LENOVO DIAGNOSTICS V4.41.0   **USER GUIDE**

LSBD – Laboratório de Sistemas e Banco de Dados

Lenovo

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LENOVO DIAGNOSTICS **USER GUIDE**

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1. LENOVO DIAGNOSTICS **OVERVIEW**

1.1 What is Lenovo Diagnostics?

Lenovo Diagnostics is a diagnostic tool that tests various devices in Lenovo computers providing feedback to the users about their machines health. Lenovo Diagnostics is composed by Modules that allows performing diagnostics for a group of devices and by Tools to create custom executions (diagnostic script), see detailed information about each device (system information) and consult the results for the tests performed in a machine (Log History).
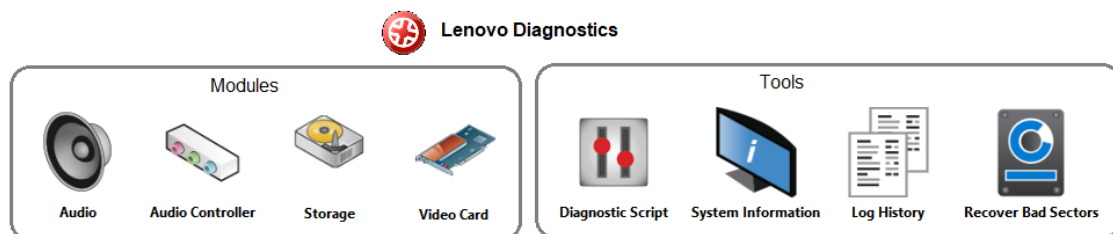
1.2 Understanding the diagnostics

Each module contains one or more tests that may be performed under one or more devices resulting in a diagnostic. This structure is displayed in the image below:
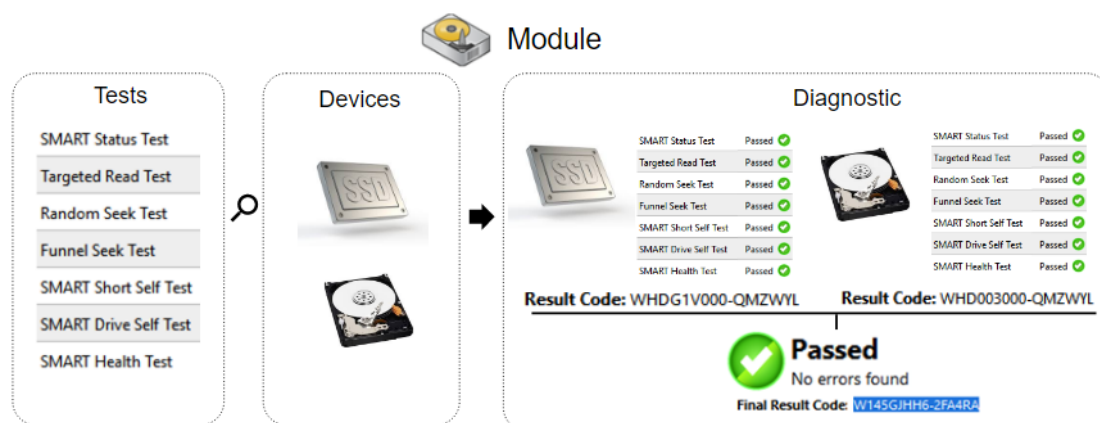
When a diagnostic is finished, Lenovo Diagnostics displays the results for each performed test and create two results codes resuming the test execution.

The tests on Lenovo Diagnostics may have the following statuses:

✅	**Passed**	When the test algorithm is executed, and no failure is found.
❌	**Failed**	When the test identifies the diagnosed device is 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 for the selected device.

The generated codes are:

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.

On the next section, you will learn how to use Lenovo Diagnostics to perform the diagnostics.

1.3 Data Collection

Lenovo Diagnostics tool perform collect anonymous data regarding tests execution for the purpose of improve hardware's diagnostics. You are able to enable or disable that function in accordance with 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.
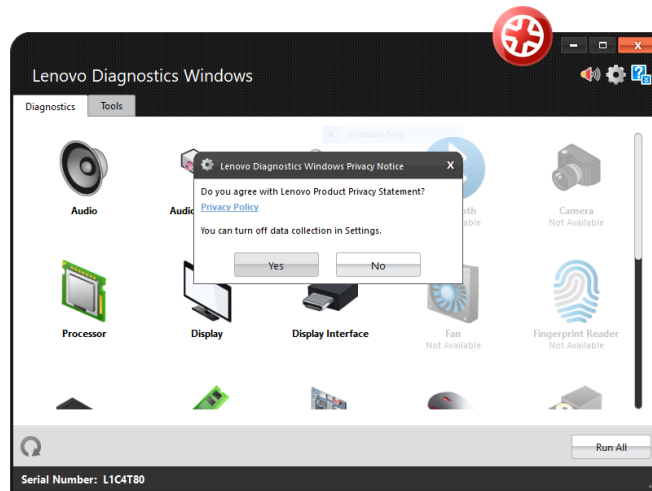
You also may change this option at any time by clicking at the Settings icon ⚙
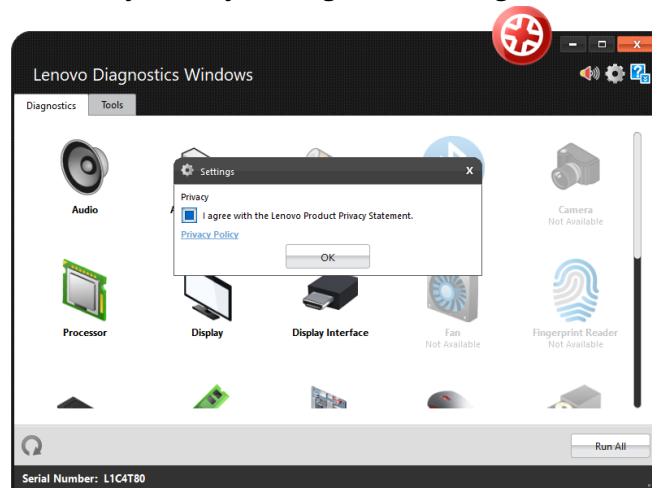
2. PERFORMING DIAGNOSTICS IN **LENOVO DIAGNOSTICS**

2.1 Lenovo Diagnostics Main screen

By opening the Lenovo Diagnostics, you will see the main screen with the tabs Diagnostics and Tools.

Diagnostics: here, you can see the modules provided by Lenovo Diagnostics and select one of them to perform tests. As you will using the application, the icons will be reordered according to the use. The modules with not

supported devices are disabled, like the modules RAID, Sensors and Wireless on the image below. On this tab, you can also select the option "Run All" to perform the diagnostic for all available modules

Refresh button : you may update the modules after plug or unplug any device.

Sound Notice button : you may choose if you want to be advised regarding tests execution.

Tools: By selecting this option, you can access additional Lenovo Diagnostic's features like Diagnostic Script, System Information, Log History screen, Recover Bad Sectors tool, eGather Report, Powercgf Reports and temperature.

2.2 Run diagnostic for a module

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

2.2.1 Select Devices and Tests

By selecting a module in the Diagnostics tab, you will be directed 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. It is also possible to select the number of times to run the set of tests in a range from 1 to 20 times.
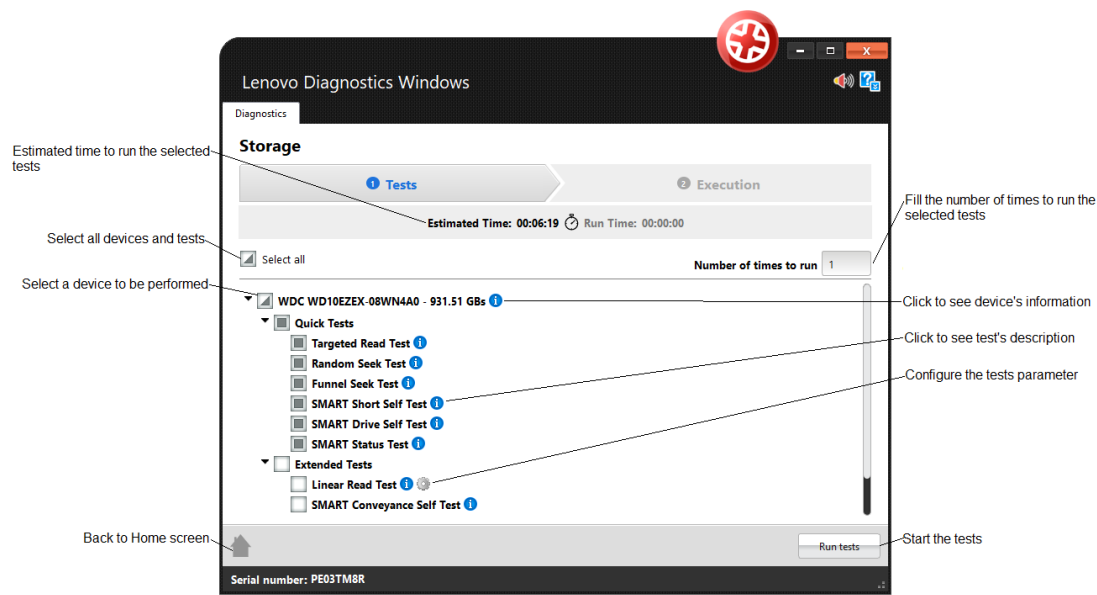
By clicking to **See Device Information**, you can view detailed information about the device. The properties displayed depends on the selected module.
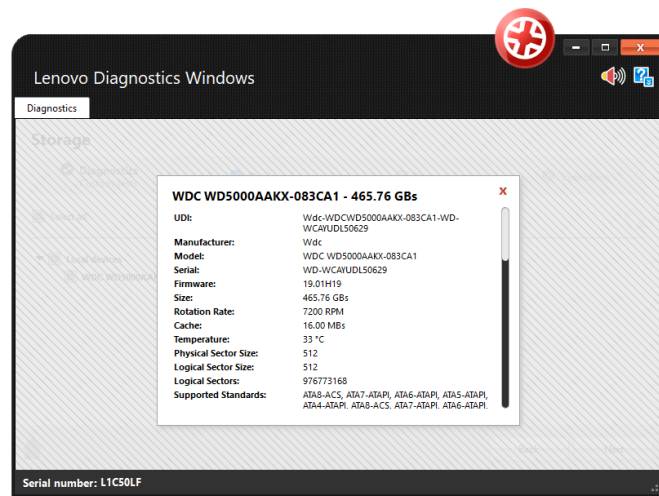
By clicking to **See test description**, you can view a brief description of the test and the estimated time to run the test, as the screen below.
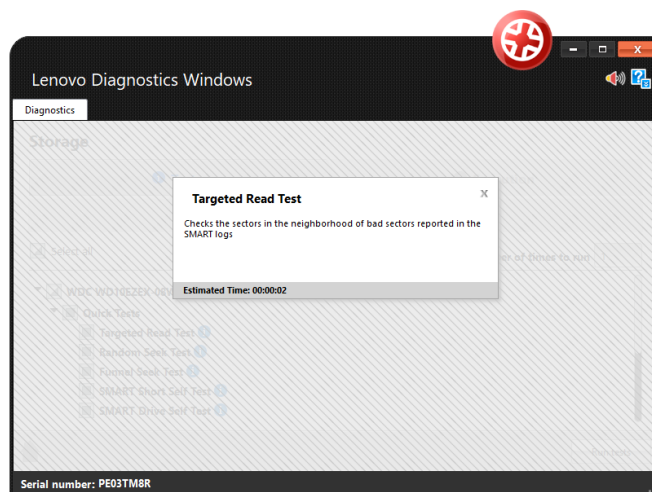
If a test supports parameters customization, the icon ⚙ is displayed next to the test name. By clicking on this icon, a popup to set the values is displayed. See in in the image below the customization for the Linear Read Test from Storage module:
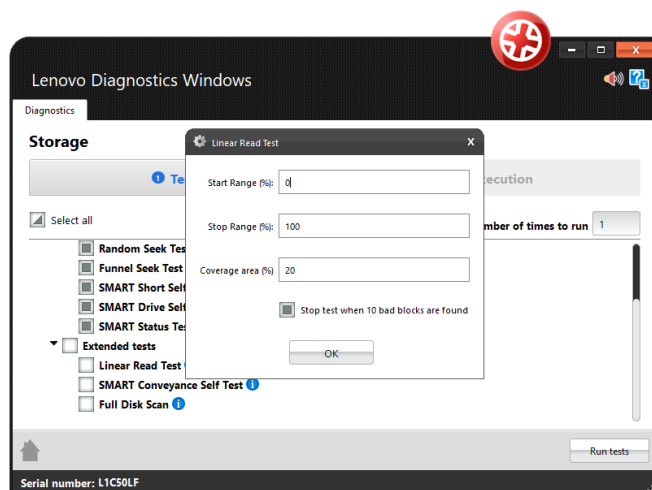
After the devices and test selection, you are able to run the diagnostic. The test execution is detailed in the next section.

