

SHOPBOT CNC ROUTER

VERSION 3.1



AUTODESK
PIER 9

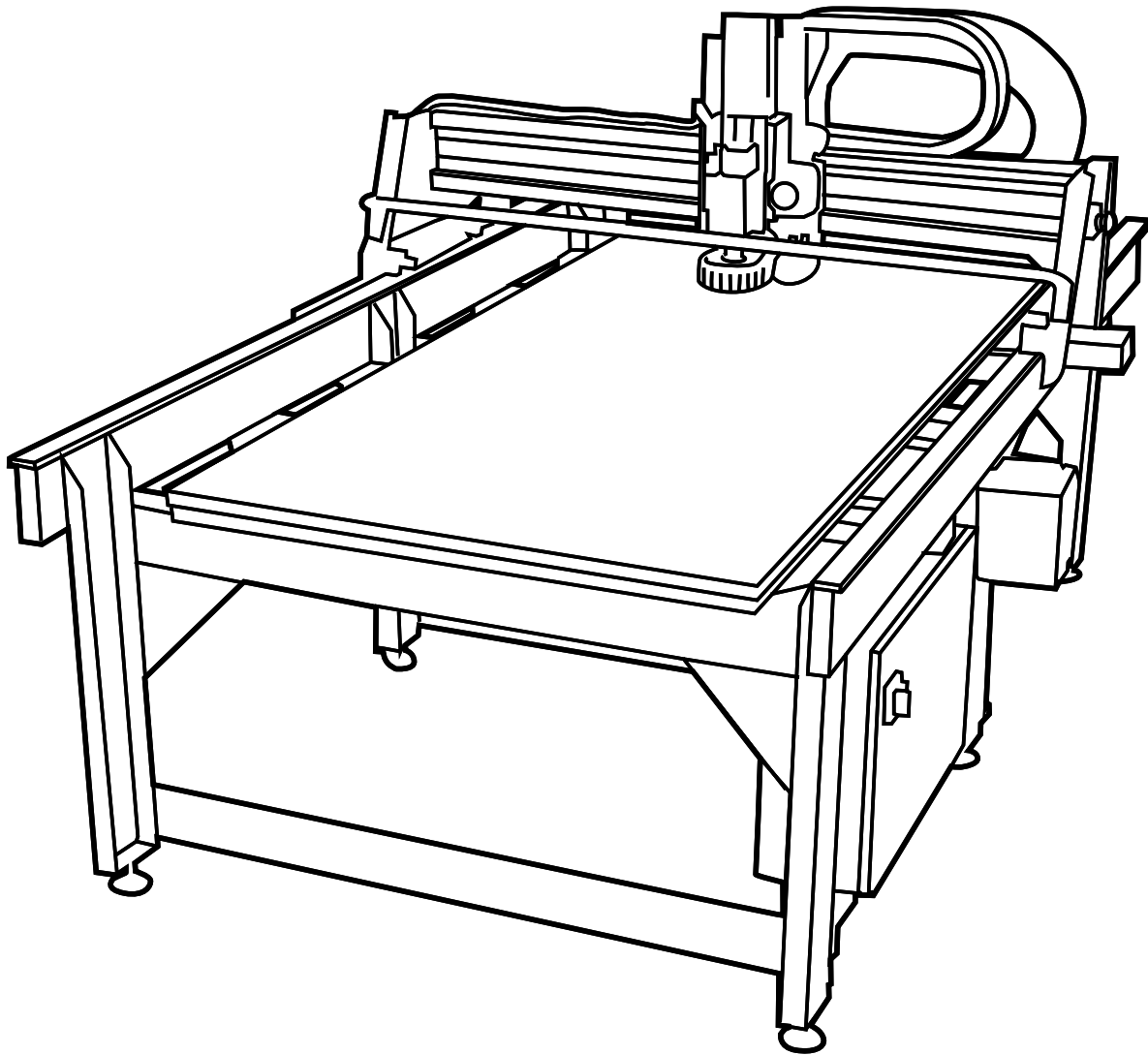
SHOPBOT CNC ROUTER

MACHINE
CONTROLS

VERSION 3.1

THE SHOPBOT ROUTER IS CAPABLE OF MAKING ACCURATE PARTS FROM YOUR CAD MODEL.

