

Panel Pro
MODEL 6148
SN 4001 and subsequent

OPERATION AND MAINTENANCE INSTRUCTIONS

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DESCRIPTION OF THE PANEL PRO 6148



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 6148 system is comprised of the Controller, the software, and the machine.

The SC3 Controller is the interface between the computer and the machine. It controls:

- x, y, and Z stepper motor drive
- Switched GFCI protected ac power for the coolant pump and engraving motor.
- It controls switching for the 3 phase spindle motor

AvCAM 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 QCAD and the Drawing library which is an extensive library of instrument panels and instrument cutouts

The Panel Pro shipping crate contains the following items:

1. The Panel Pro base, x, y, and z axis assemblies
2. 4 legs to be attached by user
3. 3 stepper motors and motor to ball screw couplers for X and Y axis.
4. 1 stepper motor with knob and coupler for Z axis.
5. Water cooled 3 phase spindle, single phase input variable frequency drive and spindle coolant pump
6. SC3 controller
7. 5 gallon cutting coolant tank (drain & filter housing in tank for shipping)
8. Submersible cutting coolant pump
9. AC power cord, X axis & YZ axis controller cables, and USB cable
10. Tool kit with various tools, starter supply of end mills, etc.
11. Software: AvCAM & QCAD, and Drawing Library (inside the 3 ring binder)
12. Optional Measure Pro.
13. Optional EG2 engraver.
14. Optional Diamond engraver.
15. Optional panel spacer kit.
16. Optional LZ2 laser engraver.

This manual is intended to help with set up and get you started with operation.

Detailed function and operating 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 at our facility at no charge other than your travel expenses. We can accommodate up to 4 individuals. The training is an 8 hour session covering CAD, machine and accessory operations. Call us if you would like to schedule training 701-255-7640.

Contact

Please send an email to Larry@BullerEnt.com and a phone number for the person primarily responsible for operating the Panel Pro. We will respond with a link to download new versions of QCAD.

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 MUST be on a table or rolling stand that is located at a right angle so that the right hand can reach the keypad, and the left hand can reach the router. The screen must be readable while seated in this position. Do not extend the USB cable beyond the supplied 10 feet. Do not utilize monitors other than those supplied by wire from the computer. Wireless mouse is OK, we discourage wireless keyboards due to lag times.**

Electrical Service:

The Panel Pro should be on its own 20 amp 120vac circuit. If there are any other loads on the circuit, they must be light loads and not heavy loads like an air compressor, air conditioner or other motor. **Do not use extension cords.**

The circuit absolutely MUST have a proper ground! The computer running the panel Pro may be on the same circuit. It is just essential that there is the same ground on both the Panel Pro and the computer.

The router draws around 12 amps at turn on. If extension cords are used or other loads on the circuit cause the voltage to dip, it may cause the processor in the controller to lock up or work erratically.

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.

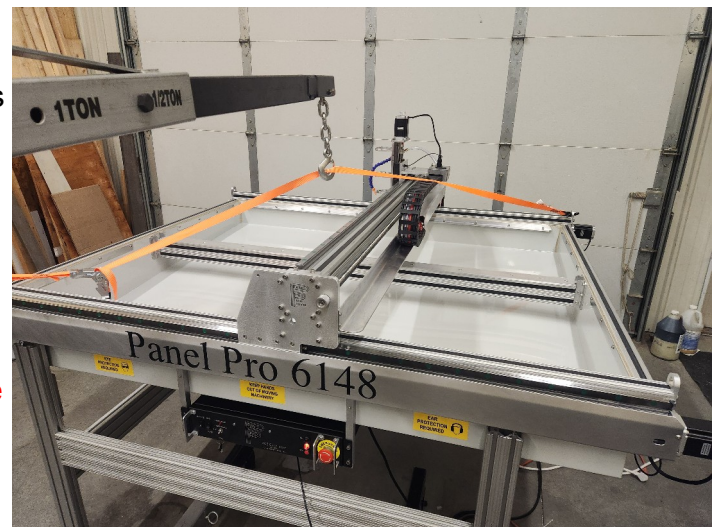
Place the crate on blocks so the legs of a cherry picker can reach underneath.

WRONG WAY

Hardware setup:

1. Remove the top by removing the screws around the sides and end of the crate.

IMPORTANT! Do NOT lift with a strap diagonally across the corners as shown in the picture to the right. Permanent damage may occur.

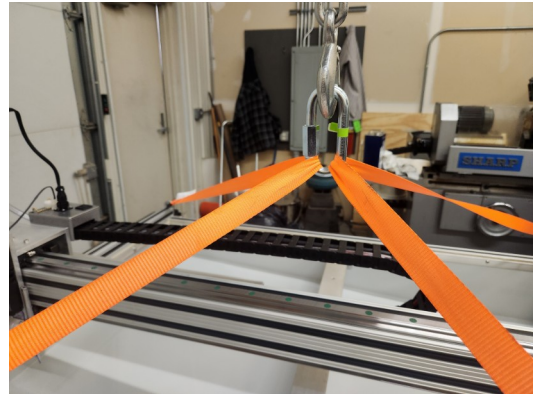


2. Remove the screws in the shipping tabs at the ends of the Panel Pro. A long extension with a 5/16 socket is helpful here.
3. Remove the boxes and legs strapped to the material mount rails in the bed.

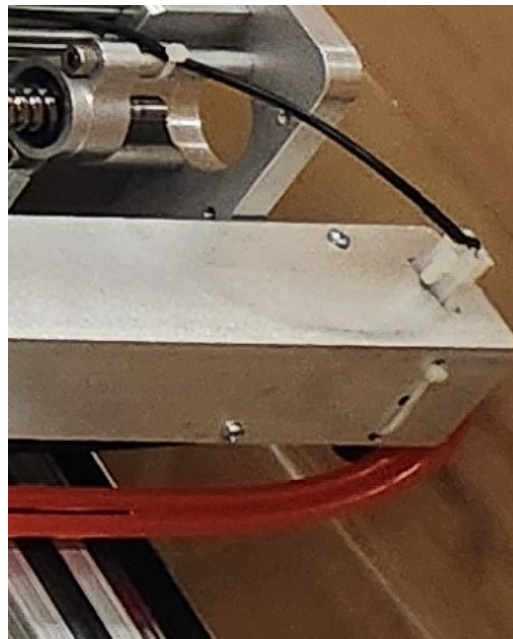
Right Way

4. Note the lifting eyes at each end of the extrusions on which the gantry moves. Move the gantry to the middle of travel by pushing on the middle of the gantry. Use 2 straps rated for 1000 pounds. set for 8 ft eye to eye. . One strap should be attached to each extrusion going through a ring to prevent slipping off of the hook. The actual weight that will be lifted is approximately 300 pounds

Lift vertically with either a cherry picker or fork lift lifting on the straps. The picture shows an acceptable lifting scheme. If one strap is shorter than the other, one side may be lower than the other, but the load is still evenly distributed. The machine is a close fit in the box. Take care that the cords or tubes do not get damaged. Note picture on right.



5. Do not apply pressure to any point other than the lifting eyes. Never lift or put pressure on the ball screws, the ball screw guards or the bottom of the pan. A person should stabilize the Panel Pro as it is being lifted.
6. Once it is clear of the crate, move the crate clear.



7. Attach leg glides (inside tool box) to legs. Set near maximum extension.
8. Remove the shipping tabs, keep the screws and **place one of the washers under each 6mm x 16 socket head screw**
9. Have all of the 6mm leg mounting screws barely started with one washer on each. If there is no washer, the screws will bottom out and not secure the leg.



10. Attach the legs with 4 6mm socket screws and washers each, using a 5mm Allen wrench with an extension .

A 5mm Allen bit is included in the tool box.

Two people are required.

One person should stabilize the Panel Pro while the other attaches the legs. **DO NOT APPLY PRESSURE TO THE BALL SCREW, BALL SCREW SUPPORTS or BALL SCREW GUARDS!** The ball screws are the long screws that drive the x,y, and z axis.

11. The drain end (left side) of the machine should be about $\frac{1}{2}$ degree or about $\frac{1}{2}$ inch lower than the right side. It is critical that both x axis rails are parallel. Level by placing your most accurate level on the X1 bearing rail (the aluminum extrusion deep end of the pan). Adjust the leg glides for $\frac{1}{2}$ degree left side down. Repeat on the X2 bearing rail extrusion. When leveling is as close as you can get it, adjust the leg glides on the left end so that both x1 and x2 ball screws touch their stops simultaneously with out any tendency to spring back.

12. Install the x axis motors.

Note for all motors. Install and tighten the 4 mounting screws, then tighten the coupler.

13. Install the “X1” motor (the motor nearest to the deep side of the drain pan) with the leads facing down, using 4 1032 screws located in the box with the motors. Rotate the coupler already installed on the motor shaft for access to the clamp screw before installation. The 1032 screws are fastened with a 4mm wrench found in the tool box. Tighten coupler to ball screw with the 3mm Allen wrench. Access to the coupler clamp screw is through a hole in the ball screw guard. **Make sure there is no slippage between the coupler and ball screw.**

14. Install the X2 motor similar to step 10. Install the 4 motor attach screws and then tighten the coupler clamp.



15. Install the “Y” motor in a similar fashion with the leads facing down. Attach the Y motor to the connector closest to the motor. Tighten coupler to ball screw. Make sure it does not slip.

