

The automatic tuner for your home miners

WarpTune Desktop User Manual

macOS · Windows · Linux

WarpTune Desktop v1.52.0 · 2026-11-26

Contents

1 What is WarpTune Desktop?

2 Before you start

3 Downloading and checking the file

4 Installing and the first start

5 The page at 127.0.0.1:8766

6 Adding miners

7 The device card, value by value

8 Dry run and going live

9 The modes

10 Calibration

11 Reading the savings

12 Updating

13 Uninstalling

14 Troubleshooting & FAQ

15 Support & links

1 · What is WarpTune Desktop?

WarpTune Desktop is a small program for your computer. It watches your Bitcoin home miners over your home network and adjusts their clock (MHz) and core voltage (mV) for you. The goal is the same hashrate for less power, or a little more hashrate where your hardware has room.

You set up and control it in your web browser, on a page that only your own computer can open. You do not need a terminal, and you do not need to run a mining pool.

Some words used in this manual

Word	Meaning
Point	The pair of clock and core voltage a miner runs at, for example `525 MHz @ 1150 mV`.
Hand point	The point you set yourself in the miner's own web page (or the factory setting, if you never changed it). WarpTune remembers the point the miner ran at before WarpTune first wrote to it as the hand point (or takes `stock` from the settings file). It is the *ceiling* for the voltage at its own clock and at every clock below it, and the point WarpTune writes back when it stops.
Step	One rung on WarpTune's ladder of clock values. WarpTune moves a miner up one step at a time; down it may go several steps at once when it is too hot or over its power cap.
Dry run	WarpTune only watches and writes down what it *would* do. Nothing is sent to the miner.
Live	WarpTune writes clock and voltage to the miner, within its limits.
Journal	A file next to the settings file (`warptune-journal.jsonl`) where WarpTune records every reading and decision.
Share	A small proof of work the miner sends to its pool. Counting accepted shares is the most honest way to see how much a miner really hashes.

What WarpTune does

- It reads each miner every few seconds: hashrate, chip temperature, power, voltage regulator temperature, fan, chip errors.
- It decides, about every 30 seconds, whether the miner should stay, step down or step up.
- In live mode it writes the new point and reads it back to check that the miner took it.
- With a calibration (chapter 10) it measures a **clock–voltage curve**: for each clock it tries, step by step, the lowest core voltage that still runs cleanly. Then it offers you the result to apply. This works on whatever pool the miner mines.
- With the switch **Clock per chip** (WarpAxe 0.1.44 and later, chapter 7) it gives each chip of a board a clock of its own, so chips with headroom hash faster at the same voltage.
- On each card it shows what its modes save against your hand point: in watts, and per year in kWh and, once you enter your electricity price or a coupled pool reports one, in money (chapter 11).
- When it stops (logout, shutdown, update, uninstall) it writes the hand point back to every live miner.

What WarpTune never does

These limits are built in. You cannot switch them off from the page. The voltage ceiling in the first point has one exception, a switch you set yourself per miner.

- **Never above your hand voltage** at your hand clock or at any clock below it. The voltage you validated by hand is the top there; WarpTune only goes down from it. A clock step of the maker's table above your hand clock runs at most at the maker's voltage for that step. More voltage than that only if you switch on **Beyond the maker's specification (Max mode only)** for this miner (chapter 7), and then only in Max mode.
- **Never below the voltage regulator's clean range** and never below the firmware's lowest offered voltage.
- **Power limits for every step up:** at most 90 % of the board's power limit and at most 80 % of the power supply's continuous rating.
- **Temperature band.** WarpTune holds a target chip temperature (62 °C by default). It only climbs when the chip is more than 2 °C below the target. It steps down when the chip is 1.5 °C over the target, steps down urgently at 2 °C over, and drops to the lowest step at 74 °C. A voltage regulator at 100 °C blocks the way up; at 103 °C WarpTune steps down.
- **At most 12 writes per hour** per miner. More than that, or a write the miner does not confirm, switches live control off for that miner.
- **Only the miners you add.** WarpTune never touches a device that is not in its list.

> **Saving power, not finding blocks.** WarpTune makes a miner more efficient. It does not change your chance of finding a block in any meaningful way. Solo mining stays a lottery. What you get is a lower power bill for the same hashrate, or a bit more hashrate inside safe limits.

2 · Before you start

Which miners work

WarpTune talks to miners that run an **AxeOS-family firmware**. It reads their web API (`/api/system/info`) and writes clock and voltage through the same API.

Firmware	Typical boards	Notes
AxeOS (ESP-Miner)	Bitaxe (Gamma and others)	Full support.
NerdOS	NerdAxe, NerdAxe Gaia, NerdQAxe++, NerdOctaxe	Full support. NerdOS reports no 1-minute chip error rate; from NerdOS 1.1.1-alpha4 WarpTune reads per-chip errors instead.
ForgeOS	BitForge boards	Supported; publishes no list of clock options.
WarpAxe	Bitaxe Gamma, NerdQAxe++, BitForge Nano and others	Reports the most state directly (chips off on purpose, overheat stops, the power supply you entered), so WarpTune has to guess least. From WarpAxe 0.1.44 on, a board with several chips can also give each chip a clock of its own (**Clock per chip**, chapter 7).

WarpTune regulates all of them the same way. They differ in how much they report. Where a firmware says less, WarpTune infers it from power and hashrate.

Boards without a voltage regulator. A few boards cannot set their core voltage at all, for example the NerdNOS board or a devkit board. WarpAxe 0.1.45 and later reports this. On such a board WarpTune sets the **clock only**: it never writes a voltage, runs no voltage check and no calibration, and the calibration block on the card says *Not available: this board has no voltage regulator; WarpTune sets the clock only*. Everything else (modes, temperature band, power limits, savings) works as usual.

Avalon Q

The Canaan **Avalon Q** is supported in a different way. It does not speak the AxeOS API but the cgminer API on port `4028`. Its own control board sets frequency and voltage per chip, so WarpTune never touches them. WarpTune only switches between the Avalon's three **work modes** (Eco, Standard, Super). There is no calibration and no power supply field for an Avalon Q. Its power cap is the `max_watts` setting in the settings file. The network search finds an Avalon Q too (chapter 6).

> **Not supported:** devices that are not in the list above, for example small ESP32 lottery miners without an ASIC, or Antminer/Whatsminer machines. The **Check** button (chapter 6) tells you if WarpTune cannot use a device.

A computer that stays on

WarpTune runs on your computer, not on the miner. It can only regulate while it runs. Use a computer that is on whenever the miners mine and that is in the **same home network** (LAN) as the miners. A Mac, a Windows PC, a mini PC or a Raspberry Pi with a 64-bit Linux all work.

- **macOS:** Apple silicon or Intel.
- **Windows:** 64-bit Windows; Windows on ARM runs it through the built-in emulation.

- **Linux:** Debian, Ubuntu or Raspberry Pi OS (64-bit) with the `.deb`; other distributions with the AppImage.

> **Sleep stops WarpTune.** If the computer goes to sleep, WarpTune stops reading the miners, and miners stay on whatever point they had last. Turn sleep off, or at least do not let the computer sleep while miners are live.

WarpTune Desktop is meant for a computer with **one user account**. On macOS and Windows another account on the same computer could open the page too (chapter 5).

Set your hand point first

Before you add a miner, set it in its own web page to the point you trust: the factory setting, or your own tuned point that you know runs stable. WarpTune reads that point and remembers it as the ceiling and the restore point, before it writes anything to the miner. From then on it keeps that point, also after a restart of WarpTune; you change it on the card with **Change hand point** (chapter 7). At that clock and every clock below it, WarpTune will not go above that voltage. The only switch that allows more voltage, and only for clocks above your hand clock in Max mode, is **Beyond the maker's specification (Max mode only)** (chapter 7); it is off until you set it.

Any pool works — a dvb-WarpPool adds a few extras

WarpTune needs no pool of your own. Accepted shares are the most honest measure of real hashrate, and WarpTune reads them from the **miner's own counters**: how many shares the pool accepted, and at which difficulty. That works on **whatever pool** the miner mines. With these counters WarpTune regulates, runs the **calibration**, the quick check and the re-check (chapter 10), and shows the **savings** on each card (chapter 11).

A **dvb-WarpPool** (your own pool, or the public pool) is optional. If the miner mines on it and you couple it (chapter 6), WarpTune prefers the pool's worker row and adds:

- **reject reasons** on every firmware: the pool tells a stale or low-difficulty share apart from a real error,
- the **Energy** mode, which reads the pool's electricity page (chapter 9),
- the WarpTune badge on your wallet page of a public pool.

Two exceptions: a firmware that reports no share difficulty (`poolDifficulty`) gives no share verdict, so it can only be calibrated through a dvb-WarpPool coupling. And an Avalon Q is never calibrated; it only switches work modes.

One WarpTune per miner

> **Only one WarpTune may regulate a miner.** Two WarpTune instances writing to the same miner fight each other. If a miner is already tuned by another WarpTune — for example the one that comes with a dvb-WarpPool installation, or a second computer — leave it in dry run here, or remove it there first.

On one computer this is enforced: only one WarpTune process runs per settings file and port. A second start ends with an error (chapter 14). Across two computers nothing can enforce it; that is up to you.

3 · Downloading and checking the file

WarpTune Desktop is part of every dvb-WarpPool release. Download it from the release page:

git.warppool.org/dvb-projekt/dvb-WarpPool/releases

Open the newest release and pick the file for your system. `<tag>` stands for the version, for example `v1.52.0`.

System	File
macOS, Apple silicon (M1 and newer)	`WarpTune-Desktop-<tag>-aarch64.dmg`
macOS, Intel	`WarpTune-Desktop-<tag>-x86_64.dmg`
Windows (installer)	`WarpTune-Desktop-<tag>-x86_64-setup.exe`
Windows (portable, no installer)	`WarpTune-Desktop-<tag>-x86_64-windows.zip`
Debian / Ubuntu / Raspberry Pi OS 64-bit	`dvb-warptune_<version>_amd64.deb` (PC) or `…_arm64.deb` (Raspberry Pi)
Other Linux	`WarpTune-Desktop-<tag>-x86_64.AppImage` or `…-aarch64.AppImage`

> **The macOS files come a little later.** The `.dmg` files are added to the release shortly after it is published. If you do not see them yet, check again later.

The release also lists files named `dvb-warppool-tune-…tar.gz`. Those hold only the command-line program, without the page launcher; they are for people who run WarpTune as a service by hand. This manual is about WarpTune Desktop.

Checking the download

The files are not signed with a paid Apple or Microsoft certificate. Instead, every release lists a checksum file, `SHA256SUMS`, and a signature for it, `SHA256SUMS.bundle`. Check your file before you open it.

Step 1 — the checksum

Download `SHA256SUMS` next to your file. Then compute the checksum of your file:

- **macOS / Linux** (Terminal): `shasum -a 256 <file>`
- **Windows** (Command Prompt): `certutil -hashfile <file> SHA256`

Compare the long number with the line for your file in `SHA256SUMS`. They must match exactly. If they do not match, delete the file and download it again. Never open a file whose checksum does not match.

Step 2 — the signature (optional, recommended)

If you have the `cosign` tool, you can also check that `SHA256SUMS` really comes from the project. Get the project's public key `cosign.pub` from the repository and run:

```
cosign verify-blob --key cosign.pub --bundle SHA256SUMS.bundle SHA256SUMS
```

It must answer *Verified OK*. Together, the two steps prove the file is the one the project published.

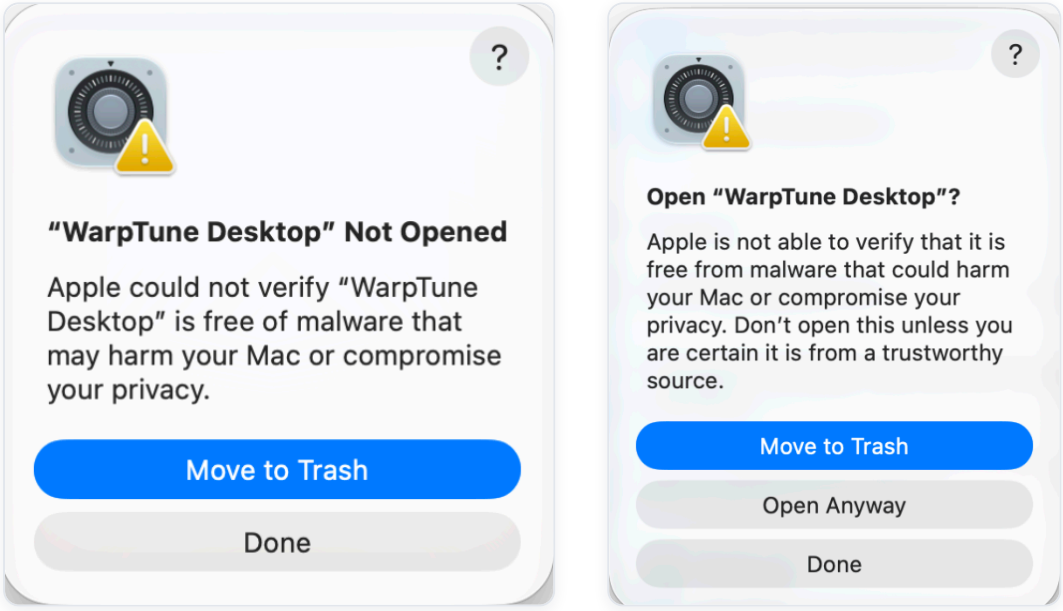
4 · Installing and the first start

Every package contains two programs. **WarpTune itself** (`dvb-warppool-tune`) does the work and serves the page. The small **launcher** (`dvb-warptune-launcher`) is what you click: it makes sure WarpTune runs, then opens the page `http://127.0.0.1:8766/` in your browser. A second click only opens the page again; it never starts WarpTune a second time.

The launcher's own questions and notes (start at login, service update, port in use, start failure) come in your system's language: English, German, Spanish, French, Italian, Japanese, Portuguese (Brazil) or Chinese, the same eight languages as the page. The screenshots here show the English version.

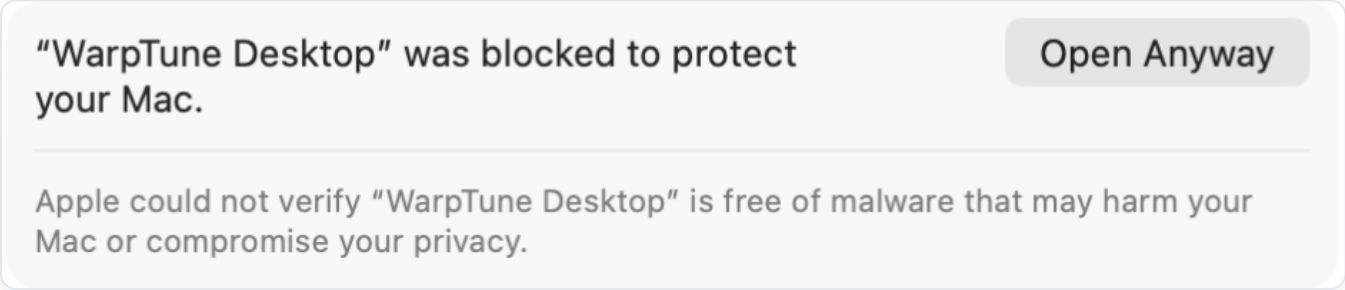
macOS

1. Open the `.dmg` and drag **WarpTune Desktop** onto **Applications**.
2. Open **WarpTune Desktop** from Applications. macOS refuses the first time, because it does not know the publisher. Click **Done** (not **Move to Trash**).



Left: the first refusal (click Done). Right: the last question after "Open Anyway" (click Open Anyway).

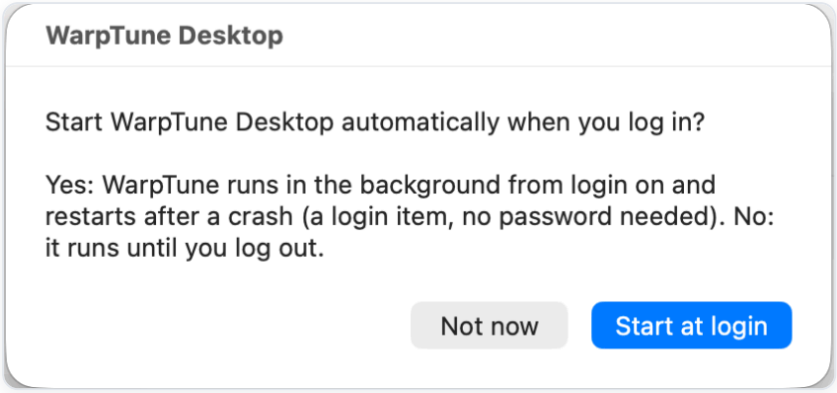
3. Open **System Settings** → **Privacy & Security**, scroll to the bottom and click **Open Anyway** next to *"WarpTune Desktop" was blocked*.



System Settings → Privacy & Security: the "Open Anyway" button for WarpTune Desktop.

4. Open **WarpTune Desktop** from Applications **once more**. macOS asks a last time. Click **Open Anyway** and confirm with your password or Touch ID. If nothing seems to happen after step 3, the question is waiting behind other windows: open the app again from Applications.

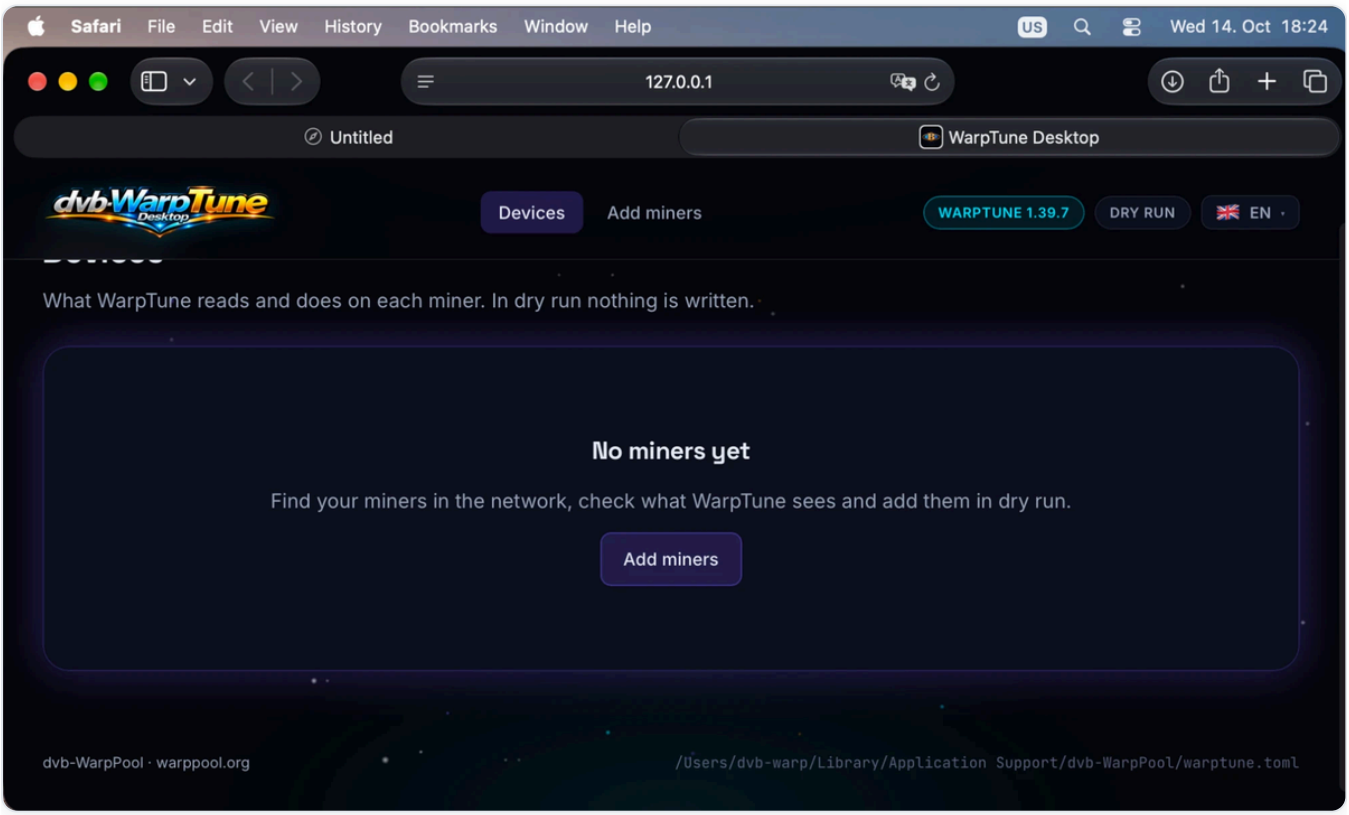
5. WarpTune asks: *Start WarpTune Desktop automatically when you log in?*



The one-time question on the first start.

- **Start at login** installs a login item (`com.dvb.warptune.desktop` , no password needed). WarpTune then runs in the background from every login on, restarts after a crash, and at logout stops cleanly: every live miner gets its hand point back. **Choose this if you plan to switch miners to live.**
- **Not now** runs WarpTune only until you log out. A logout then ends it at once, **without** writing the hand points back. Live miners would stay on their last point.

6. Your browser opens `http://127.0.0.1:8766/` . With no miners yet the page says *No miners yet* and offers **Add miners**.