P. 2



MATERIALS

i ALLOWED MATERIALS

- + Wood
- + Some plastics
- + Some foams

x BANNED MATERIALS

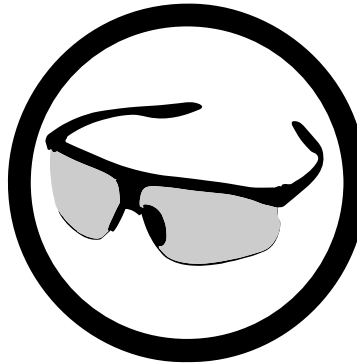
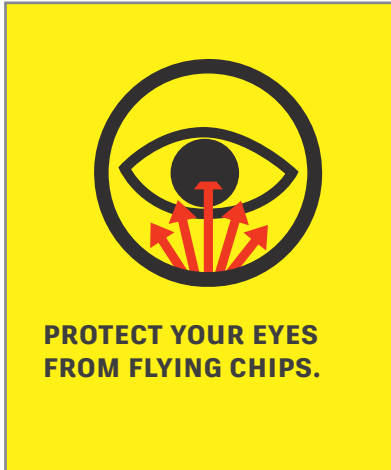
- + Metal
- + Carbon fiber and composites

? SEE SHOP STAFF FIRST

- + All other materials

USE PERSONAL PROTECTIVE EQUIPMENT WHEN OPERATING THE ROUTER.

P. 3



Always wear safety glasses.



Turn off the machine or press an E-stop before moving past the bed rails for any reason.

Remove the Safety Interlock Key before changing bits



Stay within a few feet of the console or an e-stop button.

FOLLOW ALL THE STEPS, IN ORDER.

P. 4

MACHINE SPECIFICATIONS

The ShopBot CNC router is a large 3 axis router with the following specifications:

- + 3 horsepower spindle
- + 18,000 RPM maximum spindle speed
- + Work envelope of 8' x 4' x 12" (X, Y & Z)

REQUIRED KNOWLEDGE

Before you start your work, make sure you understand the following skills:

- + Types of cutting tools
 - ▶ Which cutting tools you can use, and how they work
- + Tool holding
 - ▶ The correct way to attach a cutting tool to the ShopBot
- + Workholding
 - ▶ How to hold your workpiece to the ShopBot bed
- + ShopBot software interface
 - ▶ Operating the computer that controls the ShopBot

REQUIRED MATERIALS

Before you start your work, make sure you have the following materials:

- + An .sbp file from your completed CAM file.
- + A thumb drive to copy the .sbp file to the router.
- + Setup Sheets from your CAM software.
- + A copy of this Quick Start Guide.

STEPS FOR SUCCESSFUL USE

To make a part, you need to complete each step in order.

1. Start up the controller & router.
2. Secure the workpiece to the table
3. Install the first tool.
4. Set Z zero.
5. Set the XY Home.
6. Load the program.
7. Make an air pass.
8. Reset Z zero
9. Run the program.
10. Clean up.

MEASURING MATERIAL

After preparing your material for the router, measure it carefully and change the setup in your CAM program if needed.

ASK SHOP STAFF IF YOU ARE UNCERTAIN ABOUT WHICH BIT TO USE.

P. 5

CUTTING TOOLS

There are two basic kinds of cutting tools for the ShopBot: drill bits and end mills (or router bits).

Drill bits

- + These are the same bits used in a hand drill or drill press.
- + They are only for drilling holes, and only work when moving straight down.

End mills & router bits

- + These bits are designed to cut while moving sideways through the material.

There are two common styles of end mills, regular and ball end.

- + A regular end mill has a flat end, and is used for cutting flat surfaces.
- + A ball end mill has a hemispherical end, and is used for 3D machining and finishing passes.

Cutting tools have two parts, the *shank* and *flute*.

The flutes are the cutting edges of the bit. The shank is the section that goes into the tool holder.

The shank must always be the same diameter as the tool holder. The flutes may (or may not) be the same diameter as the shank.

