



Online version, always up to date: <https://www.wave.cc/portal/handbook>

HANDBOOK · WAVE MACHINE PORTAL + AI

Your machine in view. What the portal does – and what it does not.

This handbook describes the WAVE Machine Portal as it works today: which data is recorded, where it is stored, who can access it, how remote operation is secured, what the API provides and what the subscription costs. Anything not yet available is stated as such.

Version 1.0 · October 2026 · applies to the “WAVE Machine Portal + AI” subscription

1 At a glance

€49 net / month

per machine, router included,
6-month minimum term

Every 5 seconds

every value is stored in full

Read-only recording

data collection never writes to
the controller

No commands via API

the API and AI connections
only read data

Operation by role

View, Operate, Engineering,
Admin – every session is
logged

Data in the EU

servers in Ireland and
Germany

The portal brings together three things: **remote access** to your machine’s control panel, the **machine record** with every recorded run and its analysis, and an **API** that lets you connect your own software or your own AI (e.g. ChatGPT, Claude, Copilot) to your machine data.

2 Requirements & setup

Which machines are supported? What does WAVE need from you? What if it does not work?

Controllers and models

Model	Controller	Status
FD440, FD450	Siemens SIMATIC S7-1200 (CPU 1214C) with Kinco control panel, PLC software 4.2.x	Verified signal profile available
FD470, FD480	Siemens S7-1200, separate software line	Profile is created during setup
IC570 MAX and others	depending on year of manufacture	Profile is created during setup

The machine needs a network connection to its controller (PLC) and control panel, i.e. the Ethernet / remote access option. The WAVE router is connected to the machine network by cable and reaches the internet through its own SIM card. Your company network is not used.

No changes to the machine: recording does not modify the PLC program, does not update firmware and never writes to the controller. Data collection is read-only.

The signal profile

Each machine gets its own **signal profile**. It defines which values are read from the controller, in which unit and with which meaning. WAVE approves the profile only when

- model, serial number, PLC type and firmware match the machine (data collection checks this again on every connection),
- a test window of about 15 minutes has been recorded and compared with the values on the control panel,
- every signal has been confirmed individually.

If the PLC program or configuration changes later, recording stops rather than storing wrong values. Each run keeps the profile version it was recorded with.

Setup steps

1. Take out the subscription in the shop and pay the first monthly fee.
2. Send us: model, serial number (nameplate, a photo is fine), PLC software version (if known), machine location, delivery address for the router and the Google addresses of the people who should have access.
3. WAVE ships the pre-configured router. You connect it to the machine network and switch it on.
4. WAVE reads the PLC type and software version, sets up the signal profile, records the test window and approves the profile.
5. Your machine page is activated. Recording starts with the next run.

Money-back commitment: if WAVE cannot approve the signal profile for your machine, we refund all amounts paid in full and the subscription ends. The check takes place after the order.

Optional equipment

The portal records what the machine's controller knows. With an external vacuum pump (e.g. Leybold VARODRY) this is the chamber pressure and the machine's pump request. Values of the pump itself (speed, current, operating hours) and the defrost process are not recorded as separate signals today.

3 What is recorded

Signal list, units, sampling interval, timestamps, sample files

Signals, using the FD440 as an example

This is the approved signal profile of an FD440 with PLC software 4.2.x. Other models may differ; you can see your own profile in the portal under "Erfasste Daten" (recorded data). The portal interface is currently in German.

Group	Signals	Unit
Temperatures	Shelves (drawers) 1–8, chamber, installation room, refrigeration circuits 1 and 2 (two sensors each)	°C
Vacuum	Chamber pressure; for plausibility checks also the gauge signal voltage and the raw value of the PLC display	mbar, V
Requests	Cooling request (compressors), pump request	on/off
Production	Production running, completion confirmed, abort	on/off
Recipe	Recipe number, current step, type of each step (freezing, drying, AutoDry)	number
Sensor monitoring	Sensor alarm for each temperature sensor	on/off

