OWTS Documentation

Version: DEBUG

1 OWTS

OWTS is a **proof-of-concept** system to transmit an aircraft's **indicated airspeed (IAS)** to the winch station with low latency during winch launch.

The concept uses **two identical devices** with different roles:

- **Aircraft mode (transmitter)**: one device in each aircraft measures IAS and transmits it.
- **Winch mode (receiver)**: one device at the winch receives IAS and presents it via a local web UI.

> ⚠ **Proof of concept – not for operational use**
>
> OWTS is currently a **proof of concept**. It is **not recommended for operational use** at this stage.
>
> - **Radio compliance** and certification requirements vary by country and intended operational use.
> - **Aircraft sensor installations** (including pitot/static integration) can be regulated and may require approvals depending on local rules.

A PDF file for this documentation can be found here.

2 Setup

2.1 Initial connection (SoftAP)

WiFi quick start

After a **new flash** or **factory reset**, OWTS boots into **aircraft mode** by default.

For initial setup, connect to the device's built-in WiFi access point (SoftAP):

- **Default SSID**:
  - `aircraft mode` (no registration set): `OWTS-aircraft-<id>`
  - `winch mode`: `OWTS-winch-<id>`
  - `<id>` is derived from the device serial (tail of the MAC-derived id)
- **Default password**: `owts12345` (unless changed in Config)

After connecting to the SoftAP, open the UI:

- via IP (typical SoftAP): `https://192.168.4.1`
- or via mDNS (if your device/network supports it): `https://<name>.local` (where `<name>` matches the SoftAP SSID, lowercased)

For HTTPS / browser certificate notes, see Web UI.

2.2 Name / SSID behavior

The device uses its current "network label" for:

- the SoftAP SSID, and
- the mDNS hostname (`<name>.local`) when station mode is connected.

In aircraft mode, if you set the aircraft **registration** (e.g. `D-1234`), the name changes to `OWTS-D-1234` and the device may reboot after saving so the WiFi identity updates cleanly.

2.2.1 Examples (illustrative)

`<id>` is the **last 6 characters** of the device serial (MAC-derived). If your serial is `441bf6fb4ab0`, then `<id>` is `fb4ab0` .

- **Winch mode**:
  - SoftAP SSID: `OWTS-winch-fb4ab0`
  - mDNS (when available): `https://owts-winch-fb4ab0.local/`

- **Aircraft mode (no registration set)**:
  - SoftAP SSID: `OWTS-aircraft-fb4ab0`
  - mDNS (when available): `https://owts-aircraft-fb4ab0.local/`
- **Aircraft mode (registration set to `D-1234`)**:
  - SoftAP SSID: `OWTS-D-1234`
  - mDNS (when available): `https://owts-d-1234.local/`

> **mDNS availability**
>
> mDNS hostname resolution depends on your phone/laptop and the network you are on. The SoftAP IP address (`192.168.4.1`) is the most reliable first-time entry point.

3 Web UI (common pages)

OWTS provides a small **on-device web UI** that is shared between **aircraft** and **winch** mode.

3.1 HTTPS (self-signed certificate)

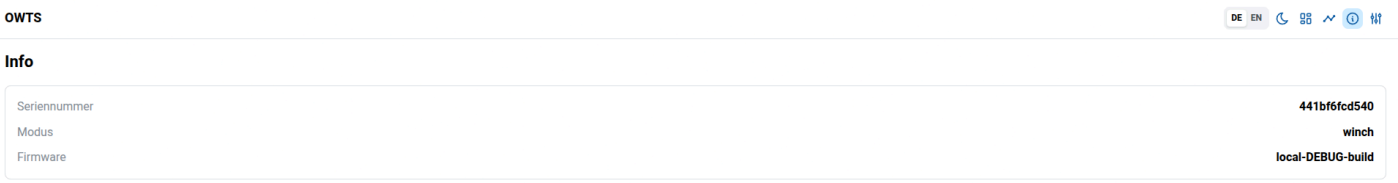
Browser warning (self-signed certificate)

The UI is served over **HTTPS**.

The device uses a **self-signed certificate**, so your browser will show a security warning on first use. This is expected.

- Proceed to the page and (if prompted) store a permanent exception for the device.
- Use this only on a **local / trusted network** (SoftAP or club LAN).

