CENTROID™

KP-3
CNC Touch Probe

Centroid KP-3 CNC Touch Probe

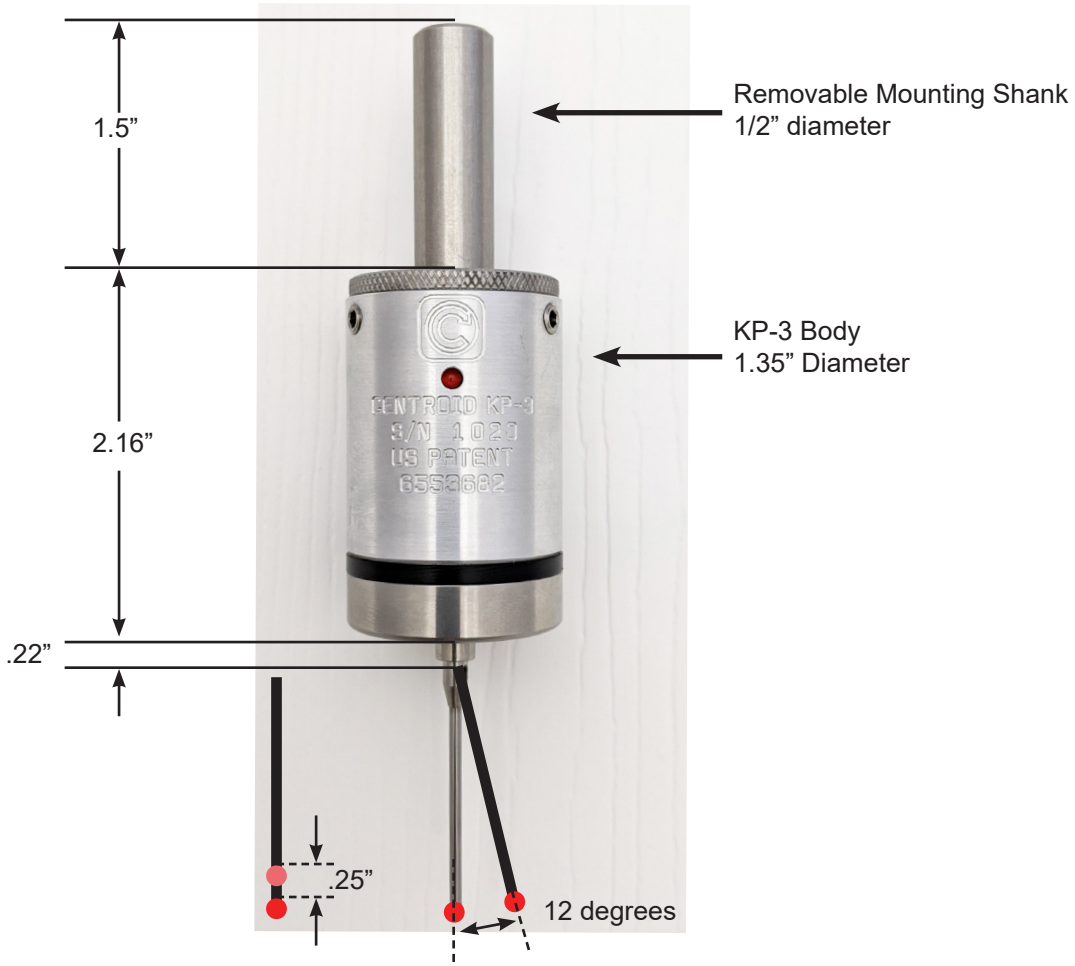
CNC Software version: CNC12 V.4.5+
Models: Acorn/AcornSix/Allin1DC/Oak/Hickory CNC

KP-3 Description

The KP-3 is a CNC Touch Probe intended for probing to find part zero's, reference positions, locate bores, bases, corners etc., and digitizing which allows for the copying of surfaces and shaped objects. The user should first become familiar with the various parts and features of the probe as shown below to facilitate assembly, installation, operation and calibration. Read the stylus installation and alignment procedures section before attempting assembly. Review the over-travel limits shown in the specifications. Exceeding the limits will damage the probe and stylus.

KP-3 Specifications

- Probing directions X+/-, Y+/-, Z-
- Unidirectional repeatability (2 sigma) 0.00006" (1.5 micron)
- Practical use on good milling machine .0005"
- Probe deflection force (X,Y) 3 ounce minimum with 40mm stylus
- Probe deflection force (Z) 15 ounce minimum
- Probe body diameter and length D= 1.35" (34.3mm) L= 2.16" (54.9mm)
- Mounting shank diameter and length D= 0.5" (12.7mm) L= 1.47" (37.3mm)
- Stylus mount thread M3 thread
- Power supply required none
- LED status indicator red when triggered (powered by input 1ma)
- Weight of probe and ½"shank 0.40 lb
- Over travel limit angle (X,Y) +/- 12 degrees from vertical
- Over travel limit (Z-) 0.25" (6.25mm)
- Environmental IP64
- Patented concentric alignment (spindle/tool holder/probe body run out adjustment)



KP-3 Acorn Kit Components

KP-3 Acorn kit part# 14947

- KP-3 probe
- 2.5 mm x 40mm carbide stem, ruby tipped stylus
- Stylus wrench
- KP-3 to Acorn hookup cable
- KP-3 to Acorn schematic download

Mounting: The standard 1/2” mounting shank design allows installation in commonly available tool holders. Other mounting options can be created by the user and installed on the KP-3 by loosening the run-out adjustment screws and removing the stock 1/2” mounting shank from the body of the probe.

KP-3 Identification

Mounting Shank

Concentricity adjustment screws. 3/32” hex

RED LED indicator light
Off = ready
ON = Probe Tripped

Serial Number

End Cap

Stylus mount boss

2.5 mm carbide stem ruby
tipped stylus

Concentricity adjustment screws. 3/32” hex

Electrical connector

Manufacturing Bar Code

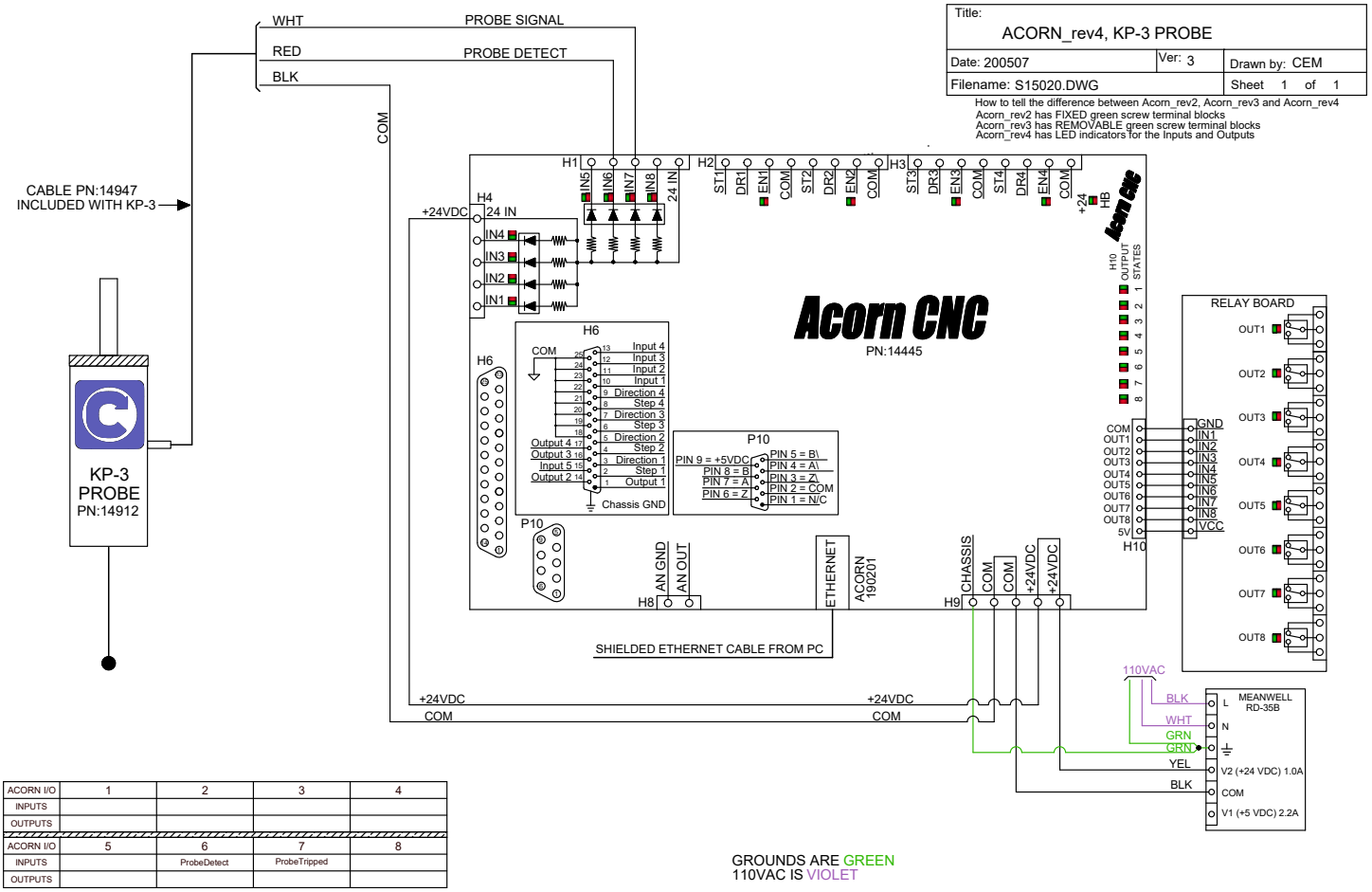
Probe Body

Stylus tighten hole

Stylus stem

Stylus tip

KP-3 Wiring to Acorn



ACORN I/O	1	2	3	4
INPUTS				
OUTPUTS				
ACORN I/O	5	6	7	8
INPUTS		ProbeDetect	ProbeTripped	
OUTPUTS				

Download full size PDF's of all Acorn schematics including this KP-3 to Acorn hookup schematic on the Acorn web page https://www.centroidcnc.com/centroid_diy/acorn_cnc_controller.html

Often it is necessary to extend the KP-3 cable. Typically this can be accomplished several ways

1.) Simply extend the flying lead wires by soldering and heat shrinking on additional length of similar wire.

2.) Run the flying lead wires to a terminal strip and use another piece of cable to run from the terminal strip to the Acorn.

