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Digitizing Probe

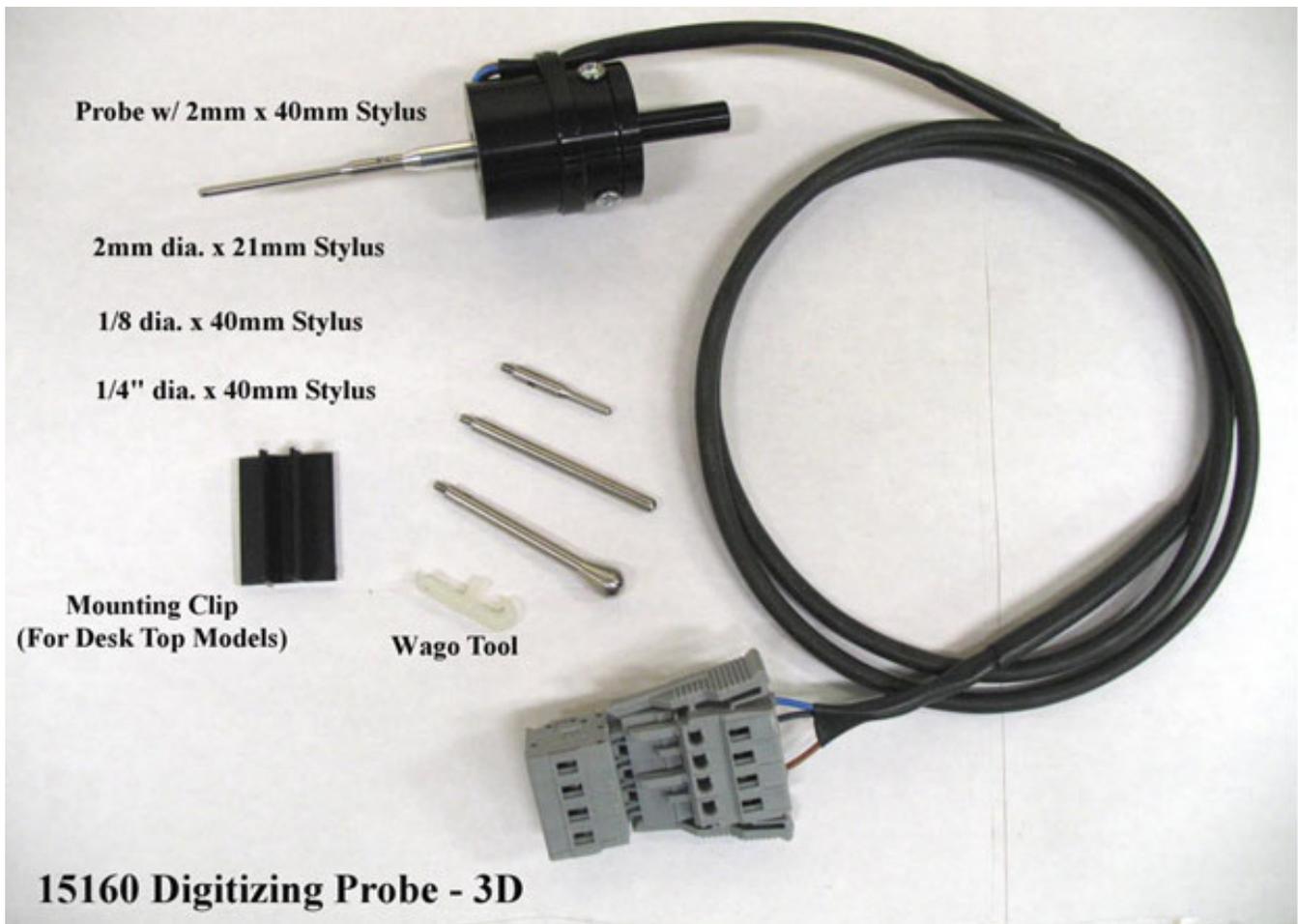


Table of Contents

Introduction	5
Installation	5
Installing the probe into a collet	5
Installing the probe into the mounting clip	5
Connecting the Probe and Selecting a Stylus.....	6
Warnings	6
Wiring the Probe.....	7
Setting Up for a 3D Probing File.....	8
Select stylus	8
Test probe.....	8
Attach original object (to be probed).....	8
Zero the Z axis.....	8
Locate the lower left corner of the original.....	8
Measure the size of the original.....	8
Check the depth of the original	8
Using the Probe.....	9
Pattern: What Kind of Copying is Preferred?	9
Probe: What Kind?	9
Format: What Kind of Output File?	10
The File Settings Fill-In Sheet.....	10
3D Probe Settings	11
2D Probe/Edge Finding Settings.....	12
Tips for 2D Probing	12
Software Tools.....	13
Other Probe to Surface Translation Options	14
Customizing (Advanced)	15
Troubleshooting.....	15

Introduction

