

# CNC PROBING

Accuracy starts at the machine

On-machine measurement and tool control systems

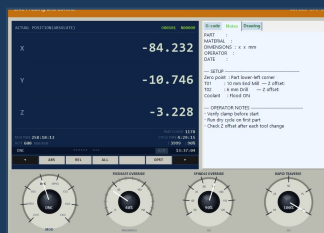


## Product catalogue



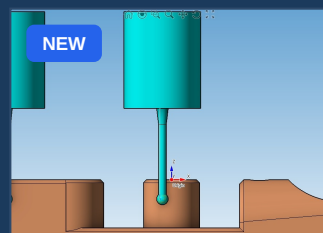
### CNC Probing

Measurement in the machine



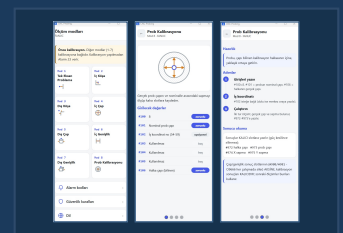
### CNC Control

Monitoring and alerts



### AutoFinish

Finishing cycle that measures and corrects itself



### Mobile app

Probe and tool setting macros



### Measuring probe

Optical · radio · hard-wired



### Laser tool setter

Non-contact measurement



### Contact tool setter

Length and diameter

### Custom software

We develop bespoke CAD/CAM and ERP integration software.

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# CNC PROBING

News from machining, mould making, metrology and on-machine measurement  
Accuracy starts at the machine



## We learned it at the machine

Built on thirty-five years of mould making and machining

**We are not a software house. We are a team that makes moulds, cuts metal and waits at the machine on the night shift. CNC Probing was not born in a laboratory; it was born in that workshop.**

### We learned the problem by living it

For thirty-five years we went through the same thing again and again. The part came off the machine, went to the inspection room and waited its turn. By the time an error was found the set-up reference was long gone; the part was re-clamped, re-datumed, sometimes re-machined. Now and then it went to scrap. The machine stood still throughout.

We tried what the market offered. Some were expensive, some were hard to use, most did not suit the control units on our machines. Writing a macro meant calling in technical support from outside. In the end we decided to build it ourselves.

### What we have built

Today we have a product family. On-machine measurement software, the AutoFinish module that measures and corrects on its own, the CNC Control monitoring software and the mobile app the operator uses at the machine. Alongside them: measuring probes, laser and contact tool setters, styli and tool holders.

None of it was designed at a desk. Every feature came out of a problem we met in our own workshop. The team that wrote the software was the same team that used the machine.

### What we believe

A measuring system should not make life hard for the person using it. The operator should not have to write macros, work out angles or go looking for a post processor. The machine control should be left alone and the existing set-up should not be disturbed.

And we believe this as well: inflated figures do nobody any good. Every value you see in this catalogue has either been measured or is given together with the way it was calculated.

### We listen to you

Every workshop has its own work, its own parts and its own habits. So we do not sell a box and walk away: we listen to what you need and, where it is called for, develop software specific to you. We work so that you get the highest yield from your CAD/CAM software under real production conditions.

### Where we are going

Our aim is to put on-machine measurement within reach of small and medium workshops. For manufacturers who cannot set up an expensive inspection room but still have to be sure of the size of their part.

The cost of a machine comes back not in the hours it stands idle but in the hours it makes good parts. Every CNC owner being able to run their machine at full capacity is among our goals.

### Software

CNC Probing measurement software  
· AutoFinish module · CNC Control · mobile app · custom CAD/CAM and ERP integrations

### Hardware

Measuring probes · laser tool setters  
· contact tool setters · styli · tool holders



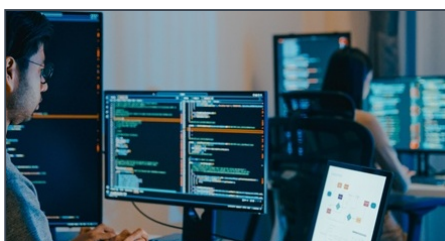
**The team that wrote the software was the same team that used the machine.**

### How we work

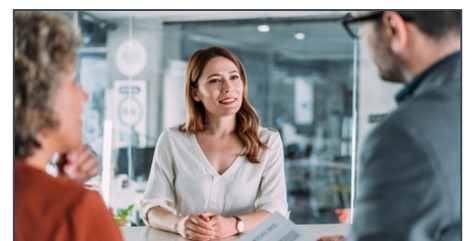
- 1 We listen**  
We talk through what you need and the conditions at your machine.
- 2 We try it in our own workshop**  
Every feature runs on our own machines first.
- 3 Then we hand it over**  
We only release it once we have seen it work in production.



Measurement inside the machine, part still clamped.



The software team is the team at the machine.



We begin by listening to what is needed.

# 400,000 euro a year in a twenty-machine shop

## What happens when measurement moves into the machine

A mid-sized manufacturer producing spare parts and moulds for a sector where a measurement record must be kept and traceable for every part runs twenty CNC machining centres. Their problem was not technical: the machines ran and the parts were in tolerance. The problem was how long the machines were not running.

In this sector the measurement record is as much a deliverable as the part itself.

### Before

At every new setup the operator found the datum by hand. Tool lengths were also set by hand, by the operator, at the machine. For inspection the part was unclamped and sent to the measuring room, and the machine waited for the result.

A broken tool was usually noticed at the end of the program; every part machined in that program then became suspect. When and why the machines stopped was not recorded at all.

### What was done

CNC Probing software, a measuring probe and a tool setter were installed on all twenty machines. CNC Control monitoring software was connected to the same machines. Installation took one macro per machine; the control units were not modified.

### Result

Finding the datum went from about twenty minutes per setup to two. Tool length and diameter are now measured automatically on the machine instead of by hand.

Because the part is measured on the machine, the unclamp-reclamp cycle and the wait for the measuring room are gone. Broken tools are caught within the cycle; no bad part moves to the next operation.

Measurement results are reported in Q-DAS format as they are taken, so traceability is unbroken at part level. The investment paid for itself in less than a year, and the largest item was not scrap but machine downtime.

# 400,000 €

per year

20 CNC machining centres

payback: under one year

### Before and after

|                                 |                                                                         |
|---------------------------------|-------------------------------------------------------------------------|
| <b>Datum</b>                    | By hand, ~20 min per setup<br>With the probe, ~2 min                    |
| <b>Tool length and diameter</b> | Set by hand at the machine<br>Automatic, straight into the offset table |
| <b>Part inspection</b>          | Unclamp, wait for the measuring room<br>On the machine while clamped    |
| <b>Broken tool</b>              | Noticed at the end of the program<br>Caught within the cycle            |
| <b>Measurement record</b>       | Compiled by hand<br>Automatic, in Q-DAS format                          |
| <b>Reason for downtime</b>      | Verbally, at the end of the shift<br>Live, recorded, with alerts        |

### Annual saving — worked example

| Item                                              | Calculation                                   | Per year         |
|---------------------------------------------------|-----------------------------------------------|------------------|
| <b>Datum and tool setting time</b>                | 20 machines × 35 min/day × 250 days = 2,917 h | 175,000 €        |
| <b>Downtime for inspection and re-clamping</b>    | 20 machines × 15 min/day × 250 days = 1,250 h | 75,000 €         |
| <b>Reduction in scrap and rework</b>              | about one third of the annual scrap cost      | 90,000 €         |
| <b>Damage and suspect parts from broken tools</b> | one incident a month instead of one a shift   | 60,000 €         |
| <b>Total</b>                                      |                                               | <b>400,000 €</b> |

A machine hour rate of 60 euro has been used. The figures come from the company's own records and vary from shop to shop. Recalculate with your own machine hour rate.

*"The machine used to stand idle at every new setup while the operator hunted for the datum. Now the probe finds it and we spend that time cutting. Across twenty machines that is hours a day."*

Production manager

*"What I feared most was seeing a broken tool when the program ended. We would set every part from that program aside as suspect. Now the machine stops itself and we lose one part."*

Machine operator



Measurement and tool setting happen at the machine, with the part still clamped. The operator no longer hunts for the datum — the probe finds it.

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## Measure your workpiece on your CNC machine

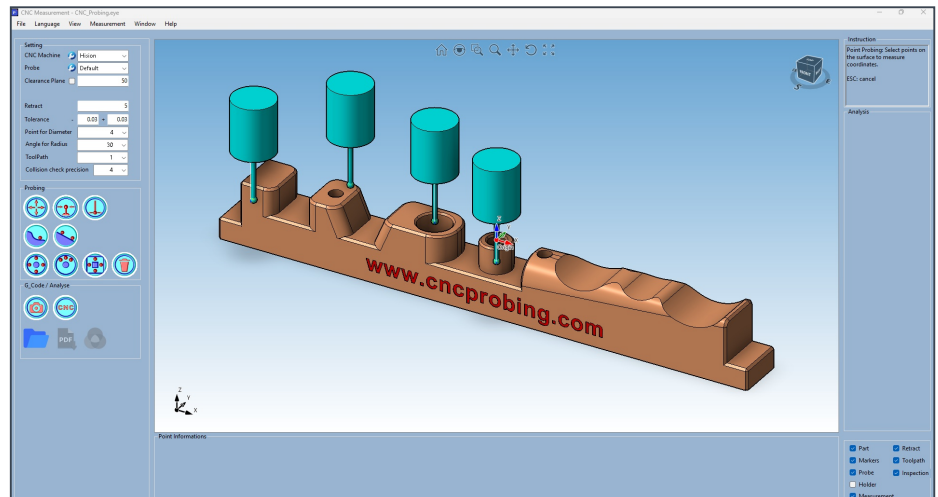
Taking a part off the machine to measure it and waiting in line at the inspection room is one of the most expensive habits in manufacturing. Once the part comes off, the set-up reference is lost; even when an error is found, the part has to be re-clamped and re-datumed to correct it. Measuring on the machine removes this loop.

Because the part stays clamped, the result comes within a few minutes and any correction is made in the same set-up. The machine does not wait for word from the inspection room. Scrap and rework go down, and the measurement record is produced as part of the job itself.

CNC Probing is software that lets the workpiece be measured on the machine tool. The measurement is taken where the part is machined and in the same set-up. Measurement points are selected on the model of the part, and the code that will run on the machine is generated by the software. The user does not have to write macros or edit G-code.

### An interface that is easy to use

Measurement types sit as icons in the left panel and the part appears in the centre of the screen in 3D. Tolerance, retract distance, the number of points for a diameter and the collision check precision are gathered in one place on the same screen. A measurement point is picked on the part itself and the chosen point is marked on screen straight away. The user works while seeing what is being done.



The CNC Probing main screen. Measurement types on the left, the part in the centre in 3D, settings in one panel.

### CNC machine library

The software keeps its own machine library. Every machine tool in the shop is defined as a separate record, edited, and set as the active machine when needed. A separate macro is produced for each machine, so records do not get mixed up in a shop running several machines.

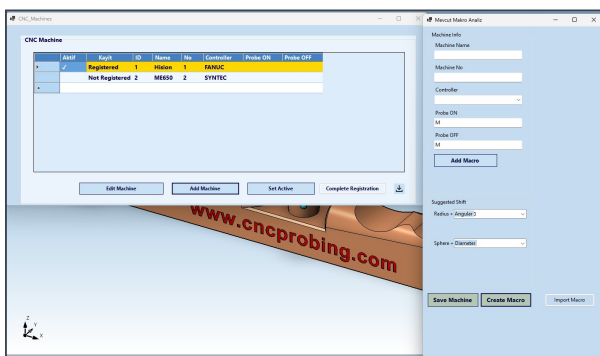
### The software resolves macro conflicts

Macros are already stored in the machine control. If a macro added from outside uses the same number, a conflict arises. CNC Probing does not leave this to the user: it analyses the macros found on the machine and produces a macro specific to that machine which does not clash with the existing ones. The process is automatic. There is no macro number to choose,

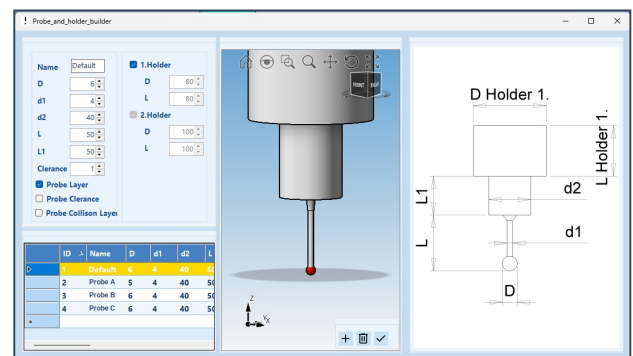
no macro to write, and no technical staff to call in for it.

### Probe library and instant 3D

Probes are kept in a library as well. You can select a stored probe or define your own: stylus diameter, stem diameter, body diameter, lengths and holder dimensions are entered. As the values are entered, the probe and the holder are built on screen in 3D at the same time, with a dimensioned diagram beside them.



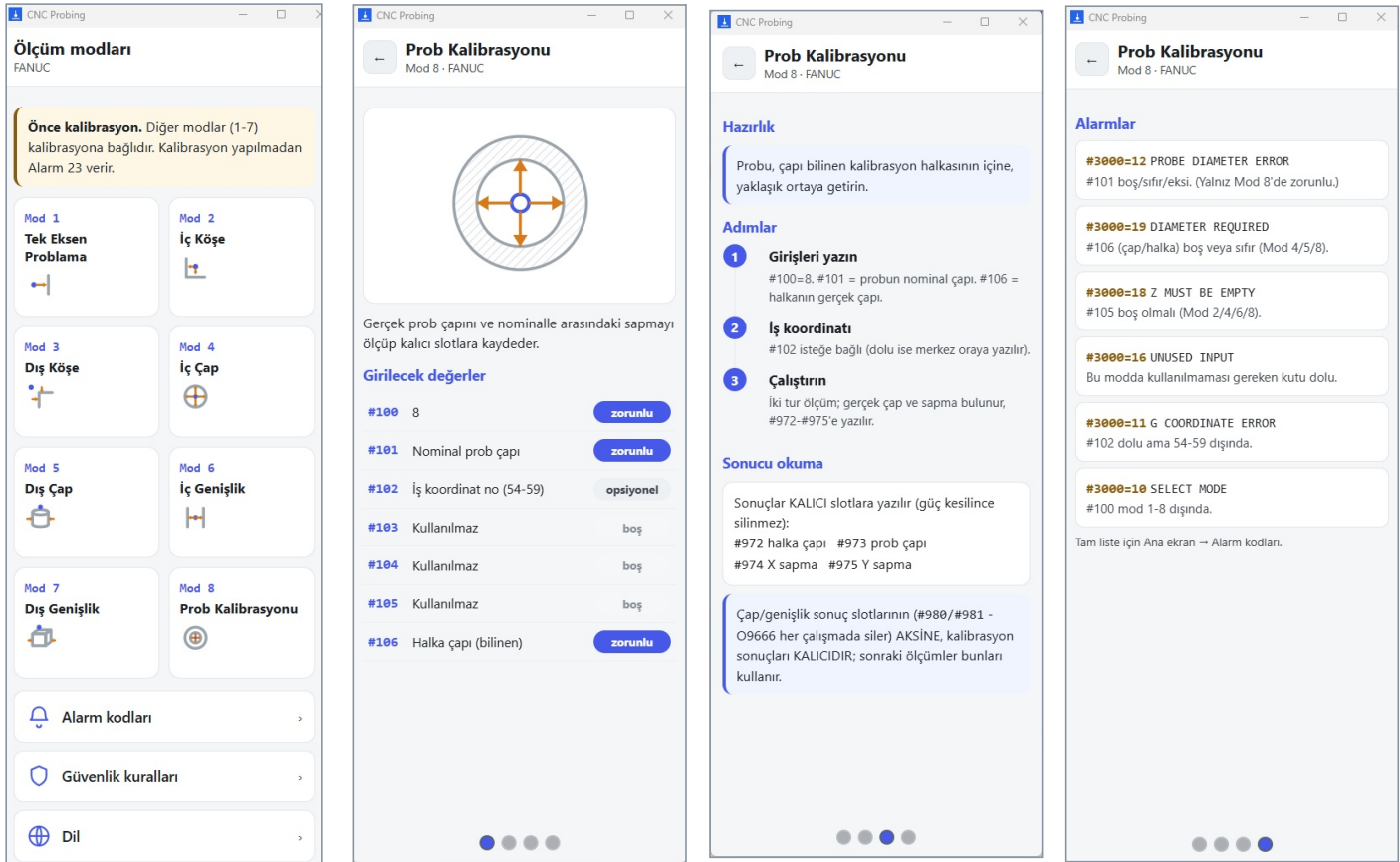
The CNC machine library and macro analysis. Each machine tool is a separate record.



The probe builder. The model appears in 3D as the dimensions are entered.

# The Mobile Macro app

The operator selects a mode, enters a value and runs it — the software does the rest



All eight measuring modes are listed on one screen.

For every mode it is stated clearly which input is mandatory and which is optional.

Preparation and steps are given in order; where the result is to be read is written down.

Alarm codes and the cause of each alarm are explained on screen.

The common approach to on-machine measurement is that the user writes their own macro program, or adapts a ready-made template by changing parameters. That method needs a user who knows macros, and separate adaptation work for every machine. CNC Probing takes a different route: the software sets up the measurement, the operator only enters values.

