

Kinematic Touch Probe Setup and Use



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1. Introduction

Thank you for your purchase of one of my touch probes. I hope you find it to be a helpful tool in your CNC toolbox.

1.1 Probe Features

- ¼" shank (useable in CNC routers using ¼" collet)
- Small overall size (body is 1" diameter, 1.25" tall)
- Comes with two interchangeable hardened/ground stainless probe tips (.045" and .073" diameters provided)
- Uses standard M3-.5 metric thread, so you can use standard CMM style probe tips if you like (CMM style probe with ruby tip not included)
- Adjustment screws so you can eliminate run out between shank and probe tip (this is important if you want to use the probe for accurate edge finding)
- Detachable cord, makes it easier to set the probe up for adjusting run out (chuck probe in spindle and rotate against a dial indicator to dial it in)
- Adjust probe trip force by exchanging springs (3 springs included)

2. Setup Your Probe

2.1 Wiring and setup

The touch probe is a simple 2 wire device that behaves like a simple normally closed (NC) switch. The probe is provided with an unterminated cable that you will have to connect to your controller, whether you solder on a connector, or wire it into a terminal on a breakout board is up to you.

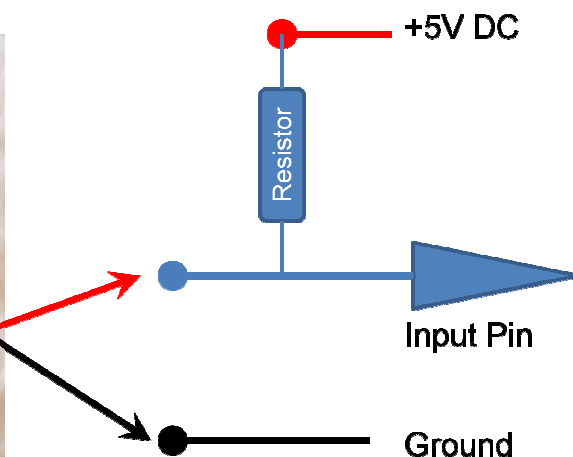
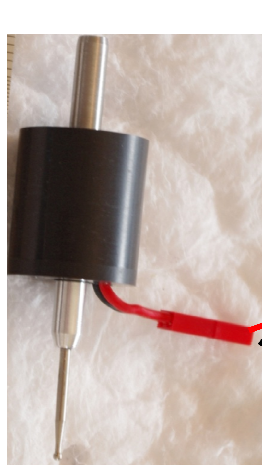
To electrically connect the probe to your machine controller, it is recommended you have a breakout board. Most breakout boards provide isolation/buffering to the computer, as well as have pull-up and pull-down resistors built in. The probe can be wired one of two ways:

2.1.1 Active-high and on an input pin with pull-up resistor

Select an open pin on your breakout board, and configure it with a pull up resistor (normally at 5v). (If not using a breakout board with built in pull-up/pull-down, use a resistor of $\sim 4.7\text{kohm}$ to a 5V source to pull up the pin.)

Attach one wire of the probe to this pin, and attach the other wire to a ground point (0v), polarity/wire colors to the probe does not matter.

When the probe is not active, the input pin will be pulled low to ground by the completed circuit to ground through the probe. When the probe is activated, the pin will pull 'high' due to the pull-up resistor. Verify by measuring with an ohm meter before proceeding to setting up the software.



•When probe inactive (not-touching), input voltage is low

•When probe active (touching), input voltage is high

•Verify setup with a multimeter before setting up controller software!

