LENOVO DIAGNOSTICS EVOLUTION V5.21.0 **USER GUIDE**

LSBD - Laboratório de Sistemas e Banco de Dados

LENOVO DIAGNOSTICS EVOLUTION **USER GUIDE**

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REVISION **HISTORY**

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2.0	Carolina Vasconcelos	Updated according to Lenovo Diagnostics Evolution v5.14.2 - Added: ○ Export tools logs button in Lenovo Diagnostics Evolution Main Screen subsection ○ Section Software Update in Application Interface section ○ Note about screen reader on Touchscreen section - Updated: ○ Description of the Settings icon in Lenovo Diagnostics Evolution Main Screen subsection ○ Tests table and Display Interactive Test image in Display section ○ In the sidebar menu, correction on RAID and Sensors sections ○ Thermal Monitor Tool in Tools section ○ Updated images: containing the application footer, added initial focus on test pop-up buttons, Log History on Tools section, Thermal Monitor Tool on Tools section	Jun 19, 2024
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		  ○ Note on Memory Section
		  ○ Contact Support Section
		  ○ Backlight Test in Keyboard Section
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		- Updated:
		  ○ Block Move Test description on Memory Section
		  ○ Mouse Device Module description on Mouse Devices Section
		  ○ GPS Interactive Test image on Sensors Section
		  ○ Tab Tools description on Diagnostics tab and Tools tab sub-section
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		  ○ Control Test description on Fan Section
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		  ○ Hyperlink on the support email on Contact Support Section
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		  ○ Updated the copyright year and initial focus on some images
		- Removed:
		  ○ Bidirectional Test on Audio Controller Section
		  ○ Duplicate functionality from the subsection Create a diagnostic script
			Apr 24, 2025

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USER GUIDE

1. LENOVO DIAGNOSTICS **OVERVIEW**

Lenovo Diagnostics Evolution is a diagnostic tool that diagnosis different components in Lenovo computers providing feedback to the users about their machine's health.

Lenovo Diagnostics Evolution is composed of Modules that allows performing diagnostics for a group of devices and provides Tools to assist in checking devices information, checking previous diagnostics executions, trying to recover defective HDD and SSD, as well creating, and running custom diagnostics.

1.1 Data Collection

Lenovo Diagnostics Evolution collects anonymous data regarding tests execution for the purpose of improving Hardware's diagnostics. You can enable or disable that function according to your preferences.

By opening the Lenovo Diagnostics tool for the first time, the application will display a message asking if you agree or not with Lenovo Product Privacy Statement.

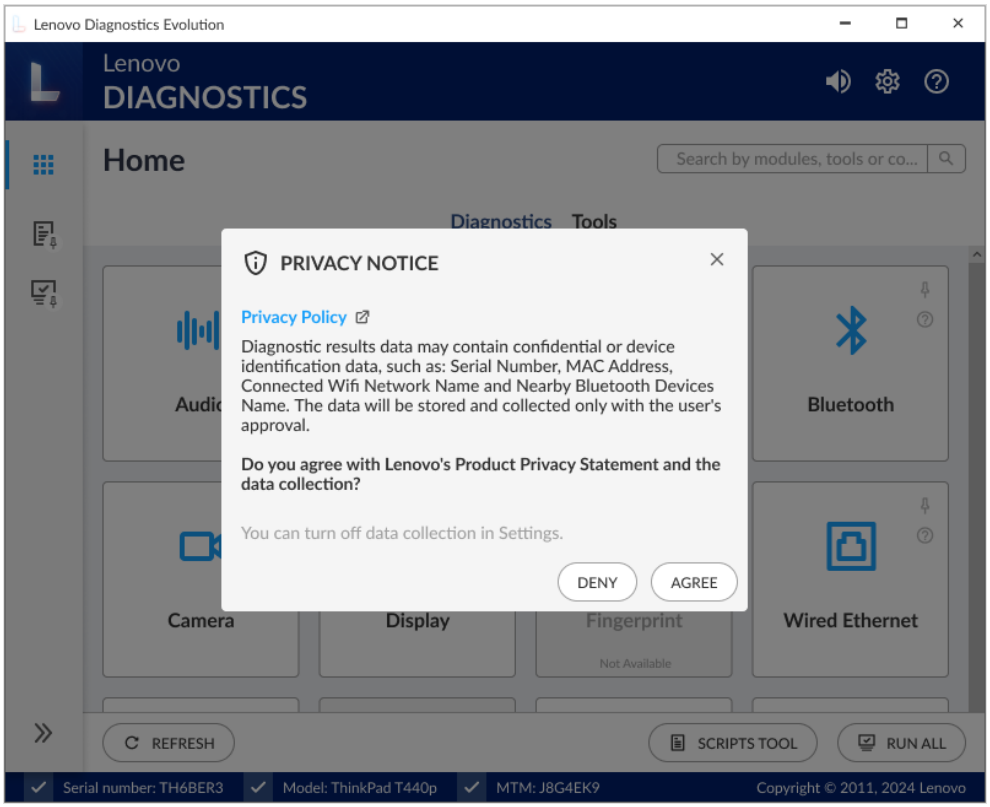


Figure 1: Lenovo Privacy Statement Pop-up

You also may change this option at any time by clicking on the Settings icon 

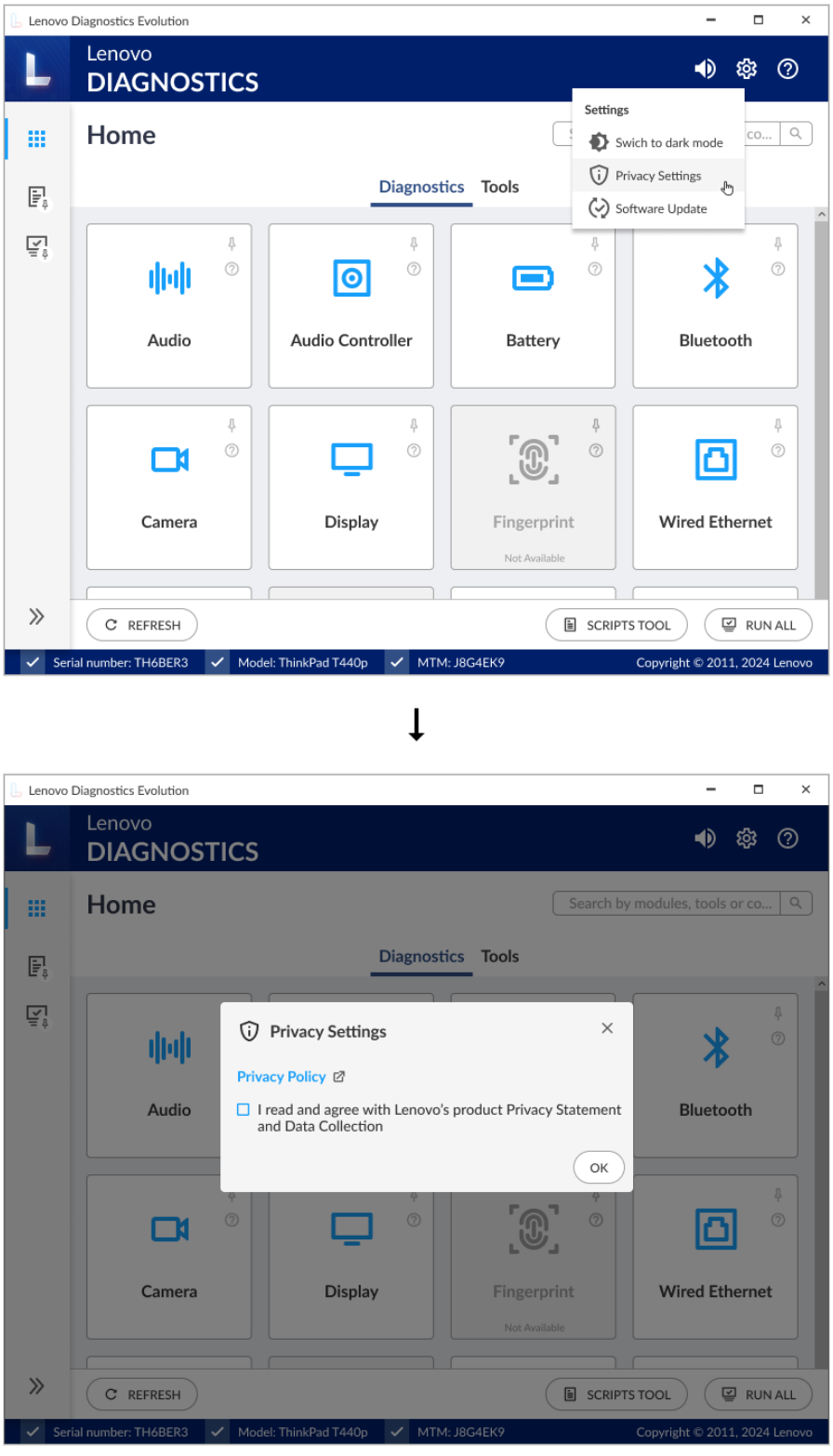


Figure 2: Lenovo Privacy Statement Settings

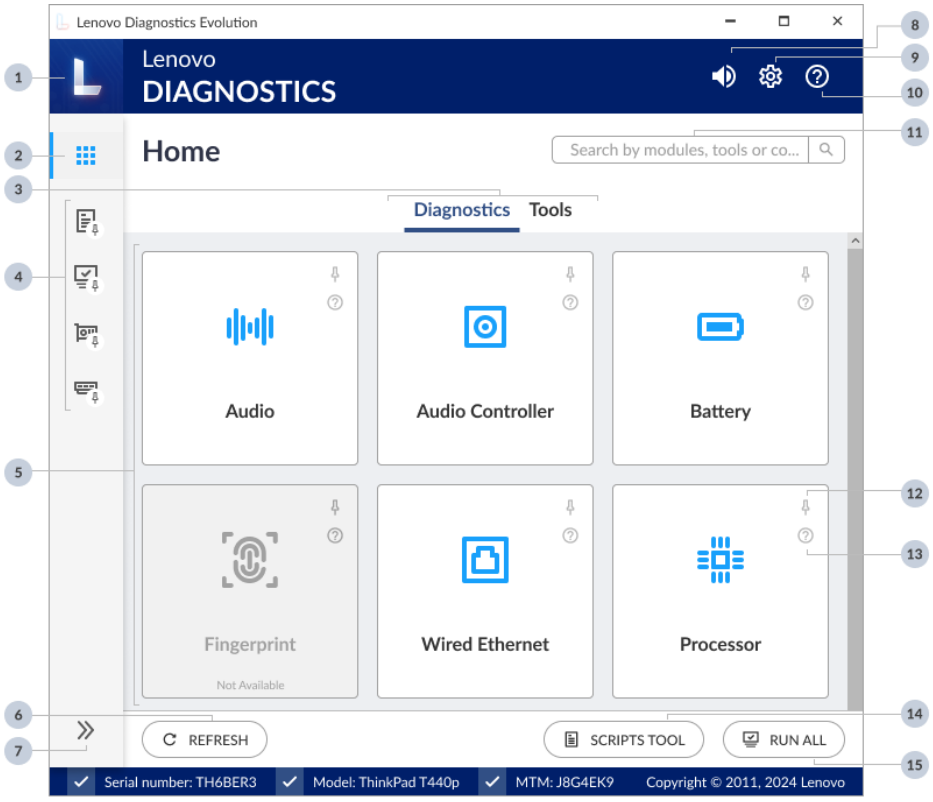
2. APPLICATION INTERFACE

2.1 Lenovo Diagnostics Evolution Main screen

By opening the Lenovo Diagnostics Evolution, you will see the main screen containing the following items:

- Top bar with icons for enabling/disabling Sound Notice, change Settings, access Help Menu.
- Sidebar with home screen icon and following tools pinned by default, Script tool, and Run All.
- Footer with the buttons: Refresh, Scripts Tool, and Run All.

On this screen, you can also see the search field and the tabs Diagnostics and Tools.



1 - Application logo
2 - Home screen icon
3 - Diagnostics tab and Tools tab
4 - Icons pinned
5 - Modules
6 - Refresh Button
7 - Expand/Collapse sidebar
8 - Sound notice icon
9 - Settings icon
10 - Help icon
11 - Search field
12 - Pin icon
13 - Help icon
14 - Scripts Tool
15 - Run all

Figure 3: Home Screen

Application logo
The application logo is displayed in the upper left corner of the screen.

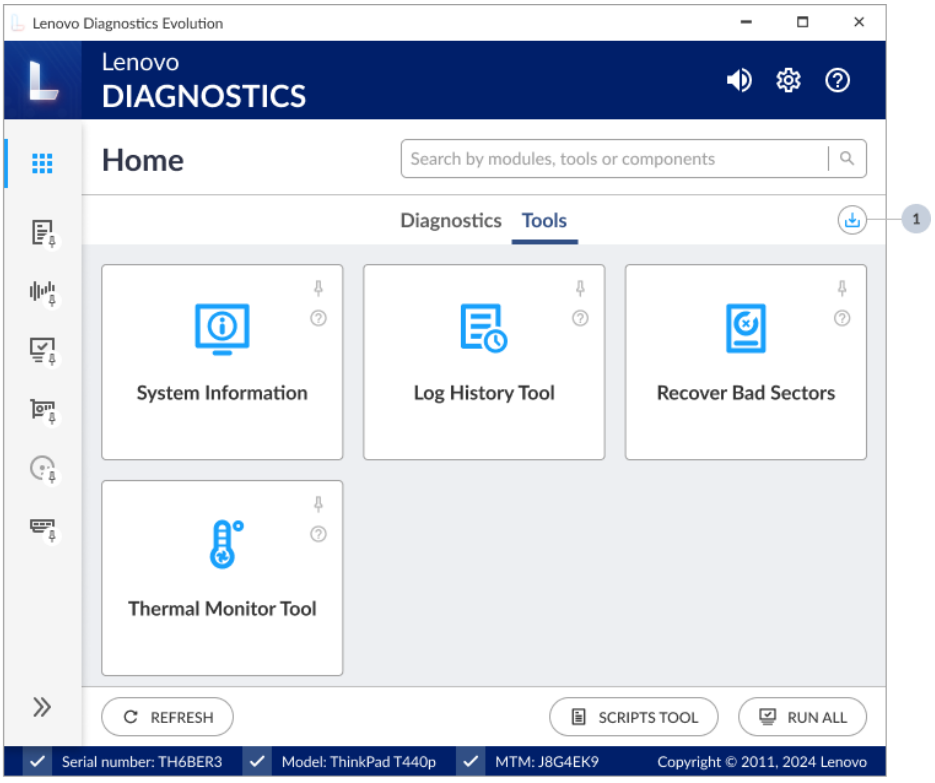
Home screen icon
The home screen icon is located in the sidebar. You can access the home screen at any time from other tools or modules.

Diagnostics tab and Tools tab

- **Tab Diagnostics**
  You can see the modules provided by Lenovo Diagnostics Evolution and select one of them to perform tests. The modules will not be enabled if no device is supported by the module.

- **Tab Tools**
  Through this tab you can access tools that can help you in the diagnostic process, such as seeing detailed information about each device (System Information), consulting and exporting result log tests performed in a machine (Log History), scanning HDD/SATA SSD devices for bad sectors (Recover Bad Sectors), and inspect the thermal information of major hardware devices (Thermal Monitor Tool).

Export tools logs button
On the Tools tab, you can quickly export the logs from System Information including the general machine information plus the available modules information and the current temperatures of the supported devices on Thermal Monitor Tool by clicking in the button shown in the image bellow:



1 - Quick export tools logs

Figure 4: Quick Export Tools Logs

Icons pinned
In the sidebar, you can add a shortcut to modules and tools by clicking on each card's pin icon on the Home Screen or by clicking the pin icon located on the sidebar elements, which is displayed when you hover over it.

Modules
On the home screen, all application modules are shown. A module contains a set of tests that can be performed for a type of device. It is enabled in the application only if the tested machine has at least one device supported by the module. When the module is not supported, the module card is grayed out, and with the label “Not Available”.

Refresh Button
You can refresh the Home Screen after plugging or unplugging any device by clicking on the Refresh button displayed at the lower-left corner of the screen.

Expand/Collapse sidebar
By clicking on the Collapse/Expand icon, you can collapse or expand the sidebar.
If the sidebar is collapsed, only the home screen icon and pinned or open elements are displayed. You can also pin or unpin sidebar elements by clicking the pin icon displayed on each of those elements.
If the sidebar is expanded, the icons and name of the elements will be displayed, and if a tool or module is open, you can close them via the X icon.

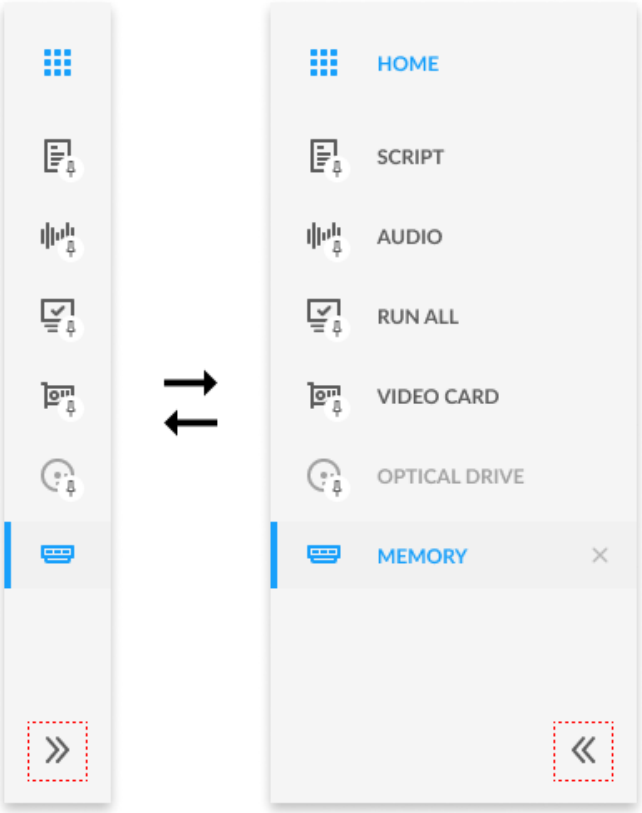


Figure 5: Sidebar

Sound notice icon
When the execution is finished, the application plays a sound notice, where two short 0.5 second beeps mean that no test has returned a failed status and a long 1-second beep means that at least 1 test has returned failed status. You can enable/disable this sound notice by clicking on the sound notice icon located at the top of the application.

Settings icon
By clicking on the Settings icon, you will see the following options:

- Switch to the dark mode or switch to standard mode;
- Enable or disable the Lenovo Product Privacy Statement and Data Collection.
- Check for software update

Help icon
By clicking on the Help icon, you will see the following options:

- See About
- See User Guide

Search field
You can search by module or tool name, or by components and the application will return related results as shown in the example below.

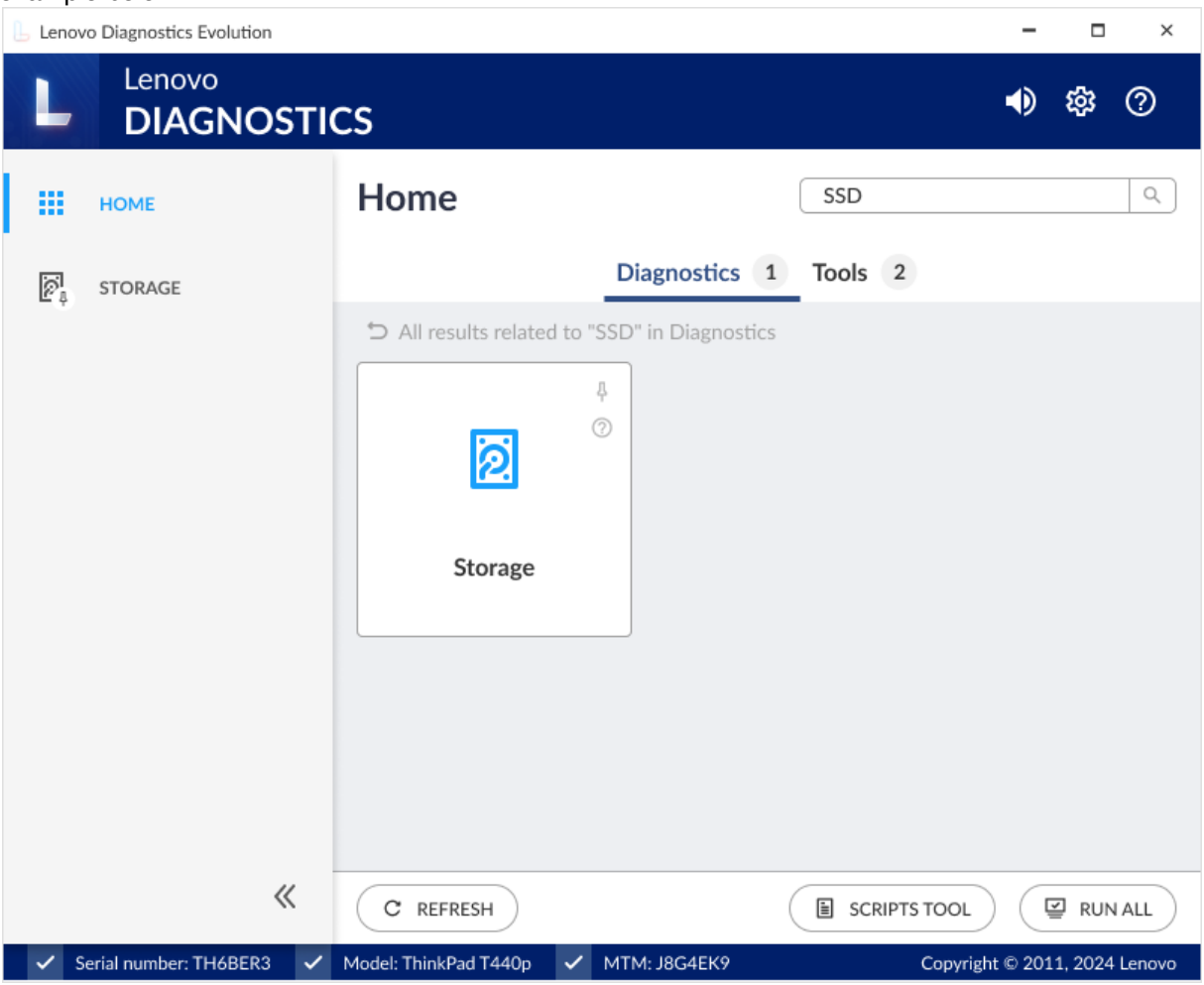


Figure 6: Search Field Example

Pin icon

The pin icon will allow you to pin modules and tools to the sidebar, which means that the module can be accessed from any screen you are on, as it will always be visible on the sidebar. In the image below, the user is viewing the Processor module but can access the Run All or Scripts Tool at any time, as it is pinned in the sidebar.

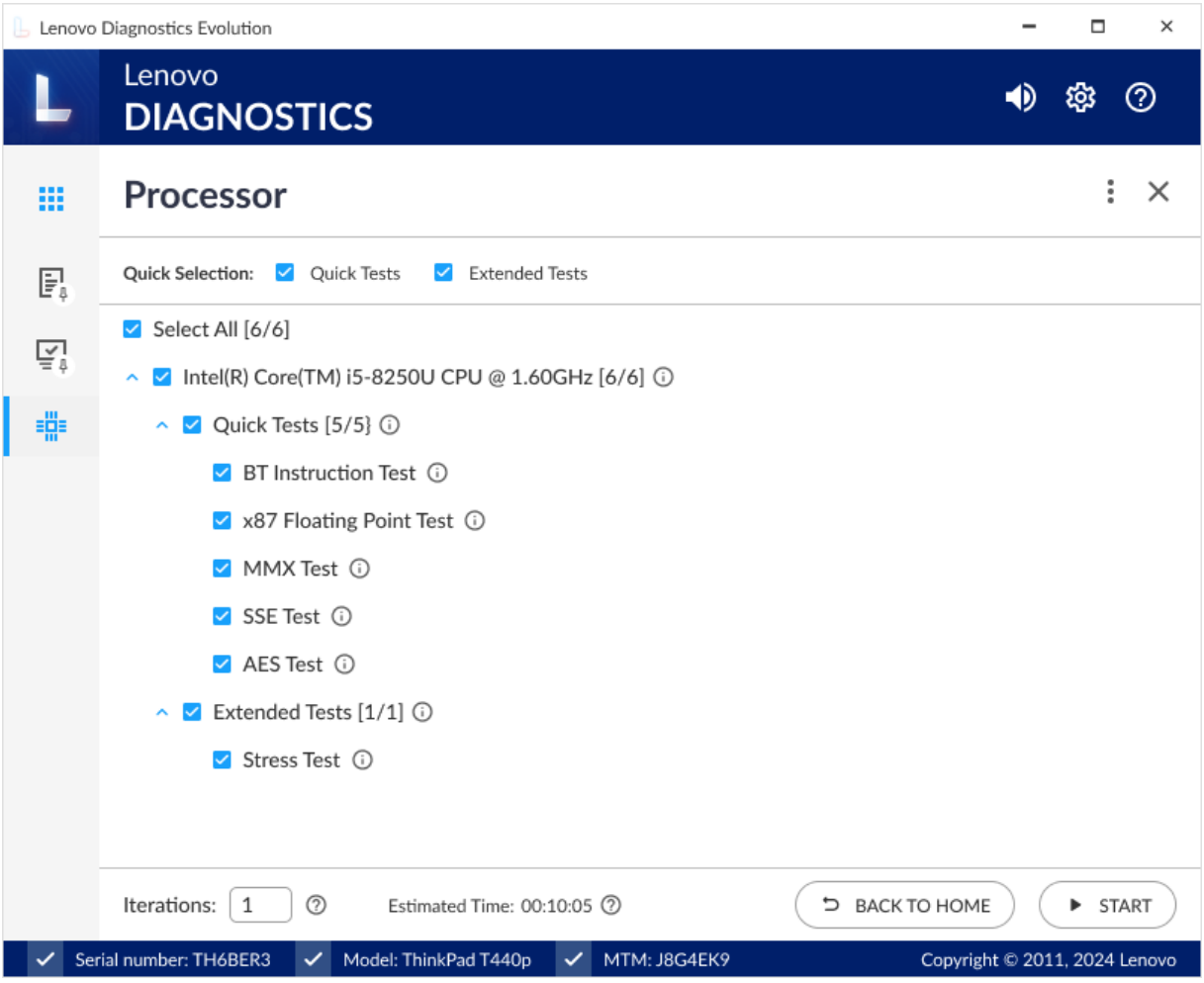


Figure 7: Sidebar Example

Help icon
By clicking in the Help icon ⓘ of each card, you can see a brief description of the respective element.

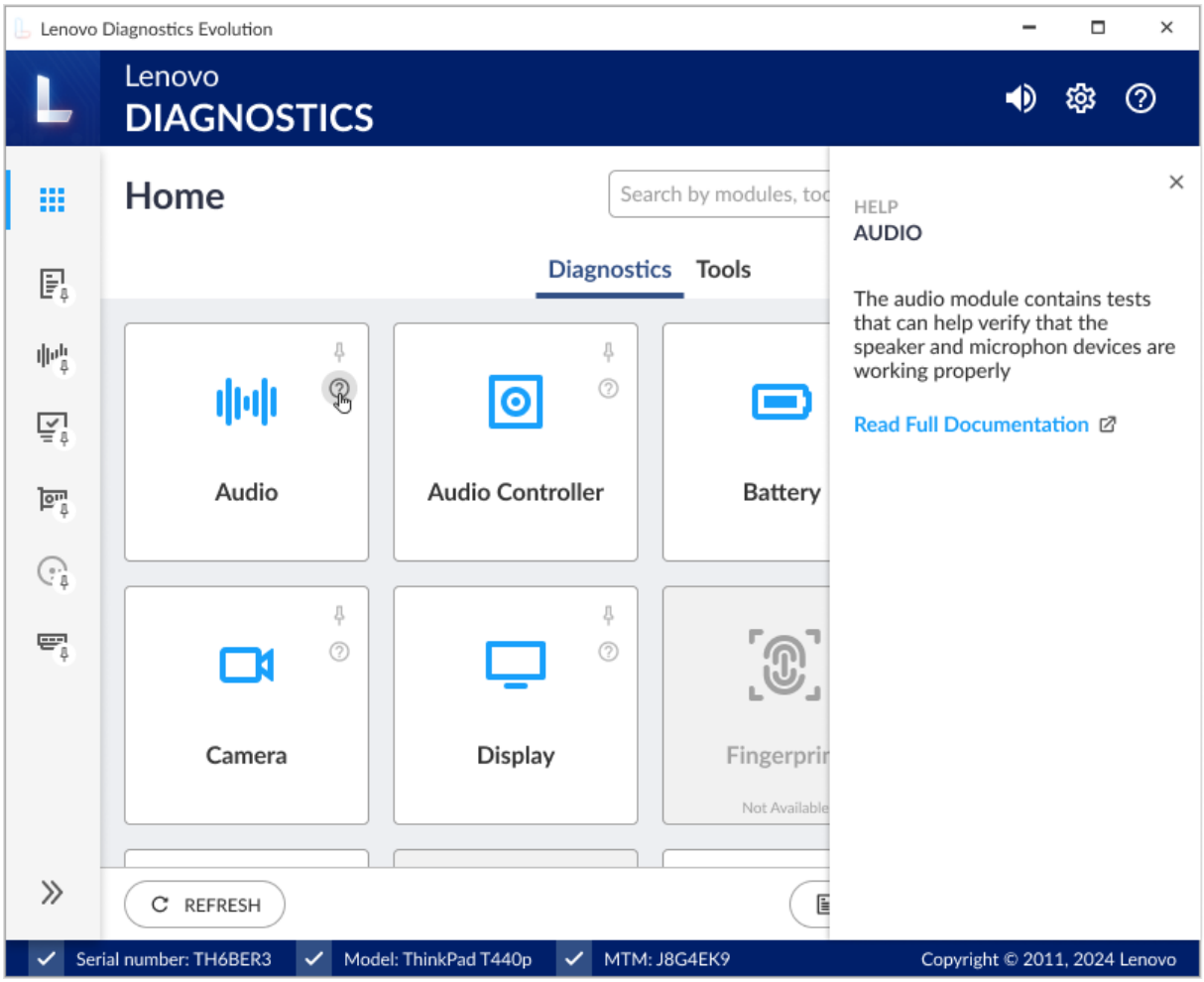


Figure 8: Module's Help

Scripts Tool
You can access the Scripts Tool by clicking on the Scripts Tool button located at the bottom of the screen on the right side.

Run All
You can access the Run All by clicking on the Run All button located at the lower-right corner of the screen.

2.2 Software Update

When a new Lenovo Diagnostic Evolution version is available, the pop-up below will be shown as soon as the system starts, informing that there is a new version to be installed. You can install it immediately by clicking on the "Download" button.

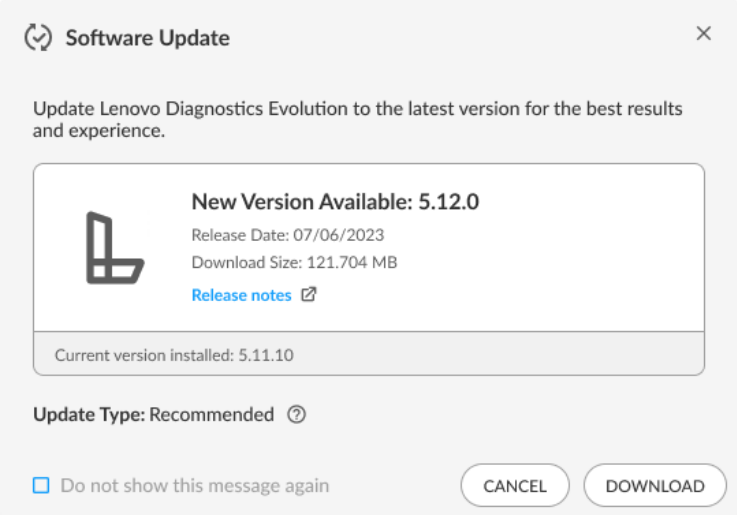


Figure 9: New Version Available

System updates are categorized into:

Update Type	Description
Optional	Optional updates are not required for the system, but may be useful when resolving issues.
Recommended	Driver updates keep your computer running at optimal performance.
Critical	Update can prevent significant problems, major malfunctions, hardware failure, or data corruption.

If the update type is "Optional" or "Recommended", you will be able to close the pop-up and continue using the application normally. In this case, you can update the version at any time by clicking on "Software Update" in the Settings icon located in the header.

Until the application isn't updated to the latest version, the system will automatically show a notification in the Settings icon reminding you that an update is available.

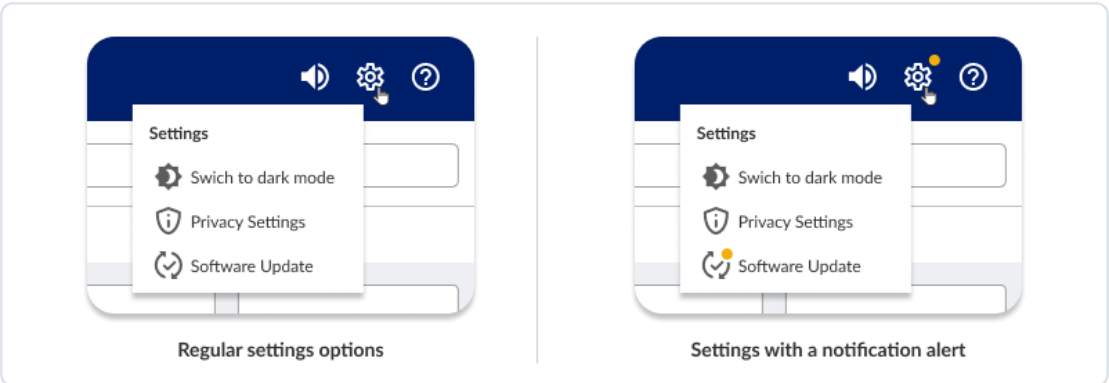


Figure 10: Software Updates Notification

If the update type is "Critical", you must update the version to continue using Lenovo Diagnostic Evolution.

Note: Internet connection is required to check software updates.

3. PERFORMING DIAGNOSTICS IN LENOVO DIAGNOSTICS EVOLUTION

3.1 Understanding the diagnostics

Each module contains tests that may be performed under one or more devices, resulting in a diagnostic. This structure is displayed in the image below:

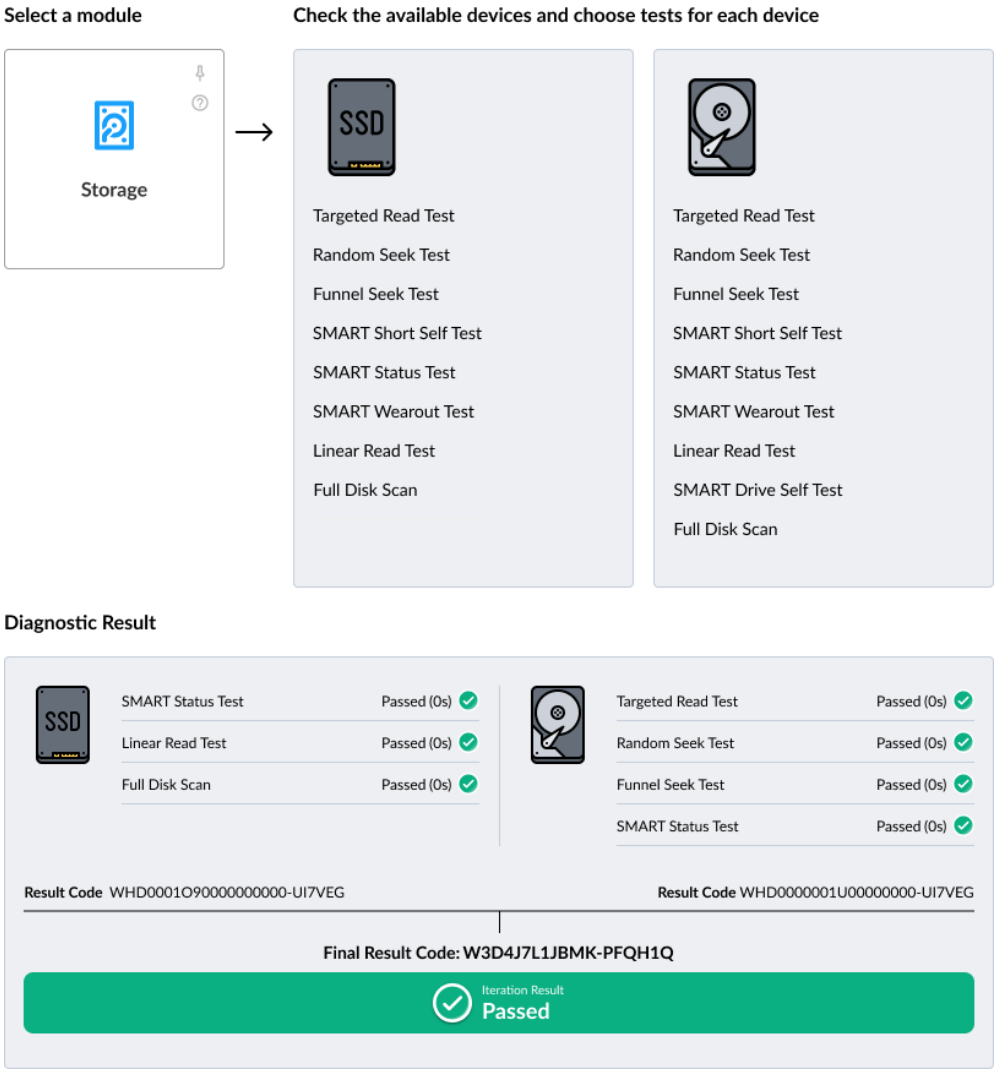


Figure 11: Diagnostics Flow

When a diagnostic is finished, Lenovo Diagnostics displays the results for each performed test and creates two codes to resume the test execution: Result Code and Final Result Code.

Result Code	Contains information about the machine serial number, system platform, and test execution status and date. This code is generated for each tested device.
Final Result Code	Contains information about the machine serial number, system platform, and execution date. This code reports also the module where the tests were performed and the tests with failed status.

The tests on Lenovo Diagnostics may have the following status:

Passed	When the test algorithm is executed, and no failure is found.
Failed	When the test identifies the diagnosed device as defective.
Warning	When the test indicates the diagnosed device may have some defect, but the result is not conclusive.
Canceled	When the test is canceled in the middle of test execution.
Not Applicable	When the test is not applicable to the selected device, for example, the device does not meet some minimum requirement for the test to be performed.

3.2 Performing diagnostics

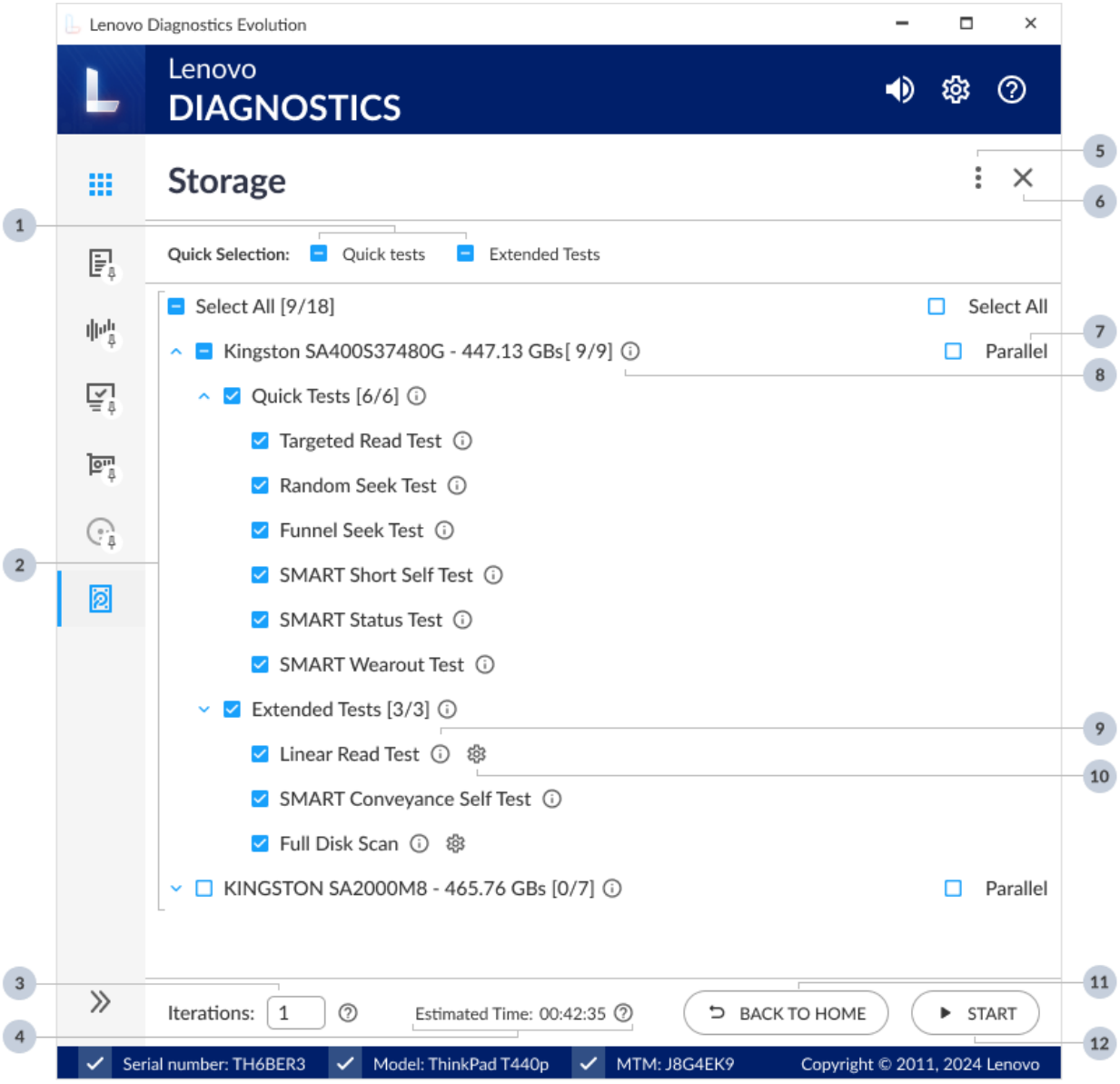
The diagnostic for a module in Lenovo Diagnostics Evolution is based on the following steps:

3.2.1 Select Devices and Tests

By selecting a module in the Diagnostics tab, you will be redirected to a screen where you can select which devices and tests will be performed.
On this step, all devices and tests supported by the selected module are displayed and you may select one or more of them to perform the tests.

Iterations: It is also possible to select the number of times to run the set of tests in a range from 1 to 999 times.

Estimated time: You can see an estimate for the diagnostic run time. The time is based on previous simulations on devices with similar specifications.



1 - Quick selection
2 - Select devices and tests
3 - Define number of iterations for the execution
4 - Estimated time for execution
5 - Module Options
6 - Close the module
7 - Select to run devices in parallel
8 - Device information
9 - Test description
10 - Customize parameters
11 - Back to home screen
12 - Start the diagnostic

Figure 12: Devices and Tests Selection Screen

By clicking to see **Device Information**, you can view detailed information about the device. The properties displayed depend on the selected module.