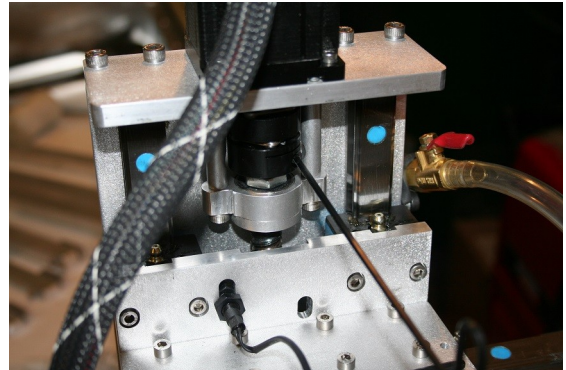
16. The Z axis is shipped in the “down” position. It will be necessary to lift it up to gain access to the coupler clamp screw as shown. It will be quite stiff. That is normal.



17. Install the Z axis motor with the 4 screws. Then tighten the coupler clamp screw. Make sure it is tight and does not slip.

18. The coolant system for the cutter is used on the Panel Pro consists of:

1. Submersible pump
2. hose support
3. Modified 5 gallon pail
4. 7 ft 3/8 ID tubing
5. ¼ female npt thread to 3/8 ID hose adapter
6. screen
7. 1 gal Koolmist
8. Drain fitting in Panel Pro pan.



Attach 90 degree elbow (part of pump) and the hose adapter found in the same package as the hose with the hose pointing up.

Place the pump in the pail with pump inlet on the bottom. Place

the pump and tank on the floor with the large hole positioned under drain hole in the pan.

Place screen on pail, position under the drain with tubing and cord facing the upper right corner of the Panel Pro.



Connect the 3/8 ID tubing from the coolant pump to the elbow near Y axis stepper motor
Connect the coolant pump power cord to the GFI connector on the back of the controller.

Add about 3 gallons of coolant. The instructions on the Koolmist bottle indicate adding 4oz of Koolmist per gallon of tap water. We recommend about 6 oz Koolmist per gallon. Take note of the resulting color. Future coolant additions can be made by approximating the color of the mix rather than exact measurement. When properly mixed the color will be similar to Windex and have a distinct oily feel.

Check the coolant level before use by simply removing the lid and observing the level. If it is less than about 2/3 full, add a gallon.

During use, if the coolant looks milky in the hose leading up to coolant spout, then the pump is sucking air. Take care not too add too much coolant during cutting to prevent overflow when all of the coolant drains into the pail.

The coolant level in the pail should cover the motor at all times for proper motor cooling.

You will find that you will need to add water frequently. It may not be necessary to add Koolmist every time, but if the color becomes less blue, then the mixture is too lean, and it loses lubrication and corrosion prevention capability. Replacement Koolmist is available at MSCdirect.com

The cutting process will create a sludge of very fine metal particles. Plan to replace the coolant and clean the pail every 3-4 months or sooner.

Plan to clean the chips out of the drain pan every day. The chips may be scraped uphill in the drain pan to facilitate draining.

19. You will find the 2 pieces of the flow director as flat pieces of aluminum shipped inside the coolant pail. Fit the 2 pieces together and Install it in the drain hole. Its purpose is to prevent coolant splashing beside the screen in the pail when a large volume of coolant is poured in the pan. It is shown assembled and installed to the right.



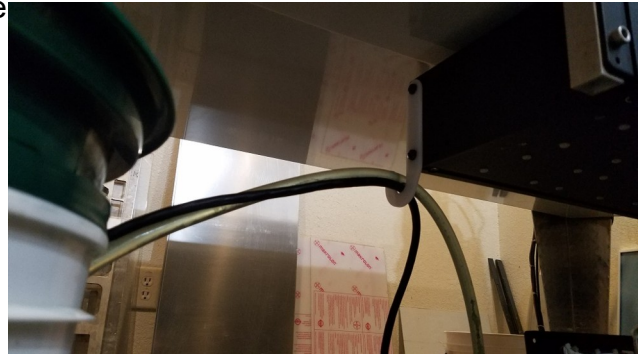
20. The controller mount bars (shipped in the tool box) are mounted to the front of the drain pan. Supplied with the controller mount bars are 8 each 6x25 mm socket head screws. Liberally apply silicone seal under the head of 4 of the 6mm socket head screws. Loosely



install the controller mount arms to the drain pan with these screws. Attach the SC3 controller to the arms with the remaining 4 6x25mm screws. Line up the arms and tighten the screws. There is a bag packaged with the controller that includes the laser key and a 2 pin shorting plug. **The 2 pin shorting plug MUST be installed on the rear of the controller in order for the controller to turn on.** The plug provides provisions for a customer supplied safety curtain.

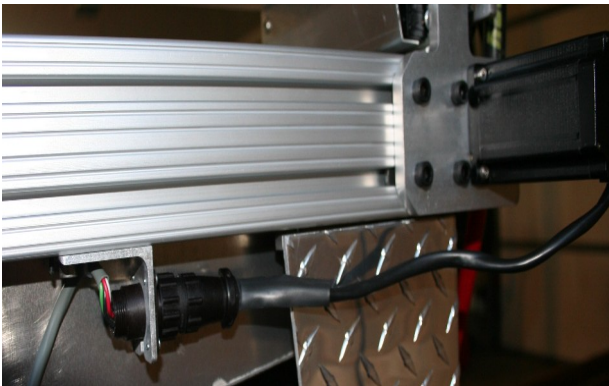
21. Remove the bottom #10 screw from the left, aft corner of the controller that faces the coolant pail. Loosen the top screw that holds the J shaped hose support. Swing the support down and reinsert the bottom screw.

Place the coolant hose and power cable on this support to maintain an angle that keeps coolant from following the hose to the floor. Route the submersible pump ac cord over the hook and connect to the back of the controller, GFCI connector labeled “pump”



22. **Verify AC power off!** 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. The X1 axis has a 3 pin white connector for the X axis limit switch and a 2 pin connector for a laser warning light. **Be careful to get the connector on the correct jack also to avoid cross threading.**

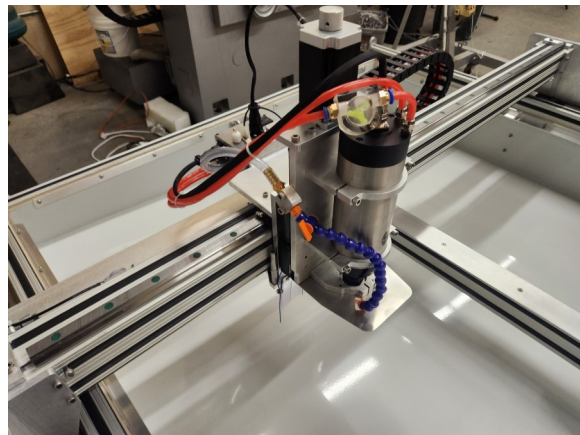
23. Locate the nuts with screws installed on the bottom of the right rail. Allow enough room to comfortably attach the motor plug. X2 axis is shown. Note that the tie wrap nib on the connector mount fits in the bottom channel with the plug parallel to the extrusion.



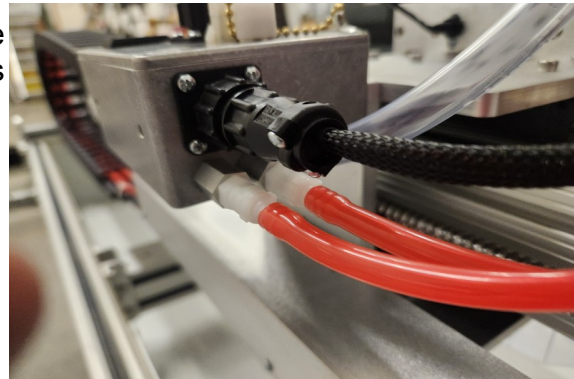
24. **Verify AC Power off!** Attach the Y/Z cable and route cable. The Y/Z cable is the same on both ends and it does not matter which end goes on the controller or the Y axis. The spindle (router) power cord should run parallel with the Y/Z cord. Use caution not to cross thread the connectors.

If you tie up cables take precaution to leave plenty of room for the cables to move full travel left to right and provide plenty of room to flex. Leave a dip in the cable to provide a place for liquid to drip off before getting to the controller. The cables are generally not visible from normal viewing angles and do not require additional wire ties etc.

Install the spindle motor. There are 2 coolant hoses and a short power cable to connect to the spindle. Remove the 2 coolant fitting nuts, press the hoses over the fittings on the spindle and secure with the nuts. Screw the electrical connector on the spindle. The flat side of the plastic flow detector should be up. Note that the spindle coolant is separate from the cutting fluid also called coolant earlier.

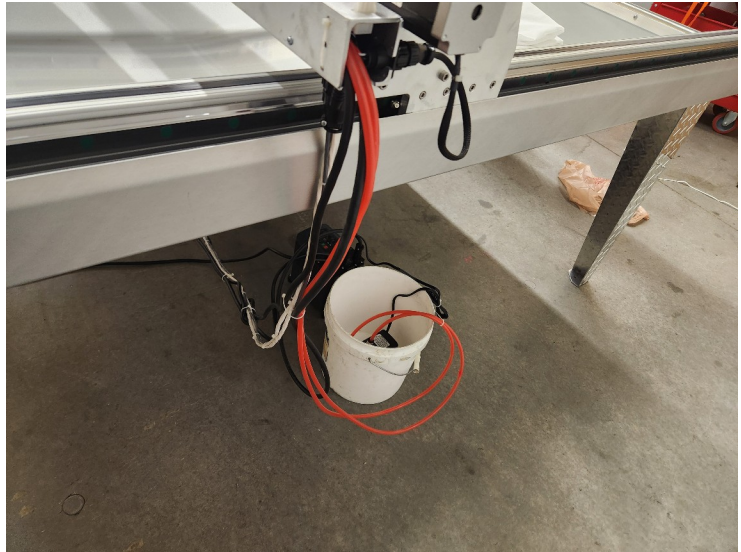


Loosen the spindle clamps, slide the spindle down through the clamps. Take care as it is fairly heavy. Don't allow it to drop on your fingers. Tighten the clamps when the flats on the spindle are above the accessory mount and the collet nut is on the bottom so you can get a wrench on both to change cutters while installed. Loosely zip tie the spindle coolant lines to the spindle power cord.



