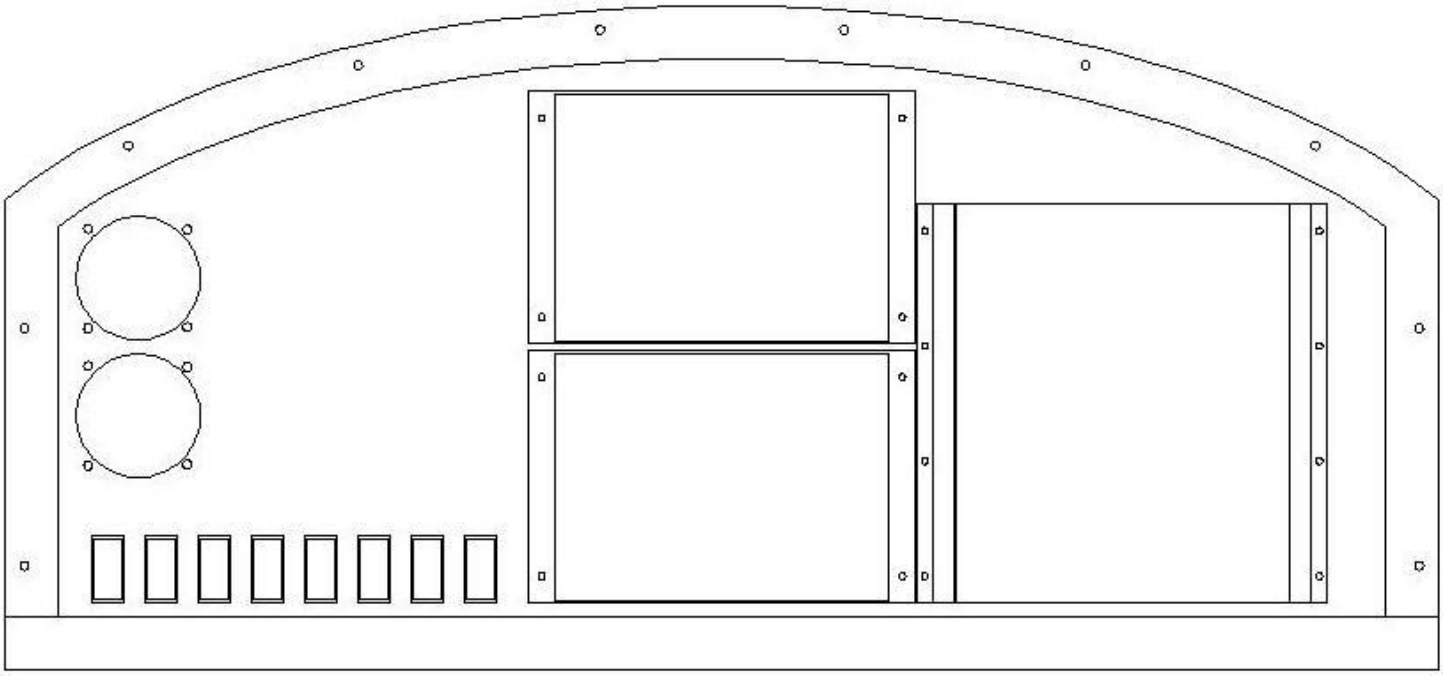
This is the panel layout I finally chose and had laser cut for my F1:

During this process, my friend and fellow pilot John Watler had been working with me doing the "engineering design" on this panel. I was able to get a cad file of the stock original F1 instrument panel from Bob Japundza and sent it to John. He in turn has spec'ed out all the positions and the cut outs for the panel. We've gone through over 20 iterations trying to find the combination I thought would work. Those iterations included adding a little over an inch to the bottom of the panel in order to fit in extra switches on the right hand side under the avionics stack. In the end, I decided to remote mount the key (unless I can fit it in the right hand corner after I mount the panel) and keep the panel the stock length. After John makes changes, he emails me an Adobe PDF file of the new layout and I email back to him. He's done some really nice work, and I think when the panel is laser cut, it should be fabulous to work with.

Here's what the PDF file from John looks like in JPEG format:



Click HERE for a PDF file of the actual layout and what the laser will cut.

And here's the actual instrument panel tried in my F1:

SWEET! Note the W51 Rocker Breakers in place on the lower left. Those are 9 of the 10 five amp rockers I bought. They snap in and out pretty easily. Can't wait to see one lit up. They are perhaps too small to engrave, but I may have a buddy of mine try it, just to see, then perhaps lacquer in the lettering. Otherwise it will be good old dry transfer or have the panel engraved, or an overlay. They make the rockers up to 20 amps. Anything over that, and you have to choose something else. I will probably have a remote mounted master and alternator field switch and breaker. I'll probably build a box in front of the throttles or at the forward end of the right armrest, or possibly even down on the stick bay cover. Lots of options.

The panel above is NOT rolled at the bottom, and in fact is a good inch lower than the factory panel (which is now part of my bell crank and other parts...). It is quite flexible in the middle without avionics shoring it up. I may run a piece of angle along the bottom. I might even make a tray or fold down mechanism for the fuses that I need over the 9 rocker breakers.

Now to start running some wires!!!

Avionics

EFIS

The panel will have a Grand Rapids Technologies Horizon 1 EFIS engine monitor and an EFIS type navigation system. I'm planning on having dual screens. One for the engine and instruments, and the other for navigation. This is the dual screen single brain (AHRS) system. It will have all options except the internal GPS. So it will come with ARINC 129 interface, fuel flow, fuel pressure and manifold pressure sensors. This system eliminates the need for almost every gauge on the panel. And it's a full function 6 cylinder engine monitor. It's a fairly complicated setup, but once you have it up and running, you get much more from this package than you probably ever could from individual gauges.

Radios

The avionics stack will probably be all Garmin. A GNS 480 GPS/COMM will be the anchor radio. I'll also use an GTX-327 Transponder since the UPS SL-70 is now out of production. If I don't run out of money, I may also install an SL-40 COMM. That way I can have dual COMMs with FOUR channel monitoring capability, If I do that, I'll probably get a GMA-340 audio panel.

I really like those UPS (now Garmin AT) radios. Garmin has a habit of selling products and within a few years, stop production, and then a few years stop supporting them. I have a Garmin GPS/COMM that works fine, but once it breaks, it's a doorstop. The SL-40 and the GNS-480 are both Apollo (UPS, now Garmin AT) designs. Both have stand by frequency monitor, and the SL-40 has a built in intercom. You just wonder how long Garmin is going to support them. With the GNS-480 (previously the CX-80), it will probably be quite some time. That seems to be the best unit Garmin has going at this time.

Garmin doesn't like experimenters to install their own avionics and have stated that their policy that warranty claims will only be covered if the install was performed and bench tested by an avionics distributor. IOW, if you do it yourself and you "smoke" the equipment, you will in all likelyhood be paying the bill. Having said that, I was told in so many words that if an experimental builder has a warranty issue becsause the avionic is defective from the Garmin factory, they have always taken care of the issue.