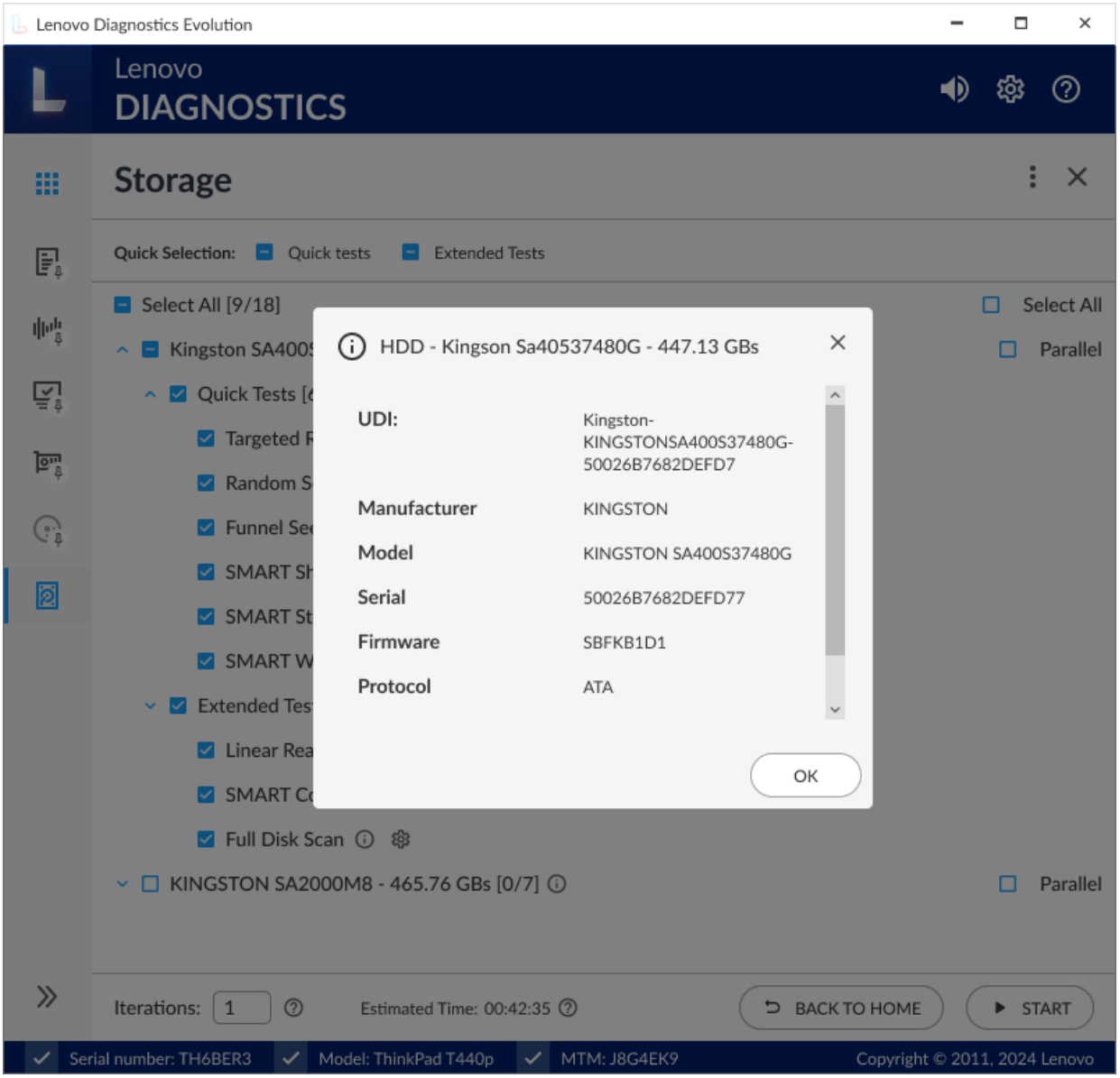


Figure 13: Device Information

By clicking to see the **Test Description**, you can view a brief description of the test and the estimated time to run the test, like the screen below.

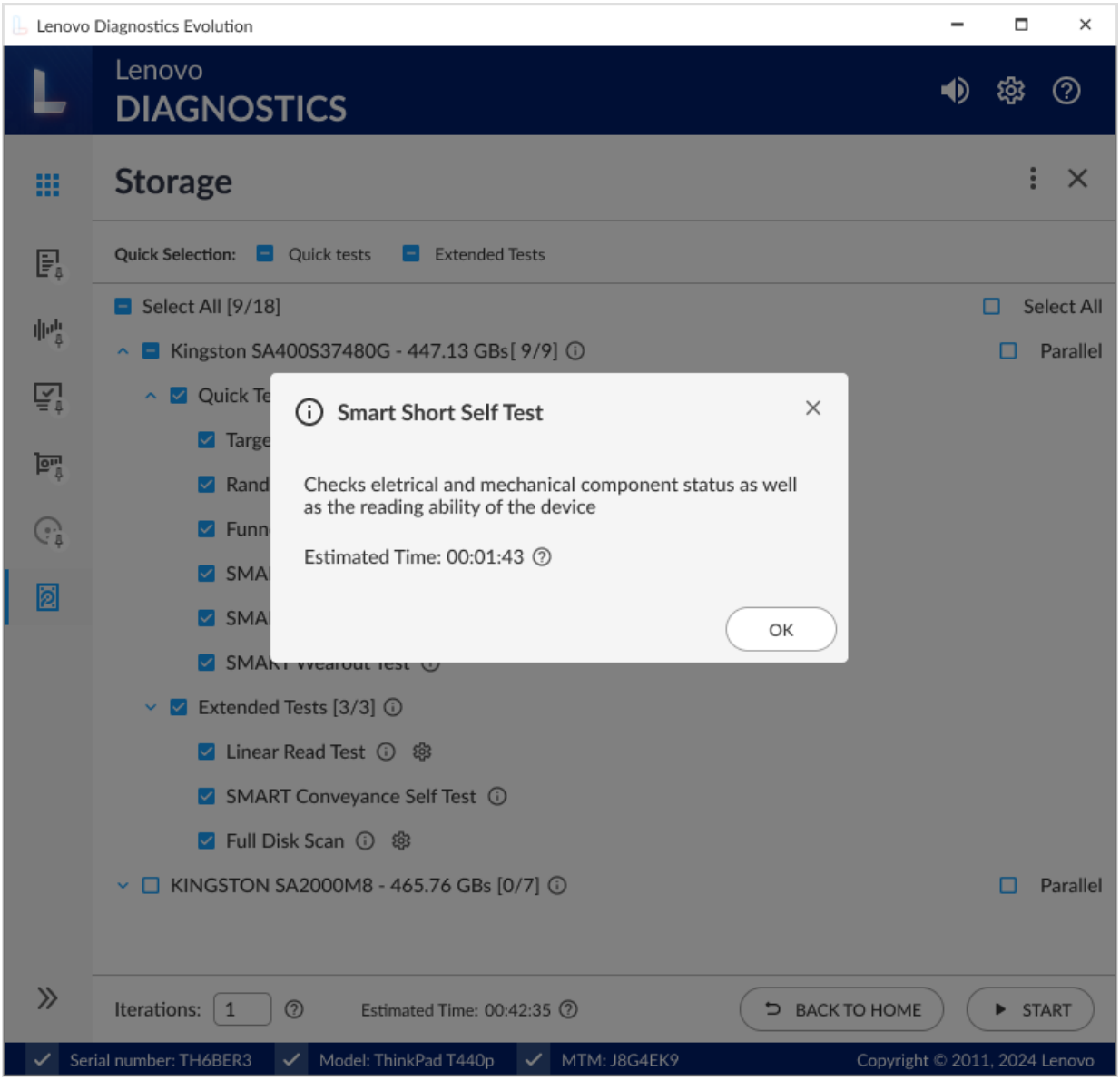


Figure 14: Test Description

By clicking to see the **Module Options**, you can view the following options: Pin/Unpin from the sidebar, and Help.

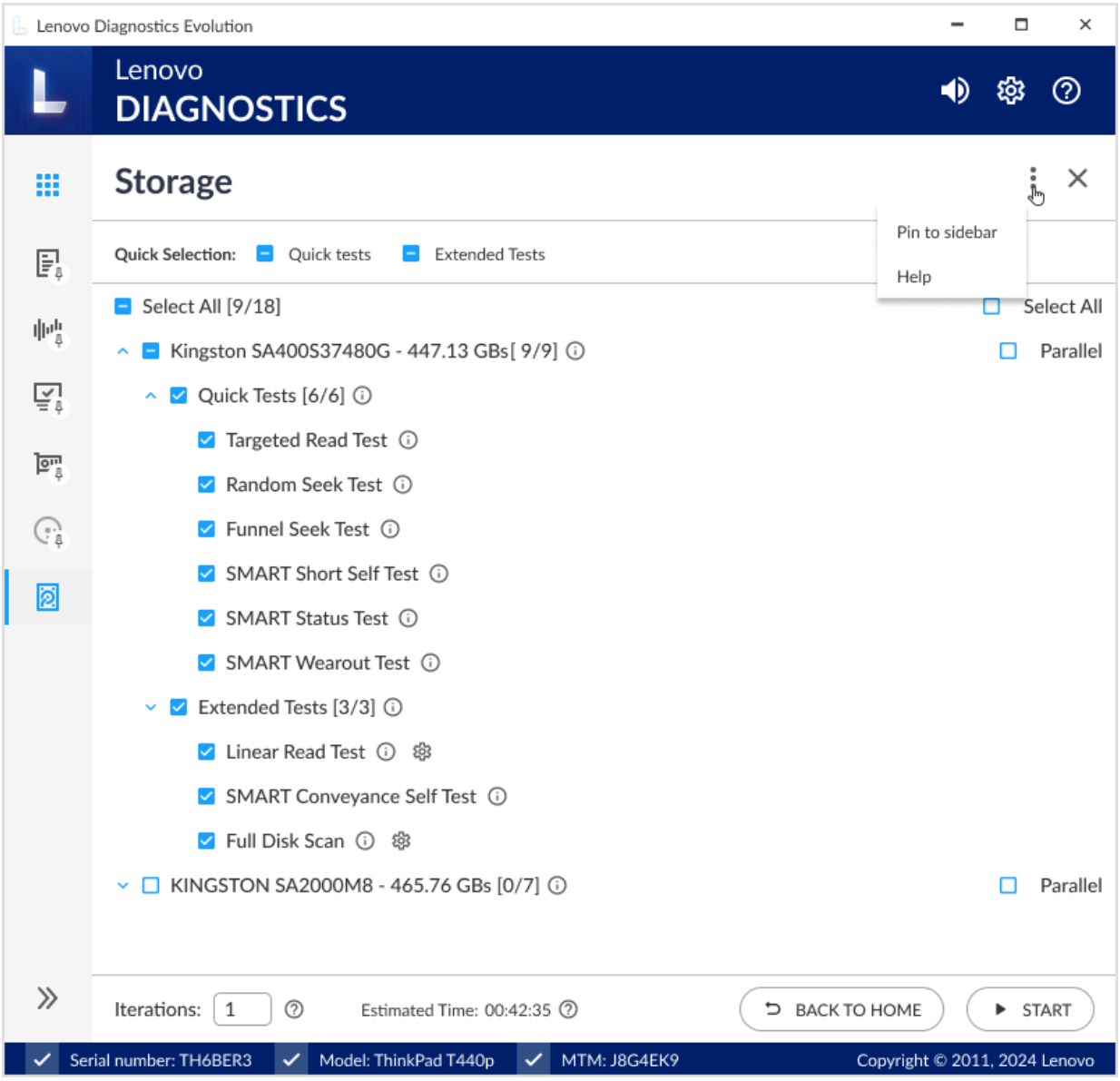


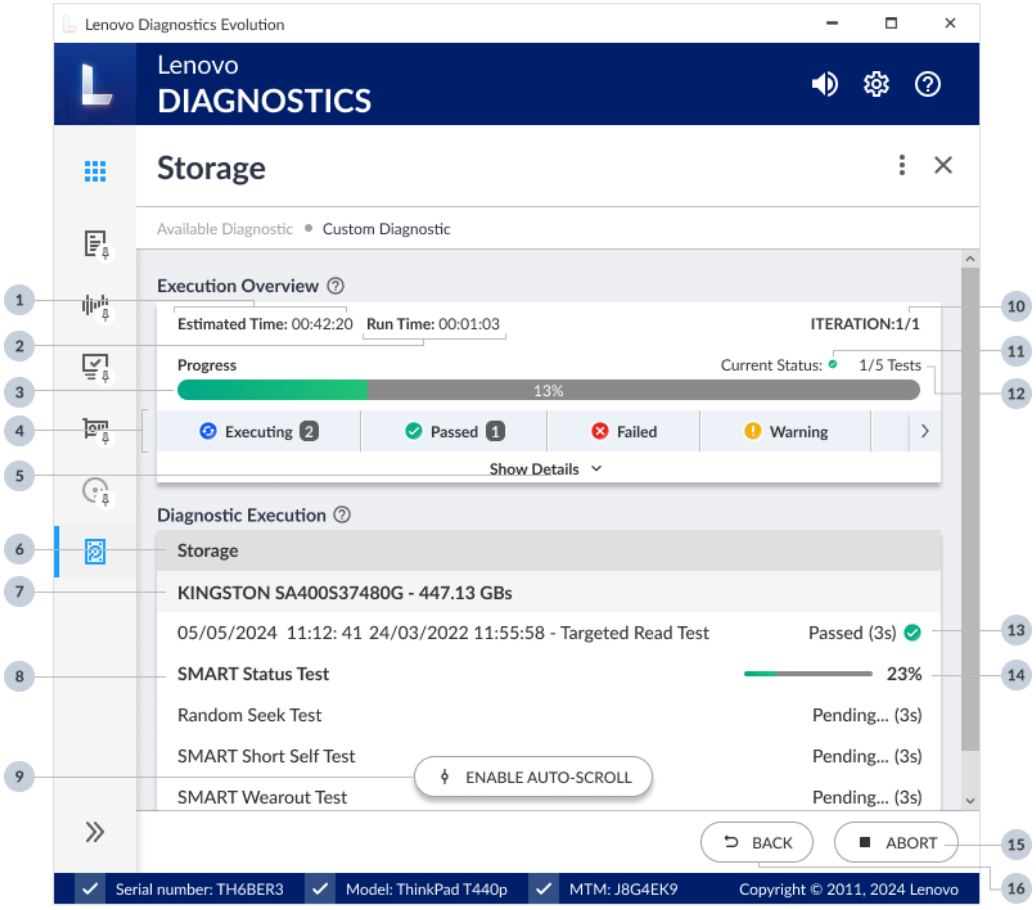
Figure 15: Modules Option

You also can close the module by clicking on “X” located next to the module options. When you close a module, you will be returned to the home screen.

3.2.2 Run Test

After configuring the execution of the tests and clicking Start, you will be directed to the Execution screen.

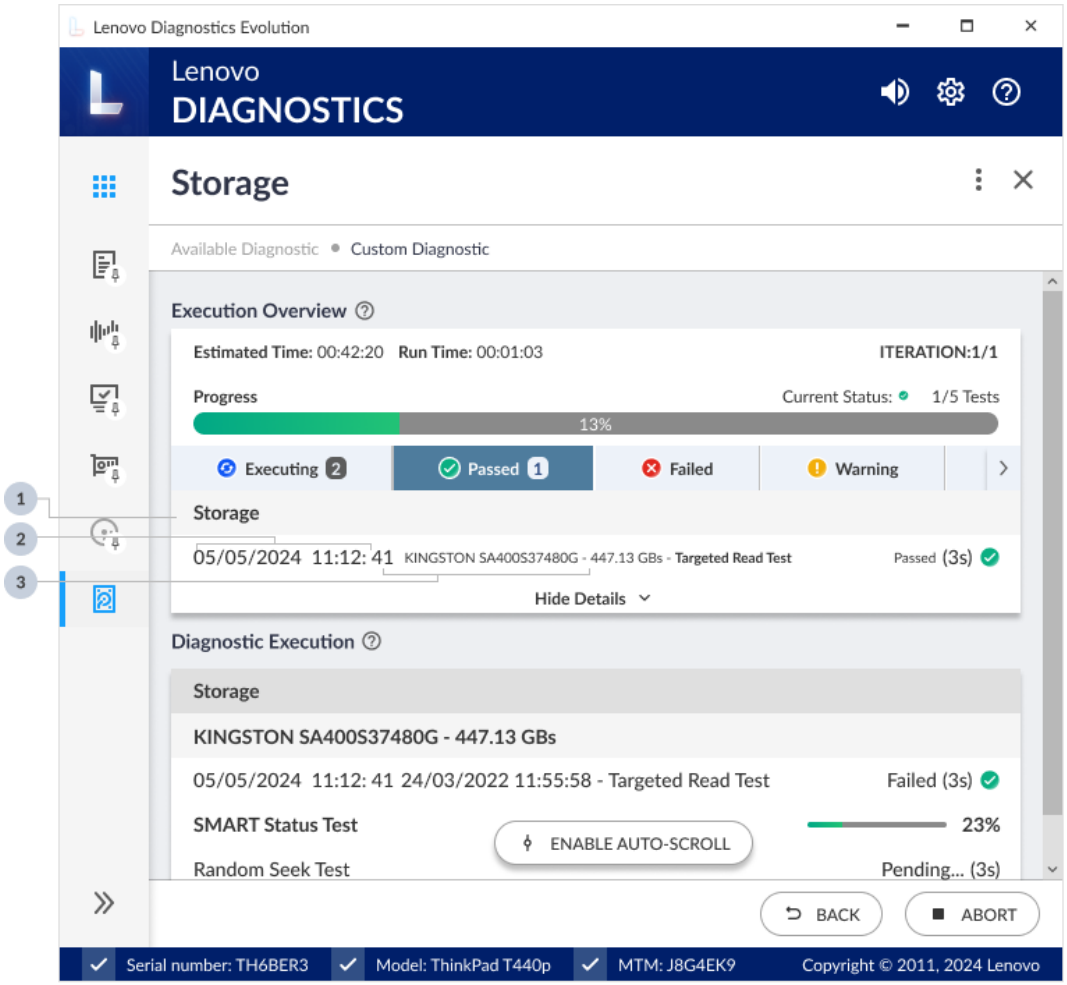
See in the image below that all devices selected in the previous steps are displayed with their respective tests.
You can follow each test execution by tracking the individual test progress, seeing the test status of each one, the overall test progress, and the time that reports the progress for all devices and tests selected. You also can see in real-time the number of tests for each status and the current status of the iteration.



1 - Estimated time for the execution
2 - Run time of the execution
3 - Iteration overall progress
4 - Execution summary
5 - More details about the summary
6 - Module Name
7 - Device name
8 - Test in progress
9 - Enable auto-scroll
10 - Current iteration/ Total iteration
11 - Preview of the iteration overall status
12 - Number of executed tests/Total of tests
13 - Test Status
14 - Test progress
15 - Abort the execution
16 - Back to test selection screen

Figure 16: Execution Screen

Execution summary: You can see the tests according to the status during the execution, just by clicking on the tab that represents the status you want to see. The image below displays all tests that returned "passed" status.



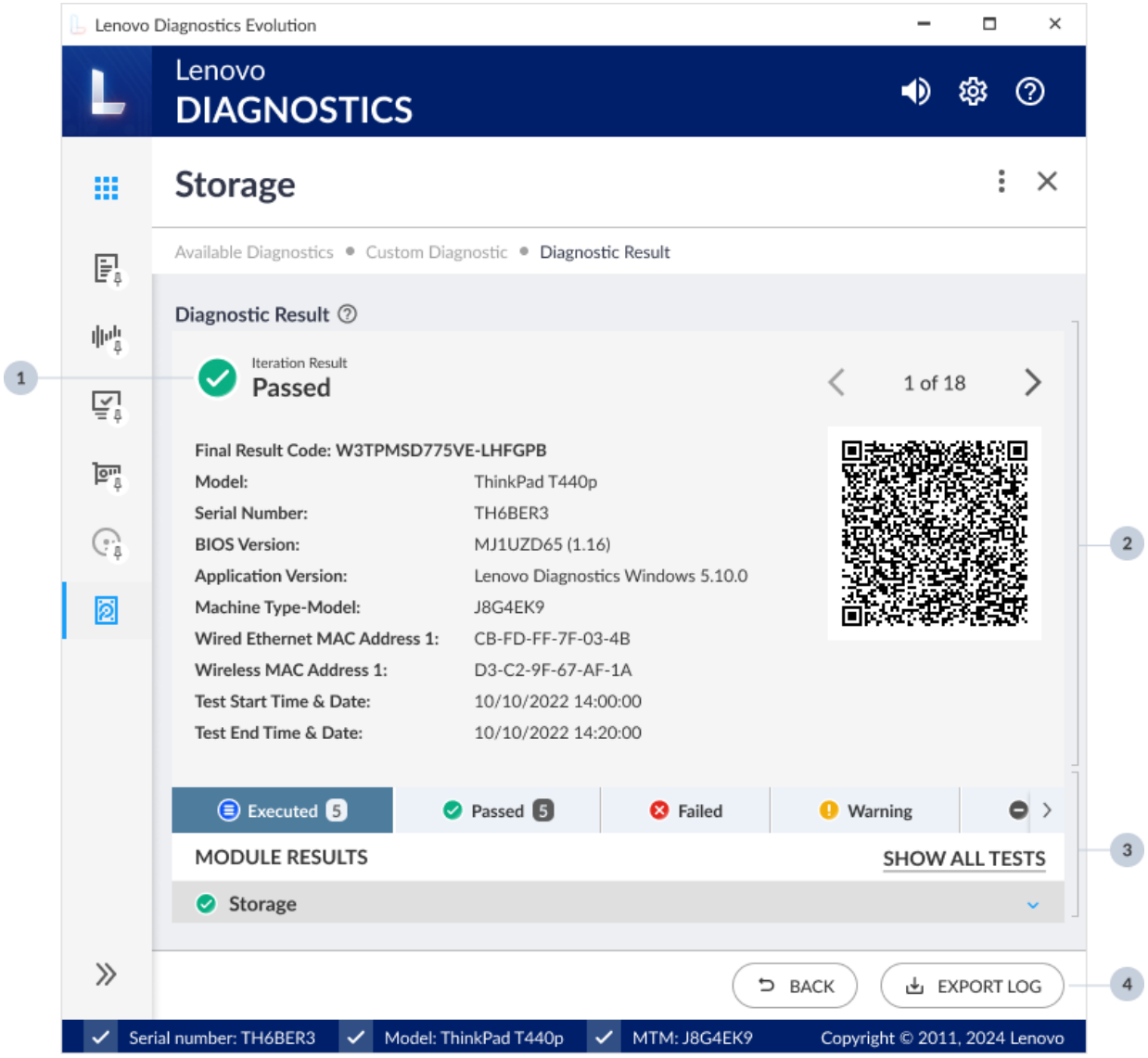
1 - Module name
2 - Device name
3 - Test name

Figure 17: Show Details Example

If you want to abort the whole test execution, you can click on Abort. In this case, the current test and all tests waiting for execution are canceled, including those from the next iterations. In the same way, the overall status for the current iteration and all next iterations will be changed to Canceled.

After all tests to being finished, the Lenovo Diagnostics Evolution generates a log with detailed information about the devices and their test results.

This log is composed of the following sections:



1 - Iteration Result
2 - General information
3 - Test Result
4 - Export Log

Figure 18: Diagnostic Result Screen

General information: contains information about the machine, test date, and final result. This section also displays a QR Code containing that information.

Figure 19: General Information Example

Test Results: displays the results and execution time of each performed test. To see the test results, you need to click on **SHOW ALL TESTS**.

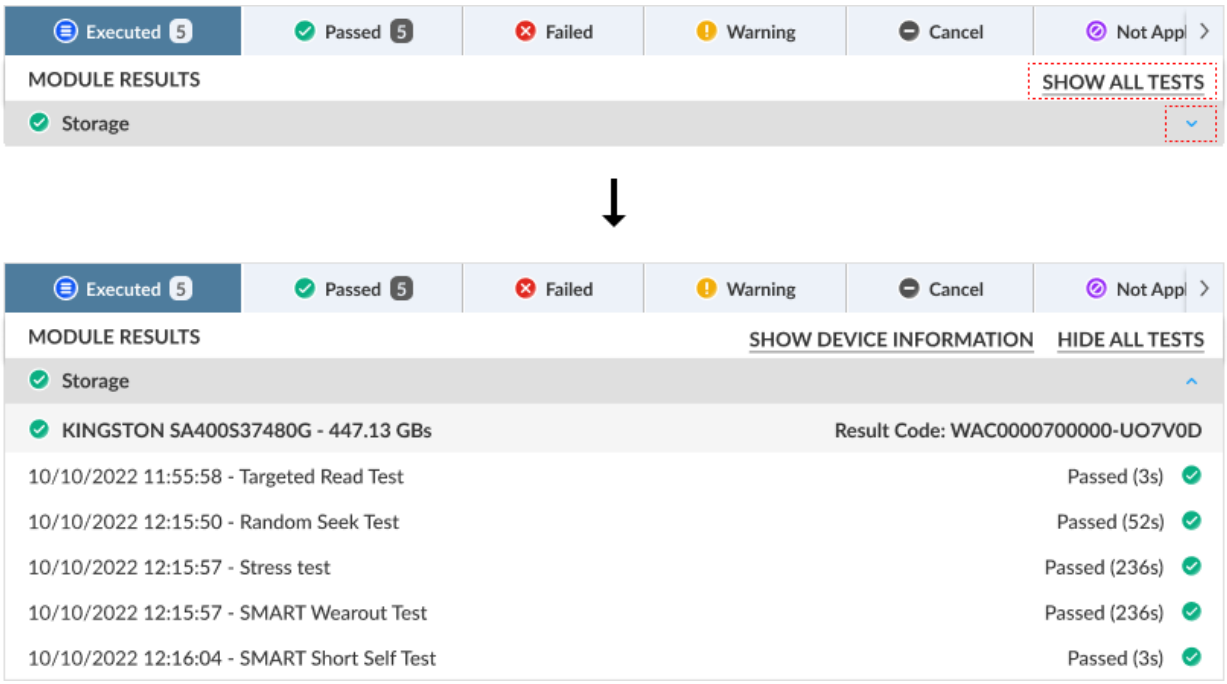


Figure 20: Show All Tests Example

Device Information: once the test results are being displayed, you can click to **SHOW DEVICE INFORMATION**. Device information is the technical details of each tested device.

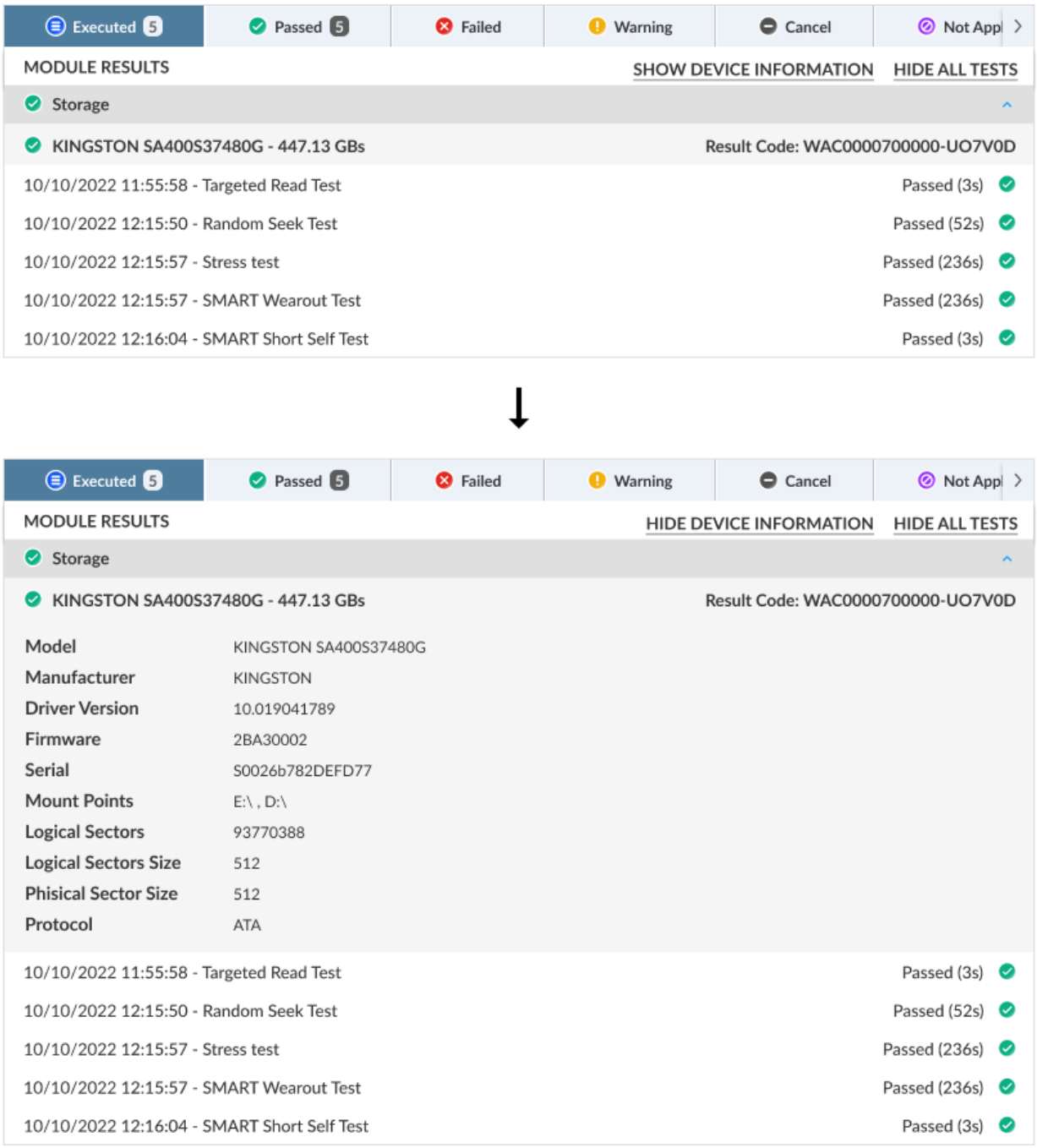
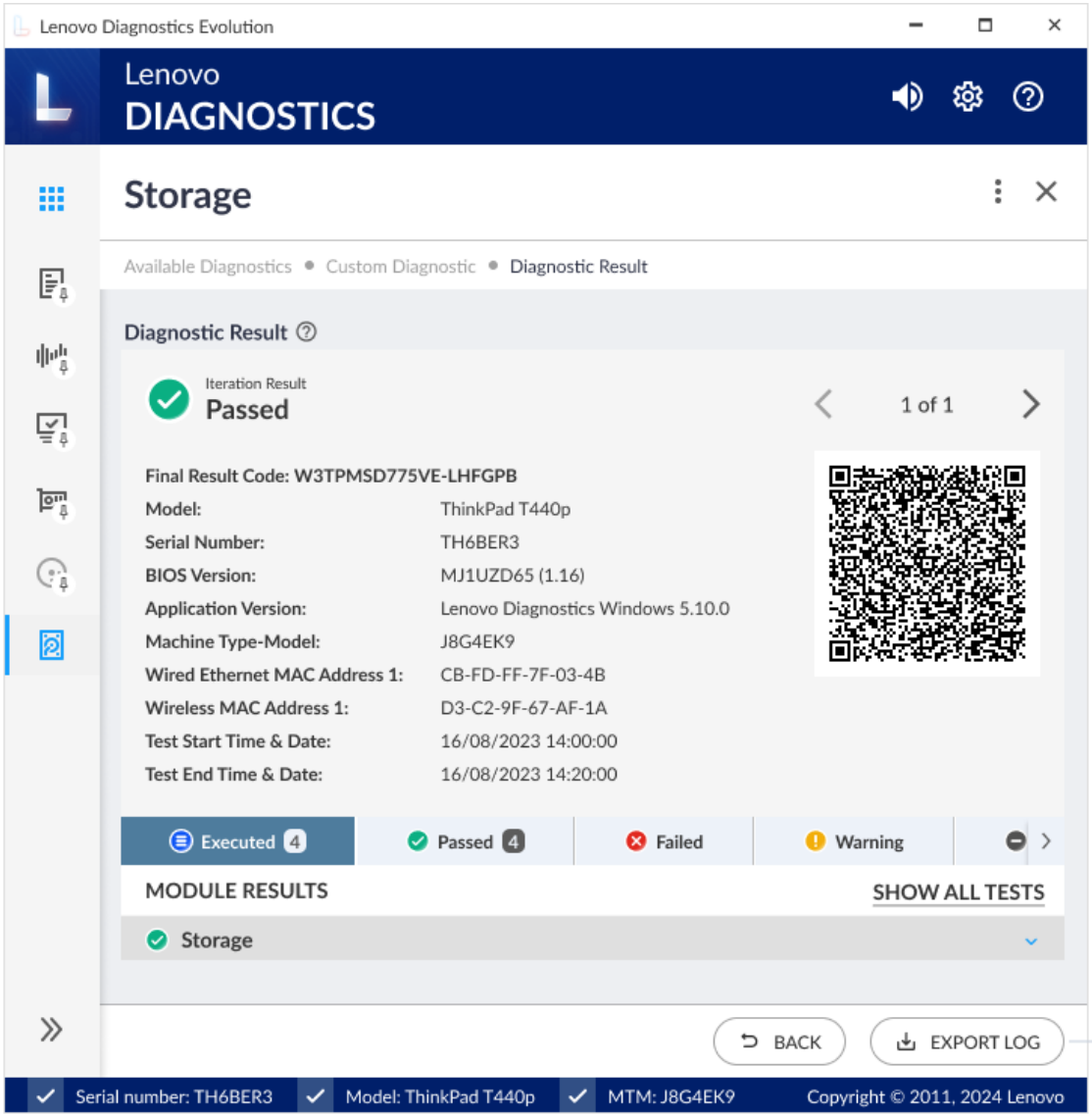


Figure 21: Show Device Information Example

Export Log: you can export the results to an HTML or PDF file. Just click the Export Log button.



1 - Export Log

Figure 22: Export Log Example

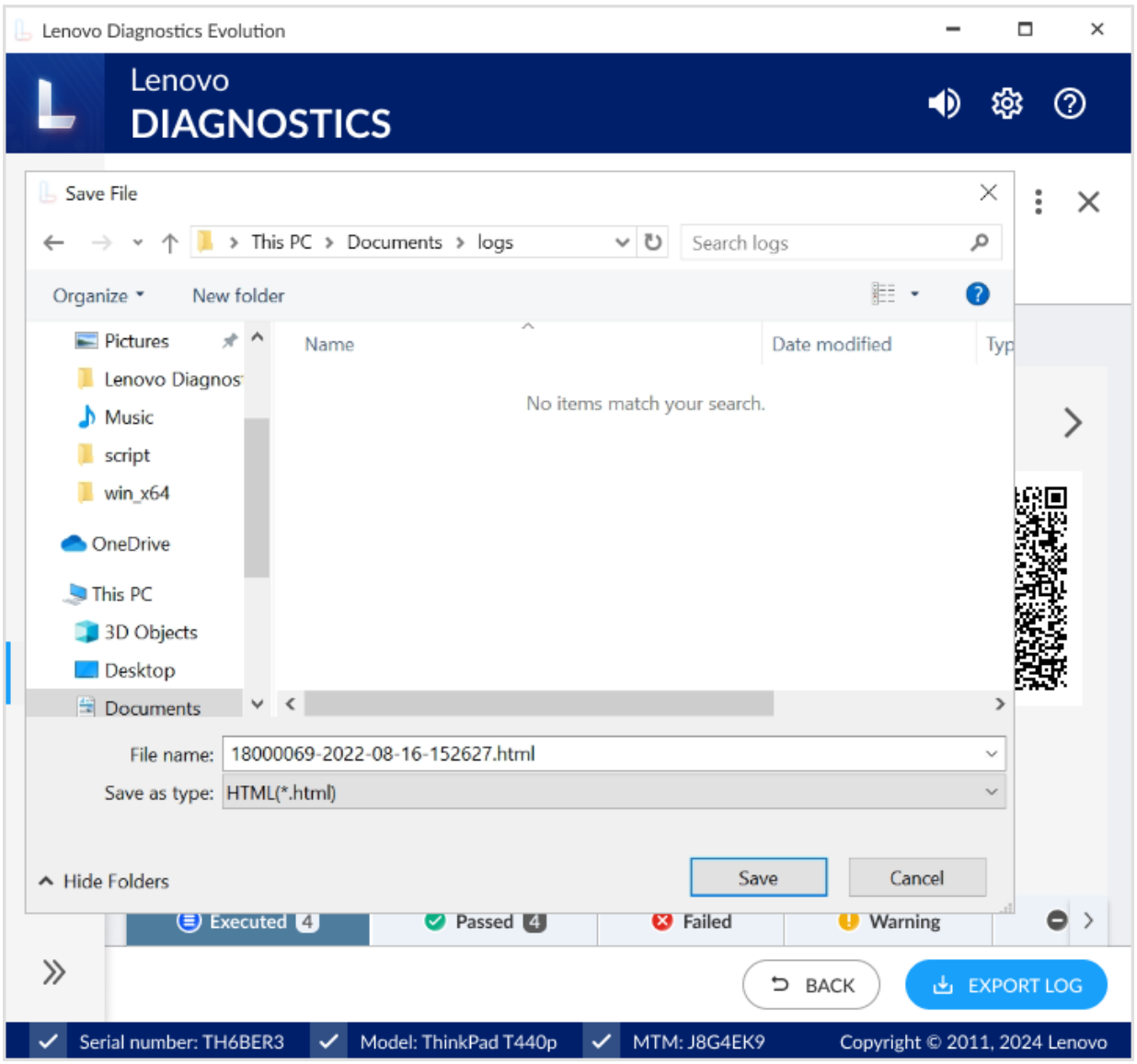


Figure 23: Save the File Example

3.3 Parallelism

Lenovo Diagnostics Evolution application allows modules and devices to run in parallel with each other. By enabling parallelism, the user can take advantage of faster execution as diagnostics occur simultaneously on different components. There are two different types of parallelism available: parallelism among module and parallelism among devices.

3.3.1 Types of Parallelism

Lenovo Diagnostics Evolution has two types of parallelism: parallelism among modules and parallelism among devices.

Parallelism execution among modules: Multiple modules can be executed at the same time.

Some modules cannot run in parallel with others due the architecture limitations. All restrictions can be found in the Parallelism Rules section.

Below you can check an example of an execution among modules via Run All screen. In this case, Processor and Video Card modules are running in parallel.

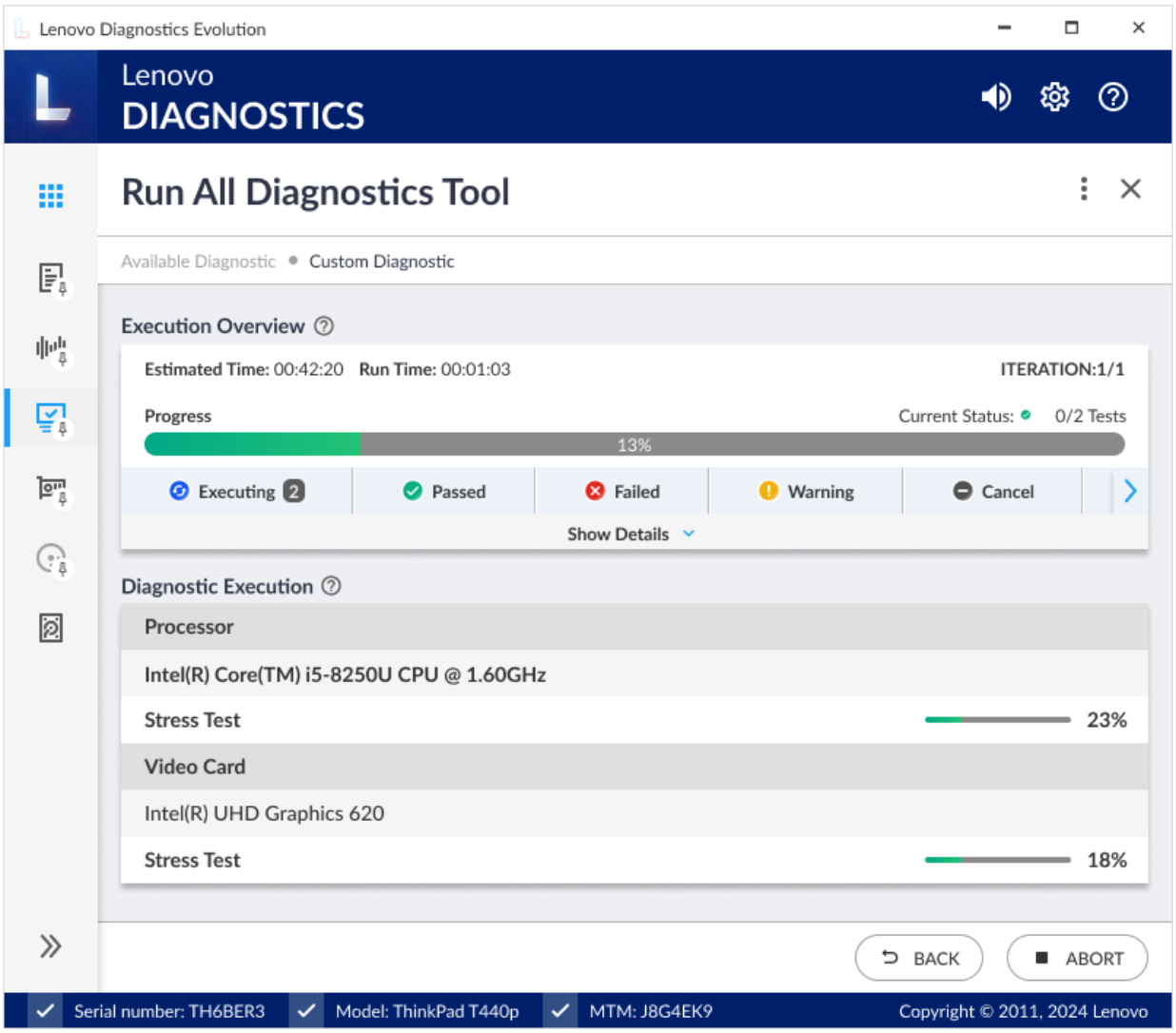


Figure 24: Parallelism among modules

Parallelism execution among devices: Multiple devices from a module can be executed at the same time. For example, on the storage module, you can select to run a full disk scan test in an HDD device and in an NVME device at the same time. Some modules doesn't have multiple device, thus, the Parallelism isn't supported. All restrictions can be found in the Parallelism Rules section.