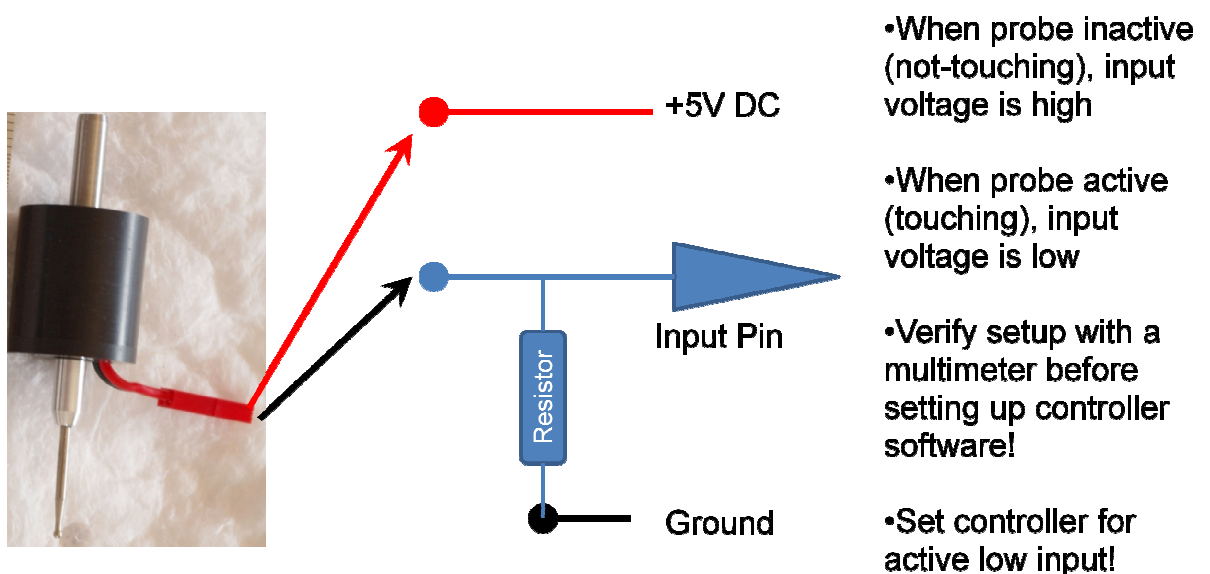
•Set controller for active high input!

2.1.2 Active-low and on an input pin with pull down resistor.

Select an open pin on your breakout board, and configure it with a pull down resistor (normally at 0v). (If not using a breakout board with built in pull-up/pull-down, use a resistor of ~4.7kohm to a 0V source to pull down the pin.)

Attach one wire of the probe to this pin, and attach the other wire to a +5v point, polarity to the probe/wire color does not matter.

When the probe is not active, the input pin will be pulled high to +5v by the completed circuit to ground through the probe. When the probe is activated, the pin will float 'low' due to the pull down resistor. Verify by measuring with an ohm meter before proceeding to setting up the software.

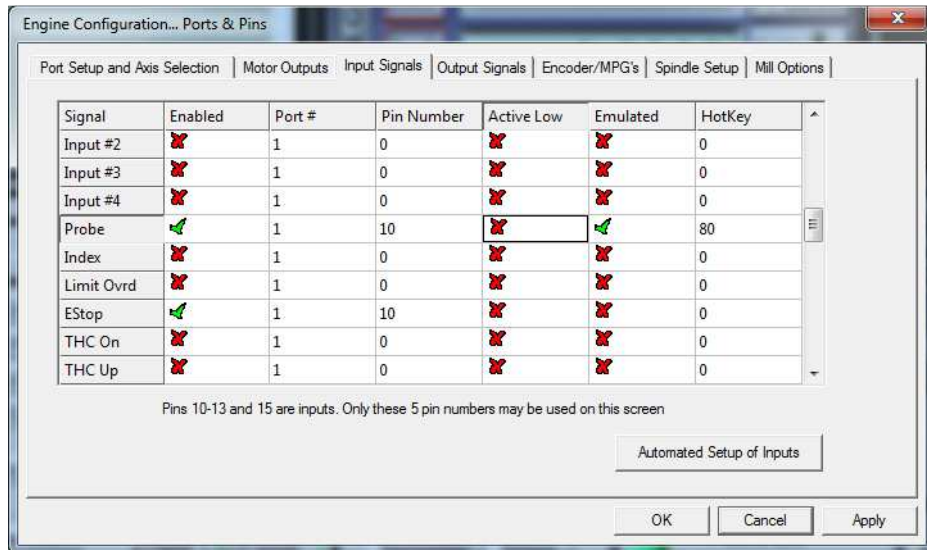


2.2 Controller – setup

The setup of your controller will be dependent upon how the probe was wired in section 2.1, and what controller software you are using. The following examples are given for a Mach3 installation. For other controllers, please reference the manual for your particular software.

