



OWTS Dokumentation

Version: DEBUG

1 OWTS

OWTS ist ein **Machbarkeitsnachweis (Proof of Concept)**, um die **angezeigte Fluggeschwindigkeit (IAS)** während des Windenstarts mit geringer Latenz von einem Flugzeug zur Windenstation zu übertragen.

Das Konzept sieht **zwei baugleiche Geräte** mit unterschiedlicher Rolle vor:

- **Flugzeugmodus (Sender)**: In jedem Flugzeug misst ein Gerät die IAS und sendet sie.
- **Windenmodus (Empfänger)**: An der Winde empfängt ein Gerät die IAS und stellt sie über eine lokale Web-Oberfläche dar.

Proof of Concept – nicht für den Betrieb

OWTS ist derzeit ein **Machbarkeitsnachweis**. Für den **operativen Einsatz** wird es in dieser Ausbaustufe **nicht empfohlen**.

- **Funkvorschriften** und Zulassungsanforderungen hängen vom Land und der beabsichtigten Nutzung ab.
- **Sensorinstallationen im Luftfahrzeug** (einschließlich Pitot/Statik) können reguliert sein und je nach nationalem Recht und Luftfahrzeugkategorie Genehmigungen erfordern.

Eine PDF-Version dieser Dokumentation finden Sie [hier](#).

2 Einrichtung

2.1 Erstverbindung (SoftAP)

WLAN-Kurzanleitung

Nach einem **neuen Flash** oder **Werkreset** startet OWTS standardmäßig im **Flugzeugmodus**.

Für die Ersteinrichtung verbinden Sie sich mit dem integrierten WLAN-Zugangspunkt (SoftAP) des Geräts:

- **Standard-SSID:**
 - **Flugzeugmodus** (kein Kennzeichen gesetzt): `OWTS-aircraft-<id>`
 - **Windenmodus:** `OWTS-winch-<id>`
 - `<id>` leitet sich aus der Geräteseriennummer ab (Ende der aus der MAC abgeleiteten Kennung)
- **Standardpasswort:** `owts12345` (sofern in der Konfiguration nicht geändert)

Nach Verbindung mit dem SoftAP öffnen Sie die Oberfläche:

- über die IP (typisch im SoftAP): `https://192.168.4.1`
- oder per mDNS (falls Gerät und Netzwerk das unterstützen): `https://<name>.local` (dabei entspricht `<name>` der SoftAP-SSID in Kleinbuchstaben)

Hinweise zu HTTPS und Browserzertifikaten finden Sie unter [Web UI](#).

2.2 Namens- / SSID-Verhalten

Das Gerät verwendet sein aktuelles „Netzwerk-Label“ für:

- die SoftAP-SSID und
- den mDNS-Hostnamen (`<name>.local`), wenn der Station-Modus verbunden ist.

Im Flugzeugmodus ändert sich der Name zu `OWTS-D-1234`, wenn Sie das **Luftfahrzeugkennzeichen** (z. B. `D-1234`) setzen; nach dem Speichern kann das Gerät neu starten, damit die WLAN-Identität sauber übernommen wird.

2.2.1 Beispiele (illustrativ)

`<id>` sind die **letzten 6 Zeichen** der Geräteseriennummer (aus der MAC abgeleitet). Lautet die Seriennummer z. B. `441bf6fb4ab0`, dann ist `<id>` `fb4ab0`.

- **Windenmodus:**
 - SoftAP-SSID: `OWTS-winch-fb4ab0`
 - mDNS (falls verfügbar): `https://owts-winch-fb4ab0.local/`

- **Flugzeugmodus (kein Kennzeichen gesetzt):**
 - SoftAP-SSID: `OWTS-aircraft-fb4ab0`
 - mDNS (falls verfügbar): `https://owts-aircraft-fb4ab0.local/`
- **Flugzeugmodus (Kennzeichen D-1234):**
 - SoftAP-SSID: `OWTS-D-1234`
 - mDNS (falls verfügbar): `https://owts-d-1234.local/`

Verfügbarkeit von mDNS

Ob `*.local` aufgelöst wird, hängt von Telefon/Notebook und dem jeweiligen Netz ab. Die SoftAP-Adresse `192.168.4.1` ist für den Erstkontakt am zuverlässigsten.

3 Web UI (gemeinsame Seiten)

OWTS stellt eine kleine **geräteinterne Web-Oberfläche** bereit, die im **Flugzeug-** und **Windenmodus** dieselbe Basisnavigation nutzt.

3.1 HTTPS (selbstsigniertes Zertifikat)

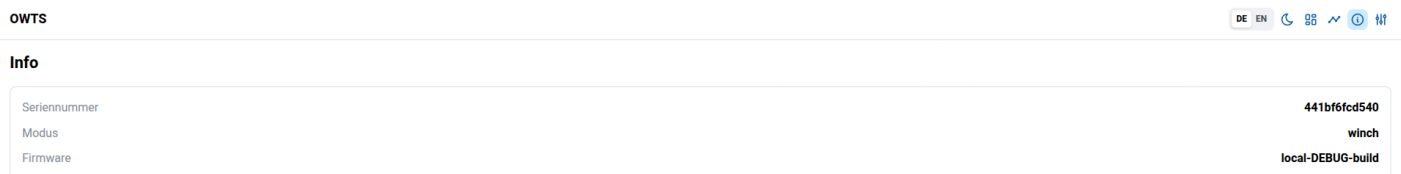
Browserhinweis (selbstsigniertes Zertifikat)

Die Oberfläche wird über **HTTPS** ausgeliefert.

