The science behind the report:

Do more with the HP Z2 Mini G1a

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 ***Do more with the HP Z2 Mini G1a***.

We concluded our hands-on testing on July 9, 2025. 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 June 16, 2025 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: Results of our testing.

	HP Z2 Mini G1a	Apple Mac mini	Apple Mac Studio
PassMark PerformanceTest v11.1			
CPU Mark score (higher is better)	60,877	39,403	53,610
Cinebench R23			
CPU multi-core score (higher is better)	38,663	23,495	29,014
GeekBench AI CPU v1.3.0	Windows ML - GPU, float32	coreml_all_fp32	coreml_all_fp32
AI framework	Intel OpenVINO™	Core ML	Core ML
AI backend	CPU	CPU	CPU
Single precision score (higher is better)	7,114	5,789	4,590
Quantized score (higher is better)	18,326	6,994	5,661

	HP Z2 Mini G1a	Apple Mac mini	Apple Mac Studio
GeekBench AI GPU v1.3.0	Windows ML - GPU, float32	coreml_all_fp32	coreml_all_fp32
AI framework	Intel OpenVINO	Core ML	Core ML
AI backend	GPU	CPU	CPU
Single precision score (higher is better)	21,135	14,199	18,008
Half precision score (higher is better)	27,828	16,050	19,323
Quantized score (higher is better)	16,788	14,342	17,588
Chaos V-Ray CPU Benchmark v6.00.01			
Overall score (higher is better)	40,754	27,711	37,632

System configuration information

Table 2: Detailed information on the systems we tested.

System	HP Z2 Mini G1a	Apple Mac Mini	Apple Mac Studio
Processor			
Vendor	AMD	Apple	Apple
Model number	AMD Ryzen™ AI Max+ Pro 395	Apple M4 Pro chip with 14-core CPU, 20-core GPU, 16-core Neural Engine	Apple M2 Ultra with 24-core CPU, 76-core GPU, 32-core Neural Engine
Core frequency (GHz)	3.0 – 5.1	4.5	3.68
Number of cores	16	14 (10 performance cores and 4 efficiency cores)	24 (16 performance cores and 8 efficiency cores)
Number of threads	32	14	24
Cache (MB)	64	10x 32, 4x 4	16x 32, 8x 4
Memory			
Amount (GB)	128	64	128
Type	LPDDR5X-8533	Unified	Unified
Speed	8000 MT/s	NA	NA
Graphics			
Vendor	AMD	Apple	Apple
Model number	AMD Radeon™ 8060S	M4 Pro 20-core GPU	M2 Ultra 76-core GPU
Driver	AMD v32.0.12045.7003	NA	NA
Storage			
Amount (TB)	1 and 1 for data storage	1	1
Type	4x M.2 2280 NVMe® PCIe® Gen 4	Onboard SSD	Onboard SSD
Connectivity/expansion			
Communications	LAN: Realtek RTL8125BPH-CG 2.5 GbE WLAN: MediaTek® Wi-Fi® 7 MT7925	LAN: Gigabit Ethernet WLAN: Wi-Fi 6E	LAN: 10 Gb Ethernet WLAN: Wi-Fi 6E
Bluetooth	5.4	5.3	5.3
USB	1x USB Type-C® 10Gbps 3x USB Type-A 10Gbps 2x Thunderbolt™ 4 with USB Type-C 40Gbps 2x USB Type-A 480Mbps	2x USB-C ports 10Gbps 3x Thunderbolt 5 USB-C 120Gbps	6x Thunderbolt 4 ports 1x SDXC (UHS-II) card 2x USB-A
Video	2x Mini Display Port 2.1	NA	1x HDMI
Display			
Size (inches)	28	28	28
Type	Acer® B286HK	Acer B286HK	Acer B286HK
Resolution	1,920 x 1,200	1,920 x 1,200	1,920 x 1,200

System	HP Z2 Mini G1a	Apple Mac Mini	Apple Mac Studio
Operating system			
Vendor	Microsoft	Apple	Apple
Name	Windows 11 Pro	macOS Se-quoia	macOS Se-quoia
Build number or version	24H2 Build 26100.4351	15.3.1	15.3.1
BIOS			
BIOS name and version	HP X53 Ver.01.02.00 (04/27/2025)	Darwin 24.3.0	Darwin 24.3.0