Some bits are available as *up-cut*, *down-cut* or *compression spiral*.

- + Up-cut
 - ▶ Sawdust is ejected from the top of the workpiece.
 - ▶ They damage the top layer of material.
 - ▶ They tend to lift the workpiece off the table. Be careful with workholding.
- + Down-cut
 - ▶ Sawdust is pushed into the workpiece.
 - ▶ They push the workpiece down onto the table.
- + Compression spiral
 - ▶ A combination bit (down-cut on top & up-cut on the bottom) designed to cut all the way through sheetgoods in a single pass.



DRILL BIT



END MILL



BALL END MILL



FLUTE SHANK



UP-CUT



DOWN-CUT



SPIRAL

SECURELY HOLDING THE MATERIAL IS CRITICAL TO SAFETY.

IF IN DOUBT, SEE SHOP STAFF.

WORKHOLDING

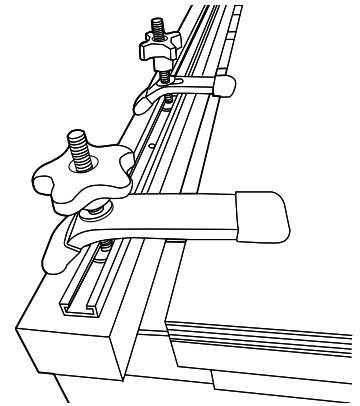
The ShopBot table was custom made by Shop Staff to make workholding faster and easier. Treat it nicely.

- + Never cut into the table more than 1/32".
 - ▶ Carefully measure your material thickness to avoid deep cuts in the table.
- + See Shop Staff before using screws as a workholding method.

Full Sheet (4' x 8') Workholding

When cutting full sheets, use clamps to hold the corners and edges to the table.

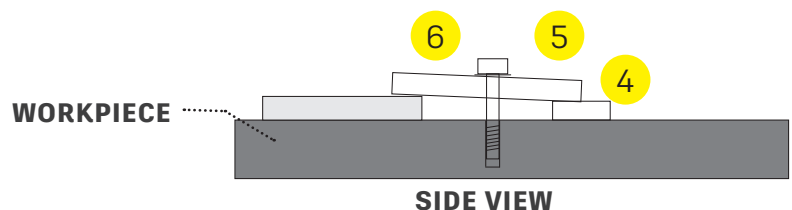
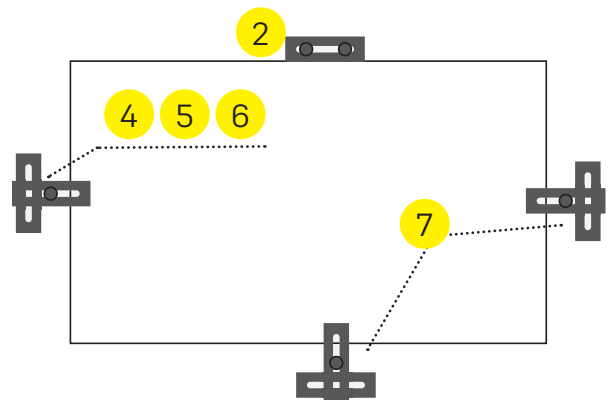
1. Square the workpiece to the ShopBot table.
2. Use the red and black clamps to hold each corner and side of the material.
 - ▶ Only use plastic and rubber clamps - no metal.
 - ▶ Use a minimum of 6 clamps; one on each corner and one on each long edge.
 - ▶ Use more clamps when possible.



Partial Sheet Workholding

The table has a grid of over 400 holes. Each hole has a threaded metal insert that nylon bolts can be screwed into. The nylon bolts secure the hold down blocks that hold your workpiece.

1. Blow out the insert with compressed air.
2. Place a hold down block flat on the table, at the back of the workpiece.
 - ▶ Place the long edge of the block against the workpiece.
3. Screw in two bolts, using washers.
 - ▶ Hand tighten the bolts.
 - ▶ Use a wrench to tighten an additional 1/4 turn.
 - ▶ Do not overtighten.
4. Place a block a few inches from your workpiece.
5. Place a second block on the first, with one end on top of your workpiece.
6. Attach them with a nylon bolt.
7. Add a minimum of two more hold downs.