Das Gerät verwendet ein **selbstsigniertes Zertifikat**; der Browser zeigt daher beim ersten Aufruf eine Sicherheitswarnung. Das ist erwartetes Verhalten.

- Rufen Sie die Seite dennoch auf und legen Sie (falls angeboten) eine dauerhafte Ausnahme für dieses Gerät an.
- Nutzen Sie dies nur in einem **lokalen / vertrauenswürdigen Netz** (SoftAP oder Vereins-LAN).

3.2 Info (nur lesen)



The screenshot shows the OWTS web interface. At the top left is the 'OWTS' logo. At the top right are navigation icons for language (DE, EN), a moon icon, a refresh icon, a search icon, and a tree icon. Below the header is the 'Info' section, which contains a table with device information:

Seriennummer	441bf6fed540
Modus	winch
Firmware	local-DEBUG-build

Die Seite **Info** zeigt Geräteidentität und Firmware-Informationen:

- **Seriennummer**: Geräteerkennung (aus der MAC abgeleitet)
- **Modus**: aktuelle Rolle (`aircraft` / `winch`)
- **Firmware**: Versionszeichenkette der Firmware

Im **Flugzeugmodus** werden außerdem das konfigurierte **Kennzeichen** und der **Typ** angezeigt.

3.3 Config (Modus, Netzwerk, Funk, Sicherheit)

Konfigurationsbereiche unterscheiden sich leicht je nach Modus (im Windenmodus gibt es zusätzlich Einstellungen für den WS2812-LED-Strip).

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 👁

[Speichern](#)

Station

Aktiv

verbunden • 10.10.1.247

SSID: FormledMgmt

Passwort: Zum Ändern eingeben 👁

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:

Sendeleistung:

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

Helligkeit:

Gedimmte Balkensegmente:
Helligkeit der LEDs für niedrigere Geschwindigkeiten als der aktuelle Balkenstand.

Richtung umkehren

Farbreihenfolge: GRB ⌵

[Speichern](#)

[Neustart](#) [Werkeset](#)

OWTS DE EN 🌙 📶 📄 🏠

Konfiguration Aktualisieren

Modus

Flugzeug ⌵

441bf6fb4ab0 • local-DEBUG-build

Speichern

Sprache

DE EN

Sicherheit

Dieses Gerät hat kein API-Passwort gesetzt. Jeder im lokalen Netz kann Einstellungen ändern. nicht gesichert

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-D-5642

Passwort: Zum Ändern eingeben 👁

Speichern

Station Aktiv

verbunden • 10.10.1.246

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

865.0 MHz 866.250 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): 10001 ppm (Grenze 10000 ppm).

Tastverhältnis-Labor-Override
 Wenn an, ignoriert Flugzeug-TX die SRD-Duty/Airtime-Obergrenze (Tischbetrieb). Wird in NVS gespeichert.

Speichern

System

Neustart Werkeset

Die **Config**-Seite (Überschrift in der Oberfläche: **Konfiguration**) steuert geräteweite Einstellungen:

- **Sicherheit (API-Passwort):**
 - Nur-Lese-Seiten funktionieren ohne Passwort.
 - Konfigurationsänderungen erfordern ein Passwort **erst nachdem** Sie eines gesetzt haben.
 - Das Passwort liegt im Browser; auf einem zweiten Telefon/Tablet müssen Sie es erneut bestätigen.
- **Modus:** Umschalten zwischen `aircraft` und `winch` (kann einen Neustart auslösen)
- **WLAN:** Access-Point- / Station-Einstellungen und Status
- **Funk:** SRD-Profil, Frequenz, Sendeleistung, Live-Anzeige des Tastverhältnisses sowie optionaler Labor-Override (nur in Builds mit Funk; **Flugzeug** sendet, **Winde** empfängt – die Airtime-Logik betrifft die Sender-Rolle)

- **System:** Neustart / Werkreset

3.3.1 Funk (SRD-Profil, Frequenz + Sendeleistung)

Wenn die Firmware mit SX1262-Unterstützung gebaut ist, bietet die Config-Seite:

- **SRD-Profil:** Auswahl der regulatorischen Zeile (Frequenzsegment, Grenzleistung, Tastverhältnis, Modem-Kompatibilität). Die Oberfläche warnt bei Überlappung mit dem FLARM-Koexistenzband, damit nur nutzbare Kanäle gewählt werden.
- **Frequenz:** Anzeige in **MHz** (die API nutzt intern Hz)
- **Sendeleistung:** in dBm
- **Tastverhältnis / Airtime** (Anzeige): Auswertung in einem **gleitenden 3600-s-Zeitfenster** (nur RAM seit Boot), zusammen mit der Profil-Grenze. Im **Flugzeugmodus** den **Labor-Override** nur am Tisch nutzen – er schaltet die Durchsetzung gegen die Profil-Grenze ab.