This document provides instructions for installing and using the Digitizing Probe (15160). This probe physically maps the 3D shape of an object or records the object's outline and writes the information to a ShopBot part file. The probe can be mounted into a 1/4" collet on any router or spindle, or can be attached to the z-axis plate using the adhesive-backed plastic clip included in the kit.

Version 3.xx of the ShopBot Control Software includes the "Copy Machine" Virtual Tool [TC] to set up the probing routine.

Installation

NOTE: This probe has an internal optical switch which differs from earlier mechanical probes. Do not use older installation and wiring instructions. If adding this probe to an older tool, or upgrading from the older mechanical probe, follow these instructions to prevent damage due to improper connections.

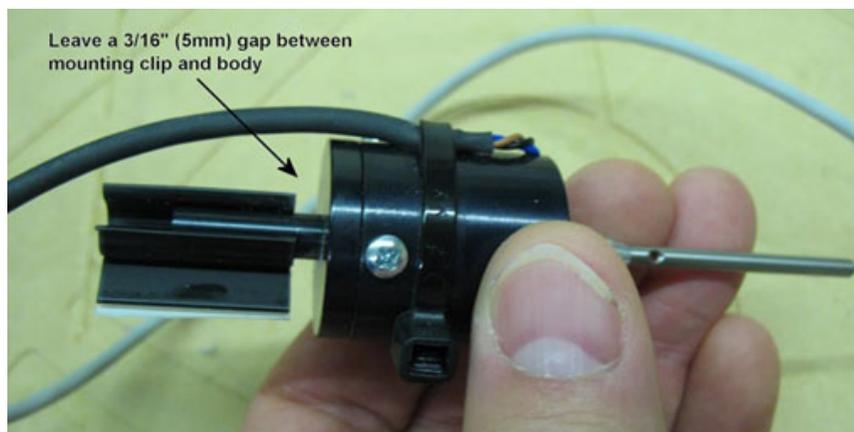
Installing the probe into a collet

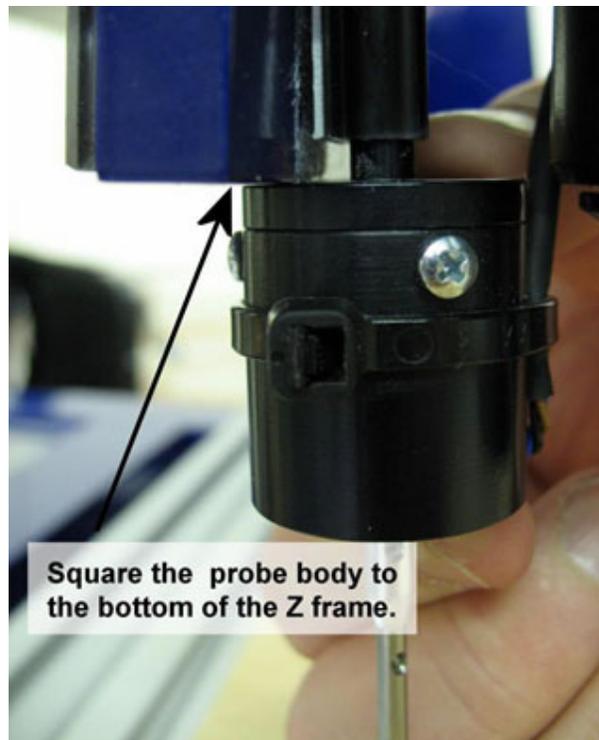
SAFETY FIRST: unplug or isolate the power to the router before installing probe.