Install the Variable Frequency Drive (VFD).

Place the vfd on the floor towards the middle of the back with a 5 gallon pail (supplied by you). There is an AC cable that needs to connect to a wall outlet with a 20 amp circuit. It is marked “unswitched AC in” The Other AC cable is marked GFCI and it plugs into the GFCI at the back of the controller marked “router”. The GFCI is powered automatically. In this case it supplies power to the cutting coolant pump as well as an ac signal to the vfd to turn on. The VFD also has a female ac plug in to power the spindle coolant pump. There is also a power cord with a male 3 pin AC connector coming off of the back of the cable guide. This is left disconnected for normal cutting with the 3 phase spindle. If the EG2 engraver is used, the power cord from the vfd to the GFCI is disconnected and the cord from the cable guide is then connected. It terminates at the female connector in the back of the z axis where the EG2 plugs in.



To reiterate, you will have 2 cords plugged into the wall. One from the controller and one from the vfd. You will have one power cord from the cable guide that is not connected during normal cutting operations.

When powered, but not commanded to run, the vfd will flash with the frequency in hertz. This is normally 400 at full speed.

Find the white box with a small submersible pump. Install the adapter and insert the shorter of the 2 tubes into the adapter. The other will return the cooling water into the pail. Place the submersible pump on the bottom of the pail. Fill with plain water.

Plug the submersible pump AC plug into the vfd connector labeled “spindle pump”. You can loosely secure the wires and hoses with zip ties. Make sure they can swing freely from side to side as the gantry travels.

The collet must be inserted into the collet nut without an end mill in place to allow the collet to spring inward engaging the extraction ring. A properly installed collet will not fall out of the nut when upside down. When properly



installed, the collet should be nearly flush with the nose of the nut. If installed incorrectly, it will cause cutting problems and destroy the nut. The picture below shows the collet when properly installed.

Install an end mill:

Insert a 3/16 (or 5mm) collet with a 1/8" end mill (double ended with 3/16 shank) with about 1/2 to 5/8" protruding from the collet nut. Use the supplied wrench on the shaft of the spindle. Use an ER20 wrench on the ER20 collet nut. We stock 3/16 and 1/8" ER20 collets. Metric collets may be used. If pressing with fingers on a collet will hold an end mill, the collet size is satisfactory.

The bottom 43mm clamp (accessory mount) below the spindle is used for the engraver and other accessories. It should be tightened down on the mounting lug of the horizontal splash plate if no accessory is in place. The horizontal splash plate helps protect the z axis ball screw from chips and cutting fluid.

Computer and software:

Install the USB driver (CDM212364.exe on the flash drive) before plugging the USB cable into your computer! See the following section on software installation. The USB driver does not need to be installed if the computer will not be used to run the Panel Pro (offline use).

Connect the AC Power supply cord to the SC3 socket. Connect the other end into a grounded 20 amp 110VAC circuit not shared by other equipment.

Recommended computer:

Windows XP or Vista are not supported and AvCAM will not install.

QCAD needs a 64 bit processor.

We recommend using a desktop style computer running Windows 10 or 11 operating system. We also recommend 8GB memory. If a computer is used that has been used for other purposes, clear out any unused programs. The only programs you should have open is AvCAM and QCAD(or other cad program). The keyboard that will control the Panel Pro absolutely must have a numeric key pad and the mouse must have a mouse wheel. The function keys need to be set to return F1 – F12, not the alternate functions like volume control.

While a lap-top will run the Panel Pro, it is not recommended. The numeric 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 at least for drawing.

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. Do not extend the supplied 10 foot USB cable.

Software Installation:

You must have administrative privileges AND run as administrator.

The software will install on Windows 10 64 bit computers.

The USB driver, AvCAM, QCAD and the drawing library are located on your AvCAM USB drive.

Navigate to the USB drive, right click QCAD autorun.bat and then Click run as administrator.

The CDM212364.exe file installs the USB drivers appropriate to your operating system including 32 and 64 bit win 7 and win 10 operating systems.

I

The USB drivers load first, then AvCAM, then the drawing libraries.

If you are asked to reboot the computer, say no and wait till the command prompt goes away. You will be asked to hit any key in between each install segment above.

QCAD may need to be installed manually by double clicking QCAD-3.31.1.MSI or newer version

Please see QCAD quick config.pdf on the thumb drive to configure QCAD.

AvCAM: load the AvCAM thumb drive into your computer. If the AvCAM install does not start automatically, go to Windows Start\run\E:QCAD autorun.bat where E is your USB drive number. This batch file installs AvCAM sets up the proper folders and copies the drawing libraries. Or double click AvCAM19299.exe to install only AvCAM.

Note the **application key** on the thumb drive envelope is your machine serial number. It will be required on the first time the AvCAM program is run on each computer it is installed on. The Activation key is the number only, no text i.e. 4001

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

Send that email to larry@bullerent.com and identify your self as the Panel Pro contact.

Install QCAD: To manually install QCAD:

double click qcad-3.31.1-pro-win64-installer.msi (or later version)

We purchase a QCAD pro license for you. Whoever was the email contact when the machine was purchased will receive an email with download instructions. This link is active for one year, however the usb drive has the version current at time of shipping.

For additional QCAD licenses or to renew downloads after one year, contact QCAD.org.

We supply a paperback QCAD manual with the machine.

See QCAD quickconfig.pdf for QCAD set up suggestions.

Drawing Library: the drawing libraries should also install automatically. To manually install: set up or navigate to C:\drawings

Use windows explorer (Windows +E), copy the aircraft and instrument folders into the

Important. You should set your screen saver / power modes so that the screen saver will not activate while the Panel Pro is running. We suggest a minimum of 2 hours so that the USB communications do not get interrupted. If USB gets interrupted, then communications will need to be re-established (F2) and the machine will have to be re-homed.

Try it out:

Power up sequence. Boot up the computer, turn Panel Pro controller on, open AvCAM.

Controller power up: The interlock jumper plug on the back of the controller must be installed or the controller will not turn on.

Verify emergency shut off switch is in the run position, release the shut off by turning the knob clockwise until it pops out. Press the “on” push button switch, the red light lights up. To turn it off, push the “off” button below the pilot light.

Pressing the emergency shut off or the red “off” switch will depower all drive and spindle operation.

Turning power back on after emergency or normal shut off will not cause any movement or spindle power turn on, however, wait 30 seconds for residual power to disappate.

Normal turn off: Close AvCAM, then turn off the controller.

When AvCAM opens, it looks for the Panel Pro on the USB list. If found, it knows the serial number of the machine and no further activation is needed. If the Panel Pro USB is not found, the user is asked for an activation key on first program opening which is simply the machine serial number. Subsequent program openings with the controller off will simply open AvCAM in the offline mode.

Assuming the Panel Pro was found when AvCAM queries the controller and if the controller power is on then communications is established and the message “firmware version 2.9 found” (or later version) appears on the status bar on the bottom of the page.

If controller power is off or not connected, the message “controller offline” appears.

If AvCAM – Machine – Hardware settings shows the Panel Pro sn4xxx but hitting connect does not initiate communications, turn off the SC3 controller, close AvCAM, wait about 30 seconds. Turn the controller back on, open AvCAM.

If the usb driver has not been installed, close AvCAM. Open the Windows device manager, look for usb devices with a yellow triangle. Uninstall/ delete that device. Unplug the usb from the controller. Install the CDM212364.exe file from the thumb drive. Plug in the usb cable from controller to computer. Open AvCAM.

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 SC3 is powered by 110vac and switches 110vac for the coolant pump and router.

Any leaks or spills should be corrected before further machine use.

Operate only on a dry floor.

Test the GFCI outlet with the router running (click spindle on status bar and check spindle on) before each use. Press the test button on the GFCI, and the router should stop. Press the reset button on the GFCI with AvCAM commanding spindle on 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 SC3 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 everywhere.

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

Ear protection is required. Keep hands clear of pinch points.

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.

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!**

Turn the SC3 power switch on. Click on the turquoise AvCAM icon on your desktop to open the AvCAM program. This is the preferred turn on sequence.

If you are connected and the SC3 controller is working the status bar on the main screen will read “firmware version 2.6 found” (or later version)

If connected to the controller then the status bar will read “controller offline”. In this case, open the options > hardware menu.

Once communication is established, verify all of the settings. Open the various setting dialogs and review the settings.

Information on the settings 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 AC19.chm.

After the machine is set up and communications established then hit the keyboard “J” or “1” key to enter the jog mode. If the jog buttons are visible on the upper left corner of the screen, you are already in jog mode.

On successful connection, a message box will ask you if it is ok to move to machine home. Unless you have a failed home switch, you always want to allow the home function to run so that the software position is synchronized with the hardware position.

The X, Y and Z axis may be exercised from the jog menu. **Note that until Z Zero is set, all axis will move at slow speed. To temporarily move at high speed, hit the 7 key.**

The jog functions may be exercised using a mouse on the buttons on the upper left side of the screen, or equivalent key pad keys.

Look in the help file contents for shortcut keys.

The keys referred to below are the numeric keypad keys, not the number keys at the top of the keyboard.

To move the x axis left, push and hold the 4 key on your numeric keypad. Assuming that the machine has been properly homed on power up, the software will limit travel to the extents of the machine. As a result, the x axis moving left as above will stop at the farthest left extension just short of the hard stop. If any axis hits a hard stop, it will normally not hurt anything, but position synchronization will be lost. That axis (or all axis should be re-homed).

The x axis, set in motion above may be stopped by releasing the **4 key**

The **6 key** will move the x axis right.

The **8 key** moves the Y axis away from the operator, the **2 key** moves it towards the operator.

Note that until the Z zero has been set, all movement will be at a slow speed.