Autopilot

The TruTrack DigiFlight-IIVSGV autopilot seems to be the best autopilot for me, and it talks to the other equipment I've chosen. The octangular AP shown is the Digitrak. I have two TruTrak servos installed already, so I have 3 axis capability. More than likely I'll end up with the TT ap in a round gauge configuration as shown below in the IFR panel layout.
I was thinking about going with a fancy EXPBUS sytem for the switches and protection, but I was afraid that if the board goes bad, the whole thing is trash. So I will probably follow the KISS rule and just go with toggles or rockers and conventional wiring.

All of the other basic round gauges could be 2.25 inch UMA or Van's gauges. The F1 panel isn't that large, and with those two big displays and a normal radio stack on the right, I had to really squeeze to get the basic round gauges in there. Don't forget, there's a sub frame behind the instrument panel that will eat up some territory around 3 sides of the perimeter. There wouldn't be a full "6 pack" of instruments in my proposed layout. I suppose I could substitute the G-meter for a tachometer. I can find a miniature tach without too much trouble. But I actually think that if my EFIS goes down, a Tachometer is not the greatest of my concerns.

I don't really *need* the audio panel with basic VFR. UPS radios have built in intercoms. I could put in a toggle switch to change radio sources if I had more than one. The only good reason to have the audio panel is to have the LMB and audible marker annunciator. I'm not crazy about any of the stand alone LMB's, so I'll stick to the audio panel if I go full IFR. When you have a plane that cost's this much, it's actually a good idea to have a full IFR panel. Not only for the capability, but for resale value and marketability.

Many thanks to the creator of the Experimental Panel Builder website, which makes panel planning a snap (well, actually a click, or drag and drop). I'm sure it saved me countless hours of work and rework.

Of course, if I am going to do ILS's, then I have to have a radio capable of getting VOR's and ILS's. UPS again, has a low heat, low power consumption, digital, solid state unit that fits the bill in the SL-30. However, the now Garmin AT SL-30 may not be produced forever, and there also are other panel configurations to achieve the precision approach needs.

I'll just have to see how comfortable my F1 avionics budget is when I get to that point. As I'm writing this, I've just invested in an IO-540 and an MT 3 bladed prop. Those two items cost more than the kit, so I'll be cash poor again for a while. And as I'm still constructing the airframe, the money for "incedentals" is still flowing like water! This kind of project is not for the faint of financial heart. I'm not rich by any means, and this project is taking a serious amount of funds. Hopefully, it will be a good investment where in a pinch, I could get my money back out of it, at the least. For now, though, the money has to be pumped in to get the thing flying.

Off to the side could be a breaker or blade fuse panel. The appeal of breaker toggles is quite good. But lighted and lettered (engraved) rockers on the panel is what I would like best. Lighted rockers would have to be "full sized" in order to be engraved. The rockers above are the smaller "finger sized".

Fuse Panel?

Breakers are fine. In-line glass fuses suck. Blade fuses are my favorite. I may end up with a combination of breakers and blade fuses. You can buy a product called SMART GLOW FUSES which are blade fuses with an LED light built in. When the fuse is blown/fails, the LED lights up. So if you have a panel of blade fuses and something blows, you don't even have to have a cabin light to figure out which one it is. No searching in the dark (as long as you have SOME power). That's just one of the reasons I like the Smart Glow Fuse idea.

I may use blade type fuses in a Blue Sea 5026 fuse block. This is a nice unit. For about $35 you get 12 fused pos and 12 neg gangs on the same block. That way you can have a easy common ground that could go direct to the battery. This of course is a big source of discussion, whether to use the frame or the battery. I'll have the choice of either, or both! But I like blade type fuses. One Blue Sea 12 gang block for the essential bus and one for the accessory bus. Location in the aircraft as yet to be determined. Later on in this project I found that Blue Sea also makes a DualBus terminal 10 gang strip. That way you can have a + and - side, with one main wire in and 9 wires out. Or you can run one wire in with a jumper and gang 18 wires out. 2 tens of one, 20 of the other! HAH! Anyway, the barrier strips are about 12 bucks. I was going to buy bus bar material and decided to go with these strips instead.

Greg Nelson has a nice blade fuse panel in his F1. It's nicely engraved. I'm not sure I like the position or setup, but heck, he's a U2 pilot, and probably knows better than me!

I I decided against this type of setup, although it is quite appealing. I still may find a loction that I might have access to the fuses in flight, but that decision may not come until I am actually wiring the plane.

Another consideration might be to put the fuse panel on the instrument panel where I was going to put all the round gauges. I like the radios on the right, and the left side may end up having a lot of dead space. If I put EVERYTHING on the instrument panel, it will be easy to access, and the side walls and "arm rest" areas cant be upholstered and look a lot cleaner.

Circuit Protection Requirements (*amperage confirmed by manufacturer)

GRT Screens 5 amp*
GRT AHRS 2 amp* not switched, always on with master, never cycle power in flight
GRT EIS 1 amp* wired always on with master
GMA-340 5 amp*
GNS-480 5 amp "Main" and 10 amp "COMM" *
SL-40 5 amp*
GTX-327 3 amp*
Elevator Trim 1 amp*
Flaps 7 amp
Aux 1 10 amp

Aux 2 10 amp

Yet another panel consideration would be to use the open space on the left for a handheld Moving Map GPS like the AVMAP EKP-IV. It has a big 7 inch display, and would be a nice backup to the GRT navigation. Then, of course, the fuse panel could go back down by the knee like Greg's panel above (more or less), or I just put breakers on the panel on behind toggle switches.

Wire Size

The idea behind circuit protection is to keep the smoke inside the wires, and keep the electrons from frying your accessories and avionics. You have to match the wire size to the load on the particular item you are powering. Here's a graph I took from a Ron Alexander article about simplified aircraft electrical systems.

Wire AN Gauge Copper	**Circuit Breaker amps**	**Fuse amps**
22	5	5
20	7.5	5
18	10	10
16	15	10
14	20	15
12	25/30	20
10	35/40	30
8	50	50

Panel Phases ??

Let's look at a cost effective, incremental manor of panel construction to get me flying with as little initial outlay as possible. Turns out, I'm not doing this, but it was a nice exercise

Phase One: "Basic VFR" instruments. I fly from a controlled airfield. I eventually want to certify my F1 for IFR flight. Therefore the basics I need are:

Primary Flight Instruments: GRT Horizon 1 EFIS (and options)
2.25 inch panel mount wet compass
Primary Engine Instruments: GRT Horizon 1 EFIS with EIS 6000 (and options)
Comm: SL-40
Nav: GRX-327
ELT: ACK-E01
Switches: Alt/Bat, keyed L/R/Both/Start, 12+/- lighted rockers (or toggles), 20 +/- breakers (or blade fuses)
Lighting: LED automotive accent lighting

I think I can install Phase 1 myself. I will probably have a shop laser cut the panel. I may make a skeleton panel, and install the instruments in "thirds". That way, if I botch a panel, I don't lose the whole thing. It will better allow "phase changes" without leaving lots of big open holes in the panel, too.

