HEIDENHAIN

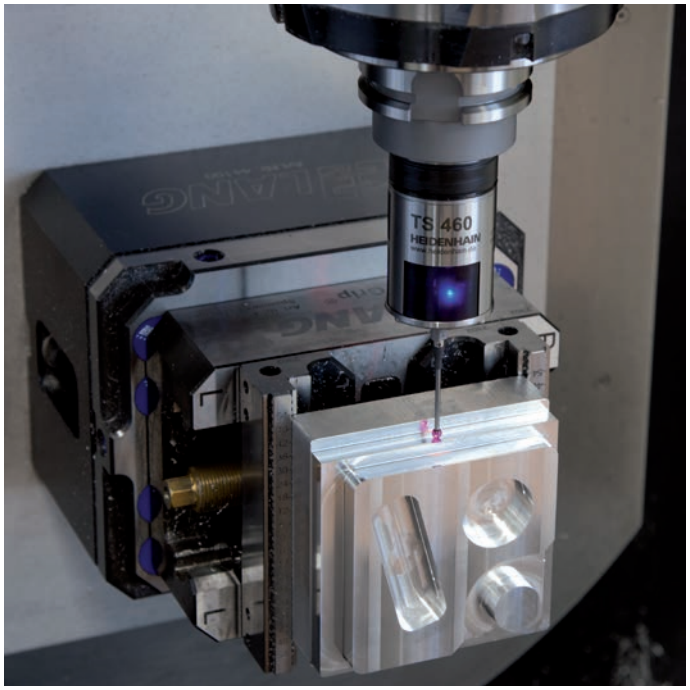

# Touch Probes

for Machine Tools

06/2019

# Touch probes for machine tools

Touch probes from HEIDENHAIN are designed for use on machine tools—particularly milling machines and machining centers. Touch probes help reduce setup times, increase machine usage time, and improve the dimensional accuracy of the finished workpieces. Setup, measuring, and monitoring functions can be performed manually or—in conjunction with most CNC controls—can be controlled by a program.




**Workpiece measurement**
HEIDENHAIN offers **TS triggering touch probes** for workpiece measurement right on the machine. The touch probes are inserted into the tool holder either manually or by the tool changer. Depending on the probing functions of the NC control, they can automatically or manually perform the following:

- Workpiece alignment
- Preset setting
- Workpiece measurement
- Digitizing or inspecting 3-D surfaces


**Tool measurement**
Successful series production hinges on the prevention of scrap or rework and on the attainment of consistently high-quality manufacturing. The tool is a decisive factor in this. Wear or tool breakage that goes undetected for extended periods, especially during unattended operation, results in defective parts and an unnecessary increase in costs. Therefore, exact measurement of the tool dimensions and the periodic inspection of the tool for wear are absolutely essential. HEIDENHAIN offers the TT touch probes for tool measurement on the machine.

With the **TT triggering touch probes**, the probe contact is deflected from its rest position, sending a trigger signal to the NC control during three-dimensional probing of a stationary or rotating tool.

**Further information:**

Comprehensive descriptions of cables and connectors can be found in the *Cables and Connectors* brochure.

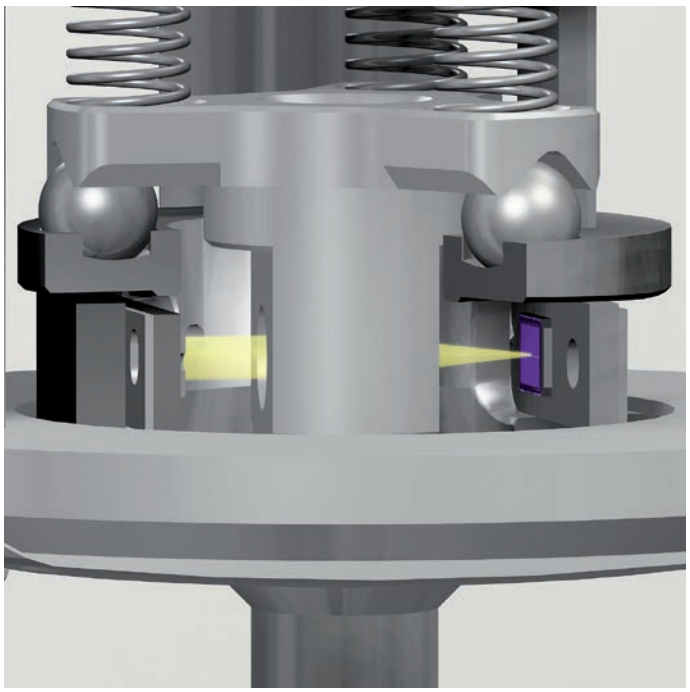
# Contents

# Innovative technologies

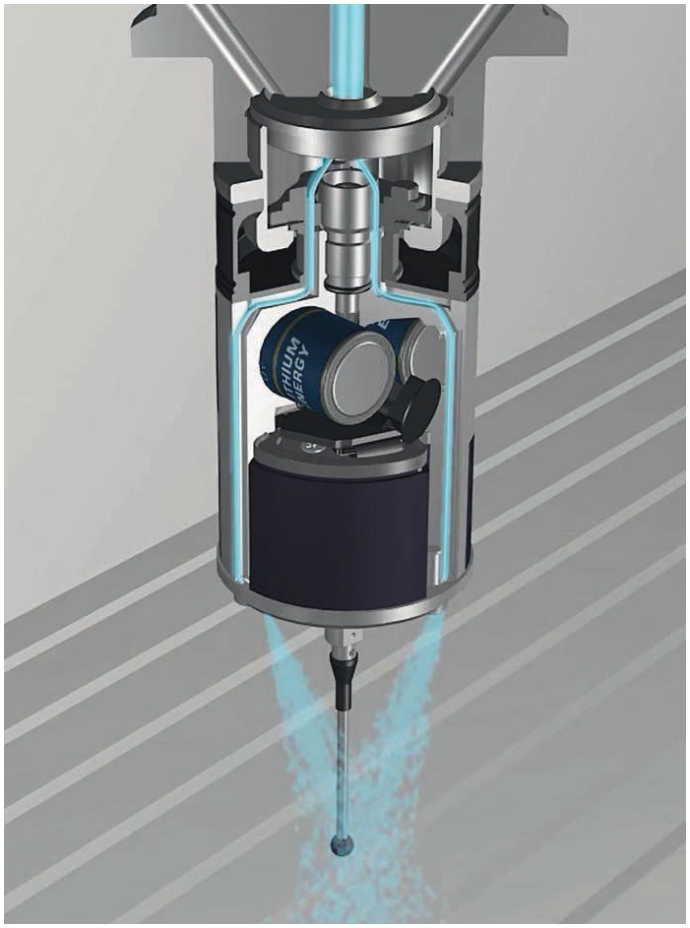
HEIDENHAIN has been developing and manufacturing touch probes for workpiece and tool measurement on machine tools for over 30 years now. It has set standards, for example, with

- its wear-free optical sensor,
- its integrated flushers/blowers for cleaning the measuring point,
- its SE 540, which is the first transceiver capable of being fully integrated into the spindle housing, and
- its collision protection for the TS 460 touch probe.

As a matter of course, many years of experience feed into the continuous development of these products. Numerous improvements have made working with the touch probes easier, more reliable, and ultimately more efficient for the operator.



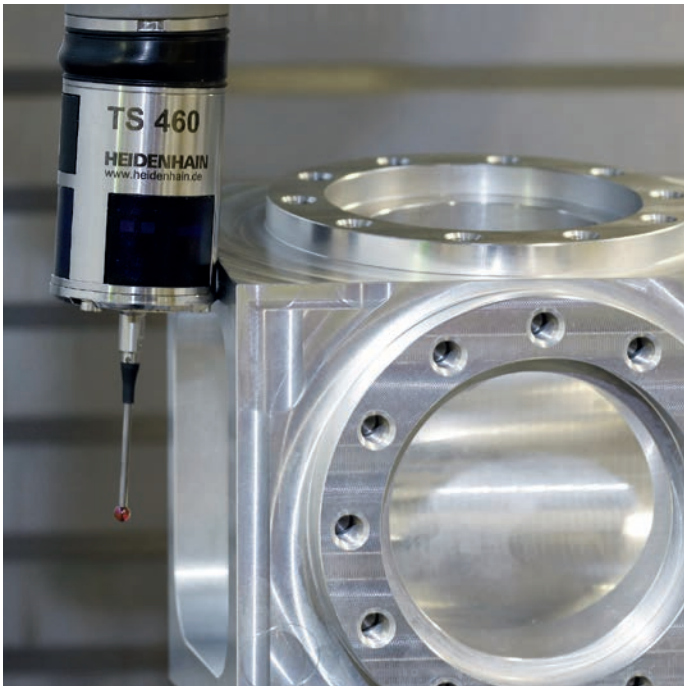
**Wear-free optical sensor**
Because the optical sensor is free of wear, it is able to provide the specified probing repeatability even after a large number of probe measurements (over 5 million switching cycles). This means that touch probes from HEIDENHAIN are also excellently suited for grinding machines. The optical sensor features an optimized lens system and an integrated preamplifier for stable output signals.



**Reliable measurement results**
Clean measuring points are a prerequisite for high process reliability. That is why all wireless TS workpiece touch probes from HEIDENHAIN have flushers/blowers for cleaning the workpiece by means of compressed air.

**Collision protection and thermal decoupling (option for TS 460)**
Collision protection is a major topic at HEIDENHAIN. The touch probes feature a sizable deflection path and offer additional safety through rated break points in the stylus and in the connecting pin for the probe contact. For expanded collision protection, including for the touch probe housing of the TS 460, HEIDENHAIN offers an optional mechanical adapter between the touch probe and the taper shank. In the event of a light collision against a fixture or workpiece, the touch probe is capable of yielding to absorb the shock. At the same time, the integrated switch deactivates the ready signal, and the control stops the machine.

Furthermore, the collision protection adapter functions as a thermal decoupler, which protects the touch probe from being heated by the spindle.



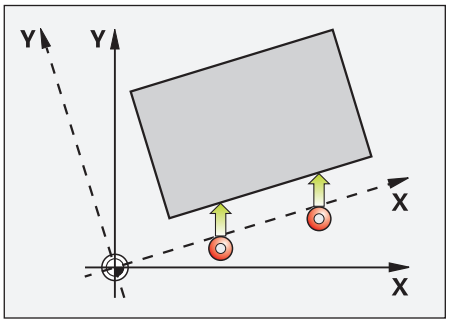

**EnDat for touch probes**
The TS 460 and TT 460 touch probes support the EnDat output interface for touch probes. In addition to providing the trigger status, the EnDat interface supplies the control with various types of additional data and diagnostic information. As a result, connecting touch probes to the TNC is particularly easy, and daily operation becomes even more reliable.

**Worldwide presence**
In whichever country your machine equipped with a touch probe may be found, HEIDENHAIN is there to support you on site.

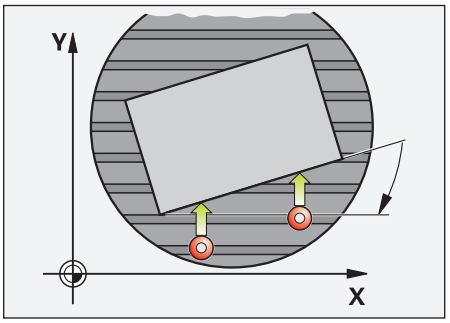
# Application examples
## Aligning the workpiece and setting the preset

**Workpiece alignment**
Exact workpiece alignment parallel to the axes is particularly important for workpieces that have already been partially machined so that their existing reference surfaces are in an accurately defined position. With the TS touch probes from HEIDENHAIN, you can avoid this time-consuming procedure and forgo the clamping devices that would otherwise be needed:

- The workpiece is clamped in any position.
- The touch probe ascertains the workpiece misalignment by probing a surface, two holes, or two studs.
- The CNC compensates for the misalignment by rotating the coordinate system. Compensation is also possible through rotation of a rotary table.

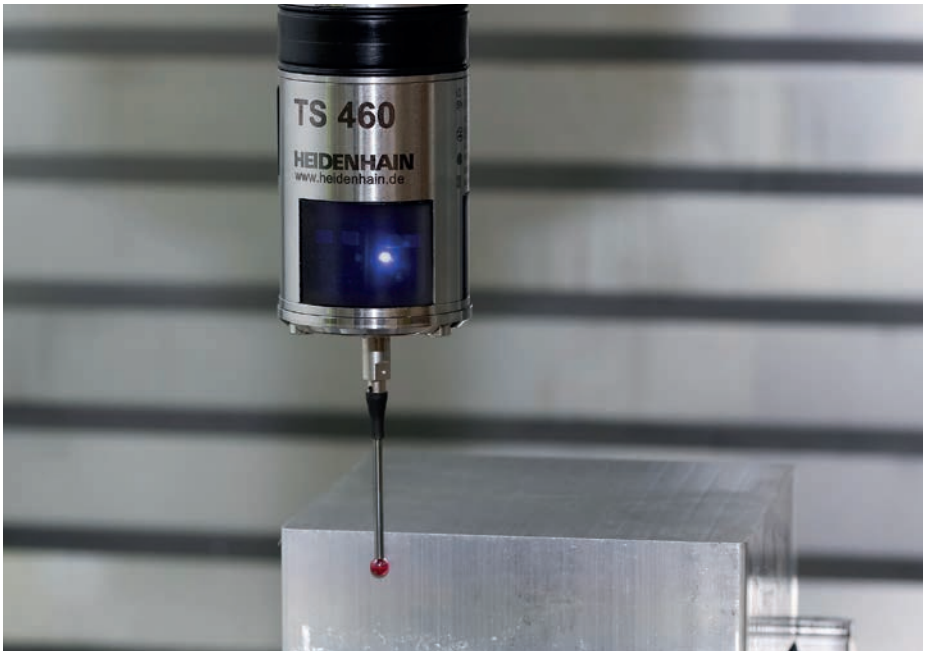


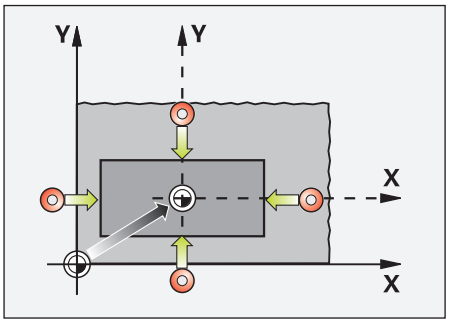
Compensating for misalignment through a basic rotation of the coordinate system



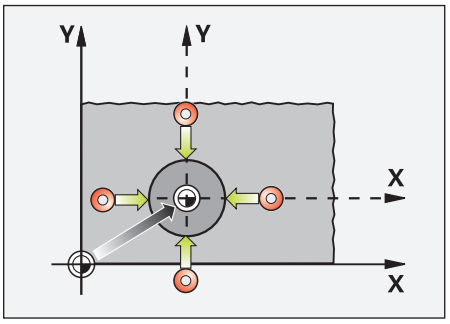
Compensating for misalignment through rotation of a rotary table

**Preset setting**
Programs for machining a workpiece are referenced to presets. Finding this point quickly and reliably with a workpiece touch probe reduces nonproductive time and increases machining accuracy. Depending on the probing functions of your CNC, the TS touch probes from HEIDENHAIN enable the automated setting of presets.

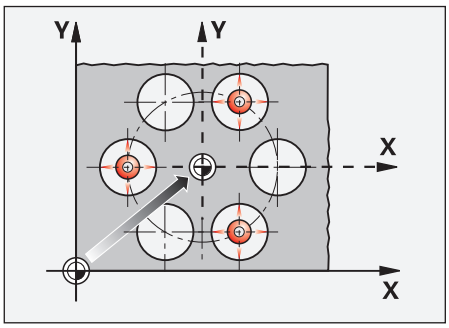


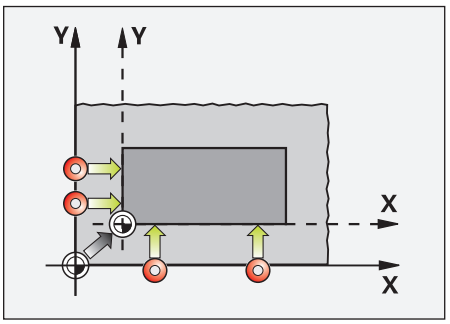
Center of a rectangular stud



Center of a circular stud



Center of a bolt hole circle



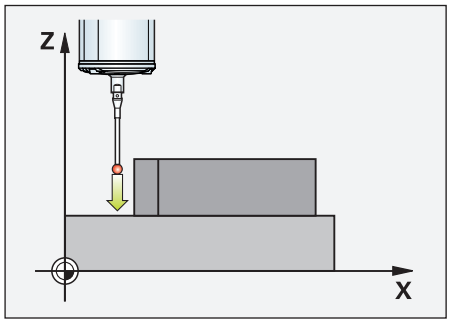
Outside corner

# Workpiece measurement

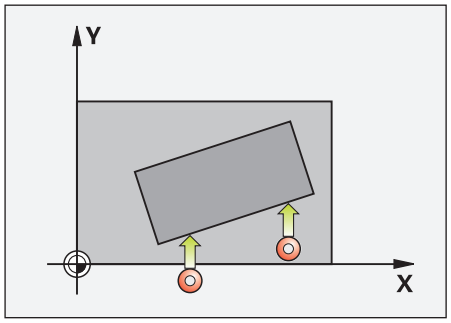
The TS touch probes from HEIDENHAIN are suited for program-controlled workpiece measurement between two machining steps, for example. The resulting position values can be used for tool-wear compensation.

Upon completion of the workpiece, the measured values can be used to document dimensional accuracy or to monitor machine trends. The CNC can output the measurement results through its data interface.

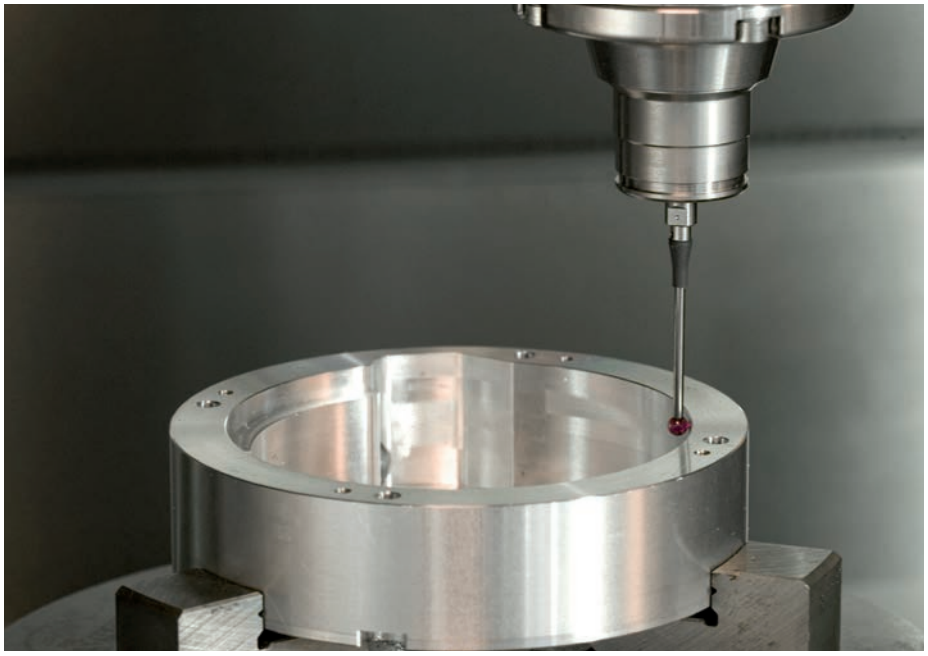
With the aid of external software—for example, FormControl (software package from Blum-Novotest) or digitizing software—you can digitize models or measure free-form surfaces right in the machine tool. In this way, you can immediately detect machining errors and correct them without reclamping. Thanks to their mechanical design and wear-free optical switch, TS touch probes from HEIDENHAIN are particularly well suited for this purpose.