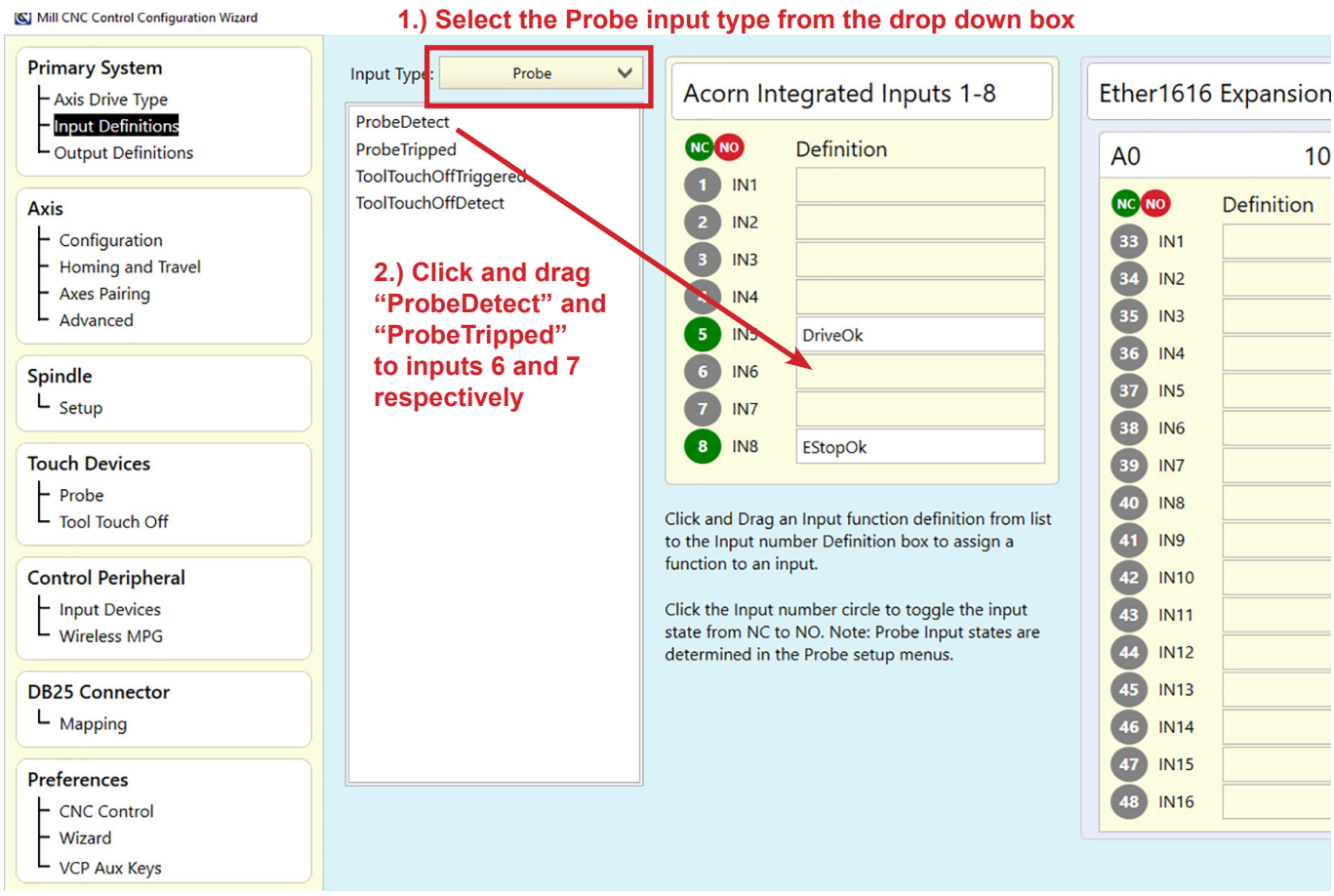
KP-3 Probe cable connector

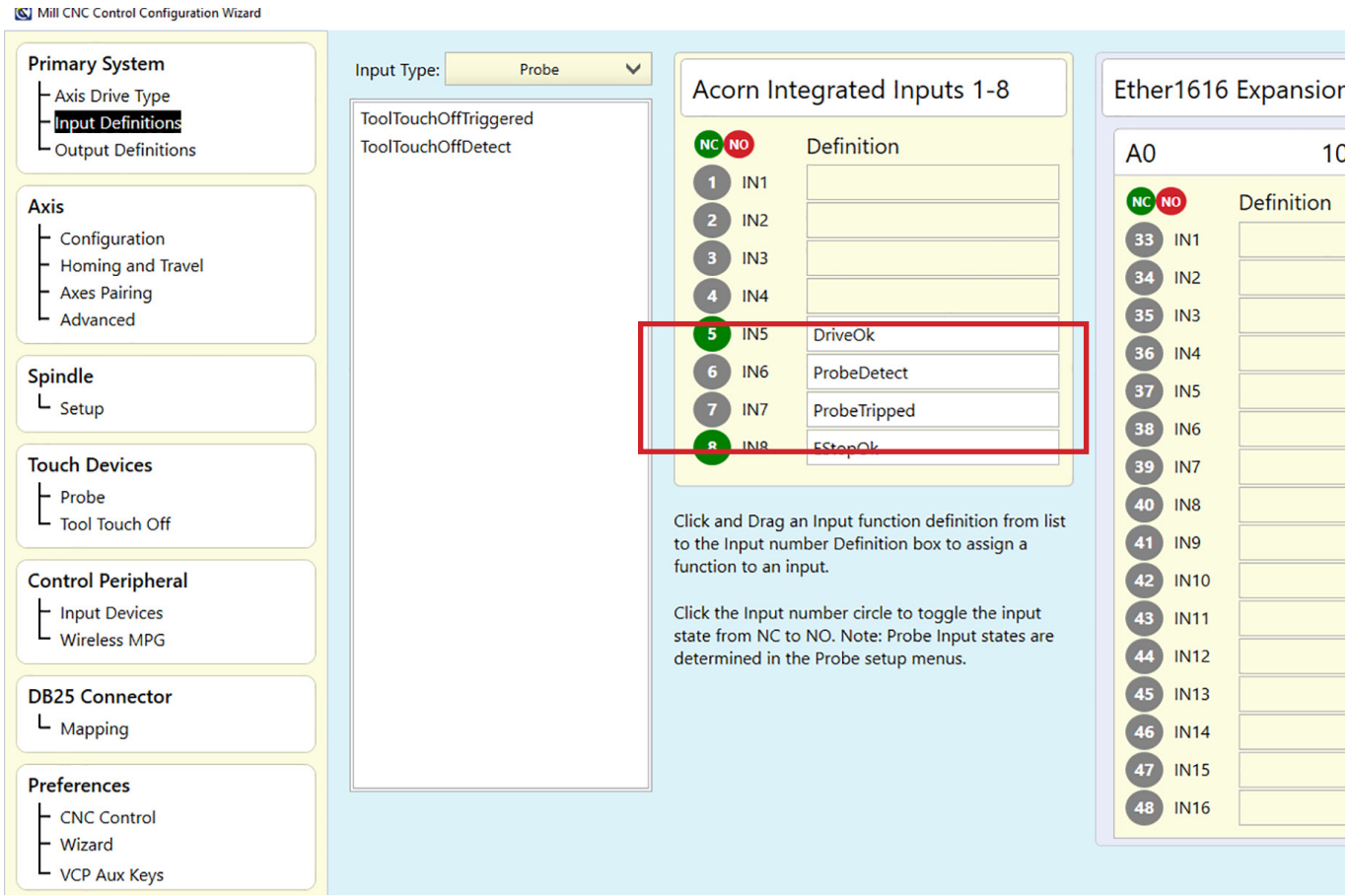
Connect the 1/8” mini jack connector into the KP-3 body and fully seat the plug!

Correct! probe cable connector is fully seated.

Incorrect, probe cable connector is not fully seated.

KP-3 Acorn Wizard configuration



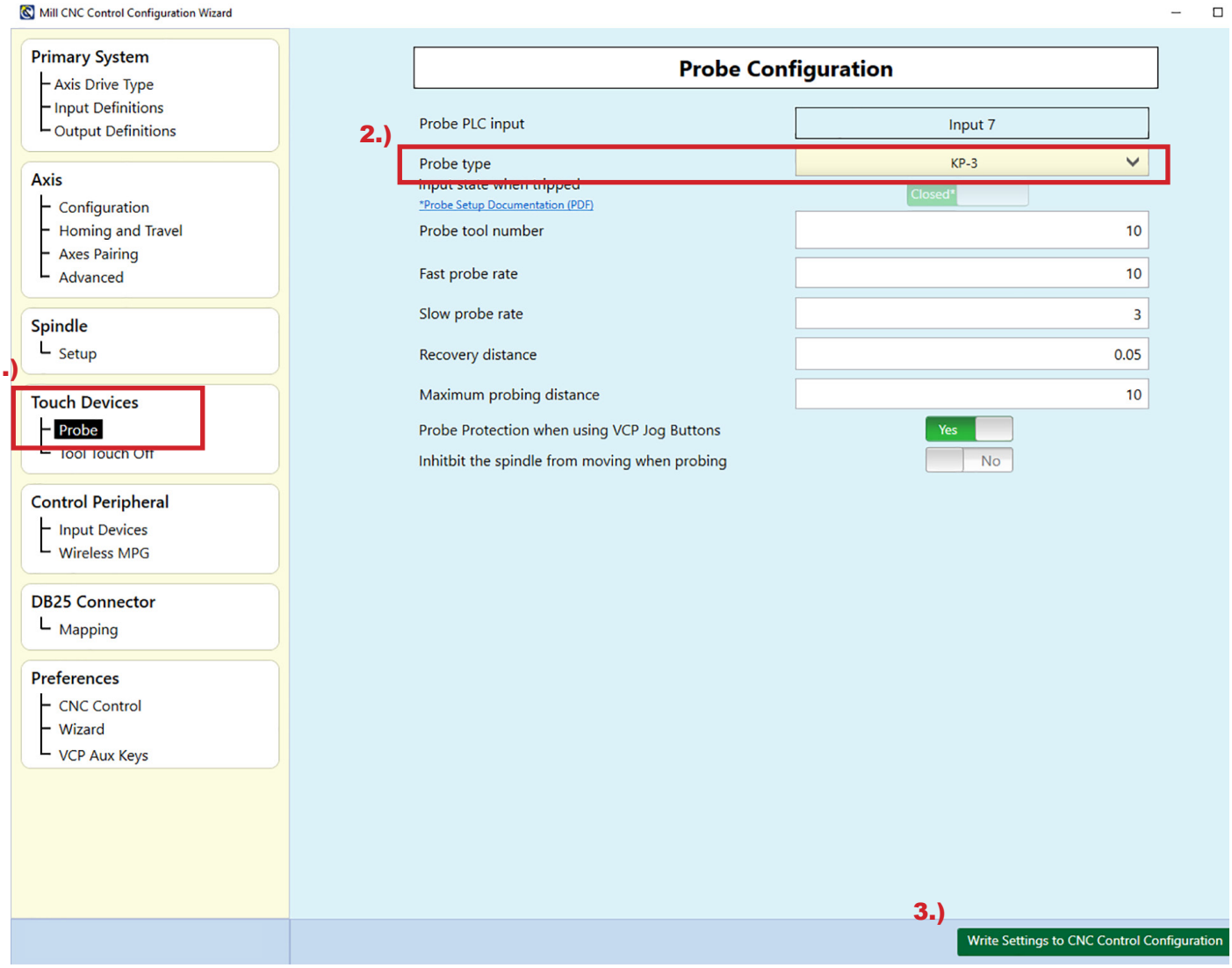


KP-3 Acorn Wizard configuration

1.) Select the Probe menu under “Touch Devices”

2.) Choose “KP-3” in the Probe Type Drop down menu.