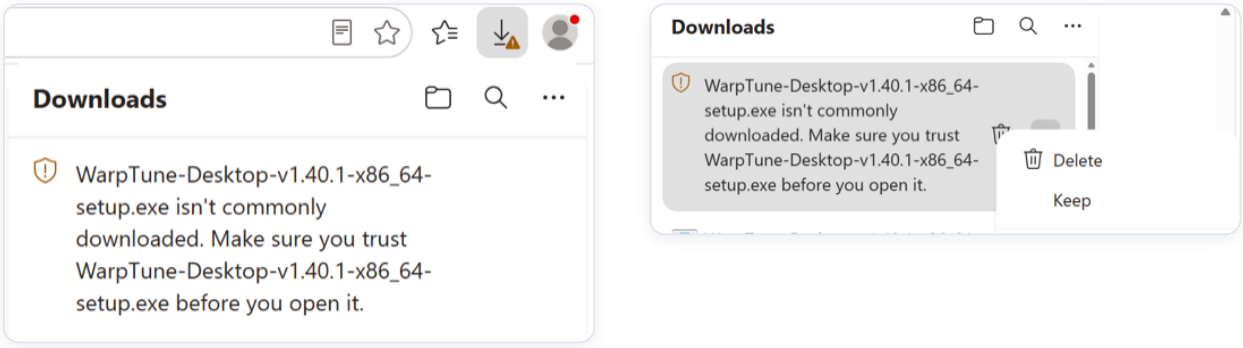
The first page on macOS: no miners yet, and the button to add them.

From now on a double-click on the app only opens the page.

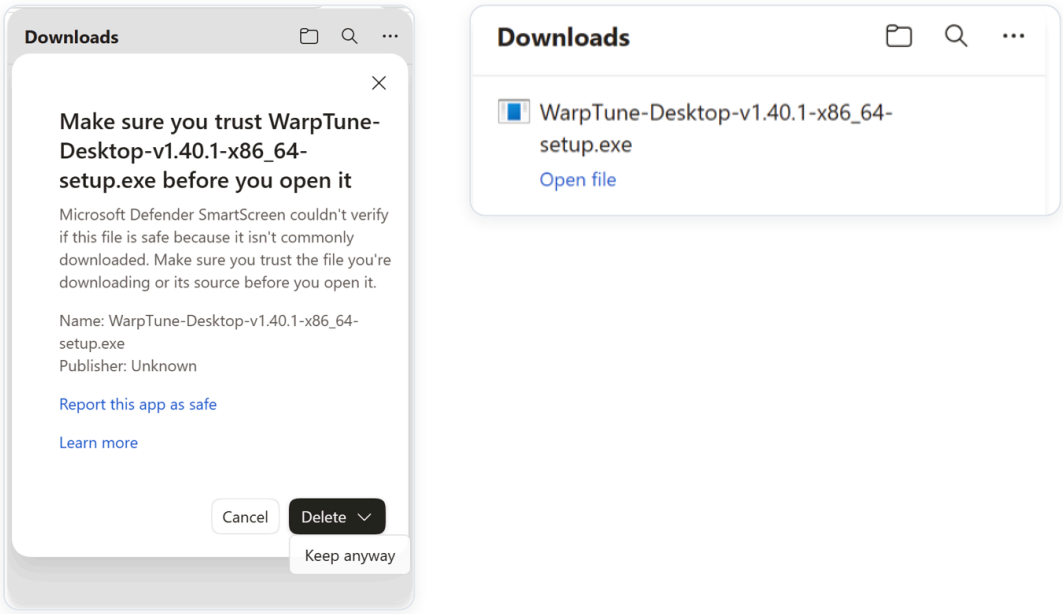
> **Already running WarpTune as a service?** If you installed WarpTune earlier with the setup script (`scripts/setup-warptune.sh`, service `com.dvb.warptune`), the app uses that service and never adds a second one. If that service is older than 1.40, the app offers to update it (chapter 12).

Windows

1. **Download with Edge.** Microsoft Edge holds the installer back before SmartScreen does: the download list says *… isn't commonly downloaded. Make sure you trust … before you open it.* Point at the entry, click **…** and choose **Keep**. Edge asks once more (*Make sure you trust … before you open it*, Publisher: Unknown): open the arrow next to **Delete** and choose **Keep anyway**. Then click **Open file**. Other browsers may show a similar warning.

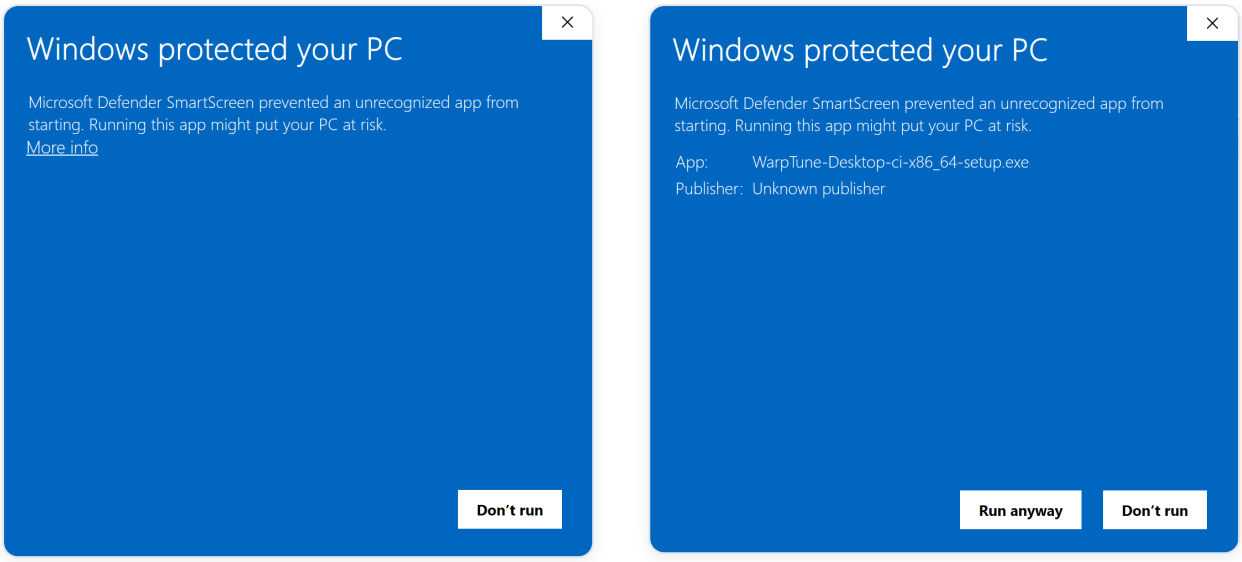


Edge download list: the warning (left), then "…" → "Keep" (right).



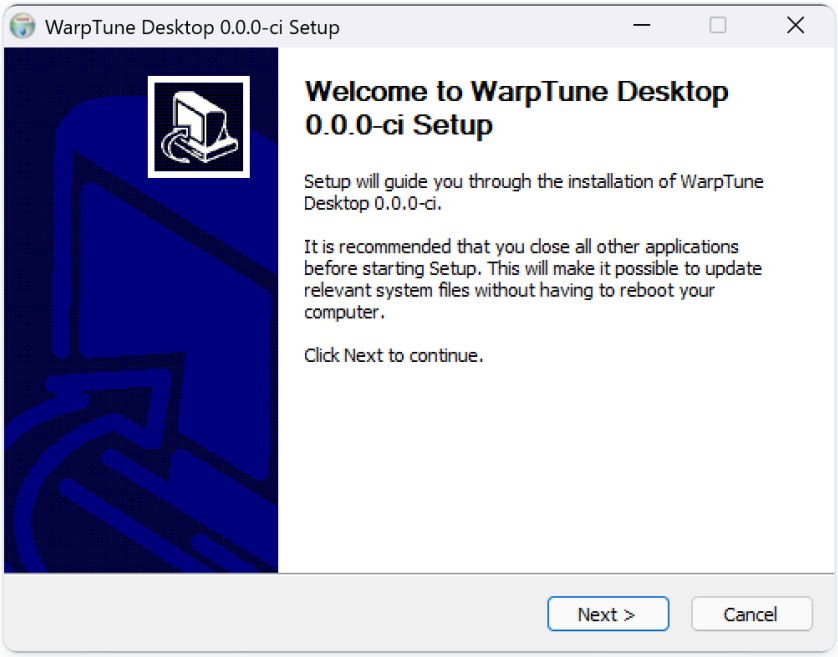
The arrow next to "Delete" → "Keep anyway" (left), then "Open file" (right).

2. Open `WarpTune-Desktop-<tag>-x86_64-setup.exe`. SmartScreen stops it with *Windows protected your PC*. Click **More info**.
3. Click **Run anyway**.



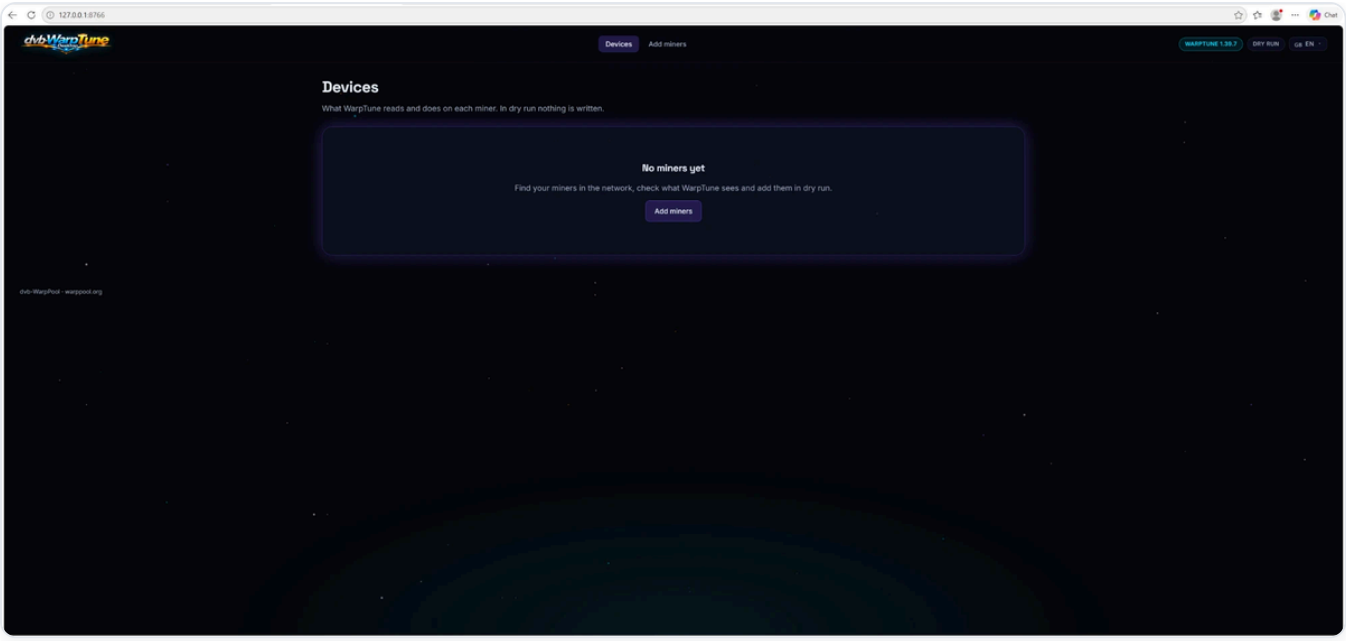
SmartScreen: first "More info" (left), then "Run anyway" (right).

4. The installer needs no administrator rights. It installs for your user only, into `%LOCALAPPDATA%\Programs\WarpTune Desktop`, adds a Start menu entry, and adds a Startup shortcut that starts WarpTune at every sign-in without a window.



The per-user installer. No administrator password is asked.

5. At the end your browser opens WarpTune Desktop.



The first page on Windows.

- The Startup shortcut can be turned off in **Task Manager** → **Startup apps**, if you prefer to start WarpTune by hand from the Start menu.
- On Windows WarpTune opens **no port** to the network. The page is served to this computer only, and miners are found without the mDNS listener. So the Windows firewall does not ask anything.
- A logoff or shutdown ends WarpTune cleanly: live miners get their hand point back first.
- The portable `.zip` holds the same two programs without an installer. Start `dvb-warptune-launcher.exe`. It does not add a Startup shortcut.

Linux

Debian, Ubuntu, Raspberry Pi OS (.deb)

1. Install the package: `sudo apt install ./dvb-warptune_<version>_<arch>.deb`
2. Click **WarpTune Desktop** in your applications menu. The first click enables and starts the user service `dvb-warptune-desktop` and opens the page.
3. To keep WarpTune running when nobody is logged in (for example on a headless Raspberry Pi), run once: `loginctl enable-linger $USER`

Any distribution (AppImage)

1. Make the file executable: `chmod +x WarpTune-Desktop-<tag>-<arch>.AppImage`
2. Double-click it. It writes the same user service, pointing at the AppImage file, and opens the page. Keep the file where it is: the service starts it from that path.

Linux shows no publisher warning. A stop of the user service (logout without linger, shutdown, `systemctl --user stop`) writes the hand points back first.

> **No desktop?** On a headless machine the page still runs, but only a browser on that same machine may open it (chapter 5). WarpTune Desktop is made for a computer with a screen.

Where things are stored

System	Settings file and journal	Logs
macOS	`~/Library/Application Support/dvb-WarpPool/warptune.toml`	Same folder: `warptune-desktop.log`, `warptune-launcher.log`
Windows	`%APPDATA%\dvb-WarpPool\warptune.toml`	Same folder
Linux	`~/.config/dvb-warppool/warptune.toml`	`journalctl --user -u dvb-warptune-desktop`

On the first start WarpTune creates an empty settings file. The page changes it for you; you do not need to open it. If you do edit it by hand, WarpTune keeps your comments, and each change from the page keeps the previous version as `warptune.toml.bak`.

5 · The page at 127.0.0.1:8766

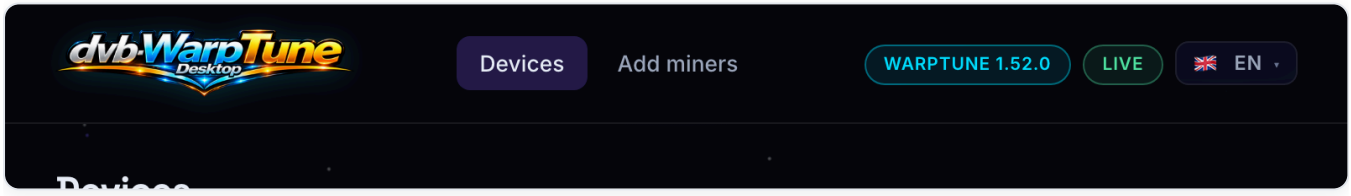
Everything in WarpTune Desktop happens on one page in your browser: `http://127.0.0.1:8766/`. The launcher opens it for you. You can also type the address yourself, or bookmark it. `http://localhost:8766/` works too.

Only this computer can open it

The page answers only a browser on the same computer. A phone or a second PC in your network cannot open it, and that is on purpose: the page can switch miners to live. In detail:

- Only connections from this computer itself are served.
- The address in the browser must be `127.0.0.1`, `localhost` or `[::1]`.
- Every action carries a session key that the running WarpTune makes at its start. Other web pages in your browser cannot read it, so they cannot send commands to WarpTune.
- Requests through a proxy are refused. Do not put a reverse proxy, an Umbrel app proxy or a Tor service in front of port 8766.

> **One user per computer.** On Linux the page also checks that the connecting program belongs to your user account. On macOS and Windows it cannot check that. Another account on the same computer could open the page. Use WarpTune Desktop on a computer that only you use.



The header: wordmark, the two sections, the version, the live state and the language.

The header, left to right

Element	What it shows or does
dvb-WarpTune Desktop wordmark	Click it to go back to the device list.
Devices	The list of your miners, one card each (chapter 7). This is the start page.
Add miners	The setup assistant: find, check and add miners, and the optional pool coupling (chapter 6).
WARPTUNE 1.52.0	The version of the running WarpTune. Hold the mouse over it to see the full path of the settings file.
LIVE or **DRY RUN**	The state of the WarpTune process as a whole. **DRY RUN**: *WarpTune only watches and journals; nothing is written to any miner.* **LIVE**: WarpTune writes clock and voltage to the miners you switched to live (for an Avalon Q: its work mode). A miner still in dry run stays untouched, even when the process is live.
WarpTune not reachable (red)	The page is open, but the WarpTune process behind it does not answer. It was stopped, or the computer was asleep. See chapter 14.

Language	English, German, Spanish, French, Italian, Japanese, Portuguese (Brazil), Chinese. The choice is stored in this browser.

Banners under the header

- *Settings changed. Apply them to WarpTune now?* with the button **Apply now**. This appears only for the global settings: the pool settings on the setup page (pool address, push token), the live switch of the WarpTune process as a whole (`[sidecar] live` — the first time you switch a miner to live while the process is still in dry run), and the `[defaults]` and `[energy]` sections. Such a change is saved in the file at once, but the running WarpTune keeps its old settings until you press **Apply now**. A change on one miner's card (live switch, mode, power supply, clock search, schedule) and adding or removing a miner need no banner: the saved entry reaches the running WarpTune at once, for that miner alone (chapter 7). The banner also appears when such a change could not be applied — a calibration runs on that miner, the miner's pool address is one the running WarpTune does not poll, or the process cannot reload. The card then names the reason and says *Saved. Apply the settings to make it count.*
- The **Apply settings** dialog explains what happens: *All miners go back to their hand point for a moment and WarpTune starts again from the new settings. A running calibration blocks this: finish it first.* Confirm with **Apply now**, or **Cancel**. Afterwards a green banner says *Settings applied.*
- **A running calibration blocks Apply.** While a calibration runs, or while its result waits for **Apply** or **Discard**, the reload is refused. Finish or stop the calibration first.
- *The settings file has an error: …* (red) means the file could not be loaded, usually after a hand edit. The running WarpTune keeps its last good settings. Fix the file, or restore `warptune.toml.bak`.

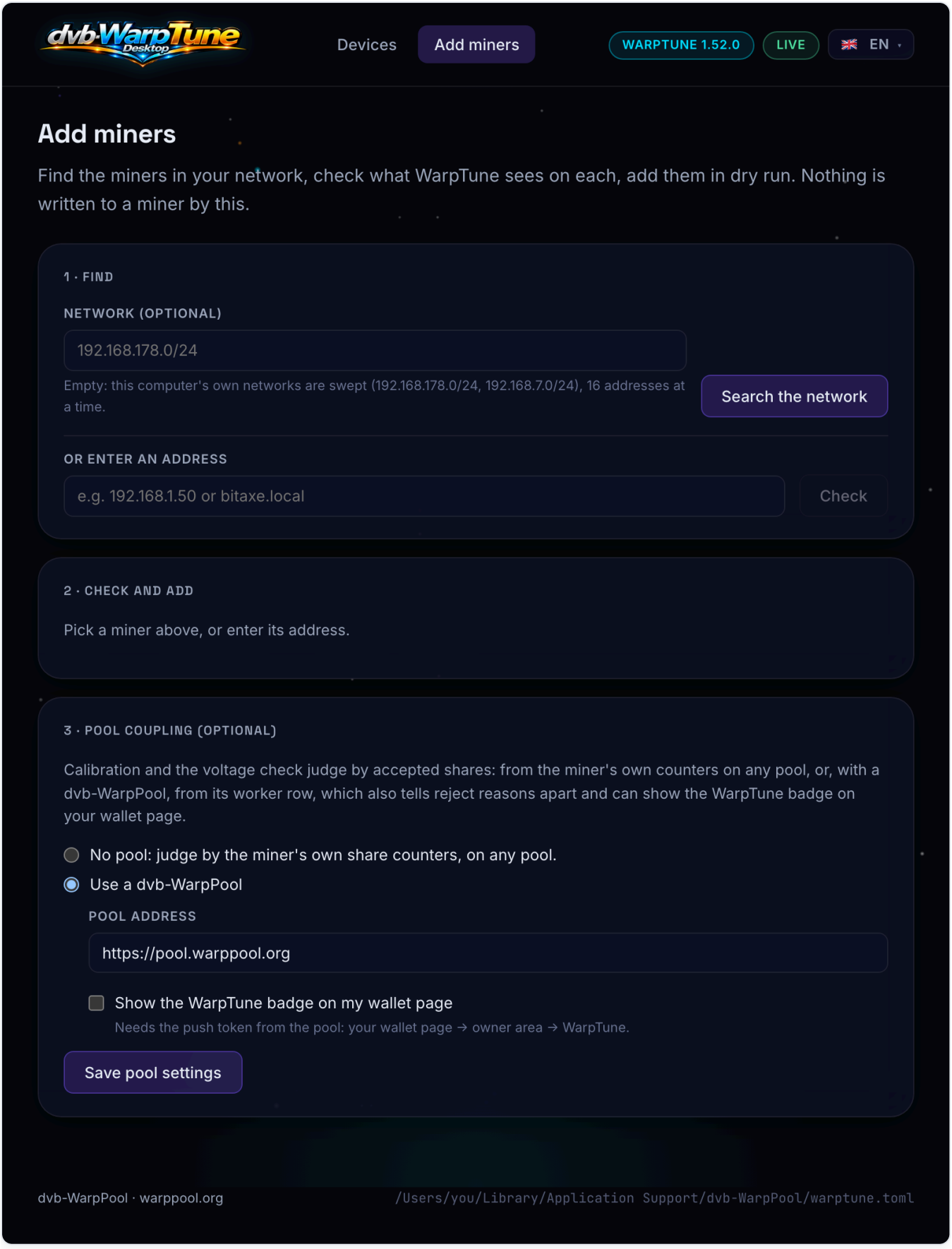
At the bottom of every page you see the path of the settings file.

Support the development

At the foot of the **Devices** page sits the card **Support the development**. It is closed at first; click its title to open it. The page remembers in this browser whether you opened or closed it. The card shows the project's Lightning address and on-chain address, each with a QR code and a **Copy** button. The QR codes and addresses are built into the program; it fetches nothing from the network for this. A donation is voluntary: WarpTune is free, with no subscription.

