

# AUTOPILOTS

# 2009

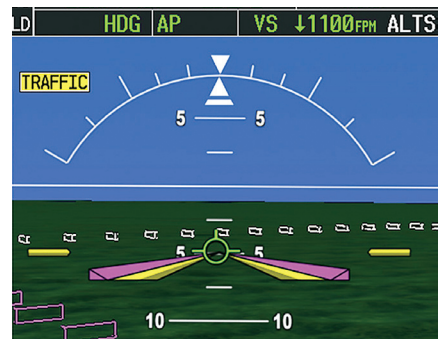
*Expert Tips,*



&

*Techniques*

*Tricks*



STORY BY DALE SMITH

**A**fter spending way too long in the background, autopilots have been receiving their share of well-deserved attention these days. Garmin's GFC 700 has sold more than its share of new G1000-equipped airplanes, while Avidyne's recently announced DF100 digital autopilot is promising to bring the digital precision provided by solid-state ADAHR inputs to owners of Entegra-equipped Cirrus SR20 and SR22 aircraft.

While all the advanced capabilities offered by these new-generation autopilots are exciting and beneficial for the fortunate few pilots who can take advantage of them, the rest of the flying population is pretty much left believing their current autopilot is as good as it's going to get. Well, maybe yes and maybe no.

The correct answer depends on what your customers are looking for. If they want to keep their wings level, their current autopilot is probably plenty good enough to do the job. If, on the other hand, they want to take advantage of some new capabilities, it's likely they're going to need to upgrade.

"Newer autopilots offer much greater technologies and capabilities," said

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Trying to compare the capabilities of two generations of AUTOPILOTS is like comparing a WALKMAN to an *iPod* — sure, they both play music, but one can do a whole lot more.

Alan Grimes, systems engineering manager for Century Flight Systems. “Properly configured, all the current generation autopilots have the ability to perform the new WAAS approaches, including LNAV, VNAV, RNAV and LPV tracking of the pseudo localizer and pseudo glideslope with astounding precision. Features like this help reduce the pilot’s workload.”

Are these capabilities enough reason to replace a perfectly good autopilot?

“In a lot of cases, customers with money to spend have to look at the situation,” said Bob Ferguson, chief pilot for Autopilots Central. “Some systems are too old and limited in functions to allow the pilot to take advantage of the new capabilities found in the rest of their avionics package. Systems that will not readily adapt to GPSs and cannot couple to the glideslope to fly WAAS/LNAV/VNAV approaches are good candidates for replacement.”

There are some aftermarket

upgrade adapter kits available to add some of the newer-generation features to legacy autopilots, but the aircraft’s owner needs to take a hard look at the cost vs. benefit equation. It might be more cost-effective in the long run to upgrade to a new system.

“It all comes down to what are they actually trying to accomplish,” Ferguson said. “Will it give them more capabilities? In many cases, people just want something new.

“People do it all the time with radios — they are taking out perfectly good King KX-155 radios with KLN-89B GPSs and putting in a Garmin stack — for all the right reasons,” Ferguson said. “But they don’t do that as frequently with autopilots. They’re too expensive, and replacing an autopilot is always ‘major surgery’ to the airplane.”

So, a customer can be left with a dilemma: His current autopilot doesn’t quite operate up to par, but a new unit is probably out of his budget. What are the guidelines for

making the repair versus a replacement?

“If it’s a system we can still get parts for and maintain properly, we can almost always overhaul it back to like-new condition for about a third of the cost of a new system,” Ferguson said. “Refurbishment is always more reasonable than replacement — unless they want new features and functions that their current system can’t give them.

“For example, I can put in a sophisticated S-TEC (now Cobham Avionics) system and give them altitude and vertical speed pre-select,” he said. “Right now, there’s no amount of money I can spend on their Century III to give them those features. If they’re important to them, they will have to upgrade.”

Trying to compare the capabilities of two generations of autopilots is like comparing a Walkman to an iPod — sure, they both play music, but one can do a whole lot more.