## Eight measuring modes

The software offers the measurements most often needed on the shop floor as ready modes: single-axis probing, inside and outside corner, inside and outside diameter, inside and outside width, and probe calibration. The user selects the mode, enters the values and runs it. There is no macro to write and no code to copy.

## Operator guide application

Every mode has its own guide screen. It explains three things: the preparation before measuring, the order of the steps, and where the result is read. Inputs are marked as mandatory, optional or not used in this mode, so the operator does not have to guess which box to fill.

The guide application is supplied as a desktop and a mobile version. It can be used at the machine with a phone or tablet; no computer is needed. The application supports eight

languages.

## Alarms with explanations

When an input is wrong or missing, the machine does not simply return an unintelligible alarm number. What each alarm means and which input caused it is written on the guide screen, so the operator can resolve the problem without waiting for technical support.

## Calibration result is permanent

Probe calibration is done once and its result is stored permanently; it is not erased even when machine power is lost. All later measurements use these values. If the other modes are run before calibration, the software warns the user and prevents an incorrect measurement.

## One macro, no post-processor

Installation is done with a single macro. The existing control unit is not modified, no post-processor is written and the CAM system is left untouched. Control units in common use across the industry are supported, with the same installation logic for all of them.

## From measurement to report

Measurements do not stay on the screen. CNC Probing CAM CMM software turns points into geometric features, compares them against tolerances and produces a quality report. The Q-DAS / AQDEF format is supported, so results transfer into the existing quality system.

## Measuring modes

|               |                     |
|---------------|---------------------|
| <b>Mode 1</b> | Single-axis probing |
| <b>Mode 2</b> | Inside corner       |
| <b>Mode 3</b> | Outside corner      |
| <b>Mode 4</b> | Inside diameter     |
| <b>Mode 5</b> | Outside diameter    |
| <b>Mode 6</b> | Inside width        |
| <b>Mode 7</b> | Outside width       |
| <b>Mode 8</b> | Probe calibration   |

## In the guide, for every mode

- Preparation
- Order of the steps
- Values to be entered
- Reading the result
- Alarm explanations

## Eight interface languages

|         |          |
|---------|----------|
| English | Türkçe   |
| Русский | 中文       |
| Deutsch | Italiano |
| Español | Français |

# Preparing the measurement

## Placing the model, choosing what to measure, knowing the probe

The accuracy of a measurement is decided before any code reaches the machine. Is the model sitting in the right place? Have the right features been selected? How does the probe actually behave? These are questions for the preparation stage, answered at the screen rather than at the machine. CNC Probing brings all three together on one screen.

### Setting the model on the machine datum

A STEP or IGES file taken from CAD/CAM software rarely arrives on the machine datum you want; the part is shifted, rotated, or its zero sits in another corner. It is a small matter, but measurement cannot begin until it is settled, because every measurement point will be worked out from this reference.

The software brings the model in and offers several ways to put the datum where it belongs. One of them builds a box around the part and offers a zero at every corner; the user picks the one they want and the part moves to it. Alignment on a plane, an edge or a point is also possible.

When the datum changes, probing points created earlier are deleted. This is deliberate: those points were worked out from a different reference, and keeping them would quietly produce a wrong result. Datum first, measurement after.

### Measurement modes

Point probing, angled surface, inside and outside circle, inside and outside radius, inside and outside pocket, and rectangular surface probing. When a mode is selected, the surfaces that suit it are highlighted on the model; the user only clicks. The software tells a bore from a boss on its own. In point probing every surface except downward-facing ones can be selected, with as many points as

wanted.

When measuring a bore or a boss, the number of points the probe touches is chosen: four or eight. More points make the measurement more dependable but lengthen the cycle. In series production four is usually enough; if the part is tight or the roundness of the bore is in doubt, it goes to eight. The choice belongs to the user; the software does not impose one.

### The settings in one panel

The values that shape a measurement are not hunted for in scattered menus; they sit in the same panel. Retract sets the distance between the probe and the workpiece. The plus and minus tolerance of the point being measured goes into Tolerance. Point for Diameter sets how many points are taken in a diameter measurement, and Angle for Radius the angle used in angular measurements. ToolPath selects the tool path number. All of it visible, all of it in one place.

### Calibration and probe check

The software carries three calibration functions. Two-dimensional ring calibration establishes the machine's behaviour in the X and Y plane by means of a ring gauge. Three-dimensional ball calibration does the same across all three axes by means of a ball gauge. In both cases the software produces the Gcode (tool path) that is needed; the user enters the ring or ball diameter, the probe diameter and the feed, and the software carries out the rest.

The third is detection of probe eccentricity. A probe is taken off and refitted many times, and at each fitting the probe axis and the spindle axis may not line up exactly; the probe runs out. That difference passes into every measurement result, and the operator usually does not notice it. The software detects the run-out of the probe ball; calibration is repeated when needed.

#### Instruction panel

It writes out, step by step, what to do at every stage of every operation. The user does not get lost in the program and learns unaided.

#### Show / hide

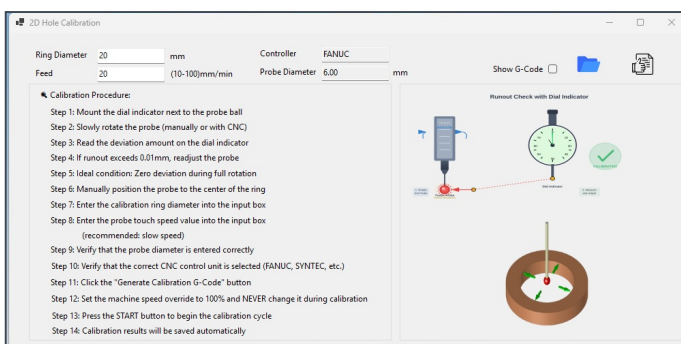
The part, the probe body, the probe ball and the tool paths are switched on and off separately. There is no need to work on a crowded screen.

#### The control is left alone

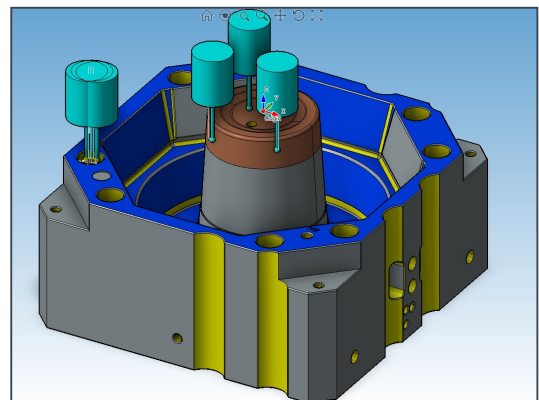
Nothing is changed in the machine control unit; existing programs and settings stay as they are.

### On three, four and five axes

The software runs on 3-axis vertical and horizontal machining centres, on 4-axis machines with a rotary table and on 5-axis machines. The more axes there are, the more directions the probe can reach the workpiece from; on 5-axis machines surfaces at different angles can be measured in a single set-up. Measuring accuracy is in the range of 0.001 – 0.005 mm; that figure is reached together with the positioning accuracy of the machine.



Two-dimensional ring calibration. The steps are written out in order on screen.



Probing points are marked on the model; probe and holder are shown.

# Before the code reaches the machine

## Collision checking, animation and machine-specific Gcode (tool path)

A probe is an expensive instrument, and when it breaks it does not only cost its own price: the machine stops, the job is delayed, a replacement is waited for. So CNC Probing puts the path it produces through three stages before sending it to the machine. A safe height is set, collision is checked, and the path is watched on screen.

### Safe height

Clearance Plane sets the height at which the probe travels from one measuring point to the next. The probe moves above this plane at speed and comes down only once it is over the measuring point. Clamps, vice jaws and the high areas of the part are thus kept out of the path.

The value can be entered by hand; the software also finds the highest point of the model and proposes a safe zone itself. One wrongly entered height costs a broken probe, which is why this field is visible from the start.

### Collision checking

What breaks a probe is usually not the measurement itself. If the stylus touches something outside the measurement, or the probe body strikes a clamp, the probe breaks or is damaged. CNC Probing runs a collision check for every measuring point as it is selected; if a collision is found, probing is not started and the user is warned.

The check takes in not only the stylus but the body and the holder as well. The dimensions entered in the probe library are there for exactly this: the software cannot call a path safe without knowing how much room each part takes up.

### The software sets the approach angle

To measure a point correctly the probe has to approach the surface at a right angle. On sloped and curved surfaces that angle changes at every point; working it out by hand takes time and leaves room for error. CNC Probing analyses the CAD geometry, calculates the surface normal at each measuring point and decides for itself which

direction the probe comes from. The user enters no angles and does no trial and error.

### Watching the path on screen first

The path that has been produced is played back as an animation in three dimensions. The probe moves step by step, and at every move the X, Y and Z coordinates, the feed and the retract value appear on screen. The animation can be wound forwards and back and stopped at any point.

This takes the place of the dry run on the machine. The usual method is to send the program to the machine, drop the feed to ten per cent and watch the path with a hand on the stop button. Watching it on screen saves both the machine time and that risk.

### The post processor is inside the software

For a tool path produced by CAM software to run on the machine, it has to be translated into code the machine understands. A post processor does that translation, and it can differ according to the CNC machine's control unit.

CNC Probing carries its post processor within itself. It produces Gcode (tool path) suited to the control of the machine chosen in the machine library; the header information, the safety lines and the cycle format are written for that machine. There is no need to obtain a post processor separately; the user takes the code, transfers it to the machine and runs it.

### Results appear without waiting

Measurement results coming back from the machine are loaded into the software and appear on screen at once. Values inside tolerance and those outside it are shown together on a colour scale; how far each point has deviated is read at a glance. There is no report to wait for once measuring is over.

Results are saved as PDF; a screenshot can be added to the report as well. Because the Q-DAS / AQDEF format is supported, measurements pass straight into the quality system.

### Gcode (tool path) form

- Coordinat System (G54)
- Tool Number
- Probing Mode
- Marker Number
- Tolerance + / -
- Retract Line
- Radius
- Measure
- Angle XY / YZ / XZ
- X, Y, Z coordinates
- With eccentricity

If probe eccentricity compensation is selected, the run-out that has been detected is carried into the code produced. Header information, safety lines and the checksum are written as well; no line has to be added to the code by hand.

### One form to the machine

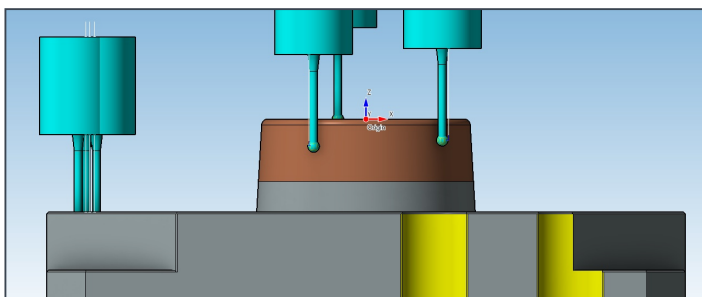
Every probing operation carried out is turned into Gcode (tool path) through a single form and transferred to the machine.

### Set up with one macro

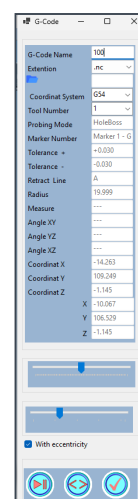
Setting up is done with a single macro; no separate post processor has to be bought.

### The report is part of the job

The measurement record is not compiled afterwards; when the cycle ends the report is ready.



Tool path animation. The probe moves step by step and the coordinates appear on screen.



The Gcode (tool path) panel

# A Ø20 ball measured on a seven-year-old machine

45 points, tolerance  $\pm 0.030$  mm, average deviation 0.003 mm

The results below came from one of our customers. The measurement was made on a CNC machine seven years old, running twenty-four hours a day in production machining. Not a new machine: one that has worked for years under real workshop conditions. The part measured is a Ø20 mm ball.

Forty-five points were taken from the surface of the ball. For each point the design coordinate the software read from the CAD model was compared with the actual coordinate the machine measured. The tolerance was entered as plus/minus 0.030 mm.

## The result

Forty-five of the forty-five points stayed within tolerance; not one fell outside. The average of the deviations came to 0.003 mm. The largest single deviation was 0.008 mm, that is, less than a quarter of the tolerance entered.

This figure takes in the machine's own positioning error, the backlash of axes that have aged, and probe repeatability, all together. It was not taken under laboratory conditions but inside production.

## How this accuracy was reached

On a machine seven years old and running continuously, what gives this result is not the probe itself. The probe only reports the moment it touches; which coordinate that moment corresponds to is what the machine states. What decides the result is the

calibration carried out before the measurement.

During calibration the machine's own mechanical backlash and axis error margins are measured. These values differ from machine to machine and change with age; they are not guessed at, they are established. The kinetic energy carried by the moving mass is taken into account as well, because that energy affects the moment the probe stops and therefore the coordinate that is read.

The real response times of the control unit and of the probe at the moment of triggering are determined too. The year the machine was built and the technology of its control change these times; the same probe does not trigger at the same instant on two different machines. Once those times are established to high accuracy, the shift they would cause does not pass into the measurement result.

The result comes not from one component but from these determinations being made together. That is why a measurement taken from an aged machine can come close to one taken from a new machine: the software accepts the machine as it is and takes its real behaviour into account.

## Why a ball was used

The ball is the one geometry that behaves the same from every direction. Whichever way the probe approaches, it finds the same surface. That makes it a harder test of a measuring system's behaviour than a flat face or a bore: if there is deviation, there is nowhere for it to hide.

# 0.003 mm

average deviation of 45 points

largest single deviation 0.008 mm  
no point outside tolerance

## Measurement summary

|                   |                           |
|-------------------|---------------------------|
| Part measured     | Ø20 mm ball               |
| Number of points  | 45                        |
| Tolerance         | $\pm 0.030$ mm            |
| Within tolerance  | 45 points                 |
| Outside tolerance | none                      |
| Average deviation | 0.003 mm                  |
| Largest deviation | 0.008 mm                  |
| Machine           | 7 years old, 24 h running |

## How the report is produced

The report is produced by the software when the measurement ends; no table is filled in by hand. For every point the design coordinate, the measured coordinate, the tolerance values, the pass status and the deviation are set out side by side. At the top, the total number of measurements and the count of good and failed points stand as a summary. It is saved as PDF and passed into the quality system in Q-DAS / AQDEF format.

## Deviation of the 45 points

the dashed lines show the tolerance entered



<

CNC Probing System v Page 1 of 2

The analysis report produced by the software

# CNC Control

## Live machine monitoring and deviation alerts



The CNC Control screen. Axis positions, run and cycle time, part count, feed and spindle override, the running G-code, setup information and operator notes on one screen.

**What a machine produces is recorded. How long it does not produce usually is not. CNC Control closes that gap: it monitors the live state of the machine, reports a deviation the moment it happens, and transfers the program to the machine itself.**

### The whole machine on one screen

The software reads the state of the connected machines live. Axis positions, run time, cycle time, part count, feed and spindle override, the tool in use and the G-code line currently running are all on one screen. Setup information and operator notes are read from the same screen: part, material, datum, tool list and warnings are all on record.

### It notices the deviation

The software does not only record. When there is an unusual stop, a drop in running speed or an unnecessary lengthening of the cycle time, it raises an alert. The alert goes to three levels at once: the operator at the machine, the production control supervisor and the management. The problem is seen when it happens, not at the end of the shift. The improvement measured in the field reaches twenty per cent on downtime reduction and cycle time conformance combined.

### Program transfer over FTP

The program is sent to the machine directly from the computer. Carrying it by USB stick or CF card disappears. This is not only a time saving: loading the wrong version, copying a file incompletely and losing the card are common failures. When the transfer goes through the software, which program went to which machine and when is also recorded.

### Drawing and solid model on the same screen

2D technical drawings and 3D solid models can be viewed inside the software. The operator opens the drawing of the part at the machine

without leaving the program. Dimensions, clamping orientation and machining order are verified visually. No hunting for a paper drawing and no walk to the office.

### The next job is prepared in advance

A list of the G-code programs that have run is kept. Which tools and which fixturing the next program will need is visible in advance, so tool and part preparation happens while the machine is still cutting. When the program ends the machine moves straight to the next job.

### No modification to the control unit

The software reads data over the machine's own communication interface. The control unit is not modified, the program is not changed and no extra hardware is needed. Control units in common use across the industry are supported.

### Where the money comes from

Most of the saving comes not from scrap but from the time the machine is not cutting. The hourly cost of a machining centre is often higher than the material cost of the part made in that hour, so every minute of downtime is a direct cost.

Where programs are transferred by hand the machine waits at every program change, and loading the wrong version means scrap. If the next job is not prepared while the machine runs, it stops again the moment the program ends.

The slow lengthening of cycle time is the most insidious item. Nobody notices it because the machine appears to be running, yet the same part takes a little longer each time. CNC Control measures that drift, so the loss is stopped before it grows.

On the investment side there is no extra hardware: the software uses the existing communication interface of the machines.

## Monitored live

### Position and axis state

Absolute and relative axis positions

### Run and cycle time

Run time, cycle time, part count

### Feed and spindle

Feed override, spindle speed, rapid traverse

### Tool and part

Tool in use, part being machined, parameters

### G-code

Running program line and program list

### Downtime

Duration and reason for the stop

### Alarm

Alarm state from the control unit

### Setup and notes

Datum, tool list, operator warnings

## Who the alert reaches

- Operator**  
at the machine, instantly
- Production control supervisor**  
within the shift
- Management**  
daily summary

# %20

combined improvement in downtime and cycle time conformance

## Costs that disappear

- Machine downtime
- Waiting for program transfer
- Scrap from loading the wrong program
- Waiting for tool and fixture preparation
- Unnoticed lengthening of cycle time
- Leaving the machine to find a drawing
- Manual reporting at the end of the shift

## It works alongside measurement

CNC Probing gives the result of the measurement: is the part in tolerance, is the tool worn. CNC Control gives the flow of production: is the machine running, how fast, why did it stop. Used together, the record of both the part and the machine is unbroken.

