



Touch Probes

For Machine Tools

www.heidenhain.com/touch-probes

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

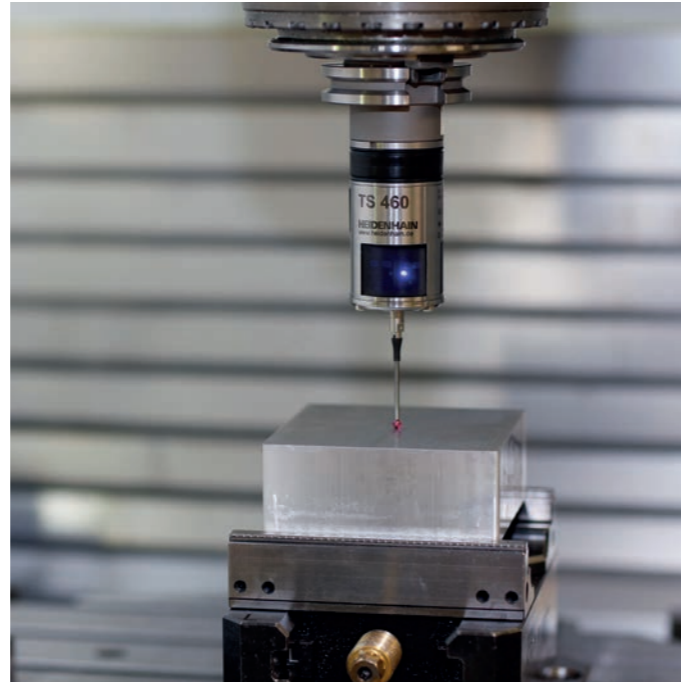
HEIDENHAIN offers **TS triggering touch probes** for workpiece measurement right on the machine. The touch probes are inserted into the tool holder either manually or by the tool changer. Depending on the probing functions of the NC control, they can automatically or manually perform the following:

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



Worldwide presence

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

Further information:

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

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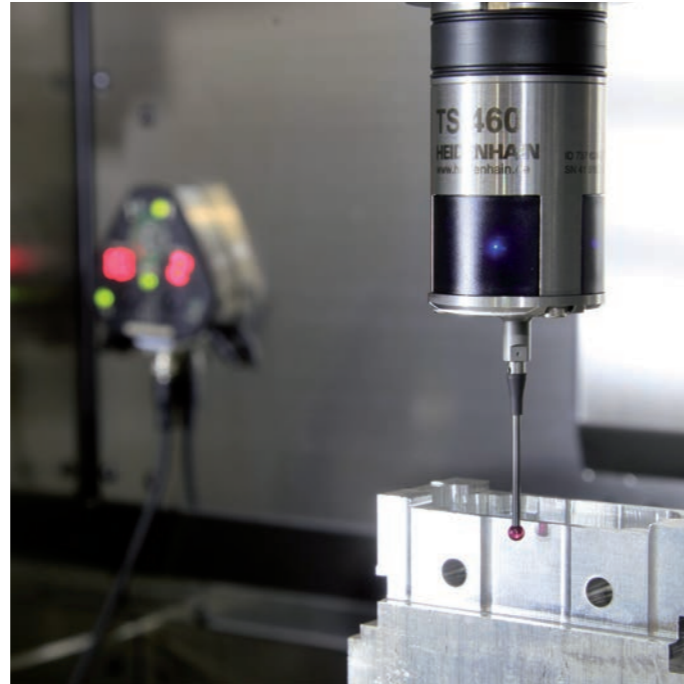
Highly effective and accurate

HEIDENHAIN has been developing and manufacturing touch probes for workpiece and tool measurement on machine tools for over 35 years now. It has set standards, for example, with

- its wear-free optical sensor,
- its integrated flushers/blowers for cleaning the measuring point with compressed air or coolant lubricant,
- its SE 540 transceiver, which is capable of being fully integrated into the spindle housing,
- its collision protection for the TS 460, and
- its EnDat interface for the TS 460, TS 760 and TS 460 touch probes.

Wear-free optical sensor

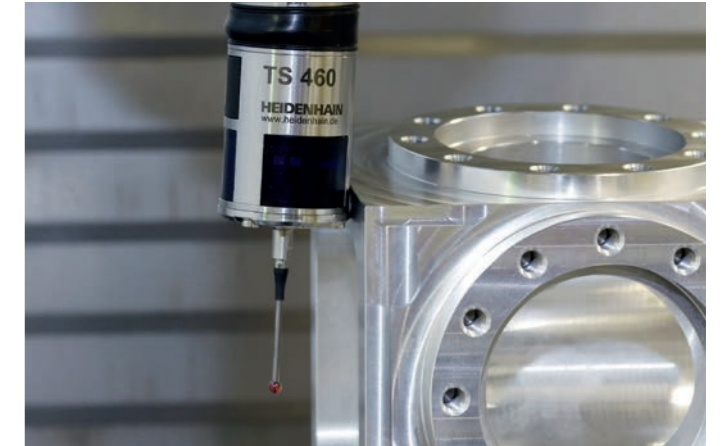
Because the optical sensor is free of wear, it is able to provide the specified probing repeatability even after a large number of probe measurements (over 50 million switching cycles). This means that touch probes from HEIDENHAIN are also excellently suited for grinding machines. The optical sensor features an optimized lens system and an integrated preamplifier for stable output signals.



Collision protection and thermal decoupling (option for TS 460)

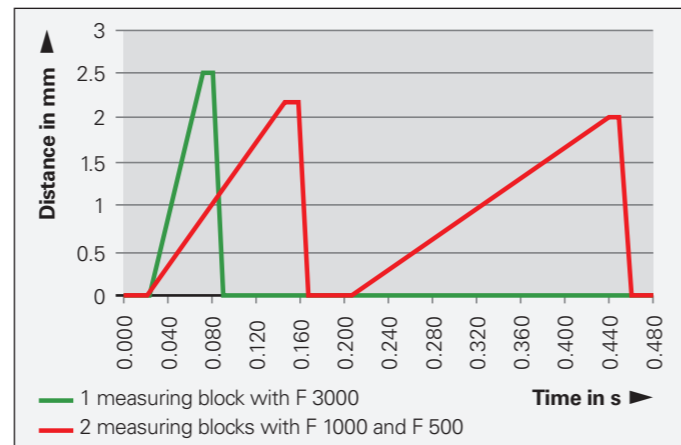
Collision protection is a major topic at HEIDENHAIN. The touch probes feature a sizable deflection path and offer additional safety through rated break points in the stylus and in the connecting pin for the probe contact. For expanded collision protection, including for the touch probe housing of the 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. An integrated switch simultaneously 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.