STARTING UP THE COMPUTER AND SHOPBOT

1. Turn on the computer.
2. Login using the name & password on the monitor.
 - ▶ Do not turn on the ShopBot until you are logged in.
3. Turn on the ShopBot.
4. Open the *ShopBot 3* program.
5. Reset the E-stops.
 - ▶ E-stop buttons are located next to the computer and on the pendant.
6. Click OK.

THE SHOPBOT IS CONTROLLED BY THE COMPUTER, AND CAN MOVE AT ANY TIME. ALWAYS USE AN E-STOP OR SAFETY INTERLOCK KEY IF YOUR BODY WILL BE NEAR THE SPINDLE.

STOPPING IN AN EMERGENCY

There are two ways to manually stop the router when it is running: space bar and emergency stop (E-stop).

Pressing the space bar is the preferred method for quickly stopping the router.

- + Pressing the space bar will:
 - ▶ Stop gantry movement
 - ▶ Bring the spindle to a stop quickly
 - ▶ Allow the job to be easily restarted
- + Using the E-Stop will:
 - ▶ Stop gantry movement
 - ▶ Kill power to the spindle. It will slowly coast to a stop and drop towards the table.
 - ▶ Cause the router will lose its known position, and will need to be reset

SAFETY INTERLOCK KEY

The safety interlock key must be inserted in the machine to enable the spindle. The key is attached to the spindle wrench to remind you.

Always remove the key before changing end mills.

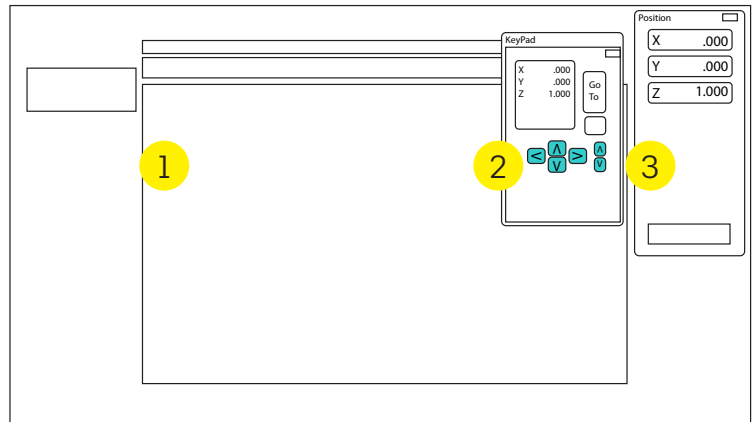
- + Removing the key will disable the spindle.

CONTROLLER

The router is run by controller software on a Windows PC.

There are 3 main windows used to run the ShopBot.

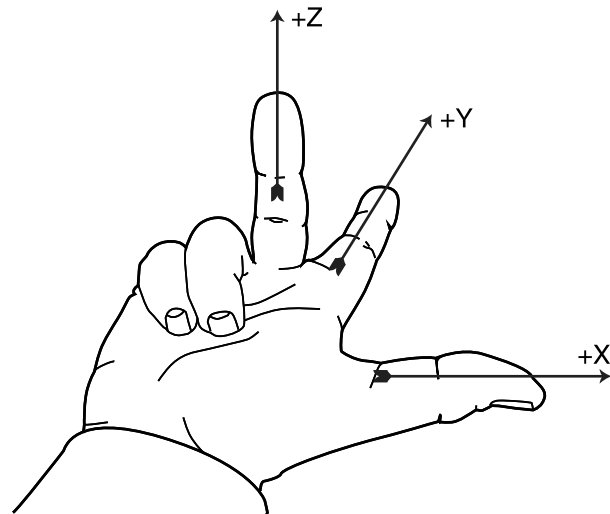
1. Command Console
 - ▶ This is the main program interface.
2. KeyPad dialog
 - ▶ Used to manually move the gantry.
 - ▶ **Always close the keypad before operating the machine. Leaving it open will cause the controller software to crash.**
3. Position Dialog
 - ▶ Displays the current X, Y & Z coordinates.
 - ▶ Has buttons to setup and run the ShopBot.