# CNC Probing AutoFinish

NEW

A finishing cycle that measures, corrects and completes itself

**AutoFinish is a module inside CNC Probing. It takes the finishing program the user has created in their own CAM system, builds its own measuring and correction cycle around it, and runs the machine until the part reaches the required size. The operator and the programmer step out of the loop.**

The gain shows most clearly on the night shift. Because finishing no longer requires the operator to stand at the machine, one operator can take on several machines in a purely supervisory role. Personnel cost in finishing falls and shift planning becomes flexible; the gain to the business is larger than the software itself.

## How this is done today

When the finishing dimension does not come out right first time, the loop is run by hand. The operator cleans the machine and measures, the programmer edits the G-code by the amount of the error, the machine runs again and is measured again. Every pass occupies two people and the machine stands still throughout.

On free-form surfaces it is worse: they cannot be measured by the operator at the machine at all. The part is unclamped, sent to a CMM, and the result awaited. The moment it comes off, the clamping datum is lost as well.

## What it gains

The programmer leaves the loop. There is no G-code to edit by hand; the correction is made through the tool offset, inside the machine. Calling the programmer on every pass disappears.

Operator intervention ends. Measuring, cleaning and correcting are part of the cycle. Once it starts, nobody needs to wait at the machine; it can run outside shift hours.

The machine does not wait between passes. In the manual loop it stands still through measurement and editing; with AutoFinish the next pass starts at once.

Scrap risk falls. The cycle does not finish until the part reaches size, and measuring with a worn tool is prevented.

No trip to the CMM for free-form surfaces. Surfaces to the operator could not measure are measured within the cycle while the part is still clamped. The part does not leave the machine,

and because the clamping datum is preserved there is no need to re-datum.

## The original G-code is untouched

The user creates the finishing program in their own CAM software; which CAM makes no difference. The program is imported into AutoFinish. The module analyses the code, identifies which tool sits in which magazine pocket and builds a master G-code on top of it. Not a line of the original changes; the master code calls it.

## The feature is defined in the software

Which dimension is to be checked — a diameter or a width — is selected in CNC Probing and written to the machine with a dedicated macro. The target value and the tolerance are not extracted from the G-code; the user sets them.

On free-form surfaces the measurement uses point probing mode: readings are taken from points defined in advance on the surface and the deviation at each point is found. Because the probe can move in three axes at once, it approaches sloped and curved surfaces normal to the face; the correction follows that deviation.

## The tool is checked on every pass

When machining ends, the length and diameter of the tool are measured and compared with the values before use. If wear exceeds the limit set by the user the machine alarms and stops; below it, the cycle continues.

## Cleaning is part of the cycle

An air blast device is taken from the magazine and the machine interior and the part are cleaned. A reading taken from a surface still carrying swarf or coolant is misleading. The device can be supplied by the customer.

## The probe is verified every pass

The probe is taken from the magazine; its length and run-out are established again on every pass, immediately before the measurement relies on them.

## The user sets the number of passes

After the offset is updated the original G-code runs again. How many passes it will run is set by the user. The cycle stops the moment the dimension falls within tolerance; the remaining passes are not run. If the passes are used up and the dimension is still outside tolerance, the machine alarms.

## Operating conditions

- Finishing pass only; zero stock allowance
- The feature must be defined in the software
- The tool wear limit is entered by the user
- The number of passes is set by the user
- An air blast device must be in the magazine
- A probe must be in the magazine

## A CNC Probing module

AutoFinish is not separate software; it runs inside CNC Probing. The measuring infrastructure and the calibration values are shared.

## CAUTION

The module works on the finishing pass only. Stock allowance must be zero; it is not used for roughing.

## What the user does

There is no macro or line of G-code for the user to write. Once the finishing program has been produced in the user's own CAM software, four things are set in CNC Probing: which dimension is to be checked, the target value and tolerance, the tool wear limit and the number of passes. Starting the cycle comes after that; the module carries out the measuring, cleaning and correction steps in its own order.



### Night shift

Runs without an operator waiting

### One operator, many machines

Supervisory role only

### Programmer out of the loop

No G-code edited by hand

### No trip to the CMM

Free-form measured on the machine

# The AutoFinish cycle

## From the CAM system to a finished part, in ten steps

The cycle ends in the user's own CAM software and begins in AutoFinish. The first four steps are preparation and are done once. The remaining six run on the machine and repeat until the dimension is within tolerance.

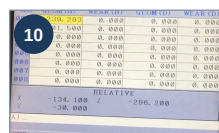
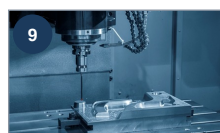
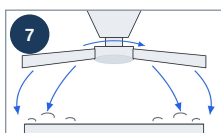
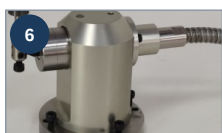
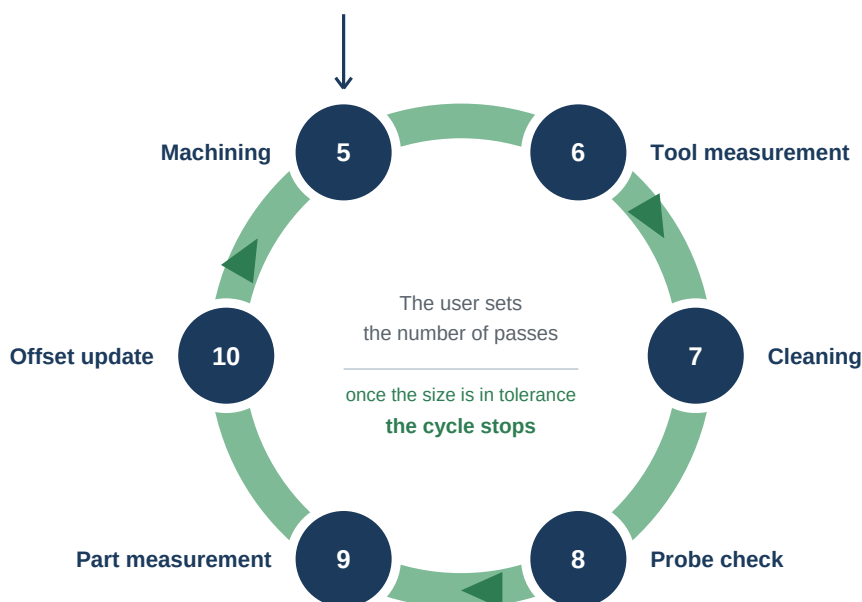
### Preparation

done once



### Cycle

the number of passes is set by the user



### How the cycle ends

#### The dimension is within tolerance

The cycle stops. Remaining passes are not run even if the set number has not been reached.

#### The tool wear limit is exceeded

The machine alarms and stops. Measuring with a worn tool is prevented.

#### Passes used up, dimension not reached

The machine alarms. The part is left to the operator.

# Catching a broken tool in cycle

## CNC Probing non-contact laser tool setters



CNC Probing non-contact laser tool setter. Transmitter and receiver face each other; when the tool enters the beam path the system produces a trigger signal.

**The most expensive failure in a machine shop is a broken tool noticed too late. A machine that does not stop at the moment of breakage keeps producing bad parts.**

In series production it is usually impossible to establish afterwards in which cycle a tool broke and why. The cost is not one scrap part: rework labour, machine standing time, a slipped delivery date and suspect parts going to the customer all count as well. A control system that catches breakage within the cycle removes all of these.

### No contact, no collision risk

The CNC Probing laser tool setter measures the tool without touching it. Transmitter and receiver face each other; when the tool enters the beam path the light reaching the receiver falls, and below the set threshold the system triggers. The axis position at that moment gives the true tool length; diameter is measured the same way. With no contact, even the smallest and most fragile cutters are checked without collision risk. A single check takes a few seconds.

### Measurement at working speed

The most important feature of this system is that measurement is taken while the tool turns at its own working speed. The result therefore includes not only the geometry of the cutter but also the deviation coming from the spindle and the tool holder. The dimension is obtained under real cutting conditions and can be corrected directly. A separate tool presetter is not needed; measured values are written automatically into the tool offset table.

### Control inside the cycle

The check is placed inside the machining cycle. The tool is measured before it starts work and again after it finishes. The difference shows the wear on the cutter; if it is outside

the expected value the tool has broken. The cycle is then stopped or a backup tool is called. The decision does not wait for the operator. Single-edge and form checking run in the same cycle.

### Built for shop-floor conditions

The optical surfaces are protected behind a pneumatic shutter that opens only during measurement; with the shutter closed, coolant and swarf cannot reach the lens. During measurement a curtain of clean compressed air continues to protect the optics. An air blast unit clears swarf and coolant from the tool immediately before measuring, which prevents false triggering. An anti-drip design and machine temperature compensation are standard.

The laser diode is switched on only for the duration of the measuring cycle. This reduces heating and power loss and extends diode life considerably. The system is connected to the CNC control unit through three enable lines.

### System components

The system consists of four main parts: laser transmitter, receiver, mounting plate and air blast module. The transmitter uses a spotting laser; the beam diameter is small and the centre of the light source is easy to adjust, which makes installation and alignment of the beam path easier. The air path is built into the housing and is normally open, so the beam path stays clean.

### Interface unit

The interface unit processes the signal from the laser system, converts it into an output the CNC control unit can read and passes it to the signal input of the control unit. The terminals are labelled individually for supply, laser on/off, pulse mode and skip inputs. Wiring must follow the user manual; incorrect connection can cause measurement error and hardware damage.



The laser beam falls on the tool; when the beam is broken the system triggers.



Interface unit and terminal connections.

## Specifications

### Measuring aperture

56 / 86 / 168 mm

### Repeatability

±1 µm (2σ)

### Connection

Hard-wired, 8 m standard

### Measuring functions

Tool length, tool diameter, broken tool detection, single-edge and form check

### Protection

Pneumatic shutter, clean air curtain, anti-drip

### Compensation

Machine temperature compensation

### Warranty

1 year

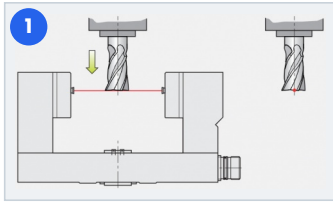
## Three measuring apertures

Three measuring apertures are offered: 56, 86 and 168 mm between transmitter and receiver, covering machines from small vertical machining centres to large-capacity ones. The connection is hard-wired; standard cable length is 8 metres and can be changed on request. The unit is delivered with the interface unit and the compressed air unit.

# Technical data and measuring functions

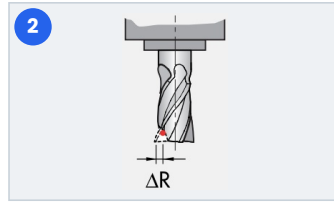
## CNC Probing non-contact laser tool setter

### Four measuring functions



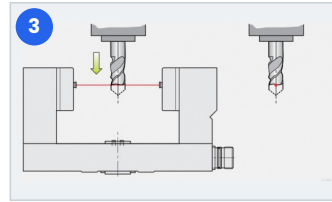
#### Tool length measurement

The tool descends into the beam path; when the beam breaks the axis position is read.



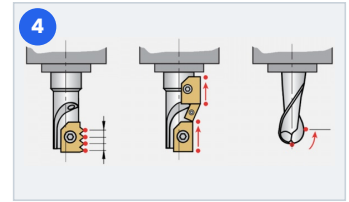
#### Tool diameter measurement

The cutter approaches the beam from the side to find diameter and wear ( $\Delta R$ ).



#### Broken tool detection

If the beam is not broken at the expected position, the tool has broken.



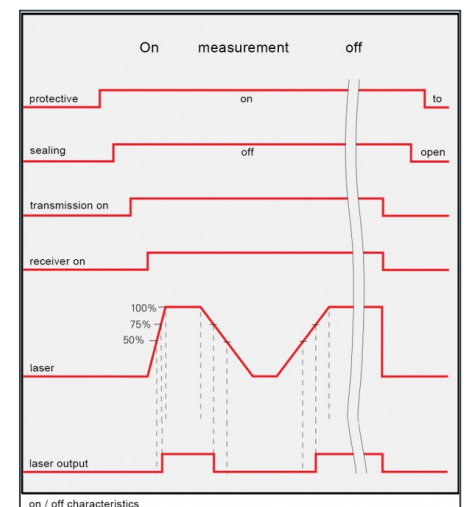
#### Single-edge and form check

Each cutting edge is checked individually; form error is detected.

### Parameters

| Parameter                                  | Value                                                                                                                                                                                        |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Principal application</b>               | High-precision, high-speed non-contact tool setting and broken tool detection on vertical and horizontal machining centres of all sizes, multi-tasking machines and gantry machining centres |
| <b>Beam alignment</b>                      | Supplied with an adjustable mounting plate on the underside                                                                                                                                  |
| <b>Connection (to interface)</b>           | Hard-wired system; cable at the end of the unit                                                                                                                                              |
| <b>Sealing</b>                             | IPX8                                                                                                                                                                                         |
| <b>Typical repeatability</b>               | $\pm 0.1 \mu\text{m}$ ( $2\sigma$ )                                                                                                                                                          |
| <b>Repeatability</b>                       | $\pm 1 \mu\text{m}$ ( $2\sigma$ )                                                                                                                                                            |
| <b>Minimum tool size</b>                   | $\varnothing 0.1 \text{ mm}$ or larger                                                                                                                                                       |
| <b>Maximum tool size</b>                   | 86 mm                                                                                                                                                                                        |
| <b>Minimum tool for breakage detection</b> | $\varnothing 0.1 \text{ mm}$ or larger                                                                                                                                                       |
| <b>Power</b>                               | 100 mA @ 24 V                                                                                                                                                                                |
| <b>Output signal</b>                       | Voltage-free solid state relay (SSR); each relay may be normally open. Max. current 50 mA, max. voltage $\pm 50 \text{ V}$                                                                   |
| <b>Storage temperature</b>                 | $-10 \text{ }^{\circ}\text{C} \dots 50 \text{ }^{\circ}\text{C}$                                                                                                                             |
| <b>Operating temperature</b>               | $5 \text{ }^{\circ}\text{C} \dots 50 \text{ }^{\circ}\text{C}$                                                                                                                               |
| <b>Life</b>                                | Tested to more than 1 million on/off cycles                                                                                                                                                  |
| <b>Pneumatic supply</b>                    | 4 mm air pipe; 6.0 bar maximum, 3.0 bar minimum                                                                                                                                              |
| <b>Cable</b>                               | $\varnothing 6.0 \text{ mm} \times 8 \text{ m}$ ; two twisted pairs, two individual cores plus screen, each core $18 \times 0.1 \text{ mm}$ insulated                                        |
| <b>Mounting</b>                            | M10                                                                                                                                                                                          |

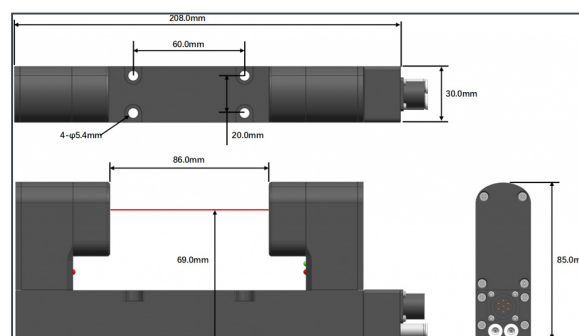
### On / off characteristics



State of the protective shutter, transmitter, receiver and laser output over the measuring cycle.

The laser system is switched on by the CNC control unit through three enable lines. The transmitter signal turns the laser beam on or off; to minimise heating and power loss the diode stays on only during the measuring cycle. When the receiver is enabled, the operating mode of the protective shutter is determined by the corresponding measuring cycle. Once transmitter and receiver are enabled, if the light reaching the receiver is at least 75 per cent of the maximum value, the output signal of the system is used as the trigger signal.

### Dimensions



Dimensions are in millimetres. Beam aperture 86 mm, beam height 69 mm, body length 208 mm. Four  $\varnothing 5.4 \text{ mm}$  holes for mounting; hole spacing 60 and 20 mm.

# Measure the tool on the machine

## S5TS contact tool setter — length, diameter and breakage detection



S5TS contact tool setter. Measurement is taken on the cylindrical contact surface beside the body.

Setting tool length by hand is one of the largest sources of idle time on a machining centre. On small-diameter cutters, breakage often goes unnoticed and bad parts pass on to the next operation. S5TS solves both problems inside the machine's own cycle.

### Length and diameter with one device

S5TS measures both tool length and tool diameter. Both measurements are taken on the same contact surface: the cylindrical contact element carried on a vertical stem beside the body. For length the tool descends onto the top face of this element; for diameter it approaches its side face. The part above the body is not the contact surface but a protective cap.

Both measurements are taken in the same cycle and the values are written directly into the tool offset table. Devices that measure length alone cannot see diameter wear; S5TS closes that gap.