Time savings and increased performance

The high probe repeatability of typically $2\sigma < 0.5\ \mu\text{m}$ enables setting up and calibration in just one measuring block with the TS 460. Not only can the second measuring block be omitted, but touch probes from HEIDENHAIN also permit high probing speeds at a consistent level of accuracy.



Reliable measurement results

High process reliability requires clean measuring points. That is why all wireless TS workpiece touch probes from HEIDENHAIN have flushers/blowers for cleaning the workpiece by means of compressed air or coolant lubricant.

EnDat for touch probes

The TS 460, TS 760 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.



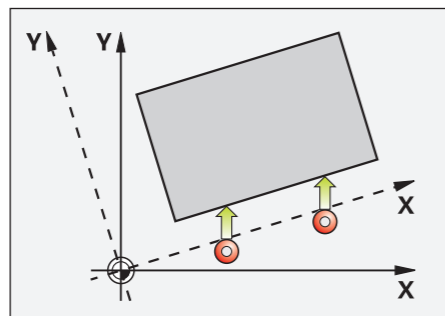
Application examples

Aligning the workpiece and setting the preset

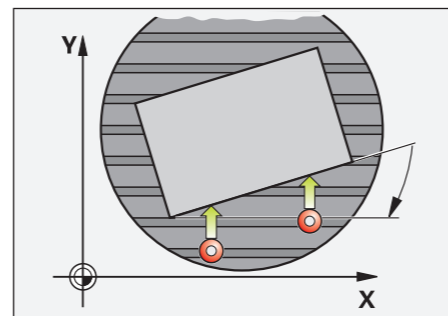
Workpiece alignment

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:

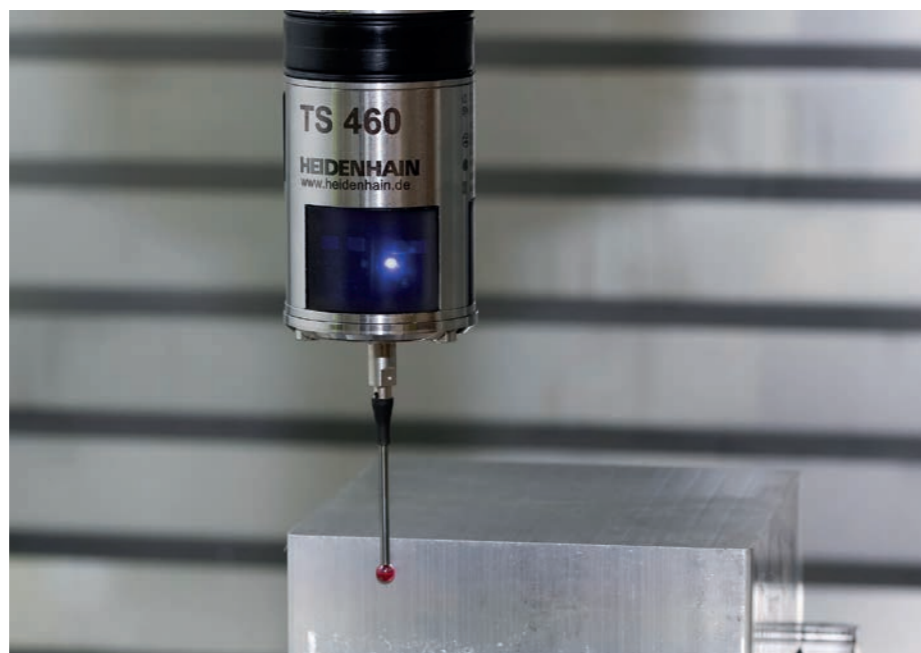
- The workpiece is clamped in any position.
- The touch probe ascertains the workpiece misalignment by probing a surface, two holes or two studs.
- The CNC compensates for the misalignment by rotating the coordinate system. Compensation is also possible through rotation of a rotary table.



Compensating for misalignment through a basic rotation of the coordinate system

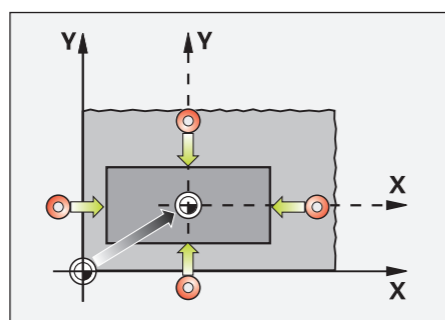


Compensating for misalignment through rotation of a rotary table

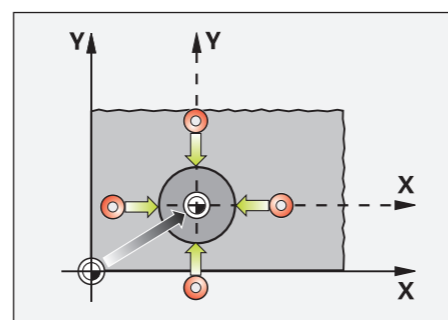


Preset setting

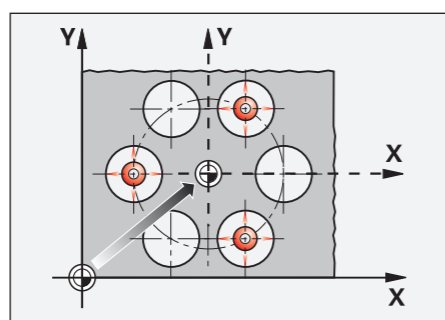
Programs for machining a workpiece are referenced to presets. Finding this point quickly and reliably with a workpiece touch probe reduces nonproductive time and increases machining accuracy. Depending on the probing functions of your CNC, the TS touch probes from HEIDENHAIN enable the automated setting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



