



The big picture

So you'll be wanting surround-sound next, eh?

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Walk the aisles in Lakeland, Florida, or Oshkosh, read the pages of this magazine, or hang around the FBO long enough and it'll become abundantly clear that avionics lead the general aviation development derby. More is happening in airborne electronics than in all the other facets of the airplane put together. (There are some powerplant developments lurking, but they're made possible by, that's right...electronics.) It's been this way for a couple of decades, of course, but the pace is definitely quickening. ■ At the head of this electronics arrow is the large-scale moving map or multifunction dis-

play. As the liquid-crystal screen moves into prominence in everything from public telephones to medical equipment, the cost associated with this technology, particularly the color version, has dropped dramatically. Just a few years ago, it would have been prohibitively expensive to fit a 6-inch diagonal screen into the cockpit; these days, it's practically the minimum requirement. ■ Modern airplanes are rapidly moving away from steam gauges. As a package, we envisioned that the Millennium Mooney would take advantage of all the newest display technologies, not just for navigation but for engine and systems monitoring as well.





So in addition to a full stack of UPS Aviation Technologies' (UPSAT) radios—headed by the MX20 multifunction display—we elected to install the Vision Microsystems VM1000 engine package, which was recently awarded a technical standard order (TSO) approval as a primary instrument set. We installed the VM1000 using supplemental type certificate (STC) approval graciously provided by Mooney modifiers Mod Works.

Once Top Gun Aviation in Stockton, California, was finished sprucing up the Mooney's airframe, it was spirited up to Aurora, Oregon, to Pacific Coast Avionics. A thriving mail-order outfit, PCA has developed its installation facilities into a similarly thriving concern. PCA's proximity to UPSAT helped to seal the deal. Learning—albeit slowly and inconsistently—from previous avionics adventures, we didn't want to be both early adopters and long-distance troubleshooters at the same time. If the PCA staff had questions about the big-screen TV going into the Mooney, a 15-minute flight would provide some useful face-to-face.

PCA began the project by removing the old avionics and instrument panel. Because this was a fairly late-model airplane, there wasn't much to be done behind the panel to prepare for the new gear. In some of our other projects, the remedial rewiring and general cleanup took a considerable amount of time. If you're starting an avionics revamp on an older airplane, plan for some labor and parts to cover various fixes. This is money well spent. Invariably, the items

The MX20 will show all the flight-plan information on the big screen.

we have chosen not to fix or replace in the midst of a major avionics job are the ones that fail or create other problems down the road. Start with a good foundation and you'll be miles ahead.

Under the guidance of project leader Ken Carpenter, the PCA crew cut a new instrument panel from 0.090-inch aluminum for both the center section and the right-hand subpanel. Because we wanted to keep the entire UPSAT stack on the left of the two avionics racks, we had to manipulate the remaining instruments and find clever homes for some of them.

For example, the VM1000 engine-monitoring system combines all the standard engine gauges into one package that we knew would go in the right-hand radio rack. That meant the strip gauges in front of the pilot could be removed. Originally, we planned to slice the standard fuel-quantity gauges from the strip and remount them elsewhere. Two problems with that. One, the strip gauges are one piece behind the panel in the 1987 Mooney. (Later models used modular gauges.) Two, the Mod Works STC for the VM1000 system calls for using VMI's capacitance gauges. We didn't have the option of complying with

The MX20 big-screen display gives you myriad options, including VFR and IFR depictions.

just part of the STC; it's all or nothing where the feds are concerned.

So we opted for the VMI capacitance gauges, which were mounted to the left of the primary instruments. It's a good thing to know how much fuel you've got, and a better thing to have that information right under your nose. These gauges are calibrated in the airplane by trial and error; the results of multiple tests are sent to VMI, which then burns a calibration chip for installation in the central processor.

With the panel reshuffling, the standard Mooney annunciator panel moved from the top of the radio stack to directly in front of the pilot. Next to that is the annunciator panel/switch box for the GX60 IFR-approved GPS. Normally, this generation of 201 has a five-by-two main-panel layout. PCA scooted the main instruments over to the right very slightly, leaving a four-by-two arrangement and room for the 2.25-inch fuel gauges and outside-air temperature gauge to the left of the airspeed indicator and turn coordinator.