Asked for	Recorded today?
Actual pressure	Yes , chamber pressure in mbar
Pressure setpoint, recipe setpoints	In preparation
Shelf, chamber and room temperature	Yes
Product temperature	No on the FD440 (no product probe in the profile)
Condenser and refrigeration circuits	Yes , via the chamber temperature and two sensors in each of the two refrigeration circuits; there is no separate condenser sensor in the FD440 profile
Phases and steps	Yes , from recipe step and step type
Recipe	Yes , recipe number and step sequence; recipe contents (setpoints) in preparation
Pump and compressors	Yes , as the controller's request (on/off); feedback signals and operating hours in preparation
Defrost	No
Controller alarms	Sensor alarms yes ; alarm and fault messages in plain text in preparation
Operator changes at the panel	No ; the log shows who operated the machine remotely and when (section 7)
Power and energy consumption	No , there is no energy meter; run and phase times are recorded

Sampling interval and time

- Values are read every **5 seconds**. Every value is stored in full; nothing is averaged or thinned out. Only the chart in the browser shows fewer points for long runs; CSV and API deliver all of them.
- Recording takes place during a run, from production start to its end. No values are stored between runs.
- Timestamps are the time of reading on the WAVE server, stored in **UTC** (ISO 8601, e.g. 2026-10-17T08:15:05.000Z). Pages show local time, the CSV file shows UTC.
- If a value cannot be read, it stays empty. Nothing is estimated or filled in. Gaps longer than two sampling intervals are marked, and every run shows its data coverage in percent.

Runs and events

A run starts automatically when the controller starts production and ends when it stops. It counts as *completed* if the controller confirms completion, otherwise as *aborted*, with the reason. Every run has a unique identifier. Events are stored as well: production start, every phase and step change, the end with its reason, and measurements becoming invalid or valid again.

Export and report

- **CSV per run:** semicolon-separated, UTF-8, decimal point. Columns: `Zeit (UTC)` (time), `Phase`, then each signal as "label [unit]" with the labels of the signal profile. All data points, no thinning.
- **PDF report:** every run page has "Bericht drucken / PDF" (print report). The report contains status, duration, data coverage, declared load, recipe steps, chart, phase times, key figures with weather, events and notes.

Sample CSV

FD440, synthetic values, first hour of a run

Sample report (PDF)

synthetic values, no real customer data

4 Analysis & service

Which analysis is included in the subscription? Automatic or by WAVE staff?

Automatically on your machine page

- **Runs:** list of the last 100 runs, the chart of each run, phase times and recipe steps.
- **Condition:** key figures per run across the last 30 runs: evacuation time and best pressure, cool-down time per refrigeration circuit, run duration, uniformity of the shelves and room temperature. The first 10 runs form your machine's "as-new" reference.
- **Notices:** the page shows a notice if a run falls outside the as-new range, exceeds the room temperature limit, or takes clearly longer than earlier runs with the same recipe.
- **Recipe tips:** from 3 runs of the same recipe for which you have entered what was in the machine (product and quantity). Examples: a drying step that runs for a long time without progress, or two steps with almost the same temperature.
- **Weather:** slower cool-down is compared with the outdoor temperature at the site (section 5).

The analysis follows fixed, transparent rules. It does not make diagnoses, and tips are suggestions based on your data, not instructions. Notices currently appear on the page only; email or push notifications are not available yet.

By the WAVE team

Use "Service" on the machine page to ask about your machine or a specific run. WAVE sees the same data as you and answers in the portal; notes and answers remain traceable. These

service requests are included in the subscription.

AI

The portal itself does not send your machine data to any AI provider. "AI" here means that you can connect your own AI or your own software through the API (section 6). With it you can build cross-run comparisons, your own analysis or alerts yourself, or you use the built-in analysis.

5 Site & weather

Where does the weather data come from, and how is it distinguished from the measured room temperature?

- **Site:** WAVE proposes the installation site from your company address. You confirm or correct it on the machine page (Admin role).
- **Source:** Open-Meteo. For each completed run, hourly outdoor temperature and humidity at the site are retrieved and stored with the run (mean, minimum, maximum). This works for runs from the last 90 days.
- **Weather model, not a measurement:** the values come from high-resolution weather models for the site, not from a sensor at your machine.
- **Room temperature:** the temperature in the installation room is measured by the machine's own sensor. The page shows both side by side: if the room follows the outdoor temperature, ventilation or cooling is often missing.
- **Privacy:** only the position rounded to about 100 m is sent to Open-Meteo – no names and no measurements. The address lookup uses OpenStreetMap (Nominatim).