### Kinematic resistive triggering

The device works on the kinematic resistive principle. The contact element sits on three ball seats under spring force; when it touches a surface the contact area in the seats reduces, resistance rises and a signal is produced. When contact is released the mechanism reseats itself within 1 micron. This reseating stability is the basis of repeatability.

Pre-travel is zero: triggering happens at the moment of contact and does not wait for the element to travel a distance. Over-travel protection is  $\pm 12.5^\circ$  in the XY plane and 6.35 mm in Z. Trigger life is more than 10 million operations and the contact surfaces are tungsten carbide.

### Wear and breakage inside the cycle

The tool is measured before it starts work and again after it finishes. The difference between the two measurements shows the wear. When the difference exceeds the permitted value the machine raises an alarm and reports that compensation is needed; in the case of breakage the cycle is stopped. The decision does not wait for the operator.

### Shop-floor conditions

The body is sealed to IP68 and has a double-protection structure; coolant and swarf cannot reach the mechanism. The cable is oil resistant, 3 metres as standard and can be changed on request. The minimum bending radius is R7. The LED on the device is normally off and lights at the moment of triggering, so operation can be confirmed visually.

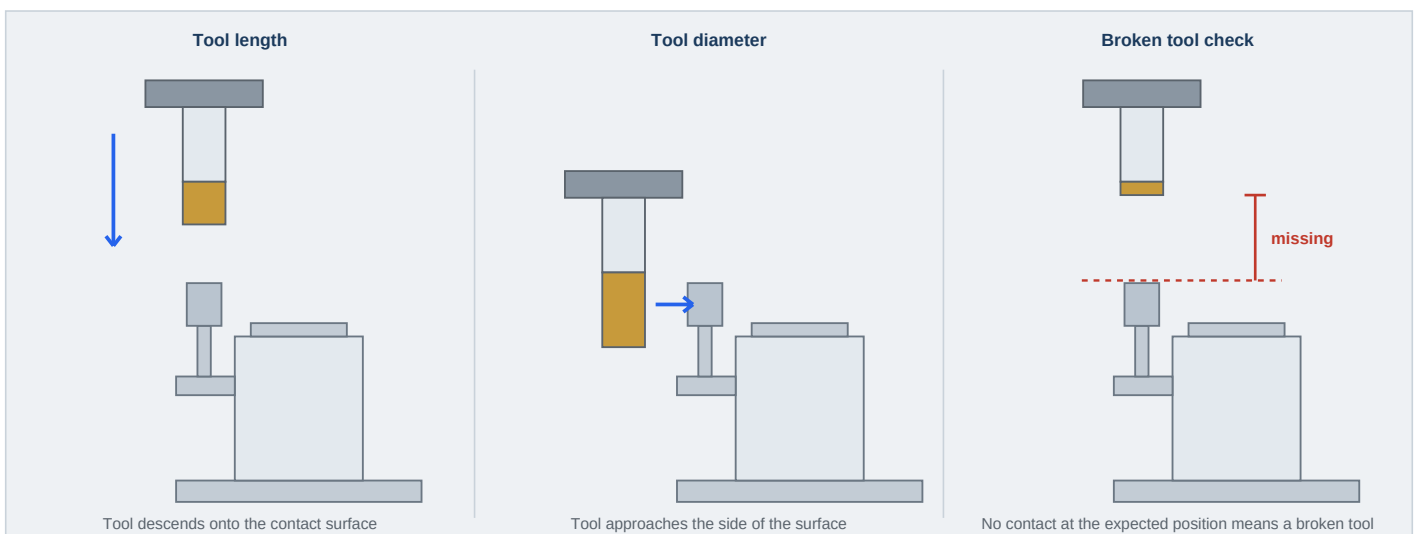
Supply is 24 V DC, 20 mA. The output is a normally open contact. Because the signal is transmitted by cable there are no battery, pairing or line-of-sight issues. Control units in common use across the industry are supported.

### Specifications

|                               |                                                            |
|-------------------------------|------------------------------------------------------------|
| <b>Model</b>                  | S5TS                                                       |
| <b>Measurement</b>            | Tool length and diameter;<br>broken tool detection         |
| <b>Sensing directions</b>     | 5 directions ( $\pm X$ , $\pm Y$ , $\pm Z$ )               |
| <b>Repeatability</b>          | 1 $\mu\text{m}$                                            |
| <b>Pre-travel</b>             | 0                                                          |
| <b>Over-travel protection</b> | XY: $\pm 12.5^\circ$<br>Z: 6.35 mm                         |
| <b>Contact force</b>          | XY: 0.4 – 0.8 N<br>Z: 4.0 N                                |
| <b>Trigger life</b>           | More than 10 million                                       |
| <b>Contact material</b>       | Tungsten carbide                                           |
| <b>Smallest tool detected</b> | $\varnothing 1.0$ mm                                       |
| <b>Sealing</b>                | IP68, double protection                                    |
| <b>Signal transmission</b>    | Hard-wired                                                 |
| <b>Output</b>                 | Normally open contact                                      |
| <b>Supply</b>                 | 24 V DC, 20 mA                                             |
| <b>Cable</b>                  | Oil resistant, 3 m standard<br>(minimum bending radius R7) |
| <b>Surface finish</b>         | Ground                                                     |
| <b>LED</b>                    | Normally off,<br>lights on triggering                      |

### Where it is used

- Standard solution on machines where a cable can be routed
- Machines whose table does not need to rotate
- Machining centres of every size, small to large
- Engraving and precision machining centres



The repeatability figure is that of the device itself; the positioning error of the machine is not included. Accuracy achieved in the field depends on how the device and the machine behave together.

# Wireless, and sharing one receiver

SOTS wireless tool setter — uses the same receiver as the probe



SOTS wireless tool setter. It consists of a measuring probe, bracket and stylus kit, and is fixed to the machine table.

Routing a cable to a tool setter is not possible on every machine. If the table moves, if the cable duct is full, or if the device is removed and refitted often, the cable becomes a limitation. SOTS offers the same measuring mechanism without a cable.

## Same mechanism, without the cable

SOTS uses the same kinematic resistive mechanism as the hard-wired model. The contact element sits on three ball seats under spring force; at contact the resistance rises and a signal is produced. Repeatability is 1 micron and trigger life is more than 10 million operations. Pre-travel is zero. Over-travel protection is  $\pm 12.5^\circ$  in the XY plane and 6.35 mm in Z. The body is sealed to IP68 and the contact surfaces are tungsten carbide.

The measurements are the same as well: tool length and diameter are measured, wear is monitored and breakage is detected within the cycle. The only difference is how the signal is transmitted.

## Modular design

SOTS is not a stand-alone device. It consists of a measuring probe, a bracket and a stylus kit. The probe is mounted on the bracket and the bracket is fixed to the machine table. This design provides two things: there is no cable, and the device can be removed and moved to another machine in minutes.

## Automated tool setting

The tool length is measured to establish the height offset and to check that the length is within tolerance. The diameter is measured while the tool turns at its own speed, and the tool size offset is set from that value. Errors from manual setting and manual data entry disappear.

## In-process control

Broken tools are detected during machining. Tool wear is compensated using measurements taken between machining steps. When wear exceeds the permitted value the machine raises an alarm and reports that compensation is needed. Control units in common use across the industry are supported.

## Specifications

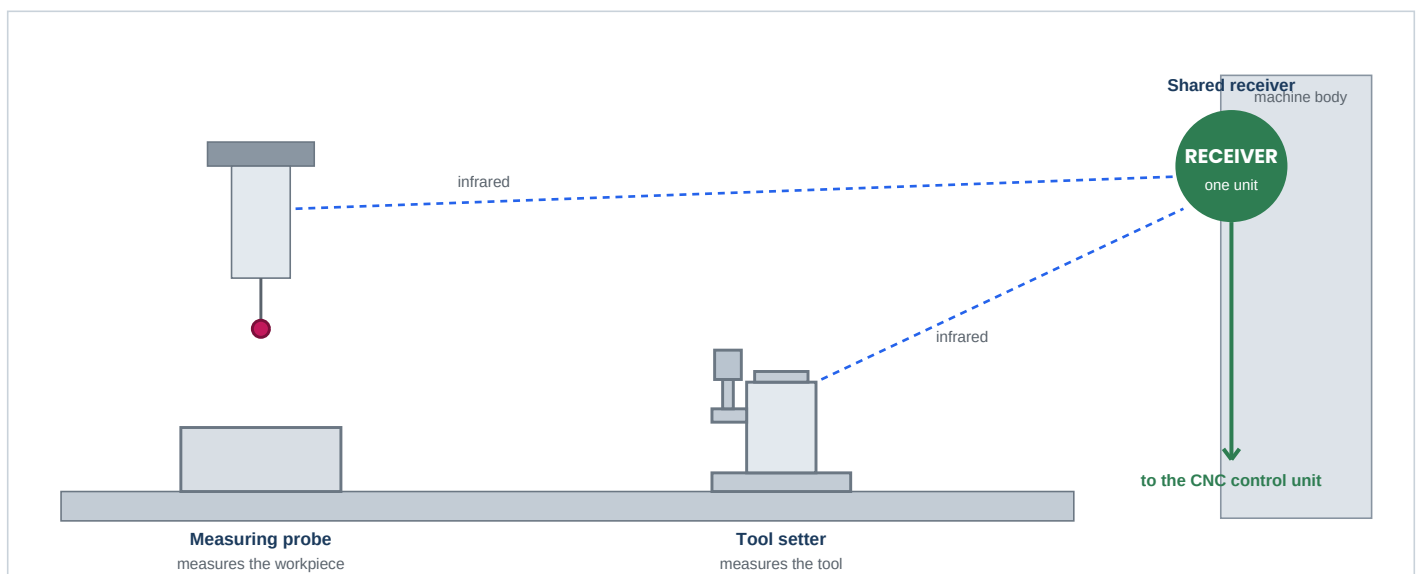
|                               |                                           |
|-------------------------------|-------------------------------------------|
| <b>Model</b>                  | SOTS                                      |
| <b>Output</b>                 | Normally open contact                     |
| <b>Sensing directions</b>     | 5 directions ( $\pm X$ , $\pm Y$ , $+Z$ ) |
| <b>Repeatability</b>          | 1 $\mu\text{m}$                           |
| <b>Pre-travel</b>             | 0                                         |
| <b>Over-travel protection</b> | XY: $\pm 12.5^\circ$<br>Z: 6.35 mm        |
| <b>Contact force</b>          | XY: 0.4 – 0.8 N<br>Z: 4.0 N               |
| <b>Trigger life</b>           | More than 10 million                      |
| <b>Contact material</b>       | Tungsten carbide                          |
| <b>Smallest tool detected</b> | $\varnothing 1.0\text{ mm}$               |
| <b>Sealing</b>                | IP68                                      |
| <b>Signal transmission</b>    | Infrared, wireless                        |
| <b>Output type</b>            | Normally open contact                     |
| <b>Receiver</b>               | Shared with the probe                     |
| <b>Surface finish</b>         | Ground                                    |

## What going wireless gives you

- Can be used on machines where no cable can be routed
- No cable problem on machines with a moving table
- Can be removed and relocated in minutes
- Shares the same receiver as the probe

## One receiver, two devices

SOTS uses the same receiver as the measuring probe. Bought together, no second receiver is needed; the macro program selects which device runs.



The repeatability figure is that of the device itself; the positioning error of the machine is not included. Accuracy achieved in the field depends on how the device and the machine behave together.

# Let the probe find the datum

CNC Probing infrared measuring probe — 1 micron repeatability



CNC Probing infrared measuring probe. It mounts in the spindle taper; transmission is 360 degrees around the probe axis.

**Finding the datum by hand after clamping a part takes time and leaves an error source that depends on the operator. A measuring probe does this automatically: it locates the part, writes the work coordinates and verifies the dimension before cutting begins.**

The CNC Probing infrared measuring probe is a unit that mounts in the spindle taper. Before machining it establishes the coordinates of the workpiece and removes incoming material error. During and after machining it takes dimensions such as flatness, distance, angle and bore diameter. Quality control is thereby moved inside the machine; scrap falls and the machine is not stopped for measurement.

## Kinematic resistive design

The probe works on the kinematic resistive principle, proven in the industry over a long period. The stylus sits on three ball seats under spring force and a current passes through those seats. When the stylus touches a surface the contact area between the balls reduces, resistance rises and the system produces a trigger signal. When contact is released the spring reseats the stylus.

The balls and rods go through a special process that provides a trigger life of 10 million operations. In addition, a micro-oscillation

self-reset design eliminates the unstable repeatability often seen in probes of this type. With a standard 50 mm stylus at 600 mm/min, unidirectional repeatability is 1 micron.

## Uninterrupted signal transmission

Signal transmission uses coded optical communication; transmission is stable, response is fast and no signal is lost. A dual-channel design with remote frequency change solves the problem of infrared probes interfering with one another in the same workshop. Transmission is 360 degrees around the probe axis and the operating range is 5 metres.

## Long battery life

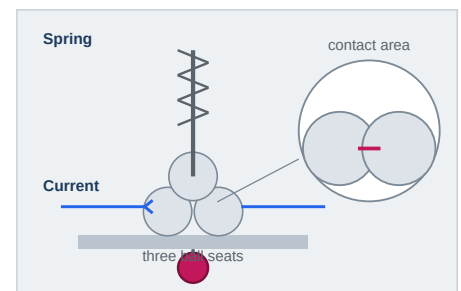
The probe uses multi-threshold power consumption control. Consumption has been reduced through improved chip and circuit design. Battery life is more than 360 days in continuous use, more than 540 days at five per cent use and more than 600 days on standby. The batteries are standard LS14250 lithium cells and are easy to source.

## Magnetic base for easy mounting

Mounting the receiver usually requires drilling holes in the machine. The CNC Probing receiver is supplied with a magnetic base; the receiver is attached to the base and the base to the sheet metal of the machine. Installation takes minutes,

## Specifications

|                                     |                                                                  |
|-------------------------------------|------------------------------------------------------------------|
| <b>Model</b>                        | SOMP40                                                           |
| <b>Unidirectional repeatability</b> | 1 µm (2σ)<br>(50 mm stylus, 600 mm/min)                          |
| <b>Sensing directions</b>           | ±X, ±Y, +Z                                                       |
| <b>Trigger force</b>                | XY: 0.4 – 0.8 N<br>Z: 4.0 N                                      |
| <b>Over-travel protection</b>       | XY: ±15°<br>Z: 6.35 mm                                           |
| <b>Signal transmission</b>          | Infrared, pulse triggered                                        |
| <b>Operating range</b>              | 5 m                                                              |
| <b>Transmission angle</b>           | 360° around the probe axis                                       |
| <b>Trigger life</b>                 | More than 10 million                                             |
| <b>Weight</b>                       | 280 g (excluding shank, with batteries)                          |
| <b>Battery</b>                      | 2 × lithium LS14250                                              |
| <b>Battery life</b>                 | Standby > 600 days<br>5% use > 540 days<br>Continuous > 360 days |
| <b>Sealing</b>                      | IP68                                                             |
| <b>Operating temperature</b>        | 0 – 60 °C                                                        |
| <b>Certification</b>                | ISO 9001                                                         |

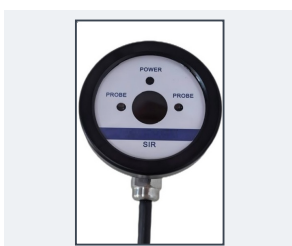


Kinematic resistive principle: at contact the area between the balls reduces, resistance rises and the probe triggers.

no holes are drilled and the receiver can be moved elsewhere if needed.

## When longer range is needed

Infrared transmission requires a clear line of sight between transmitter and receiver. On large-capacity machines, or in applications where the line of sight is broken, the radio probe model is used.



Receiver unit



Magnetic mounting base



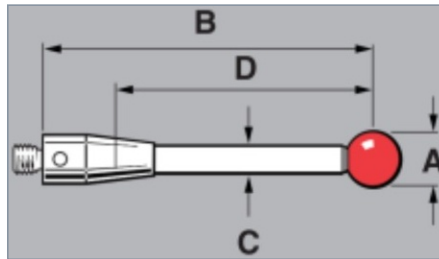
LS14250 lithium batteries

# The smallest part that decides the measurement

## CNC Probing styli — selection guide and dimension tables



Ruby, ceramic, steel and carbon fibre styli together.



A ball diameter · B overall length · C stem diameter · D effective working length (EWL).



Cylinder stylus, ceramic extension and straight stylus with extension.

The stylus is the only part of the probe that touches the workpiece. If the roundness of the ball is poor, if the stem bends or if the thread tolerance is large, the measurement is corrupted however precise the probe is. A wrongly chosen stylus can reduce measuring accuracy by as much as ten per cent.

### Straight styli

This is the most common type and is used for the majority of measurements. Stems may be shouldered or tapered; where the workpiece is easy to reach, a tapered stem gives higher rigidity. Ball materials include ruby, silicon nitride, zirconia, ceramic and tungsten carbide. Stem and holder materials are titanium, tungsten carbide, stainless steel, ceramic and carbon fibre.

### Cylinder styli

On sheet metal, pressed components and thin-walled workpieces, proper contact cannot be guaranteed with a ball stylus; a cylinder stylus is used instead. Thread profiles can also be probed and the centres of tapped holes located with this type. Ball-ended cylinder styli allow datuming in all three of the X, Y and Z directions, so surface inspection can be carried out as well.

### Extensions

Extensions are used for very deep pockets and bores, or for points that are hard to reach. Every joint adds a point of deflection, so extensions are best avoided unless they are needed.