Um Störungen von FLARM in Europa zu vermeiden, sperrt die Firmware einen Frequenzbereich:

- **868,0–868,5 MHz** ist nicht auswählbar und wird von der API abgelehnt

Die Oberfläche markiert den gesperrten Bereich am Slider und wählt automatisch den nächsten erlaubten Kanal, wenn Sie in den gesperrten Bereich ziehen.

3.3.2 API-Passwort (empfohlen)

OWTS kann Konfigurationsänderungen mit einem **API-Passwort** schützen.

- **Nur-Lese-Seiten** (Monitoring, Telemetrie, Logs) bleiben ohne Passwort nutzbar.
- **Änderungen** (Speichern, Neustart, Werkreset, WLAN usw.) erfordern ein Passwort **erst nachdem** Sie eines konfiguriert haben.

3.3.2.1 Passwort setzen oder ändern

1. Web-Oberfläche öffnen.
2. Zu **Config** → **Sicherheit** wechseln.
3. Passwort eingeben und **Passwort setzen** bzw. **Passwort ändern** wählen.

3.3.2.2 Zweites Telefon oder Tablet

Das Passwort wird **im Browser** (lokaler Speicher) abgelegt, nicht auf dem Gerät. Öffnen Sie OWTS von einem weiteren Gerät, geben Sie das Passwort erneut unter **Config** → **Sicherheit** ein und wählen Sie **Prüfen**.

3.3.3 Netzwerknamen (Kennzeichen / Modus)

Das Gerät nutzt sein aktuelles „Netzwerk-Label“ für die SoftAP-SSID und den mDNS-Hostnamen (`<name>.local`), wenn eine Station-Verbindung zum WLAN besteht.

- Standardnamen:
 - Flugzeugmodus (kein Kennzeichen): `OWTS-aircraft-<id>`
 - Windenmodus: `OWTS-winch-<id>`
- Im Flugzeugmodus mit gesetztem **Kennzeichen** (z. B. `D-1234`) lautet der Name `OWTS-D-1234`.

Beispiele (gleiches `<id>` wie in [Einrichtung](#)): endet die Seriennummer mit `fb4ab0`, dann gilt:

- Windenmodus: SSID `OWTS-winch-fb4ab0`, mDNS `https://owts-winch-fb4ab0.local/`
- Flugzeug (ohne Kennzeichen): SSID `OWTS-aircraft-fb4ab0`, mDNS `https://owts-aircraft-fb4ab0.local/`
- Flugzeug (Kennzeichen `D-1234`): SSID `OWTS-D-1234`, mDNS `https://owts-d-1234.local/`

Änderungen an Identitätsfeldern (z. B. Kennzeichen) können kurz nach dem Speichern einen Neustart auslösen, damit die WLAN-Identität sauber aktualisiert wird; die Oberfläche lädt neu.