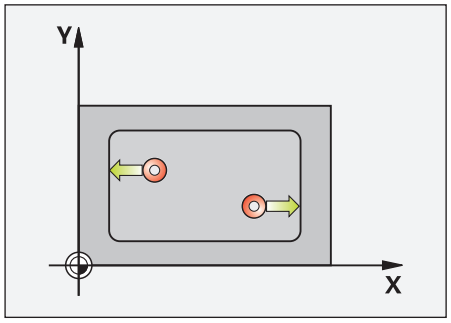


Measuring individual positions in an axis

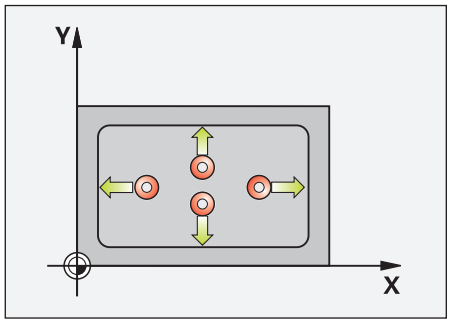


Measuring the angle of a line

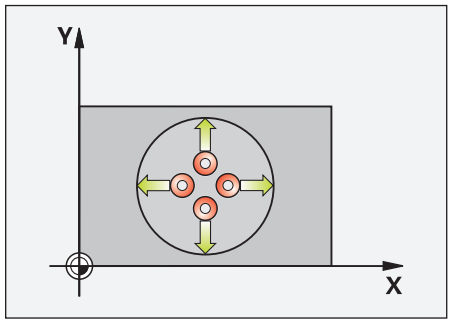




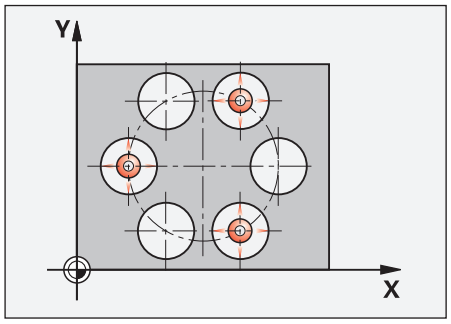
Length measurement



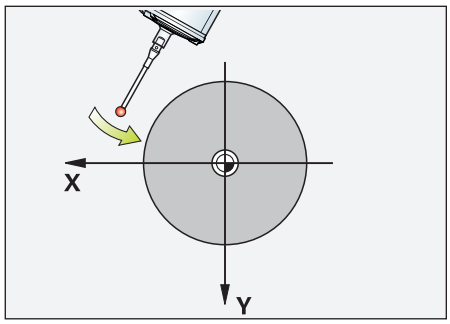
Measuring a rectangular pocket



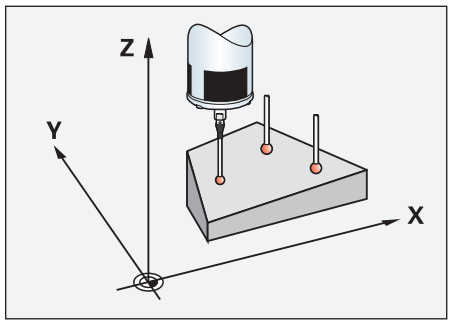
Measuring a circular pocket/hole



Measuring a bolt hole circle



Measuring a diameter

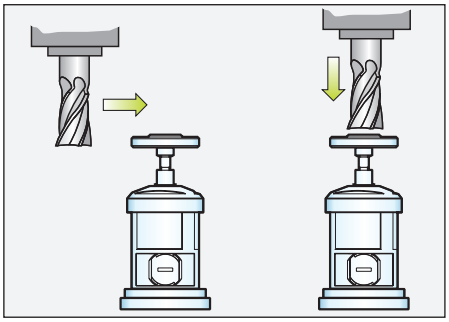


Measuring the angle of a plane

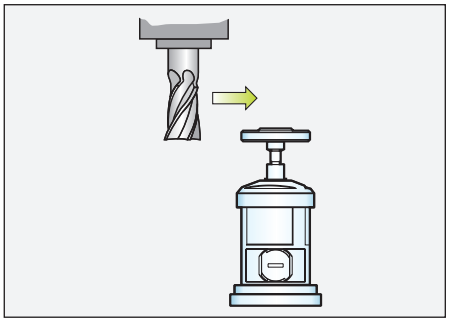
# Tool measurement

Consistently high machining accuracy requires an exact measurement of tool data and cyclical inspection of tool wear. The TT tool touch probes can measure a wide variety of tools right on the machine. For milling cutters, length and diameter are measured, and it is also possible to measure individual teeth. The CNC automatically saves the measured tool data in the tool memory for later use in the part program.

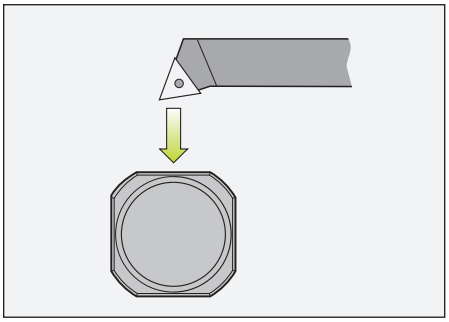
Using a cuboid probe contact, you can also measure lathe tools and check them for wear or breakage. For effective tool-tip radius compensation, you need only add the cutter radius to your entries in the CNC.



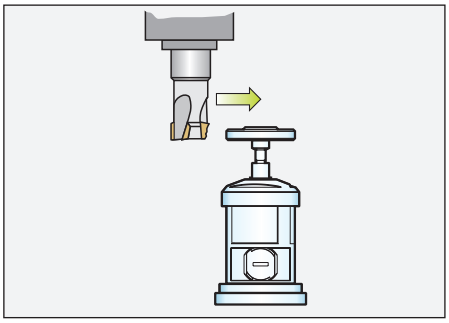
Tool length and radius measurement with stationary or rotating spindle



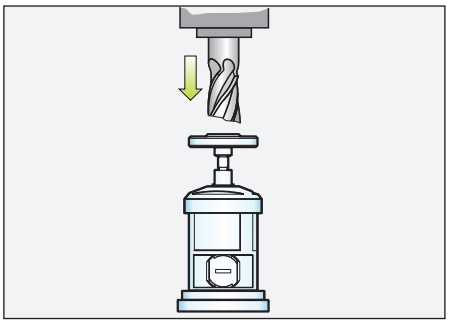
Individual tooth measurement, such as for inspecting indexable inserts (not for brittle materials)



Lathe tool measurement



Tool wear measurement



Tool breakage monitoring

# Inspecting and optimizing machine accuracy

**Calibrating rotary axes***
Accuracy requirements are becoming ever more stringent, particularly in the realm of 5-axis machining. Complex parts must be manufactured with both precision and reproducible accuracy, including over extended periods of time.

With a TS touch probe and a KKH calibration sphere from HEIDENHAIN, you can calibrate the rotary axes of your machine and minimize measurement error in the machine's kinematic description. This capability makes sustained high-accuracy machining possible—from one-off parts all the way to large production series. For kinematics measurements, it plays no role whether the rotary axis is a swivel head, rotary table, or tilting table.

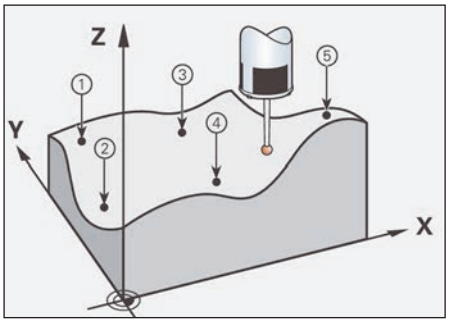
A particularly rigid calibration sphere should be used for kinematics measurements. This helps to reduce deformations that occur as a result of probing forces. The KKH calibration spheres from HEIDENHAIN, which are specially designed for this type of application, exhibit particularly high rigidity and are available in various lengths.

**Calibration spheres:**

| | |
|---|---|
| KKH 100; height: 100 mm | ID 655475-02 |
| KKH 250; height: 250 mm | ID 655475-01 |

These calibration spheres are also well suited for 3-D calibration* of the touch probe. This kind of calibration is necessary, for example, when 3-D geometries are to be measured with exactness. Following 3-D calibration, the individual triggering behavior of the touch probe can be compensated for in any direction. By this means, highly accurate three-dimensional measured values can be attained.

* These functions must be implemented in the machine and control by the machine manufacturer.

# Selection guide for TS workpiece touch probes

The TS workpiece touch probes from HEIDENHAIN help you perform setup, measuring, and inspection functions directly on the machine tool.

The stylus of a TS touch trigger probe is deflected upon contact with a workpiece surface. In that instant, the TS generates a trigger signal that is transmitted to the control either over a cable or by an infrared or radio signal. The control simultaneously saves the actual position values as measured by the machine axis encoders and uses this information for further processing.

| | TS workpiece touch probes | | |
|---|---|---|---|
| | **TS 460** | **TS 642** | **TS 740** |
| **Area of application** | Machining centers; milling, drilling, and boring machines; lathes with automatic tool changers | | |
| **Signal transmission** | Radio or infrared | Infrared | Infrared |
| **Probe repeatability** | 2 σ ≤ 1 µm | | 2 σ ≤ 0.25 µm |
| **Power supply** | Rechargeable or nonrechargeable batteries | Rechargeable or nonrechargeable batteries | |
| **Connection over** | SE 660, SE 540,[1] SE 642,[1] SE 661[2] | SE 540, SE 642, SE 660 | SE 540, SE 642 |
| **Interface to control** | HTL or EnDat 2.2 via the SE | HTL via the SE | |

[1] Only for infrared transmission
[2] For EnDat

HEIDENHAIN touch probes are available in various versions for the measurement of workpieces on machining centers, milling, drilling, and boring machines, as well as on CNC lathes:

Touch probes with **wireless signal transmission** for machines equipped with automatic tool changers:

**TS 460**: new generation standard touch probe for radio and infrared transmission, featuring compact dimensions
**TS 642**: infrared transmission, activation by switch in the taper shank, and compatibility with previous generations of touch probes
**TS 740**: high probe accuracy and repeatability, low probing force, featuring infrared transmission

Touch probes with **cable-bound signal transmission** for machines with manual tool changing, as well as for grinding machines and lathes:

**TS 150**: new generation, with axial or radial cable connection on its base
**TS 260**: new generation, axial or radial cable connection
**TS 248**: new generation, axial or radial cable connection, featuring reduced deflection force


| | TS 248<br>TS 260 | TS 150 |
|---|---|---|
| | Milling, drilling, and boring machines with manual tool changing, as well as lathes and grinding machines | Grinding machines |
| | Axial or radial cable | |
| | 2 σ ≤ 1 µm | |
| | DC 15 V to 30 V | Via UTI 150 |
| | – | Via UTI 150 |
| | HTL and floating switching output | |

## Contents




# Principle of operation
## Sensor

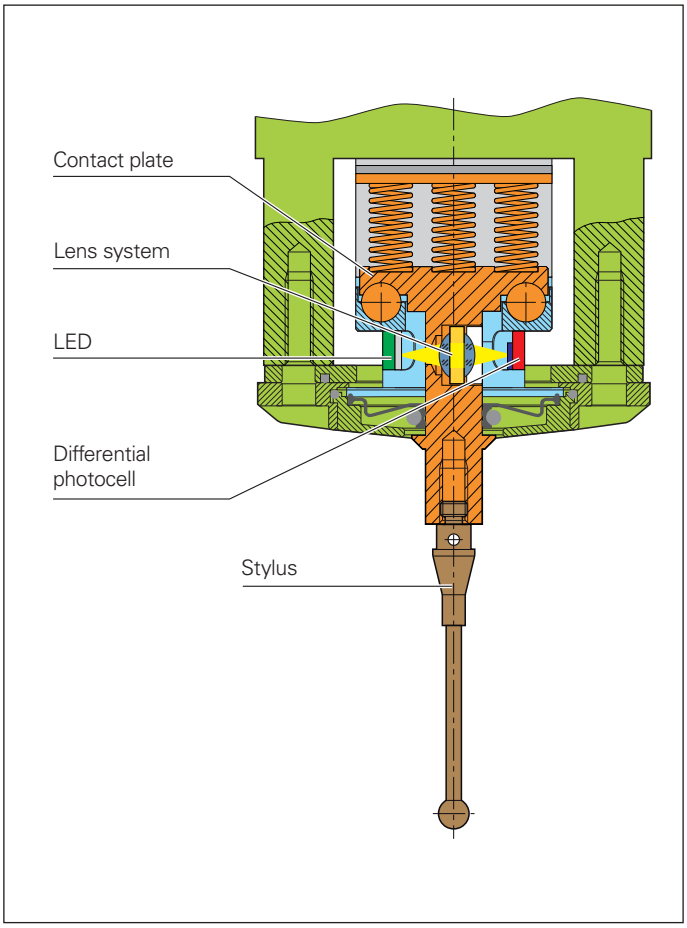
**TS 150, TS 248, TS 260, TS 460, TS 642**
These touch probes from HEIDENHAIN operate with an optical switch as their sensor. A lens system collimates the light emitted by an LED and focuses it onto a differential photocell. Upon deflection of the stylus, the differential photocell produces a trigger signal.

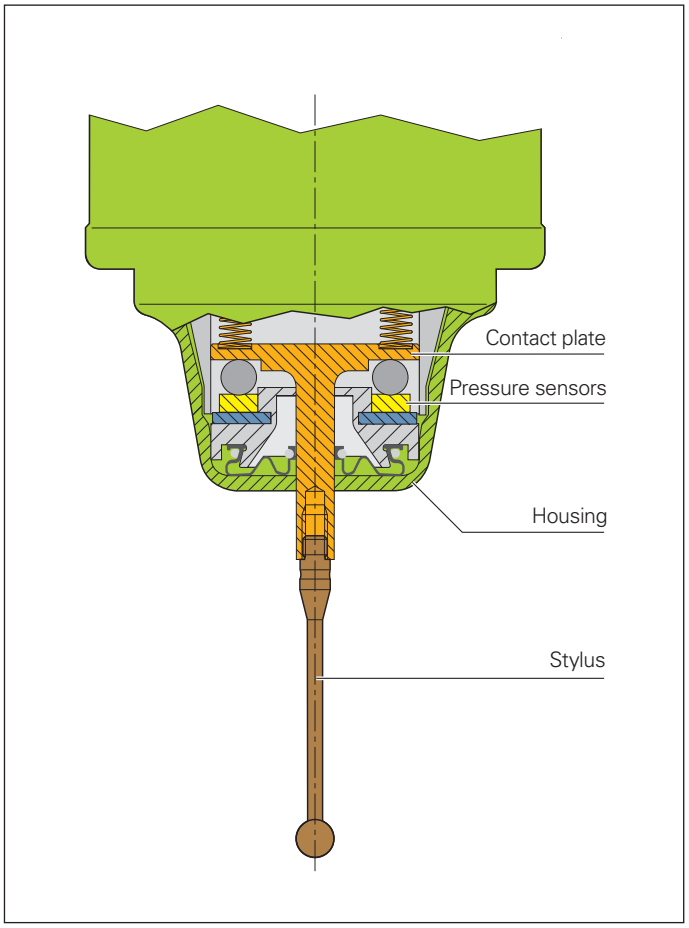
The stylus of the TS is rigidly connected to a plate that is integrated in the probe housing on a three-point bearing. This three-point bearing ensures the physically ideal rest position.

Thanks to the non-contacting optical switch, the sensor is free of wear. As a result, HEIDENHAIN touch probes ensure high long-term stability with constant probe repeatability even after a high number of measuring cycles (e.g., as with in-process applications).

**TS 740**
The TS 740 uses a high-precision pressure sensor. The trigger pulse is obtained through force analysis. The forces that arise during probing are processed electronically. This method delivers extremely homogeneous probe accuracy over 360°.

With the TS 740, the deflection of the stylus is measured by multiple pressure sensors arranged between the contact plate and the probe housing. During probing of a workpiece, the stylus is deflected and a force acts on the sensors. The resulting signals are processed and the trigger signal is generated. The relatively low probing forces involved provide high probe accuracy and repeatability, virtually without the characteristics of tactile probing.



# Accuracy

**Probe accuracy**
The probe accuracy is the measurement error that is determined based on the measurement of a test object from **different directions**.

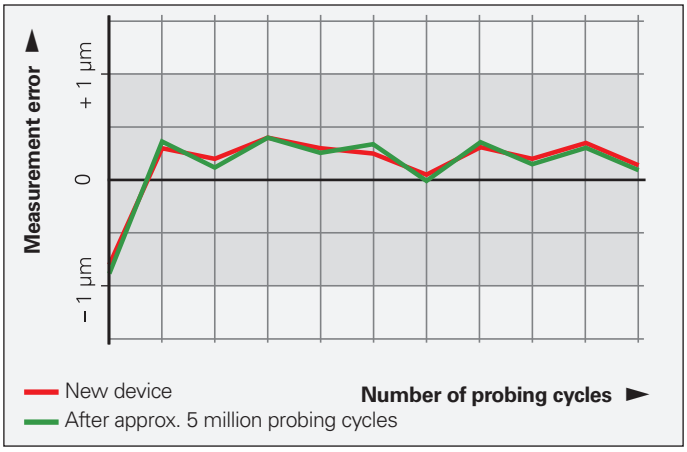
The probe accuracy also includes the effective ball radius. The effective ball radius is calculated based on the actual ball radius and the stylus deflection required for generating the trigger signal. Stylus bending is also taken into account.

The probe accuracy of a touch probe is measured at HEIDENHAIN on precision measuring machines. The reference temperature is 22 °C, and the stylus used is the T404 (length: 40 mm; ball diameter: 4 mm).