There are jog buttons on the screen as well. Click and hold to move. Keep the pointer on the button and release to stop

Z axis:

The home position of the Z axis is all the way up, just short of a hard stop and has a maximum travel down of about 3.125 inches.

When at any position, hold the **3 key** to move move it down at a slow rate until it reaches the soft limit.

The **9 key** raises it all the way to the top, normally at the position where the home routine found the home switch. This does perform the homing procedure.

The **7 key** raises the z axis to retract level.

The **1 key** commands z to the cutting depth. (you will need to confirm with enter).

The **0 key** will lower z to the z zero level.

There are 3 related z axis positions set on the Z control dialog opened by clicking the Z axis position on the status bar or tapping the z key on the keyboard.

The **Z zero** is the point where the end mill or other tool is in contact with the surface of the material to cut. To set Z zero, hold the 3 key, then release it about .1" above the surface. Set the axis select under the main screen jog keys to z, and the increment to .001. Move the z axis using the mouse wheel until a piece of paper gets tight between the end mill and material. Tap the z keyboard key to open the z dialog. Tap Z again to set this position as Z zero.

Z retract is the position above z work zero that the z axis will raise to when commanded up by software. The goal is to use as little time traveling up and down without working as possible, but still have the end mill clear clamps or other obstructions. Initially set this at about 1". This can be set on the move options page or the z control dialog.

Cut depth is the distance below z zero that the end mill will descend to when cutting, or actually doing the work that a particular mode is used for. For instance cutting a panel with a 3/16 shank end mill with 1/8" flute diameter, and 1/4" length of cut. (our standard double ended mill) Assume a material thickness of .090", and z zero set at the material surface. Cutting depth should be about -.125. Once Z Zero has been set, the X and Y axis will jog at the rapid speed if the Z is above zero. See the help file for a detailed discussion of the Z axis. With any dialog open, tap the F1 key for help relative to that dialog.

To use the screen based jog buttons, left click on the desired button and hold the mouse pointer on the button. To stop, release the mouse left click while the pointer remains on the button.

Note that the AvCAM help file is a dynamic document that is updated with AvCAM updates. Hit F1 on any dialog for help with that dialog.

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 end mill must be at work zero or other known location.

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 set the work zero at the current location.

Cut a file from metal larger than the finished part:

The material should be no taller than 27" to allow access to clamp it to the mounting bars. The nominal x travel is 61" in x direction and 26" in Y. The maximum x travel is 62" but the left side will be off the left side of the bed. The maximum Y travel is 26.25" Maximum material size is 62" - end mill diameter in x, 26" - end mill diameter in Y.

Material support MUST allow the cutout slugs to drop free so they don't jam or get flipped up on to uncut material which would be a hazard.

Select material of adequate size so the router clears the clamps, which are best placed in the corners and where the material crosses a mount bar. 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. .032 Material should be supported about every 6 inches.

Material spacers are supplied in the tool box. These can be fabricated from inexpensive paint sticks.

Take care to set the mounting bars and spacers so as NOT to restrict cutout pieces from falling free

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:

Use the 1/8" end mill with a 3/16" shank and a .250 length of cut for the normal cuts on .062 and thicker material. If you need to make 3/32 holes for nut plates, put those holes on a separate layer and cut those holes first, then change to the 1/8" end mill and cut the rest of the cutouts. 3/32 end mills can be used on material less than .062 thick.

Use a 1 or 2 flute end mill on 2024T3. Use a 1 flute end mill on any material softer than 2024T3.

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 F2 key must be hit to establish communications.

Verify that the controller spindle switch is set to auto, and the router on/off switch is on.

Set the work zero using the “R” key or other position setting tools described in the help file > contents > cutting files.

If Z zero has not been set, set it now.

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. **Never use only water!**

Fill the coolant tank within 5” 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.

At a minimum coolant needs to cover the pump at all times.

Plan to replace the coolant and clean tank every 3- 6 months, possibly more frequently in hot locations. If carbon fiber or other composites are cut, plan to change the coolant after every use.

Coolant Spout:

Make sure that the horizontal splash plate is attached and the coolant spout is directly pointing at the cut. Set the coolant volume control valve at the top of the flexible tube to about half. The coolant stream directed exactly at the cut is more important than a high volume.

COOLANT FILTER:

The routing process produces a large quantity of metal chips. Most of the chips will stay in the pan, The screen on top of the coolant pail will catch what drains through.

Simulate the file before cutting.

The process of simulation does all the work of joining the dxf file entities into the correct order and direction as well as computing tool paths.

Open the file.

Select the layers to cut.

Select the operating mode (auto tool path for normal cutting)

Open the cut dialog, (blue icon on tool bar with a C in the middle), click nearest cutting order, Set sim speed at 100 (max) or slower to better visualize the cut. The joining and sorting is done and then the actual tool path is simulated. The Colors indicate the pass number 1 = brown, 2 = red, 3 = orange, 4 = yellow, 5 = green (the resistor colors)

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 WD40. Remove the collet and end mill. Clean out any chips and spray collet and collet bore with WD40.

SC3 Control Unit

PWR: The on button turns AC power on. The off button as well as the emer stop switch 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 between the on and off switch is lighted when the internal components are receiving AC power. The jumper plug in the back needs to

be plugged in for the power to come on. The connector provides provisions for a customer supplied guarding system and will shut down the machine when open.

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 SC3.

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 20 inches per minute cut speed for 1/8” 2024t3, and 200 to 250 inches per minute traverse speed.

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.

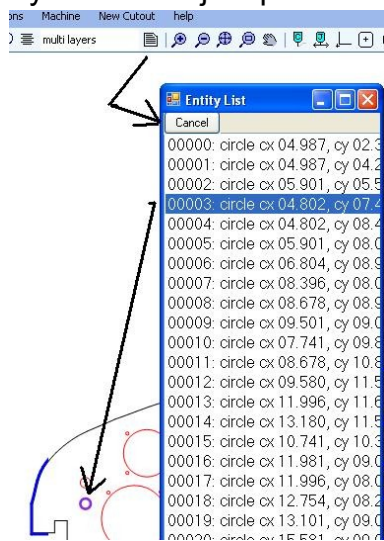
Suspend cutting:

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 also switch the SC3 pause and spindle switch to 0. This is good for repositioning clamps. When ready to continue, turn the spindle switch back on then the pause switch to run.



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.

The Pause switch will stop movement even if there are communications issues that would keep the ESC key from working. If you need to change clamps etc. with the pause switch in the (0) position, turn the spindle switch to 0
Switching the Pause switch to (1) resumes movement. Make sure the spindle is turned back on.

DRAWING FOR THE PANEL PRO

Set up Windows:

Open windows explorer.
Click the view tab

Click options, then in folder options click the view tab.
Check “show hidden files, folders and drives”
Uncheck “Hide extensions for known file types”
Click OK

QCAD

Installation:

A single user QCAD license is provided for you using the data and email supplied by you. The current version of QCAD is supplied on the USB drive. The email listed will receive a download link where the program can be downloaded.

The purchase includes free updates for a year. This is not a subscription. The program continues to function normally after a year. Should you wish to download after the year is over, you can purchase another years download for 30% off of the original price directly from <https://qcad.org/en/>

The price at the time of this writing was \$44.00

What is CAD

Please refer to the book “QCAD An introduction to computer aided design” supplied with the Panel Pro. The following is a suggestion on setting up your QCAD. The book has operation instructions.

QCAD tour:

QCAD 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 “LI” .

QCAD configuration

In order to configure QCAD, QCAD needs to open once and then close to create several required folders.

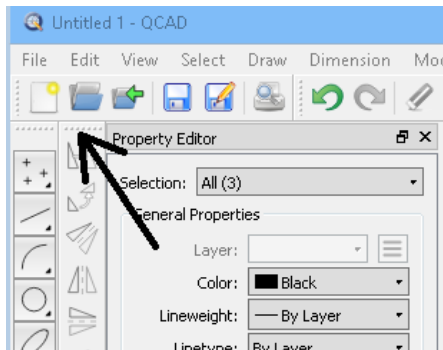
QCAD.ini initialization file and panelpro.dxf template file are provided on the USB drive. With QCAD closed:

Windows explorer needs to be set to view hidden items. Windows explorer – view – show file name extensions and hidden items checked.

Copy QCAD.ini to users - your user name – appdata – roaming

copy PanelPro.dxf from the USB drive to Program files – QCAD – libraries -templates.

Now open QCAD.

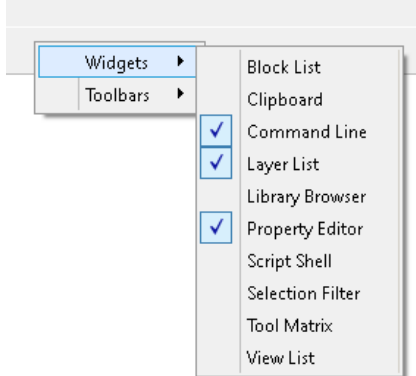


There are two types of items to display on the main screen. Toolbars which include commands to draw lines etc, and Widgets that are a kind of form that is docked to a particular place on the screen such as property editor.

The toolbars can be moved by clicking on the dotted line on the top or left of the tool bar and dragging it to a new position.

