Panel Pro
MODEL 4824a with AvCAM

OPERATION AND MAINTENANCE INSTRUCTIONS

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DESCRIPTION OF THE PANEL PRO 4824a

The purpose of the Panel Pro is to route complex assemblies of lines, points, circles, and arcs in sheet aluminum. It accomplishes this by reading a dxf file generated by popular computer aided drafting programs. This is especially useful since commonly used shapes such as instrument cutouts can be drawn and stored for subsequent combination into various instrument panels. The machine is also useful to fabricate various adapters and brackets that have many corners and cutouts.

Panel Pro 4824a system is comprised of the Controller, the software, and the machine.

The SC2b Controller is the interface between the computer and the machine. It controls:

- x and y stepper motor 48vdc drive and power
- Switched GFCI protected ac power for the coolant pump and spindle motor.
- 12vdc output to control the z axis solenoid valve

AvCAM software is the operating software. The software is the key to the entire system. It generates all of the control signals to control the Panel Pro. Also included with the system is EasyCAD Ver 7.5x and the Drawing library which is an extensive library of predrawn instrument panels and instruments.

The Panel Pro shipping crate contains the following items:

1. The Panel Pro base, x,y, and z axis assemblies
2. 4 legs
3. 2 stepper motors for X and Y drive
4. Porter Cable 892S router
5. SC2b controller
6. coolant tank (drain & filter housing in tank for shipping)
7. coolant pump.
8. AC power cord, X axis / YZ axis controller cables, and RS232 serial port cable
9. Tool kit with various tools, starter supply of end mills, etc.
10. Software-AvCAM & EasyCAD, and Drawing Library (inside the 3 ring binder)
11. Optional Measure Pro with software
12. Optional EG1 engraver.
13. Optional Diamond engraver.
14. Optional King air panel spacer kit.

This manual is intended to help with set up and get you started with operation.
Detailed functions and information can be found in the AvCAM help file.

Training

While most of our users are able to learn Panel Pro operation by careful study of the paper manual and help file, training is available either at your location or ours. For new machine owners, we can train at your continental U.S. facility for direct expenses incurred. This is offered on Saturday training dates only. Week day training is available at extra cost. You are welcome to travel to our facility for no charge training. Call us if you would like to schedule training 701-255-7640.

SETTING UP THE PANEL PRO

Planning the area:
You should have enough room for access on the front side (the deep side of the drain pan), left and rear sides. **The computer should be on a table that is located at a right angle so that the right hand can reach the keypad, and the left hand can reach the router.**

Shop air must be available to the rear of the Panel Pro with enough slack in the hose for the entire x axis travel.

Nearby running water is highly recommended to wash chips off of hands and finished parts, and to replenish the coolant. A laundry tub works great for this purpose.

Hardware setup:

PANEL PRO

1. After removing the crate top, remove the 2x2s in the top ends of the crate.

2. Remove the screws in the shipping tabs at the ends of the Panel Pro. A long extension is helpful here.

3. When unpacking or lifting the Panel Pro, take care to lift only on the square structure on the ends, or the ½" mount rails mounted near the ends, or the Y axis plate near the ends. Do not lift on the Y axis base plate (3/8 x 8 x 38 plate) near its center, only at its ends. Never lift or put pressure on the lead screws.

4. Attach leg glides (inside tool box) to legs. Set near maximum extension.

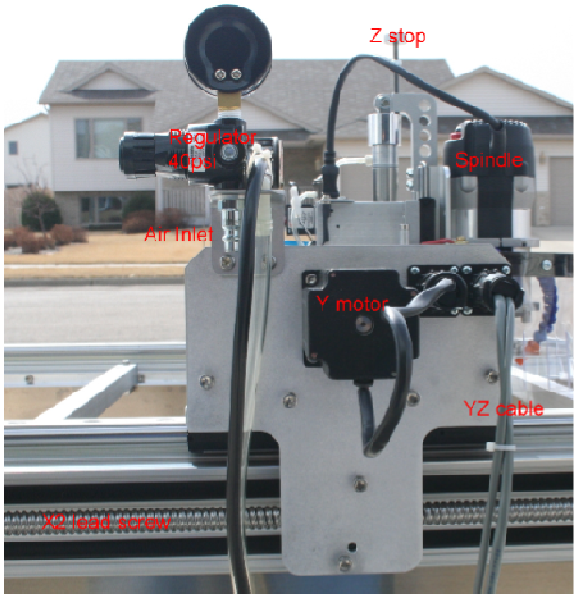
5. Remove the shipping tabs, discard the washers.

6. Have all of the 6mm leg mounting screws barely started.

7. Attach the legs with 4 6mm socket screws each, using a 5mm Allen wrench with extension. **A 5mm Allen bit is included in the tool box.** Two people are required. Stand the base unit on the end of the drain pan and have one person support it in that position while the other attaches the legs. **DO NOT APPLY PRESSURE TO THE LEAD SCREW, or LEAD SCREW SUPPORTS!**

8. **Level the machine** by placing your most accurate level on the X1 bearing rail (the bearing rail near the deep end of the pan). Adjust the leg glides for an exact level. Repeat on the X2 bearing rail. Note that common levels are not sensitive enough.
9.
10. Install the "X1" motor (the motor nearest to the deep side of the drain pan) using 4 6mm screws located in the box with the motors. The x axis is the one with the longest lead screw. Tighten coupler to lead screw with a 7/64 Allen wrench (not included). **Make sure there is no slippage between the coupler and lead screw.**

11. Install the "Y" motor in a similar fashion. Attach the Y motor to the connector closest to the motor. Tighten coupler to lead screw.



12. Attach shop air to the Y axis air fitting. (Milton industrial) Adjusting the z axis up and down speed is best done after the AvCAM software is installed. Adjust the air pressure with the knob just under and to the side of the pressure gage to 40 psi. Note that there is a "float" switch on the z axis pneumatic solenoid. When the toggle switch points away from the operator, the pressure is released and the z axis floats down. This is used to check end mill position, but normal operations should be conducted with the toggle switch in the normal automatic position toward the operator. If the x or y axis moves with the end mill dragging on the surface there is a high likely hood that the bit will break.

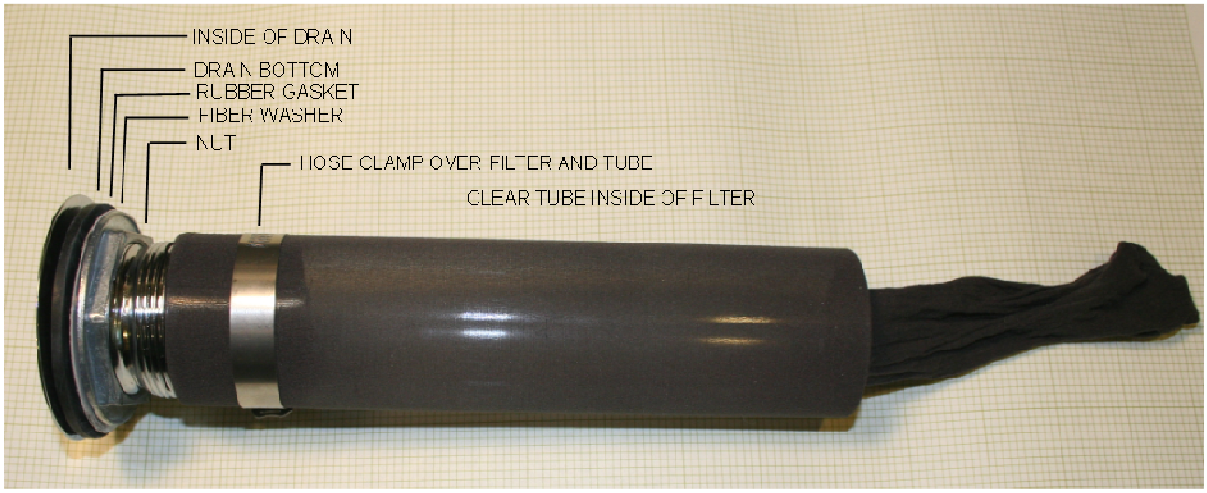
13. Unpack the coolant tank box strapped between mount bars. The drain fitting and filter housing are located in the coolant tank for shipping. The pump is fastened to the side of the shipping crate.

14. Install the drain fitting through the hole in the drain pan. The rubber gasket goes on the outside with the paper washer between the rubber gasket and nut.

15. Route the 7 foot clear coolant hose from the back side of the Y assembly cable guide to the barb fitting on the pump. The hose may be shortened as required, but it needs to be long enough to reach when the X axis is at full travel.

16. Place the pump cover onto the coolant tank. Use the cover mount screws at your discretion. Consider shearing the tank cover so that the coolant level is visible. The baffled front section is not an indicator of coolant level at the pump.

17. The filter housing is shipped with a filter in its normal position. Stretch the filter around the outside of the clear tube.



18. Place the filter housing on the drain all the way to the top, and tighten the clamp so the screw driver fitting is accessible when the unit is in operation.

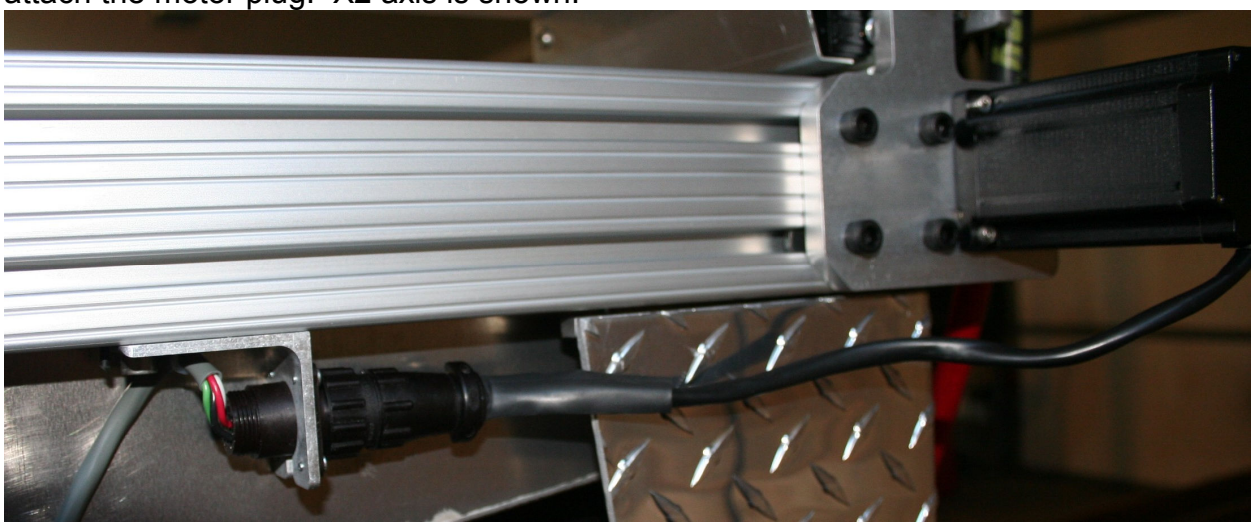
19. Remove the tape from the half round screen over the drain hole in the drain pan. It is taped in its normal operating position. This keeps larger chips from the filter assembly which would rapidly fill otherwise. Most of the chips should be retained in the drain pan for easy removal.

20. Place the pump and tank on the floor with the large hole positioned under the chip filter. Adjust the leg glides so that the coolant pump will slide out from under the filter housing. Consider placing a couple of 2x4s under the tank to keep the bottom off of the floor.

21. The controller mount bars (shipped in the tool box) are mounted to the front of the drain pan. Supplied with the controller mount bars are 8 each 6x25 mm socket head screws. Liberally apply silicone seal under the head of 4 of the 6mm socket head screws. Loosely install the controller mount arms to the drain pan with these screws. Attach the SC2B controller to the arms with the remaining 4 6x25mm screws. Line up the arms and tighten the screws.

22. Attach the X interconnect cable 16 pin Amp connector to the controller. The controller connector has a keying pin to prevent installation on the Y/Z connector.

The X axis cable will have 2 connectors with angle brackets. Locate the nuts with screws installed on the bottom of the right rail. Allow enough room to comfortably attach the motor plug. X2 axis is shown.

