N997CZ — GSU 25C ADAHRS Deviation Analysis & Replacement Verification

Original justification for service / replacement of the second ADAHRS (AHRS #2), prepared 2026-06-08, now updated 2026-06-13 with post-replacement verification data. From Garmin G3X flight-data logs.

Aircraft	N997CZ — Van's RV-10 (Experimental Amateur-Built), Lycoming IO-540, based KHEF
Avionics	Garmin G3X Touch; two GSU 25C ADAHRS (AHRS #1 & AHRS #2) + G5 electronic standby (SFD)
Data	Per-flight G3X flight-data logs (~1 Hz), flights 1–17 (2026-04-11 to 2026-06-13)
Unit in question	AHRS #2 — GSU 25C, original S/N **5Q2002262**. **REPLACED with a Garmin overhauled unit after flight 15 / before flight 16** (new unit S/N to be recorded).
Garmin case	AHRS #1 — Ref 32650868K1 / Q# 1011151. AHRS#1 replacement (S/N 5Q2102717) installed before flight 13; AHRS#2 replacement installed before flight 16. **Original cores 5Q2001016 (AHRS#1) and 5Q2002262 (AHRS#2) to be returned per Garmin instructions.**

Background

Through Phase 1 flight testing this aircraft has shown recurring in-flight **ATTITUDE** and **HEADING MISCOMPARE** annunciations and elevated ADAHRS deviation, concentrated during high-vibration / high-acceleration regimes (notably the takeoff roll) and maneuvering. Two corrective actions were taken: (1) the propeller was dynamically balanced (vibration reduced 0.57 → 0.01 IPS); and (2) **AHRS #1 was replaced with an overhauled unit from Garmin** (received and installed before flight 13; the original AHRS#1 core, S/N 5Q2001016, has been removed but has **not yet been shipped back to Garmin**). The analysis below isolates the effect of each action.

What the flight data shows

1. The prop balance broadly reduced deviation on all three AHRS sources — but did not eliminate the large excursions.

2. Replacing AHRS #1 corrected AHRS #1:

- In-flight AHRS #1 re-align ("AHRS1 ALIGN") annunciation time: **350 s total across flights 5–12** (old unit) → **0 s on flights 13, 14, 15** (new unit).
- Maximum cross-ADAHRS **roll** disagreement: **~136° on flight 12** (old unit, in flight) → **under 10° on flights 13–15** (new unit).
- Extreme deviation excursions (>500% reported µDEV) were eliminated with the new unit.

3. The remaining deviation now tracks to AHRS #2 (the original, unserviced unit):

- Considering only the larger excursions (reported deviation >200%), windowed from the start of the takeoff roll to touchdown and pooled by era: **AHRS #1 was the highest-deviation of the three sources on EVERY flight 5–12; after replacing AHRS #1, AHRS #2 is the highest-deviation source on EVERY flight 13, 14, 15.** The worst-performing unit flipped from #1 to #2 at the replacement (see Chart 1).
- AHRS #2 re-align ("AHRS2 ALIGN") events, which had **never** appeared in flight on the old configuration, appeared on flight 15 (**118 s**), with the system annunciating "USING AHRS1" (reverting to the new AHRS #1) for 120 s (see Chart 2).
- **The AHRS #2 re-align is REPRODUCIBLE ON DEMAND:** it can be induced repeatedly by flying high angle-of-attack (slow, full-power) climbs. On flight 15 it recurred in ~8 separate events, all during the slow climbs (median ~89 KIAS, full power, nose-up) within a single 30-minute window — the fault can be triggered again at will for any diagnostic Garmin would like.

4. Post-replacement verification (AHRS #2 overhauled unit, flights 16–17)

AHRS #2 was replaced with a Garmin overhauled unit after flight 15. Flights 16 and 17 (2026-06-13) are the first with **both** ADAHRS overhauled. All metrics below are windowed from the start of the takeoff roll to touchdown (power-on / alignment samples excluded):

- **ATTITUDE / HEADING MISCOMPARE annunciation time: flight 15 had 346 s ATT + 209 s HDG → flights 16 and 17 each had 0 s of both.** The miscompares that persisted even after the AHRS#1 overhaul (because AHRS#2 was still disagreeing) are now fully resolved.
- **AHRS #2 re-align ("AHRS2 ALIGN"): 118 s on flight 15 → 0 s on flights 16 and 17**, with no "USING AHRS1" reversion. AHRS #1 re-align also remains at 0 s.
- Maximum cross-ADAHRS **roll** disagreement: **0.8° (F16) and 3.0° (F17)** — vs ~136° on flight 12 with the original AHRS#1. No >500% deviation tumbles on either unit.