The probe itself can be installed into the 1/4" collet of the spindle/router, just like a cutter bit of the same size. Secure the probe snugly in the collet so that it does not rotate. If the spindle/router rotates easily, use a piece of tape to keep it from turning.

Installing the probe into the mounting clip

On Desktop models, install the probe using the plastic mounting clip. This will provide several inches of clearance and prevent problems caused by the Z- axis hitting its upper limit during probing. Press the probe firmly into the mounting clip as shown in the photo, leaving a gap between the clip and the probe body as shown in the photo below. Peel off the adhesive backing and center the clip on the Z-axis plate, directly behind the router/spindle. Be sure that the body of the probe is square to the bottom of the Z plate.





Connecting the Probe and Selecting a Stylus

Connect the gray Wago plug on the end of the probe wire into the corresponding plug on the machine. On Buddy and Gantry tools, this plug will come from the wire guide/e-chain. On the Desktop model, the plug sits on the lower left side of the frame.

The probe comes fitted with a 1/8" stylus. This is a good general purpose size, which allows probing an object and then immediately cutting it with a 1/8" bit.

Also included is a 1/4" stylus for larger work and point plotting, and two 2mm styli, which are best for higher resolution work. To replace a stylus, gently unscrew it from the adapter (the tapered metal piece that goes into the probe housing) and replace it with the desired size.

Warnings

DO NOT turn on the router/spindle while probing. Power to the router/spindle is not needed, and routers should be left in the off position. Spindles may have power going to the variable frequency device (VFD) and the fan may stay on, but turning on the router/spindle during probing may destroy the probe and/or cause physical injury.

DO NOT use the C2 Command (the Z-zero routine) with the ShopBot Probe because the Z-zero plate operates in the "normally open" mode, and turns on input #1 when it makes contact. The probe works in the "normally closed" mode and turns off input #1 when it makes contact. The end result will be a bent stylus and a broken probe.

DO NOT attach the alligator clip from the Z-zero plate to the Z-zero plate itself during probing. This will result in a broken probe and/or a bent, unusable stylus.

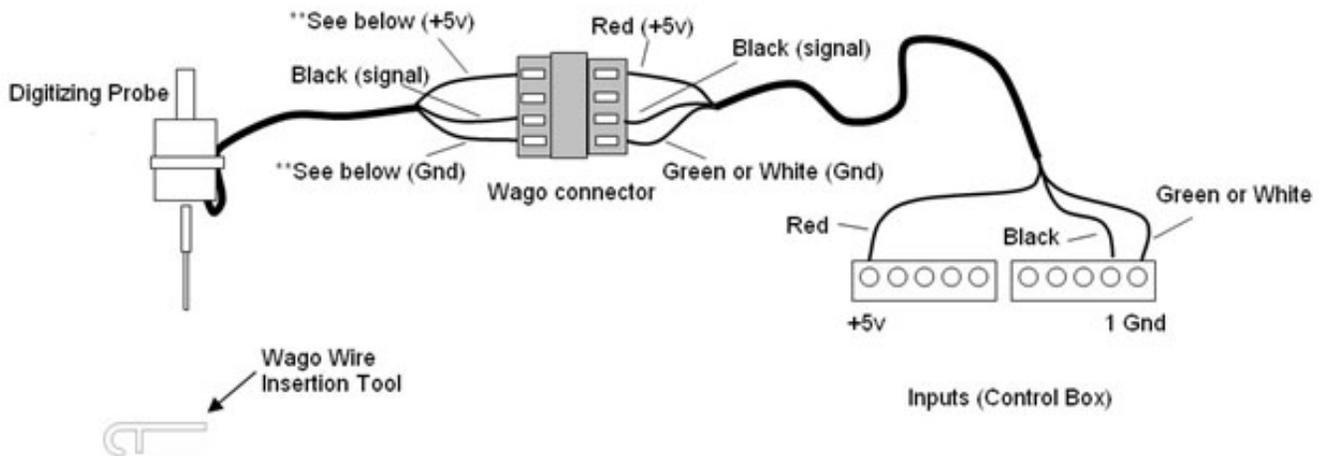
DO NOT leave the probe plugged in when not in use. When probing is completed, unplug the connector and remove the probe from the collet or mounting clip.