How we tested

Setting up the system (Windows)

Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set the Windows (plugged in) Power Mode to Best Performance.
4. Set Screen and Sleep options to Never:
    a. Right-click the desktop, and select Display settings.
    b. Select System from the left column.
    c. Click Power & Battery.
    d. For all power options listed under Screen and Sleep, select Never.
5. Disable User Account Control notifications:
    a. Select Windows Start, type `UAC`, and press Enter.
    b. Move the slider control to Never notify, and click OK.
6. Run Windows Update, and install all updates available.
7. Run the HP/Dell/Lenovo Support Assistant utilities, and install all recommended BIOS and driver updates available.
8. Verify the date and time are correct, and synchronize the system clock with the time server.
9. Pause Automatic Windows Updates:
    a. Click the Windows Start button.
    b. Type `Windows Update settings` and press Enter.
    c. From the Pause updates drop-down menu, select Pause for 5 weeks.

Capturing an image

1. Connect an external HDD to the system.
2. Click Windows Menu button, and type `Control Panel` in the search bar. Click Control Pane l → System and Security → Backup and Restore (Windows 7) → 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. When you see the prompt to create a system repair disc, 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 See more recovery options.
6. Select System image recovery.
7. Select the User account.
8. Enter the system password, and click Continue.
9. At the Restore system files and settings screen, select Next.
10. Verify that the external HDD is selected, and click Next.
11. Once the recovery has completed, click Finish.

Setting up the system (macOS)

Setting up and updating the OEM image

1. Boot the system.
2. Follow the on-screen instructions to complete installation, using the default selections when appropriate.
3. Set Energy Mode to High Power (processor dependent).
    a. Select System Settings.
    b. Select Energy. On notebook systems select Battery.
    c. Change Energy Mode to High Power.
    d. Set Screen and Sleep options to Never:
    e. Select System Settings.
    f. Select Screen Saver.
    g. Select Lock Screen.
    h. Change the following options to Never:
        - Start Screen Saver when inactive.
        - Turn display off on battery when inactive.
        - Turn display off on power adapter when inactive.
        - Require password after screen saver begins or display is turned off.
4. Verify resolution is 1,920 x 1,080:
    a. Select System Settings.
    b. Select Display.
    c. Verify that the display resolution is set to 1,920 x 1,080.
5. Run Software Update and install all updates available.
6. Verify the date and time are correct.
7. Enable Automatic log in:
    a. Select System Settings.
    b. In the search box, type `Users & Groups`.
    c. Click Users & Groups.
    d. Select the drop-down menu next to the Automatically log in as setting, and select the User account.
8. Disable Automatic Mac Updates:
    a. Select System Settings.
    b. Click General.
    c. Click Software Update.
    d. Click the information icon next to Automatic updates.
    e. Disable Download new updates when available.

Capturing an image

1. Connect an external HDD to the system.
2. Click the Apple, and select System Settings.
3. Select General, and select Time Machine.
4. Click Add Backup Disk, and select the drive. Wait for the initial backup to complete.
5. Click Options.
6. Set Backup Frequency to Manually.
7. Click Done.

Restoring an image

1. Shut down the system.
2. Press and hold the power button until Loading startup options appears.
3. Select Options, and click Continue.
4. Select Disk Utility.
5. Select Macintosh HD.
6. Click Erase HD.
7. At the Erase APFS volume group "Macintosh HD" screen, click Erase.
8. At the Erase Mac dialog screen, click Erase Mac.
9. At the Are you sure screen, click Erase Mac and Restart.
10. Select a Wi-Fi network, and click Join.
11. Click Exit to Recovery.
12. Select Reinstall macOS Sequoia, and click Continue.
13. At the macOS Sequoia screen, click Continue.
14. At the license agreement screen, click Agree.
15. Click Agree.
16. Select the Macintosh HD, and click Continue.
17. Select Your Country or Region, and click Continue.
18. At the Accessibility screen click Not Now.
19. Select a Wi-Fi network, and click Continue.
20. At the Data & Privacy screen click Continue.
21. At the Migration Assistant screen choose From a Mac, Time Machine backup or Startup disk, and click Continue.
22. Connect an external HDD to the system.
23. Select the backup image, and click Continue.
24. At the Select a Backup screen, select the correct backup date and time, and click Continue.
25. Ensure all boxes are checked, and click Continue.
26. Enter the Administrator password, and click Ok.
27. After the backup restore completes, click Done.

