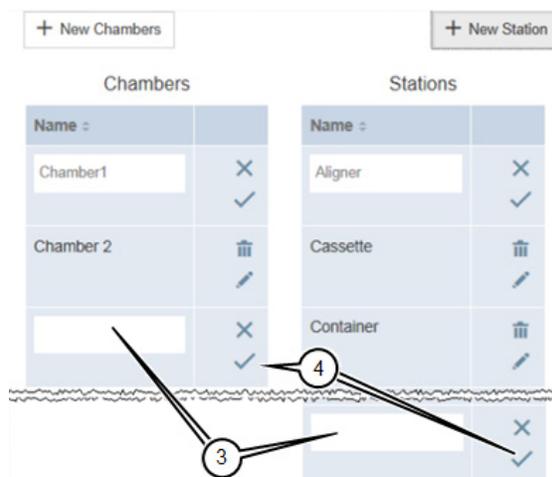
3.6   History Page

The **History** page displays information about missions that have run.

1. To view the **History** page, click **History**.

NOTE

*   *shows that the mission ran successfully*
*   *shows that the mission did not run successfully*

3.7   Administration Page

The **Administration** page allows those with Administrator-level privileges to remote-connect to KT Automation Stations to perform troubleshooting.

IMPORTANT

The Administration page is available only to those who log in with the role of Administrator.

1. To view the **Administration** page, click **Administration**.
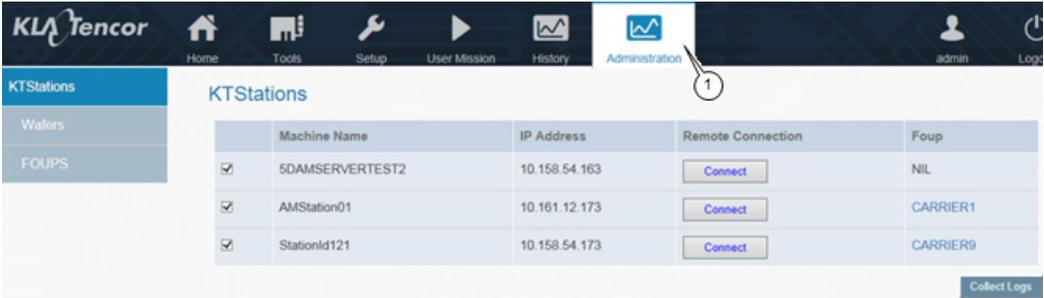
3.8   Automation Metrology Wafer Functions

3.8.1   Edit or Add an Automation Metrology Wafer Mission Recipe

1. In the **Setup** page, click **Recipes**.

2. Click the folder where the recipe you want to edit or add is located.

3. Continue as follows:

If you want to...	Then continue with...
Add a new folder	step 4
Edit an existing recipe or add a new recipe	step 5
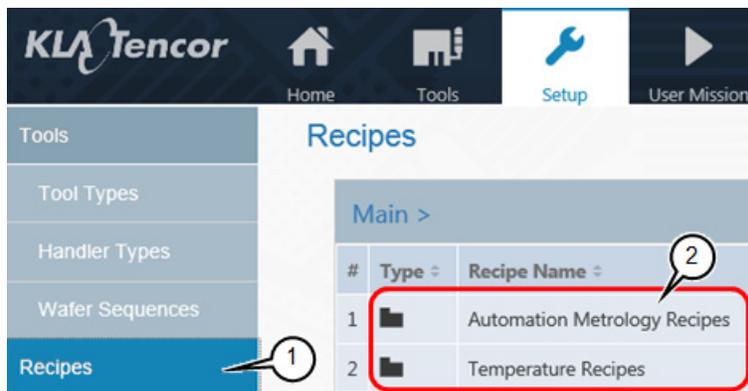
4. To add a new folder:

- Click **Folder**.

- Type the **Folder Name**.

- Click **Save**.
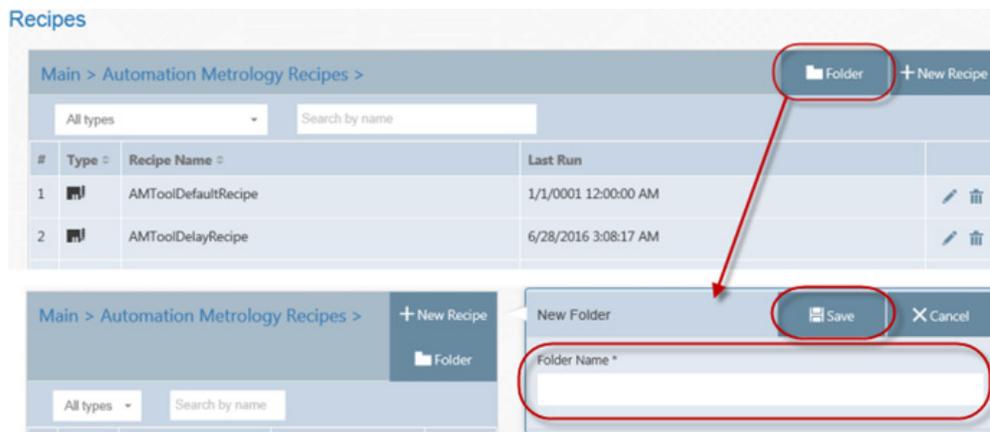
5. To edit an existing recipe or add a new recipe:

- Click the Edit icon for the recipe, or

- Click + **New Recipe**.

