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Aspen Evolution

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AVIONICS EVALUATION

Aspen Evolution Practical, Affordable

While it might not exactly be cheap, you don't have to buy a half-million dollar airplane to have it. Modular design and in-depth engineering make it a winner.

by Larry Anglisano and Paul Bertorelli

The aftermarket has waited for what seems an eternity for a reasonably priced glass alternative to primary steam-gauge flight instruments. With much fanfare and no small risk, Albuquerque-based Aspen Avionics fills the void with their EFD1000 series PFD at a cost that's easy on the budget. It's not a big-screen PFD and it's still too early to call the product a universal slam-dunk winner, but in our view Aspen is off to a great start.

SMART INNOVATION

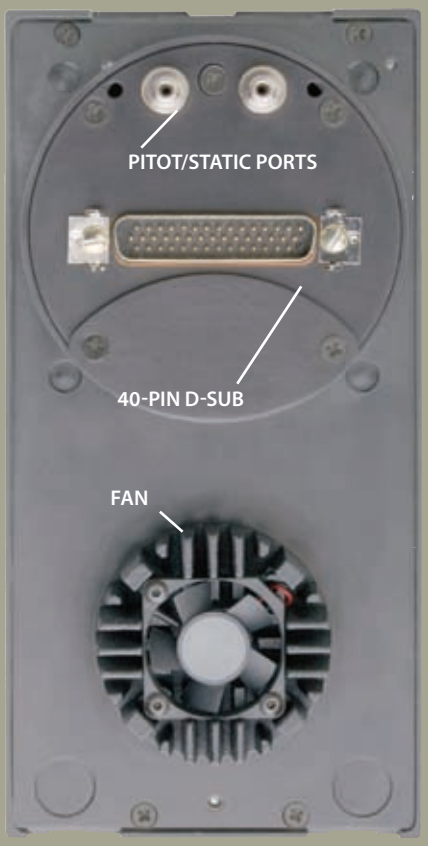
Enjoying some sales success with the AT300 terrain awareness/mini MFD combo, Aspen brings its second product to the market in an impressively short time frame—less than a year since its introduction at EAA AirVenture 2007. Moreover, the new Aspen Evolution hardware design mimics no other existing product. This is refreshing from a young company living in an environment where successful products from Garmin and Avidyne have set a lofty standard.

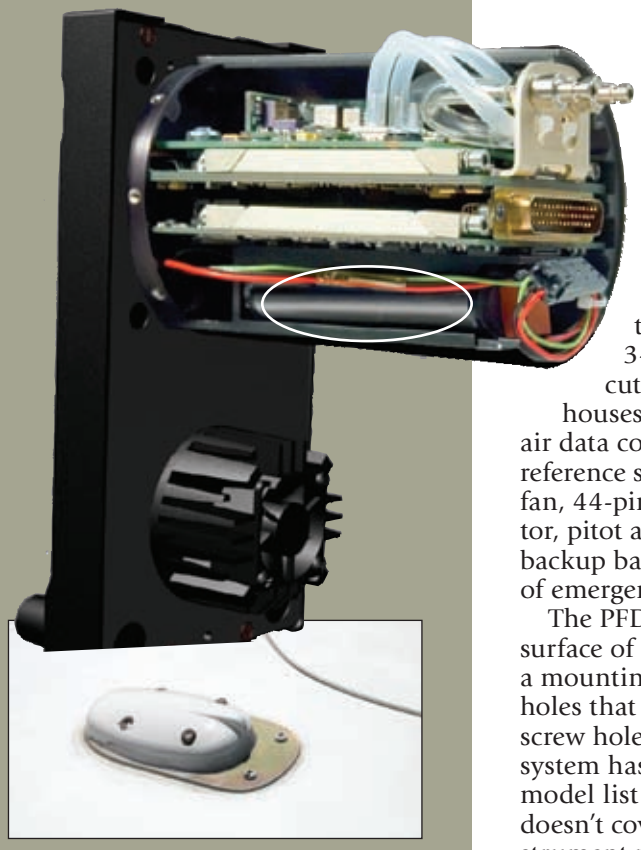
Aspen seems to have aligned several factors for success: Acceptable price point, oodles of working capital and the cooperation of the FAA's certification branch are the top three. As we go to press, EFD1000 installations and product availability are off to a disappointingly slow start compared to the company's early delivery projections. Deliveries should pick up steam and we're in the process of overseeing several installations. This shouldn't be a difficult task, as several thousand units have been ordered by Aspen's dealer network.