3.) Press Write Settings to CNC control and follow the instructions on the screen.

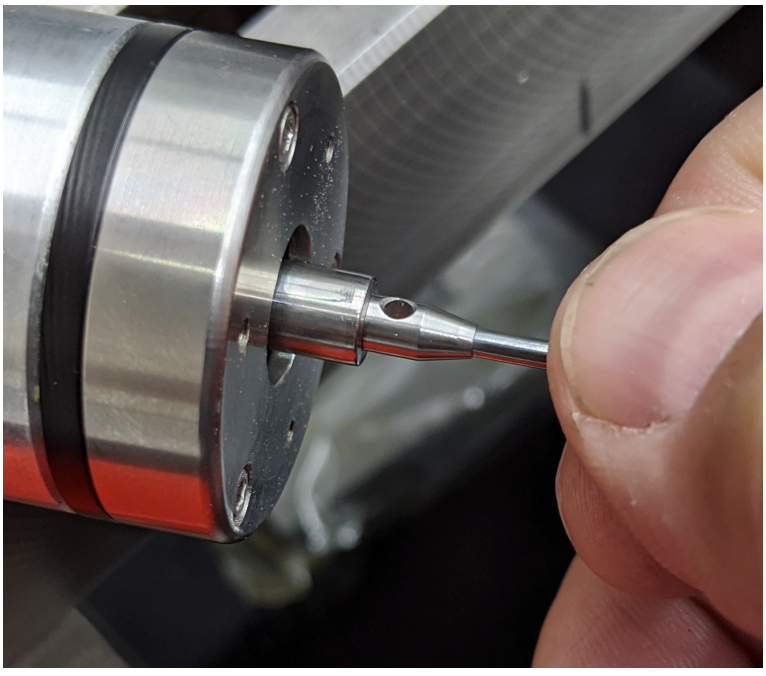


KP-3 Stylus installation

See the KP-3 Unboxing video for a demonstration on how to install the stylus in the KP-3
https://youtu.be/HbOMSKYuy6g

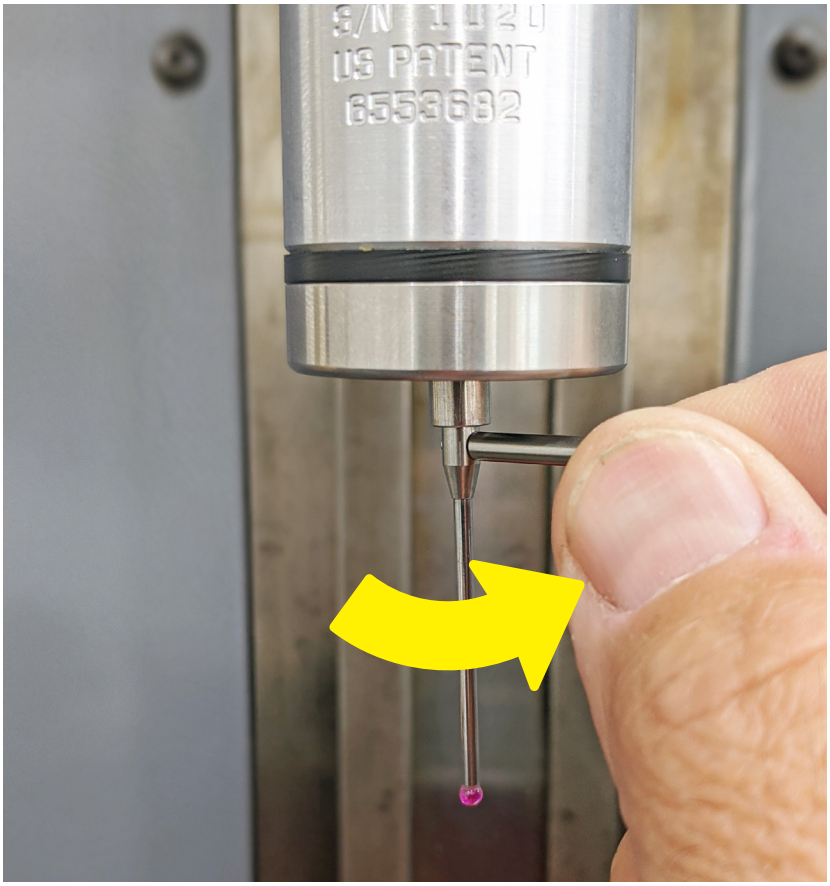
Step 1: Inspect the threads and mating surfaces of the stylus and stylus mount boss. They must be clean and free of defects. The stylus mount boss is M3 thread. Only use M3 thread styli.

STEP 2: Thread the stylus into the probe stylus mount boss using fingers only. The shoulder of the stylus threads should meet the face of the stylus mount boss with minimal twisting effort. If there is a gap between the shoulder of the stylus threads and the boss face that can not be closed using just fingers to turn the stylus then remove the stylus and clean and check threads. Be sure stylus is M3 thread! If gap still can not be closed try another stylus. DO NOT FORCE THE THREADS! This step must be completed successfully before proceeding!



KP-3 Stylus installation

STEP 3: Finish tightening the stylus by inserting the stylus wrench in the stylus wrench hole and slowly tighten. Snug the stylus until the probe begins to deflect and when you feel a mild but firm stop has been reached stop applying torque, the stylus is now completely tight. Applying too much torque can damage the probe or stylus.



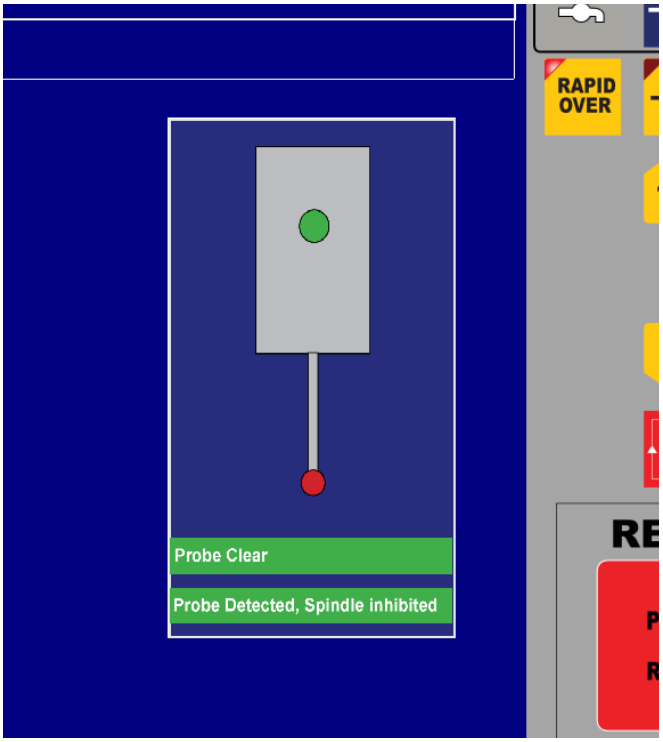
Stylus Removal: If the stylus must be removed insert a pin in the stylus wrench hole and slowly loosen. The stylus mount boss will turn with the stylus and begin to retract into the probe then firmly stop. When the firm stop has been reached apply a small amount of additional torque to break the threads free. If excessive torque is required grasp the stylus mount boss with smooth jaw pliers to prevent damage to the probe. If the stylus was installed correctly it will not require excessive force to remove it.

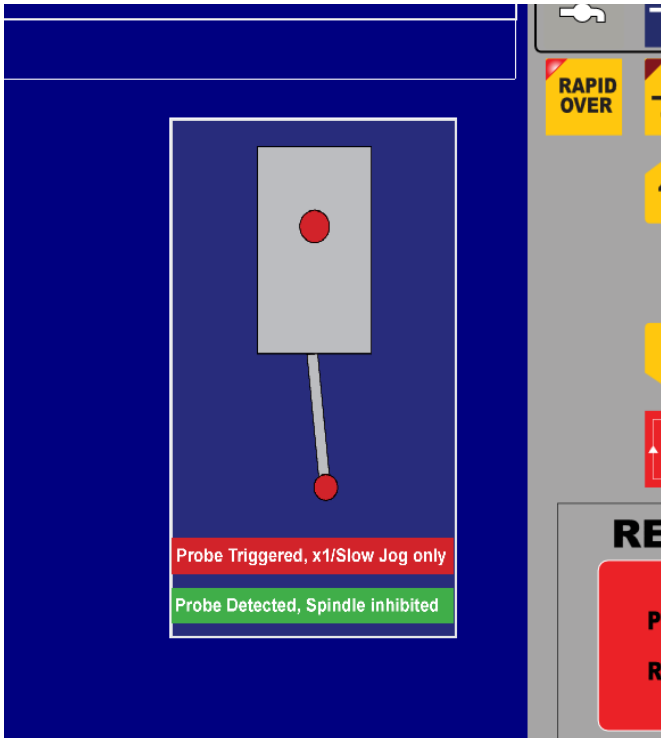
Testing the KP-3

“Bench test” the KP-3, you can have the probe on the bench or in the spindle whatever is safest.

1.) Enter into the CNC12 Probing Cycle menu, F1 Setup, F1 Part, F5 Probe, pick F1 Bore probing cycle.
2.) With the KP-3 plugged in (make sure Plug is FULLY seated!), manually trigger the probe by gently touching the stylus to trigger the probe observe the Probe state indicator graphic on the screen. If the probe is configured and wired properly the Probe tripped graphic on the screen will indicate that the probe has been tripped.