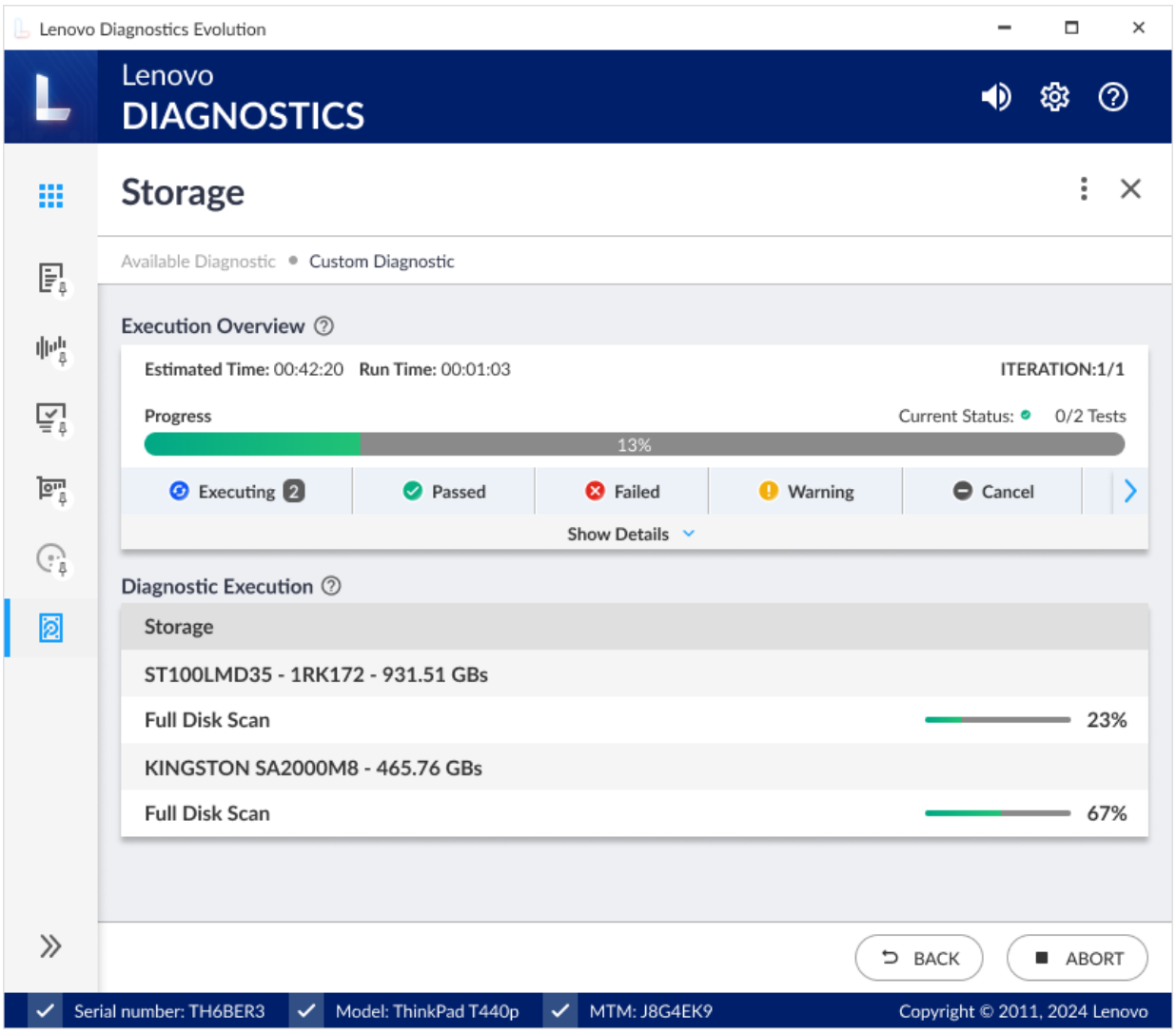


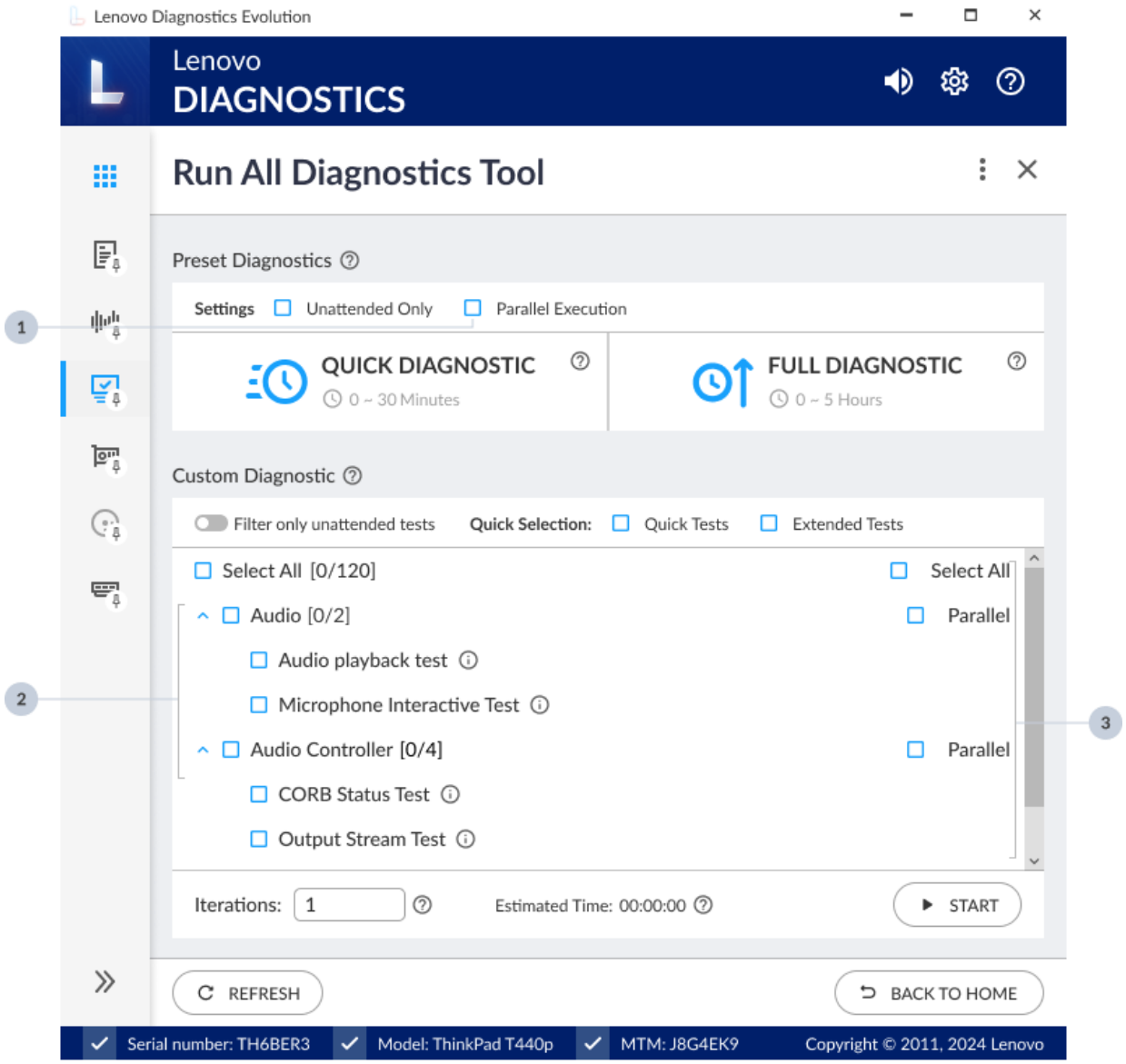
Figure 25: Parallelism among devices

3.3.2 How to Enable and Disable Parallelism

The user must be able to enable and disable the parallel execution during the selection of the tests. By default, the parallel execution is disabled.

The parallel execution among modules and devices can be configured on the following flows: **Run All**, **Scripts Tool**, and **Via Module**.

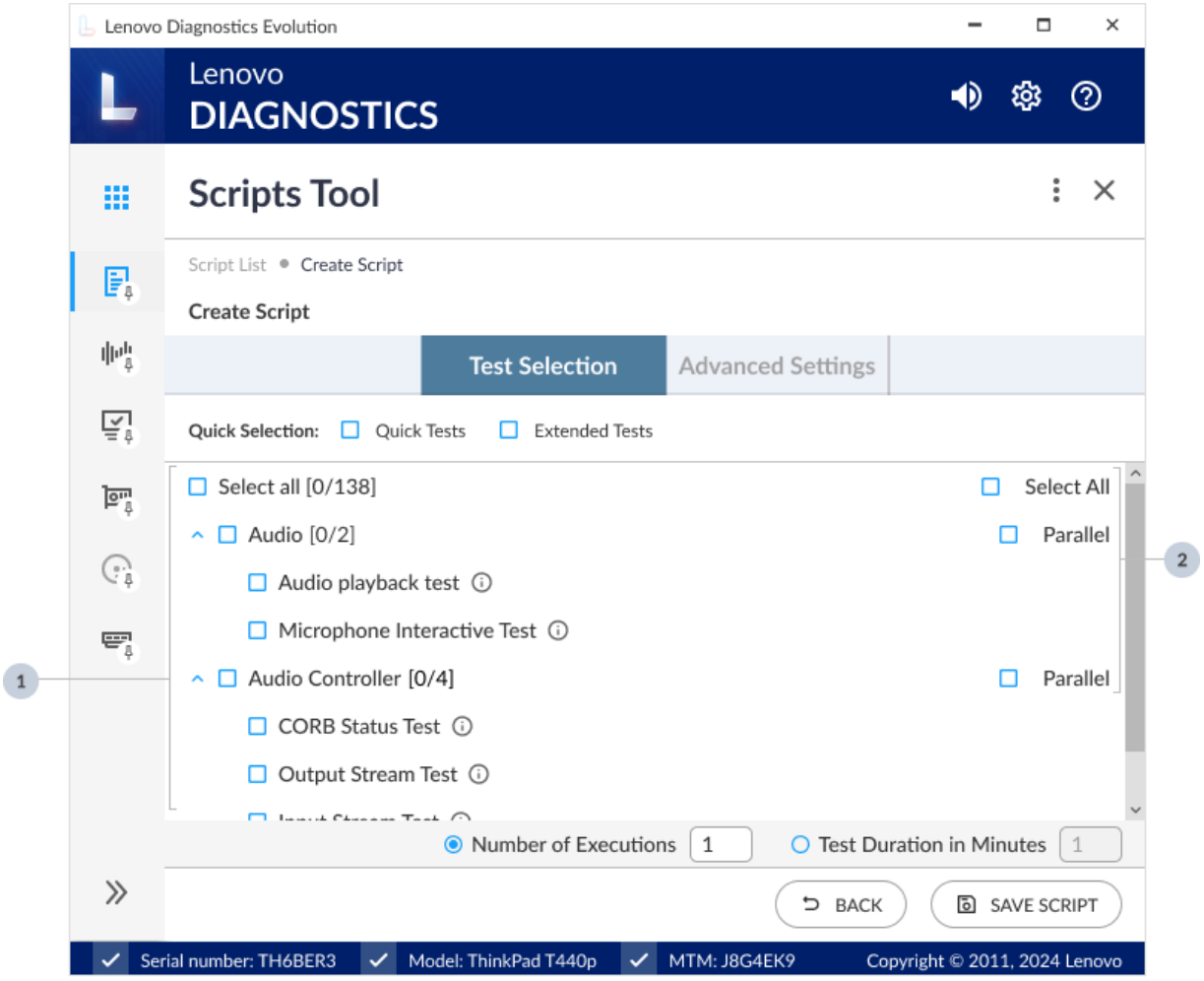
Run All



1 - Select this option to run Quick and Full Diagnostics in parallel
2 - Selected Modules
3 - Select the parallel option to run modules in parallel

Figure 26: Parallelism on Run All Screen

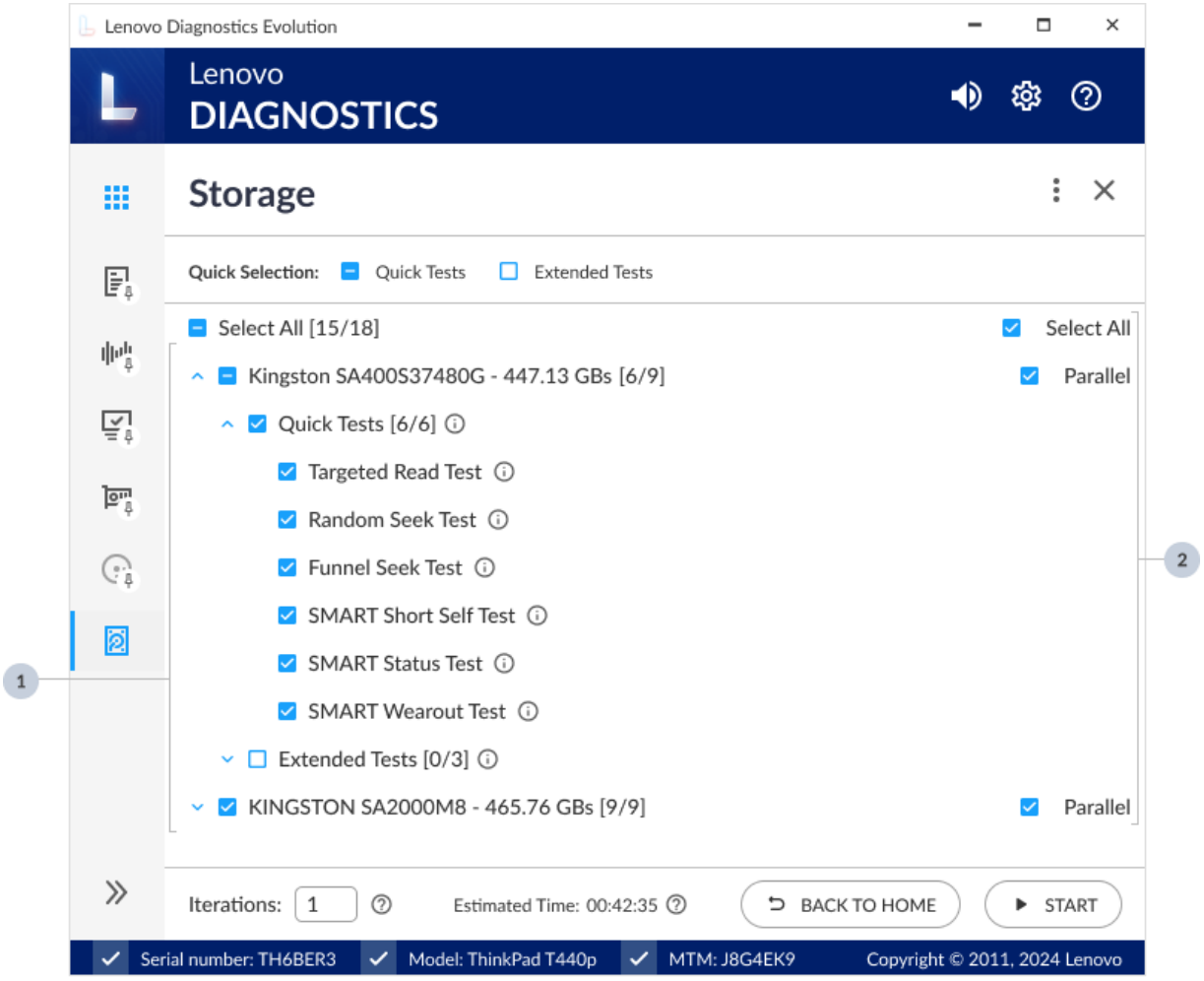
Scripts



1 - Selected Modules
2 - Select to run Modules in parallel

Figure 27: Parallelism on Scripts Screen

Module Screen



1 - Select devices and tests
2 - Select to run the devices in parallel

Figure 28: Parallelism on Module Screen

3.3.3 Parallelism Rules

The parallelism cannot be enabled for all modules and devices due architecture limitations. Below you may check all the rules that defines the parallelism support:

- The parallelism among modules is only available if the module contains at least one unattended test supported.
- The parallelism among modules is not supported if the module has at least one attended selected.
- The parallelism among devices it's only supported on Video Card and Storage module.
- The parallelism among modules and devices is not supported for Motherboard and Memory modules.

4. LENOVO DIAGNOSTICS EVOLUTION MODULES AND TESTS

This section provides information about all modules available in Lenovo Diagnostics Evolution and their respective tests. Here, you will understand the approach implemented by each test and how these tests should be performed to assure the correct diagnostic of your machine.

4.1 Audio

The Audio module contains tests that can help verify that the speaker and microphone devices are working properly.

The Audio module is composed of the following tests:

Test	Test type	Attendance
Audio Playback Test	Quick	Attended
Microphone Interactive Test	Quick	Attended

Audio Playback Test
The audio playback test plays random sounds through the audio hardware. The user must be able to listen and identify the sound played correctly.

Before starting the test, you can change the execution mode by clicking on the settings icon next to the test name, according to the image below:

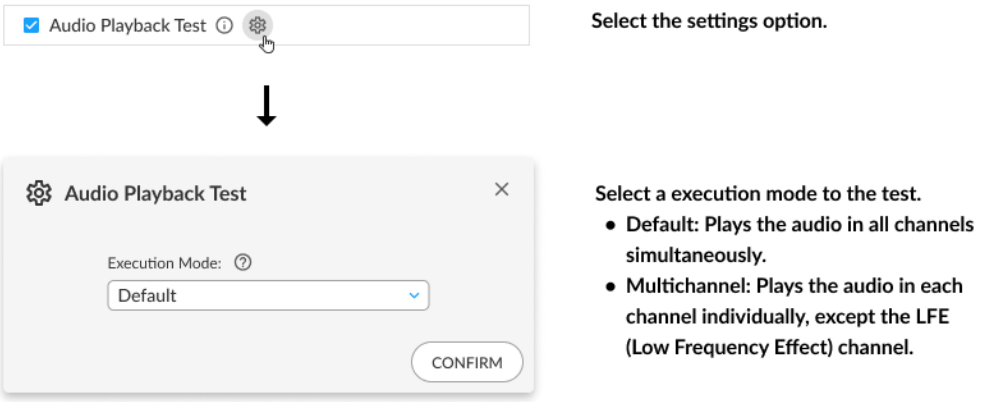
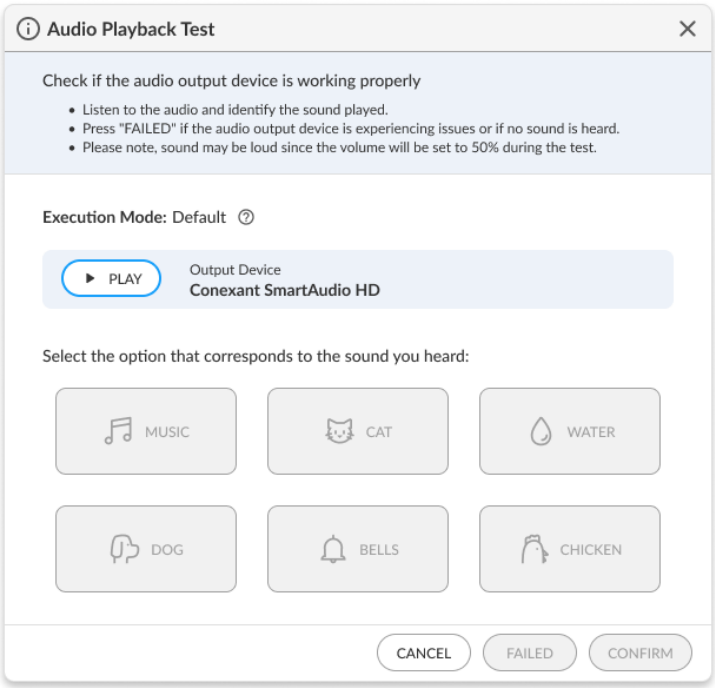


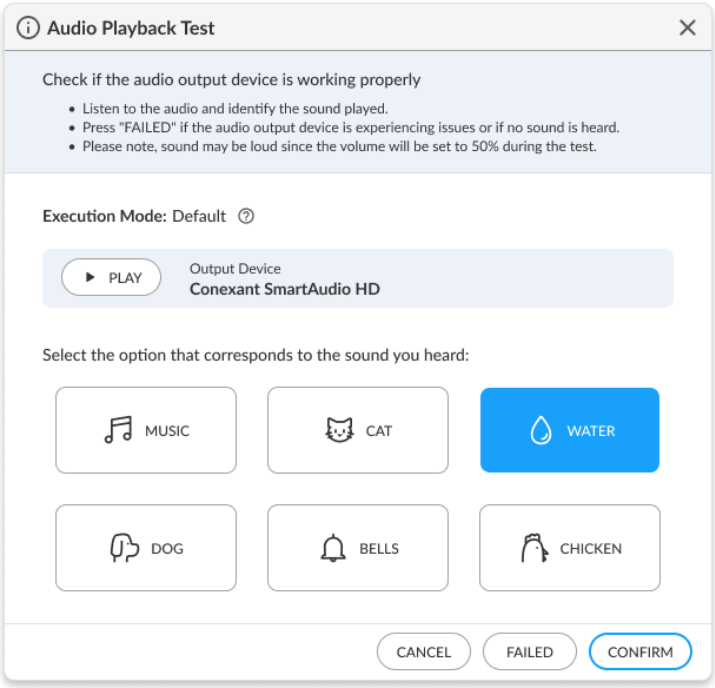
Figure 29: Audio Playback Settings

By selecting the Default Mode, the test execution is based on the workflow below.

Listen to the audio and identify the sound played.



Select the option that corresponds to the sound you heard.

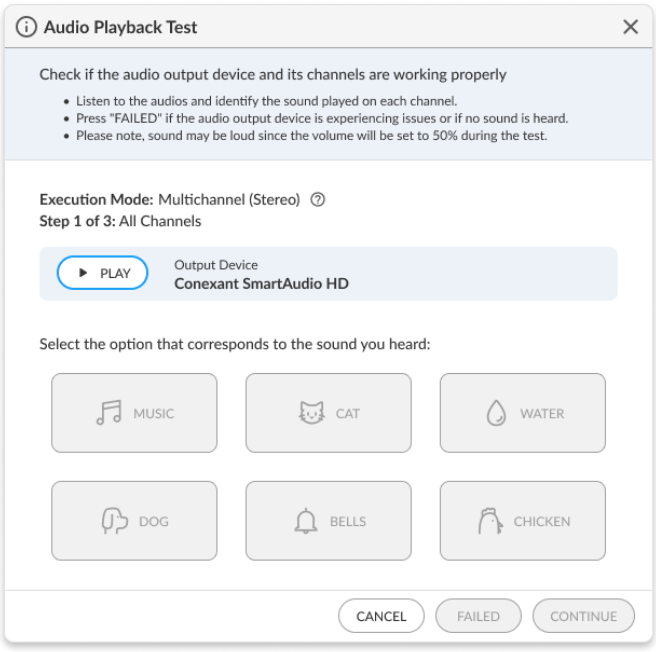


If necessary, you can listen to the audio multiple times.
Press "CONFIRM" to validate the answer or "FAILED" if there are any issues.

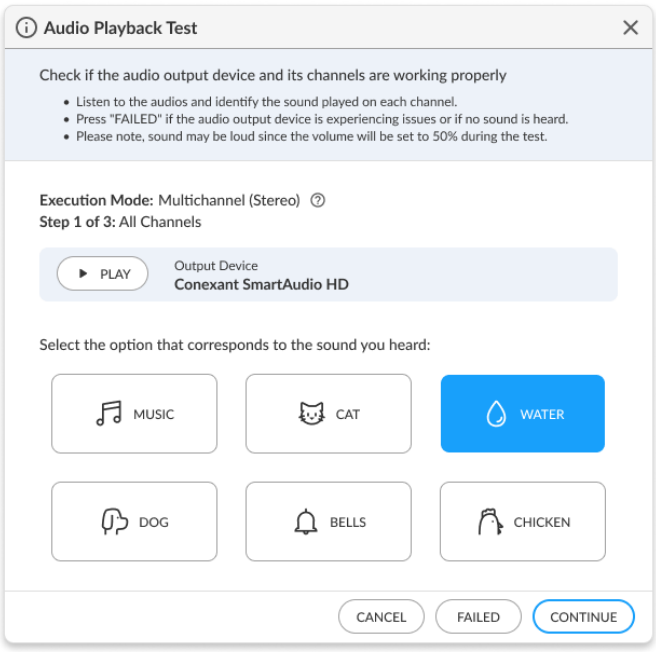
Figure 30: Audio Playback Test – Default Execution Mode

By selecting the Multichannel Mode, the test execution is based on the workflow below, and the steps is shown according to the channels available:

Listen to the audios and identify the sound played on each channel.



In each step, select the option that corresponds to the sound you heard.
Press "CONTINUE" to proceed to the next step and repeat the listening and selection process until the end of test.



If necessary, you can listen to the audio multiple times.
Press "CONTINUE" to validate the answers, in the last step press "CONFIRM".
Press "FAILED" if there are any issues.

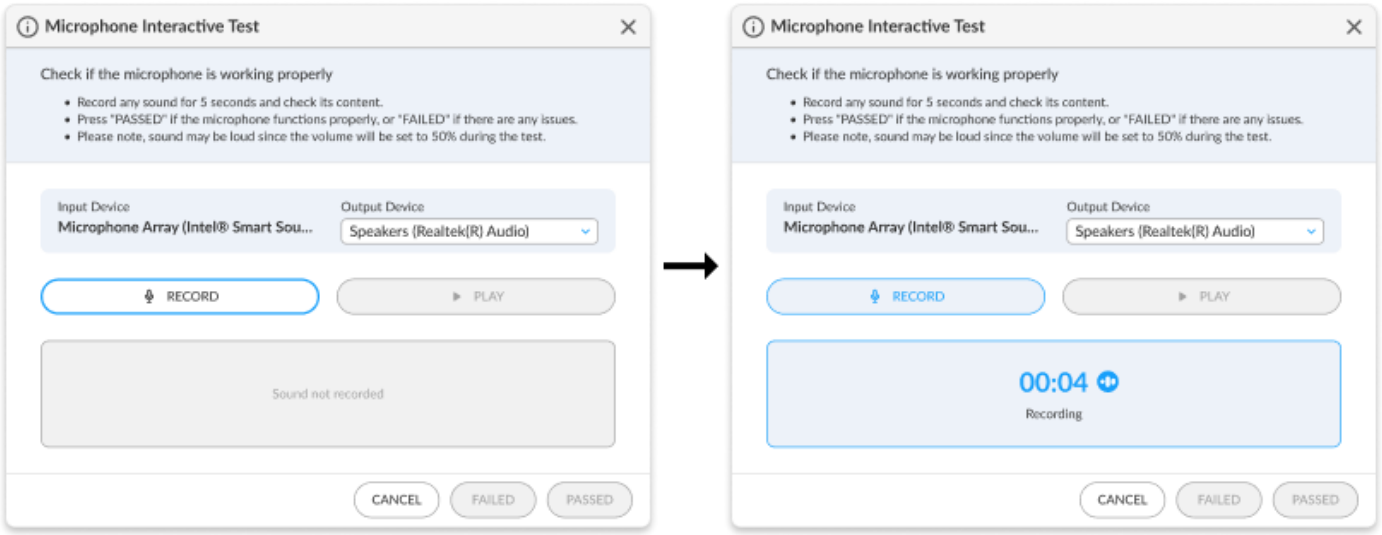
Figure 31: Audio Playback Test – Multichannel Execution Mode

Microphone Interactive Test

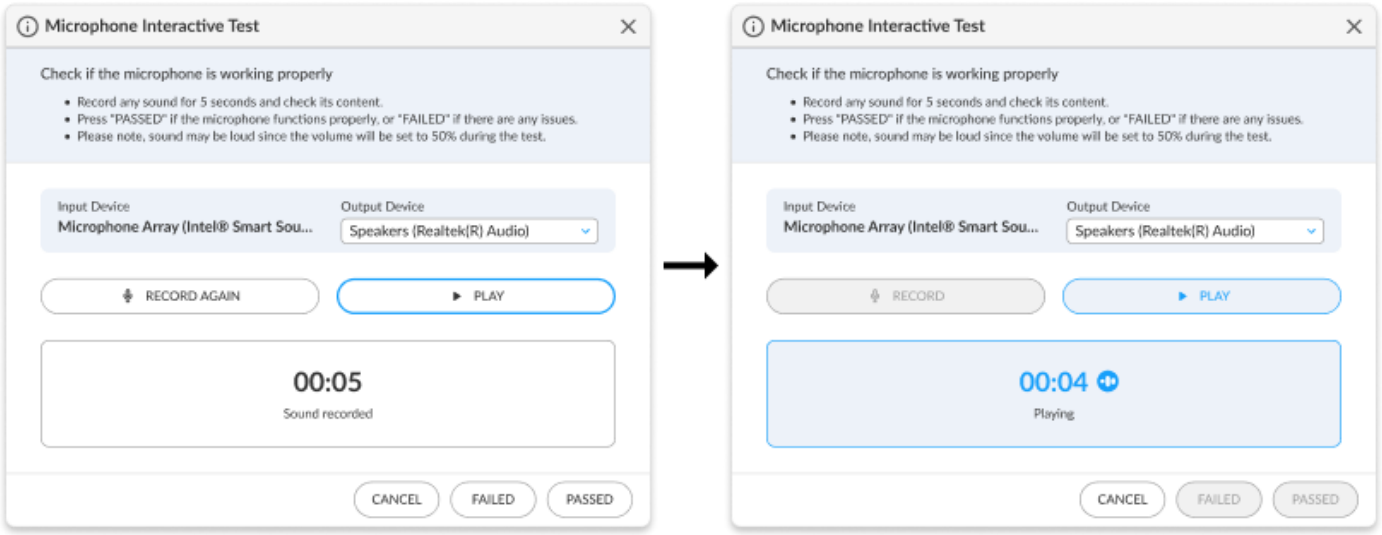
This test helps to identify if the microphone is capable of capturing sound properly.

The microphone interactive test is performed according to the following workflow:

Press record and speak or make any sound on the microphone. The record will have 5 seconds of duration.



Listen the recorded audio and check if the content played corresponds to the expected.



If necessary, you can record again and listen to the audio multiple times.
If there are multiple audio outputs, you can also switch the output device.
Press "PASSED" if the microphone functions properly, or "FAILED" if there are any issues.

Figure 32: Microphone Interactive Test Flow

4.2 Audio Controller

The Audio Controller module contains tests that can verify that the audio controllers are working properly.

The Audio Controller module is composed of the following tests:

Test	Test type	Attendance
CORB Status Test	Quick	Unattended
Output Stream Test	Quick	Unattended
Input Stream Test	Quick	Unattended
Bidirectional Stream Test	Quick	Unattended

CORB Status Test
This test checks the status of the Command Outbound Ring Buffer (CORB) mechanism.

Output Stream Test
This test checks the status of the output streams. Before starting the test, Lenovo Diagnostics advises you that a short audio tune will be played as displayed in the image below.

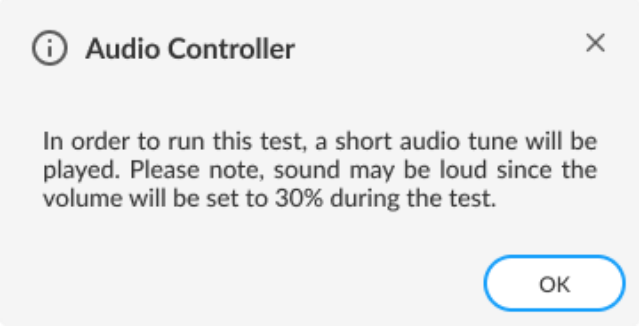


Figure 33: Output Stream Test Pop-up

Input Stream Test
This test checks the status of the input streams.

Bidirectional Stream Test
This test checks the status of the bidirectional streams.

4.3 Battery

The Battery module contains tests that help verify that the battery devices are working properly.

The Battery module is composed of the following tests:

Test	Test type	Attendance
Battery Health Test	Quick	Unattended
Battery Temperature Test	Quick	Unattended
Battery Discharge Test	Extended	Attended
Battery Charge Test	Extended	Attended

Battery Health Test
Battery Health Test checks the device charge capacity and other important battery properties to evaluate the device's health.

Battery Temperature Test
The Temperature test evaluates if the battery temperature is too high, which may prevent it from charging properly.

Battery Discharge Test
Battery Discharge Test checks the device charge capacity and other important battery properties to evaluate the device's health. If there is an AC cable plugged in, you must unplug it before proceeding to the test as displayed below.

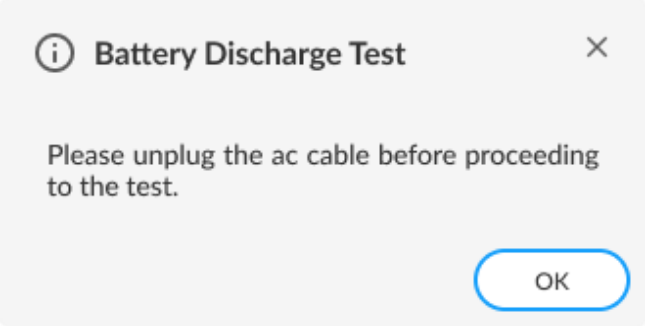


Figure 34: Battery Discharge Test Pop-up

Before starting the test, you can change the duration of the test by clicking on the settings icon next to the test name, according to the image below:

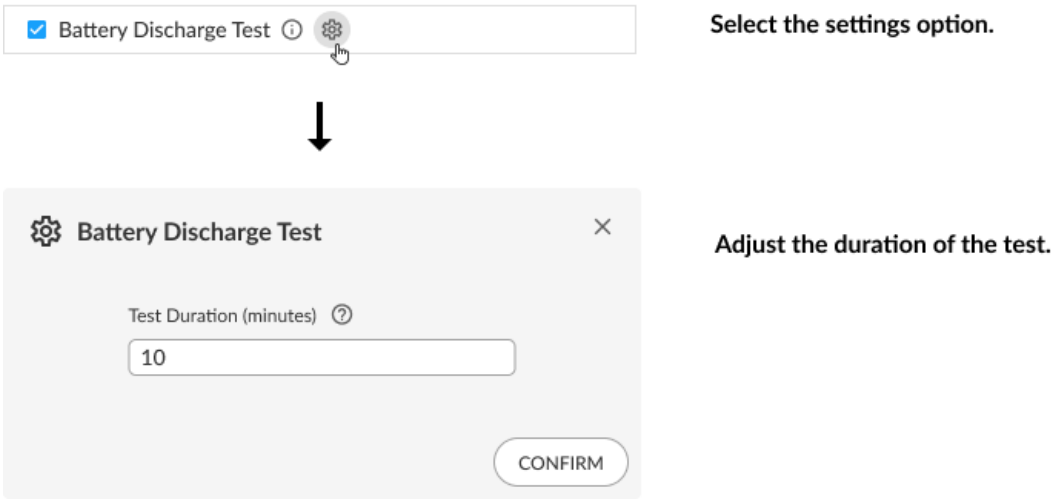


Figure 35: Customizable Parameter for the Battery Discharge Test

Note: This test requires the remaining battery charge must be greater than 20%.

Battery Charge Test
The test checks if the battery charge increases while the AC cable is connected. If there is no AC cable plugged you should connect it before proceeding to the test.

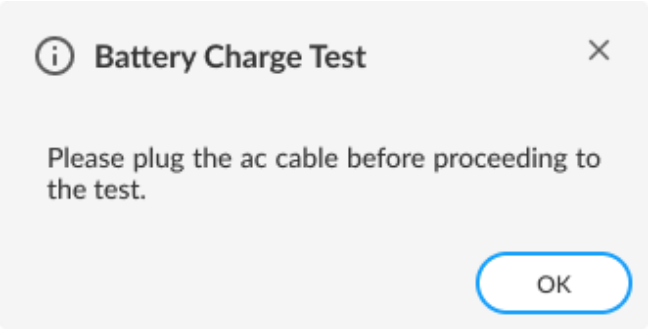


Figure 36: Battery Charge Test Pop-up

Before starting the test, you can change the duration of the test by clicking on the settings icon next to the test name, according to the image below:

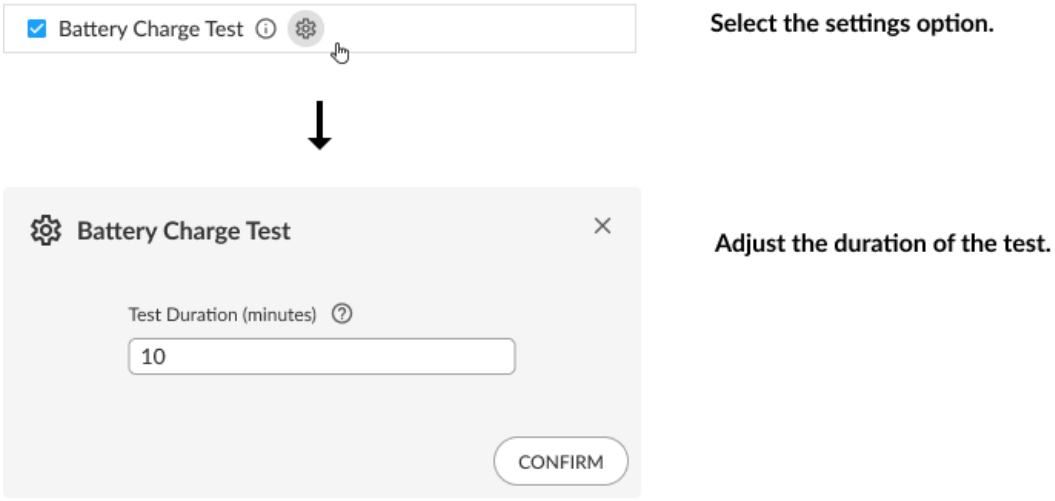


Figure 37: Customizable Parameter for the Battery Charge Test

Note: This test requires the battery charge must be less than or equal to 93%.

4.4 Bluetooth

The Bluetooth module contains tests that can verify that the Bluetooth is working properly.

The Bluetooth module is composed of the following test:

Test	Test type	Attendance
Scan Test	Quick	Unattended

Scan Test
Scan for nearby active Bluetooth devices.

The test starts by asking you to make sure the Bluetooth device is enabled and there is another Bluetooth close and active.

Figure 38: Scan Test

4.5 Camera

The Camera module contains tests that can help verify that the camera devices are working properly.

The Camera module is composed of the following test:

Test	Test type	Attendance
Camera Capture Test	Quick	Attended
Camera Barcode Test	Quick	Attended

Camera Capture Test

Verify if the camera device is working properly based on your feedback for the captured images. This test is performed according to the following workflow:

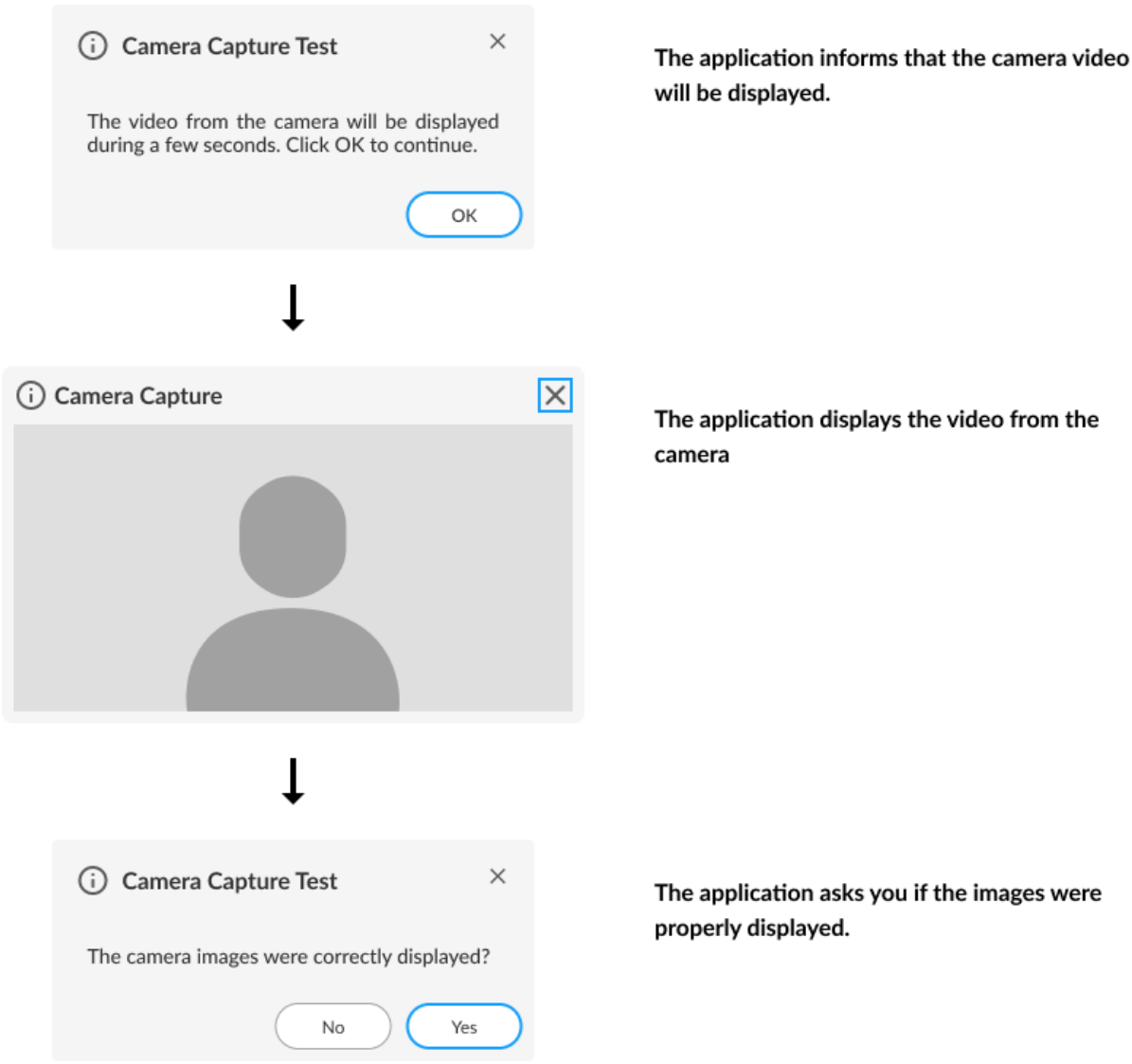


Figure 39: Camera Capture Test

Camera Barcode Test
Verifies if the camera device is properly working by checking if it can read a barcode. The test starts by asking you to point a QR code or a barcode to the camera.

For the test to be successfully completed, the Barcode/QR Code content must contain a maximum of 60 characters and be composed of only letters and numbers.

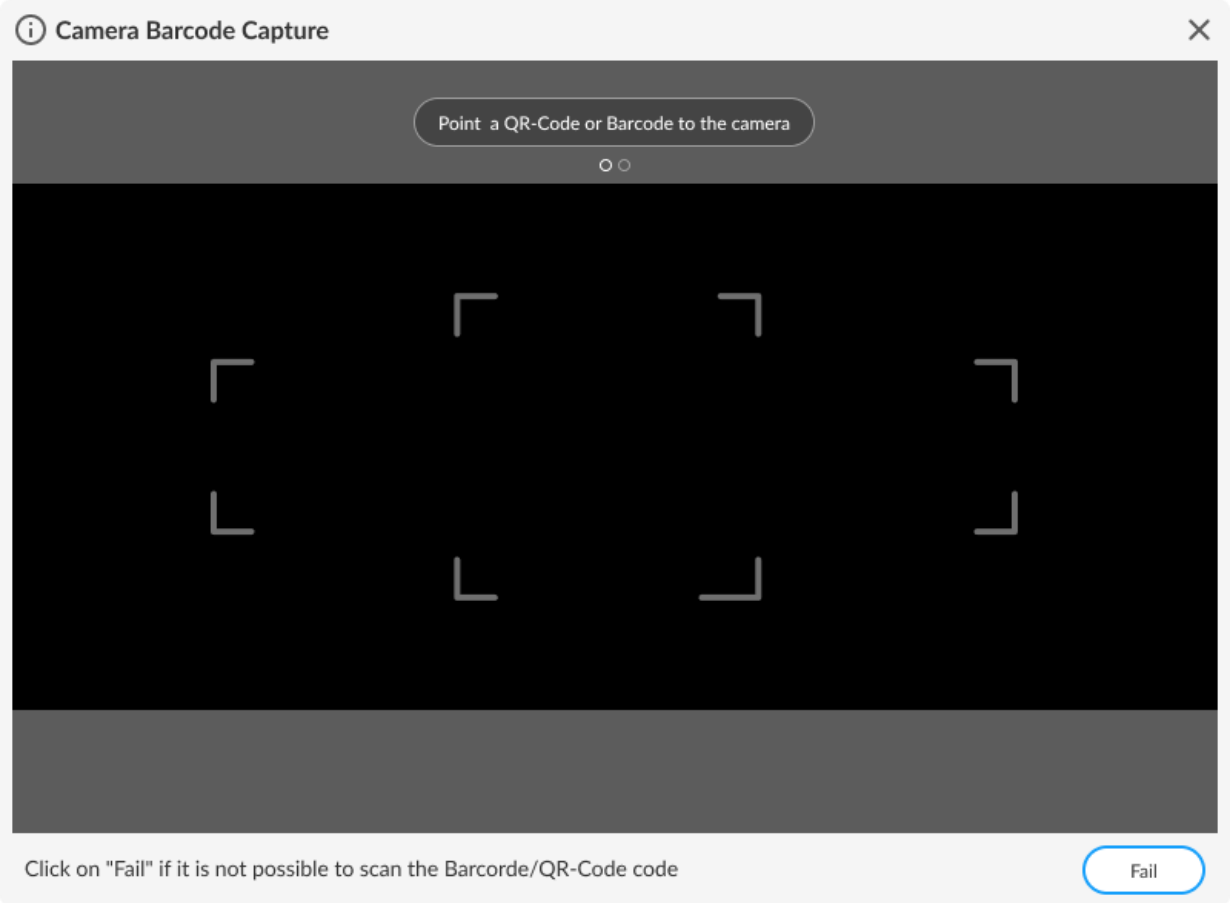


Figure 40: Barcode Test

4.6 Processor

The Processor module contains tests that can verify that the processor is working properly.

The Processor module is composed of the following tests:

Test	Test type	Attendance
BT Instruction Test	Quick	Unattended
x87 Floating Point Test	Quick	Unattended
MMX Test	Quick	Unattended
SSE Test	Quick	Unattended
AES Test	Quick	Unattended
Stress Test	Extended	Unattended

BT Instruction Test
The test checks the processor support for BT instruction.

x87 Floating Point Test
The test checks the processor support for x87 Floating Point instructions. If the processor does not support such a feature, the test returns unsupported.

MMX Test
The test checks the processor support for MMX instructions. If the processor does not support such a feature, the test returns unsupported.

SSE Test
The test checks the processor support for SSE Family (SSE, SSE2, SSE3, SSSE3, SSE4.1, SSE4.2) instructions. If the processor does not support such a feature, the test returns unsupported.

AES Test
The test checks the processor support for AES instructions. If the processor does not support such a feature, the test returns unsupported.