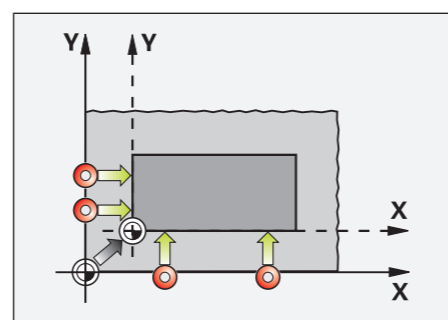
Center of a rectangular stud



Center of a circular stud



Center of a bolt hole circle



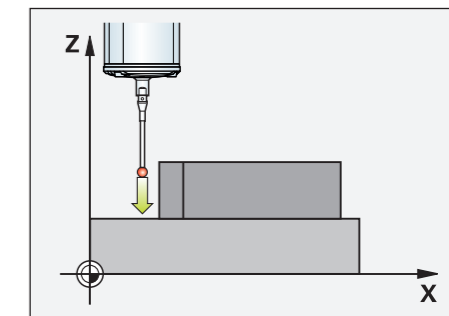
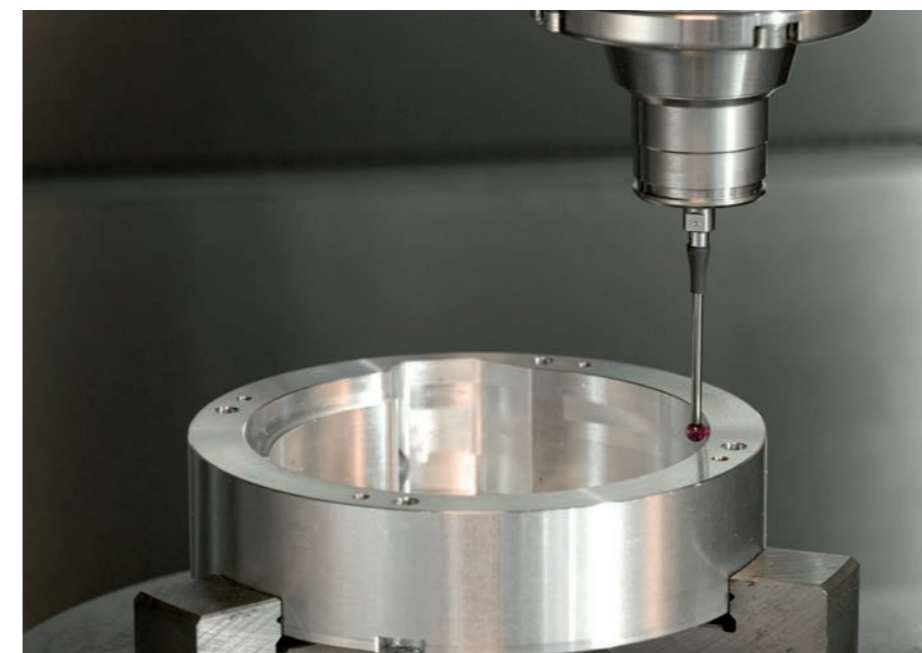
Outside corner

Workpiece measurement

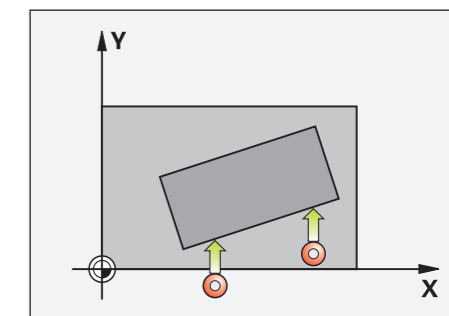
The TS touch probes from HEIDENHAIN are suited for program-controlled workpiece measurement between two machining steps, for example. The resulting position values can be used for tool-wear compensation.

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.

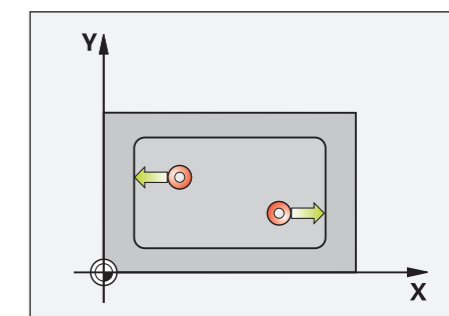
With the aid of external software—for example, FormControl (software package from Blum-Novotest) or digitizing software—you can digitize models or measure free-form surfaces right in the machine tool. In this way, you can immediately detect machining errors and correct them without reclamping. Thanks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



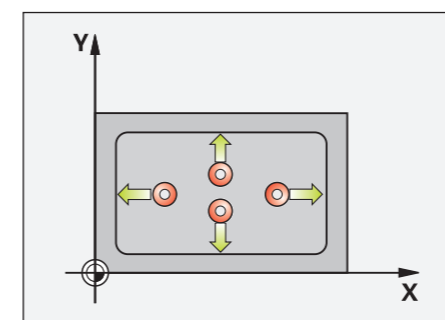
Measuring individual positions in an axis