The center of the panel, and the bottom of the panel will not change. I will probably install a rocker or toggle in position at the bottom, even if it is not hooked up. Then I will have a "sub panel" for the avionics stack, and a sub panel for the instrument stack. This probably won't be sophisticated, just a plain sheet of aluminum that will probably screw down right over the "skeleton" panel.

Phase Two: "IFR" Instruments. Time to add approach certifiable equipment and the autopilot.
Primary IFR Instrument: Garmin GNS-430
Secondary IFR Instruments: Garmin GMA-430 audio panel with LMB and marker receiver.
TruTrak DigiFlight-IIVSGV

Phase Three: "Supplemental" Instruments.
Backup 2.25 inch gauges: Airspeed Indicator
Vertical Speed Indicator
Turn and Bank Indicator - TruTrak
Artificial Horizon - TruTrack

Building the panel in increments saves me some cash flow. I can probably get into Phase 1 for about 15K. I think Phase 2 will run another 15K. Finally, Phase 3 would probably be about another 6K or so. The price of the TruTrak AI is not published yet. Note that I do not show the exact T&B, which from TruTrack is about $500.

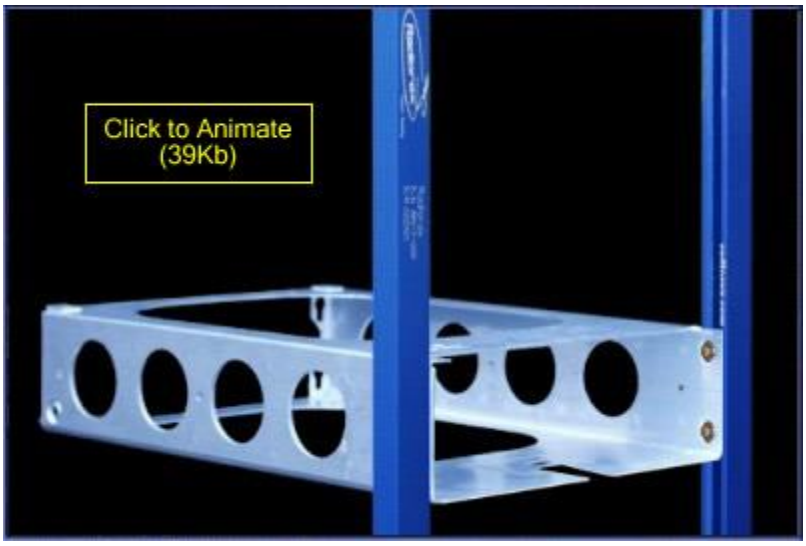
The Ultimate Panel gives me about as much redundancy as you can expect. With a dual battery system, and/or a dual alternator system, electrical failure has all but been eliminated. With the addition of the round gauges, if I get failure of one or all of the glass panels, I still have the tried and true basics to complete a flight.

Well, that was a good mental exercise, but I'm not going to set my panel up in phases. I'm going for the gusto from the get go. More to come.

Mounting Systems

Garmin Radios

I've pondered the issue of how the radio stack will go in on my panel. What are the dimensions? How are the avionics secured? Do you have to have supports at the rear? Well, I did a little research and found RADIORAX, a company that makes extruded rails with sliding stainless screw fasteners to hold the trays for standard panel mount avionics. The product is FAA approved and can be utilized in certified aircraft as well as experimental aircraft. Not cheap by any means at about $200 for a standard single row 8 inch experimental avionics stack. The standard kit gets you the two extruded rails and mounting hardware for an experimental aircraft or certified "short stack" (which is double the price!). The rails are only 8 inches long, near as I can tell. That seemed awfully short. So I went to Garmin's website and measured up the dimensions. Based on the measurements on the Garmin website, with the 4 unit stack I have planed for the right side of the panel, I will need either 6.9 inches (with a GNS 430) or 7.5 inches (with a GNS 480). Some measurements on the Garmin site specify BEZEL height, some do not. This does not give you much margin for error. And all the avionics will undoubtedly need to be completely butted up against each other. I.E., no room for cooling. With the GNS 430, there could be a cooling issue.