Styli are produced in standard and custom sizes. Ball diameter, overall length, stem diameter and effective working length are all given in the dimension tables on the following page. If a geometry not listed in the tables is required, custom production is possible.

### Choosing the material

Tungsten carbide gives high rigidity and is preferred for small stem diameters and shouldered styli. With large stem diameters and long styli, however, its weight needs attention. Ceramic is light and is therefore used for long styli; it is thermally stable and provides break protection in machine tool applications. Steel gives high rigidity in standard applications where weight is not an issue. Carbon fibre weighs about one fifth of tungsten carbide and is the best choice for very long styli and for production environments needing thermal stability.

### Three rules when choosing a stylus

#### 1 Choose by the material being machined

On hard workpieces use stainless steel or tungsten carbide styli; bending during measurement is then minimal. Do not use ruby balls on aluminium or cast iron — adhesion and wear occur and the measurement is corrupted.

#### 2 Short styli and large balls are more accurate

A short stem reduces the chance of bending and deformation. A larger ball diameter generally gives higher accuracy. Keeping the number of parts low reduces the risk of deflection at the joints.

#### 3 Take vibration into account

On machines with high vibration use carbon fibre styli; damping is good and the risk of collision and breakage falls. Avoid ceramic styli on machines where vibration is pronounced.

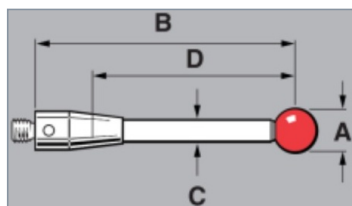
## Selection by stem material

| Material                | Weight     | Rigidity      | Where it is used                                                      |
|-------------------------|------------|---------------|-----------------------------------------------------------------------|
| <b>Tungsten carbide</b> | Heavy      | Very high     | Small stem diameters and shouldered styli; most standard applications |
| <b>Ceramic</b>          | Light      | Medium – high | Long styli; thermal stability and break protection on the machine     |
| <b>Steel</b>            | Heavy      | High          | Standard applications where weight is not an issue                    |
| <b>Carbon fibre</b>     | Very light | Medium        | Very long styli; machines with high vibration                         |

Ball material is chosen separately: ruby, silicon nitride, zirconia, ceramic or tungsten carbide. Holder and stem materials are titanium, tungsten carbide, stainless steel, ceramic and carbon fibre.

# Dimension tables

## CNC Probing styli — standard dimensions



### Meaning of the letters in the tables

- A** Ball diameter (mm)
- B** Overall length (mm)
- C** Stem diameter (mm)
- D** Effective working length — EWL (mm)

All styli have an M4 connecting thread. Model codes refer to standard sizes; for custom sizes please contact the sales department.

### Ruby ball styli with tungsten carbide stems

| No. |             | M4-DWB20-1.0 | M4-DWB20-2.0 | M4-DWB50-2.0 | M4-DWB20-3.0 | M4-DWB50-3.0 | M4-DWB20-4.0 | M4-DWB50-4.0 | M4-DWB20-5.0 | M4-DWB50-5.0 | M4-DWB20-6.0 | M4-DWB50-6.0 |
|-----|-------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| A   | Ball dia/mm | 1.0          | 2.0          | 2.0          | 3.0          | 3.0          | 4.0          | 4.0          | 5.0          | 5.0          | 6.0          | 6.0          |
| B   | Length/mm   | 20.0         | 20.0         | 50.0         | 20.0         | 50.0         | 20.0         | 50.0         | 20.0         | 50.0         | 20.0         | 50.0         |
| C   | Stem dia/mm | 0.7          | 1.5          | 1.5          | 2.0          | 2.0          | 2.0          | 2.0          | 2.5          | 2.5          | 2.5          | 2.5          |
| D   | EWL/mm      | 10.0         | 10.0         | 40.0         | 8.5          | 40.0         | 8.5          | 40.0         | 7.9          | 35.0         | 10.7         | 35.0         |

### Ruby ball styli with ceramic stems

| No. |             | M4-DPB50-4.0 | M4-DPB50-5.0 | M4-DPB75-5.0 | M4-DPB100-5.0 | M4-DPB50-6.0 | M4-DPB75-6.0 | M4-DPB100-6.0 | M4-DPB150-6.0 |
|-----|-------------|--------------|--------------|--------------|---------------|--------------|--------------|---------------|---------------|
| A   | Ball dia/mm | 4.0          | 5.0          | 5.0          | 5.0           | 6.0          | 6.0          | 6.0           | 6.0           |
| B   | Length/mm   | 50.0         | 50.0         | 75.0         | 100.0         | 50.0         | 75.0         | 100.0         | 150.0         |
| C   | Stem dia/mm | 3.0          | 3.8          | 3.8          | 3.8           | 4.5          | 4.5          | 4.5           | 4.5           |
| D   | EWL/mm      | 40.0         | 35.0         | 60.0         | 85.0          | 35.0         | 60.0         | 85.0          | 135.0         |

### Cylinder styli

| NO.               | M4-DWP10-0.5 | M4-DWP20-1.0 | M4-DWP20-2.0 |
|-------------------|--------------|--------------|--------------|
| Cylinder dia/mm   | 0.5          | 1.0          | 2.0          |
| Overall length/mm | 10.0         | 20.0         | 20.0         |
| EWL/mm            | 5.0          | 10.0         | 10.0         |

### Extensions

| NO.         | M4-DPP30 | M4-DPP50 | M4-DPP100 |
|-------------|----------|----------|-----------|
| length/mm   | 30.0     | 50.0     | 100.0     |
| Stem dia/mm | 7.4      | 7.4      | 7.4       |

### What to state when ordering a stylus

- **Ball diameter** A larger ball measures more accurately; a smaller ball reaches into narrow places.
- **Overall length** Choose the shortest length that reaches the deepest point.
- **Stem material** Decided by the vibration behaviour of the machine.
- **Ball material** Ruby is not used on aluminium or cast iron.
- **Connecting thread** M4 as standard; state if a different thread is required.

# The part that seats the probe in the spindle

## CNC Probing tool holders — BT, HSK, SK and CAT



CNC Probing probe tool holders. Every holder is delivered with its pull stud and centring adjustment screws.

The probe is mounted in the spindle taper with a tool holder. The job of the holder is not only to hold: it seats the probe in line with the spindle axis. If the holder is chosen wrongly, or if centring is not carried out, every measurement carries a constant deviation however precise the probe is.

### Two pieces of information are enough

Choosing the right holder requires two things to be known: the spindle taper of the machine and the body diameter of the probe. The taper is read from the machine model; the body diameter is 11.2 mm or 20 mm depending on the probe model chosen. The model code combines these two.

### Four taper families

The range covers BT, HSK, SK and CAT tapers. BT and SK series are common on machining centres of Japanese and European origin, the CAT series on machines of American origin, and the HSK series on high-speed and precision machining centres. Both E and A type bodies are available in the HSK family.

### Pull stud and adjusting screws included

Every holder is delivered together with its pull stud and centring adjustment screws. No separate parts need to be ordered. The adjusting screws bring the stylus tip in line with the spindle axis; this adjustment is made once when the probe is first fitted.

After mounting, probe calibration is run. Calibration measures the residual deviation coming from the holder and probe combination, and the software takes this into account in all subsequent measurements. Error from the holder therefore does not pass into the measurement result.

### Selection in four steps

- 1 Identify the spindle taper**  
BT, HSK, SK or CAT; read from the machine model.
- 2 Identify the taper number**  
For example BT40, HSK63A, SK50.
- 3 Identify the probe body diameter**  
11.2 or 20 mm depending on the probe model.
- 4 Build the model code**  
Taper and body diameter combine.

### How to read the code

#### CP-BT40-D11.2

BT40 taper · 11.2 mm probe body diameter

In the HSK family, E and A types are stated separately.

## Model list

| BT series     | HSK series      | SK series     | CAT series     |
|---------------|-----------------|---------------|----------------|
| CP-BT30-D11.2 | CP-HSK25E-D11.2 | CP-SK30-D11.2 | CP-CAT30-D11.2 |
| CP-BT30-D20   | CP-HSK32E-D11.2 | CP-SK40-D11.2 | CP-CAT40-D11.2 |
| CP-BT40-D11.2 | CP-HSK40E-D11.2 | CP-SK50-D11.2 | CP-CAT50-D11.2 |
| CP-BT40-D20   | CP-HSK50E-D11.2 | CP-SK40-D20   | CP-CAT50-D20   |
| CP-BT50-D11.2 | CP-HSK63E-D11.2 | CP-SK50-D20   |                |
| CP-BT50-D20   | CP-HSK63A-D20   |               |                |
|               | CP-HSK100A-D20  |               |                |

# Choosing the right product

## Answer three questions and the product chooses itself

Most on-machine measurement products look alike. The difference does not show in the specification list; it shows where the product is used. A wrongly chosen device will work, but it will not give the benefit expected: the signal drops out, the measurement you need cannot be taken, or the device does not fit on the machine. Reducing the choice to three questions removes that risk.

### 1. What are you going to measure?

There are two product groups and they do different jobs. A probe measures the workpiece: it finds the datum while the part is still clamped, takes dimensions and checks flatness and angles. A tool setter measures the tool: its length and diameter, plus wear and breakage.

In most workshops both are needed. A measurement taken from the workpiece can only be calculated correctly when the true length and diameter of the tool are known. Measurement without tool control shows wear as if it were an error of the part.

### 2. How will the signal be transmitted?

There are three transmission types; the choice follows the size of the machine and the geometry of the part. Optical transmission requires a clear line of sight; it is the most economical solution on small and medium vertical machining centres, with an operating range of 5 metres.

Radio transmission needs no line of sight, as the signal passes behind obstacles. It is the right choice for deep mould cavities, large workpieces, gantry machines and five-axis applications.

Hard-wired transmission has no battery and no signal loss. However, because a cable is attached, the device stays in a fixed position and cannot be used with a tool changer. As tool setters sit fixed on the table, hard wiring is not a limitation there but an advantage.

### 3. Which measurement do you need?

CNC Probing tool setters measure both length and diameter. Devices measuring length alone are cheaper but cannot see diameter wear. Unnoticed, that wear drifts the part out of tolerance, and through the probe it looks like an error of the part. Such devices are not in our range.

### What completes the choice

#### 1 Tool holder

A holder matching the spindle taper of the machine is required to mount the probe. BT, HSK, SK and CAT families are available.

#### 2 Stylus

Selected according to the geometry to be measured and the workpiece material. Ball diameter, length, stem material and ball material are specified.

#### 3 Software

The hardware collects points; what turns those points into geometry, tolerance and a report is the software. Eight measuring modes are ready to use and no macro writing is required.

## Tool setter comparison

|                        | S5TS                                                      | SOTS                                                      | SNC86                                                            |
|------------------------|-----------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------------|
| Type                   | Contact                                                   | Contact                                                   | Non-contact, laser                                               |
| Signal generation      | Kinematic resistive                                       | Kinematic resistive                                       | Laser beam interruption                                          |
| Transmission           | Hard-wired, 3 m                                           | Radio                                                     | Hard-wired                                                       |
| Measurement            | Length and diameter                                       | Length and diameter                                       | Length and diameter                                              |
| Broken tool detection  | Yes                                                       | Yes                                                       | Yes                                                              |
| Smallest tool detected | Ø1.0 mm                                                   | Ø1.0 mm                                                   | Ø0.1 mm                                                          |
| Repeatability          | 1 µm                                                      | 1 µm                                                      | ±1 µm                                                            |
| Machine size           | Small to large                                            | Small to large                                            | Small to large                                                   |
| Where it is preferred  | Standard solution on machines where a cable can be routed | On machines where cabling is difficult or the table moves | For very small tools and work where the tool must not be touched |

## Measuring probe comparison

|                         | Optical                                   | Radio                              | Hard-wired            |
|-------------------------|-------------------------------------------|------------------------------------|-----------------------|
| Line of sight           | Required                                  | Not required                       | Not relevant          |
| Operating range         | 5 m                                       | Longer                             | Cable length          |
| Battery                 | Yes                                       | Yes                                | No                    |
| Mounts in spindle taper | Yes                                       | Yes                                | No                    |
| Suitable machine        | Small to medium vertical machining centre | Large, gantry, five-axis           | Lathe, fixed mounting |
| Suitable part           | Small and medium parts                    | Deep cavities, moulds, large parts | Turned parts          |

Repeatability figures are those of the device itself; the positioning error of the machine is not included. Accuracy achieved in the field depends on how the device and the machine behave together.

# User manual

## S5TS contact tool setter — length, diameter and breakage detection

### 1. About this manual

This manual covers the installation, connection and use of the CNC PROBING S5TS contact tool setter. The device measures tool length and diameter, monitors wear and detects broken tools.

The manual describes the hardware only. Measuring cycles, cycle codes and the macro programs to be used are explained in the CNC Probing application.

#### CAUTION

Read this manual before installing the device. Incorrect mounting and incorrect contact method will destroy repeatability and can cause permanent damage.

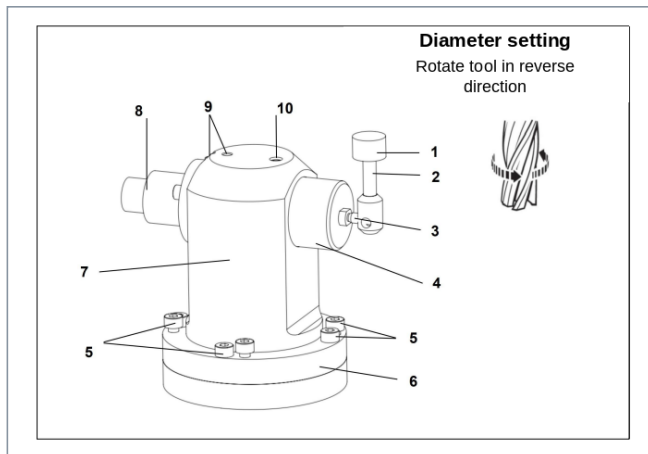
#### Safety

- When positioning the device manually or automatically, make sure the feed of the machine stops immediately if the stylus is unexpectedly deflected.
- Use only the original spare parts listed in this manual for maintenance and repair.

#### Validity

This document applies to the hardware valid at the date of issue. The right to make technical changes is reserved.

### 2. Parts of the device



Parts of the device, and reverse rotation of the tool for diameter measurement.

- |                               |                      |
|-------------------------------|----------------------|
| 1 Stylus                      | 6 Base               |
| 2 Stylus holder               | 7 Body               |
| 3 Break stem                  | 8 Cable              |
| 4 Probe                       | 9 Probe fixing screw |
| 5 Levelling adjustment screws | 10 Indicator lamp    |

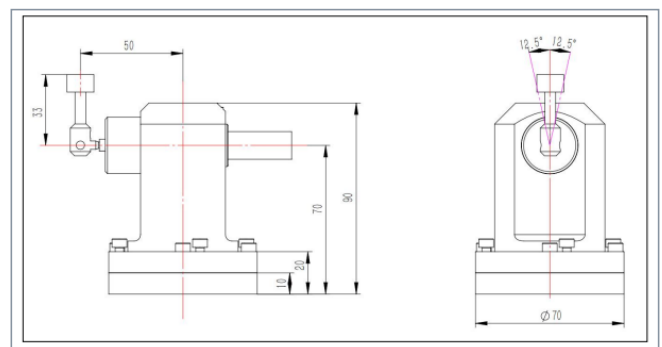
Measurement is made with the stylus fitted to the probe on the side of the body. The stylus attaches to the stylus holder, and the holder to the break stem.

#### Break stem

The break stem is a safety part. When the stylus over-travels, the stem breaks at its weakest point and prevents damage to the probe mechanism. A broken stem does not mean a faulty device: fit a new break stem and stylus, then repeat levelling.

### 3. Specifications

|                     |                                                                                                            |
|---------------------|------------------------------------------------------------------------------------------------------------|
| Model               | S5TS-L                                                                                                     |
| Output              | Normally open contact                                                                                      |
| Sensing directions  | 5 directions ( $\pm X$ , $\pm Y$ , $+Z$ )                                                                  |
| Pre-travel          | 0                                                                                                          |
| Travel              | $\pm 12.5^\circ$ , Z 6.35 mm                                                                               |
| Repeatability       | Less than 1 $\mu\text{m}$                                                                                  |
| Trigger life        | More than 10 million                                                                                       |
| Protection class    | IP68                                                                                                       |
| Contact force       | XY: 0.4 – 0.8 N · Z: 4.0 N                                                                                 |
| Signal transmission | Hard-wired                                                                                                 |
| Contact material    | Tungsten carbide                                                                                           |
| Surface finish      | Ground                                                                                                     |
| Supply              | 24 V DC, 20 mA                                                                                             |
| Cable               | Oil resistant, 3 m standard (custom lengths available), minimum bending radius R7                          |
| Indicator lamp      | Normally off, lights on triggering                                                                         |
| Dimensions          | Body height 90 mm · Base diameter $\varnothing 70$ mm · Stylus centre distance 50 mm · Stylus height 33 mm |



Device dimensions. Dimensions are in millimetres.