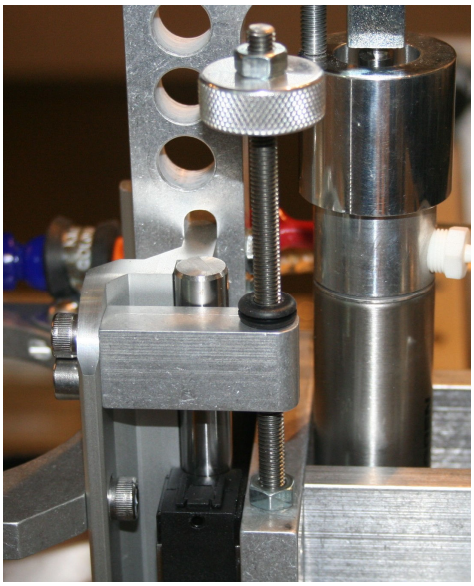


23. Attach the Y/Z cable and route cable with the 9 pin plug on the long cord to the Y assembly **outboard** receptacle'

24. Route the pump power cord to the SC2B controller and connect to either AC receptacle on the SC2B controller.

25. Locate the Z axis stop screw tie wrapped to the Z axis arm. Insert it in the Z axis arm attached to the pneumatic cylinder.

26. Locate the Z axis up stop and install it as depicted. Under normal use, it should be adjusted so the bumper takes the shock just before the z axis hits the top of the cylinder travel.



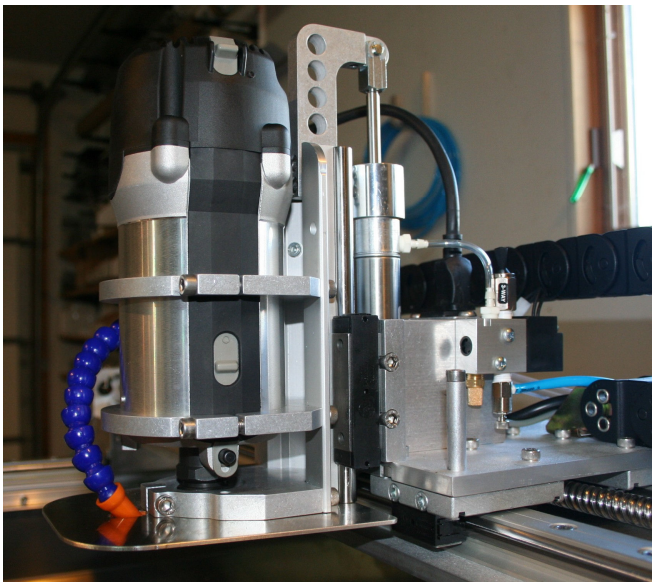
27. Remove Porter Cable router from its box. The router base is not used in this application and may be discarded if hand routing is not anticipated. Also the ¼" collet is provided, but not used with the Panel Pro.

28. The ½" collet and ER11 collet adapter have been installed and dialed in for maximum accuracy. Do not loosen the large Collet nut. If it is necessary to

replace the collet adapter, note the orientation of the ½" collet to the spindle, or better yet utilize a dial indicator to install in the clocking that results in max accuracy.

29. Loosen 2 router mount clamps on Z axis and install Porter Cable router so that the bottom of the machined portion of the router casting is at the bottom edge of the bottom clamp. Snug the clamp screws equally. Don't over tighten.

30. The bottom 43mm clamp (foot) is used for the engraver and other accessories. The lower clamp tightening screw may be removed for normal use. Don't clamp it down tight without an engraver or touch probe installed or it may make it difficult to install the engraver.
31. Insert a 3/16 collet with a 1/8" end mill (double ended with 3/16 shank) with about 7/8" protruding from the collet nut. The end mill gage found in the tool box is helpful with this. Use Porter Cable spindle lock and a common 9/16 wrench on the ER11 collet nut. This adapter uses industry standard ER11 collets available from machine tool supply houses like Enco or MSC.



32. Plug the router cord into the connector on the Z axis as shown.

33.

34. Plug the AC cord that exits the machine near the air regulator in to the GFI AC socket on the SC2B.

35. Note: the GFCI test cannot be completed until the computer has commanded the spindle and pump power on, and the manual switch on the controller is on. It should be tested weekly.

36. Connect the 9-pin male/female serial cable from your computers serial port to the SC2B. If your computer only has USB ports, it will be necessary to use a USB to serial converter.

37. Connect the Power cord to the SC2B.

38. Mix about 36 ounces #78 coolant concentrate to 6 gallons of water. Pour it into the coolant tank.

Recommended computer:
We recommend using a desktop style computer running Windows XP operating system. While a lap-top will run the Panel Pro, the key pad is used frequently. An external key pad may be employed, however the Num Lock has to be on to use it, and then it remaps the main key board so that the U,I,O,J,K,L,M keys are now number keys. If you have to type in a file name, it becomes awkward switching the num lock on and off.

Also plan to have at least a 17" monitor with about 1024 x 768 pixel setting.
Arrange the computer so that the right hand can be on the keyboard or mouse and the left hand can reach the middle of the Panel Pro.

CAUTION!

There should be no reason to be injured while operating the Panel Pro if a few simple precautions and common sense are exercised.

The SC2B is powered by 110vac and switches 110vac for the coolant pump and router.

Any Drain pan leaks should be corrected before further machine use.

Operate only on a dry floor.

Test the GFCI outlet with the router running before each use. Press the test button, and the router should stop. Press the reset button to resume operation.

Do not operate the machine if the floor in the area is wet.

If any coolant leak is noticed, immediately disconnect the power from the SC2B from a dry location and repair the leak. Make sure any area where power cords run are dry.

Under no circumstances should the guard around the router bit be removed while the router is running. Coolant and metal chips will fly every where.

Eye guards are recommended. As the milling bit performs drilling operations, sometimes some chips can fly.

Ear protection is required.

We make no claims as to the medical properties of or continued exposure to aluminum. It is recommended that you avoid contact with the copious chips generated by the

cutting action. The chips are sharp and can easily embed themselves in the skin. Nitrile gloves are quite effective at keeping chips at bay.

Chips should be flushed off with running water. If flushing with water does not remove chips, or metal slivers, then rubbing with clean Scotch Brite will often remove small metal slivers.

Wear safety glasses.

Keep fingers away from moving parts to keep them from getting pinched. When the pressure builds up the stepper motors will start skipping steps, but a painful bruise possibly a broken bone could result if fingers (or other parts of the body) are placed between moving and non moving parts.

Keep fingers away from the router bit. It will cut fast and sure. Again **DO NOT REMOVE THE GUARD! KEEP FINGERS CLEAR!**

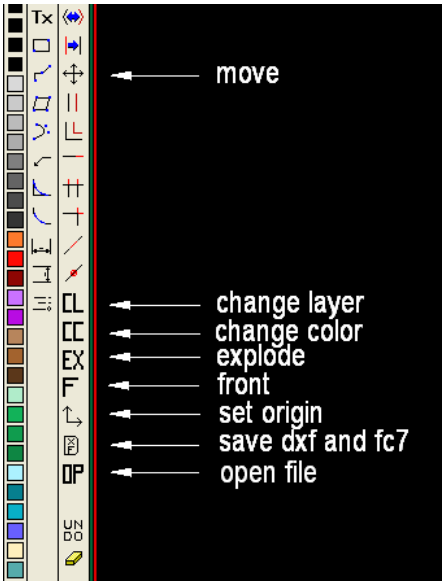
Software Installation:

There are two applications and the drawing library on your AvCAM disk.

AvCAM: load the AvCAM CD into your CD drive. If the AvCAM install does not start automatically, go to Windows Start\run\E:autorun.bat where E is your CDrom drive number. This batch file installs AvCAM and EasyCAD, sets up the proper folders and copies the drawing libraries.

We recommend Windows XP or later operating system. A windows 98 operating system may or may not work. We can not provide any support for a Win98 system.

The initial installation must be accomplished from the CDrom. Note the **application key** on the CDROM envelope. It will be required on the first time the program is run. Update installations will not require the application key.



Install EasyCAD: EasyCAD should automatically install when AvCAM is installed.

To manually install EasyCAD:

Click Windows Start\run.

Type in E:\EasyCAD75x.exe where E is your cdrom drive number.

I recommend installing in the default C:\ECW750 folder. Other files are dependant on this path name.

If you already have drawings in the C:\ECW750 folder, copy them to another folder to protect from overwriting.

EasyCAD license:

Your EasyCAD license is on a printed email in the binder pocket. If we did not have user information when the machine was shipped, call Linda at 701-255-7640 or email Linda@bullerent.com with the email where it should be sent.

Important! A valid email address is required to provide you with AvCAM updates.

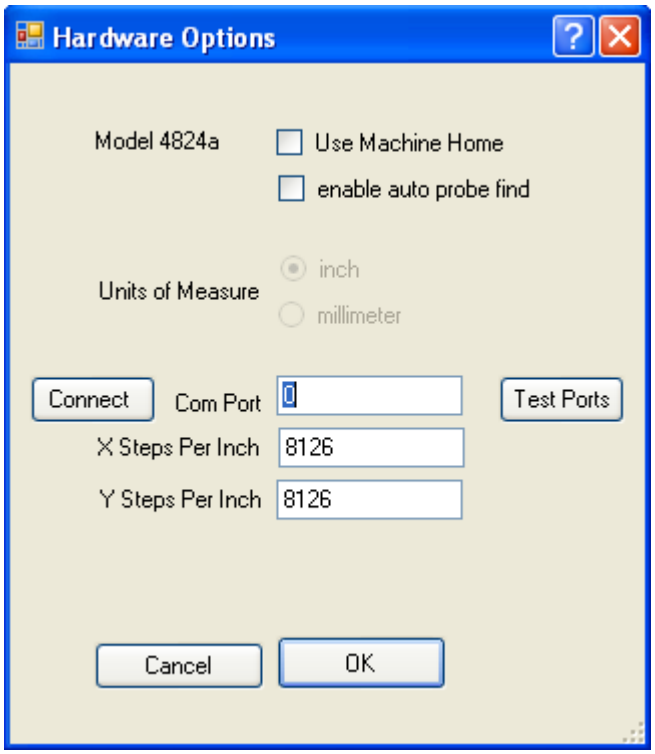
If you want a hard copy of the EasyCAD manual, contact Evolution Computing at www.fastcad.com v7manual.pdf is supplied on the CDROM.

If installed automatically, there will be additional icons that represent menu commands. These are commands frequently used drawing for the Panel Pro. If properly configured, there will be 2 rows of icons on the left side of the screen. To Manually install these icons, make sure EasyCAD is shut down, open the config folder on the install cdrom and copy all of the files in that folder to your EasyCAD folder.

Drawing Library: the drawing libraries should also install automatically. To manually install: Use windows explorer (Windows +E), copy the aircraft and instrument folders into the same folder you have set up for EasyCAD.

Try it out:

Turn the SC2B power switch on. (It may already be on). Click on the blue AvCAM icon on your desktop to open the AvCAM program.



The first time the program is powered up, the com port is set on Com1.

If you are connected to Com1 and the SC2B controller is working properly, the status bar will read “firmware version 1.5x found”. This is your indication that the computer and controller have linked together.

If Com 1 was not the port connected to the controller then the status bar will

read “controller not found”. In this case, open the options > hardware menu.
If you know the port number used, enter it in the com port text box and click OK.

If the controller is connected to a serial port, but you don’t know the number, double click the com port text box. The program will look at com ports one through ten for the presence of the controller. If successful, a pop up will inform you of the port it was found on.