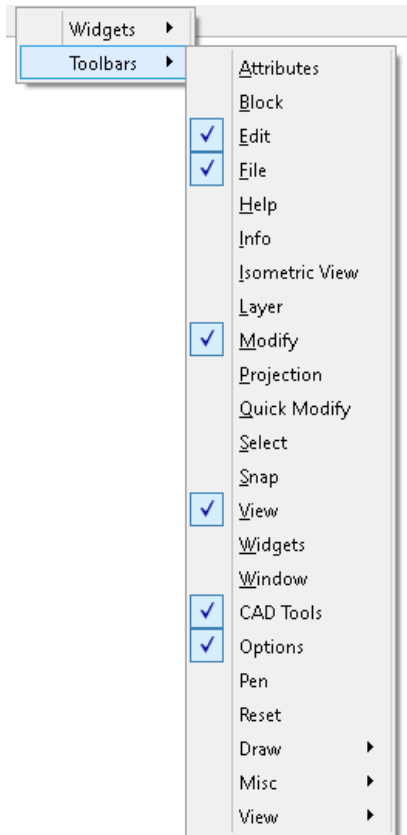
Widgets can be moved by left clicking its title bar and dragging to a new position.

In the picture above, the CAD tools and modify toolbars are on the left. The Property Editor widget is on the left just to the right of the modify toolbar.

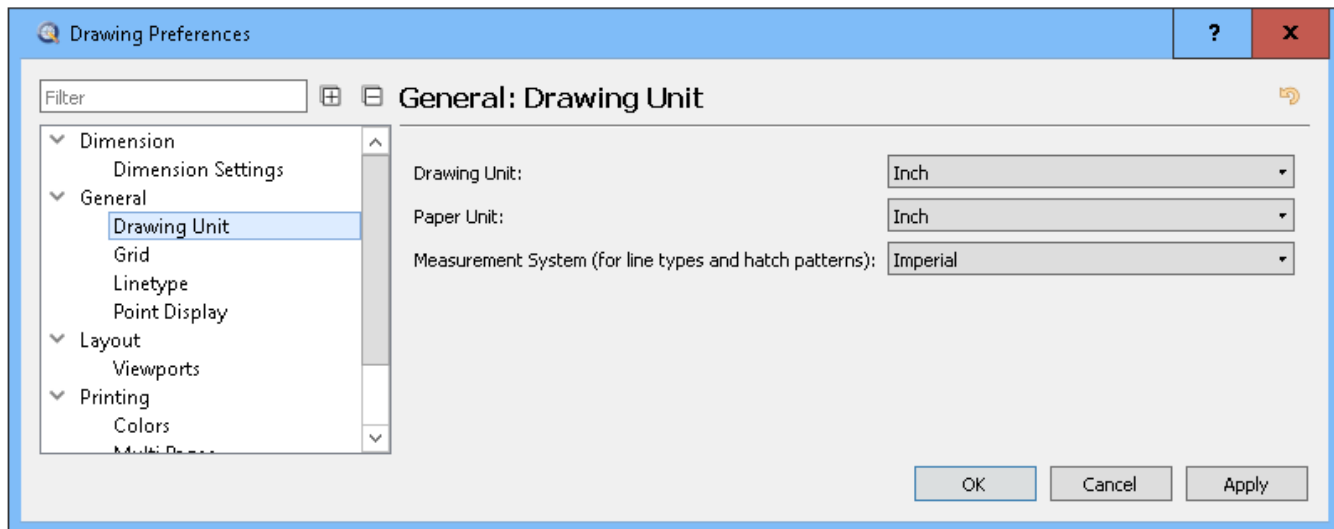


Widgets are selected by right clicking the menu bar at the top of the screen. The picture shows the recommended selections.

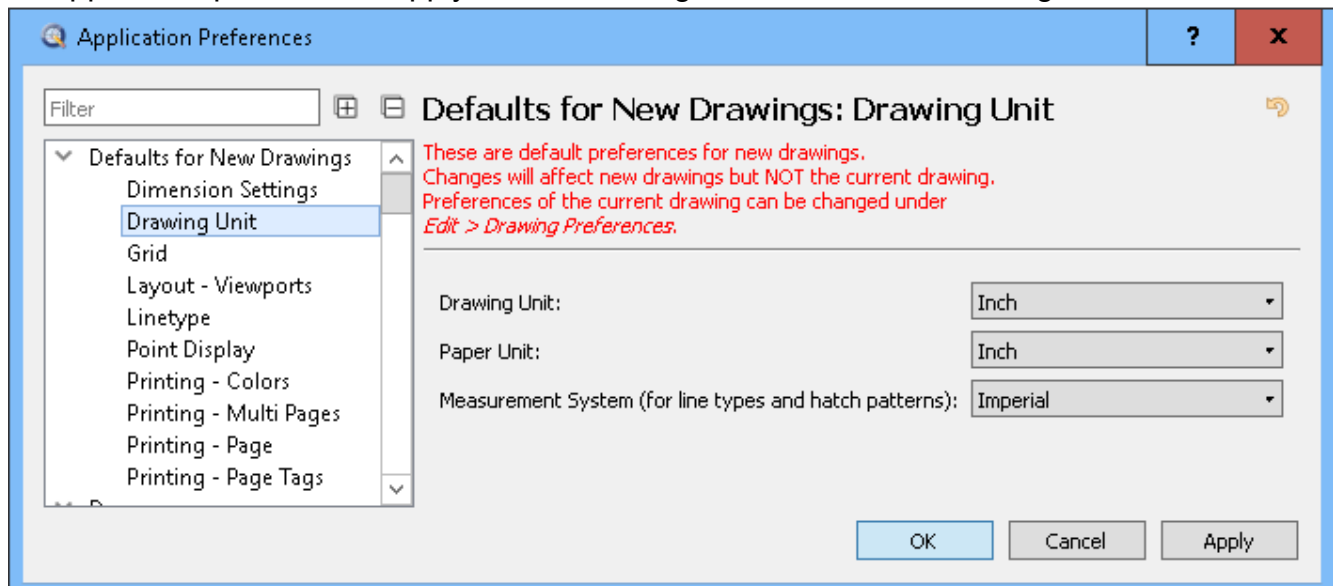
Toolbars are similarly selected and the recommended toolbars are shown to the right.

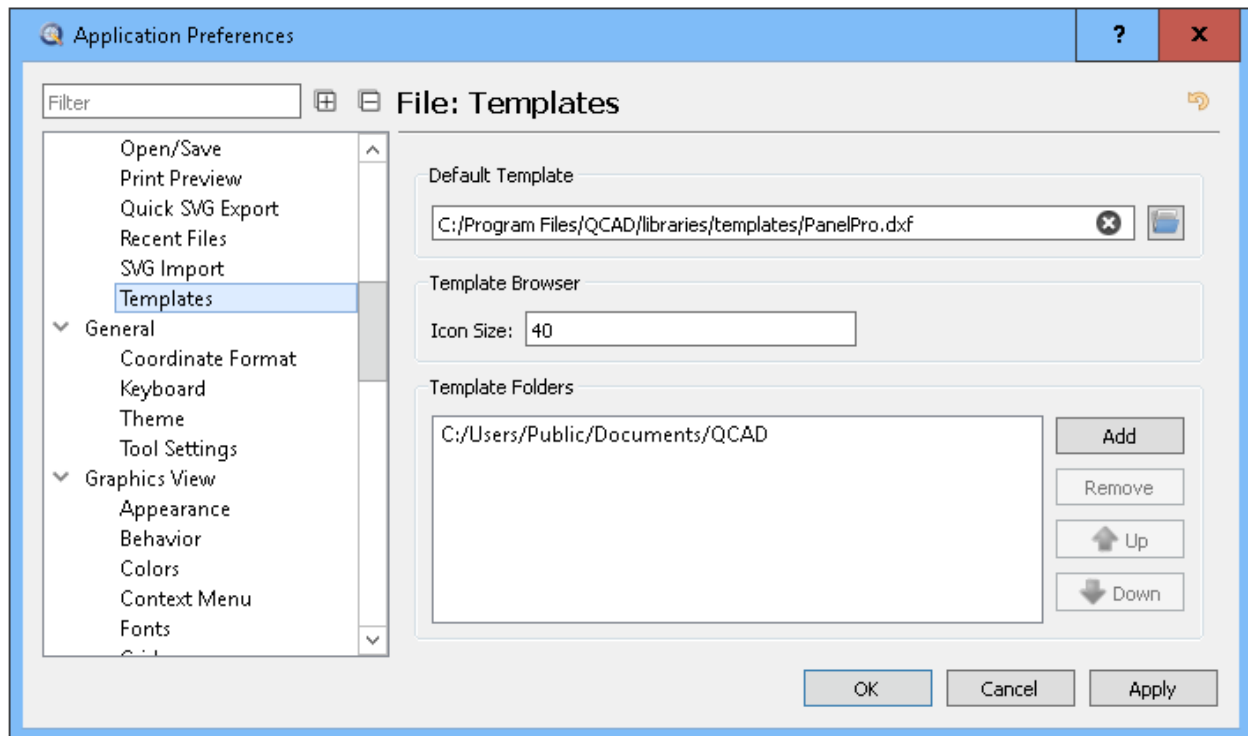


Menu - Edit – Drawing preferences – Drawing unit should be set to Inch. AvCAM 18 and 19 can convert metric to inches on drawing load, but all AvCAM operations are imperial inches.