For now, the approved model list of about 400 aircraft models is limited to those with a Vne of 210 knots IAS or less. Aspen used a single-engine Piper to obtain the initial STC, so it couldn't demonstrate the effects of higher speeds during flight test. This omits several common light twins from the approval list, but further certification is in the works.

We're already impressed with the level of high-quality field support for this new

Eventually, Aspen's Evolution system will offer three modules, far right, a center primary flight display and two flanking multifunction displays for weather, terrain, synthetic vision and other data. The EFD1000 core unit, near right, is remarkably compact. Two additional remote boxes are required to run it.





The EFD1000 series contains its own back-up battery located in the bottom of the top display element (circled). Air data plumbing also enters the instrument from the rear. A remote module with accelerometers, GPS engine and an antenna is mounted on the roof of the cabin. The GPS is not for primary navigation but for backup orientation.

product, but in our view, Aspen's seasoned field service engineers will have their work cut out for them as big numbers of installs hit hangar floors.

THE MACHINE

The EFD1000 series PFD line is among several emerging products in the Evolution flight display family. The company is also working on certification of the EFD500 and 1000 series MFD to complement the PFD, which is the launch product. For now, there are three models of the ADAHRS-driven EFD1000, differing only by operating software. The $5995 EFD1000 Pilot is the entry-level PFD. This version won't interface with remote nav or GPS sources so it can't overlay navigational data on its lower or navigation screen. Think of the Pilot version as an electronic display of flight instruments, with a familiar slaved directional gyro (no EHSI).

The $9995 EFD1000 Pro version will be the market leader, with ADI, EHSI with dual bearing pointers for displaying multiple GPS and nav sources, flight director input, integrated GPSS digital autopilot steering and heading command outputs, plus a base map with curved flight plan segments, including procedure turns and holding patterns.

The EFD1000 has voice prompting, an altitude minder, integral GPS annunciation, wind vector data, which Aspen calls a "ground track indicator," as well as airspeed, slip/skid, altimeter and vertical speed in tape/trend format in true PFD style. The to-be-released $12,995 flagship EFD1000 ATP model adds future traffic, weather and charting functions. The three models of PFDs share identical hardware so upgrade should be easily accomplished by loading software.

The EFD1000 chassis is designed to occupy the space of a traditional attitude and directional gyro vertical pair in a standard six-pack grouping of instruments. The 6-inch diagonal, active matrix LCD display sports 32,768 colors and has anti-reflective coated lenses. From bezel to bezel, the unit measures 3.5 inches wide and 7 inches tall. It fits nicely where the old steam gauge attitude and directional gyro used to live on most panels.

The rear of the unit has a self-contained module that slips into the existing 3-inch instrument panel cutouts. The rear chassis also houses electronics including air data computer, attitude heading reference system (AHRS), a cooling fan, 44-pin D-sub electrical connector, pitot and static input ports and a backup battery providing 30 minutes of emergency power to the PFD.

The PFD saddles up to the front surface of the instrument panel using a mounting bracket with pre-drilled holes that catch existing instrument screw holes on the panel. While the system has an STC, via approved model list (STC-AML), the STC doesn't cover modifications to an instrument panel. It's up to the installing shop to gain local FSDO approvals on major alterations made to the instrument panel.

While we're on the topic of instrument panels, there are stringent guidelines to follow for retaining existing instruments. If your initial plan was to move all of your steam gauges to the copilot's panel, you'll be disappointed. While the EFD1000 is certified for use as a primary flight display under day/night and IFR and VFR conditions, there are governing FARs that require backup instruments.

FAR 23.1311 calls for a backup airspeed, altimeter and attitude indicator, as you'll find in all of the glass-equipped new aircraft. The Aspen installation instructions require the backup attitude gyro to be placed within an acceptable field of view on the pilot's panel, ±35 degrees from pilot's view centerline.

The Aspen PFD won't free up much space on the panel and in many cases will require some crafty effort to retain an aesthetically pleasing flow of instruments. Still, in our view, it beats having to replace an entire pilot's panel and the ungodly amount of labor and expense entailed in doing that.