2.2.2 Run Tests

After configuring the tests execution and clicking to **Run Test,** you will be directed to the Execution screen. This screen is displayed for both Recommended and Custom tests.

In the image below, you can see a screen of the test execution. See the popup advising you to refrain from using your computer unless requested by some tests. Follow this advisement is important because some tests may not be performed correctly if the needed machine resources are in use.
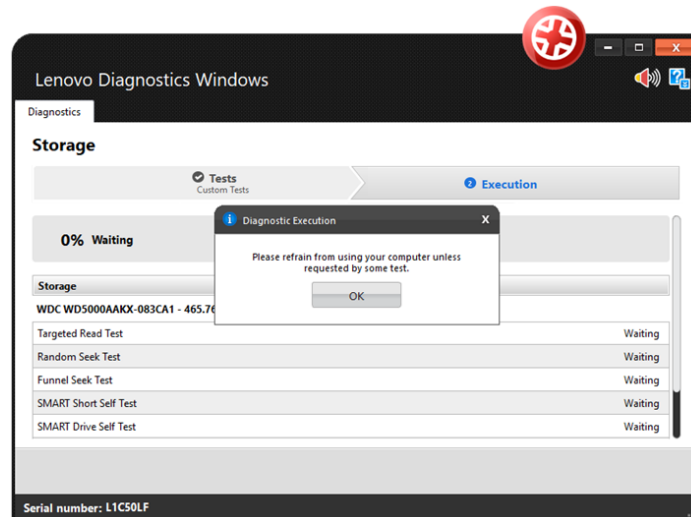
Once you have pressed OK, the tests execution begins. See in the image below that all devices selected in the previous steps are displayed with their respective tests. You can follow each test execution by tracking the individual test progress and see the test status of each one. In addition, you can see the overall test progress and time that reports the progress for all devices and tests selected.

If you have selected **Custom Tests** with more than one iteration, you will be able to see amount iterations that fail navigate around these iterations in order to see the executions already finished and the executions not started yet.
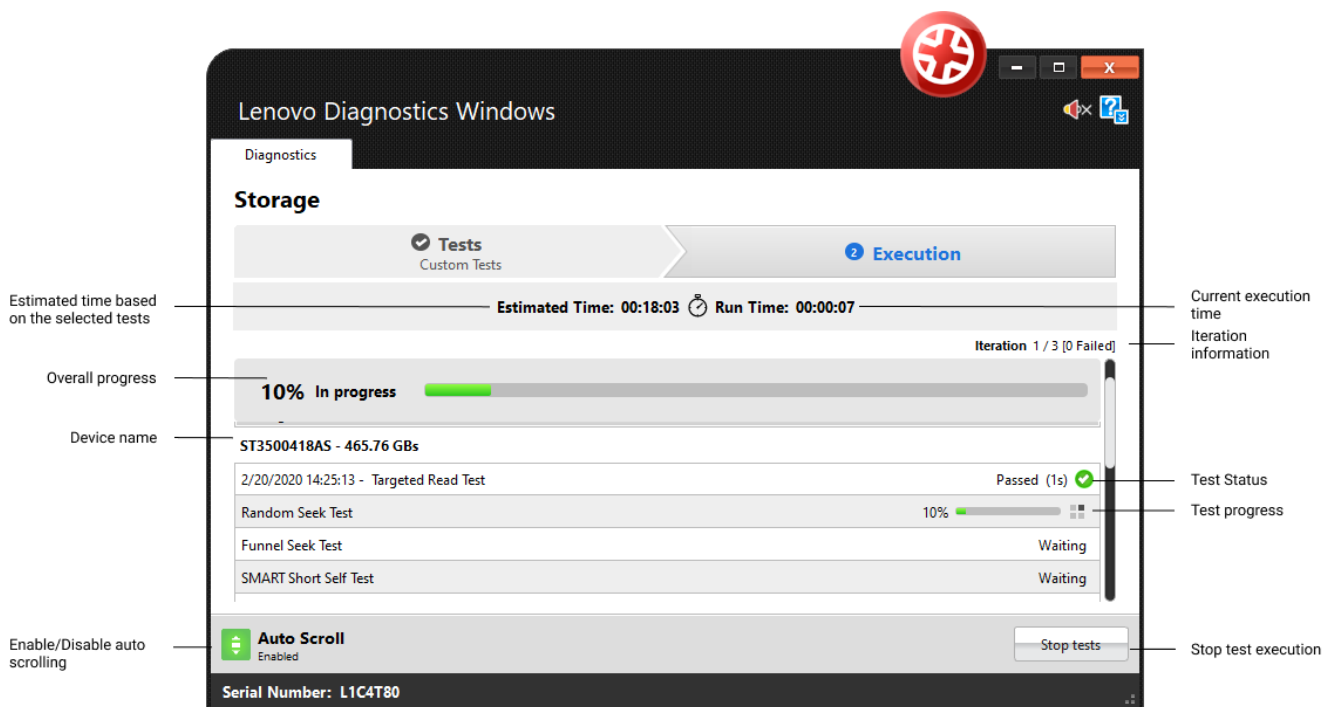
Some tests has specific guidelines that should be followed by the user to assure the correct execution. In this case, before to begin the execution of these tests, the application displays a popup with the test instructions. For instance, the Audio Playback test asks the user to make sure the output device is working correctly and advises a probably loud sound will played.
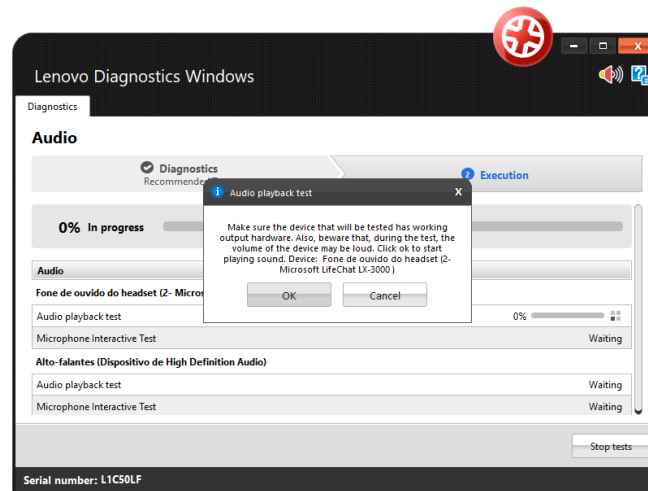
If you chose to continue by pressing the **OK** button, the execution continues normally. If you click on Cancel, the current test is canceled and the execution proceeds to the other tests not executed yet.

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

After all tests to being finished, system displays the screen below where is possible to analyze the test results.
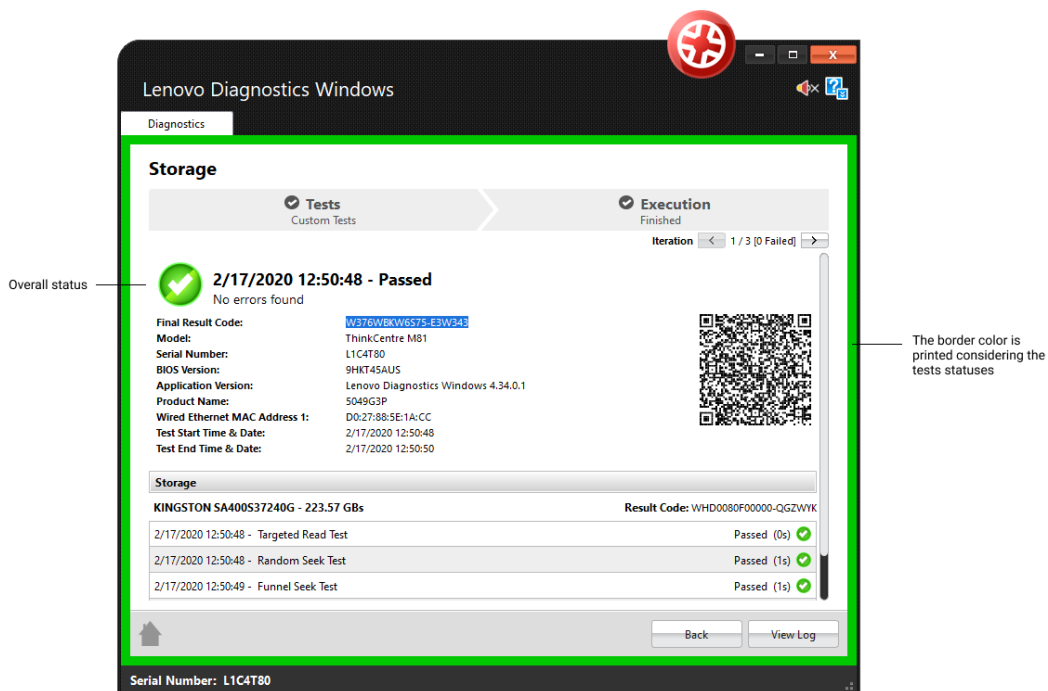
In this above image, you can see each test results, information about machine, final result code and test date. This section also displays a QR Code that containing all those information.

2.3 See Execution Log

After a diagnostic execution, Lenovo Diagnostics generates a log with detailed information about the devices and their test results. This log is composed by the following sections:

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

Device information: displays the technical details of each tested device and their respective result codes.

Test Results: displays the results and execution time of each performed test.

3. LENOVO DIAGNOSTICS **MODULES AND TESTS**

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

3.1 Audio

The Audio module is composed by the following tests:

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

Audio Playback Test

The audio playback test tries to play random numbers through the audio hardware and asks the user in what order the numbers were played.
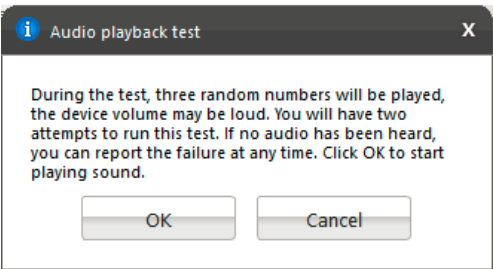
Advise the user that device volume may be loud during the execution.
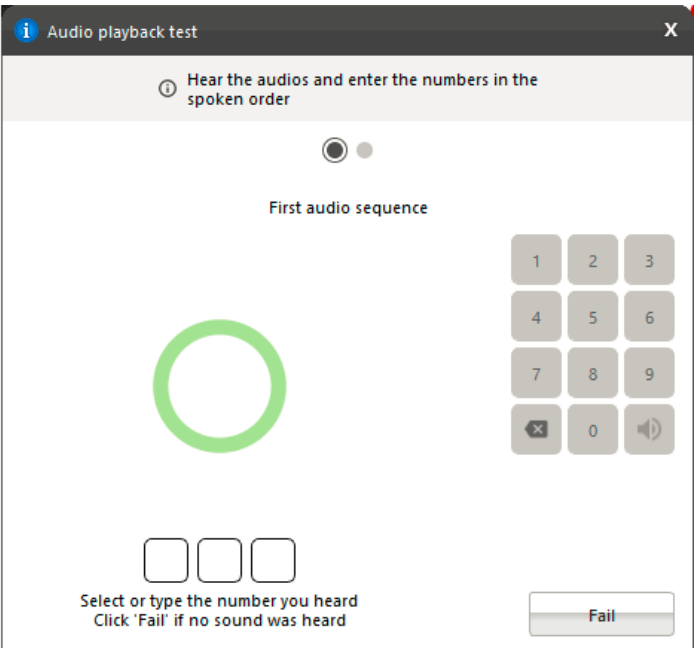
Play three random numbers and ask the user what order the numbers were played.

