Modern laptop design guidelines Release 1 draft (2026)

This specification is available on the mwiacek.com and github.com/marcinwiacek/modern_laptop as text, PDF and ODT document.

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Abstract

Different companies created for years great laptops, unfortunately in the end many of them suffered from the same mistakes. This specification & white book can help in avoiding similar situations in the future. It contains clear rules and recommendations, which should be followed in modern laptops to make them environment and user-friendly. Such implementation is today very important especially, that wrong design in specific cases can be dangerous and has impact on users health (we don’t concentrate on using some chemicals during production process and it rather includes for example continuous irritation, eyes or ears problems).

Market background: we have growing prices of all components (especially because of the speculation with SSD and RAM, but also implementing more effective processes, which should end in creating cheaper chips, but are more expensive in maintenance). Majority of configurations are not available outside US, devices cannot be tested before buying or user doesn’t know anything about used LCD models and other key parameters and cannot check it even on the package box (it’s visible for Dell, HP, but also for Acer, LG and others). Companies are removing human support at

all (users cannot contact anybody and always hear just standard answers). We observe less technical reviews in the internet (it's because of sponsored texts, AI sloop and problems with skilled engineers) and there is bigger and bigger problems with buying something useful, what will handle concrete requirements or work at least so good like older devices (in the end wrong choices are leading to the fear or comments against modern technology).

Provided document is currently based on various experiences and long-term research (doesn't have AI elements). It was created after unsuccessful laptop update in the 2026 (problems were described in the document end). This situation looks a little bit like with Thinkpad devices (many people prefer older models from IBM) and shows very good closed circle in market – people don't buy new laptops, because they have ugly elements, and companies are not giving customization and better options, because don't see big sales and popularity.

Please remember, that system is always so good like weakest element, for example pairing the best CPU with blinking screen, cheap looking case or very bright blinding status lights on the cover is totally ruining user experience.

We believe, that unhealthy design rules+market saturation make, that only really useful devices can be sold in many copies. We're sure, that implementing described here rules could help in returning laptop devices into full glory and achieving such success like with original IBM PC (if single company doesn't have enough resources, we advice to make some kind of working group creating some standards and projects together especially that assembling capacities are already available according to the video "The Making of a Premium Laptop: An In-Depth factory Documentary" – example members for this group could be for example Tuxedo, Framework, System76 and Geekom).

Note: to make things more simple we name main laptop firmware BIOS (although classic BIOS in X86 was replaced by UEFI long time ago).

License

Version history

Release 1 draft – 2 March 2026
Notes can be sent on the git-hub or directly to the Marcin Wiącek: marcin (***dot***) wiacek (***at***) mwiacek(***dot***)com

Size and form

We will cover here mainly the most popular smallest size 14". We see, that it's currently possible to create very light devices and difference between 13" and 14" is so small, that 13,6", 13" and everything below should be excluded.

Next laptop size is 15,6" and various notes from this document can be of course scaled.

There will discussed mainly classic form (bottom part with battery, motherboard, touchpad and keyboard staying on the surface, top part with the screen opening with different angles).

We don’t cover here other forms, for example:

1. connecting Android phone into laptop case (it can work in desktop mode) like with NexDock (offtopic: such case should have big battery, matt screen and place to put device inside or in the touchpad place)
2. using tablets with keyboard (offtopic: they’re nice, but normally it’s not possible to have good matt screen and Huawei MatePad 11,5S seems to have poor contrast)
3. connecting mini PC to the laptop case in screen back (Mind xPlay, which in our opinion is too expensive)

Weight

Let’s look on some available models:

Model	Battery [Wh]	Screen ["]	Weight [g]
Fujitsu Zero	31	14	634
Fujitsu FMV Note U	64	14	848
Toshina Portege X40L-M	65	14	875 (some docs say 1050)
Asus Zenbook A14	70	14	990
Clevo (the whole series including L14xMU)	72	14	990
GEEKOM GeeBook X14 Pro	72	14	999
HONOR MagicBook Art 14 2025	60	14,6	1030
Dell XPS13 with Lunar Lake	55	13,4	1210
Macbook Air 13 M4	53,8	13,6	1225
Framework 13	61	13,5	1300
Dell XPS14 with Panther Lake	70	14	1380
Honor MagicBook Pro 14 2026	92	14,6	1415

Although it’s not always the rule, we observe, that US models are normally heavier (Honor gives not only big battery, but also heavy double cooling system and was mentioned for comparison).