Gently trigger with finger while running a probing cycle in air to test probe before using the Touch Probe





Test before every use!

Even after the initial setup and operational verification it is always good practice to get in the habit of manually checking the probe to confirm that it is functioning every time BEFORE running a probing cycle to prevent a Probe crash. This quick test is easy and will save you heart ache by verifying that the probe is plugged in and functioning before running an automatic probing cycle.

To manually test a Touch Probe using a Automatic probing cycle.
1.) With the KP-3 plugged in (make sure Plug is FULLY seated!) and in the machine tool. Turn down the Feed Rate Override to 10 or 20%.

2.) Position the Touch Probe in the center of the X Y travel of the machine tool.

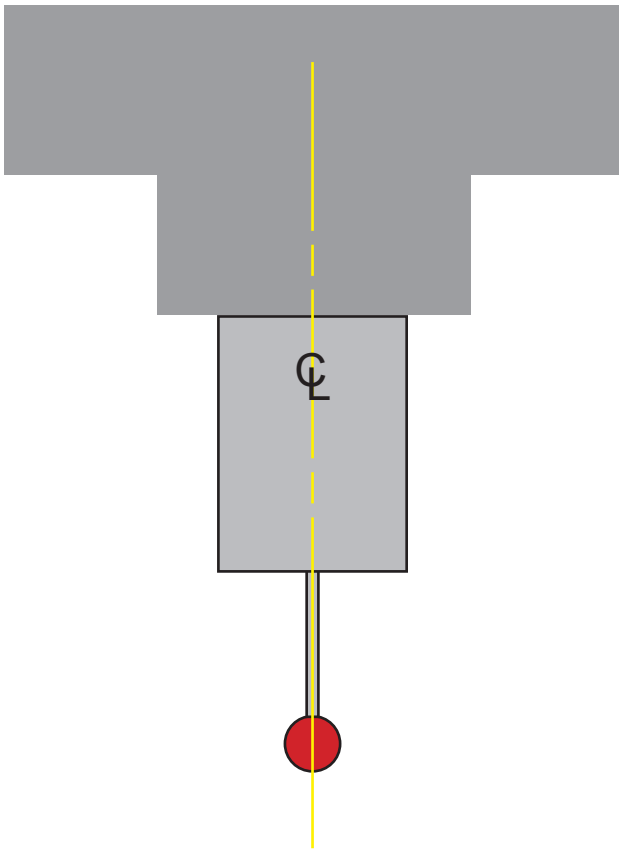
3.) With the Touch Probe in clear space start the Center of Bore probing cycle, the probe will begin to move to seek out the edges of the bore at the quadrants, at this slow speed you'll have plenty of time to trip the probe with your fingers to verify that it is working. No need to complete the probing cycle, cancel at anytime once the probe functionality has been verified.

Touch Probe Alignment

Now that you know the probe works and is triggering properly along with a probing cycle we need to make sure the probe stylus tip is concentric with the spindle and then the probe will be ready to use!

Probe Alignment: Center the Ball of the stylus so that it is concentric with the spindle

Using an indicator and the three run out adjustment screws on the body of the probe we will adjust the concentricity of stylus ball to be concentric with the spindle. This adjustment will place the center of the stylus ball in center of the spindle axis (stylus tip run-out)



Touch Probe Concentricity

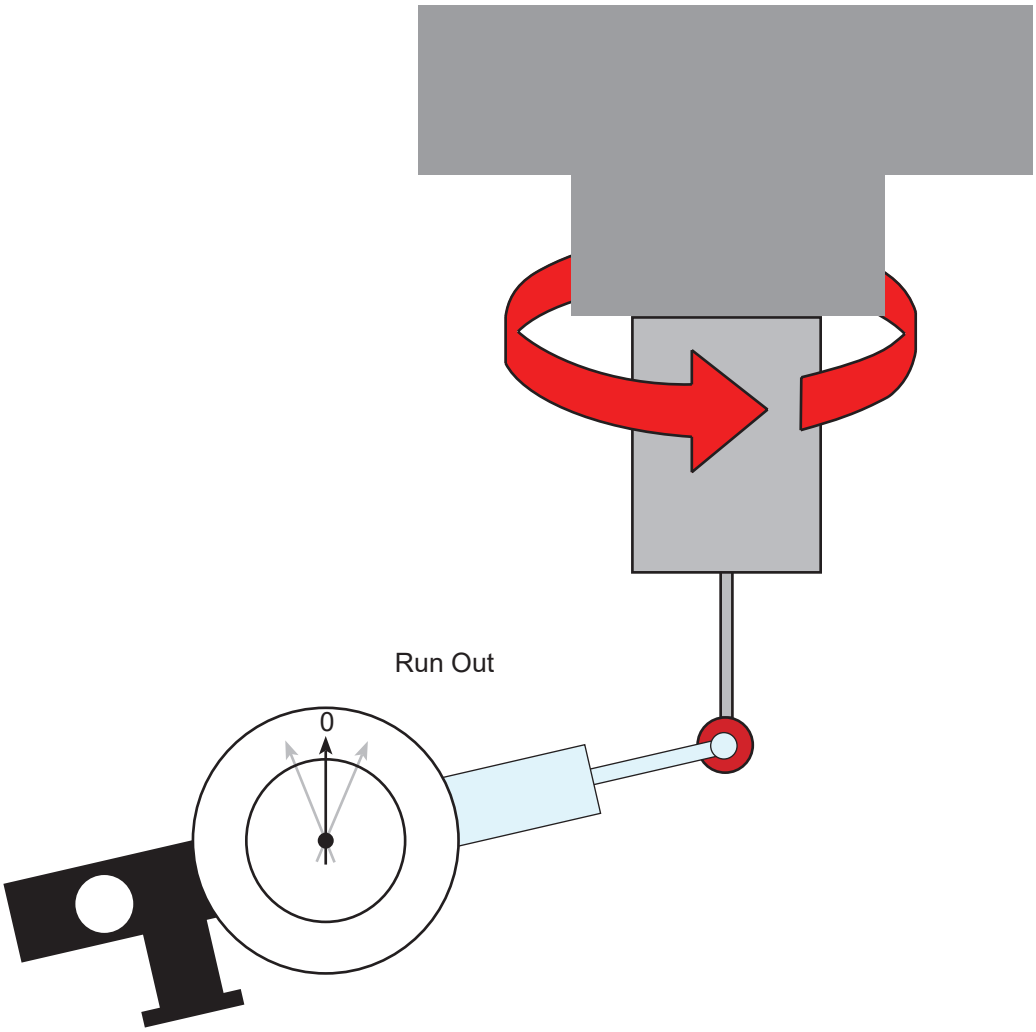
Probe “run-out” is the amount the probe tip moves an indicator as the spindle is rotated. Run-out adjustment is necessary to ensure that the center of the probe tip is aligned with the center of the spindle rotation axis. This eliminates any undesired off-sets between the probe and the cutting tool centers when digitizing or doing automated part set-up.

When to Check Probe Run Out:
Any time the probe is removed from its holder, the stylus is changed or the probe is used in a different machine, the alignment procedure should be repeated to ensure accuracy. The user should also repeat the alignment procedure if the unit is dropped or receives any sudden external shock. It is good practice to periodically check alignment for quality control and to establish a base line maintenance schedule.

Pr**obe to Spindle alignment adjustment**
The run-out adjustment procedure is necessary to ensure that the center of the probe tip is aligned with the center of the spindle rotation axis. This eliminates any undesired off-sets between the probe and the cutting tool centers when digitizing or doing automated part set-up.

Required Tools:

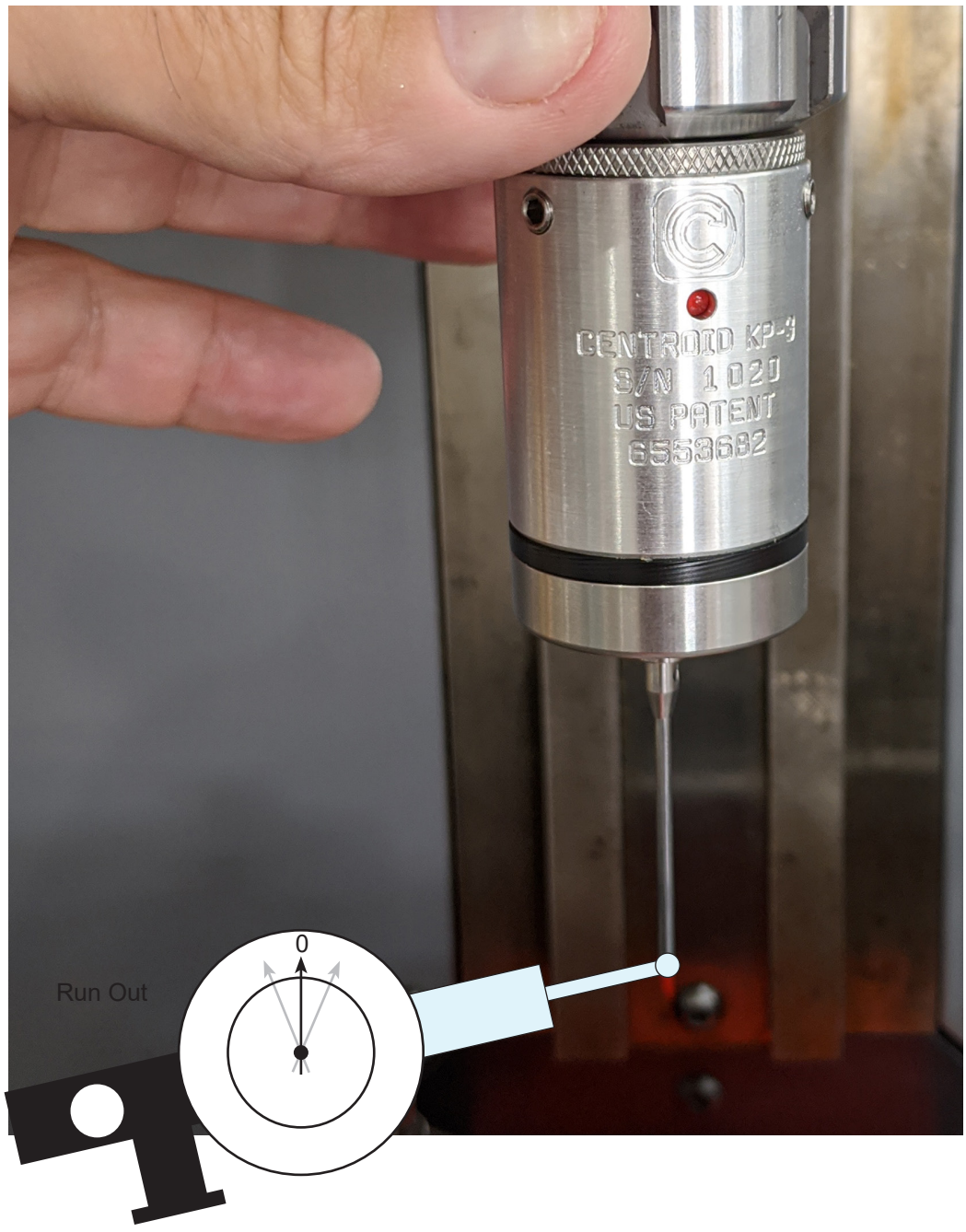
3/32” hex wrench
0.001” or better Test Indicator with Magnetic Base
0.500” Dedicated Tool Holder