Few other hitches have slowed the Mooney program. We've opted for a new Century autopilot called the Triden, which combines the computer and display unit into a 3-inch-square box; most other Century autopilots are designed with radio stack-width computer/display modules. The packaging was ideal. We were fast running out of radio rack space but had an open 3-inch hole in

We decided to jump on the large-screen bandwagon in a big way.

the main panel. Unfortunately, the preapproval status of the autopilot meant that, despite its using the same servos and basic computer as the Century 2000, we couldn't so much as install the servos. Nor could we activate the electric pitch trim that's part of the system. We did manage to lay in the main wiring loom for the autopilot and mount the servo brackets. Century expects certification in the third quarter of the year.

Otherwise, the installation was remarkably straightforward. PCA's guys had the most difficulty installing the capacitance fuel probes because you have to unseal several inspection panels in the Mooney's integral fuel tanks. That becomes a tremendous amount of effort, with the ever-present chance that you'll have to reseal something after the fact. Indeed, one of the fuel probe covers—the old probes come out, and the new ones mount in a different location—began to leak on the morning the airplane was due to leave for the Sun 'n Fun EAA Fly-In in Florida.

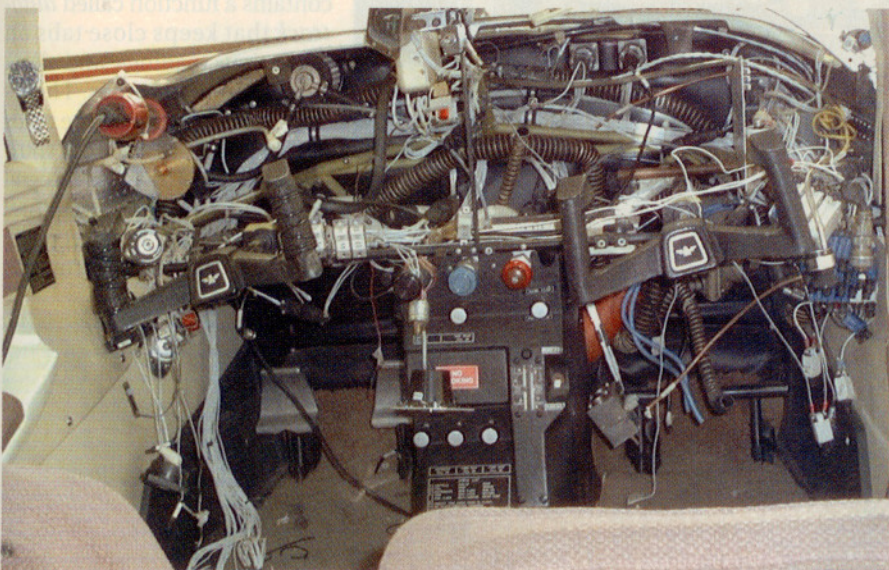
With the Millennium Mooney, we decided to jump on the large-screen bandwagon in a big way. So at the heart of our avionics retrofit is the UPSAT MX20 multifunction display. We used the version without an internal GPS receiver; in any event, the built-in receiver is just for backup and can't be used for primary navigation.

The MX20's resolution is 640 × 480

pixels with more than 65,000 colors. It's truly a multipurpose player, maintaining in its database a collection of sectional-style VFR charts and IFR en route maps. The MX20 can also display information from a remote lightning detection device—although we've installed an Insight Strikefinder, for reasons we'll explain later—and traffic information from a TCAS sensor. It's a versatile and easily read display that is a massive step up from the previous generation of simple moving maps.

As mentioned, the MX20 is a "dumb" box, taking position and datalink information from other boxes and displaying the information to the pilot. The GX60 provides the basic position information and flight-plan data. The MX20 will show all the flight-plan information on the big screen, including airport diagrams and other details, as well as the flight-plan or direct-to course line. Naturally, when you've selected a GPS or overlay approach, all the waypoints are depicted on the map, greatly improving situational awareness and simplifying the process of flying sometimes fussy GPS approaches. (There's nothing like seeing the missed-approach waypoint hanging out there in space to ease tensions on a low-minimums approach in true-blue IMC.) One thing the MX20 doesn't do is show the appropriate waypoints for an ILS or localizer approach.