Wiring the Probe

NOTE: If the gray wago connector from the probe is already plugged into the matching connector on the Z-axis, skip the following step.

If a Z-zero plate is not present, it will be necessary to run a 3-wire (24-26 gauge) cable from the probe connector shown below:

- Connect the RED wire to the 5v+ terminal on the input strip.
- Connect the GREEN/WHITE wire to one of the Ground terminals.
- Connect the BLACK wire to Input#1.



Disconnect the probe from the connector to the Z-zero plate when the probe is not in use. Other color wires may be used as long as they correspond to the wires on the probe side correctly. Remember that DAMAGE to the probe can result from improper wiring.

The table below shows the color codes for the probe wires. Note that there are three possible color schemes.

	Possible Wire Colors in cable from Probe		
+5v	RED	RED	BROWN
Signal	BLACK	BLACK	BLACK
Ground	GREEN	WHITE	BLUE

The probe sensitivity has been set at the factory and is not adjustable. A red LED in the probe indicates when it is connected and functioning normally. When the tip of the probe touches a surface, the LED will be turned off indicating contact.

Setting Up for a 3D Probing File

Select stylus

The probe automatically creates an offset, so choose the same sized stylus as the cutting bit. See “Troubleshooting” for more information on additional styli.

Test probe

Install probe into either a collet or plastic mounting clip.

Test the probe before setting up a file. Once the probe is attached, the indicator for Input Switch #1 should be activated on the ShopBot Control software display. The indicator should go out when the probe is touched and/or deflected. **NOTE:** Upon entering the variables for the probing file, it is no longer possible to test the probe.

Attach original object (to be probed)

The original object needs to be firmly attached so that it will not move or vibrate when the probe physically touches it. Double-sided tape works well, but make sure that it doesn't protrude.

Zero the Z axis

Do not use the Z-zero program (C2) with the probe. For a 3D file, establish zero by using the Keyboard Control (SK or K to bring up Keyboard Control, Page Up and Page Down to move the Z axis) to locate the tip of the probe slightly above the highest point of the original. Escape out of Keyboard Control, then use ZZ to zero the Z-axis at that location. If performing an edge detection file, read the instructions for where to locate or zero the Z for that file.

Locate the lower left corner of the original

Use the arrow keys on the Keyboard Control (K) to move the tip of the stylus slightly beyond the lower left corner of the original. Zero the X and Y axes (Esc, then Z2). Enter 0,0 for the X and Y when prompted for starting location coordinates.

If not re-zeroing, simply note the location of the X and Y on the ShopBot Control Software display when the probe tip is located at the lower left corner. Enter those values as the starting location when probing file is set up.

Measure the size of the original

Use a tape measure to measure the length of the original along the X-axis and Y-axis. To ensure that the entire object gets probed, measure out slightly past the edge of the object in each axis. Note these measurements to enter them during setup.