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:
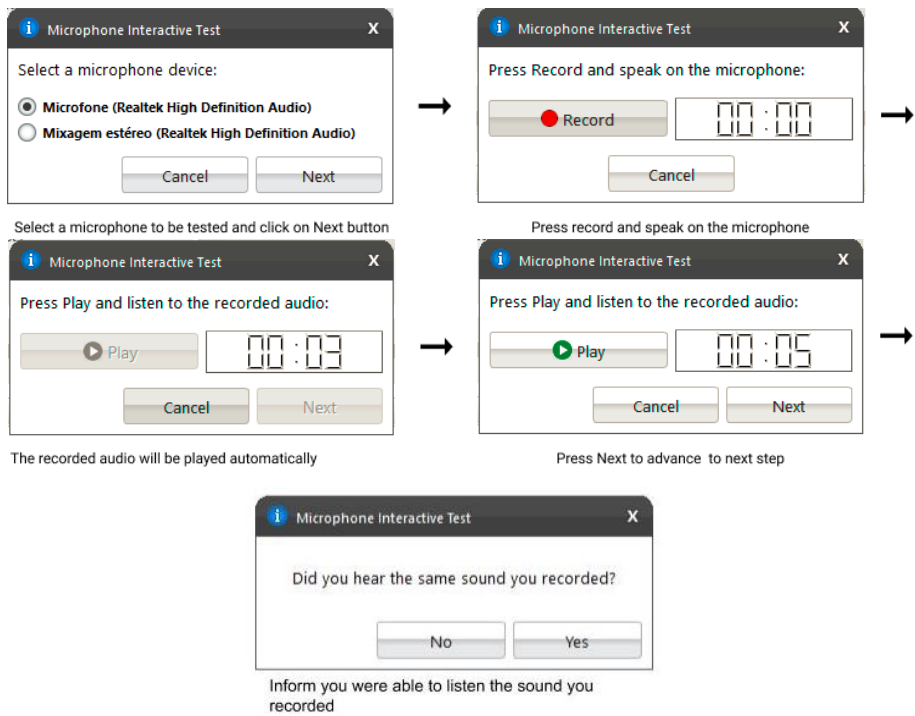
3.2 Audio Controller

The Audio Controller module is composed by 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 the user that a short audio tune will be played as displayed in the image below.
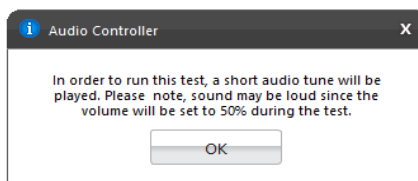
Input Stream Test
This test checks the status of the input streams.

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

3.3 Battery

The Battery module is composed by the following tests:

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

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

Battery Discharge Test
Battery Discharge Test checks the device charge capacity and other important battery properties in order to evaluate device's health. If there is an AC cable plugged you will must to unplug it before proceeding to the test as displayed below.
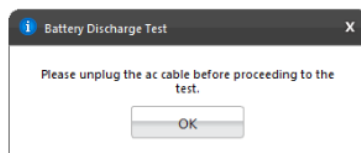
Battery Charge Test
The test checks if the battery charge increases while the AC cable is connected. If there is no AC cable plugged you should connect it before proceeding to the test.
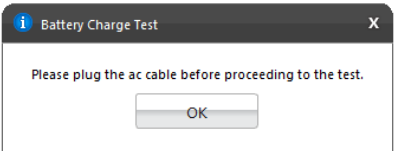
Battery Temperature Test

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

3.4 Camera

 The Camera module is composed by the following tests:

Test	Test type	Attendance
Camera Capture Test	Quick	Attended

Camera Capture Test

Verifies if the camera device is working properly based on the user's feedback for the captures images. This test is performed according to the following workflow:

Inform the user the video from camera will be displayed → Display the video from camera → Ask the user if the images was properly displayed
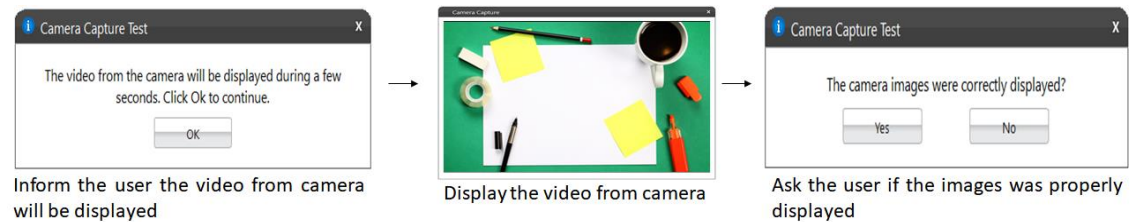
3.5 Fan

 The Fan module is composed by the following test:

'	Test type	Attendance
Control Test	Quick	Unattended

Control Test

Check if the fan controller is able to work on higher speeds according to predefined levels (0-7) in the firmware.

3.6 Processor

The Processor module is composed by the following tests:

Test	Test type	Attendance
BT Instruction Test	Quick	Unattended
x87 Floating Point Test	Quick	Unattended
MMX Test	Quick	Unattended
3dnow! Test	Quick	Unattended
SSE Family 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 feature, the test returns unsupported.

MMX Test

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

3dnow! Test

The test checks the processor support for 3Dnow! Instructions. This test only runs in AMD processors. If the processor does not support such 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 feature, the test returns unsupported.

AES Test

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

Stress Test

The stress test performs a sequence of continuous check on all processor cores for 10 minutes. While running this test, the CPU temperature can increase considerably

3.7 Display

The Display module is composed by the following tests:

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

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

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

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

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

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

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

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

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.

Sharpness Test

This test identifies sharpness problems.

Resolution Fitting Test

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

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.

Advise the user that her screen will be filled with some colors.

Fill the screen with a color.

Ask the user which number is being displayed.
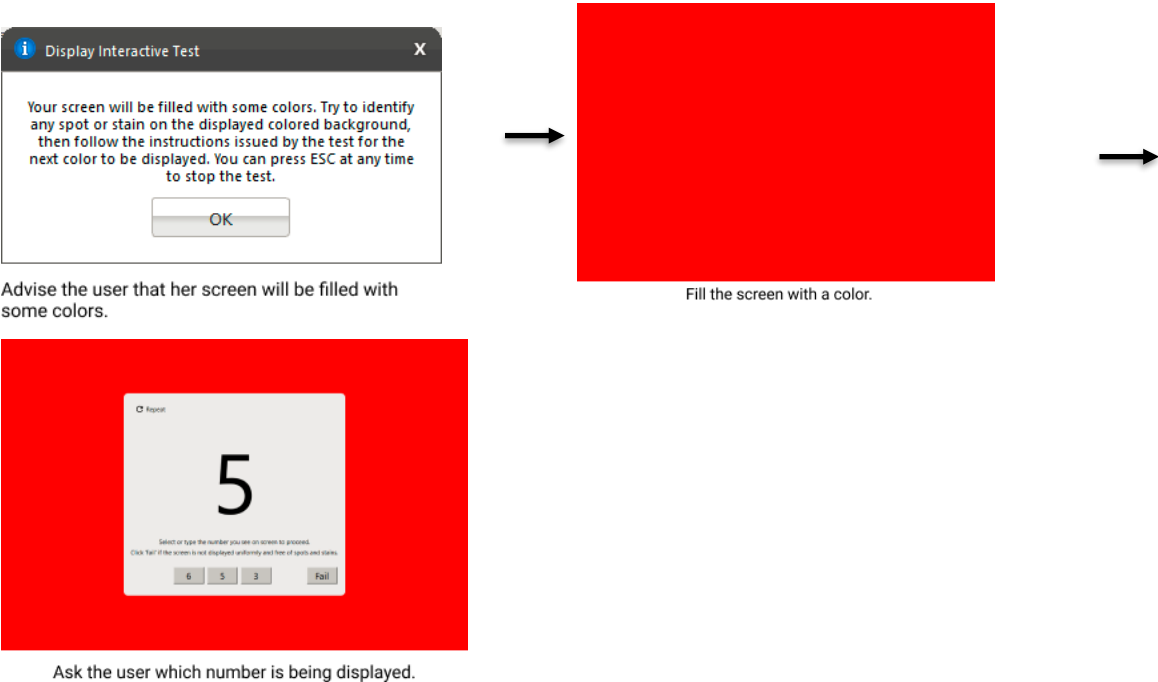
All Purity tests from Display module are performed according to the following workflow:

Advise the user that her screen will be filled with the color

Fill the screen with the color

Ask the user if the color was properly displayed
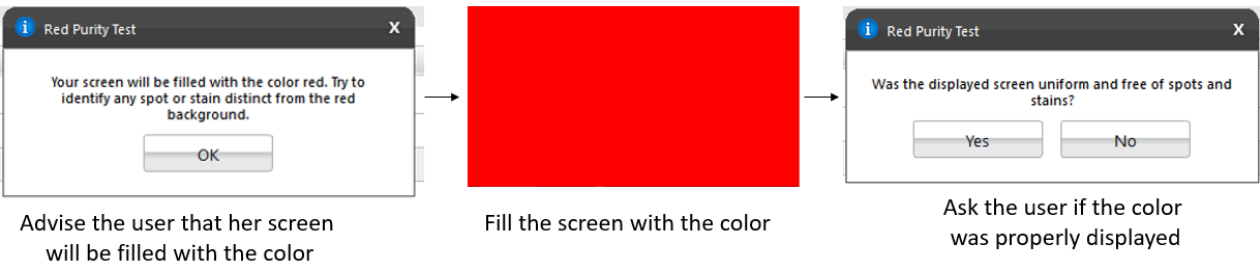
3.8 Display Interface

The Display module is composed by 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.

3.9 Keyboard

The Keyboard module is composed by 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

PS2 Keyboard Test

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

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 the user confirms the all keys that him have pressed was displayed, the test is finished as Passed. Otherwise the test is finished as Failed.
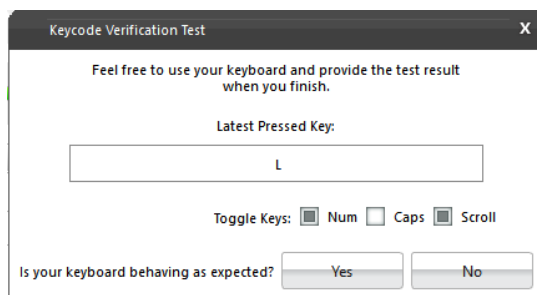
Advanced Test

Interactive test to verify the status of the keyboard keys.

The test will marking the pressed keys until you test all keys. You are able to select the most appropriate keyboard layout.
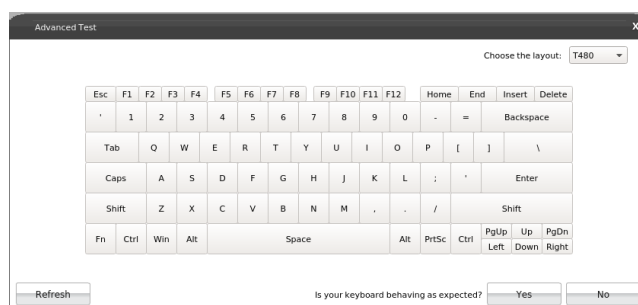
3.10 Memory

The Memory module is composed by 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

Quick Random Pattern Test

The test consists of filling the memory with a random 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, and writing its complement in an 8 bytes block size (64 bits) and then checking it again. This procedure is repeated twice, being the first one addressing 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 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 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 Read 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 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 Read 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 shift 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 testing 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 shift 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 test is intended to cover most of the Stuck-At Faults and some cases of Coupling Faults, and also testing 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 is able to 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 which 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 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 random 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. In order 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 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. It repeats the movements described above 80 times. 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.

3.11 Motherboard

The Motherboard module is composed by 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 the status registers of the PCI Express onboard devices 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.

3.12 Optical Drive

The Optical Drive module is composed by 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:
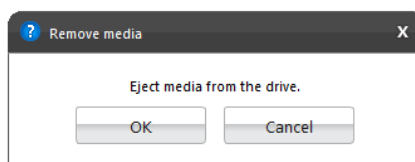
Linear Seek Test

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

Read and Compare Test

Checks the drive'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 the user must have a media containing at least the following amount of date 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 an optical media. For executing this test you must have a 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 the following workflow:
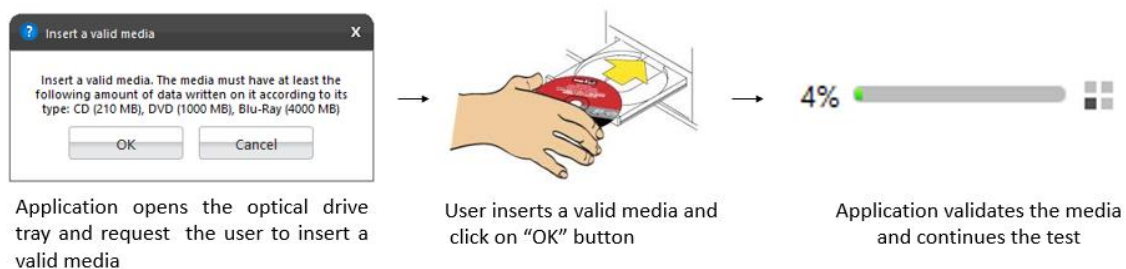
3.13 PCI Express

The PCI Express module is composed by the following tests:

Test	Test type	Attendance
Status Test	Quick	Attended

Status Test
Verifies that all of the PCI Express devices are recognized and communicating with the system.