3.4 Logs (Geräte-Logviewer)

OWTS

DE EN ↻ 🔍 📄 📄 📄 📄 📄

Logs LIVE 127 lines

```
1 I (492) [owts.logcap]: Log capture enabled (lines=100, line_max=192)
2 I (492) [owts.main]: esp32s3, 2 core(s), WiFi/BLE, rev v0.2, 8MB external flash
3 I (502) [owts.main]: Minimum free heap size: 288552 bytes
4 I (502) [owts.main]: Software Version: local-DEBUG-build
5 I (542) [owts.main]: Mode: AIRCRAFT, Serial: 441bf6fb4ab0, MAC: 44:1b:f6:fb:4a:b0
6 I (542) [owts.oled]: OLED I2C port=0 SDA=17 SCL=18 RST=21
7 I (552) [owts.oled]: Heltec Vext: GP1036 LOW
8 I (682) [owts.oled]: OLED initialized
9 I (682) pp: pp rom version: e7ae62f
10 I (682) net80211: net80211 rom version: e7ae62f
11 I (752) [owts.wifi]: STA connecting to SSID=FormledMgmt
12 I (752) [owts.wifi]: AP started SSID=OWTS-D-5642 password=owts12345
13 I (762) mdns_mem: mDNS task will be created from internal RAM
14 I (762) [owts.mdns]: mDNS: _http._tcp port 80 hostname OWTS-D-5642.local
15 I (762) [owts.mdns]: mDNS: _https._tcp port 443 hostname OWTS-D-5642.local
16 I (772) [owts.main]: Boot info: ID=441bf6fb4ab0 mode=aircraft AP ssid=OWTS-D-5642 AP pw=owts12345
17 I (782) [owts.main]: Boot info: STA ssid=FormledMgmt
18 I (1042) [owts.spiffs]: Mounted SPIFFS: used=315507 total=3968561
19 I (1162) [owts.web]: Starting HTTP redirect server on port 80
20 I (1172) [owts.web]: Starting HTTPS server on port 443
21 I (1172) esp_https_server: Starting server
22 I (1172) esp_https_server: Server listening on port 443
23 I (1172) [owts.web]: HTTPS server started
24 I (2292) esp_netif_handlers: sta ip: 10.10.1.246, mask: 255.255.0.0, gw: 10.10.0.1
25 I (2292) [owts.mdns]: mDNS: _http._tcp port 80 hostname OWTS-D-5642.local
26 I (2292) [owts.mdns]: mDNS: _https._tcp port 443 hostname OWTS-D-5642.local
27 I (7402) [owts.oled]: OLED: boot screen ended; runtime drawing enabled
28 I (7402) [owts.sensors]: MS452500 I2C: port=1 SDA=4(1) SCL=5(1) addr=0x28
29 I (7402) [owts.sensors]: MS452500 probe OK addr=0x28
30 I (7412) [owts.ms452500]: MS452500 ready addr=0x28 output=A range=e1psi
31 I (7412) [owts.sensors]: Aircraft sensors started (MS452500)
32 I (7422) [owts.radio]: SX1262 pins: NSS=8 SCK=9 MOSI=10 MISO=11 RST=12 BUSY=13 DIO1=14
33 I (7422) [owts.radio]: Radio: mode=AIRCRAFT + role=TX (GFSK beacon)
34 I (7462) [owts.radio]: SX1262 TCXO: DIO3 @ 1.6 V (Heltec-style, RadioLib default)
35 I (7482) [owts.radio]: RF frequency 868000000 Hz, TX 14 dBm
36 I (7502) [owts.radio]: SX1262 get_status=0xa2
37 I (7502) [owts.radio]: Radio ready (call owts_radio_start_traffic for TX/RX)
38 I (7502) [owts.aircraft_state]: state loop: poll=100ms
39 I (7802) [owts.radio]: [TX] aircraft task (bursts @ 20 Hz, protobuf, rfs47 B)
40 I (8312) [owts.sensors]: MS452500 auto-zero: collecting (10/10)
41 I (8312) [owts.sensors]: MS452500 bias set: 21.7Pa
42 I (12472) esp_https_server: performing session handshake
43 E (12802) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
44 E (12802) esp_https_server: esp_tls_create_server_session failed, 0x7780
45 E (12812) httpd: httpd_accept_conn: session creation failed
46 W (12812) httpd: httpd_server: error accepting new connection
47 I (12822) esp_https_server: performing session handshake
48 I (15432) esp_https_server: performing session handshake
49 E (15762) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
50 E (15762) esp_https_server: esp_tls_create_server_session failed, 0x7780
51 E (15772) httpd: httpd_accept_conn: session creation failed
52 W (15772) httpd: httpd_server: error accepting new connection
53 I (16082) esp_https_server: performing session handshake
54 E (16422) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
55 E (16422) esp_https_server: esp_tls_create_server_session failed, 0x7780
56 E (16432) httpd: httpd_accept_conn: session creation failed
57 W (16432) httpd: httpd_server: error accepting new connection
58 I (16592) esp_https_server: performing session handshake
59 I (17222) esp_https_server: performing session handshake
60 E (17572) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
61 E (17572) esp_https_server: esp_tls_create_server_session failed, 0x7780
62 E (17572) httpd: httpd_accept_conn: session creation failed
63 W (17572) httpd: httpd_server: error accepting new connection
64 I (17922) esp_https_server: performing session handshake
65 E (18262) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
66 E (18262) esp_https_server: esp_tls_create_server_session failed, 0x7780
67 E (18272) httpd: httpd_accept_conn: session creation failed
68 W (18272) httpd: httpd_server: error accepting new connection
69 I (18542) esp_https_server: performing session handshake
70 E (18872) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
71 E (18872) esp_https_server: esp_tls_create_server_session failed, 0x7780
72 E (18882) httpd: httpd_accept_conn: session creation failed
73 W (18882) httpd: httpd_server: error accepting new connection
74 I (18902) esp_https_server: performing session handshake
75 I (19402) esp_https_server: performing session handshake
76 E (19732) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
77 E (19732) esp_https_server: esp_tls_create_server_session failed, 0x7780
78 E (19742) httpd: httpd_accept_conn: session creation failed
79 W (19742) httpd: httpd_server: error accepting new connection
80 I (19752) esp_https_server: performing session handshake
81 E (20082) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
82 E (20082) esp_https_server: esp_tls_create_server_session failed, 0x7780
83 E (20082) httpd: httpd_accept_conn: session creation failed
84 W (20092) httpd: httpd_server: error accepting new connection
85 I (20102) esp_https_server: performing session handshake
86 I (20592) esp_https_server: performing session handshake
87 I (34502) esp_https_server: performing session handshake
88 E (34842) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
89 E (34842) esp_https_server: esp_tls_create_server_session failed, 0x7780
90 E (34842) httpd: httpd_accept_conn: session creation failed
91 W (34852) httpd: httpd_server: error accepting new connection
92 E (35072) esp-tls-mbedtls: write error :-0x0050
93 I (35072) esp_https_server: performing session handshake
94 E (35782) esp-tls-mbedtls: read error :-0x0050
95 I (35792) esp_https_server: performing session handshake
96 E (36112) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
97 E (36112) esp_https_server: esp_tls_create_server_session failed, 0x7780
98 E (36122) httpd: httpd_accept_conn: session creation failed
99 W (36122) httpd: httpd_server: error accepting new connection
100 I (36412) esp_https_server: performing session handshake
101 E (36742) esp-tls-mbedtls: mbedtls_ssl_handshake returned -0x7780
102 E (36742) esp_https_server: esp_tls_create_server_session failed, 0x7780
103 E (36742) httpd: httpd_accept_conn: session creation failed
104 W (36742) httpd: httpd_server: error accepting new connection
105 I (48672) [owts.radio]: [TX] burst start: 40 s @ 20 Hz
106 I (48672) [owts.aircraft_state]: arm burst: IAS=54 >= v_en=50 t_send=40s
107 I (48752) [owts.radio]: [TX] burst stop early: IAS=49 < v_en=50
108 I (48752) [owts.radio]: [TX] burst end, standby
109 I (74992) [owts.sensors]: MS452500 auto-rezero: start (|dp|<=30Pa for >=21s landed)
110 I (75892) [owts.sensors]: MS452500 auto-rezero: step dp=-0.1Pa bias=21.7Pa
111 I (76892) [owts.sensors]: MS452500 auto-rezero: step dp=-0.1Pa bias=21.7Pa
112 I (77892) [owts.sensors]: MS452500 auto-rezero: step dp=-1.1Pa bias=21.6Pa
113 I (78892) [owts.sensors]: MS452500 auto-rezero: step dp=-5.3Pa bias=21.6Pa
```

```
114 I (79892) [owts.sensors]: MS4525D0 auto-rezero: step dp=-1.1Pa bias=21.6Pa
115 I (80892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.6Pa bias=21.6Pa
116 I (81892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.6Pa bias=21.5Pa
117 I (82892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.6Pa bias=21.5Pa
118 I (83892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.1Pa bias=21.5Pa
119 I (84892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.1Pa bias=21.5Pa
120 I (85892) [owts.sensors]: MS4525D0 auto-rezero: step dp=-1.0Pa bias=21.5Pa
121 I (86892) [owts.sensors]: MS4525D0 auto-rezero: step dp=2.2Pa bias=21.5Pa
122 I (87892) [owts.sensors]: MS4525D0 auto-rezero: step dp=-1.0Pa bias=21.5Pa
123 I (88892) [owts.sensors]: MS4525D0 auto-rezero: step dp=2.2Pa bias=21.5Pa
124 I (89892) [owts.sensors]: MS4525D0 auto-rezero: step dp=-1.0Pa bias=21.5Pa
125 I (90892) [owts.sensors]: MS4525D0 auto-rezero: step dp=0.6Pa bias=21.5Pa
126 I (91892) [owts.sensors]: MS4525D0 auto-rezero: step dp=-1.0Pa bias=21.5Pa
127 I (92492) [owts.sensors]: MS4525D0 auto-rezero: complete (bias=21.5Pa)
```