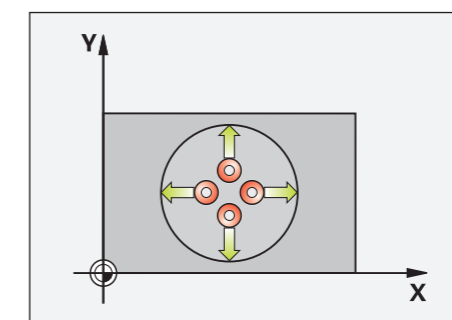
Measuring the angle of a line



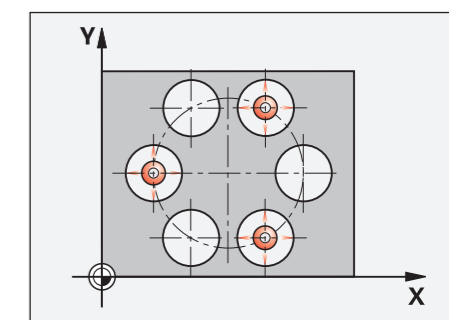
Length measurement



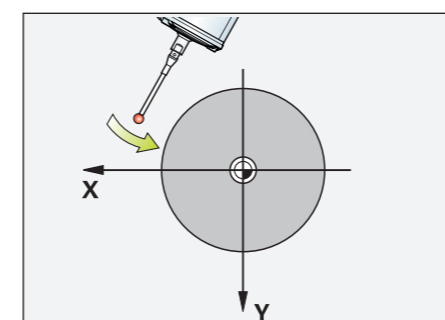
Measuring a rectangular pocket



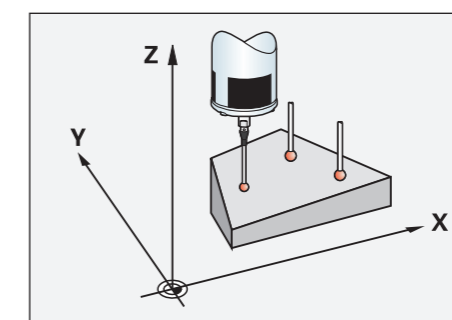
Measuring a circular pocket/hole



Measuring a bolt hole circle



Measuring a diameter



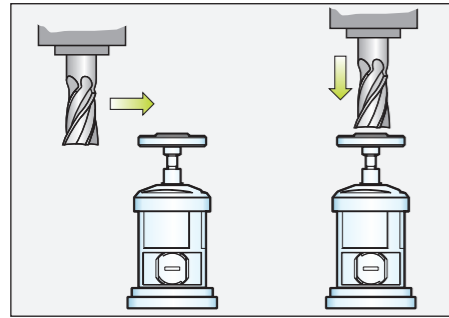
Measuring the angle of a plane

Tool measurement

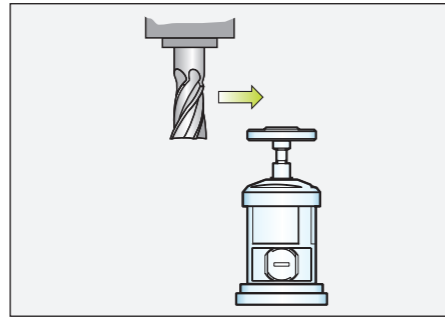
Consistently high machining accuracy requires an exact measurement of tool data and cyclical inspection of tool wear. The TT tool touch probes can measure a wide variety of tools right on the machine. For milling cutters, length and diameter

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.

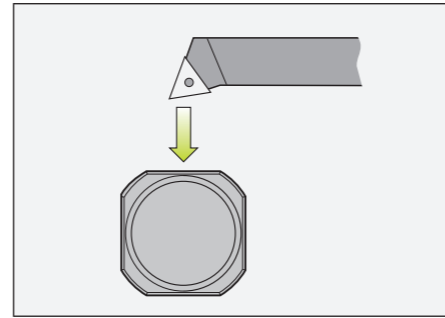
Using a cuboid probe contact, you can also measure lathe tools and check them for wear or breakage. For effective tool-tip radius compensation, you need only add the cutter radius to your entries in the CNC.



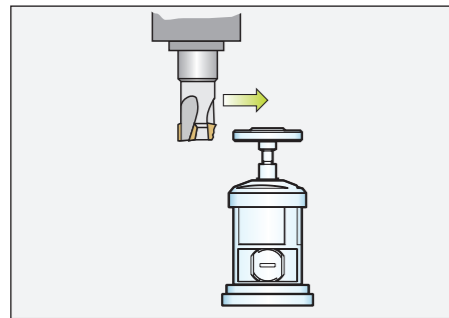
Tool length and radius measurement with stationary or rotating spindle



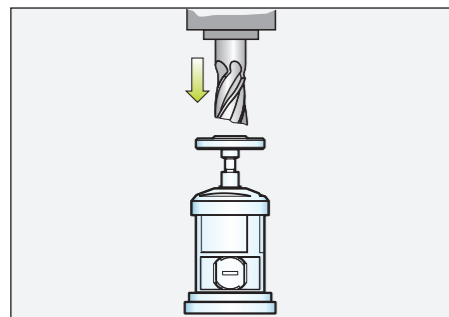
Individual tooth measurement, such as for inspecting indexable inserts (not for brittle materials)



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.

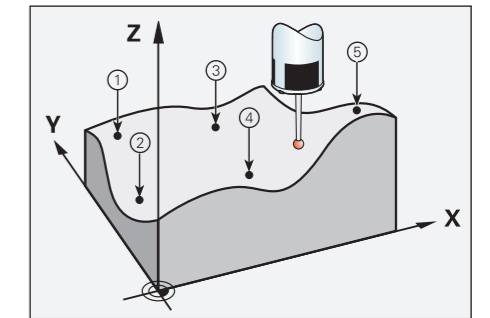
A particularly rigid calibration sphere should be used for kinematics measurements. This helps to reduce deformations that occur as a result of probing forces. The KKH calibration spheres from HEIDENHAIN, which are specially designed for this type of application, exhibit particularly high rigidity and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

Calibration spheres:

KKH 80; height: 80 mm ID 655475-03
KKH 250; height: 250 mm ID 655475-01

These calibration spheres are also well suited for 3D calibration* of the touch probe. This kind of calibration is necessary, for example, when 3D geometries are to be measured with exactness. Following 3D 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. At that moment the TS generates a trigger signal that, depending on the model, is transmitted to the control either by cable or by radio or infrared transmission. The control simultaneously saves the actual position values as measured by the machine axis encoders and uses this information for further processing.

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: universal 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 760: high probing accuracy and repeatability, low probing force, featuring radio and 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/TS 750: high probing accuracy (TS 750), with axial or radial cable connection on its base

TS 260: axial or radial cable connection

| | TS workpiece touch probes | | | | |
|-----------------------------|---|------------------------|--|--|--------------------------------|
| | TS 460 | TS 642 | TS 760 | TS 260 | TS 150 TS 750 |
| Area of application | Machining centers; milling, drilling and boring machines; lathes with automatic tool changers | | | Milling, drilling and boring machines with manual tool changing, as well as lathes and grinding machines | Grinding machines |
| Signal transmission | Radio/infrared | Infrared | Radio/infrared | Axial or radial cable | |
| Probe repeatability | 2 σ \leq 1 μ m | | 2 σ \leq 0.25 μ m | 2 σ \leq 1 μ m | 2 σ \leq 0.25 μ m |
| Power supply | Rechargeable or nonrechargeable batteries | | | DC 10 V to 30 V | DC 10 V to 30 V (via UTI 150) |
| Connection over | SE 660, SE 540, ¹⁾ SE 640, ¹⁾ SE 661 ²⁾ | SE 540, SE 640, SE 660 | SE 660, SE 540, ¹⁾ SE 640, ¹⁾ SE 661 ²⁾ | – | UTI 150 |
| Interface to control | HTL or EnDat 2.2 via the SE | HTL via the SE | HTL or EnDat 2.2 via the SE | HTL and floating switching output | |