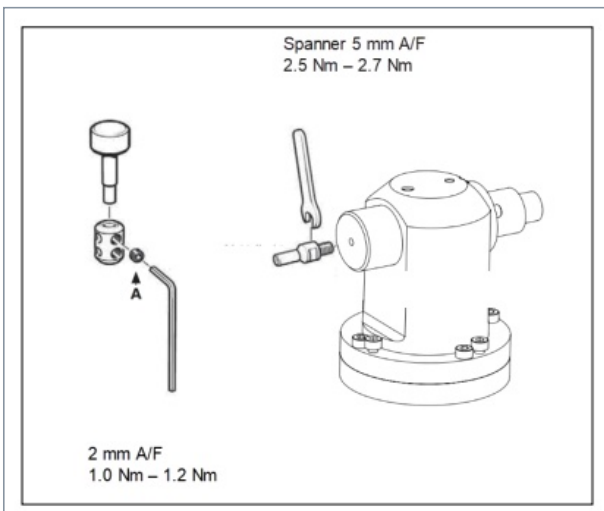
## 4. Installation

### 4.1 Installation sequence

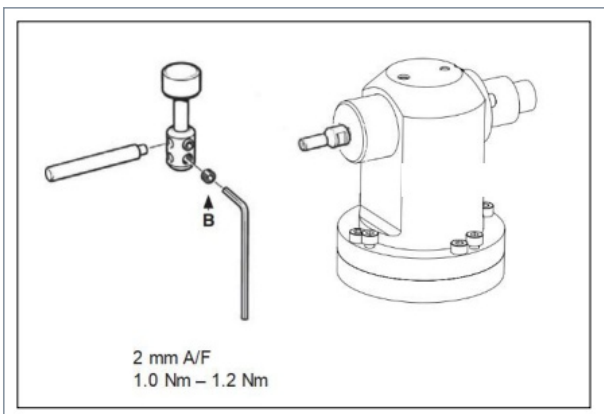
- 1 Clear the worktable and select the installation position.
- 2 Remove the lower base using a 4 mm hex wrench.
- 3 Secure the lower base to the worktable with T-bolts (not supplied).
- 4 Fit the stylus (section 4.2).
- 5 Refit the device on the lower base and tighten the two locking screws. Do not tighten the adjusting screws before levelling.
- 6 Level the stylus (section 4.3).
- 7 Make the electrical connection (section 5).
- 8 Check the output signal and the measurement (sections 6 and 7).

### 4.2 Fitting the stylus

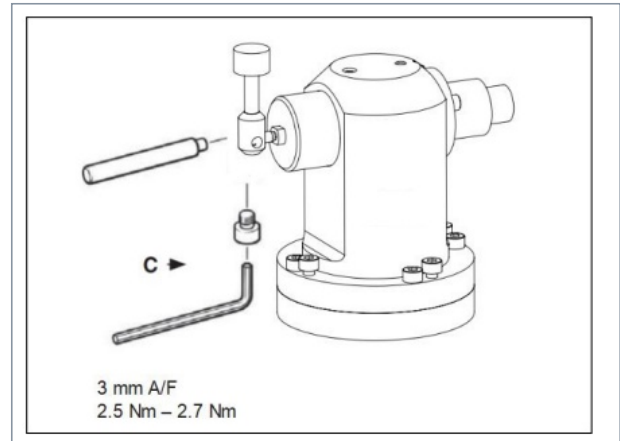
The stylus is retained in the stylus holder by tightening grub screw A. The holder and stylus are placed onto the break stem, grub screw B is fitted loosely, then screw C is fitted into the stylus holder and all screws are tightened.



Screw A: 2 mm hex, 1.0 – 1.2 Nm. Support bar: 5 mm spanner, 2.5 – 2.7 Nm.



Screw B: 2 mm hex, 1.0 – 1.2 Nm.



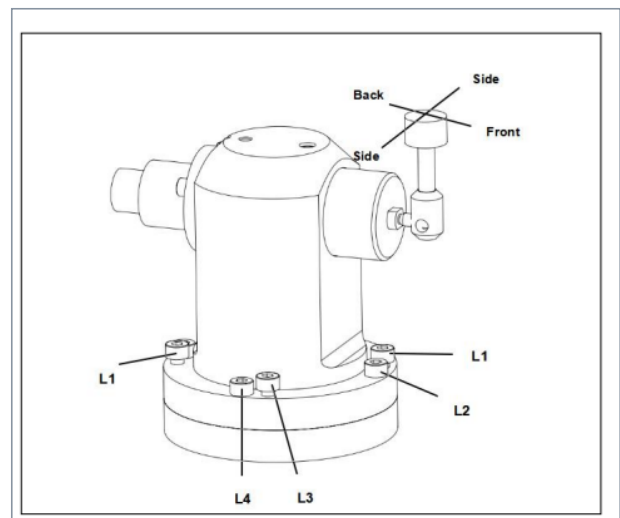
Screw C: 3 mm hex, 2.5 – 2.7 Nm.

### CAUTION

Always use the support bar when adding or removing parts attached to the break stem. Tighten the screws to the torque values given; over-tightening weakens the stem.

### 4.3 Levelling the stylus

Levelling is carried out in two stages. The aim is to bring the stylus within 0.01 mm in the horizontal plane.



Levelling adjustment screws: L1, L2, L3 and L4.

#### Adjustment in the side directions

- 1 Bring the stylus close to horizontal, preferably within 0.04 mm.
- 2 Lightly tighten screws L2 and L4 that connect to the bottom plate.
- 3 Adjust the two L3 screws on the side to bring the stylus within 0.01 mm.
- 4 Tighten the two L4 side screws.

#### Adjustment in the front and back directions

- 1 Before adjustment the deviation in the front and back directions may be 0.1 mm. The front is higher and the back lower, so the front of the base plate should be set as low as possible.

- 2 First fix the front L2 screw; horizontal accuracy is then about 0.05 mm.
- 3 Tighten screw L1 slowly to raise the base plate at the back and bring the stylus level within 0.01 mm.

#### 4.4 Mounting orientation and contact force

Contact force applies in the specified mounting orientation of the device. Unless stated otherwise this orientation is vertical. When the orientation is changed, the weight of the moving part affects the contact force:

- If a device specified for vertical mounting is used horizontally, the contact force increases by the weight of the moving part.
- If a device specified for horizontal mounting is used vertically, the contact force decreases; this can cause a zero reset error.

#### 4.5 Installation precautions

- Install the device in an area of the table with little swarf and splash.
- The device must be mounted vertically; a flat seating of the base prevents accuracy error.
- After wiring is complete, place the device in the measuring position, test it and then fix the correct position.
- Supply must stay within 24 V DC  $\pm 10\%$ , 20 mA maximum; overload burns out the internal components.
- The pulling strength of the supply and signal line is below 20 N (2 kg). The bending radius of the metal conduit is R7.
- If pneumatics are used, the air pipe outer diameter should be 4 mm and inner diameter 2.5 mm, with air pressure between 0.3 and 0.6 MPa.
- If high-pressure coolant or a water jet strikes the face of the device, fit a protective cover.
- Install the blowing device so that it does not leak.

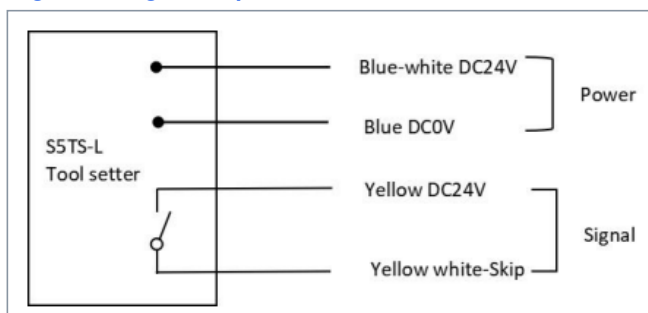
#### CAUTION

Do not rotate the head of the tool setter. Rotating it damages the precision components.

### 5. Electrical connection

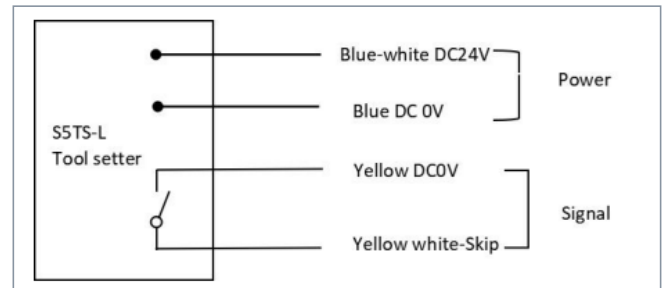
The device can be connected in two output modes. Which mode is used depends on the control unit of the machine.

#### High level signal output



Power: blue-white 24 V, blue 0 V. Signal: yellow 24 V, yellow-white skip input.

#### Low level signal output



Power: blue-white 24 V, blue 0 V. Signal: yellow 0 V, yellow-white skip input.

- Make sure the device is earthed when the machine body is earthed.
- Route the cable at a bending radius of at least R7; R25 if a protective conduit is used.
- Route the cable away from motor supply lines and noise sources.
- Do not damage the cable while routing it; a damaged cable destroys the water resistance.

### 6. Checking the trigger signal

- 1 Connect the signal cores to the control unit and run the measuring program.
- 2 Press the stylus, remove your hand quickly and watch the indicator lamp.
- 3 While pressing the stylus, check whether the signal changes from 0 to 1 at the control unit.

### 7. Trial run in MDI mode

Once it is confirmed that the trigger signal is received, run the program step by step in MDI mode. Set the feed rate low first and confirm that the program runs correctly. If anything unexpected happens, press the emergency stop immediately.

After these steps are complete, tool length, diameter and broken tool detection can be carried out automatically.

### 8. Calibration

The tool setter is only one component of the measuring system that communicates with the machine. Every part of the system can introduce a constant difference between the position the stylus touches and the position reported to the machine. Without calibration this difference appears as a measuring error; calibration allows the software to compensate for it.

In normal use this difference does not change. Calibration should nevertheless be carried out in the following cases:

- When the system is used for the first time.
- When the trigger filter delay is changed.
- At regular intervals, to compensate for mechanical changes in the machine.

Details of the calibration cycle and the cycle code to be used are given in the CNC Probing application.

## 9. Automatic setting of tool length and diameter

The purpose of measuring tool length is to establish the positional relationship between the cutting tool and the surface of the workpiece. The device is an elastic element of fixed height mounted on the machine table. When the tool touches the contact surface, the relationship between the cutting edge and the workpiece surface is obtained indirectly from the relationship between the cutting edge and the table.

### Semi-automatic operation

Move the machine spindle in manual mode and bring the cutting tool axis to the centre of the contact surface. Keep the cutting edge 10 to 20 mm above the contact surface. Run the tool setting program; the length and diameter values are written automatically into the control unit.

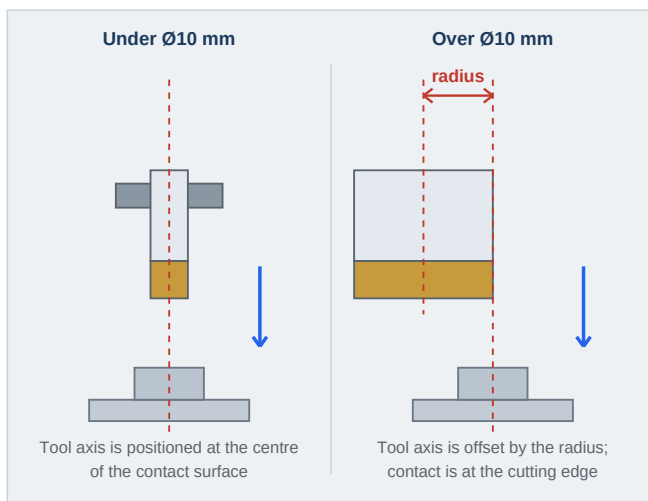
### Automatic operation

The preparation program and the semi-automatic operation program are combined into one program and run together.

### Positioning for tools over Ø10 mm

If the tool diameter is below 10 mm, measurement is direct: the tool axis is positioned at the centre of the contact surface and moved down in Z.

If the tool diameter is greater than 10 mm, the tool axis is offset sideways by the tool radius and the measurement is made in Z at that position. Contact is then made at the cutting edge rather than at the centre of the tool. Example: to measure the length of a Ø50 mm tool, the X axis position is -25 and Y is 0, and the move is made in Z.



For a small tool, measurement is at the centre; for a large tool, at the cutting edge.

## 10. Correct tool contact

- The cutting tool must make contact along a straight line in the direction in which it is pushed.
- The travel limit of the device must not be exceeded. Excessive push damages both the device and the cutter.
- For tool length measurement the tool is rotated in the reverse direction while making contact.

- Tool speed should be kept between 50 and 200 mm/min. This range varies with the electrical response time of the machine.
- Even on the same tool, changing the approach feed rate or the contact point causes measuring error. The feed rate and contact point set for a tool must be kept constant.

### CAUTION

Do not press and spring the contact surface by hand. This damages the internal precision components. The same rule applies during installation, cleaning and testing.

## 11. Maintenance

The contact surface must be cleaned daily. Swarf, coolant and oil building up on the surface shift the measuring point and destroy repeatability.

Do not allow swarf to build up on surfaces the air pipe cannot reach; clean these by hand. Body and base mounting screws are checked at regular intervals.

## 12. Post-installation checklist

- ☐ Table clean, device square and secured with T-bolts
- ☐ Stylus and break stem tightened to the torque values
- ☐ Levelling within 0.01 mm
- ☐ Cable routed at R7 minimum, away from noise sources
- ☐ Pulling force below 20 N
- ☐ Supply 24 V  $\pm 10\%$ , 20 mA maximum
- ☐ Trigger signal gives a 0-1 change at the control unit
- ☐ Calibration carried out
- ☐ Approach feed rate within 50 – 200 mm/min
- ☐ Radius offset applied for tools over Ø10 mm
- ☐ Contact surface cleaned daily
- ☐ No pressing and springing by hand

## 13. Common situations

|                                         |                                                                                                                                                                                      |
|-----------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measurement differs every time</b>   | Approach feed rate or contact point is changing · Swarf or coolant on the contact surface · Levelling has drifted · Base or mounting screws loose · Device not square to the spindle |
| <b>No signal is produced</b>            | Cable connection or supply interrupted · Yellow and yellow-white cores wrongly connected · Tool is not reaching the contact surface                                                  |
| <b>Indicator lamp does not light</b>    | No supply or reversed polarity · Current limit exceeded                                                                                                                              |
| <b>Zero reset error</b>                 | Device used in a mounting orientation other than the one specified · Contact force reduced by the weight of the moving part                                                          |
| <b>False triggering under vibration</b> | Approach feed rate too high · Base not rigid enough · Cable routed close to a noise source                                                                                           |

|                                                 |                                                                                                              |
|-------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| <b>Stylus has broken</b>                        | Over-travel occurred and the break stem did its job · Fit a new break stem and stylus, then repeat levelling |
| <b>Device does not reseat after measurement</b> | Swarf has built up around the contact element · It may have been pressed and sprung by hand                  |

## 14. Warranty

The warranty period is 12 months from the date of purchase. If a problem arises in the material or workmanship of the body under normal use and maintenance within the warranty period, free repair and replacement of parts are provided after verification. Keep the maintenance certificate in case of failure.

### Not covered by the warranty

- Damage caused by incorrect installation and operation.
- Disassembly or modification of the product, or replacement of internal parts.
- Water, oil and similar substances entering the device through careless use.
- Failure or damage caused by natural disasters.

# User manual

## SOTS wireless tool setter — length, diameter and breakage detection

### 1. About this manual

This manual covers the installation, connection and use of the CNC PROBING SOTS wireless tool setter. The device measures tool length and diameter, monitors wear and detects broken tools. The signal is transmitted by infrared; no cable is required.

The manual describes the hardware only. Measuring cycles, cycle codes and the macro programs to be used are explained in the CNC Probing application.

#### CAUTION

Read this manual before installing the device. Incorrect mounting and incorrect contact method will destroy repeatability and can cause permanent damage.

#### Safety

- When positioning the device manually or automatically, make sure the feed of the machine stops immediately if the stylus is unexpectedly deflected.
- Use only the original spare parts listed in this manual for maintenance and repair.

#### Validity

This document applies to the hardware valid at the date of issue. The right to make technical changes is reserved.

### 2. Parts of the system



SOTS wireless tool setter and SIR receiver unit.

- |                 |                          |
|-----------------|--------------------------|
| 1 Stylus        | 5 Bracket                |
| 2 Stylus holder | 6 Base                   |
| 3 Break stem    | 7 Receiver unit          |
| 4 Probe         | 8 Magnetic mounting base |

SOTS is not a stand-alone device: it consists of a measuring probe, a bracket and a stylus kit. The probe is fixed to the bracket and the bracket to the machine table. The signal is transmitted by infrared to the receiver unit.

#### Break stem

The break stem is a safety part. When the stylus over-travels, the stem breaks at its weakest point and prevents damage to the probe mechanism. A broken stem does not mean a faulty device: fit a new break stem and stylus, then repeat levelling.

#### Shared receiver

SOTS can use the same receiver unit as the CNC PROBING measuring probe. When the two devices are used together no second receiver is needed; which device runs is determined by the macro program.

