



## The science behind the report:

# Two Lenovo ThinkPad business laptops powered by Intel Core i3-10110U and Core i5-10310U vPro processors achieved higher benchmark performance than comparable systems powered by AMD Ryzen 3 PRO 4450U and Ryzen 5 PRO 4650U processors

This document describes what we tested, how we tested, and what we found. To learn how these facts translate into real-world benefits, read the report [Two Lenovo ThinkPad business laptops powered by Intel Core i3-10110U and Core i5-10310U vPro processors achieved higher benchmark performance than comparable systems powered by AMD Ryzen 3 PRO 4450U and Ryzen 5 PRO 4650U processors](#).

We concluded our hands-on testing on April 7, 2021. During testing, we determined the appropriate hardware and software configurations and applied updates as they became available. The results in this report reflect configurations that we finalized on November 18, 2020 or earlier. Unavoidably, these configurations may not represent the latest versions available when this report appears.

## Our results

To learn more about how we have calculated the wins in this report, go to <http://facts.pt/calculating-and-highlighting-wins>. Unless we state otherwise, we have followed the rules and principles we outline in that document.

Table 1: Battery life and performance results for two Lenovo ThinkPad X13 laptops we tested. Except for WebXPRT 3 subtest scores, which reflect time in milliseconds, higher scores are better. Source: Principled Technologies.

	Lenovo® ThinkPad® X13 Intel® Core™ i3-10110U	Lenovo ThinkPad X13 Ryzen™ 3 PRO 4450U	Improvement with Intel Core i3-10110U	
			(raw)	(percentage)
<b>MobileMark® 2018</b>				
Overall Battery Life (hours:min)	8:44	8:06	0:38	7.81%
Overall Performance Qualification	944	766	178	23.23%
Productivity subscore	859	765	94	12.28%
Creativity subscore	966	859	107	12.45%
Web Browsing subscore	1,014	685	329	48.02%

	Lenovo® ThinkPad® X13 Intel® Core™ i3-10110U	Lenovo ThinkPad X13 Ryzen™ 3 PRO 4450U	Improvement with Intel Core i3-10110U	
			(raw)	(percentage)
<b>WebXPRT 3 (Edge browser) battery best performance setting</b>				
<b>Overall score</b>	<b>183</b>	<b>111</b>	<b>72</b>	<b>64.86%</b>
Photo Enhancement (ms) <i>(Lower is better)</i>	351	558	207	37.09%
Organize Album using AI (ms) <i>(Lower is better)</i>	2,718	4,878	2,160	44.28%
Stock Option Pricing (ms) <i>(Lower is better)</i>	176	317	141	44.47%
Encrypt Notes and OCR Scan (ms) <i>(Lower is better)</i>	2,172	3,456	1,284	37.15%
Sales Graphs (ms) <i>(Lower is better)</i>	455	836	381	45.57%
Online Homework (ms) <i>(Lower is better)</i>	2,048	2,813	765	27.19%

Table 2: Battery life and performance results for two Lenovo ThinkPad T14 laptops we tested. Except for WebXPRT 3 subtest scores, which reflect time in milliseconds, higher scores are better. Parentheses indicate negative numbers. Source: Principled Technologies.