ELECTRICAL INSTALLATIONS

Besides the display itself, there's an RSM or remote sensor module

ASPEN EVOLUTION CONTROL SET

ATTITUDE DISPLAY

BUGGED SPEED

AIRSPEED TAPE

CUSTOMIZED VSPEEDS

TRUE AIRSPEED

DATA BAR AIRDATA CALCS GROUNDSPEED/OAT/ WINDS ALOFT

NAVIGATION DISPLAY

CURRENT NAV SOURCE/WAY-POINT NAME/TIME/DISTANCE

TRACK AND HEADING DATA

NEXT LEG

NAV ROUTE/FLIGHTPLAN MAP

NAV DISPLAY SCALE

BUGGED ALTITUDE

REVERSION (MULTI-SCREEN SETUPS) AND BACKUP POWER OVERRIDE

ALTITUDE TAPE

MAP RANGE TOGGLE

MENU ACTIVATION

HOT KEYS FOR MENUS

TOGGLES TAPES ON/OFF

360/ARC VIEW

MAP ON/OFF

TURN RATE INDICATOR

VERTICAL SPEED INDICATOR

MODE SYNC KNOB FOR DATA ENTRY/EDIT

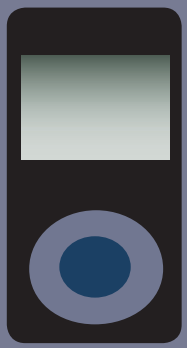
SINGLE LINE POINTER NAV SOURCE SELECT

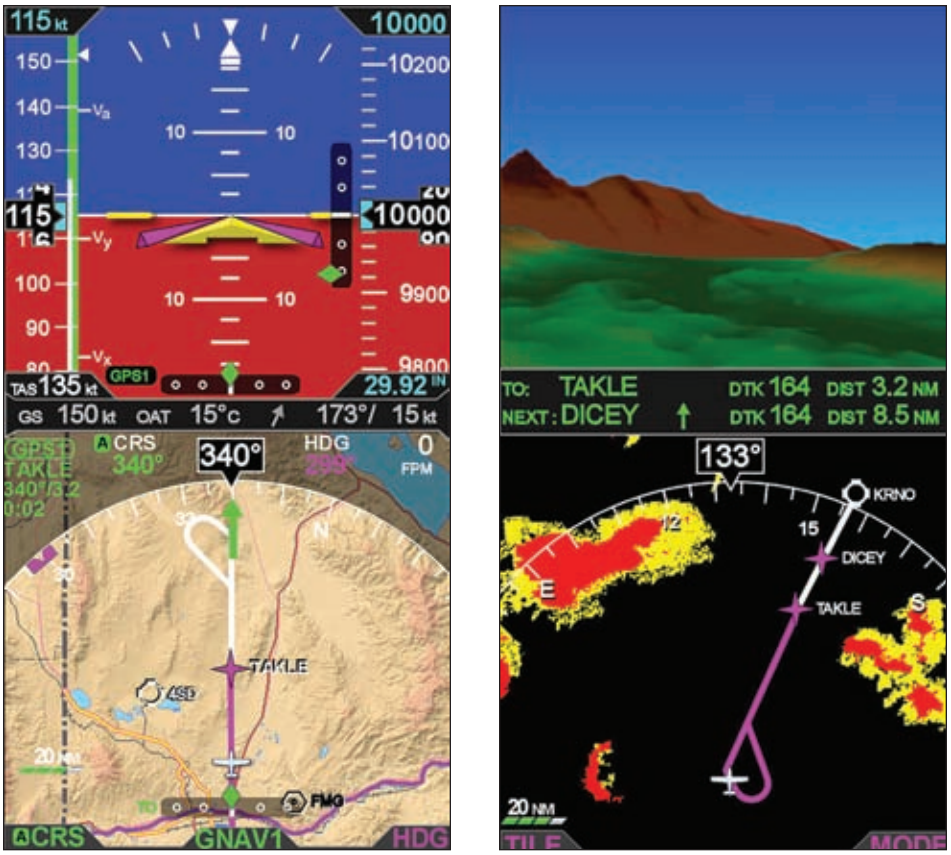
CDI NAV SOURCE SELECT

SINGLE LINE POINTER NAV SOURCE SELECT

HEAR (AND SEE) MORE HERE

For a detailed ground tour of the Aspen Evolution with audio and a photo series, log on to our sister publication, www.avweb.com and click the podcast button in the upper right of the home page. Then click the "more" button and scroll down the Aspen Evolution photo podcast link. No special player is required to view and hear this slide program, just an audio cap able computer. The program offers a detailed explanation of the Evolution control set and logic.





Aspen's view of the future includes detailed terrain display, left, and synthetic vision based on data derived from a three-dimensional terrain database, right. These features will be available in future iterations in a version called the ATP.

which resembles a GPS antenna and is mounted atop the fuselage. We recently counted 14 antennas mounted to the skin on a Beechcraft twin and with an EFD1000 and its remote RSM, the total would be 15. Luckily the RSM can be mounted further back on the fuselage toward the tail, where there might be some remaining real estate. The rub is there can't be magnetic disturbances, since the RSM houses 3-D heading flux sensors and accelerometers, which are critical for flight data integrity. It also needs to be mounted within ± 4 degrees to the longitudinal axis of the aircraft.