We recommend 1.0kg or less for 14” devices – it can be achieved and it’s today more manufacturer decision than technology/cost problem.

Battery

We don’t know, where exactly this came from, but many companies already proved, that 14” laptops can be created with 70Wh or bigger battery.

We strongly believe, that user should have two choices:

1. battery as big as possible (starting from 72Wh, can be maximally 99Wh because of airlines regulations)
2. small battery (for example 20Wh), which could be just used, when laptop is moved from desk to desk - in all companies and corporations devices are normally connected to the charger or docking station and it’s enough to have 20-30 minutes working time

Battery should have easy ability of disconnecting, when user has got standard screwdriver. There shouldn’t be special manual skills required for this and connector should be designed this way, that user can easy connect it or disconnect without big force and making shortcuts on the motherboard.

Power sources should give information about number of full charging cycles, designed and current capacity, charging power, manufacturing date, manufacturer and serial number. Users should be informed about estimated cycles, when battery is going into 80% of designed capacity (companies should provide similar information like for the phones in the EU).

Good practice is implementing maximal charging levels or charging patterns in BIOS (Framework has got it latest 3.x BIOS releases, Dell and good companies for years)

We welcome using modern chemistry (carbon batteries) and batteries with more charging cycles - please remember, that many customers can pay extra for bigger and better units.

Screen

Many years ago people were using CRT displays (big, heavy, with all kind of radiation and blinking). Later we have seen plasma displays and they were gone after some time.

Market went into LCD displays with long time reaction & backlight done with PWM (it's fast enabling and disabling for it). Some people were highly reacting with eyes problems and headache and many companies happily started using DC backlight (all backlight LED are just using different voltage, but working the whole time). The main problem here is, that today almost nobody clearly specify, whether there is PWM or DC used.

And we have seen the same backlight problem with OLED displays – they're simply blinking (typical PWM frequency is 120 or 240Hz) and according to our best knowledge only one company (Honor) is making something more with this providing PWM backlight working with 4320Hz or DC dimming.

Because of all these factors we suggest providing three classes of the screens for every device:

1. LCD with minimum Full HD 1920x1080 or 2K 1920x1200 resolution (both concentrated on low power usage)
2. LCD with high resolution (for example 4K)
3. AMOLED

Every class should contain matt/non-glare/anti-glare version (or something similar like nano glass in Apple), for LCD there should be always provided models with:

1. better contrast (at least 1500:1, everything below 1000:1 is totally unacceptable),
2. color coverage at least so good like in models available few years ago, which means 100% sRGB (market cannot go back and implement quality from previous decades),
3. DC dimming (PWM should be excluded at all),
4. clear information about number of colors supported by hardware (whether this is 6, 8 or 10-bit color palette)
5. at least 300 or 400 nits for maximal brightness
6. information about minimal brightness (it should be as low as possible)

We don't define here color temperature (although ideal is 6500K), viewing angles (for IPS they're typically very good), black level & response time (both should be as small as possible), blue light migrations type, display refresh rates (whether it's just 60Hz or more) and similar things, but we believe, that better parameters are always welcome and this in manufacturers interest improving them. Glass & touch layers and privacy filters must be clearly marked, because in many implementations they can lead to the quality decrease because of reflections or picture angles.

We observe today big logical error in strategy saying:

1. there can be sold laptops with worse screens
2. devices with good screen need always powerful CPU, big RAM and big battery

Today many users need (second) laptop just for editing texts, watching videos in Youtube or making remote connection to VDIs with good internals. Cheap devices are normally used in schools and work and many times cannot be replaced because of budget or policy (this makes problems, when especially young people are forced to use them and cannot check with doctor, if they're vulnerable to screen issues).

Currently even reputable brands can be problematic for some people – Macbook Pro are using PWM and both Air and Pro are using different brightness on the edges and so called temporal dithering (people are trying to mitigate this problem with tools like StillColor, but it's not always working).

Please have in mind, that panels from first group (FullHD or 2K) in various devices can provide up to 10 more hours of battery work, they just need to be adjusted by user for comfortable work (it's connected with setting up operating system, using correct font size, scaling and anti-aliasing and sometimes requires resigning from Linux distributions based on Gnome/GTK 4.x, because they provide just gray anti-aliasing and don't handle especially such panels in very nice way).