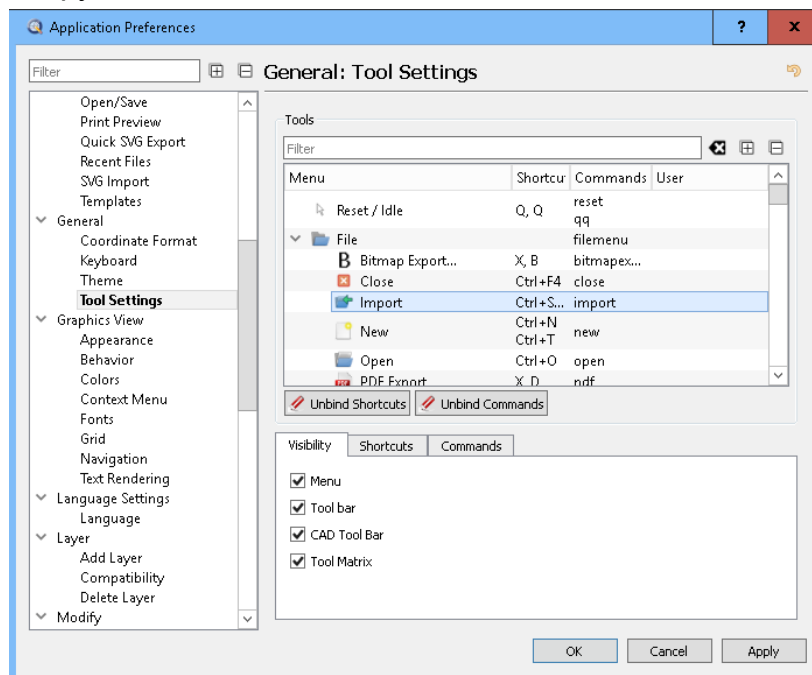


Drawing Preferences apply to the current drawing only
 Menu – Edit - Application preferences opens the Application preferences dialog.
 Application preferences apply to new drawings. Recommended settings are shown





The PanelProTemplate.DXF template file is available at www.bullerent.com/downloads and on the USB drive. Copy it and save it to the folder listed above.



This will load common layers and settings so you don't have to create new ones every time you start a new drawing. This file can be opened and edited to suite your needs such as adding new layers that you want every time.

General - Tool settings is the place where you can show or hide commands on tool bars. Click on the tool (Import is selected) check the boxes where you want it to show.

Menu is the main menu at the top of the screen

Tool Bar is the main tool bar at the top of the screen

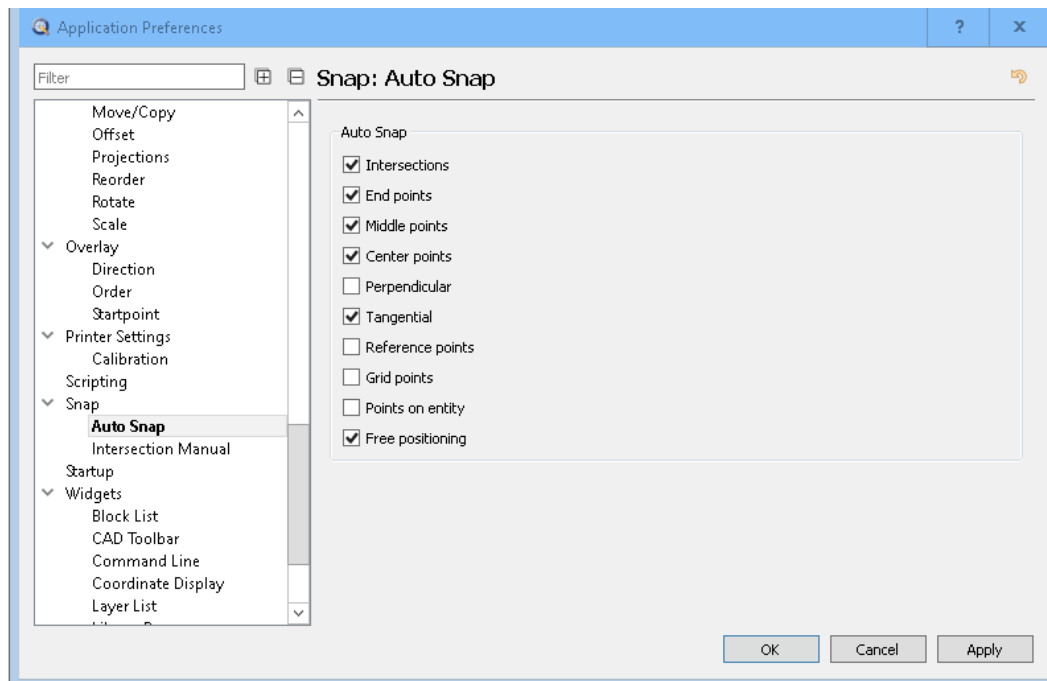
CAD Tool Bar is the Tool bar at the left of the screen where you select the entities to draw.

Tool Matrix is a widget with an alternative view of the draw tools.

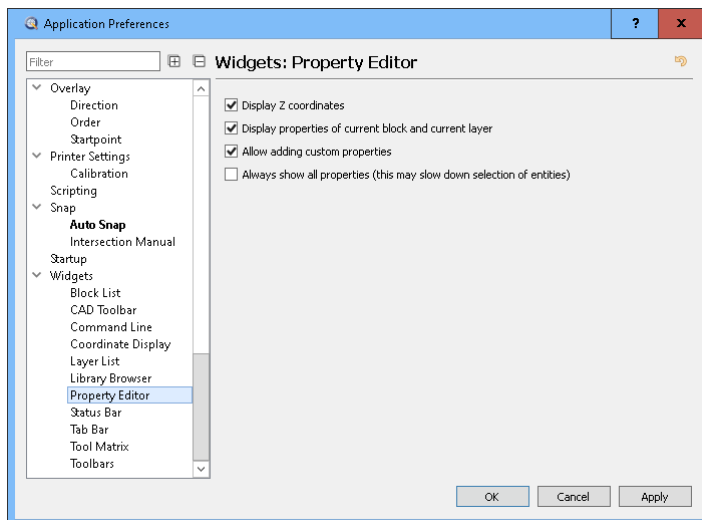
We recommend most commands show on the menu.

The picture on the following page illustrates the import icon. Import is used to insert one drawing into another such as an instrument onto a panel.

There are many tools that are simply not used and can be turned off to declutter your toolbars.



Recommended Auto snap settings.



Property Editor is where things like layers and colors are changed. 99.99% of the drawing does not need a z display. It is however available as shown.

There are several places where selection of icon size is allowed. Consider a smaller icon size to allow more drawing space. We typically have the Tab bar turned off. QCAD can have multiple drawings open. They can be selected by the tab bar or on the window menu.

When all of your changes have been made, click ok. Close and re-open QCAD.

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. K1206.dxf Individual cutouts are stored in the drawing library folder Instruments.
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.dxf
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 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.

Instruments are inserted as blocks from the file – import menu or



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.

Inside. The desired final dimension layer (i.e. 3 1/8 " hole for an instrument) older drawings may use layer 2. It is not a required name, just that any layer not named outside will place the tool path on the inside.

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.

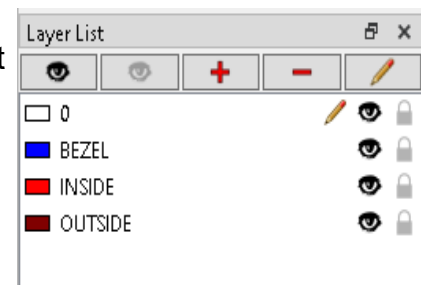
See AvCAM – help – special layer names

Whenever QCAD 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, QCAD 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 QCAD – view – Layer list if the layer list is not displayed.

Layers can be hidden by clicking the eye on the layer you want to hide in the layer dialog. It can be restored by clicking again. Bezel and Outside are hidden and layer 2 is current in the picture shown.



The highlighted layer is current.

A handy feature is the hide all (grayed out eye on the top) and show all (the Black eye on the top) 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.

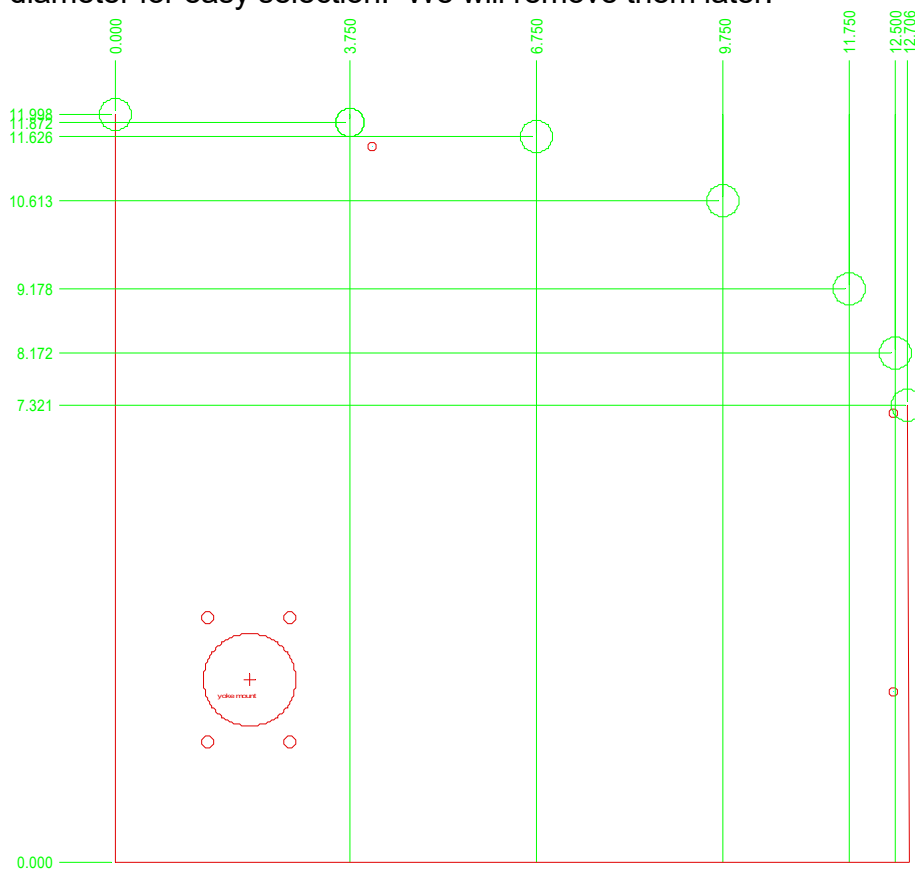
This is a discussion of techniques to hand measure a panel.

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.