Stress Test
The stress test performs a sequence of continuous checks on all processor cores for 10 minutes. While running this test, the CPU temperature can increase considerably.
During the test you can check the CPU temperature, according to the image below:

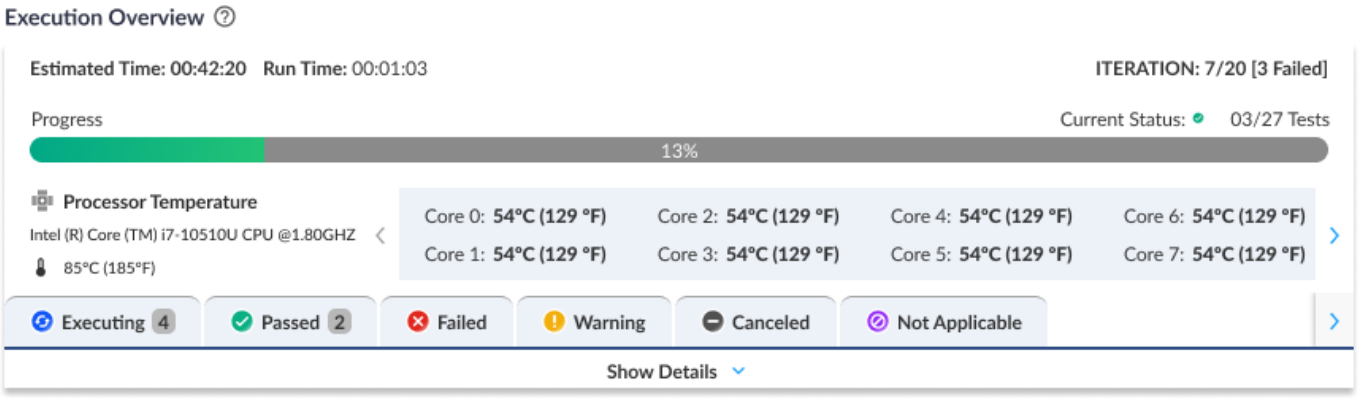


Figure 41: CPU Stress Test

4.7 Display

The Display module contains tests that can help verify that the display devices are working properly.

The Display module is composed of the following tests:

Test	Test type	Attendance
Resolution Fitting Test	Quick	Unattended
Red Purity test	Quick	Attended
Green Purity test	Quick	Attended
Blue Purity test	Quick	Attended
Black Purity test	Quick	Attended
White Purity test	Quick	Attended
Color Transition Test	Quick	Attended
Monochromatic Mesh Test	Quick	Attended
Inverted Monochromatic Mesh Test	Quick	Attended
Sharpness Test	Quick	Attended
Display Interactive Test	Quick	Attended

Resolution Fitting Test
This test checks if the system can take full advantage of the display's native resolution.

Red Purity test
This test identifies any dead pixel or burn-in problem within the red channel.

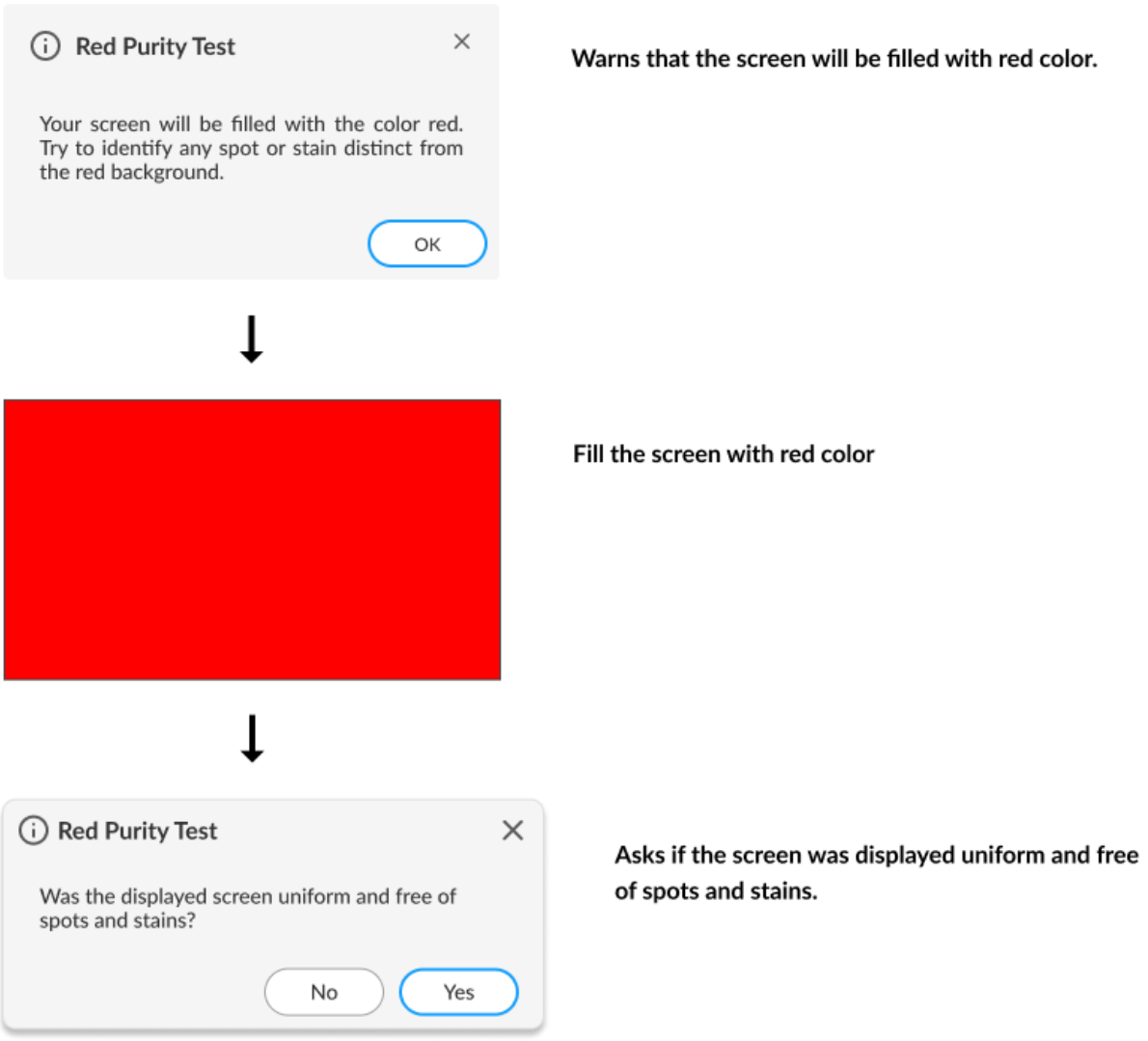


Figure 42: Red Purity Test

Green Purity test
This test identifies any dead pixel or burn-in problem within the green channel.

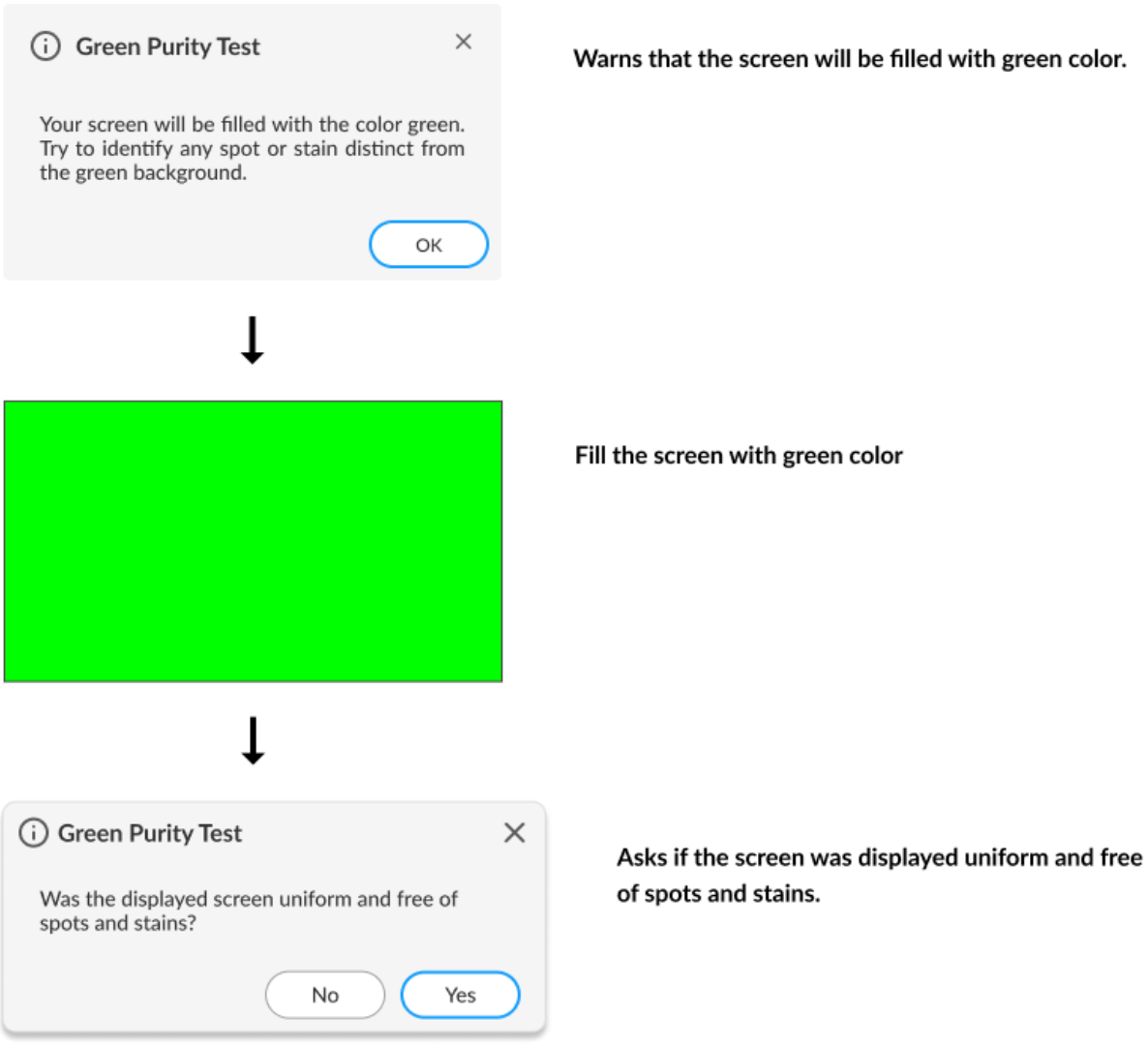


Figure 43: Green Purity Test

Blue Purity test
This test identifies any dead pixel or burn-in problem within the blue channel.

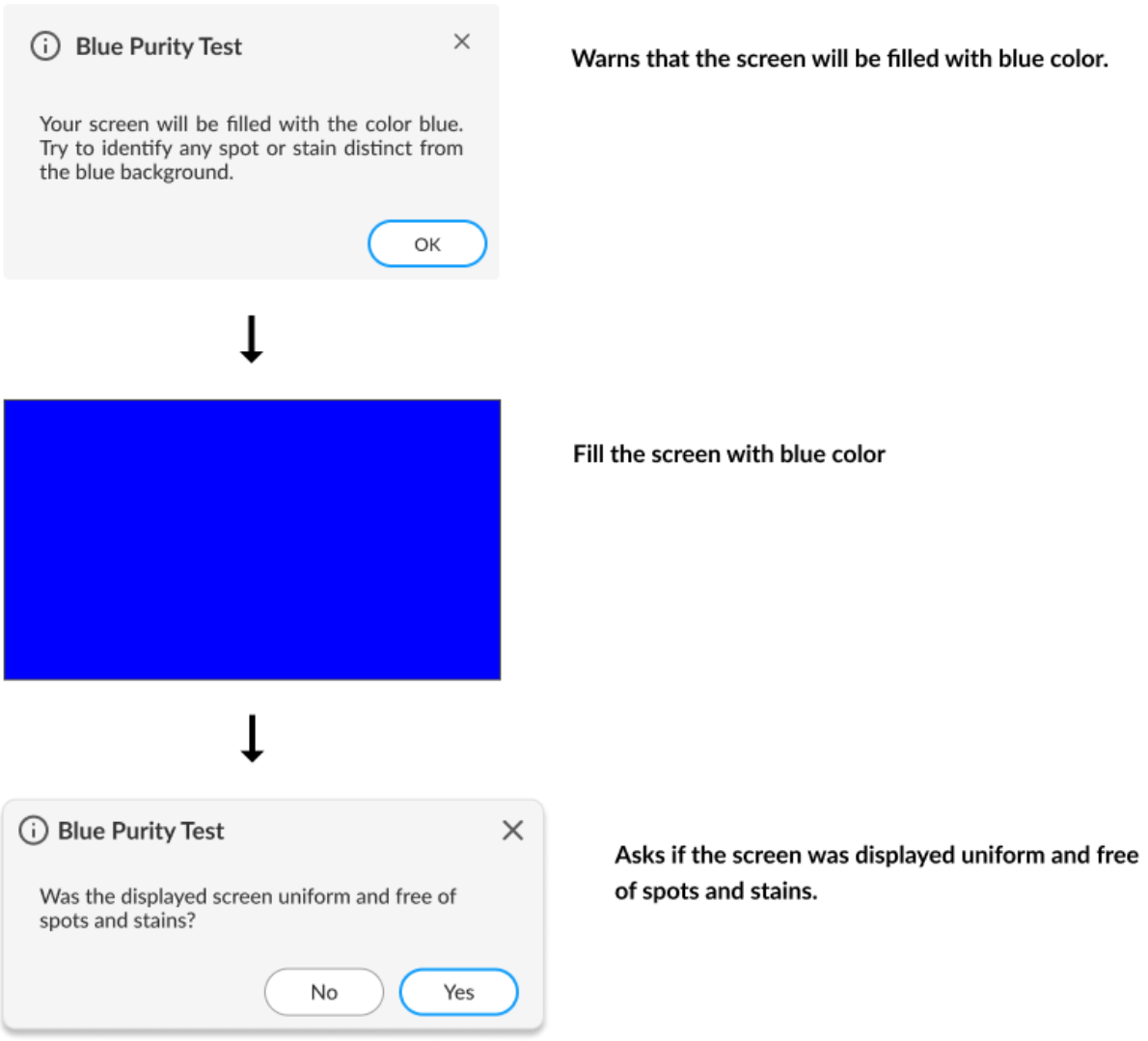


Figure 44: Blue Purity Test

Black Purity test
This test identifies any dead pixel or burn-in problem within the black channel.

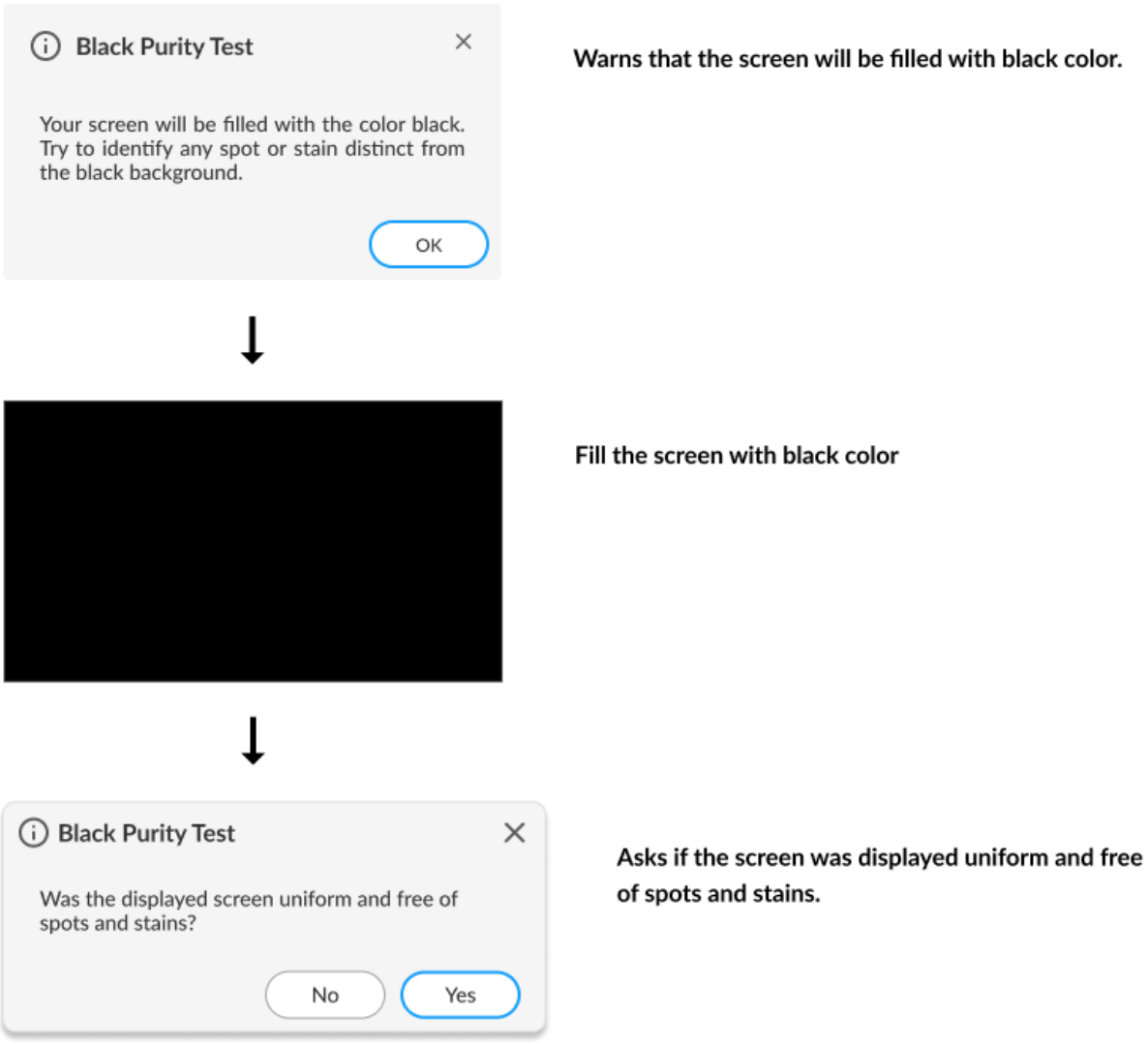


Figure 45: Black Purity Test

White Purity test
This test identifies any dead pixel or burn-in problem within the white channel.

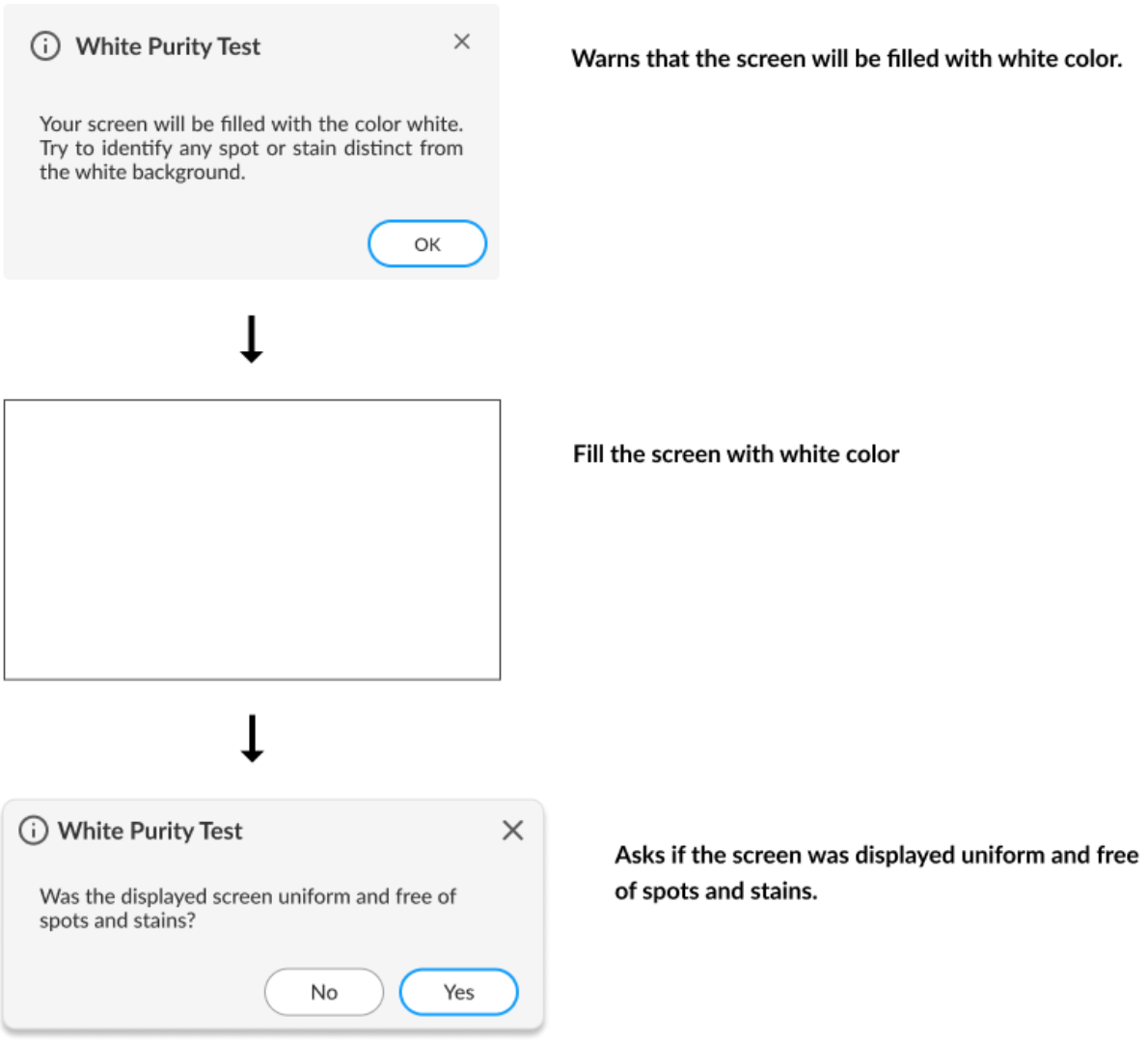
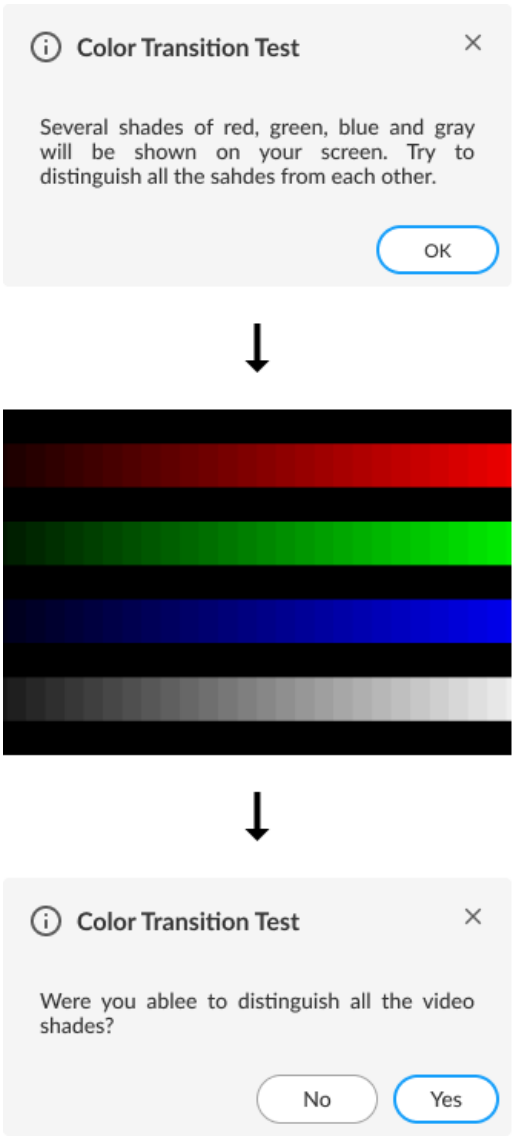


Figure 46: White Purity Test

Color Transition Test
This test identifies any problem with the display's color distinction.



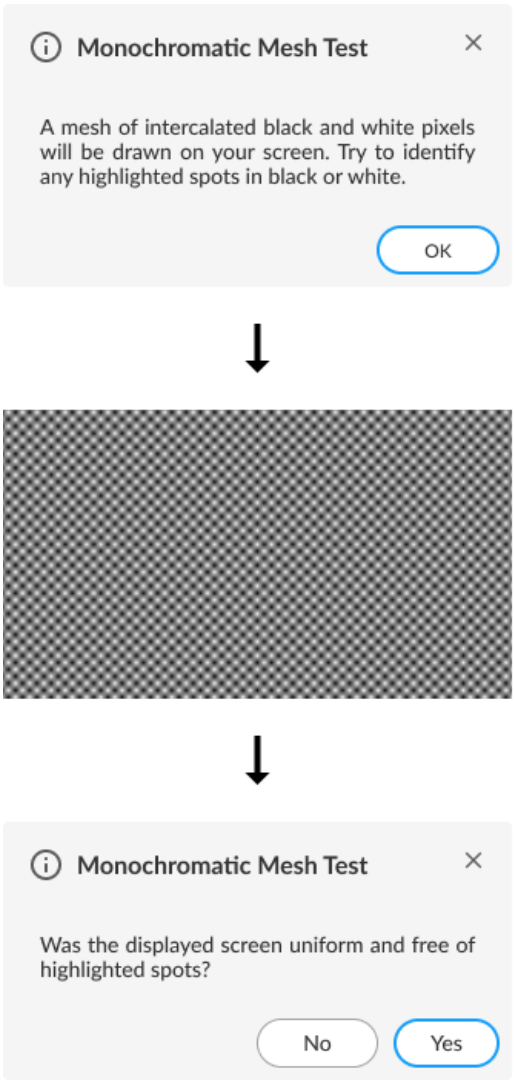
Warns that the screen will be filled with several shades of red, green, blue, and gray.

Fill the screen with the shades.

Asks if the screen was displayed uniform and free of spots and stains.

Figure 47: Color Transition Test

Monochromatic Mesh Test
This test identifies stuck pixels as they will be highlighted in contrast with the background.



Warns that the screen will be filled with a monochromatic mesh of black and white pixels.

Fill the screen with the mesh.

Asks if the image was uniform and free of highlighted spots.

Figure 48: Monochromatic Mesh Test

Inverted Monochromatic Mesh Test
This test identifies stuck pixels as they will be highlighted in contrast with the background. In this test black and white pixels are inverted.

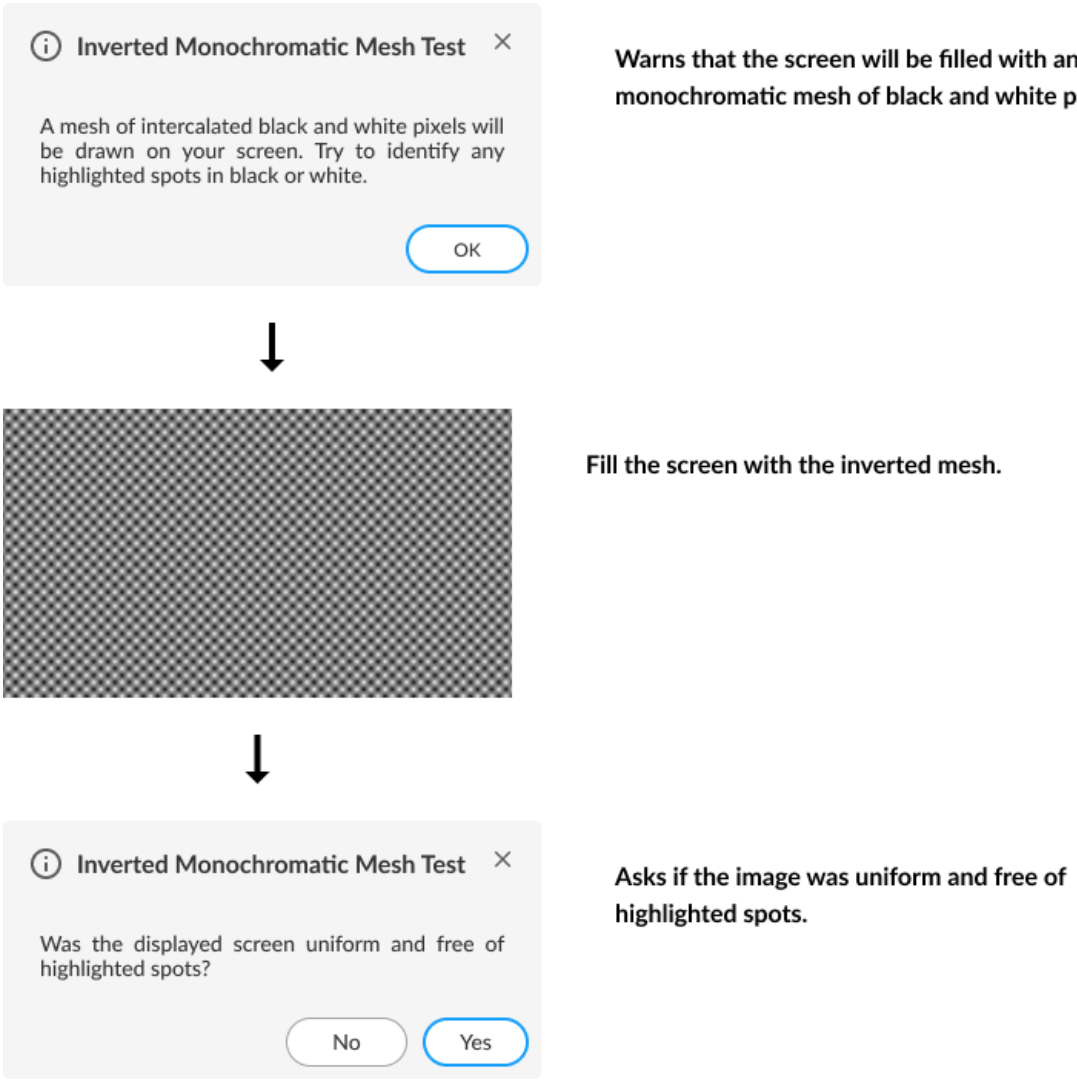


Figure 49: Inverted Monochromatic Mesh Test

Sharpness Test
This test identifies sharpness problems.

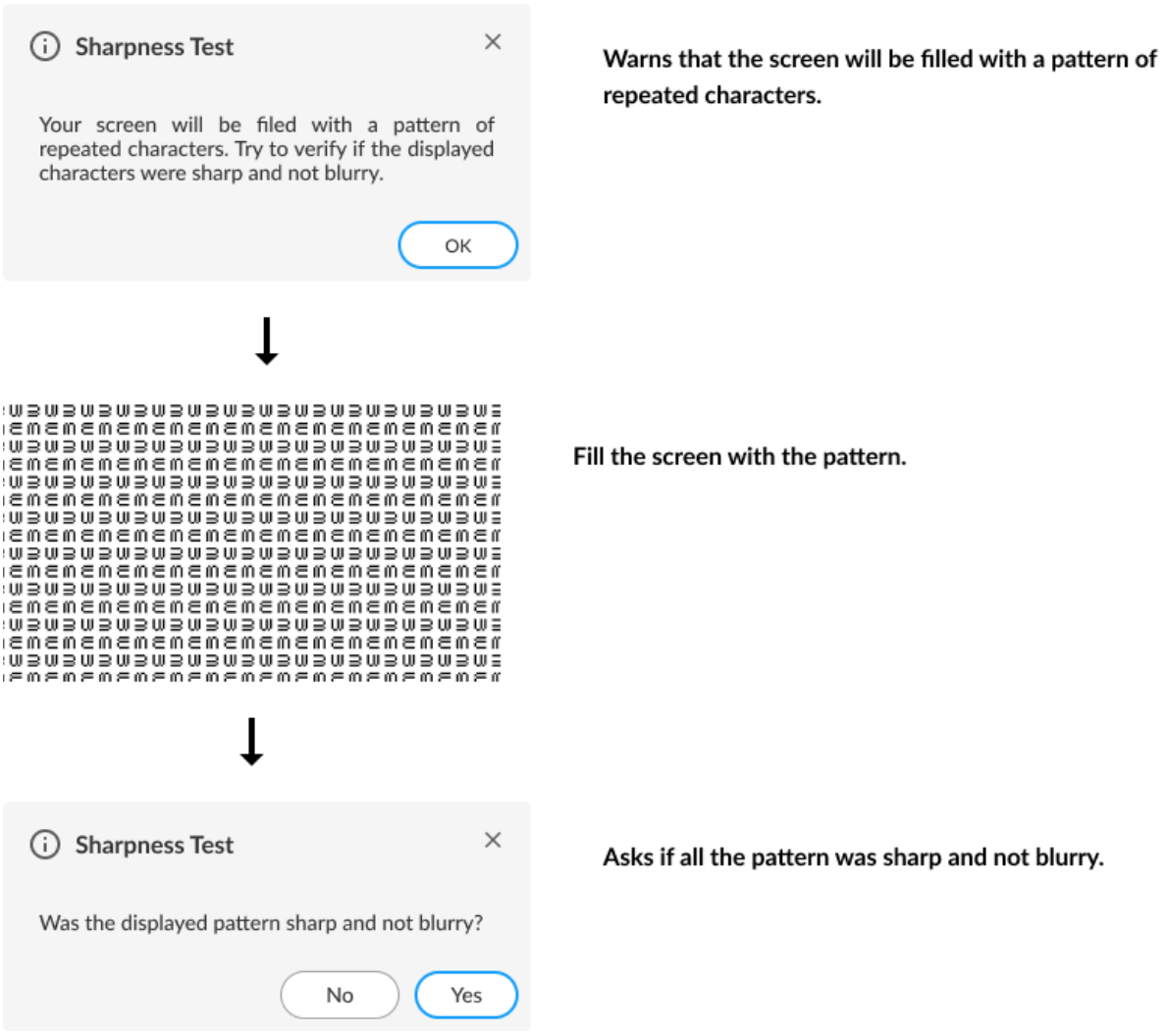
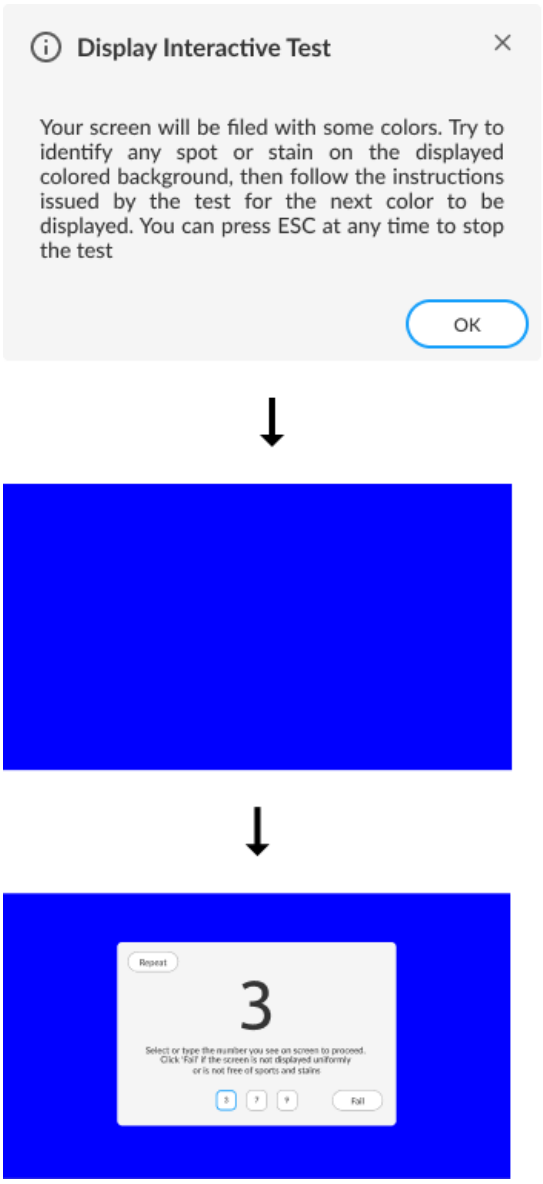


Figure 50: Sharpness Test

Display Interactive Test

The Display Interactive Test is the combination of all purity tests. The purity tests aim to identify dead pixels or burn-in problems in the channels: red, green, blue, black, and white. In additional you shall inform the number you are seeing on the screen.



The application warns you that your screen will be filled with some colors.

Application fills your screen with a color.

The application asks for you which number is being displayed.

Figure 51: Display Interactive Test

4.8 Display Interface

The Display Interface module contains tests that can verify that the communication with the monitors is working properly and that the EDID is consistent.

The Display module is composed of the following tests:

Test	Test type	Attendance
EDID Checksum Test	Quick	Unattended
Display Communication Test	Quick	Unattended

EDID Checksum Test
This test checks the integrity of the Extended Display Identification Data (EDID) checksum provided by the monitor.

Display Communication Test
This test checks the communication with the monitor.

4.9 Fan

The Fan module contains tests that can verify that the fan is working properly on high speeds.

The Fan module is composed of the following test:

Test	Test type	Attendance
Control Test	Quick	Unattended

Control Test
Checks if the fan controller is able to work on higher speeds according to predefined levels in the firmware.

4.10 Fingerprint Reader

The Fingerprint Reader module contains tests that can help verify that the fingerprint reader devices are working properly.

The Fingerprint module is composed of the following tests:

Test	Test type	Attendance
Recognition Test	Quick	Attended

Recognition Test

The test prompts you to swipe or touch a finger on the fingerprint device. Before the test start, it's displayed the informational pop-up according to the image below:

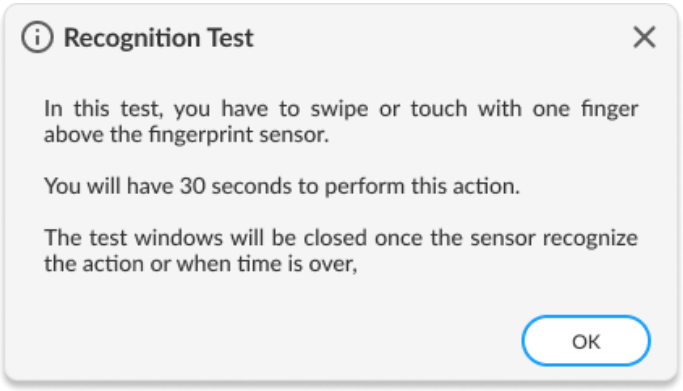


Figure 52: Recognition Test Pop-up

The test starts by asking you to swipe or touch your device.

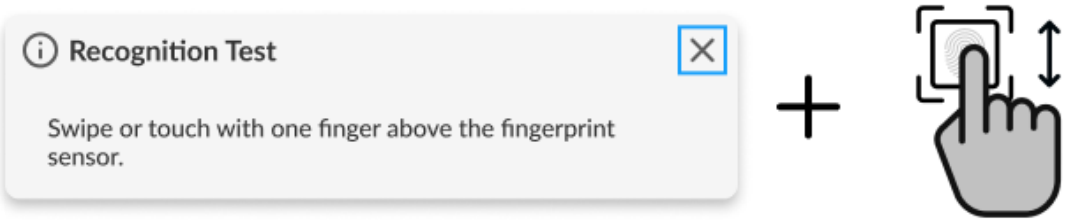


Figure 53: Recognition Test

If you do not perform any action for 30 seconds, the following pop-up is displayed:

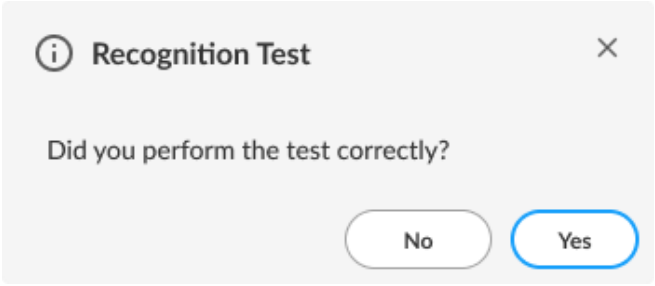


Figure 54: Recognition Test - Confirmation Pop-up

If you select “Yes”, reporting that the test was performed according to the instructions, the test will fail. In this case, the application assumes that it was not possible to detect the device, indicating a bad working of it. If you select “No”, the test is canceled because the actions required were not properly executed.

4.11 Keyboard

The Keyboard module contains tests that can help verify that the keyboard devices are working properly.

The Keyboard module is composed of the following tests:

Test	Test type	Attendance
PS2 Keyboard Test	Quick	Unattended
USB Keyboard Test	Quick	Unattended
Keycode Verification Test	Quick	Attended
Advanced Test	Quick	Attended
Backlight Test	Quick	Attended

PS2 Keyboard Test
This test tries to identify any defective PS/2 keyboard detected on this machine.

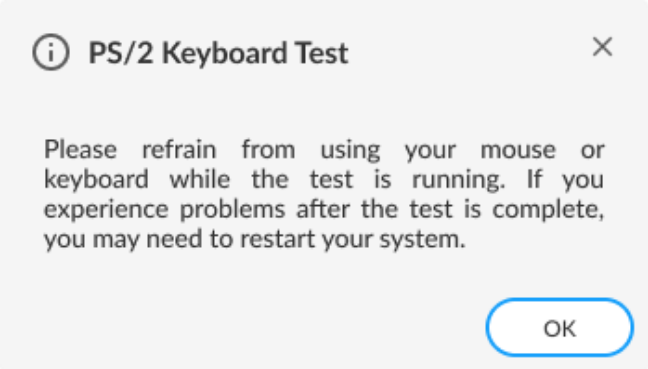


Figure 55: PS2 Keyboard Test Pop-up

USB Keyboard Test
This test tries to identify any defective USB keyboard detected on this machine.

Keycode Verification Test
Presents the latest pressed key to the user in a legible format and the current state of the toggle keys.

If you confirm that all keys that he has pressed were displayed, the test is finished as Passed. Otherwise, the test is finished as Failed.

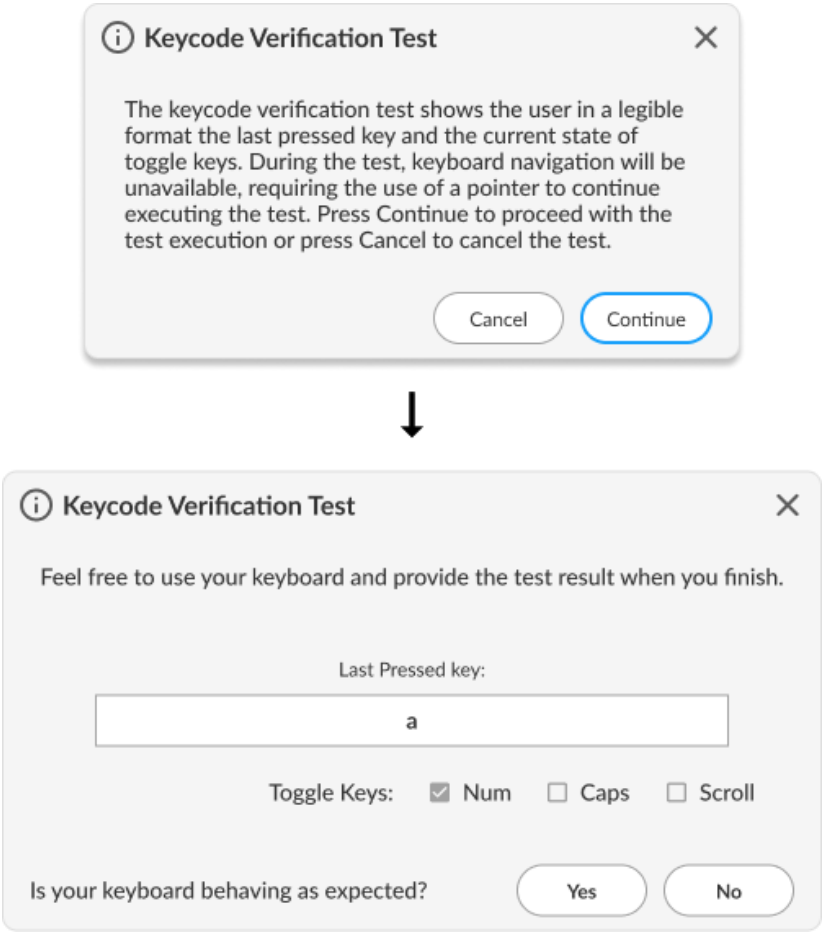


Figure 56: Keycode Verification Test

Advanced Test
Interactive test to verify the status of the keyboard keys.
The test will mark the pressed keys until you test all keys. You can select the most appropriate keyboard layout.

Figure 57: Advanced Test

Backlight Test
Interactive test to verify if the keyboard backlight is working properly by controlling its intensity.

The test starts by asking if the keyboard has a backlight symbol. If you answer yes, the test will guide you on turning it on then asks if it worked.

