G1000 FAILURE MODES

When the big, red Xs appear on the display, something has gone wrong. Here's a guide to what can go wrong and what you can do about it.

by Fred Simonds

Instrument student Phil and I are in a new Cessna 182 with a fully optioned G1000 Flight Management System, including the highly regarded GFC700 autopilot.

In solid IMC we are cleared to our final altitude of 9000 feet. Phil sets the altitude and vertical speed bugs.

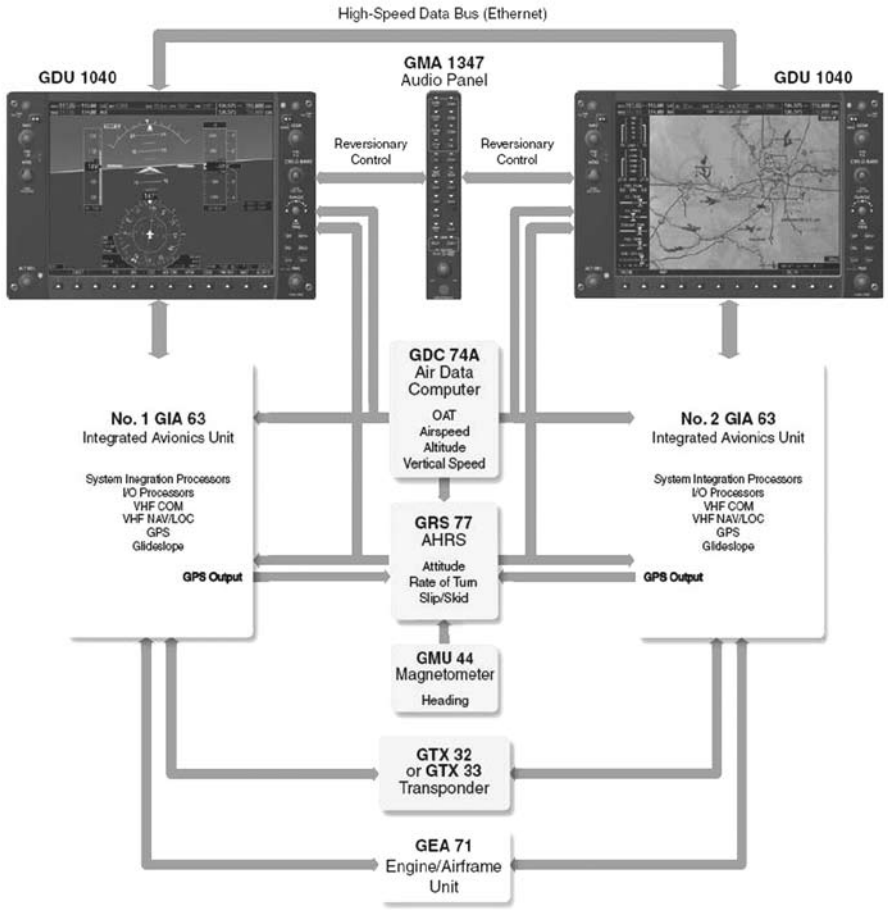
The GFC700 engages, climbs and levels us at 9000. All seems right, but ineluctable Murphy chooses his battlegrounds with care. Within our milk bottle world , I gaze at the instruments.

Our airspeed soon shows a slight decrease. I then note a slight pitch up and climb. In a heartbeat we have transited 200 feet upward for no reason, and the airspeed has decayed toward double digits.

Phil pickles off the autopilot, but the damage is done. The autopilot precipitated a nose-up trim runaway. Against the nearly full aft trim I push hard on the yoke to regain control and roll in forward trim.

Phil pulls the autopilot circuit breaker. ATC says nothing. We have averted a stall in IMC as well as having to explain an altitude deviation.

I scroll to the AUX System Status page, and find a big, red X next to the GFC700. The autopilot, the trigger for this article about G1000 system failures, an all-too-neglected aspect of G1000 training.



The full system diagram for the G1000. No failure of the system or a component renders your airplane unflyable. Knowing the consequences of particular failures speeds your troubleshooting and minimizes disruption.