You can fly with the MX20 in IFR or VFR modes, or with a customized map



It's never pretty, this large-scale avionics revamp. Thanks to the bright minds at Pacific Coast Avionics, it all went back together superbly.

The SL30 nav/com is a clever and easy to use VHF nav/com with a host of features.

that's part sectional and part IFR helper. That's the one we used most on the Mooney's first cross-continent trip. In this mode, the map shows airspace and a sectional-like depiction of terrain height. It can also show airways with Victor or Jet identifications, minimum en route altitudes, leg distances, and navaid information. It's quite a lot to put on even a large screen, but the MX20 works it out most of the time. There are instances in which the screen becomes overly cluttered, but simplifying the picture is straightforward. We would, however, encourage UPSAT to discard some of the clever illustrations for things like NDBs and VORs—they are reproduced in the sectional idiom and become too large on the digital page. A simpler presentation would result in less clutter. While we're complaining, we'd also like to see UPSAT give the pilot access to flight plans and other navigational minutiae through the big screen.

Controlled flight into terrain, or CFIT, has become a darling among safety issues, and the MX20 deals with the possibility directly. In its memory is a terrain map that's compared to the airplane's current position and altitude. You will receive a warning if the airplane is within two minutes of terrain mapped to be at or above your altitude. You can also switch to a dedicated map and see the relationship of the surrounding terrain to your altitude.

As with all IFR installations, redundancy becomes a serious consideration. With the SL30 nav/com—a clever and easy-to-use VHF nav/com with a host of features—and the GX60 GPS/com, we have dual coms and dual navigation sources. We're impressed with the tidy SL70 transponder—it's functionally straightforward and full of useful features. Similarly, the PS Engineering-made SL15 audio panel, which will be traded for the model with a marker beacon

receiver, is also top-notch; the four inter-com positions are wired for stereo sound.

Frankly, the reliability of modern boxes leaves us less concerned with a nav failure than would have been true a couple of years ago. We think relying on just two independent boxes is a low-risk proposition. One benefit of the UPSAT theology in contrast to boxes that combine GPS with a VHF nav/com is that if there's an electronic brain hemorrhage, you can slip out the affected box and leave much of your dispatch capabilities in place. That said, we'd probably carry a battery-powered handheld in the airplane just for good measure and a touch of luck.

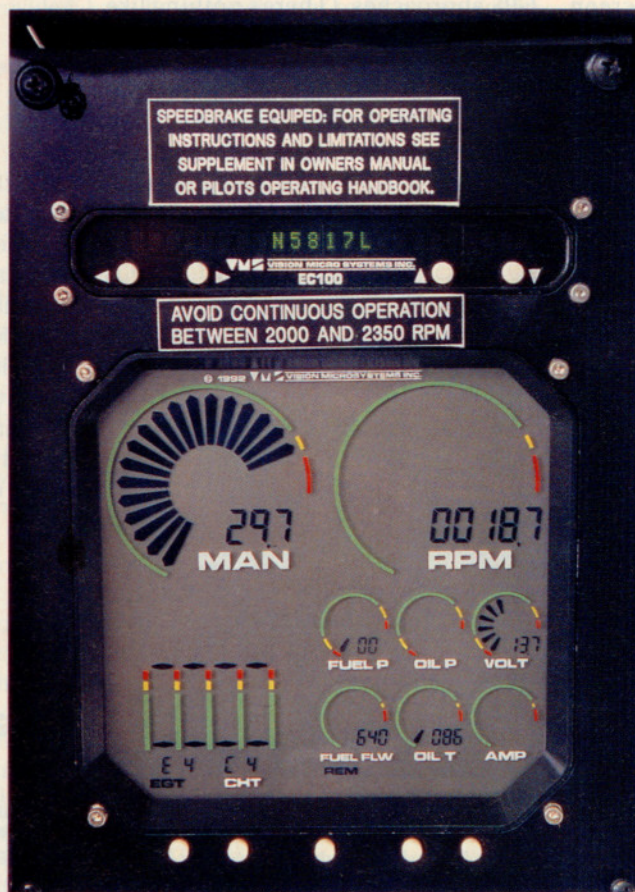
Some people might object to our putting all the engine-monitoring eggs into one basket with the VM1000 setup. But this product has been in experimental aircraft for nearly a decade with a good service history and plenty of incremental development. Central to the system is a large liquid-crystal display that presents manifold pressure and rpm in large analog and digital formats. Below those readouts are smaller