Touch Probe Concentricity alignment

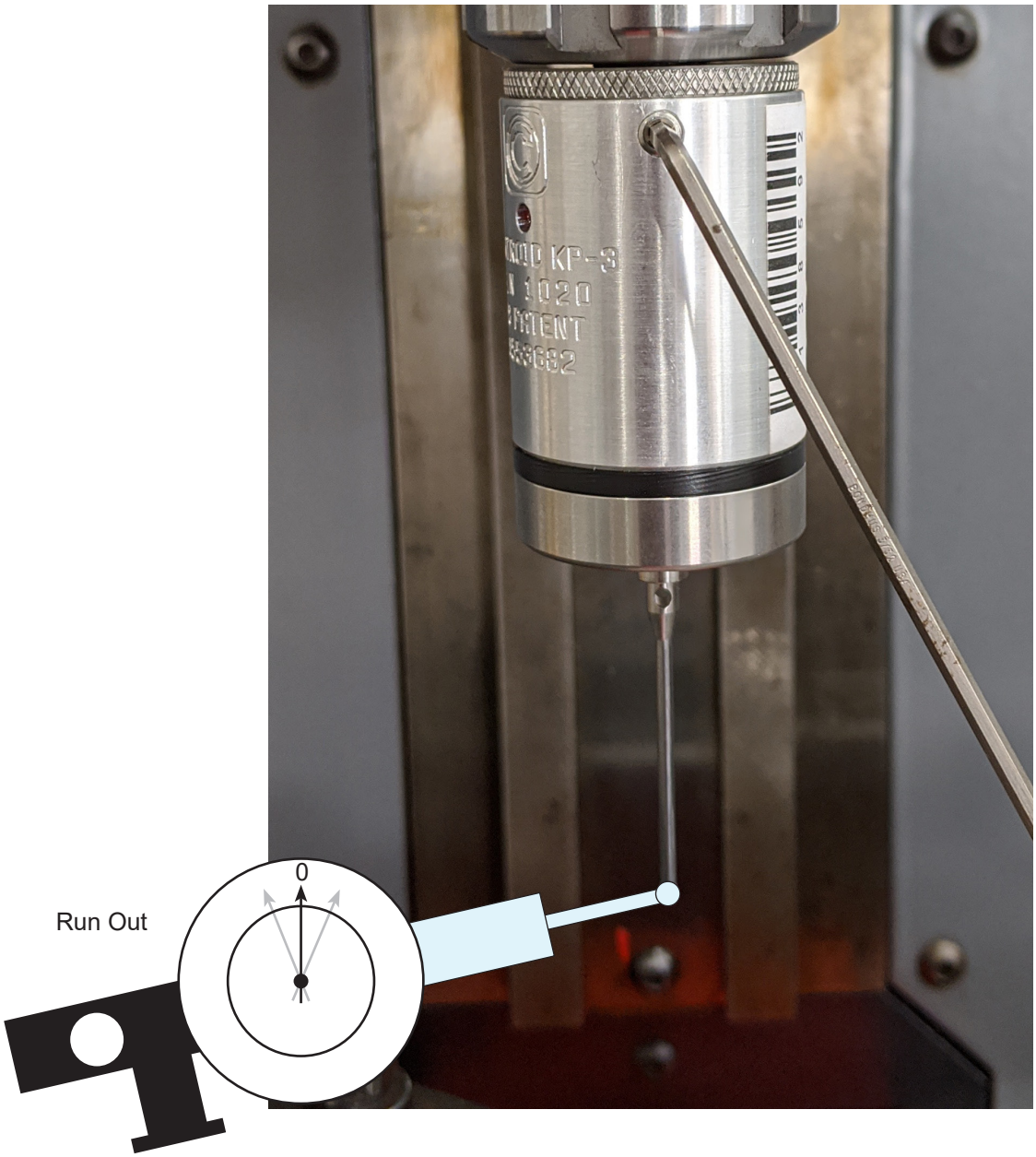
STEP 1: Install the KP-3 Probe into the dedicated 0.500” tool holder in the machine spindle.

STEP 2: Position the dial indicator, as shown in the photo below, with the finger of the dial indicator on the front and center of the stylus ball. Insert the 3/32” hex wrench in the run-out adjustment set screw directly above the finger of the dial indicator. Loosen the set screw by turning the hex wrench counter clockwise while watching the dial indicator reading decrease. Turn the hex wrench clockwise and watch the dial indicator reading increase.



STEP 3: Rotate the spindle by hand (without touching the probe) so that the probe spins through a full 360 degrees and watch the dial indicator to locate the high and low run-out rotation positions of the stylus. Adjust the dial indicator so that the entire run-out of the tip can be seen on the dial. If the run-out exceeds the range of the dial then begin at the highest point of the run-out and set the dial indicator so it is at the limit of its range at this point.

STEP 4: Rotate the probe so that the nearest run-out adjustment set screw is above the finger tip of the indicator. Using the 3/32” hex wrench slowly turn the setscrew directly above the indicator finger, in the counter clock-wise direction, the dial indicator will show the reduction in the run-out. Stop loosening this set screw and tighten the set screw that was nearest the low run-out position. Do not allow the probe to become loose on the mounting shank by adjusting in small increments. Adjust in increments that are about one third of the remaining run-out.



STEP 5: Repeat steps 4 until no run-out of the tip is visible on the dial indicator needle. If a set screws become too tight before you have finished the adjustment, do not force them, instead loosen the setscrew that corresponds with the highest reading on the dial indicator, and tighten the set screw at the lowest reading. Only adjust a set screw when it is directly above the indicator finger. This way you can see the full effect of the adjustment you are making. The final small adjustment is best made by loosening a set screw at the high point of run-out.

Turning the set screw Clockwise moves the screw in,

Causing the probe body to move out.

Turning the set screw Counter Clockwise moves the screw out,

causing the probe body to move in.

Touch Probe “Pre-Travel” stylus diameter calibration procedure.

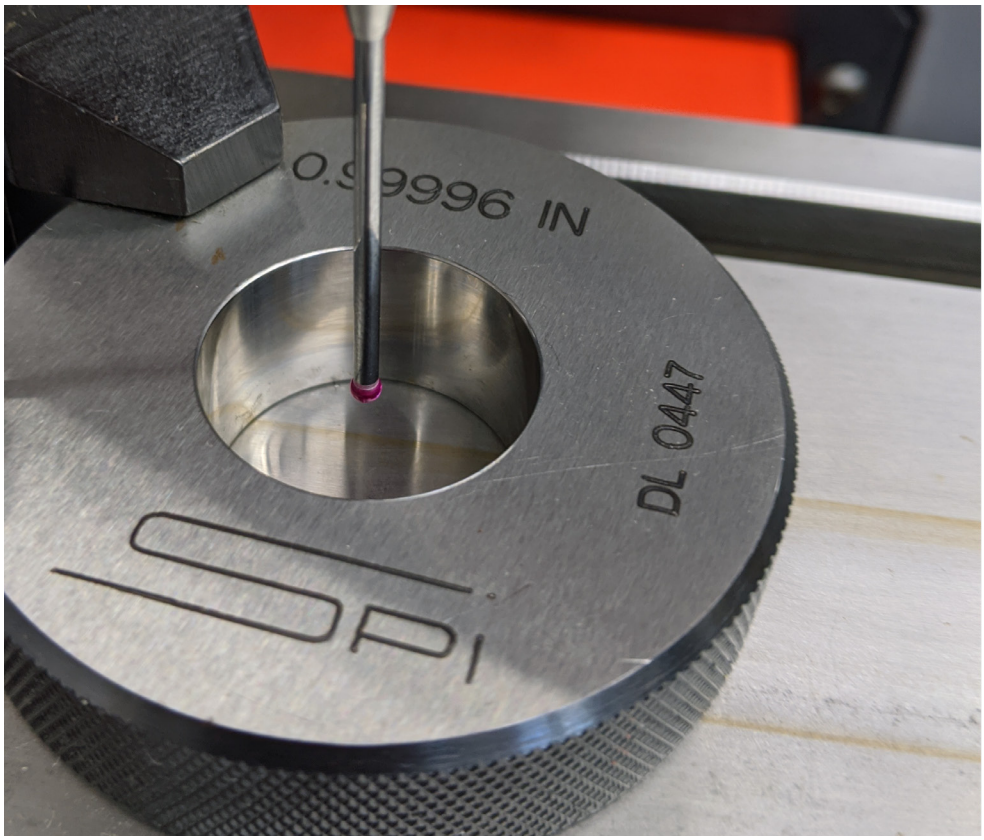
Calibrate the probe stylus diameter for the tool library. Just entering the value of the probe tip diameter in the tool library will not produce accurate results unless they are corrected for stylus pre-travel.
Pre-travel is the amount of deflection of the stylus tip before the probe detects the surface. This value varies depending on the length of the stylus and the speed and direction that the stylus tip is moving when it makes contact with the surface being probed or digitized. Pre-travel variation amount should be stated in probe specifications relative to stylus length and direction of travel limitations. A probe that has small pre-travel variation with no restriction on stylus length and direction of travel will be quite expensive. Machine characteristics including lash and input latency also contribute to the need to calibrate the stylus diameter. Each stylus has its own

Stylus diameter calibration procedure.