6 · Adding miners

Click **Add miners** in the header (or the button on the empty device list). The assistant has three cards. Nothing on this page writes to a miner. It only reads from miners and writes the settings file.



The Add miners page before a search: 1 · Find, 2 · Check and add, 3 · Pool coupling (here with a pool address entered).

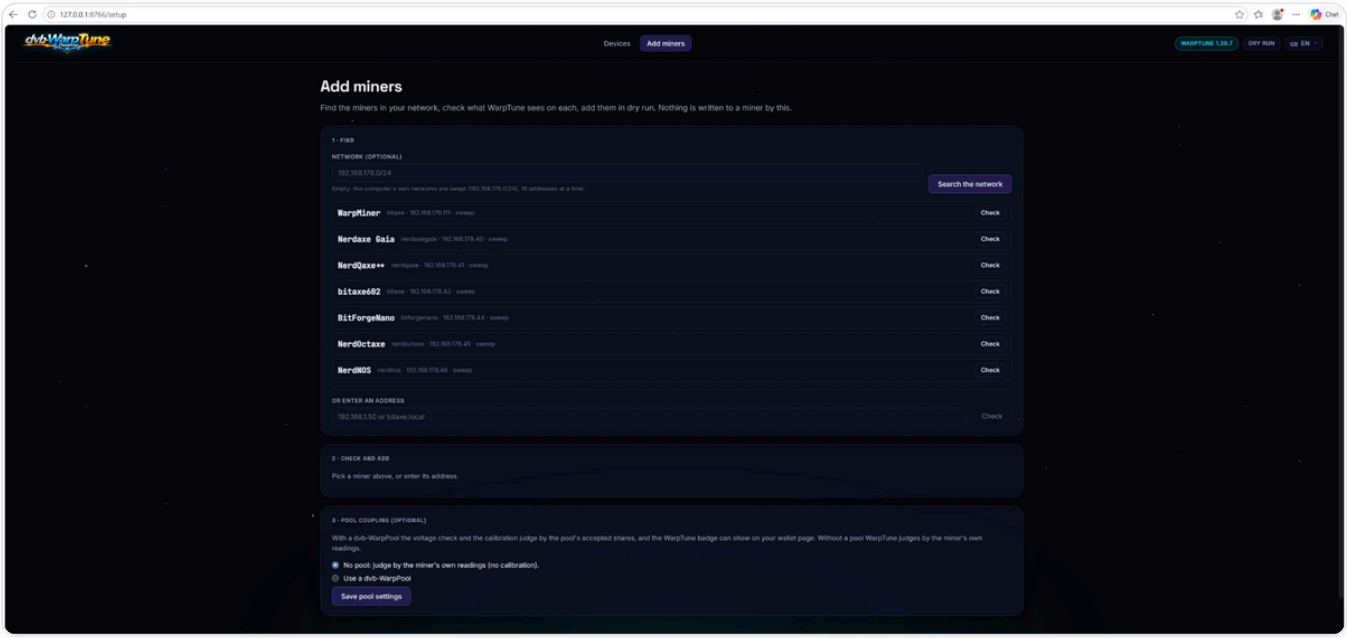
1 · Find

Click **Search the network**. The button shows **Searching…** while it works. WarpTune searches in two ways, and only when you press the button — it never scans your network on its own:

- **Network sweep.** WarpTune asks every address of this computer's own home networks for `/api/system/info`, the address every AxeOS-family miner answers. It asks at most 16 addresses at a time and waits 1.5 seconds per address, so your router is not flooded. At the same time it sends the read-only cgminer command `version` to port 4028 of the same address, which is how an **Avalon Q** answers (it has no web API). Nothing is written to any device. The small text under the field names the networks it sweeps, for example *Empty: this computer's own networks are swept (192.168.178.0/24), 16 addresses at a time.*
- **mDNS** (the "Bonjour" announcements some miners send). On a Mac the system's own mDNS service hides these from WarpTune, and on Windows WarpTune leaves mDNS out so the firewall does not ask. The page then says *mDNS found nothing on this system (normal on macOS/Windows); the list comes from the network sweep.* That is fine: the sweep finds AxeOS-family miners anyway.

Network (optional): leave it empty in most cases. If your miners are in a different private network than the computer (for example a separate IoT network), type it here, like `192.168.10.0/24`. It must be a private network of size /22 to /30.

Only one search runs at a time. If nothing answers, the page says *No miner answered. Check that the miners are on and in the same network as this computer, or enter the network above.*



Search results (from a test on Windows with a pre-release build, hence the older version badge).

Each line of the result shows the miner's name, then its type, its address and how it was found (`sweep` or `mdns`). An Avalon Q appears as *Avalon Q* followed by the last characters of its network (MAC) address, with the type `avalonq`. A miner that is already in your list shows *already added*. For the others click **Check**.

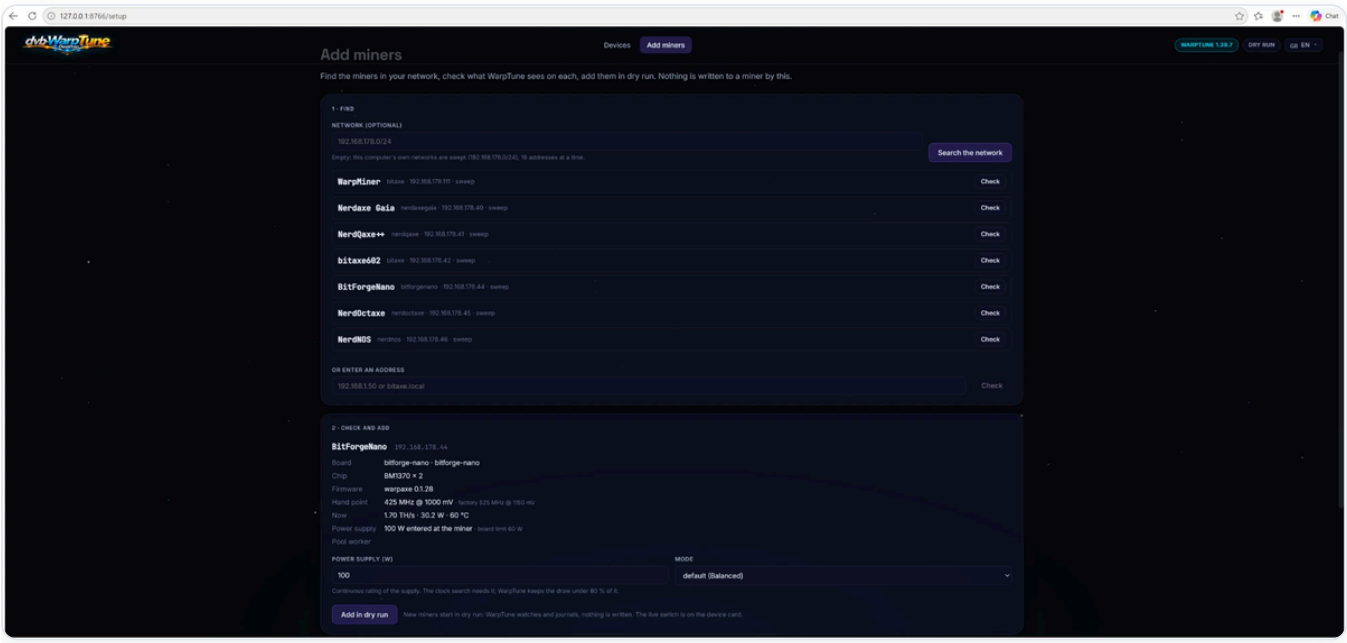
Adding a miner by its address

Under **Or enter an address** type the miner's IP address or name (for example `192.168.1.50` or `bitaxe.local`) and click **Check**. Use this for a miner the search did not list, for example one in another network. If the address has no AxeOS API, **Check** tries the Avalon Q's cgminer API on port 4028.

> **Give your miners fixed addresses.** WarpTune stores the address you add. If your router gives the miner a new address later, WarpTune loses it. Reserve a fixed address for each miner in your router (often called "DHCP reservation").

2 · Check and add

Check reads the miner once and shows what WarpTune sees. Nothing is written.



The check of a BitForge Nano, with the power supply field and the mode before adding it.

Line	Meaning
Board	The board model and version the firmware reports.
Chip	The ASIC chip type and how many there are, for example `BM1370 × 2`.
Firmware	Name and version of the firmware.
Hand point	The point the miner runs at right now. WarpTune remembers it as its ceiling and restore point before it first writes to the miner (chapter 7, *Hand point*). Behind it, in small text, the factory point if the firmware reports one (*factory 525 MHz @ 1150 mV*).
Now	Current hashrate, power and chip temperature.
Power supply	The power supply rating WarpTune will use, and where it comes from: *… W entered at the miner* (WarpAxe has a field for it), *… W, the board's stock supply* (a known board), or *no supply rating known*. Behind it the board's power limit (*board limit 60 W*).
Pool worker	The pool login the miner uses (address.worker). With a coupled dvb-WarpPool, WarpTune finds the miner's worker row on the pool with this name.

If WarpTune cannot use the device, a red line says why: *WarpTune cannot use this device: ….*

Before you press "Add in dry run"

- **Power supply (W)**: the **continuous rating** of the miner's power supply in watts (1 to 2500). It is pre-filled with the board's stock supply where WarpTune knows it. Check the label on your supply and correct it if you use a different one. WarpTune keeps the draw under 80 % of this number for every step up, and the clock search (chapter 10) needs it. If the rating was entered on the miner itself (WarpAxe: Settings → Power supply), the field is not offered here: change it on the miner.
- **Mode**: how WarpTune should run this miner (chapter 9). **default (Balanced)** is a good start. **Energy** is greyed out until the settings can take it; the text under the field says why (chapter 9).

Then click **Add in dry run**. The page confirms: *… added — WarpTune is watching it in dry run.* New miners always start in **dry run**: WarpTune watches and journals, nothing is written. The live switch is on the device card.

The running WarpTune starts watching the new miner at once; nothing needs to be applied. Go to **Devices** to see its card.

3 · Pool coupling (optional)

Here you tell WarpTune whether your miners mine on a dvb-WarpPool. The card explains: *Calibration and the voltage check judge by accepted shares: from the miner's own counters on any pool, or, with a dvb-WarpPool, from its worker row, which also tells reject reasons apart and can show the WarpTune badge on your wallet page.*

- **No pool: judge by the miner's own share counters, on any pool.** The right choice when your miners mine on any other pool (or on a dvb-WarpPool you do not want to couple). Calibration, the quick check, the re-check and the savings line all work; WarpTune reads the accepted shares and their difficulty from the miner itself.
- **Use a dvb-WarpPool**: enter the **Pool address**, starting with `http://` or `https://`. Examples: the public pool `https://pool.warppool.org`, or your own pool on your network, like `http://192.168.1.20:18334`. WarpTune then prefers each miner's worker row on the pool, which also tells reject reasons apart. If a miner has no row there (it mines elsewhere, or the row went idle), WarpTune uses that miner's own counters instead.

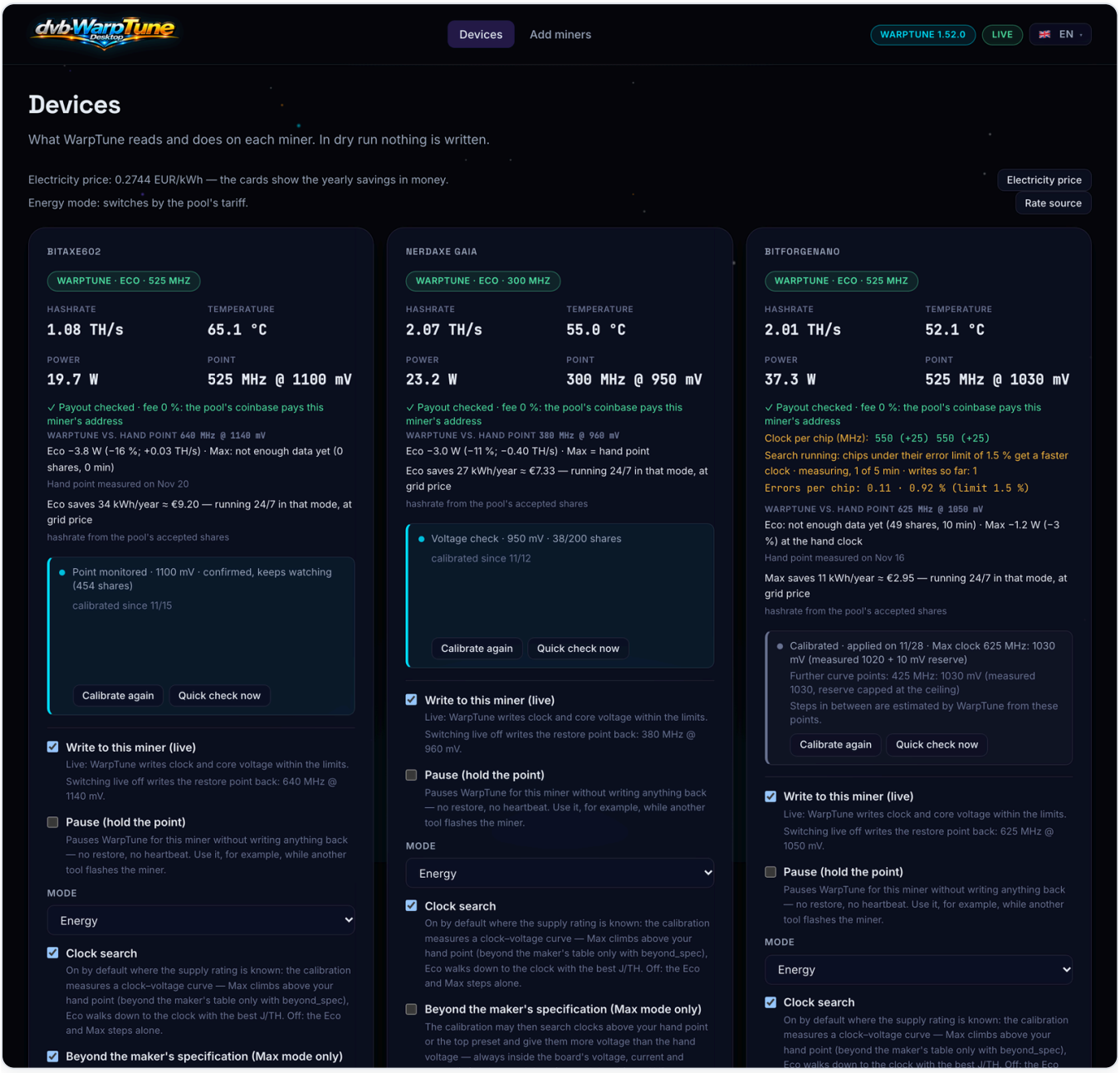
> **Pool on Umbrel?** The Umbrel app hides the pool's data behind its login. From version 1.28.0 the Umbrel pool offers the data without login on port `18335`. Use `http://<umbrel-address>:18335` as the pool address.

Show the WarpTune badge on my wallet page is for a **public** pool: WarpTune then sends its status to the pool every 30 seconds, and your wallet page there shows a WarpTune badge per miner. It needs a **Push token**, which you get on the pool: your wallet page → owner area → WarpTune. Paste it into the field. The token is stored in `warptune.env` next to the settings file (readable only by you), not in the settings file. **Remove token** deletes it again. Nothing flows from the pool back to a miner.

Click **Save pool settings**, then **Apply now** on the Devices page. The pool settings are global, so they are one of the few changes that still need the banner (chapter 5).

7 · The device card, value by value

The **Devices** page shows one card per miner in your list: *What WarpTune reads and does on each miner. In dry run nothing is written.* The page refreshes on its own every few seconds.

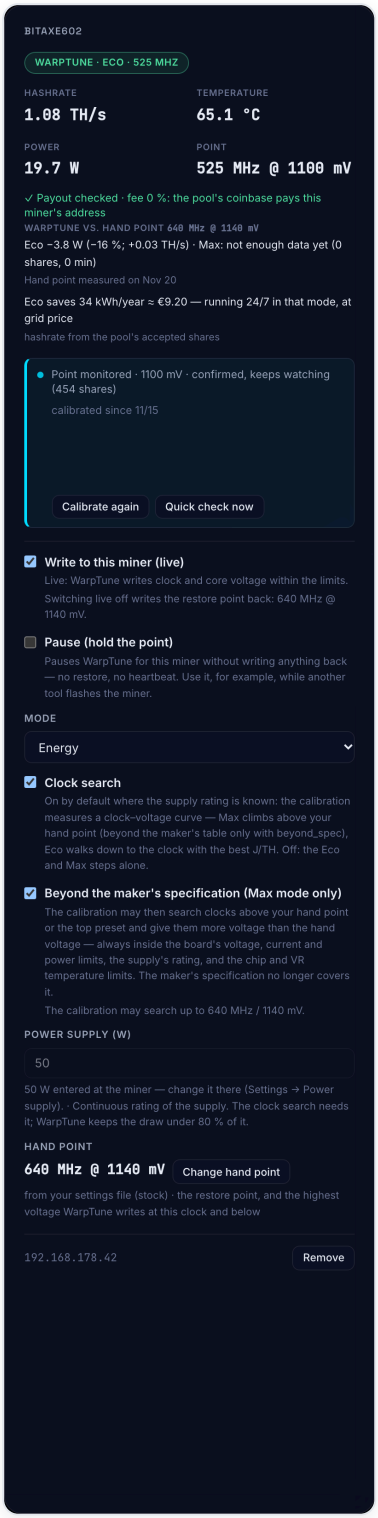


The Devices page (first row): a Bitaxe Gamma with an applied calibration, a NerdAxe Gaia with a running voltage check, a BitForge Nano with an applied calibration and a running clock-per-chip search. All three are live, in Energy mode, here running Eco on the tariff.

If no pool is set, a line above the cards says *No pool coupling: the share verdict comes from the miner's own counters (accepted shares and their difficulty), on whatever pool it mines. A dvb-WarpPool adds reject reasons and the badge on your wallet page (Add miners → Pool).* This is a note, not a warning: everything on the cards works without a pool.

Under it a line shows your electricity price, for example *Electricity price: 0.28 EUR/kWh — the cards show the yearly savings in money.* Without an entry of your own, a coupled dvb-WarpPool that has an electricity tariff lends its price: *Electricity price from the pool: 0.2744 EUR/kWh — the cards show the yearly savings in*

money. An entry of your own replaces it. Without either (for example on `pool.warppool.org`, which has no tariff) the line says *No electricity price set: the cards show kWh per year only.* The button **Electricity price** next to it opens the price form (chapter 11).

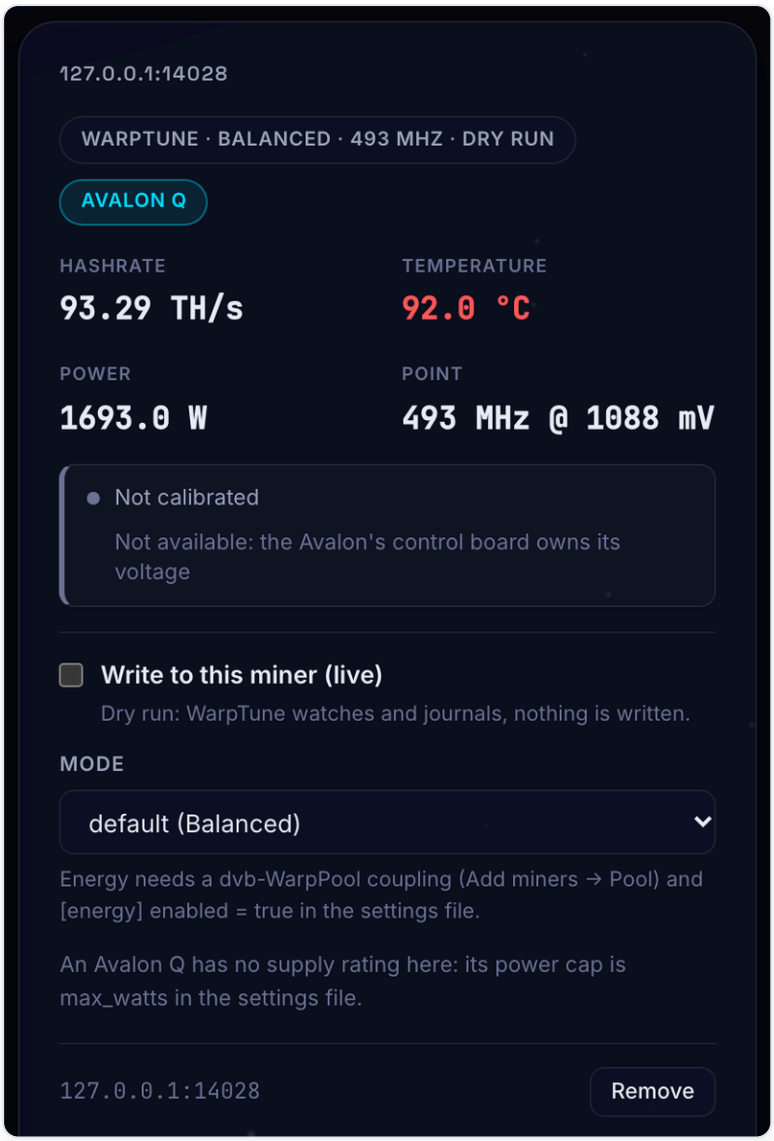


One complete card (Bitaxe Gamma): name, WarpTune badge, the four values, the savings line, the calibration block, the live switch, Pause, mode, the clock search switches, power supply, the hand point with Change hand point, and the address with Remove.