3.14 Mouse Devices

The Mouse Devices module is composed by 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 the user to perform some actions regarding them. The Click Test execution is based on the workflow below.

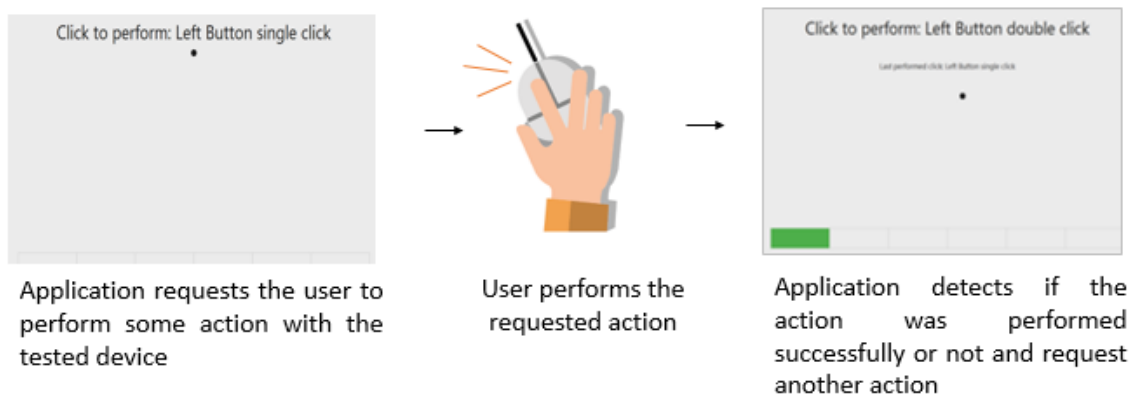Application requests the user to perform some action with the tested device → User performs the requested action → Application detects if the action was performed successfully or not and request another action

The user 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 pointing device.

The user has 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 the user does not perform any action for 30 seconds, the following popup is displayed:

If the user 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 the user selects "No", the test is canceled because the actions required were not properly executed.

Precision Test and Press Precision Test

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

Application requests the user to move the pointer through the depicted area.

User performs the requested action

Application detects if the pointer was moved without to reach the outside area

If the user gets to move the pointer through the entire depicted area without to reach the outside area the test is finished as passed. If the outside area was reached two times the test will fail. If the pointer is not moved for more than 30 seconds the test windows is going to be closed and the following message is displaying to the user:
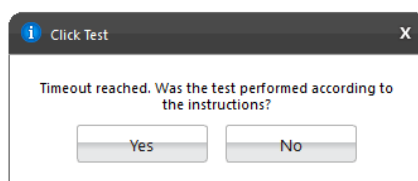

If the user select "Yes", reporting the test was performed according to the instructions, the test will be finished as "failed". In this case, the application assumes that it was not possible to detect the device movement, indicating a bad working of the device. If the user selects "No", the test is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

Note: For executing Press Precision test, you must press any button from mouse and move the pointer.

3.15 RAID

The RAID module is composed by 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.

3.16 Storage

The Storage module is composed by the following tests:

Test	Test type	Attendance
SMART Status Test	Quick	Unattended
Targeted Read Test	Quick	Unattended
Random Seek Test	Quick	Unattended
Funnel Seek Test	Quick	Unattended
SMART Short Self-Test	Quick	Unattended
SMART Drive Self-Test	Quick	Unattended
Default Self-Test	Quick	Unattended
Device Read Test	Quick	Unattended
SMART Wearout Test	Quick	Unattended
NVME Controller Status Test	Quick	Unattended
NVME SMART Temperature Test	Quick	Unattended
NVME SMART Reliability Test	Quick	Unattended
NVME SMART Spare Space Test	Quick	Unattended
Extended Random Seek Test	Extended	Unattended
Extended Funnel Seek Test	Extended	Unattended
Extended Self-Test	Extended	Unattended
Device Write Test	Extended	Unattended
Linear Read Test	Extended	Unattended
SMART Conveyance Test	Extended	Unattended

Full Disk Scan Test	Extended	Unattended

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 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 quick random 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 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.

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

Full Disk Scan Test
This test performs a full verification of the disk.
All devices and their supported tests are listed below:

TEST	DEVICE
SMART STATUS TEST	HDD SATA, SAS AND SSD SATA
TARGETED READ TEST	HDD SATA, SAS AND SSD SATA
RANDOM SEEK TEST	HDD SATA, SAS AND SSD SATA
FUNNEL SEEK TEST	HDD SATA, SAS AND SSD SATA
SMART SHORT SELF TEST	HDD SATA, SAS AND SSD SATA
SMART DRIVE SELF TEST	HDD SATA
DEFAULT SELF TEST	SAS
DEVICE READ TEST	SSD EMMC, SSD NVME AND OPTANE
SMART WEAROUT TEST	SSD SATA, SSD NVME AND OPTANE
NVME CONTROLLER STATUS TEST	SSD NVME AND OPTANE
NVME SMART TEMPERATURE TEST	SSD NVME AND OPTANE
NVME SMART RELIABILITY TEST	SSD NVME AND OPTANE
NVME SMART SPARE SPACE TEST	SSD NVME AND OPTANE
EXTENDED RANDOM SEEK TEST	SAS
EXTENDED FUNNEL SEEK TEST	SAS
EXTENDED SELF-TEST	SAS
DEVICE WRITE TEST	SSD EMMC, SSD NVME AND OPTANE
LINEAR READ TEST	HDD SATA, SAS, SSD SATA, SSD EMMC, SSD NVME AND OPTANE

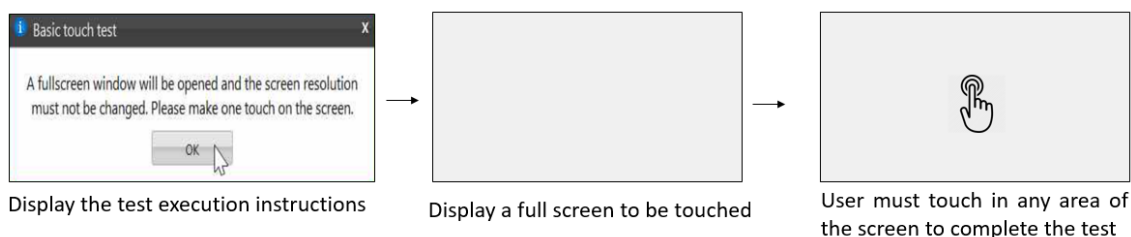|	
SMART CONVEYANCE TEST	HDD SATA AND SSD SATA
FULL DISK SCAN TEST	HDD SATA, SAS, SSD SATA, SSD EMMC, SSD NVME AND OPTANE

3.17 Touchscreen

The Touchscreen module is composed by 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

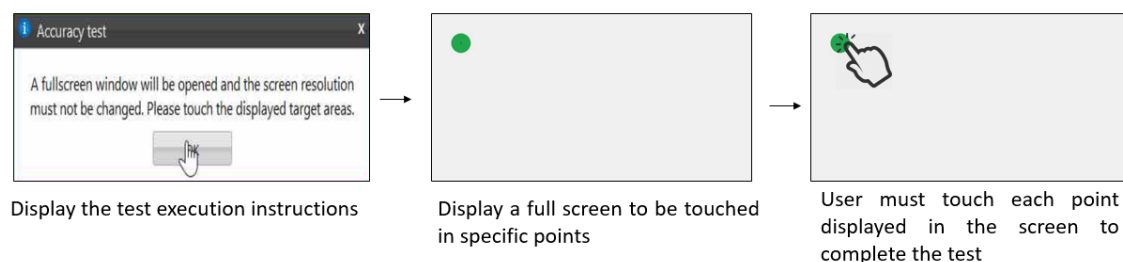**Basic Touch Test**

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

Display the test execution instructions

Display a full screen to be touched

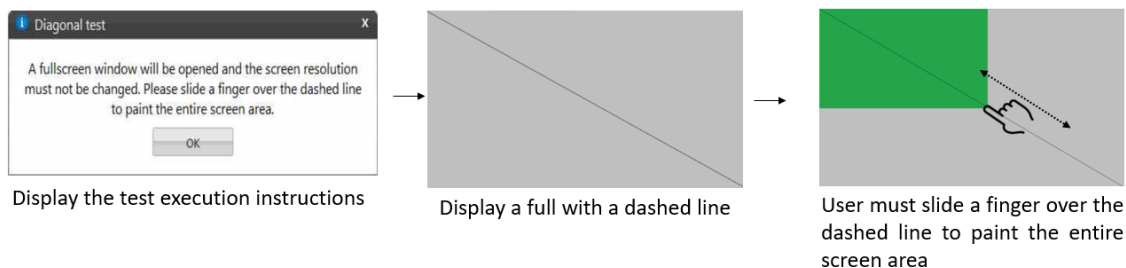User must touch in any area of the screen to complete the test

Accuracy test

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

Display the test execution instructions

Display a full screen to be touched in specific points

User must touch each point displayed in the screen to complete the test
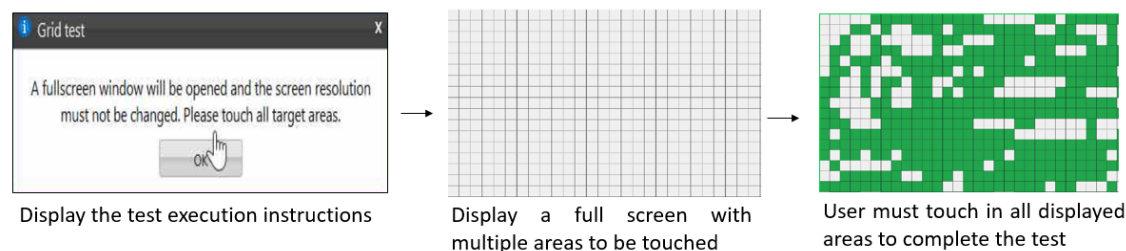
Diagonal Test

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:
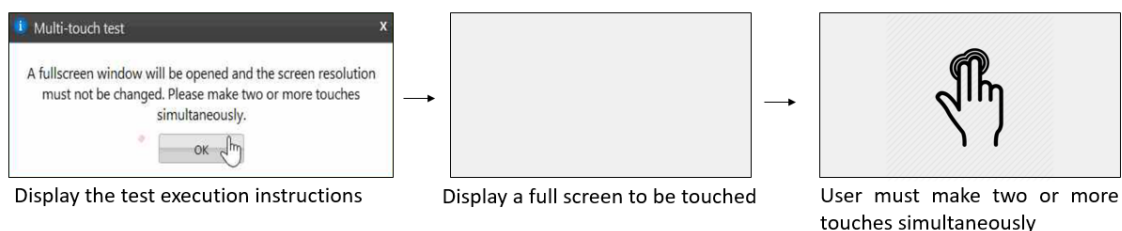
Display the test execution instructions

Display a full with a dashed line

User must slide a finger over the dashed line to paint the entire screen area

Grid test

The Grid test will verify if any areas of touchscreen are not able to receive touch events.

Display the test execution instructions

Display a full screen with multiple areas to be touched

User must touch in all displayed areas to complete the test

Multi-touch Test

The Multi-touch test will verify if the system is receiving multi-touch events.