	Lenovo ThinkPad T14 Intel Core i5-10310U vPro	Lenovo ThinkPad T14 Ryzen 5 PRO 4650U	Improvement with Intel Core i5-10310U vPro	
			(raw)	(percentage)
<b>MobileMark 2018</b>				
<b>Overall Battery Life (hours:min)</b>	<b>7:28</b>	<b>7:36</b>	<b>(0:08)</b>	<b>(1.7%)</b>
<b>Overall Performance Qualification</b>	<b>1,211</b>	<b>805</b>	<b>406</b>	<b>50.43%</b>
Productivity subscore	1,076	788	288	36.54%
Creativity subscore	1,306	918	388	42.26%
Web Browsing subscore	1,264	722	542	75.06%
<b>WebXPRT 3 (Edge browser) battery best performance setting</b>				
<b>Overall score</b>	<b>206</b>	<b>116</b>	<b>90</b>	<b>77.58%</b>
Photo Enhancement (ms) <i>(Lower is better)</i>	318	539	221	41.00%
Organize Album using AI (ms) <i>(Lower is better)</i>	2,491	4,728	2,237	47.31%
Stock Option Pricing (ms) <i>(Lower is better)</i>	177	296	119	40.20%
Encrypt Notes and OCR Scan (ms) <i>(Lower is better)</i>	1,998	3,316	1,318	39.74%
Sales Graphs (ms) <i>(Lower is better)</i>	418	802	384	47.88%
Online Homework (ms) <i>(Lower is better)</i>	1,431	2,564	1,133	44.18%

Note: In addition to the two pairs of laptops we discuss in the report, we also tested another pair of Lenovo ThinkPad T14 systems, one powered by the Intel Core i7-10610U vPro processor and one powered by the AMD Ryzen 7 PRO 4750U.

## System configuration information

Table 3: Detailed information on the systems we tested.

System configuration information	Lenovo ThinkPad X13 (Intel processor)	Lenovo ThinkPad X13 (AMD processor)
<b>Processor</b>		
Vendor	Intel	AMD
Name	Core i3	Ryzen 3 PRO
Model number	10110U	4450U
Core frequency (GHz)	2.1-4.1	2.5-3.7
Number of cores	2	4
Cache (MB)	4	4
<b>Memory</b>		
Amount (GB)	8	8
Type	LPDDR4	LPDDR4
Speed (MHz)	2,667	3,200
Single / Dual Channel	Dual	Dual
<b>Graphics</b>		
Vendor	Intel	AMD
Model number	UHD Graphics	Radeon Vega
<b>Storage</b>		
Vendor	Micron®	Samsung®
Model Number	MTFDHBA256TDV	MZVLB256HBHQ-000L7
Amount	256 GB	256 GB
Type	M.2 PCIe® NVMe™	M.2 PCIe NVMe
<b>Connectivity/expansion</b>		
Wireless internet	Intel AX201 WiFi 6	Intel AX200 WiFi 6
Bluetooth	5.1	5.1
USB	2 x USB 3.2 Gen 1 (1 always on) 2 x USB-C (DisplayPort, Data Transfer, Power Delivery)	2 x USB 3.2 Gen 1 (1 always on) 2 x USB-C (DisplayPort, Data Transfer, Power Delivery)
Video	HDMI 1.4	HDMI 2.0
<b>Battery</b>		
Type	Lithium-Ion	Lithium-Ion
Rated capacity (Wh)	48	48

System configuration information	Lenovo ThinkPad X13 (Intel processor)	Lenovo ThinkPad X13 (AMD processor)
Display		
Size (in.)	13.3	13.3
Type	FHD	FHD
Resolution	1,920 x 1,080	1,920 x 1,080
Touchscreen	No	No
Operating system		
Vendor	Microsoft	Microsoft
Name	Windows 10 Pro	Windows 10 Pro
Build number or version	10.0.18363	10.0.18363
BIOS		
BIOS name and version	Lenovo N2YET25W (1.14)	Lenovo R1CET56W (1.25)
Dimensions		
Height (in.)	0.66	0.69
Width (in.)	12.3	12.3
Depth (in.)	8.6	8.6
Weight (lbs.)	2.84	2.84

Table 4: Detailed information on the systems we tested.