### 3. Specifications

|                     |                                              |
|---------------------|----------------------------------------------|
| Model               | SOTS                                         |
| Output              | Normally open contact                        |
| Sensing directions  | 5 directions ( $\pm X$ , $\pm Y$ , $\pm Z$ ) |
| Pre-travel          | 0                                            |
| Travel              | $\pm 12.5^\circ$ , Z 6.35 mm                 |
| Repeatability       | Less than 1 $\mu\text{m}$                    |
| Trigger life        | More than 10 million                         |
| Protection class    | IP68                                         |
| Contact force       | XY: 0.4 – 0.8 N · Z: 4.0 N                   |
| Signal transmission | Infrared, wireless                           |
| Contact material    | Tungsten carbide                             |
| Surface finish      | Ground                                       |
| Construction        | Measuring probe, bracket and stylus kit      |
| Receiver            | Can be shared with the measuring probe       |

#### Receiver unit

|                       |                                           |
|-----------------------|-------------------------------------------|
| Model                 | SIR                                       |
| Output signal         | Power on signal or trigger signal         |
| Mounting              | Strong magnetic base or universal support |
| Supply                | 24 V DC $\pm 4$ V                         |
| Cable                 | 5.0 mm                                    |
| Protection class      | IP68                                      |
| Operating temperature | 10 – 60 $^\circ\text{C}$                  |

## 4. Installation

### 4.1 Mounting the device

- 1 Clear the table and select the mounting position. Avoid areas with heavy swarf and splash.
- 2 Fix the bracket to the table. The device must be mounted vertically with the base seated flat.
- 3 Fit the stylus and tighten to the torque values.
- 4 Level the stylus.
- 5 Position and connect the receiver unit (section 5).
- 6 Check the trigger signal (section 6).

### 4.2 Mounting orientation and contact force

Contact force applies in the specified mounting orientation of the device. Unless stated otherwise this orientation is vertical. When the orientation is changed, the weight of the moving part affects the contact force:

- If a device specified for vertical mounting is used horizontally, the contact force increases by the weight of the moving part.
- If a device specified for horizontal mounting is used vertically, the contact force decreases; this can cause a zero reset error.

### 4.3 Installation precautions

- Install the device in an area of the table with little swarf and splash.
- The device must be mounted vertically; a flat seating of the base prevents accuracy error.
- After wiring is complete, place the device in the measuring position, test it and then fix the correct position.
- The receiver supply must stay within 24 V DC  $\pm 4$  V.
- The pulling strength of the receiver cable is below 20 N (2 kg); the bending radius is R7.
- If pneumatics are used, the air pipe outer diameter should be 4 mm and inner diameter 2.5 mm, with air pressure between 0.3 and 0.6 MPa.
- If high-pressure coolant or a water jet strikes the face of the device, fit a protective cover.
- Install the blowing device so that it does not leak.

#### CAUTION

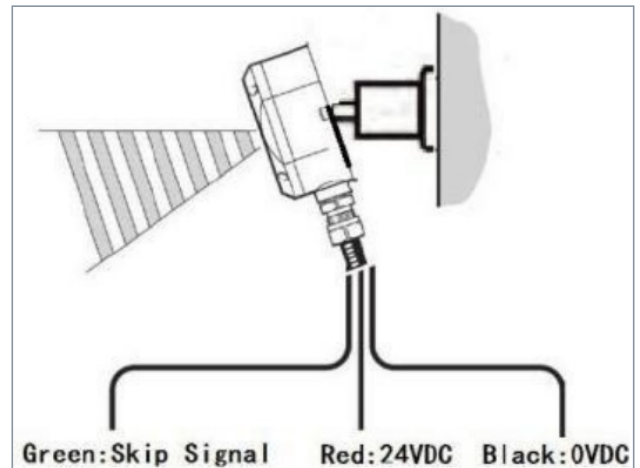
Do not rotate the head of the tool setter. Rotating it damages the precision components.

## 5. Connecting the receiver unit

### 5.1 Positioning

The receiver is mounted on the machine body so that the line of sight to the device stays clear. No fixture, workpiece or guard should interrupt that line. The receiver is fixed with a strong magnetic base or a universal support; the magnetic base means no holes have to be drilled in the machine.

### 5.2 Cable connection



Receiver unit cable connection.

|               |                                                |
|---------------|------------------------------------------------|
| <b>Red</b>    | +24 V DC supply                                |
| <b>Black</b>  | 0 V DC supply                                  |
| <b>Green</b>  | Skip signal — to the CNC control unit          |
| <b>Yellow</b> | Low battery warning — connection not mandatory |

The yellow core carries the low battery warning. Connecting it is not mandatory, but when connected the control unit warns before the battery runs out and an unexpected stoppage is avoided.

## 6. Checking the trigger signal

The example below is for a FANUC control unit and input address X4.7. The address used varies with the machine.

- 1 Open the system and PMC screen on the control unit. Check that the state of X4.7 changes from 0 to 1 when the stylus is touched.
- 2 Switch to MDI mode and enter the following lines:

```
G91 G31 X100. F100. ;
G91 G01 Y100. F100. ;
```

At the start only the X axis moves. When the stylus is touched the X motion stops and the program continues with the Y move. If this behaviour is seen, the G31 skip function is working and the receiver has been installed correctly.

#### WARNING

Carry out the test at a low feed rate and press the emergency stop immediately if anything unexpected happens.

## 7. Trial run in MDI mode

Once it is confirmed that the trigger signal is received, run the program step by step in MDI mode. Set the feed rate low first and confirm that the program runs correctly. If anything unexpected happens, press the emergency stop immediately.

After these steps are complete, tool length, diameter and broken tool detection can be carried out automatically.

## 8. Calibration

The tool setter is only one component of the measuring system that communicates with the machine. Every part of the system can introduce a constant difference between the position the stylus touches and the position reported to the machine. Without calibration this difference appears as a measuring error; calibration allows the software to compensate for it.

In normal use this difference does not change. Calibration should nevertheless be carried out in the following cases:

- When the system is used for the first time.
- When the trigger filter delay is changed.
- At regular intervals, to compensate for mechanical changes in the machine.

Details of the calibration cycle and the cycle code to be used are given in the CNC Probing application.

## 9. Automatic setting of tool length and diameter

The purpose of measuring tool length is to establish the positional relationship between the cutting tool and the surface of the workpiece. The device is an elastic element of fixed height mounted on the machine table. When the tool touches the contact surface, the relationship between the cutting edge and the workpiece surface is obtained indirectly from the relationship between the cutting edge and the table.

### Semi-automatic operation

Move the machine spindle in manual mode and bring the cutting tool axis to the centre of the contact surface. Keep the cutting edge 10 to 20 mm above the contact surface. Run the tool setting program; the length and diameter values are written automatically into the control unit.

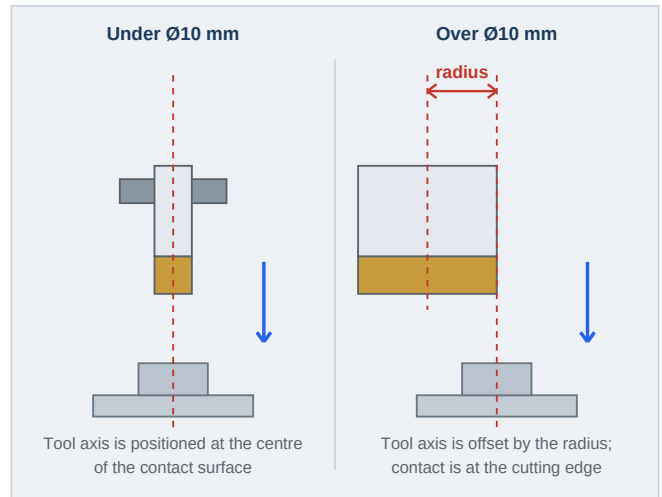
### Automatic operation

The preparation program and the semi-automatic operation program are combined into one program and run together.

### Positioning for tools over Ø10 mm

If the tool diameter is below 10 mm, measurement is direct: the tool axis is positioned at the centre of the contact surface and moved down in Z.

If the tool diameter is greater than 10 mm, the tool axis is offset sideways by the tool radius and the measurement is made in Z at that position. Contact is then made at the cutting edge rather than at the centre of the tool. Example: to measure the length of a Ø50 mm tool, the X axis position is -25 and Y is 0, and the move is made in Z.



For a small tool, measurement is at the centre; for a large tool, at the cutting edge.

## 10. Correct tool contact

- The cutting tool must make contact along a straight line in the direction in which it is pushed.
- The travel limit of the device must not be exceeded. Excessive push damages both the device and the cutter.
- For tool length measurement the tool is rotated in the reverse direction while making contact.
- Tool speed should be kept between 50 and 200 mm/min. This range varies with the electrical response time of the machine.
- Even on the same tool, changing the approach feed rate or the contact point causes measuring error. The feed rate and contact point set for a tool must be kept constant.

### CAUTION

Do not press and spring the contact surface by hand. This damages the internal precision components. The same rule applies during installation, cleaning and testing.

## 11. Maintenance

The contact surface must be cleaned daily. Swarf, coolant and oil building up on the surface shift the measuring point and destroy repeatability.

The window of the receiver unit is also cleaned regularly; swarf and coolant on the window cause signal loss. Do not allow swarf to build up on surfaces the air pipe cannot reach.

## 12. Post-installation checklist

- ☐ Table clean, device square and mounting screws tight
- ☐ Stylus and break stem tightened to the torque values
- ☐ Levelling within 0.01 mm
- ☐ Line of sight between device and receiver is clear
- ☐ Receiver cable connected correctly (red, black, green)
- ☐ Receiver supply 24 V  $\pm$ 4 V
- ☐ Trigger signal gives a 0-1 change at the control unit

- ☐ G31 skip function tested and working
- ☐ Calibration carried out
- ☐ Approach feed rate within 50 – 200 mm/min
- ☐ Radius offset applied for tools over Ø10 mm
- ☐ Contact surface cleaned daily
- ☐ No pressing and springing by hand

### 13. Common situations

|                                                |                                                                                                                                                                 |
|------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Measurement differs every time</b>          | Approach feed rate or contact point is changing · Swarf or coolant on the contact surface · Bracket or mounting screws loose · Device not square to the spindle |
| <b>No signal is produced</b>                   | Line of sight between device and receiver is blocked · Receiver cable wrongly connected · No supply · Battery flat                                              |
| <b>Signal drops out intermittently</b>         | Line of sight interrupted by a fixture or the workpiece · Swarf or coolant on the receiver window · Receiver too far away                                       |
| <b>Low battery warning appears</b>             | Battery life is used up · If the yellow core is connected, the control unit displays the warning                                                                |
| <b>Zero reset error</b>                        | Device used in a mounting orientation other than the one specified · Contact force reduced by the weight of the moving part                                     |
| <b>False triggering under vibration</b>        | Approach feed rate too high · Bracket not rigid enough                                                                                                          |
| <b>Stylus has broken</b>                       | Over-travel occurred and the break stem did its job · Fit a new break stem and stylus, then repeat levelling                                                    |
| <b>Device does not reset after measurement</b> | Swarf has built up around the contact element · It may have been pressed and sprung by hand                                                                     |

### 14. Warranty

The warranty period is 12 months from the date of purchase. If a problem arises in the material or workmanship of the body under normal use and maintenance within the warranty period, free repair and replacement of parts are provided after verification. Keep the maintenance certificate in case of failure.

#### Not covered by the warranty

- Damage caused by incorrect installation and operation.
- Disassembly or modification of the product, or replacement of internal parts.
- Water, oil and similar substances entering the device through careless use.
- Failure or damage caused by natural disasters.

# User manual

## SNC non-contact laser tool setting system — SNC56 · SNC86 · SNC168

### 1. About this manual

This manual covers the installation, adjustment and maintenance of the CNC PROBING SNC non-contact laser tool setting system. It covers three models: SNC56, SNC86 and SNC168. The models differ in measuring aperture; the operating principle and the installation procedure are the same.

The manual describes the hardware only. Measuring cycles, cycle codes and the macro programs to be used are explained in the CNC Probing application.

#### CAUTION

Failure to follow the procedures in this manual may result in exposure to harmful radiation. Maintenance on the system may only be carried out after the power has been switched off.

### Liability and warranty

Care has been taken to verify the accuracy of this document before publication. The right to change product and software specifications without prior notice is reserved. The standard warranty period is one year.

### Machine tool

CNC machine tools must always be operated by trained personnel in accordance with the instructions of the manufacturer.

### Notice to the machine manufacturer

It is the responsibility of the machine supplier to make the user aware of the hazards involved in operation and to ensure that adequate guards and safety interlocks are provided.

#### CAUTION

Under certain conditions the system may falsely indicate that the beam is not blocked. Do not rely on the probe signal alone to stop the movement of the machine.

### 2. Laser safety

The laser used in the SNC system emits visible red light at a wavelength of 680 nm with an output power below 1 mW. Under the definitions of BS EN 60825-1:2014 (IEC 60825-1:2014), SNC is a class 2 laser product. A permanent warning label is attached to one side of the transmitter housing.

#### Basic safety precautions

- Read all operating instructions before using this product.
- The product may only be installed and used by trained personnel.
- Use eye protection against mechanical injury and against contamination by coolant and swarf.
- Avoid breathing in coolant vapour from the machine.

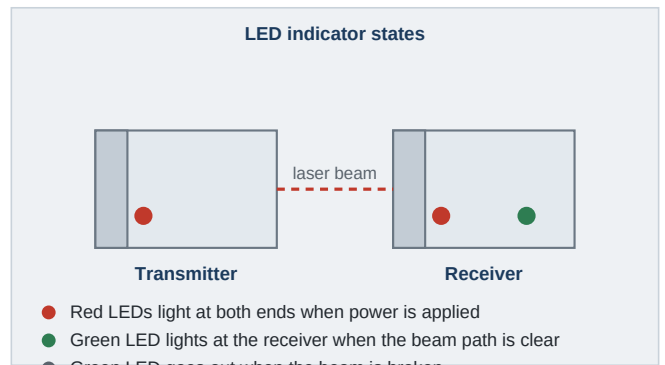
- Do not block the light aperture or the pneumatic supply of the transmitter, the receiver or the air blast system.
- Do not interrupt the beam path with reflective surfaces.

### 3. System overview



CNC PROBING SNC non-contact laser tool setting system.

When the tool passes through the laser beam, the system detects that the beam is blocked. The output signal sent to the control unit determines the presence of the tool and the position of the tool tip. Both tool setting and broken tool detection are carried out this way.



#### Operating rules

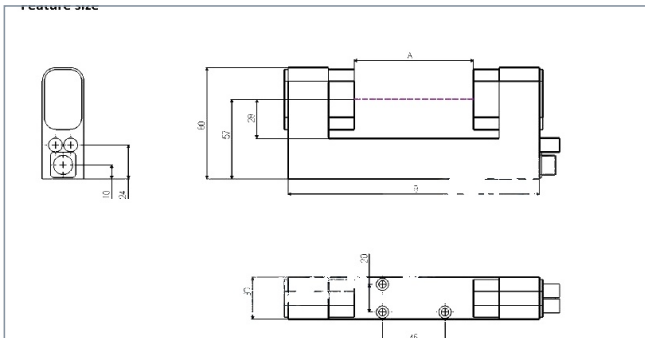
- SNC is a precision instrument and must be handled with care.
- Make sure all connections are secure.
- Keep the electrical contacts clean.
- Install the system where it will not be affected while the machine is running.
- Choose a position where swarf does not build up; do not allow excessive waste to accumulate around the unit.
- Secure cables, air hoses and protective conduit so that no load is transferred to the unit and nothing is damaged.
- Best measuring performance is achieved when air and power are supplied to the unit continuously.

- The optics should be checked for contamination approximately every month. The interval may be extended or shortened according to actual conditions.

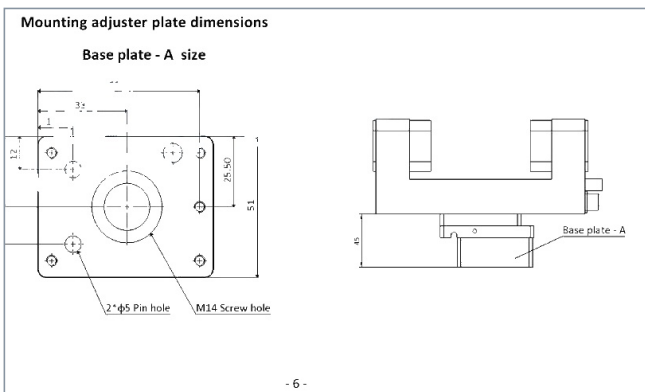
#### 4. Models and dimensions

| Model  | Aperture A | Length B | Smallest tool (typical) |
|--------|------------|----------|-------------------------|
| SNC56  | 56 mm      | 178 mm   | 0.05 mm                 |
| SNC86  | 86 mm      | 208 mm   | 0.06 mm                 |
| SNC168 | 168 mm     | 290 mm   | 0.2 mm                  |

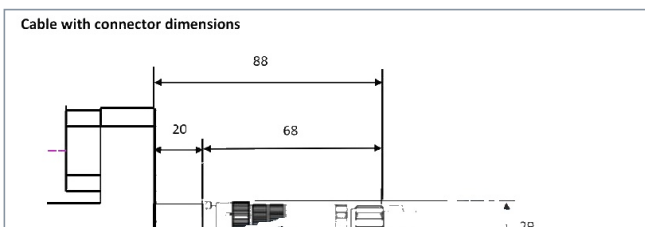
The smallest tool diameters in the table are typical values for reference only. The figure of Ø0.1 mm given in the specifications is the guaranteed value.



Body dimensions. A is the measuring aperture and B the body length; the values are given in the table above.



Adjustable mounting plate dimensions.



Cable with connector dimensions.