Display the test execution instructions

Display a full screen to be touched

User must make two or more touches simultaneously

3.18 Video Card

The Video Card module is composed by 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
Extended Video Memory Test	Extended	Unattended

Stress Test	Extended	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
Wireframe Stress Test	Extended	Unattended
Texture Pipeline Test	Quick	Unattended

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

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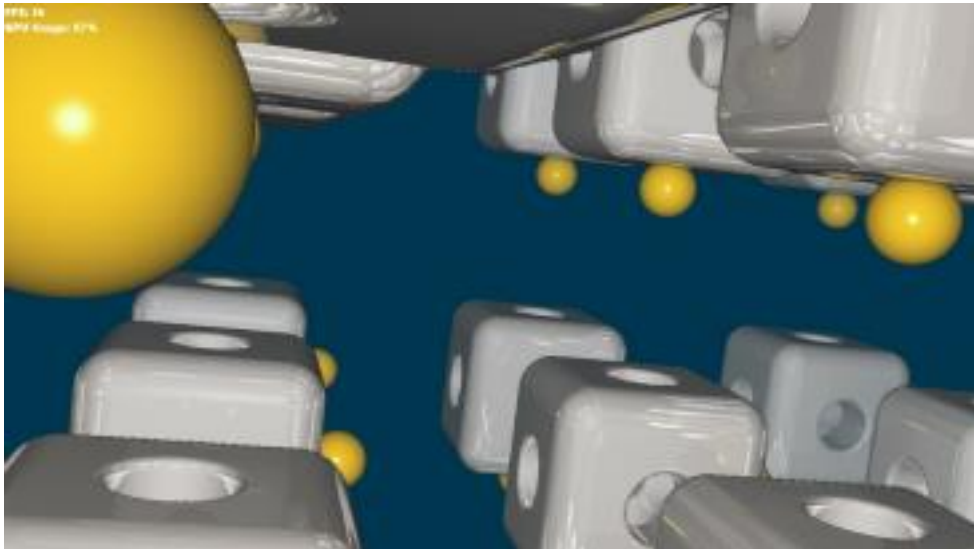
DirectCompute Standard Mathematical Operations Test
Performs several standard mathematical operations in order to test that the video board processing units are in good condition using DirectCompute.

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

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.

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

3.19 Wired Ethernet

The Wired Ethernet module is composed by the following tests:

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

Link Test
The Link Test will verify if the Ethernet network device is faulty based on its operational status. The test starts by asking the user if the network device is connected to a network.
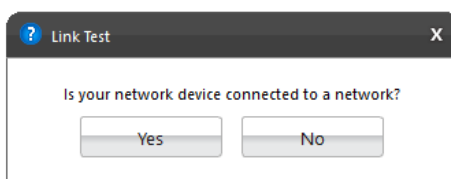
The test is performed according to the user answer. If the user selected "Yes", the test tries to establish a network link and if the user select "No" the tests verifies if the device has, indeed, no network link.

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.

3.20 Wireless

The Wired Ethernet module is composed by 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

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.

3.21 Sensors

The Sensors module is composed by the following tests:

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

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.

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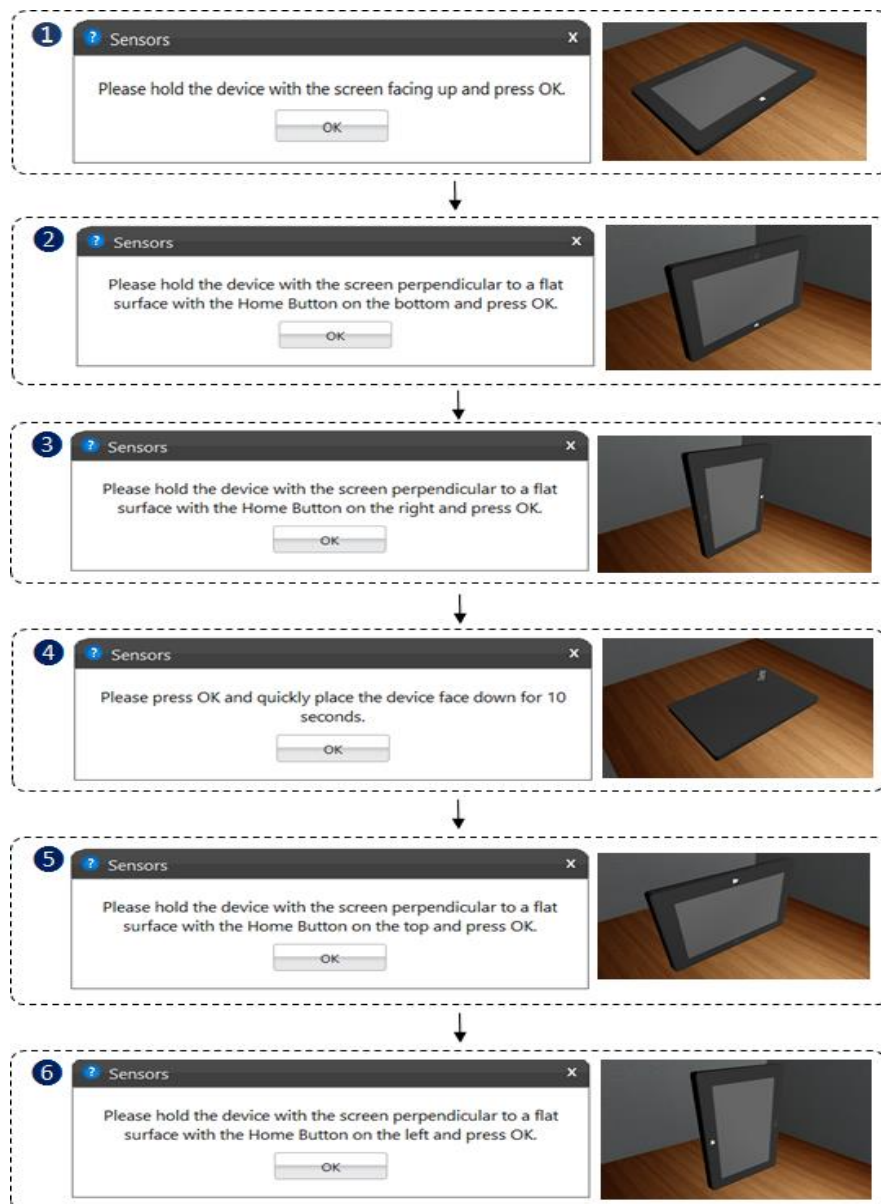
Gyrometer Interactive Test

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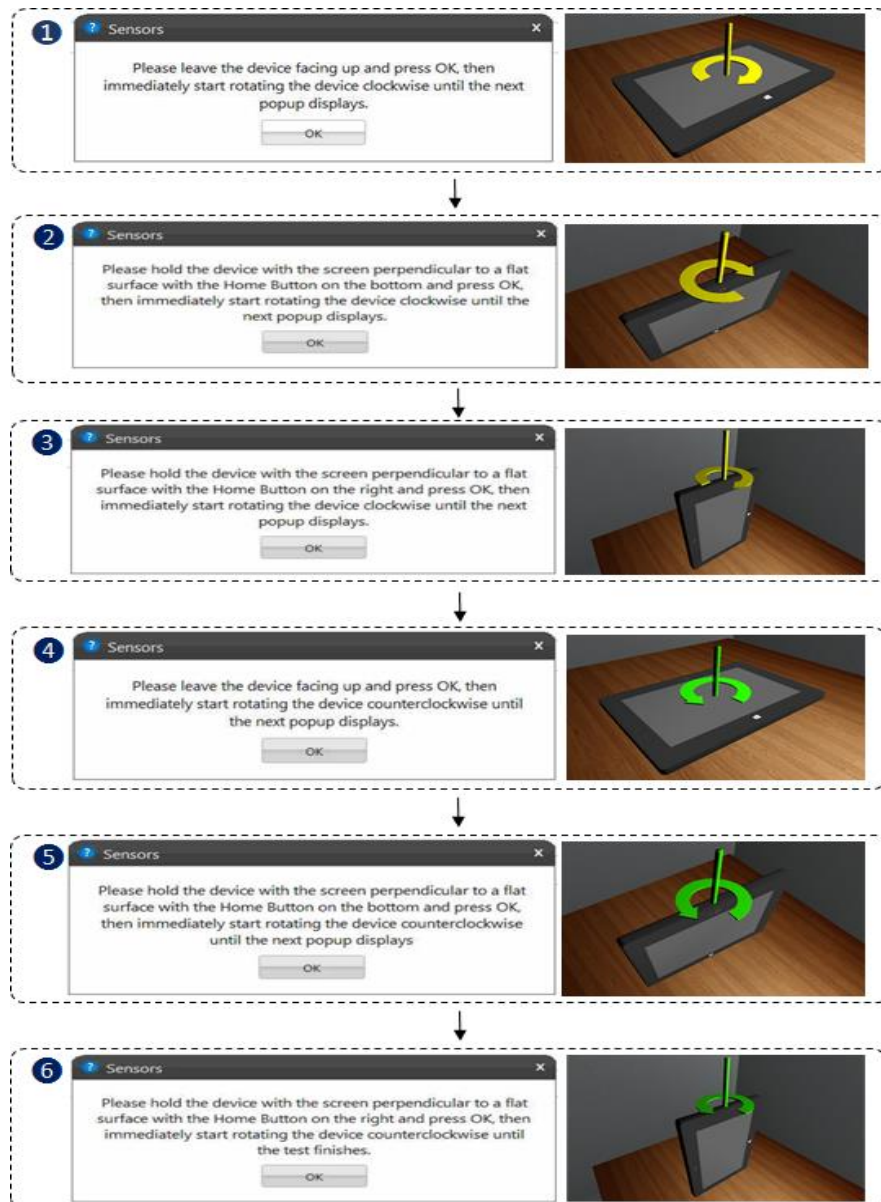
GPS Communication Test

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.

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.

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 localization
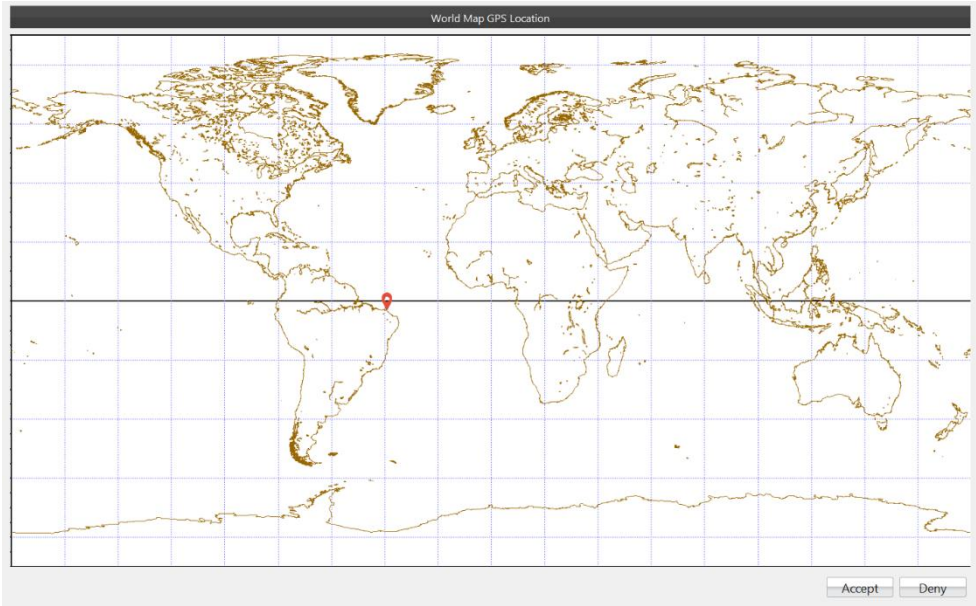
Lid Closure Test

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 to the user open and close the notebook lid.
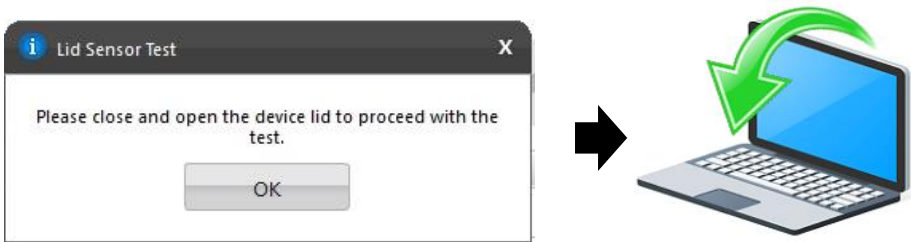
3.22 Bluetooth

The Bluetooth module is composed by the following tests:

Test	Test type	Attendance
Scan Test	Quick	Attended

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.
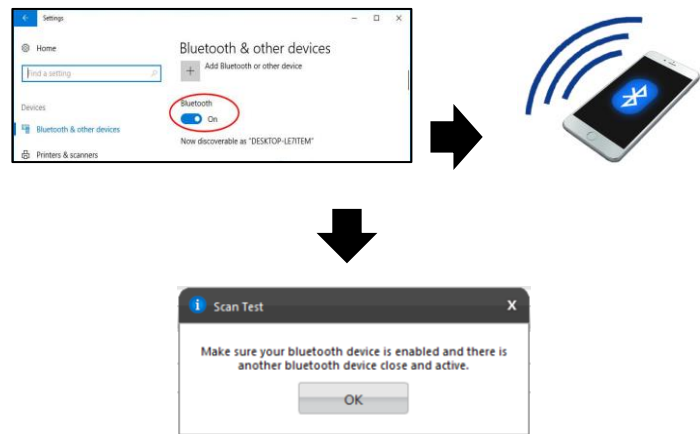
3.23 Fingerprint

   The Fingerprint module is composed by the following tests:

Test	Test type	Attendance
Recognition Test	Quick	Attended

Recognition Test

The test prompts the user to swipe or touch a finger on the fingerprint device. The test starts by asking you to swipe or touch in your device.
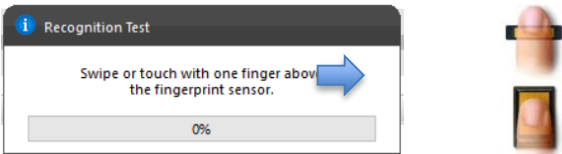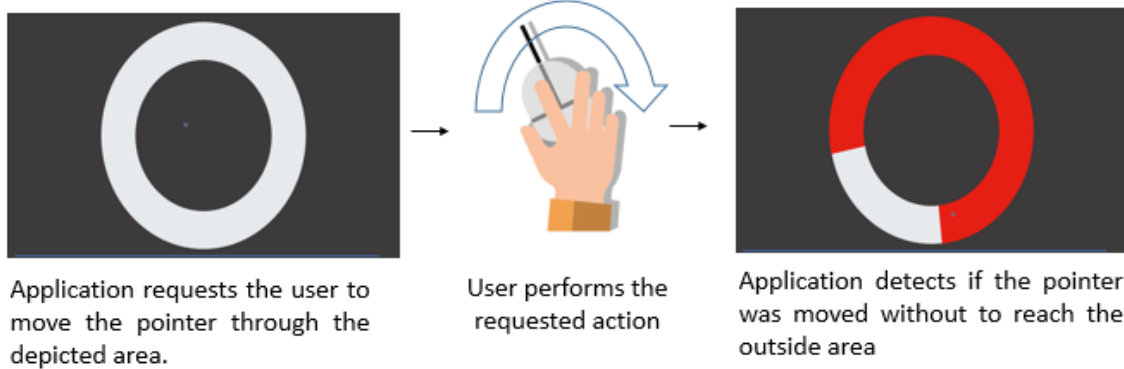

If the user does not perform any action for 30 seconds, the following popup is displayed:
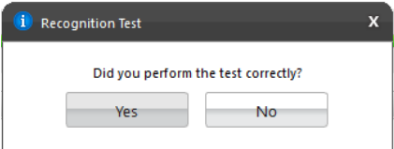
If the user select "Yes", reporting that the test was performed according to the instructions, the test will fail. In this case, the application assumes that it was not possible to detect the device, indicating a bad working of it. If the user selects "No", the test is canceled because the actions required were not properly executed.

3.24 Touchpad Devices

The Touchpad Devices module is composed by 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 the user to perform some actions regarding them. The Click Test execution is based on the workflow below.
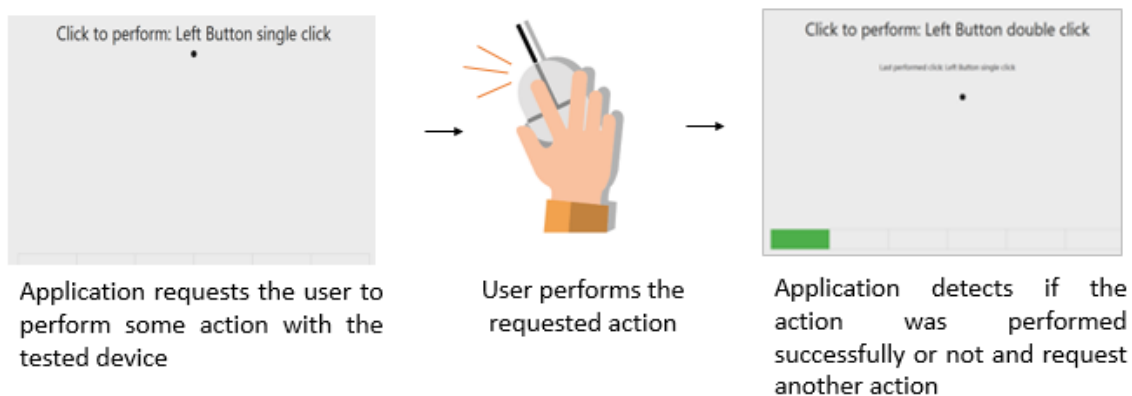
The user must perform one by one, the actions issued by the test. Note that the actions requested depends on the numbers and types of buttons present in your touchpad device.

The user has 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.

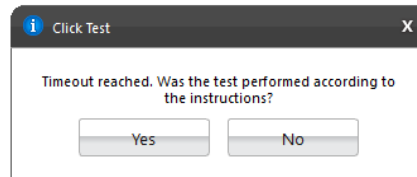If the user does not perform any action for 30 seconds, the following popup is displayed:

If the user selects "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 the user selects "No", the test is canceled because the actions required were not properly executed.

Precision Test and Press Precision Test

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

Application requests the user to move the pointer through the depicted area.

User performs the requested action

Application detects if the pointer was moved without to reach the outside area

If the user gets to move the pointer through the entire depicted area without to reach the outside area the test is finished as passed. If the outside area was reached two times the test will fail. If the pointer is not moved for more than 30 seconds the test windows is going to be closed and the following message is displaying to the user:

If the user selects "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 the user selects "No", the test is canceled because the required actions were not properly executed.

Note: For executing Press Precision test, you must press any button from touchpad and move the pointer.

3.25 SIM Card

The SIM Card module is composed by 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.

4. EXPLORING LENOVO **RUN ALL OPTION**

Run All option allows to perform all supported tests from all supported modules at the same execution. In this flow is not possible to select devices, thus all devices will be tested. It is possible to choose if the Attended tests should be performed or not.

When the checkbox is marked, the application will run Unattended + Attended tests from the test execution option selected.

4.1 Quick tests

Click on Quick tests button to perform all quick tests.
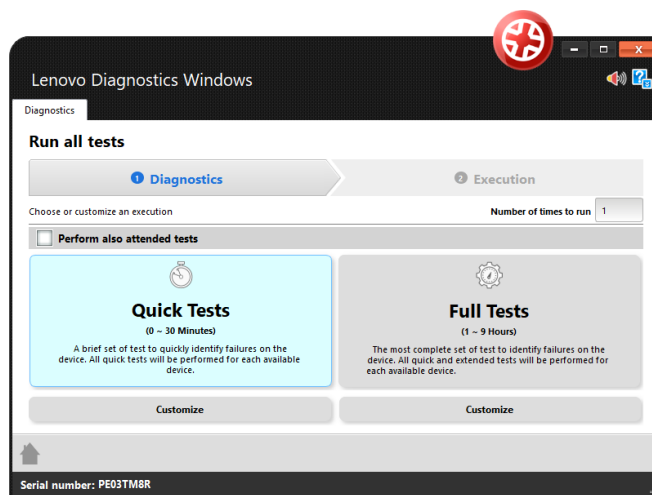
4.2 Quick tests (customized option)

Click to Customize to remove any module or test from the list of tests that will be performed.
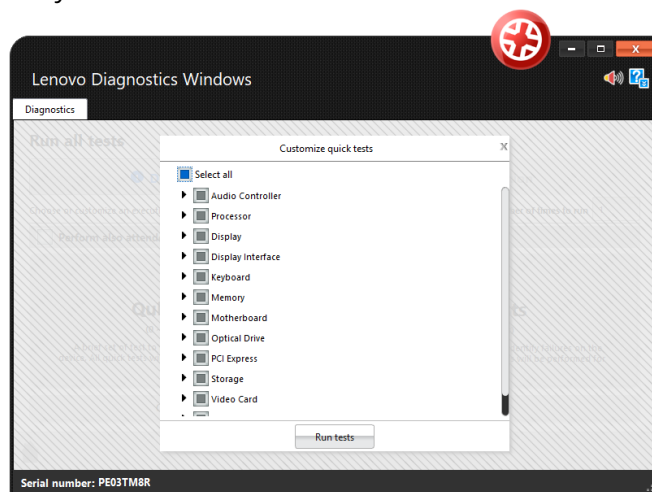
4.3 Full tests

Click on Quick tests button to perform all tests quick and extended.
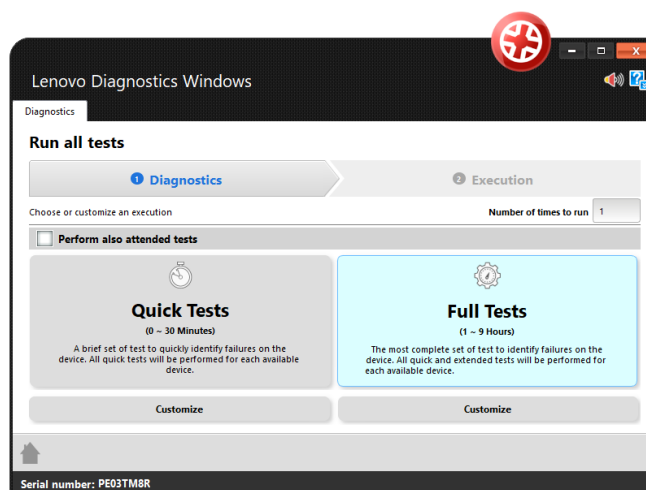
4.4 Full tests (customized option)

Click to Customize to remove any module or test from the list of tests that will be performed.
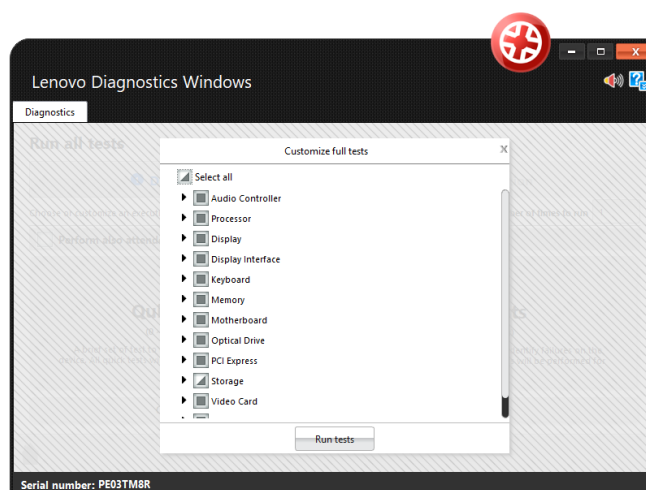
5. EXPLORING LENOVO **DIAGNOSTICS TOOLS**

This section provides information about:

Updated according to Lenovo Diagnostics 4.32

5. 1 Diagnostic Script

The Diagnostic Script is a tool that allows user to create a custom list of tests from any module. By selecting this tool, the following options are displayed:

- **Create**: allows to create a new diagnostic script.
- **Edit**: allows editing a diagnostic script saved previously.
- **Execute**: allows to perform the tests configures in a diagnostic script.
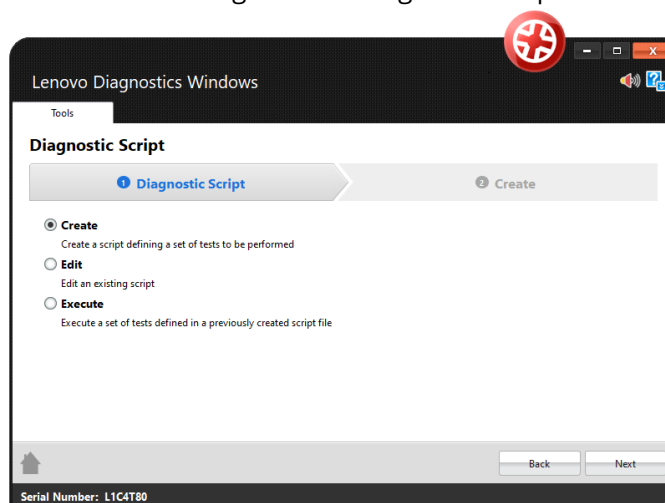
Warning: When the user executes a script, unsupported tests on the machine will receive the status – **NOT APPLICABLE**.