3.2 About (read-only)



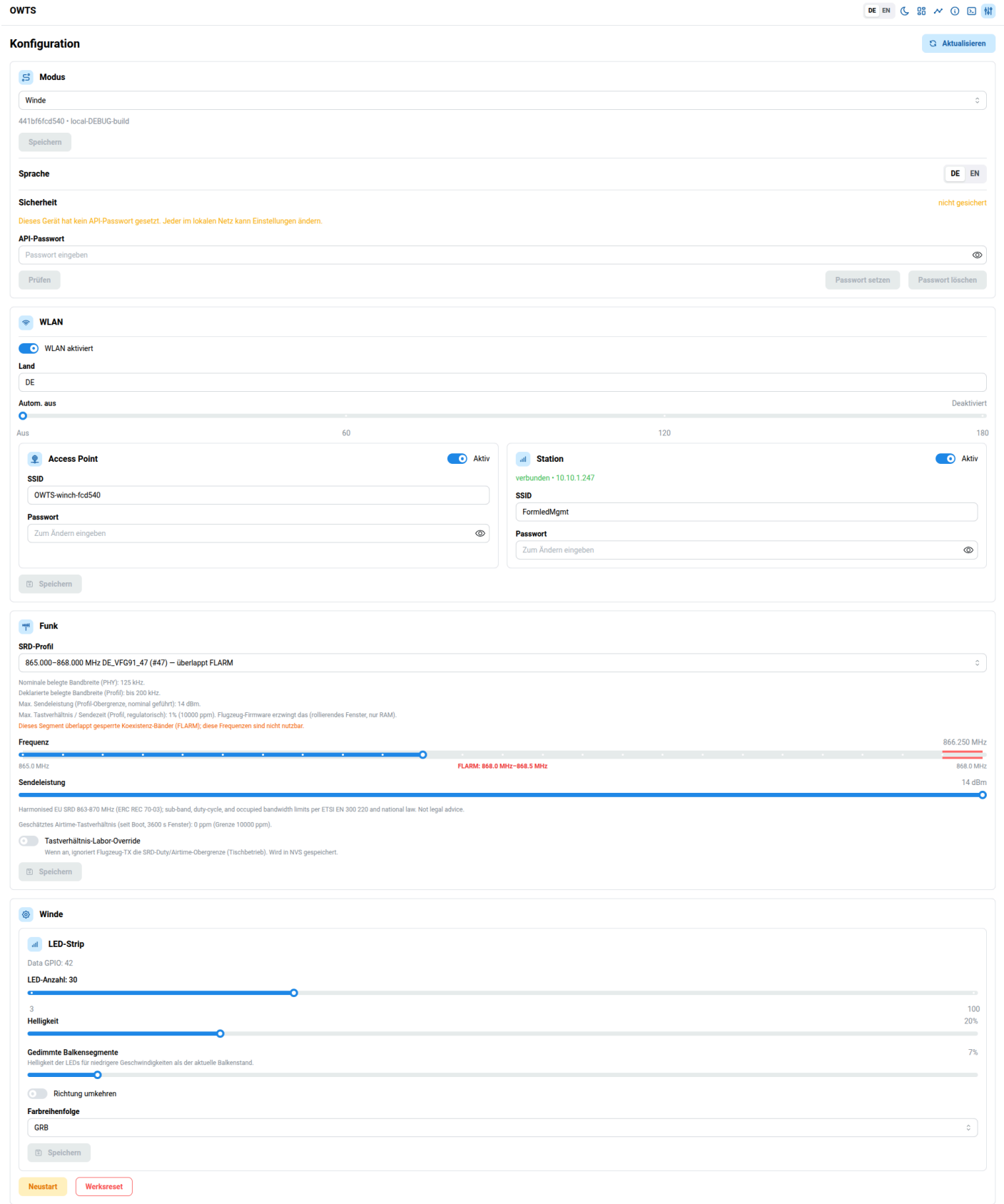
The **About** page shows device identity and firmware information:

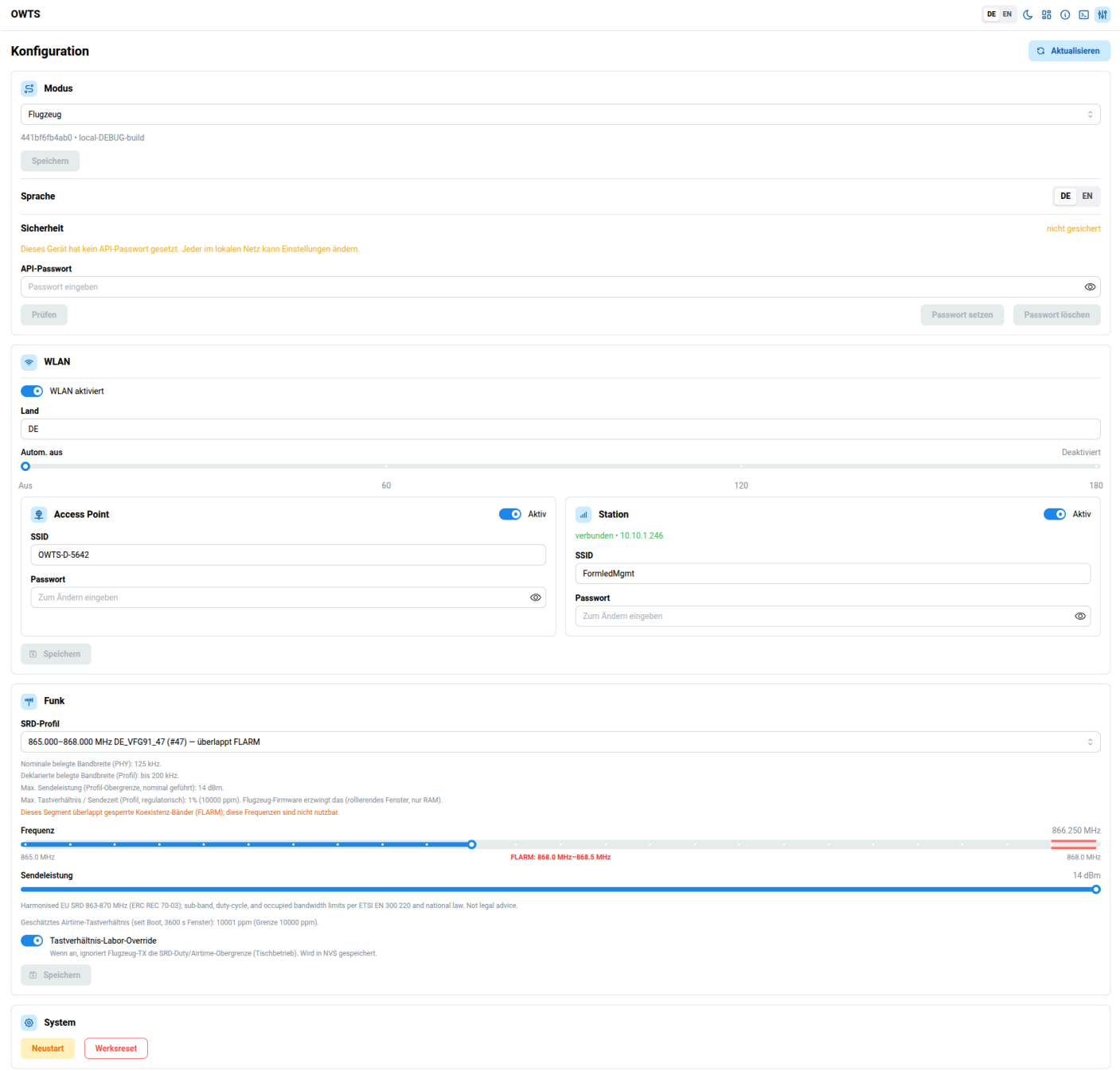
- **Serial**: device identifier (derived from MAC)
- **Mode**: current device role (`aircraft` / `winch`)
- **Firmware**: firmware version string

In **aircraft mode**, it additionally shows the configured **registration/type**.