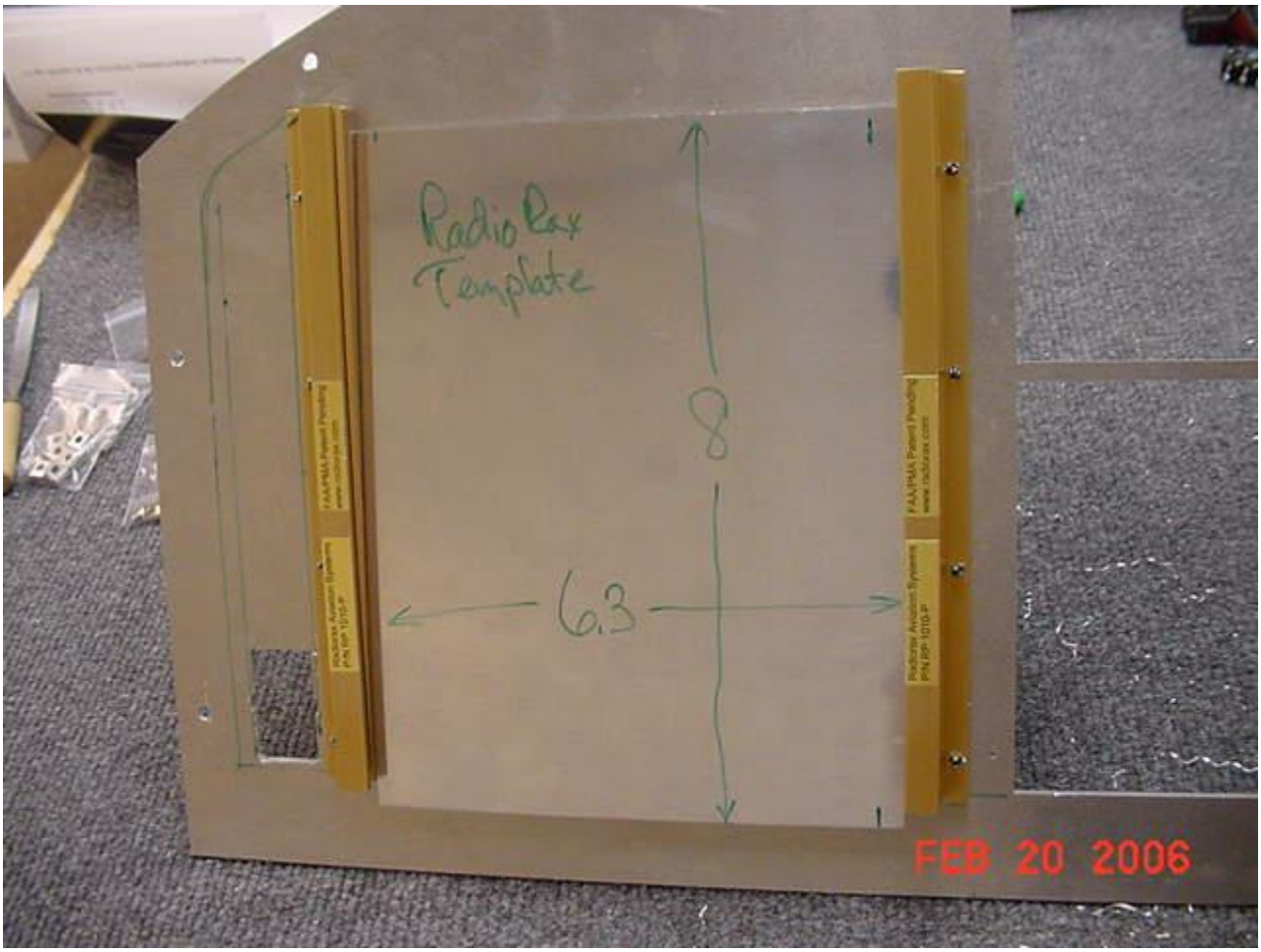


I have emailed RadioRax to ask about the Garmin measurements and to get more details on their products. If the rails are only 8 inches long, it is going to be VERY close trying to mount a GNS 480 in the panel. I'm assured by RadioRax that the entire stack of Garmin radios WILL fit. Now it's a mater of physical panel space. It will be a VERY tight fit with a stock panel and a 530. More than likely, I'll end up with a 430 and use the stock panel.

The rails mount to the back of the panel with 4 steel set screws (or AD4 rivets) on each side. The RK1010-8 is for experimental aircraft. The kit comes with enough hardware to install 4 trays. You can buy a separate installation kit that helps you align the rails on the panel. Since I only plan to do this installation once, I think I'll just use my trays as the install jig. Since my panel was laser cut, aligning the rails at 6.30 inches behind the 6.25 cutout shouldn't be that big of a problem.

So far, the only retailer I can find for the RadioRax is Aircraft Spruce. RadioRax does sell directly via telephone. More information is available on their website.

I bought the RadioRax mounting system from ACS. It comes in a nice little package with instructions similar to what's on their website. For a bunch of extra money, you can buy an alignment device that you actually screw into the rails so that you can get the rails mounted in your panel very precisely. It's going to be a tough little job to get 6.3 inches between the rails mounted just outside a 6.25 opening. I made my own template out of .032 aluminum sheet. My instrument panel is already laser drilled for the screw holes, so all I really have to do is square the two rails up with the template over the panel cut out for the instrument and back drill the holes into the rails.



It was a little tough getting the template and rails centered with an even .0025 lip on each side of the panel,. I confirmed that it was perfect with a scanning electron microscope. Well, ok, I eyeballed it. Turns out that the 25 thousandths on each side is about the thickness of an ultra fine Sharpie tip!, so it was pretty easy to compensate. I drilled the rails to the panel using the laser punched holes in the panel. Only interference I may run into is the panel sub frame arch. Teh right rail goes up and nearly contacts that panel support. I could have just lowered the rails, but I wanted to keep the lower edge of the panel as clear as possible, just in case I wanted to add a large formed angle or some other avionics or equipment attachments.

GRT Horizon 1 EFIS

The GRT website has a lot of information. The Multi Function Display (MFD) mounts to the instrument panel simply by screwing the faceplate to the display through the panel using 4 each #6 screws. Man, that couldn't be much easier! Then the only problem is to find a mounting location for all the other stuff that you have to hook into it. Fortunately, there is plenty of room behind the panel and back to the firewall to mount additional items. I think having that SSW/boot cowl doubler running to the firewall may give me a location to mount some stuff. Randy Pflanzer has a really great system of walls and "trays" built behind his panel which gives plenty of room to attach stuff .

March 2006 I finally was able to get the dual EFIS re-ordered and paid for. It should be in my hands by the end of the month. Before it arrives, I started contemplating mounting the AHRS and the EIS modules.

Since the EFIS screens are only 3.5 inches deep, there is a LOT of room behind them. There is some 16+ inches from the back of the instrument panel to the firewall. I decided I need a mounting shelf similar to the one under the left boot cowl. I made a template out of .032 aluminum sheet, made 3/4 inch boxed edges and measured the shelf to sit in between the brake master cylinder supports on the firewall. My instrument panel lower edge is about 1 1/4 inch deep, but remember, the instrument panel is slightly canted. The top of the panel leans forward. So the EFIS screens will actually be sticking out the back of the instrument panel and the forward edge of the back of the lower EFIS screen will be lower than the opening cut into the instrument panel. I allowed 1/2 inch clearance for that canted angle. If it's not enough, I just have to modify the shelf to sit lower.

Round Gauges: 2.25 vs. 3.125

The F1 has a relatively small panel. Not that much bigger than the RV-8. There's not a lot of room for duplicity. However, there is room for everything you need, if you juggle things right.

I really thought having backup 2 1/4 inch gauges would be neat. However, what I've found out is that the readability of the little gauges is not that great. The printing is clear enough, but if you want a 20K foot altimeter, and a 300 mph airspeed and a 3k foot vsi, you either can't get it, or the increments displayed will be so large that the output is nearly meaningless. Many 2.250 s are made for ultralights, and they don't have the specs for a Rocket. 120 mph, 1000 fpm, and 10K feet just aren't enough. My rocket needs 300 mph, 4000 fpm, and at least 20K feet. So it's important to get the right scale. While looking at this, I was thinking that the increased performance scales on such a small dial face was going to be hard to read and really only give you relative information. Well, they would just be backup instruments, anyway. However, if you could get all the small gauges in digital readout, or LCD, it would be a different story.

The one thing I haven't found on the net, but I'm sure it's out there is a 2.25 artificial horizon, or attitude indicator. I'm pretty sure they are available, but it needs to be electric and I think I remember seeing a price on them around $4000. That's a bit much for my purposes. At that kind of cost, I may just put in an electric turn and bank, and be stuck with "partial panel" if things go to shit. I know TruTrack makes an indicator that small, and I think it's only about 5 bills. (as of this editing, TruTrak is now producing a 2.25 attitude indicator, and it will probably be available at SNF, 2005, for about $1200) Another choice would be to put a Dynon E10A with battery backup as a stand alone secondary. The Dynon (or BM Lite) wouldn't be a 2.25 sized gauge, but for less than half the cost of a miniature artificial horizon, I'd make room for this backup instrument.