In ideal situation for every class there should be provided list of hardware models (we cannot have so called "lottery") and connector info and BIOS shouldn't be locked to any specific module (model or part number).

Device could have light sensor, but in any case user must have option for disabling it.

We concentrate in this document on classic form and of course there are already some devices with foldable screens (Compal Inifinite or Thinkpad X1 Fold) or two displays (Asus Zenbook Duo) – all notes about picture quality apply to them.

Case colors

In ideal situation every device should be available at least in two variants:

1. total matt black (like in IBM Thinkpads)
2. black frame over screen+silver bottom case (like in Macbook Air M1)

More variants are welcome and Framework customization is good example.

Case layout

Hinges in 2-in-1 laptop need to work in the 360 degrees angle and normal laptop could be opened maximally into 180 degrees angle (not less). There are two possibilities for opening the last one:

1. screen cover opens in ideal plain line with bottom part (preferred and visible for example in Schenker VIA 14 from 2020 or 2021)
2. screen opens below bottom part (non preferred, but currently standard)

Bottom part (keyboard, touchpad, battery, motherboard, etc.) consists always from two elements and can be created using two ways:

1. bottom element is created in one piece with laptop sides and is closed with top element with touchpad and keyboard (it's preferred) – this is done for example in Framework 13 or Dell XPS14 from 2026
2. top element with touchpad and keyboard is covering top and laptop sides and is closed with bottom element – this is done for example in Lenovo T14s gen 6 and majority of laptops

Number one is preferred, because:

1. it's easier to create laptop, which could survive some liquid in the surface
2. keyboard and touchpad could be replaced without big effort
3. motherboard has got all elements on the top and all heat goes up and could be taken by top cover working as big radiator

We don't recommend any ventilation holes on the top (left and right side of the keyboard) and bottom – all ventilation should go over sides (back part from the screen side, but created this way, that will not heat screen too much).

MIL-STD 8106 or IP norm and protection against liquid and dust are very welcome. Case cannot be twisted and we don't welcome any stickers on it (in the end user is paying for them and they don't provide any added value). Additionally it should be possible to open screen just with one hand.

Keyboard

We don't strictly define type of keyboard – we can only recommend, that keys feedback must be clear, keys can be pressed at least 1.5mm down, should be as silent as possible and there is required durability. We additionally highly recommend some kind of protection against liquids and making gaps among keys (zero-lattice keyboards are normally ending with pressing few keys or bad looking device after some time). We don't want to see anywhere capacitive touch keys – Dell tried them for few years and it was not working.

Good example of keyboard implementation are today Apple and Lenovo Thinkpad products.

Every keyboard layout should be presented by manufacturer on the page in the graphic form (it will allow for avoiding confusion especially between ISO or ANSI layouts) and users should be able to easy replace one keyboard with another – it will allow for migrating from one predefined configuration into another, give device second life, when device is suffering from keyboard problems, etc.

Future implementations could provide e-ink pictures on the keys (they're using power only during changing picture) and some way of changing layout.

Some typical problems:

1. replaced Ctrl and Fn keys – today standard is rather Ctrl on the left side, in opposite situation it's good to provide option in BIOS for reversing assignment
2. small arrow keys – it's resolved in Lenovo Thinkpad by providing keyboard in extra space on the right below corner going out typical rectangle shape (alternative: only up and down keys are small and left/right keys are with normal size)

3. small right Shift – we haven't seen it, but there are some information in Internet about it as well
4. power button put on the top right keyboard corner (users many times pressing it for example instead of Del key) – we propose merging it with Esc key (pressing it with Fn key or alone over four seconds will simulate power button), replacing with Del like in MSI laptops or making any reaction after few seconds
5. separate offline key – it cannot be normally disabled in popular OS and we propose to replace with combination with Fn key to avoid mistake pressing (additionally it should be far away from combinations disabling sound, etc.)
6. separate Skype key – we propose removing it

Some companies are creating separate line for Home/End, PgUp/PgDn on the right side – it's acceptable, but it's taking precious space and all these keys could be replaced with Fn+arrow key combinations.

Keyboard light cannot enable automatically in any situation, it should be always controllable by user (Fn+key and BIOS option).

Proposed test for manufactures: putting liquid on the keyboard, waiting until it disappear and checking, that device is still correctly working.

Touchpad

Today there are used two types: classic or haptic.