3.3 Config (mode + network + radio + security)

Winch vs aircraft mode have slightly different config sections (winch includes the WS2812 LED strip settings).


OWTS
DE EN
Konfiguration
Aktualisieren
Modus
Winde
441bf6fcd540 • local-DEBUG-build
Speichern
Sprache
DE EN
Sicherheit
nicht gesichert
Dieses Gerät hat kein API-Passwort gesetzt. Jeder im lokalen Netz kann Einstellungen ändern.
API-Passwort
Passwort eingeben
Prüfen
Passwort setzen
Passwort löschen
WLAN
WLAN aktiviert
Land
DE
Autom. aus
Deaktiviert
Aus
60
120
180
Access Point
Aktiv
SSID
OWTS-winch-fcd540
Passwort
Zum Ändern eingeben
Station
Aktiv
verbunden • 10.10.1.247
SSID
FormledMgmt
Passwort
Zum Ändern eingeben
Speichern
Funk
SRD-Profil
865.000–868.000 MHz DE_VFG91_47 (#47) — überlappt FLARM
Nominale belegte Bandbreite (PHY): 125 kHz.
Deklarierte belegte Bandbreite (Profil): bis 200 kHz.
Max. Sendeleistung (Profil-Obergrenze, nominal geführt): 14 dBm.
Max. Tastverhältnis / Sendezeit (Profil, regulatorisch): 1% (10000 ppm). Flugzeug-Firmware erzwingt das (rollierendes Fenster, nur RAM).
Dieses Segment überlappt gesperrte Koexistenz-Bänder (FLARM); diese Frequenzen sind nicht nutzbar.
Frequenz
866.250 MHz
865.0 MHz
FLARM: 868.0 MHz–868.5 MHz
868.0 MHz
Sendeleistung
14 dBm
Harmonised EU SRD 863-870 MHz (ERC REC 70-03); sub-band, duty-cycle, and occupied bandwidth limits per ETSI EN 300 220 and national law. Not legal advice.
Geschätztes Airtime-Tastverhältnis (seit Boot, 3600 s Fenster): 0 ppm (Grenze 10000 ppm).
Tastverhältnis-Labor-Override
Wenn an, ignoriert Flugzeug-TX die SRD-Duty/Airtime-Obergrenze (Tischbetrieb). Wird in NVS gespeichert.
Speichern
Winde
LED-Strip
Data GPIO: 42
LED-Anzahl: 30
3
100
Helligkeit
20%
Gedimmte Balkensegmente
Helligkeit der LEDs für niedrigere Geschwindigkeiten als der aktuelle Balkenstand.
7%
Richtung umkehren
Farbreihenfolge
GRB
Speichern
Neustart
Werksreset



The **Config** page controls device-wide settings:

- **Security (API password)**:
  - Read-only pages work without a password.
  - Configuration changes require a password **only after** you set one.
  - The password is stored in your browser; on a second phone/tablet you must validate again.
- **Mode**: switch between `aircraft` and `winch` (may reboot)
- **WiFi**: AP / station settings and status
- **Radio**: SRD profile, frequency, TX power, live duty readout, and optional lab duty override (only in builds that include radio settings; **aircraft** transmits, **winch** receives — duty accounting applies to the aircraft role)

- **System**: reboot / factory reset

3.3.1 Radio (SRD profile, frequency + TX power)

If the firmware build includes SX1262 support, the Config page exposes:

- **SRD profile**: pick the regulatory row (frequency segment, max power, duty cap, modem compatibility). The UI warns when a segment overlaps the FLARM coexistence band so you stay on usable channels.
- **Frequency**: shown in **MHz** (the API uses Hz internally)
- **TX power**: in dBm
- **Duty / airtime** (readout): **3600 s** sliding window (RAM since boot), shown alongside the active profile cap. In **aircraft** mode, enable **Lab duty override** only for bench use — it disables enforcement against the profile cap.

To avoid interference with FLARM in Europe, the firmware enforces a blocked frequency window:

- **868.0–868.5 MHz** is not selectable and will be rejected by the API

The UI visualizes this block on the slider and automatically selects the nearest allowed channel if you drag into the blocked region.

3.3.2 API password (recommended)

OWTS can protect configuration changes with an **API password**.

- **Read-only pages** (monitoring/telemetry/logs) keep working without a password.
- **Changes** (Save buttons, reboot, factory reset, WiFi changes, etc.) require a password **only after** you configure one.

3.3.2.1 Set or change the password

1. Open the UI.
2. Go to **Config** → **Security**.
3. Enter a password and press **Set/Update password**.

3.3.2.2 Using a second phone/tablet

The password is stored **in your browser** (local storage), not on the device. If you open OWTS from another device, you will need to enter the password again under **Config** → **Security** and press **Validate**.

3.3.3 Network name changes (registration / mode)

The device uses its current “network label” for the SoftAP SSID and for the mDNS hostname (`<name>.local`) when connected to a WiFi station network.

- Default names:
  - aircraft mode (no registration set): `OWTS-aircraft-<id>`

  - winch mode: `OWTS-winch-<id>`
- In aircraft mode, if a **registration** is set (e.g. `D-1234`), the name becomes `OWTS-D-1234`.