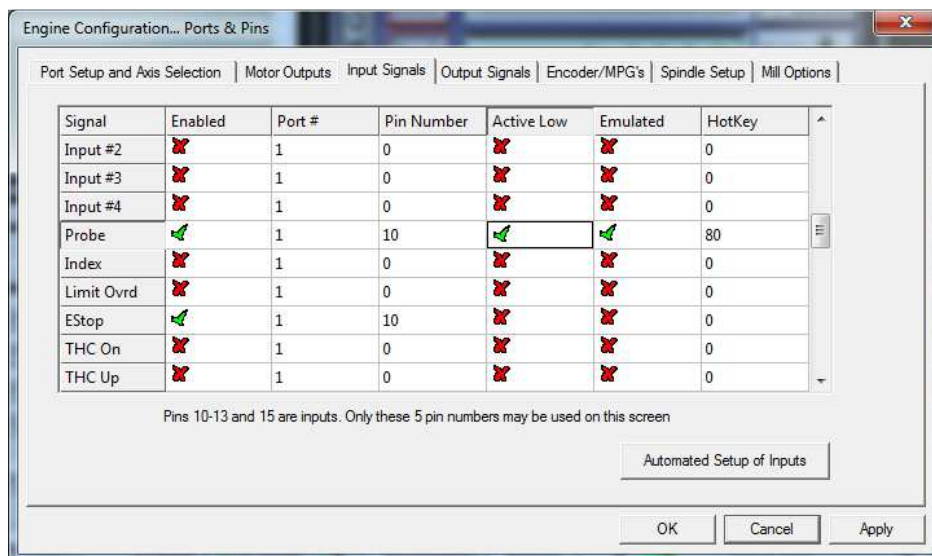
For an active high setup:

- Go to Config -> Ports&Pins -> Inputs Signals tab
- Find "probe" in the list, and assign the proper values for Port and Pin # that were physically wired to in section 2.1.
- Check 'enabled' and Leave 'Active Low' Unchecked



For an active low setup:

- Go to Config -> Ports&Pins -> Inputs Signals tab
- Find “probe” in the list, and assign the proper values for Port and Pin # that were physically wired to in section 2.1.
- Check ‘enabled’ and ‘Active Low’



2.3 Installing the tips

The probe is supplied with two tips, and will also accept industry standard tips threaded with an M3-.5 thread. Thread in your selected tip and lightly tighten while pulling the tip out of the body (this keeps the internal moving contact hub seated without lifting out of its electrical contacts). Do not over tighten! If you over tighten, it may result in the probe contact hub lifting out of its ball contacts.

If this happens, the internal hub rotates and slip outwards a bit. Just push back in lightly, and rotate counter clockwise till you feel the contacts reseat back into the ball contacts.

2.4 Adjusting the probe tip tension

Your probe is shipped with a 'heavy' spring, a 'medium' spring, and a 'light' spring. Depending on what you are trying to measure/touch, you may find that a lighter spring tension is necessary, such as for thin flexible parts or rubber or foam items. I recommend keeping the 'heavy' spring installed unless you are probing something requiring a very light touch for the following reasons:

- The probe cannot be adjusted for concentricity with the light spring installed, and may be difficult to adjust with the medium spring (as the tip will be deflected by the force of an indicator stylus on it). Reference section 2.5 below for adjustment process.
- You may find that the probe can be triggered by vibrations from just the table or spindle accelerations during axis travel with the lightest spring installed. If this occurs, you may have to reduce acceleration or velocity values while probing.
- There is a risk that the very light spring cannot always 'reset' the tip following a touch, especially if the tip is over-traveled on a touch or crashed. It may then be required to help reset the tip by gently flicking the stylus or pulling it outward from the body.

Long story short.... Use the lightest spring you need to do the job, as there are trade offs, and you will likely be forced to probe items slowly with the lightest spring installed.