Check the depth of the original

The default deepest depth for the probing files is -2” from the Z-zero location. If the original is deeper than that, ensure the probe stylus is long enough. Be sure that no other parts of the Z-axis (including the shoulder of the spindle/router, the probe body, etc) will hit the original while probing.

The max depth value during setup can be edited if an appropriate stylus is available. Otherwise, it may be necessary to slice the original horizontally so that each probe is 2” deep or less.

Using the Probe

When ready to probe an object, go to: Tools > Copy Machine. Remember - DO NOT use the C2 Command (the Z-zero routine) with the ShopBot Probe.

When Copy Machine is opened, the following window, with three tabs – pattern, probe, and format - will walk through the setup process.

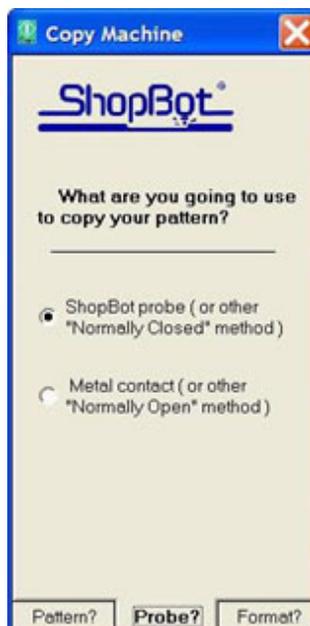
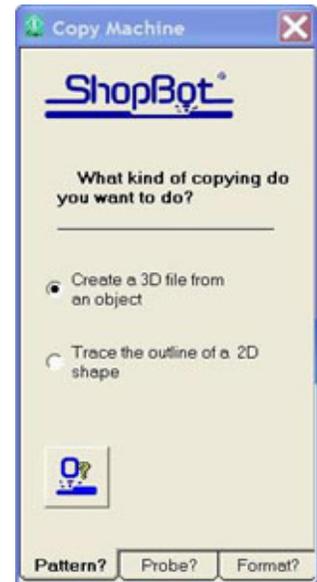
Pattern: What Kind of Copying is Preferred?

- Create a file to cut a 3D replica of the original:

These programs sample the X, Y and Z coordinates for each point on the original object. The probe determines the plunge depth (Z) at each step along one run of the X-axis of the original, then moves one step over along the Y-axis before reading back along the X.

- Trace the outline without probing the center.

The probe travels until it touches the edge of the object. It then executes a series of small circles away from and back into the object to follow the edge of the original. As the probe detects points along the edge, it writes that X and Y location to a file.



Probe: What Kind?

- The ShopBot 3D Digitizing Probe works like a switch that is “Normally Closed”. When the probe is properly wired into the control box and not making contact with anything, the circuit is complete (closed) and input light #1 is on. When the probe contacts the surface of the original, the switch opens to break contact and input light #1 turns off. The advantage of this scheme is that the software can test to make sure that the probe is present and hooked up before starting a probing procedure.
- A metal probe that makes contact with a metal part is sufficient for use with one of the “Normally Open” files. At rest, the circuit is incomplete and the indicator light is off. When the metal stylus makes contact with the metal edge of the original, the circuit closes and the indicator light turns on. That point when the circuit is complete is written to the probing file. See the .txt information files of the edge-detector programs (especially the ones for “normally open”) for suggestions on how to create a probe.

Format: What Kind of Output File?

- A ShopBot .sbp part file is generally the preferred file format. Selecting this option creates a file that is ready to cut, but can also be easily converted into a surface and manipulated.
 - To cut directly, simply open and run the file once probing is complete. To change the size of the finished object, change the proportion of the axes (X, Y and/or Z) when using FP to run the part file.
 - To edit this file, use Tools > Probe to Surface Translator and save as a surfaced .dxf (triangular mesh) file which can be brought into PartWorks3D, Cut3D, Aspire or ArtCam Pro.
- A .dxf file of points creates a point-cloud which can be manipulated in some CAD programs. Be aware that Aspire, Partworks3D and Cut3D cannot read this type of file.
- A dxf polyline file creates a 3d polyline which can be manipulated in some CAD programs. Be aware that Aspire, Partworks3D and Cut3D cannot read this type of file.