5.1.1 Create a diagnostic script

By selecting the option "Create" and clicking on the Next 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. The tests not supported by the tested machine are marked with the icon ⓘ.

It is also possible to configure the execution of this tests according 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 999999999. 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 999999999. In this case, the diagnostic will be finished when this time is reached and all tests from the current iteration are finished. Notice that even if the time is reached the tests will be performed until the end in the current iteration.

Module Execution sequence: allows you to select the order in which the modules will be executed by dragging and dropping the modules in the list. The list will be filled according to the selected modules.
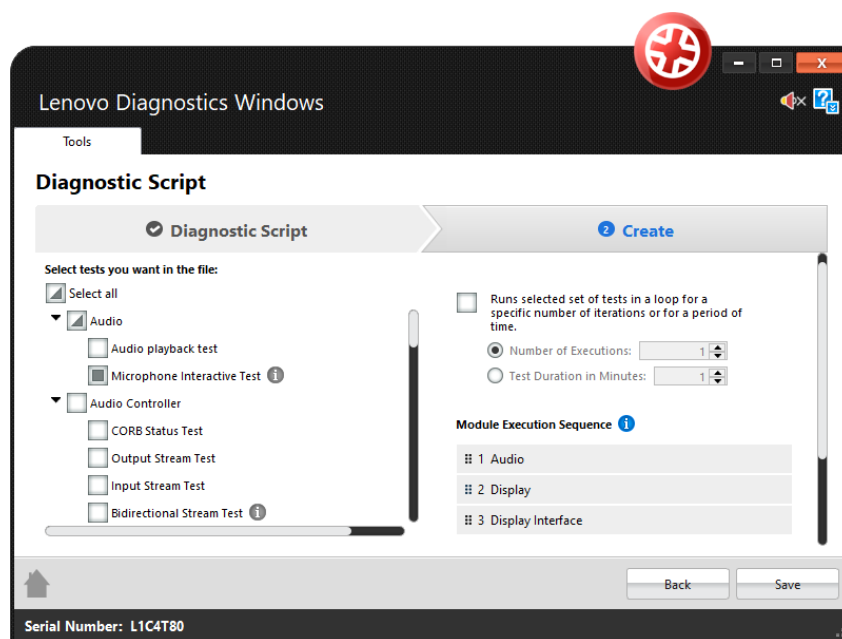
5.1.2 Edit a diagnostic script

By selecting the option "Edit", the Lenovo Diagnostics displays a field where is possible to select an existing diagnostic script to be edited.
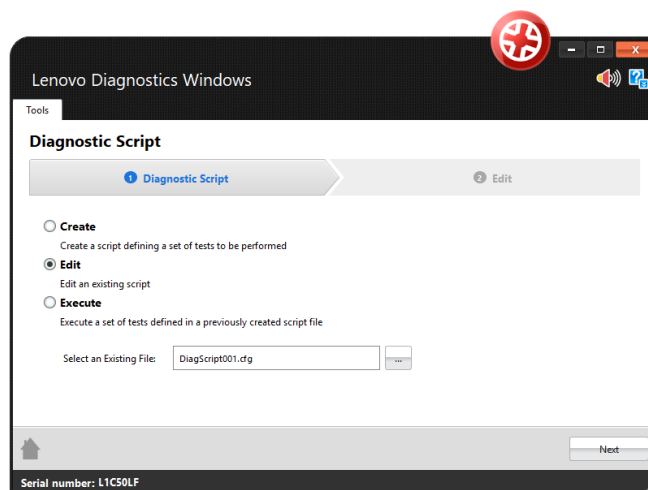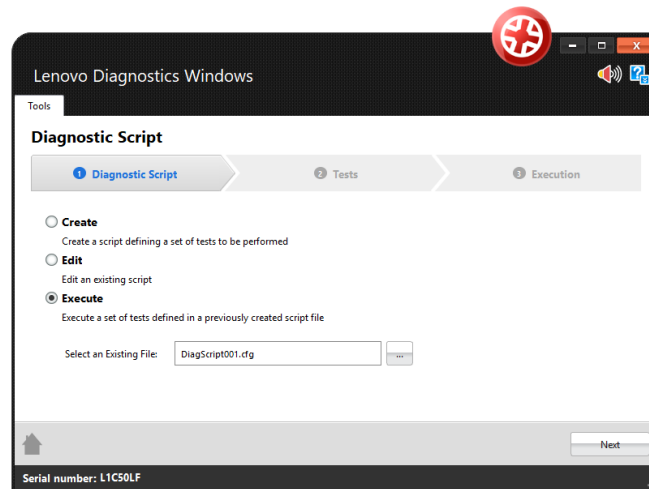
By selecting this file and clicking on the Next button, a screen is displayed with the configuration from the selected diagnostic script. Here it is possible to modify this configuration by changing the list of tests, modify the number of executions or duration minutes and change the order of modules execution. By clicking on Save button all changes are saved in the current file and clicking on Save as it is possible to create a new file with the current configuration.
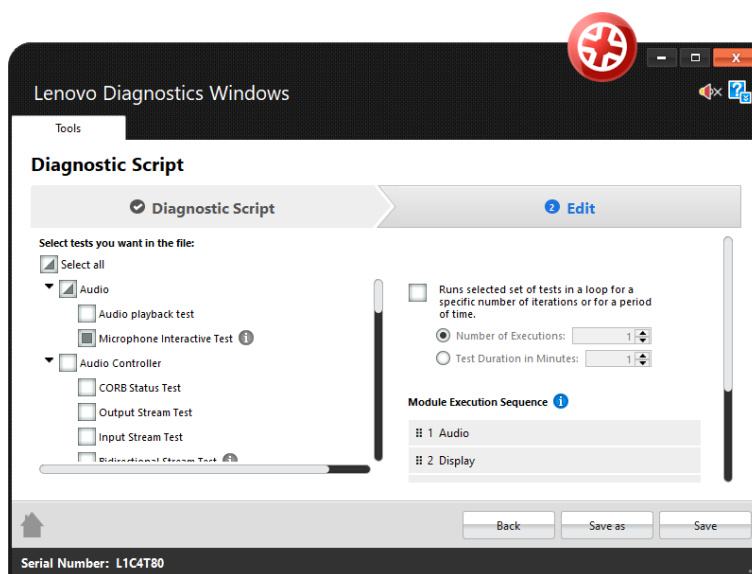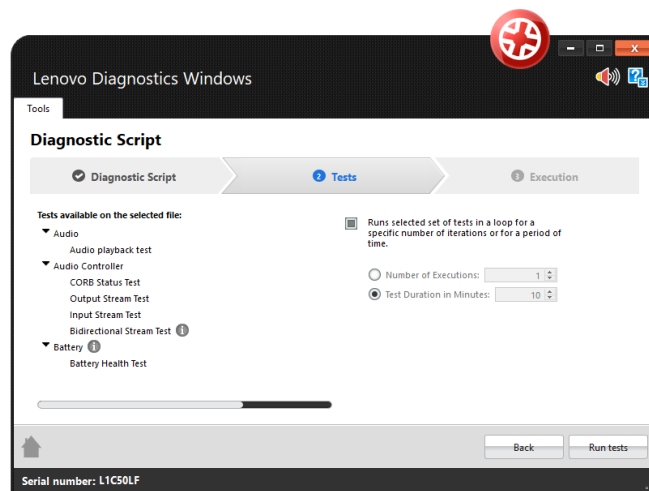

5.1.3 Execute a diagnostic script

By selecting the option "Execute", the Lenovo Diagnostics displays a field where is possible to select an existing diagnostic script to be performed.

By selecting a valid diagnostic script file and clicking on the Next button, a screen is displayed with the configuration from the selected diagnostic script. All selected tests are listed selected and the not supported one are marked with the icon ⓘ.

By clicking to Run Tests, the diagnostic script execution screen is displayed and all supported tests are performed. The not supported tests that do not have an associated device are filtered on this execution. It is possible to finish the execution anytime by clicking on Stop Test.
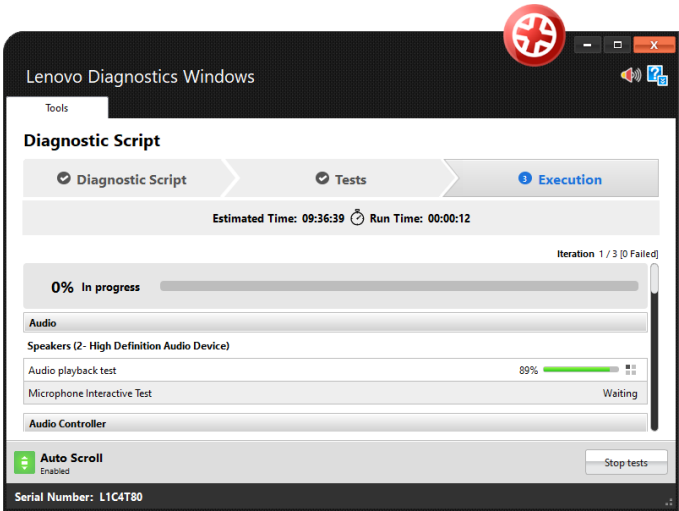
When the diagnostic is finished, the following popup is displayed with the execution summary.
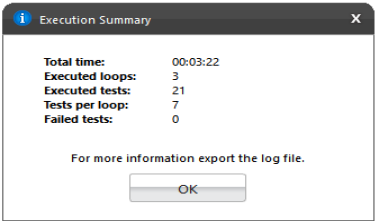
The user can view the execution log by clicking View log.

It is also possible to export all executions log to a PDF file by clicking Export all log or export a specific iteration by clicking on Export log.
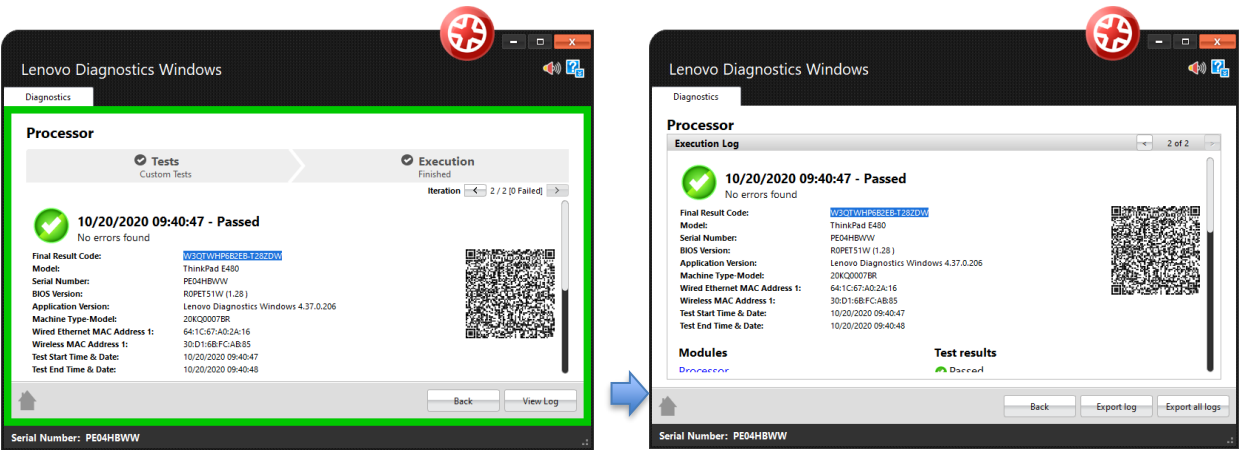
5.2 System Information

The system information tool allows the user to see general information about the system and the available module's devices. See in the screen below that is possible navigating between the modules and export the information by module or export all information at the same time.
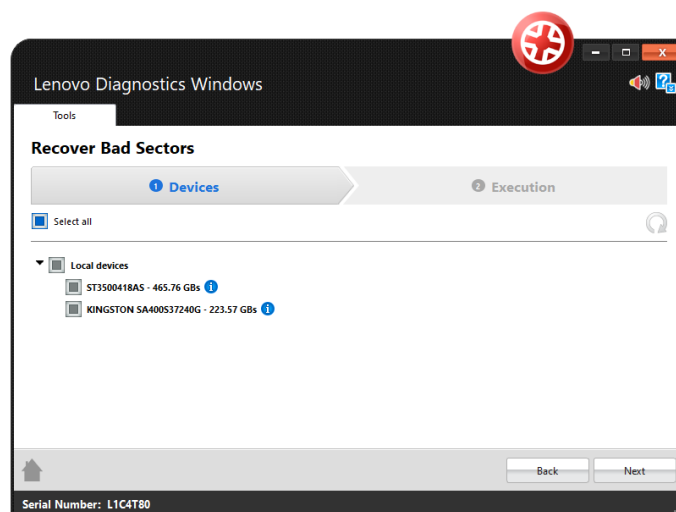