Examples (same `<id>` as in Setup): if the device serial ends with `fb4ab0`, then:

- Winch mode: SSID `OWTS-winch-fb4ab0`, mDNS `https://owts-winch-fb4ab0.local/`
- Aircraft (no registration): SSID `OWTS-aircraft-fb4ab0`, mDNS `https://owts-aircraft-fb4ab0.local/`
- Aircraft (registration `D-1234`): SSID `OWTS-D-1234`, mDNS `https://owts-d-1234.local/`

Changing identity fields (like aircraft registration) can cause the device to reboot shortly after saving so the WiFi identity updates cleanly (the UI will reload).

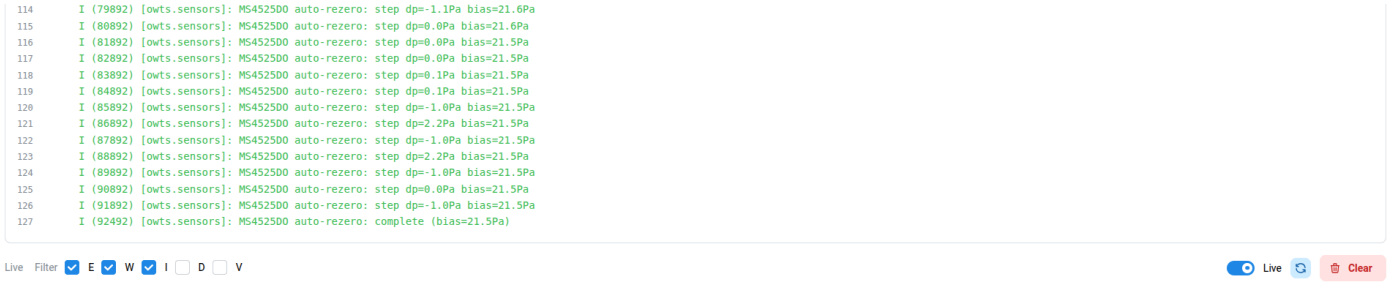
3.4 Logs (device log viewer)

OWTS

DE EN

Logs LIVE 127 lines

```
I (492) [owts.logcap]: Log capture enabled (lines=100, line_max=192)
I (492) [owts.main]: esp32s3, 2 core(s), WiFi/BLE, rev v0.2, 8MB external flash
I (502) [owts.main]: Minimum free heap size: 288552 bytes
I (502) [owts.main]: Software Version: local-DEBUG-build
I (542) [owts.main]: Mode: AIRCRAFT, Serial: 441bf6fb4ab0, MAC: 44:1b:f6:fb:4a:b0
I (542) [owts.oled]: OLED I2C port=0 SDA=17 SCL=18 RST=21
I (552) [owts.oled]: Heltec Vext: GPIO36 LOW
I (682) [owts.oled]: OLED initialized
I (682) pp: pp rom version: e7ae62f
I (682) net80211: net80211 rom version: e7ae62f
I (752) [owts.wifi]: STA connecting to SSID=FormledMgmt
I (752) [owts.wifi]: AP started SSID=OWTS-D-5642 password=owts12345
I (762) mdns_mem: mDNS task will be created from internal RAM
I (762) [owts.mdns]: mDNS: _http._tcp port 80 hostname OWTS-D-5642.local
I (762) [owts.mdns]: mDNS: _https._tcp port 443 hostname OWTS-D-5642.local
I (772) [owts.main]: Boot info: ID=441bf6fb4ab0 mode=aircraft AP ssid=OWTS-D-5642 AP pw=owts12345
I (782) [owts.main]: Boot info: STA ssid=FormledMgmt
I (1042) [owts.spiffs]: Mounted SPIFFS: used=315507 total=3968561
I (1162) [owts.web]: Starting HTTP redirect server on port 80
I (1172) [owts.web]: Starting HTTPS server on port 443
I (1172) esp_https_server: Starting server
I (1172) esp_https_server: Server listening on port 443
I (1172) [owts.web]: HTTPS server started
I (2292) esp_netif_handlers: sta ip: 10.10.1.246, mask: 255.255.0.0, gw: 10.10.0.1
I (2292) [owts.mdns]: mDNS: _http._tcp port 80 hostname OWTS-D-5642.local
I (2292) [owts.mdns]: mDNS: _https._tcp port 443 hostname OWTS-D-5642.local
I (7402) [owts.oled]: OLED: boot screen ended; runtime drawing enabled
I (7402) [owts.sensors]: MS4525DO I2C: port=1 SDA=4(1) SCL=5(1) addr=0x28
I (7402) [owts.sensors]: MS4525DO probe OK addr=0x28
I (7412) [owts.ms4525do]: MS4525DO ready addr=0x28 output=A range=±1psi
I (7412) [owts.sensors]: Aircraft sensors started (MS4525DO)
I (7422) [owts.radio]: SX1262 pins: NSS=8 SCK=9 MOSI=10 MISO=11 RST=12 BUSY=13 DIO1=14
I (7422) [owts.radio]: Radio: mode=AIRCRAFT → role=TX (GFSK beacon)
I (7462) [owts.radio]: SX1262 TCXO: DIO3 @ 1.6 V (Heltec-style, RadioLib default)
I (7482) [owts.radio]: RF frequency 868000000 Hz, TX 14 dBm
I (7502) [owts.radio]: SX1262 get_status=0xa2
I (7502) [owts.radio]: Radio ready (call owts_radio_start_traffic for TX/RX)
I (7502) [owts.aircraft_state]: state loop: poll=100ms
I (7802) [owts.radio]: [TX] aircraft task (bursts @ 20 Hz, protobuf, rfs47 B)
I (8312) [owts.sensors]: MS4525DO auto-zero: collecting (10/10)
I (8312) [owts.sensors]: MS4525DO bias set: 21.7Pa
I (12472) esp_https_server: performing session handshake
E (12802) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (12802) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (12812) httpd: httpd_accept_conn: session creation failed
W (12812) httpd: httpd_server: error accepting new connection
I (12822) esp_https_server: performing session handshake
I (15432) esp_https_server: performing session handshake
E (15762) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (15762) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (15772) httpd: httpd_accept_conn: session creation failed