In minimal configuration user should see only:

1. surface for moving fingers, which could be additionally pressed (device should be created this way, that such action will always generate button press)
2. surface for moving fingers + separately buttons

Edges must be clearly marked and separated from device edges (Dell and Asus tried something else and user feedback was negative).

Device could implement automatic disabling internal touchpad after connecting external USB mouse or could have Fn+key option for setting it on/off.

In ideal situation there should be used touch layer known from phone/tablets (when this is more efficient than classic touchpad models) and user should know, whether haptic version (with motors) need more energy than classic one. Some extra implementations could provide e-ink on the the touchpad surface and displaying some data (or even using this area for providing touch surface with ability of pen writing like in Compal Al Book).

All holes between edges and internals should be somewhere protected. Proposed test for manufacturers: putting liquid on the touchpad surface, waiting until it disappear and checking, that device is still correctly working.

External devices

Device should implement one of two standards:

1. replaceable port modules like in Framework laptops – specification is available for free in git-hub (every module should be clear marked with power usage info), similar concent was presented with ThinkBook Modular AI PC Concept
2. fixed amount of ports: minimal proposed set is 2xUSB-C (one on the left, one on the right), jack port, at least one USB-A, HDMI and (micro)SD card reader

Laptops can of course implement more ports (for example smart card readers, LTE modem, NFC or Oculink for connecting external graphic cards) or mix these two approaches (preferred) - for example device could have 2xUSB-C (one on the left, one on the right), jack port and one or two replaceable port modules (one on the left, one on the right).

USB hubs, card reader other internal subsystems should not take any energy, when external devices are not connected – even few mA is not acceptable and when standard cannot provide zero mA power draw, user should be able to disable everything from the BIOS (one exception: USB-C ports must be always prepared for charging).

Devices should accept at least few popular chargers – for example 30W, 35W (dual port) and bigger Apple power bricks.

In ideal situation USB ports could have option for disconnecting data pins (for security) or protection against big voltage and dust (no holes between cover and port). User should always have clear information about supported wattage and connection speed. User should have been informed, that charging external devices option can take extra power (when design doesn't follow our other recommendation and laptop needs extra power draw taken 24/7 to check, if anything is connected).

All ports should provide physically enough separation – for example after connecting cables into two USB ports next to each other user should have enough space to catch every of them with fingers (instead of 3mm like in some laptops we suggest to make gap 1-1,5cm)

Framework modules should provide reasonable explanation for power usage, for example we don't understand, why USB-C to USB-A converters seem to draw power according to some notes on their forum (these should be just mechanical modules without own chip).

We don't like using magnets at all from various reasons and don't recommend Apple solution for connecting charging cable.

Multimedia

Currently the most popular standard are cameras above screens – we require, that every of them has got mechanical cover (covering main camera should remove not only the whole device from PCI or USB bus, but also mechanically disconnect internal microphones).

Device cannot have BIOS startup sound ("gong" like in Apple), but can provide some ping, when BIOS detect critical hardware failure, problem with charging, attempts for firmware tampering or problematic external devices. Mute for sound card could be possible with FN+key combination (additionally sound subsystem should be disconnected from all buses, when sound volume is zero).

We leave speakers implementation to every manufacturer – they just shouldn't have holes on the case bottom or top.

There is required jack connector for connecting headphones.

Light indicators

Device should provide absolute minimal set of light indicators on the case. Some rules:

1. information about enabling device is not required at all – we very like Macbook approach
2. we could see optional information about ongoing charging process (some blinking green LED), changing power mode (green LED blinking for a moment) and low battery level (some blinking red LED)
3. we could see optional information about Caps lock and other keyboard modes (this is highly NOT preferred, but possible; in ideal situation user should have option in BIOS for disabling it)

Lights could be replaced with e-ink screens, which need power during changing content only.

CPU and platform

Currently on the market we have few standards:

1. X86 normally implemented with Intel or AMD CPU (it's strange, that they still don't support X86S standard)
2. ARM (in many cases gives more energy saving than X86 and can give comparable or better performance, what was perfectly proved by Snapdragon and Apple M chips)
3. RISC-V (totally opened, but not powerful today)
4. FPGA (small niche mainly for emulators)

This document doesn't define anything, however it's strongly recommended, that:

1. user know power usage in few typical situations (like BIOS screen)
2. device has got support at least for two popular OS (suggested: Windows and at least selected Linux distributions)

Cooling

Cooling can be done with fan(s), AirJet (membranes vibrating at ultrasonic frequency) or using passive way (with heat pipes, radiator or vapor chamber). First two options require some power from the battery and we highly recommend to give user option of selecting fan/jet/TDP profile in BIOS with clear info, when device will be totally passive cooled (silent) or not.