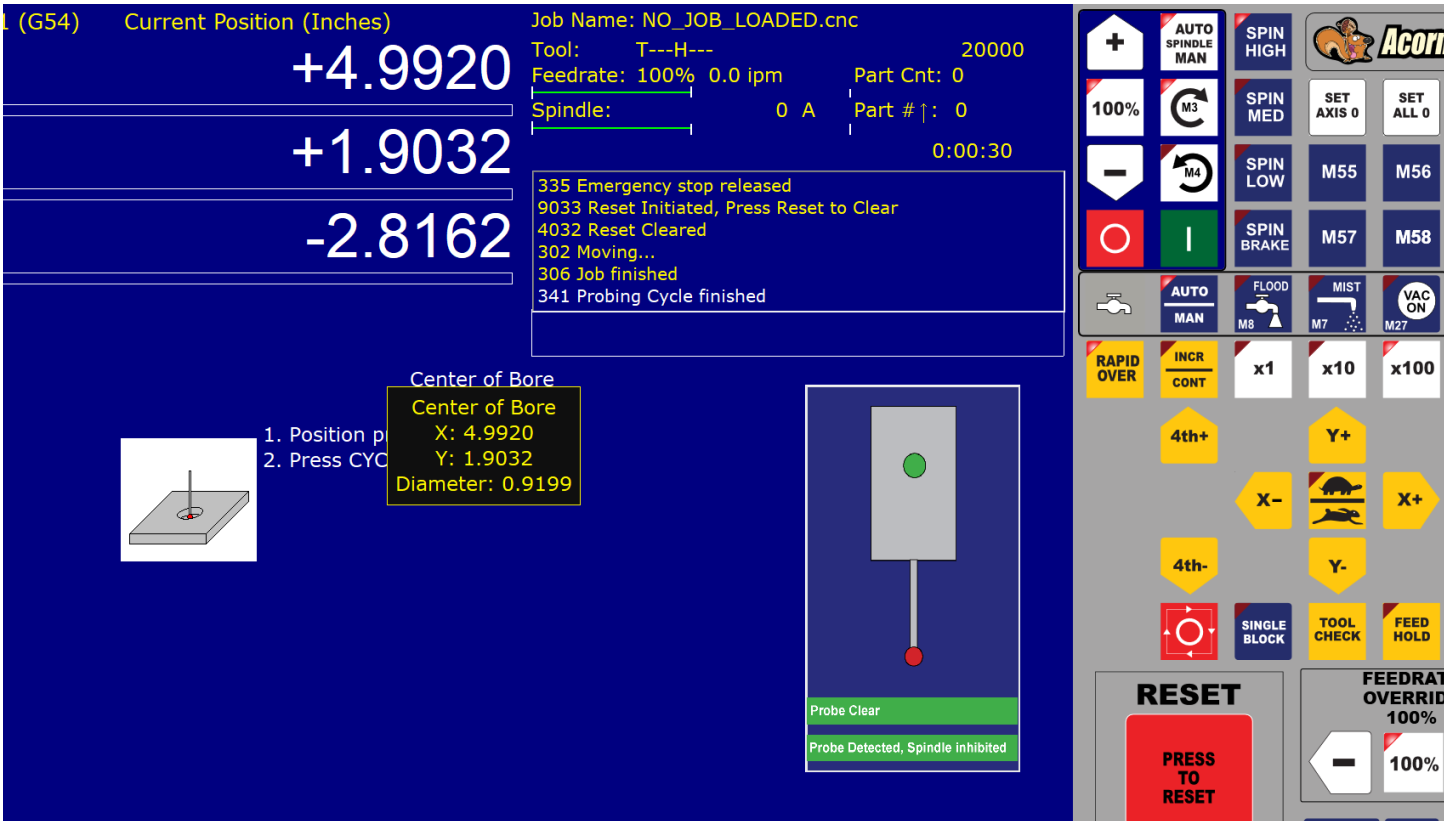
1.) Fixture a precision ring gauge on the machine tool. The ring must lie flat on the work table/vise with the center line of the bore aligned with the center line of the probe stylus/spindle. Make sure the probe is plugged in and working and test before use! Go to the Tool Library Offset menu and set the diameter for the Probe Tool Number to 0.0000 in our case Tool 10 is the Probe Tool number so we set Diameter 10 to 0.0000

2.) Jog the probe over the center (roughly) of the ring gauge, and then slowly jog the Z-axis down until the tip of the probe is inside the bore and not touching anything.

3.) From the main screen of CNC12, press <F1-Setup>, then <F1-part>, then <F5-Probing>, then <F1-Bore>,and finally <Cycle Start>. The control will jog the stylus to and probe each quadrant of the bore. It will then return to the center of the bore. The message box will appear on the screen displaying the measured bore diameter.



A message box will appear on the screen that will display the measured diameter of the bore.

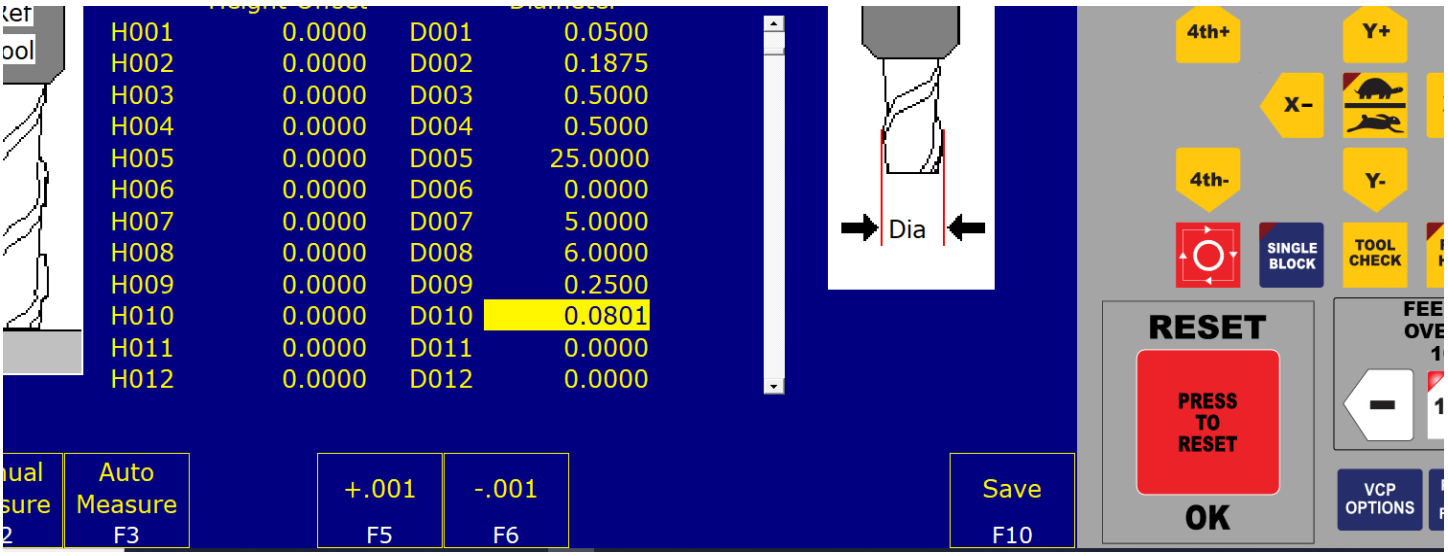


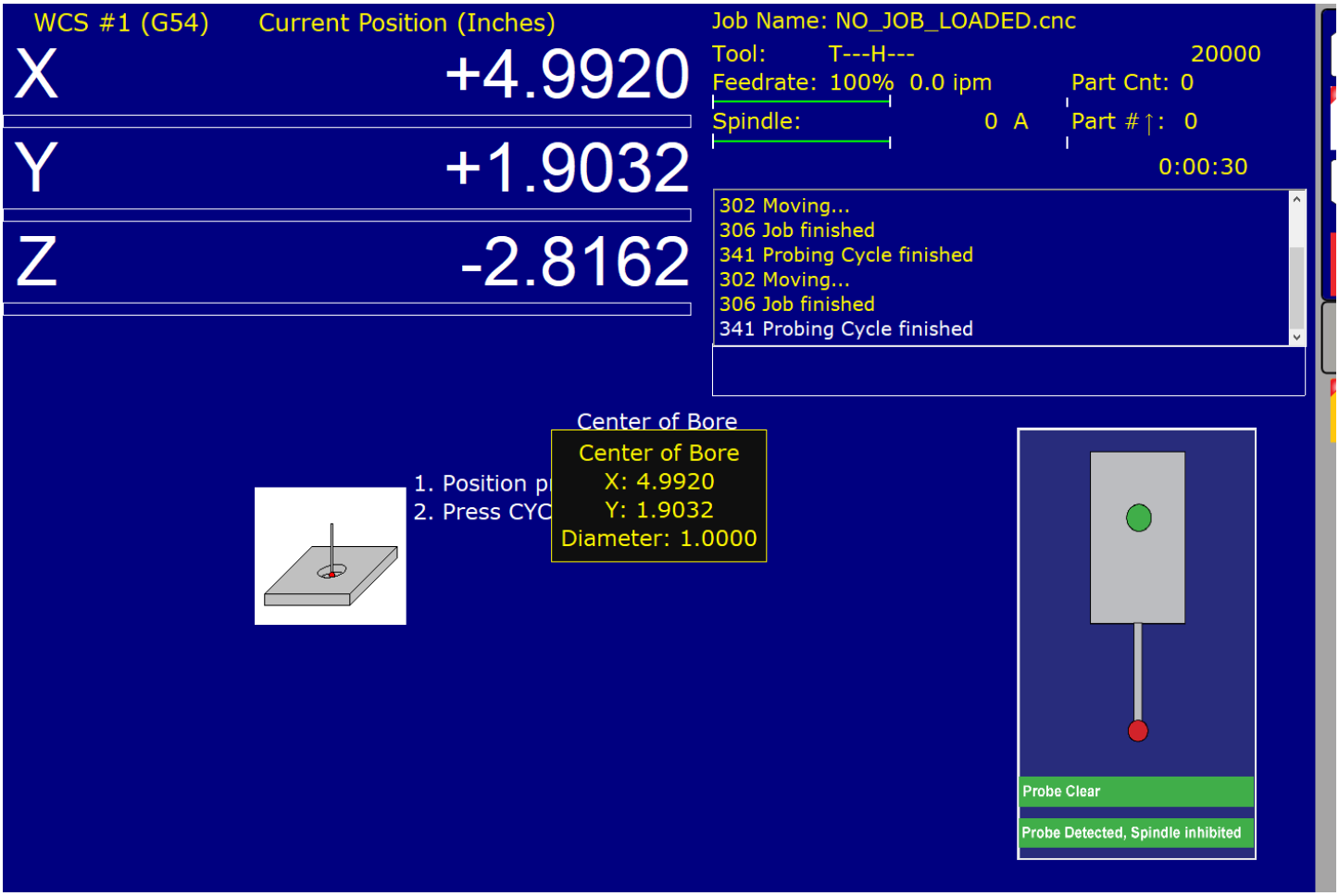
Subtract this number from the known diameter of the gauge bore. The resulting number will be the calibrated diameter of the probe stylus tip with the pre travel taken into consideration.