¹⁾ Only for infrared transmission

²⁾ For EnDat

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Principle of operation

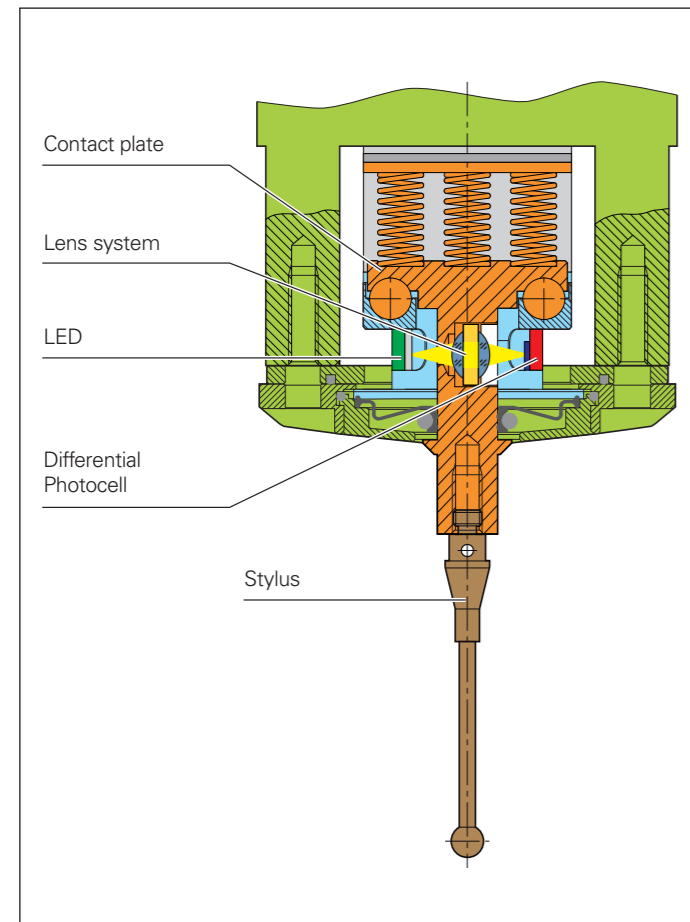
Sensor

TS 150, 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.

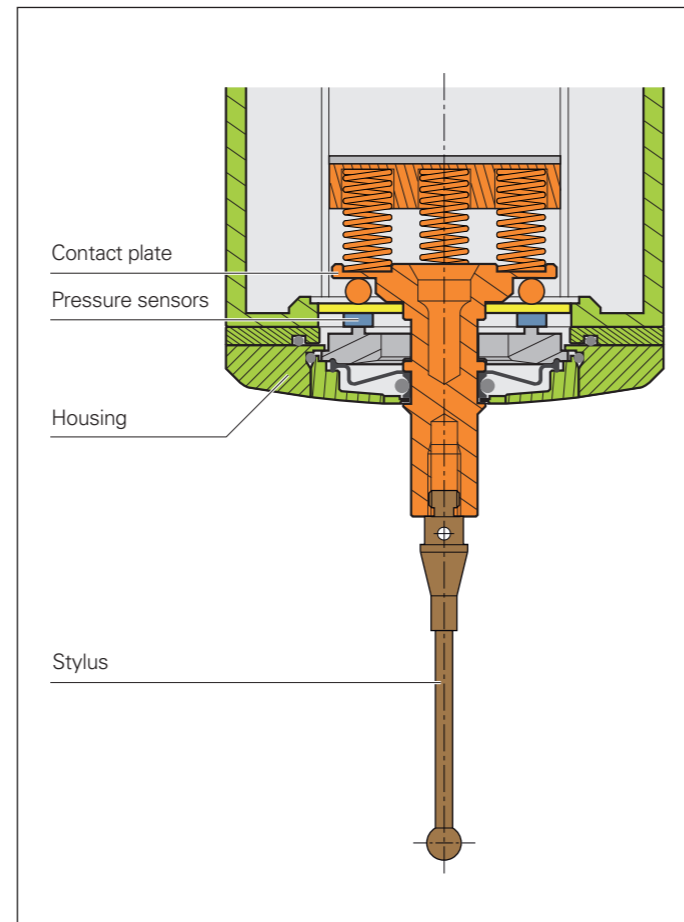
Thanks to the non-contacting optical switch, the sensor is free of wear. As a result, HEIDENHAIN touch probes ensure high long-term stability with constant probe repeatability even after a high number of measuring cycles (e.g., as with in-process applications).



TS 760, TS 750

The TS 760 and TS 750 use 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 probing accuracy over 360°.

With the TS 760 or TS 750, 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 probing accuracy and repeatability, virtually without any effect on the measured object.



Accuracy

Probing accuracy

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

The probing 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 probing accuracy of a touch probe is measured at HEIDENHAIN on precision measuring machines. The reference temperature is 22 °C. Refer to the specifications for the stylus that is used.