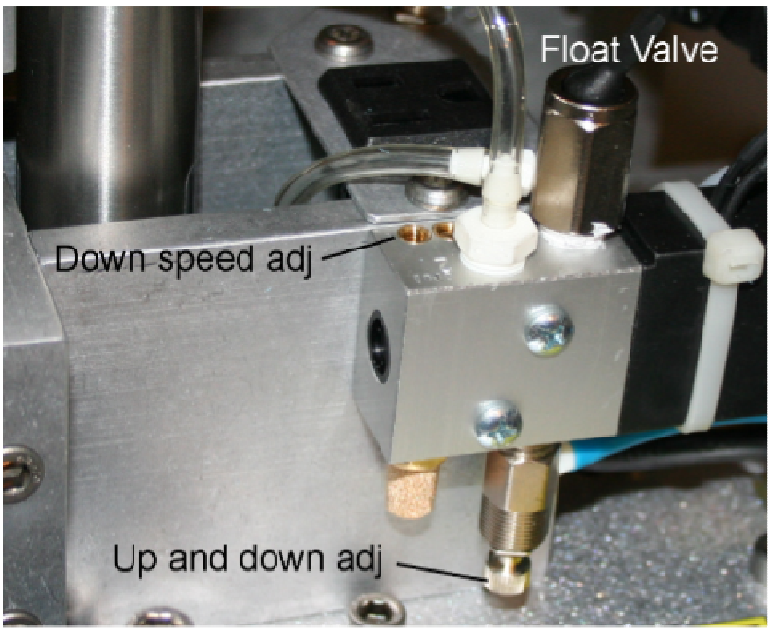
Once communication is established, now is a good time to set up and verify all of the options. The important ones are the port number, machine model, and steps per inch on the options > hardware.

Information on the options can be found in the help file. Click F1 to get context sensitive help on any open window. The help file is the main operating manual for the Panel Pro.

If the help file is not found, navigate to the folder where AvCAM is located if prompted and locate AC.chm.

After the machine is set up and communications established then hit the keyboard “J” or “1” key to the jog mode.

Click the down “3” key or 3 on your key pad (num lock must be on). This will activate the Z axis after the spindle delay has timed out. If the spindle is running, it may be shut off with the spindle on/off switch or the controller spindle off switch so that you don’t have to listen to a unnecessary noise. Clicking the 9 key will raise the z axis. If nothing happens, check that the manual spindle and z axis switches are on. Check that the status bar says “firmware version 1.5x found” (communications established). Check that the controller to Y axis plug is on the outboard receptacle. See the help file contents “trouble shooting”.



Check z axis speed:
To exercise the z axis, open AvCAM, hit the 1 key to enter jog mode.
Hit the keyboard 3 to lower the z axis (turn the spindle switch off for z testing)
The first down stroke will include the spindle delay. After that times out (2 seconds) you can run the z axis up (9 key)

and down (3 key) to check z pneumatic timing.

On the Z axis solenoid is a float valve whose purpose is to gently lower the z axis for checking alignment of the end mill to a material edge to establish a particular position. The Normal setting is with the handle toward the operator. If the z axis is left in the down position, it will start cutting if the spindle is turning, and the bit will probably break when it tries to cut in rapid traverse.

The pneumatics are adjusted at assembly, but may require adjustment from time to time.

The router used should be mounted so that proper weight is felt by the pneumatics

Adjust the pressure regulator to 40 psi. There are 2 air adjustments that control the Z up and down time. On the

solenoid valve located on the Z axis assembly is a needle valve control marked “1” and another marked “2”. The valve marked “2” is not used and should be approximately flush with the solenoid valve body. The valve marked “1” controls the down speed. Typically this will be about ¼ turn from full closed. . A proper down speed to move from upper stop to lower stop is about a count of “one thousand one”, or slightly less than a second. The needle valve located by the pressure regulator controls the up speed, but there is some interaction with the down speed. The up speed should be adjusted faster than the down speed, but not so fast that it slams up. If you have to make adjustments, back out the #1 valve a couple turns, adjust the bottom needle valve for a quick one count for z up, and then adjust the #1 valve for a one thousand one count going down.

The X and Y axis may be exercised from the jog menu. Make sure that the rapid traverse speed is not too high.

If the rapid traverse is set too high the motor torque may drop to a level that cannot sustain movement, and your position will be lost.

The maximum 4824 rapid traverse is around 150 IPM.

Cutting a drawing

We’ll start our discussion by routing a single instrument hole. For instance, an altimeter drawing is an individual shape, its reference (drawing origin), was placed at the center of the instrument. Altimeter.DXF can be found in the Instrument > Standard folder of

the drawing library. When the routing starts, the bit must be at the place on the metal you are cutting that coincides with the drawing reference. For instance, the 0,0 position of the altimeter.dxf file is in the center of the instrument. Since we want to just cut that instrument, the 0,0 position of the machine must be at the center of where you want the instrument cut out. The R key may be used to zero the machine position at its current location.

AvCAM Machine > find lower left edge is used to set 0,0 to the lower left corner.

Cut a file from metal larger than the finished part:

Select material of adequate size so the router clears the clamps, which are best placed in the corners. Generally leave about 1 inch around each edge.

Material should be supported about every foot, and spaced away from the rails so you don't cut through the rails.

Material spacers are supplied in the tool box. These can be fabricated from inexpensive plastic lattice strips found in most lumber yards.

Cut a file from an existing blank:

Use a large carpenter square to square the blank with the x axis bearing rail. Take care that clamps are placed in areas that will not be cut. Clearance must be maintained from the end mill, and the collet nut.

End mill:

If you are starting a complete panel, it is generally a good idea to install a new end mill. Used end mills may be used where tolerances or finish are not as critical. End mills may be inspected using a loupe or strong magnifying glass. **ANY** chipping on the cutting edge is cause for rejection.

Turn on controller:

The computer and controller may be turned on in any sequence, but normally, turn on the controller before AvCAM is opened, If AvCAM is started first, then the keyboard R key must be hit to zero out the xy axis and establish communications.

Verify that the spindle and z axis switches are all on auto (1 position).

Check z axis:

Verify the pressure gage is 40 pounds.

Jog to a position where the end mill is in the area to be cut. Move the float valve to down (handle away from operator). The length of cut of a typical 1/8” end mill is ½”. You want to adjust the depth so that it cuts as deep as possible (cutting on a stiffer part of the end mill), but not so deep that it cuts through the material mount rails.

The Z stop screw is a 6mm x 1 thread, so each turn will make a z axis change of .039375” or just under .040”.

While resting on the top of your 1/8” thick material, loosen the z stop screw jam nut and turn it down till it touches the stop on the top of the pneumatic cylinder, then back it off 5 turns and tighten the jam nut. This will allow the end mill to penetrate about .200”. Assuming the lattice spacers are about 1/8” thick, it will cut through the material, the spacers, but miss the mount rails.

Move the float (manual Z) valve to auto (towards the operator) .

Caution! Always have the z axis up before moving to avoid end mill breakage!

Verify coolant:

The coolant performs several functions.

- Cools the cutter bit.
- Flushes chips off of the material.
- Lubricates end mill. Keeps aluminum from building up on the bit. Material buildup will drastically increase cutting pressure breaking bits.

COOLANT:

The recommended coolant is Cool Mist #78. It does not stain aluminum when rinsed off promptly after cutting and provides good lubricity. Mix the coolant with 4-6 oz of coolant to 1 gallon of tap water, note the color of the mixed coolant. As the machine is used, coolant will evaporate. Often it is only necessary to add water. Watch the color of the coolant to maintain approximate mixture. It should have a pale blue color. If it is too weak of a mixture, then corrosion will be more of a problem.

Fill the coolant tank within 2” of the top. If the coolant is too low, it will not pump at all or there will be bubbles in the clear coolant hose. When bubbles appear dump about a gallon of water into the drain pan. Clean parts with clear water to remove residual coolant. Dried coolant leaves a sticky film.

Plan to replace the coolant and clean tank every 3- 6 months.

COOLANT FILTER:

The routing process produces a large quantity of metal chips.

Place the screen mesh over the hole in the drain pan. This keeps most of the chips in the pan for later clean up. For cutting plastic, remove the top screen as the plastic cuttings will plug it up. The top screen does not need to be used at all, but it results in more frequent filter changes.

Place the fabric filter over the edge of the filter housing and allow the center of the filter to drop inside the housing.

Slide the housing on to the drain fitting and secure with a hose clamp. The clamp should extend over the filter to secure it. The fabric filter catches the smaller particles. When it is full, simply remove it, throw it away and put a new one on.

Simulate the file before cutting.

The process of simulation does all the work of joining entities into the correct order and direction.

Open the cut dialog, click auto tool path, click nearest cutting order, move the sim delay to .001, click simulate. The joining and sorting is done and then the actual tool path is simulated. If a non zero finish cut is specified, a red path indicates the rough cut and the blue path indicates the final or finish cut.

Cut the file

Ready?? Click cut the file. The router turns on, proceeds to the starting point, lowers to the cutting position and commences cutting. No further intervention is required. Assure that coolant is flowing. (Adjust the spindle delay time in move options to allow time for the spindle to come up to speed and the coolant to reach the top.) When routing is complete, the router will raise and power will be removed from the router and the coolant pump.

When cutting is completed, clean the machine. Wipe down the steel parts with a dry rag and spray with a light coat of LPS2. Spray LPS2 liberally under and around the linear bearings. Remove the collet and end mill. Clean out any chips and spray collet and collet bore with LPS2.

SC2B Control Unit

PWR: turns AC power on and off. It also acts as an emergency off. In the off position, it removes all AC power from the internal components. If the spindle is running, or the x or y axis is moving, everything will stop in the off position and will not automatically restart when turned back on. The light in the PWR rocker switch is lighted when the internal components are receiving AC power.

Spindle: The “1” position allows the computer to switch the ac power to the rear gfci socket. The “0” position removes control from the switch thereby removing power from the socket. Before performing any maintenance, remove the power cord from the SC2.

If the internal ac switch shorts, power could still be applied to the rear socket even with the spindle switch off.
Zaxis: the “1” position allows normal automatic control of the z axis. The “0” position inhibits automatic lowering of the z axis.

Positioning the Panel Pro:

Jog to the position you want to be 0,0 and hit the keyboard “r” key.

You can individually set the x or y axis to zero or to another position by clicking the x or y position on the status bar. For instance you have a 1/8” hole that you know is located at 5,3.4. Position the end mill so that it will fall freely into the 1/8” hole. Click the x position and enter 5 on the form and click ok. Click the Y axis position and enter 3.4 on the form and click ok. The position readouts should now say 5 and 3.4

Similarly if you have a panel blank that is clamped down and squared, you can move the Y axis so a 1/8” end mill just clears the bottom edge of the panel and enter -.0625 in the Y axis form. Using jog, move to the left side of the panel. Move the x axis with the mouse wheel so that the end mill just clears the left edge. Set the X position to -.0625

AvCAM leaves the X and Y axis engaged at all times to avoid inadvertent loss of position. It is possible to disable the x and y axis in machine > disable axis, but the actual position may jump as much as .002 from the reported position when the axis are energized.

Cut the panel:

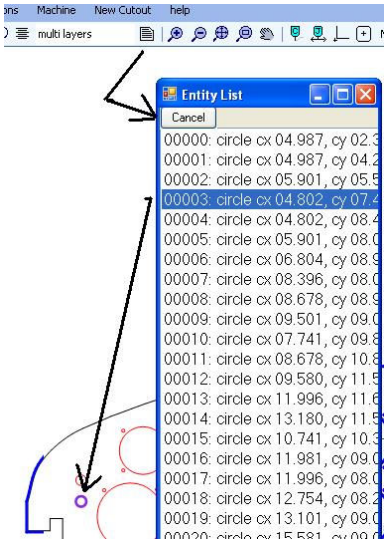
Open the cut dxf file form.
Verify the correct layers are selected.
Click **move options** and verify the correct cut and traverse speed are selected. (about 12 inches per minute cut speed for 1/8” 2024t3, and 200 to 250 inches per minute traverse speed.
Verify z down delay at around 1.3 second, and z up delay about .3 seconds.
See the help file for details on move options. (Hit F1 with the move option form open)
Click ok to close move options.

Ready? Click “cut the file”
The xy axis proceeds to the start of the first entity and cuts the file.
When complete, it will raise the z axis and stop the router and coolant.

Suspend cutting:
There are various reasons to stop cutting. One of the main ones is if a bit breaks. Another is if you want to reposition clamps.

To stop, hit the ESC key. Motion stops, but z stays down and the router continues to run.
If you want to just pause in position, you can switch the SC2 Z and spindle switches to 0. This is good for repositioning clamps. When ready to continue, turn the z and spindle switches back on and hit enter.