Live Filter E W I D V Live

Die Seite **Logs** zeigt die zuletzt erfassten Logzeilen des Geräts:

- Das Gerät hält nur einen kleinen **Ringpuffer im Arbeitsspeicher**.
- Die Oberfläche kann lokal mehr Zeilen zwischenspeichern, sodass Sie weiter zurückscrollen können als der Gerätepuffer hergibt.
- Mit dem **Stufenfilter** blenden Sie **E** (Fehler), **W** (Warnung), **I** (Info), **D** (Debug) und **V** (ausführlich) ein oder aus.
- Scrollen Sie nach oben, stoppt das automatische Mitlaufen neuer Zeilen; am Seitenende wieder ankommen setzt das Live-Tailing fort.

4 Betriebsarten

4.1 Flugzeugmodus (Sender)

Im **Flugzeugmodus** misst das OWTS-Gerät die **angezeigte Fluggeschwindigkeit (IAS)** des Luftfahrzeugs und sendet sie per Funk an den Windenempfänger.

Proof of Concept – nicht für den Betrieb

OWTS ist derzeit ein **Machbarkeitsnachweis**. Für den **operativen Einsatz** wird es in dieser Ausbaustufe **nicht empfohlen**.

- **Funkvorschriften** und Zulassungsanforderungen hängen vom Land und der beabsichtigten Nutzung ab.
- **Sensorinstallationen im Luftfahrzeug** (einschließlich Pitot/Statik) können reguliert sein und je nach nationalem Recht und Luftfahrzeugkategorie Genehmigungen erfordern.

4.1.1 Ziele im Flugzeugmodus

- Stabile, latenzarme IAS an die Windenstation liefern.
- Bedienung schlank halten: ein Gerät im Flugzeug, einmal konfiguriert, wiederholt nutzbar.