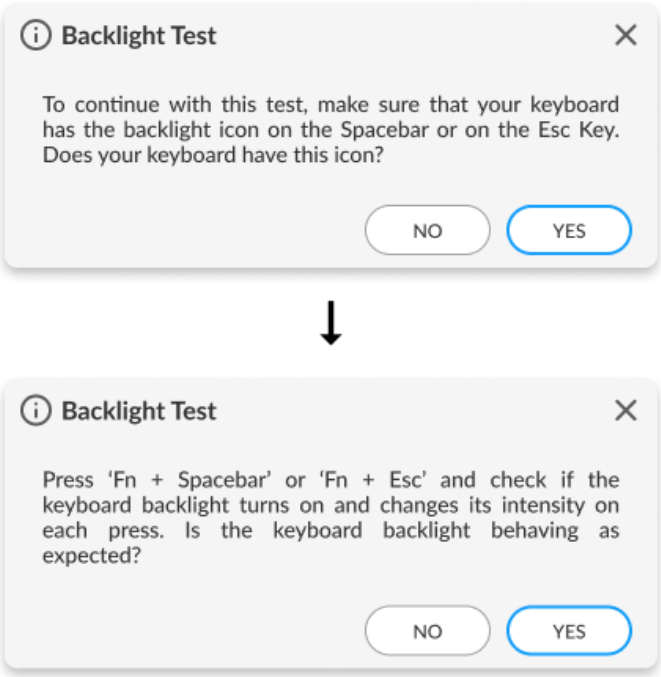


Figure 58: Backlight Test

4.12 Memory

The Memory module contains tests that can verify that the memory is working properly.

The Memory module is composed of the following tests:

Test	Test type	Attendance
Quick Random Pattern Test	Quick	Unattended
Advanced Integrity Test	Extended	Unattended
Address Test	Extended	Unattended
Bit Low Test	Extended	Unattended
Bit High Test	Extended	Unattended
Walking Ones Left Test	Extended	Unattended
Walking Ones Right Test	Extended	Unattended
Modulo-20 Test	Extended	Unattended
Moving Inversions 8Bit Test	Extended	Unattended
Moving Inversions 32 Bit Test	Extended	Unattended
Random Pattern Test	Extended	Unattended
Random Number Sequence Test	Extended	Unattended
Block Move Test	Extended	Unattended
Nibble Move Test	Extended	Unattended

Note: The memory tests allocate 80% of the available memory. Which implies high memory consumption, potentially causing performance issues including slowness.

Quick Random Pattern Test
The test consists of filling the memory with a randomly generated pattern and then checking that the pattern was correctly written. When checking, it writes the pattern's binary complement and checks again. The test is repeated twice. By default, 15 random patterns are used, therefore, the test runs once for each of these patterns.

Advanced Integrity Test
The test is based on the March C- enhanced algorithm. This test consists of filling the accessible memory with a pattern, checking it, writing its complement in an 8 bytes block size (64 bits), and then checking it again. This procedure is repeated twice, in the first time the pattern is addressed in the accessible memory from the highest position to the lowest and the second time by doing the inverse path. This test is intended to cover Stuck-At Faults and some Coupling Faults and Transition Faults.

Address Test
This test consists of writing to each memory address its own address. After that, the algorithm reads the memory previously written and checks if they still store their own address. This test is intended to cover any addressing fault in the accessible memory range.

Bit Low Test
This test consists of filling the memory buffer with a pattern where all bits are 0 and then checking it. When checking for this pattern, it writes its binary complement, and finally checks if the complement was stored accordingly. Such a process is repeated 4 times. This test is intended to identify the most serious Stuck-At Faults, some cases of Transition Faults, and some cases of reading Random Faults.

Bit High Test
This test consists of filling the memory buffer with a pattern where all bits are 1 and then checking it. When checking for this pattern, it writes its binary complement, and finally checks if the complement was stored accordingly. Such a process is repeated 4 times. This test is intended to identify the most serious Stuck-At Faults, some cases of Transition Faults, and some cases of reading Random Faults.

Walking Ones Left Test
The Walking Ones Left Test consists of writing a pattern where only the rightmost bit is set (e.g. 00000001), then shifting this pattern to the left (e.g. 00000010) until the end of the size of a byte, writing it again at the same memory address each time such pattern is shifted. Therefore, the test is intended to cover most of the Stuck-At Faults and some cases of Coupling Faults, and also test the data bus by confirming that every bit can be written.

Walking Ones Right Test
The Walking Ones Right Test consists of writing a pattern where only the leftmost bit is set (e.g. 10000000), then shifting this pattern to the right (e.g. 01000000) until the end of the size of a byte, writing it again at the same memory address each time such pattern is shifted. Therefore, such a test is intended to cover most of the Stuck-At Faults and some cases of Coupling Faults and also test the data bus by confirming that every bit can be written.

Modulo-20 Test
The test consists of writing into an interval of 20 memory locations for each block with a pattern and filling all other locations with its complement 6 times. Unlike the other tests, the Modulo-20 test is not affected by buffering or caching, so it can detect most of the Stuck-At Faults, Coupling Faults, Transition Faults and Read Random Faults that are not detected by other testing approaches.

Moving Inversions 8Bit Test
The test consists of filling the memory with the 8-bit wide pattern: 10000000 and then checking that the pattern was correctly written. When checking, it writes the pattern's binary complement (01111111) and checks it again. The procedure described earlier is repeated 8 times, one for each pattern right shifted: 10000000, 01000000, 00100000, 00010000, 00001000, 00000100, 00000010, 00000001.

Moving Inversions 32 Bit Test
This test fills all the accessible memory with a shifting pattern, that is, a value that is binary left shifted as it is written out through the accessible memory of every memory block. Once the pattern reaches 0x80000000 (a value with the left most bit set to 1 only) then the pattern is reset to 0x00000001. After that, it checks the written values and writes their binary complements, starting from the first memory address to the last one. Finally, the algorithm checks the memory for the complements written in the previous step, being this checking starting from the last element down to the first one. Such a process is repeated 2 times. This test presents a more thorough approach intended to cover most of the Stuck-At Faults and Transition Faults and some cases of Coupling Faults and Read Random Faults.

Random Pattern Test
The test consists of filling the memory with a randomly generated pattern and then checking that the pattern was correctly written. When checking, it writes the pattern's binary complement and checks it again. This process is repeated twice. By default, 50 random patterns are used, therefore the test runs once for each of these patterns.

Random Number Sequence Test
The test consists of filling the memory with one different random generated pattern for each memory address and then checking that the pattern was correctly written. To check it, the test must generate these numbers based on a seed that may be reset to reproduce the sequence. When checking, it writes the pattern's binary complement and it checks again. Such a process is repeated several times. This test is intended to cover most of the Stuck-At Faults, Coupling Faults, and some cases of Transition Faults and Read Random Faults.

Block Move Test
The test consists of moving memory data around within memory blocks. The movements are repeated 64 times moving 64-bit blocks. Finally, the test checks every memory address to verify if it is consistent.

Nibble Move Test
This test consists of writing to a nibble (a nibble is a group of four bits) a pattern value in each memory address, then it validates every nibble individually. It repeats this process until all nibbles in every address are checked.

4.13 Motherboard

The Motherboard module contains tests that can verify that the motherboard components are working properly.

The Motherboard module is composed of the following tests:

Test	Test type	Attendance
Chipset Test	Quick	Unattended
PCI/PCI-e Test	Quick	Unattended
RTC Test	Quick	Unattended
USB Test	Quick	Unattended

Chipset Test
The test checks the status registers of the controllers that form the foundation of the motherboard chipset. These controllers are EHCI, OHCI, xHCI, and SATA.

PCI/PCI-e Test
The PCI/PCI-e Test checks if all PCI Express devices are recognized, communicate with the system, and check the status registers for unexpected errors or power failure.

RTC Test
The test checks the following RTC (Real Time Clock) properties: accuracy and rollover. The test attempts to guarantee the correct operation of these properties.

USB Test
The test checks the status of USB devices. If any errors are indicated, the test fails.

4.14 Mouse Devices

The Mouse Devices module contains tests that can help verify that the mouse and TrackPoint devices are working properly.

The Mouse Devices module is composed of the following tests:

Test	Test type	Attendance
Click Test	Quick	Attended
Precision Test	Quick	Attended
Press Precision Test	Quick	Attended

Click Test

It does a check on the device's buttons, issuing you to perform some actions regarding them. The Click Test execution is based on the workflow below.

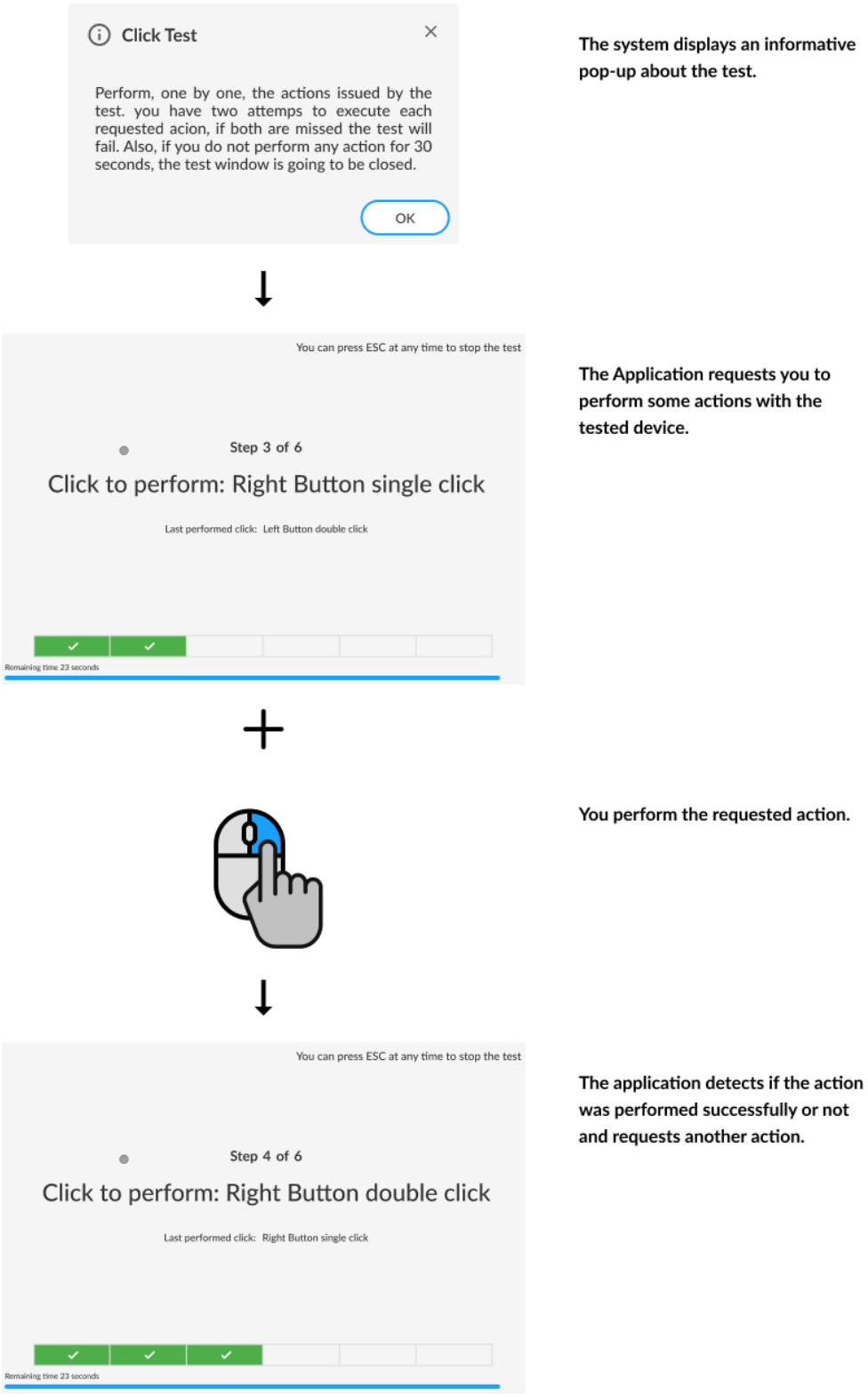


Figure 59: Mouse Click Test

You must perform one by one, the actions issued by the test. Note that the actions requested depend on the numbers and types of buttons present in your pointing device.

You have two attempts to execute each requested action. If the requested action was detected by the application, it is considered as passed. Otherwise, the action is considered as “Failed”. The Click Test is considered as “Passed” if all actions required are passed.

If you do not perform any action for 30 seconds, the following pop-up is displayed:

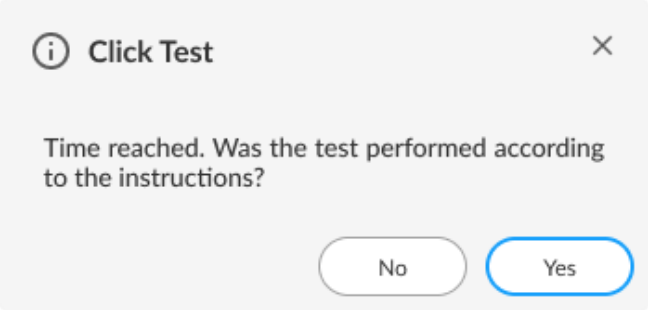


Figure 60: Mouse Click Test Confirmation Pop-up

If you select “Yes”, reporting that the test was performed according to the instructions the test will fail. In this case, the application assumes that it was not possible to detect the device, indicating a bad working of it. If you select “No”, the test is canceled because the actions required were not properly executed.

Precision Test

Tests the device movement precision. The Precision Test execution is based on the following workflow:

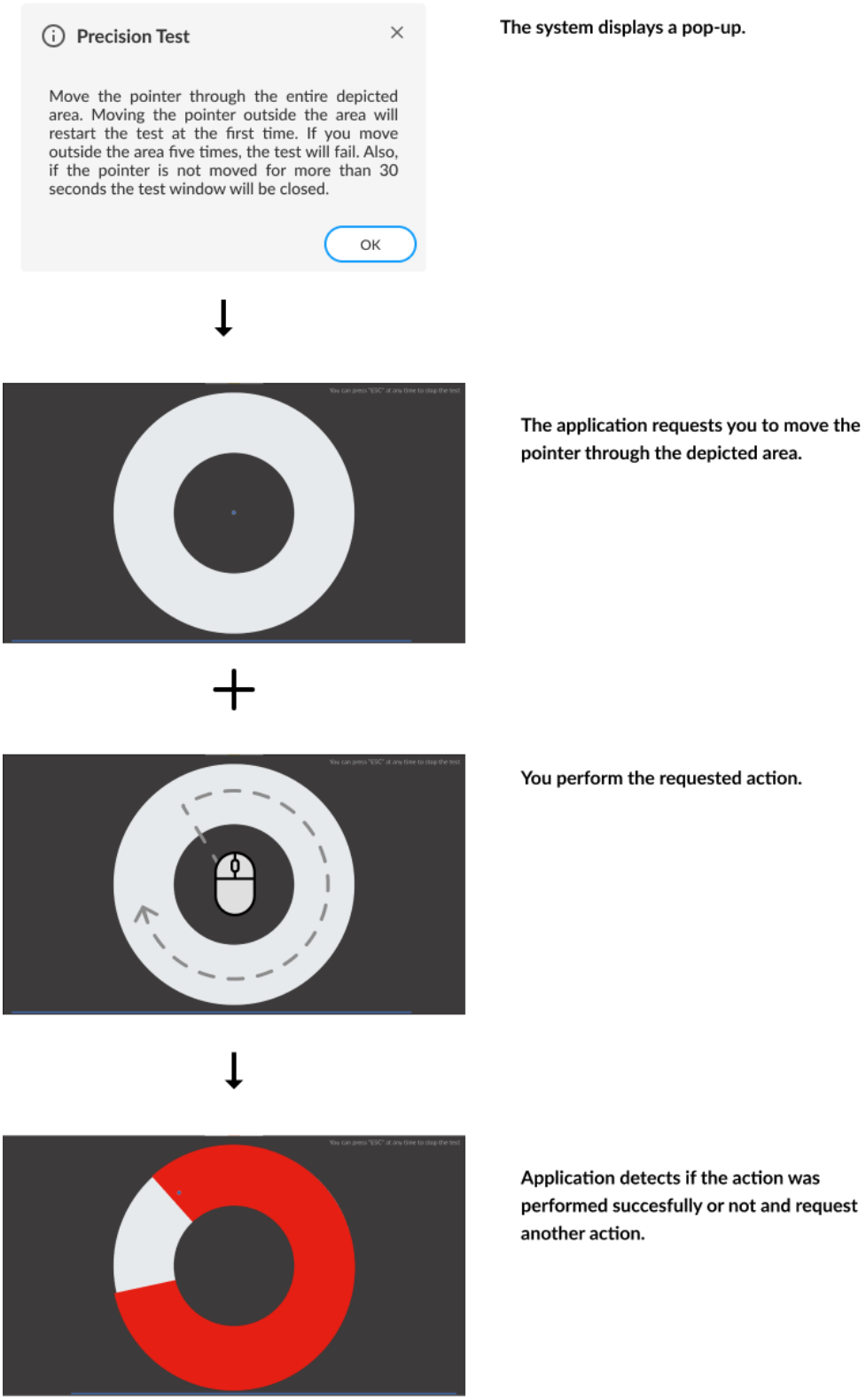


Figure 61: Mouse Precision Test

If you get to move the pointer through the entire depicted area without reaching the outside area the test is finished as passed. If the outside area was reached five times the test will fail. If the pointer is not moved for more than 30 seconds the test window is going to be closed and the following message is displayed to you:

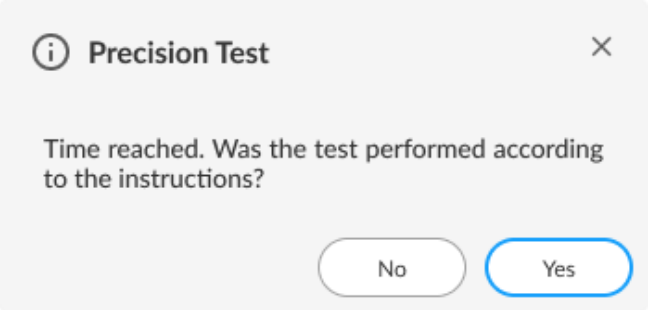


Figure 62: Mouse Precision Test Confirmation Pop-up

If you select “Yes”, reporting the test was performed according to the instructions, the test will be finished as “failed”. In this case, the application assumes that it was not possible to detect the device movement, indicating a bad working of the device. If you select “No”, the test is canceled because the required actions were not properly executed.

Press Precision Test

Tests the device movement precision while any combination of mouse buttons is pressed. The Press Precision Test execution is based on the following workflow:

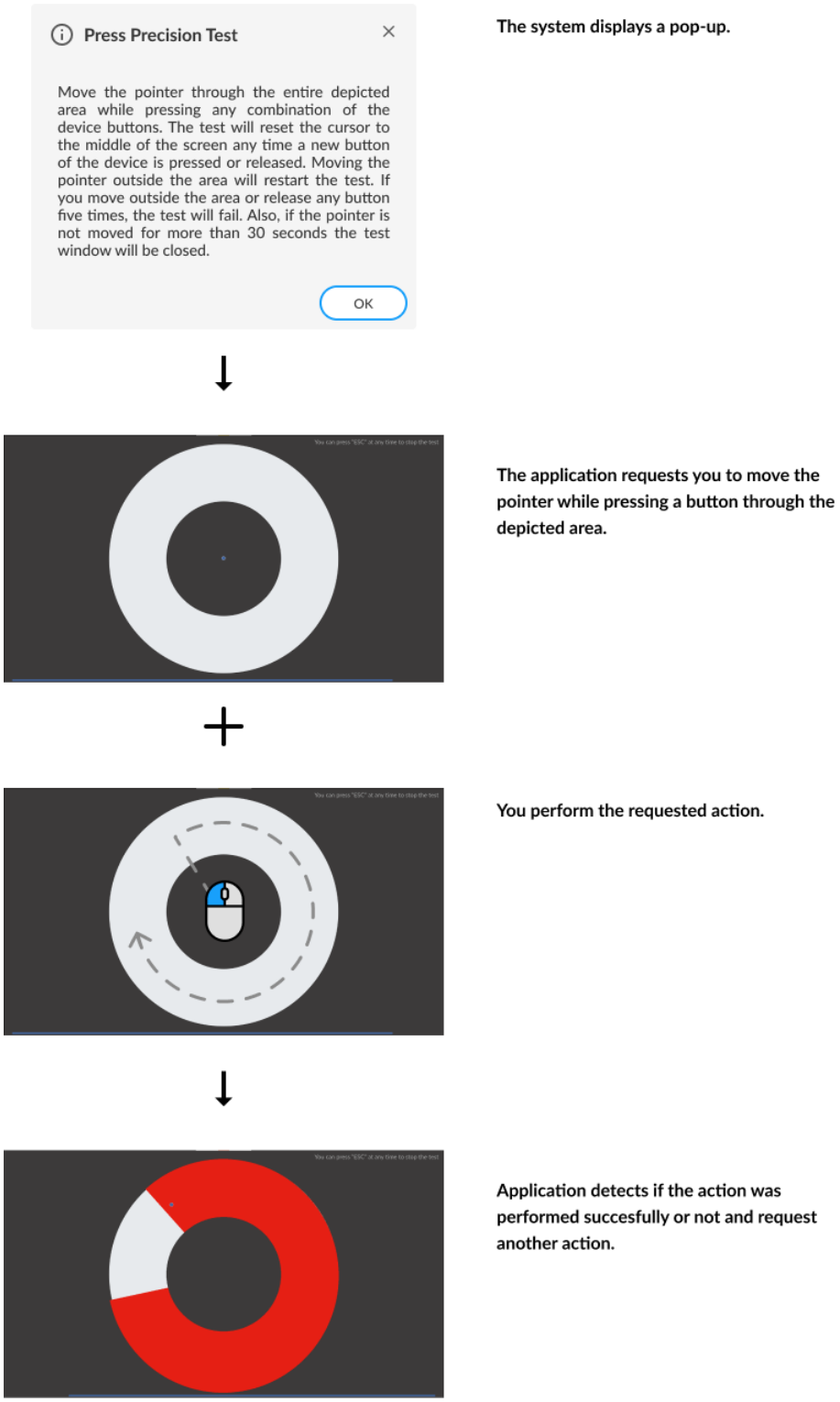


Figure 63: Mouse Press Precision Test

If you press the button and get to move the pointer through the entire depicted area without reaching the outside area the test is finished as passed. If the outside area was reached five times or the pressed button release at least five times the test will fail. If the pointer is not moved for more than 30 seconds the test window is going to be closed and the following message is displayed to you:

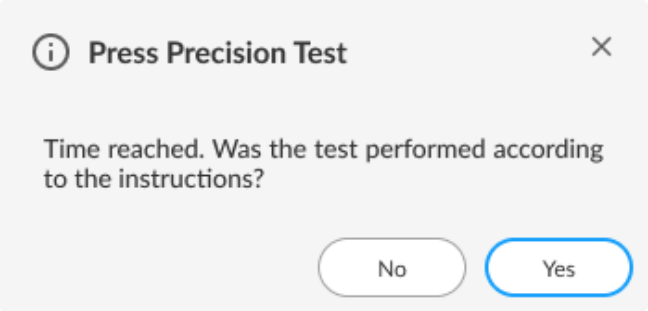


Figure 64: Mouse Press Precision Test Confirmation Pop-up

If you select “Yes”, reporting the test was performed according to the instructions, the test will be finished as “failed”. In this case, the application assumes that it was not possible to detect the device movement, indicating a bad working of the device. If you select “No”, the test is canceled because the required actions were not properly executed.

4.15 Optical Drive

The Optical Drive module contains tests that can help verify that the optical drive devices are working properly.

The Optical Drive module is composed of the following tests:

Test	Test type	Attendance
Media-Less Optical Self-Test	Quick	Unattended
Linear Seek Test	Quick	Attended
Random Seek Test	Quick	Attended
Funnel Seek Test	Quick	Attended
Read and Compare Test	Quick	Attended
Write Test	Quick	Attended

Media-Less Optical Self-Test
Checks the optical drive's internal components. This test requires that no media is inserted into the drive. Therefore if any media was detected into the drive the application displays the following message:

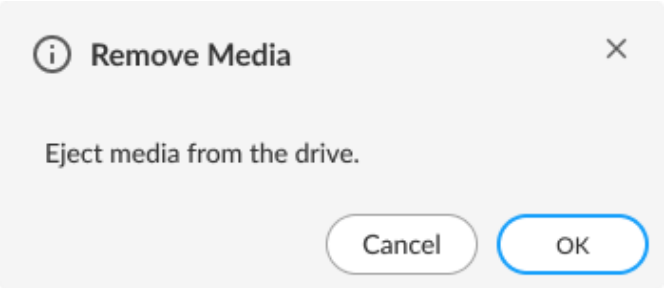


Figure 65: Media-Less Optical Self-Test Pop-up

Linear Seek Test
Checks the integrity of the optical drive's mechanism by continuously moving the drive's head all around the media. To execute this test you must have a media containing at least the following amount of data written on it according to its type: CD (210 MB), DVD (1000 MB), Blu-Ray (4000 MB).

Random Seek Test
Checks the integrity of the optical drive's transmission mechanism by moving the drive's head through random positions on the media. For executing this test you must have a media containing at least the following amount of data written on it according to its type: CD (210 MB), DVD (1000 MB), Blu-Ray (4000 MB).

Funnel Seek Test
Checks the integrity of the optical drive's mechanism by moving the drive's head in a funnel pattern. For executing this test you must have a media containing at least the following amount of data written on it according to its type: CD (210 MB), DVD (1000 MB), Blu-Ray (4000 MB).

Read and Compare Test
Checks the driver's ability to make correct read operations. Performs two linear read operations and compares the information obtained from the two reads. For executing this test you must have a media containing at least the following amount of data written on it according to its type: CD (210 MB), DVD (1000 MB), Blu-Ray (4000 MB).

Write Test
Checks the capability of the drive to write correctly to optical media. For executing this test you must have blank media (CDR, CD-RW, DVD-R, DVD-RW, BD-R, BD-RE).

Linear Seek Test, Random Seek Test, Funnel Seek Test, Read and Compare Test and Write Test are performed according to the following workflow:

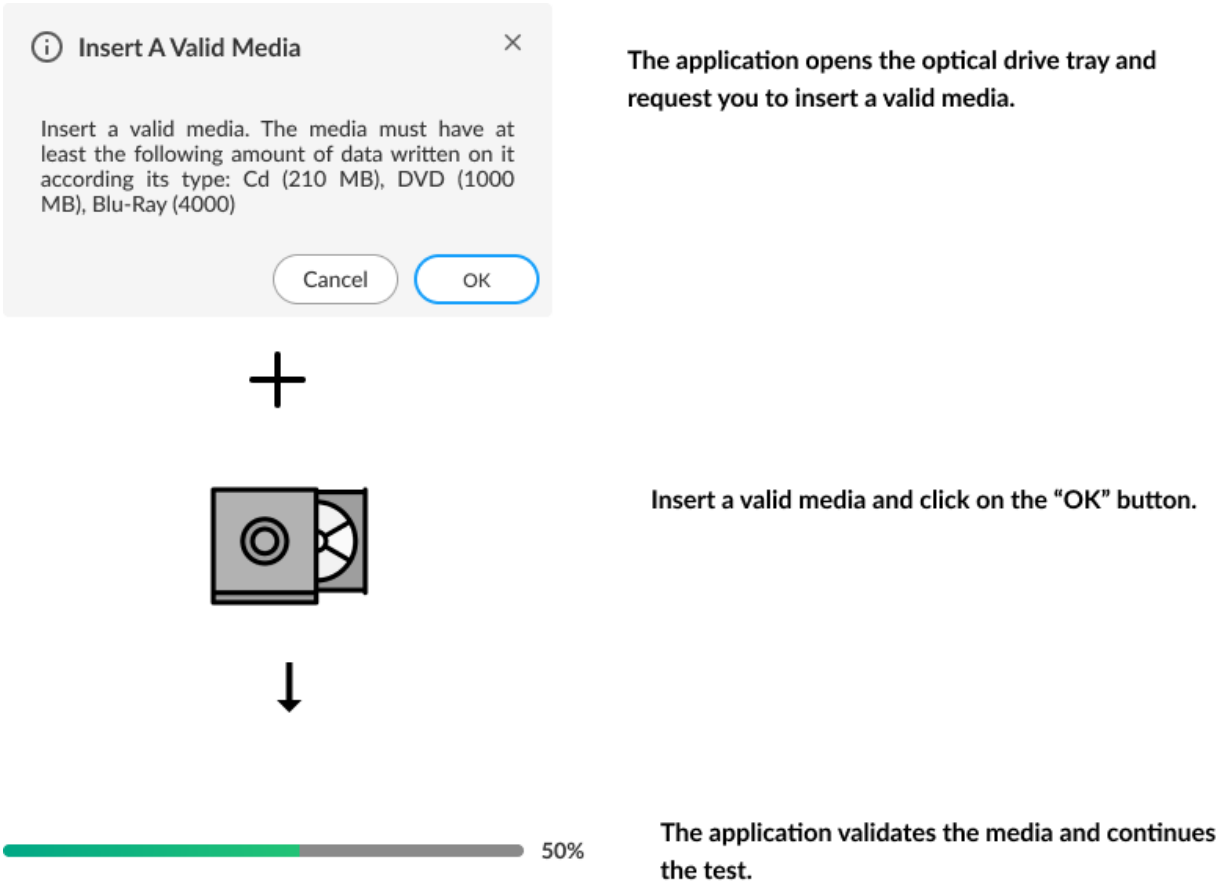


Figure 66: Optical Drive Tests Flow

4.16 RAID

The RAID module contains tests that can verify the health of the RAID controller.

The RAID module is composed of the following tests:

Test	Test type	Attendance
Battery Status Test	Quick	Unattended
Enclosure Status Test	Quick	Unattended
Logical Drive Status Test	Quick	Unattended
RAID Status Test	Quick	Unattended
RAID Controller Status Test	Quick	Unattended
Consistency Check	Extended	Attended

Battery Status Test
Checks the health of the controller's BBU (Battery Backup Unit)

Enclosure Status Test
Checks the status of the enclosures used by a RAID controller

Logical Drive Status Test
Checks the status of each logical drive in the RAID controller

RAID Status Test
Checks the status of each RAID volume in the RAID controller

RAID Controller Status Test
Checks the status of each RAID controller itself.

Consistency Check
Checks the consistency of each controller's logical drive. This test might take a few hours to run depending on how many logical and physical drives are present in the RAID controller.

4.17 Storage

The Storage module contains tests that can verify that the storage devices are working properly.

The Storage module is composed of the following tests:

Test	Test type	Attendance	Supported On
SMART Status Test	Quick	Unattended	HDD/SSD SATA, SAS, UFS
Targeted Read Test	Quick	Unattended	HDD/SSD SATA
Random Seek Test	Quick	Unattended	HDD/SSD SATA, SAS, UFS
Funnel Seek Test	Quick	Unattended	HDD/SSD SATA, SAS, UFS
SMART Short Self Test	Quick	Unattended	HDD/SSD SATA, SAS, UFS
SMART Drive Self Test	Quick	Unattended	HDD SATA
Default Self Test	Quick	Unattended	SAS, UFS
Device Read Test	Quick	Unattended	EMMC, NVME, OPTANE
SMART Wearout Test	Quick	Unattended	EMMC, NVME, OPTANE
NVME Controller Status Test	Quick	Unattended	NVME, DISABLED OPTANE. If the NVMe device is attached to a RAID controller, the test won't be supported
NVME SMART Temperature Test	Quick	Unattended	NVME, OPTANE
NVME SMART Reliability Test	Quick	Unattended	NVME, OPTANE
NVME SMART Spare Space Test	Quick	Unattended	NVME, OPTANE
Extended Random Seek Test	Extended	Unattended	SAS, UFS
Extended Funnel Seek Test	Extended	Unattended	SAS, UFS
Extended Self Test	Extended	Unattended	SAS, UFS
Device Write Test	Extended	Unattended	EMMC, NVME, DISABLED OPTANE
Linear Read Test	Extended	Unattended	HDD/SSD SATA, SAS, EMMC, NVME, OPTANE, UFS
SMART Conveyance Test	Extended	Unattended	HDD/SSD SATA
Full Disk Scan Test	Extended	Unattended	HDD/SSD SATA, SAS, EMMC, NVME, OPTANE, UFS

SMART Status Test
Checks the status reported by SMART to quickly identify whether a device is defective or not.

Targeted Read Test
Checks the sectors in the neighborhood of bad sectors reported in the SMART logs.

Random Seek Test
Checks the integrity of the servo mechanism of a device by checking sectors at several randomly chosen addresses.

Funnel Seek Test
Checks the integrity of the servo mechanism of a device by checking sectors following a "funnel" or "butterfly" pattern.

SMART Short Self Test
Checks electrical and mechanical component status as well as the reading ability of the device.

SMART Drive Self Test
Proprietary Lenovo Drive Self-Test (DST) that mixes sequential and random reads to the disk.

Default Self Test
Vendor specific test that runs a quick check.

Device Read Test
Tests if it is possible to correctly read sectors in different areas of the storage device.

SMART Wearout Test
SMART Wearout Test checks the wearout level of the attached SSD device by reading SMART attributes and informs whether the device is in good condition or has reached its wearout limit.

NVME Controller Status Test
This test detects if the device behaves as expected.

NVME SMART Temperature Test
This test detects if the current temperature for the device is in a critical state.

NVME SMART Reliability Test
This test detects if the device is still reliable based on SMART metrics.

NVME SMART Spare Space Test
This test detects if the spare space in the device is critically low.

Extended Random Seek Test
Works similar to the Quick Random Seek test, but the number of checked sectors is larger and it does not stop when the first bad sector is found.

Extended Funnel Seek Test
Works similar to a quick funnel test, but the number of checked sectors is larger and it does not stop when the first bad sector is found.

Extended Self Test
Works similar to a quick Short Self Test, but checks more sectors.

Device Write Test
The Storage Device Write Test will verify if it is possible to write data on different areas of the device and then read the data correctly."

Linear Read Test
Checks the integrity of the storage device by reading its sectors following a linear pattern.

Before starting the test, you can define the start range and stop range of the test area, also you can define the coverage of the test area, and the maximum number of errors allowed during execution by clicking on the settings icon next to the test name:

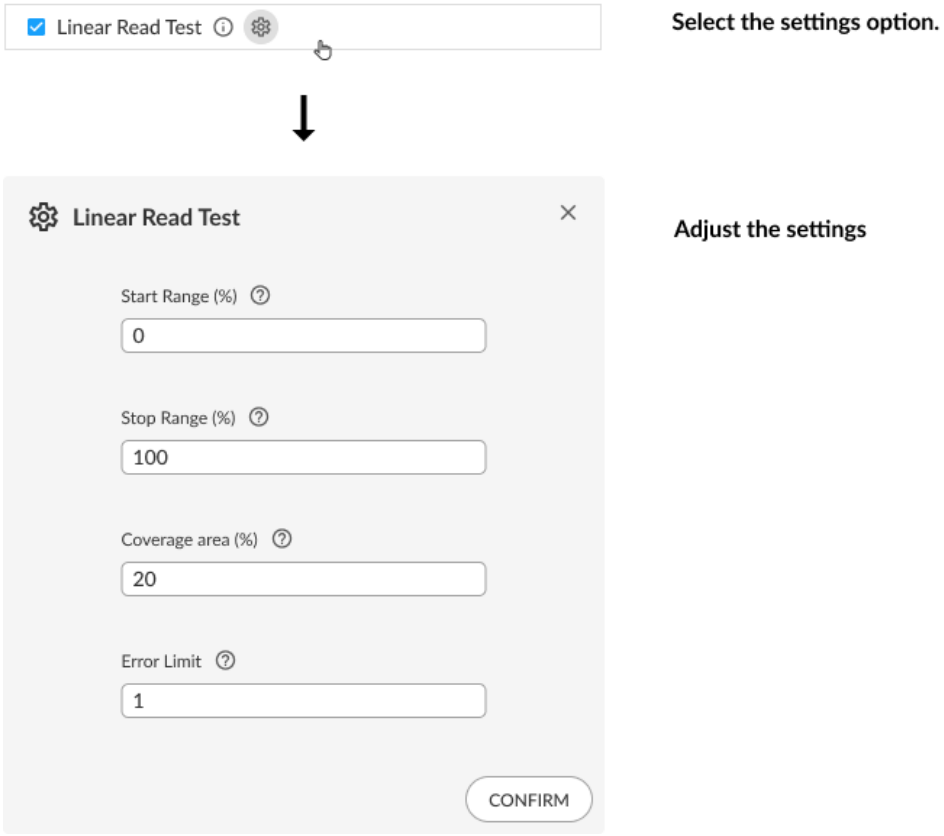


Figure 67: Customizable Parameters for the Linear Read Test

SMART Conveyance Test
Checks the device's integrity through the status returned by the SMART Conveyance test.

Full Disk Scan Test
This test performs a full verification of the disk.

Before starting the test, you can define the maximum number of errors allowed during execution by clicking on the settings icon next to the test name:

Figure 68: Customizable Parameter for the Full Disk Scan Test

4.18 Video Card

The Video Card module contains tests that can verify that the video card devices are working properly.

The Video Card module is composed of the following tests:

Test	Test type	Attendance
Video Memory Test	Quick	Unattended
CUDA Memory Fault Test	Quick	Unattended
CUDA Address Test	Quick	Unattended
CUDA Moving Inversion Test	Quick	Unattended
CUDA Block Move Test	Quick	Unattended
CUDA Random Number Sequence Test	Quick	Unattended
CUDA Modulo X Test	Quick	Unattended
DirectCompute Standard Mathematical Operations Test	Quick	Unattended
DirectCompute Advanced Mathematical Operations Test	Quick	Unattended
CUDA Standard Mathematical Operations Test	Quick	Unattended
CUDA Advanced Mathematical Operations Test	Quick	Unattended
Texture Pipeline Test	Quick	Unattended
Extended Video Memory Test	Extended	Unattended
Stress Test	Extended	Unattended
Wireframe Stress Test	Extended	Unattended

Video card devices can run concurrently during the execution of the tests, except the Stress or Wireframe Stress tests that are executed in serial.

Video Memory Test
Verifies if some data patterns are consistently read from and written to video card memory.

CUDA Memory Fault Test
This test executes the March C- algorithm on memory GPU. This test detects Stuck-at-Faults (SAF), Address Faults (AF), Transition Faults (TF), and Coupling Faults (CF).

CUDA Address Test
This test loads each memory location with its own address and then checks for consistency, to detect addressing errors.

CUDA Moving Inversion Test
This test detects memory errors by writing a pattern and checking if each memory location holds this pattern.

CUDA Block Move Test
Blocks of memory are initialized with 8-bytes shifting patterns that are moved to different locations to detect memory errors.

CUDA Random Number Sequence Test

This test generates a random sequence and fills the GPU memory with it, then checks if these blocks still hold the same random pattern sequence.

CUDA Modulo X Test
This test detects faults due to the interaction of neighboring memory cells. A pattern is written for the addresses starting with an offset equal to zero and increasing by 20 until the end of the allocation. After, all the addresses not filled with the pattern are filled with its complement. The pattern is checked for the addresses they are supposed to be written and this process starts another iteration adding the offset by 1. This process is repeated until all memory locations are tested.

DirectCompute Standard Mathematical Operations Test
Performs several standard mathematical operations in order to test that the video card processing units are in good condition using DirectCompute.

DirectCompute Advanced Mathematical Operations Test
Performs several advanced mathematical operations in order to test that the video card processing units are in good condition using DirectCompute.

CUDA Standard Mathematical Operations Test
Performs several standard mathematical operations in order to test that the video card processing units are in good condition using CUDA.

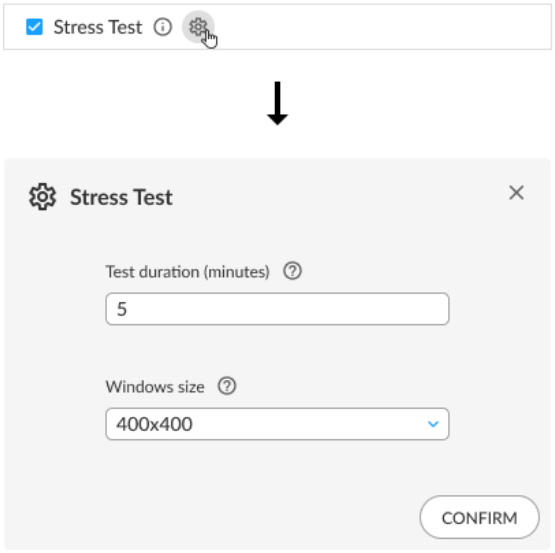
CUDA Advanced Mathematical Operations Test
Performs several advanced mathematical operations in order to test that the video card processing units are in good condition using CUDA.

Texture Pipeline Test
Sends texture patterns to be rendered by the graphics pipeline and checks for loss of data when comparing input and output

Extended Video Memory Test
Similar to Video Memory Test, but performs an extended analysis with more data patterns

Stress Test

Executes heavy operations on the video card for the purpose of stressing the GPU and verifying that the results remain reliable under stress. Before starting the test, you can change the duration of the test and the window size of the animation by clicking on the settings icon next to the test name:

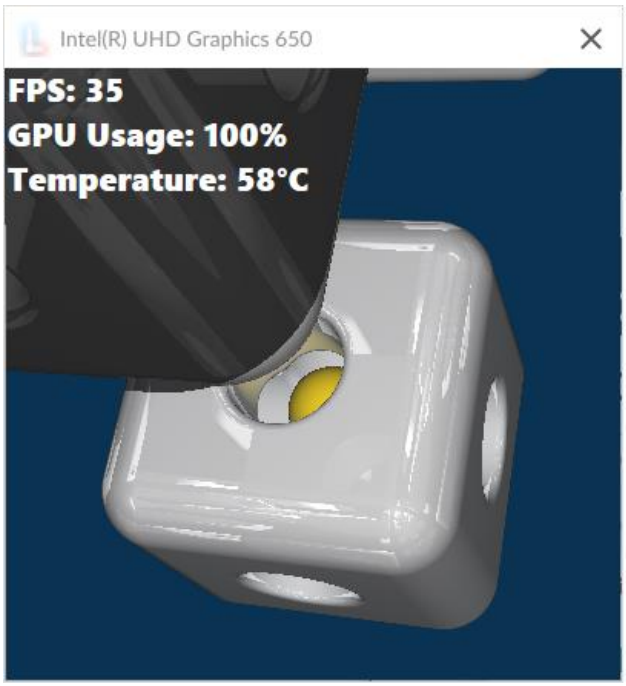


Click on the settings button

Adjust the time duration and the windows size.

Figure 69: Customizable Parameters for the Video Card Stress Test

During the test execution, an animation is displayed and information of the FPS, GPU, and temperature are shown.



During the execution, is displayed an animation and are shown information about the FPS, GPU, and temperature.

Figure 70: Video Card Stress Test Animation

Wireframe Stress Test
Executes heavy wireframe operations on the video card for the purpose of stressing the GPU and verifying that the results remain reliable under stress. Before starting the test, you can change the duration of the test by clicking on the settings icon next to the test name, according to the image below:

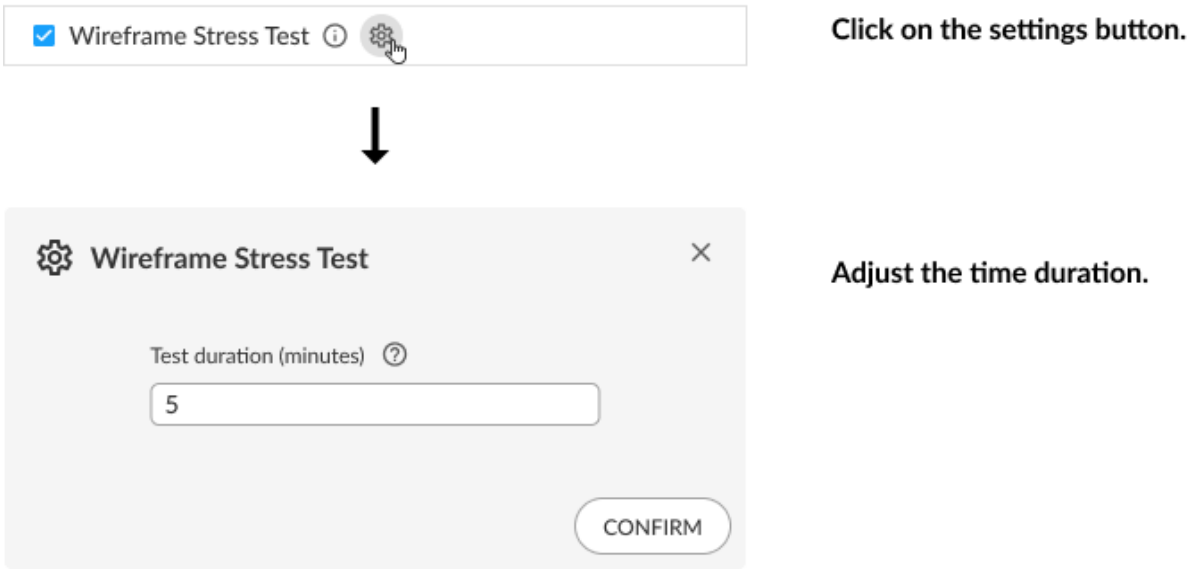


Figure 71: Customizable Parameter for the Wireframe Stress Test

4.19 Wired Ethernet

The Wired Ethernet module contains tests that can help verify that the ethernet network devices are working properly.