When a Failure Occurs

Know this first: G1000 failures are rare and no G1000 component failure can make the airplane unflyable. Even an autopilot failure which is logically closest to the control surfaces can be overcome. The first rule in dealing with any sort of failure of the G1000 is the same as any other malfunction aboard an aircraft: *fly the airplane.*

G1000 instrument failures manifest themselves with unmistakable red Xs. If you get one that is more than momentary, you may have a failure.

More subtle failures, such as our autopilot disappointment, cause the airplane to misbehave. As PIC, you surely know what's right and not.

The Five Questions:

1. Can I fix it?

Check the circuit breakers; one may have popped due to a momentary glitch. You get one shot at resetting any breaker in any airplane.

If it pops again, leave it out. After resetting it, check the G1000 System Status page. A red X means a real component failure.

2. How is my flight information affected?

This means airspeed, altitude, ver-

tical speed and outside air temperature. All of these derive from the GDC74 Air Data Computer.

If the ADC quits, it will show a red X over the affected instruments and on the System Status page.

In Cessnas, one circuit breaker is shared between the ADC and Attitude and Heading Reference System (AHRS).

Cycling it causes the AHRS to reinitialize, which takes less than a minute, but you must temporarily use the standby attitude indicator. The AHRS can initialize in flight at bank angles up to 20 degrees.

3. How is my navigation ability affected?

The system diagram shows two Garmin Integrated Avionics Units or GIAs that house independent VOR, LOC, GS and GPS receivers. The units differ only in that the number one unit houses the GFC700 Flight Director if so equipped. It's hard to lose navigation capability altogether.

In the event of a dual GPS failure or more likely a localized GPS system outage, the G1000 reverts to Dead Reckoning mode as shown by a magenta DR warning in the HSI compass card.

Then it acts as a poor-man's inertial navigation system whose accuracy diminishes with time. It's time to pull out that VOR navigation stuff your wise old instructor insisted you learn.

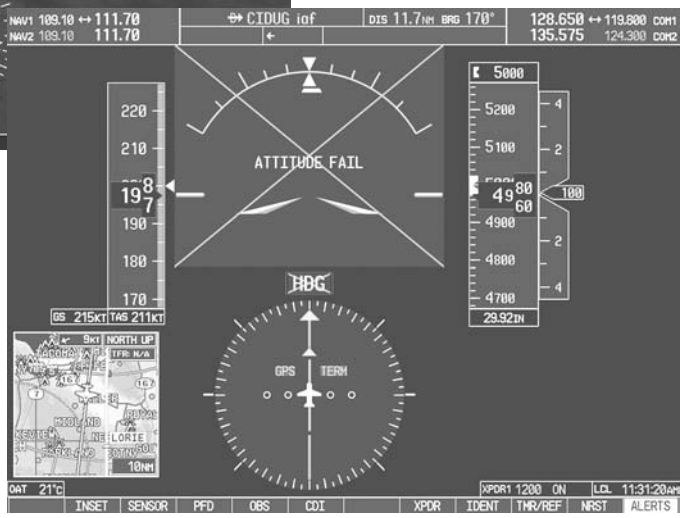
4. How is my communications capability affected?

Each GIA also contains a communications radio, so losing comm completely is also unlikely. A red X denotes a failed radio.

5. How is my autopilot affected?

Airplanes equipped with a Bendix-King KAP140 autopilot are minimally affected since there is little integration with the G1000.

The KAP140 is connected to the number two GIA; if that fails it takes the KAP140 with it. Effects of specific failures on the GFC700 are discussed below.



And things were going so well. At left the Primary Flight Display, with pathway, if full-functioning glory. Below, AHRS failure annunciated. It's so rare that you may only get to see it here or in a simulator. The solution? Keep flying the airplane and revert to the standby attitude and heading indicators.

Specific Failures

Let's look at eight major failure modes and see how each degrades G1000 functionality.

For all failures, check the circuit breakers and avoid or exit IMC if you can. Under FAR §91.187 you must also report any in-flight malfunction affecting navigational, approach or communications equipment.