W (15772) httpd: httpd_server: error accepting new connection
I (16082) esp_https_server: performing session handshake
E (16422) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (16422) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (16432) httpd: httpd_accept_conn: session creation failed
W (16432) httpd: httpd_server: error accepting new connection
I (16592) esp_https_server: performing session handshake
I (17222) esp_https_server: performing session handshake
E (17572) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (17572) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (17572) httpd: httpd_accept_conn: session creation failed
W (17572) httpd: httpd_server: error accepting new connection
I (17922) esp_https_server: performing session handshake
E (18262) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (18262) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (18272) httpd: httpd_accept_conn: session creation failed
W (18272) httpd: httpd_server: error accepting new connection
I (18542) esp_https_server: performing session handshake
E (18872) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (18872) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (18882) httpd: httpd_accept_conn: session creation failed
W (18882) httpd: httpd_server: error accepting new connection
I (18902) esp_https_server: performing session handshake
I (19402) esp_https_server: performing session handshake
E (19732) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (19732) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (19742) httpd: httpd_accept_conn: session creation failed
W (19742) httpd: httpd_server: error accepting new connection
I (19752) esp_https_server: performing session handshake
E (20082) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (20082) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (20082) httpd: httpd_accept_conn: session creation failed
W (20092) httpd: httpd_server: error accepting new connection
I (20102) esp_https_server: performing session handshake
I (20592) esp_https_server: performing session handshake
I (34502) esp_https_server: performing session handshake
E (34842) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (34842) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (34842) httpd: httpd_accept_conn: session creation failed
W (34852) httpd: httpd_server: error accepting new connection
E (35072) esp-tls-mbedtls: write error :-0x0050
I (35072) esp_https_server: performing session handshake
E (35782) esp-tls-mbedtls: read error :-0x0050
I (35792) esp_https_server: performing session handshake
E (36112) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (36112) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (36122) httpd: httpd_accept_conn: session creation failed
W (36122) httpd: httpd_server: error accepting new connection
I (36412) esp_https_server: performing session handshake
E (36742) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
E (36742) esp_https_server: esp_tls_create_server_session failed, 0x7780
E (36742) httpd: httpd_accept_conn: session creation failed
W (36742) httpd: httpd_server: error accepting new connection
I (48672) [owts.radio]: [TX] burst start: 40 s @ 20 Hz
I (48672) [owts.aircraft_state]: arm burst: IAS=54 ≥ v_en=50 t_send=40s
I (48752) [owts.radio]: [TX] burst stop early: IAS=49 < v_en=50
I (48752) [owts.radio]: [TX] burst end, standby
I (74992) [owts.sensors]: MS4525DO auto-rezero: start (|dp|<=30Pa for >=21s landed)
I (75892) [owts.sensors]: MS4525DO auto-rezero: step dp=-0.1Pa bias=21.7Pa
I (76892) [owts.sensors]: MS4525DO auto-rezero: step dp=-0.1Pa bias=21.7Pa
I (77892) [owts.sensors]: MS4525DO auto-rezero: step dp=-1.1Pa bias=21.6Pa
I (78892) [owts.sensors]: MS4525DO auto-rezero: step dp=-5.3Pa bias=21.6Pa
```