AXIS LABELS

To help remember which direction is positive on the 3 axes, use the *right hand rule*.

1. Stand at the computer, looking at the long side of the machine.
 2. Hold out your right hand, like in the illustration.
 - ▶ Each finger is pointing in the positive direction.
- + The long axis is X.
 - + The short axis is Y
 - + Z is the vertical axis.

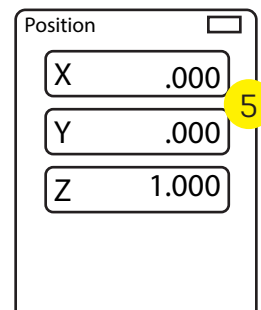
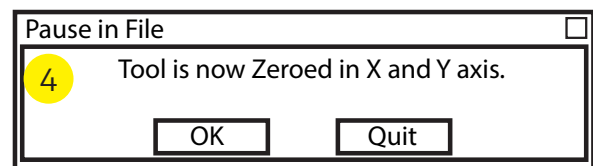


THE NEXT STEPS WILL ENABLE THE SHOPBOT TO MOVE. MAKE SURE THE BED AND RAILS ARE CLEAR.

PREPARE THE SHOPBOT

The following steps will have the machine travel to the limit switches on the X & Y axis, and reset the zero positions.

1. Press the blue **RESET** button on the pendant.
 - ▶ This locks the stepper motors and enables movement.
 - ▶ Do not move the gantry by hand when the control box is on.
2. **Close the Keypad dialog.**
3. Press **C 3** on the keyboard.
 - ▶ Alternate: Select **Cuts** in the top bar, then **C3 - Home X & Y Axes**.
 - ▶ The gantry will move to the machine home position.
4. A dialog box should open.
 - ▶ Click OK.
5. Check the Position Dialog to confirm that X & Y values are 0 and Z is 1.
 - ▶ See Shop Staff if the coordinates are incorrect.



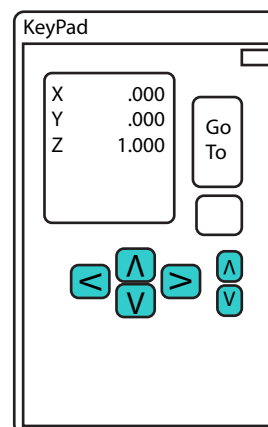
ALWAYS CLOSE THE KEYPAD DIALOG BEFORE STARTING ANOTHER OPERATION. THE CONTROLLER SOFTWARE WILL CRASH IF IT'S OPEN.

JOG THE SPINDLE

The next steps will bring the spindle to a location where you can insert an end mill.

You can move the gantry with the Keypad dialog.

1. Press **K** to open the Keypad dialog.
2. Use the blue arrow keys to move the gantry.
3. Close the Keypad dialog.



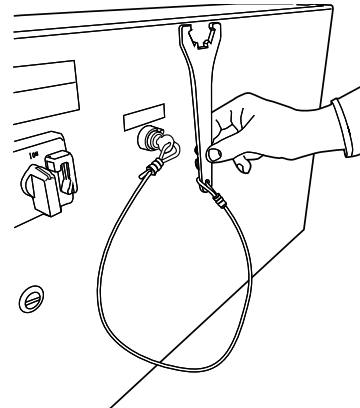
REMOVE THE KEY FROM THE MACHINE BEFORE EVERY TOOL CHANGE.

P. 10

SAFETY INTERLOCK KEY

Before the ShopBot can rotate the spindle, the key must be inserted in the lock on the side of the controller box.

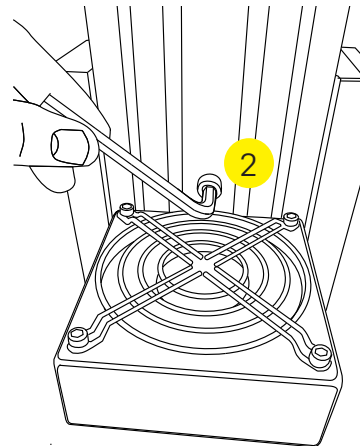
- + If the key isn't in the lock, it should be in the second drawer of the ShopBot cabinet.
- + The collet wrench is attached to the key to remind you to remove the key (and disable the spindle) every time you do a tool change.