I can live without a backup VSI. I don't need a DG, I pretty much got out of the use of one back when I had my Tiger. I only used it when the GPS's went down. And even then I usually referred to the vertical compass. Those DG's tend to precess so much over time that they become fairly useless if you forget to update them continuously. A vertical card compass in the panel beats a standard DG any day in my book.

I would like to have a backup AH (AI). I'll be waiting for TruTraks to come out and get priced ($1200). I would imagine that will happen at SNF, but the information is trickling out to a couple websites. At the same time, I would like to have a turn coordinator, and will probably go with the TruTrak unit there, too. Both of these gauges are available in a 2.25 gauge, and since they are more relative than numerical, the smaller size would be acceptable.

The TruTrak autopilot brain comes standard in a 2.25 round faced "gauge". That's a no brainer. The octagonal unit is to be in production soon. I really don't have room for an avionics stack style unit, unless I start a new stack on the left side of the panel. And I want a wet compass, which I already own in a 2.25 panel mount size. So I think overall I'm still best off with at least 2 of the small round gauges. There's just not room on the left side of the GRT screens for a full 6 pack. Dangit! Mark, you need to make this ship about 4 inches WIDER!

Then it's a matter of whether or not I want the backups. And if I want to install the AS, VSI, ALT and TACH, I'm probably better off going 3 1/8. So at this point, it looks like a combination of round gauges and trying to make those look pretty. I'm not real excited about that prospect. I think I'll end up putting 2 small and 4 large round gauges on the left side in a "6 pack". It won't really be a 6 pack, but I may at least have some redundancy. I think in the beginning, I may still go with phase installation. Perhaps I may never get around to installing phase 3.

Then add back the AvMap EKP-IV. And I like having it vertical. So I think I'd more the two round gauges to the side to accommodate 4 large round gauges, which might eventually be installed in Phase 3:

See?! Am I wishy washy or what? But this way I have some kick ass navigation capability, and even have some 3d nav capablilities even if all but the AvMap fails. Notice that I now have the GNS 480 in there (actually a CX-80?). Don't know if I need it, and it BARELY fits. The problem there is will I have room for toggles at the bottom. I think rockers and breaker/toggles are out, unless I have a new panel cut and add about another inch at the bottom. That may be in the cards anyway.
However one of the concerns I have is how short I am. And the lower the panel goes, the lower I have

to sit, and the less I'll be able to see over the panel. It seems I've had plenty of leg room sitting in the few Rockets I've entered, but you can only lower the panel so far.

Now I can work with my factory provided panel. Other than the switches, I don't really need any lighting. I think an LED string under the edging of the glare shield will suffice. And I have a couple LED flashlights handy, too.

The latest and greatest panel. I still plan on leaving out all but two round gauges on the left. Note that everything has been moved inboard to allow distance from the sub frame behind the instrument panel which is not correctly depicted on EPanelbuiler.

Notice that I am back to rockers. Also, I'm back to considering the GNS-480 due to the ease of use reported by pilots using them, and of course the enhanced capabilities with ILS and GPS WAAS approaches. Panel space is still a factor. My buddy John Watler plotted out the actual cut outs on a cad program and made measurements for the panel. He said there was no room along the bottom of the avionics stack unless I dump a radio (COMM2) or fall back to a much smaller GPS COMM. Well, with the switches being breakers, and the fact that I was going to put them along the right side anyway, we might as well put some switches there. That was John's idea, actually, and I LIKE IT! And since we can only fit 5 rockers next to the avionics, how about a master and then a rocker for each Garmin radio? Well, perhaps I can put them to better use. More than likely, I won't need them at all. and can leave that side "clean". But it an excellent use of the space.

Rockers, Toggles and Breakers, OH MY!

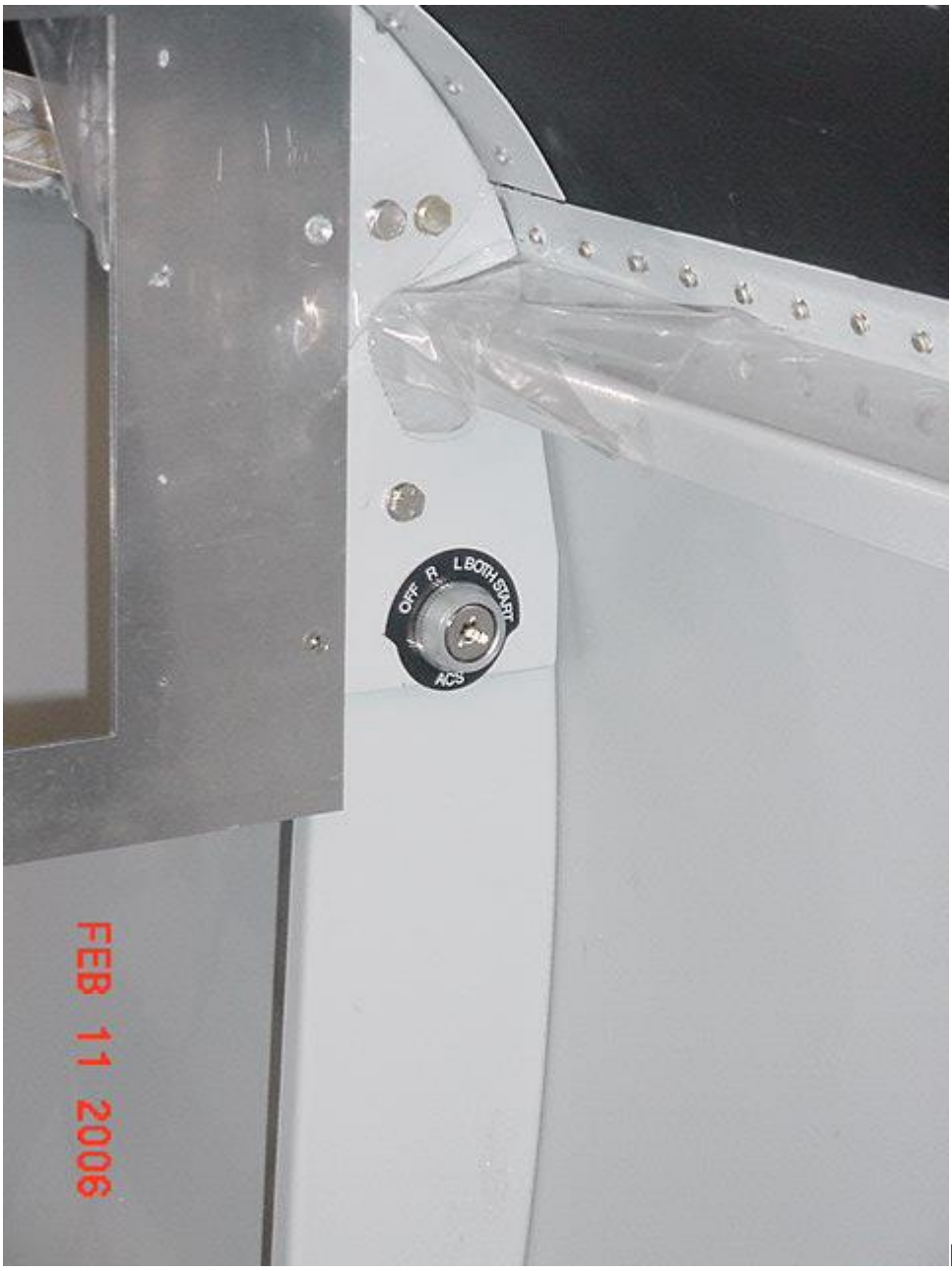
I've been trying to decide on what type of switches to use. I'm having a hard time finding LED lighted rockers that I can have engraved. At least it's a problem on the web. I may have to go to SNF to find out. I could use simple tape labels and toggle breakers. That way I could clean up some of those breaker dots on the right side of the panel. Probably not all of them, though. Ideally, I'd like to have rockers that change colors when on. That probably means a circuit board. I would prefer at least that the rockers be lighted when on. Always lighted is OK, too.I've even looked into tactile and LCD switches, but I don't know how to put them on a circuit board. And I don't even wanna price that stuff. But they do look cool.