Erste Schritte




Erstverbindung (SoftAP), Standardpasswort sowie URL/mDNS sind in [Einrichtung](#) beschrieben. Gemeinsame UI-Seiten (Info / Config / Logs) stehen unter [Web UI](#).

4.1.2 Flugzeugprofil konfigurieren

Konfigurieren Sie das Flugzeuggerät über die Oberfläche; die Einstellungen werden auf dem Gerät dauerhaft gespeichert.

Konfiguration → **Funk** (SX1262-Builds): SRD-Profil, Frequenz/Leistung, Anzeige des Tastverhältnisses über ein **gleitendes 3600-s-Zeitfenster** sowie optionaler Labor-Override – siehe [Web UI](#) → [Funk](#).

4.1.2.1 Flugzeug-Einstellungen (bearbeitbar)

OWTS DE EN   

Flugzeug-Einstellungen 441bf6fcd540

Kennzeichen

Kennzeichen

Typ

Typ

Geschwindigkeitszone

<p>v_min <small>Minimale Schleppgeschwindigkeit.</small></p> <input type="text" value="100"/>	<p>v_opt <small>Optimale Schleppgeschwindigkeit.</small></p> <input type="text" value="110"/>
<p>v_max <small>Maximale Schleppgeschwindigkeit.</small></p> <input type="text" value="130"/>	<p>v_en <small>Telemetrie-Startgeschwindigkeit (Sendung beginnt ab dieser Geschwindigkeit).</small></p> <input type="text" value="50"/>

Telemetrie-Sendedauer (s)



Telemetrie-Sendedauer (s): 60
Sekunden, die das Gerät nach erkanntem Start weiterhin IAS-Telemetrie sendet.

Landezeit (s)

Landezeit (s): 120
Sekunden, die IAS unter v_en bleiben muss, bevor der nächste Start wieder möglich ist.

Einheit Geschwindigkeit

<p>Einheit Geschwindigkeit</p> <input type="text" value="km/h"/>	<p>Einheit Höhe</p> <input type="text" value="m"/>
--	--

 Speichern
 Aktualisieren

4.1.2.1.1 Identität

- **Kennzeichen:** Luftfahrzeugkennzeichen (Anzeige am Windenempfänger und in der Historie).
- **Typ:** kurze Typbezeichnung (ebenfalls Empfänger und Historie).

Ändern Sie eines der Felder und wählen Sie **Speichern**, um es zu übernehmen.

Kennzeichenänderung kann Neustart auslösen

In der aktuellen Firmware-/Frontend-Logik kann eine Änderung der Identität kurz nach dem Speichern einen Gerätereustart auslösen (die Oberfläche lädt neu).

4.1.2.1.2 Geschwindigkeitsband

Das Geschwindigkeitsband definiert den Zielbereich, den die Winde optisch darstellt:

- **v_min:** minimale Windenstartgeschwindigkeit (untere Grenze)
- **v_opt:** optimale Windenstartgeschwindigkeit (Zielwert)
- **v_max:** maximale Windenstartgeschwindigkeit (obere Grenze)

Die Werte werden als Ganzzahlen in der gewählten **Geschwindigkeitseinheit** gespeichert (siehe unten).

4.1.2.1.3 Telemetrie-Sendefenster

- **v_en**: Startgeschwindigkeit für Telemetrie
Der Sender beginnt mit der Übertragung, wenn die IAS diesen Wert erreicht oder überschreitet.
- **Telemetrie-Sendezeit (s)** (`t_send`): wie lange nach erkanntem Start noch gesendet wird.
- **Lande-Sperre (s)** (`landing_hold_s`): die IAS muss für diese Dauer unter `v_en` bleiben, bevor ein neuer Start „scharf“ geschaltet werden kann (reduziert Mehrfachauslösungen).

4.1.2.1.4 Einheiten

- **Geschwindigkeit**: `km/h` oder `kts`
- **Höhe**: `m` oder `ft` (Anzeige/Metadaten in den aktuellen Builds)

Nach Änderungen **Speichern** wählen.

4.1.3 Sicht der Winde

Im Flugzeugmodus liefert der Sender typischerweise:

- aktuelle IAS (in der konfigurierten Einheit)
- Identifikation des Luftfahrzeugs (Kennzeichen / Typ)
- grundlegende Statusinformationen (sofern die jeweilige Firmware-Build das vorsieht)

4.2 Windenmodus (Empfänger)

Im **Windenmodus** empfängt das OWTS-Gerät die IAS-Telemetrie des Flugzeugs und stellt sie lokal bereit über:

- die **geräteinterne Web-Oberfläche** und
- die **REST-API** (von der UI genutzt, hilfreich für Diagnose und Integration).

Proof of Concept – nicht für den Betrieb

OWTS ist derzeit ein **Machbarkeitsnachweis**. Für den **operativen Einsatz** wird es in dieser Ausbaustufe **nicht empfohlen**. Siehe die Hinweise in der Dokumentation zum Flugzeugmodus zu Funkvorschriften und Betriebseinschränkungen.