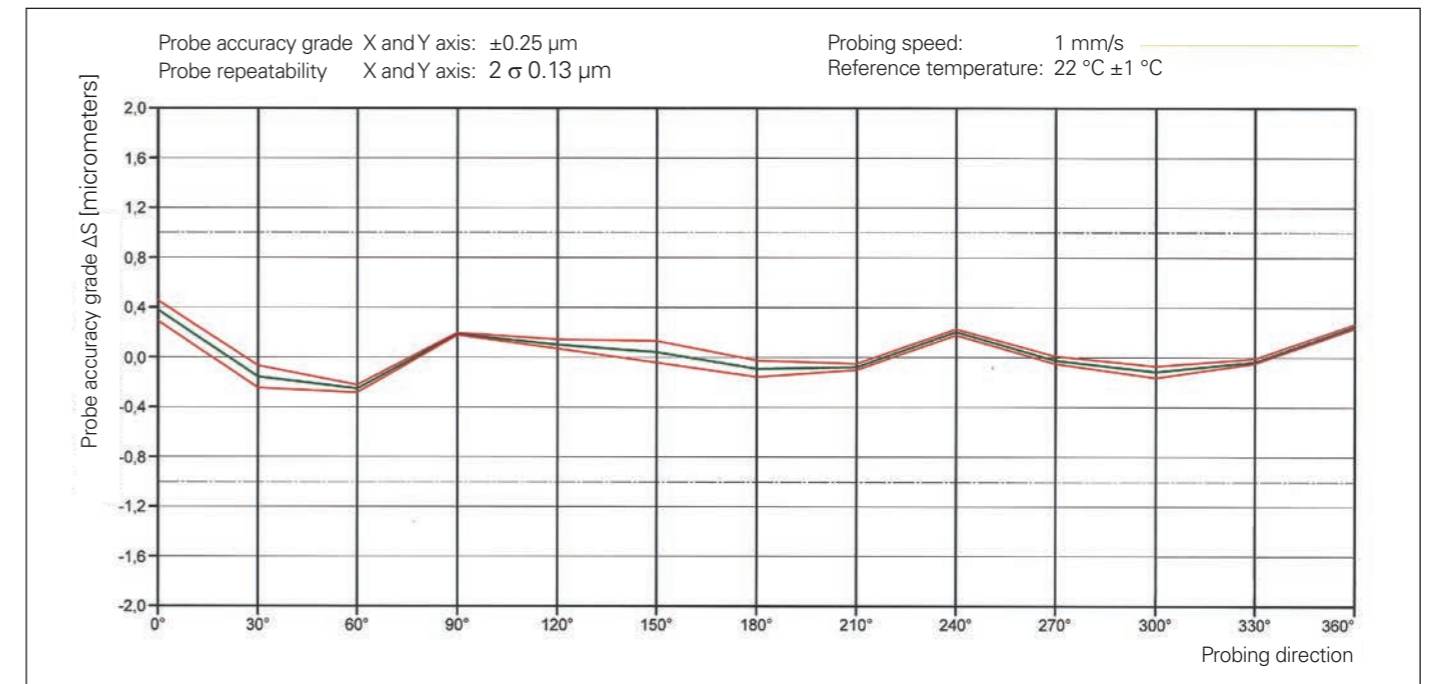
The **TS 760** and **TS 750** touch probes are characterized particularly by high probing accuracy and repeatability. These features, together with the low probing force, make these touch probes suitable for highly demanding measuring tasks on machine tools.

Probe repeatability

Probe repeatability represents the measurement errors that result after the repeated probing of a test object **from one direction**. Typical values can be maintained or even improved on with optimum orientation.

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 probing accuracy.



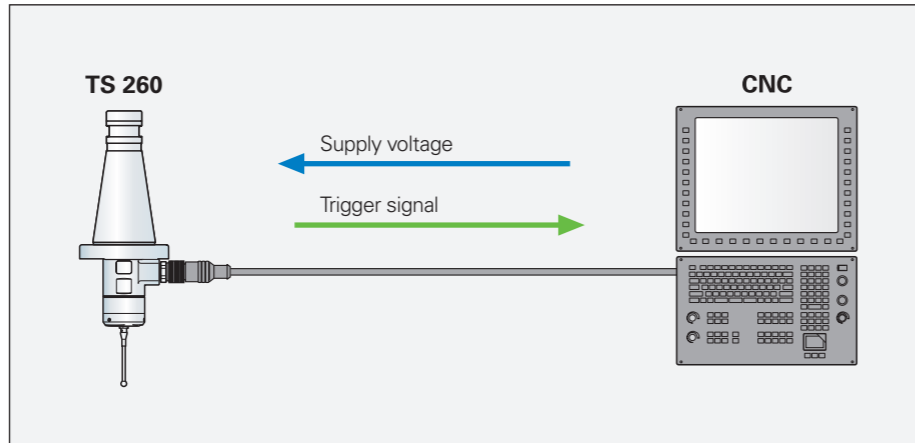
Excerpt from a calibration chart

Signal transmission

Cable-bound signal transmission

The TS 150, TS 750 and TS 260 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

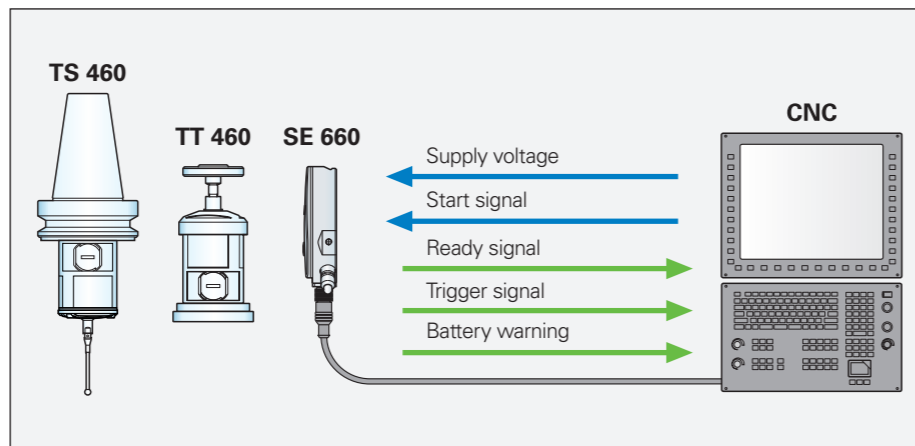
In the case of wireless touch probes, signals are transmitted to the SE transceiver as follows:

- For the **TS 460 and TS 760**, by radio or infrared transmission
- For the **TS 642**, 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 and SE 661** for radio and infrared transmission; SE shared by TS 460, TS 760 and TT 460
- **SE 540** for only infrared transmission; for installation in the spindle head
- **SE 640** for only infrared transmission



The SE 660 and SE 661 communicate with the TS 460, TS 760 and TT 460. The SE 540 and SE 640 can be used in any combination with the TS 460, TS 642 and TS 760 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 640 |
|--------------------------------|----------------|--------|----------|--------|
| TS 460 TS 760 | Radio/infrared | | Infrared | |
| TS 642 | 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 and the TS 760 provides high noise immunity with extremely short transmission times of approximately 0.2 ms for the trigger signal.