I found Potter & Brumfield has now come out with Potter & Brumfield W51 LIGHTED ROCKER BREAKERS!! So nix the breaker toggles and bring on *THE ROCKERS!!*

W51 Rocker Breakers

My rocker breakers came in. The seem OK. They aren't large enough to really bother having engraved, because they are only "finger sized" and not "thumb sized". As John Watler was laying out my panel on cad and keeping all the dimensions straight, I kept playing with EPanelBuilder and trying to figure out my best panel configuration. There's lots of options. The latest idea is to only have one COMM. the GNS480 was originally an Apollo radio, and therefor has monitor on standby. That's all I was really interested in. And the 480 is reportedly much more easy to use than the 430/530 series. So I reconfigured the panel again and asked John if I could fit switches under the stack if I dumped the SL-40 and he said affirmative. So now I'm back to a shorter stack with switches on both sides. If I move the key and the master off the panel, I could actually put 25 rocker breakers on the panel. 11 on each side at the bottom and 4 along the side. Well, that was a bit much, and I don't need that many switches. I do probably need that much circuit protection, but that many rockers just starts looking a wee bit dorky.

Ignition Switch



I was having trouble finding a suitable place for my ACS A-510-2K keyed ignition switch and locks set. I didn't want it in the panel. I wanted it preferably on the right side. I wanted to be able to work the throttle with my left hand and use the key start with my right. Actually, with a dual LightSpeed Plasma III ignition, I don't think I'll really need to catch the engine with the left hand throttle, so I'll probably end up holding the stick back with my left hand.

The key switch was going to go in the panel, but the base of the switch is so bulky, it was going to take up a LOT of space. The F1 panel isn't all that big, so finding an appropriate nook was necessary and troublesome. I was going to put it on the bulkhead at the right just below the instrument panel, but thought that I would probably try to stick an eyeball air vent there.

So finally, I was looking at the panel. Wondering what the hell I was going to do with that single open bolt hole between the other four AN3 bolts I was using. Hmmm... nope, can't fit it in there. I was looking at the back of the sub frame and just didn't like ANY location at all. Finally I checked out the area where the special angle shims are used to bolt the bottom of the instrument panel sub frame parts to the bulkhead. That looked like a great place.

Now comes the problem. I brain farted. The 7/8 inch threaded key tube of the ignition switch was too short, and the base was too wide. I took the bolts out of the angles and removed the R4 shim. The switch placard covers the bolt holes perfectly. The switch will sit in the panel at an angle, but I think I can work around that. I used my step drills from each side and went all the way up through the pilot hole to 7/8. Stuck the barrel through the hole. Drat, still not enough to make the knurled nut look right. Also, there was some concern about how much support the instrument panel was going to get.

I decided to cut the R4 shim into pieces and place it between the panels ABOVE the other thick aluminum part (which the ignition barrel now goes through). I trimmed two small pieces of the R4 shim, drilled out that tooling hole between the other support bolts, and used two opposing R4 shims there to support the panel. I put an AN3 -7 through there and bolted it up. It pulled the panel right back against the sup frame, worked beautifully. Between the single shimmed AN3 bolt and the steel barrel of the ignition switch, I think the right side of the instrument panel will be supported beautifully.

You can see in the pic that the bolt isn't exactly centered in the angle shim. Well, I can live with that. I

actually used the original bolt holes I drilled in the shim, and then trimmed the part to fit.

What you cannot see is that there is a reverse twin sandwiched in between the panels directly behind the R4 shim. That squares up the panel, bolt, and nut so that everything fits flush.

Not so for the ignition switch. It sits at an angle. How to remedy that? Well, you could shim between the panel and the body of the ignition switch. That's not too hard. I thought about gluing up a series of .032 sheet, or just mill down a nice thick piece of 1/8 aluminum. What I chose to do, was shave off the knurled nut at the front that locks down the barrel to the panel. I had to grind down the nut anyway, because the barrel didn't fit far enough through the panel. I had to trim it back half way through the knurled half of the nut.

Next I went ahead and installed an eyeball vent.

Eyeball Vent

Well, it's not really that much of an instrument panel item, but I'll throw it in here since it affects the panel wiring a bit. I bought a rather expensive machined grey eyeball vent from ACS. I test fit the housing (backplate?) on the panel sub frame just below the ignition switch. I wanted it as close to the switch, but as high on the sub frame as I could get it. Once I chose the position of the vent, I drilled a centered pilot hole, then used a 1.5 inch spade bit to make the initial hole. Then I took a template that I made of the part of the vent that sticks through the panel and traced it. After that, it was just a matter of using a dremel drum and sanding it to size, positioning the base, then match drilling four holes for the #8 cs screws that hold it in place.

You could easily cs the panel and put the base behind the panel instead of in front. I may go back later and change it, but for how, I'm leaving the whole thing showing on the front of the panel. I placed a stainless screw clamp on the back. Later on, I'm going to either plumb a vent from the wing root, or cut a NACA vent into the boot cowl.

Center Avionics Shelf

There isn't nearly enough room on the firewall to mount everything that goes behind the instrument panel to support the avionics and gauges. I've already made a shelf on the left side of the boot cowl to support the Main bus and the starter solenoid. Now I need another one to mount the GRT Horizon 1 EFIS AHRS module as well as the LightSpeed (LSE) electronic ignition control modules (and the EIS engine management module). This shelf needs to be pretty large, and it will probably end up tiered or stacked.

The center avionics shelf needs to be level and rigid for mounting the GRT AHRS. The AHRS is going to be my primary attitude indicator. If I want the plane to fly level by the AHRS AI, I have to make sure that the AHRS is oriented properly.