ADJUST THE DUST SHROUD

The dust shroud must be lowered to access the spindle.

1. Remove the key from the controller box.
2. Loosen the Allen screw so the shroud can move.
 - ▶ The wrench should be in the top drawer.
- + Lower the shroud to access the spindle.

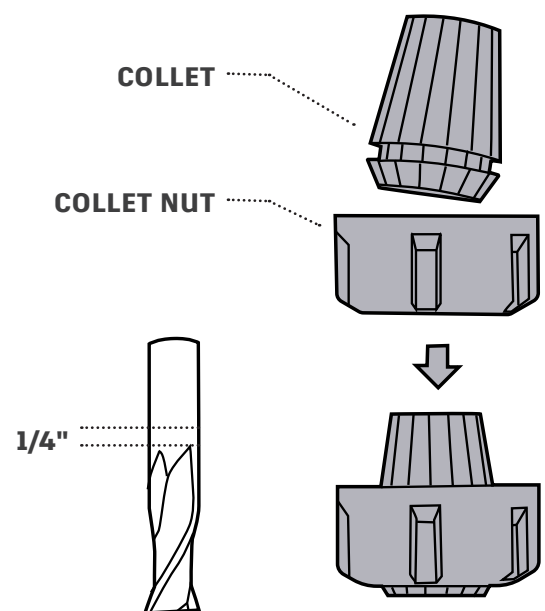


INSERT THE TOOLING

The shank of the end mill must be the same size as the collet.

1. Tap the collet on a piece of wood to knock out any sawdust.
2. Snap the collet into the collet nut.
3. Loosely thread the collet nut onto the spindle.
 - ▶ The threads are very fine. It's easy to cross-thread the spindle. Be careful.
4. Slip the end mill into the collet.
5. Hand tighten the collet nut.
 - ▶ Leave 1/4" of shank sticking out of the collet.
6. Tighten the collet with the wrenches.
 - ▶ "Monkey tight" not "gorilla tight".
7. Adjust the dust shroud.
 - ▶ The top of the shroud should be even with the top of the collet.

To remove the bit, loosen the collet nut and put away the bit and tools.



CAREFULLY MEASURE THE MATERIAL THICKNESS BEFORE ENTERING IT INTO THE CAM SOFTWARE.

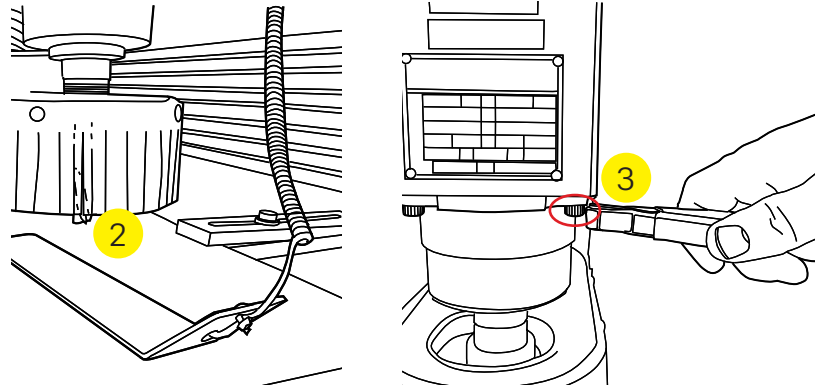
P. 11

It is important to not damage the table. These steps will help avoid mistakes.

- + If you are cutting all the way through your material, limit your cut to an extra 1/32"
- + Carefully measure the thickness of your material and enter the value into your CAM software.
- + Use the *Zero Plate* to find Z Zero (the exact top of your material).

SET Z ZERO

1. Jog the spindle over your workpiece.
2. Place the Zero Plate under the end mill.
3. Attach the *ground clamp* to the standoff on the spindle.
4. In the [C]uts menu, select C2 - Zero Z axis w/ Zzero plate".
5. Press **Enter** when you are ready to set Z Zero.
 - ▶ The spindle will lower until the end mill touches the Zero Plate twice.
 - ▶ If it fails, restart the software.
 - ▶ Not closing the control panel will cause it to fail.
6. Remove the ground clamp, and put away the Zero Plate.