Title and badges

The card title is the miner's name (its hostname), or its address when it reports no name. Under it, one badge:

Badge	Meaning
WarpTune · Max · 550 MHz (green)	WarpTune regulates this miner live. It shows the mode it runs in right now and the clock. In Energy mode it shows the mode Energy picked (Eco, Balanced or Max).
WarpTune · … · dry run (grey)	WarpTune watches this miner but writes nothing.
… · waiting for PV surplus	Energy mode with solar: the miner waits until the surplus covers the next step.
… · paused / **stopped** / **excluded** (yellow)	WarpTune is holding, has stopped, or has left this miner out. The tooltip says why.
… · paused (holds the point) (yellow)	You ticked **Pause (hold the point)** on the card: WarpTune writes nothing to this miner and keeps reading (chapter 8).
… · standby (green)	An Avalon Q in standby by the schedule, the Energy mode or its own timer (v1.46); the line under the chip says until when.
… · standby (red), line *Standby (device error)*	An Avalon Q that WarpTune put into standby because the miner reported an error, or that switched itself off. No wake time is set: check the miner, then wake it on the device (chapter 9). While the Avalon is only held in Eco for an error, the badge is amber.
… · pool unreachable · chips off	WarpAxe 0.1.42 or later (and ForgeOS 1.8 or later): the miner reaches no pool and has switched its chips off until one answers. WarpTune waits and judges nothing meanwhile. Check the pool address and the network.
… · no telemetry (red)	The miner does not answer. Check that it is on and still at the same address.
… · control off (red)	WarpTune stopped writing to this miner by a safety rule (too many writes in an hour, a write the miner did not confirm, too many device restarts). The card names the reason. Once you have found the cause, press **Switch writes on again** on the card (chapter 8); no restart of WarpTune is needed.
… · stale (grey)	The last reading is old.
waiting for the first reading…	The miner was just started; the first reading is on its way.
not running: apply the settings	The miner is in the file, but the running WarpTune does not run it: a saved change on its card could not be applied (the card names the reason), or the process cannot reload. Press **Apply now**.
disabled	The miner is switched off in the settings file (`enabled = false`).
Avalon Q	This miner is an Avalon Q, regulated by work modes.



An Avalon Q card (test miner, dry run): the Avalon Q badge, no calibration, no power supply field, no clock search.

Hold the mouse over the WarpTune badge for details: the **Last decision** with its reason (for example why it held or stepped down), the target temperature, the core current against its warning line, and the configured mode if it is Energy.

The four values

Value	Meaning
Hashrate	What the miner reports right now. Small miners swing a lot; judge over minutes, not seconds.
Temperature	Chip temperature in °C. Shown in red above 75 °C.
Power	The power the miner reports, in watts.
Point	Clock and core voltage right now, for example `550 MHz @ 1100 mV`.

On a board with several chips that reports a temperature per chip (WarpAxe 0.1.42 and later), a line under the values lists them, chip 1 first: *Chip temperatures: 58.1 °C · 60.4 °C · 59.0 °C · 61.2 °C*. The line only shows the readings; there is nothing to set on it.

The savings line

WARPTUNE VS. HAND POINT 640 MHz @ 1140 mV followed by a short line such as *Eco –5.7 W (–24 %; –0.33 TH/s) · Max –2.6 W (–11 %) at the hand clock*. It compares WarpTune's points with your hand point. Under it a second line turns the watts into a year, for example *Eco saves 50 kWh/year ≈ €13.98 · Max saves 23 kWh/year ≈ €6.38 — running 24/7 in that mode, at grid price*, and a small line names where the hashrate comes from. Chapter 11 explains it. It works with or without a pool.

Warning lines

A red-edged box appears only when something needs your attention:

- *chip … domain … off*: a part of a chip stopped hashing at this point. WarpTune counts the voltage as too low there. If it keeps happening, the card tells you to switch the miner off at the power supply for a few seconds.
- *hand point … draws about … W, over the … W board limit*: your hand point draws more than the limit allows. WarpTune then restores the highest step under the limit instead.
- *hand point is tight: … MHz would need … mV, more than your hand voltage*: a step at your hand clock or below it had a chip domain switch off and would need more than your hand voltage. WarpTune stays at the hand voltage there and holds a step under the hand clock off for a week. If this repeats, raise the hand point's voltage on the miner and save it with **Change hand point**.
- *core current … A is near the … A warn line (… %): no step up from here*: the chip's power stage is close to its limit.
- *chain re-initialised …* (WarpAxe boards): WarpTune switched the chips off and on to bring a dropped chip part back. At most three times an hour, never during a calibration. Close it with **×**.
- *Fan chip missing · chips off* (WarpAxe 0.1.49): the fan and temperature chip did not answer at start. The firmware keeps the chips off until the miner restarts. WarpTune holds: it writes nothing and sends no chips-on and no reboot. The badge turns red too (**fan chip missing · chips off**). Check the fan cable, then restart the miner.
- *Pool connection possibly rerouted*: the miner mines over unencrypted Stratum V1, and for ten minutes the pool and the miner have disagreed. Either the miner reports a share difficulty at least four times the one the pool last gave it, or its shares keep being accepted while the pool sees no connection from it. This is how a rerouted connection looks: a foreign server answers in the pool's place and takes the miner's work (Braiins reported such attacks in November 2026). In the first case the line names both difficulties. The badge turns red too (**pool connection rerouted?**). WarpTune writes nothing to the miner because of it. The cure is to switch the miner to Stratum V2 or to Stratum V1 over TLS. A miner that already mines encrypted, one on its fallback pool, one that is disconnected, and one with a fallback pool set whose firmware does not say whether it mines there are not judged. If you change the pool address, port or user, the comparison starts over. The line goes once the difficulty and the connection match the pool again.
- *Held at main pool* (WarpAxe with the plain-pool check, 0.1.51 or later): the miner's main pool is protected (TLS, or Stratum V2), but its certificate was rejected, and the fallback pool is unencrypted on the internet. The firmware does not switch to it, so the chips get no work meanwhile. The badge turns red too (**held at main pool · certificate rejected**). WarpTune writes nothing to the miner because of it. Check the main pool's certificate or its pinned key, or set an encrypted fallback pool. The line goes once the main pool is accepted and delivers work, or once you save the pool settings.
- *Unencrypted connection to an internet pool* (amber; same firmware): the miner mines over unencrypted Stratum V1 on a pool on the internet, its main or its fallback pool. If the connection were rerouted, another

server could take its work. This is a hint, not a finding: switch the miner to Stratum V2 or to Stratum V1 over TLS. A pool on your own network (a private address or a local name) raises no line. Older firmware does not report either state; then neither line shows.

- *Payout missing* or *Fee over the limit* (WarpAxe 0.1.49, only with the firmware's payout check on): for two blocks in a row, the pool in use paid this miner's address nothing, or it kept more fee than the limit allows. The fee line names the pool's fee and the limit (WarpAxe's default limit is 2 %). The firmware itself switches to the other pool, or only warns if there is none. WarpTune only shows it and writes one journal line per new find; its regulation does not react. While the pool pays, a green line says *Payout checked · fee … %* instead.

Regulator set up again (WarpAxe 0.1.49): this one is not a box but the reason under **Last decision**: *the firmware set up the core voltage regulator again by chips off → on …*. The firmware re-initialised the core regulator and switched the chips off and on. WarpTune starts the measurement of this point over and gives no verdict on the step.

Pool unreachable (WarpAxe 0.1.42 and later, ForgeOS 1.8 and later): when the miner reaches no pool, the firmware switches its chips off until a pool answers. The card then shows the line *Pool unreachable · chips off — the miner has switched its chips off until a pool answers; WarpTune holds and judges nothing meanwhile*, and the badge adds **pool unreachable · chips off**. WarpTune writes nothing in that time and marks no step as bad: a missing pool says nothing about clock or voltage. Check the pool address on the miner and your network. When the pool answers again, the miner starts its chips by itself and WarpTune carries on.

Chip error limits

Every chip makes a few calculation errors. Firmware that counts them reports an **error rate** in percent. WarpTune compares it with limits that depend on the **chip type** the firmware reports, because chip types differ a lot: a BM1373 (NerdAxe Gaia, Bitaxe Naja Duo) runs a healthy 4–8 %, a BM1370 (Bitaxe Gamma, NerdQAxe++, NerdOctaxe) under 1 %.

Chip	No step up above	Step down above	Calibration and clock per chip: the error limit
BM1370	1.5 %	2.5 %	1.5 %
BM1373	7 %	9 %	7 %
every other chip (BM1366, BM1368, BM1397, unknown)	1 %	2 %	1 %

- **No step up above:** while the rate over the last minute is above this line, WarpTune takes no step up and counts the voltage as short of good.
- **Step down above:** two decisions in a row above this line, and WarpTune steps down.
- **The error limit** judges every voltage of a calibration (chapter 10) and every chip in the clock per chip (below). The card calls it the *limit*, for example *Errors per chip: 0.45 · 0.24 · 0.24 · 1.34 % (limit 1.5 %)*.

The rate counts only once a point has been on for a minute. A calibration line such as *at 950 mV too many chip errors (4.8 %, now 3.1 %)* means: at that voltage the rate was over the limit. You can set your own lines per miner in the settings file (`error_up_max_pct`, `error_down_pct`, `calib_error_line_pct`); without them the chip's lines apply.

The calibration block

The framed box in the middle of the card shows the state of the calibration and its buttons: **Not calibrated**, progress while one runs, the result, or **Calibrated · result applied**. Chapter 10 explains every part.

Write to this miner (live)

The checkbox **Write to this miner (live)** is the live switch for this one miner. The small text under it says the state:

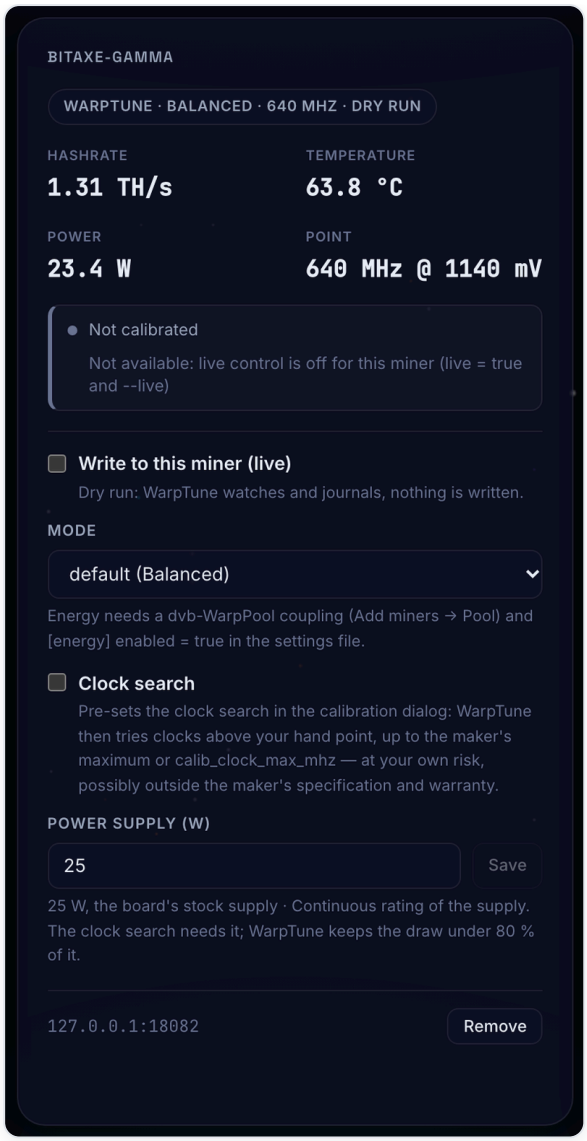
- *Dry run: WarpTune watches and journals, nothing is written.*
- *Live after you apply the settings: WarpTune still runs the old ones.* — you switched the first miner to live while the WarpTune process itself was still in dry run; the process switch needs **Apply now**. Once the process is live, a miner's own live switch takes effect at once and this text does not appear.
- *Live: WarpTune writes clock and core voltage within the limits.* For an Avalon Q: *Live: WarpTune switches this miner's work mode (Eco / Standard / Super) within the limits.*
- *WarpTune stopped writing to this miner on its own: the note on the card says why, and the button there switches the writes on again.* — a safety rule switched the writes off (chapter 8, When WarpTune stops writing by itself).

Switching on always asks first. Chapter 8 explains the dialog. Switching off (back to dry run) does not ask; it takes effect at once: the miner gets its hand point back and is only watched from then on (*Saved — WarpTune restarted its control of this miner with the new settings.*).

Mode

A drop-down with **default (Balanced)**, **Eco**, **Balanced**, **Max** and **Energy**. The choice is saved and active at once: WarpTune stops this one miner's loop and starts it again with the new mode. A live miner is handed over at the point it runs at; nothing is written back in between, with the exceptions in chapter 8 (*When WarpTune stops*). The card says *Saved — WarpTune restarted its control of this miner with the new settings.* The other miners run on untouched. See chapter 9.

Energy is greyed out unless the settings can take it. The text under the field then says: *Energy needs a dvb-WarpPool coupling (Add miners → Pool) and [energy] enabled = true in the settings file.* A miner that already runs in Energy keeps the option selectable.



A Bitaxe Gamma card in dry run (test miner): Energy is greyed out, the reason is shown under the mode; the Clock search switch below it.

Clock search

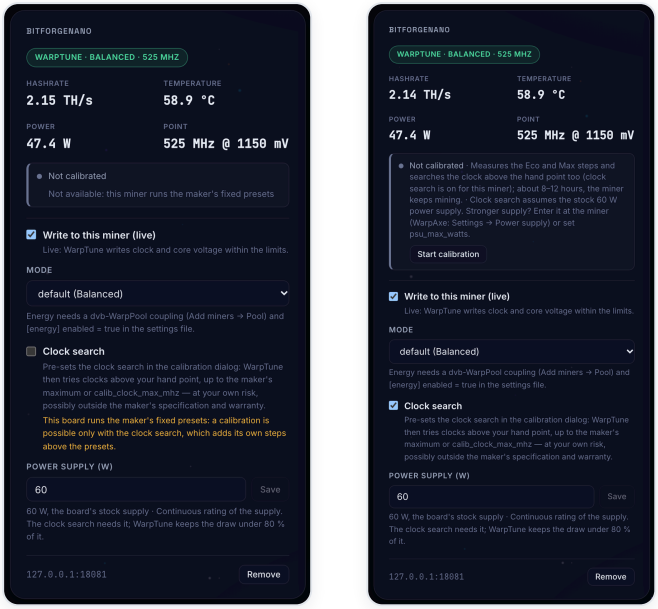
The checkbox **Clock search** decides whether a calibration measures the clock too, and pre-sets the same box in the calibration dialog (chapter 10). The text under it: *On by default where the supply rating is known: the calibration measures a clock–voltage curve — Max climbs above your hand point (beyond the maker's table only with beyond_spec), Eco walks down to the clock with the best J/TH. Off: the Eco and Max steps alone.*

- **On** (the default, as soon as WarpTune knows the power supply's rating, see **Power supply (W)** below): a calibration measures several clocks, each at its own lowest voltage. Eco looks for the clock that needs the least energy per terahash; Max looks for more hashrate above your hand point.
- **Off**: a calibration measures only the voltage of the Eco step and of the Max step, at the clocks they have.

The switch alone changes nothing on the miner; it only matters when you start a calibration. It is saved and active at once (the card says *Saved — WarpTune restarted its control of this miner with the new settings.*). In the settings file it is the key `calib_clock`. An Avalon Q has no such switch.

On a board that runs the maker's fixed presets, the **BitForge Nano**, a note in orange adds: *This board runs the maker's fixed presets: a calibration is possible only with the clock search, which adds its own steps*

above the presets. Tick the box; the card then offers **Start calibration**.



BitForge Nano (test miner): left with the clock search off (calibration not available, orange note), right after ticking it (Start calibration offered).

In Max the Nano runs at **625 MHz**, WarpAxe's highest preset, with the voltage its calibration found (about 1050 mV), instead of ForgeOS's 636 MHz at 1160 mV (its top preset before ForgeOS 1.8, which moved it to 610 MHz at 1200 mV). That is about 2.55 instead of the advertised 2.6 TH/s (636 → 625 MHz, −1.7 %), with about 11 % less core current than the ForgeOS preset, which sits right at the voltage regulator's (TPS546D24A) 38 A warning line, and a clear margin to its 40 A protective shutdown. WarpTune takes no further clock step up once the core current passes 90 % of that warning line (34.2 A). Since 625 MHz is also WarpAxe's top preset for the Nano, the clock search finds no room above it as long as **Beyond the maker's specification (Max mode only)** is off; the calibration then measures the Eco curve and the voltage of the Max step. With that switch on (and a supply that fits), the Max curve may search above 625 MHz, up to 700 MHz on the Nano.

Clock per chip

The chips of one board share the core voltage and, normally, the clock. The weakest chip then sets the point for all of them, and the stronger chips waste their headroom. From WarpAxe 0.1.44 on, the firmware can run each chip at its own clock: a small **offset** in MHz on top of the board's clock (the *chain clock*). The firmware does not search for these offsets itself. WarpTune does, if you switch it on.

The checkbox **Clock per chip** appears only on miners whose firmware reports a clock per chip (WarpAxe 0.1.44 and later, a board with more than one chip). An Avalon Q never has it. It is **off by default**. The text under it:

Off by default. When on, WarpTune searches for each chip's own clock at the operating point the miner holds and writes it as an offset: in every mode, Eco included, chips with headroom run faster at the same voltage (above the maker's clock only with beyond_spec, and only with a known power limit). A search takes one to two hours and drives chips up to their error limit; offsets set on the miner are replaced. On a board with its chips in series (Bitaxe Naja Duo) no chip runs faster: a chip over its error limit gets a slower clock in steps of 5 MHz, which gives it a larger share of the voltage.

Like every switch on the card it is saved and active at once. In the settings file it is `chip_clock = true`.

> **WarpTune owns the offsets once the switch is on.** Offsets you set by hand on the miner are replaced. If you want to keep your own offsets, leave the switch off.

How the search works

- **Same point, faster chips.** The regulation keeps clock and voltage of the board where they are. The search only looks for the highest clock at which each chip still does its work: its error rate stays clearly under its error limit (the table under *Chip error limits* above) and its own hashrate reaches at least 92 % of what its clock should give. More hashrate at the same voltage means better efficiency, so this runs in every mode, Eco included.
- **It waits for a quiet point.** A search starts only once the point has stayed unchanged and undisturbed for **30 minutes**. It stops the moment anything else happens: a calibration, a pool outage, chips switched off, an overheat stop or a pause, a silent chip, a dropped chip domain, a self-test, a reboot, a new point. Each of these starts the 30 minutes over.
- **Rounds of 25 MHz, then 5 MHz.** All chips still in the search go up one coarse step of 25 MHz together, in one write. After 90 seconds to settle, each chip is judged on its own for 5 to 10 minutes. A chip whose step fails goes back that step and waits; the others carry on. Then the chips that failed go on in fine steps of 5 MHz, up to just under the step they failed on. At the end, one more window checks the whole board at its new clocks. A search takes **one to two hours**.
- **A step fails** when the chip's errors are not clearly under its limit, when its hashrate falls short or does not follow the faster clock, or when the chip resets itself (its counters start over while the others run on). A chip that resets goes back to the last offset it passed and takes no further steps.
- **Upper bounds.** No chip runs more than **100 MHz above the chain clock**, and none above the maker's highest clock. Above the maker's clock only with **Beyond the maker's specification (Max mode only)**, and in Max mode only; Balanced and Eco stay inside the maker's range.
- **Room for every raise.** Before each round WarpTune checks: chip more than 2 °C under its target, voltage regulator under its limit, fan at 90 % or less, a known power limit with at least 3 % room left, and a supply whose input voltage has not fallen by more than 1.5 % since the search began. Without a known power limit (see **Power supply (W)**) no chip is raised. Where the room is short, the chips with the lowest error rate go first; two hours later the search goes on for the others if there is room again.
- **Writes.** The search writes only while the miner has had fewer than eight writes in the hour, so it can never trip the 12-writes breaker. A dry-run miner gets nothing written.
- **When a raise does not hold.** If the regulation has to step the clock down while chips run faster, the result is dropped and for **six hours** no chip gets a faster clock.
- **Results are kept** per point and checked again after a day, or when the chip temperature has moved by 5 °C. A check takes back only a chip that drifted. Every write of the point carries the offsets found for exactly that point, or none.
- **A calibration always measures without offsets.** When one starts, the offsets are taken off; the search waits until it has finished.

Boards with their chips in series

On most boards every chip gets the full core voltage (the chips sit *in parallel*). On a few boards the chips sit *in series* and share the voltage between them. There, slowing one chip moves voltage towards it and away from the others, so the search above would do harm. WarpTune therefore runs it only where the firmware reports the chips in parallel.

- **Bitaxe Naja Duo** (two BM1373 in series, one chip per voltage domain): WarpTune **balances** the board instead. As long as both chips are clearly under their error limit, nothing is written. Only the one chip clearly over its limit is slowed, in steps of 5 MHz, one write per step, never further from the other chip than the spread the firmware allows (25 MHz, or 8 % of the clock where that is less). No chip runs faster than the chain clock. Every step is judged on both chips: the other chip must stay clearly under its limit and reach its hashrate, otherwise the board goes back to the step before. The search ends at the smallest slowing that brings the chip under its limit, after at most five steps (about 30 to 60 minutes). After a chip has reset itself on a step, no search runs on that miner for six hours. A measured example (our Naja Duo at 550 MHz and 1080 mV, November 2026): the second chip ran at about 2.7 % errors with the first at 0.02 %. The search slowed the second chip once, by 5 MHz; its errors fell to about 1.2 %, under the 1.5 % limit set for this miner in the settings file (`calib_error_line_pct = 1.5` instead of the BM1373's 7 %), and the search ended there. The first chip stayed at 0.02 %. In a test by hand, slowing it further down to –20 MHz brought its errors to about 0.1 % and saved about 1 W, with the board's valid hashrate unchanged within its usual spread; that is why the search stops at the limit and does not chase lower error rates.
- **Bitaxe Gamma Hex, NerdQAxe++ Rev 7** and other boards with several chips per voltage domain: left alone. The firmware does not say which chip sits in which domain. Nothing is written, offsets you set on the miner stay, and the card says *No search on this board: the search runs only where the firmware reports the chips in parallel on the core voltage, or in series with one chip per voltage domain*.