In the case of a broken bit (end mill) the xy axis will have traveled some distance before you hit ESC. In this case it is better to hit ESC a second time to completely halt operation. The Z axis will raise and the router turns off. After replacing the bit, you need to find the entity number to restart the cut.



Click entity list and highlight an entity entry. They are entered in the order they will cut. Using the mouse or arrow keys, move through the list until the entity is highlighted that you want to start on. Click cancel. The Entity listed will be entered in the cut file start entity.

The file does not need to be simulated again. Click cut the file.

You will get a warning that the starting position is not zero. Assuming you have not moved the xy axis hit enter to acknowledge this is ok. You will get another message indicating the starting entity is not zero. Hit enter to acknowledge this also. The skipped entities will be drawn, but not cut.

DRAWING FOR THE PANEL PRO

EasyCAD

EasyCAD is especially suited for use with the Panel Pro.

One of the most useful properties is the ability to insert instrument drawings (insert part). EasyCAD keeps all of the entities grouped so that the entire instrument can be moved, or erased, keeping all of its entities intact. When the entire file is exported as a dxf, EasyCAD exports the individual entities so it is not necessary to have libraries of dxf files.

EasyCAD tour:

EasyCAD uses a system of menus and toolbars to access commands. All commands can also be initiated with a text command. For instance a line can be initiated by opening the draw>line menu, clicking the line tool on the tool bar, or typing the word "line" and hitting enter.

In this document when we refer to a command, it will take the form of the menu item ie draw followed by a ">" and the sub menus also separated by the forward arrow. So a line command takes the form of draw>line.

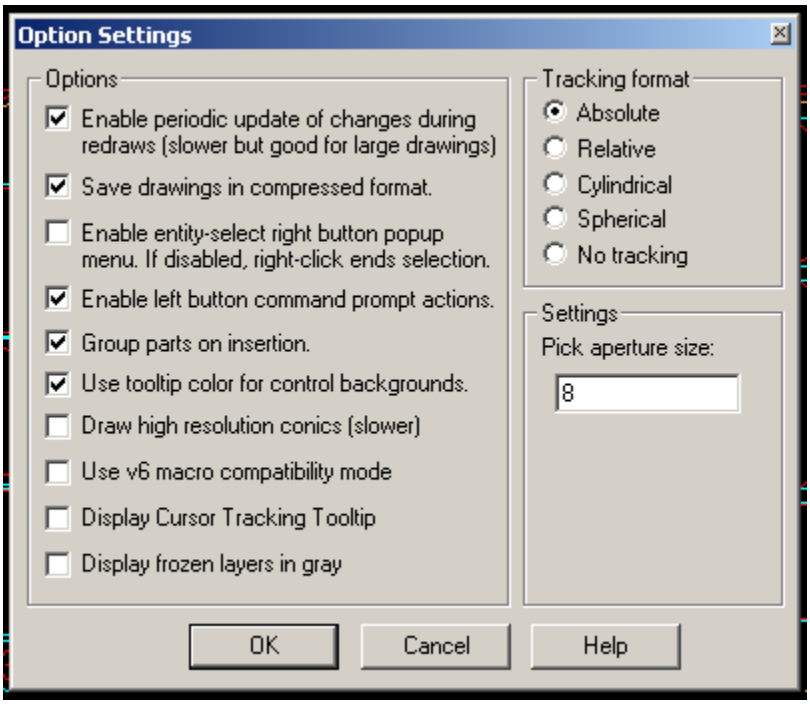
This is a good time to customize the drawing desktop for your preferences.
If you copied the configuration files from the distribution disk to your EasyCAD7 folder, some customization will already have taken place.
You should see a color bar, a draw bar, and an edit bar on the left side of the screen, and a standard icon bar on the right. See software installation for more information on extra econs.

On the bottom of the screen you will see an icon with a hammer on it. Click on that to customize tool bar placement as desired. On the lower left corner of the pop up menu, verify that "use scroll bars" is checked.

When you invoke the file>new command, the settings specified in the standard.ft7 template file will be loaded so that text styles, line styles, layers and other settings will be loaded. See the EasyCAD help file for more information on templates.

Open specs > options and make sure the items are checked or unchecked the same as shown below. Two items are particularly important. "Group parts on insertion" makes sure that all of the entities associated with an instrument stay together when inserted into your cut file

"Display cursor tracking tool tip" will use up your computers resources slowing it way down after awhile.



What is CAD

CAD (Computer Aided Drafting) is nothing more than a database of drawing entities and the properties that define those entities. CAD is a vector based program rather than a paint type program. Paint and drawing programs simply turn pixels on or off on a screen. They are simply visual and not scaleable since there is no definition of which pixels belong to what object. Vector graphics involve entities such as lines that have properties such as a starting and ending point. Such an entity may be scaled for display on a screen or paper.

EasyCAD is a 2 axis drawing program. Looking at the screen, left and right is the X axis, where moving right results in a higher number. IE moving from a 0,0 coordinate to a 10,0 coordinate places us at a position 10” to the right of the previous position.

The Y axis is viewed on the screen top to bottom and moving up yields more positive positions.

The view for drawing an instrument panel would be if the panel was on a table viewed from the top.

The plan of attack:

The most efficient way to make panels is to:

1. Create each cutout (instrument or even a round hole for a switch) as a separate file and store it with a name for future use, I.E. KI206.fc7.
2. Draw the panel shape and store it also as a file using the serial number of the airplane as a reference. I.E. BB421plt.fc7
3. Start a new drawing and insert the panel drawing, and the instruments as desired. Save it as a dxf as a “cut” file. I.E. BB421pltCut.dxf
4. Load the file in AvCAM and preview it.
5. Cut the file.

When future panels of the same type are required, your cut file (also saved as the native fc7 format) can be edited by simply deleting instruments not wanted and replacing them with different ones.

There are many Instruments and panels in the library supplied with the Panel Pro, and in many cases are ready to be used. At some time however, you will need to draw your own panels and instruments.

The following is an exercise to familiarize you with some of the techniques used in drawing an instrument for cutting on the Panel Pro. In most cases an instrument can be generated in AvCAM “new cutout” in about 30 seconds. Drawing them by hand could take 30 minutes.

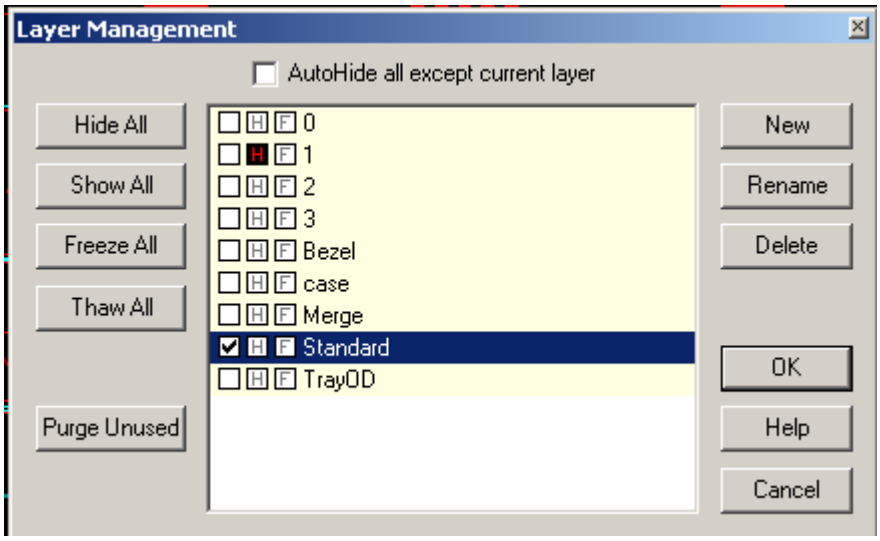
Layers:
Think of layers as a layer of vellum or translucent material that different information is drawn on. For instance one layer of a house drawing would have the foundation drawn, another layer would have basement rooms, another layer could have main floor rooms, another layer the wiring, etc. Now if all of this information would be viewed at once, it would be a hopeless jumble of lines, however if we remove all but the foundation and basement rooms, we have a clear picture of that portion of the plan.

CAD is simply a file with the definitions of entities. Such as the start and end coordinate of a line. In addition there is provision in that definition for the name or number of a layer. We use that information to separate out different information. When AvCAM reads the file it ignores all layers except the layers selected in the AvCAM layer management dialog.

Any layer name can be used, however many of the drawing on the library inherited the layer structure from earlier days when only layer numbers were used, and I recommend using what is already in use.
2. The desired final dimension layer (i.e. 3 1/8 “ hole for an instrument)
Bezel. The shape and size of the highest and widest parts of the instrument to avoid side to side interference.
TrayOD: The outside dimensions of the panel mount trays. It is useful to locate mounting rails.
Outside: The outside layer is the outer perimeter of the panel or part. The layer name “outside” is required to alert AvCAM to cut this on the outside and cut clockwise.

Whenever EasyCAD makes a new entity, it is drawn on the layer currently selected, and using the currently selected color.

When you chamfer the corner of 2 lines, EasyCAD creates a new line that represents the chamfer line using the currently selected layer and the currently selected color.



Open the layer dialog by clicking the layer icon, usually on the right side of the screen. Layers can be hidden by clicking the "H" on the layer you want to hide in the layer dialog. The example on the left shows layer 1 hidden, and all of the rest of the layers visible.

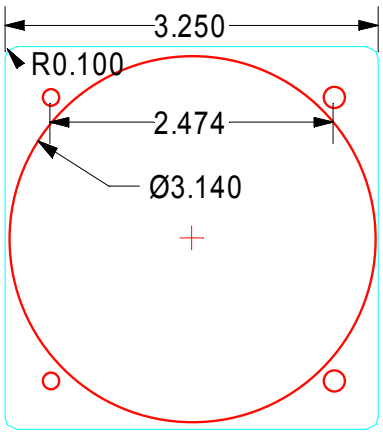
The check mark on "Standard" indicates it is the current layer.

A handy feature is the hide all and show all buttons which hide all of the layers except the current layer, and show all of course un-hides them. Freeze can be used to protect a layer from inadvertent editing. I don't use that often, because when an instrument is inserted, the individual entities are protected. One note is that it may be necessary to snap to entities on an inserted file. If the snap won't work, try showing all layers.

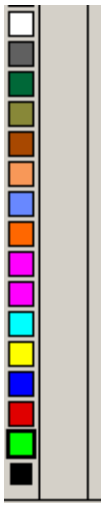
Do not use a layer named "block"! When AvCAM sees the word block it assumes that it should save the block definition. If you have a layer named block, the drawing will not be useable for AvCAM.

Drawing entities:
If you look at the draw menu, you will see the drawing entities that EasyCAD will draw. AvCAM will recognized line, arc, circle, polyline, and point entities.

Draw instruments:



Consider the instrument to the left as a manufacturer may draw it. This is a standard cutout for a 3.125" instrument with allowance for paint.



When EasyCAD opens a new file, the current layer is “standard”. It is useful to organize information on layers that can be turned on or off so as not to clutter other information. Many of the drawings included in the drawing package have their roots back in the “DOS” days when layers were numbered and not named. Back then we adopted layer 2 as the layer to contain the final desired cutout sized entities and have not changed it.

We will start by drawing the cutout. Select the layer icon  (right side, icon with 4 horizontal solid lines). Click new and type in “2” for the new layer name. Click new again and repeat with “1”. On the lines with the layer names there are 3 boxes. The first box if checked indicates the current layer on which any new entities will reside. Next to that is a box that if checked indicates that layer is hidden.
For now check the layer 2 box to select it as current, and click ok.

Next move the mouse pointer to the color bar and select the third color from the bottom “red”.