Conclusion

The original AHRS #2 (S/N 5Q2002262) exhibited the same in-flight deviation and re-align signature that AHRS #1 had shown before its overhaul, and the overhaul of AHRS #1 resolved that unit. **With the overhauled AHRS #2 now installed, the attitude/heading miscompares and re-aligns have gone to zero across flights 16–17 — confirming the AHRS #2 replacement resolved the remaining fault.** This document is retained as the verification record; the two original cores (5Q2001016, 5Q2002262) will be returned to Garmin per their instructions.

Respectfully submitted,
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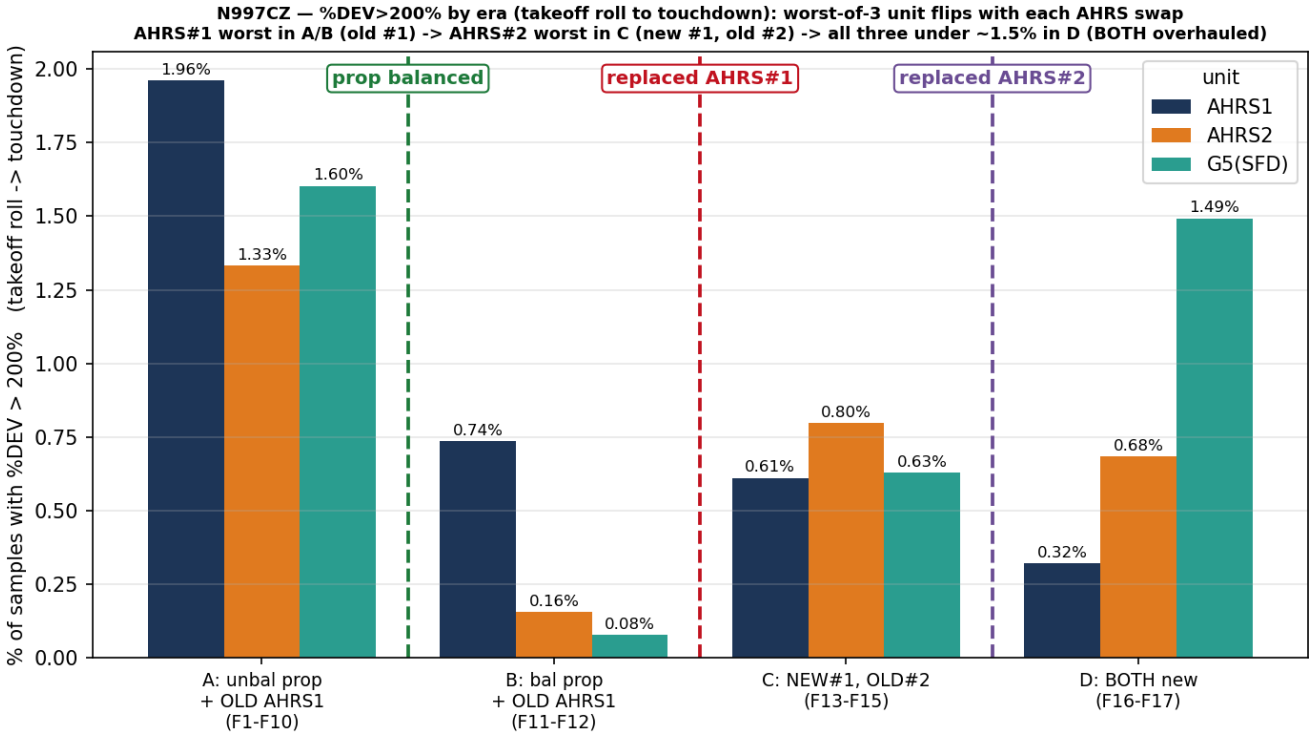
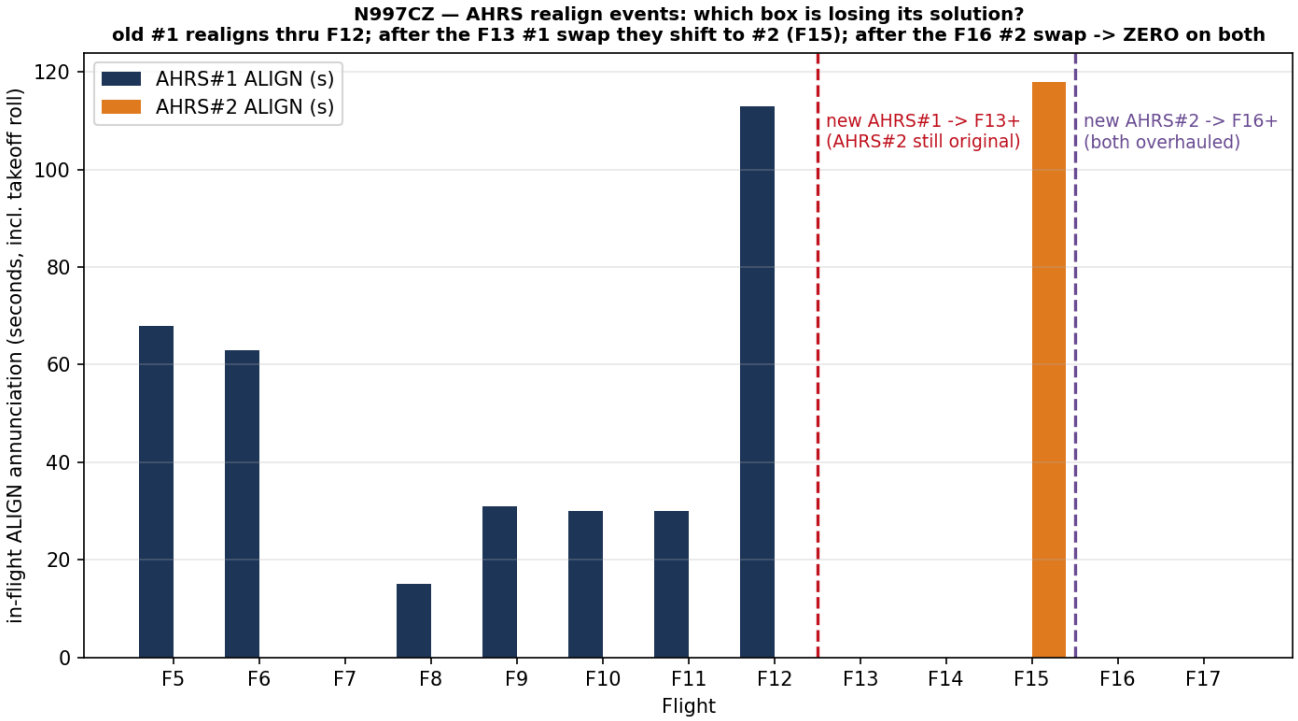
Chart 1 — ADAHRS deviation by era (reported %DEV > 200%, takeoff roll to touchdown)



Each bar = the percentage of in-flight samples in which that unit reported deviation above 200%. Era A: original prop + original AHRS#1. Era B: after prop balance, still original AHRS#1. Era C: after the AHRS#1 replacement (AHRS#2 still original). Era D: after the AHRS#2 replacement (both units overhauled). The prop balance lowers all three units (A→B); after replacing AHRS#1 (B→C) **AHRS#2 becomes the highest-deviation unit**; after replacing AHRS#2 (C→D) **all three sources sit under ~1.5%**. (These two low-maneuvering flights make this maneuvering-sensitive metric less discriminating than the re-align and miscompare results above.)

Chart 2 — In-flight ADAHRS re-align ("ALIGN") events per flight



Seconds per flight that each unit annunciated an in-flight re-align (loss/reacquisition of its attitude solution), including the takeoff roll. **AHRS#1 (navy) re-aligned on flights 5–12 and stopped completely once the overhauled unit was installed at flight 13. On flight 15 the re-align appears instead on AHRS#2 (orange). After the AHRS#2 overhaul was installed (flight 16+), re-aligns go to zero on BOTH units** — the verification result.