6 API & your own AI

Historical and live data, identifiers, events, weather, authentication, scopes, limits, export, costs, commands

The API is **read-only**. There is no command that changes anything on the machine. It is included in the subscription at no extra charge. You create connections yourself in the portal under **"KI verbinden"** (connect AI), where you also find the exact addresses.

Two ways

Way	For	Authentication
MCP	AI assistants such as ChatGPT, Claude, Microsoft Copilot Studio, Perplexity. Address: <code>https://remote.wave.cc/mcp</code>	OAuth 2.1 with PKCE (you confirm access in the portal) or a WAVE key
REST / JSON	Your own software: <code>POST /portal/ai/api</code> with <code>{"tool": ..., "arguments": {...}}</code> . OpenAPI 3.1 description at <code>/portal/ai/openapi.json</code>	WAVE key as bearer token

Scopes

Each connection is limited to the machines and data areas you select when you create it:

Scope	Content
<code>machines:read</code>	Machines and status
<code>runs:read</code>	Runs and measurements
<code>documents:read</code>	Product documents
<code>offers:read</code>	Approved offers
<code>service:read</code>	Service history

Queries

Query	Returns
<code>list_machines</code>	Your approved machines with model, serial number, remote access and site
<code>list_runs</code>	The last 100 runs of a machine: identifier, recipe, start, end, status, duration, data coverage, key figures, declared load, weather during the run
<code>get_run</code>	One run with signal list, measurements (500 per page, continue with <code>offset</code>), phases, gaps, events, notes, notices and hourly weather
<code>get_documents</code>	Approved product documents for the machine
<code>list_offers</code>	Your approved offers
<code>list_service</code>	Service requests of your customer account for the selected machines

```
curl -X POST https://www.wave.cc/portal/ai/api \
-H "Authorization: Bearer wai_..." -H "Content-Type: application/json" \
-d '{"tool": "get_run", "arguments": {"machine_id": 12, "run_id": 345, "offset": 0}}'
```

Live data

Measurements reach the portal in batches about once a minute. For a run in progress, `get_run` returns all values transmitted so far; the machine page refreshes every 30 seconds. There is no separate data stream.

Security and limits

- Keys start with `wai_`, are shown only once and are stored by WAVE only as a hash. A connection is valid for 90 days and can be revoked immediately at any time. OAuth access tokens are valid for 15 minutes.

- Every query checks your current permissions. If a person is removed from a machine, their data access ends as well.
- At most 90 queries per minute per connection, 500 data points per page, 900 KB per response, 100 machines per connection.
- There is no bulk export. Export is per run, as CSV or page by page via `get_run`.
- Every query is logged by WAVE.

7 Remote access & operation

What can be operated remotely? Roles, login, logging, on-site safety, connection loss, WAVE access

How it works

The router establishes an encrypted VPN connection (WireGuard) to the WAVE server in Nuremberg, Germany. Data collection reads the measurements over this connection, and authorised people use it to open the **control panel** in their browser. They see the same screen as on the machine's panel.

What can be operated: exactly what the machine's panel allows, for example start and stop, setpoints and recipes. The portal only transmits screen, mouse and keyboard. There is no separate command channel that bypasses the controller, and the API (section 6) cannot operate the machine.

Roles

Role	May
View (Ansehen)	machine page, runs and CSV; view the control panel only (inputs are discarded on the server)
Operate (Bedienen)	as View, plus operate the panel and enter load details
Engineering (Technik)	as Operate, intended for technicians and integrators
Admin	as Engineering, plus invite and remove people and confirm the site

The customer account that owns the machine is always Admin. Invitations can have an expiry date and can be revoked at any time. Service requests are made by the customer account that owns the machine.

Read-only use: invite people with the "View" role and connect software through the API, which is read-only anyway. Then only the customer account that owns the machine and WAVE service can operate it.

Login

- Login only with a Google account (Gmail or Google Workspace) with a verified email address. The portal has no passwords of its own.
- **Two-factor:** the portal relies on the security of your Google account. We recommend 2-Step Verification; in Google Workspace your administrator can enforce it. The portal does not add a second factor of its own.
- A portal login is valid for 30 days, a panel session for at most 8 hours. The panel is opened with a single-use access token valid for 60 seconds.