"gauges" for fuel pressure, oil pressure, volts, fuel flow (with internal fuel computing), oil temperature, and amps. Next to those circular presentations are stacked bars for exhaust-gas and cylinder-head temperatures, with small digital displays of the actual temperatures below. You can manually switch through the cylinders and see what's what, or have the VM1000 constantly display the first-to-peak cylinder's EGT and the hottest CHT (often on a different cylinder). The VM1000 also has short-term data logging; it'll show the high and low values for all parameters for that flight. It resets itself for the next flight, however, so there's no long-term recording.

The VM1000 is connected to the EC100 annunciator panel. Normally, this item would be put under the pilot's nose, but we ran out of room, so it resides above the VM1000. It contains an advisory system that responds to exceedences noted by the VM1000 and notifies the pilot with a beep in the headphones and a single-line description of the problem. It also contains a checklist and the ability to mirror some of the data displayed by the main VM1000 panel.

So far, we're pleased with the VM1000. It's easy to read and the combination of analog and digital presentations is nearly ideal. One glance and you can tell instantly if all the readings are normal. Moreover, the VM1000 contains a function called *auto-track* that keeps close tabs on the various readings, and alerts you to small changes. This is better than waiting for the readings to go off the scale. As you'd expect, the VM1000 has integral lean-find functions and a fuel computer that gives fuel used, remaining, and time to empty as you fly along.

Beyond the big-screens—the MX20 and the VM1000—the Millennium Mooney's panel is pretty straightforward. Along with the upcoming Century autopilot, we have the company's MSD1000 electric HSI and pneumatic attitude indicator. We're trying one of Insight's new Strikefinders with a brighter display—so far so good. We elected



Vision Microsystems' VM1000 combines into one neat package gauges that normally are scattered around the panel.

AOPA would like to thank the following companies that donated or discounted their products and services to refurbish the Millennium Mooney or otherwise assisted in the project.

Autopilot and horizontal situation indicator (HSI)

Century Flight Systems
Municipal Airport, Post Office Box 610
Mineral Wells, Texas 76068
940/325-2517
Fax 940/325-2646
www.centuryflight.com

Avionics installation

Pacific Coast Avionics
22783 Airport Road
Aurora State Airport
Aurora, Oregon 97002
800/353-0370
Fax 503/678-6292
E-mail: info@pacific-coast-avionics.com
www.pacific-coast-avionics.com/

Avionics suite (including multifunction display, GPS receiver, nav/com, transponder, and audio panel/marker beacon)

UPS Aviation Technologies
2345 Turner Road SE
Salem, Oregon 97302
800/525-6726
Fax 503/364-2138
www.upsat.com

Integrated engine-instrument system


Vision Microsystems
4071 Hannigan Road, Suite T
Bellingham, Washington 98226
360/714-8203
Fax 360/714-8253

STC approval for engine-instrument package

Mod Works
8250 Skyline Way
Punta Gorda, Florida 33982
941/637-6770
Fax 941/637-9628
www.modworks.com

to make the lightning-detection equipment separate from the main moving map for reasons of clarity. Last year, with the Cessna 206 Aero SUV and its electronic HSI, there were times when the lightning information was hard to pluck from the combined navigation information. This separation also means that if the main screen packs up en route, you'll still have a way of avoiding storms.

We're anticipating putting lots of time behind this panel and getting to use the new Century autopilot in the months ahead. It's an excellent, capable package that we're all anxious to learn.

 *Links to additional information about the Millennium Mooney may be found on AOPA Online (www.aopa.org/pilot/links.shtml). E-mail the author at marc.cook@aopa.org*