For example with a 1” ring gauge (ours measures .99996”) and a 2.5 mm (.0984252”) probe tip. and with the measured diameter in step 3 is displayed as: .9199”

.99996 -.9199” = .08006” The calibrated probe tip diameter with probe pretravel compensated for is .08006” for this stylus.

4.) Test the new Probe Diameter. Go back to the tool library and enter .08006” for the Diameter of Tool 10 (the probe tool number) and run the Bore Probing cycle again! CNC12 will round the diameter number to .0801”





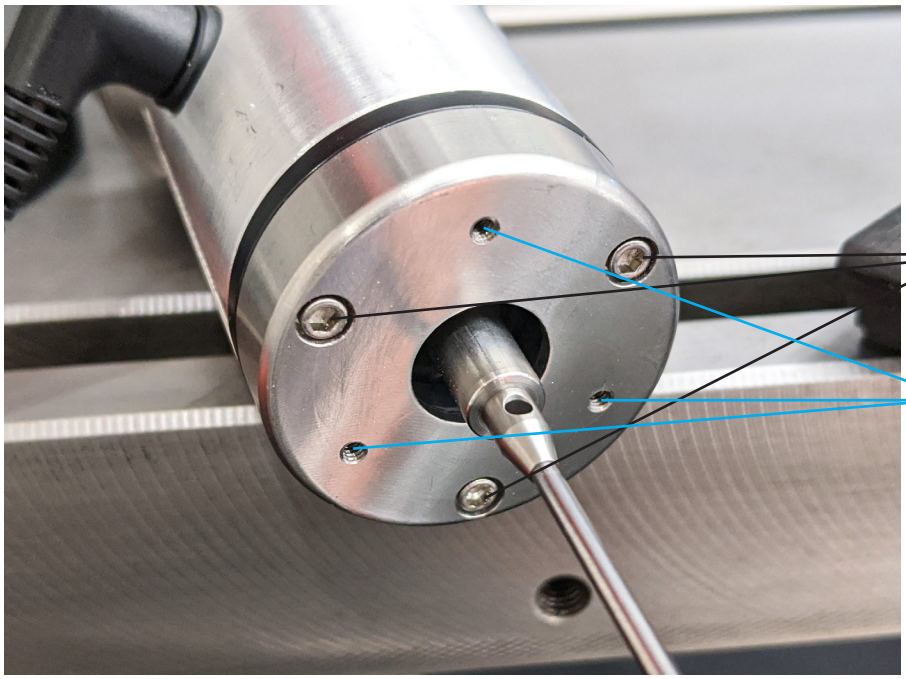
You can tweak the probe stylus pretravel calibration diameter and repeat as needed to obtain as close a measurement as possible to the actual ring gauge diameter. Assuming the machine has low backlash and the probe is accurate, it is possible to obtained +/- .0002” repeatability when measuring the ring gauge diameter with a good probe and a machine in good condition.

The Probe Stylus Calibration is now complete. Probe is ready for probing and digitizing!

Each different Stylus will have a different pretravel compensated calibration diameter. Do this procedure for each stylus. Make a table and record the calibrated diameter values for each stylus. Be sure to update the Probe Diameter in the Tool Library to match the stylus being used when swapping out to a new stylus!

Special Cases

There are three screws on the bottom of the KP-3, these are the angular adjustment screws, these are set at the factory and in general do not need to be adjusted.



Angular Alignment:
Angular alignment is the relation of the spindle center line to the stylus stem center line. This adjustment is SET AT THE FACTORY. This adjustment is rarely needed except when extremely small or long stylus or a straight shank stylus (shank is same diameter as ball end) is used, Typically verifying that the Angular Alignment is not grossly off is all that is needed. The angular alignment and run-out adjustments are not the same thing but are interdependent. The run-out at the stylus mount end of the stylus stem should be nearly the same as the runout at the tip. (Note: Adjust the stylus tip run-out after checking the Angular Alignment). Note: Special cases When the stylus tip and stem are nearly the same diameter this adjustment is critical to keep the stem from contacting a vertical surface before the tip. This adjustment is also convenient to adjust parallelism when flat disc or block stylus types are used.

To check the angular alignment begin by sweeping in the KP-3 at the base of the stylus stem (the end away from the tip) with the dial indicator. If the run-out indicated at this point is greater than the difference between the stylus tip diameter and stem diameter then it will be possible for the stem to contact a vertical surface before the tip (also called “shanking out”). In this case angular adjustment is needed. If the difference between the tip diameter and the stem diameter is less than the measured run out, no Angular adjustment is needed.

MAINTENANCE AND CARE

- Do not use compressed air to clean the KP-3 as this may force contaminants into the electrical connector and inside the Probe body damaging the probe.
- Do not use Compressed Air to blow off parts near the KP-3 the reflected air stream full of debris will risk damage to probe.
- Do not submerge the KP-3 and avoid direct flow of coolant or wash down
- Do not expose to excessive heat (120F/50C +), KP-3 Operating Temperature 50-95F/10-35C.
- Wipe off excess liquids to prevent degradation of the rubber seal and LED indicator lens.

Do not ship or store the probe with the stylus mount boss pushed into the probe body as this will negatively affect internal lubrication.

Store KP-3 vertical with nose pointing down.

The KP-3 has no internal user serviceable parts or adjustments and should only be serviced by Centroid.

Alignment adjustments. Regularly check alignment. Any time the probe is removed from its holder, the stylus is changed or the probe is used in a different machine, the alignment procedure should be repeated to ensure accuracy.

The user should also repeat the alignment procedure if the unit is dropped or receives any sudden external shock. The KP-3 body is aluminum and the end cap is stainless steel and should only be wiped clean with compatible cleaners.

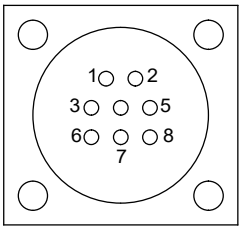
It is good practice to periodically check alignment for quality control and to establish a base line maintenance schedule. See “Stylus Installation and Alignment Procedures” section of this manual.

KP-3 Internal Bulkhead cable wiring for Oak and Allin1DC

Allin1DC and Oak Internal "Bulkhead" Probe cable

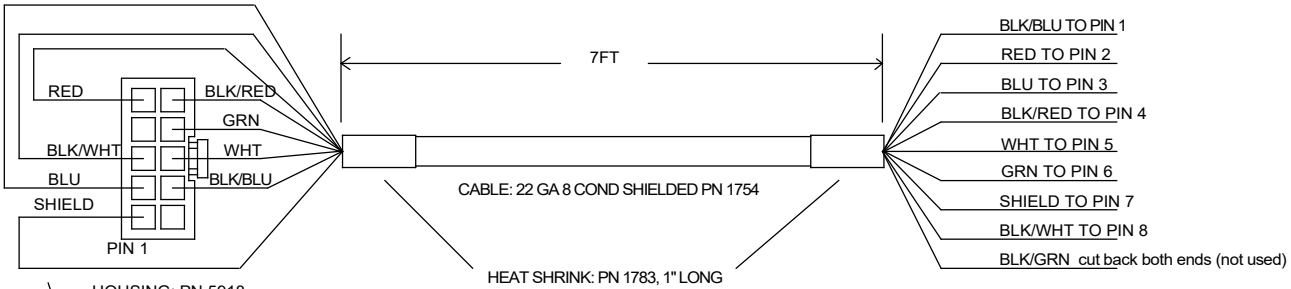
Cable goes from Allin1DC/Oak onboard Probe connector to a round bulkhead connector

WIRE FUNCTIONS	
COLOR	SIGNAL
RED	+12V SUPPLY FUSED
BLK/RED	INPUT 772 TT DETECT
GRN	INPUT 771 PROBE DETECT
BLK/WHT	COM SUPPLY
WHT	INPUT 769 PROBE MECH
BLU	COM SUPPLY
BLK/BLU	INPUT 770 PROBE DSP
BLK/GRN	NOT USED
BARE	SHIELD DRAIN



HOUSING: PN 1008

TERMINALS: PN 981



HOUSING: PN 5918

TERMINALS: PN 5511

COVER WITH BLUE HEATSHRINK PN 1970 BOTH ENDS

REVISION HISTORY:

120113 ADDED TT DETECT AND 8 COND CABLE

svn://software/hardware/Cables/PROBE_TT.DSN

Sub. Assy.: 11211 DWG NO: S14779

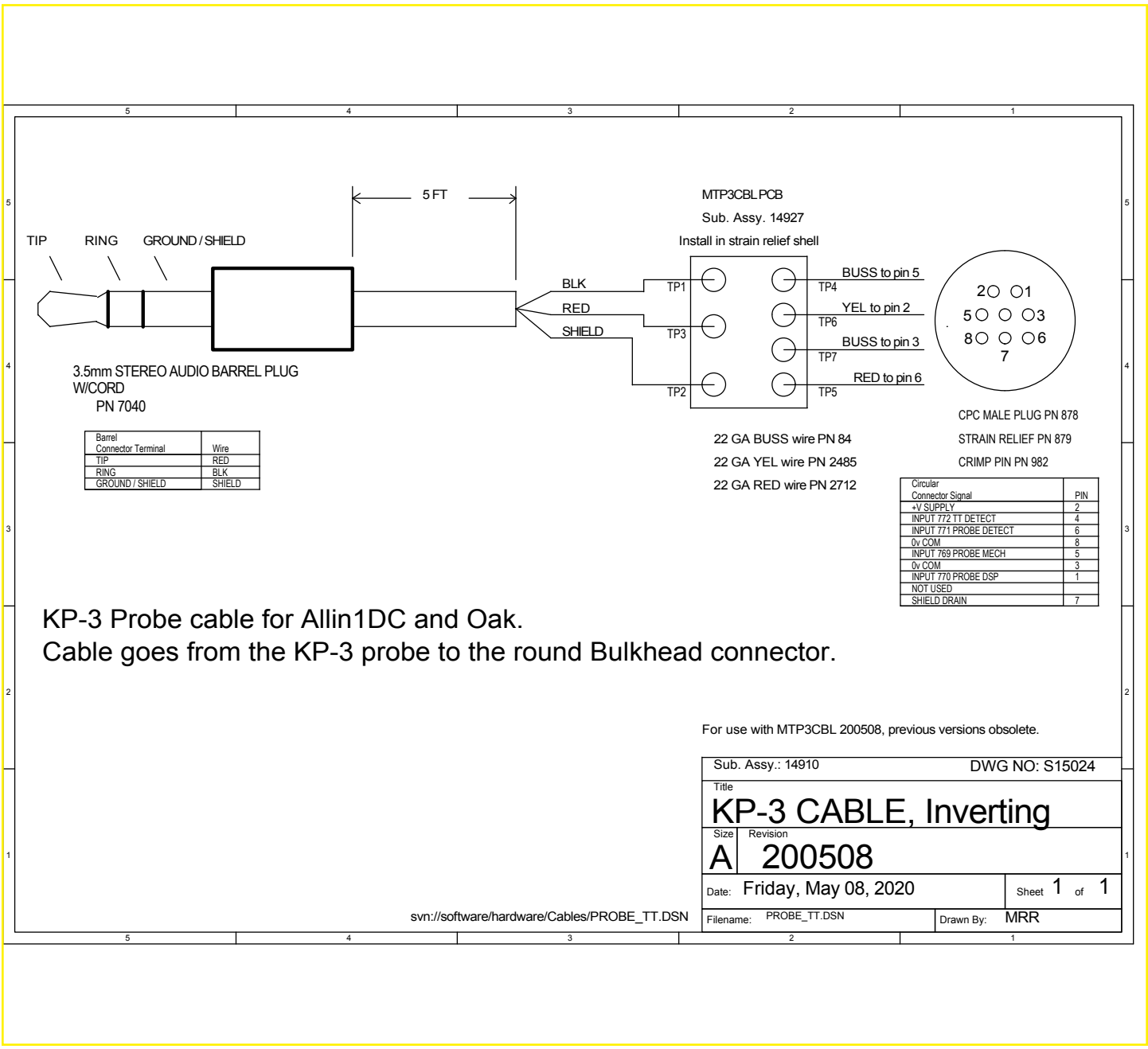
Title: Internal Probe Cable

Size: A Revision: 120113

Date: Wednesday, August 24, 2016 Sheet 1 of 1

Filename: svn://software/hardware/Cables/PROBE_TT.DSN Auth: MRR

KP-3 Probe Cable for use with Oak or Allin1DC



Barrel Connector Terminal	Wire
TIP	RED
RING	BLK
GROUND / SHIELD	SHIELD

Circular Connector Signal	PIN
+V SUPPLY	2
INPUT 772 TT DETECT	4
INPUT 771 PROBE DETECT	6
0v COM	8
INPUT 769 PROBE MECH	5
0v COM	3
INPUT 770 PROBE DSP	1
NOT USED	
SHIELD DRAIN	7

CNC12 KP-3 configuration for Oak and Allin1DC

CNC12 V4.16+ requires a Pro or Ultimate License for Probe functionality.
Oak/Allin1DC control system parameters below are the recommended basic settings SAE Inch and Millimeters in (mm) These are the suggested starting values. Some of these parameters are typically adjusted by the integrator/user to suit the probing/digitizing application. F1 setup, F3 config, type in password (137), F3 parameters.

Parameter	Setting	Description
11	50769	The PLC input for the Probe signal
12	10	Tool Library number of the Probe
13	0.020 (.508)	Clearance amount nominal
14	30 (762)	Fast Probing Rate
15	3 (76.2)	Slow Probing Rate
16	5 (127)	Maximum Search Distance
18	50771	PLC input, Spindle Inhibit/probe connected
120	0.020 (0.508)	Probe stuck clearance amount
121	0.020 (0.508)	Grid digitizing minimum Z pullback
122	0.0002 (0.005)	Grid digitizing dead band distance
123	0	Radial clearance move
151	0	Repeatability tolerance
153	1	Probe protection enable
155	0	Probe type enable
186	1	Probe stuck retry disable
366	1	Probe deceleration Multiplier

Probe Jog Parameters control operator machine jogging speeds when the probe is connected. Probe must decelerate to stop when contacting a surface without exceeding overtravel limits. See probe specifications and set fast probing rates so that over travel specification is not exceeded. Probe will be damaged if over travel limit is exceeded by any amount.

F1 Setup, F3 Config, F3 Machine, F1 Jog, F8 Probe Jog

Axis	Probe Slow Jog	Probe Fast Jog -	Probe Fast Job +
1	25	150	150
2	25	150	150
3	25	75	150
4	25	100	100

Note: In this example axis 3 is the Z axis which only has 0.150 inches of overtravel limit in the (-) direction. Axis 4 is a rotary axis overtravel will depend on distance from center of rotation.

KP-3 wiring and use with other CNC controls

The KP-3 is compatible with most any CNC control with an input for a probe.

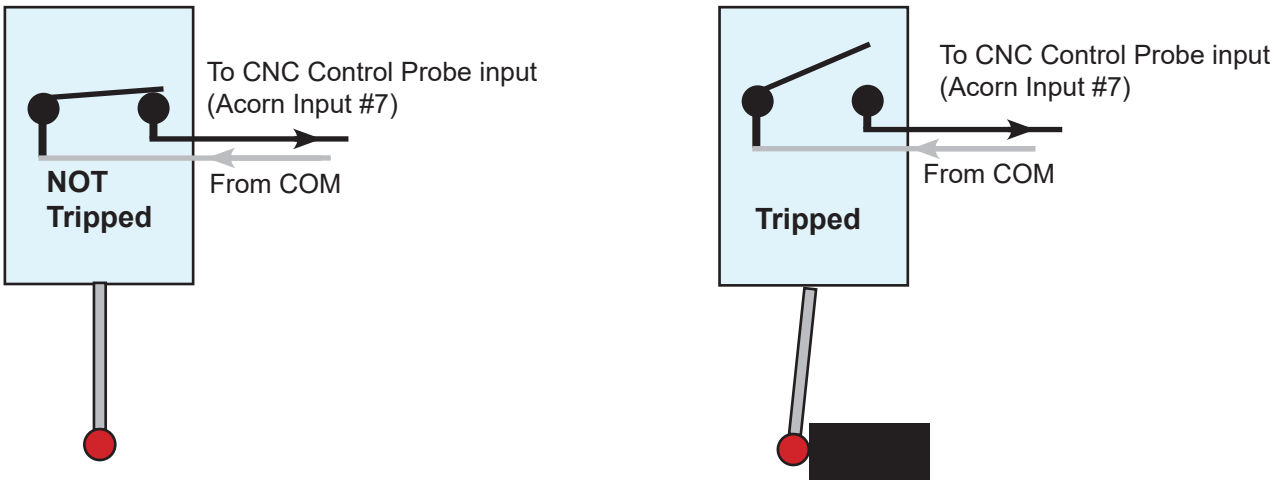
The KP-3 itself is a kinematic probe which simply breaks continuity through the precision kinematic seat (a super accurate switch) when tripped. So, said another way when the probe is not tripped there is continuity through the switch, and when the probe is tripped the switch opens breaking the continuity.

The operating voltage of the KP-3 is 5 to 24 Vdc

If you cut into the 3.5 mm Barrel plug cord there are three wires as seen below.

The KP-3 itself has an output signal is that of a normally closed switch. (NC= When the probe touches a surface the switch opens.)

A "Normally Closed" Probe OPENS the Input when tripped

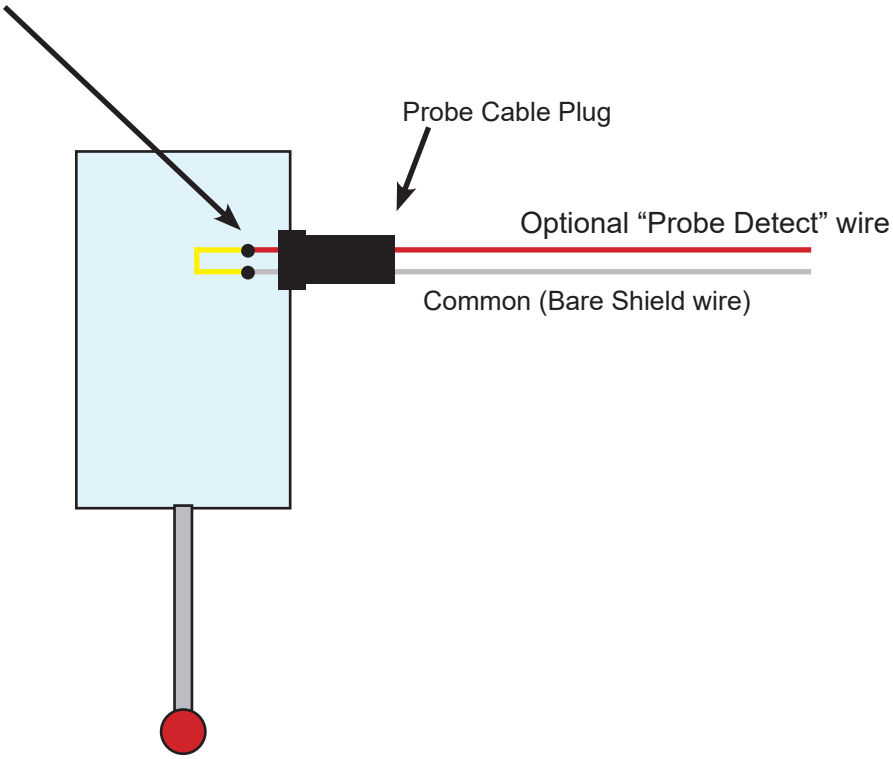


Probe Detection Input Circuit:

A “Normally Closed” Probe DETECTION Circuit CLOSES the Input when Probe is plugged in.

Centroid KP-3 has a simple Probe Detection Circuit built into the probe which when the probe is plugged in by the operator lets CNC12 know that a probe is active and in use. This detection input tells CNC12 to start activate Probe Protection. For instance, the spindle will be disabled so the user can not turn on the spindle with the probe plugged in, probe protection will also stop all movement if a probe is tripped unexpectedly to try and prevent crashing of the probe. After CNC12 sees an “unexpected probe contact” (a probe trigger event not during a probing cycle) it will only allow the user to jog in the opposite direction that the probe was moving when the contact occurred to prevent the user from accidentally moving the probe further into the contact direction causing damage to the probe. So, you can see it is important to use a Probe Detection input.

Internal “jumper” connects Red probe cable “Probe Detection” wire to common together. This is wired to the CNC control input that is set to ‘sense’ whether the probe is plugged in or not. Typically the CNC control software will inhibit the spindle from being allowed to turn on when the probe is plugged in, also smarter CNC controls have “unexpected probe contact” logic to help avoid accidental crashes. When the probe is plugged in the input is closed.



Related Resources

KP-3 Unboxing Video
https://youtu.be/HbOMSKYuy6g

KP-3 Setup Video.
https://youtu.be/a6LVseKI7do

Acorn Probe and TT setup Manual
https://www.centroidcnc.com/centroid_diy/downloads/acorn_documentation/acorn_probe_setup.pdf

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