Experience say, that companies many times are setting up cooling in very conservative way or doing something totally opposite. Devices created in compliance with this document cannot enable CPU thermal throttling, which is normally last line of defense against physical damage (CPU should start decreasing clocks at least few degrees below breaking point). This can be checked with such tools like HWINFO and it doesn't matter in this moment, if we speak about activating it for short time – if it's done many times every day, we assume, that CPU can start degradation much faster than expected.

We don’t accept using liquid metal at all – in the end it makes often electrical shortcuts or damage structure of the chip in the motherboard (in Youtube you can find various repairs related to it from Asus devices). The same problem is with liquid cooling.

Fans should be implemented using standard models and they should work in the most silent way. Very good idea is implementing reverse fan mode like in TravelMate P6 (it could help in removing dust).

We recommend providing cooling not only into CPU and chipset, but also into disk, Wifi card, VRM regulators and RAM.

RAM

There are three possibilities:

1. soldered on the motherboard with LPDDR chips (can be they put into separate laminate connected into motherboard?)
2. SO-DIMM modules
3. CAMM2 modules

First and third options can use less energy and are recommended. There could be used hybrid approach like in some Clevo laptops – LPDDR + one slot (SO-DIMM). If device has got few physical modules, it would be good to give option for disabling some of them (in case, when they’re damaged or when user wants to save power).

User data

Laptop must have ability of physical disconnecting module with user data and it shouldn’t be hardware locked into concrete unit (user can of course use Bitlocker saving encryption keys in TPM and won’t be able to decode data in other units, but this is OS specific). We recommend implementing the most popular M.2 2280 M-Key format for NVME devices (when there is only SATA B-Key or one-side disk supported, it must be clearly defined in the documentation).

Using non standard extensions cards with just flash memory chips (Apple solution from Mac Mini) or eMMC/UFS is not recommended, but possible - it should be clearly defined and in every situation device must collect information for user about memory degradation level.

In this specification we’re against using OEM disks – they come normally without any firmware updates (fixes) and without any TBW parameter info (estimated amount of data possible to write).

We also very recommend to provide clear information about power usage with sold units – for example according to Techpowerup reviews some WD disks need even 1.058W in idle, when in the same time some Samsung are taking 0.023W.

Mainboard/motherboard

It should consist of three parts: main motherboard and flexible modules on two sides with external connectors (one on the left, one on the right)

It’s strongly advised, that motherboard is using standard market standards like M.2 2280 (NVME when possible, eventually SATA in cheaper devices), one or two M.2 2240 (for extension cards like second disk, NPU, FPGA, WWAN or Wifi). All slots should be fully disabled in BIOS – it can allow for example for using just one disk and switching between private and work configuration.

Good practice is implementing info about first start date and counter of opening device case – it seems to be implemented in Framework products.

Manufacturers could consider their mechanical compliance with Framework 13 motherboards and providing some schematics giving repair ability (in the same time we don't like putting stickers with QR codes in internal components because of security and using some materials for their producing).

We don't accept whining coils at all.

BIOS and firmware

Currently in the market we have few standard implementations, for example products from Insyde, AMI or Coreboot.

We have few recommendations:

1. Coreboot is preferred because it's provided with source (in the same time we understand that sometimes it cannot be used because of enterprise requirements or legal reasons)
2. all main BIOS implementations from the box normally provide many options, but manufacturers are limiting them to avoid problems with wrong configuration by users. We're against this practice – better technical options are much more important than for example nice GUI
3. BIOS should provide clear info, whether device is after normal support cycle from the manufacturer
4. device during editing BIOS options and booting should go into highest possible energy saving mode
5. flashing new version should be only possible after switching some jumper on the motherboard or after pressing some special Fn combination on the start (without it all chips in motherboard without exception should be switched into read-only mode)
6. wrong flashing new version or changing settings should not be problem – especially better and more expensive motherboards could start from backup and should have automatically called "reset to default" after few incorrect POST procedures
7. devices should not have RTC battery anymore (we like Framework suggestion that motherboard could use them just in some cases)
8. there should be provided basic hardware info and upgrade from the BIOS level
9. we don't like QR codes in BIOS (they can transfer potentially to suspicious pages)

TPM and Secure Boot

There are many reports, that Microsoft is using TPM for tracking user activities and Secure Boot could be potentially used for blocking alternative OS. We believe, that enabling/disabling such features is optional, but they must be available because of Windows 11 or enterprise requirements.