System configuration information	Lenovo ThinkPad T14 (Intel processor)	Lenovo ThinkPad T14 (AMD processor)
Processor		
Vendor	Intel	AMD
Name	Core i5	Ryzen 5 PRO
Model number	10310U	4650U
Core frequency (GHz)	1.7-4.4	2.1-4.0
Number of cores	4	6
Cache (MB)	6	8
Memory		
Amount (GB)	16	6
Type	LPDDR4	LPDDR4
Speed (MHz)	2,667	3,200
Graphics		
Vendor	Intel	AMD
Model number	UHD Graphics	Radeon Graphics

System configuration information	Lenovo ThinkPad T14 (Intel processor)	Lenovo ThinkPad T14 (AMD processor)
Storage		
Vendor	Samsung	Samsung
Model Number	MZVLB512HBJQ-000L7	MZVLB512HBJQ-000L7
Amount	512 GB	512 GB
Type	M.2 PCIe NVMe	M.2 PCIe NVMe
Connectivity/expansion		
Wired internet	Intel I219-LM	Realtek® PCIe GBE
Wireless internet	Intel AX201 WiFi 6	Intel AX200 WiFi 6
Bluetooth	5.1	5.1
USB	2 x USB 3.2 Gen 1 (1 always on) 2 x USB-C (DisplayPort, Data Transfer, Power Delivery)	2 x USB 3.2 Gen 1 (1 always on) 2 x USB-C (DisplayPort, Data Transfer, Power Delivery)
Video	HDMI 1.4	HDMI 2.0
Battery		
Type	Lithium-Ion	Lithium-Ion
Rated capacity (Wh)	50	50
Display		
Size (in.)	14.0	14.0
Type	FHD	FHD
Resolution	1,920 x 1,080	1,920 x 1,080
Touchscreen	Yes	Yes
Operating system		
Vendor	Microsoft	Microsoft
Name	Windows 10 Pro	Windows 10 Pro
Build number or version	10.0.18363	10.0.18363
BIOS		
BIOS name and version	Lenovo N2XET26W (1.16)	Lenovo R1BET60W (1.29)
Dimensions		
Height (in.)	0.70	0.70
Width (in.)	12.9	12.9
Depth (in.)	8.9	8.9
Weight (lbs.)	3.23	3.23

# How we tested

## Setting up the systems

### Capturing driver information from the OEM factory image

1. Connect an external HDD to the system.
2. On the external drive, create a directory named Drivers.
3. Hold the Shift key, and restart the system.
4. Choose Troubleshoot→Advanced options→Command prompt.
5. Type `DISM /image:C: /export-driver /destination:D:\drivers` (Note: In this scenario the external drive is labeled D; however, this name may differ depending on the configuration of the system.)

### Installing Windows 10 Pro

1. Connect the external HDD that contains the captured OEM drivers to the system.
2. In the BIOS, disable SecureBoot.
3. Install a clean version of Windows 10 Pro onto the test system.
4. To complete installation, follow the on-screen instructions, using the default selections when appropriate.
5. To install any missing drivers, open Device Manager, and use the OEM factory drivers captured onto the external HDD.
6. Set DPI scaling to 100%, and set Screen and Sleep options to Never.
  - a. Right-click on the desktop and select Display settings.
  - b. Under the Scale and layout section, for the Change the size of text, apps, and other items option, select 100%.
  - c. From the left column, select Power & Sleep.
  - d. For all power options listed under Screen and Sleep, select Never.
  - e. From the left column, select Battery.
  - f. Verify that Battery Saver is Off and that Lower screen brightness while on battery saver is unchecked.
7. Disable User Account Control notifications.
  - a. Select Windows Start, type UAC, and press the Enter key.
  - b. Move the slider control to Never notify, and click OK.
8. Run Windows Update, and install all updates available.
9. Launch the Windows Store app, and install all Store app updates.
10. Launch each vendor proprietary utility app installed on each system, and update any drivers or BIOS files.
  - For Lenovo, run the Lenovo Vantage utility.
  - To install the latest chipset and graphics drivers available, go to either <https://www.intel.com/content/www/us/en/support.html> or <https://www.amd.com/en/support>.
11. Verify the date and time are correct, and synchronize the system clock with the time server.
12. On the system with an AMD processor, adjust the AMD Vari-Bright setting to Maximum brightness.
  - a. Right-click the desktop, and select AMD Radeon Software.
  - b. At the Welcome to the new Radeon Software experience screen, click Skip This.
  - c. In the top right corner, click the Settings Gear icon.
  - d. Click the Display tab.
  - e. Move the Vari-Bright slider to Maximum brightness.
13. Disable Automatic Windows Update.
  - a. Right-click the Windows Start button.
  - b. Select Computer Management.
  - c. Select Services and Applications.
  - d. Select Services.
  - e. Scroll down, and double-click Windows Update.
  - f. Click Stop.
  - g. From the Startup type drop-down menu, select Disabled.

