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GLASS COCKPIT · SYSTEMS GUIDE

Garmin G1000 Study Guide

How the system is built, how to fly with it, and how to answer for it on a checkride

Written for pilots training in G1000-equipped airplanes. Aircraft-neutral: your airplane, software version, and options come first. Cross-referenced to the Private Pilot ACS (FAA-S-ACS-6C).

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This free sample is from the Garmin G1000 Study Guide: how the sensors build your instruments, and failures and abnormal situations. Free to share in this form. Independent study material, not an FAA publication, and not a substitute for your POH/AFM or flight instruction. Always verify against current FAA sources.

3. How the sensors build your instruments

A steam-gauge airplane has one instrument per sensor. A G1000 airplane has **sensors, computers, and displays**, and the displays only show what the computers tell them. Understanding that chain is the key to diagnosing a failure quickly: if you know which box feeds which number, a red X tells you where to look.

Air data: airspeed, altitude, vertical speed, temperature

- The **pitot tube** and **static ports** send pressure to the **air data computer (ADC)**. A temperature probe sends outside air temperature.
- The ADC converts pressure to **indicated airspeed** (pitot minus static), **pressure altitude** (static, then corrected with the baro setting you enter), and **vertical speed** (the rate of change of static pressure).
- With the temperature, the ADC also computes **true airspeed** and **density altitude**.
- The system computes **wind** by comparing your true airspeed and heading from the air data and AHRS with your groundspeed and track from the GPS. If any of those is wrong or missing, the wind display is wrong or disappears. That makes the wind display a good cross-check: a sudden strange wind often means one of the inputs has a problem.
- A blocked pitot or static source produces the same errors as on analog instruments (frozen airspeed with altitude change, frozen altimeter). The difference is that the G1000 can show a red X when it detects a bad reading, and the standby instruments give you something independent to compare.

Attitude and heading: the AHRS

- The **attitude and heading reference system (AHRS)** replaces the vacuum-driven attitude indicator and the gyro-driven heading indicator. Instead of spinning gyros, it uses solid-state **rate sensors** (they measure how fast the airplane is rotating) and **accelerometers** (they measure acceleration and the direction of gravity).
- It combines those with data from the **magnetometer** (heading), the **air data computer** (airspeed), and the **GPS** (position and groundspeed). The computer blends these sources to keep attitude and heading accurate and corrects for errors over time.
- This is why the AHRS needs a short **alignment** after power-up, and why it can show an alignment message after unusual maneuvers or in turbulence. If a source it depends on fails (for example the magnetometer or GPS), the AHRS can keep working with reduced accuracy, or it can flag part of its output. The display tells you which.
- Because there are no spinning gyros, there is no precession and no tumble limit, but the AHRS can still be fooled by a bad magnetic environment (a magnetometer near a steel object or a strong electrical current), so keep metal and magnets away from the magnetometer location.

Why the red X matters

A red X means the system has decided the data is not trustworthy and has removed it. That is intentional and good. A wrong number displayed confidently is more dangerous than a missing one. When you see a red X, find out which function failed (attitude, heading, airspeed, altitude, or vertical speed), then decide which sensor chain is involved and which standby or alternate source you will use.

Red X on	Likely source	Your backup
Airspeed, altitude, vertical speed (all together)	Air data computer or pitot/static problem	Standby airspeed and altimeter
Airspeed only	Pitot blockage or a pitot heat problem	Standby airspeed, GPS groundspeed as a cross-check

Red X on	Likely source	Your backup
Attitude and heading	AHRS failure or loss of its power	Standby attitude indicator, magnetic compass
Heading only	Magnetometer problem	Magnetic compass, GPS track
Engine values	Engine/airframe unit or a sensor	Remaining gauges, your POH limits, a conservative power setting

12. Failures and abnormal situations

This is the part of the G1000 that students most often fear, and the part examiners most often test (Task IX.C includes electronic flight display malfunction). The rule is the same as for any failure: **aviate, navigate, communicate**. Fly the airplane first, identify what failed, and use the POH and AFM supplement.

Failure	What you see	What to do (general)
Display failure (PFD or MFD)	A blank screen, or the working display switches to a combined layout (reversion).	Fly the airplane using the working display and the standby instruments. Press the display backup button if the system has not done it itself. Tell ATC if it affects you.
AHRS failure	Red X on attitude and heading, or an alignment message.	Use the standby attitude indicator and the magnetic compass. Don't use the PFD attitude until it is valid.
Air data failure	Red X on airspeed, altitude, or vertical speed.	Use the standby airspeed and altimeter. Use GPS groundspeed and altitude only as cross-checks. Know where your pitot and static sources are.
Magnetometer failure	Heading flag or red X on heading.	Use the compass. GPS track can help with direction.
GPS failure	A loss of position message and a changed map.	Use pilotage, dead reckoning, and VORs (if available). Tell ATC if needed.
COM or NAV radio failure	No transmit or receive, or a failed annunciation.	Check the audio panel, volume, squelch, and headset. Switch to the other radio. Follow lost communication procedures.
Electrical failure (alternator)	A low-voltage or alternator failure alert. The system runs on the battery.	Follow the POH checklist. Reduce the electrical load and plan to land as soon as practical. Know how long the battery will last and what is on the essential bus.
Autopilot failure or disconnect	A disconnect tone and annunciation.	Take control of the airplane immediately. Trim as needed.
Database or card problem	A message at startup or in flight.	Decide whether it affects the flight. Do not rely on affected data.

> Always check what your **airplane's AFM supplement** says about each failure and any limits on continued flight. Many G1000 airplanes require specific equipment (a standby instrument, the backup battery) to be working to dispatch, so the question "Can we go?" connects to the equipment and airworthiness material in Task I.B.

What the examiner may do

- Cover a display or an instrument, and ask you to continue the flight.
- Pull a circuit breaker, if it is safe and allowed, to simulate a failure.
- Ask you to describe what you would see and what you would do, if the test airplane cannot simulate it.

That was a sample.

The full guide explains every Task the same way.

The full Garmin G1000 Study Guide (24 pages) includes:

- Fourteen chapters, from the system architecture to the autopilot
- The PFD, MFD, navigation, and audio panel, explained in aircraft-neutral terms
- Where the G1000 shows up in the ACS
- Study drills to practice on the ground or in a simulator

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