#### 5. Specifications

|                                             |                                                                                                                                                                                              |
|---------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Laser type</b>                           | Power < 1 mW, wavelength 680 nm, class 2                                                                                                                                                     |
| <b>Connection</b>                           | Hard-wired; cable at the end of the unit                                                                                                                                                     |
| <b>Sealing</b>                              | IPX8                                                                                                                                                                                         |
| <b>Best repeatability</b>                   | ±0.1 μm (2σ)                                                                                                                                                                                 |
| <b>Typical repeatability</b>                | ±1 μm (2σ)                                                                                                                                                                                   |
| <b>Smallest tool</b>                        | Ø0.1 mm or larger (guaranteed figure)                                                                                                                                                        |
| <b>Largest tool</b>                         | Up to the measuring aperture of the model: 56 / 86 / 168 mm                                                                                                                                  |
| <b>Smallest tool for breakage detection</b> | Ø0.1 mm or larger                                                                                                                                                                            |
| <b>Power</b>                                | 100 mA @ 24 V                                                                                                                                                                                |
| <b>Output signal</b>                        | Voltage-free solid state relay (SSR); each relay may be normally open. Current max. 50 mA, voltage max. ±50 V                                                                                |
| <b>Storage temperature</b>                  | -10 °C ... 50 °C                                                                                                                                                                             |
| <b>Operating temperature</b>                | 5 °C ... 50 °C                                                                                                                                                                               |
| <b>Life</b>                                 | Tested to more than 1 million on/off cycles                                                                                                                                                  |
| <b>Pneumatic supply</b>                     | 4 mm air pipe; 6.0 bar maximum, 3.0 bar minimum                                                                                                                                              |
| <b>Cable</b>                                | Ø6.0 mm × 5 m; two twisted pairs, two individual cores plus screen, each core 18 × 0.1 mm insulated                                                                                          |
| <b>Mounting</b>                             | M10                                                                                                                                                                                          |
| <b>Beam alignment</b>                       | Adjustable mounting plate on the underside                                                                                                                                                   |
| <b>Application</b>                          | High-precision, high-speed non-contact tool setting and broken tool detection on vertical and horizontal machining centres of all sizes, multi-tasking machines and gantry machining centres |

#### 6. Installation

##### 6.1 What the installation requires

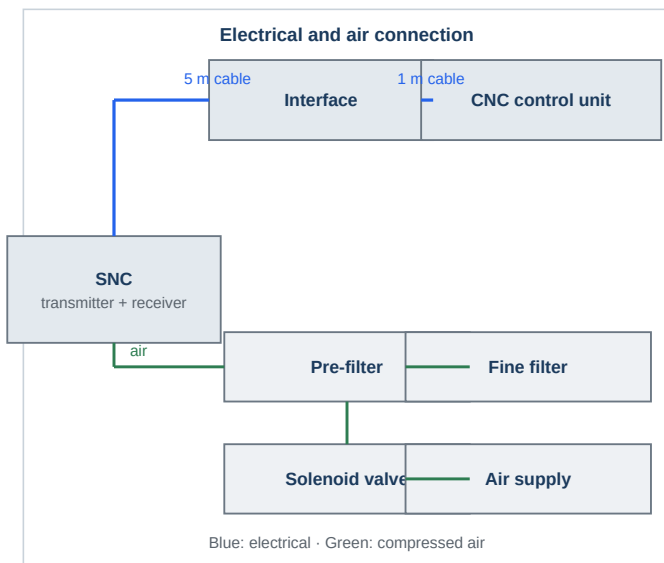
- Unit: make sure the measuring aperture suits your application; if a different aperture is needed, contact the supplier.
- Bracket: choose a bracket suitable for the application.
- Air supply: clean, dry air is required, meeting ISO 8573-1 class 1.3.1 (0.01 μm). If this cannot be met, use a filter/regulator. The air blast system needs up to 5.0 bar and a solenoid valve to control it.
- Interface: required for the system to work.
- Software: non-contact tool setting software is needed to run the detection and measuring cycles.
- Accessories: protective conduit and fittings may be needed depending on the installation.

## 6.2 Installation sequence

- 1 Install the air components. Do not turn on the air supply or set the pressure at this stage.
- 2 Install the system units.
- 3 Install the interface.
- 4 Switch on the interface power.
- 5 Turn on the air supply to the unit and set the pressure.
- 6 Align the beam.
- 7 Calibrate the system.

## 6.3 Guidelines for best practice

- Where possible, connect the air supply to the filter/regulator unit of the machine. Do not connect the unit to an air supply containing oil.
- Protect the air pipe inside the machine; prevent contamination at both ends.
- Before connecting the air pipe to the unit, turn the air supply on for a while to blow out debris inside the pipe. When no more debris comes out, turn the supply off and connect it.
- Keep the air pipe as short as possible to reduce the pressure drop.
- If the air supply is 5 °C warmer than ambient and humid, use an air dryer.



## 6.4 Installing the air preparation pack

### CAUTION

Before starting to install the components, make sure the machine can operate safely.

- Secure the air conditioner vertically to a suitable surface with its bracket. It must be within 25 m of the unit.
- Connect clean air to the regulator inlet. Use air that has passed through the filter of the machine.
- An additional filter may be needed if contamination of the compressed air is suspected.
- Install the system after the air components are prepared. Do not turn on the air supply until the system and the interface are installed and powered.

## 6.5 Installing the system

### CAUTION

Before starting to install the system, make sure the machine can operate safely. Switch off the machine power when working inside the cabinet.

- 1 Choose a position where air can escape freely from the laser aperture. Do not install where a lot of swarf collects.
- 2 Fix the adjusting base to the machine table. Set the adjusting plate roughly parallel to the machine axis.
- 3 Use a dial gauge to set the plate square to the spindle, within 0.5 mm.
- 4 Lay the protective conduit inside the machine, check the length and shorten it if necessary.
- 5 Thread the cable and air hose through the conduit. Do not apply excessive force; use a suitable amount of lubricant if needed.
- 6 Connect the cable to the electrical cabinet of the machine. Do not route it next to motors, power cables or other sources of noise.
- 7 Protect the free end of the air pipe before connecting it, so that no debris gets inside.
- 8 Connect the air pipe to the regulator and to the air blast solenoid valve.
- 9 Open both solenoid valves, turn on the air supply and purge all three air pipes to clear debris.
- 10 Turn off the air supply, connect the air pipe to the unit and make sure no load is transferred to the unit during operation.
- 11 If necessary, wrap the protective conduit over the air hose and cable.

## 6.6 Installing the interface

### CAUTION

Before installing the interface, make sure the machine is safe. Switch off the machine power when working inside the cabinet.

The interface is installed in the CNC control cabinet, as far as possible from sources of interference such as transformers and motor drives. It processes the signal from the unit, converts it into an output the control unit can read and sends it to the signal input.



Interface unit and terminal connections.

## 7. Cable connection

The system has two cables. The 5 m cable has an aviation plug at one end and a terminal block at the other; it connects the unit to the interface. The 1 m cable connects the interface to the machine.

|                                                                                   |                     |                                                                                           |
|-----------------------------------------------------------------------------------|---------------------|-------------------------------------------------------------------------------------------|
|  | <b>Red</b>          | 24 V DC supply                                                                            |
|  | <b>Black</b>        | 0 V DC supply                                                                             |
|  | <b>Orange</b>       | Turns the laser on; connects to the output controlled by an M code                        |
|  | <b>Green</b>        | Skip signal                                                                               |
|  | <b>Blue</b>         | 24 V DC. With high-speed skip on FANUC, connect to the 5 V terminal of the high-speed I/O |
|  | <b>Yellow</b>       | Connects to the output controlled by an M code                                            |
|  | <b>White</b>        | Connects to the output controlled by an M code (anti-drip mode)                           |
|  | <b>Yellow-green</b> | Earth                                                                                     |

- With high-speed skip on a FANUC system, the blue core connects to the 5 V terminal of the high-speed I/O.
- Connecting the white core enables anti-drip mode.
- Connecting the white and yellow cores together enables latch mode.
- All 0 V and earth connections must go to the star point of the machine. Failure to do so creates a potential difference between earths.
- Cables must not be routed alongside high-current lines or near high-speed data lines. Keep cable lengths to a minimum.

## 8. Power-up and air pressure

### 8.1 Power-up

#### CAUTION

Before switching on, make sure the machine can operate safely. Make sure the interface is powered off before plugging or unplugging it.

- Confirm that the interface and the air supply are connected correctly.
- Switch on the interface power.
- Check that all LED indicators on the transmitter and receiver are lit.

### 8.2 Setting the system air pressure

- Make sure the interface is connected and turn on the air supply.
- Set the first stage filtration to 0.5 MPa and the second stage to 0.3 MPa.
- Check that the status indicator is lit and in its normal state.
- Check that the protective blast at the laser aperture is on.
- Switch the laser on and confirm that it works normally together with the blast.

If the air supply pressure varies while the machine is running, the system air pressure may need to be raised to allow for the fluctuation.

### 8.3 Setting the blast pressure

- Turn on the air supply and operate the solenoid valve.
- Raise the pressure until it is enough to clear swarf and coolant left from machining.
- 5.0 bar is the recommended pressure; 6.0 bar (0.6 MPa) is the maximum.
- For very small tools the pressure can be reduced to avoid damaging the tool.

#### Pressure units

| MPa | bar | psi |
|-----|-----|-----|
| 0.2 | 2   | 29  |
| 0.4 | 4   | 58  |
| 0.6 | 6   | 87  |
| 0.8 | 8   | 116 |
| 1.0 | 10  | 145 |

## 9. Beam alignment

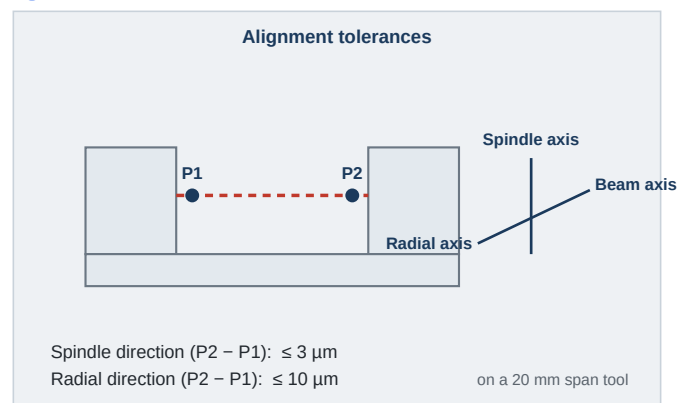
Alignment means bringing the laser beam parallel to the machine axes. Transmitter and receiver are correctly set at the factory; after installation the alignment cycle is run to verify this.

#### CAUTION

Before alignment, make sure the machine can operate safely.

### 9.1 Alignment procedure

- 1 Run the beam alignment cycle.
- 2 If the result is outside tolerance, loosen the X and Y axis locking screws, align the unit to the axes by hand and tighten the screws. Take care not to move the hard-wired connections.
- 3 Loosen the Z axis locking screw, adjust the Z axis adjusting screw and tighten the locking screw carefully without moving the unit.
- 4 Run the cycle again after alignment is complete.



These values are sufficient for most tool setting applications.

## 10. Signal test

The example below is for a Siemens control unit. The address used varies with the machine.

- Confirm where the skip signal is connected. For X122.13 use MEAS=1; for X132.13 use MEAS=2.
- In MDA mode open the laser valve, switch the laser on and run the line:

**MEAS=1 G91 G01 X100 F100**

- When the machine starts moving, break the beam with your finger or an object. If the machine stops, the signal is normal.

### WARNING

Carry out the test at a low feed rate and press the emergency stop immediately if anything unexpected happens.

## 11. Calibration

SNC is only one component of the measuring system that communicates with the machine. Every part of the system can introduce a constant difference between the position where measurement takes place and the position reported to the machine. Without calibration this difference appears as a measuring error; calibration allows the software to compensate for it.

In normal use this difference does not change. Calibration should nevertheless be carried out in the following cases:

- When the system is used for the first time.
- When the trigger filter delay is changed.
- At regular intervals, to compensate for mechanical changes in the machine.

Details of the calibration cycle and the cycle code to be used are given in the CNC Probing application.

## 12. Tool setting

Once calibration is complete, tool measurement can begin. The system offers the following functions:

- Tool length setting
- Tool radius / diameter setting
- Tool length and radius together
- Cutting edge inspection
- Broken tool detection — jump-in check
- Solid tool breakage detection
- Tool radius and linear profile detection
- Arc radius measuring cycle



The laser beam falls on the tool; when the beam is broken the system triggers.

## 13. Fault-finding

### Unit does not switch on (red LEDs not lit)

Connection failure — check the wiring · Wrong supply voltage — check the interface supply · Blown fuse — check the connections for a short circuit · Damaged cable — replace it

### No laser beam leaves the transmitter

The protective shutter is closing the unit — check that the air supply is on · Air pipe damaged or kinked · Laser aperture blocked — check the pneumatic supply

### Poor repeatability or spurious readings

Coolant or swarf on the tool — clean with an air blast, optimise the blast pressure, check the nozzle is not damaged or blocked · Feed rate too high — 2.0 µm per revolution is recommended · Electrical interference — do not route the cables alongside high-current lines, make sure the screen is connected to the interface · Thermal growth of machine and workpiece — minimise temperature change, calibrate more often · Excessive machine vibration

### Measurement drifts

Air pressure set incorrectly · Calibration and offset update not happening · Measuring speed differs from the calibration speed · Measurement taken in the acceleration or deceleration zone · Poor machine repeatability from worn slides · Loose brackets · Poor tool change repeatability — repeat the measurement without a tool change and compare · Poorly regulated supply · Coolant drips or mist — select anti-drip mode

**Air blast problems**

Nozzle squeals — pressure is low, raise it until the noise stops, do not exceed 0.6 MPa ·  
Coolant comes from the nozzle when the blast is on — check the nozzle and replace if needed ·  
No air from the blast — check the nozzle is fitted correctly and the air supply is on

**14. Maintenance**

SNC is designed to work with minimal maintenance in an environment of hot metal chips and coolant. Carry out only the routine maintenance described in this section. If a product under warranty needs repair or overhaul, it should be sent to the supplier.

**CAUTION**

Before any maintenance work, make sure the machine is safe and the interface power is switched off.

**14.1 Checking the fluid level**

Check the fluid level in each filter cup regularly. The level must stay below the filter element.

**14.2 Draining the fluid**

- 1 Switch off the air supply. A significant amount of fluid drains from the filter cup.
- 2 Switch the air supply on and set the pressure as described in 8.2.
- 3 If the level is still high, repeat until it drops to a suitable level.

**14.3 Cleaning the optics****CAUTION**

The work in this section may only be carried out by personnel trained in the use of laser products. Before removing the airway block to clean the optics, the transmitter must be powered off; otherwise there is exposure to the laser beam.

If the air reaching the unit is contaminated, the transmitter and receiver may need cleaning. Contamination keeps the system in a permanently triggered state. If contamination is suspected, find and correct the cause first and replace the air hose if necessary. Clean the units one at a time: remove the airway block and clean the lens with the cleaning kit.

Equipment required: 2.5 mm hex wrench and cleaning kit.

**15. Post-installation checklist**

- ☐ Air preparation pack mounted vertically, within 25 m of the unit
- ☐ Air quality meets ISO 8573-1 class 1.3.1 (0.01 µm)
- ☐ Mounting plate square to the spindle, within 0.5 mm
- ☐ Cable routed away from sources of electrical noise
- ☐ Screen and earth connected to the star point of the machine
- ☐ First stage filter 0.5 MPa, second stage 0.3 MPa
- ☐ Blast pressure 5.0 bar recommended, 6.0 bar maximum

- ☐ Red LEDs lit at both ends when powered
- ☐ Green LED lit at the receiver when the laser is on
- ☐ Beam alignment cycle run and tolerances met
- ☐ Skip signal verified at the machine
- ☐ Calibration carried out
- ☐ Optics added to the monthly check schedule

**16. Pack list**

|                                                                         |       |
|-------------------------------------------------------------------------|-------|
| <b>SNC unit (transmitter and receiver, integrated air blast module)</b> | 1 pc  |
| <b>Adjustable mounting plate</b>                                        | 1 pc  |
| <b>Interface unit</b>                                                   | 1 pc  |
| <b>Connection cable, 5 m (aviation plug – terminal block)</b>           | 1 pc  |
| <b>Interface – machine cable, 1 m</b>                                   | 1 pc  |
| <b>Air preparation pack (filter / regulator)</b>                        | 1 pc  |
| <b>Air hose and fittings</b>                                            | 1 set |
| <b>Optics cleaning kit</b>                                              | 1 pc  |
| <b>User manual</b>                                                      | 1 pc  |

**17. Warranty**

The warranty period is one year from the date of purchase. Unless a separate written agreement is made, all equipment and software are sold under the standard terms.

**Not covered by the warranty**

- Negligence, improper operation or improper use.
- Unauthorised modification or alteration of the product.
- Equipment purchased from another supplier; in that case contact that supplier regarding the warranty.



## We do not take the part off the machine to measure it.



Measuring and correction passes are completed during machining; the clamping datum is preserved.

CNC Probing turns a CNC machine tool into a coordinate measuring machine. The part is measured while clamped, tools are set on the machine and broken tools are caught within the cycle. The measurement record is created with the job.

Developed with 35 years of machining and mould making experience.

### Contact

web

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e-mail

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### Products

- CNC Probing software
- CNC Probing AutoFinish module
- CNC Control software
- Mobile application
- Measuring probes
- Laser and contact tool setters
- Styli and tool holders
- Bespoke CAD/CAM and ERP integration software

## CNC PROBING

Accuracy starts at the machine