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# Autopilot Troubleshooting Checklist

*From Cobham Avionics, Integrated Systems*

- Obtain a detailed history of all aircraft maintenance.
- Obtain a detailed description of all relevant flight characteristics and parameters, such as altitudes, autopilot modes, CG locations, airspeeds, frequency of occurrence, etc.
  - Obtain a static-system leak rate at a simulated altitude of 18,000 feet. (Ensure the static system is connected to the autopilot transducer.)
    - Has the aircraft's control system been inspected for worn parts? (Bolts, bushings, cables, pulleys, rod-ends, etc.?)
    - Has the aircraft's control system been inspected for excessive play?
    - Has the aircraft's control system been inspected for excessive friction?
    - Has the aircraft's control system been lubricated in accordance with the aircraft manufacturer's specifications?
    - Has each aircraft control surface been inspected for proper installation?
    - Has each aircraft control surface been inspected for freedom of movement?
    - Has the travel of each aircraft control surface been verified to be within the aircraft manufacturer's specifications?
    - Has the programmer/computer tray been installed in accordance with the STC?
      - Is the programmer/computer tray properly supported?
      - Is the programmer/computer completely seated in its tray?
      - Has the autopilot wiring harness been properly separated from the aircraft's AC and DC power buses? □

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Another challenge for owners trying to make the repair vs. replacement decision is finding a qualified avionics shop to do the work.

“With regards to the older systems, there aren't many qualified autopilot shops out there with the parts inventory,” Ferguson said. “And they don't have the experience level to do a tear-down and rebuild. For example, there is no factory-authorized repair of Century servos outside the factory itself. There is no servo overhaul manual from Century.

“A typical shop can't take a servo apart, put it back together, call it overhauled, and put it in a customer's airplane — there is no procedure to do that from Century,” he said.

Ferguson said Autopilots Central wrote its own manual and had it FAA-approved.

“We have a lot of motor overhaul experience because of the overhaul manuals we've written for other companies. A lot of shops these days don't want to do that level of work,” he said.

## **AUTOPILOT TROUBLESHOOTING 101**

Another major factor in the repair vs. replacement equation is, just how sick is the aircraft's current autopilot? More importantly, is the problem really autopilot-related or is there another cause?

“One of the best ways to troubleshoot an autopilot is start with all the systems around it. Use a holistic approach, if you will,” said Greg Plantz, vice president of sales and marketing for Cobham Avionics, Integrated Systems (formerly

Perhaps the most common cause of autopilot  
“malfunctions” is a *“LOOSE NUT IN THE COCKPIT”*  
— aka “OPERATOR ERROR” — or more likely, operator  
misunderstanding of how the equipment is supposed to work.

S-TEC Corp., prior to merging with Chelton Flight System).

“You have to take the approach that just because the airplane is not flying correctly with the autopilot, it may not be autopilot-related. If the airplane just came from the maintenance, paint or upholstery shop, then I have a good idea where to look first for the cause of the problem — especially if the pilot reports that the system was working fine before it went in for work.

“You can spend 30 minutes asking the right questions and looking at the right things and save yourself days of troubleshooting work,” Plantz said. “We had a customer come in and said his autopilot cut off every time he turned on his strobe lights. We discovered they had wrapped the autopilot wires in with the strobe wires; so, every time they flashed, they got a 50-volt spike in the autopilot and it would kick off. We separated the wires and everything was fine — but all along they swore it was an autopilot problem.”

Plantz shared another instance when an owner of a Cessna 414 came to them with a pitch-porpoise problem.

“We started asking questions about loads and such, and when

we got to the weight-and-balance he said it was OK. Well, we put the airplane on the scale and found it was about four inches outside the aft CG,” Plantz said. “Turned out he had cases of oil, two sets of golf clubs and all kinds of other stuff under a blanket in the rear. Once we took it all out, the airplane was back in CG and flew fine. We could have spent days trying to figure out a technical reason for the problem if we hadn’t checked the weight-and-balance.”