Running PassMark PerformanceTest (Windows)

Setting up the test

1. Install PassMark PerformanceTest.
2. Download PassMark PerformanceTest from ***https://www.passmark.com/products/performancetest/download.php***.
3. To begin the installation, press Install.
4. Select Accept to accept the license agreement, and press Next.
5. After the installation completes, deselect Launch Performance Test, and press Finish.

Running the test

1. To launch PassMark PerformanceTest, press the PassMark PerformanceTest icon.
2. To start the benchmark, press Run Benchmark.
3. When the test completes, record the results.
4. Complete steps 1 through 3 two more times.
5. Report the median of the three runs.

Running PassMark PerformanceTest (macOS)

Note: The macOS version differs from the Windows version and can run only CPU Mark and Memory Mark benchmarks.

Setting up the test

1. Install PassMark PerformanceTest.
2. Download PassMark PerformanceTest from ***https://www.passmark.com/products/performancetest/download.php***.
3. To begin the installation, press Install.
4. Select Accept to accept the license agreement, and press Next.
5. After the installation is complete, deselect Launch Performance Test, and press Finish.

Running the test

1. To launch PassMark PerformanceTest, press the PassMark PerformanceTest icon.
2. To start the CPU Mark benchmark, press Run next to CPU Mark.
3. When the test completes, record the results.
4. To start the Memory Mark benchmark, press Run next to Memory Mark.
5. When the test completes, record the results.
6. Complete steps 1 through 5 two more times.
7. Report the median of the three runs.

Running Cinebench R23 (Windows and macOS)

Setting up the test

1. Download and install Cinebench R23 from ***https://www.maxon.net/en/downloads***.

Running the test

1. Launch Cinebench.
2. Select File→Advanced benchmark.
3. Set the Minimum Test Duration to Off.
4. Select either CPU (Multi Core) or CPU (Single Core) and click Start.
5. Record the result.
6. Wait 10 minutes before re-running.
7. Complete steps 1 through 7 twice more and record the median result.

Running Geekbench AI (Windows)

Setting up the test

1. Purchase and download a Geekbench AI Pro license from ***https://www.geekbench.com/ai/download/***.
2. Using all the defaults, run the installer, and install the benchmark.

Running the test

1. Launch Geekbench AI.
2. Enter the license key.
3. For CPU/NPU testing, select:
   - AI Framework: Intel OpenVINO
   - AI Backend: CPU
   - AI Device: processor
4. For GPU testing, select:
   - AI Framework: ONNX
   - AI Backend: DirectML
   - AI Device: graphics card
5. Click Run AI Benchmark.
6. Wait 5 minutes, repeat steps 3 through 5, and capture the median of three runs.

Running Geekbench AI (macOS)

Setting up the test

1. Purchase and download a Geekbench AI Pro license from ***https://www.geekbench.com/ai/***.
2. Using all the defaults, run the installer, and install the benchmark.

Running the test

1. Launch Geekbench AI.
2. Enter the license key.
3. Set AI Framework to Core ML.

4. From the AI Backend drop-down menu, choose either CPU or GPU.
5. Click Run AI Benchmark.
6. Record the result.
7. Wait 5 minutes before re-running.
8. Complete steps 1 through 7 two more times.

Running V-Ray Chaos benchmark (Windows and macOS)

Setting up the V-Ray Benchmark

1. Download the V-Ray Benchmark from ***https://www.chaos.com/benchmark-download***. We used version 6.00.01.

Running the V-Ray Benchmark

We captured the following metrics for this testing.

- V-Ray – CPU

1. Run V-Ray benchmark
2. Using V-Ray for CPU, run V-Ray for 5 minutes. Record the results.
3. Wait 5 minutes, and complete step 2 twice.

Read the report ▶

This project was commissioned by HP.