Tail draggers, when they become approved for installation, will require mounting adapters because of the slope of their fuselages while on the ground. The RSM also contains a backup GPS engine and outside air temperature sensor. The RSM connects to the PFD with a run of shielded cable, so once again aircraft headliners—and in some cases, lots of the interior—will need to be removed. Pressurized aircraft will need engineering approval unless the RSM is mounted outside of the pressure vessel. The STC doesn't cover RSM installations on composite and fabric aircraft.

Installers will have to endure a silly calibration/compass swing procedure where the aircraft is taxied at a constant rate for 60 seconds in a circle with a radius equaling twice the length of the aircraft wing, which ends up being approximately 30 or so feet. This is repeated multiple times to test cardinal heading accuracy. We pity the test crews on airports with small taxiways and limited ramp space.

A third box, the remote ACU (analog converter unit), measures roughly 6 by 4 inches and weighs less than a pound, is essentially an electronic hub that's required in EFD1000 Pro and ATP units. This ACU converts analog signals originating from non-ARINC nav sources (KX155s for example) to digital data buses and then passes the converted data along to the PFD.

The PFD also talks back to the ACU, passing along converted digital signals to analog autopilot logic for driving heading and course commands. For interfaces that have dual Garmin GNS500/400 series navigators, these systems can be wired directly to the PFD without going through the ACU since they output ARINC. The Aspen is provisioned for five digital ARINC inputs, one ARINC output, five RS232 serial inputs and three RS232 serial outputs.

AUTOPILOT INTERFACING

As we've noted in the past, a costly hassle inherent with many existing autopilots is the upkeep of the gyros that drive them. So when the EFD1000 was first introduced, many owners assumed that the system would jump-start an old analog autopilot by feeding a sharper digital reference to the existing flight computer, replacing the iron gyros.

Well, the Evolution isn't the fix everyone was waiting for. For autopilots that rely on gyro-based inputs for roll and pitch reference, which is nearly all of them, the Aspen won't offer improved performance. If you have an S-TEC autopilot, for example, the system's turn coordinator needs to be retained.

The same is true for the Bendix/King KFC and KAP series autopilots as well as models from Century and ARC/Cessna. In our view, a true PFD would provide all the autopilot references to the autopilot, eliminating mechanical autopilot gyros altogether. Other manufacturers are in the process of engineering this required emulation for their soon-to-be-released PFDs, but Aspen left this engineering and FAA approval process out of the EFD1000.

What the Aspen will do is provide autopilot heading datum, course datum and navigation left/right signals as any HSI or DG that has autopilot outputs will. A sought-after feature integral to the EFD1000 Pro and ATP models is GPSS digital steering, when connected with a GPS navigator that outputs digital ARINC labels. GNS430 and 530 series, of course, have such outputs.

This eliminates the need for external roll steering converters. For GPS units that output only RS232, the GPSS feature won't work. The EFD1000 also displays single-cue flight director command bars when interfaced with the Bendix/King KI256 FD gyro. This command bar data isn't sent back to the autopilot as a reference—it's an on-screen display input only.

RICH FEATURES

The EFD1000 is so information-loaded that we can't come close to summarizing each function. See our sidebar for a real world report on the EFD1000 Pro in action. The display is divided into three major parts. On top is the familiar electronic attitude display, with airspeed drum and pointer overlaid on an airspeed indicator tape on the left and altitude drum and pointer plus an altitude bug overlaid on an altitude tape on the right.

There are also vertical and lateral deviation indicators overlaid on the attitude display, so your eyeballs are always fixed on attitude data and the navigational crosshairs when you're on an approach. This is how it's done in jets and is now a welcome addition for small aircraft, too.

A data bar separates the top and bottom of the display and offers data such as true airspeed, outside air temperature, groundspeed, wind vector information, to name a few. As you would expect from a PFD or any glass display, the data is pilot customizable. In our view, geeks and IFR professionals will load the display with as much data as allowed , while others will display the basics.

The bottom half of the screen displays navigational data including electronic HSI or a directional gyro on the Pilot model. Dual bearing pointers can display dual nav sources in true EHSI form. There's a basic map display that can be overlaid below the EHSI, if connected to an appropriate GPS that outputs active legs of the flight plan. Additionally, a base map that presents airports, VORs, intersections as well as holds and procedure turns can be displayed.