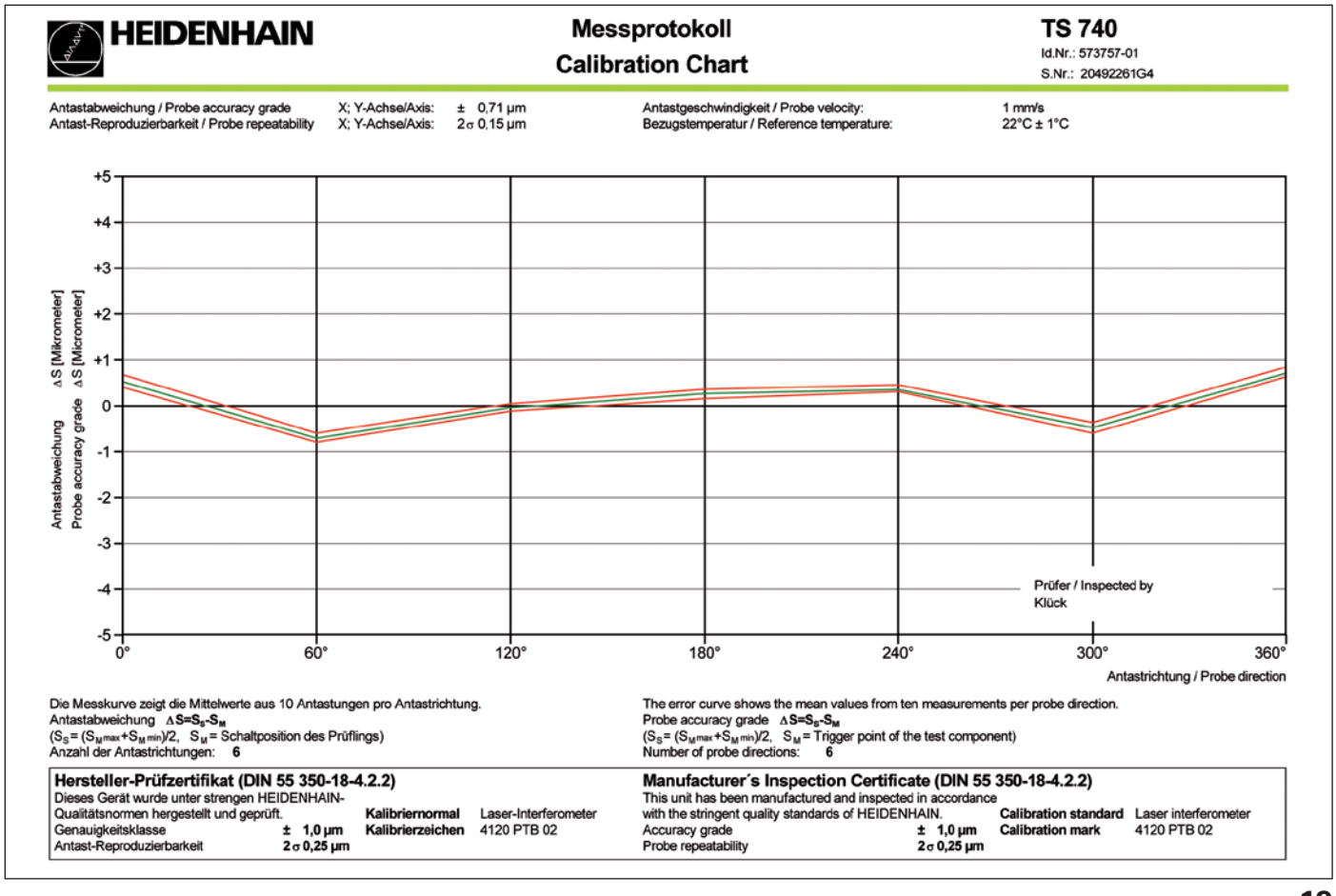
The **TS 740** triggering touch probe is particularly characterized by high probe accuracy and repeatability. These features, together with the low probing force of the TS 740, make it suitable for highly demanding measuring tasks on machine tools.

**Probe repeatability**
Probe repeatability represents the measurement errors that result after the repeated probing of a test object **from one direction**.

**Influence of probe styli**
Stylus length and stylus material directly influence the trigger characteristics of a touch probe. Styli from HEIDENHAIN meet highest quality requirements and ensure exceptional probe accuracy.




Typical repeatability curve of a TS 2xx/4xx/6xx touch probe: results of repeated probing from one direction at a defined spindle orientation



# Signal transmission

## Cable-bound signal transmission

The TS 150, TS 260, and TS 248 touch probes feature a plug-in cable over which the voltage is supplied and the trigger signal is transmitted.

When the TS 260 is used for milling, drilling, and boring machines, the machine operator manually inserts the touch probe into the spindle. The spindle must be locked before the touch probe can be inserted (spindle stop). The CNC's probing cycles can run with both vertical and horizontal spindles.

## Wireless signal transmission

In the case of wireless touch probes, signals are transmitted to the SE transceiver as follows:

- For the **TS 460**, by radio or infrared transmission
- For the **TS 642 and TS 740**, by infrared transmission

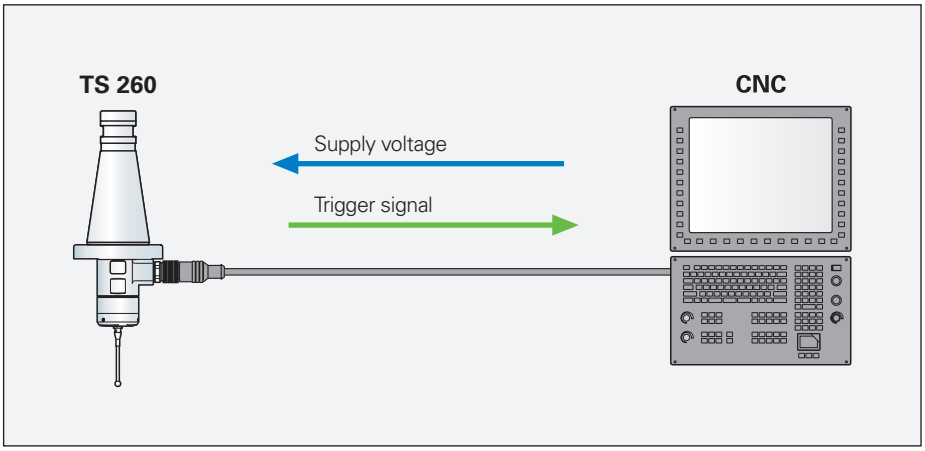
As a result, these touch probes are well suited for use on machines with automatic tool changers.

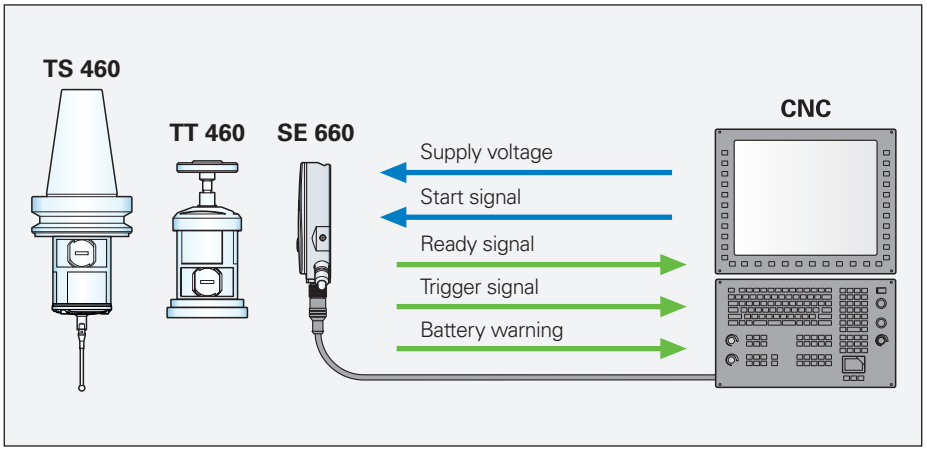
The following transceivers are available:

- **SE 660, SE 661** for radio and infrared transmission; SE shared by TS 460 and TT 460
- **SE 540** for only infrared transmission; for installation in the spindle head
- **SE 642** for only infrared transmission; SE shared by TS and TT

The SE 660 and SE 661 communicate with the TS 460 and TT 460. The SE 540 and SE 642 can be used in any combination with the TS 4xx, TS 642, and TS 740 touch probes.

The following signals are transmitted: the **start signal** activates the touch probe. The touch probe indicates operability by means of a **ready signal**. A deflection of the stylus produces the **trigger signal**. When the battery capacity becomes low, a **battery warning** is output. The falling edge of the start signal switches the touch probe off.




| | SE 660 | SE 661 | SE 540 | SE 642 |
|---|---|---|---|---|
| **TS 460** | Radio/infrared | | Infrared | Infrared |
| **TS 642** | Infrared | – | Infrared | Infrared |
| **TS 740** | – | | Infrared | Infrared |

Signal transmission types and combinations between TS and SE

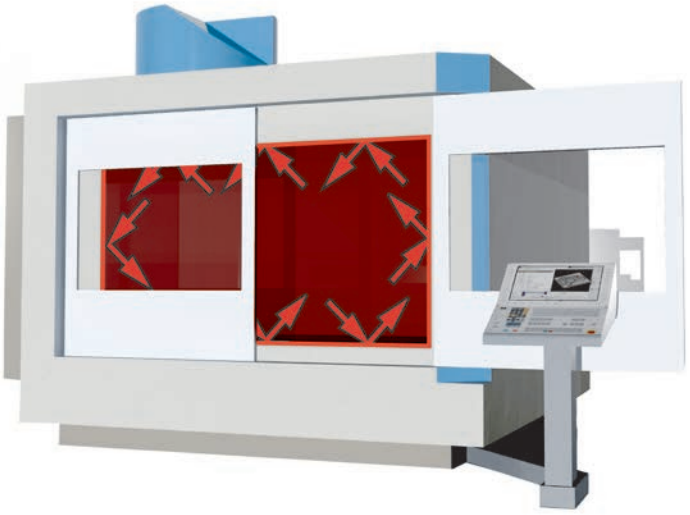
**Infrared transmission**
Infrared transmission is ideal for compact machines with closed working spaces. Thanks to reflection, the signal is received even in otherwise inaccessible locations. Infrared transmission has a range of up to 7 m. The carrier frequency method used by the TS 460 provides high noise immunity with extremely short transmission times of approximately 0.2 ms for the trigger signal.

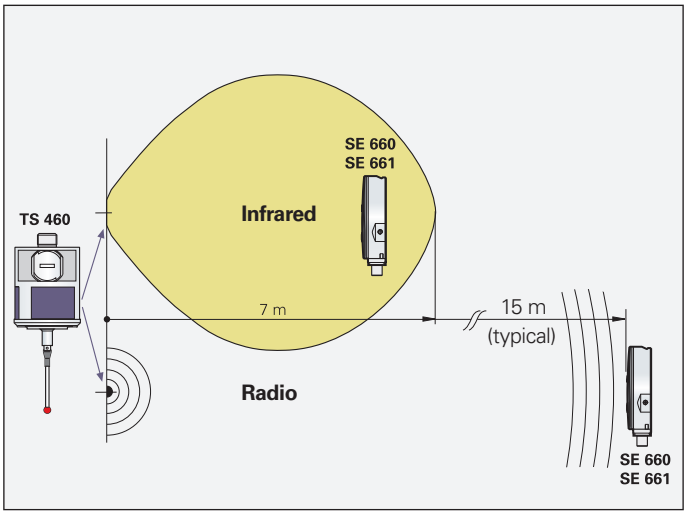
**Radio transmission (only TS 460, TT 460)**
Radio transmission is used primarily for large machine tools. The range is usually 15 m, but much larger ranges are possible in practice under ideal circumstances. Radio transmission operates in the free ISM band at 2.4 GHz and features 16 channels. The transmission times for the trigger signal are approximately 10 ms. Each touch probe is uniquely addressed.

**Hybrid technology: signal transmission via radio or infrared signals (only TS 460, TT 460)**
The dual signal transmission of the TS 460 combines the advantages of radio signals (high range and large quantities of data) with infrared signals (fast signal transmission). You can switch between three possibilities: pure infrared transmission (factory default setting), pure radio transmission, or mixed operation. This arrangement offers the following benefits:

- You save time per measuring cycle without sacrificing accuracy if you activate the touch probe by radio while it is still in the tool changer (i.e., outside of the working space). Measurement is then conducted with infrared transmission, thereby enabling short transmission times.
- You can operate a single touch probe version on different types of machines (milling machines, lathes, grinding machines) and on any machine size (from small and enclosed to large and open).

Regardless of whether you work with radio or infrared transmission, you require only one SE 660 or SE 661 transceiver.





# Transmission range

## Infrared transmission

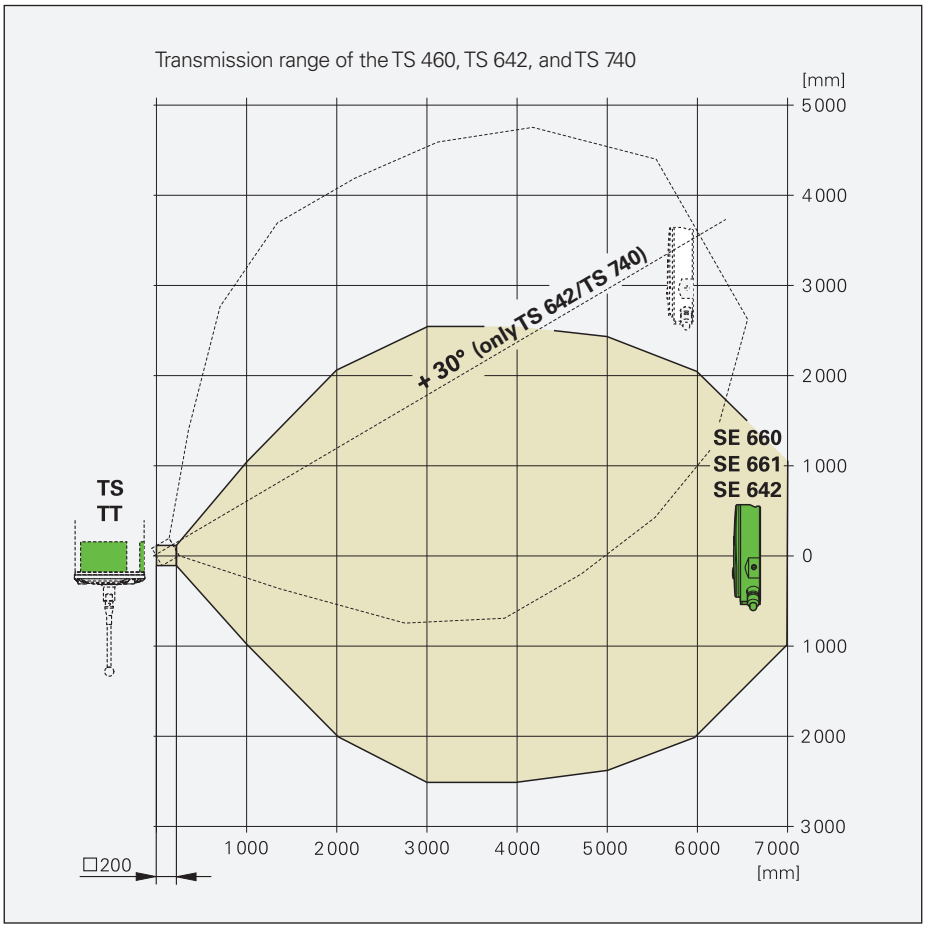
The transmission area between the SE transceiver and touch probes with infrared transmission exhibits a lobe shape. To ensure optimum signal transmission in both directions, you should mount the transceiver such that the touch probe is located within this area during all of its operating positions. If the infrared transmission is disturbed or the signal becomes too weak, the SE notifies the CNC by means of the ready signal. The size of the transmission area depends on both the touch probe and the transceiver being used.

### 360° emission

The LEDs and receiver modules for infrared transmission are distributed in such a way that uniform emission is available over the entire circumference (360°). This ensures a 360° emission range for reliable reception without prior spindle orientation.

### Angle of emission

The TS 642 and TS 740 wireless touch probes are available with horizontal emission angles of 0° or +30° for adaptation to the given machine design. The TS 460 permits communication with the SE 540 in the normal version.

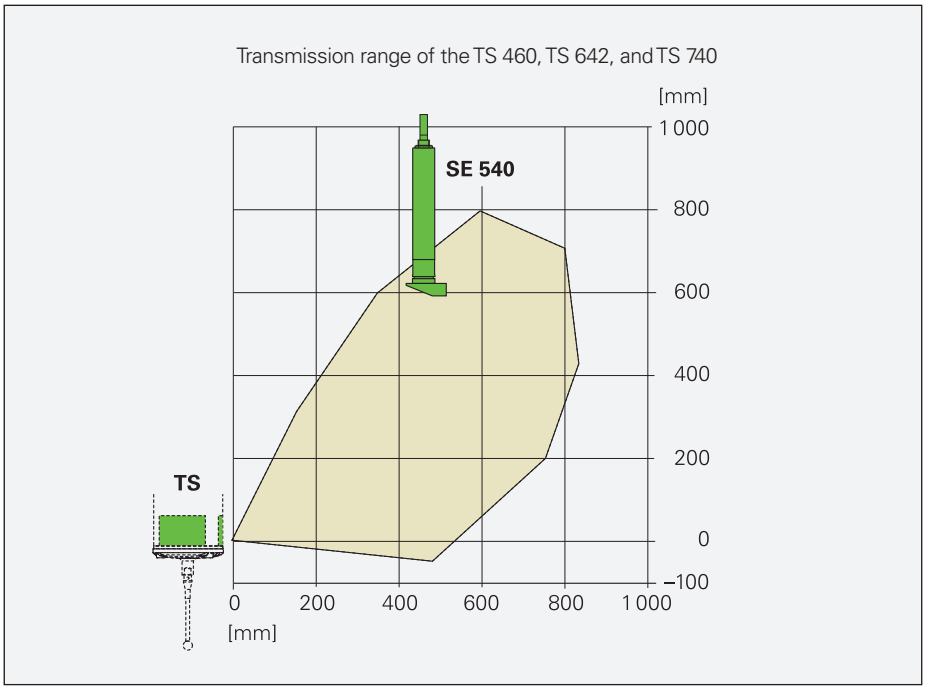



## Radio transmission

The TS 460 touch probe's radio transmission is direction-independent. The transmission range is typically 15 m, but much larger ranges are possible under optimum conditions.

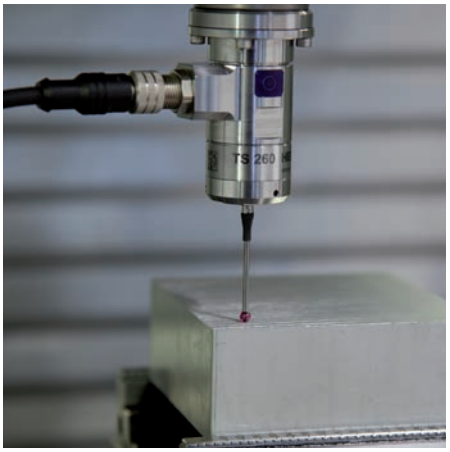
## Transmission signal quality

The signal quality of the infrared or radio transmission is shown on the SE by means of a multicolor LED (see *Optical status indicator*). It can thus be immediately seen whether the touch probe is still within the transmission range of the SE.



# Optical status indicator

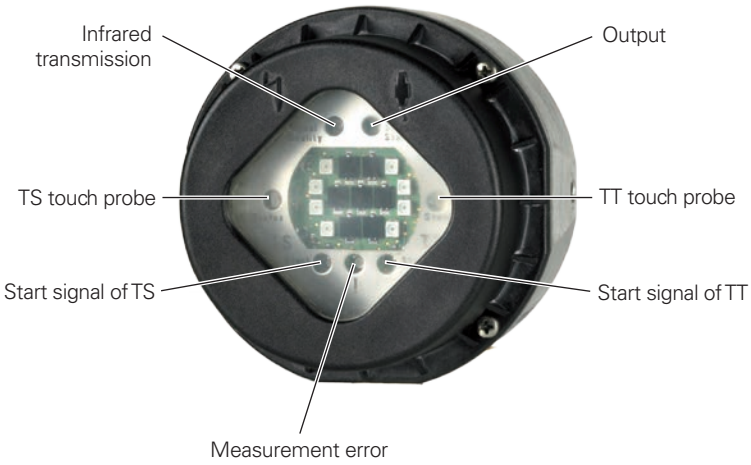
Touch probes and transceivers from HEIDENHAIN are equipped with LEDs that indicate not only the output signals but also the respective state of the device (stylus deflection, readiness, etc.). You can therefore check the touch probe status and the transmission distance at a single glance. This feature simplifies both installation and operation.