The Wired Ethernet module is composed of the following tests:

Test	Test type	Attendance
Internet Connection Test	Quick	Unattended
Link Test	Quick	Attended

Internet Connection Test
Tests the internet connection by initiating a TCP connection with an external host, sending an HTTP request, and waiting for the host's reply. The test is canceled if the tested device has no wired connection using IPv4 to network.

Link Test

The Link Test will verify if the Ethernet network device is faulty based on its operational status. The test starts by asking you if the network device is connected to a network.

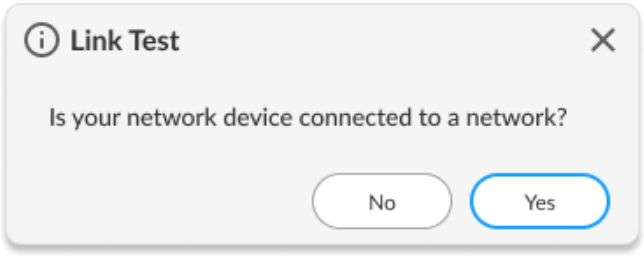


Figure 72: Link Test Confirmation Pop-up

The test is performed according to your answer. If you selected “Yes”, the test tries to establish a network link and if you select “No” the test verifies if the device has, indeed, no network link.

4.20 Wireless

The Wireless module contains tests that can verify that the wireless devices are working properly.

The Wireless module is composed of the following tests:

Test	Test type	Attendance
Radio Enabled Test	Quick	Unattended
Network Scan Test	Quick	Unattended
Signal Strength Test	Quick	Unattended

Radio Enabled Test
Verifies that the wireless is turned on.

Network Scan Test
Verifies that the wireless adapter can detect available networks. Make sure that there is a properly configured router or access point nearby before running this test.

Signal Strength Test
Tests the wireless connection quality for the wireless adapter. Make sure that there is a properly configured router or access point nearby before running this test.

4.21 Touchpad Devices

The Touchpad Devices module contains tests that can help verify that the touchpad devices are working properly.

The Touchpad Devices module is composed of the following tests:

Test	Test type	Attendance
Click Test	Quick	Attended
Precision Test	Quick	Attended
Press Precision Test	Quick	Attended

Click Test

It does a check on the device's buttons, issuing you to perform some actions regarding them. The Click Test execution is based on the workflow below.

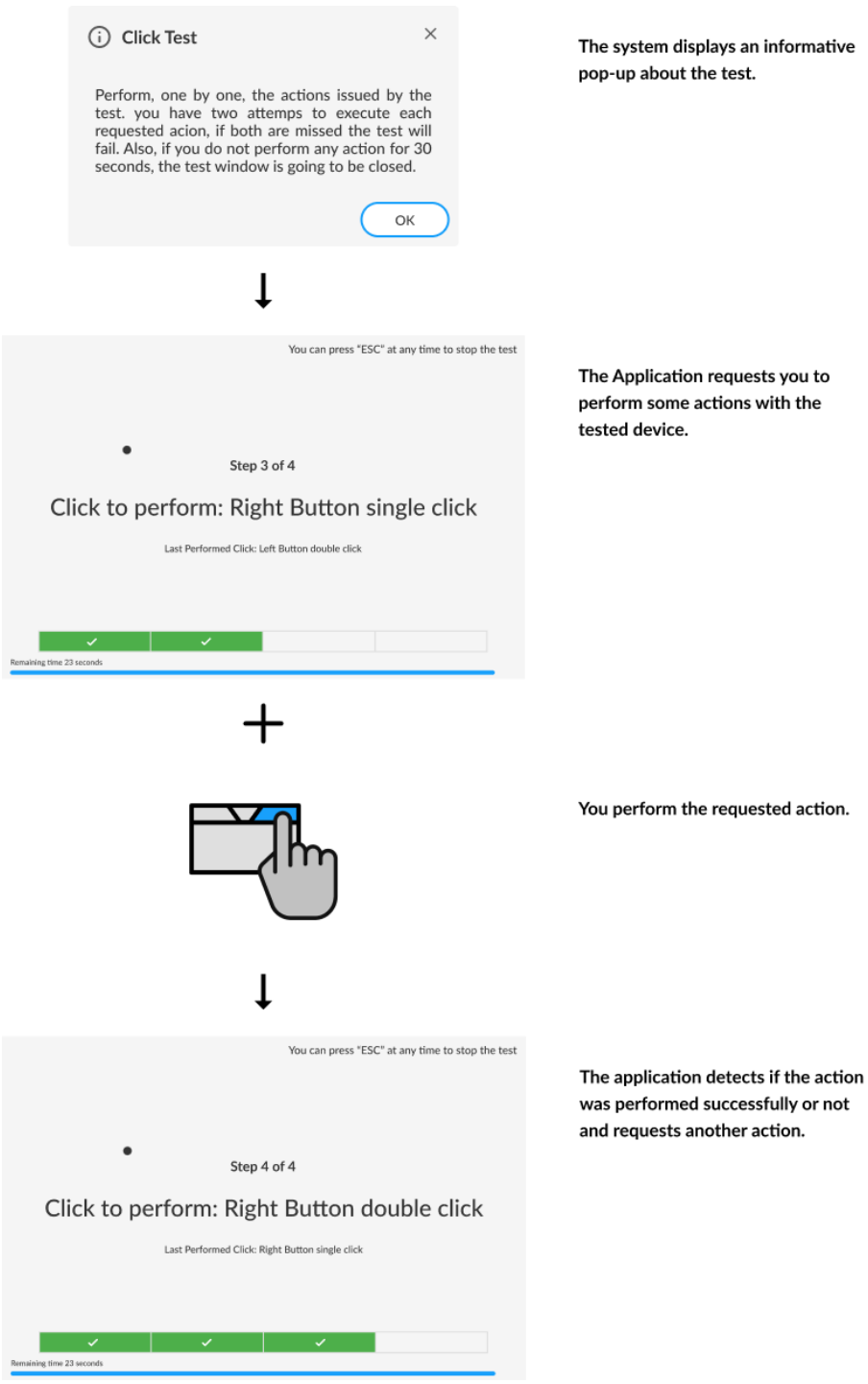


Figure 73: Touchpad Click Test

You must perform one by one, the actions issued by the test. Note that the actions requested depends on the numbers and types of buttons present in your touchpad device.

You have two attempts to execute each requested action. If the requested action was detected by the application, it is considered as passed. Otherwise, the action is considered as “Failed”. The Click Test is considered as “Passed” if all actions required are passed.

If you do not perform any action for 30 seconds, the following pop-up is displayed:

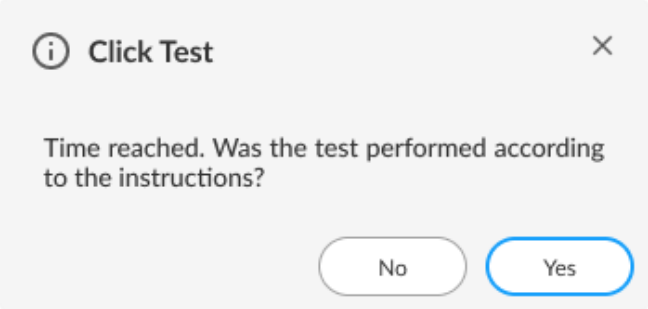


Figure 74: Touchpad Click Test Confirmation Pop-up

If you select “Yes”, reporting that the test was performed according to the instructions the test will fail. In this case, the application assumes that it was not possible to detect the device, indicating a bad working of it. If you select “No”, the test is canceled because the actions required were not properly executed.

Precision Test

Tests the device movement precision. The Precision Test execution is based on the following workflow:

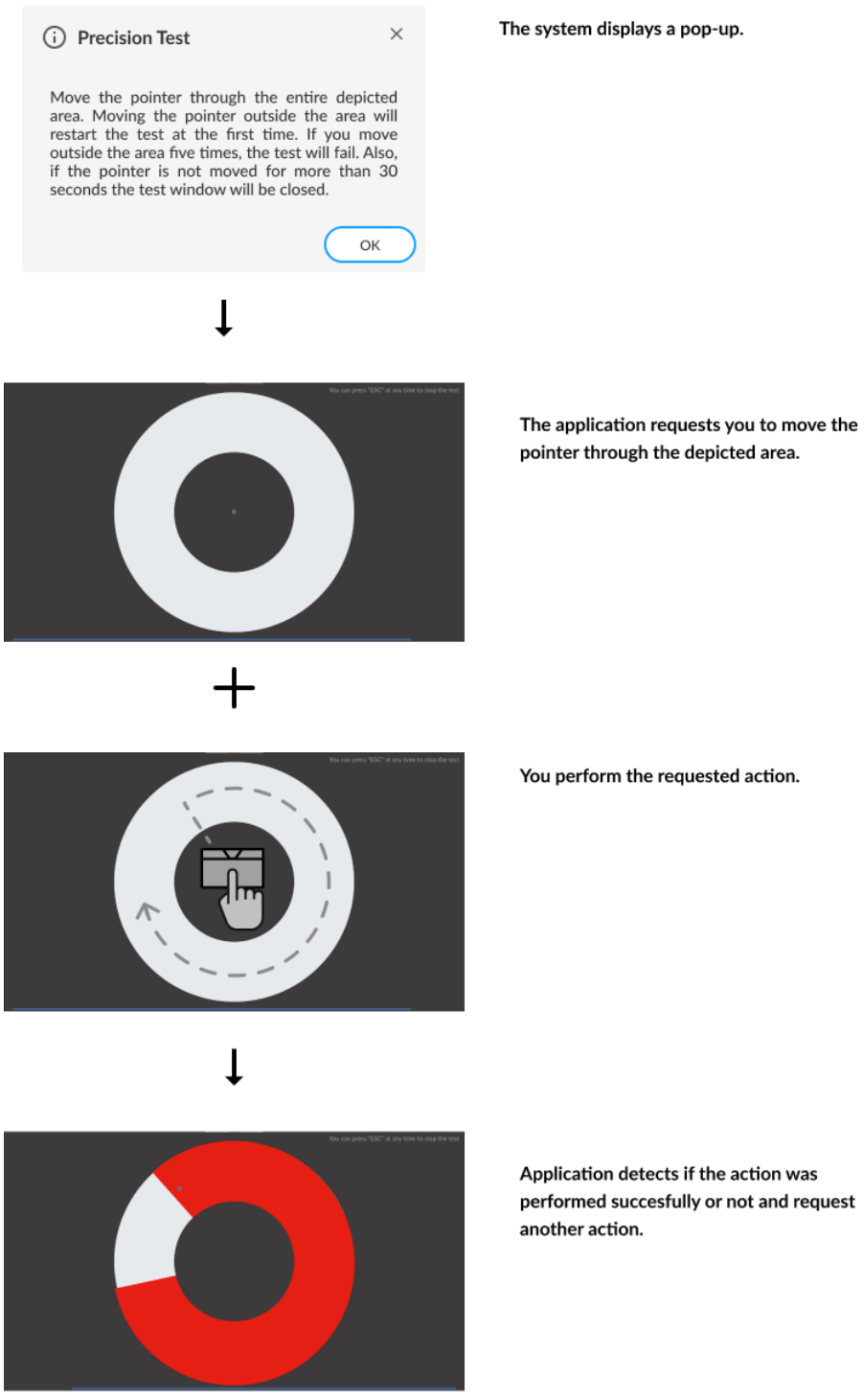


Figure 75: Touchpad Precision Test

If you get to move the pointer through the entire depicted area without reaching the outside area the test is finished as passed. If the outside area was reached five times the test will fail. If the pointer is not moved for more than 30 seconds the test window is going to be closed and the following message is displayed for you:

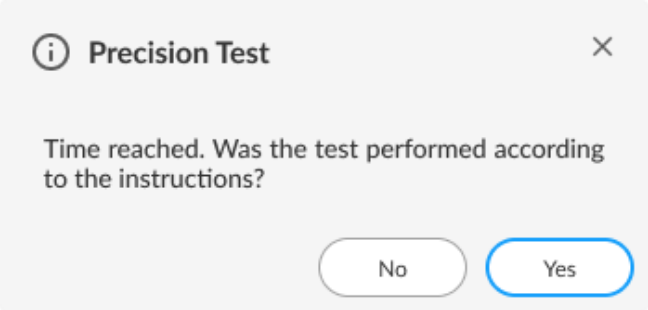


Figure 76: Touchpad Precision Test Confirmation Pop-up

If you select “Yes”, reporting the test was performed according to the instructions, the test will be finished as “failed”. In this case, the application assumes that it was not possible to detect the device movement, indicating a bad working of the device. If you select “No”, the test is canceled because the required actions were not properly executed.

Press Precision Test

Tests the device movement precision while any combination of touchpad buttons is pressed. The Press Precision Test execution is based on the following workflow:

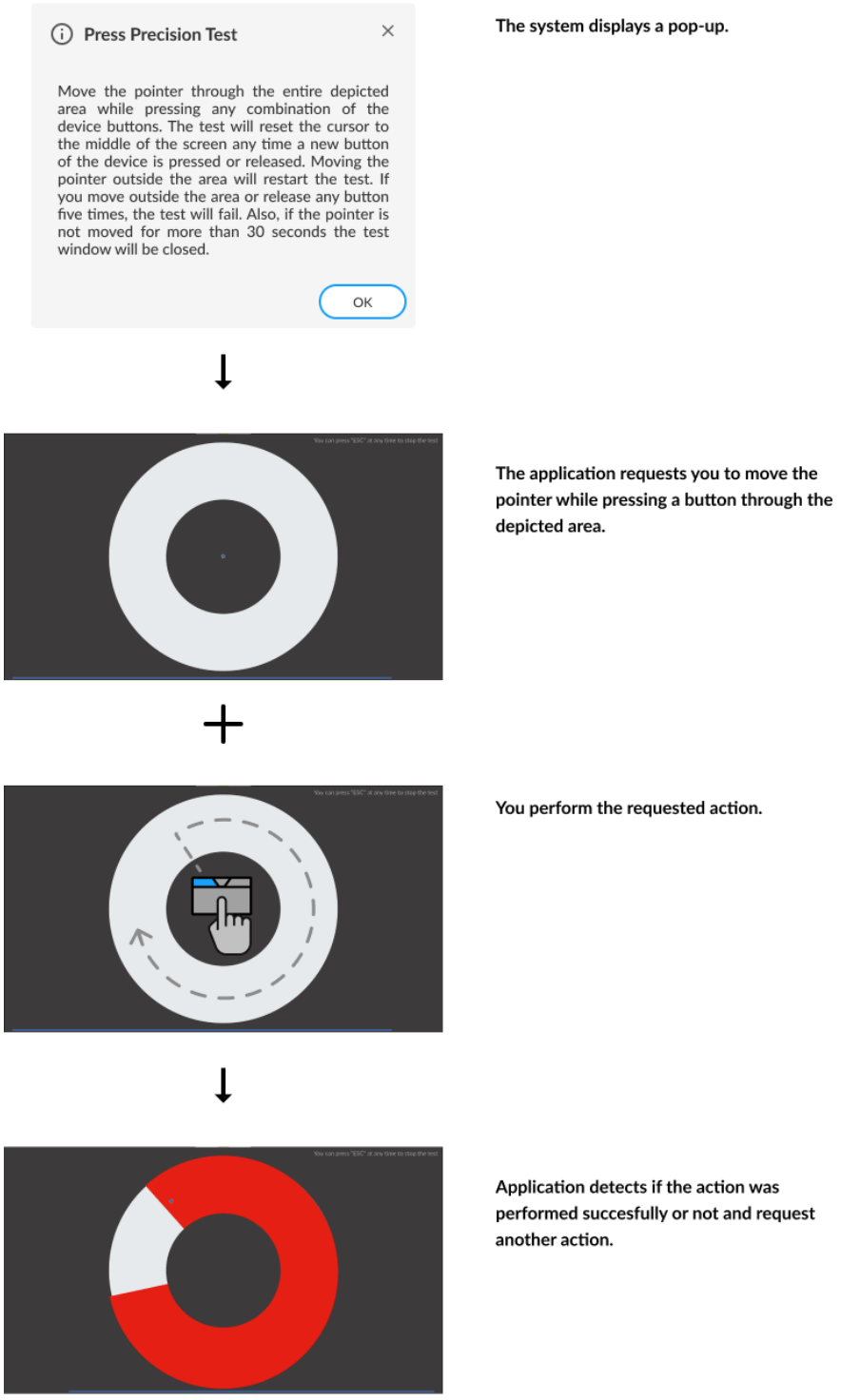


Figure 77: Touchpad Press Precision Test

If you press the button and get to move the pointer through the entire depicted area without reaching the outside area the test is finished as passed. If the outside area was reached five times or the pressed button release at least five times the test will fail. If the pointer is not moved for more than 30 seconds the test window is going to be closed and the following message is displayed to you:

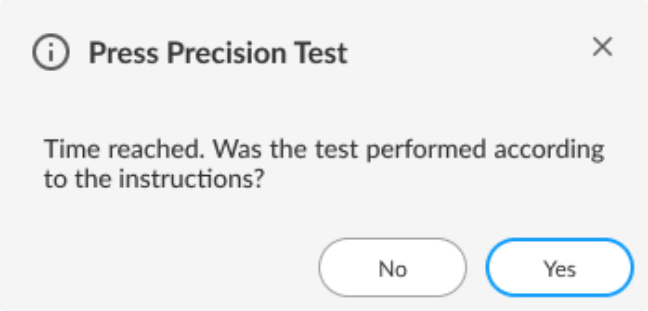


Figure 78: Touchpad Press Precision Test Confirmation Pop-up

If you select “Yes”, reporting the test was performed according to the instructions, the test will be finished as “failed”. In this case, the application assumes that it was not possible to detect the device movement, indicating a bad working of the device. If you select “No”, the test is canceled because the required actions were not properly executed.

4.22 Touchscreen

The Touchscreen module comprises display devices with touchscreens.

The Touchscreen module is composed of the following tests:

Test	Test type	Attendance
Basic Touch Test	Quick	Attended
Accuracy Test	Quick	Attended
Diagonal Test	Quick	Attended
Grid Test	Quick	Attended
Multi-touch Test	Quick	Attended

Note: If the screen reader (example: Window Narrator) is enabled, Touchscreen tests will be canceled automatically.

Basic Touch Test

The Basic touch test will verify if the system is receiving touch events. This test is based on the following workflow:

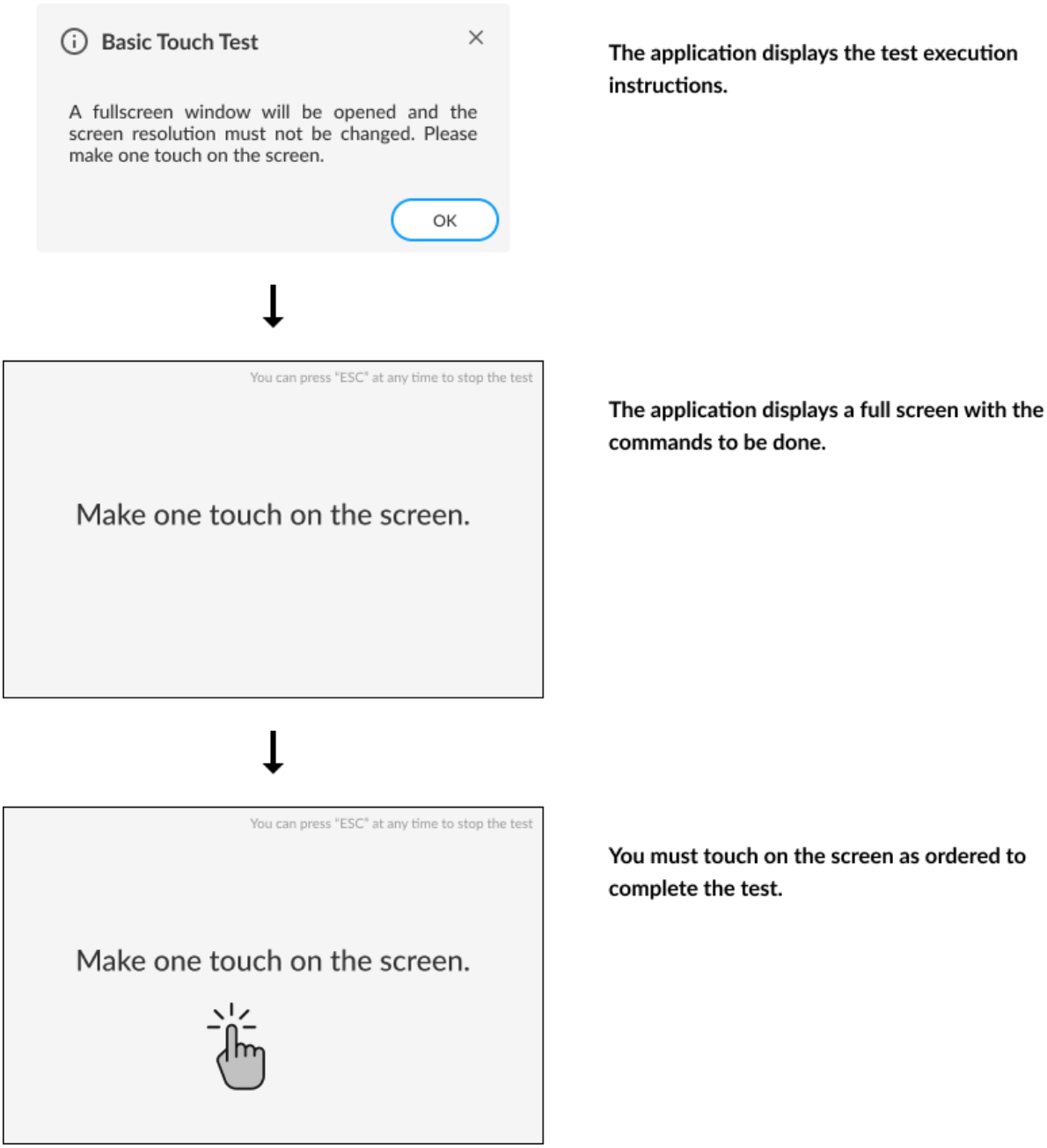


Figure 79: Basic Touch Test

Accuracy test

The Accuracy test will verify if the touchpoints are accurate with the screen mapping. This test is based on the following workflow:

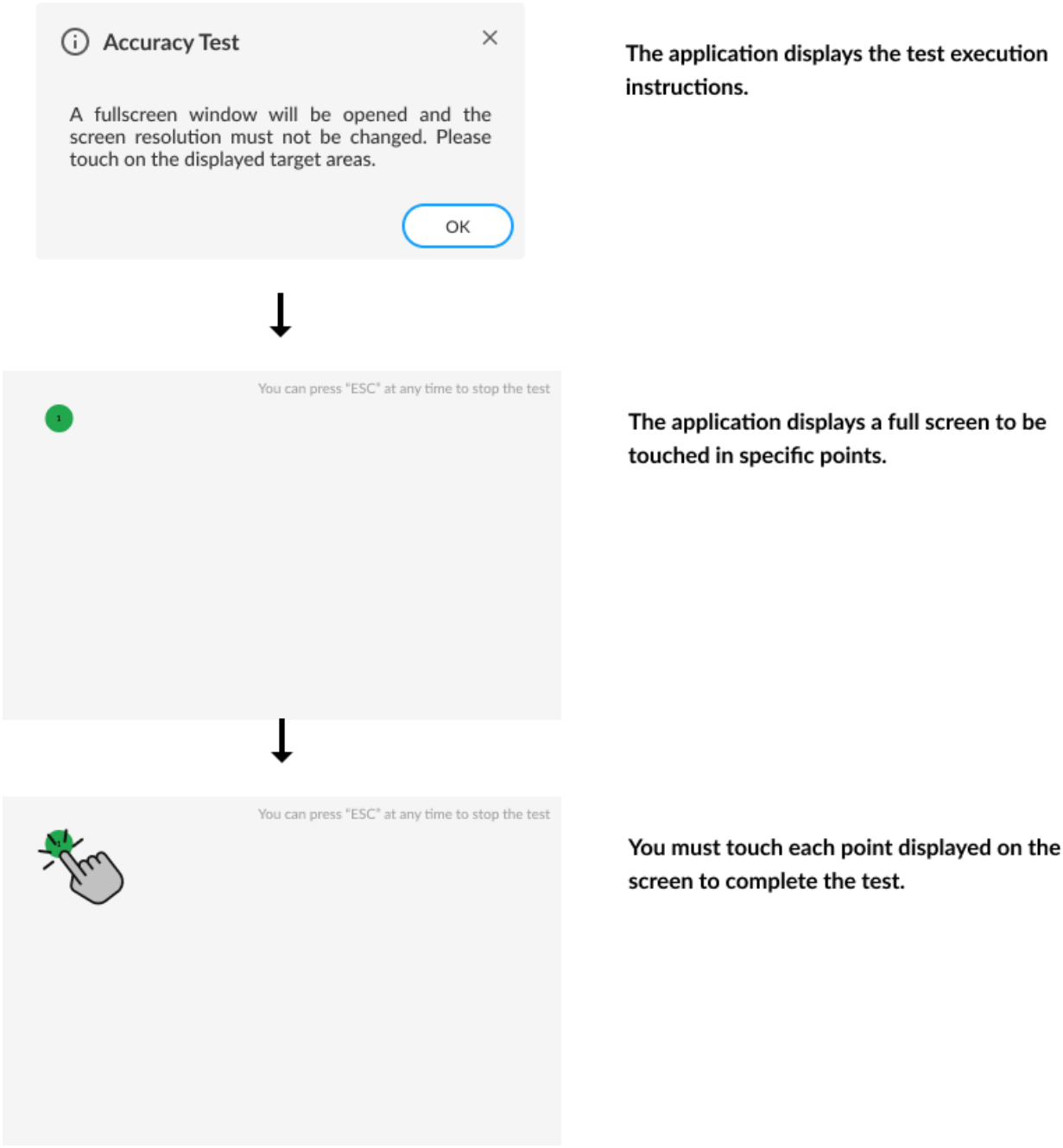


Figure 80: Accuracy Test

Diagonal Test

The Diagonal test will verify if rows and columns of the touchscreen are sensing through a diagonal gesture on the screen. This test is based on the following workflow:

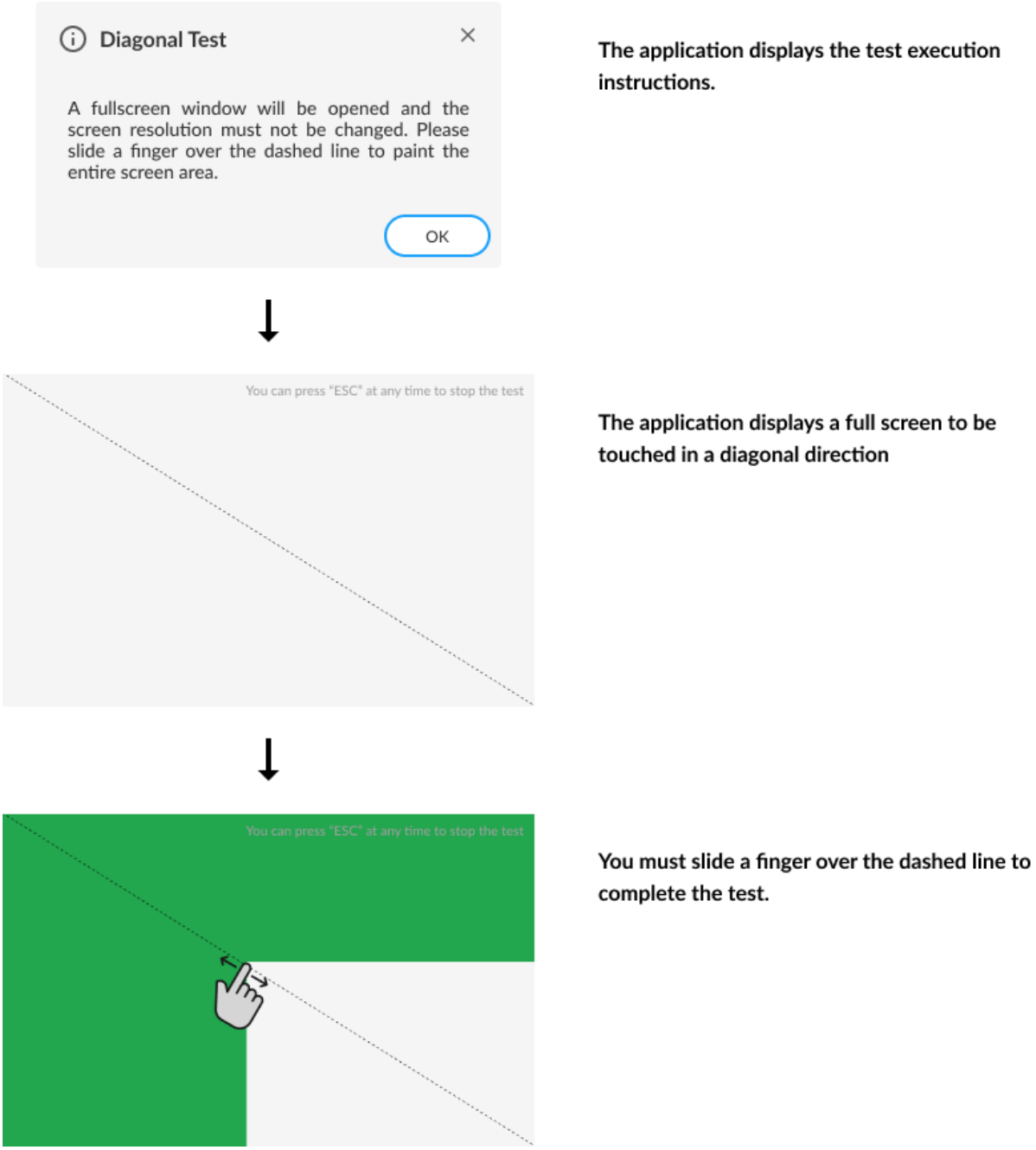


Figure 81: Diagonal Test

Grid test

The Grid test will verify if any areas of the touchscreen are not able to receive touch events. This test is based on the following workflow:

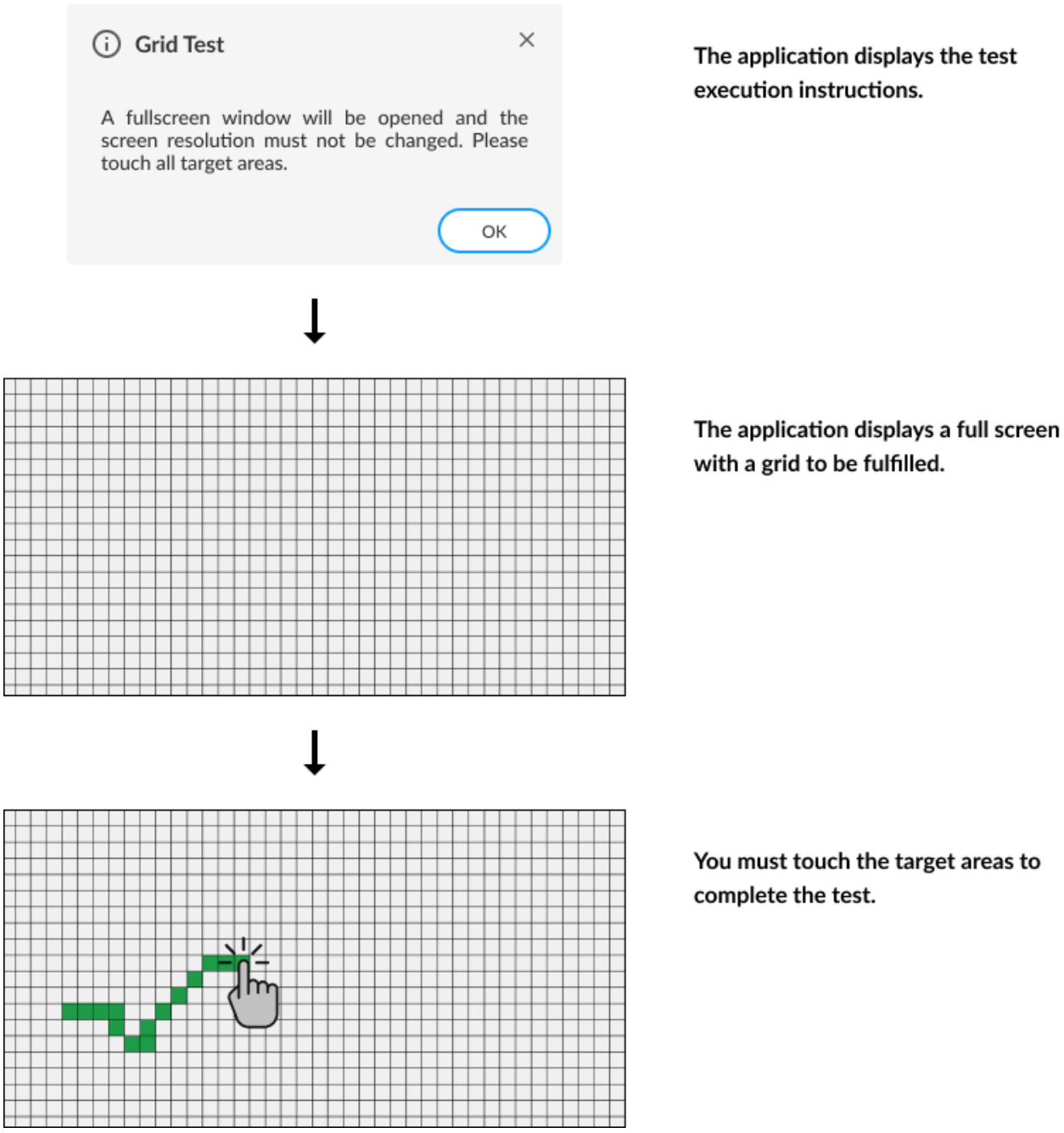


Figure 82: Grid Test

Multi-touch Test

The Multi-touch test will verify if the system is receiving multi-touch events. This test is based on the following workflow:

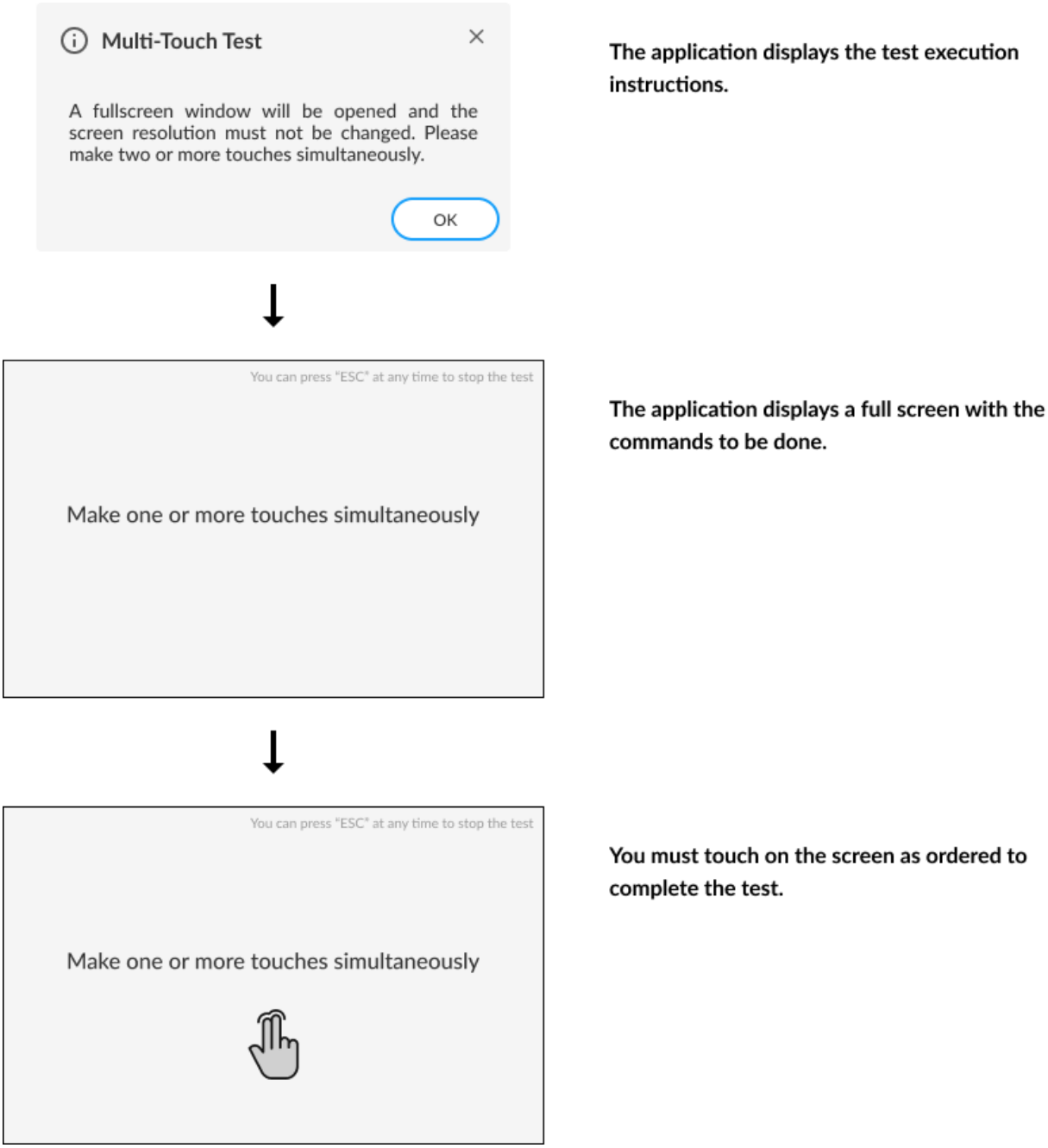


Figure 83: Multi-touch Test

4.23 Sensors

The Sensors module comprises the sensors devices of the machine, such as GPS, gyroscope, accelerometer, compass, and lid closing sensor.

The Sensors module is composed of the following tests:

Test	Test type	Attendance
Accelerometer Noise Test	Quick	Unattended
Gyrometer Noise Test	Quick	Unattended
Compass Noise Test	Quick	Unattended
GPS Communication Test	Quick	Unattended
Accelerometer Interactive Test	Quick	Attended
Gyrometer Interactive Test	Quick	Attended
Lid Closure Test	Quick	Attended
GPS Interactive Test	Extended	Attended
GPS Lock Test	Extended	Unattended

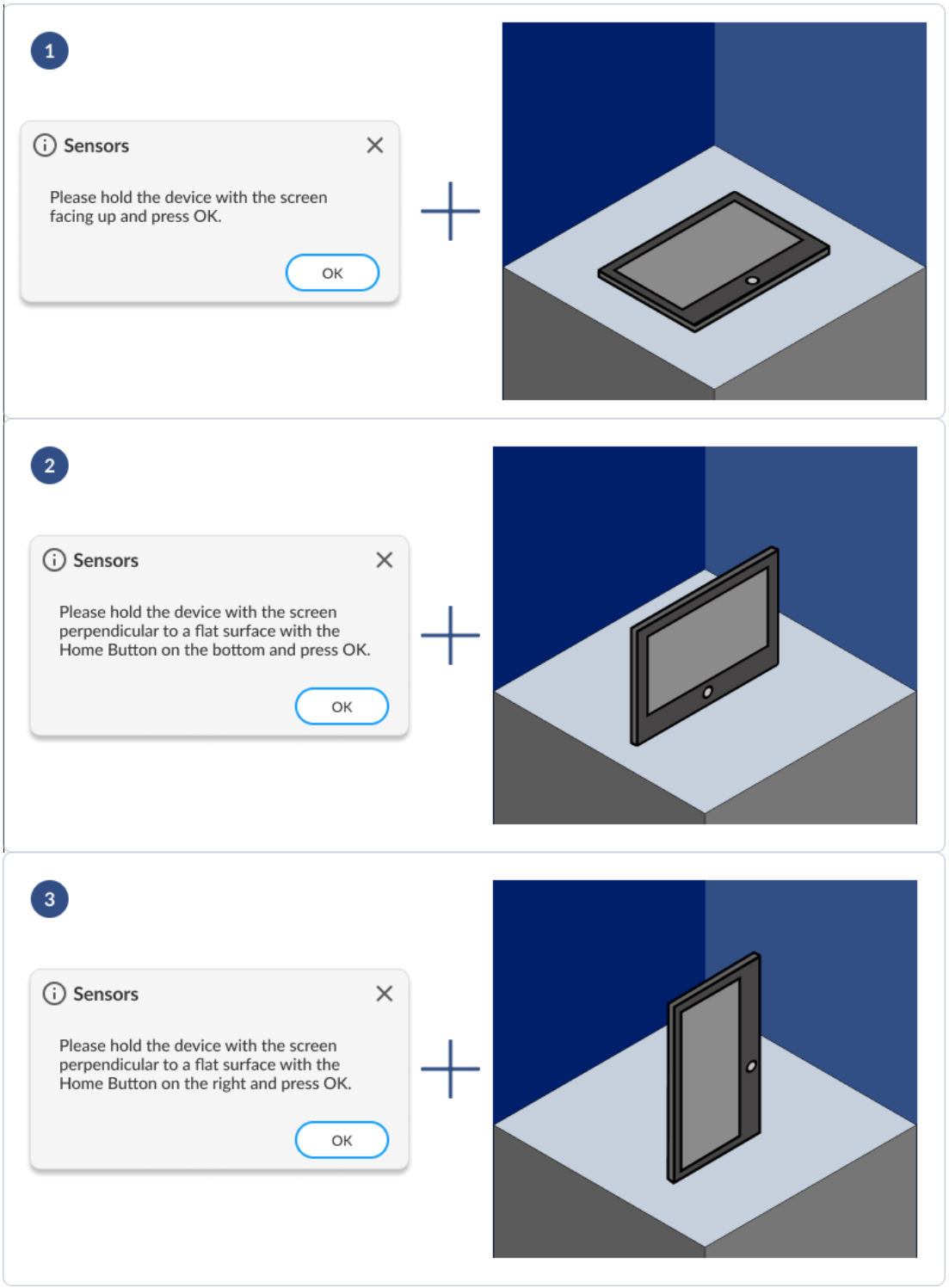
Accelerometer Noise Test
The Accelerometer Noise Test will verify the variation of the readings from the accelerometer over time and check if the noise detected is acceptable.

Gyrometer Noise Test
The Gyrometer Noise Test will verify the variation of the readings from the gyrometer over time and check if the noise detected is acceptable.

Compass Noise Test
The Compass Noise Test will verify the variation of the readings from the compass over time and check if the noise detected is acceptable.

GPS Communication Test
This test communicates with the GPS device and attempts to retrieve data. If data collection is successful within a specified time interval, the test returns Success.

Accelerometer Interactive Test
The Accelerometer Interactive Test will check if the values returned by the accelerometer in different positions are correct.