## Capturing an image

1. Connect an external HDD to the system.
2. Right-click the desktop, and select Personalize→Home→Update & security→Backup→More options→See advanced settings→System Image Backup→Create a system image.
3. Verify that the external HDD is selected as the save drive, and click Next.
4. Verify that all drives are selected to back up, and click Next.
5. Click Start backup.
6. At the Do you want to create a system repair disc screen, select No, and close the dialogs.

## Restoring an image

1. Connect an external HDD to the system.
2. Press and hold the Shift key while restarting the system.
3. Select Troubleshoot.
4. Select Advanced options.
5. Select System image recovery.
6. Select the User account.
7. Enter the system password, and click Continue.
8. Verify that the external HDD is selected, and click Next.
9. Once the recovery has completed, click Finish.

## Measuring performance with benchmarks

### WebXPRT 3

#### Setting up the test

1. Verify that the newest version of Microsoft Edge is installed. If it is not, go to <https://www.microsoft.com/en-us/edge> to download and install it.

#### Running the test

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `Cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Unplug the laptop.
7. Open the web browser under test and go to <http://www.principledtechnologies.com/benchmarkxpert/webxpert/>.
8. Click Run WebXPRT 3.
9. At the Ready to test your browser screen, click Continue.
10. Click Start.
11. When the test completes, record the results.
12. Click the option to rerun WebXPRT 3.
13. When the test completes, record the results.
14. Repeat steps 11 through 12 once more, and note the median score of the three test runs.

## MobileMark 2018

### Avoiding antivirus software conflicts

MobileMark 2018 is not compatible with any virus-scanning software, so we uninstalled any such software present on the notebook PCs before we installed the benchmark.

### Avoiding pre-installed software conflicts

MobileMark 2018 installs the following applications, which its test scripts employ:

#### Productivity

- Adobe® Acrobat® Pro DC
- AutoIT 3.3.14.2
- Google Chrome™
- Microsoft Excel 2016
- Microsoft OneNote 2016
- Microsoft Outlook 2016
- Microsoft PowerPoint 2016
- Microsoft Word 2016
- Windows Zip

#### Creativity

- Adobe Photoshop® CC
- Adobe Lightroom® Classic CC
- CyberLink PowerDirector® 2015

#### Web Browsing

- Google Chrome
- Microsoft Movies & TV

If any of these applications already exist on the system under test, they could cause problems with the benchmark due to software conflicts. To avoid any such issues, we uninstalled all conflicting pre-installed software applications—including different versions of any of the programs MobileMark 2018 uses—before we installed the benchmark.

### Adjusting display brightness and power settings

The brightness of a notebook's display affects its battery life. Therefore, BAPCo requires that, before you test with MobileMark 2018, you ensure the brightness of the notebook's monitor is greater than or equal to 200 nits in the center of a completely white screen while the notebook is unplugged and running on battery power. The measurement follows the standards from the Video Electronics Standards Association ([www.vesa.org](http://www.vesa.org)).

We complied with this standard for all our tests by setting each notebook PC's brightness as close to 200 nits as we could without going below that level. We used the following procedure before we started each test. Note: This procedure assumes we began with the notebook plugged into the power supply.