The lower edge of my instrument panel sits about 1 full inch lower than factory. I measured to the firewall from the back of the panel and then between the brake master cylinder supports on the firewall. Consequently, the shelf can be a box with 3/4 inch sides and 16 5/8 long and 7 1/4 wide. I

squared up a piece of .032 2024 and cut the corners out. I bent the sheet into a rectangular box. With the lower edge of the box/shelf at the lower edge of the instrument panel there is enough room for the cant of the instrument panel which causes the EFIS screens sticking down at the forward lower edge.

Once the shelf is drilled to the firewall (probably for nutplates and #6 cs screws), I'll level the shelf with the ship and drill it to the firewall and prep it for nutplates and #6 screws as well. The shelf has to be level fore and aft, even more critically, left and right. Level (or straight) in Yaw is easy. The panel is parallel to the firewall (more or less). Level in roll is easy, too, as long as the shelf is made even and square. Lining up the shelf with the lower edge of the instrument panel SHOULD orient the shelf level across the sides of the ship. The tricky aspect of leveling the shelf is in pitch. I'll have to attach the shelf to the instrument panel first, then use my digital level and drill the self in a position level with the top rivet line on the aft turtle deck.

At this point, in order to level the shelf, I lined the top edge up with the top edge of the screen cutout. Interestingly, I had a scrap piece of would to set under the shelf across the master cylinder support brackets that perfectly leveled the shelf. Now I need to lower the shelf 1/2 inch on each end to keep it level and put the lower edge of the shelf at the lower edge of the instrument panel and out of the way of the 3.5 inch deep EFIS screens sticking down from the canted panel.

Using .032 made the shelf fairly stiff. I thought about adding stiffeners on the bottom. but decided that I need to mount another shelf on top of the center shelf to mount the LSE Plasma III CDI control units. That will actually stiffen the shelf a bit more.

Orienting all these units together (and the EIS) is a bit of a hassle. The AHRS is 6x4x3.5 and can only be mounted one way. The CDI control units are 7.2x6.4x1.5 inches, they have cables coming out each side (a pair of 9 pin cables on one side and a pair of coax cables on the other), and I need to mount two of them.

I thought it would be easiest to make sure the center shelf was level. It doesn't matter how you orient the CDI control units, you just have to make it easy to get to the cables. Ideally, for service it would be nice to have them come out the control unit toward the left and right, as opposed to fore and aft. But I'm VERY close to the Garmin stack on the right side. Also, I don't know if the cables come out the 6.4 side or the 7.2 inch side of the control unit.

I took a bit of .025 T-6 and bent up a mounting bracket for the CDI control units to stack them over the top of the AHRS. It was VERY flimsy since I wanted to make it 4 inches tall to clear the top of the AHRS. So I pitched that one out and made another bracket out of .032 inch 2024 sheet. That is much stiffer, and as a side bonus, mounting it to the center shelf will make the shelf much stiffer, too. I went ahead and made the bracket mounting area 7 1/4 x 7 1/2 inches, which should allow me to orient the CPU's right/left or fore/aft. I hope it's right/left, and I hope the 6.4 inch side is the cable mounting side. That way, I can mount the CPU's at the left side of the bracket, so that the right side cabes can clear the Garmin stack easier. Here's a pic of my guesstimated mounting:

Now I just need the units (or a technical drawing with dimensions) so I can determine whether or not this mounting scheme will work for the LSE CDI CPU's.

April '06 GRT shipped my EFIS before they ran out the door to Sun and Fun. I received the entire package during the week, since I didn't go to SNF this year (for the first time in about 10 years...). Man, there's a LOT to that dual screen/EIS system!

In order to stabilize the instrument panel as well as have a location to mount the AHRS of the EFIS, the EIS (engine instrument system) main module, and the Plasma III EI modules, I had to mount the center shelf/tray to the firewall and the instrument panel. GRT wants that AHRS aligned with the centerline of the ship (although it's not perhaps as critical as aligning the magnatometer with the AHRS). I decided to do the very best I could to get the center avionics shelf aligned LEVEL with all 3 axises of the ship.

Yaw is the easy axis. I ASSume that the firewall and the instrument panel are parallel, and making a rectangular tray to fit between them keeps that plane square with the ship... in yaw, anyway.

Pitch and roll were a little tougher. First, I drilled 3 pretty pilot holes in the instrument panel for the attach screws of the avionics center shelf. I drilled them up to #40 at 3/8 inch from the lower edge of the panel. Then I lined up the lower edge of the shelf with the bottom of the instrument panel, and went no lower as to hide the edges of the shelf. From there, I began to find level. My fuselage is sitting on a wooden table, some foam and a saw horse under the tail. It's not perfectly level. Based on measurements made with my digital level, the fuselage is about .8 degrees to the left and .9 degrees nose down. So those were the measurements I tried to achieve with the tray.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I set my digital level across the back of the tray, as close to the panel as possible. Reaching up under the panel while sitting in the pilots seat, I tweaked the center shelf to .9 and match drilled the right side. Then I double checked the level and drilled the left side. Then the center hole. So far, so good.

The firewall end was a little tougher. I pre-drilled the tray for 3 holes up to #40. I had the front of the tray clekoed to the instrument panel, and the firewall end set on a combination of small wooden blocks. I had to play with the blocks and the level until I matched not only the level I wanted of pitch, but also in roll. The tray is not rigid on it's own, and can twist a bit. That's sort of good when trying to set it up because you can tweak it a bit. If I bent it perfectly square and flat when I fist made the shelf, the flex would be a detriment. But I ain't that good at bending sheet metal, and the flanges aren't perfect. Pretty damn close, though. So once the firewall end of the tray was positioned, I marked the right hole with a sharpie. Then I got the smallest drill bit I had and drilled the center of the mark on the stainless firewall. Did I tell you that I hate stainless? I drilled using 3 bits up to a #40, then clekoed that one hole. Recheck for level and mark the left hole. Drill 3 bits up to #40 and cleko again. CRAP. I ended up .5 degrees off after drilling. Out comes the round needle file and I started massaging the holes. Once I got the holes where I wanted by filing ALL 4 outside holes (tray and firewall) I got the tray lowered and rotated back to level. I know this all was probably not necessary, but I was going for accuracy in level. If I was a better technician, I probably wouldn't have had to spend a couple hours working on this, but in the end I was very pleased with what I had accomplished.

The GRT comes with partially assembled cables. I had to cut the wires and shorten them and reassemble the cables. My AHRS sits about 7 inches from the Display Units (DU), so my wire runs will be quite short. I put the AHRS, with the cable attached, on the clekoed tray and aligned it up with the right side of the tray. Now in it's final position, I marked the AHRS position and then removed the

AHRS and the center shelf and took them to the bench. I drilled the 4 mounting holes for the AHRS #6 screws and test screwed down the AHRS to the shelf. It was then I noticed how flimsy the shelf was, even though it is made from .032. I decided that when I attached the AHRS, I also need stiffeners under the shelf. I cut a couple of 3/4 x 3/4 formed angles and aligned them under the AHRS shelf screw holes. I drilled attach holes around the screws 1 inch on center. I riveted #6 screw nutplates and the stiffeners to the shelf at the same time. The shelf still isn't rock solid rigid, but when screwed down, everything should be pretty well set.