Radio transmission (only TS 460, TS 760 and TT 460)

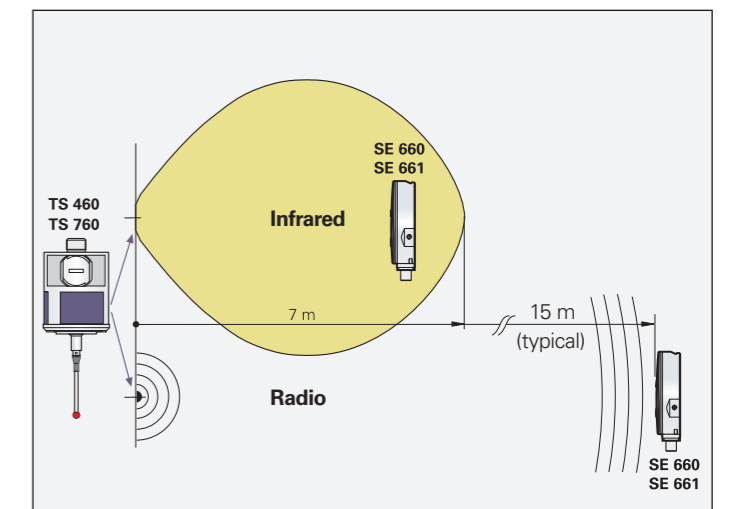
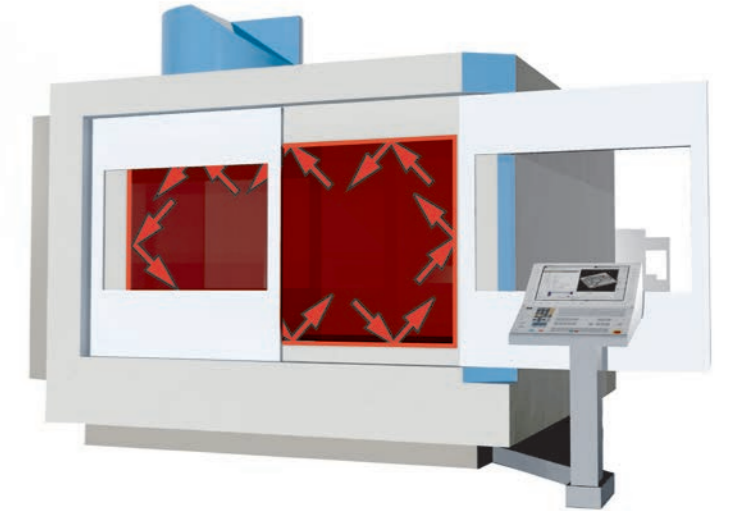
Radio transmission is used primarily for large machine tools. The range is usually 15 m, but much larger ranges are possible in practice under ideal circumstances. Radio transmission operates in the free ISM band at 2.4 GHz and features 16 channels. The transmission times for the trigger signal are approximately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

Hybrid technology: signal transmission via radio or infrared signals (only TS 460, TS 760 and TT 460)

The dual signal transmission of the touch probes 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

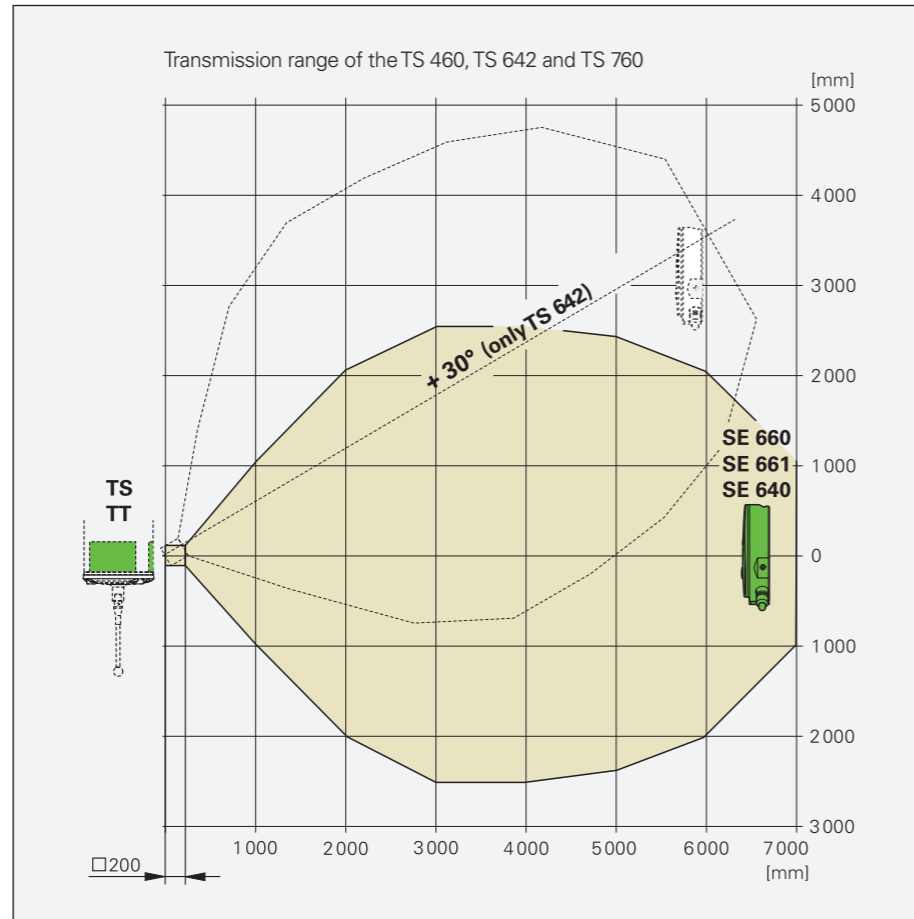
The transmission area between the SE transceiver and touch probes with infrared transmission exhibits a lobe shape. To ensure optimum signal transmission in both directions, you should mount the transceiver such that the touch probe is located within this area during all of its operating positions. If 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 wireless touch probe is available with horizontal emission angles of 0° or +30° for adaptation to the given machine design. The TS 460 and TS 760 permit communication with the SE 540 in the normal version.