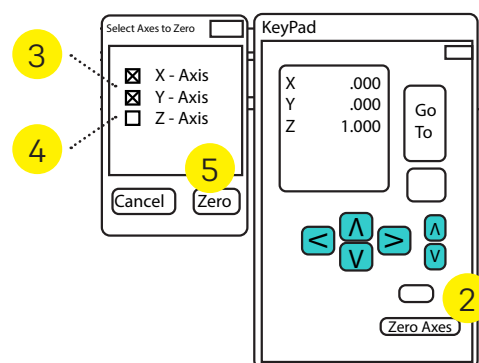
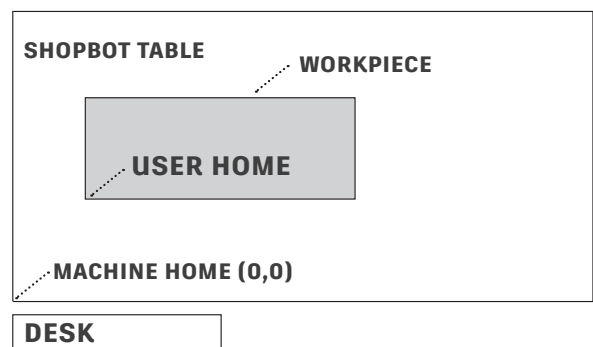


USER HOME

User Home is a user defined zero point. It's the same point that you defined in your CAM software as X0, Y0.

SET USER HOME

1. Jog the spindle to the bottom left corner of your material.
 - ▶ Taking a photo of the computer screen will allow you to return to the same spot in the event of a crash.
2. Click **Zero Axes** in the KeyPad dialog.
3. Select X & Y.
4. Ensure that Z is not checked.
5. Click the ZERO button.



RUNNING AN AIR PASS WILL HELP ELIMINATE EXPENSIVE ERRORS.

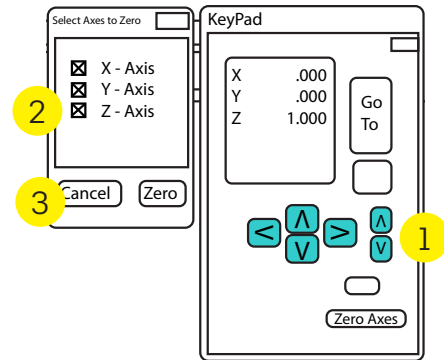
P. 12

SET UP FOR AN AIR PASS

An air pass is a test cut, with the Z axis set high enough that it won't actually cut anything. Set a false Z0, make the air pass, and if all goes well, set the real Z0 and cut the part.

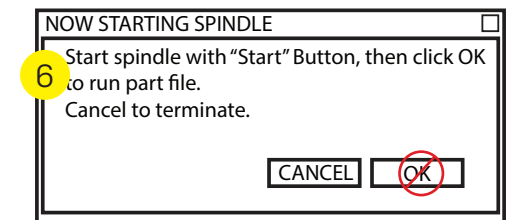
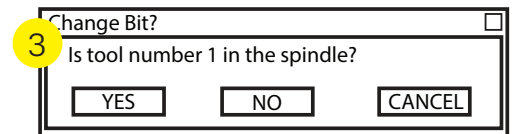
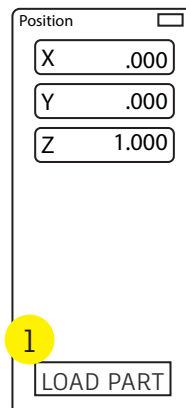
Set a Z for an air pass

- Jog the spindle a few inches above your material.
 - This must be higher than your material thickness.
 - Use an even number, like 2".
- In the KeyPad dialog, select Z- Axis only.
- Click Zero.
- Confirm in the KeyPad dialog that Z has been set to 0.
 - This will set Z0 2" above your part. After the air pass, you'll enter the correct Z0.