The File Settings Fill-In Sheet

After responding to all three questions and **clicking on the Copy button**, a fill-in sheet will appear. This sheet is related to the type of file that was chosen. Enter details such as the size of the area to be probed (3D) and the stepover between probe points (resolution). The smaller the stepover value, the greater the resolution and the longer it will take to probe the original.

3D probe settings	
X-axis scan pattern size	6
Y-axis scan pattern size	6
Safe Z-Axis Clearance	2
Maximum probing depth	0
X-axis step-over value	0.01
Y-axis step-over value	0.01
X and Y axis Move speed	2
Z axis Move speed	1
Input switch number	1
Surface Tolerance	0.025
Limit max plunge?	<input type="checkbox"/> 1.5
Dominant axis	X
Probe tip diameter	0.125

Edge finding settings	
Scan Resolution	0.25
Safe maximum Y-axis location	24
Move speed	0.5
Probe tip diameter	0.125
Safe Zup for output file	1
Cut depth for output file	-0.25
Input switch number	1

3D Probe Settings

- **X-axis scan pattern size** – The dimension of the item to be probed along its X-axis
- **Y-axis scan pattern size** – The dimension of the item to be probed along its Y- axis
- **Safe Z-axis clearance** - A dimensional value that allows the probe tip to clear the highest point on the item being probed.
- **Maximum probing depth** – The “floor” value for the probe’s downward travel in the Z-axis.
- **X-axis stepover value** – The distance the probe will travel in the X-axis before performing the next probing plunge. The smaller this value, the finer the resolution, but the longer the probing process will take and the larger the resulting probe file will be. There is a relationship between this value and the diameter of the probe that will create a point of diminishing returns with regard to achievable resolution.
- **Y-axis stepover value** – See “X-axis stepover value”.
- **X and Y move speed** – How fast, in inches per second, the probe will move in the X-axis and Y-axis. Considering the small movements involved in probing, this value doesn’t have tremendous impact and usually does not get altered often.
- **Z-axis move speed** – How fast, in inches per second, the probe will move in the Z-axis. This can have an effect on how long probing takes as a lot of the time is spent moving the Z-axis. If there is a narrow difference between the Safe Z-axis clearance and the maximum probing depth, a slower speed is okay. If there is a large difference, the operator can speed this up to save time, but it is necessary to respect the fragility of the probe, as well as object being probed. This is the speed the probe will be most likely traveling when it comes into contact with the probed object.
- **Input switch number** – What input switch line will change states when the probe contacts something (what input is the probe wired into)?
- **Surface tolerance** – What is the largest change in Z-axis expected from X/Y raster point to X/Y raster point (how much should the probe lift on the Z-axis after making contact before the next X/Y move)?
- **Limit max plunge?** – This setting allows for optionally specifying a value that will limit ANY ONE PLUNGE to that depth so that the z-axis will never move down more than that much in any plunge. There are some 3D probing situations like patterns where there are holes in the blank or probing continues beyond the edge of the blank like on a surfboard, when the body of the probe might hit the edge of the blank before it gets to the absolute maximum depth value that was set.
- **Dominant axis** – The 3D Copy Machine routines move along in rows in a “raster” method, and in early versions the rows were always parallel to the X axis. Though X parallel works fine for most probing, there are some situations that call for the rows being parallel to the Y-axis. The newest Copy Machine allows the selection of X-parallel or Y-parallel rows.

IMPORTANT: the probe-to-surface translator (if editing probe files in a 3D modeling program) will only work when the dominant axis is set for X. Setting it for Y is fine if creating an .sbp to cut a 1:1 replica without editing the file first.

- **Probe tip diameter** – Needed to compute the actual centerline X/Y/Z coordinates to record when the probe makes contact with the probed object.