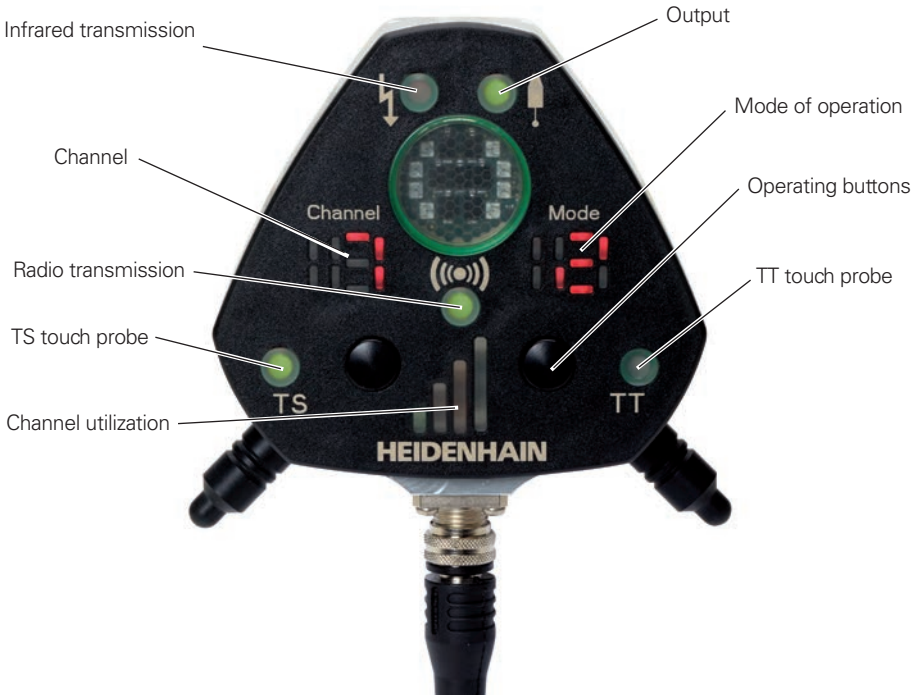
**TS touch probes**
The TS touch probes feature multiple LEDs arrayed along their circumference (although not on the TS 150) such that they are visible at any angle. These LEDs indicate stylus deflection and, in the case of wireless touch probes, also display their readiness.

**SE 540 transceiver**
The SE 540 transceiver features a single multicolor LED indicator that continuously displays the state of the touch probe (readiness, deflection, and battery capacity).

**SE 642 transceiver**
The SE 642 is equipped with multiple multicolor LED indicators that, in addition to indicating status, also facilitate diagnostics. These LEDs indicate the following:
- Readiness
- Active touch probe
- Deflection
- Battery capacity
- Quality of infrared transmission
- Disturbances and faults




**SE 660 and SE 661 transceivers**
In addition to featuring LEDs, the SE 660 for radio and infrared transmission also features segment and bar displays. These provide comprehensive information on commissioning, operation, and diagnostics:
- Readiness
- Active touch probe
- Deflection
- Battery capacity
- Quality of the radio or infrared signal
- Connection setup
- Channel utilization for radio signal
- Collision and faults
- Channel
- Mode of operation



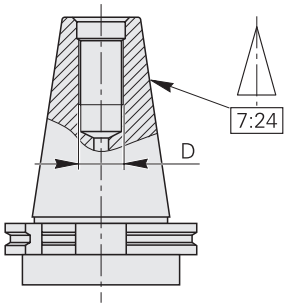
# Mounting
## Workpiece touch probes

The TS workpiece touch probes from HEIDENHAIN are suitable for use on a wide variety of machine tools and feature a corresponding selection of mounting options:

- **Taper shanks** for machining centers and for milling, drilling, and boring machines
- **Tool holders** for special solutions
- **Fastening screw threads** for custom mounting solutions (e.g., on lathes or grinding machines)

### Taper shanks

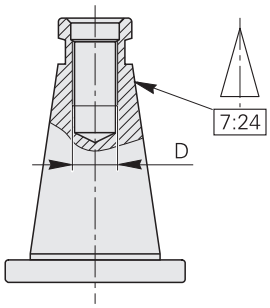
The TS workpiece touch probes are inserted directly into the machine spindle. An assortment of taper shanks is delivered with the TS for use with various clamping systems. A selection is listed here. All other commercially available taper shanks are available upon request.




**DIN 69871**

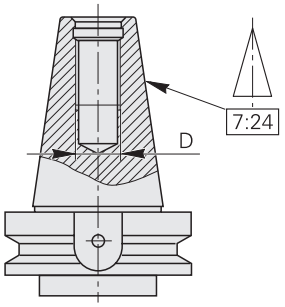
| Taper | D |
|---|---|
| SK-A 40 | M16 |
| SK-A 45 | M20 |
| SK-A 50 | M24 |
| SK-AD/B 30 | M12 |
| SK-AD/B 40[1)] | M16 |
| SK-AD/B 45 | M20 |
| SK-AD/B 50[1)] | M24 |
| SK-AD/B 60 | M30 |
| SK-AD/B 50 BIG PLUS | M24 |

[1)] Also available in extended length



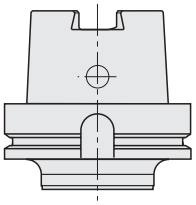

**DIN 2080**

| Taper | D |
|---|---|
| SK-A 40 | M16 |
| SK-A 45 | M20 |
| SK-A 50 | M24 |
| SK-A 50 | UNC 1.000-8 |




**JIS B 6339**

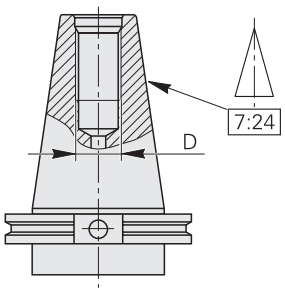
| Taper | D |
|---|---|
| BT 30 | M12 |
| BT 40 | M16 |
| BT 50 | M24 |



**DIN 69893**

| Taper |
|---|
| HSK-E 25 |
| HSK-E 32 |
| HSK-A 40 |
| HSK-E 40 |
| HSK-A 50 |
| HSK-E 50 |
| HSK-A 63[1)] |
| HSK-B 63 |
| HSK-F 63 |
| HSK-A 80 |
| HSK-A 100[1)] |

[1)] Also available in extended length




**ASME B5.50**

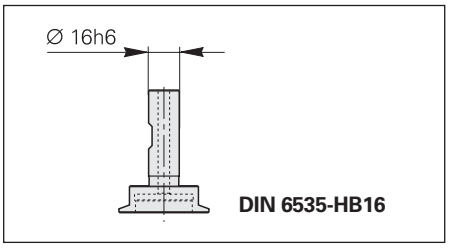
| Taper | D |
|---|---|
| SK 40 | UNC 1x000-8 |
| SK 50 | UNC 1x000-8 |

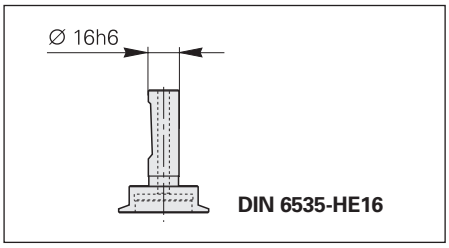
BIG PLUS is a registered trademark of BIG DAISHOWA SEIKI CO., LTD.

## Tool holders

If you use other shanks, the touch probes can be held by standardized cylindrical shanks in commercially available collet chucks. Cylindrical shanks are available for the following tool holders:

- Weldon or shrink-fit chuck as per DIN 6535-HB16
- Whistle notch as per DIN 6535-HE16

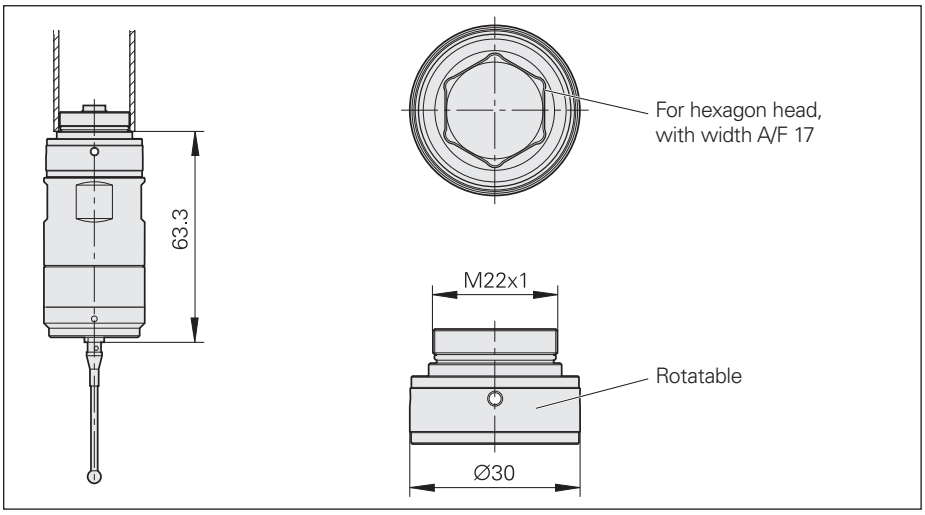



## Threaded mounting hole

The TS touch probes can also be supplied without taper shanks. In this case, a thread is used for mounting.

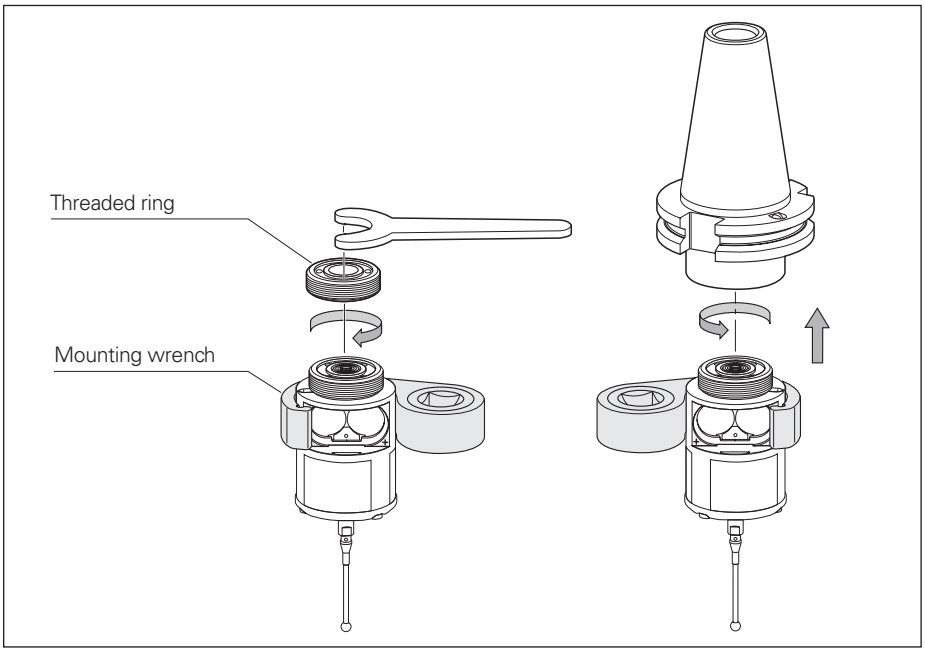
- M16x1 for the TS 150
- M28x0.75 for the TS 260/TS 248
- M12x0.5 for the TS 460/TS 444
- M30x0.5 for the TS 642/TS 740/TS 460




*Accessories:*

**Coupling joint for the TS 260/TS 248**
ID 643089-01

The M22x1 coupling joint with external thread is used for simple attachment of the TS 260/TS 248 to a machine element, or mounting base, or via a tilting device (e.g., on lathes or grinding machines). With the aid of the coupling joint, the TS can also be rotated as desired on a rigid fastening element. This allows you, for example, to align the TS with an asymmetric or cuboid probe contact exactly parallel to the machine axes.



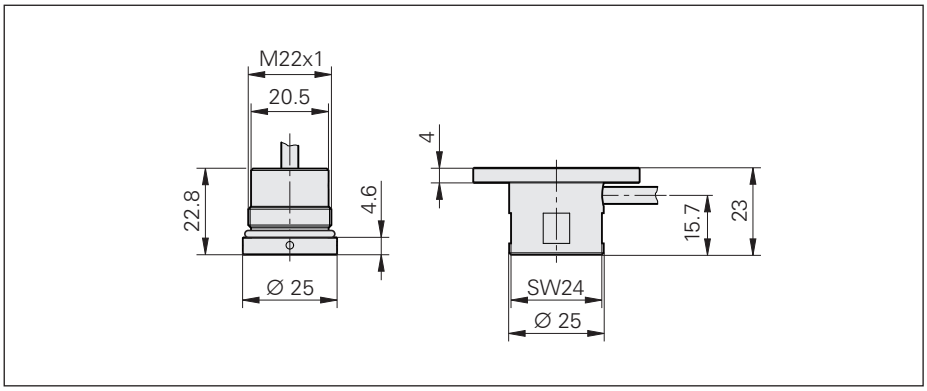

**M12/M30 threaded ring**
ID 391026-01

The threaded ring serves to adapt the taper shanks and tool holders with M30 thread to the TS 4xx (M12 x 0.5)

**Mounting wrench**
For mounting a taper shank on the
TS 460: ID 1034244-01
TS 740/TS 642: ID 519833-01

**Mounting base for TS 150**
ID 1184715-10 axial
ID 1213408-10 radial

The mounting base with integrated cable outlet is required for installation of the TS 150.



# Transceiver

The SE transceiver for infrared transmission should be mounted such that it remains within the transmission range of the touch probe across the machine's entire range of traverse. For radio transmission, sufficient clearance from sources of interference must be ensured. The lateral clearance to metal surfaces must be at least 60 mm.

**SE 660, SE 661, and SE 642 transceivers**
Thanks to their high IP67 rating, these SE can be mounted as desired in the working space and can be exposed to coolant. If the SE is to be used for both a workpiece touch probe and a TT 460 tool touch probe, then it must be ensured during mounting that the SE can communicate with both touch probes.

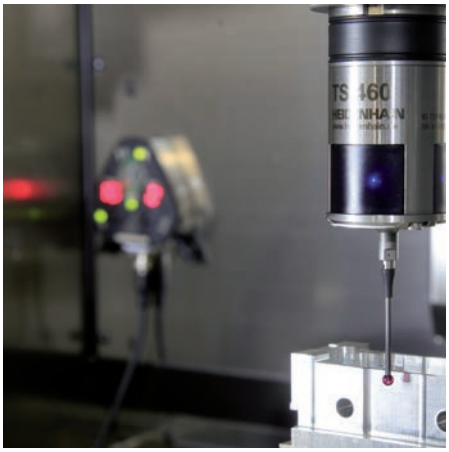
The transceiver is fastened from the side by two M5 threaded holes. Appropriate holders are available as accessories for simple mounting. It is also easy to retrofit.

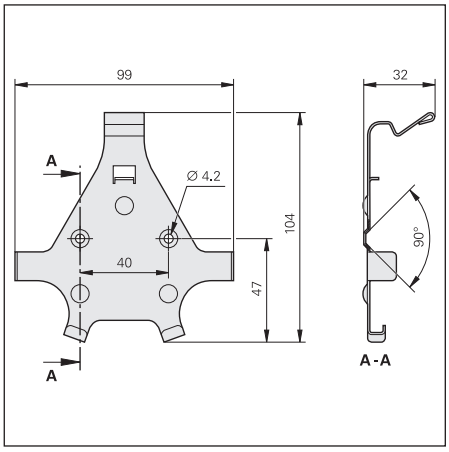
*Accessories*
**Holder for SE 660 and SE 661**
ID 744677-01

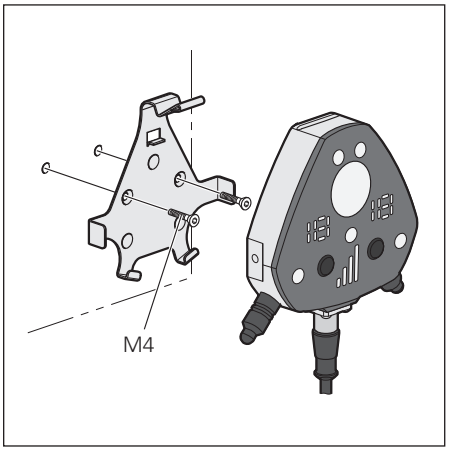
The holder for the SE 660 is secured to a machine element with two M4 screws, while the SE itself is simply clipped in.

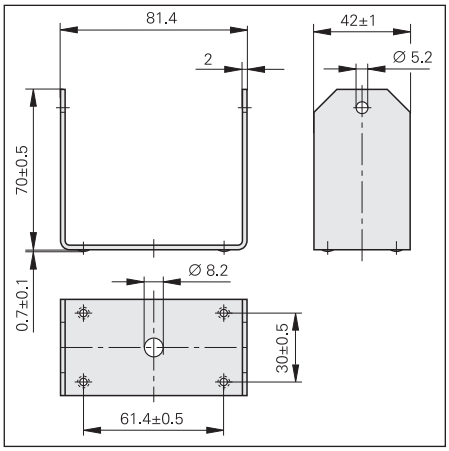
**Holder for SE 642**
ID 370827-01

**SE 540 transceiver**
The SE 540 is intended for integration in the spindle head. Except for a few cases, such as on machines with quills, this fact ensures transmission on machines with very large traverse ranges or with swivel heads. The transmission range of the infrared signal is appropriate to the mounting situation. Because the SE 540 is always located above and to the side of the TS, HEIDENHAIN recommends the use of touch probes with a +30° emission angle. The machine must be designed to support the SE 540.

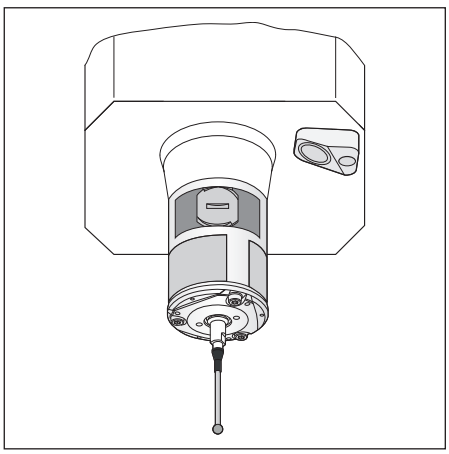


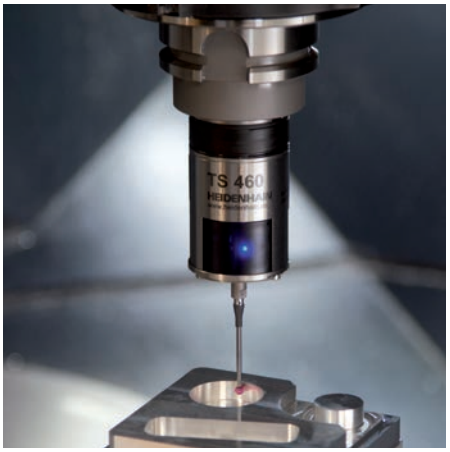




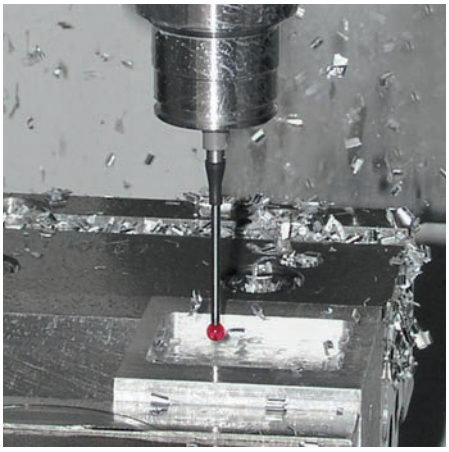
# Probing

The workpiece geometry or position is ascertained by the TS workpiece touch probe through mechanical probing. To ensure correct measurement, the workpiece should be free of chips and other foreign matter.

Upon deflection of the stylus, a trigger signal is transmitted to the control. In addition, the deflection is indicated by LEDs on the circumference of the touch probe.