Safeguards when operating

- The panel always opens in view mode first. Operating has to be chosen explicitly.
- Only one person can operate at a time.
- An operating session ends after 10 minutes without input.
- Permissions are re-checked every 15 seconds. If they are withdrawn, the session ends immediately.
- The panel credentials are stored encrypted on the WAVE server and are never sent to the browser.

Log

The **operating log** ("Bedienprotokoll") on the machine page shows who opened the panel and when, whether viewing or operating, for how long, why the session ended and how many inputs were blocked. Everyone with access can see it. Individual keystrokes are not recorded. In addition, WAVE keeps an internal log of changes to access and invitations, site and load details, notes, AI connections and every API query.

On-site safety and connection loss

- All safety functions and interlocks of the machine remain fully active. Remote operation is subject to the same limits as the panel.
- Anyone at the machine sees every input on the panel and can intervene at any time.
- If the connection is lost, the machine continues its current program unchanged. The panel session ends without automatic reconnection, and measurements are missing for the duration of the interruption (section 8).

Access by WAVE

WAVE service has Admin rights on every connected machine so that we can set it up and help you. It is listed visibly as "WAVE-Service" in your machine's list of people, and every panel session of a WAVE employee appears with their email address in the operating log.

8 Storage & data rights

Where and with which providers is data stored, for how long, at what resolution? Who owns it? Backup, buffering, export, cancellation, AI training

Where the data is stored

Provider	Purpose	Location
Vercel	Running the portal and the API	Dublin, Ireland
Turso	Database with measurements, runs and machine record	Ireland (AWS)
Hetzner	VPN server, data collection, control panel	Nuremberg, Germany
Mobile network operator	Router internet connection (SIM)	–
Google	Login	–
Open-Meteo, OpenStreetMap	Weather and address lookup, only with the rounded site or address	–

How long and at what resolution

- All measurements remain stored at the 5-second resolution, without aggregation and without automatic deletion during the subscription.
- Measurements and events are only appended and are not changed afterwards.
- The database is backed up continuously by the provider. For your own records we recommend regular exports.

If the connection fails

Measurements are read over the VPN connection on the WAVE server. If the machine's internet connection fails, nothing can be read during that time; the gap is marked in the run and not filled in afterwards. The machine itself keeps working undisturbed. If, on the other hand, the connection between the WAVE server and the database fails, a persistent queue holds up to 100,000 data points and transmits them completely later.

Who owns the data and who can see it

- You retain the rights to your machine data.
- Access is limited to the people you invite (according to their role), WAVE service for setup and support, and the providers listed above as far as necessary for operation.
- **Anonymised use by WAVE:** WAVE may use measurement data in anonymised form – without company name, location, notes or product details – for its own analysis, for example for reference values per machine model or to improve analysis and AI models. You can

object at any time without giving reasons (email to office@wave.cc); your data will then only be used for your own machine.

Export and cancellation

- You can download every run as CSV or retrieve it through the API at any time.
- When the subscription ends, remote access and recording end. Previous runs remain readable and exportable for the customer account. On request we delete the measurement data of your machine completely.

9 Prices & terms

Price, term, router, SIM, costs, billing, multiple machines, shared pump

Price	€49 net per month and machine
Minimum term	6 months (€294 net). After that, cancellable monthly to the end of the month.
Start and billing	The subscription starts with the first payment in the shop and is billed monthly.
Router	Included in the price. It becomes your property; no return is required.
SIM and data	Included in the price (fair use).
Shipping and setup	Included in the price.
Controller	No changes to PLC program, firmware or hardware required.
API and AI	Included at no extra charge.
If it does not fit	Full refund if the signal profile cannot be approved (section 2).
Multiple machines	The price applies per machine. For larger fleets, please contact us.

Corvina packages in the shop

The Corvina packages in the shop (monthly €49 with your own SIM card or €89 with a SIM card from WAVE, plus 3- and 5-year packages) belong to the existing Corvina remote service. They are a separate offer. The terms in this section apply to the Machine Portal.

Two machines sharing one pump

Each machine has its own subscription and its own machine record. For each machine, its chamber pressure and its pump request are recorded. The shared pump itself is not measured, and its running time is not split between the machines. When both machines request vacuum at the same time can be seen by comparing the runs of both machines over time, for example via CSV or the API.

10 Contact

Questions about the portal, setup or your data: office@wave.cc. Customers with access are best served via "Service" on the machine page.

Subscription: wave.cc/shop/iot · Login: Portal

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