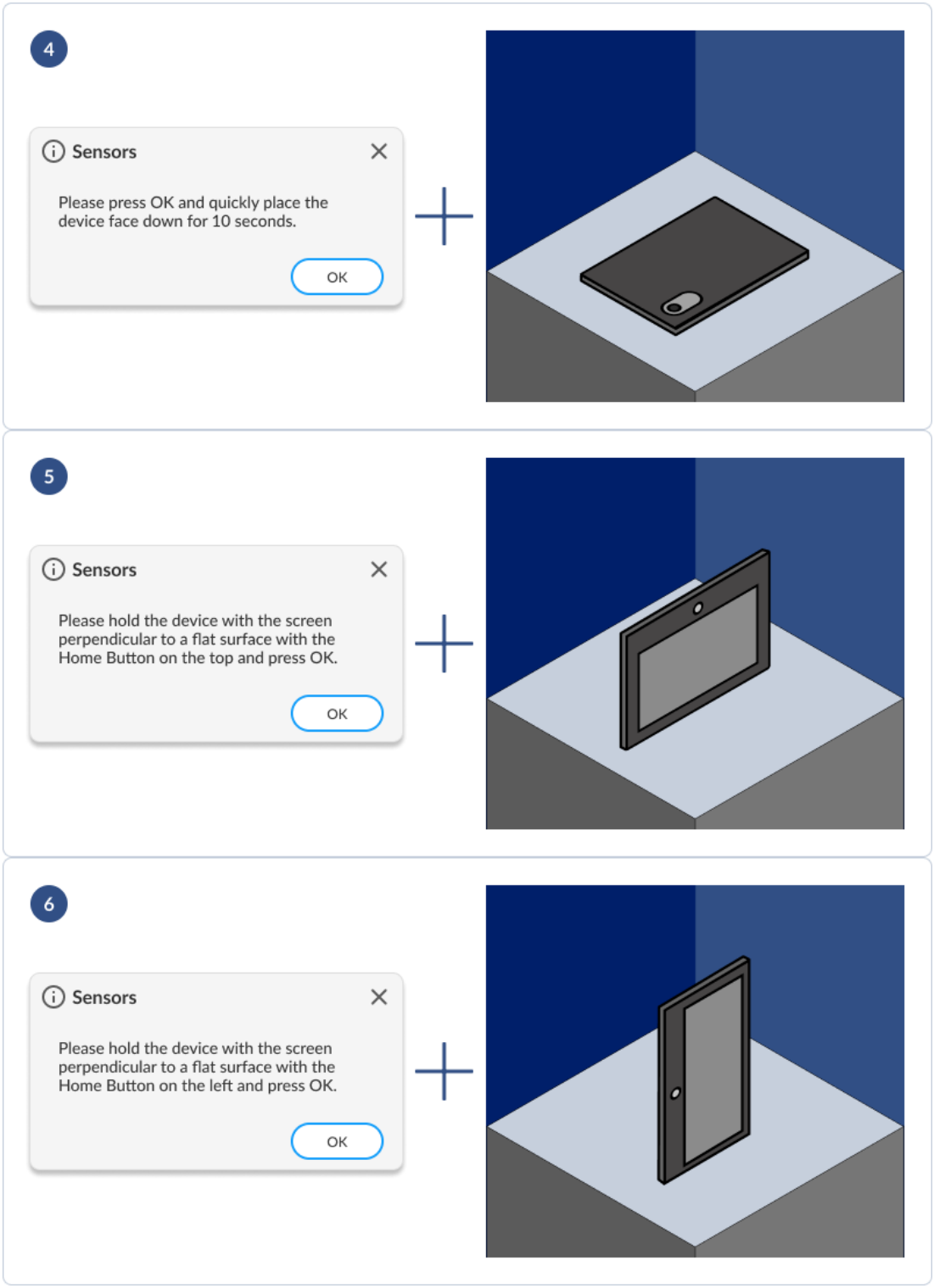
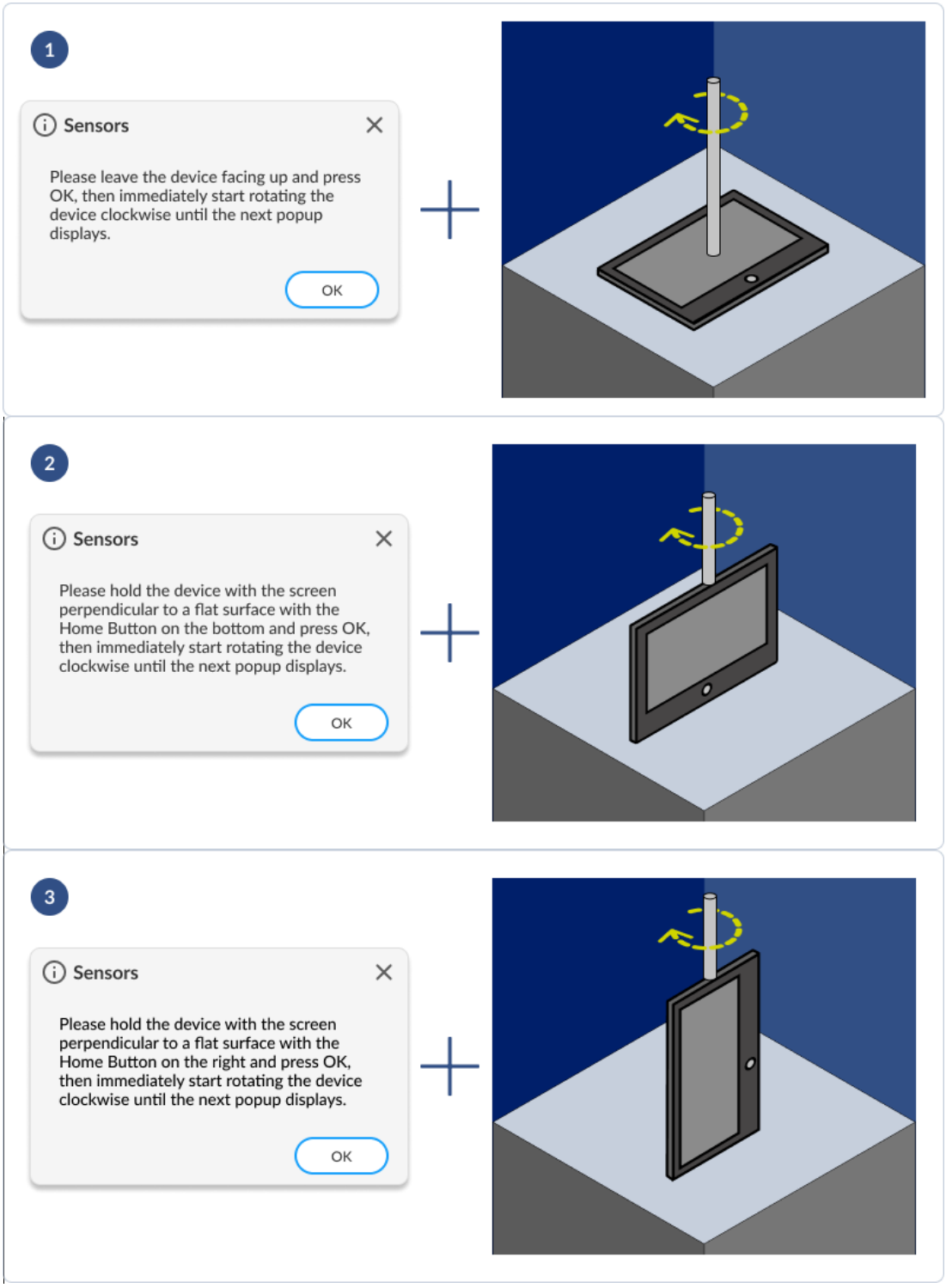


Figure 84: Accelerometer Interactive Test

Gyrometer Interactive Test

The Gyrometer Interactive Test will check if the values returned by the gyrometer in different positions are correct.



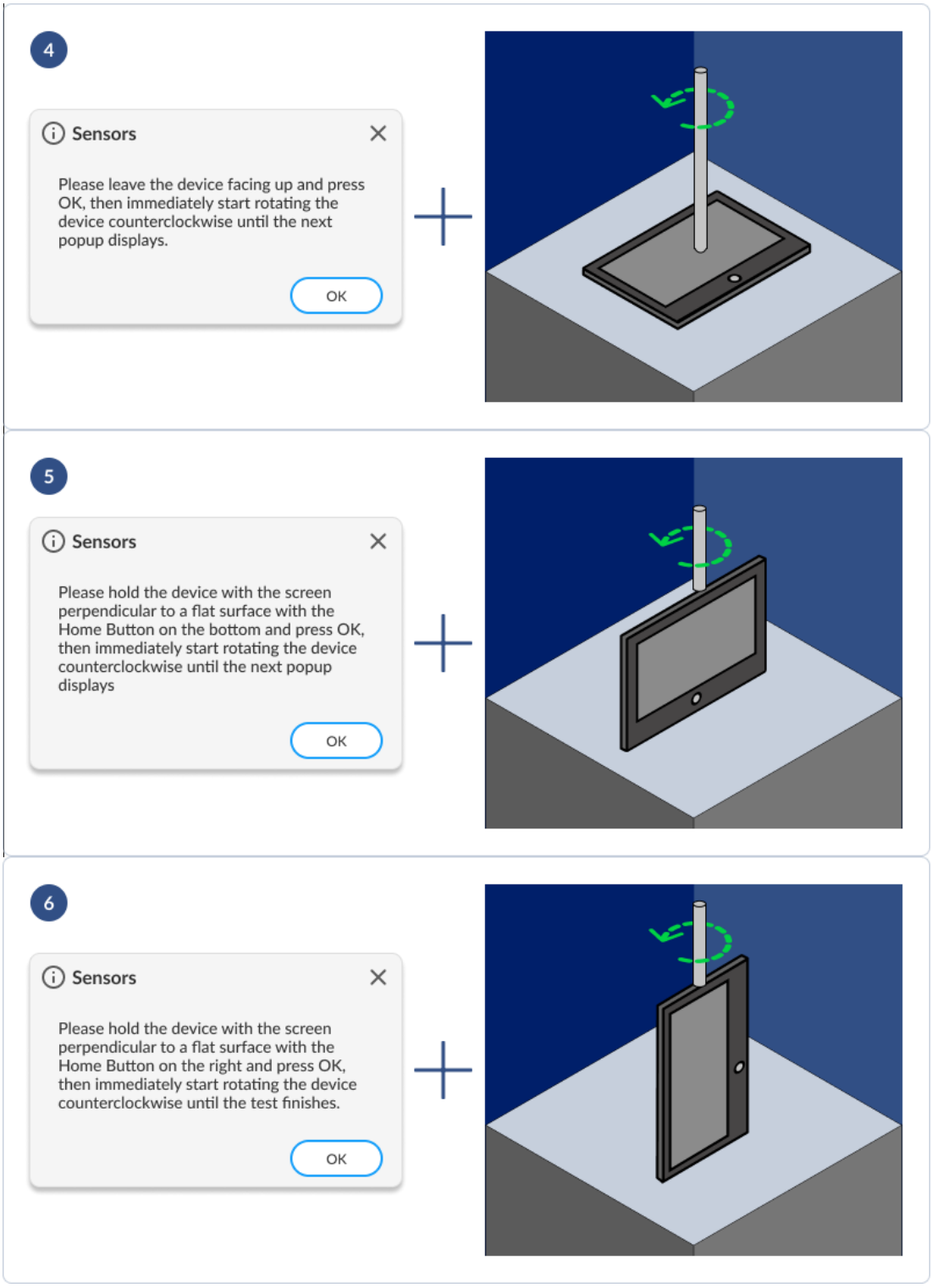


Figure 85: Gyrometer Interactive Test

Lid Closure Test
This test verifies if the lid sensor is capturing the events of closing and opening the lid. The test will fail if these events are not captured.

The test will ask you to open and close the notebook lid.

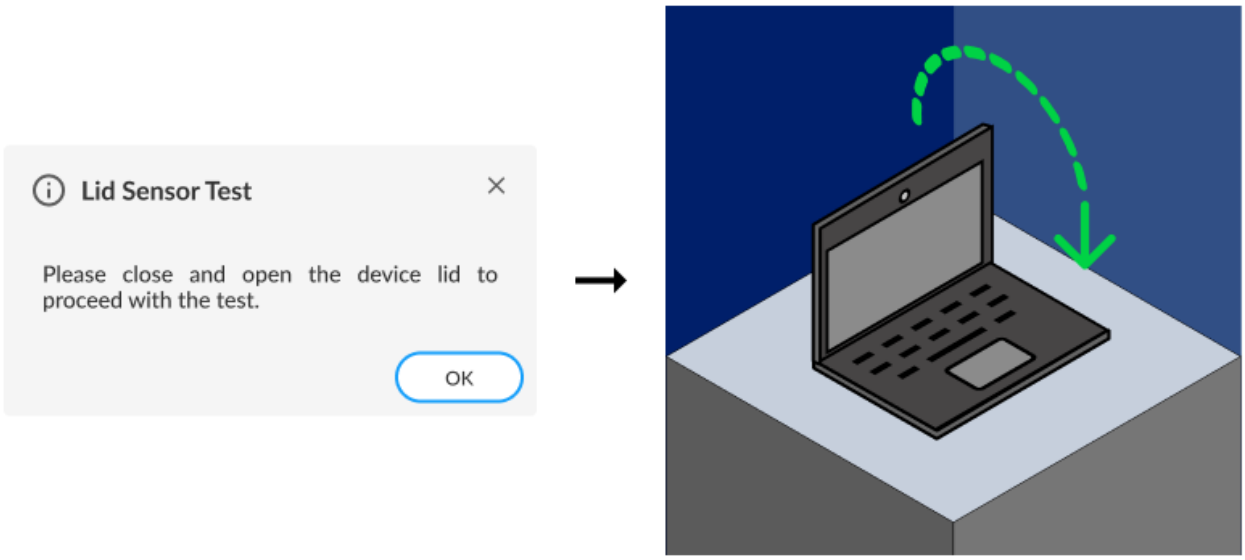


Figure 86: Lid Closure Test

GPS Interactive Test

This test communicates with the GPS sensor device and attempts to retrieve the current location coordinates. If the location coordinates collection is successful, a map is displayed of the current location.

The test will show a globe image indicating the current computer location.

Figure 87: GPS Interactive Test

GPS Lock Test
This test verifies that the GPS is receiving signals of sufficient quality from enough satellites to calculate a location. If the GPS device does report a position fix within the specified time, the test returns Success. Before starting the test, you can define the timeout values of the test in the minutes by clicking on the settings icon next to the test name:

Figure 88: Customizable Parameter for the GPS Lock Test

4.24 SIM Card

The SIM Card module comprises the SIM and e-SIM card devices of the machine.

The SIM Card module is composed of the following tests:

Test	Test type	Attendance
Network Scan Test	Quick	Unattended
Radio Enabled Test	Quick	Unattended
Signal Strength Test	Quick	Unattended

Network Scan Test
Checks if the device can identify mobile networks nearby.

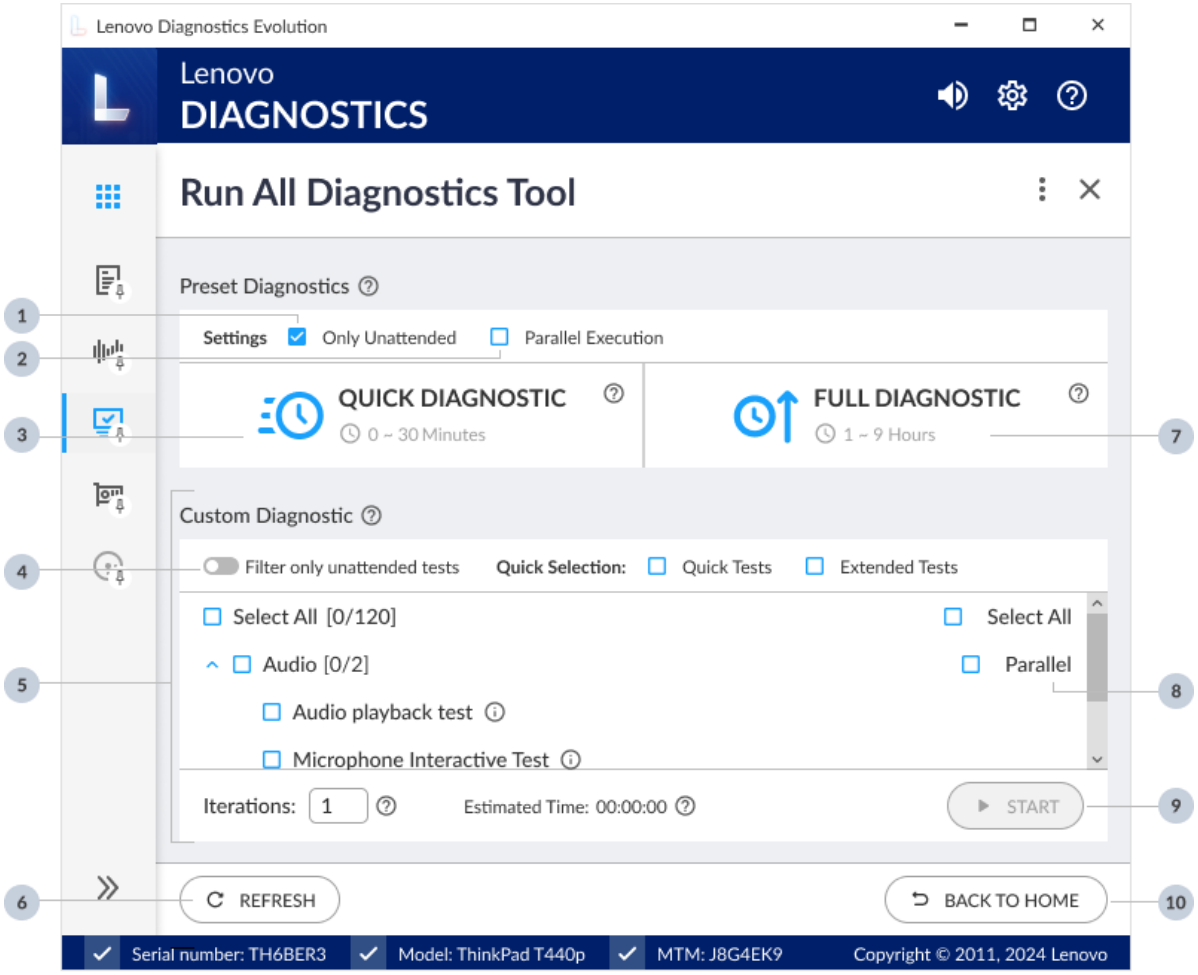
Radio Enabled Test
Checks the radio connection state and informs if the SIM card is operating normally, or if it's blocked either by software or hardware.

Signal Strength Test
Checks if the signal intensity from the home provider network is above an acceptable limit.

5. EXPLORING LENOVO DIAGNOSTICS EVOLUTION TOOLS

5.1 Run All

Run All Tool allows performing all supported tests from all supported modules at the same execution. In this flow it is not possible to select devices, thus all devices will be tested.



1 - Run only Unattended Tests
2 - Enable parallelism among modules
3 - Run quick diagnostics
4 - Click to filter only unattended tests
5 - Customize the execution
6 - Refresh devices
7 - Run all diagnostics
8 - Enable this module to run in parallel with others
9 - Start custom diagnostic
10 - Back to home screen

Figure 89: Run All Screen

Preset Diagnostics

This section contains predefined test sets that aim to diagnose all devices available in the same run. In this execution mode, it's possible to choose if the Attended Tests should be performed or not by clicking on "Only Unattended Tests", as well as to choose if the modules should be performed in parallel with each other by clicking on "Parallel Execution".

- **Quick**
  Click on Quick card to perform all quick tests according to your preferences defined in Preset Diagnostics settings.

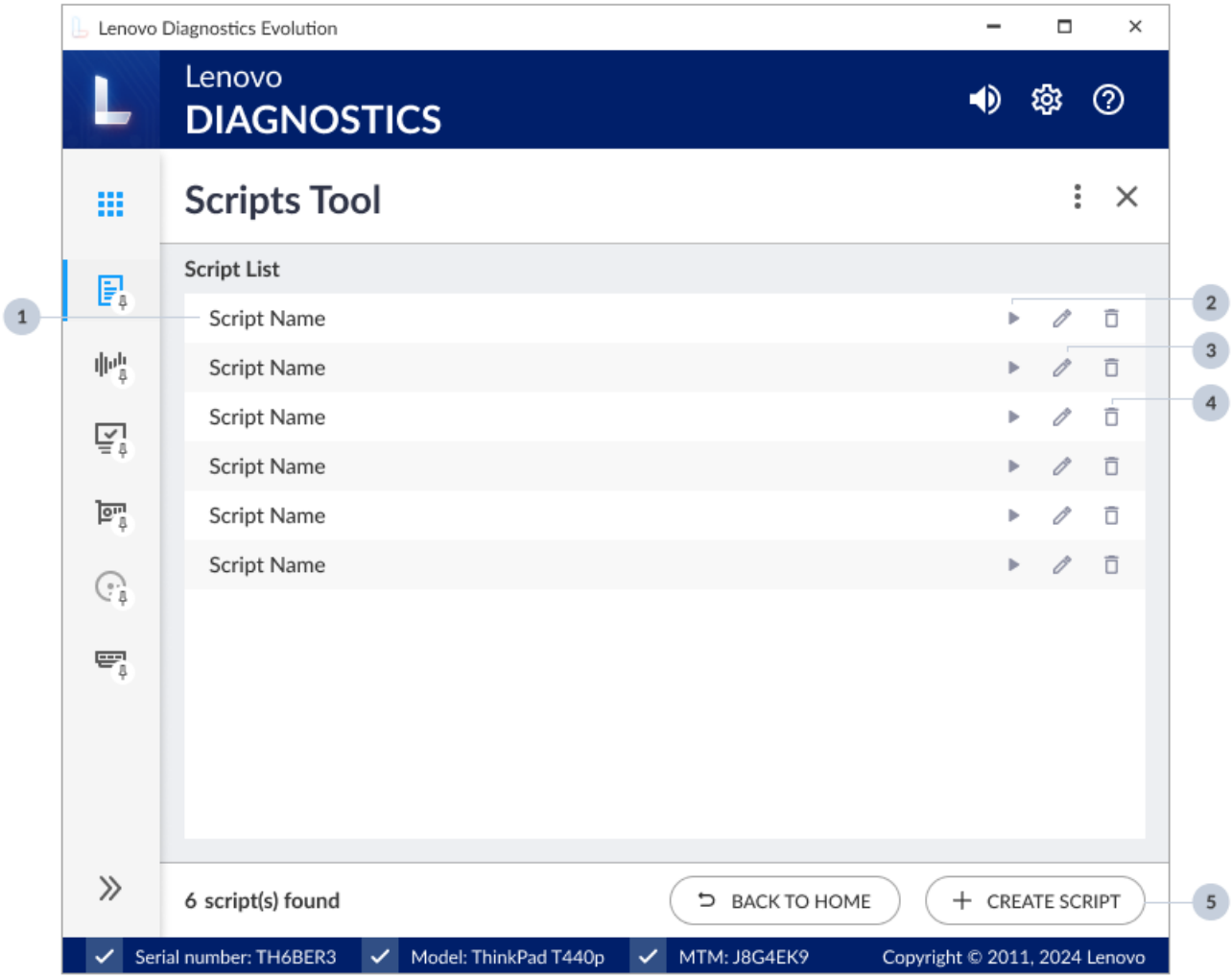
- **Full**
  Click on Full card to perform all tests (Quick + Extended) according to your preferences defined in Preset Diagnostics settings.

Custom Diagnostics
In this section, you can select any module/test to be run, choose which modules will run in parallel, enter the number of iterations, and filter the test list to display only unattended tests.
To filter by unattended tests, just to enable the "Filter only unattended tests" toggle. You also can use the "Quick Selection" to quickly select a set of tests.

5.2 Scripts Tool

The Scripts Tool allows you to create a custom list of tests from any module.

If there are existing scripts, you can also perform the following actions: Execute, edit, and delete.



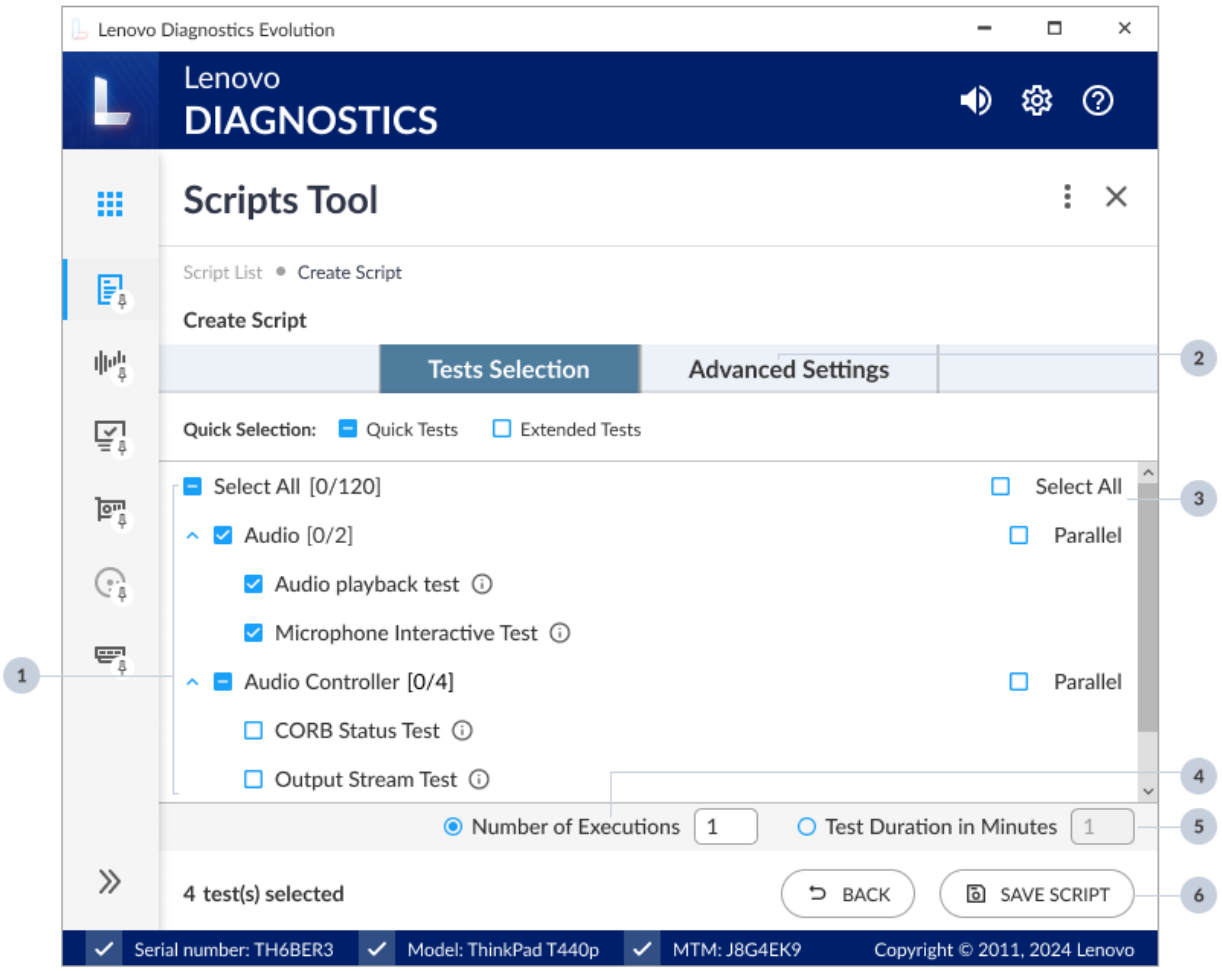
1. Script Name
2. Execute Script
3. Edit Script
4. Delete Script
5. Create Script

Figure 90: Scripts Tool (Scripts List)

5.2.1 Create a diagnostic script

By clicking on the **Create Script** button, the screen below will be displayed. This screen allows selecting a set of tests to be performed from a list with all tests present in Lenovo Diagnostics Evolution. You can select the modules

to be run in parallel and define advanced settings for tests and modules. The tests not supported by the tested machine are marked with this warning icon ⚠



1. Select tests
2. Advanced settings for the script
3. Enable Parallel execution for all modules
4. Define the number of iterations for the script
5. Define the execution duration for the script
6. Save script

Figure 91: Scripts Tool (Script Creation)

It is also possible to configure the execution of these tests according to one of the following parameters:

Number of Executions: allows performing the tests according to a specific number of executions in a range from 1 to 999. In this case, the diagnostic will be finished when all iterations are completed.

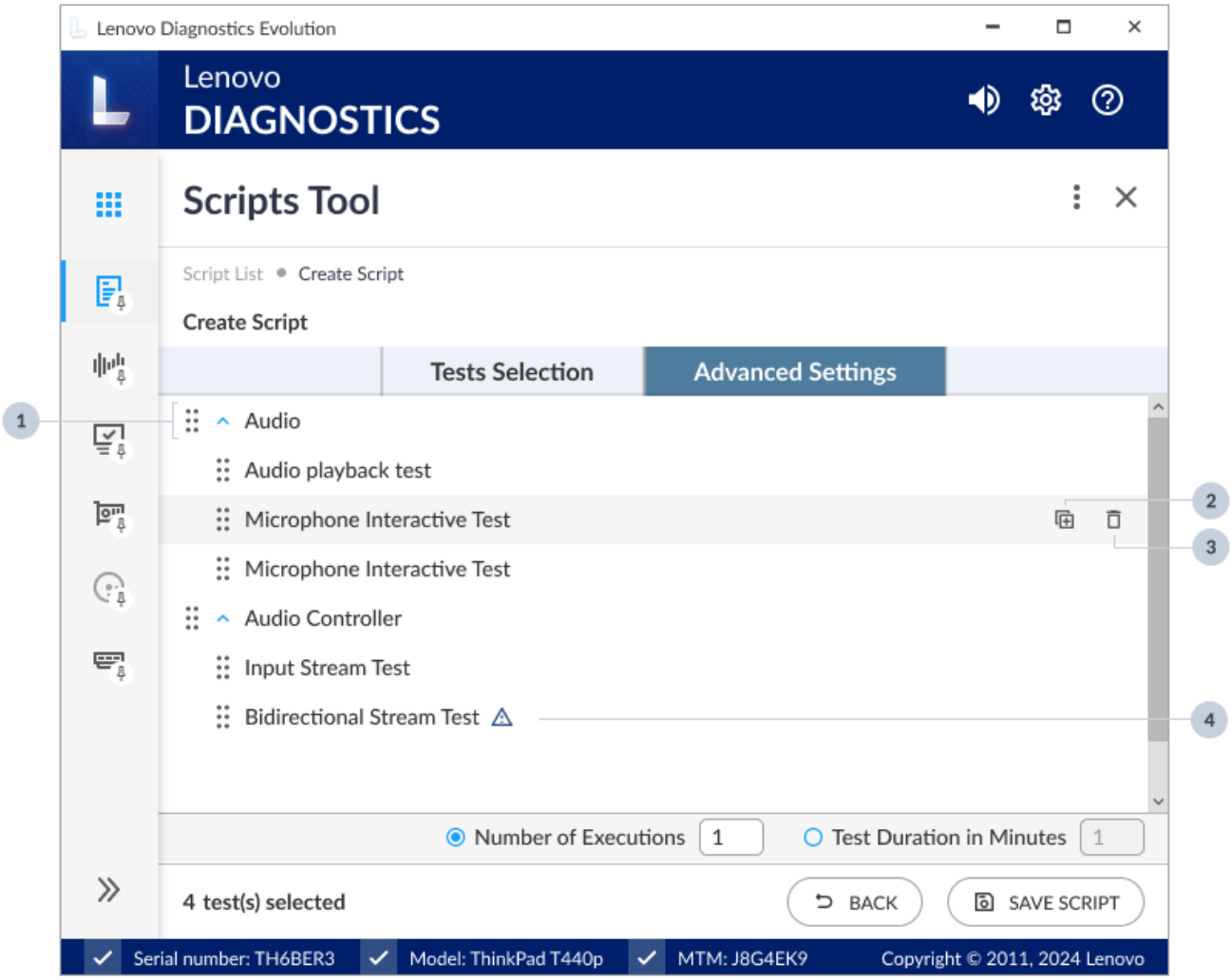
Test Duration in Minutes: allows performing the tests according to a specific number of minutes in a range from 1 to 999. In this case, the diagnostic will be finished when this time is reached and all tests from the current iteration are finished.

Once you select at least 1 test, the advanced settings tab is enabled, and you can configure the following parameters:

Module Execution Sequence: This allows you to select the order in which the modules will be executed by dragging and dropping the modules and tests in the list.

Duplicate a test: This allows tests to be duplicated in the same execution.

Note: The script name cannot contain the following characters / \ : * . ? ~ < > |



1. Click, drag and drop a test or modul
2. Duplicate a test
3. Delete duplicate test
4. Test not supported in that machine

Figure 92: Scripts Tool (Advanced Settings)

5.2.2 Edit a diagnostic script

By clicking on the **Edit script** icon, a screen is displayed with the configuration from the selected diagnostic script.

Here it is possible to modify this configuration by changing the list of tests and which modules will be run in parallel, modifying the number of executions or duration minutes, and changing the advanced settings.

By clicking on the **Save Script** button all changes are saved in the current script and clicking on **Save as** it is possible to create a new script with the current configuration.

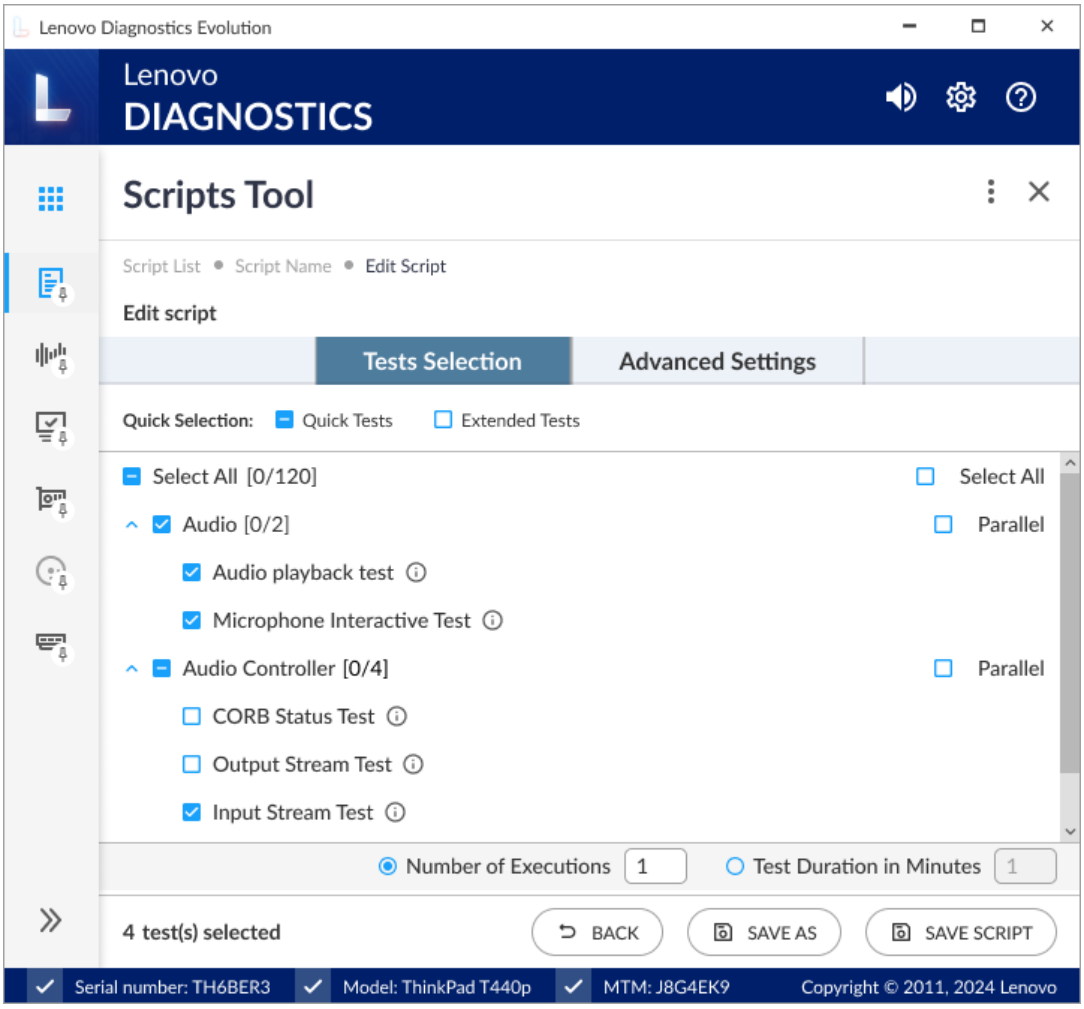


Figure 93: Scripts Tool (Edit Script)

5.2.3 Delete a diagnostic script

By clicking on the **Delete Script** button, the application will show a pop-up message to confirm the operation.

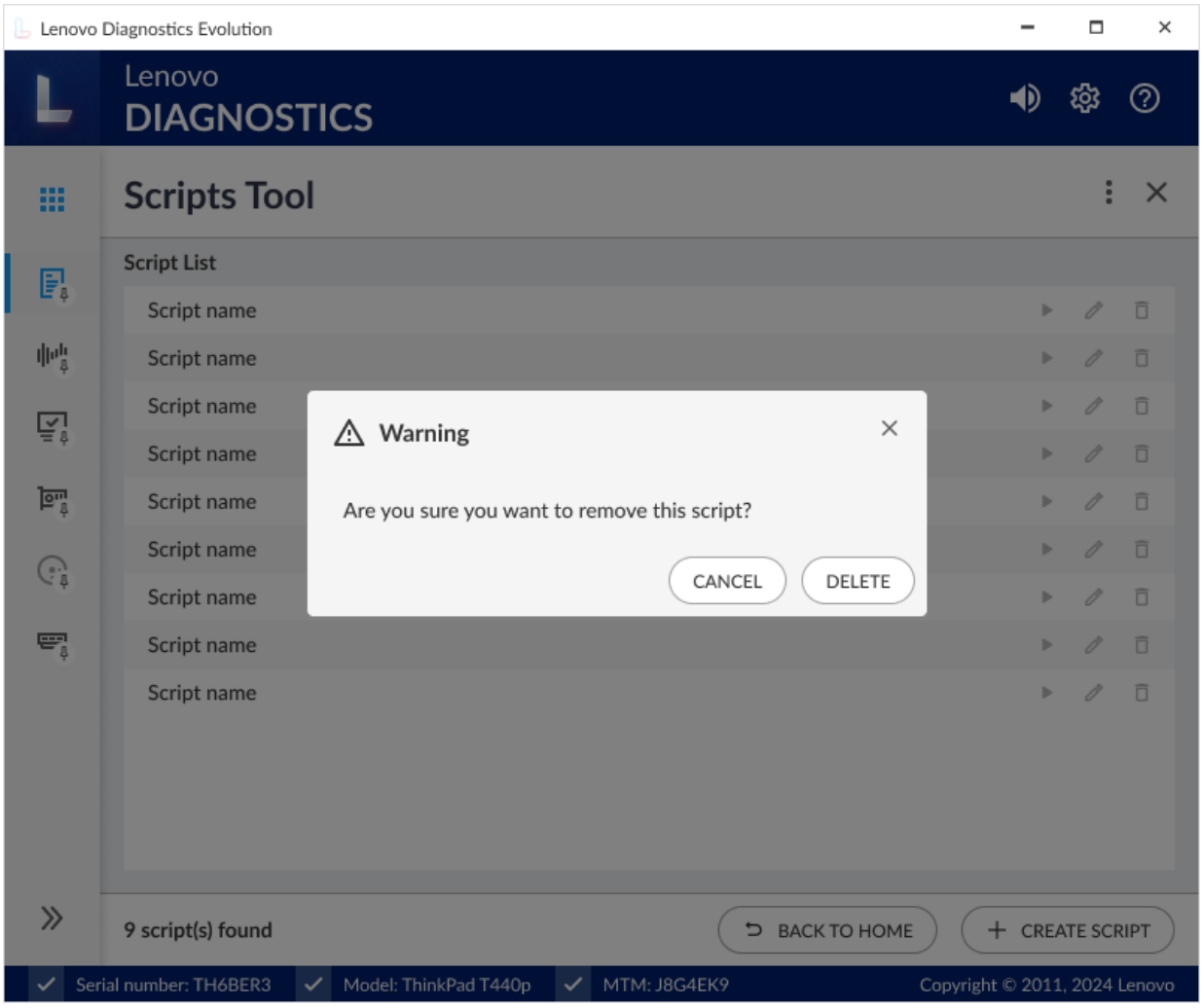


Figure 94: Scripts Tool (Delete Script)

5.2.4 Execute a diagnostic script

By clicking on the **Execute Script** button or on the script row, a screen is displayed with the configuration from the selected diagnostic script.

All selected tests are listed and the not supported ones are marked with this warning icon ⚠ .

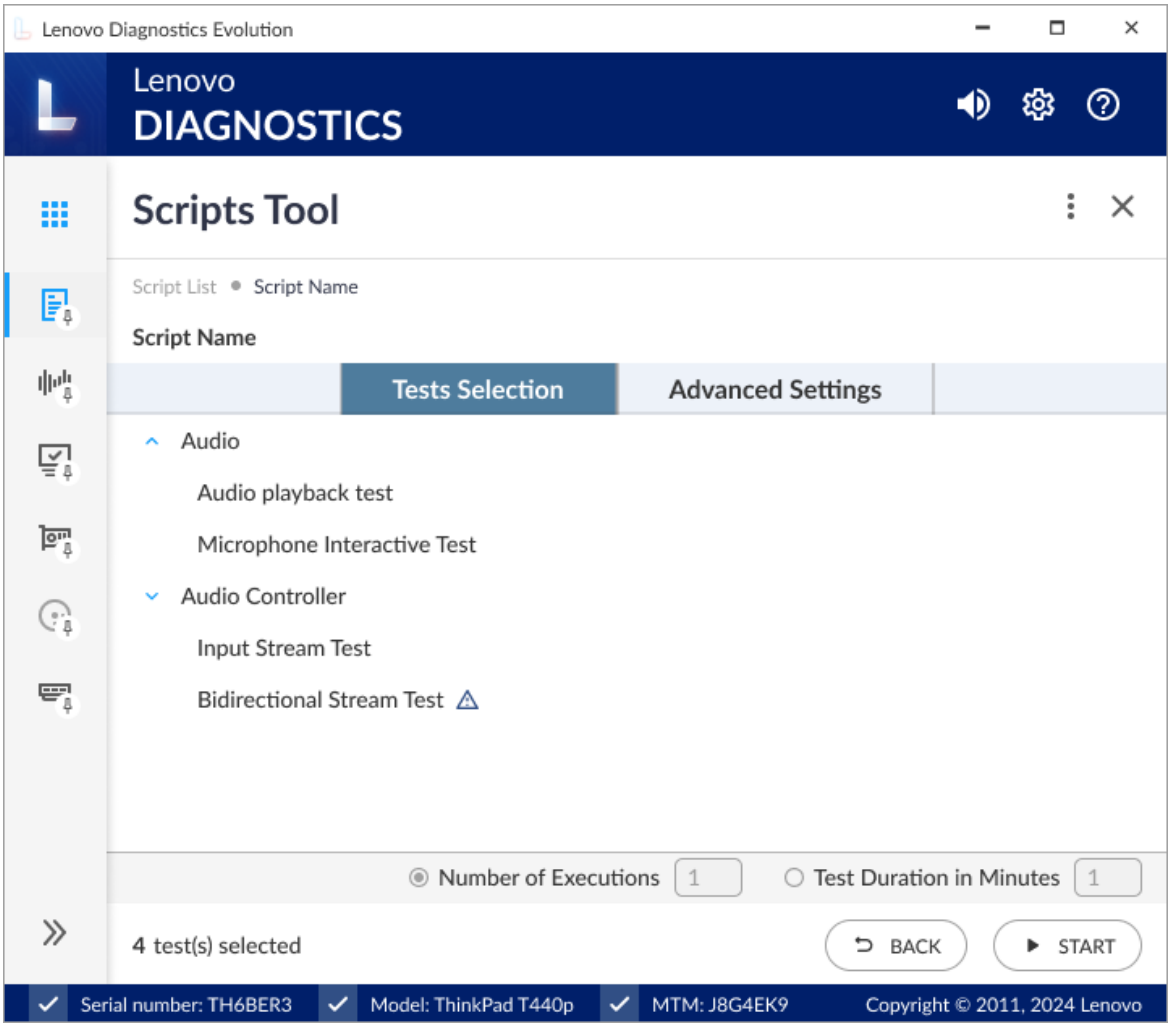


Figure 95: Scripts Tool (Script Summary)

By clicking on the **Start** button, the diagnostic script execution screen is displayed, and all supported tests are performed. The not supported tests that which don't have an associated device are filtered on this execution. It is possible to finish the execution any time by clicking on **Abort**.