1. To create a completely blank, white screen, open Microsoft Paint by clicking Start→All Programs→Accessories→Paint.
2. Press Ctrl+W to open the Resize and Skew dialog.
3. Under Horizontal and Vertical, enter 200, and click OK.
4. Click the View tab.
5. To view a white screen, click Full screen.
6. To allow the screen to warm, wait 45 minutes.
7. Unplug the notebook from the power supply, and measure the display's brightness using a luminance meter in the center of the screen. (We used a Gossen Mavolux5032C luxmeter.)
8. If the reading is below or significantly greater than 200 nits, adjust the screen brightness to as close to 200 nits as you can without going under, and retest:
  - a. Click the Windows Start button.
  - b. In the Windows Start search box, type `display settings`
  - c. Adjust the slider to change the Display brightness to the correct percentage that produces no less than 200 nits.
9. Allow the notebook to run on battery power for 10 minutes, re-measure the display, and adjust the brightness up or down as necessary.
10. Verify that the notebook saved the brightness setting by plugging in the system, unplugging it, and taking another reading.

### Using the MobileMark built-in configuration tool

This tool supports three levels of configuration:

1. Only makes changes that are REQUIRED for the benchmark to run.
2. Additionally, makes changes that are RECOMMENDED for repeatable results.
3. Additionally, makes OPTIONAL changes that help ensure best results.

The configuration tool makes the following configuration changes at each of the three levels:

#### **Level 1 - Required**

- Disables User Account Control (UAC)
- Set DPI Scaling to 100%
- Disables Low Battery Actions
- Disables Network Proxies
- Disables System Sleep and Hibernate
- Disables Windows Update
- Enables Windows Search

#### **Level 2 - Recommended**

- Create BAPCo power scheme
- Set Power Plan Type to Balanced
- Set CPU Adaptive Mode
- Disables Battery Saver Dimming
- Verifies Battery Saver Threshold
- Disables Disk Defrag
- Disables Windows Error Reporting
- Disables Windows Lock Screen
- Disables Windows Pop-ups
- Disables Screen Saver and Monitor Timeout
- Disables Windows Sidebar/Gadgets
- Disables Desktop Slideshow
- Disables Windows Defender
- Disables Windows Firewall
- Set Font Smoothing

#### **Level 3 - Optional**

- Disables Hard Disk Timeout
- Disables System Restore
- Ignores Laptop Lid Close

We chose the official BAPCo “Run Benchmark” default as outlined in the BAPCo MobileMark2018 User Guide ([http://bapco.com/wp-content/uploads/2019/03/BAPCo\\_MobileMark2018\\_user\\_guide\\_v1.3.pdf](http://bapco.com/wp-content/uploads/2019/03/BAPCo_MobileMark2018_user_guide_v1.3.pdf)), which runs the benchmark using the Required and Recommended options.

### **Setting up the performance-qualified battery life test**

1. Verify that the wireless adapter is enabled and connected to a wireless router that is not connected to the internet.
2. Verify that the screen brightness is set to no less than 200 nits.
3. Install MobileMark 2018 with the default options.

### **Running the performance-qualified battery life test**

1. Boot the system.
2. Select Windows Start.
3. Type `cmd`, and press Ctrl+Shift+Enter.
4. Type `cmd.exe /c start /wait Rundll32.exe advapi32.dll,ProcessIdleTasks`. Do not interact with the system until the command completes.
5. After the command completes, wait five minutes before running the test.
6. Launch MobileMark 2018.
7. Click on the Settings Gear icon.
8. Verify that Conditioning Run is enabled.
9. Enter a name for the benchmark run.
10. To return to the main menu, click the Back button.
11. Click Run Benchmark.
12. When prompted, unplug the AC power adapter. The test will begin immediately.

The benchmark is complete when the notebook PC has fully depleted its battery and is no longer operational when running on battery power.

We executed the MobileMark 2018 benchmark three times on the system and took the median battery life run as the representative score for that test.

Read the report at <http://facts.pt/m1CL8op> ►

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