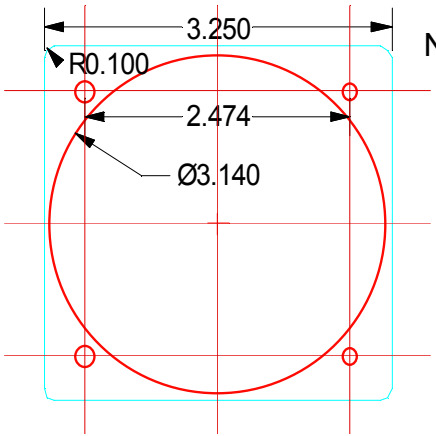
Click draw>circles>diameter and center. There are a number of methods to define the entities. In this case we will enter the diameter of the circle and its center coordinates. Note the data entry / command bar on the lower left of the screen. It should say diameter (2.000) or some other number. The number displayed is the diameter that will be drawn when you right click or hit enter unless otherwise specified. In this case type the number 3.140 and hit enter. A 3.140 diameter circle will attach to the mouse pointer. We want a precise center coordinate, so type the number 0,0 and hit enter or right click on the mouse.

Now let’s draw circles to indicate the location of the mount holes. We can calculate the coordinates with a calculator and enter each circle, but let’s use the power of CAD to do some of the calculations.

Construction lines are temporary lines we draw to measure from.

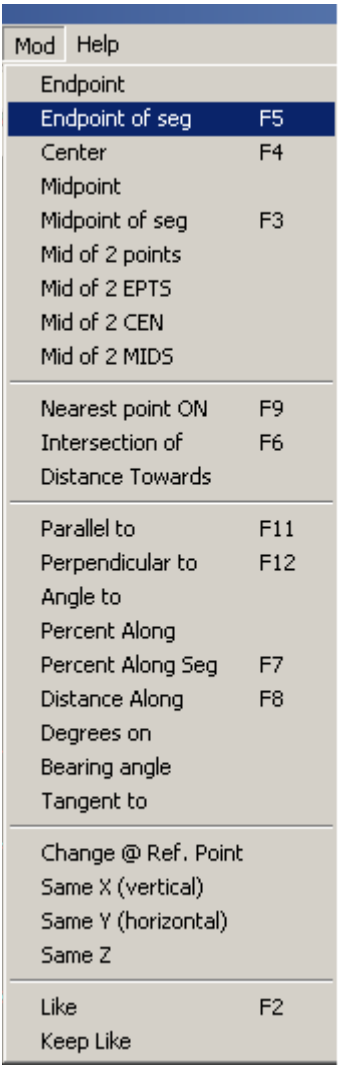
Click the line icon (upper left side) or draw > line. Enter 0,-2 to start a line on the centerline starting at the bottom. Click the ortho button on the bottom. This forces lines exactly left/right or up/down. Next move the mouse so that the line extends beyond the top of the instrument. Left click to set the end of the line.

Repeat with a line from left center (-2,0) to right center.



Note that the horizontal distance between mount hole centers is 2.474. Divide this by 2 to get 1.237. Select the offset one icon (left side 2 vertical lines) When we draw a line, a number in parenthesis appear in the lower

left data entry bar which usually is the last number used in that command. In this case enter 1.237. Either right click or hit enter to accept. The data entry bar now says "entity". Click on the horizontal line. Now pick a side by left clicking on the side of the line that you want the offset line to appear. Click on the top side, a line appears parallel to the horizontal construction line, offset by 1.237".



Repeat this command by right clicking. Accept 1.237 by right clicking. Select the center horizontal line by left clicking. Select the lower side by left clicking.

Repeat an offset on the left and right of the vertical construction line.

What we have now is 4 lines whose corners intersect at the centerlines of the mount holes. Select draw>circles>diameter and center. Enter .125 for the diameter. Now instead of entering a coordinate for the center, we will use a "snap" click mod>intersection of. Click one of the intersection lines, and now the other.
A 1/8" hole appears at the intersection. Repeat with the other holes.

Note that we have numeric dimensions on our drawing. These are not necessary because the dimensions are inherent in the drawing, and only used in this case where the user does not have access to the cad program. Let's erase the construction lines no longer needed. Click edit > erase or the yellow eraser icon on the left lower side. Click on the 4 lines that intersect the mount holes. The lines change color when selected. Leave the center construction lines.

Snaps:

We mentioned snaps earlier. The picture at left illustrates the EasyCAD mod menu. The mod menu modifies a command to "snap" to a specific location, usually a part of an entity such as end point or mid point of a line, or center of a circle.

When you are asked (message on the status bar such as "1st point") to supply a coordinate, you can:

- Type the coordinate (i.e. 5.64,3.75) and hit enter
- Move the mouse visually and click (not very precise).
- Snap to a preset point on the screen (can be set to 16ths or what ever) but usually we need finer resolution so to avoid snapping to a point we don't want, normally have the "snap button" off as shown.

- Snap to a point on an existing entity. This is what I use the most. This actually uses the “mod” menu on the left, and the “snap buttons on the bottom tool bar should be left off, (out) as above.

For instance you want to draw a line that starts precisely at the end of another line. You would first invoke the line command, and when the status bar says “1st point” you would open the mod menu and click on “Endpoint of segment” (or simply hit F5) then click the line that you want to reference the end point of. This precisely selects the coordinate of the end point of that line as the starting point of your new line.

There are 4 Function “F” keys you should learn.

1. **F3** is the midpoint of a line or arc (if the arc started at 0 deg and ended at 180 deg, the mid point would be at 90 deg)
2. **F4** the center of an entity. In the case of a circle or arc, it is the center, in the case of a line it is the same as mid point, in the case of a closed polyline, it is the center of all of the enclosed area.
3. **F5** Endpoint of a line or arc or polyline segment.
4. **F6** Intersection of two lines.

See the EasyCAD help file for more information.

Now it’s time to draw the bezel. It’s important to include an accurate bezel dimension so side to side panel space conflicts can be resolved. Click on the layer icon and enter a new layer called “bezel” and select it as the current layer.

Select the cyan color. (color 5 on the left hand color bar)
The width and height of the bezel is 3.25 / 2 = 1.625
Offset the center vertical and horizontal lines by 1.625
Now you have a box centered on 0,0.
To fillet the corners, click draw>fillet/chamfer/offset>fillet and trim
Select the 2 lines to fillet. Enter the fillet radius (.1), hit enter.
Repeat with the other 3 bezel corners. We can now erase the center construction lines.

Note that AvCAM must have totally enclosed regions in order to compute tool paths. This means that the lines and arcs used to form that region must not have gaps or overlaps at their end points. Also, there cannot be entities that overlay another entity with a common endpoint.

Mount holes:
AvCAM uses the circles that depict the mount holes. If the circle is equal to or smaller than the end mill, Panel Pro will plunge down and back up, leaving a hole just slightly bigger than the end mill. If the circle is larger than the end mill, it will cut it at actual dimensions.

The object here is to introduce you to drawing principles. I urge you to explore the EasyCAD help file which has information on every command.

Grouping:
Grouping is the characteristic of EasyCAD to keep selected entities together when moving or deleting them. This results in all of the entities staying together and not getting misplaced or moved out of position inadvertently.

An important consideration is that you need to verify that specs > options > group parts on insertion is checked. DXF files generated by Panel Pro can be inserted without change. When this is set, then when parts files such as a KI206.fc7 or KI206.dxf are inserted, they will be grouped.

However, be sure that you don't open a DXF file consisting of inserted parts for editing because the grouping will be lost. The native EasyCAD file format file extension is .fc7. files saved as an .fc7 will retain the grouping. Files saved as .dxf will not retain grouping.

An individual instrument may be edited in either a dxf or fc7 format since we are not concerned about grouping. It is when we have a panel with instruments that grouping needs to be considered.

Create a "cut" file

1. Draw each individual instrument and preferably save in FC7 format.
2. Draw the panel outline on layer "outside" to cut the outside dimensions of the panel.
3. Open a new file and insert > insert part the panel.FC7 followed by insertion of the instruments.
4. Save the file as a panelcut.FC7 (I use the aircraft serial number and then the letters Plt, Ctr, or Cp and the word cut as a naming convention IE BB538PltCut.fc7) for future editing, then as a panelcut.dxf file. This is the file that Panel Pro will use. Avoid using N numbers for naming. N numbers change and only identify the owner at that time, where as a serial number is permanent and identifies specific makes and models. For instance BB538 is a King

Air 200. This is useful for re-use of drawings.

Use an existing cut file.

1. Open an existing panelcut.FC7 file (opening a dxf file will not keep the entities grouped, and is vulnerable to errors)
2. Immediately save to a newnamecut.FC7 file to avoid contaminating an existing good file.
3. To change an instrument, draw a circle in the center of an existing instrument to make a handy location reference of its center. Delete the instrument not wanted and insert the desired instrument.FC7, snapping to the center (f4) of the circle. Delete the circle.
4. Save as FC7 and then dxf.

Use a DWG file from Easy Cad.

1. Load the dwg file. This has the same effect as loading a dxf file in that the instruments may be ungrouped.
2. Turn the cutout layers back on, and draw circles in the middle of them for reference. Use mod > center (F4) to snap to the center of existing circles. Hint, draw the circles on a temp layer, then turn that layer off and erase the other entities.
3. Insert the instruments and panels in a FC7 format using the circles as reference. This is often easier than using AutoCAD directly.

EASY CAD LIST COMMAND:

The list command allows viewing of the details such as start and end points for lines, radius, center coordinate, start and end bearing for arcs, and the direction of lines.

Offsets:
Using the offset command is very useful to make construction lines for precision location referencing another entity.

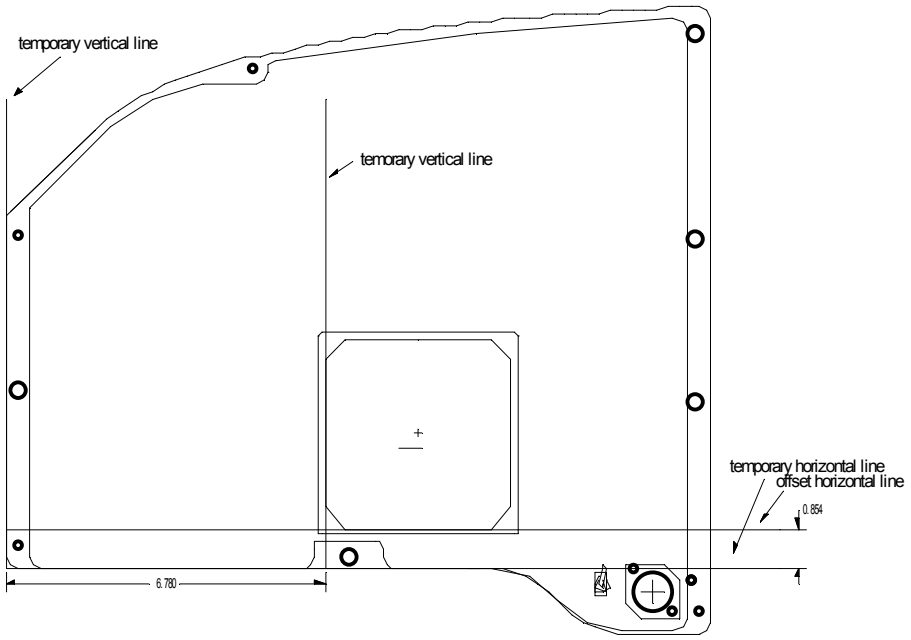
Items to remember about the offset command:

- The offset entity will reside on the current layer using the current color.
- Offsets drawn directly on an inserted instrument or panel or other group becomes part of that group. It is often useful to draw construction lines base on panel edges. The best practice is to draw a line from 0,0 to say 0,15 for a vertical reference. Use a color different from your panel drawing to help differentiate it, and make it long enough so that it can be selected without selecting the underlying panel. You can draw lines based on snaps (F5 end point, F3 midpoint etc) to use as temporary lines to offset from.

For instance, you have an existing panel and need to position a ATI3 instrument in the same place as the original. Make a line from the left edge of the panel extending upwards (ortho on). Make another line starting at the end of (F5) one of the drawing entities from the lower edge of the panel you will be measuring from and extend it left or right (ortho on).

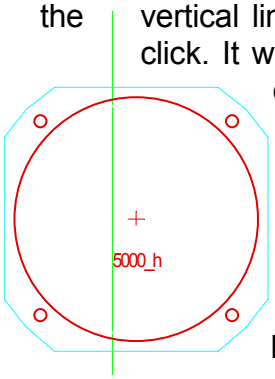
Now measure from the left edge of the original panel to the left side of the opening of the ATI hole you want to copy. Using the offset command (color and layer don't matter, it will be erased) offset the line you drew by the amount you measured.