2D Probe/Edge Finding Settings

- **Scan resolution** - Higher resolution yields greater detail and accuracy, but takes longer to complete a probe file.
- **Safe max Y-axis location** - The search for the pattern will begin by moving in the positive Y direction and will keep moving in that direction until it contacts the pattern or reaches this Y-axis position. This is an ABSOLUTE value and most of the time this will be set to the Y-axis dimension of the table.
- **Move speed** - How fast, in inches per second, the probe will move in the X and Y axis.
- **Probe tip diameter** - The diameter of the stylus being used. The software uses this number to calculate the offset and determine an accurate centerline.
- **Safe Z-up for output file** - If taking the probe file and cutting new parts without editing the model, this mode creates a safe z pull-up height for the cut file. For example, if probing an object that is 0.5” high and need to cut duplicates out of 1” thick material, set this variable for about 1.25.”
- **Cut depth for output file** - Set this value for the cut depth for the material that duplicates will be cut from. This can be edited in the toolpathing program.
- **Input switch number** - The default is 1. It should not be necessary to change this unless intentionally switching to a different input.

Tips for 2D Probing

- Securely mount the pattern to the table. Ensure that it doesn't move when being probed, and that it is high enough off the table surface so the probe doesn't drag on the table.
- Before starting the Copy Machine, pick a starting point where a large Y-axis move will contact the edge of the pattern - or wait until the keypad opens later on. Also make sure that a large enough value for “Safe maximum Y-axis stop location” is picked so that this first Y-axis move will make it to the starting point.
- If using the foil tape method (to provide an electrical contact for using the “normally open” switch mode), be sure that the foil goes completely around the pattern with no breaks or gaps.
- The stylus probably won't land exactly on a corner. If the pattern has sharp corners, it will be necessary to edit the file in a CAD program or manually add the coordinates of the corner to the ShopBot file with a text editor.

Software Tools

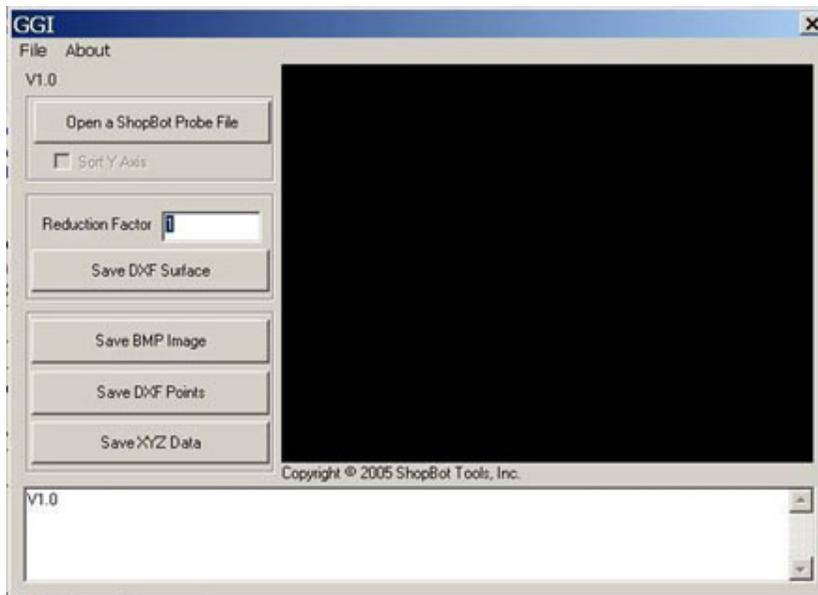
If a ShopBot .sbp file has been created, mount an appropriately sized piece of material stock on the table in the correct location. Mount the right bit, set zeros in all three axes, and run the newly created file.

Otherwise, it will be necessary to make some alterations before a file you can be used to create an object.



In the ShopBot Control Panel, select Tools, then Probe to Surface Translator.