5.3 Log History

The Log History tool allows the user to see the logs of all executions performed in a machine. See in the image below it is possible to find logs by informing a period and export all logs.
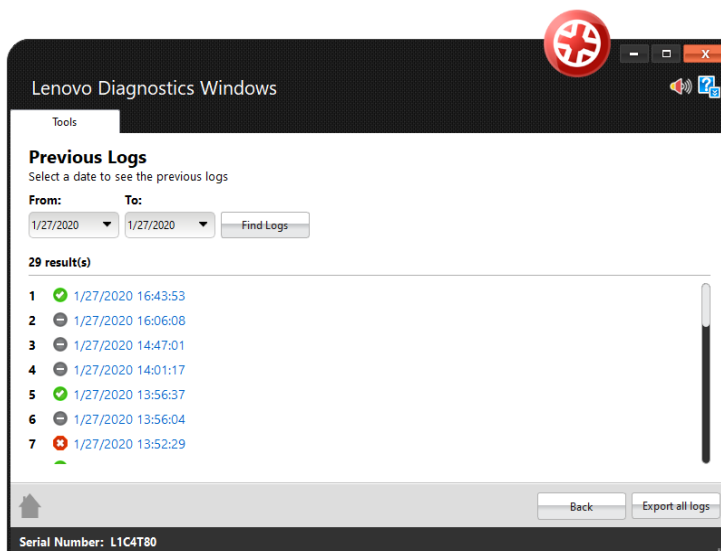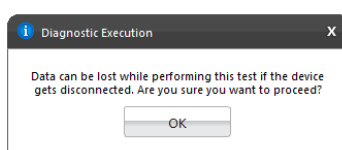
5.4 Recover Bad Sectors

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


Be aware to perform a backup of your disk before performing this operation. The recovery operation can cause data loss and requires your confirmation.


5.5 SMART Tool

SMART tool provides a list of storage devices and shows, for each one, the SMART attributes and its information. You are able to export that information to a PDF or HTML file. It is possible to export information for each storage device separately or for all available devices in the same file. Supported devices are NVMe and HDD / SSD SATA.
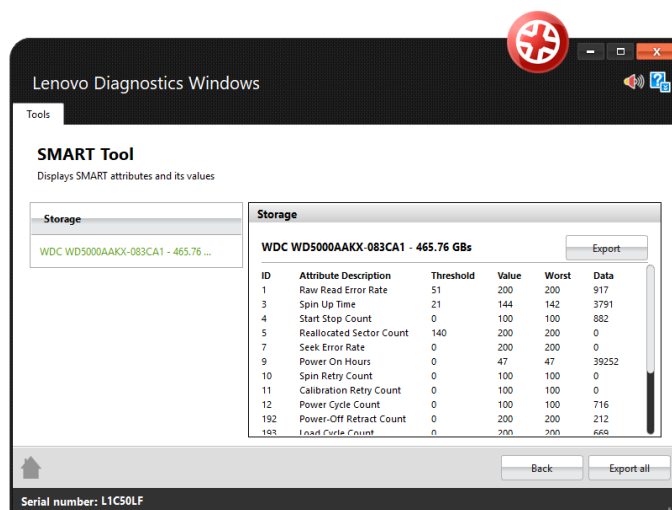
5.6 eGather Report

This report provides system software and hardware information focused mainly on software and its drivers. You are able to export that information to a HTML or PDF file by clicking on **Export All** button or export each section separately by clicking on **Export** button.
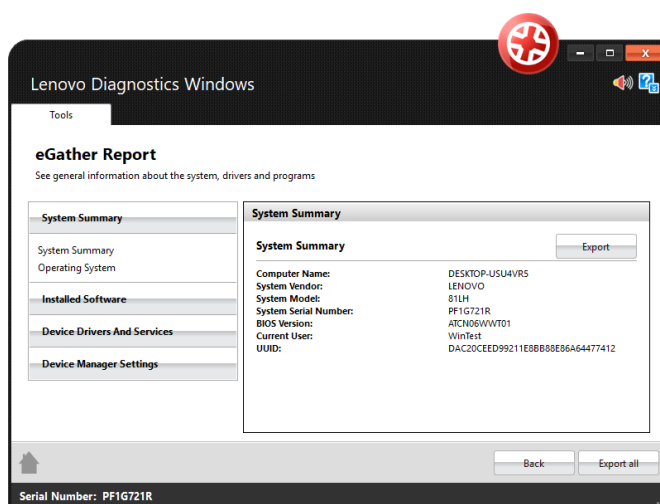

5.7 Powercfg Reports

These reports provide information about the battery usage, energy efficiency, power-scheme settings, and system power translations.
You are able to generate all reports by clicking on the **Generate all reports** button.
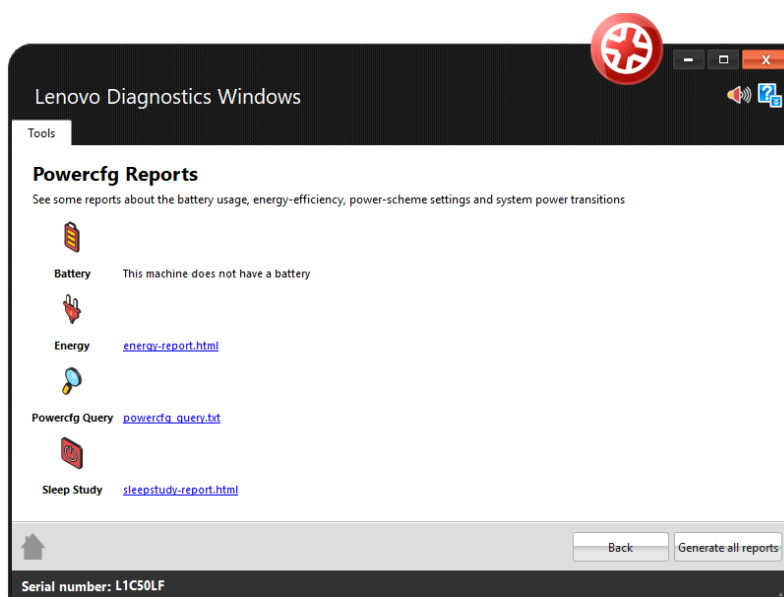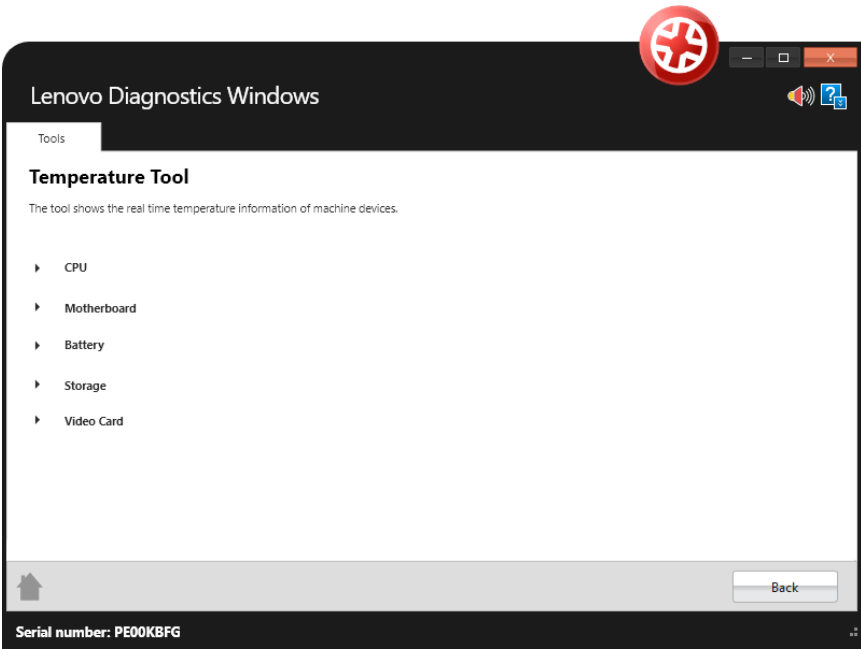
5.8 Network Speed Tool

The tool measures the average download/upload speed and the average latency time. You are able to perform the tests by clicking on the button Run Tests.
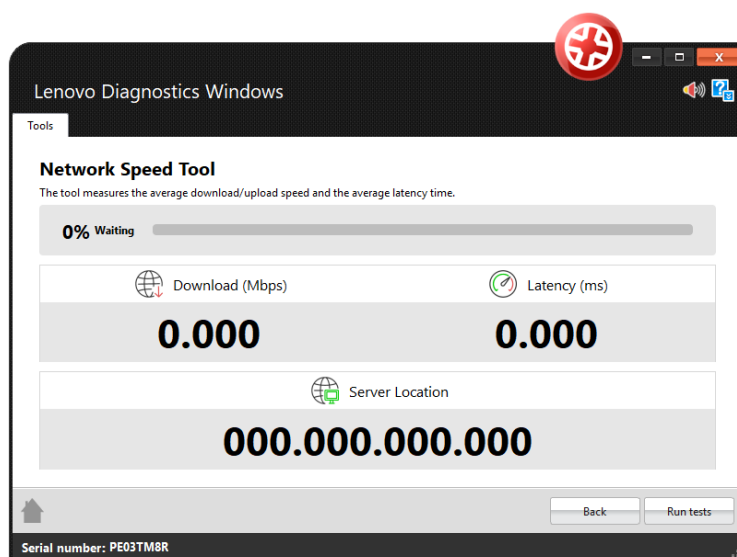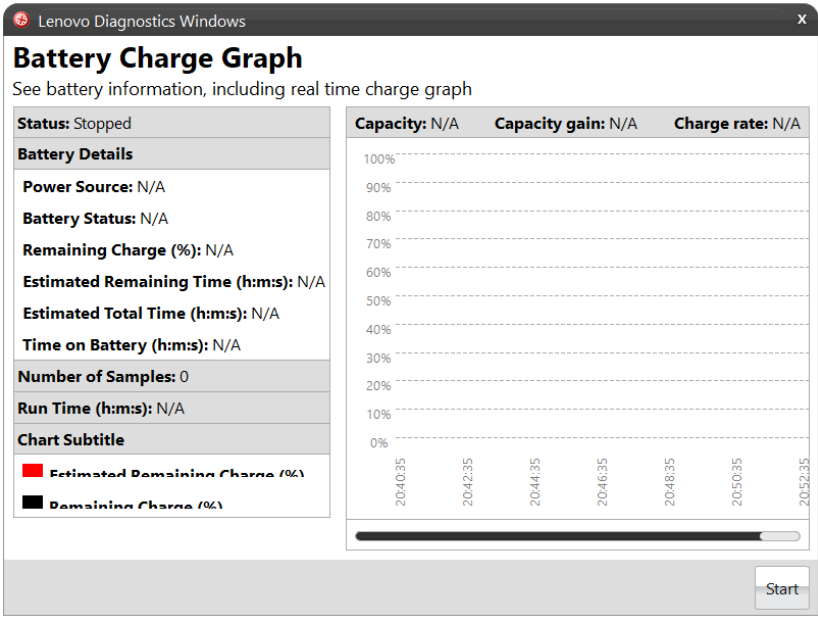

5.9 Temperature Tool

The tool shows the real time temperature information of machine devices.

5.10 Battery Charge Graph

See battery information, including real time charge graph

6. SYSTEM EVENTS SUPPORTED

Some changes in power states of machine can impact the tests execution. The diagnostics are canceled if one of these events happen:

- Shutdown
- Restart
- Sleep
- Hibernate
- Sign out

If the tests be canceled because these events, will be displayed the bellow message: "*Test aborted because a system event that could compromise the outcome has happened.*"

7. GLOSSARY

Extended Test: type of test that is performed in some hours.

Quick test: type of test that is performed in some minutes.

Unattended test: It is a test that does not depends from the user actions to be executed. All step are performed automatically by the application.

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

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