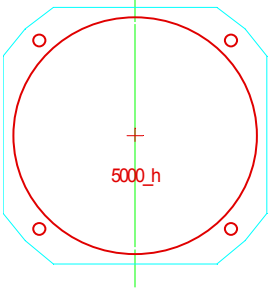
Do the same with the lower edge of the ATI hole measured from the lower edge of the panel. We can use these temporary lines to line up the instrument we wish to insert.



You can now draw a construction line from the center of the instrument and then draw offsets from that to place other instruments on the same vertical or horizontal centerline. If you have two intersecting lines you can place an inserted instrument (instruments have there 0,0 point in the center) by clicking mod>intersection or F6, then clicking on the intersection of the two lines you want to place it on.

Another technique, to adjust an instrument so that it moves directly onto an existing line, in the illustration below, we want to move the instrument so that it is directly on the vertical line. Click edit > move, click the instrument you want to move, right click. It will ask where you want to move from. Hit F4 (center) then click on the circle that defines the instrument hole. You will be asked where to move to. Hit the F6 key (intersection). Click on the vertical line, then click on the horizontal line that comprises the center mark of the instrument. The instrument will move from the center of the instrument to the intersection of the vertical line and the horizontal line of the center mark.





Draw a panel:

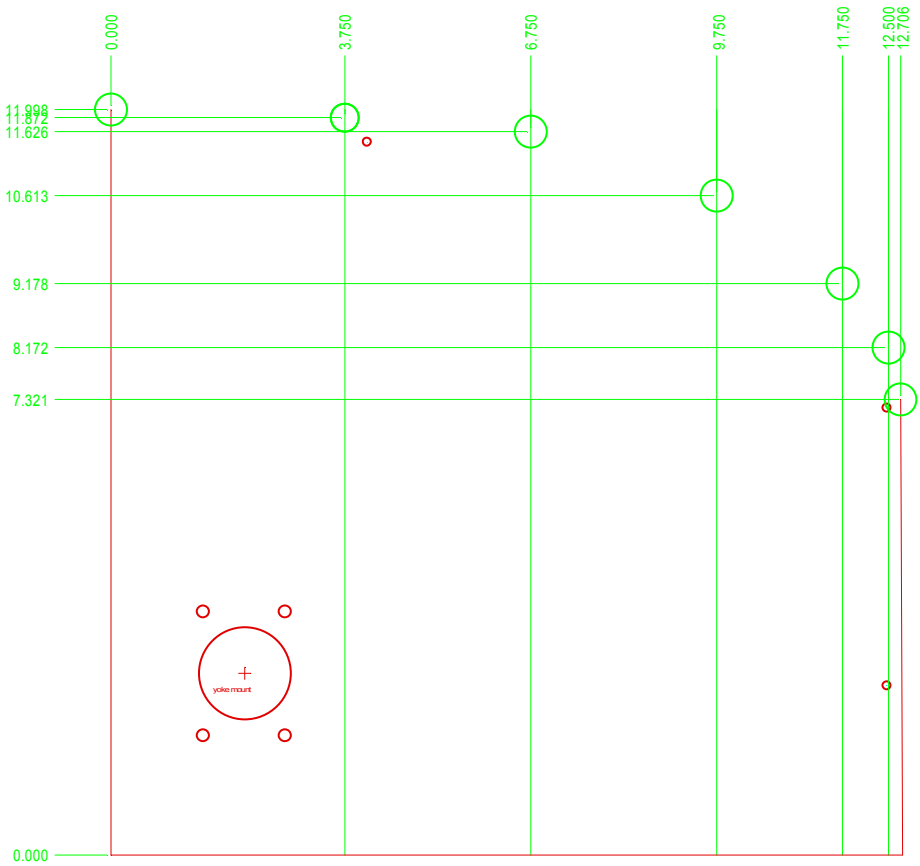
The preferred technique for measuring panel perimeters is to use the Measure Pro.

This is a discussion of techniques to hand measure a panel.

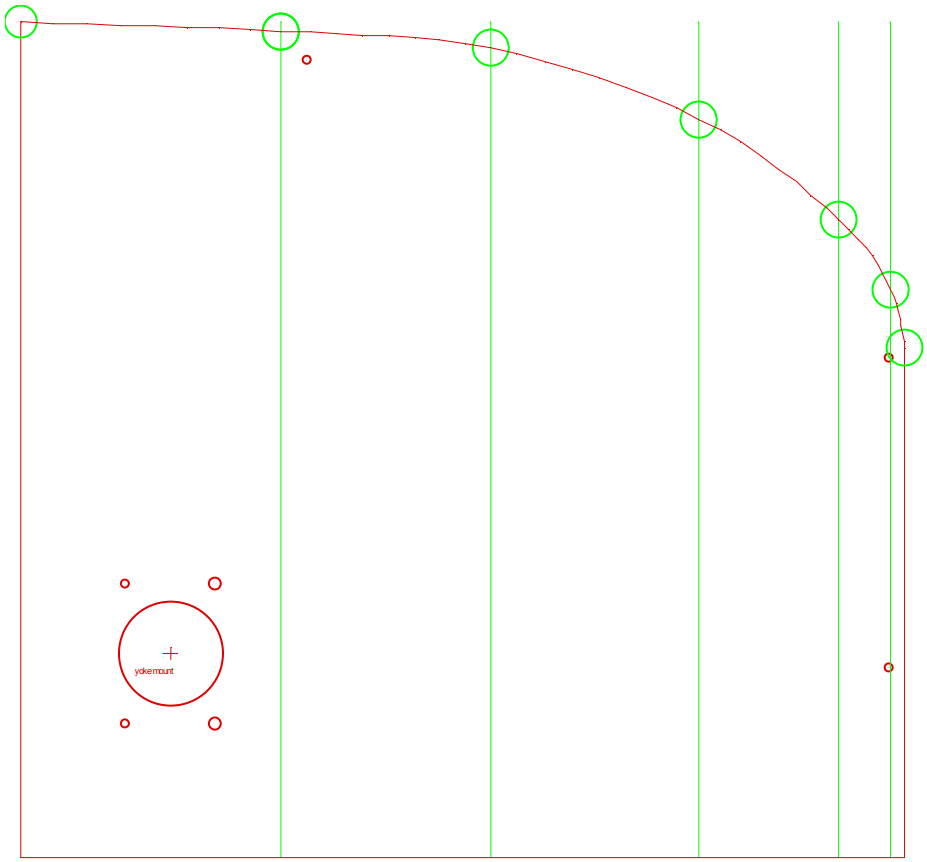
You have a 206 copilot's panel to draw. Here is how. Place the panel on a large piece of paper and draw a line around it with a fine tip pencil. Measure the easy parts with a caliper if possible, or a good quality 24" steel rule. This panel is basically square with a curve at the top. It measures 12.706 wide and 11.998 high (we used a 24" caliper). On a new file make a line from 0,0 to 11.998,0 on layer 2, red color.

Draw another line from 12.706,0 to 0,0 for the bottom line.
Now draw vertical lines on your paper that are parallel with the left side line. Make the distances easy to measure like 3.75. What we are trying to accomplish is to generate the curve by defining control points. If a curve is real gentle, a point every couple inches or so is sufficient. If the curve changes a lot, then we need points every half inch or so. After the vertical lines are drawn measure the vertical distance where the vertical drawn line intersects with the top curve.

Using those coordinates, draw circles on your screen. The circles should be about ½" diameter for easy selection. We will remove them later.



Now we will connect these points using the center snap (F4) with a parabolic spline. AvCAM does not support parabolic splines, however, when exported to a dxf file, EasyCAD breaks it down into a normal polyline with a bunch of segments.



You don't need the vertical lines on your screen drawing, they are on this illustration to show how they would be placed on your paper drawing. If you are happy with the shape of the curve, you can erase your temporary circles.

Measuring the control yoke hole:
First let's measure the diameter of the yoke hole with a caliper at 1.5". Then measure from the lower edge of the panel to the lower edge of the hole and find that it is 2.188". 2.188 + ½ the yoke hole diameter (.75) is 2.938, the vertical coordinate of the hole. Measure the left edge of the panel to the hole = 1.398. 1.398+ .75 = 2.148. You can place a circle at this coordinate, but a better solution is to generate a 1.5" round hole (you can even include the mount holes) with AvCAM and insert it at 2.148,2.938.

You can use the same technique to locate other holes. I do not recommend cutting the panel mount holes, since they likely will not match another panel, and they are quite difficult to measure accurately. What I normally do is match drill to the existing panel.

AUTOCAD DRAWINGS FOR THE PANEL PRO

The following describes techniques used to create a DXF file that Panel Pro will use to cut out an instrument panel. This assumes that the reader is already familiar with AutoCAD and highlights techniques used with the Panel Pro.

The entities to be cut need to be on the desired layer, usually layer 2. Entities not intended to be cut such as bezels or text notes should be on another layer.

IMPORTANT!
An efficient instrument panel drawing technique breaks a drawing into manageable pieces. Draw each instrument cutout and save it in a convenient directory organized by manufacturer. The same can be done with the drawing of the panel outline itself. These drawings can then be combined at a later date to create whatever panel is desired. The process to do this is open a new drawing, insert > block panel name.dxf or dwg at 0,0. Then insert>block instrument names at wherever. Save the file as a dwg. Then save as a dxf. See a later discussion on the save as procedures.

Drawing concepts:

The following describes the techniques used to hand draw an instrument. It is presented to familiarize you with the techniques used to draw an instrument or other cutout.

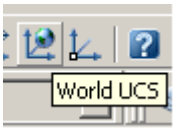
When actually preparing a panel to cut however, you should insert the instruments and other cutouts as blocks either from the drawing library or if they are not in the library, use the “new cutout” utilities in AvCAM. These tools will create a dxf file with only the instrument entities in it. A typical instrument cutout can be made in about 15 seconds using this method.

AutoCAD has the ability to “cut and paste”. **Avoid** using this technique for panel drawings. AvCAM supports originally drawn and block type entities.

Some methods of drawing also make use of symbol libraries. This method is also not supported.

The best place to start is by drawing a single instrument cutout, but first a couple of set up items.

Open a new drawing using model space as opposed to paper space. The drawing must be made in full size. Paper space is used to scale large objects for a given sheet of paper. It is normally not needed for instrument or panel drawings, as they can be scaled to fit the paper at print time.



Use the world coordinate system (WCS) not a user coordinate system (ucs). A user coordinate system may be used to make intermediate calculations by setting the 0,0 coordinate to a different location, however, when the drawing is saved as a dxf file, it reverts to the world coordinate system, and the 0,0 point may where you expected.

For this exercise we will assume an ATI shaped hole that we will cut out to 3.2" wide 3.2" high that has a diagonal measurement of 3.92" and a distance between mounting holes of 3.06". In addition, the 0,0 (insertion point) will be at the center of the instrument. The insertion point could be at the lower left corner, however since different instruments have different dimensions, it would be difficult to align a row of instruments based on an edge.