Intel ME or vPro Enterprise Management

They're used for making remote connection to the device and doing something even without OS knowledge. First of them is implemented even in consumer products and was criticized for years because of unclear structure and possible security flaws.

We strongly recommend, that every company should allow installing latest ME firmware versions separately from main BIOS updates as long as they're provided by Intel (the same is with AGESA from AMD).

Additional problem is power usage. Various sources (like System76 in git-hub) provide information, that disabling ME with HAP bit in some systems could lead to extra battery drain - because of it we ask for providing info, which setup can decrease power usage and which can increase security.

Power saving

This section will try to describe things in very generic way, however we will use mode names from X86.

The list of defined system modes looks currently like this (the bigger number, the more savings):

1. S0 – everything is on
2. S0iX – modern standby, where device can from time to time execute some actions like checking mails (s2idle)
3. S1 – power on suspend (obsolete, not used anymore)
4. S2 – CPU power off (obsolete, not used anymore)
5. S3 – suspend to RAM (sleep/standby, where user cannot do anything without resuming and lack of battery power can lead to loosing non-saved data)
6. S4 – suspend to disk (hibernation, where data from RAM are saved to disk and user cannot do anything without resuming)
7. S5 – shutdown, device can take some power
8. G3 – full off mechanical state

Some components have own power levels, for example:

1. Intel CPU can normally enter 10 power saving levels (C1-C10)
2. PCI devices have D0, D1, D2, D3Hot, D3Cold modes (L0-L3 states including ASPM)

All laptops should clearly specify, what is supported by hardware and BIOS (buggy implementation of S0iX in many X86 devices/OS makes, that we highly suggest giving user ability of using S3 mode; additionally motherboard support for ASPM and C10 CPU mode is “must have” today).

Below there is provided some summary of power saving rules:

1. when laptop is on, user don’t see any power light on the case/power button and device is trying to save as much as possible power on all buses
2. when laptop is on and lid is closed, it should disable screen, camera, keyboard lights and go into mode selected by user (standby/hibernation or no further action)
3. when laptop is off/in hibernation and not charging, power should be given to RTC only (cannot go into EC, RAM, CPU, keyboard lights, etc.)
4. when laptop is in standby and not charging, power should be given to RAM and RTC only (EC and other elements must be totally disabled)
5. when laptop is in off/hibernation/standby, could be resumed by power button only, if it’s saving power (no need to check for keyboard and touchbar press by EC)
6. when laptop is charging, power could be optionally given to the green LED on the case (it can blink, when battery is not full)
7. when laptop is not charging, power could be optionally given to red LED (it should blink from time to time, when battery level is below concrete critical level)
8. when laptop is changing power mode (going to standby or hibernate), can show blinking green LED, when it’s done correctly (but only for moment)
9. alternative to LED could be small e-ink screen showing battery level or some warnings

10. when nothing is connected to USB/HDMI/card reader and other external ports, related internal components like controllers should be totally disabled and removed from the bus
11. user should be able to configure hibernation, when power level goes below some level
12. user should be able to create timeout for going into standby or disabling screen
13. lid closing sensor should be pure mechanical and can't take any power from the battery
14. devices with more RAM chips could implement cutting off power to concrete chips, when they're not used (in ideal situation OS should make memory alignment based on physical structure and allocate memory in the most energy efficient way)

Notebookcheck is making review of different devices. We assume, that their results are quite comparable (idle contains minimum measured value):

Device	**Off [W]**	**Standby [W]**	**Idle [W]**
Macbook Air M1 8GB RAM	0.03	0.04	1.9
tablet Lenovo Yoga Tab 12GB 11.1" 3200x200 LTPS	0.1	0.2	1.2
tablet iPad 2025 6GB 11" 2360x1640 IPS	0.12	0.17	1.43
tablet Poco Pad X1 8GB 11,2" 3200x2136 TFT	0.07	0.16	0.7

Windows laptops look always much worse, for example:

Device	**Off [W]**	**Standby [W]**	**Idle [W]**
Schenker VIA 14 2021 Intel 16GB 14" 1920x1080 IPS	0.23	0.74	2.9
Lenovo T14s gen 6 Snapdragon 32GB 14" 1920x1200 IPS	0.4	0.8	2.4
Lenovo T14s gen 6 Lunar Lake 32GB 14" 1920x1200 IPS	0.3	0.7	3
Lenovo T14s gen 6 AMD 32GB 14" 1920x1200 IPS	0.2	0.5	2.8
Dell Pro 13 Premium Lunar Lake 32GB 1920x1200 IPS	0.15	0.6	2
Dell XPS13 2025 Lunar Lake 16GB 13,4" 1920x1200 IPS	0.35	0.56	1.3
Dell XPS14 2026 Intel 355 16GB 14" 1920x1200 IPS	0.18	0.67	1.6
Dell XPS14 2026 Intel 358H 32GB 14" 2880x1800 OLED	0.21	0.8	3.1
Framework Intel 155H 32GB 13,5" 2880x1920 IPS	0.38	1.1	2.5
Geebook X14 Pro Intel 32GB 14" 2880x1800 OLED	0.8	1.2	6
Chuwi CoreBook Air AMD 16GB 14" 1920x1200 IPS	0.78	0.83	3.9
Honor MagicBook Pro 14 2026 32GB 14,6" 3120x2080 OLED	0.11	0.8	6.8

Can be standby power usage explained just by refreshing bigger RAM? (it's sometimes even 5x bigger and we don't even compare to Macbook, which potentially can save everything to disk) Or is cost of resuming device by pressing touchpad or any key? Or wrong design, where camera and unnecessary elements are not off? Or finally Intel ME?

Why we get sometimes even 6x bigger power usage in idle with some models than in tablets? Is it disk problem? (using NVME with own controller instead of UFS flash) Non-optimal checking for touchpad or key press? (can EC be enabled only after user action? Can be using phone/tablet touch layers more energy effective than classic touchpad?) Or is it just Intel/AMD architecture or Intel ME? (rather not, because T14s with Snapdragon suffers for the same problem)

And finally why we get such high numbers in off state? They should be practically equal zero (we recommend 0.01W when possible) - currently mobile laptops have bigger power drain than stationary devices connected 24/7 to the wall socket.

The answer could be partially connected with EC (Embedded Controller) working even when device is off – it looks that many designs are probably not taking care of optimizing it and making it energy efficient. Companies are the most often probably following design with Zephyr OS – is it time for change? And time for thinking about power draw coming from all lights and other elements mentioned in this document? (small separately, huge together)

We believe, that today companies cannot implement “something” and we just ask for:

1. providing things defined by specs for years – we should mention here Asus with wrong ACPI implementation (see “Asus Gaming Laptop ACPI Firmware DPC Stall: A Deep Technical Investigation” in the git-hub).
2. giving only better results in next generations – very good example is Dell XPS14 from 2026, which seems to work much shorter on Wifi than older Dell laptops (info from notebookcheck)

We understand, that power usage depends on content displayed on the screen (white colors normally needs more), brightness, power level on the Wifi or even software configuration (for example saving temp files on RAM-disk instead of SSD).

We don’t want to go into discussion, which operating system is more energy efficient.

Different companies or internet pages should provide consistent testing framework (for example it’s a little bit suspicious to see claims, that some 14” OLED Panther Lake devices are working 30+ hours on the 79W battery when it’s not confirmed in more places). It leads to the more generic conclusion, that users should always look into various sources and comparing different usage patterns.

Operating system

Like mentioned earlier, it’s optimal, when device has got support for Windows AND for example some Linux distributions.

Although it’s comfortable, when device could have working OS just after unpacking from the box, we strongly suggest, that:

1. all drivers are generic and available from Windows Update or distribution/Linux kernel itself (must be generic)
2. user will reformat disk and install everything using generic operating system images (some “problematic” software can be installed in the factory even with manufacturer knowledge)

Modularity

In our opinion devices should have as high note as possible according to iFixit.

We strongly advice providing updates ability for older models (very good example is Framework giving few motherboards and other parts for the same case or Compal Adapt X concept).

Locking components on the model/serial number (making “white lists”) is not acceptable and unfortunately Apple is good example of such bad behaviors.