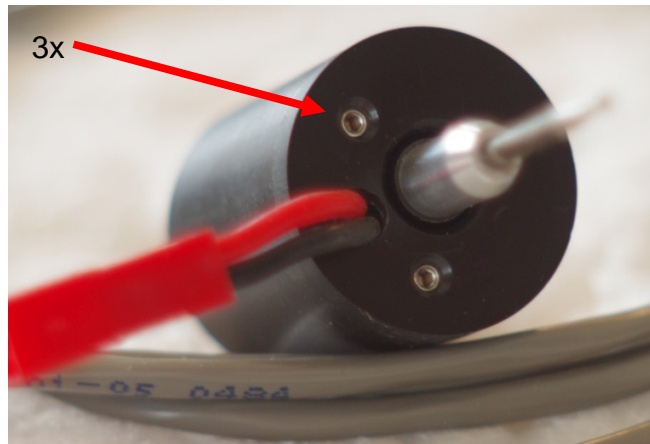
To change the spring, unscrew the lower 'cap' from the upper shank/body, while holding the probe in a vertical or upright position. Lift the shank/body upwards and you will have the spring available to replace. The probe tip and switch contacts will remain in the lower 'cap' unless you tip it over. Simply exchange the spring, ensure the probe hub pins (3X) are still engaged in the PC-board/balls, and reinstall the upper shank/body ensuring the spring pilots properly on both ends. Gently retighten the lower 'cap' to the upper shank/body.

2.5 Adjusting the probe tip concentricity

If you will just be using the probe to get 'point clouds' and copy items by basic scanning, adjustment of the probe is not required, collection of data points is all relative to individual touch points.

However, if you wish to use the probe for accurately locating edges, centers, measuring bores, etc for setup to machining, the probe tip must be adjusted to be on center with the shank. Otherwise, finding the center of a bore won't

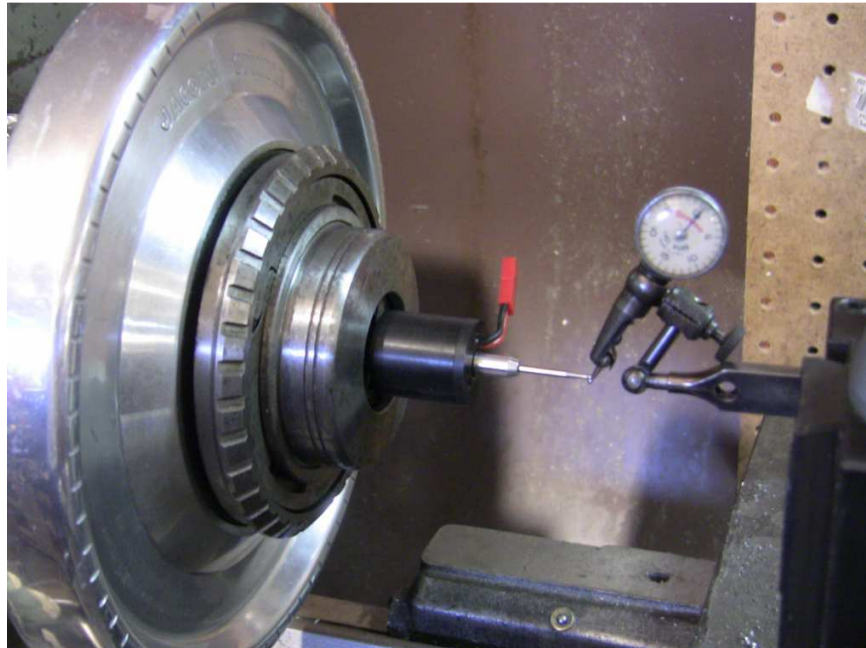
necessarily position the center of your spindle in the right location. This is accomplished via the 3 socket screws located around the bottom of the probe.



To align the tip, you will need to install the probe into the spindle of a mill or lathe, and measure the run out using a dial test indicator. Unless you have an extremely light indicator, you will also likely have to install the 'heavy' spring to do the tip adjusting, and then install the 'lighter' or 'medium' springs following adjustment (reference section 2.4). As long as the orientation of the probe hub on the PC board is not disturbed during spring replacement with the lighter spring, the tip adjustment should not be affected. This can be rechecked visually by spinning the probe next to the indicator tip.