The **Logs** page shows recent log output captured by the device:

- The device keeps only a small **in-memory ring buffer**.
- The UI can cache more lines locally, so you can scroll back further than the device ring buffer.
- Use the **level filter** to show/hide `E` (error), `W` (warning), `I` (info), `D` (debug), and `V` (verbose) lines.
- If you scroll up, the view stops auto-following new lines; scroll back to the bottom to resume live tailing.

4 Modes

4.1 Aircraft mode (transmitter)

In **aircraft mode**, the OWTS device measures the aircraft's **indicated airspeed (IAS)** and transmits it to the winch receiver over the radio link.

> **Proof of concept – not for operational use**
>
> OWTS is currently a **proof of concept**. It is **not recommended for operational use** at this stage.
>
> - **Radio compliance** and certification requirements depend on the country and intended use.
> - **Aircraft sensor installations** (including pitot/static integration) may be regulated and require approvals depending on local rules and aircraft category.

4.1.1 Goals in aircraft mode

- Provide a stable, low-latency IAS signal to the winch station.
- Keep operation simple: one device in the aircraft, configured once, then used repeatedly.

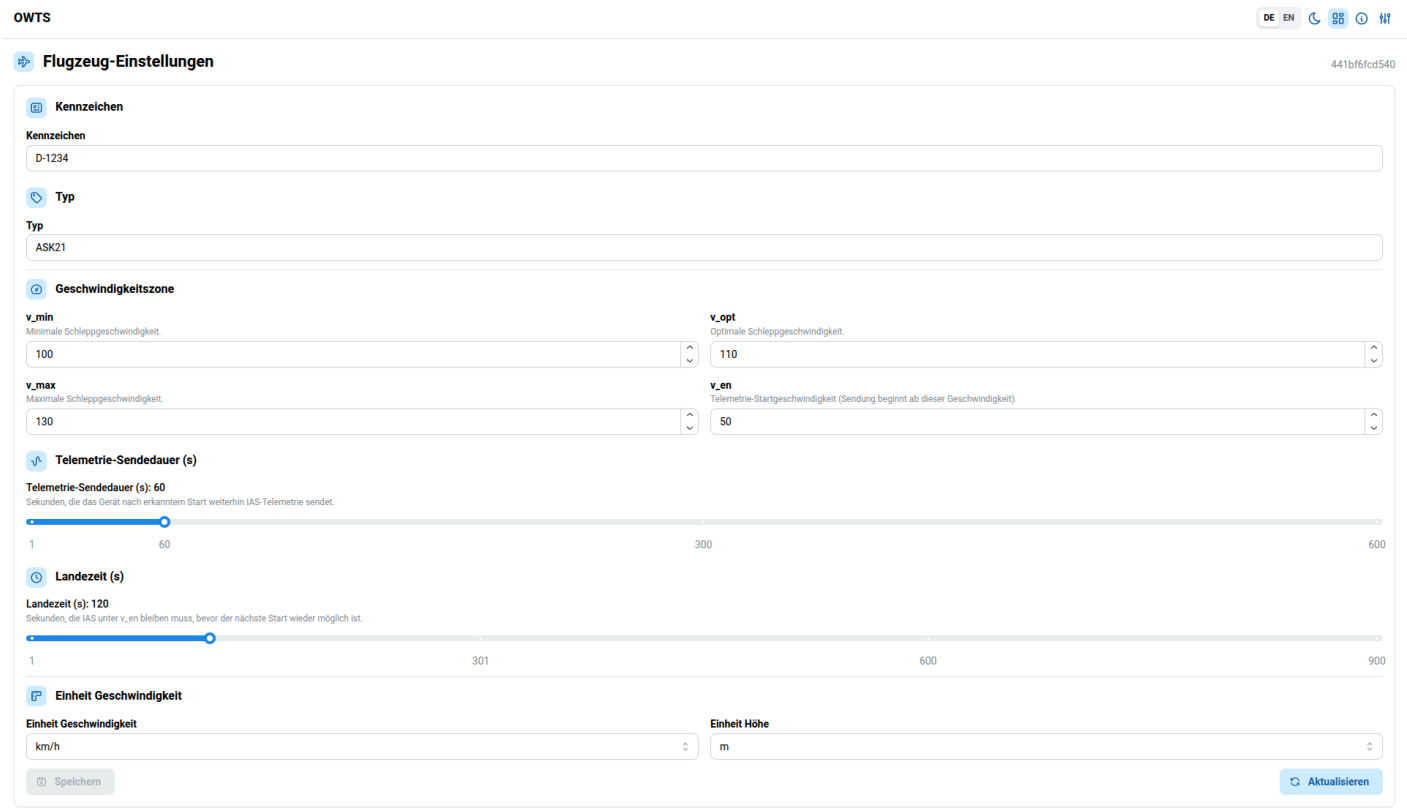
> **Getting started**
>
> Initial connection (SoftAP), default password, and URL/mDNS notes live in Setup. Shared UI pages (About/Config/Logs) are documented in Web UI.

4.1.2 Configure aircraft profile

Use the UI to configure the aircraft device. The settings are persisted on the device.

Config → Radio (SX1262 builds): SRD profile, frequency/power, rolling duty readout, and optional lab duty override — see Web UI → Radio.

4.1.2.1 Aircraft settings page (editable)



4.1.2.1.1 Identity

- **Registration**: aircraft registration (shown on the winch receiver and in history).
- **Type**: short aircraft type string (shown on the winch receiver and in history).

Change either field and press **Save** to persist it.

> **Registration changes may trigger a restart**
>
> In the current firmware/frontend behavior, changing identity fields can cause the device to reboot shortly after saving (the UI will reload).

4.1.2.1.2 Speed zone

The speed zone defines the target band the winch side will display:

- **v_min**: minimum winch launch speed (lower limit)
- **v_opt**: optimal winch launch speed (target)
- **v_max**: maximum winch launch speed (upper limit)

These values are stored as integers in the selected **speed unit** (see below).

4.1.2.1.3 Telemetry transmit policy

- **v_en**: telemetry start speed
  The transmitter starts sending when IAS is at/above this speed.
- **Telemetry transmit time (s)** (`t_send`): how long the device keeps transmitting after a launch is detected.
- **Landing hold (s)** (`landing_hold_s`): IAS must stay below `v_en` for this long before a new launch can be armed (helps avoid repeated triggers).

4.1.2.1.4 Units

- **Speed unit**: `km/h` or `kts`
- **Height unit**: `m` or `ft` (used for display/metadata in current builds)

After changes, press **Save**.

4.1.3 What the winch sees

In aircraft mode, the transmitter typically provides:

- Current IAS (in the configured unit)
- Aircraft identification (registration/type)
- Basic status information (if supported by the current firmware build)

4.2 Winch mode (receiver)

In **winch mode**, the OWTS device receives the aircraft's IAS telemetry and exposes it locally via:

- the **on-device web UI**, and
- the **REST API** (used by the UI and useful for troubleshooting/integration).