A lower voltage on a board with chips in series

On a board WarpTune balances (the Bitaxe Naja Duo), a second switch goes one step further: **Lower voltage on a board with chips in series**. If the weak chip runs a little slower than the balance needs, the whole board gets by with less voltage. Measured on our Naja Duo at 550 MHz, two hours each with the pool's shares (November 2026):

Board voltage, offsets	Power	Chip errors (board)	Energy per hash
1100 mV, none	88.7 W	0.15 %	11.72 J/TH
1060 mV, second chip –20 MHz	81.3 W	0.50 %	10.95 J/TH

That is about 6.6 % less energy per hash, with no rejected share in either run. The switch is off by default and needs **Clock per chip**; WarpTune Desktop offers it on a board it balances. Its text on the page:

Off by default; needs “Clock per chip”. On a board with chips in series (Bitaxe Naja Duo), once the chips are balanced, WarpTune lowers the board's voltage step by step: first the weakest chip gets a clock 10 MHz slower, then the voltage goes down 20 mV, in total at most 40 mV below the voltage the miner ran at before. A step is kept only if every chip stays clearly under 1 % errors and the energy per hash improves by at least 1 %; otherwise voltage and clocks go back. Only in Eco and Balanced. If the errors rise later, WarpTune goes back by itself.

In the settings file it is `chip_clock_lower = true`, next to `chip_clock = true`.

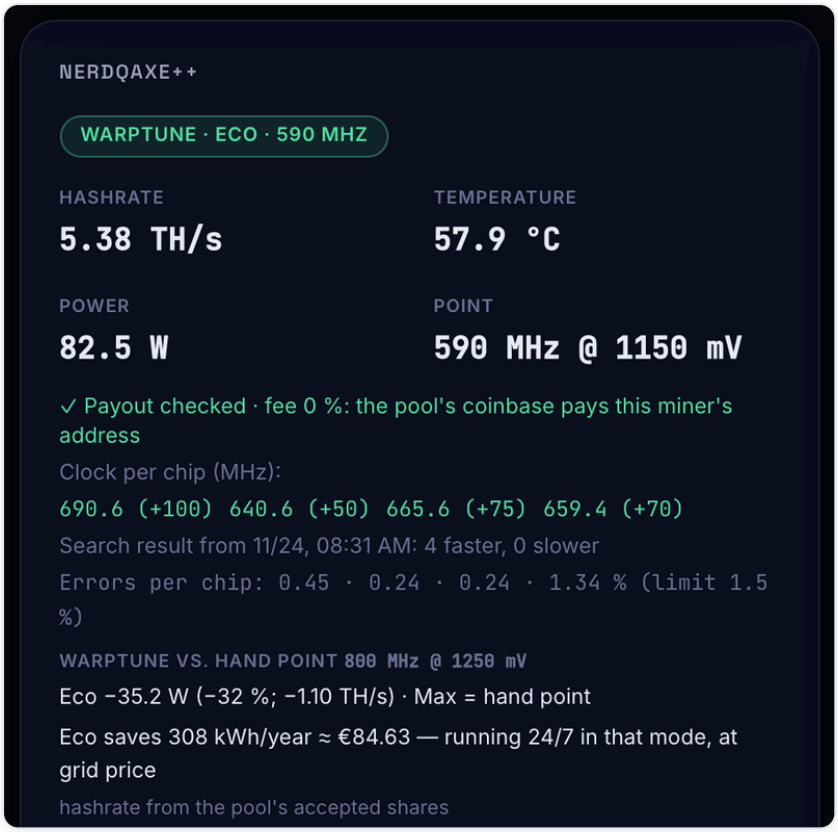
- **When it starts.** Once the balance has its result at the calibrated voltage of that clock, in Eco or Balanced. A miner you have not calibrated is not searched; calibrate first.
- **How it steps.** Always the clock first, then the voltage: the chip with the most errors gets 10 MHz less and the board is measured for 5 to 10 minutes; then the voltage goes down 20 mV and the board is measured again. At most two such pairs, so at most 40 mV, in about an hour.

- **What counts.** At the lower voltage every chip must stay clearly under 1 % errors and reach its hashrate, and the energy per hash must be at least 1 % better than before the pair. The 1 % is this search's own limit; the error limit of the balance is not used here.
- **If a step does not pass.** Voltage and clocks go back together to the last pair that passed, and the search ends.
- **Afterwards.** WarpTune keeps watching. If a chip is clearly over 1 % for ten minutes, the board goes one pair back; if the regulation finds the miner short of its hashrate, a chip domain switches off, or you calibrate again, the lower voltage is dropped and the miner runs at its normal voltage again. If the chips or the miner ended it — a search that went as far as it could, a pair taken back, a chip that reset itself, a pair whose offsets no longer hold, the miner rebooting in the middle of a search, a voltage the miner does not take — there is no new search at that clock for a day. After any other reason (the regulation dropping the lower voltage as above, a mode change, a WarpTune restart in the middle of a search, a failed write of the clock offsets) the next search waits two hours. The first time the regulation drops a pair, its two hours replace the day of the search before; a second time at the same clock within a day, the wait is a day.
- **What it does not change.** Your calibrated voltages stay as they are. The lower voltage is kept separately and only applies together with its clock offsets. In Max it is not applied: the miner runs at its normal voltage there. If you turn the switch off again, the miner goes back to its normal voltage as soon as the saved change restarts its control.

On a board with chips in series the card's status line always begins with what WarpTune does there: *Clock per chip: balancing*, or *Clock per chip: balancing and lower voltage* with this switch on; the texts below follow it. On the card, the status line reads *Search running: lower voltage for the balanced board. First the weakest chip gets a clock 10 MHz slower, then the board's voltage goes down 20 mV; every chip must stay under 1.0 % errors* while it searches and *voltage lowered to 1060 mV (instead of 1100 mV), 6.6 % less energy per hash* once a pair is in force. With the switch on, no search running and no pair in force, the line says why not: *Lower voltage: only in Eco and Balanced* (also in Energy before it has chosen a mode), *Lower voltage: needs the calibrated voltage at this clock — calibrate the miner first*, or *Lower voltage: next search in about 2 h*.

> **The switch is new.** The numbers above were measured by hand. On our Naja Duo the search found the same pair on its own (November 25, 2026: 1060 mV with the second chip at –20 MHz, about 6 % less energy per hash). The miner then ran for two hours on that pair with no rejected shares. After a hard WarpTune restart the pair was still in force. In Max the pair is not applied (the board runs at its normal voltage); after switching back to Balanced it was applied again.

The block on the card



NerdQAxe++, four chips +100/+50/+75/+70 MHz over 590 MHz, errors per chip 0.45/0.24/0.24/1.34 % (limit 1.5 %).

With the switch on, the card shows a block of up to three lines:

- *Clock per chip (MHz): 690 (+100) · 640 (+50) · 665 (+75) · 660 (+70)*: each chip's clock, chip 1 first, and in brackets its offset to the chain clock. A chip that runs faster is shown in green, a slower one in orange, a chip without an offset in grey. Hold the mouse over a number to see which chip it is.
- One status line, for example:
  - *Search running: chips under their error limit of 1.5 % get a faster clock · measuring, 3 of 5 min · writes so far: 4* (on a Naja Duo: *Search running: the chip over its error limit of 7.0 % gets a slower clock in small steps; the other chip is checked at every step*),
  - *Checking the stored result against the error limit of 1.5 %*: the daily check,
  - *Search result from 11/24, 09:12 AM: 4 faster, 0 slower*: the result in force, with the number of faster and slower chips,
  - *The search starts once the operating point has stayed unchanged for 30 minutes (12 min to go)*,
  - *The search waits until the calibration has finished; the calibration measures without offsets*,
  - *The search waits: the hourly write limit is almost used up — the remaining writes are kept for the regulation*,
  - *No chip gets a faster clock for now: the regulation stepped down while chips were running faster* (the six-hour rest),
  - *The per-chip clock search is off: this miner is in dry run, WarpTune writes nothing*.

  Other waiting reasons name what the search waits for: a silent chip or a dropped chip domain, chips switched off, the miner on hold, no work from the pool, a self-test.

- *Errors per chip: 0.45 · 0.24 · 0.24 · 1.34 % (limit 1.5 %)*: each chip's error rate in the last window, against the limit its steps are judged by.

The WarpAxe dashboard on the miner shows the same offsets and names them as set **by WarpTune** (WarpAxe 0.1.47 and later).

Beyond the maker's specification (Max mode only)

Normally WarpTune stays inside the maker's specification: no clock above the maker's highest step and, at your hand clock and below it, no voltage above your hand voltage; a maker's step above your hand clock gets at most the maker's voltage for it. The checkbox **Beyond the maker's specification (Max mode only)** lifts this above your hand clock, for **Max mode only**. Your hand clock and every clock below it keep your hand voltage as their ceiling either way. The box is **off by default**; in the settings file it is the key `beyond_spec`. The text under it:

The calibration may then search clocks above your hand point or the top preset and give them more voltage than the hand voltage — always inside the board's voltage, current and power limits, the supply's rating, and the chip and VR temperature limits. The maker's specification no longer covers it.

- The Max curve of a calibration may climb above your hand point and above the maker's top step, up to the maker's beyond-spec maximum (for example 800 MHz on a BM1370 board, 700 MHz on a BitForge Nano), and give those clocks more voltage than your hand voltage, up to the board's highest allowed voltage.
- Every other limit stays: the board's voltage, current and power limits, 80 % of the power supply, the chip and voltage regulator temperature limits, the fan at 90 % at most.
- Clocks found this way are used in **Max** mode only. Balanced and Eco never use them. The hand point itself is never raised and stays the restore point.
- With **Clock per chip**, single chips may then run above the maker's clock too, in Max mode.

With the switch on, a line under it says how far the calibration may go, for example *The calibration may search up to 700 MHz / 1200 mV.*

The checkbox can only be set when the power supply fits. Otherwise it is greyed out, and an orange line says why:

The line says	What to do
Supply rating unknown — enter it at the miner (WarpAxe: Settings → Power supply) or set psu_max_watts.	Enter the rating (see **Power supply (W)** below).
No power limit from a hardware figure (board limit or supply rating).	WarpTune knows neither the board's power limit nor the supply's rating. Enter the supply's rating.
The hand point's draw has not been measured yet: let the miner run at its hand point for a few minutes.	Wait a few minutes with the miner at its hand point.
The hand point already uses the supply: no room above it.	Your hand point already draws as much as the power limit allows for a step up (the lowest of 90 % of the board limit, 80 % of the supply and `max_watts`). Only a stronger supply makes room.

If `beyond_spec = true` is already in the settings file but the supply does not fit, the box shows ticked and locked, and the line adds *beyond_spec is set in the file: the regulation keeps its steps, the calibration searches nothing above the hand point until the supply fits.*

> **At your own risk.** Clocks and voltages beyond the maker's specification may be outside the warranty. They mean more power, more heat and more fan noise. WarpTune's limits reduce the risk; they do not remove it.

Power supply (W)

The continuous rating of the miner's power supply. The text under the field says where the number comes from:

Text	What it means / what you can do
… W entered at the miner — change it there (Settings → Power supply).	WarpAxe firmware lets you enter the rating on the miner. The field is locked here; change it on the miner. A change there is picked up without a restart.
… W from the settings	The number you entered on this page. Change it and click **Save**. Empty the field and save to remove it.
… W, the board's stock supply	A guess from the board type (for example 25 W for a Bitaxe Gamma, 60 W for a BitForge Nano). If your supply is different, type the real rating and click **Save**.
no supply rating known	Enter it. Without a rating there is no clock search, and **Beyond the maker's specification (Max mode only)** stays locked.

Save stays grey until you change the number. Allowed values are 1 to 2500 W. For an Avalon Q there is no field: *Power cap on an Avalon Q: max_watts in the settings file.*

> **Several miners on one power supply?** Split its rating among them so the shares add up to no more than the supply's rating, and enter each share at its miner. Example: a 600 W supply as 240 W + 150 W + 100 W. WarpTune then keeps each miner under 80 % of its share.

Power supply check by input voltage

A power supply that is too weak shows it first in the input voltage: it drops under load. WarpTune watches for this on every raise: Max steps, the clock search, the calibration and the clock per chip.

- Before the first raise of a climb, WarpTune remembers the smoothed input voltage.
- If the input then falls by more than 3 % of the nominal voltage on settled readings, WarpTune goes one step back and marks that step. That is 0.15 V on 5 V boards and 0.36 V on 12 V boards. The same happens when WarpAxe's own sag warning comes on after the raise.
- If WarpAxe measures a sag of 6 % or more, or its sag warning is on, every raise is blocked.
- The clock per chip has its own, stricter line: once the input has fallen by 1.5 % of the nominal voltage since the search began, WarpTune raises no further chip.
- The first readings at a new point do not count.
- The remembered voltage is dropped at every step down, after a reboot, when the miner stops by itself, at the end of a pause, at a mode change, and 15 minutes after the last raise.

The reason under **Last decision** then says, for example, *input voltage sagged … V since the raise (… → … V): the power supply is giving way*. The check works with the plain input voltage of any firmware. WarpAxe 0.1.45 and later adds its own sag readings. On an Avalon Q, WarpTune reads the 12 V that its power supply reports.

Hand point

Above the address the card shows your hand point, for example **Hand point 525 MHz @ 1150 mV**, and where it comes from:

Text	Meaning
remembered on 2026-10-03, before WarpTune first wrote to the miner	The point the miner ran at before WarpTune's first write. WarpTune keeps it, also after a restart, a crash or a firmware update on the same board. Only you change it.
the point the miner runs at; WarpTune has not written to it yet	The miner is still in dry run. Until WarpTune writes for the first time, each start takes the point the miner runs at then, so a change you make by hand before going live counts.
from your settings file (stock)	You set the hand point yourself (`stock` in `warptune.toml`, or with **Change hand point**). It always wins.
uncertain: taken after WarpTune had written to the miner — confirm it with Change hand point	Only after an update from an older version: the journal did not show the point from before WarpTune's first write. WarpTune keeps the point, and the start line in the journal names it and the last start's restore point. Check it and save your real hand point with **Change hand point**.
the maker's default; no point seen yet	The miner did not report its point at the start. WarpTune remembers nothing and writes nothing to it, not even on a stop, until the miner reports one for two readings in a row; then this miner's control starts again and takes that point.

The hand point is the restore point and the highest voltage WarpTune writes at your hand clock and at every clock below it. Above your hand clock WarpTune uses only the maker's steps at the maker's voltage; more only with **Beyond the maker's specification (Max mode only)**. This holds for every miner, whether or not you ever set `stock`. A point above your hand clock that was calibrated with that switch keeps its voltage only in Max mode: in Eco or Balanced it is written at the maker's voltage, which is the safe direction; if it does not run cleanly there, WarpTune steps it down as usual.

Change hand point opens two fields, clock (MHz) and voltage (mV), filled with the hand point in force. **Save as hand point** writes them as `stock` into the settings file. While the miner is in dry run (not paused) and runs at another point, a second button takes that point: **Take the miner's point (… MHz @ … mV)**, as long as WarpTune has never written to this miner. A point WarpTune wrote itself is never offered. With a hand point from the settings file, **Back to the remembered point** removes `stock` again; WarpTune keeps your last `stock` as the remembered point, so that is where it falls back to. Saving restarts this miner's loop, which then works with the new hand point. A live miner is handed over at the point it runs at; the old hand point is not written back, with the exceptions in chapter 8 (*When WarpTune stops*).

WarpTune keeps the remembered points in `warptune-hand-points.json` next to the journal. Another board on the same address starts over with its own point. If the miner runs somewhere else than the remembered point when WarpTune starts (a crash before the restore, a change by hand after going live), the

start line in the journal says so and the restore still goes to the hand point. `check-config` prints each miner's hand point and its source.

> **Updating from an older version?** WarpTune takes the point of the last start in the journal before its first write since the last change of device (a start on the maker's default excepted). Calibrated voltages under your hand clock that lie above your hand voltage are written at the hand voltage from then on.

Address and Remove

At the bottom the card shows the address WarpTune uses for the miner, and **Remove**. Remove asks *Remove miner …?* and deletes the miner's entry from the settings file. WarpTune stops regulating it at once; a live miner gets its hand point back as its loop stops. The other miners run on untouched. The journal keeps the miner's history.

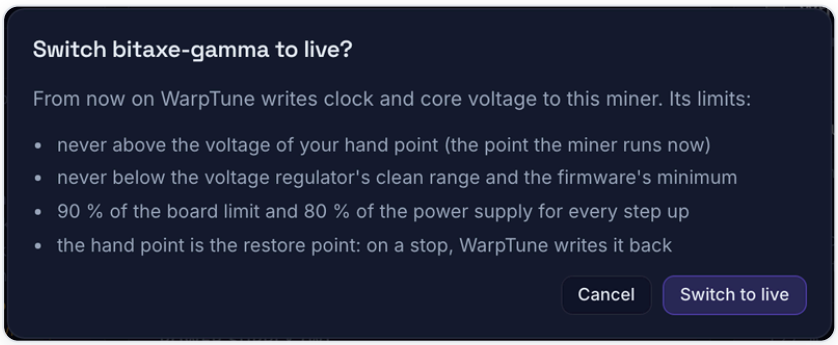
8 · Dry run and going live

Every miner starts in **dry run**. WarpTune reads it and writes down, in the journal, every decision it would take. Use this time to see what WarpTune would do — for a few hours, or a day. Hold the mouse over the WarpTune badge to see the last decision.

Switching a miner to live

1. Tick **Write to this miner (live)** on its card.
2. A dialog opens: **Switch … to live?** It says: *From now on WarpTune writes clock and core voltage to this miner. Its limits:*
   - at your hand clock and below never above your hand voltage (the point the miner ran at before WarpTune first wrote to it, or `stock` from the settings file); above the hand clock only the maker's steps at their table voltage, more only with “Beyond the maker's specification” in Max mode,
   - never below the voltage regulator's clean range and the firmware's minimum,
   - 90 % of the board limit and 80 % of the power supply for every step up,
   - the hand point is the restore point: on a stop, WarpTune writes it back.

   The first line is meant for your hand clock and every clock below it. A step of the maker's table above your hand clock may run at the maker's voltage for that step, and with **Beyond the maker's specification (Max mode only)** switched on, a calibrated Max clock may get more voltage than your hand voltage (chapter 7).
3. If the WarpTune process itself is still in dry run, the dialog adds: *This also switches the WarpTune process itself to live ([sidecar] live = true in the settings file).* If other miners in your file are already marked live, it names them: they go live too with this step.
4. Click **Switch to live** (or **Cancel**).
5. The miner's own switch takes effect at once: WarpTune starts this miner's loop again with live on, and the card text changes to *Live: WarpTune writes clock and core voltage within the limits.* Only when the dialog also switched the WarpTune process itself to live does the banner appear: the card then says *Live after you apply the settings* until you press **Apply now**. The header shows **LIVE**.

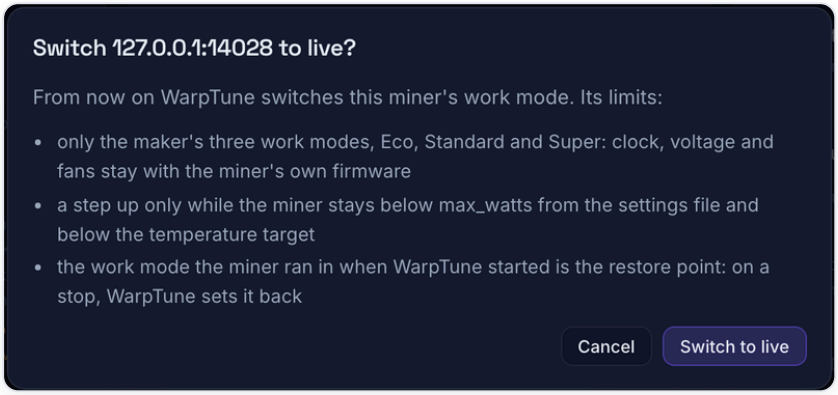


The question before a miner goes live (test miner; here the process is already live, so the extra note about the process switch is not shown).

An Avalon Q goes live differently

For an Avalon Q the dialog names what WarpTune really does there: *From now on WarpTune switches this miner's work mode. Its limits:*

- only the maker's three work modes, Eco, Standard and Super: clock, voltage and fans stay with the miner's own firmware,
- a step up only while the miner stays below `max_watts` from the settings file and below the temperature target,
- the Eco work mode is the restore point, whatever mode the miner ran in when WarpTune started: on a stop, WarpTune sets Eco.



The live question for an Avalon Q (test miner): work modes only.

Two switches, both needed

A miner is written to only when **both** are on: the miner's own live switch, and the process switch. The first live switch on the page sets both. Turning one miner back to dry run leaves the process live; the other live miners keep going.

Going back to dry run

Untick **Write to this miner (live)**. The miner gets its hand point back at once and is only watched from then on; the other miners run on untouched.