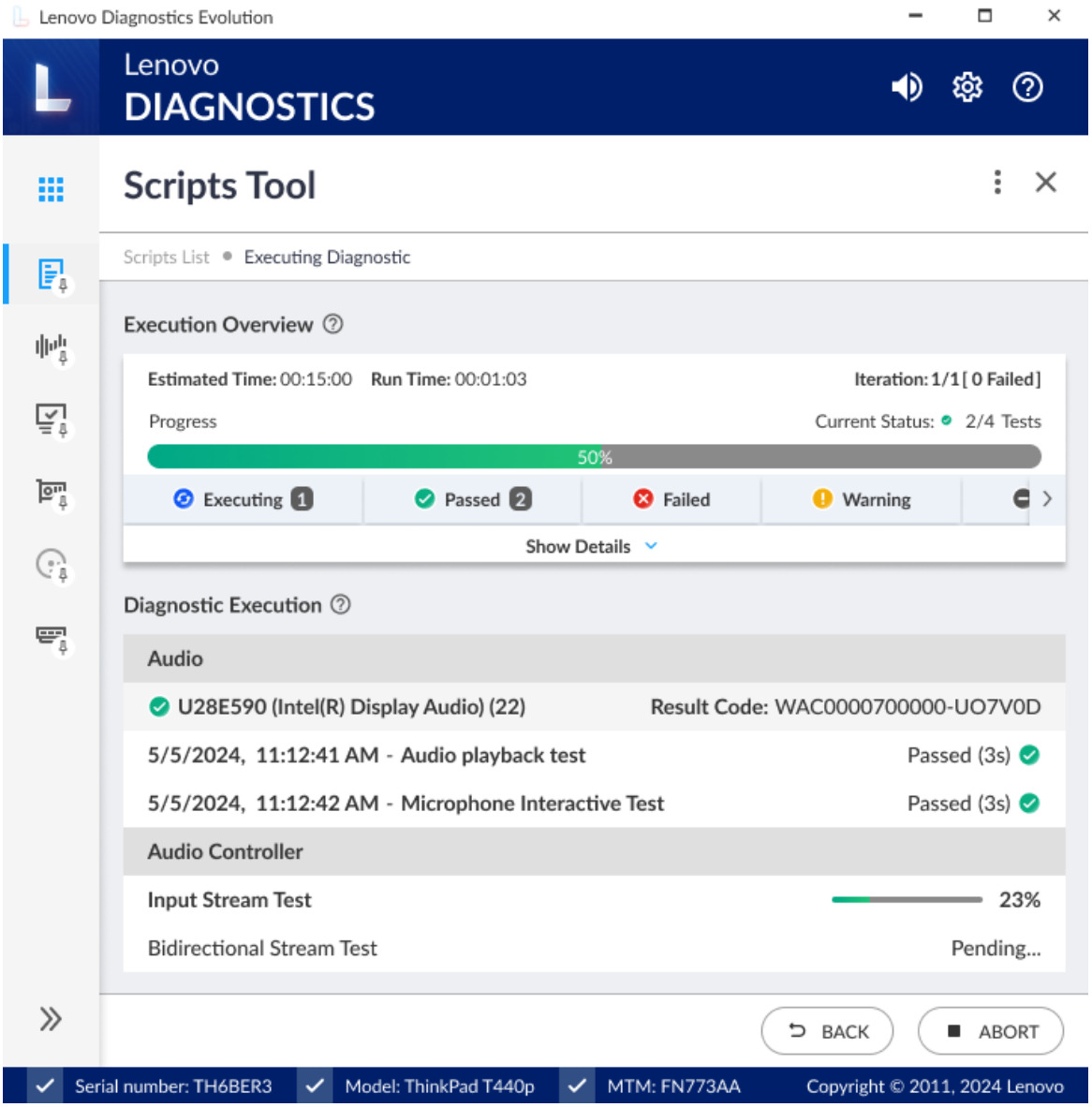
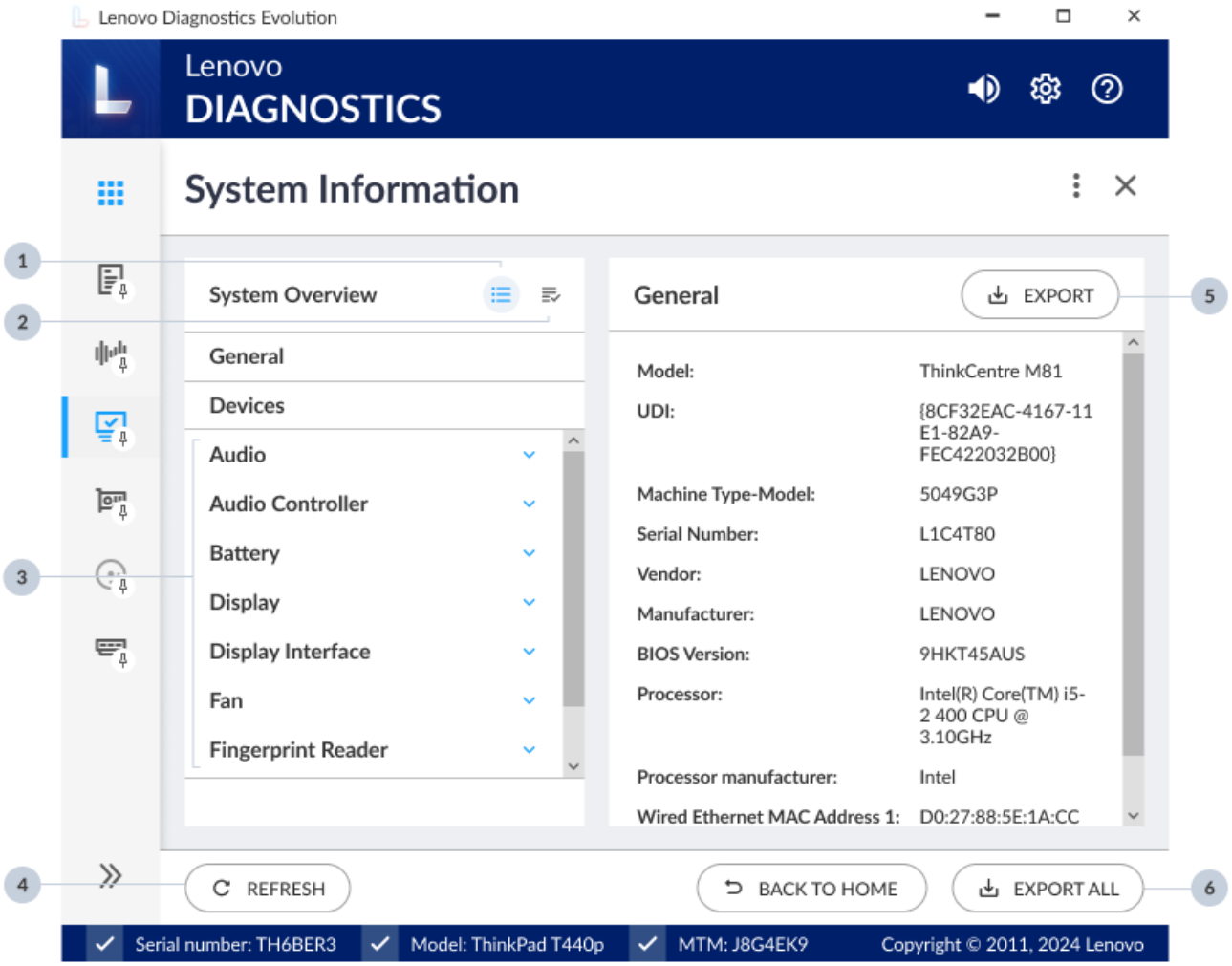


Figure 96: Scripts Tool (Script Execution)

When the diagnostic is finished, the log of execution is displayed. It is possible to export each iteration to a PDF or HTML file by clicking on the **Export** button.

5.3 System Information Tool

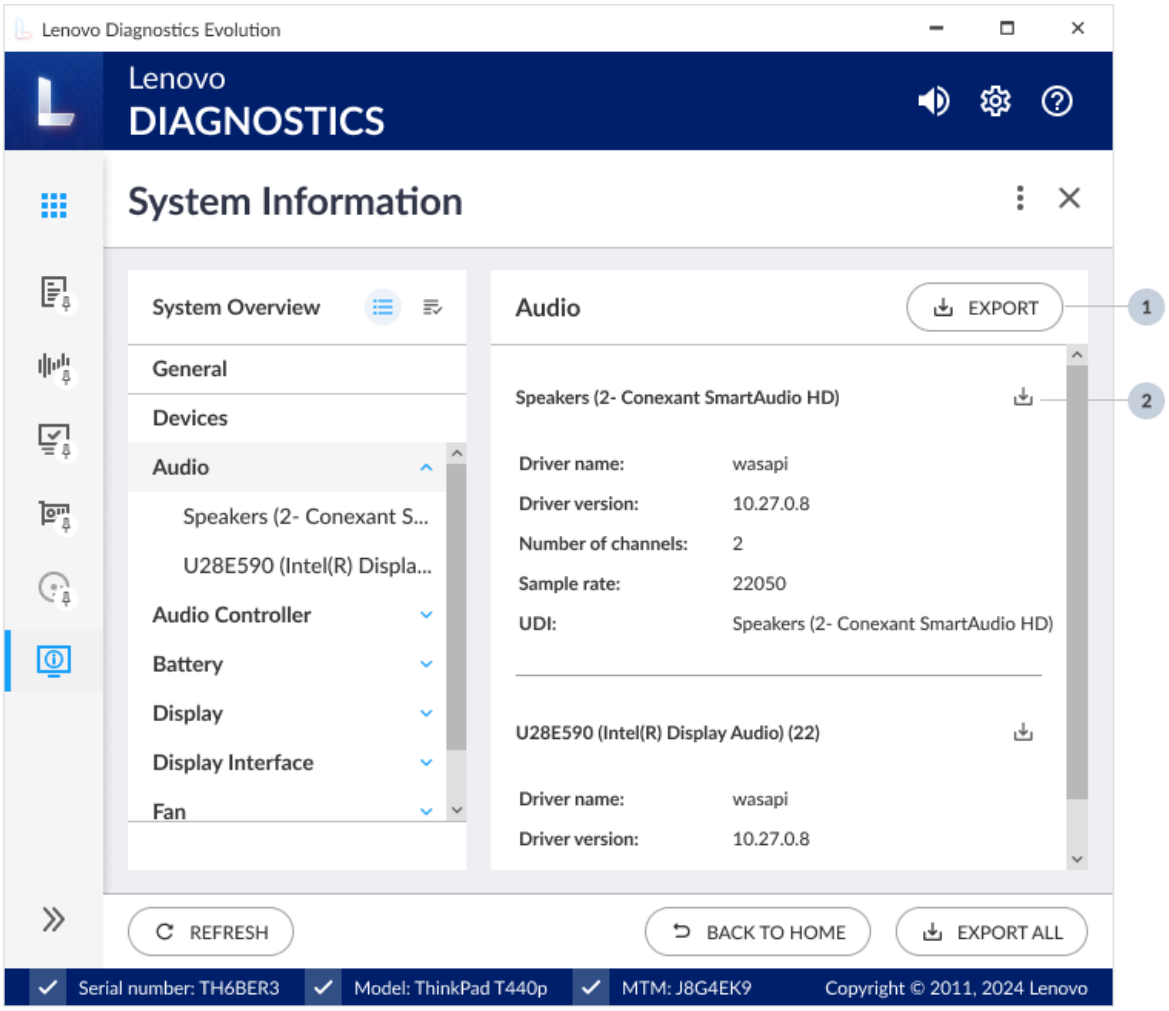
The system information tool allows you to see general information about the system and the available module's devices. See in the screen below that it's possible to navigate between the modules and export the General Information, select multiple devices/modules to be exported, or export all information in a single click.



1 - Device list
2 - Select multiples devices/modules
3 - Modules
4 - Refresh devices
5 - Export general machine information
6 - Export information from all devices

Figure 97: System Information Screen

You also can export the information from a module, or a specific device.



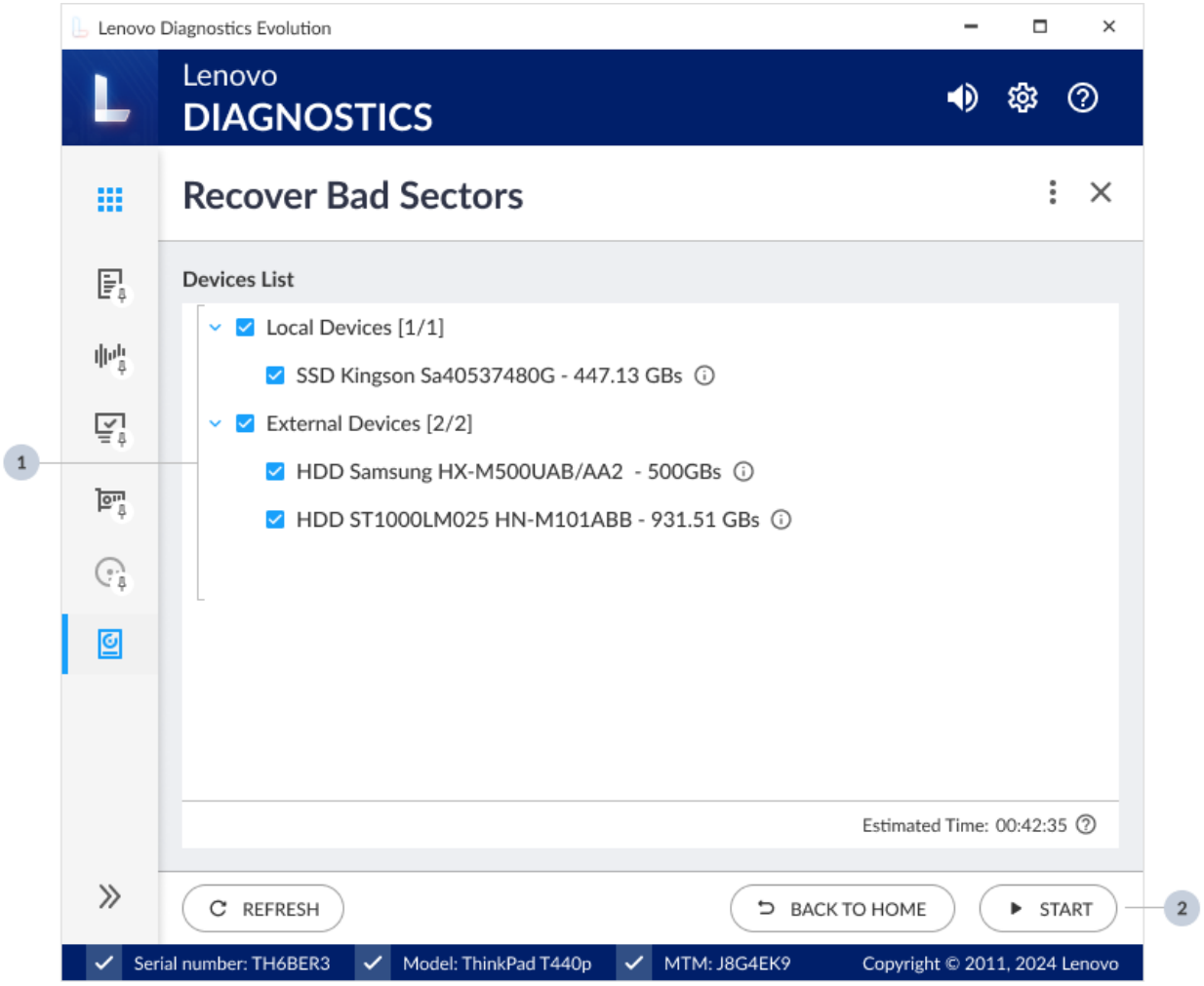
1 - Export module information
2 - Export device information

Figure 98: System Information (View Module Information)

5.4 Recover Bad Sectors Tool

The Recover Bad Sectors tool allows the user to scan HDD/SSD/SSHD SATA/NVMe devices for bad sectors and fix them whenever possible.

You can perform the tool on a specific device or all in supported devices. All devices will be executed sequentially.

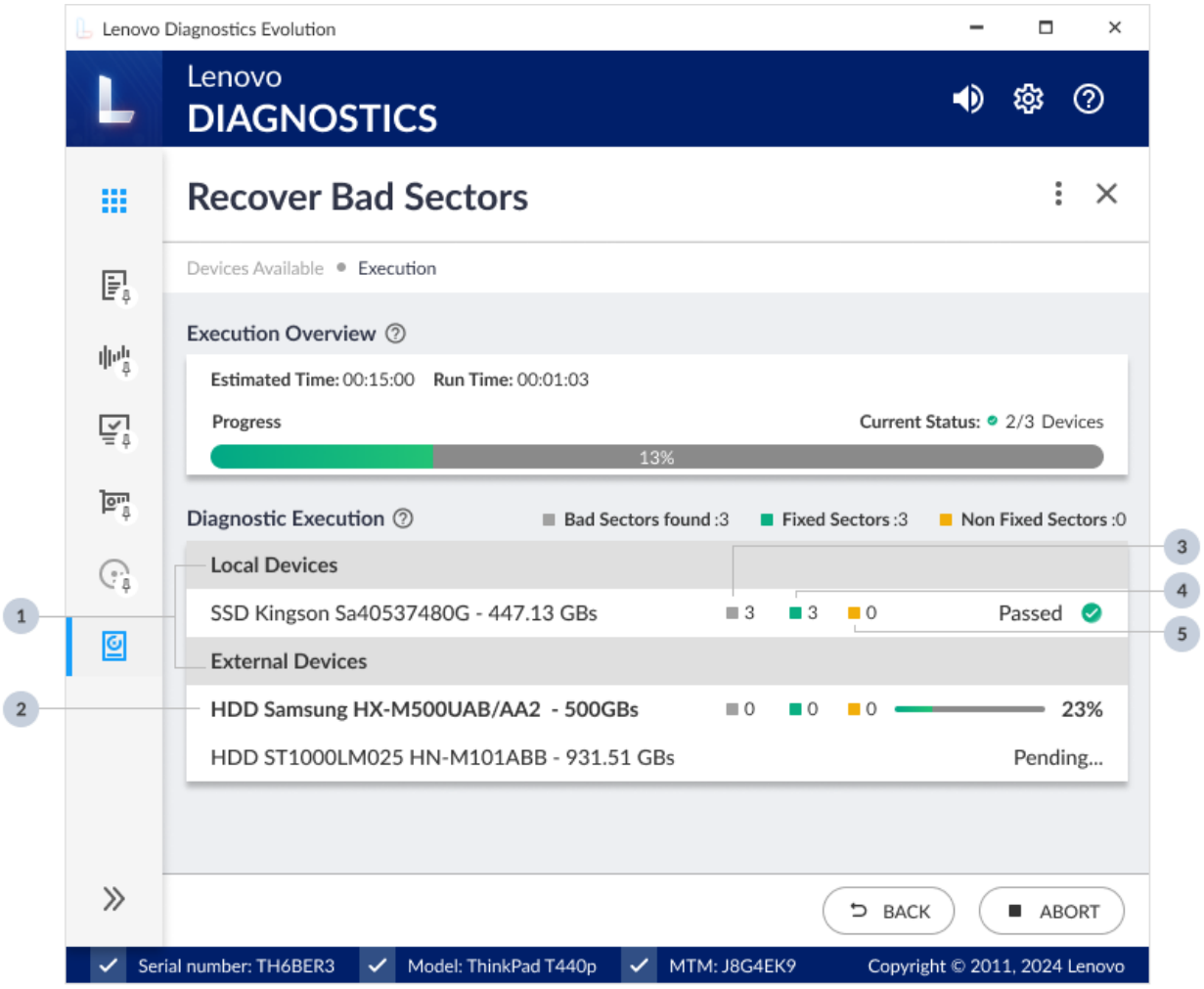


1 - List of supported devices
2 - Click to start the execution

Figure 99: Recover Bad Sectors Screen

On the Recover Bad Sectors screen, you can see the **list of supported devices** on your machine. You can select one or more devices for the execution.

By clicking on the **Start** button, the Execution Screen is displayed. In it, you will be able to follow the evolution of the general progress and each device, as well as the amount of Bad Sectors Found, Fixed Sectors, and Non-Fixed Sectors.



1 - Device types
2 - Device name
3 - Number of bad sectors found
4 - Number of fixed sectors
5 - Number of non-fixed sectors

Figure 100: Recover Bad Sectors Execution

5.5 Log History Tool

The Log History Tool allows you to see and export all logs of executions performed in the machine via Run All, Script Tool, and Modules.

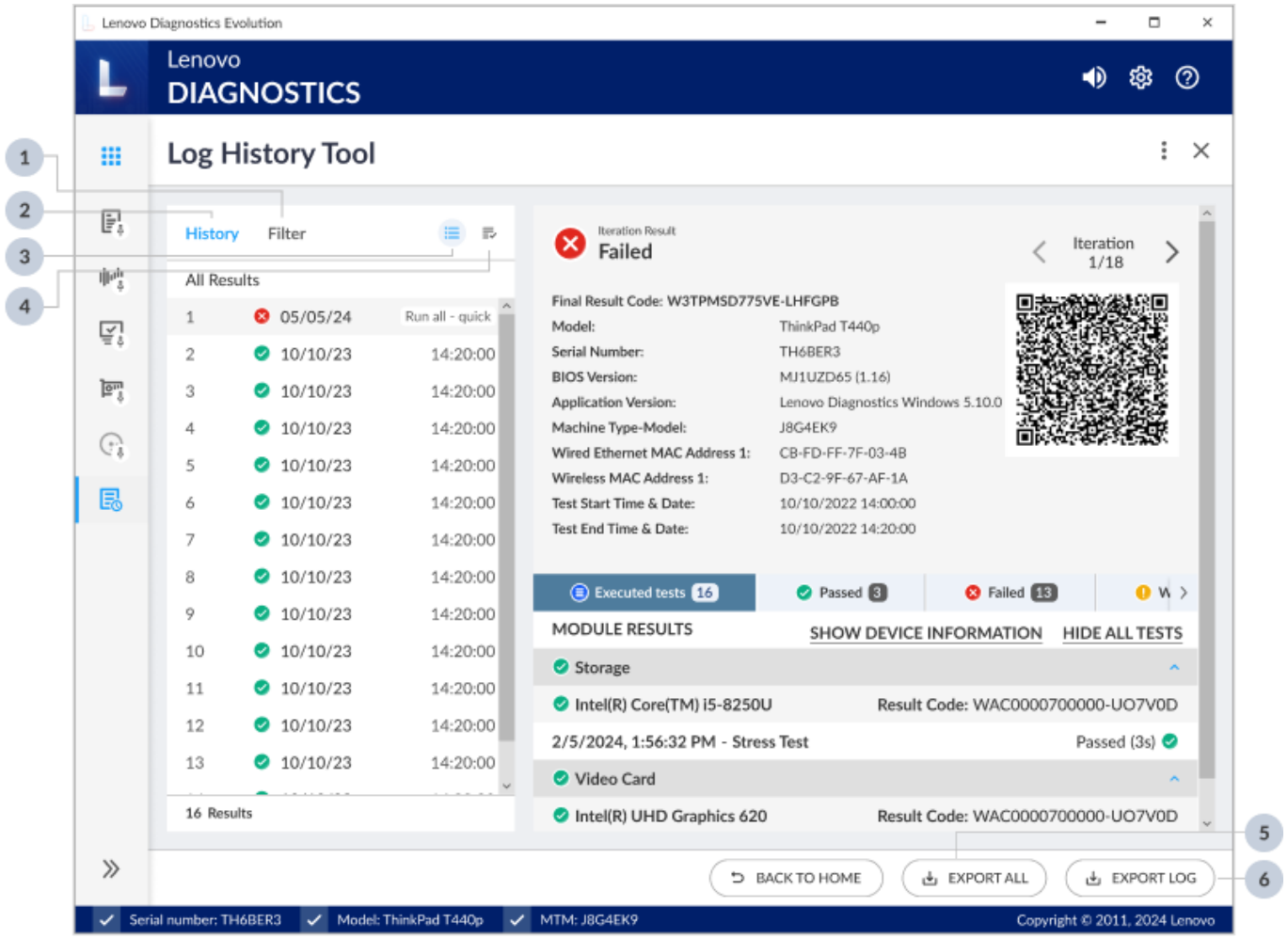
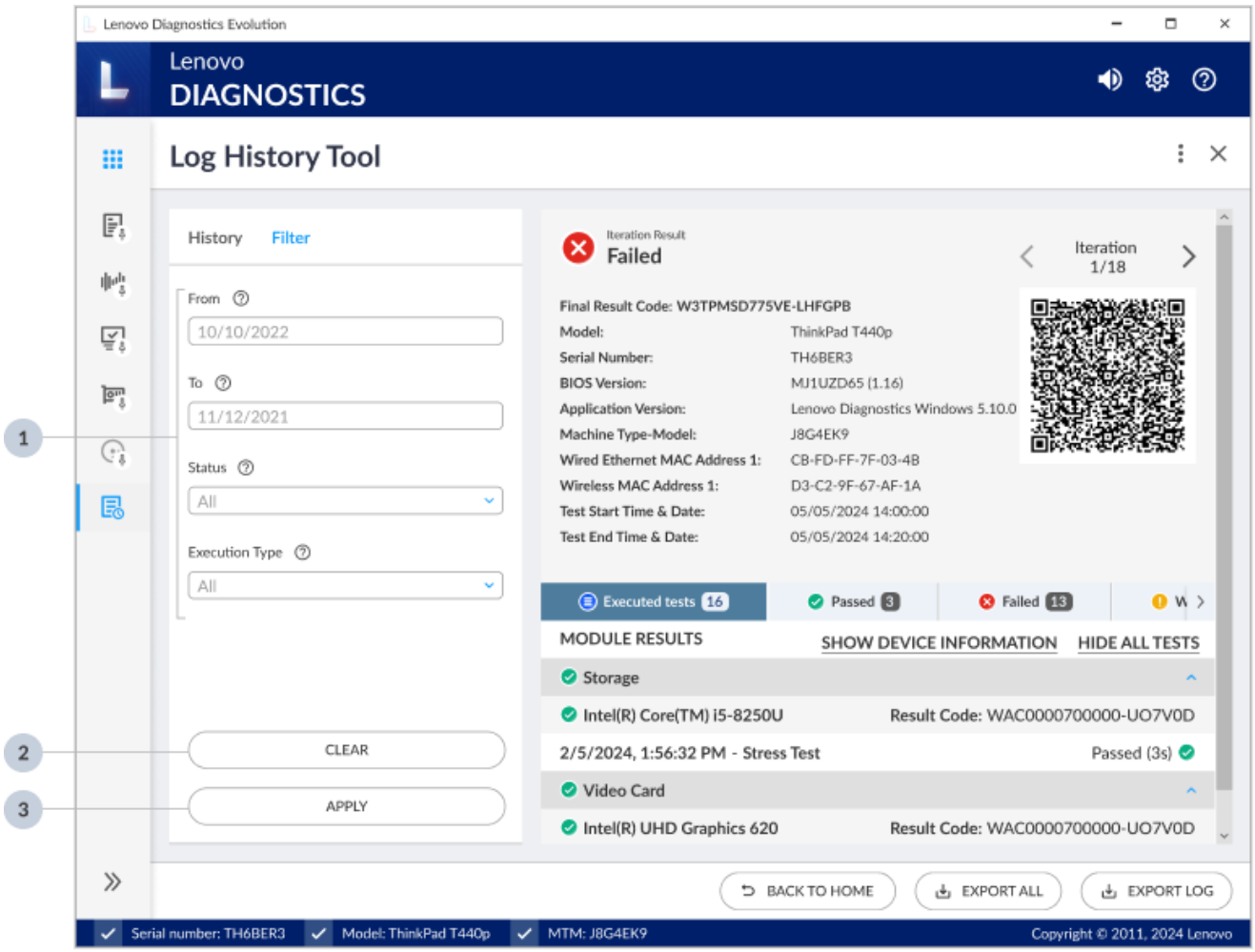


Figure 101: Log History Screen

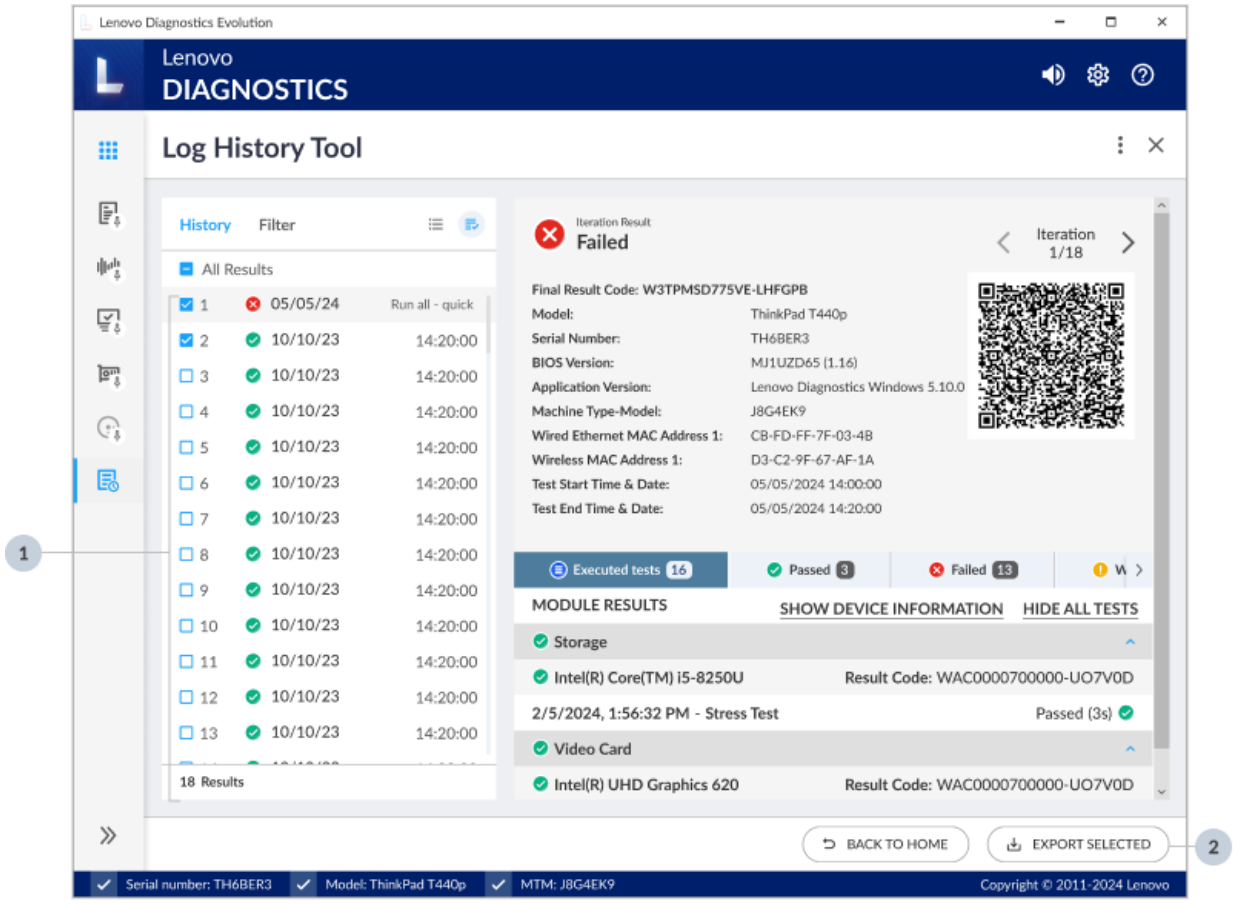
By clicking on the **Filter tab**, you can filter the logs by date using the From and To fields, by Status, and by Execution Type.



1 - Fields to customize the filter
2 - Click to clear filter fields
3 - Click to apply filter

Figure 102: Log History (Filter Logs)

By clicking on the **Select Multiple Logs** icon, you can select one or more logs to be exported at the same time.



1 - Click to on the checkboxes to select the logs
2 - Click to export selected logs

Figure 103: Log History (Select Multiple Devices)

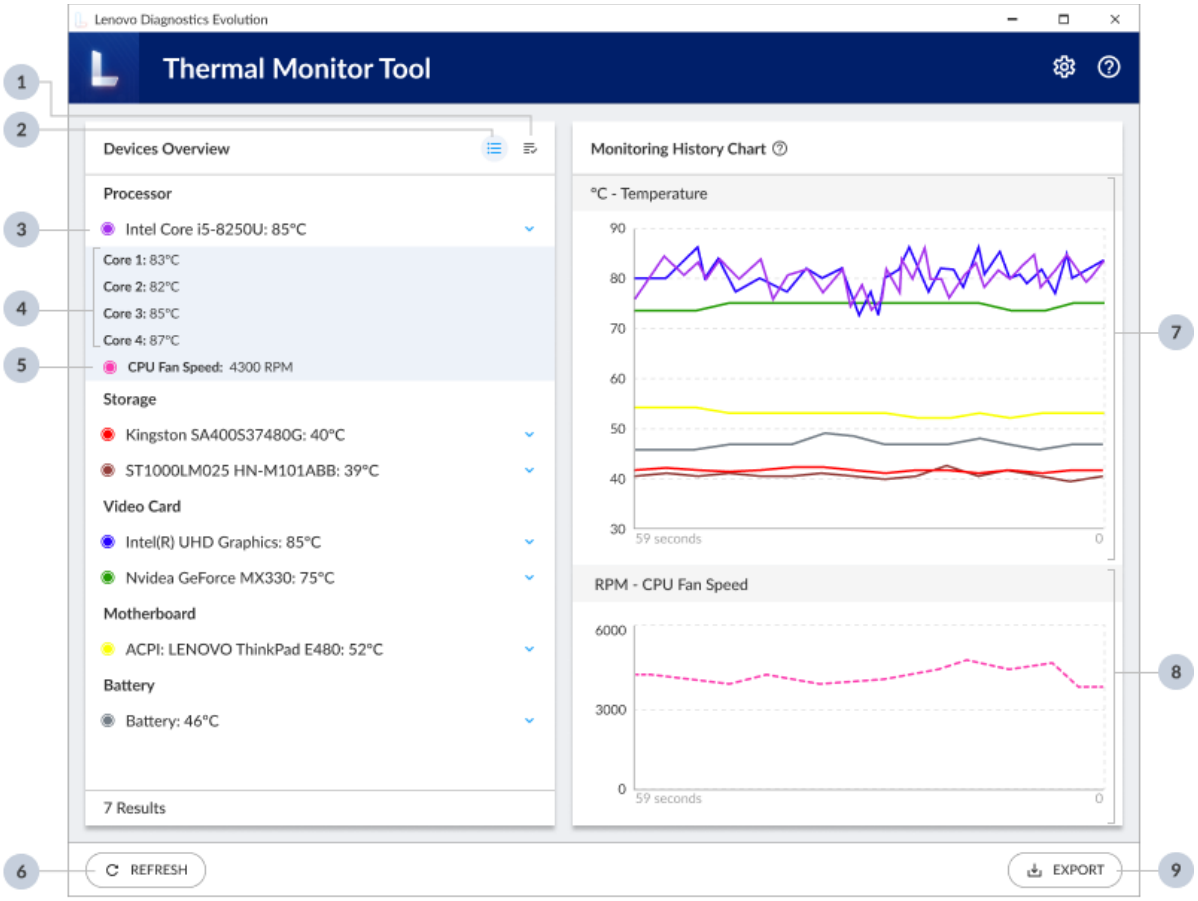
You are able to **export** the logs of executions performed in the machine by clicking on the export buttons:

- **Export All Button**: by clicking on it, you can export all Logs found in the filter. The logs must be saved in HTML format inside a .zip folder.
- **Export Log Button**: by clicking on it, you can export only the log being displayed, in the HTML or PDF format for each run.
- **Export Selected Button**: by clicking on it, you can export only the selected logs. The logs must be saved in HTML format inside a .zip folder.

5.6 Thermal Monitor Tool

The Thermal Monitor Tool allows you to see the thermal information (temperature and fan speed) of some hardware devices in real-time.

On the **Devices Overview**, you can see the list of supported devices on your machine with their respective temperature. On the **Monitoring History Chart**, the charts show the device's thermal information collected over the last 60 seconds. See the description of each component in the image below.



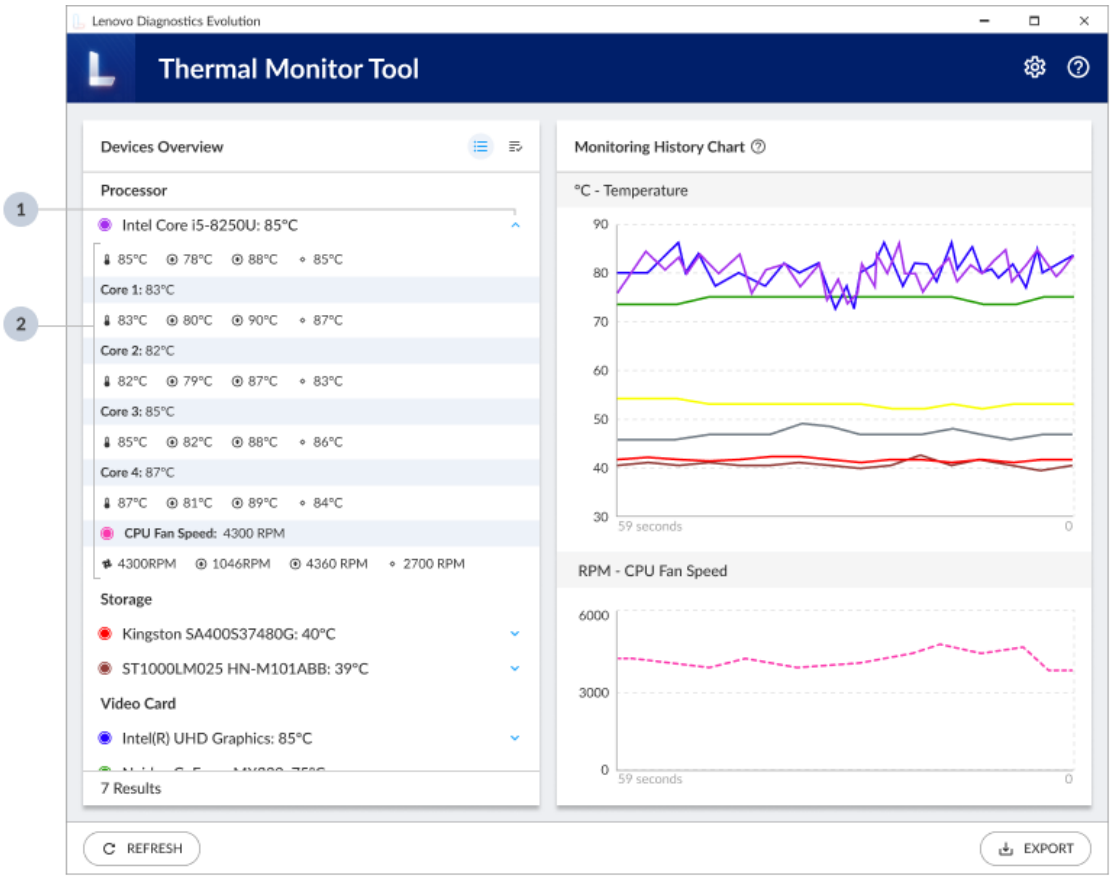
1 - Selection Mode view
2 - List Mode View
3 - Current device temperature
4 - Current cores temperatures
5 - Current CPU Fan Speed
6 - Refresh the devices, charts and logs
7 - Temperature Chart
8 - Fan Speed Chart
9 - Export detailed log information

Figure 104: Thermal Monitor Tool Overview

Note: The cores temperature is only shown for Intel Processors.

By clicking on the **Settings** button, you are able to switch the temperature scale between Celsius and Fahrenheit.

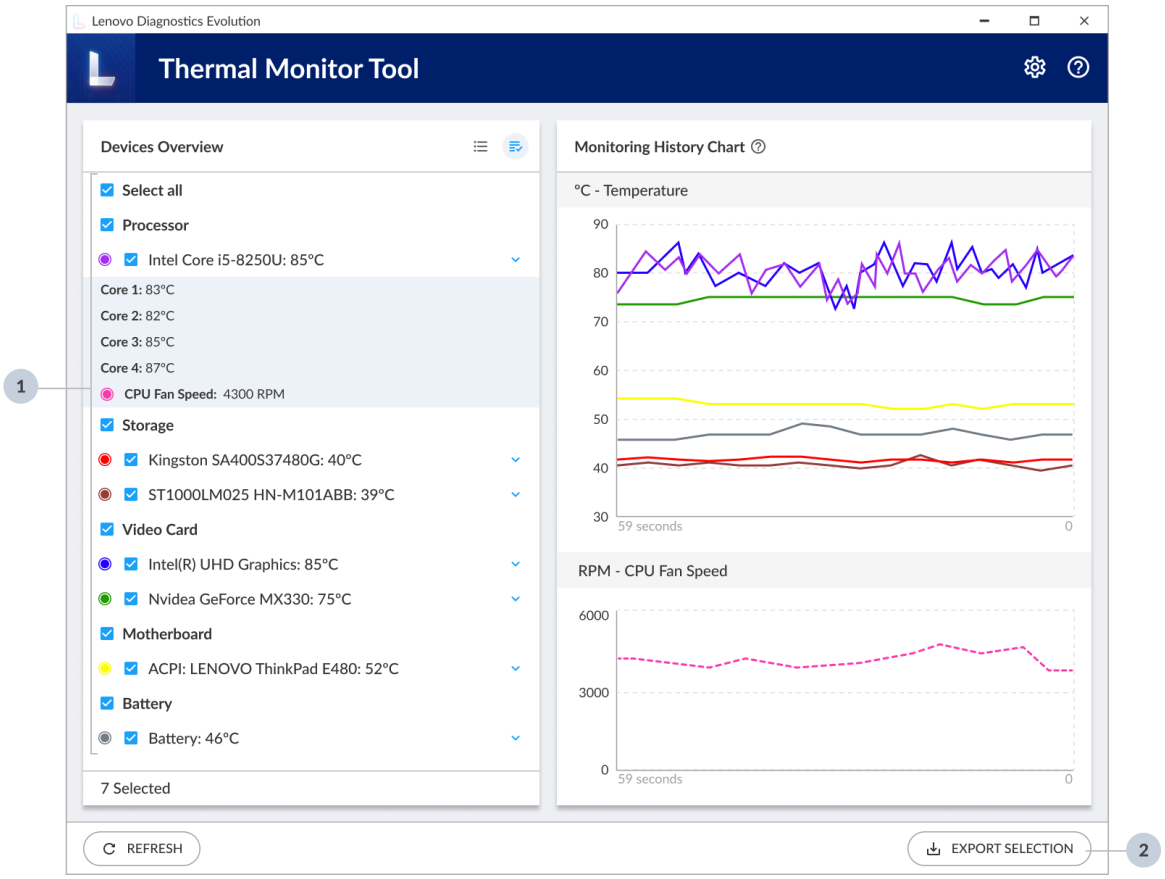
By clicking on the Collapse/Expand icon, you can collapse or expand the thermal information to see the current, minimum, maximum, and average temperatures.



1 - Collapse/Expand thermal information
2 - Expanded device thermal information

Figure 105: Thermal Monitor Tool (Collapse/Expand thermal information)

By clicking on the **Selection Mode** icon, you can select one or more devices to be shown in the chart or to be exported at the same time.



1 - Click to on the check-boxes to select devices to show in the chart view
2 - Click to export selected devices

Figure 106: Thermal Monitor Tool (Selection Mode)

You are able to **export** the detailed log by clicking on the export buttons:

- **Export**: by clicking on it, you can export the log containing all devices thermal information.
- **Export Selection**: by clicking on it while in the **Selection Mode**, you can export only the selected devices thermal information.

The logs will be saved in HTML and TXT format inside a .zip file.

6. GLOSSARY

Attended test: It is a test that depends on some user action to be executed.

Extended Test: A type of test that can be performed in several minutes.

Module: a module contains a set of tests that can be performed for a type of device. It is enabled in the application only if the tested machine has at least one device supported by the module.

Quick test: A type of test that is performed in a few minutes.

Screen reader: A software program that read the text and elements displayed on the computer screen.

Unattended test: It is a test that does not depend on the user actions to be executed. All steps are performed automatically by the application

TrackPoint: Is a pointing stick, commonly found on ThinkPad laptops, that allows you to control the cursor on your screen. It is a small, red joystick-like nub located between the G, H, and B keys on the keyboard. You can use it to move the cursor smoothly and accurately without lifting your hands off the keyboard.

7. CONTACT SUPPORT

Do you need help or have any questions?

If you need assistance, have questions about our services, or wish to provide feedback for improvement, please do not hesitate to contact our support team via email at diagssupport@lenovo.com.

Thank you for choosing our services!