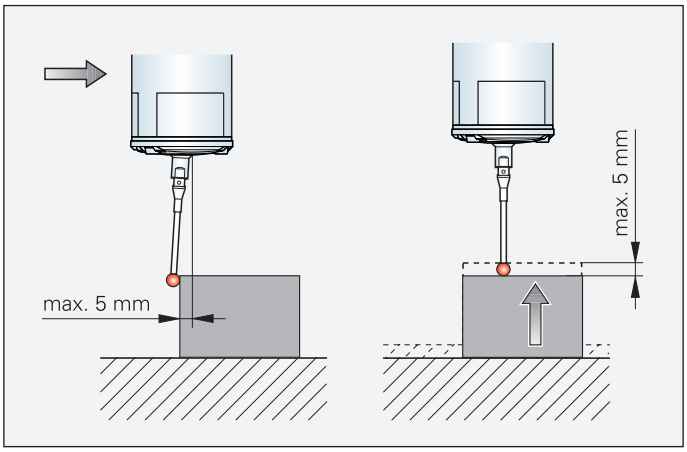

The wireless touch probes feature an integrated **flusher/blower system**: the probing point can be cleaned of coarse contaminants by means of compressed air through jets at the bottom of the probe. Even chip accumulation in pockets is no problem. This feature allows automatic measuring cycles during unattended operation. The flusher/blower system can work only on machines with a compressed-air duct running through the spindle. Maximum pressure is 15 bar for the TS 460.

**Probing velocity**
Signal propagation times of the CNC, as well as infrared transmission and especially radio transmission, influence the probe repeatability of the touch probe. In addition to the signal propagation time, the permissible stylus deflection must also be taken into account for the maximum probing velocity. The mechanically permissible probing velocity is shown in the specifications.

**Deflection of the probe contact**
The maximum permissible deflection of the stylus is 5 mm in every direction (for a stylus length of 40 mm). The machine must stop moving within this distance in order to avoid damage to the touch probe.

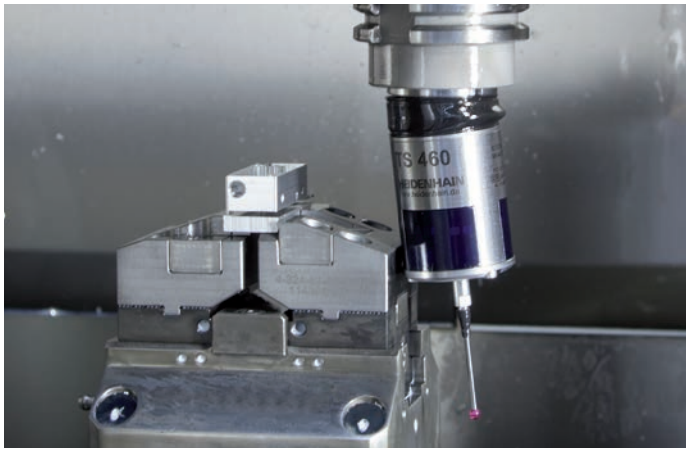
Deflection of the stylus



# Collision protection and thermal decoupling (option with TS 460)

**Mechanical collision protection**
A mechanical adapter between the touch probe and taper shank is used for collision protection. The touch probe is thus capable of giving slightly during light collisions of its housing against a fixture or workpiece. An integrated switch simultaneously deactivates the ready signal, and the control stops the machine. Thus, collision protection works only when the touch probe is activated.

The undamaged touch probe is recalibrated (via the control's calibration cycle), and you can then continue working. The collision protection adapter does not cause any additional error—not even at high accelerations (e.g., during tool change).




The collision protection adapter protects the touch probe from mechanically induced damage ...

**Thermal decoupling**
The collision protection adapter also functions as a thermal decoupler. This feature protects the touch probe from being heated by the spindle.

If the spindle heats up strongly due to previous machining operations—particularly during long measuring cycles—then the touch probe can become hot as well. Faulty measurements may be the result. Yet thanks to its collision protection feature, the touch probe with thermal decoupling reduces heat conduction from the spindle to the touch probe.

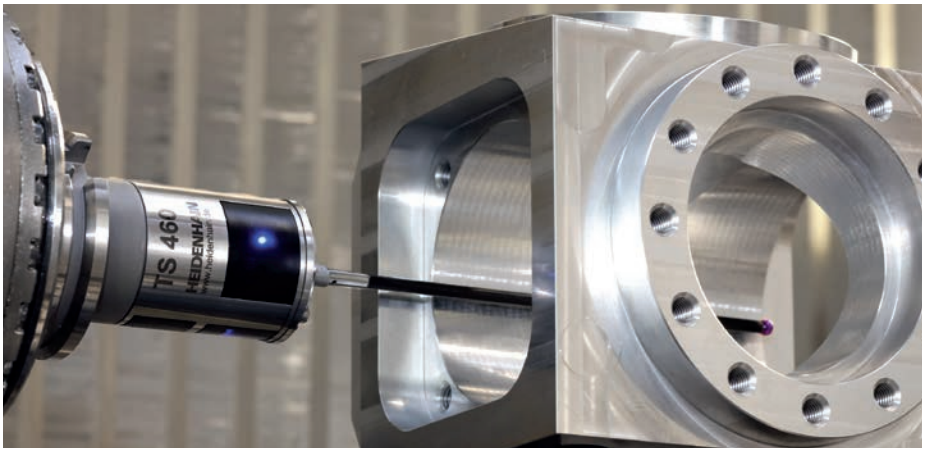

... and serves as a thermal decoupler (at left, with collision protection adapter)

# Styli

**Styli for the TS**
HEIDENHAIN offers styli in a variety of lengths and ball-tip diameters. All styli are attached to the TS touch probes by means of an M3 thread. Starting from a ball-tip diameter of 4 mm, a rated break point protects the touch probe from mechanically induced damage caused by operator error. The following styli are included in delivery with the TS touch probes:

- For the TS 150, T404
- For the TS 260/TS 248, 2 x T404
- For the TS 460, T404 and T409
- For the TS 642 and TS 740, T404 and T424

By means of the coupling joint, the TS 260/TS 248 can be mounted in a particular orientation so that asymmetric and cuboid probe contacts can be exactly aligned.



Ball-tip stylus with carbon-fiber shaft

**Ball-tip styli with steel shaft**

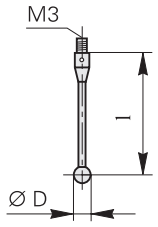
| Model | ID | Length l | Ball diameter D |
|---|---|---|---|
| T421 | 295770-21 | 21 mm | 1 mm |
| T422 | 295770-22 | 21 mm | 2 mm |
| T423 | 295770-23 | 21 mm | 3 mm |
| T424 | 352776-24 | 21 mm | 4 mm |
| T403 | 295770-03 | 40 mm | 3 mm |
| T404 | 352776-04 | 40 mm | 4 mm |
| T405 | 352776-05 | 40 mm | 5 mm |
| T406 | 352776-06 | 40 mm | 6 mm |
| T408 | 352776-08 | 40 mm | 8 mm |
| T409 | 352776-19 | 60 mm | 4 mm |

**Ball-tip styli with carbon-fiber shaft**

| Model | ID | Length l | Ball diameter D |
|---|---|---|---|
| T510 | 805228-01 | 100 mm | 5 mm |
| T515 | 805228-02 | 150 mm | 5 mm |
| T520 | 805228-03 | 200 mm | 5 mm |
| T530 | 805228-05 | 300 mm | 5 mm |
| T615 | 805228-10 | 150 mm | 6 mm |
| T610 | 805228-07 | 100 mm | 6 mm |

Additional styli, including special shapes, are available upon request.

Styli




**Star-type insert**
For up to five styli (e.g., T404 or T421)
ID 1090725-01

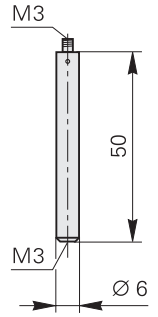
**Stylus adapters**
For the fastening of styli with M4 thread
ID 730192-01

**Stylus extension**

| Model | ID | Length l | Material |
|---|---|---|---|
| T490 | 296566-90 | 50 mm | Steel |
| T790 | 1213836-06 | 60 mm | Titanium |

The stylus extension may be used only in conjunction with the short styli (21 mm in length).

Extension

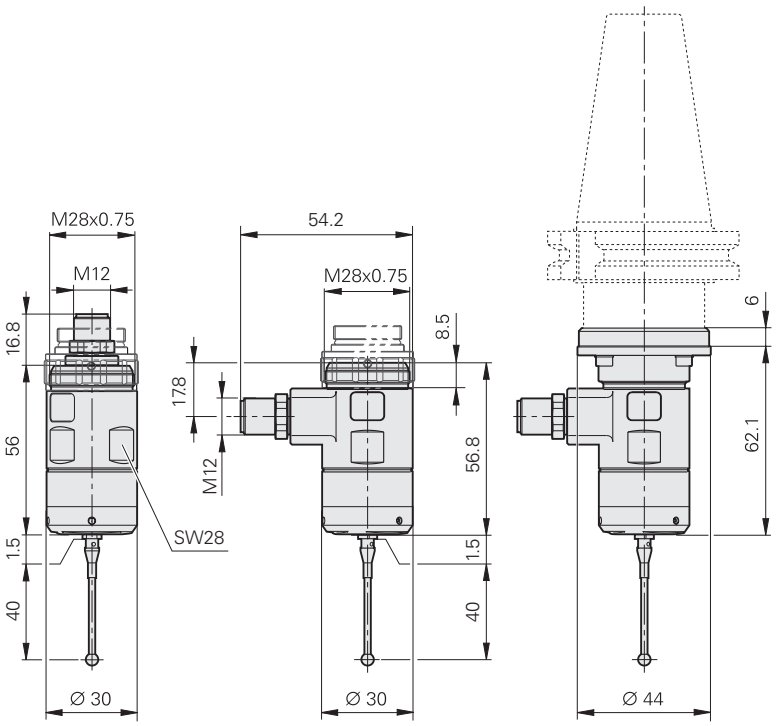


# TS 248, TS 260, and TS 150
## Workpiece touch probes

**TS 248, TS 260**

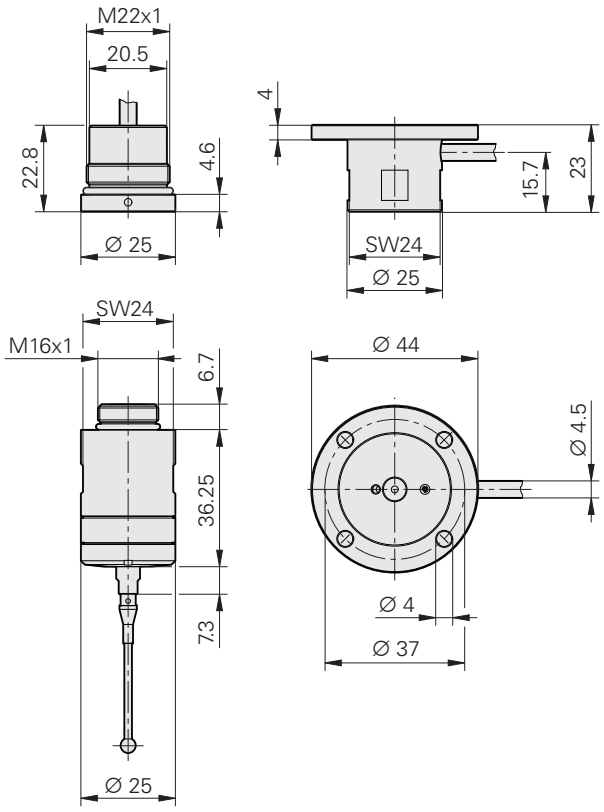

**Axial flange socket**


**Radial flange socket**




**TS 150**


**With mounting base**



| Workpiece touch probe | Cable<br><br>TS 248<br>TS 260 | TS 150 |
|---|---|---|
| **Probe accuracy** | ≤ ±5 µm with use of the T404 standard stylus | |
| **Probe repeatability**<br>Repeated probing from one direction | 2 σ ≤ 1 µm at a probing velocity of 1 m/min<br>*Typical values:*<br>2 σ ≤ 1 µm at a probing velocity of 3 m/min<br>2 σ ≤ 4 µm at a probing velocity of 5 m/min | |
| **Deflection of probe contact** | ≤ 5 mm in all directions (with stylus length L = 40 mm) | |
| **Deflection forces** | *Axial:* ≈ 8 N (*TS 248:* ≈ 4 N)<br>*Radial:* ≈ 1 N (*TS 248:* ≈ 0.5 N) | |
| **Probing velocity** | ≤ 5 m/min | |
| **Protection** EN 60529 | IP68 | |
| **Operating temperature** | 10 °C to 40 °C | |
| **Storage temperature** | –20 °C to 70 °C | |
| **Mass** without taper shank | ≈ 0.15 kg | ≈ 0.1 kg |
| **Fastening*** | • With taper shank[1] (only with radial flange socket)<br>• Via M28x0.75 external thread<br>• Via coupling joint with M22x1 external thread | • Via M16x1 external thread on the mounting base<br>• Contact on the mounting base<br>• Axial cable outlet: M22x1 for fastening to the machine<br>• Radial cable outlet: fastened to the machine with four M3 screws |
| **Electrical connection*** | 8-pin M12 flange socket, axial or radial | Two-pole sliding contact on the mounting base |
| Cable length | ≤ 25 m | |
| **Supply voltage**[2] | DC 15 V to 30 V/≤ 100 mA (without load) | DC 15 V to 30 V/≤ 85 mA (without load) |
| **Output signals**[2] | • Trigger signals S and $\overline{S}$ (square-wave signal and its inverted signal)<br>• Floating trigger output | |
| HTL signal levels[2] | $U_H \geq 20$ V at $-I_H \leq 20$ mA<br>$U_L \leq 2.8$ V at $I_L \leq 20$ mA<br>at rated voltage of DC 24 V | |
| **Signal transmission** | Cable | |

* Please select when ordering
[1] See *Mounting* on page 18
[2] With the TS 150: over the UTI 150

# TS 460, TS 642, and TS 740
## Workpiece touch probes

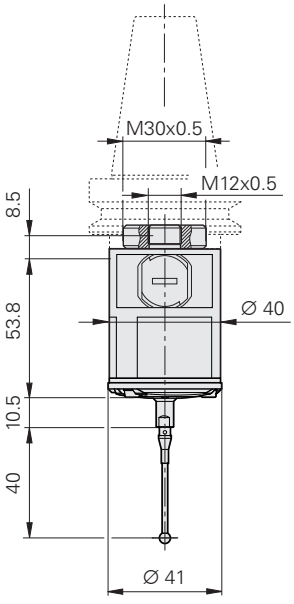
mm
Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm

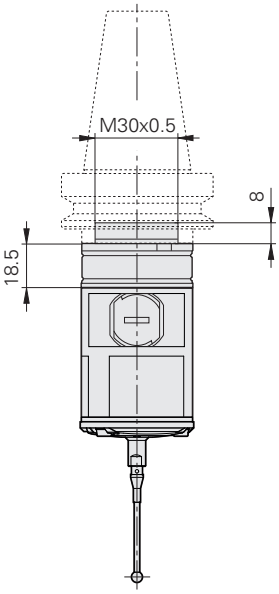

**TS 460**


**TS 642**

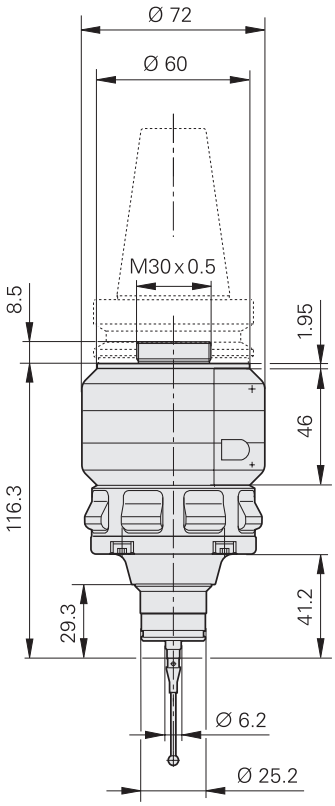

**TS 740**

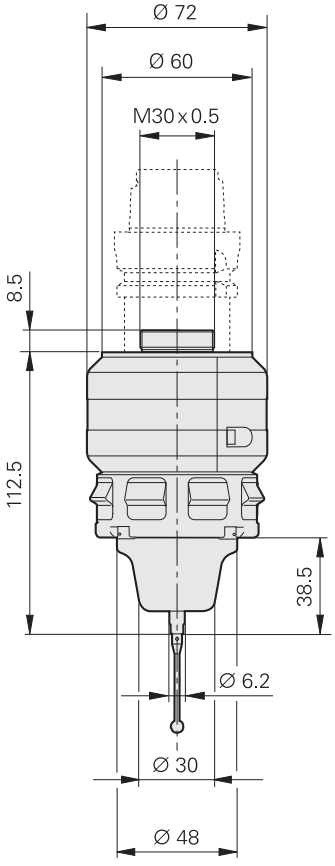
**With collision protection**




**With collision protection**



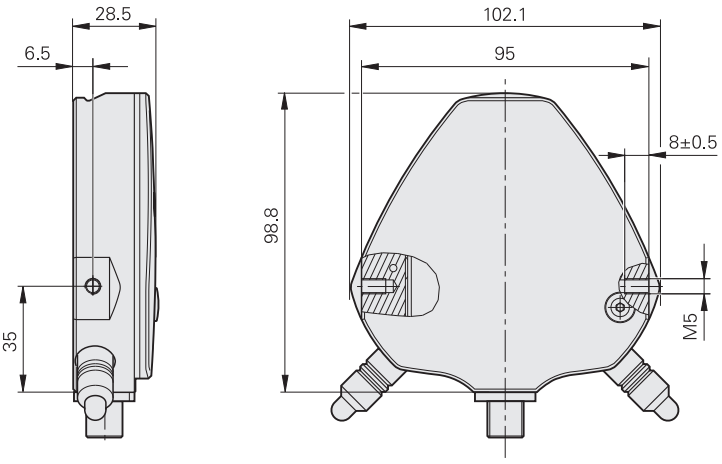



| Workpiece touch probe | Radio and infrared<br>TS 460 | Infrared<br>TS 642 | <br>TS 740 |
|---|---|---|---|
| **Probe accuracy** | ≤ ±5 µm with use of the T404 standard stylus | | ≤ ±1 µm with use of the T404 standard stylus |
| **Probe repeatability**<br>Repeated probing from one direction | 2 σ ≤ 1 µm at a probing velocity of 1 m/min<br>*Typical values:*<br>2 σ ≤ 1 µm at a probing velocity of 3 m/min<br>2 σ ≤ 4 µm at a probing velocity of 5 m/min | | 2 σ ≤ 0.25 µm<br>at a probing velocity of 0.25 m/min |
| **Deflection of probe contact** | ≤ 5 mm in all directions (with stylus length L = 40 mm) | | |
| **Deflection forces** | *Axial:* ≈ 8 N<br>*Radial:* ≈ 1 N | | *Axial:* ≈ 0.6 N<br>*Radial:* ≈ 0.2 N |
| **Probing velocity** | ≤ 5 m/min | | ≤ 0.25 m/min |
| **Collision protection** | Optional | – | |
| **Protection** EN 60529 | IP68 | | |
| **Operating temperature** | 10 °C to 40 °C | | |
| **Storage temperature** | –20 °C to 70 °C | | |
| **Mass** without taper shank | ≈ 0.2 kg | ≈ 1.1 kg | |
| **Fastening*** | • With taper shank[1)]<br>• Via M12x0.5 external thread | • With taper shank[1)]<br>• Without taper shank (M30x0.5 connecting thread) | |
| **Signal transmission** | Radio and infrared transmission (selectable) with 360° emission to the SE | Infrared transmission with 360° emission | |
| **Emission angle of the infrared signal*** | 0° | 0° or +30° | |
| **TS switch-on/off** | Radio or infrared signal (selectable) from the SE | Via switch in the taper shank or infrared signal from the SE | Infrared signal from the SE |
| **Power supply** | Two rechargeable or nonrechargeable batteries, 1 V to 4 V each; size $^1/_2$ AA or size LR1[4)] | Two rechargeable or nonrechargeable batteries, 1 V to 4 V each; size C or size A[4)] | |
| Operating time | Typically 90 h[3)] with alkaline batteries (included in delivery); typically 400 h[3)] possible with lithium batteries | Typically 400 h with alkaline batteries (included in delivery); typically 800 h possible with lithium batteries | Typically 220 h with alkaline batteries (included in delivery); typically 500 h possible with lithium batteries |
| **Transceiver*** | • SE 661[2)]/SE 660 for radio and infrared transmission<br>• SE 642 for infrared transmission<br>• SE 540 for infrared transmission; for integration in the spindle head | SE 540, SE 642, or SE 660 (only infrared) | SE 540 or SE 642 |
| **Interface** | HTL or EnDat 2.2 via the SE | HTL | |