The page tells you beforehand which point that is: under the live switch of a live miner it says *Switching live off writes the restore point back: 800 MHz @ 1250 mV.* This line names the hand point. If the hand point would draw more than the power limit allows or come too close to the core current warning line, WarpTune writes the highest step below it that stays within both instead, and names it in the journal. On some miners the hand point is the fastest and hottest point they have, so look at this line before you switch off. If the miner should keep the point it runs at right now, use the pause below instead.

Pause (hold the point)

The checkbox **Pause (hold the point)** stops WarpTune for this one miner without writing anything to it: no restore point (not even when WarpTune stops), no step, no calibration, no fan target, no device command. WarpTune no longer renews the heartbeat; a running one it ends once, so the firmware takes its own regulation back. WarpTune keeps reading the miner and writing the journal. Under the checkbox it then says *Paused: WarpTune writes nothing to this miner and keeps reading. Switching it off returns to live or dry run without a restore.*, and the pool's **Devices** tab says *Paused by you: WarpTune holds the point and writes nothing to this miner (no restore, no heartbeat); it keeps reading.* Use it, for example, while another tool flashes the miner or while you test something on it by hand. The pause acts at once, without restarting this miner's control or any other's. Untick it and the miner goes back to live or dry run, as it was before, again without a restore. The pause is saved in the configuration, so it stays in place across a restart of WarpTune until you untick it.

When WarpTune stops

On a clean stop WarpTune writes the hand point back to every live miner and reads it back to confirm. This happens:

- at every **Apply now** (briefly, then it starts again),
- for one miner alone, when you turn its live switch off on its card or remove the miner (chapter 7): that miner's loop stops and writes the hand point back if WarpTune had changed the device,
- macOS with the login item: at logout and shutdown,
- Windows: at sign-out and shutdown,
- Linux: when the user service stops,
- on an update and on uninstall.

Any other change on a miner's card normally writes nothing back. A change that restarts that miner's loop (the mode, the hand point, a limit, the power supply, the clock search) hands the miner over to the new loop, provided its live switch stays on: that loop takes the miner over at the point it runs at, and the hand point is written back later, when that loop stops. The hand point is written back at once in three cases: WarpTune had itself stopped writing to the miner (next section); a **Clock per chip** search is under way or the change switches **Clock per chip** off; or WarpTune no longer regulates the device under the new settings. The schedule and the pause restart nothing: they take effect in the running loop at once.

A miner you paused (**Pause (hold the point)**) gets nothing written back on a stop either; it keeps the point it runs at. If the hand point would draw more than the power limit or come too close to the core-current warning line, WarpTune writes the highest step under both instead and names it in the journal. After a handover that step also applies to the new loop until it has measured for itself, even if it stops before its first reading. If the miner is paused when you save a change that would write the hand point back at once, WarpTune writes it back when you lift the pause.

> **macOS with "Not now":** a logout ends WarpTune at once, **without** the restore. Live miners then stay on their last point. For live miners on a Mac, choose **Start at login**.

> **Changing a miner by hand while WarpTune runs** is possible. WarpTune sees the new point on its next reading, lets the miner settle and judges it afresh. Your hand point stays as it is: once WarpTune has written to the miner, a restart does not take the point it runs at. If you want a new hand point, set it with **Change hand point** on the card (chapter 7).

When WarpTune stops writing by itself

When something is wrong, WarpTune switches off its writes to a miner on its own and from then on only watches it. The card then says why, for example **WarpTune stopped writing to this miner (10/21, 07:36 AM): the write breaker tripped — 12 writes within an hour**. The reasons are:

- **the write breaker tripped:** more than 12 writes within an hour. This protects against a miner that swings back and forth. Restoring the old point after a device restart does not count towards this, for up to three restarts an hour,
- **too many device restarts**,
- **writes kept failing** (the miner did not answer),
- **the device did not take a write** (it answered, but runs at a different point).

Once you have found the cause, press **Switch writes on again** on the card and confirm. The count starts over, and you don't need to restart WarpTune. If the cause is still there, WarpTune stops again.

The heartbeat to WarpAxe

WarpAxe can regulate a miner by itself too. So that the firmware and WarpTune do not work against each other, WarpTune sends a WarpAxe miner it regulates live (a WarpAxe build that offers it) a short **heartbeat** about every two minutes. While the heartbeat is fresh, the firmware's own control steps back and leaves the regulation to WarpTune. If the heartbeats stop (WarpTune stopped, the computer sleeps or crashed), the firmware **takes over again 10 minutes after the last one**, so a miner is never left without regulation. When a miner leaves live (live off, a stop, the miner removed), WarpTune ends the heartbeat at once. Nothing is sent in dry run, to other firmware, or to an Avalon Q, and the heartbeat writes nothing to the miner's flash memory. A paused miner (**Pause (hold the point)**) gets no heartbeat either.

Self-test on the miner (WarpAxe)

WarpAxe v0.1.34 and later can test itself while it mines. The test takes about 80 seconds; clock and voltage stay as they are. While it runs, the card shows **Self-test running on the miner — WarpTune writes nothing meanwhile**: WarpTune holds back every step and pauses a running calibration, so the test is not disturbed. Afterwards the card shows the result, for example **Last self-test 10/21, 10:00 AM: passed**.

9 · The modes

The mode tells WarpTune what to aim for. You pick it per miner, on the card or when you add the miner. Every mode keeps all the limits from chapter 1.

Mode	What WarpTune does	Good for
default (Balanced)	Uses the mode set for all miners in the settings file. Out of the box that is Balanced.	Most people.
Eco	Aims for the lowest energy per terahash (J/TH). It weighs the steps by their measured efficiency and only climbs when efficiency does not get worse. It keeps 2 °C more distance to the target temperature.	Lowest power bill, quieter fan, a bit less hashrate.
Balanced	Holds the target temperature and takes the highest step that the temperature and power budget allow.	A good everyday setting.
Max	Like Balanced. In addition it uses a higher clock found by a calibration with clock search (chapter 10) and, only with **Beyond the maker's specification (Max mode only)** switched on (chapter 7), clocks above the maker's table.	Most hashrate inside the limits.
Energy	Switches between Eco, Balanced and Max by your electricity situation, as reported by a dvb-WarpPool: Max on solar surplus, Eco when power is expensive, Balanced otherwise.	Homes with solar or a time-based tariff and a dvb-WarpPool with its energy page set up.

> **The clock can go above your hand clock; the voltage never goes above your hand voltage at your hand clock or below it.** If the maker's table has higher clock steps and power, temperature and current leave room, Balanced and Max may use them, each at most at the maker's voltage for that step. Clocks beyond the maker's table, and more voltage than that, only in Max with **Beyond the maker's specification (Max mode only)** switched on (chapter 7).

Energy mode in detail

Energy mode needs three things:

1. a pool address under **Add miners → 3 · Pool coupling**,
2. that pool must have its **electricity view** set up (tariff and, if you have one, the solar feed). WarpTune reads it from the pool's `/api/energy`,
3. the line `enabled = true` under `[energy]` in the settings file. **The page has no switch for this**; you have to add it to `warptune.toml` by hand:

   ```
   [energy]
   enabled = true
   ```

> **Until then, Energy is greyed out.** On the device card and in the setup assistant the option **Energy** cannot be picked while the pool address or `[energy] enabled = true` is missing. The text under the field says: *Energy needs a dvb-WarpPool coupling (Add miners → Pool) and [energy] enabled = true in the settings file.* After you added the line, reload the page; the option becomes available. A miner that already runs in Energy keeps the option selectable.

How Energy decides, with the default settings:

- **Solar surplus** reported by the pool → Max (only as far as the surplus carries the miner; a step that would need grid power is not taken),
- **electricity at or above 0.30 €/kWh** → Eco,
- otherwise → Balanced,
- at least 10 minutes between two switches, so a passing cloud does not flip the miner back and forth,
- if the pool's feed is lost, or until the first reading after a start, → Eco.

While a calibration runs, Energy mode pauses; it comes back when the calibration ends.

How far a miner climbs on solar surplus. In Max on surplus a miner may draw its present power plus the surplus the pool reports, minus a reserve: `surplus_reserve_w`, 300 W by default. The reserve keeps the step up from eating the very surplus that allowed it. 300 W suits a miner with big steps such as an Avalon Q; a small miner that draws only 30–50 W more in Max would wait for a lot of surplus. You can set the reserve per miner in the settings file, for example:

```
[[miner]]
host = "192.168.1.41"
surplus_reserve_w = 210
```

Keep it above the pool's own surplus buffer of 200 W (210–250 W for a small miner). The page has no field for it; like every change in the file, it takes effect after **Apply now**. While the surplus does not cover the next step, the badge says **waiting for PV surplus**.

Rate source: the pool's tariff or Energy-Charts

By default Energy mode switches by the pool's tariff. It can also use the exchange price instead. On the **Devices** page, under the electricity price, click **Rate source** (the button is there once a pool is coupled). A small form opens:

- **Rate for the energy mode**: **The pool's tariff** (the default) or **Energy-Charts day-ahead spot price**. Energy-Charts is the public day-ahead spot price of Fraunhofer ISE, one price per quarter hour. You need no account. The next three fields appear only with Energy-Charts.
- **Bidding zone**: `DE-LU` by default. Write it exactly as Energy-Charts does, for example `IT-North`.
- **Surcharge per kWh (EUR, gross)**: your grid fees, levies and margin. It is added to every kWh.
- **VAT on the spot price (%)**: the VAT on the exchange price.
- **Save**.

The rate is: spot price in EUR/MWh ÷ 1000 × (1 + VAT %) + surcharge per kWh. Example: 100 EUR/MWh with 19 % VAT and a surcharge of 0.15 EUR gives 0.1 × 1.19 + 0.15 = 0.269 EUR/kWh. Both VAT and surcharge are 0 until you enter them. The form writes these keys under `[energy]` in the settings file:

```
tariff_source = "energy-charts"
energy_charts_zone = "DE-LU"
```

`spot_vat_pct = 19`
`spot_surcharge_per_kwh = 0.15`

Like every `[energy]` change, it takes effect after **Apply now** in the banner. Which rate counts:

- The pool's **solar surplus** always comes first.
- Without a spot price for the current quarter hour, the pool's tariff applies.
- Without a fresh reading from the pool, WarpTune stays in Eco, as before. Energy-Charts too needs the pool coupling.

WarpTune fetches the prices in the background, only while Energy mode is on. After an error it waits longer before each new try. The line next to the button shows the price of the current quarter hour, for example *Energy mode: Energy-Charts spot price DE-LU — now 0.269 EUR/kWh (100 EUR/MWh on the exchange, plus your surcharge and VAT).* If the fetch failed, it says *Energy mode: the Energy-Charts DE-LU price could not be fetched (…) — the pool's tariff applies until it can be.*

Avalon Q

For an Avalon Q the modes map to its work modes: WarpTune moves between Eco, Standard and Super by the same rules. A mode switch gets a minute to show and three minutes to settle. The Avalon's own fan control stays in charge; its failsafe temperature is 100 °C, because the Avalon Q runs at 85–95 °C by design.

Avalon Q: schedule, standby and quiet windows

An Avalon Q can go to **standby**: the hash board switches off, the fans stop, and the miner's API keeps answering. From v1.46 WarpTune uses this in three ways, all on the Avalon's card.

Schedule. Add a schedule on the card opens a plan with its own switch and any number of windows: on chosen weekdays or every day, from a start to an end time (an end at or before the start runs over midnight), optionally only between two dates (*11-01* to *02-28* every winter, or two full dates once). A window is **Off (standby)** or **Quiet (Eco + fan cap)**. In an off-window WarpTune sets the Eco work mode, writes the window's end into the miner as its wake time and only then puts the miner into standby — the Avalon never sleeps without its wake and wakes on its own even when WarpTune or this computer is off; while it sleeps WarpTune checks that the miner still holds the wake time, and writes it again if not. A window cannot start and end at the same time. The card says *Standby until 06:00 (schedule)*. If you wake the miner from the Avalon app inside a window, WarpTune leaves it awake until the window ends. A standby you set on the miner yourself is left alone until the miner wakes. After a wake — by the miner's own timer, by WarpTune or by you — WarpTune clears the standby and wake times it wrote into the miner, and waits for the hashrate to come back (about three minutes) before it judges the board again; the card says *coming up after a wake or boot* meanwhile. In a quiet window WarpTune runs Eco and caps the fan (default 40 %); when the chips come within 2 °C of the target the cap is released at once and set again after five cool minutes, and leaving the window always restores the automatic fan. With **Schedule on** switched off, the plan stays in the file and applies nothing. A saved schedule — like the two switches below — takes effect on the Avalon's next tick; nothing needs to be applied and the miner's loop does not restart.

Standby instead of Eco on grid power. In Energy mode, and only when the pool's electricity view has a solar feed, the card offers the switch **Standby instead of Eco on grid power**. With it, the miner goes to standby instead of Eco while the pool reports no solar surplus at an expensive rate, and wakes when the surplus comes back and would still cover the miner's own Eco draw — after 30 minutes at the least, and it then stays awake for 30 minutes too, so clouds do not make it sleep and wake all afternoon. A safety wake six hours out is written into the miner and renewed while it sleeps, so it never sleeps forever if WarpTune

stops. If the pool's electricity feed goes dark, that neither wakes the miner nor keeps it asleep beyond that safety wake. An off-window of the schedule wins over solar surplus; outside the windows the Energy mode decides.

Reboot when it hangs. Off by default; the switch on the card turns it on per miner. If the miner is awake, its API answers, its pool is alive and keeps sending work, but it reports no hashrate for ten minutes, WarpTune reboots it once — at most once an hour and three times in 24 hours, never in standby and never in the first fifteen minutes after a boot or a wake. A pool or node outage is not a hang: the card says so and nothing is rebooted. The card also shows the fan duty, the power supply's watts and 12 V bus, and the miner's own hardware error rate since boot, and warns from 8 % on (not in the first hour after a boot). In place of the hand-point comparison (the hand point of an Avalon is its Eco mode) the card sums what the control did over the last seven days: *12 h Super on PV surplus · 40 h standby (~1.9 kWh instead of ~34 kWh in Eco)* — recorded time only; a younger journal says how many hours or days it covers.

Avalon Q: errors, chips and power supply

When the Avalon reports an error. The Avalon's own controller reports errors about itself: error bits, one error word per hash board, and an error code of the power supply. WarpTune reads them and steps back *before* the miner stops hashing. A report counts once it has stood for three reads in a row and for a minute, and only while the hash board works.

- **Fan, overheating or hash board error:** WarpTune sets the **Eco** work mode at once and holds it until the error has been gone for ten minutes. The card says *The miner reports an error (fan): held in the Eco work mode*, and the badge turns amber. Afterwards: *The miner no longer reports an error: the Eco work mode is held until 14:20*.
- **Still reported after 15 minutes in Eco, or a power supply error:** WarpTune puts the miner into **standby with no wake time programmed**. WarpTune never wakes it from this standby, not after a restart, not by the schedule, not by the Energy mode. The badge turns red, the line under it says *Standby (device error)*, and the card says *In standby after an error the miner reported (power supply error …). No wake time is programmed: check the miner, then wake it on the device.*
- **The miner switched itself off** for a fault (power, hash board, overheating, fan and so on): *The miner switched itself off: chips too hot. WarpTune does not wake it: check the miner, then wake it on the device.* WarpTune leaves it alone and clears a wake time it had written into the miner earlier.
- An inlet temperature out of range counts only after ten minutes without a break and never leads to standby. Network and pool reports are only noted: *The miner reports: pool inactive. WarpTune notes it and does not act on it.*

These protective steps go out even while the write breaker has tripped, but only on a live miner; in dry run the card says what WarpTune *would* do. While a fault holds Eco, a stop of WarpTune writes no restore point: the miner stays in Eco. Hold the mouse over the line for the rules in full.

The chips. Under the 7-day line an Avalon card has a folding box **Chips**, closed by default. WarpTune only reads these values; nothing on the miner changes. Its header always shows the counts, for example *160 ok*, *0 weak*, *0 dead*, and a line for each of the first two weak or dead chips, for example *Chip 87 (string 3) weak: 52 % of the mean over the last 3 h, temperature and voltage normal*.

Status	Meaning
ok	The chip's work counter rises like the board's mean.

weak	Over the last 12 hours (or the history so far, at least 3 hours) the chip did less than 90 % of the mean, clearly more than random scatter. A hint only; WarpTune changes nothing.
dead	The chip's counter stood still for 30 minutes, or rose by less than half the mean over 2 hours. It is noted in the journal.
pending	Not judged yet: a chip reads pending for its first 30 minutes. Weak can be judged only after three hours; until then the box says *Status still being determined: 45 of 180 min collected*. A reboot starts the history over.

Opened, the box shows one row per **string** of chips in series (on the Avalon Q, 160 chips in 4 strings of 40) with a small square per chip. The buttons **Status**, **Temperature** and **Voltage** colour the squares by status, by chip temperature or by chip voltage (with the lowest and highest value at the ends of the colour bar). Point at or tap a square for that chip, for example *Chip 87 · weak · 52 % over 3 h · 63 °C · 283 mV*. Under the grid: the chip temperature range and mean (*Chip temperature 55–71 °C, mean 63.4 °C*), the *Spread since miner start: 2.9 %* (how far the chips' work lies apart, as a standard deviation in percent of the mean), the weakest chip, and *Voltage per string: S1 11.21 V · S2 11.19 V · …*.

The power supply line. The card also shows the supply as the Avalon reports it: *Supply 870 W · 12.1 V bus · hash board 818 W at 11.9 V / 69 A · 94 % efficiency*. The first part is the power at the wall and the 12 V bus. Where the miner reports it, the second part is the hash board's own supply rail (its DC power, voltage and current), and the **efficiency** of the supply: hash board watts divided by wall watts. Nothing is shown in standby.

Maintenance: the dust filter. Under the chips an Avalon card has a second folding box **Maintenance**, closed by default. Its first line is the dust filter, for example *Filter: 34 % · cleaning due in about 55 days, around Jan 18, 2027*. The Avalon counts the minutes since the filter was last cleaned, and its firmware shows its "filter dirty" reminder at 83 days; that is 100 %, the same percentage the Avalon Family app shows as **Filter Clear**. The line turns amber from 90 % and red at 100 %: *Filter: 102 % · cleaning due — clean it and reset it in the Avalon app*. Opened, the box says how many days ago the filter was last cleaned and the date it falls due. The counter only runs while the Avalon's firmware runs (standby included), so the date is approximate. After cleaning, reset the counter in the Avalon Family app (**Filter Clear**). WarpTune only reads the counter and never resets it. A firmware that does not report the counter shows no filter line.

Maintenance: last start and error counters. Under the filter the box names why the Avalon last started, for example *Last start: power on*. Power on, a reboot from the web page or over the API, a factory reset and a firmware update are normal; any other reason is amber for the first 72 hours after the start and then stands in the closed box too, for example *Last start: control board lost contact with the hash board*, or with a *(kernel panic)* or *(hardware watchdog reset)* after it. A fan error the Avalon reports shows red: *Fan error reported (FanErr 2)*. The hardware error counter and the CRC counters of the hash board and of its link to the control board appear only once they have risen since WarpTune first read them or since the Avalon last started: *Hardware errors: +3 since 11/24/26, 10:00 AM*. A rise is amber for 24 hours after the counter last went up (the Avalon Q's hardware error counter rises by about one every week or two), later it stays muted in the open box only; so does an unusual start reason after 72 hours. A fan error stays red as long as the Avalon reports it. Everything amber or red also stands in the closed box. The journal (`avalon_log` lines, once per change, never on every read) records a restart of the Avalon with its reason, each pool connection loss the Avalon logged with its start, end and length (*pool connection lost … (10 s)*), a changed firmware part, a changed device setting (display, solo mining, activation), the hash board's bin grade once when WarpTune starts, and free memory falling under 20 MB.

10 · Calibration

A calibration finds out how low the core voltage of a miner can go while it still hashes cleanly. Lower voltage means less power and less heat for the same clock. Every chip is different, so WarpTune measures it on your miner instead of guessing.

What you need

- The miner is **live** (chapter 8).
- A firmware that reports its accepted shares and their difficulty (`poolDifficulty`). AxeOS, NerdOS and WarpAxe do. The miner can mine on **any pool**: the accepted shares judge each voltage, read from the miner's own counters or, with a dvb-WarpPool coupling, from the pool's worker row. **No pool coupling is needed.**
- Not an Avalon Q (its control board owns the voltage).
- For a BitForge Nano, which runs on the maker's fixed presets: only with the **Clock search** switch on its card ticked (chapter 7). The switch acts at once; nothing needs to be applied.
- A board with a voltage regulator. On a board without one (for example the NerdNOS board or a devkit, chapter 2) the card says *Not available: this board has no voltage regulator; WarpTune sets the clock only*.

If something is missing, the card says *Not available: …* with the reason, for example *Not available: live control is off for this miner (live = true and --live)* or *Not available: the firmware reports no share difficulty, so there is no share verdict (a dvb-WarpPool coupling supplies one)*.

Where the share verdict comes from

The calibration dialog names the source of the shares in one line:

The dialog says	Meaning
Share verdict: the coupled pool's worker row	A dvb-WarpPool is coupled and has a row for this miner. The pool tells rejects apart (stale, low difficulty) on every firmware.
Share verdict: the miner's own counters (accepted shares × difficulty), on whatever pool it mines	No pool row: WarpTune counts the shares the miner itself reports, each at the difficulty in force. The firmware names its reject reasons.
Share verdict: the miner's own counters; this firmware gives no reject reasons, so every reject counts and the reject window is larger	For example NerdOS. WarpTune counts every reject as a sign of a too-low voltage and judges rejects over 150 shares instead of 40. That is the careful side: in doubt the voltage stays higher.

The limits, share counts and reserves are the same for all three sources.