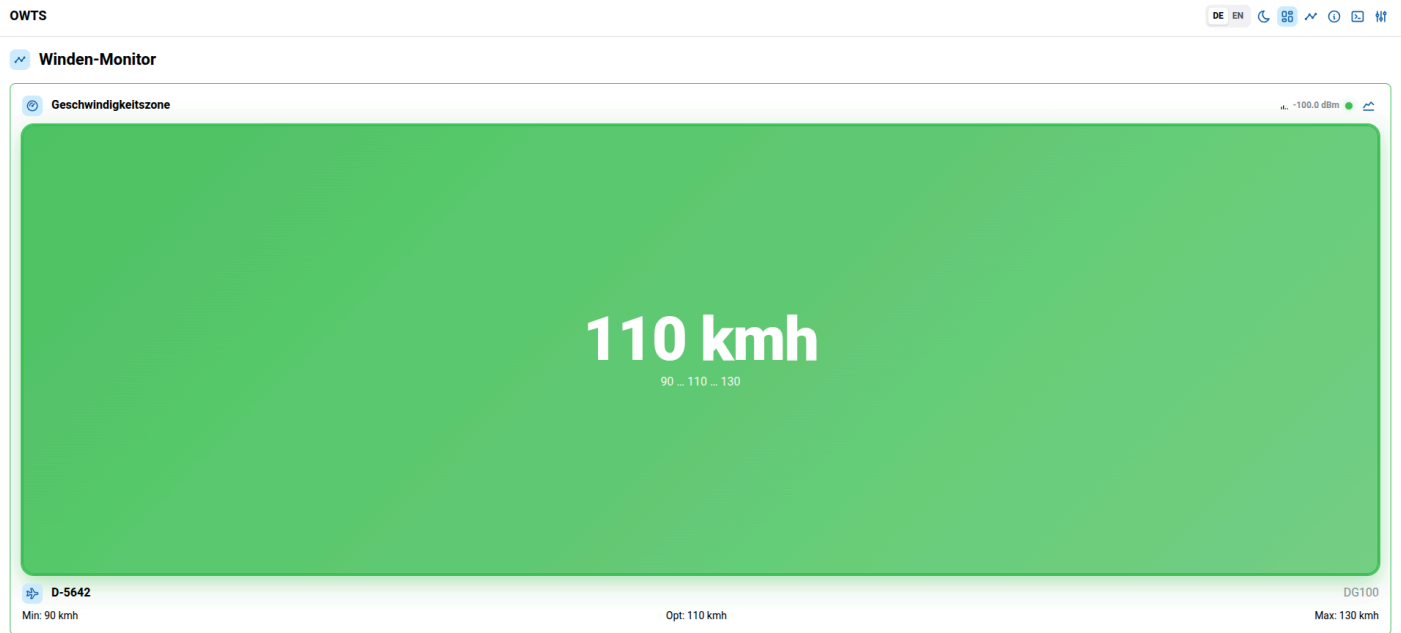
Erste Schritte

Erstverbindung (SoftAP), Standardpasswort sowie URL/mDNS sind in [Einrichtung](#) beschrieben. Gemeinsame UI-Seiten (Info / Config / Logs) stehen unter [Web UI](#).

4.2.1 Typischer Ablauf an der Winde

- Prüfen Sie, dass der Empfänger im **Windenmodus** steht.
- Bestätigen Sie den Funkempfang (Telemetrie sollte aktualisieren, solange der Flugzeugsender aktiv ist).
- Nutzen Sie die UI für aktuelle IAS und das konfigurierte Geschwindigkeitsband (min/opt/max).
- Ist das Gerät geschützt, geben Sie unter **Config** → **Sicherheit** das **API-Passwort** ein und bestätigen Sie es mit **Prüfen**, bevor Sie Einstellungen ändern (Neustart, WLAN usw.).