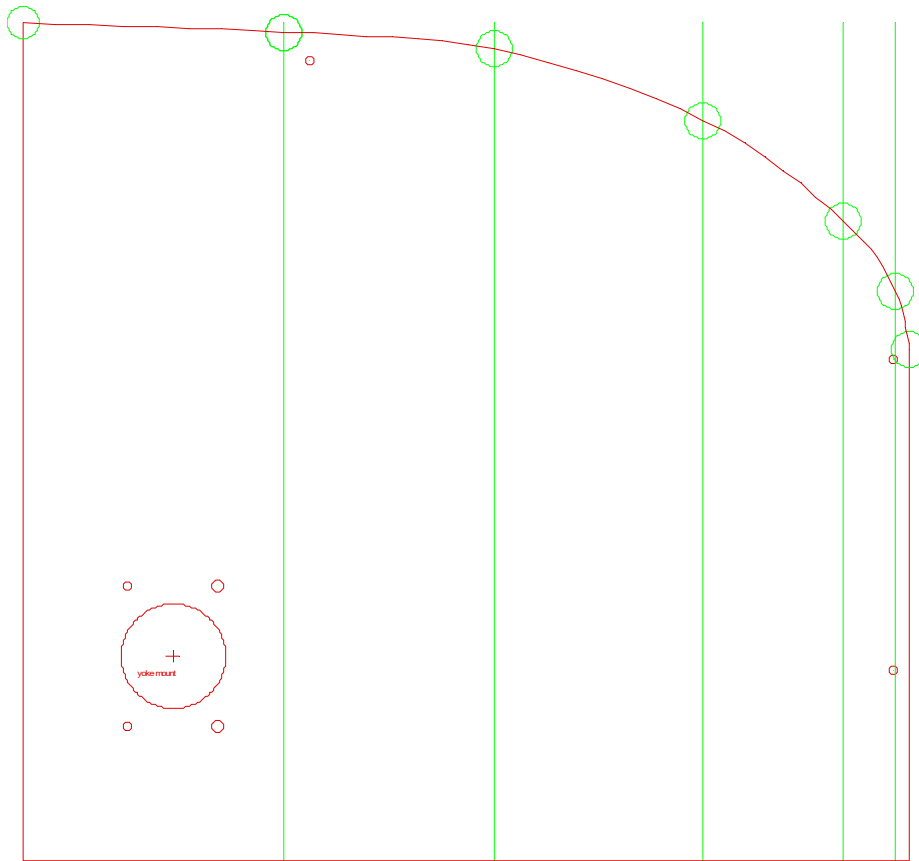
Draw another line from 12.706,0 to 0,0 for the bottom line.

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 1/2" diameter for easy selection. We will remove them later.



Now we will connect these points using the center snap with a spline (fit points) . Splines work fine for Panel curves. Avoid them for instruments or where a sharp inside corner occurs.



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". $2.188 + \frac{1}{2}$ 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.

When done drawing, simply save as DXF. QCAD closes the file after saving so other programs such as AvCAM can read it even though the drawing is still visible on the QCAD screen and available for further editing.

This is by no means a complete tutorial on QCAD. We encourage you to view our videos <https://bullerent.com/videos/> As well as peruse the QCAD paper back book and help file. Contact us for specific Panel Pro drawing questions.

Trouble shooting

Bit breaks:

- Use only high quality high strength end mills. EM125-1 supplied in started kit. The preferred end mill is the double ended 1/8" end mill with the 3/16 shank.
- 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 around 18" 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.
- It is not uncommon to have an end mill that is .001 - .002 under size. Our Em125-2 seems to run a bit under size. Set the end mill to a smaller size, i.e. .123 instead of .125 This will make all inside holes a bit larger and outside measurements smaller
- 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 ball 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
- If cutting any material softer than 20924-T3, use a single flute end mill we suggest the our EM125-2.
- Never use a 4 flute end mill on aluminum.
- Use sharp end mill.
- Make sure there are no loose components on the machine such as the Z axis bearings.
- Use holding nibs for outside cuts. See help > index > holding nibs.

Panel Pro will not respond to jog commands (status bar reads “controller not found” on power up.

- USB cable not hooked up
- USB drivers not installed
- Power turned off
- Microcontroller problem in controller (contact Buller Enterprises, Inc.)

X or Y axis will not move, or move very slowly.

- Z zero not set
- 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.
- The z axis is less than .2” above z zero (go slow height)
- Jog speed on the on screen jog keys is set less than 100

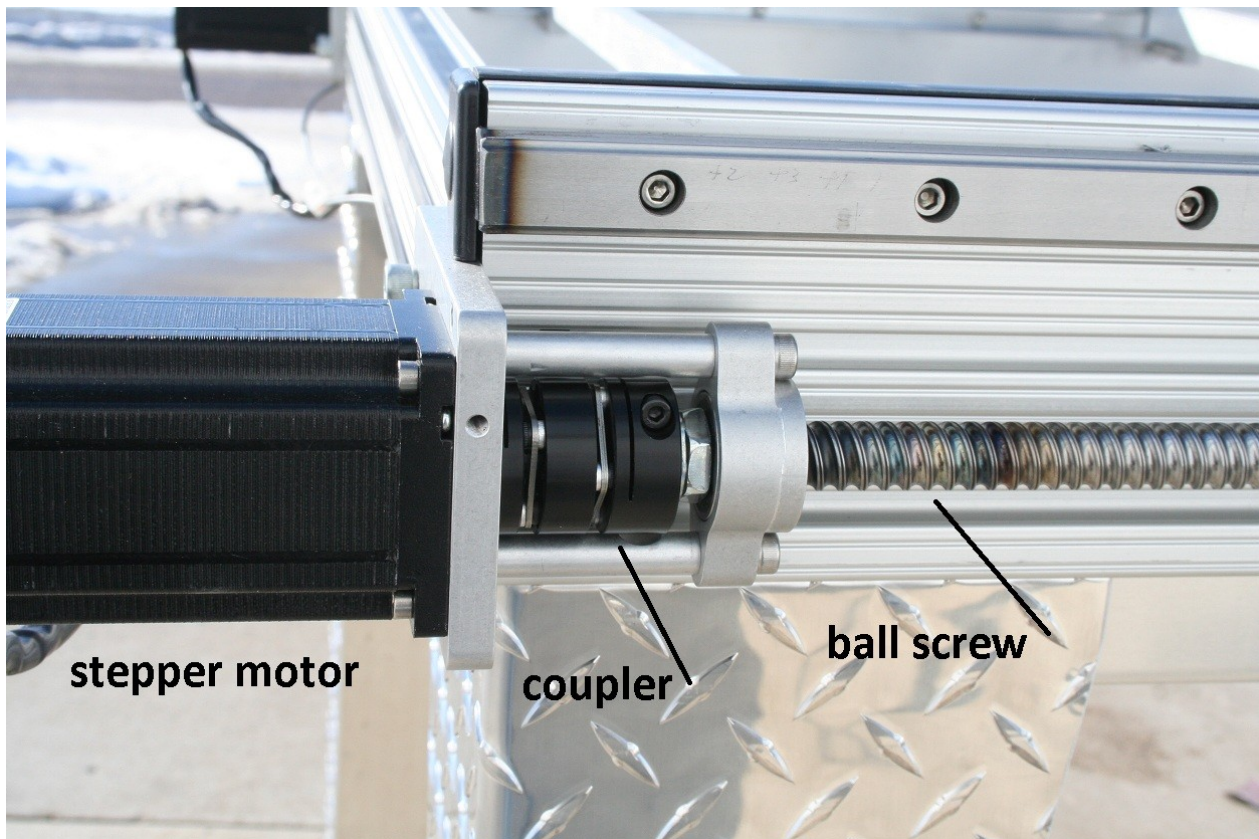
Jerky or erratic movement

- If only one motor is mis-behaving, one of the two driver circuits may be open anywhere between the drivers in the controller and the motor.
- Make sure motor to ball screw coupler is tight.

- Make sure both X axis motors are running. Disconnect the x axis motors with the power off. Then power back on and observe the motors while homing to see if both are 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 or parts on the machine as the X or Y axis may hit them and cause a jam.
- **Confirm there is no slippage between motor and ball screw.** This is actually a fairly common situation on initial set up where the motors are installed but the couplers not tightened.



The picture shows the X2 axis with the guard removed. We have used various couplers, but the arrangement is the same regardless of which coupler is used or the axis it is on. To check for slippage, turn on the controller. The motor will magnetically lock in place. Grasp the ball screw with a pliers (you won't hurt it, the critical area is the grooves) and turn. At some force, you will be able to overcome the magnetic detent, but there must be zero slippage until that happens. Tighten the coupler until there is no slippage. Inspect the coupler for breaks, cracks or loose hardware. The screws holding the pieces together on the coupler above can work loose. If that is the case, the coupler must be disassembled, tightened, and reinstalled.

MAINTAINING THE PANEL PRO

PREVENTATIVE MAINTENANCE: After cutting, wipe the ways (linear bearing rails) with a clean cloth or paper towel before closing AvCAM. There are wipers on the bearing packs. However a small amount of coolant may track into the bearings. The lower Y axis bearings are particularly exposed. 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 Spindle Control – Spindle on, to turn on the coolant. Remove any remaining chips. Uncheck spindle on to turn the spindle off.

Remove the clear plastic splash guard and horizontal splash plate. Rinse in water and dry.

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

There are 12 grease zerks. Grease once a month with general purpose grease. Aeroshell 22 is preferred. One or 2 shots of grease should be adequate. Pay particular attention to the bottom Y and bottom Z zerks.



Collet maintenance:

The picture on the left shows a collet after cutting a large 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.

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 and or cause poor cut quality because the flutes are not equally sharing the load.

To avoid end mill slippage, the collet should be installed dry. That however invites corrosion so it is a good practice to remove, clean and dry when not in use. The collet nut threads should be oiled.