> **A high pool difficulty slows the calibration.** Every verdict waits for its shares. On a pool with a high fixed difficulty a small miner finds shares only now and then. If the shares cannot arrive within the stage's time limit, WarpTune refuses the start and gives the numbers, for example *Start refused …: the shares come too slowly for a verdict within the stage's timeout (difficulty 65536 at 1200 GH/s: 400 shares take 26.1 h, the stage's timeout is 4.0 h); a lower pool difficulty or a dvb-WarpPool coupling helps*. Pools with variable difficulty (most solo pools, every dvb-WarpPool) adjust it to the miner, so this rarely happens there.

How a full calibration works

A calibration measures **stages**, one after the other. Each stage is one clock, and it finds the lowest core voltage at which that clock still runs cleanly. Which clocks are measured depends on the **Clock search** switch (chapter 7):

- **Clock search on** (the default where the power supply's rating is known): the stages form a **clock–voltage curve**. The Eco curve walks down from the Eco clock to the clock with the best energy per terahash (J/TH); the Max curve climbs up from your hand point. Both are explained in *The clock search: a clock–voltage curve* below.
- **Clock search off**: two stages only, the miner's **Eco step** and its **Max step** (the top step, usually your hand point).

Each stage goes like this:

1. **Hold the step.** WarpTune holds the miner on the stage's clock. Safety moves (heat, current, a dead chip) still happen and end the stage.
2. **Reference.** WarpTune first judges the starting voltage on **200 accepted shares**. This is the "before" for the comparison: hashrate, watts, efficiency. If the reference itself is short of good, the stage does not give up: it searches **upward** in 10 mV steps to the first stable voltage. At your hand clock and below it, it climbs at most to your hand voltage; above your hand clock at most to the maker's voltage for that step, with **Beyond the maker's specification (Max mode only)** up to the board's highest voltage. **Your hand point itself is never raised.** If the hand point is short of good, the card says so (see *The result*).
3. **Search.** Then it lowers the voltage by 10 mV at a time. Each voltage is judged on 200 shares. A close call is confirmed on a second window (400 shares in total). The chip error counters count as well: a voltage whose error rate lies over the chip's error limit (chapter 7, *Chip error limits*) fails, even when the shares are fine. The search goes down **to the first voltage that fails**, however many steps that takes, and never below the chip's minimum or the voltage regulator's clean range.
4. **Confirmation.** The voltage found gets one more full share verdict on new shares before it counts. A single good window can be luck.
5. **Result.** The result is the lowest voltage that was good above the highest voltage that failed. Where chip errors cost more hashrate than the lower voltage saves, WarpTune picks the voltage with the most hashrate per watt instead, and says so.

The miner keeps mining the whole time. How long a calibration takes depends on the number of clocks and on how fast the miner finds shares: the dialog shows the **expected duration** before you start (for example *Expected duration: about 6 h to 11 h.*). Each step has its own time limit of 4 hours (the setting `calib_timeout_s`): a clock the miner cannot reach, or a voltage that gets no verdict in that time, ends the stage. The limit starts over with every verdict, so a long curve needs no longer limit.

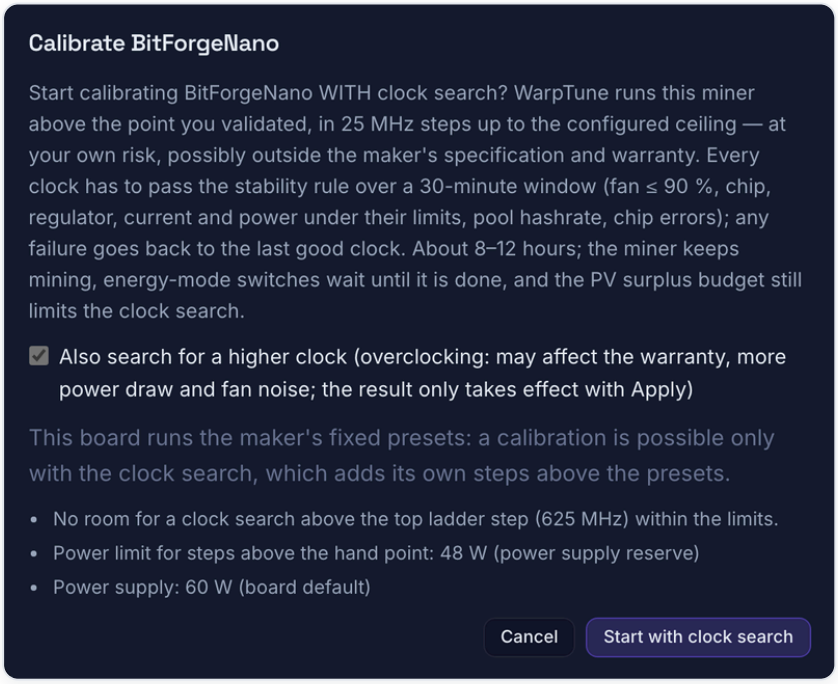
Starting it

In the calibration block click **Start calibration** (after an earlier result: **Calibrate again**). Next to the button a hint says what will be measured. With the clock search on: *Measures the Eco and Max curves — clock and voltage together, each clock down to its first failure; the dialog shows the expected duration; the miner keeps mining.* With it off: *Measures the Eco and Max steps one after the other, down to the first failure; the dialog shows the expected duration; the miner keeps mining.* A dialog opens, titled **Calibrate …**:

- A short text of what will happen; Energy mode pauses meanwhile.

- The checkbox **Search the clock too: Max climbs above the hand point (beyond the maker's table only with beyond_spec), Eco walks down to the clock with the best J/TH — each clock at its own minimum voltage. The result only takes effect with Apply.**
- A line on where Max ends and what sets that limit, for example *Max is searched up to 640 MHz / 1140 mV — limit: ladder_cap_mhz and voltage_max_mv in the miner settings.* Other limits it may name: *the maker's top step; above it only with "Beyond the maker's specification"*, *the maker's beyond-spec maximum*, *calib_clock_max_mhz in the miner settings*, or *the power supply / board power limit (beyond_spec is set, but the supply does not fit)*.
- With **Beyond the maker's specification (Max mode only)** on: *Beyond the maker's specification: clocks up to 700 MHz, voltage up to 1200 mV.*
- The expected duration, for example *Expected duration: about 6 h to 11 h.* It is the shortest and the longest time the plan can take at the miner's present share rate.
- The power limit for steps above the hand point (*Power limit for steps above the hand point: … W (…)*), the power supply rating (*Power supply: … W (…)*), each with its source, and the share source.
- **Cancel** and **Start calibration** (with the box ticked: **Start with clock search**).

The checkbox starts ticked when the **Clock search** switch on the card is on. On a **BitForge Nano** (maker's fixed presets) it is ticked and **locked**, with the note *This board runs the maker's fixed presets: a calibration is possible only with the clock search, which adds its own steps above the presets.* Without a known power supply rating it is off and greyed out, with the note *No power supply rating known: enter it at the miner (WarpAxe: Settings → Power supply) or set psu_max_watts — then WarpTune also searches upward.* Where WarpTune assumes the board's stock supply, the card adds *Clock search assumes the stock 25 W power supply. Stronger supply? Enter it at the miner (WarpAxe: Settings → Power supply) or set psu_max_watts.*



The calibration dialog of a BitForge Nano (test miner): clock search ticked and locked, the presets note, and the lines for ceiling, power limit and power supply. Here the test miner already sits at its power limit, so the dialog reports no room for a higher clock.

The clock search: a clock–voltage curve

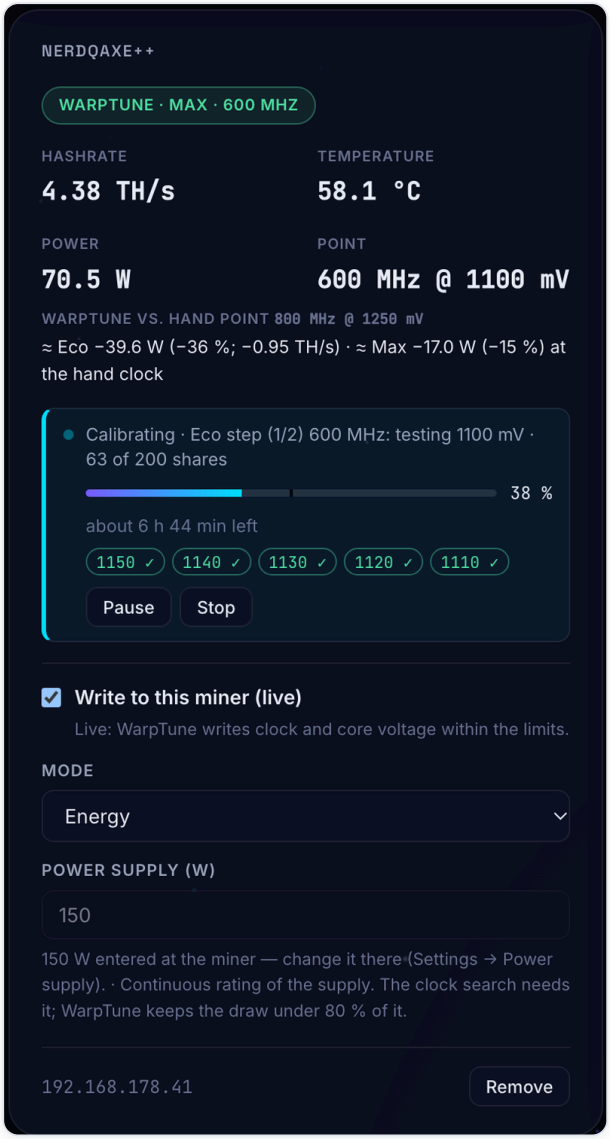
With the clock search on, a calibration measures more than two points. Every clock gets its own lowest voltage, and together they form a curve.

- **Eco walks down.** After the Eco clock, the next lower clock of the ladder is measured, starting at the voltage the last clock found and walking down to its first failure. This goes on while the energy per terahash (J/TH) gets better. It ends when two clocks in a row bring no better J/TH, when the voltage reaches its floor, at the lowest clock of the ladder, or three clocks (75 MHz) under the start, so that a calibration stays under a day. The clock with the best measured J/TH becomes the **Eco clock**. On a miner that was never calibrated, the Eco curve starts at your hand clock, so every first calibration measures both Eco and Max.
- **Max climbs up.** After your hand point, the next clock above it is measured, in 25 MHz steps, starting at the last voltage found and raising it as far as it needs. The climb ends at the first limit the clock hits while it is watched: the voltage ceiling, chip or voltage regulator temperature, core current, the power limit, 80 % of the power supply's rating, the fan over 90 %, too few good shares or too many chip errors. **Without Beyond the maker's specification (Max mode only)** the Max curve ends at the maker's top step, and no clock gets more than the maker's voltage for it. **With** it (and a supply that fits) it may go on up to the maker's beyond-spec maximum, with more voltage than your hand voltage (chapter 7). The highest clock that passed becomes the **Max clock**.
- **In between.** Clock steps between two measured clocks take a voltage WarpTune estimates from their neighbours: never above the higher neighbour's voltage.

A clock search never raises your hand point itself; it stays the restore point. The quick check (below) never searches the clock.

> **Overclocking is at your own risk.** A clock above the point you validated may be outside the specification and the warranty; with **Beyond the maker's specification (Max mode only)** it is outside the maker's specification for sure. It means more power and more fan noise. Without a known power supply rating the checkbox is off and greyed out, and the dialog says where to enter one.

While it runs



A calibration under way on a NerdQAxe++: stage, voltage under test, shares counted, progress, time left, the voltages judged so far, Pause and Stop.

The block shows, for example: *Calibrating · Eco step (1/5) 600 MHz: testing 1100 mV · 63 of 200 shares*.

- **Stage** and its number (1/5: the first of five clocks), the clock, the voltage under test, and the shares counted towards the verdict. With the clock search the number of stages can grow while the calibration runs, as the curve adds the next clock.
- During the confirmation of a voltage found: *Calibrating · Max step (2/5) 640 MHz: confirming 1080 mV · 120 of 200 new shares*. Only shares that arrive after the confirmation began count.
- A **progress bar** with a percentage and *about … left*.
- Small tags for every voltage judged so far: `1150 ✓` = good, a cross = short of good.
- *Close call — a second window is confirming it (400 shares in total)* when a verdict needs more shares.
- A calibration started with an older version (before v1.48) may still show its clock stage: *testing … MHz at … mV for 30 min* and the maxima seen so far (fan, chip, voltage regulator, power). It finishes as it was planned.

Buttons:

- **Pause**: WarpTune tunes the miner as usual again (*Calibration paused · WarpTune tunes the miner as usual*). **Resume** starts the open stage's reference again.
- **Stop** asks first: *Stop the calibration of …? The miner goes back to its hand voltage. Finished steps keep their result and the miner's card offers Apply / Discard; the step under way is lost.* It ends the calibration and puts the miner back on its hand voltage. **Stages that were already finished keep their result**: the card shows it with *Stopped early (…) · the result of the finished stages can still be applied; the stages not reached are listed without one*, and offers Apply / Discard. A stop before any stage finished leaves nothing to apply.

A calibration survives a restart of WarpTune: it continues where it was. If WarpTune restarts with live control off, the calibration stops.

The result

When all stages are through, the miner returns to its starting voltage and the block says *Calibration finished · apply the result?*. Each stage gets a row:



A result (here already applied) on a Bitaxe Gamma: Eco step and Max step, each with voltages, power and hashrate against the reference.

Part	Example	Meaning

Stage and clock	**Eco clock 525 MHz**	Which clock was measured. With the clock search, the stage that became the Eco clock is called **Eco clock**, the one that became the Max clock **Max clock**, one clock that is both **Eco and Max clock**, and every other measured clock **Curve point**. Without the clock search, and for a stage without a result, the rows keep **Eco step** / **Max step**.
Voltages	`1030 → 1020 mV`	The starting (reference) voltage → the voltage the miner will run at after Apply.
Found + reserve	*found 1000 mV + 20 mV reserve*	The lowest good voltage, plus a safety reserve of 20 mV for a warmer day. The reserve never goes above the stage's reference (*reserve capped at the starting voltage*). A voltage that was found by searching *upward* (the reference was short of good) is capped at the step's ceiling instead.
How the floor was found	*floor found — 1030 mV failed*	A lower voltage failed, so the floor is known.
	chip minimum 1000 mV reached — no failure seen, may go lower	The search hit the chip's minimum without a failure.
	firmware minimum — … mV not accepted, no failure seen	The firmware refused to go lower.
	ended early — floor not determined	A timeout or a safety move ended the stage first.
Power	`−11.4 %` power, *reference 23.7 W*	Power at the new voltage against the reference.
Hashrate	`102 %` Hashrate, *reference 108 %*	Hashrate from the accepted shares against the expected rate, at the new voltage and at the reference. Share counts are noisy; a few percent up or down is normal.

A stage without a result says *… no result (…)* with the reason, for example a timeout, a clock that could not be reached, or *the ceiling of this step, … mV, is not stable: nothing above it to try* (the upward search reached the highest voltage it may use and the clock still did not run cleanly). The other stages keep their results.

If your **hand point** itself did not run cleanly, the card says so plainly: *Your hand point 640 MHz @ 1140 mV did not run stable during the calibration — raise its voltage or lower its clock. WarpTune never raises it.* Set a safer hand point on the miner's own web page (chapter 2) and calibrate again.

Under the rows you may see *measured at a fan target of 65 °C*. The fan target is part of the measurement; if you change it on the miner, the card says *… the result is for the old target; calibrate again?*. After a clock search the card may suggest a different fan target with a button **Set fan target … °C**; that is an estimate, not a measurement.

Apply or Discard

- **Apply** asks first. Without the clock search: *Apply the result for …? The voltages found, plus a 20 mV reserve, become the operating point; the hand point stays the ceiling.* After a clock search the question names the clocks found: *Apply the result for …? Clocks found: Eco clock 500 MHz, Max clock 650 MHz. The voltages found, plus a 20 mV reserve, become the operating points; a Max clock above the hand point becomes the top step of Max mode, and the hand point stays the point to return to.*
- **Discard** keeps the hand voltages: *Calibrated · result discarded on … · hand voltages kept*. Every step the calibration added is taken out again.

After Apply the block says *Calibrated · result applied* and later lists what is in force, for example:

Calibrated · applied on 11/20 · Eco clock 500 MHz: 1060 mV (measured 1040 + 20 mV reserve) · Max clock 650 MHz: 1180 mV (measured 1160 + 20 mV reserve)
Further curve points: 525 MHz: 1080 mV (measured 1060 + 20 mV reserve) · 625 MHz: 1150 mV (measured 1130 + 20 mV reserve)
Steps in between are estimated by WarpTune from these points.

- The first line names the two clocks the modes run at: the **Eco clock** (the top of Eco mode) and the **Max clock** (the top of Max mode), each with the voltage in force, the voltage measured and the reserve.
- *Further curve points* are the other clocks measured on the way. Whenever the miner runs at one of these clocks, in any mode, it gets that voltage.
- *(measured …, reserve capped at the ceiling)* instead of the reserve: the voltage plus 20 mV would have been above the step's ceiling.
- *…, now 1080 mV after a raise in operation*: since the Apply, WarpTune has raised this step's voltage because it fell short later (next section).

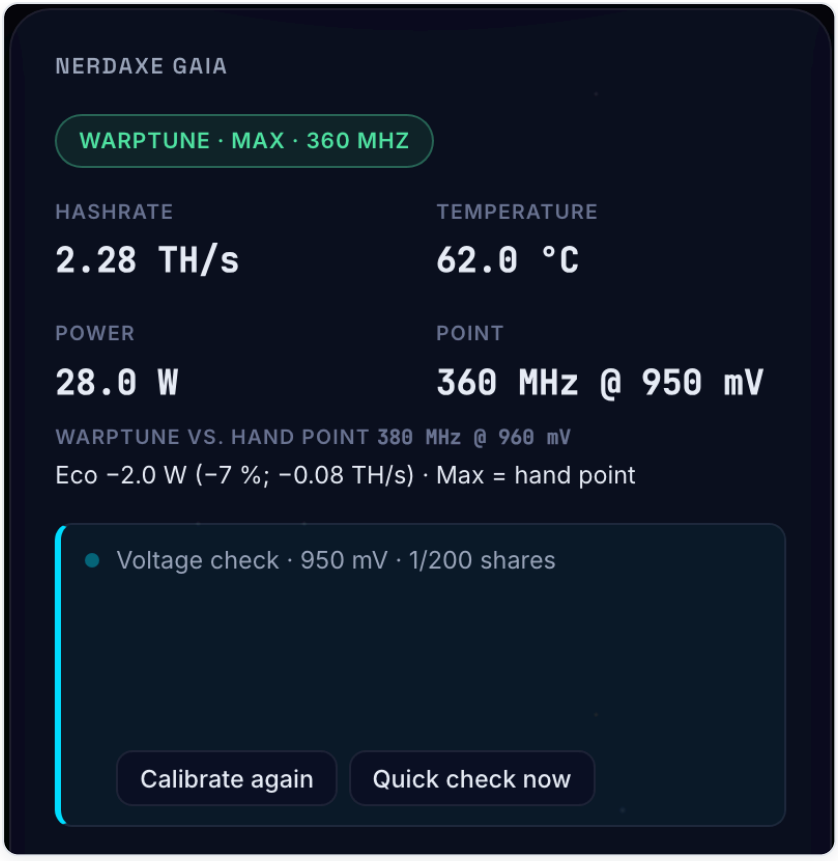
The hand point stays the ceiling and the restore point either way. A stopped or failed calibration message can be closed with **×**; that only hides it in this browser.

A calibrated voltage is watched

After Apply, WarpTune keeps checking. If a calibrated step falls short on the shares later, WarpTune raises that step's voltage by 10 mV (never above the reference) and keeps the new value. One noisy window is not enough for that, and a step is raised at most twice a day. The card then adds *now … mV after a raise in operation* to that clock. A step that has run cleanly for six hours at a raised voltage goes back down one step towards the applied value.

Besides calibrations, WarpTune runs its own **voltage check** in normal operation. The block then shows one of these lines. They are not a calibration, and the calibration buttons stay available next to them:

- *Voltage check · 950 mV · 1/200 shares*: the voltage being judged and the shares counted so far, with a bar.
- *Point monitored · … mV · confirmed, keeps watching (… shares)*: the voltage is confirmed; WarpTune keeps counting.
- *Voltage checked · 350 MHz needs 960 mV (table 940)* (or *runs at …*): the voltage found against the maker's table. It may add why, for example *at 950 mV too many chip errors (4.8 %, now 3.1 %)*, and an estimate like *approx. +4 % power draw*.



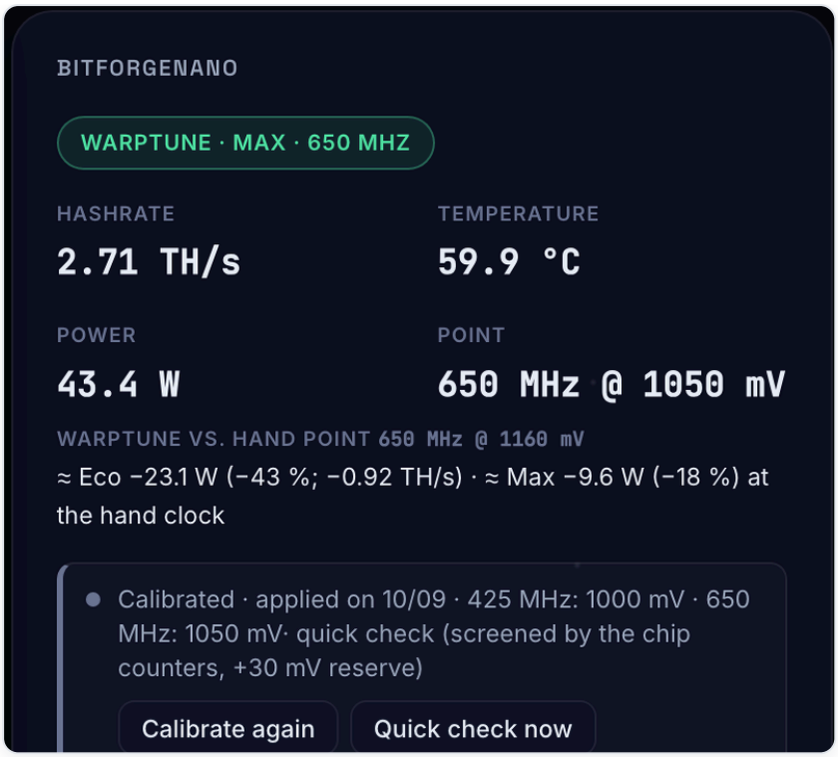
The ongoing voltage check on a NerdAxe Gaia: the voltage being judged and the shares counted so far.