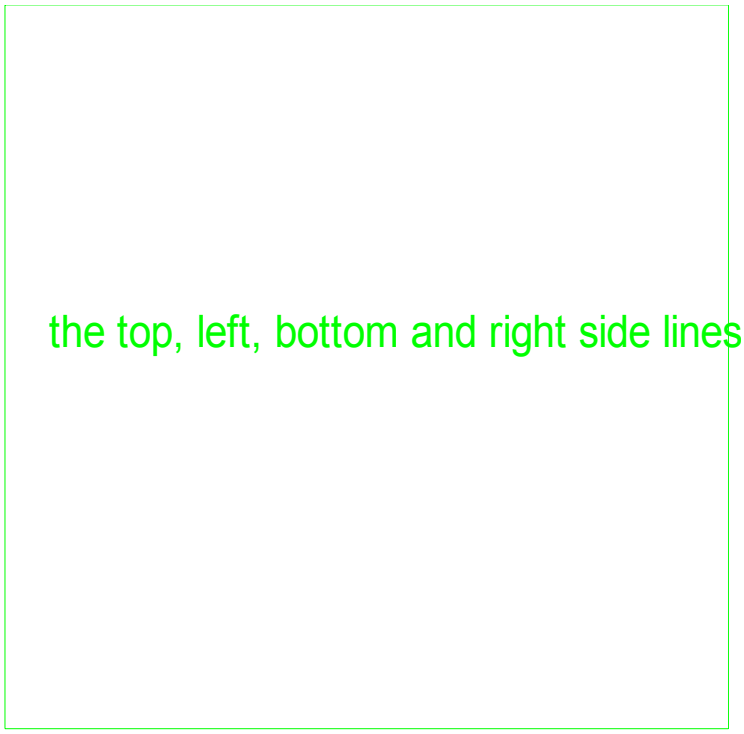
Layers:
Many of the drawings were made back in the days of DOS based CAD systems. At that time, only numbered layers were used. Layers separate out common items of interest. AvCAM will cut the entities on any one selected layer. The entities that comprise the cutout dimensions are on layer 2. Later versions of CAD allowed alpha layer names, and the bezel entities are on the “bezel” layer. For panel mount radio cutouts there is a trayOD layer, and the panel perimeter is the “outside” layer.

Do not use a layer named “block”! When AvCAM sees the word block it assumes that it should save the block definition. If you have a layer named block, the drawing will not be useable for AvCAM.

Colors:
Normally colors and line styles have no effect to AvCAM.

The default background in AutoCAD is white. Most of the drawings in our library were made in EasyCAD with a dark background. This will display as black in AutoCAD, however some of the other colors may appear strange as the colors don’t necessarily map out the same between EasyCad and AutoCAD.

Draw an ATI3 instrument.



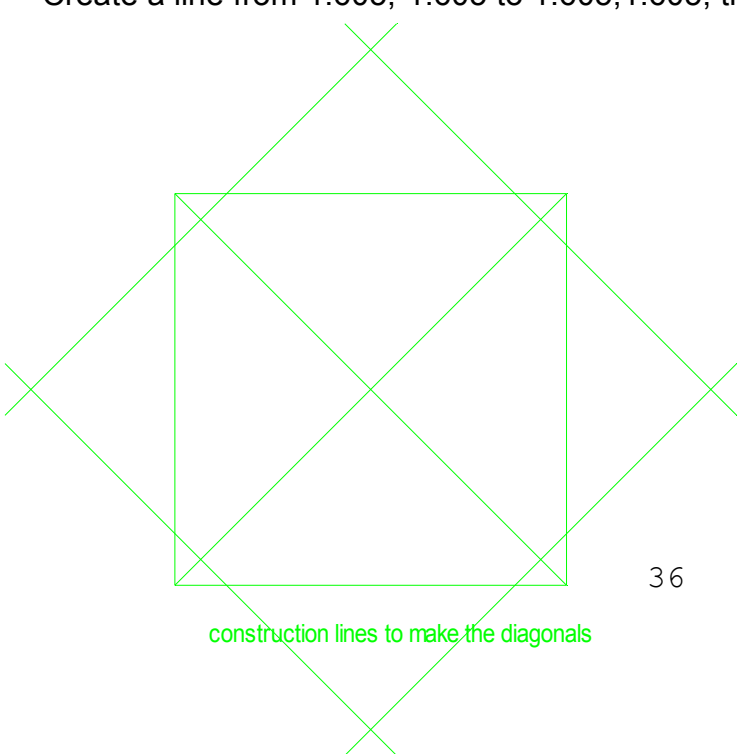
A standard ATI3 cutout dimensions are 3.21 wide, 3.21 high, 3.92 diagonal across the corners. The distance between mount holes is 3.06.

We will first draw the cutout.

Select (or create layer 2)
Divide the height and width (3.21) by 2 = 1.605
Divide the diagonal 3.92 by 2 = 1.96
It is good to start and finish on the top center of a ati or square type instrument.

Create a line from 0,1.605 to –1.605,1.605 to create the left half of the top line. Note that it extends left, which when connected into a polyline with the pedit command will rotate counter clockwise.
Create a line from –1.605,1.605 to –1.605,-1.605, the left side of the cut out.
Create a line from –1.605,-1.605 to 1.605,-1.605, the bottom line.
Create a line from 1.605,-1.605 to 1.605,1.605, the right side line.

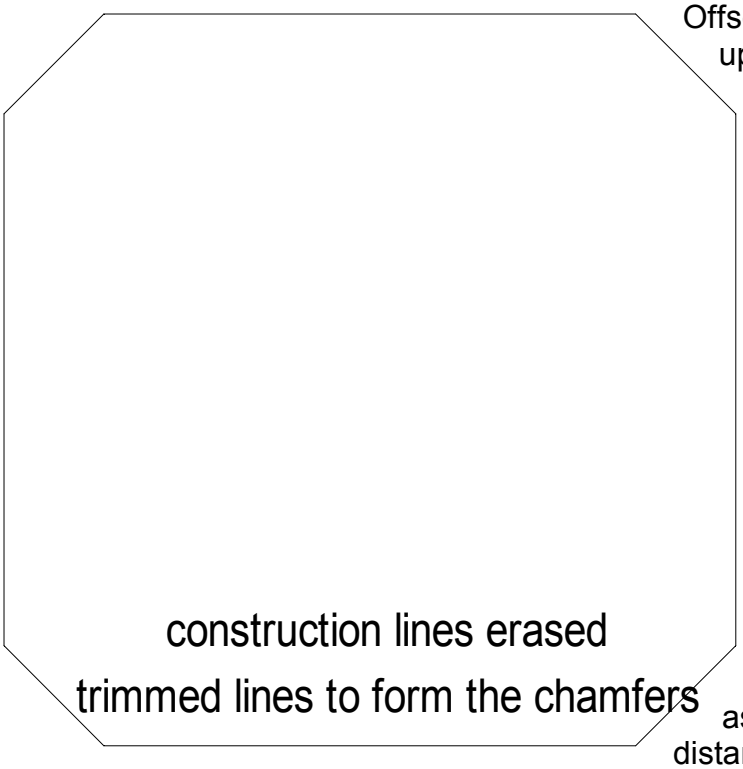
Create a line from 1.605,1.605 to 0,1.605, the right half of the top line



Draw a line from the lower right corner using object snaps (end point) diagonally to the left top corner, also using the end point snap to precisely locate the end point.

Offset that line by 1.92 on the lower and upper sides.

Draw a line from the lower left corner to the upper right corner.



Offset that line by 1.92 on the lower and upper sides.

This forms the diagonal corners.

If we knew the actual chamfer, we could use that with the chamfer command, but usually the instrument manufacturers drawings specify a diagonal measurement.

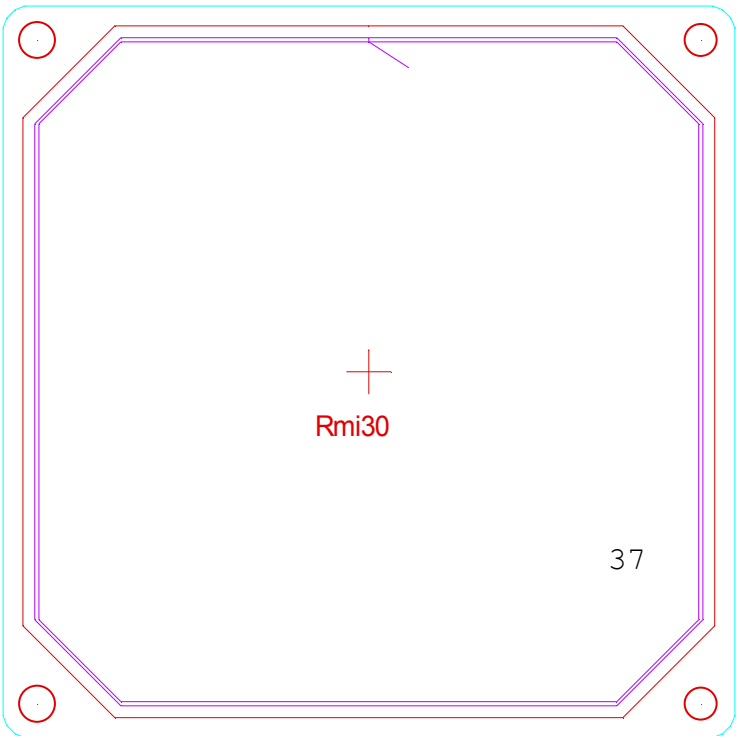
We can use the chamfer command to trim the lines created by the offsets.

The construction lines drawn from corner to corner can be erased now.

Select the chamfer command. It first asks you to specify the chamfer distance. Enter 0.

Select the chamfer command and select the top line and the top left diagonal line to trim the ends. Repeat with the other lines until we have the octagonal ATI shape.

Now we will create the mount holes.
Make layer 2 current
Draw a .125" circle at 1.53,1.53, -1.53,1.53, -1.53,-1.53, 1.53,-1.53.



You can draw the bezel to verify clearance between instruments or structure.

Note that the RMI30 drawing depicts a rough cut and finish tool path. Tool paths are automatically generated by AvCAM and are not required in your drawings. These

were used by previous Panel Pro operating software.

An easy way to generate an instrument dxf file:
Open AvCAM

Click on the ATI  tool.
Type in the height, 3.21
Type in the width, 3.21.
Type in the distance across the corner chamfers or type in the chamfer distance 3.92.
Type in the upper right mount hole coordinate 1.53,1.53. (1/2 of the center to center distance of the mount holes)
Optionally type in the size of the case or bezel
Click “OK”
Enter the name of the file to save, ie ATI3.

A dxf file with the cutout and mounting holes has been created with the proper layers.
This process takes just a few seconds.
The dxf file can be inserted directly into panel drawings using the insert > block > browse command.

If you wish to add more detail, open the dxf file directly from the file > open command.
You can save it as a dwg file if desired.
Make the panel outline:

For AvCAM, place the outside perimeter entities on layer “outside” .

Similar techniques are used for Panel cutouts. There will be inside cutouts like switch holes, mounting holes and the like.

If you have accurate mounting hole information by all means cut them with the Panel Pro. In many cases each aircraft has panel mounting tolerances that make this difficult. It is quite difficult to manually measure mounting holes on an existing panel.

Start a new drawing as above.
Execute the purge command to make sure there are no old blocks hiding in memory.
Make layer “outside” current.
Start with the lower left of your drawing at 0,0. (world coordinate system)

Draw any combination of lines, arcs and polylines to create the perimeter of the panel.
Curves are not supported in AvCAM, but can be drawn in AutoCAD and exploded before saving to dxf.

Draw circles for the switch holes and mounting holes if desired.

AutoCAD file issues.

When you open a New file, it will be a dwg type. You can save it as dxf, but it will hold the dxf file open. It must be explicitly closed in autocad before another program such as AvCAM can read it.

Creating a cutfile:
We now have a 560 pilots panel and an ati3 instrument in our library. To assemble library parts into a cut panel proceed as follows.
Open a new drawing.
From the Insert > block > browse menu, specify the file 560(dwg or dxf) and insert it at 0,0.

Insert the file ati3 at 3,6.
Insert the file ati3 at 9,6.
Insert the file ati3 at 3,11.
Insert the file ati3 at 9,11.
Or use the various snap options.

Blocks are supported in AvCAM with these limitations. They can be nested only one deep. That means that a block may contain blocks, but no deeper nesting is allowed. Depending on the drawing complexity, rotated blocks MAY work. Rotated blocks that include engraved text will probably not work. Simulate in AvCAM to verify.

Save the file as DXF.
Close the file in AutoCAD.
Open AvCAM.
Open the cut dialog. Verify the endmill size. Verify auto tool path is checked. Click simulate.