NOTE

If you are editing an existing recipe, enter or select new values only for those items that you need to update.

6. Type a **Recipe Name**.

7. Select a **Recipe Type**.

8. Select the recipe's **Start Trigger** (the trigger to start data acquisition).

   The following are available start triggers:

Trigger	Description
Door Open	FOUP door opens
Delay	Data acquisition begins after specified delay (in seconds) from start of mission
Wafer Leaves FOUP	Wafer is picked from the FOUP at the start of a tool mission

9. If you selected **Delay** in the previous step, enter the **Delay (seconds)**.

10. Select the recipe's **Stop Trigger** (the trigger to stop data acquisition).

    The following are available stop triggers:

Trigger	Description
Door Close	FOUP door closes
Duration	Data acquisition ends after the specified duration (in seconds) of data acquisition
Wafer Return to FOUP	Wafer is returned to the FOUP at the end of a tool mission

11. If you selected **Duration** in the previous step, enter the **Duration (seconds)**.

12. When you have entered all the values, click **Save**.

3.8.2   Define and Execute an Automation Metrology Wafer User Mission

The **User Mission** page allows you to define and execute an Automation Metrology Wafer user mission.

IMPORTANT

Before you can define a mission, the applicable recipes, tools, and carrier IDs must have been defined in the KT Automation system (see Section 3.5 *and* Section 3.8.1*).*

1. To view the **User Mission** page, click **User Mission**.

3. KT Automation Web UI
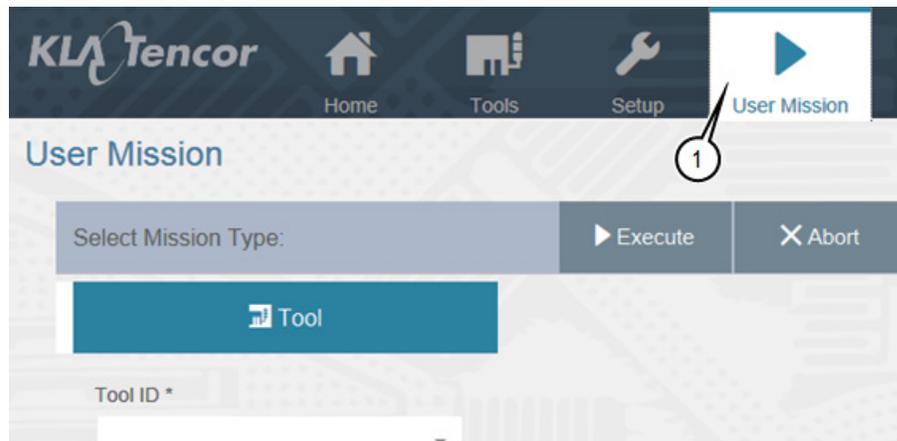
2. Select the following:

- **Tool ID** of the target tool to be measured by the mission

[NOTE icon] **NOTE**

*Tool Type is populated automatically once **Tool ID** is selected.*

- **Tool Recipe** to be executed by the tool when the FOUP is placed on the tool

- **Carrier ID** of the FOUP that will execute the mission

- **Wafer ID** of the wafer that will execute the mission

- **Mission Recipe** that defines the mission's start and stop parameters

- **Analysis Recipe** that defines the template used to analyze the raw data and provide the results (SensArray wafers only)

- Chamber in which the recipe will be executed (optional)

3. If you want the results of the mission to be reported to the FA Host, click
    Report to FA Host.

    Not selected   *Selected*

    [ ] Report to FA Host   [👁] Report to FA Host

4. Type the **Load Port Number** of the load port on which the FOUP will be
    loaded (if applicable to the selected recipe).

5. When you have set up all the mission parameters and loaded the FOUP on
    the load port, click **Execute**.

Once the mission is completed and the FOUP has been returned to the station,
mission data is automatically uploaded to the Automation Controller and is
visible on the History page (see Section 3.6).

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Glossary

Term, acronym, abbreviation	Description
CID	Wafer Carrier ID (serial number contained in RF Pill of FOUP; might also be Lot ID, if written by fab)
FA	Factory Automation (software- and communications-based control of a semiconductor fab)
FOUP	Front-Opening Universal Pod (wafer container)
GEM	Generic Model for Communications and Control of SEMI Equipment
GSS	Global Support Services (KLA-Tencor Support organization).
HWID	Hardware ID (serial number of the specified hardware component such as SensArray Wafer)
KT	KLA-Tencor Corporation
KTAF	KT Automation FOUP (to charge, transport, and store KT in situ test wafers)
KTAS	KT Automation Station (charging and communication station for Automation FOUPs)
MES	Manufacturing Execution System (the fab Host)
Mission	Execution of a single KT Automation job/cycle
OHT	Overhead Transport system (fab automation system for FOUP transportation)
UI	User Interface
WID	Wafer ID (T7 Mark on the bottom of the wafer)

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Revision History

Revision Date	New Rev. Level	Changes Made	Reviewer	Approver
10/2016	AA	Initial Issue	Avi Zaban	Henry Lam
	AB	DCR T35533: Add Regulatory Compliance Statements (Section 1.4); other minor edits	Avi Zaban	Henry Lam

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