Quick check now

Quick check now is a faster calibration. It is offered only on firmware that reports chip error counters (a 1-minute error rate or per-chip readings).

1. **Screen.** From the voltage the miner runs at now, it goes down 10 mV at a time and watches the chip error counters for about 10 minutes per step, as long as the errors stay near the starting level.
2. **Candidate.** The last step that screened good.
3. **Confirm.** Only the candidate gets the full share verdict (200 shares). If it falls short, one step up and again.

It takes about **1.5–2 hours per stage**, never searches the clock, and **Apply** adds a reserve of **30 mV** instead of 20. The result is tagged *quick check (screened by the chip counters, +30 mV reserve)*.



A BitForge Nano calibrated by a quick check: date, the points taken over, and the quick-check tag.

The automatic re-check

28 days after an Apply, WarpTune starts a quick check on its own, one step below the applied voltage — once per Apply, only on a live miner with chip counters, and never while another calibration is open. Its result is only a suggestion and waits on the card like any other result. The card explains: *passed means the step below still runs without errors and there is nothing to change; failed means the applied voltage has become tight*.

When a start is refused

The card says *Start refused …: …*, for example *a calibration is running or a result waits for apply or discard*, *live control is off*, or *nothing to measure — …* (the stage's voltage is already at its floor), *the shares come too slowly for a verdict within the stage's timeout …* (see the note above) or *no share verdict: the firmware reports no share difficulty and no pool row stands in*. See chapter 14.

11 · Reading the savings

Each card shows what WarpTune changes against your own hand point. The line reads, for example:

WARPTUNE VS. HAND POINT 640 MHz @ 1140 mV
Eco –5.7 W (–24 %; –0.33 TH/s) · Max –2.6 W (–11 %) at the hand clock

The three points compared

- **Hand point**: the point the miner runs at without WarpTune. It is named in the heading. If it equals the factory setting, the heading adds *(= factory setting)*.
- **Eco point**: WarpTune's Eco step at its present voltage.
- **Max point**: WarpTune's top step at its present voltage.

How to read the line

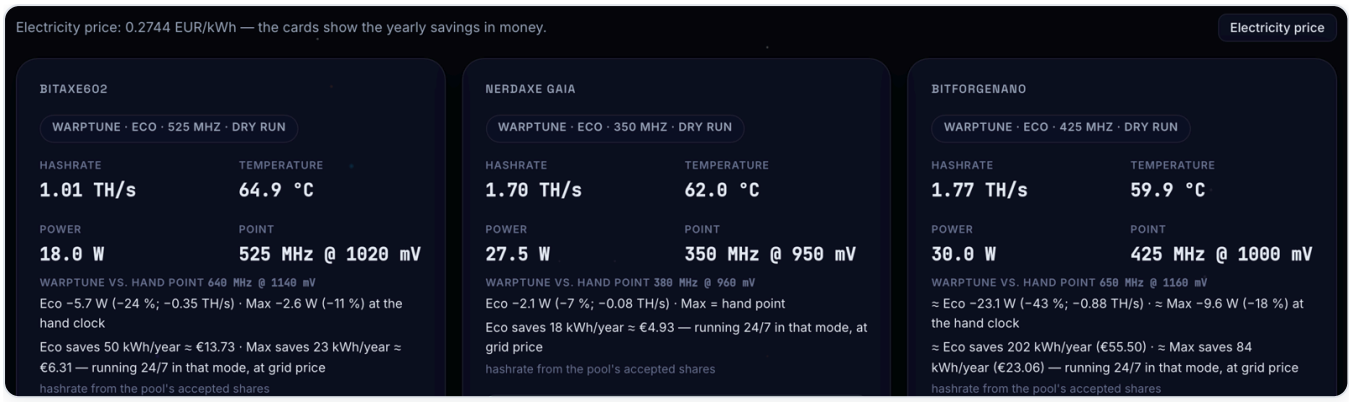
Part	Meaning
Eco –5.7 W (–24 %; –0.33 TH/s)	In Eco the miner draws 5.7 W less than at the hand point (24 % less), and hashes 0.33 TH/s less. Eco trades a bit of hashrate for a lot less power.
Max +0.12 TH/s (+5 % ±3 %; +2.1 W)	In Max the miner hashes more than at the hand point; ± is the share noise. Behind it the extra power.
Max –2.6 W (–11 %) at the hand clock	Max runs at the same clock as your hand point, so it adds no hashrate, but it saves power through the lower calibrated voltage.
Eco = hand point / *Max = hand point*	That point is the hand point itself; nothing to compare.
≈ in front	Estimated: the point is no longer visited (for example the hand voltage after a calibration) and no earlier measurement of it is kept, so WarpTune scaled it from the nearest measured point at the same clock.
not enough data yet (… shares, … min)	A point counts from 200 shares and 30 minutes on it. Wait.
Hand point measured on Nov 17	A small line under the comparison: the figures for that point are its last valid measurement, from that day, kept because the last 7 days have too little on it. See "Older measurements" below.

Hold the mouse over the line for the basis of each point: watts, TH/s, shares, minutes and the last stay.

Per year, in kWh and money

Under the line a second line turns the watts into a year:

Eco saves 50 kWh/year ≈ €13.98 · Max saves 23 kWh/year ≈ €6.38 — running 24/7 in that mode, at grid price



The price line above the cards and, on each card, the yearly line under the watts: "Eco saves 50 kWh/year ≈ €13.73 · Max saves 23 kWh/year ≈ €6.31 — running 24/7 in that mode, at grid price". A leading ≈ marks an estimate; the amount then stands in brackets.

Part	Meaning
Eco saves 50 kWh/year ≈ €13.98	If the miner ran in Eco all year, 24 hours a day, it would use 50 kWh less than at the hand point; at your price that is about €13.98.
Max costs 9 kWh/year ≈ €2.52 more	Max draws more than the hand point (for more hashrate); this is what that extra power costs in a year.
running 24/7 in that mode, at grid price	The figure assumes the mode all year round and your full grid price. Solar power, a time-based tariff and the hours the miner really spends in each mode are not counted in.
running 24/7 in that mode; enter your electricity price to see it in money	No price is known yet, neither your own nor one from a coupled pool: you see the kWh only.
≈ in front	The point is estimated, as in the line above.

A mode whose difference is under half a kWh a year is left out of this line.

Entering your electricity price

Above the cards, on the **Devices** page, click **Electricity price**. A small form opens:

- **Price per kWh**: what you pay for one kWh from the grid, for example `0.28`. Leave it empty (or 0) and save to remove the price again.
- **Currency (ISO code)**: the three-letter code of your currency, for example `EUR`, `USD`, `CHF`. The page suggests one from your browser's region; check it.
- **Save**. The text under the form says: *Your grid price and its currency — a setting, not a guess. The cards use it at once; WarpTune does not need it, so there is nothing to apply.*

The line above the cards then says *Electricity price: 0.28 EUR/kWh — the cards show the yearly savings in money.* A wrong entry gives *Enter a price of 0 or more and a three-letter currency code such as EUR.* The price is stored in the settings file (`[energy]`, keys `price_per_kwh` and `currency`). WarpTune never guesses a price from your location. Without your entry it takes the electricity price a coupled dvb-WarpPool reports, if the pool has a tariff; the line above the cards then says *Electricity price from the pool: 0.2744 EUR/kWh — the cards show the yearly savings in money. An entry of your own replaces it.* A pool without a tariff (for example `pool.warppool.org`) changes nothing: you see kWh only. Your own entry always wins.

The amounts are written in your page language's number format, with the currency you entered or the pool's.

> **On a dvb-WarpPool's devices page** the same yearly line uses the pool operator's single default electricity tariff (Admin → Electricity tariff; time-of-use slots do not count there). If the operator set none, the line says *running 24/7 in that mode; the pool operator has set no electricity tariff*.

Where the numbers come from

- Hashrate comes from **accepted shares** over the last 7 days: from a coupled dvb-WarpPool's worker row where there is one, otherwise from the miner's own share counters, on whatever pool it mines. A small line under the card's line names the source: *hashrate from the pool's accepted shares* or *hashrate from the miner's own share counters*.
- Power comes from the miner's own readings.
- WarpTune recomputes the line every 30 minutes.

Older measurements

A miner that runs in Eco for weeks no longer visits its hand point, and after 7 days the hand point has no shares left in the window. WarpTune therefore keeps the last valid measurement of each compared point (hand point, Eco point, Max point) and uses it as long as the last 7 days have too little on that point. The line under the comparison then names the day it was measured, for example *Hand point measured on Nov 17*; the tooltip adds *the last valid measurement, from Nov 17, kept until a new one replaces it*. The watts, the hashrate and the yearly kWh and money are computed from it exactly as from a fresh measurement.

- A new valid measurement of the same point (at least 200 shares and 30 minutes within the last 7 days) replaces it, and the date line goes away.
- It is kept per exact point (clock and voltage). If you set another hand point, or a calibration moves the Eco or Max step, the new point shows nothing until it is measured; the old measurement stays and shows again if the point comes back. WarpTune keeps up to six points per miner, always including the current ones.
- It shows only under the firmware family and major version it was measured on: it keeps showing after an update within them; after a switch to another firmware it stays stored and shows again once the miner is back on the original one.
- Another device at the miner's address clears all of that miner's kept measurements. Miners removed from the settings lose theirs.

The kept measurements are stored in `warptune-savings-held.json` next to the journal. On the first start with this version, WarpTune fills it from the journal for each miner that has no entry yet (with the miner's own share counters), so a hand point measured weeks ago shows again. If the file is damaged, WarpTune moves it aside and refills it from the journal at the next start.

Why the hand point and not the factory point? The hand point is the honest "without WarpTune": it is where your miner runs when WarpTune is not running. If you never tuned by hand, it *is* the factory point.

Always "not enough data"? A point counts from 200 shares and 30 minutes on it; on a pool with a high difficulty that takes longer. With a pool coupling, also check that the miner mines on the pool you entered and that its worker name is exactly the one the pool shows (address.worker, same spelling). A private pool that hides its data needs a read token (setting `pool_token_env` in the settings file). Without a pool row WarpTune falls back to the miner's own counters.

12 · Updating

Download the new version from the release page and check it, as in chapter 3. Your settings file, journal and calibration results stay; they are not part of the program. After an update, check the version badge in the header.

Windows

Run the new `…-setup.exe` over the old one. The installer stops the running WarpTune cleanly first (live miners get their hand point back, up to 20 seconds), then copies the new files, then you start it from the Start menu (or at the next sign-in).

macOS

1. Drag the new **WarpTune Desktop** from the `.dmg` into Applications and replace the old one. The running WarpTune keeps running the old version for now.
2. Restart WarpTune so the new version runs. In Terminal:
   `"/Applications/WarpTune Desktop.app/Contents/MacOS/dvb-warptune-launcher" --stop`
   This stops it cleanly; live miners get their hand point back.
   - With the login item, macOS starts WarpTune again by itself, now from the new app.
   - Without the login item, open **WarpTune Desktop** again.
3. The first time, macOS may ask again (chapter 4). Check the version badge in the header.

> **Simpler, if you do not mind a logout:** replace the app, log out and log in again. With the login item the logout stops WarpTune cleanly and the login starts the new version.

Linux

- **.deb:** `sudo apt install ./dvb-warptune_<new>_<arch>.deb`, then `systemctl --user restart dvb-warptune-desktop`. The restart writes the hand points back before the new version starts.
- **AppImage:** stop it with `./WarpTune-Desktop-<old>.AppImage --stop` or `systemctl --user stop dvb-warptune-desktop`, then put the new AppImage **at the same path** as the old one (rename it to the old file name) and start it. The user service points at that path.

The "Update service" question

If you installed WarpTune before version 1.40 as a service (with the setup script), that old service answers on port 8766 but has no page. The app then does not open an empty page. It asks (on Linux as a small window if `zenity` is installed, else as a message):

A WarpTune service without the Desktop page is running (a version before 1.40, …). Update it to the version in this app? The service restarts: live miners get their hand point written back and are regulated again from there. Not possible while a calibration runs.

- **Update service** copies the program from the app over the service's program and restarts the service. Then the page opens.
- **Not now** leaves everything as it is.
- While the old service runs a calibration, or a result waits for Apply / Discard, the update is refused: finish it on the pool's devices page first, then open the app again.

13 · Uninstalling

Uninstalling removes the program. It writes the hand points back to all live miners first. Your settings file and journal stay, so a later reinstall finds everything again. Delete that folder by hand if you want it gone (paths in chapter 4).

macOS

1. In Terminal:
   `"/Applications/WarpTune Desktop.app/Contents/MacOS/dvb-warptune-launcher" --uninstall`
   This removes the login item and stops WarpTune.
2. Drag **WarpTune Desktop** from Applications to the Trash.

A service installed with the setup script (`com.dvb.warptune`) is not touched by this; remove that with `scripts/setup-warptune.sh --uninstall`.

Windows

Settings → **Apps**, find **WarpTune Desktop**, click **Uninstall**. The uninstaller stops WarpTune cleanly first, then removes the program, the Start menu entry and the Startup shortcut.

Linux

1. First: `dvb-warptune-launcher --uninstall` (for the AppImage: `./WarpTune-Desktop-<tag>.AppImage --uninstall`). This stops the user service with the restore and disables it.
2. Then: `sudo apt remove dvb-warptune` , or delete the AppImage.

> **Do step 1 first.** `apt remove` alone cannot reach your user session. It would leave the user service enabled and WarpTune running on a deleted program.

14 · Troubleshooting & FAQ

The page does not open.

- Type `http://127.0.0.1:8766/` into your browser yourself. The launcher may have started WarpTune without opening the browser (the Windows Startup shortcut does that on purpose).
- Open it on **this** computer. From another device it does not open; that is by design (chapter 5).
- Click the app or Start menu entry once more. If WarpTune does not run, that starts it.
- A message *WarpTune started but its page did not answer in time; see the log next to warptune.toml.* means WarpTune did not come up. Look into the log (chapter 4). A common cause is the next point.

"Port in use" / "already running".

Only one WarpTune runs per settings file and port. A second start ends with an error. Causes: a WarpTune service from the setup script still runs, a second copy (for example the portable zip next to the installed one), or another program uses port 8766. Stop the other one, or use only one way to run WarpTune. The app itself never starts a second copy: if a WarpTune with a page already answers, it only opens the page.

The header says "WarpTune not reachable".

The page is still open, but WarpTune stopped, or the computer was asleep. Click the app again to start it. On macOS without the login item, a logout ends it.

macOS says the app "can't be opened" or "Not Opened".

That is Gatekeeper, because the app is not signed with a paid certificate. Follow the steps in chapter 4: **Done**, then **System Settings** → **Privacy & Security** → **Open Anyway**, then open the app again and confirm. Check the download first (chapter 3).

The search finds no miner, or not all of them.

- Are the miners on, and in the same network as the computer? A guest Wi-Fi or a separate IoT network is a different network. Type that network into **Network (optional)**, or add the miner by its address.
- mDNS finds nothing on macOS and Windows: normal. On Windows WarpTune leaves mDNS out, so the firewall does not ask; the network sweep of this computer's own /24 networks finds the miners.
- A VPN on the computer can hide the home network. Pause it for the search.
- An Avalon Q is found through its cgminer port 4028. If it does not show, check that its API is reachable from this computer (some routers or VLANs block the port), or enter its address.

Will the firewall ask?

Normally not. WarpTune serves its page on 127.0.0.1 only, and on Windows it does not listen for mDNS. On macOS and Linux the mDNS search may listen briefly on the network while you search. Only if you change the settings file to serve WarpTune's status to a pool on another machine (`bind = "0.0.0.0:8766"`) will Windows ask; allow it for private networks only.

A miner is already tuned by another WarpTune.

Leave it in dry run here, or remove it from the other WarpTune first. Two WarpTune instances on one miner write against each other (chapter 2).

Why is calibration not available, or why was the start refused?

The card says	What to do
live control is off for this miner	Switch the miner to live on its card; that takes effect at once (the first time, the process switch may still need **Apply now**).
the firmware reports no share difficulty	This firmware gives no share verdict of its own. Update the firmware, or let the miner mine on a dvb-WarpPool and couple it (Add miners → 3 · Pool coupling).
the shares come too slowly for a verdict within the stage's timeout	The pool's difficulty is too high for this miner. Set a lower difficulty at the pool, if it offers one, or mine on a pool with variable difficulty (for example a dvb-WarpPool).
the Avalon's control board owns its voltage	Nothing; the Avalon Q is regulated by work modes only.
this miner runs the maker's fixed presets	BitForge Nano: tick **Clock search** on its card; it takes effect at once.
this board has no voltage regulator; WarpTune sets the clock only	Nothing to do: the board cannot change its core voltage (for example the NerdNOS board or a devkit). WarpTune regulates its clock; there is nothing to calibrate.
WarpTune is paused for this miner and writes nothing	Untick **Pause (hold the point)** on its card.
no fresh WarpTune snapshot	The miner does not answer right now. Check it.
a calibration is running or a result waits for apply or discard	Finish the open one: Stop, or Apply / Discard.
nothing to measure — …	The step's voltage is already at its floor; there is nothing below to try.
Quick check now missing	The firmware reports no chip error counters. Use the full calibration.

Do I need a pool for the calibration?

No. Since v1.41 the calibration, the quick check and the re-check judge each voltage on the miner's own share counters, on whatever pool it mines. A dvb-WarpPool coupling is only preferred where it exists: it tells reject reasons apart on every firmware and can show the WarpTune badge on your wallet page. Exceptions: a firmware without a share difficulty, and the Avalon Q, which only switches work modes.

The savings show kWh but no money.

No electricity price is set. Click **Electricity price** above the cards, enter your grid price and currency, and save (chapter 11). Nothing needs to be applied.

"Apply now" is refused.

A calibration runs, or its result waits for Apply / Discard. Finish it first. If the banner says the settings file has an error, the running WarpTune keeps its old settings until the file is fixed. A change on one miner's card normally needs no **Apply now** at all; if it could not be applied (a calibration runs on that miner, its pool address is one the running WarpTune does not poll, or the process cannot reload), the card shows the reason, the badge says **not running: apply the settings**, and the banner stays until you press **Apply now**.

"Energy" is greyed out.

Energy needs a pool address (Add miners → 3 · Pool coupling) and `[energy] enabled = true` in the settings file. See chapter 9.

The badge says "control off".

A safety rule stopped WarpTune's writes to this miner: more than 12 writes in an hour, a write the miner did not confirm, writes that kept failing, or too many device restarts. The card names the reason, for example *WarpTune stopped writing to this miner (10/21, 07:36 AM): the write breaker tripped — 12 writes within an hour*. Check the miner (does its web page respond, is the firmware busy with an update?). Then press **Switch writes on again** on the card and confirm (*Switch WarpTune's writes to … on again? The write breaker's count starts over; if the cause is still there, it trips again.*). No restart of WarpTune is needed (chapter 8).

The card says "No search on this board" under "Clock per chip".

The board's chips share the voltage in a way the search cannot handle (for example a Bitaxe Gamma Hex or a NerdQAxe++ Rev 7), or the firmware does not report how the chips are wired. Nothing is written and nothing is wrong; you can switch **Clock per chip** off again (chapter 7).

Is it safe to change settings on the miner while WarpTune runs?

Yes. WarpTune sees the change and judges the new point. But the hand point WarpTune restores stays the one it remembered before its first write to the miner; set a new one with **Change hand point** (chapter 7). The fan target is part of a calibration; changing it ends a running one.

Does WarpTune work when the computer sleeps?

No. While the computer sleeps, WarpTune does nothing, and live miners stay on their last point. Turn off sleep on the computer that runs WarpTune.

15 · Support & links

Documentation	docs.warppool.org
First start with pictures	docs.warppool.org/warptune-desktop-open.html
WarpTune	warppool.org/warptune/
Downloads	git.warppool.org/dvb-projekt/dvb-WarpPool/releases
Report a problem	git.warppool.org/dvb-projekt/dvb-WarpPool/issues
Technical guide (settings file, service, journal)	scripts/warptune-setup.md
WarpAxe firmware	warppool.org/warpaxe/
Contact	dvbprojekt@gmx.de

When you report a problem, please add: your system (macOS / Windows / Linux), the version from the header, the miner's board and firmware (from **Check**), and the last lines of the log (chapter 4). The log contains your miners' local addresses, but no passwords; tokens are kept in `warptune.env`, which you should never share.

WarpTune Desktop is part of dvb-WarpPool, free and open-source software (AGPL-3.0-or-later, with a commercial licence available). This manual describes WarpTune Desktop v1.52.0. Screens may differ slightly between releases; the screenshots show real miners on a home network. Changing clock and voltage of a miner is at your own risk; WarpTune's limits reduce that risk but do not remove it. Mining is probabilistic; nothing here is a promise of reward.

Same hashrate, less heat. Happy mining.