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Trouble shooting

Bit breaks:

- Use only high quality high strength end mills. Such as Metal Removal PN 159-3453-27 (M30293) or Atrax PN 85297083 supplied in started kit. The preferred end mill is the double ended 1/8” end mill with the 3/16 shank.
- Bit breaks when the interior slug parts from the parent metal. Use a lead in line that is about 45 degrees from the direction of travel at the cut off point. This leaves a feathered edge, and the slug will not bounce back into the end mill. See the help file and the AutoCAD and EasyCAD drawing sections in this manual.
- Bit is chipped or dull, taking excessive cutting force. Even a very minor chip on the cutting edge will result in deteriorated cut finish and accuracy.
- Excessive feed rate. A normal feed rate for 1/8” 2024 T3 is 10-12” per minute.
- Cutting material that is too thick. Any thing thicker than.125 aluminum should be cut with multiple passes not exceeding .125 per pass, removing chips from the slots between passes. A good coolant flow will help remove the chips.
- Moving and running into obstacles without the router running.
- End mill is not secure in the collet allowing the end mill to slip down to the non cutting area on the shank. The router will sound like it is laboring.
- Improper volume or maladjusted coolant. The end mill must be lubricated to avoid material build up, and chips must be flushed away.
- If an end mill has broken inside the collet, it may have left a burr. Run a 1/8” fine file through the collet to remove burrs.

Inside dimensions are too small:

- End mill chipped or dull.
- A normal cut is usually about .001 to .002 smaller than drawn.
- Finish cut should be checked.
- Using excessive cutting speed
- Using wrong end mill size on the cut dialog.
- If only the x or y dimension is too small suspect backlash or loose parts. Also make sure that the motor to lead screw coupler is not broken or loose.

Inside dimensions too large:

- End mill is bent or crooked in collet
- Wrong end mill size specified on the cut dialog.
- Make sure collet is clean.

Outside dimensions too large:
- Verify “use holding nibs” is checked on the cut dialog.

Finish poor:
Make sure work is clamped securely so it cannot move vertically or horizontally.
- Use rough cut and fine cut
- Use sharp end mill.
- Make sure there are no loose components on the machine such as the Z axis bearings.

Panel Pro will not respond to jog commands (status bar reads “controller not found” on power up.
- RS232 cable not hooked up
- Power turned off
- Proper port selected in the defaults menu. (double click on options > hardware > port to auto locate controller)
- Microcontroller problem in controller (contact Buller Enterprises, Inc.)

X or Y axis will not move, or move very slowly.
- Check options > hardware > steps per inch should be approximately 5080.
- Check options > move > traverse speed should normally set at 200 to 250. If a large number like 1000 is used, the movement may be very slow.

Jerky or erratic movement
- Make sure that traverse speed is not set too high.
- If you are using a network, make sure that either the network is working properly or disabled in my computer\system. An unplugged network cable will raise havoc with Panel Pro.
- If only one motor is mis-behaving, one of the two driver circuits may be open anywhere between the drivers and motor.
- Make sure motor to lead screw coupler is not dragging on surrounding structure.
- Make sure both X axis motors are running. Disconnect the x axis ball nuts from the Y axis and jog to see if one is not running.

Mis-alignment from one hole to another. The Panel Pro has lost steps.

- Check that panel is mounted so that full travel can be achieved. If the X or Y axis hits a stop (or any other obstruction) the axis that hit the obstruction will be offset.
- Never leave tools on the machine as the X or Y axis may hit them and cause a jam.
- If the rapid traverse speed (options > move options > rapid traverse rate) is excessive or near it's maximum speed, the torque is drastically reduced and if there is any binding, steps may be lost creating the offset.
- Confirm there is no slippage between motor and lead screw.
- Check that motor to lead screw coupler is not broken.

MAINTAINING THE PANEL PRO

Adjust Z down travel:

Push the z assembly down and let the tip of the end mill to rest on the material to be cut. Loosen the jam nut with a 10mm wrench, turn the adjust screw for a clearance of the material thickness plus 1/16”. Each turn moves just under .040”

PREVENTATIVE MAINTENANCE: After cutting, wipe the ways (linear bearing rails) with a clean cloth or paper towel. Make sure there are no chips left on the ways. Spray a light coat of oil such as WD40 or if you are in a high humidity environment, LPS2 on the ways and bearings. Using the jog menu, hit “7” to turn on the coolant. Remove any remaining chips. Hit “7” again to turn the coolant off.

If the machine is not going to be used for a couple days, cover it with a cloth.

Be sure to clean out the chips from the pan daily to prevent corrosion.

Porter Cable router:

The router is an off the shelf router that uses brushes on the commutator. Brushes will wear out. Porter Cable lists life at 150 hours. Contact Porter Cable for parts. They are common and often available locally.

Collet maintenance:

The picture on the left shows a collet after cutting a King Air panel. It should be cleaned whenever the end mill is changed. An Exacto knife or a 6” rule can be used to clean the collet slots out. When the major crud has been removed, blow out the collet and collet bore with an air hose. Before reassembly spray a coat of WD40

on the collet and collet bore.

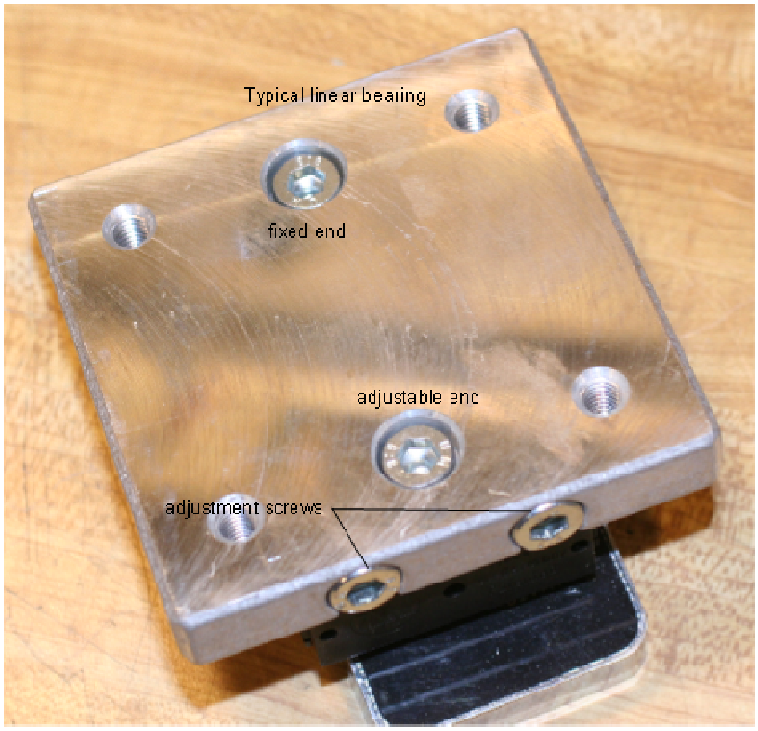
Any chips in the collet system will cause the end mill to run out of true. This will cause the end mill to break more frequently because the flutes are not equally sharing the load.

If an end mill breaks inside the collet, gently run a 1/8” fine round file inside to remove burrs. Plan to replace the collet every 6 months or so.

LINEAR BEARING ADJUSTMENT: The linear bearings in the x,y, and z axis must have zero backlash, but over-tightening will flat spot the bearings, ruining them. Warranty does not cover flat spotted or rusted bearings. The bearings must be adjusted individually with the shaft that they will be running on.

Instructions for x, y and z axis are similar. Remove the z assembly to adjust the y axis bearings. Remove the y axis assembly to adjust the x axis bearings. Adjust each bearing carriage separately.

Never remove or install a preloaded linear bearing on a bearing rail!



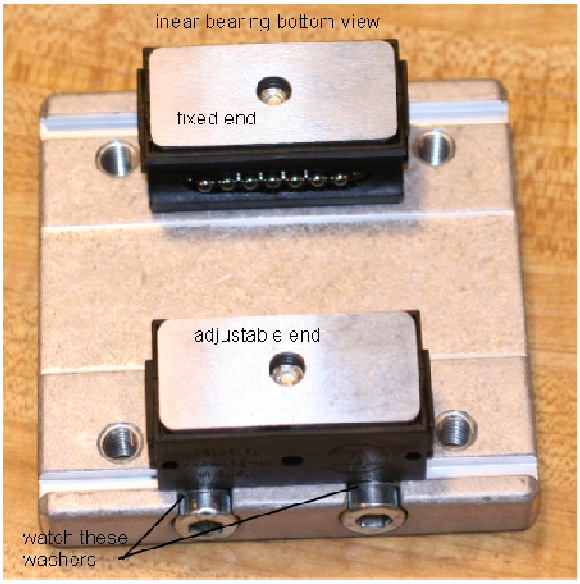
To remove a bearing from a rail, loosen the adjustable end bearing mount screw and the adjustment screws. The bearing can now be slid off of the end of the rail.

Clean, inspect and lubricate the bearings. Work some white lithium grease between the balls and roll them around so the grease gets into the recirculating area.

The adjustable end bearing should be removed and a thin film of grease applied between

the bearing and the carriage. Take care that the smooth machined surface of the bearing is against the carriage.

Reinstall on the rail with the adjustable end loose.



Snug the adjustable end mount screws making sure that you don't pinch the washers on the adjustment screws.

Roll the carriage back and forth on the rail while tightening the adjustment screws. When you are getting close, you will feel a change in rolling resistance, and maybe some roughness as the balls go around the corner. Adjust on the other screw and the feel should be smoother. Very gently work back and forth until there is smooth rolling with a slight drag.

If you go too far, loosen the adjustment screws, and then the mount screws and repeat the adjustment.

When loose, the bearing blocks should roll freely. When properly tightened, they should have a light drag. If the adjusting screws are unequal, a heavy notchy feeling will be felt.

Do not remove the bearings from the shafts or ball nuts from the ball screws as this will liberate bearing balls! $$$$!

Adjust x to y axis square:

To test square, mount a stiff piece of material close to the Y zero end with 3 corners clamped. Use a known good carpenter square to get fairly square to start with, then make a cut along 2 edges.

Thoroughly deburr while leaving the piece clamped in, and test the square with a 6" machinists square or a known good square.

To adjust, clamp a dial indicator on the motor end of the Y axis and zero before loosening any screws.

Loosen the 8 screws on the motor and operator end of the Y lead screw. Move the motor end about .005” for every .001” out of square in 6”.

Tighten the 8 screws on each end making sure the dial indicator did not change.

Move the x axis and Y axis about +.010, zero the x and y axis and make another test cut.

Repeat until square.

Adjust Ballnut backlash:

The X and Y axis ball nuts have an adjustment for back lash. To check for backlash grasp the axis in question near the ball nut mounts and wiggle back and forth. If there is backlash, a clunking sound will be heard. Make sure the ball nut mount screws are tight. The adjust screw is located between the mount screws and uses a 3mm Allen wrench. Tighten slightly until clunking sound disappears. Traverse the axis end to end and listen for any unusual sounds or binding. Some areas of the lead screw may be slightly tighter than others. The ball nut needs to be adjusted for the tightest location.

ADJUST LEAD SCREW BACKLASH:

This adjustment preloads the lead screw bearings.

The Panel Pro 4824a X and Y axis are similar. They use a double bearing at the motor end and a floating bearing at the knob end. The knob end has two Bellville washers that the knob tightens against with the screw in the middle of the knob. This eliminates backlash with constant preload on the bearings. The pointed end of the Bellville washers should oppose each other, one end pointed to the flange bearing, and the other to the knob.

Hold the lead screw (on the screw part, not the smooth machined part) with pliers near nut end. Remove the 6mm screw (5mm allen) and remove the old locktite.

Tighten the 6mm screw in the center of the knurled nut against the Bellville washers until backlash is eliminated plus ½ turn. Proper torque will allow enough preload to turn the lead screw and motor (power off) with the knob. If it is too loose, the knob will not

turn the motor. The 6mm screw should be tightened with LockTight 242, and left overnight to set up.

REMOVE Z AXIS ASSY:

Remove router from spindle mount.
Remove 2 832 screws from air valve.
Remove the air supply line from the air valve.
Remove the 2 6mm screws attaching the AC plug.
Remove the 18 6mm screws attaching the Z base plate to the linear bearings and ball nut.

STORAGE

Make a habit of covering the Panel Pro after use. Keep the ways clean and oiled with LPS2. For long term storage coat the steel parts with a preservative oil like LPS3.