Display Failures

Should a GDU Display Unit fail, the system automatically switches to reversionary mode. The PFD flight and engine instruments appear on the remaining display, displacing the moving map but not the PFD Inset map. Whichever display fails, it will take its associated GIA with it.

If automatic reversion fails, hit the red Display Backup button to force reversion. This button can also be used to practice failures in flight.

If the PFD fails, GIA1 fails, and takes the GFC700 out completely, including autopilot and flight director.

If the MFD fails, GIA2 is likewise lost. GFC 700 capability is unaffected.

GIA Integrated Avionics Unit

If one GIA fails, a red "X" appears in its COM/NAV frequency boxes and an alert annunciation appears to the right of the PFD altitude and vertical speed tapes. It is seamlessly replaced by the other GIA including any active GPS navigation with no pilot intervention.

If both GIAs fail, the AHRS and ADC keep providing heading, attitude and air data directly to the GDU displays. Partial GIA failures are more likely since the COM/NAV/GPS components are independent within a GIA.

AHRS

Losing heading and attitude reference is one of the most debilitating failure modes. It forces you to use the standby attitude indicator, breaking your nor-

mal scan.

The GPS position on the moving map still works and the GPS-derived MFD compass rose far surpasses the wet compass for heading information.

The attitude function works even if the GPS, ADC or magnetometer modes that work.

Should a combined AHRS and ADC failure occur, only the NAVCOMs, GPS and manual electric trim survive. The GFC700 fails completely.

You can still shoot an approach

The full G1000 in a Cessna 172 showing relative positions of PFD, MFD and standby instruments.

inputs fail, but not the AHRS itself.

The HSI fails along with the slip/skid indicator and the bearing pointers, but the CDI still works. While the GFC700 fails completely, the manual electric trim survives.

Air Data Computer

The GDC74 ADC provides all air-based information: airspeed, altitude, vertical speed and outside air temperature.

While there is a standby airspeed and altimeter, there is no VSI backup and your scan is once again pressed hard.

Navigation and communications are unaffected. Transponder Mode C altitude reporting falls back to Mode A, making operation in Class C and B airspace contingent on ATC approval.

The GFC700 fails partially: lateral modes (e.g., HDG and NAV) of the flight director continue working, but only simple pitch mode survives vertically. The AFCS Status Box will show because the GPS, CDI and GS still function. This should also be practiced to develop and maintain proficiency.

Airborne, we simulate this failure using a template (more on this later).

Never pull circuit breakers to simulate any G1000 failure.

Magnetometer Failure

Heading information comes from the GMU44 tri-axial magnetometer in the wing which feeds the AHRS system.

If the GMU fails, stabilized heading data is lost, which means the HSI compass card becomes a simple CDI and the bearing pointers also fail. Substitutes are the GPS and wet compass.

The GFC700's vertical modes and roll mode keep working. NAV modes will continue working if engaged prior to the failure, but will not engage after failure.

Transponder

If the GTX32/33 fails, a red X appears over the PFD transponder box and an advisory message appears.

Engine Indication System

Should the GEA71 fail, all engine/airframe data is lost.

It is far more likely that individual engine/airframe sensors will quit such as EGT/CHT probes.

Again, red X's tells the story. In some aircraft, EIS-related advisories may also appear.

Audio Panel

Last in this dismal outline is the audio panel. The GMA1347's emergency mode connects the pilot to COM1.

The intercom fails. You cannot use the GFC700 autopilot since there will be no aural annunciations such as AP disconnect.

What You Can Do

First, know enough Garmin nomenclature so you can identify a failed core component in the System Status display as noted above.

Second, practice. Practice PFD and MFD failures in a simulator and then airborne.

You will discover ways to use the G1000's remaining information to take some of the sting out of a failure.

If you press the PFD menu button once, you will be offered dimming choices for both the PFD and MFD to simulate a failed display. This works in the air and in the Garmin PC Trainer. Use the avionics dimmer to dim both displays.

To really press yourself, the G1000 PC trainer can simulate very granular failures.

Third, there is a template that fits over the PFD and simulates a combined ADC/AHRS failure. You can download one free from my web page below.

Fred Simonds is a Gold Seal CFII and factory-certified G1000 instructor. See his web page at www.fredonflying.com.