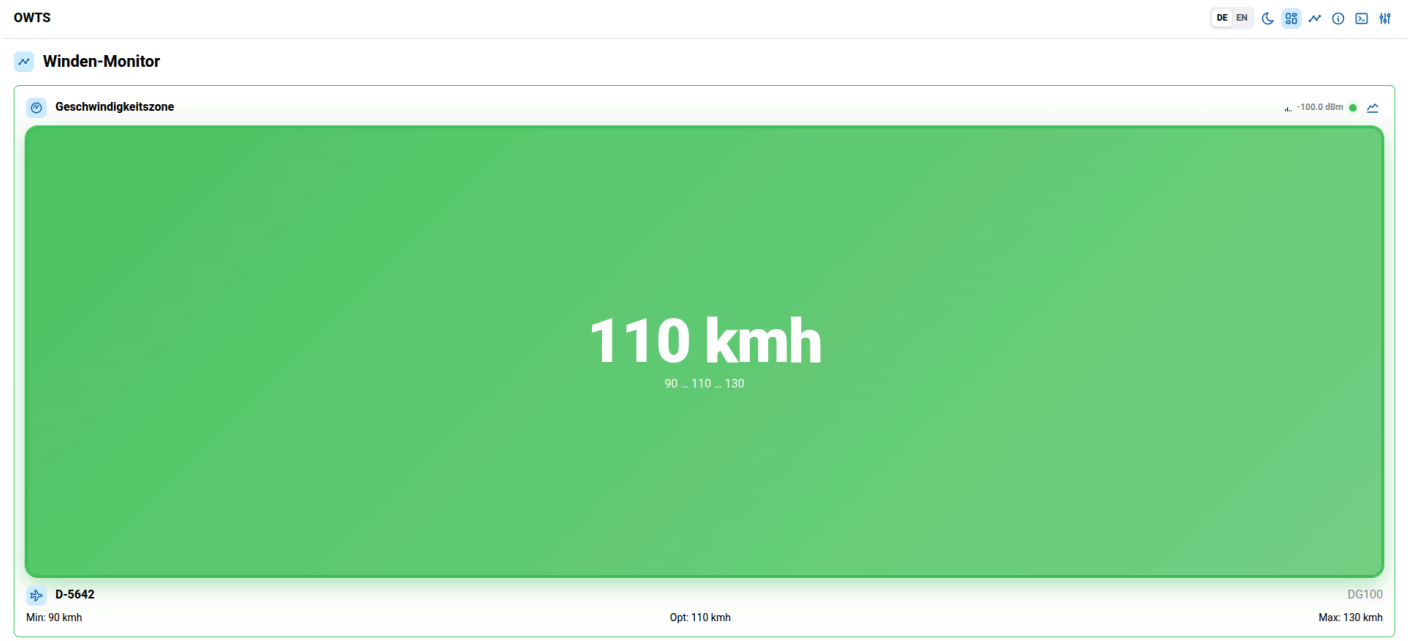
> **Proof of concept – not for operational use**
>
> OWTS is currently a **proof of concept**. It is **not recommended for operational use** at this stage. See the notes in the aircraft-mode documentation regarding radio compliance and operational constraints.

> **Getting started**
>
> Initial connection (SoftAP), default password, and URL/mDNS notes live in Setup. Shared UI pages (About/Config/Logs) are documented in Web UI.

4.2.1 Typical workflow at the winch

- Verify the receiver is set to **winch mode**.
- Confirm radio reception (telemetry should update while the aircraft transmitter is active).
- Use the UI to view the current IAS and the configured speed band (min/opt/max).
- If the device is secured, enter and validate the **API password** under **Config → Security** before attempting any configuration changes (reboot, WiFi changes, etc.).

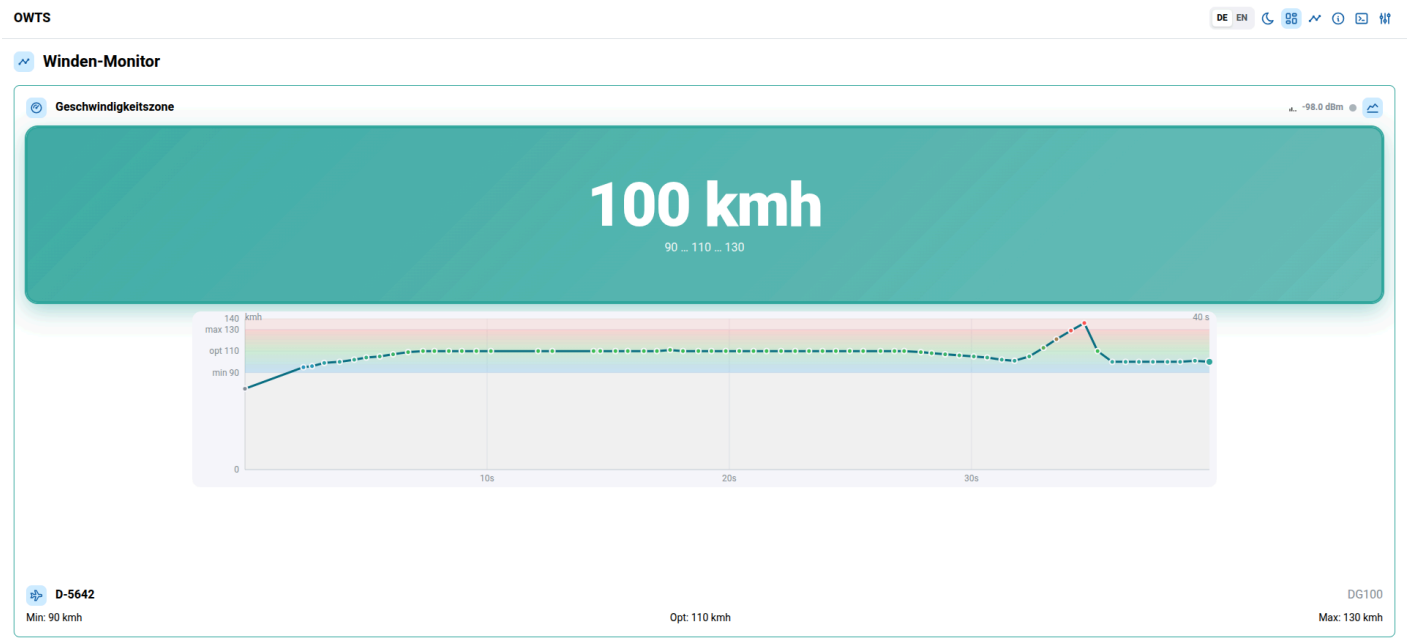
4.2.2 Winch monitor (live view)



The **Winch monitor** is the default home screen in winch mode.

- **Speed zone panel**: large color-coded status:
  - shows current IAS and the configured speed zone (min/opt/max)
  - color indicates whether IAS is below/inside/above the configured band
- **RX activity LED**: small indicator next to the graph toggle
  - blinks **green** briefly when **new telemetry** is decoded
  - stays **grey** when polling succeeds but no new telemetry arrived
- **RX signal strength**: RSSI in **dBm** (shown only when telemetry is available)
- **Aircraft identity**: registration and type are shown below the panel when telemetry is available.