The indicator can be clamped down or used on a mag-base and setup as convenient. Disconnect the lead wire at the probe to make the process easier and prevent tangled wire. As you revolve the probe about its axis, adjust the screws a very small amount at a time to remove any measured run out. As the tip comes close to being on center, it will take fractions of a rotation of the adjustment screws to remove a few tenths of run out. Deflect the probe and release, and re-check the run out and readjust if necessary. **(Please go to YouTube and search for 'eabrust' for a video on the process).**

Your probe has been initially adjusted before shipment to you, but should be readjusted when received and anytime a new tip is installed, as most of the runout correction is for the tips themselves.



Do not screw the top of the socket head screws deeper than $\sim .050$ inches from the surfaces of the cap. If you need to back adjustment screws out, you may need to gently pull on the probe tip outwards to re-seat the internal components back onto the adjustment screws, as the internal spring is light.

3. Using Your Probe

3.1 Using the Touch Probe with Mach3

There are numerous existing 'wizards' or 'screensets' for Mach3 for basic touch probe usage. I am currently working on my own probing wizard software, but it is not currently ready for general usage.

Please be aware that Mach3 handles a probe input, but does very little with it out of the box without user written MACROS to provide the functionality. Probing is accomplished with a G31 command. If you are currently at position $x=0, y=0$ and you issue a command "G31 X1.0 F2.0", the spindle will move towards $X=1$ until it either:

- 1) Makes contact, stops moving, and records the touched position into internal variables 2000 (x location, at center of tip), 2001 (y location, at center of tip), and 2002 (z location of tip). Macro code is then used to adjust the recorded location by ball diameter, etc.
- 2) Reaches $x=1$ without contacting anything. However Mach3 still sets the internal variables as if it touched, and records the location into the variables. Well written

code will be able to determine if the probe traveled the full distance and indicate if there was or was not a real touch.

I recommend the following as good options that provide probing functionality (a Google search will get you there):

- MachStdMill Professional (Calypso Ventures)
- 2010 screenset
- The 'bed of nails' probing wizard included with Mach3

Before doing any actual probing in Mach3 (every time you install the probe in the spindle!), I recommend that you test the touch-triggering by viewing a signal LED in Mach3 tied to the probe input and verifying that it activates. If the control software doesn't see the probe trigger event, the probe will crash and likely break the tip off of the probe. The following picture is an example of how I setup my Mach3 probe wizard screen to give a large visual indicator.



I would also recommend that as you learn how to probe with the software you are using, that you start by test probing into loosely clamped items or your finger to ensure it behaves as you think it will.

3.2 Using the Touch Probe with other controllers

Please reference the user manuals available for the control software you use. LinuxCNC can handle probing, and there are some basic routines available on the internet. LinuxCNC performs probing operations using codes G38.2, G38.3, G38.4, and G38.5.

Example codes for LinuxCNC probing: <http://timeguy.com/cradek/01262579508>

3.3 Caring after your touch probe

Other than adjusting the probe tip for run out/concentricity to the shank, there is nothing else that is required. The tip should be aligned anytime you change to a different tip, or if you have an accidental 'over-travel' or 'crash' during probing. The internal contacts are of non-corrosive high conductivity materials and should provide years of service without needing cleaning.

The probe tip should not be forced beyond its range of travel. The tip will provide a small amount of over-travel in all directions, but the use of appropriate federates and accel rates should be used when probing to prevent the tip from over-traveling (ie, be sure the spindle stops traveling promptly when a touch is registered)

Please take care to route the cord so that it doesn't get dragged around or hung up while in use. This is especially important on gantry style routers where the spindle is traveling around the table, and may use up all the slack in your cable running from the probe to the controller. The connector provided in the coord is not meant to be a safety breakaway, but rather only there for convenience in adjusting the probe tip. Pulling directly on the cord may result in the wires pulling out of the connectors. Please pull connectors apart by pulling only on the red connector halves.

Crashes happen! Spare parts will be able to be purchased if you should happen to damage your probe, just email me! (eabrust@sbcglobal.net).



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