Adjust x to y axis square:

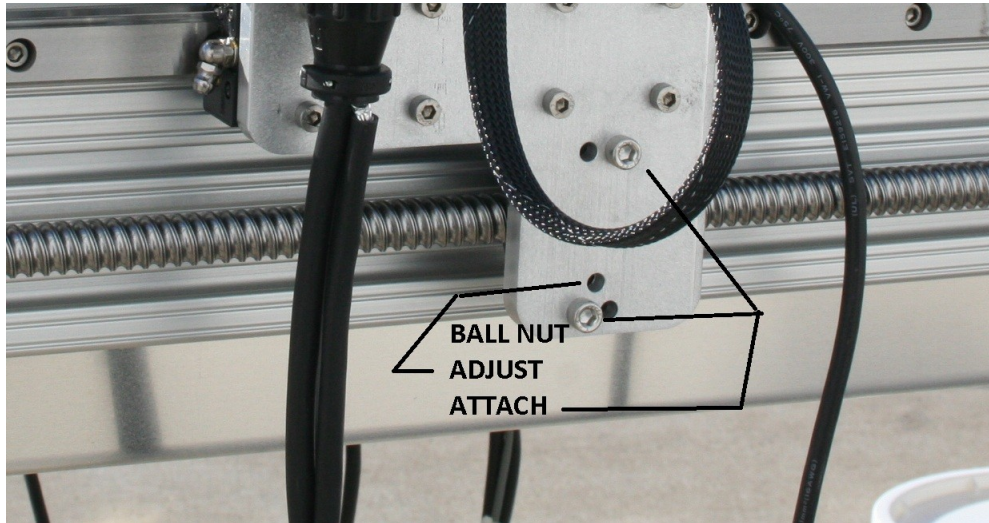
Make sure the machine is level. With the power off, move the x1 and x2 ball screws using the knobs on the left end of the machine simultaneously until both touch their stops. The stop is a 6mm dog point (blunt) set screw that is Loctited into the Motor mounting plates on the X1, and X2 axis.

Both should normally hit their stops at the same time, but if an obstruction gets in the way of one x axis, it will stop, but the other will continue until there is enough binding to stop it as well. At this point the X and Y axis will be out of square with each other and the position will be lost.

Turn off SC3 power and relieve any obvious binding. Turn back on and go through the home sequence. Verify both x1 and x2 contact their hard stops at the same time. If they don't, turn the controller power off or disable the drivers from the AvCAM > machine menu.

Adjust Ballnut backlash:

The X and Y axis ball nuts have an adjustment for backlash. 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 ball screw may be slightly tighter than others. The ball nut needs to be adjusted for the tightest location. The picture shows the X2 axis, but the X1 axis and Y axis have a similar arrangement.



Caution! Over tightening the ball nut adjusting screw will destroy the ball nut \$\$

ADJUST BALL SCREW BACKLASH:

This adjustment preloads the ball screw bearings.

The Panel Pro 6148 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 ball screw (on the screw part, not the smooth machined part) with pliers near nut end. Loosen the $\frac{1}{4}$ x 20 stop nut from the knob.

The knob is threaded. The knob should be tightened about $\frac{1}{4}$ to $\frac{3}{8}$ of a turn beyond the point where the knob contacts the belleville washers.

Tighten the jamnut make sure the knob to ballscrew position does not shift while tightening the jam 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.

3 axis operations with the Panel Pro 6148

The Panel Pro 6148 utilizes a full Z axis that can be software controlled within its travel.

In most cases you will still use a 2D cad file and use the z axis cut depth to control how deep the end mill will cut.

There are several defined positions on the Z axis.

Home is the position at the top of the travel where the Z home switch opens. It is at or very near the absolute mechanical up limit.

Maximum travel from the home position is approximately 3.125" and is also close to the mechanical travel limit.

The 4 main defined positions are:

- Retract
- Go slow
- Zero
- Cut depth

The retract, go slow, and cut depth are relative to work zero. When AvCAM commands a Z down to cut depth, it will travel at the currently selected rapid traverse speed to zero, and then at the cutting speed to cut depth.

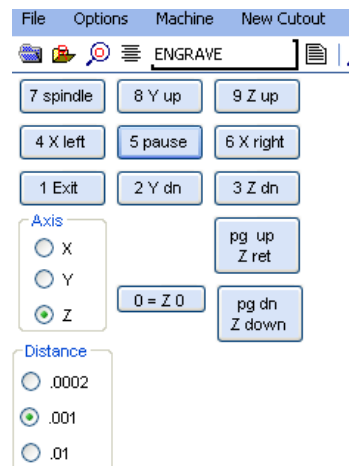
What ever tool you are using will need to have a zero reference. Normally the Z work zero will be the position where the tool (i.e. end mill) tip is on the surface of the material to be cut.

To set Z work Zero:

Use the jog keys (see the help file) and jog to a position somewhere near where your x/y zero will be.

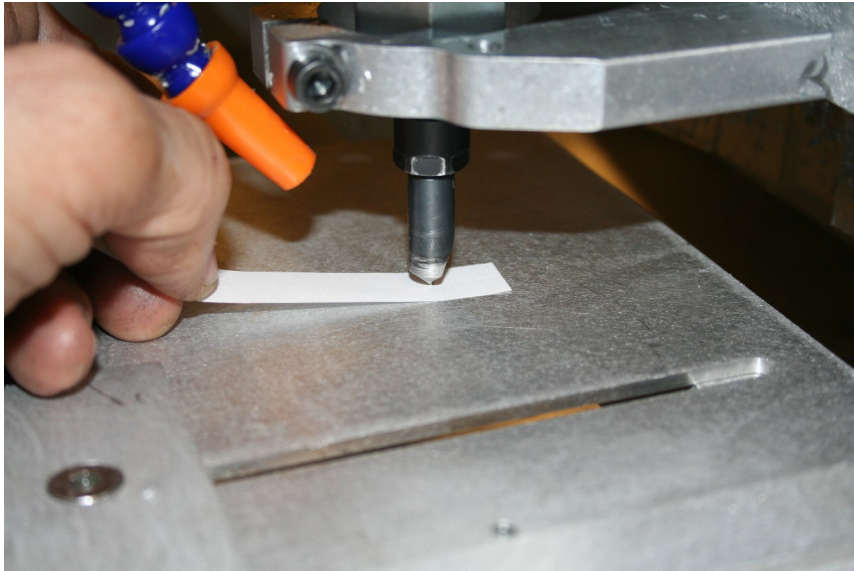
Use the 3 key to move the z axis down to about .1" above the surface. Use the mouse wheel set to move the z axis (right click any where on screen to move between x, y, and z) and the increment set to .001 per mouse wheel detent (left mouse click on screen to move between .0002, .001, and .01 inches per mouse wheel detent)

Place a strip of ordinary paper which is about .004" thick between the end mill or other tool.



Using the mouse wheel move the z axis down until you can not easily pull the paper out. Tap the Z key on the keyboard. The Z control dialog will appear. Tap Z again. A pop up will ask if you want to set the current location to zero, respond yes. If you inadvertently run the z axis down too far, it can damage your tool or more likely cause the z axis to lose position. If you suspect that you may have gone too far, tap the home key to reset the Z axis position. Then re set the z zero. Tapping the "0" key will lower the z axis to the zero set point. If position has been lost, the tip of the tool will be above zero.

Be aware that the Z Zero will change for each tool, and each change in material thickness. Also be aware that hitting the 0 key before setting z zero may damage the end mill, or work or cause the z axis to lose position in which case it the home procedure would need to be run by tapping the home z button on the z control.



The retract setting is where the z axis will move to when it is not cutting and moving to its

Z control for ATP, MTP modes

Home Z
 move full up
 Move to retract
 move to work zero
 move to cut depth
 Disable
 Exit

Tool Probe
 Probe Height 0.762
 Test Probe
 Probe end mill
 Hit Esc to stop

distance from Z Zero
 Z retract level 0.7500
 Go Slow Height 0.1000
 Set Z retract to current Z 0.2500
 Set Z work zero to current Z -0.5000

distance from home
 Set cutting depth to current Z -0.6250
 -3.5000

depth per pass -0.1250
 number of passes 1
 Finish cut allowance 0.0000
 Z feed rate 11
 Dwell .0000

next cut location. It needs to be high enough to clear any clamps or obstructions. If there are no obstructions, then a setting like the .250 in the picture will save time. It can be entered directly as a positive number in the text box, or you can move the z axis where you want the retract position to be, open the z control dialog by clicking the Z status box and clicking the “Set Z retract” button.

When the z axis is at or below the **Go Slow** height the x and y axis will move at feed rate when jogging. The user can hit the “G” key to move at rapid rate to the go slow height.

Similarly, the cutting depth can be set by direct entry or the set cutting depth button. We will talk about cutting depth again later.

Cutting Check list:

- Draw the file. Inside cuts on any layer NOT named outside. All outside cuts must be on the layer that starts with “outside”. Save the file to dxf. If your CAD

does not close the DXF file when saving, it must be explicitly closed. QCAD will properly close the file on saving.

- Open the File in AvCAM.
- Select the layer(s) you want to cut in this operation.
- Set the operating mode, I.E. auto tool path
- Set the end mill diameter in the cut dialog
- Simulate the file
- Install the tool on the router
- Set the x/y zero. This only needs to be done once for the file.
- Set the Z zero, verify retract level and cut depth. The retract may remain the same for all tools, however the Z zero and cut depth will likely change for each tool.
- Verify router switch is on and the spindle switch on the controller is on.
- Verify cut speeds. The cut speed should be in the 20 IPM range for a 1/8" end mill and 1/8" 2024T3.
- Verify adequate coolant in tank and pump plugged in.
- Repeat Z zero, cut depth and end mill diameter settings for each tool change.