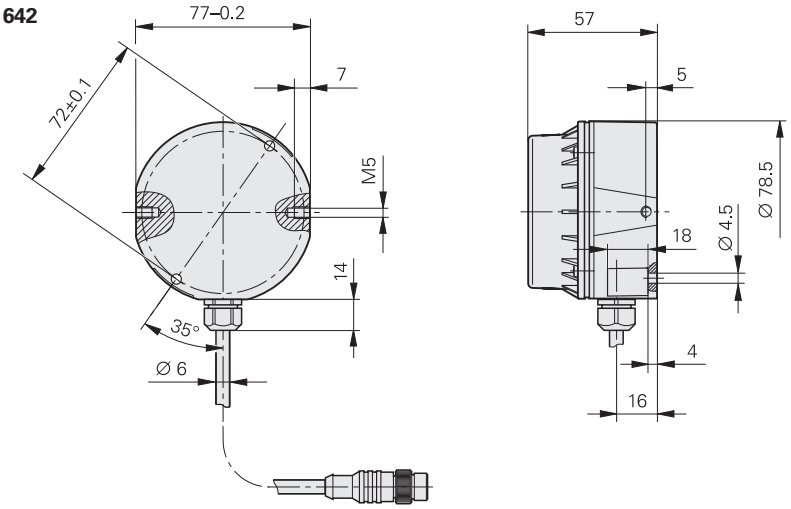
***** Please select when ordering
1) See *Mounting* on page 18
2) With EnDat interface
3) Reduced operating time in the presence of high ambient radio traffic or with frequent, short probing intervals
4) Via adapter, included in delivery

# SE 661, SE 660, SE 642, and SE 540
Transceivers

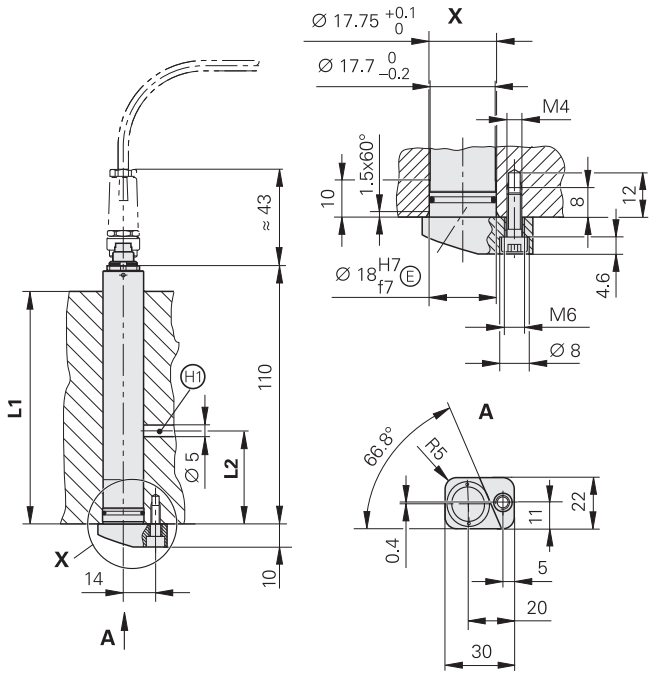

**SE 660**
**SE 661**




**SE 642**




**SE 540**




mm
Tolerancing ISO 8015
ISO 2768 - m H
≤ 6 mm: ±0.2 mm

Ⓗ1 = If L1 > 100: provide a drain hole;
L2 = 10 mm to 100 mm

| Transceiver | Radio and infrared | | Infrared | |
|---|---|---|---|---|
| | **SE 661** | **SE 660** | **SE 642** | **SE 540** |
| **Use with** | TS 460 and TT 460; any number may be connected | TS 460 and TT 460; up to four each may be connected (depending on version) | TS 460, TS 642, TS 740, and TT 460 | TS 460, TS 642, or TS 740 |
| **Signal transmission** | Radio or infrared | | Infrared | |
| **Area of application** | In working space of machine | | | In location hole in the spindle head |
| **Interface** | Serial data (EnDat 2.2)<br>• Activation<br>• Trigger signal<br>• Ready signal<br>• Diagnosis | Square-wave signals (HTL)<br>• Start signals R(-TS) and R(-TT)<br>• Ready signals B(-TS) and B(-TT)<br>• Trigger signals S and $\overline{S}$<br>• Battery warning $\overline{W}$ | | Square-wave signals (HTL)<br>• Start signal R<br>• Ready signal B<br>• Trigger signal $\overline{S}$<br>• Battery warning $\overline{W}$ |
| **Optical status indicator** | For infrared transmission, radio transmission, radio channel quality, channel, operating mode, and whether workpiece or tool touch probe | | For infrared transmission, errors, and whether workpiece or tool touch probe | For touch probe |
| **Electrical connection*** | 8-pin M12 flange socket | 12-pin M12 flange socket | Cable, 0.5 m/2 m with 12-pin M12 connector | 8-pin M9 flange socket |
| Cable length | ≤ 50 m | ≤ 20 m with adapter cable Ø 6 mm<br>≤ 50 m with adapter cable Ø 6 mm and adapter cable Ø 8 mm for extension | | ≤ 30 m with adapter cable Ø 4.5 mm<br>≤ 50 m with adapter cable Ø 4.5 mm and adapter cable Ø 8 mm for extension |
| Supply voltage | DC 15 V to 30 V | | | |
| Current consumption without load[1)]<br>Infrared<br>Normal operation<br>Transmission (max. 3.0 s)<br>Radio | <br>3.8 $W_{eff}$ (≤ 220 $mA_{eff}$)<br>12 $W_{PK}$ (≤ 755 $mA_{PK}$)<br>2.4 $W_{eff}$ (≤ 135 $mA_{eff}$) | <br>3.4 $W_{eff}$ (≤ 200 $mA_{eff}$)<br>10.7 $W_{PK}$ (≤ 680 $mA_{PK}$)<br>2.1 $W_{eff}$ (≤ 120 $mA_{eff}$) | <br>5.1 $W_{eff}$ (≤ 250 $mA_{eff}$)<br>8.3 $W_{PK}$ (≤ 550 $mA_{PK}$)<br>– | <br>3.7 $W_{eff}$ (≤ 150 $mA_{eff}$)<br>4.3 $W_{PK}$ (≤ 210 $mA_{PK}$)<br>– |
| **Protection** EN 60529 | IP68 | | | |
| **Operating temperature** | 10 °C to 40 °C | | | 10 °C to 60 °C |
| **Storage temperature** | –20 °C to 70 °C | | | –20 °C to 70 °C |
| **Mass** without cable | ≈ 0.3 kg | | ≈ 0.2 kg | ≈ 0.1 kg |

***** Please select when ordering
[1)] At minimum supply voltage

# Selection guide for TT tool touch probes

Tool measurement on the machine shortens non-productive times, increases machining accuracy, and reduces the scrapping and reworking of machined parts. The tactile TT touch probes allow you to measure your tools efficiently and reliably.

Due to their rugged design and high degree of protection, these tool touch probes can be installed directly within the machine tool's work envelope.

**TT touch probes**
The TT 160 and TT 460 tool touch probes are touch trigger probes for the measurement and inspection of tools. The TT 160 uses cable-bound signal transmission, while the TT 460 communicates wirelessly with the SE 660 or SE 661 via a radio or infrared transmission path.

The disk-shaped probe contact of the TT is deflected during the tactile probing of a tool. In that instant, the TT generates a trigger signal that is transmitted to the control, where it is then processed further. The trigger signal is generated by means of a wear-free optical sensor featuring a high level of reliability.

The probe contact is easy to exchange. The connecting pin for the probe contact features a rated break point. This protects the touch probe from mechanically induced damage due to operator error.

| | **TT tool touch probes** | |
|---|---|---|
| | **TT 160** | **TT 460** |
| **Probing forces** | *Axial:* 8 N, *radial:* 1 N | |
| **Sensitivity to unclean tools** | Very small | |
| **Possible measuring cycles** | Length, radius, breakage, individual teeth | |
| **Signal transmission** | Cable | Radio/infrared to SE 660, SE 661; infrared to the SE 642 |
| **Interface** | HTL | HTL, EnDat 2.2 over the SE |
| **Repeatability** | 2 σ ≤ 1 µm | |
| **Min. tool diameter** | 3 mm[1)] | |
| **Max. tool diameter** | Unlimited | |

[1)] Probing force must not result in tool damage

## Contents




# General information

In conjunction with the measuring cycles of the CNC control, the TT tool touch probes enable the control to measure tools automatically while they are in the machine spindle. The control saves the values measured for tool length and radius in the central tool file. By inspecting the tool during machining, you can quickly and directly measure wear or breakage so as to prevent scrap or rework. If the measured deviations lie outside the tolerances, or if the monitored life of the tool is exceeded, the control can lock the tool or automatically insert a replacement tool.

With the **TT 460**, all signals are conveyed to the control via radio or infrared transmission. Advantages:
- Greatly increased mobility
- Rapid installation at any location
- Deployable on rotary and tilting tables as well

**You benefit from the following**: with the TT 160 or TT 460 tool touch probe, you can have your CNC machine be productive during unattended shifts without expecting a loss in accuracy or even scrap.

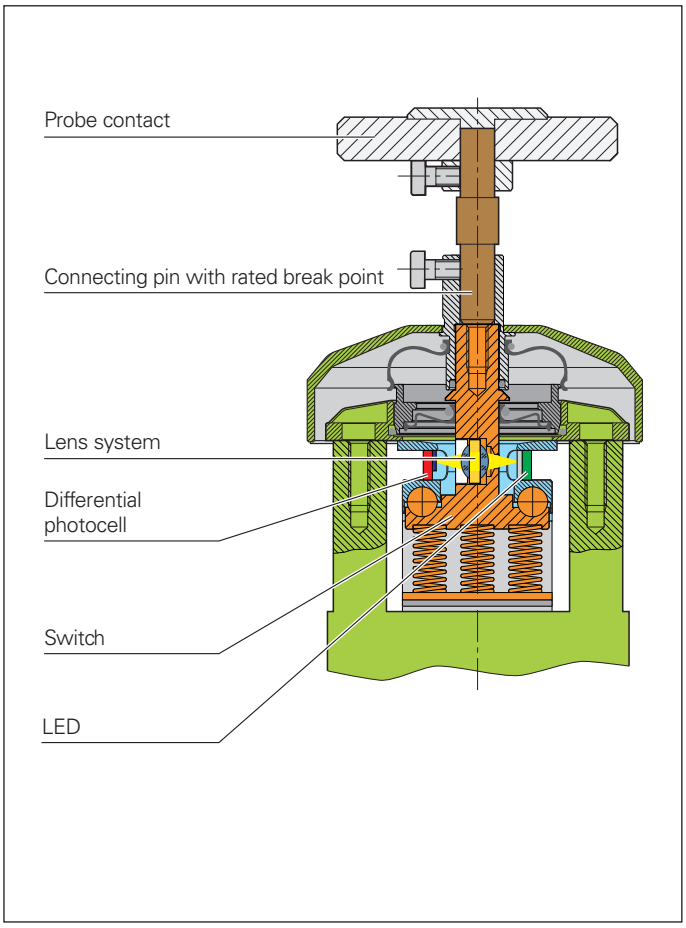
# Principle of operation
## Sensor

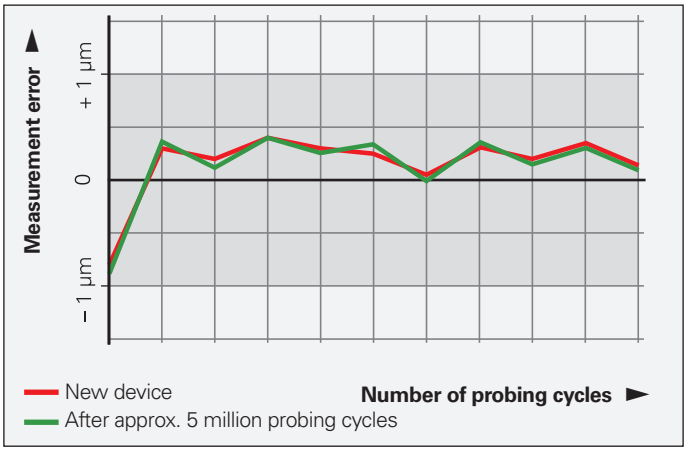
Touch probes from HEIDENHAIN operate with an optical switch as sensor. A lens system collimates the light emitted by an LED and focuses it onto a differential photocell. Upon deflection of the probe contact, the differential photocell produces a trigger signal. The probe contact of the TT is rigidly connected to a plate that is integrated in the probe housing on a three-point bearing. This three-point bearing ensures the physically ideal rest position.

Due to its contact-free optical switch, the sensor operates without wear, thereby ensuring the high long-term stability of HEIDENHAIN touch probes.

**Repeatability**
For tool measurement, the repeatability of the probing process is of primary importance. The probe repeatability specifies the error that is determined through repeated probing of a tool from one direction at an ambient temperature of 20 °C.

The probe accuracy of a touch probe is measured at HEIDENHAIN on precision measuring machines.



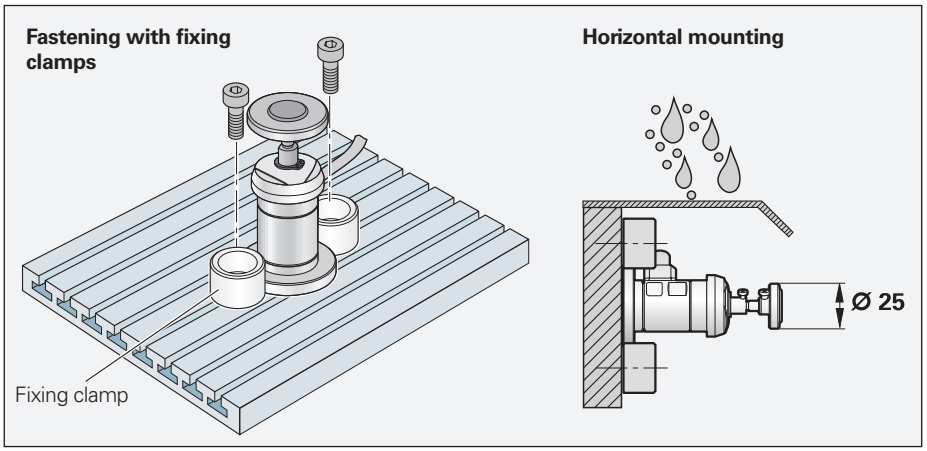

Typical repeatability curve of a touch probe: results of repeated probing from one direction

# Mounting
## TT tool touch probe

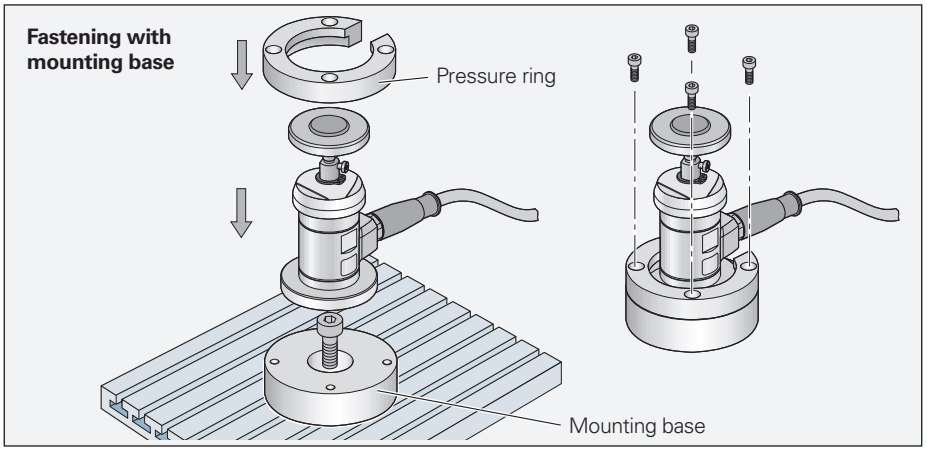
The tool touch probes feature an IP67 rating and can thus be installed within the working space of the machine. The TT is mounted with two fixing clamps or on a space-saving mounting base that is available as an accessory.

The TT with 40 mm probe contact should be operated vertically to ensure reliable probing and optimum protection against contamination. Like the cuboid probe contact, the 25 mm diameter SC02 probe contact can also be operated when mounted in a horizontal position.

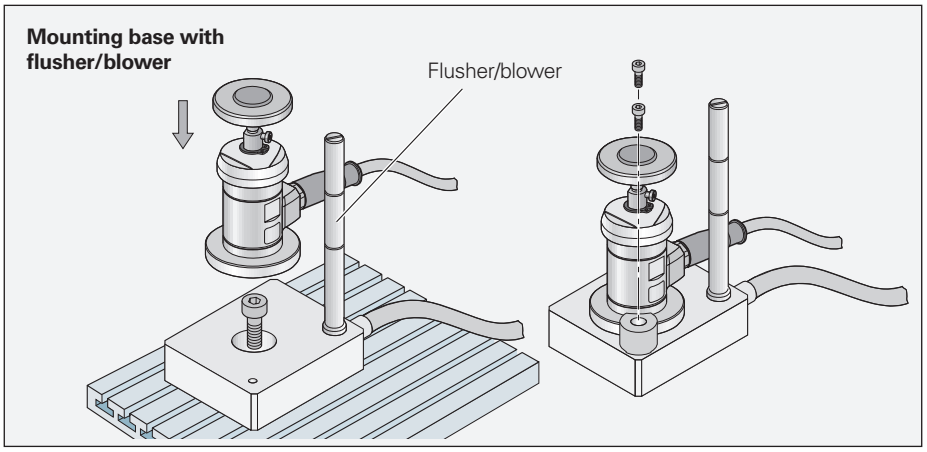
During workpiece machining, the TT must be switched off in order to ensure that the vibrations that accompany normal machining do not trigger a probe signal and cause an interruption.



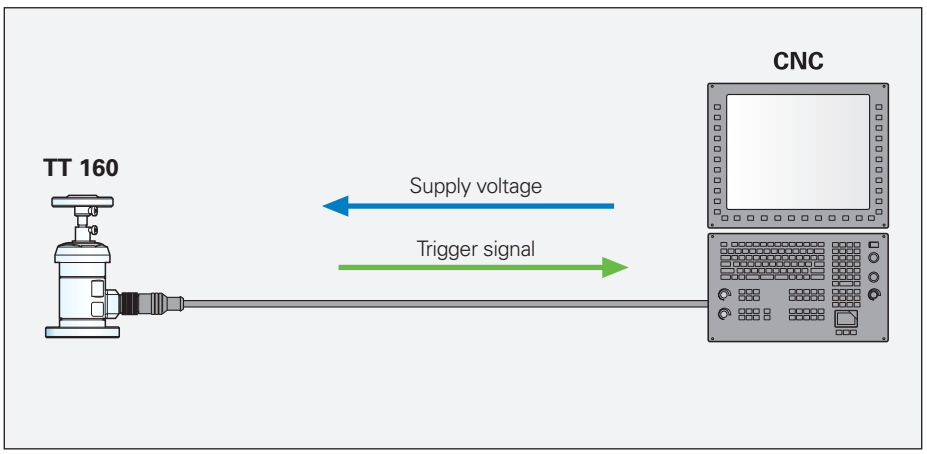

*Accessories:*
**Mounting base** for TT
For fastening with a central screw
TT 160: ID 332400-01
TT 460: ID 651586-01




**Mounting base with flusher/blower**
For cleaning the tool
Air connection for Ø 4/6 tube
ID 767594-01




**Supply voltage and signal transmission**
For the TT 160 touch probe, both the supply voltage and the trigger signal are provided over the touch probe's cable. The TT 460 wirelessly transmits the trigger signals to the SE 660 or SE 661 transceiver (see page 14/15).