Select the probe file to convert by pressing the Open a ShopBot Probe File button.



After selecting the file, a grayscale representation of the model will appear in the black box as shown below. If no such image appears, the file most likely did not complete properly. Refer to the troubleshooting section for instructions on how to edit the file to add the proper end statement code to complete the file.



To create a DXF comprised of lines between probe points (creates a mesh of the surface of your object), press the **Save DXF Surface** button and choose a destination file name and location. This is the best option for creating a file to edit in a 3D CAD/CAM program.

Note: The conversion process may take quite some time (depending on file size), doesn't yield much time to other CPU processes, and only uses the mouse cursor hourglass to show it is working, so it is preferable to perform the conversions on a computer other than the actual ShopBot control computer. Be patient!

When the process is finished, the word **Done!** will appear in the information window at the bottom of the dialog.

The .dxf file is now ready to be edited in the 3D software.

Other Probe to Surface Translation Options

Save BMP Image – This option is self-explanatory. Once translated to a Windows Bitmap image file, the file can be converted to other file formats, if required.

Save DXF Points - Instead of creating a DXF file comprised of line entities that defines the surface of the object probed, it is also possible to create a DXF file that is comprised only of point entities corresponding to the contact points recorded by the Copy Machine in the SBP file. This is commonly referred to as a “point cloud”.

Save XYZ Data - This option will reduce the data from the SBP file into raw coordinate data. Every contact point is listed on an individual line as three space-delimited fields in X, Y, and Z order. This format is useful for importing into other applications for further processing. It can also be imported into a spreadsheet if necessary. This would also be considered a “point cloud”, but in a very basic format, a delimited text file.

Customizing (Advanced)

See the FAQ in Copy Machine for current info.

The probe can be wired into any input other than input #4...however, it will be necessary to go through the probing file (FE, then the name of the probing file) and change the ON INPUT lines in the file accordingly.

A home-made probe can be created as long as the contact with the material is sensed by an electrical event. In the case of a metal part, this is the electrical contact of a stylus with the grounded part. The physical probe can be extremely simple, but in order to sample a wide variety of shapes and edge angles, the stylus should be stiff and precise, with reliable electrical switching with low activation tolerances.

The probe stylus sets the offset for the cutter bit, so it is best if the stylus is the same size and geometry (flat end or round nose) as the bit to be used to cut out the object. A machinist can create a stylus (keep it as light as possible), or purchase styli from a supply company.

Troubleshooting

The probe initially collects data fine, but shuts off after a period of data collection

Check that the screen saver and any power saving modes on the computer are turned off.

Usually, the path to get to screen saver options is: My Computer > Control Panel > Display > Screen-saver (choose "none")

Usually, the path to get to the power options is: My Computer > Control Panel > Power Options

Never let the computer hibernate or shut down when probing.

Where can I get other styli if I don't want to have them machined myself?

www.mscdirect.com : search for styli, SPI brand.

My probe file stopped halfway through because of a power outage. What can I do?

In the event that the probing process was interrupted before completion, the resulting output file will be unreadable despite the "dxf" file extension.

Dxf files need closing information at the end and when the probing is interrupted, that information isn't written. If it's necessary to manually add it, open the file in a text editor - the built-in ShopBot editor works great – and scroll down to the end.

CAD programs may be pretty fussy so a single letter or number out of place can make the file unreadable. For this reason, **we highly recommend copying and pasting straight out of this document to avoid errors.**

Note that the only use of the letter "O" is in "EOF" below. All others are the digit zero (0).

If the .dxf points option was used in either 2D or 3D, add the following three lines after the last lines of the file:

ENDSEC

0

EOF

If the .dxf polyline option in 3D was used, add the following nine lines to the end of the file:

SEQEND

8 DEFAULT 5

0

0

ENDSEC 0

EOF

If the .dxf polyline option in 2D was used, add the following lines to the end of the file:

SEQEND

0

ENDSEC

0

EOF