Plasma EI Brackets

The Light Speed Engineering (LSE) Plasma III ignition for my Mattituck TMX-IO-540 engine has two control modules. The modules measure about 6.5 x 7.2 x 1.5 and can be oriented in just about any position you can figure out. I decided to mound mine on a shelf fabricated to attach to the center tray over the top of the AHRS.

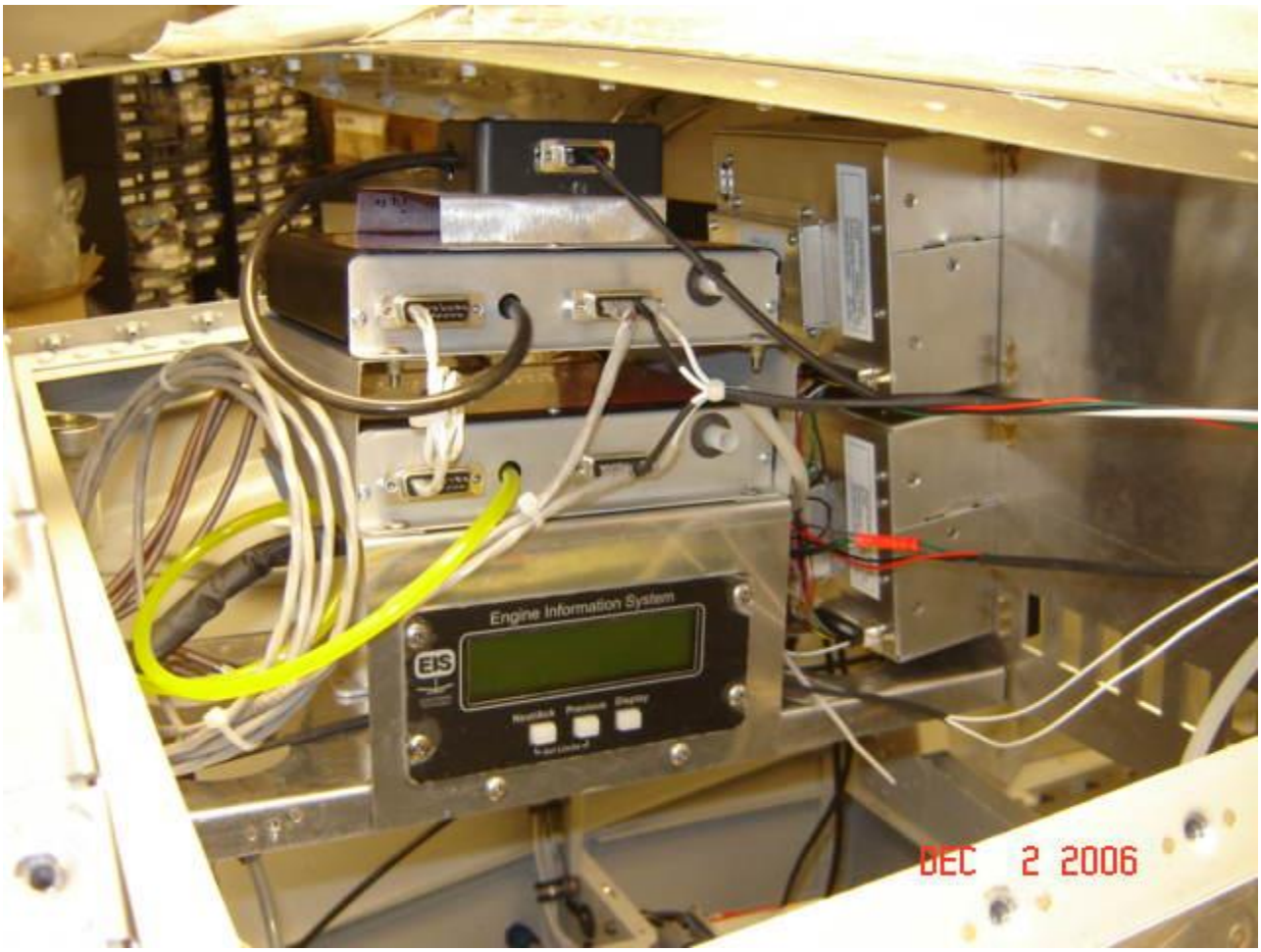
The Plasma III EI modules can be stacked. That's what I intend to do when my engine and EI arrive. So I only need one shelf, one mounting location.
I fashioned a pair of "L" shaped brackets to screw into the sides of the center avionics shelf. The brackets hold the Plasma III CDI's over the top of the GRT AHRS. the brackets also hold the GRT EIS LED module on the left side.

The lower CDI screws directly into nutplates in the lower brackets. There is breathing room between

the bottom of the CDI and the AHRS for heat. The upper CDI is then attached to a couple of "C" shaped brackets (made from .025 sheet) that screw through the Plasma III factory hold down screw holes. That CDI is set 2.5 inches above the other unit to allow plenty of air circulation underneath.

This mounting location allows a small amount of working room between the GRT DU's and the center avionics shelf stack. There is about 5 inches between the forward end of this stack and the firewall.

BTW, this set up has the Plasma III CDI's offset to the left by one inch. That was to allow clearance between the high voltage cables and adapters on the right side of the CDI units and the Garmin avionics stack. I bought right angle BNC adapters and put them on the CDI's, then essentially positioned them as far to the left on the center shelf as I could manage. There shouldn't be any physical interference between the cables and the Garmin units or trays hung in the RadioRax mounts.



Note that in the pics above that I also mounted a little shelf above the top controller to mount the GRT MAP sensor. The two Plasma III controllers and the MAP sensor all have to share a MAP line from the engine. It was a convenient, albeit unsophisticated place to put the sensor.

Compass

Yes, I put a wet compass in the panel. When all else fails, it's good to have a good ol' wisky compass. Also, since I'm putting a round gauge autopilot in place, I figured two round holes were symmetrical. I have had vertical compass cards before, and considered one of those (less movement), but as inaccurate as a wet compass is, I have always found the vertical compasses to be worse. So why spend the money....

ELT Annunciator

New rules require a remote contoller of the ELT. That little annunciator/operation unit has to be put in a conspicuous place. I was going to put mine top dead center in my panel, over the top of my GRT EFIS screens, but it was VERY tight on space. So I decided to leave a little room for the avionics stack to expand nother and put the ELT annunciator in the dead space above.

My ACK E01 annunciator requires a battery. That battery has to be replaced in 7 years if it is lithium, and 4 years if it is alkaline. Hooking it up is pretty easy, you just run a phone cord from the ELT to the instrument panel. It even uses the same phone cord plug. Easy peasey.