# Probing

The hardened probe contact of the TT tool touch probe permits direct probing of the tool as it rotates in its noncutting direction. Depending on the tool diameter, speeds of up to 1000 rpm are permissible. The probe contact can be exchanged quickly by simply screwing it into the touch probe through a fit.

The maximum permissible deflection of the probe contact is 5 mm in any direction. The machine must stop moving within this distance.

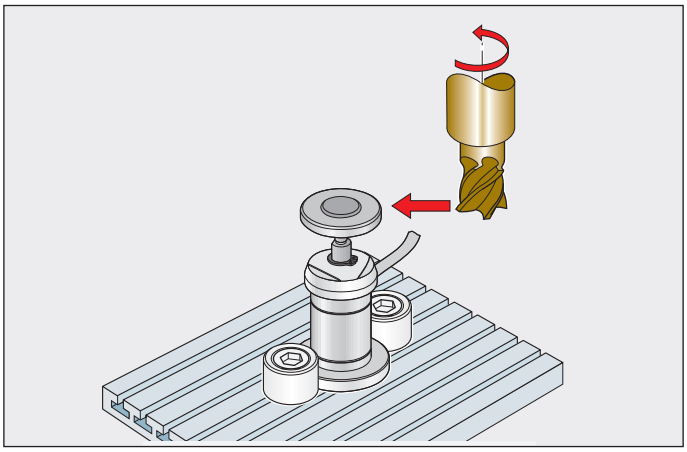
The probe contact of the TT features a **rated break point** in order to protect the touch probe from mechanically induced damage due to operator error. The rated break point is effective in all probing directions. A rubber sleeve offers protection from splinters. A defective connecting pin can easily be replaced without needing to readjust the TT.

**Optical deflection display**
LEDs on the TT 160 additionally indicate deflection of the probe contact. On the TT 460, the state of the touch probe is also shown by LEDs on the SE transceiver. This characteristic is especially useful for testing correct operation, since you can see at a glance whether the TT is currently deflected.

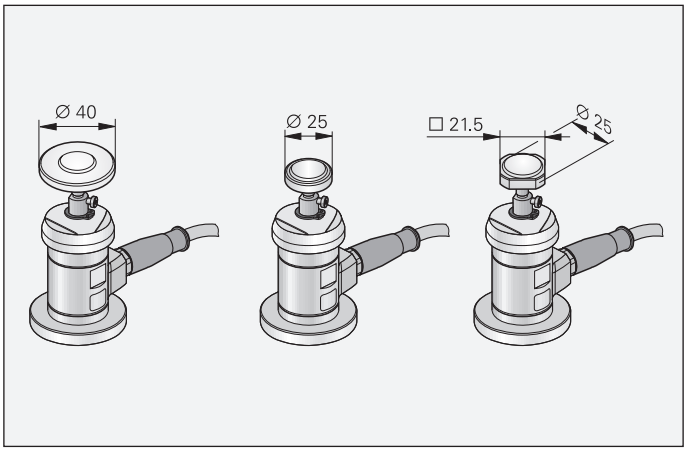
**Probe contacts**
For probing **milling cutters**, the tool touch probes are equipped with a disk-shaped probe contact with a diameter of 40 mm (for example). A disk-shaped probe contact with a diameter of 25 mm is available as an accessory. Due to its low weight, this probe contact is particularly recommended when the TT is mounted horizontally.

The TT tool touch probe can also be used to calibrate **lathe tools**. To this end, a cuboid probe contact (available as an accessory) is used, whose flat surfaces are contacted by the lathe tool. By this means, you can periodically inspect tools in NC-controlled lathes for breakage and wear in order to ensure process reliability.

The probe contacts can be ordered separately for replacement. Replacing them is simple and does not require readjustment of the TT.



Connecting pin for the probe contact (shown without rubber sleeve)



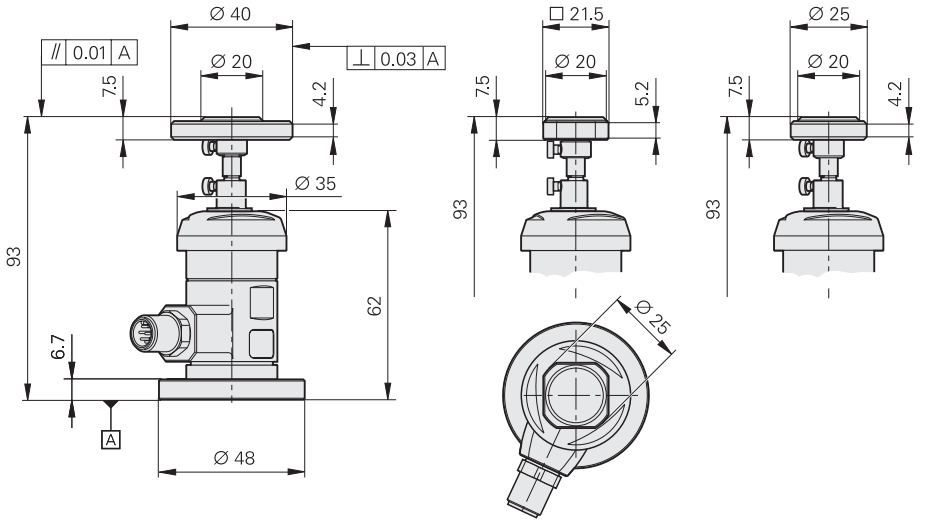

*Accessories:*
**Probe contact** SC02 Ø 25 mm
ID 574752-01

**Probe contact** SC01 Ø 40 mm
ID 527801-01

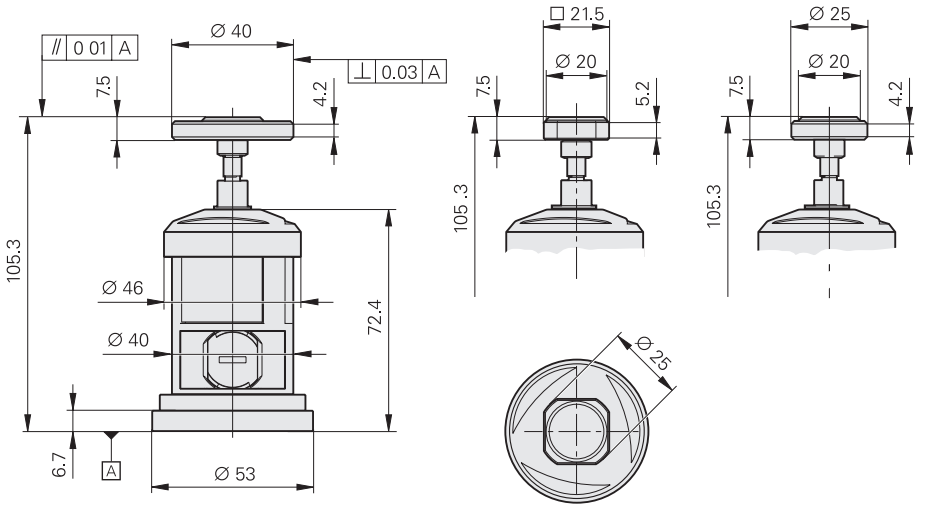
**Probe contact** cuboid
ID 676497-01

# TT 160 and TT 460
## Tool touch probes

**TT 160**


**TT 460**

| Tool touch probe | Cable<br>TT 160 | Radio and infrared<br>TT 460 |
|---|---|---|
| **Probe accuracy** | ≤ ±15 µm | |
| **Probe repeatability**<br>Repeated probing from one direction | 2 σ ≤ 1 µm at a probing velocity of 1 m/min<br>*Typical values:*<br>2 σ ≤ 1 µm at a probing velocity of 3 m/min<br>2 σ ≤ 4 µm at a probing velocity of 5 m/min | |
| **Deflection of the probe contact** | ≤ 5 mm in all directions | |
| **Deflection forces** | *Axial:* ≈ 8 N<br>*Radial:* ≈ 1 N | |
| **Probing velocity** | ≤ 5 m/min | |
| **Protection** EN 60529 | IP68 | |
| **Operating temperature** | 10 °C to 40 °C | |
| **Storage temperature** | –20 °C to 70 °C | |
| **Mass** | ≈ 0.3 kg | ≈ 0.4 kg |
| **Mounting on the machine table** | • Fastening via fixing clamps (included in delivery)<br>• Fastening with mounting base (accessory) | |
| **Electrical connection*** | 8-pin M12 flange socket | • SE 660[1)] for radio and infrared transmission<br>• SE 642 [1)] for infrared transmission<br>• SE 661[3)] for radio and infrared transmission |
| Signal transmission | Cable | Radio or infrared transmission (selectable) with 360° emission to the SE |
| Cable length | ≤ 25 m | – |
| **Interface** | HTL, floating switching output (trigger) | HTL or EnDat 2.2 via the SE |
| **TT switch-on/off** | – | Radio or infrared signal (selectable) from the SE |
| **Power supply** | DC 10 V to 30 V/≤ 100 mA (without load) | Two rechargeable or nonrechargeable batteries, 1 V to 4 V each; size $^1/_2$ AA or size LR1 |
| Operating time | – | Typically 90 h[2)] with alkaline batteries (included in delivery);<br>typically 400 h[2)] possible with lithium batteries |

***** Please select when ordering
[1)] SE shared by TS 460 and TT 460, see page 28
[2)] Reduced operating time in the presence of high ambient radio traffic or with frequent, short probing intervals
[3)] With EnDat interface

# Power supply

**Cable-connected touch probes**
The cable-bound TS 260, TS 248, and TT 160 touch probes, as well as the SE transceivers, are powered by the control. The cable-bound TS 150 touch probe is powered by the UTI 150. The maximum cable lengths shown in the specifications apply to HEIDENHAIN cables.

**Wireless touch probes**
The **TS 460, TS 642, TS 740,** and **TT 460** touch probes with wireless transmission are each powered by two rechargeable or nonrechargeable batteries with a nominal voltage of 1 V to 4 V. The length of the operating time depends heavily on the type and size of battery used (see table for examples). The typical operating times indicated in the specifications apply only to the use of lithium batteries. An operating time of 400 h assumes utilization over a period of 12 months in three-shift operation and at a 5 % usage rate.

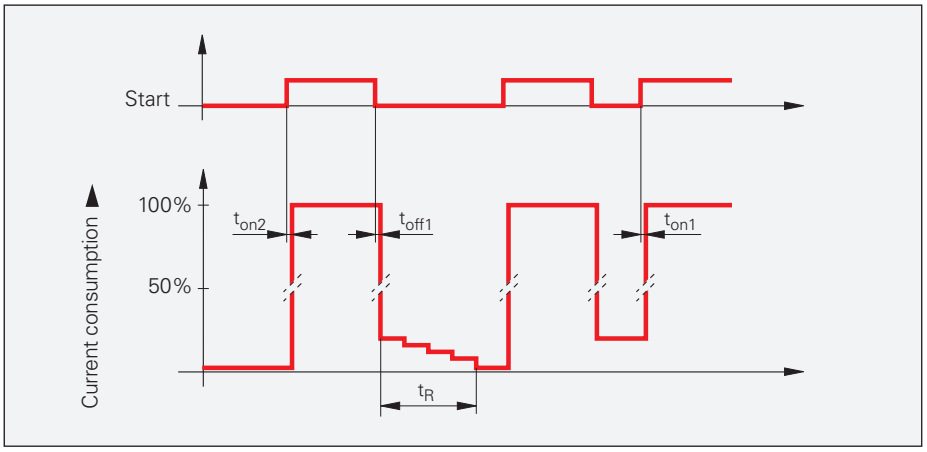
The touch probe electronics automatically detect the type of batteries being used. When the battery capacity gets low, the SE outputs a battery warning to the control. For operation with rechargeable batteries, the touch probes are provided with deep discharge protection: the touch probe switches off before the battery charge is exhausted.

The TS 460 and TT 460 touch probes feature intelligent battery management for the purpose of minimizing current consumption. When switching off, the touch probe switches incrementally to its stand-by state. The longer a touch probe has been switched off, the less current it consumes. Activation of a touch probe from a low stand-by level takes only a split second longer. This ensures high, praxis-oriented availability.

When switched off in infrared transmission, the touch probes go into stand-by mode and, after eight hours, into sleep mode. Longer switch-on times for activation of the touch probe should thus be expected (see *Switching the TS 460/TS 642/TS 740/ TT 460 on and off*).

| | Battery size | Operating time[1] | | |
|---|---|---|---|---|
| | | Lithium battery | Alkaline battery | NiMH battery |
| **TS 460**<br>**TT 460** | 1/2 AA<br>N/LR1/Lady[2] | 400 h<br>– | –<br>90 h[3] | 60 h<br>60 h |
| **TS 642** | C | 800 h | 400 h | 250 h |
| | A[2] | 400 h | 200 h | 125 h |
| **TS 740** | C | 500 h | 220 h[3] | 140 h |
| | A[2] | 250 h | 110 h | 70 h |

[1] **Please note**: These are approximate values that can vary depending on the manufacturer
[2] Via adapter
[3] Included in delivery




TS 460/TT 460 current consumption
*Signal times*
Switch-on delay
- From stand-by mode: $t_{on2}$ typically 1 s
- From reduced consumption mode: $t_{on1}$ typically 0.25 s

Switch-off delay
- With infrared transmission: $t_{off1} < 1$ s
- With radio transmission: $t_{off1} < 1$ s

# Interfaces
## HTL trigger signals

### Touch probes with cable-bound signal transmission

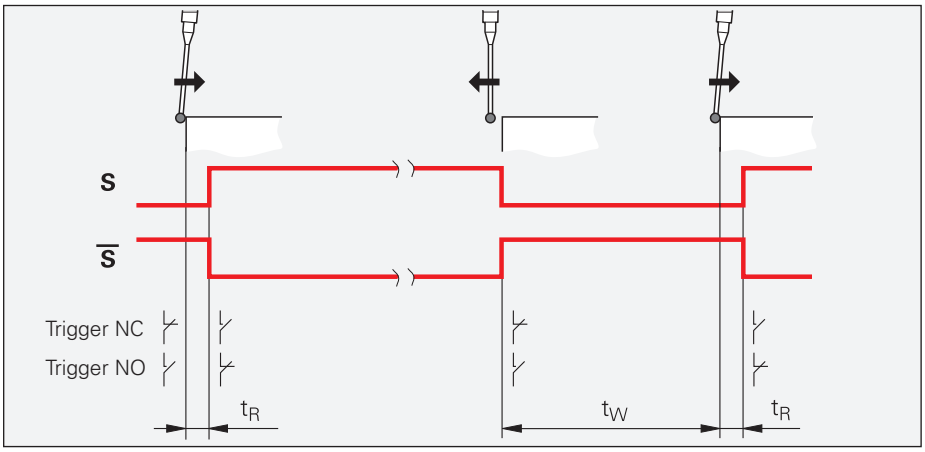
Upon deflection of the stylus or probe contact of the **TS 150, TS 260, TS 248**, or **TT 160**, a square-wave trigger signal **S** and its inverted signal $\overline{\mathbf{S}}$ are generated.

*HTL signal levels S, $\overline{S}$*
$U_H \geq (U_P - 2.2\ V)$ at $-I_H \leq 20$ mA
$U_L \leq 1.8$ V at $I_L \leq 20$ mA

In addition, these touch probes feature two floating switching outputs (**Trigger NO** and **Trigger NC**) that are realized by means of an optocoupler as a normally closed contact and normally open contact. The switching outputs can be connected directly to control inputs that require galvanic isolation (e.g., Fanuc High Speed Skip).

*Load capacity of optocoupler*
$U_{max} \leq 15$ V
$I_{max} \leq 50$ mA
$\Delta U \leq 1$ V (typically 0.3 V at I = 50 mA)

Since the spindle must be locked in place before the TS can be inserted, the connecting cables and adapter cables are equipped with jumpers. This enables the CNC to conduct the required safety check when the touch probe is connected.




Trigger signal for TS 260/TS 248/TT 160
Response time $t_R \leq 10$ µs
Repeat interval $t_W > 25$ ms

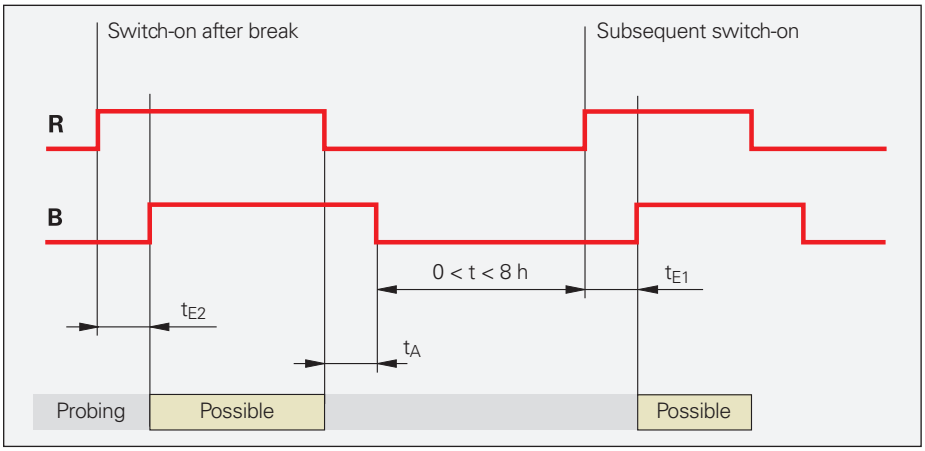
### Touch probes with wireless signal transmission

The **TS 460, TS 740**, and **TT 460** touch probes are triggered by the CNC over the SE. The rising edge of the **start signal R** activates the TS, while the falling edge deactivates it.

When inserted into the spindle, the **TS 642** touch probe is activated via the microswitch integrated in the taper shank.

The SE uses the **ready signal B** to notify the control that the touch probe is activated and within the reception area of the SE. The workpiece can now be probed.

The delay time *t* when switching the probe on or off depends on the distance between the SE and TS, and on the mode of the touch probe's power supply. Subsequent to initial switch-on (when the TS is in stand-by mode), the typical value for activation is 250 ms; for deactivation, it is 350 ms (1000 ms for the maximum distance). When activating the probe after a longer interval (the TS goes into sleep mode after 8 hours), the delay can be up to 3 s.




Switching the TS 460/TS 642/TS 740/TT 460 on and off
*Signal times*
Switch-on delay
$t_{E1} \leq 1000$ ms (typically 250 ms)
$t_{E2} \leq 3000$ ms
Switch-off delay
$t_A \leq 1000$ ms (typically 350 ms)

**Further information:**

Comprehensive descriptions of general electrical information can be found in the *Cables and Connectors* brochure.

Upon deflection of the stylus or probe contact, a square-wave **trigger signal $\overline{S}$** is generated.