The left and right control knobs are intuitive with a positive feel; and pushing in on the knobs activates a cursor function and rotating the knob cycles through available options, in a round-robin sequence. The knobs also serve double duty as heading command and course setting. If the knobs aren't touched for 10 seconds, their functions stow in a "home" state, so the user won't inadvertently change modes. The right knob stows in heading command mode, as this is used most often. Similarly, the left knob stows in course command mode for course changes. But when navigating in GPS mode, users won't likely set the course pointer too often since the EFD1000 has an automatic

WRINGING IT OUT

EASY LOGIC, TERRIFIC OPS MANUAL

One of the great puzzlements in the world of avionics development is why Garmin, which pioneered easy operating logic in portables and its 400/500 series navigators, didn't carry this over to the G1000. But that's a topic for another article. The bottom line is that Aspen and Avidyne are the beneficiaries.

If you're up to speed on the GNS430 or 530, operating the Evolution will be relatively easy. Although it's rich in features and has two operating knobs and 11 keys, our brief flight demo of the system in April suggests that it doesn't suffer from the can't-get-there-from-here logic blind alleys that bedevil other glass systems.

First, the display. Even in direct sunlight, it reads well. The colors remain crisp and although there's a bit of inevitable washout, the typography and labels remain readable. However, due to the small size of the display, we found the digits on some of the labels difficult to read. This was aggravated by another feature the Evolution has: To avoid the tedium of endless knob scrolling of data, the Evolution has a feature that ramps up the rate of digit change as your scroll. Nice idea. But with the small digits, we found ourselves getting into a bizarre PIO in trying to set an altitude warning without overshooting. Either the rate needs to be damped or the digits made larger.

Operation of the unit is logical, overall. After it fires up and the ADAHRS finds which way is up, it's ready to rock. All of the flight plan and nav setup is done on the panel-mount navigators, of course, and the fruit of this is displayed on the lower half of the instrument—what Aspen calls the navigation display— in familiar magenta and white lines. But there's not much detail; for that, look to the panel-mount displays or, eventually, the Aspen MFDs.

The two knobs at the bottom of the bezel have different functions depending on operational context and these are controlled via the single menu key. The primary use of the knobs will be for baro setting and heading/altitude/airspeed/warning value bugs. The nice thing about the Evolution is that if you get stuck somewhere in its logic—frankly, that's hard to do—it yields to trial-and-error knob and button pushing.

As noted in the main article, this thing has a lot of input functions. You can, for instance, display course guidance for the CDI from GPS, VOR or V-LOC, all toggled around the horn by a single key on the center of the lower bezel. Easy. (A little green label tells you which source you're using.) Similarly, the HSI/nav display can show a pair of RMI-type needles—one with a single-line pointer, another with a double-line pointer—from any of the nav sources. In a world increasingly dominated by automated cockpits with full-color moving maps, this capability strikes us as a bit of a throwback, but we're told some pilots swear by it.

For our demo flight, Aspen's Scott Smith and Doug Cayne demonstrated one neat trick: back-up power supply. When the main bus goes away, the Evolution reverts to its own onboard battery which will keep you upright and navigating minimally for up to 30 minutes. This feature alone may entice some buyers.

AC TV

For a video demonstration of the Aspen Evolution in a Cirrus SR22, log on to **www.avweb.com**, then click the video button in the upper right of the home page, then the "more video of the week" link. Scroll down to the Aspen Evolution flight demo video. The video shows the product's principal features and modes.

course selection function, similar to autoslew found on other EHSI systems. This feature automatically lines up the course pointer to the desired track for each active leg of a flight plan or waypoint, saving you the trouble of doing it manually.

Three nav source select keys live at the bottom of the bezel, which commands the CDI and bearing pointer overlay of remote nav sources. Available sources for overlay are GPS 1, GPS 2, VLOC 1 and VLOC 2. Notice that there is no ADF overlay and we'll hardly miss it. "Hot keys" stacked along the right bezel are for accessing menus and executing system commands.

CONCLUSION

There's lots of momentum behind Aspen and their new Evolution display product line. It's an understatement to say they have a product that a huge number of owners want, mainly because of the reasonable asking price, the stinging reality of spinning iron gyro failures in the clouds and, if for nothing else, the high level gee-whiz appeal.

But will smiles turn to frowns when owners confront the installation invoices? We think there will be lots of this and we don't think that invoices topping $15,000 are out of line given the capabilities of the mid-range Pro model. Many shops we spoke with told us they can't put a hard number on installation given the unfamiliar approvals and technical hurdles that yet remain.

Some projects will require extensive rewiring, some will need more panel work than expected and some will stumble through the interface and setup. And one large caveat: As of mid-May, we still haven't seen any production units, nor have any other shops we know of. But as we noted, Aspen has a great team in place to support a well-engineered product that, at this early juncture, looks to be a game changer.

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