In the future it could be for example considered:

1. replacing battery, motherboard, RAM, disk, touchpad and keyboard by user
2. providing own external connector modules like earlier described (Framework compatible)
3. disconnecting the whole part with the screen and using it as separate monitor
4. using motherboard outside in the mini PC case like proposed by Framework
5. using keyboard and touchpad remotely/on the cable

Sales

User should have option of buying just device in the package (even without charger and external cables). Connected sales are very bad practice and we recommend, that laptops can be ordered without OS and disks (eventually without RAM too, when possible). Region locking should not be visible and every company must provide ordering any configuration into all countries, which are not on the sanction list.

Examples:

1. Dell is giving some options, but doesn't allow for buying everything without OS and is removing some color options in some countries – this is bad practice
2. HP is giving all series options mainly in US and in the Europe many times sells only one or two predefined configurations – this is again bad practice
3. Acer is giving only predefined configurations – this is very bad practice
4. Lenovo is giving all options for Thinkpad – this is recommended
5. Framework should allow orders to the Switzerland in the Europe (if there is not available local reseller and support center, all warranty repairs should be done in other country after sending device on user cost)
6. Tuxedo gives many technical information – this is recommended

In this moment we strongly advice to create less models, but more polished and with more options available – Apple with just two notebook lines (Air and Pro) is very good example.

Marketing

It cannot be misleading, for example Framework saying "Framework Laptop 13 isn't our computer. It's yours" can suggest "Framework Laptop 13 is our computer" on first look (it sounds much worse than "Framework Laptop 13 is yours computer").

People don't need stickers on the case+very long unclear product names ("HP EliteBook X G1i 14 inch Notebook Next Gen AI PC" sounds rather bad), additionally mentioning about AI is just irritating - devices don't have big NPU and many functions are not working like expected or are very criticized by experts (like Recall in Windows), additionally AI is currently one of biggest reasons for prices increases and companies reorganizations.

Companies selling hardware should rather concentrate on improving it than advertising and creating own OS – we don't like initiatives like Pop!_OS, because it looks like unnecessary splitting resources (in our opinion much better works providing generic hardware or putting drivers directly into Linux kernel)

Problems mentioned in the abstract

This document was mainly created in Ubuntu 22.04 working in the 14” Hyperbook L14 from 2021 (Clevo L140MU, which is almost the same like Schenker VIA 14 2021) with Intel 11gen, 8GB RAM, 1kg, black matt case, low power LCD screen, battery 73Wh, Samsung SSD, no ventilation holes on the bottom. Device was configured for passive work and initially achieving 36h on the battery in the light text editing work, it’s currently using S0iX (S3 doesn’t work very well) and entering maximally into C8 CPU power level (minimum powertop usage is 1.82W and normally in idle it’s ca. 2W shown).

It was not replaced yet, because in 2026 it’s impossible to find something at least so good in all areas and aspects. There were considered different options, but they had always weak points, for example:

1. Acer Travelmate P6 Lunar Lake (1kg, seems to be niche product and can’t be bought with English keyboard layout),
2. Apple Macbook Air M4 (more heavy, with smaller battery and problems with screen reflections and picture dithering used because LCD supports less colors than Mac OS),
3. Clevo L24xLUx (sold by PC Specialists with the “14” Fusion, Copilot+ PC” name, unfortunately without possible BIOS updates, with two lights on the case and Tianma TM140VDHP21 screen without clear info about backlight)
4. Dell Premium 13 with Lunar Lake (potential CPU throttling, smaller battery, heavier, zero-lattice keyboard and M.2 2240 disk),
5. Dell XPS13 with Lunar Lake (CPU throttling, smaller battery, heavier, keyboard and function keys and in the end white color)
6. Dell XPS14 with Panther Lake (keyboard, CPU throttling, weaker Wifi results than for Dell Premium 13 or XPS13)
7. Geekom GeekBook X14 Pro (screen and too high off/standby/idle power usage)
8. Chuwi CoreBook Air (short battery life)
9. HP EliteBook X Gi1 14 with Lunar Lake (difficult to buy)
10. Lenovo T14s gen 6 Lunar Lake (heavier, fan on the bottom, smaller battery)
11. Lenovo T14s gen 6 Snapdragon (heavier, fan on the bottom, smaller battery, Linux compatibility problems)

We understand, that there is progress between 2021 and 2026… but too many things are on the same or worse level and thinking, that new models need new CPU only is wrong (problems are deeper and much more fundamental).