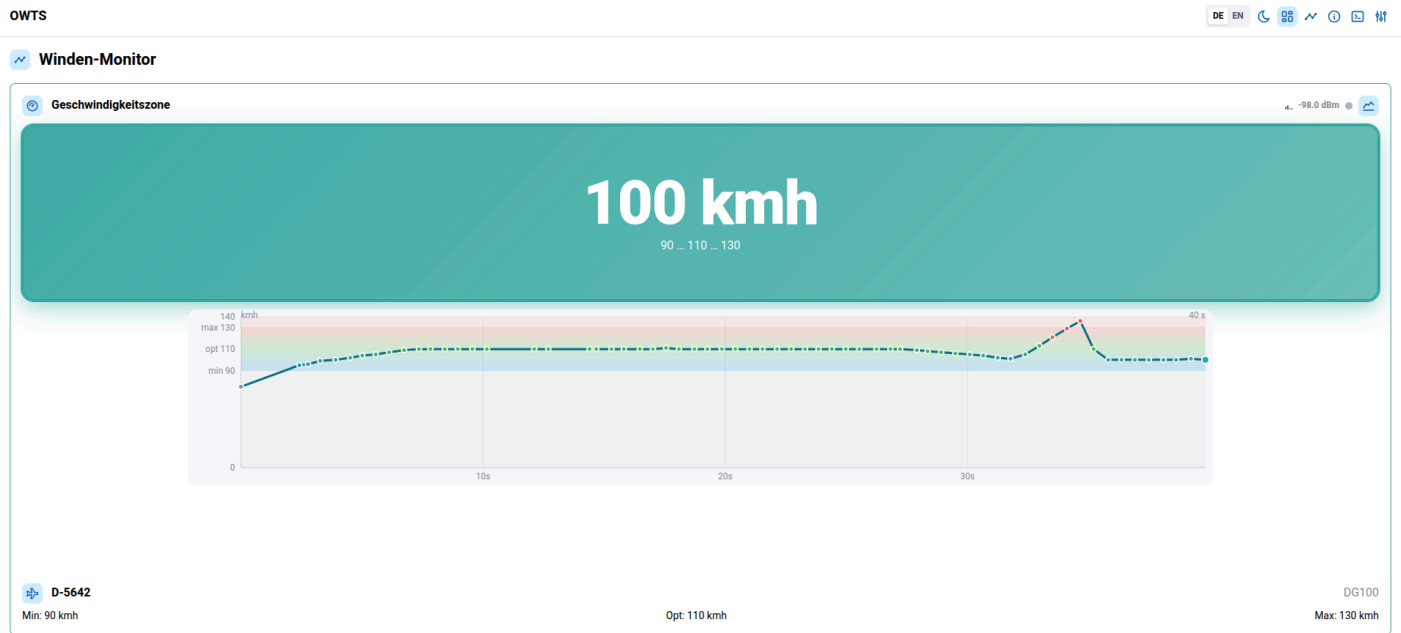
4.2.2 Winden-Monitor (Live-Ansicht)



Der **Winden-Monitor** ist die Standard-Startseite im Windenmodus.

- **Geschwindigkeitsband:** große farbcodierte Anzeige:
 - zeigt aktuelle IAS und das Band (min/opt/max)
 - Farbe signalisiert: unterhalb / innerhalb / oberhalb des Bandes
- **RX-Aktivitäts-LED:** kleine Anzeige neben dem Graph-Button
 - blinkt kurz **grün**, wenn **neue Telemetrie** decodiert wurde
 - bleibt **grau**, wenn das Polling erfolgreich ist, aber keine neue Telemetrie kam
- **RX-Signalstärke:** RSSI in **dBm** (nur sichtbar, wenn Telemetrie vorliegt)
- **Flugzeugidentität:** Kennzeichen und Typ erscheinen unter dem Panel, wenn Telemetrie vorliegt.

4.2.2.1 Winden-Monitor (mit Graph)



Mit **Graph umschalten** blenden Sie ein Live-Diagramm der IAS über der Zeit ein.

4.2.3 WS2812 LED-Strip (optional)

Wenn der Windenempfänger mit einem WS2812/WS2812B LED-Strip gebaut und verdrahtet ist, kann er den aktuellen Geschwindigkeitsbereich visuell darstellen:

- **Aus:** unterhalb v_{\min} / keine Telemetrie
- **Blau** → **Grün** → **Rot:** um v_{\min} → v_{opt} → v_{\max}

Die LED-Einstellungen konfigurieren Sie im Gerät unter **Config** (Windenmodus):

- **LED-Anzahl**
- **Helligkeit** (aktives Geschwindigkeitssegment)
- **Gedimmte Balkensegmente** – relative Helligkeit für LEDs unterhalb der aktuellen IAS
- **Richtung umkehren**
- **Farbreihenfolge** (z. B. GRB vs RGB)

Das Speichern der LED-Einstellungen löst einen **Neustart** des Geräts aus.

4.2.4 Starthistorie (lokal im Browser)



Die Seite **Letzte Starts** listet kürzlich erfasste Starts.

Historie liegt im Browser

Die Starthistorie steht im **lokalen Speicher** Ihres Browsers (nicht auf dem Gerät) und ist an das jeweilige Telefon/Tablet gebunden.

- Jeder Eintrag zeigt eine kleine IAS-Verlaufsvorschau und einen Zeitstempel.
- Mit dem **Papierkorb-Symbol** löschen Sie einen gespeicherten Starteintrag.

4.2.5 Fehlersuche (Kurzliste)

- **Keine Aktualisierung:**
 - Flugzeuggerät eingeschaltet und im **Flugzeugmodus**?
 - Stimmen Funkparameter (Frequenz/Leistung gemäß Implementierung) auf beiden Seiten überein?
- **UI lädt, Werte bleiben leer:**
 - Empfänger hat noch keine Telemetrie decodiert (oder sie ist abgelaufen).
 - Öffnen Sie die Seite **Logs** in der Web-Oberfläche, um zu prüfen, ob Telemetrie ankommt und ob Funk- oder Decode-Fehler protokolliert werden.

5 Hardware

Dieser Abschnitt wird erweitert. OWTS zielt derzeit auf:

- Heltec WiFi LoRa 32 (V3.2) / HTIT-WB32LA V3.2 – [Datenblatt \(PDF\)](#)
- Differenzdrucksensor MS4525DO (IAS) – [Datenblatt \(PDF\)](#)

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