4.2.2.1 Winch monitor (with graph)



Use the **graph toggle** (📈) to show a live plot of IAS over time.

4.2.3 WS2812 LED strip (optional)

If your winch receiver is built and wired with a WS2812/WS2812B LED strip, it can visualize the current speed zone:

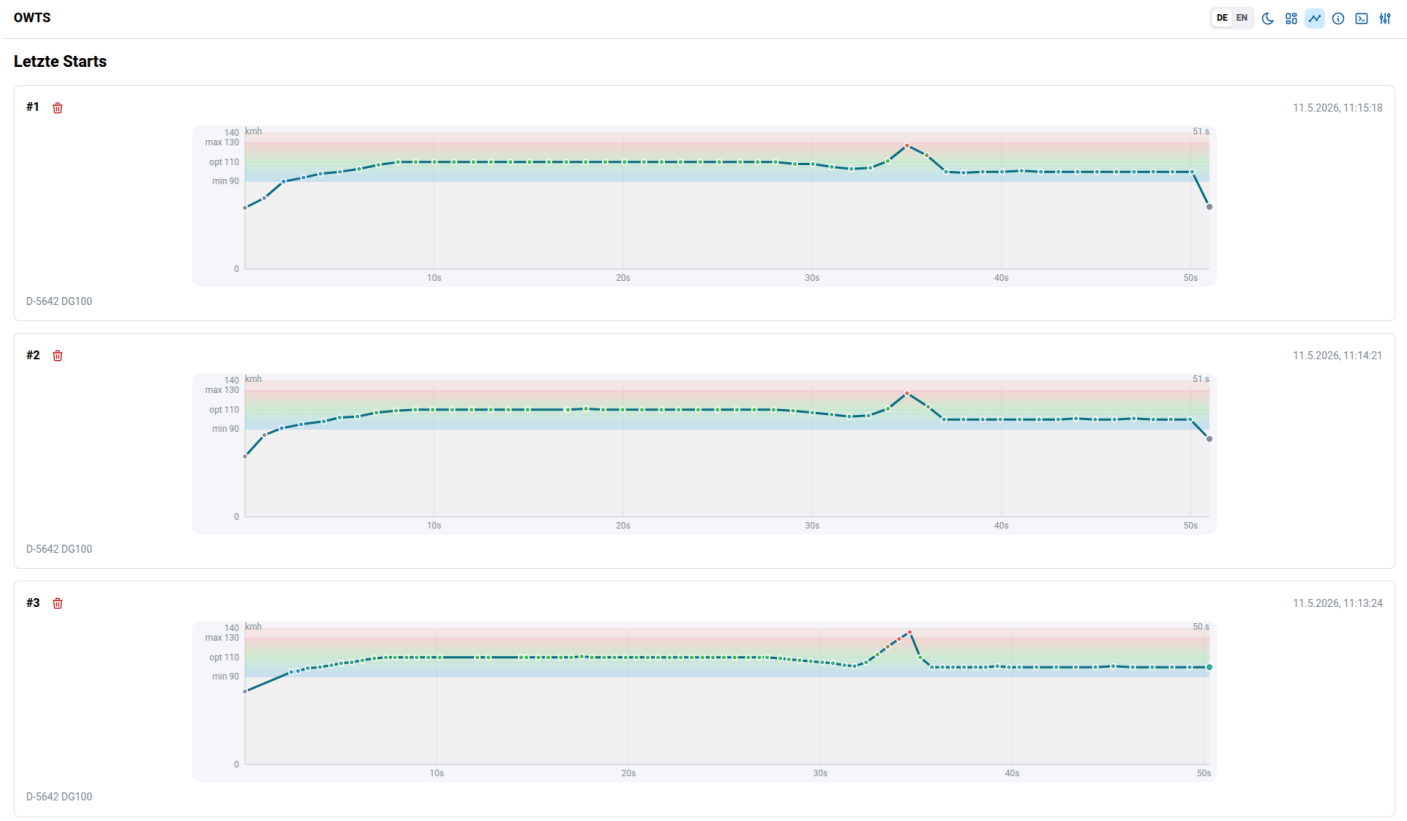
- **Off**: below v_{min} / no telemetry
- **Blue** → **Green** → **Red**: around $v_{min} \rightarrow v_{opt} \rightarrow v_{max}$

The strip settings are configured on the device in **Config** (winch mode):

- **LED count**
- **Brightness** (active speed segment)
- **Dimmed bar segments** — relative brightness for LEDs below current IAS (VU-style)
- **Reverse direction**
- **Color order** (e.g. GRB vs RGB)

Saving LED settings **reboots** the device.

4.2.4 Launch history (stored locally in the browser)



The **Last launches** page shows a small list of recent launches.

> **History is stored in the browser**
>
> Launch history is stored in your browser's local storage (not on the device). It is tied to the specific phone/tablet you use for viewing the UI.

- Each entry shows a small IAS profile preview and a timestamp.
- Use the **trash icon** (🗑️) to delete a stored launch entry.

4.2.5 Troubleshooting (quick checks)

- **No updates**:
  - Confirm the aircraft device is powered and in **aircraft mode**.
  - Check that both devices use compatible radio settings (frequency/power as implemented).
- **UI loads but values are empty**:
  - The receiver may not have decoded telemetry yet (or it has timed out).
  - Open the **Logs** page in the web UI to see whether telemetry is being received and whether there are radio / decode errors.

5 Hardware

This section will be expanded. OWTS currently targets:

- Heltec WiFi LoRa 32 (V3.2) / HTIT-WB32LA V3.2 — datasheet (PDF)
- MS4525DO differential pressure sensor (IAS) — datasheet (PDF)

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