Load the part file

- Click **Load Part** in the Position Dialog.
- Load your .sbp file.
- Confirm that the tool in the spindle is tool specified in your CAM.
- Click OK in the Position Dialog.
- Do **not** click OK yet.



Prepare for the air pass

- Check that the zero plate has been put away.
- Check that the ShopBot table is clear.
- Click Start in the Position Dialog.
- Do **not** click OK yet.

YOU MUST MANUALLY START THE SPINDLE BEFORE RUNNING THE PROGRAM.

IF THE AIR PASS IS SUCCESSFUL YOU CAN CUT YOUR PARTS.

P. 13

MAKE THE AIR PASS

1. Press the Reset button on the pendant.
2. Press the Start button on the pendant.
 - ▶ Visually confirm that the spindle is rotating.
3. Click OK in the dialog box.
 - ▶ This will start gantry movement.
4. Stay near the computer the entire time the ShopBot is running.
 - ▶ Use the space bar to pause the machine if there's a problem.
- + Watch the toolpath, and observe what it's doing.
 - ▶ If the cutting tool is not going where you expect it to, or if it's dropping too far down, there's something wrong with your CAM. See Shop Staff.
 - ▶ If the air pass is successful, you're ready for the real thing.

MAKE THE CUT

Reset Z zero

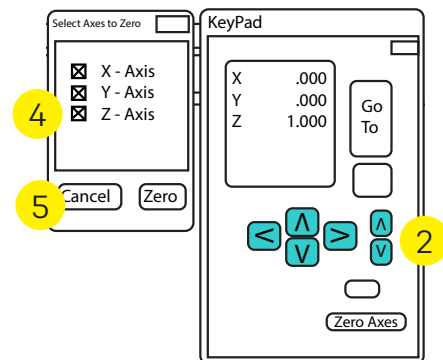
1. Open the KeyPad dialog.
2. Jog the spindle down to the real Z zero.
 - ▶ If you went to 2" to set Z zero for your air pass, go to -2".
3. Click the Zero Axes button.
4. Select Z - Axis.
5. Click Zero.

Re-run the program

1. How??
2. Start the spindle.
 - ▶ Confirm it is rotating.
3. Start the dust collection.
4. Start the cut.
5. Stay near the computer the entire time the ShopBot is running.
 - ▶ Use the space bar to pause the machine if there's a problem.

TOOL CHANGES

- + Always remove the key when performing a tool change.
- + Always make an air pass.



DUST COLLECTION

There are two dust collectors:

- + Dust Gorilla
 - ▶ It removes large chips.
 - ▶ If the red light is blinking on top of the dust collector drum see Shop Staff before going further.
- + The passive filter
 - ▶ It filters dust from the air.

Both machines have a remote in the drawer. Press the button on each remote to start the unit.

PREPARATION

1. Startup the controller and ShopBot.
2. Secure your material to the router table.
 - ▶ Ask Shop Staff for help if needed.
3. Install the first tool.
4. Set XY0.
5. Load the program.
6. Make an air pass.
7. Set Z zero.

REGENERATE TOOL PATHS AFTER MEASURING THE ACTUAL STOCK.

USING THE ROUTER

1. Confirm the correct tool is in the spindle.
2. Run the program.
3. Load the next tool.
 - ▶ Use the Safety Interlock Key.
4. Make an air pass.
5. Set Z zero for that tool.
6. Put away the previous tool.
7. Restart the program.
8. Repeat for each tool.

ALWAYS REMOVE THE KEY WHEN CHANGING TOOLS.

CLEANUP

1. Remove the key from the control box.
 - ▶ Put it away in the drawer.
2. Remove and put away any tools.
3. Jog the spindle half way down the bed.
 - ▶ This keeps people from moving the gantry when the machine is off.
4. Remove and put away all hold downs and other workholding.
5. Vacuum the table.
6. Throw away any scrap wood.
 - ▶ Cut down large pieces of scrap.
7. Large square pieces can be placed in the materials rack.
8. Clean the floor with a HEPA filter vacuum.
9. Turn off the dust collection.

PRESS THE E-STOP BEFORE REMOVING STOCK FROM THE TABLE.