While asking the pilot questions prior to beginning the troubleshooting process is the best practice, be forewarned: You must be careful with both the questions you ask and how you interpret the answers you get back.

“The first thing a technician has to remember is the worst information you are going to get is from the pilot,” Plantz said. “You don’t want to get caught up on chasing non-quantifiable information. They don’t remember any of the details, they just know, ‘It didn’t work right.’”

Ferguson said a technician must know what the autopilot is supposed to do. “He can use that knowledge to quiz the pilot reporting the malfunctions to specifically describe exactly how the system isn’t performing.”

Another excellent tip is to always fly with the customer to see how the system performs and how the pilot operates the system.

“First thing I tell guys to do is to see if the airplane will fly straight and level with the autopilot off,” Plantz said. “If you can’t trim it to fly straight with the autopilot off, then it won’t fly straight with it on.”

Perhaps the most common cause of autopilot “malfunctions” is a “loose nut in the cockpit” — aka “operator error” — or more likely, operator misunderstanding of how the equipment is supposed to work.

“I call it ‘finger problems,’” Plantz said. “I’ve flown with people who right after they take off, they look like they’re dialing a telephone — they’re hitting buttons so fast. They expect the autopilot to do everything at the same time. It can’t. Some common sense has to come into play.”

### START WITH A K.I.S.S. APPROACH

If you determine there is a problem with the autopilot itself, the best way to begin troubleshooting is by keeping it simple. Start with the manufacturer’s published testing procedures.

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“Follow the procedures for the ground-system test,” Grimes said. “We have publications out there that will tell you how to troubleshoot a system in the aircraft to determine the defective LRU (line replacement unit). A thorough ground-check is critical.

“Always check the current draw on the servo motor. You may have a motor that acts right until it gets a bit of higher current,” he said. “It should draw less than half an amp at startup when the motor first starts spinning without the clutch engaged. In situations where we have more than a half or three quarters of an amp or current draw, it can cause a pitch-porpoise or a wing-rock.”

Grimes said the servomotor sometimes will build up carbon on the armature between it and the brushes, causing the servo to have a higher than normal starting voltage.

“Operating the motor back and forth at the rated voltage a few times with the clutch disengaged may clean the armature and return the starting voltage to an acceptable level,” Grimes said. “Also, in the older systems, there may be what we call ‘split-pin connectors,’ which are the old round blue 4, 5, 7 and 9 contact connectors in which the female sockets are split. Over time, these connectors lose their spring tension and create bad connections between them and the male pins. Simply changing these connectors can fix many intermittent or solid fault problems.”

Should you run into a particularly stubborn autopilot problem, instead of wasting a lot of time trying to hunt down the cause, take a few minutes and call the system’s OEM or a shop specializing in autopilots.

“Shops that don’t do this every day have quite a learning curve before they can take the autopilot out and put it back in and set it up properly,” Ferguson said. “If they do it wrong, they can set up situations where the autopilot is not safe for the pilot. They can also set up situations where what was just repaired won’t stay repaired for long.”

### IT’S EASIER THAN IT LOOKS

There’s no denying autopilots are extremely sophisticated and capable systems — the key word here is “systems.” Unlike transponders and nav/coms, autopilot controllers, servos and sensors are integrated with many parts of the aircraft; therefore, troubleshooting these sophisticated systems is challenging but not necessarily difficult — if you understand how they really work.

“I believe this whole autopilot troubleshooting thing comes down to common sense — more so than anything else on the airplane,” Plantz said. “It’s not difficult. People want to make it difficult, but it’s not. Most likely the problem is actually something very simple. It’s probably cables that are too loose or too tight, or friction, or a servo voltage problem or maybe a static leak or water in the static system.

“Once you identify the problem, start your troubleshooting with the most likely cause, then work your way back to the autopilot from there,” he said. “Chances are, you won’t have to go too far. If it’s a real autopilot problem, it probably won’t work at all. Most electronics don’t develop problems slowly; they just quit working.” □

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*If you have comments or questions about this article, send e-mails to [avionicsnews@aea.net](mailto:avionicsnews@aea.net).*