*Signal times*
Response time $t_{R1}$
- With infrared transmission: 0.2 ms
- With radio transmission: 10 ms

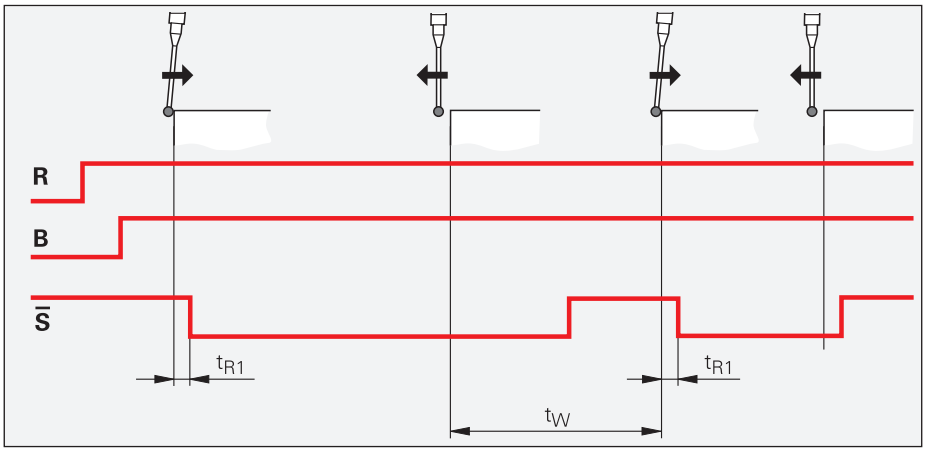
Repeat interval $t_W$ > 25 ms

In the event of a disturbance, the ready signal B is reset. The response time between the occurrence of the disturbance and the resetting of the ready signal depends on the type of signal transmission.

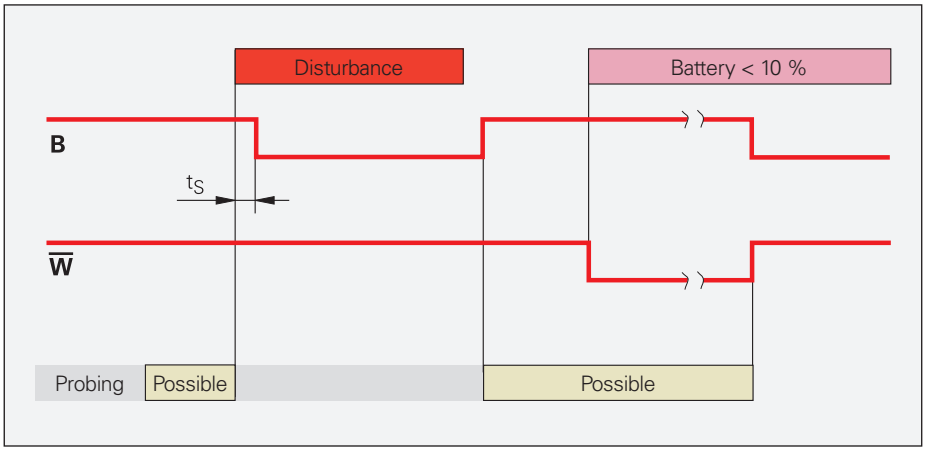
*Signal times*
Response time for interrupted signal transmission $t_S$
- With infrared transmission: ≤ 40 ms
- With radio transmission: ≤ 55 ms

Response time for collision (with collision protection adapter) $t_S$
- With infrared transmission: ≤ 40 ms
- With radio transmission: ≤ 20 ms

The **battery warning $\overline{W}$** reports that the battery capacity has fallen below 10 %. The ready signal also resets the battery warning.



Probing with TS 460/TS 642/TS 740/TT 460



Behavior during disturbance and battery warning

**⊓⊔ HTL signal levels**

**R**
$U_H$ = (10 V ... 30 V) at $I_H$ ≤ 4 mA
$U_L$ ≤ 2 V at $-I_L$ ≤ 0.2 mA

**B/$\overline{S}$/$\overline{W}$**
$U_H$ ≥ ($U_P$ – 2.2 V) at $-I_H$ ≤ 20 mA
$U_L$ ≤ 1.8 V at $I_L$ ≤ 20 mA

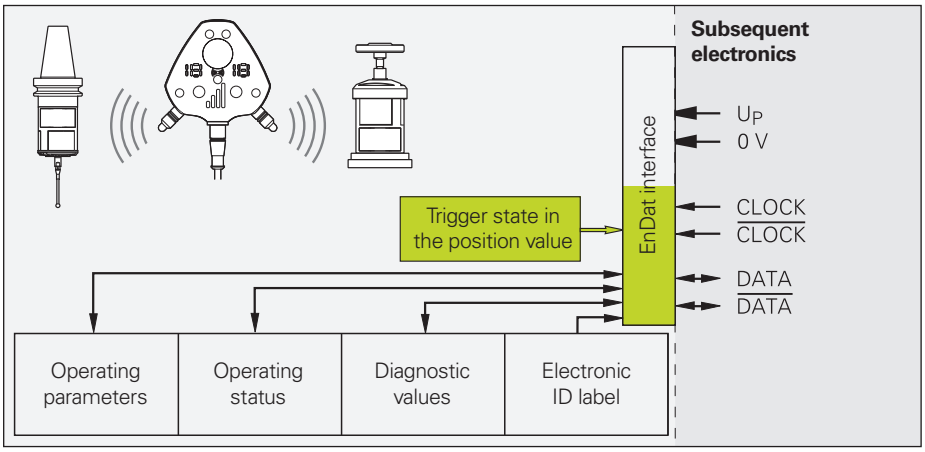
# EnDat for touch probes

Certain versions of the **TS 460** and **TT 460** touch probes are available with the **EnDat interface**. The EnDat interface from HEIDENHAIN is a digital, bidirectional interface that transmits the trigger status as well as diagnostic information and additional data from the touch probe. Thanks to the interface's serial transmission method, multiple items of data can be transmitted simultaneously.

**EnDat for touch probes**
The switching data is transmitted in the position value. The interface is a device-specific interface for touch probes.

The EnDat interface transmits the following data:

- Position value:
  - Touch probe is deflected (timestamp in additional data)
  - Touch probe is ready
  - Battery warning
  - Collision (if supported by touch probe)
- Additional data and diagnostic capabilities:
  - Battery voltage (only with activation via radio)
  - Timestamp
  - Type of transmission (infrared or radio)
  - Signal strength and transmission statistics
  - Installation (only with activation via radio)
    - Device name
    - ID number
    - Serial number
    - Radio channel
- Commands:
  - Connect touch probe to SE, switch on
  - Scan radio channels

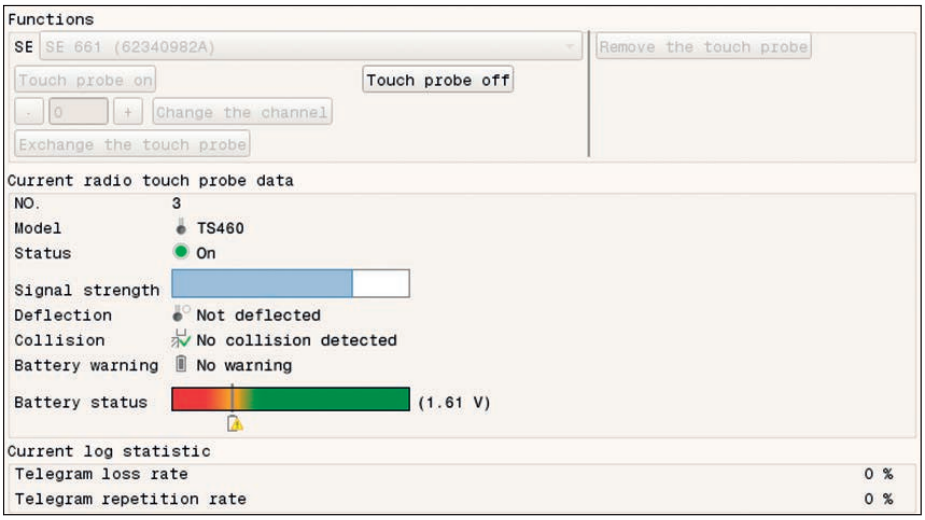



The TS 460 and TT 460 touch probes can be connected to the SE 661 through radio and/or infrared transmission. In infrared mode, the probing information, readiness status, and battery warning are available. In radio mode, additional data from the touch probe is available. The provision of this additional data is an enormous benefit of EnDat-capable touch probes.

EnDat transmission allows the status of the touch probe to be depicted in detail via the subsequent electronics. Information about the touch probe, the battery, and the signal strength can be shown in a straightforward manner. In the case of a TS 460 with collision protection, differentiation between a collision and the lack of readiness is possible as well. The availability of the touch probe can be increased by this differentiation.

Installation and device management are performed on the control. The control display can provide an overview of all of the connected devices, including their serial numbers and transmission types.

Upon deflection of the touch probe, a timestamp is sent along with the switching data. This timestamp allows the control to calculate the correct probing position, regardless of the probing velocity. Recalibration is therefore unnecessary for probing at different velocities or for switching between radio and infrared transmission.



# Connection to CNC controls

HEIDENHAIN touch probes feature universal interfaces that permit connection with virtually all relevant CNC controls for machine tools. As needed, HEIDENHAIN offers UTI interface electronics and optional software packages to supplement the touch probe cycles in the control. A reliable connection and the functional deployment of HEIDENHAIN touch probes is thereby ensured, regardless of the make of the control.

| CNC | Touch probes | Interface | Control input | Cycles | |
|---|---|---|---|---|---|
| | | | | CNC-internal | Separate software from HEIDENHAIN |
| **HEIDENHAIN**<br>TNC 640<br>TNC 620<br>CNC PILOT 640<br>MANUALplus 620 | Radio/infrared:<br>TS 460<br>TT 460<br>Via SE 661 | EnDat for touch probes | *Only PLB 62xx:*<br>X112, X113 | **Workpiece measurement**<br>• Workpiece alignment<br>• Preset setting<br>• Workpiece measurement<br>**Tool measurement**<br>• Length, radius<br>• Wear, breakage<br>• Individual teeth | – |
| **HEIDENHAIN**<br>TNC 640<br>TNC 620<br>iTNC 530<br>TNC 320<br>TNC 128<br>CNC PILOT 640<br>MANUALplus 620 | *Cable:*<br>TS 248<br>TS 260<br>TS 150 with UTI 150<br>TT 160<br><br>*Radio/infrared:*<br>TS 460<br>TT 460<br>Via SE 660<br><br>*Infrared:*<br>TS 460<br>TS 444<br>TS 642<br>TS 740<br>TT 460<br>Via SE 642, SE 540 | HTL | *HSCI*[1]*:*<br>X112, X113 | | |
| | | | *Others*[2]*:*<br>X12, X13 | | |
| **Siemens**<br>828D<br>840D<br>840D sl | | | X121, X122, or X132 | **Workpiece measurement**<br>• Workpiece alignment<br>• Preset setting<br>• Workpiece measurement<br>**Tool measurement**<br>• Length, radius<br>• Wear, breakage | |
| **Fanuc**<br>0<br>0i<br>16<br>18<br>21<br>30<br>31<br>32<br>3xi | | | *Recommended:*<br>HIGH SPEED SKIP[3] | – | **Workpiece measurement**<br>• Workpiece alignment<br>• Preset setting<br>• Workpiece measurement<br>**Tool measurement**<br>• Length, radius<br>• Wear, breakage |
| | | | *Possible:*<br>SKIP (24 V) | | |
| **Mitsubishi**<br>M70/M700 series<br>M64/M640 series | | | SKIP (24 V) | **Basic cycles** for<br>• Preset setting<br>• Tool length | |
| **Mazak**<br>Mazatrol Fusion<br>Mazatrol Matrix<br>Mazatrol Smart<br>Mazatrol Smooth X | | | | | |

[1] When multiple touch probes are operated with the SE 660, a UTI 660 is required
[2] If the TS 460 and TT 460 are operated together, a UTI 240 is required
[3] If the trigger signal S is used, a UTI 491 is required

# Interface electronics for integration

For adaption of the touch probe signals to the CNC control, a UTI interface unit may be required under certain circumstances. This is particularly true when SE transceivers are connected to Fanuc controls, or when older CNC controls are retrofitted with a touch probe.

**UTI 491**
Die UTI 491 interface unit is a simple optocoupler relay. With it, touch probes can be connected with galvanic isolation to the High-Speed Skip input on Fanuc controls. The floating touch-probe switching inputs (Trigger NO and Trigger NC) can also be connected directly to control inputs that require galvanic isolation.

ID 802467-01

**UTI 150**
The UTI 150 interface unit is required if you want to operate the TS 150 touch probe on NC controls. It adapts the touch probe signals to the control and serves as the power supply for the touch probe. The touch probe status is indicated by LEDs. The UTI 150 is installed in the electrical cabinet of the machine.

ID 1133534-01

UTI 150

**UTI 660**
The UTI 660 interface unit is required if you want to connect multiple TS 460 and TT 460 touch probes to a HEIDENHAIN control that does not support EnDat. The UTI 660 enables you to operate up to four TS 460 and four TT 460 probes on a control.

ID 1169537-01

UTI 660

**Further information:**
Comprehensive descriptions of cables and connectors can be found in the *Cables and Connectors* brochure.

# HEIDENHAIN

**DR. JOHANNES HEIDENHAIN GmbH**
Dr.-Johannes-Heidenhain-Straße 5
**83301 Traunreut, Germany**
☏ +49 8669 31-0
FAX +49 8669 32-5061
E-mail: info@heidenhain.de

**www.heidenhain.de**

**Vollständige und weitere Adressen siehe www.heidenhain.de**
***For complete and further addresses see www.heidenhain.de***

**DE** **HEIDENHAIN Vertrieb Deutschland**
83301 Traunreut, Deutschland
☏ 08669 31-3132
FAX 08669 32-3132
E-Mail: hd@heidenhain.de

**HEIDENHAIN Technisches Büro Nord**
12681 Berlin, Deutschland
☏ 030 54705-240

**HEIDENHAIN Technisches Büro Mitte**
07751 Jena, Deutschland
☏ 03641 4728-250

**HEIDENHAIN Technisches Büro West**
44379 Dortmund, Deutschland
☏ 0231 618083-0

**HEIDENHAIN Technisches Büro Südwest**
70771 Leinfelden-Echterdingen, Deutschland
☏ 0711 993395-0

**HEIDENHAIN Technisches Büro Südost**
83301 Traunreut, Deutschland
☏ 08669 31-1337

**AR** **NAKASE SRL.**
B1653AOX Villa Ballester, Argentina
www.heidenhain.com.ar

**AT** **HEIDENHAIN Techn. Büro Österreich**
83301 Traunreut, Germany
www.heidenhain.de

**AU** **FCR MOTION TECHNOLOGY PTY LTD**
Laverton North Victoria 3026, Australia
E-mail: sales@fcrmotion.com

**BE** **HEIDENHAIN N.V.**
1760 Roosdaal, Belgium
www.heidenhain.be

**BG** **ESD Bulgaria Ltd.**
Sofia 1172, Bulgaria
www.esd.bg

**BR** **HEIDENHAIN Brasil Ltda.**
04763-070 – São Paulo – SP, Brazil
www.heidenhain.com.br

**BY** **GERTNER Service GmbH**
220026 Minsk, Belarus
www.heidenhain.by

**CA** **HEIDENHAIN CORPORATION**
Mississauga, OntarioL5T2N2, Canada
www.heidenhain.com

**CH** **HEIDENHAIN (SCHWEIZ) AG**
8603 Schwerzenbach, Switzerland
www.heidenhain.ch

**CN** **DR. JOHANNES HEIDENHAIN (CHINA) Co., Ltd.**
Beijing 101312, China
www.heidenhain.com.cn

**CZ** **HEIDENHAIN s.r.o.**
102 00 Praha 10, Czech Republic
www.heidenhain.cz

**DK** **TP TEKNIK A/S**
2670 Greve, Denmark
www.tp-gruppen.dk

**ES** **FARRESA ELECTRONICA S.A.**
08028 Barcelona, Spain
www.farresa.es

**FI** **HEIDENHAIN Scandinavia AB**
01740 Vantaa, Finland
www.heidenhain.fi

**FR** **HEIDENHAIN FRANCE sarl**
92310 Sèvres, France
www.heidenhain.fr

**GB** **HEIDENHAIN (G.B.) Limited**
Burgess Hill RH15 9RD, United Kingdom
www.heidenhain.co.uk

**GR** **MB Milionis Vassilis**
17341 Athens, Greece
www.heidenhain.gr

**HR** Croatia → **SL**

**HU** **HEIDENHAIN Kereskedelmi Képviselet**
1239 Budapest, Hungary
www.heidenhain.hu

**ID** **PT Servitama Era Toolsindo**
Jakarta 13930, Indonesia
E-mail: ptset@group.gts.co.id

**IL** **NEUMO VARGUS MARKETING LTD.**
Holon, 58859, Israel
E-mail: neumo@neumo-vargus.co.il

**IN** **HEIDENHAIN Optics & Electronics India Private Limited**
Chetpet, Chennai 600 031, India
www.heidenhain.in

**IT** **HEIDENHAIN ITALIANA S.r.l.**
20128 Milano, Italy
www.heidenhain.it

**JP** **HEIDENHAIN K.K.**
Tokyo 102-0083, Japan
www.heidenhain.co.jp

**KR** **HEIDENHAIN Korea LTD..**
Gasan-Dong, Seoul, Korea, 153-782
www.heidenhain.co.kr

**MX** **HEIDENHAIN CORPORATION MEXICO**
20290 Aguascalientes, AGS., Mexico
E-mail: info@heidenhain.com

**MY** **ISOSERVE SDN. BHD.**
43200 Balakong, Selangor
E-mail: sales@isoserve.com.my

**NL** **HEIDENHAIN NEDERLAND B.V.**
6716 BM Ede, Netherlands
www.heidenhain.nl

**NO** **HEIDENHAIN Scandinavia AB**
7300 Orkanger, Norway
www.heidenhain.no

**NZ** **Llama ENGINEERING Ltd**
5012 Wellington, New Zealand
E-mail: info@llamaengineering.co.nz

**PH** **MACHINEBANKS' CORPORATION**
Quezon City, Philippines 1113
E-mail: info@machinebanks.com

**PL** **APS**
02-384 Warszawa, Poland
www.heidenhain.pl

**PT** **FARRESA ELECTRÓNICA, LDA.**
4470 - 177 Maia, Portugal
www.farresa.pt

**RO** **HEIDENHAIN Reprezentanţă Romania**
Braşov, 500407, Romania
www.heidenhain.ro

**RS** Serbia → **BG**

**RU** **OOO HEIDENHAIN**
115172 Moscow, Russia
www.heidenhain.ru

**SE** **HEIDENHAIN Scandinavia AB**
12739 Skärholmen, Sweden
www.heidenhain.se

**SG** **HEIDENHAIN PACIFIC PTE LTD**
Singapore 408593
www.heidenhain.com.sg

**SK** **KOPRETINA TN s.r.o.**
91101 Trencin, Slovakia
www.kopretina.sk

**SL** **NAVO d.o.o.**
2000 Maribor, Slovenia
www.heidenhain.si

**TH** **HEIDENHAIN (THAILAND) LTD**
Bangkok 10250, Thailand
www.heidenhain.co.th

**TR** **T&M Mühendislik San. ve Tic. LTD. ŞTİ.**
34775 Y. Dudullu –
Ümraniye-Istanbul, Turkey
www.heidenhain.com.tr

**TW** **HEIDENHAIN Co., Ltd.**
Taichung 40768, Taiwan R.O.C.
www.heidenhain.com.tw

**UA** **Gertner Service GmbH Büro Kiev**
02094 Kiev, Ukraine
www.heidenhain.ua

**US** **HEIDENHAIN CORPORATION**
Schaumburg, IL 60173-5337, USA
www.heidenhain.com

**VN** **AMS Co. Ltd**
HCM City, Vietnam
E-mail: davidgoh@amsvn.com

**ZA** **MAFEMA SALES SERVICES C.C.**
Midrand 1685, South Africa
www.heidenhain.co.za

1113984-25 · 10 · 06/2019 · CD · Printed in Germany