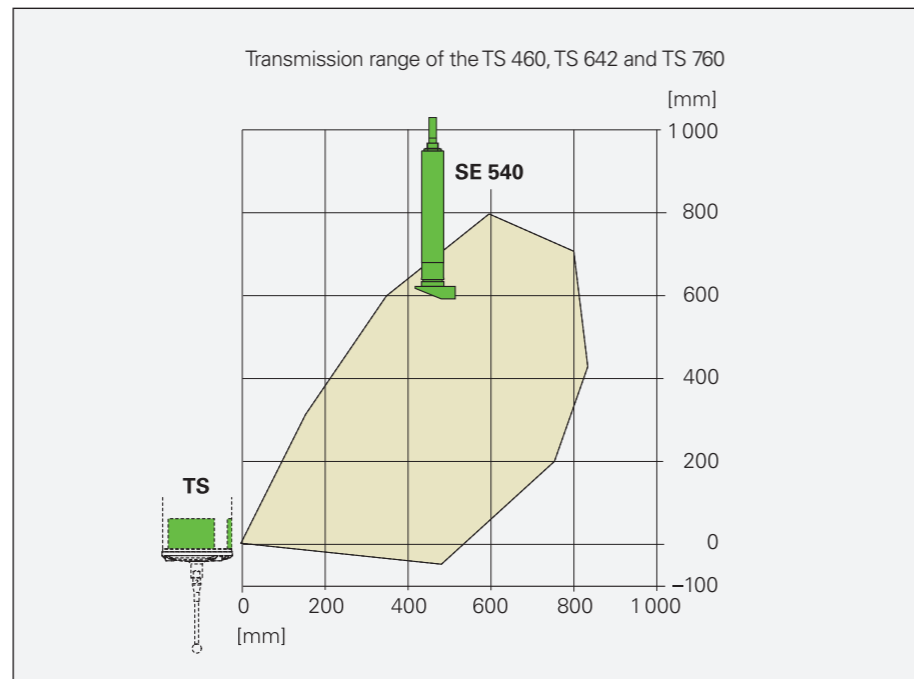


Radio transmission

The radio transmission of the TS 460 and TS 760 touch probes 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 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 / TS 750) 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 640 transceiver

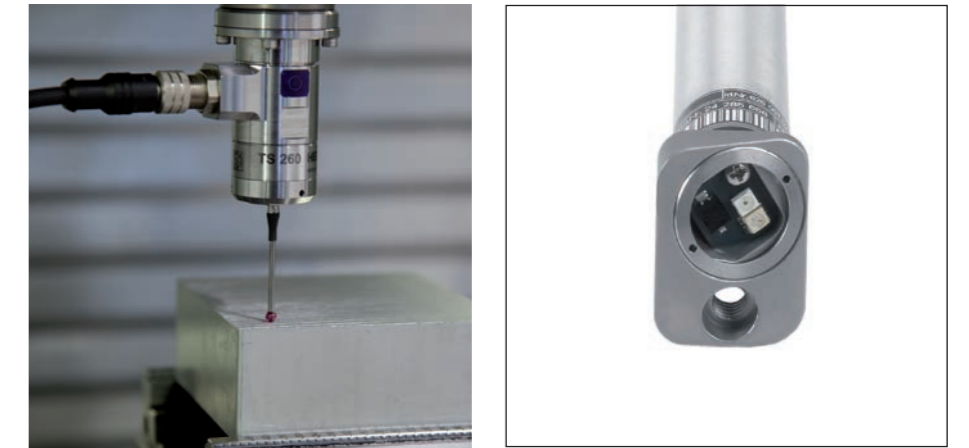
The SE 640 is equipped with multiple multicolor LED indicators that, in addition to indicating status, also facilitate diagnostics. These LEDs indicate the following:

- 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 units for radio and infrared transmission also feature 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, such as BIG PLUS, are available upon request.

DIN 69871
Taper **D**
 SK-AD/B 30 M12
 SK-AD/B 40¹⁾ M16
 SK-AD/B 45 M20
 SK-AD/B 50¹⁾ M24
 SK-AD/B 60 M30

¹⁾ Also available in extended length

DIN 2080¹⁾
Taper **D**
 SK-A 40 M16
 SK-A 45 M20
 SK-A 50 M24
 SK-A 50 UNC 1.000-8

¹⁾ Only for the TS 260

JIS B 6339
Taper **D**
 BT/BBT 30 M12
 BT/BBT 40 M16
 BT/BBT 50 M24

DIN 69893
Taper
 HSK-E 25
 HSK-E 32
 HSK-A 40
 HSK-A 50
 HSK-A 63¹⁾
 HSK-B 63
 HSK-A 80
 HSK-A 100¹⁾

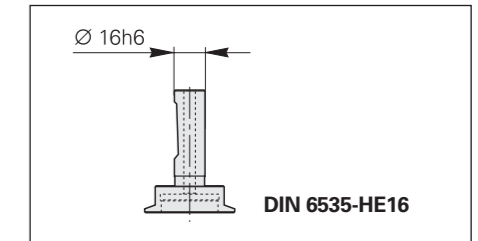
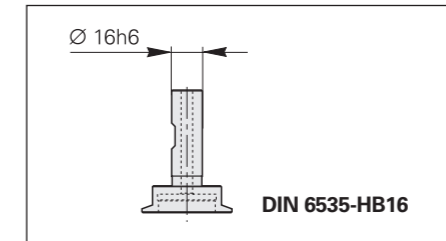
¹⁾ Also available in extended length

ASME B5.5
Taper **D**
 SK 40 UNC 1x000-8
 SK 50 UNC 1x000-8

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/TS 750
- M28x0.75 for the TS 260
- M12x0.5 for the TS 460/TS 760
- M30x0.5 for the TS 642/TS 760/TS 460

Accessories:

Coupling joint for TS 260
 ID 643089-01

The M22x1 coupling joint with external thread is used for simple attachment of the TS 260 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.

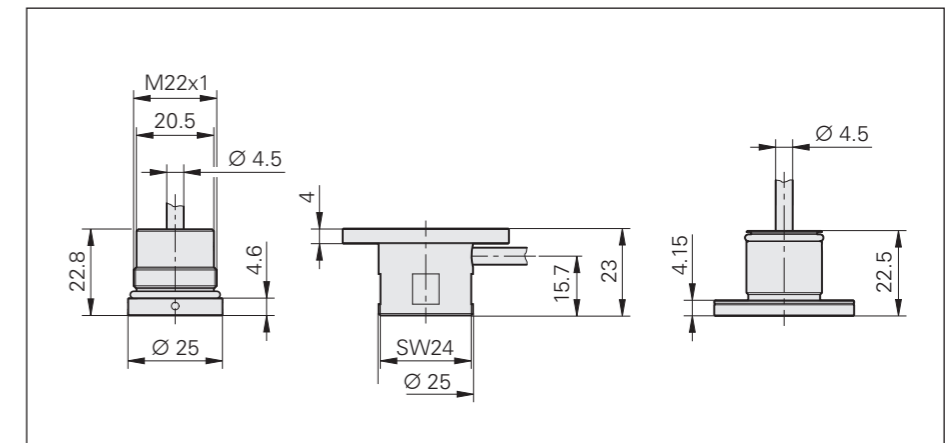
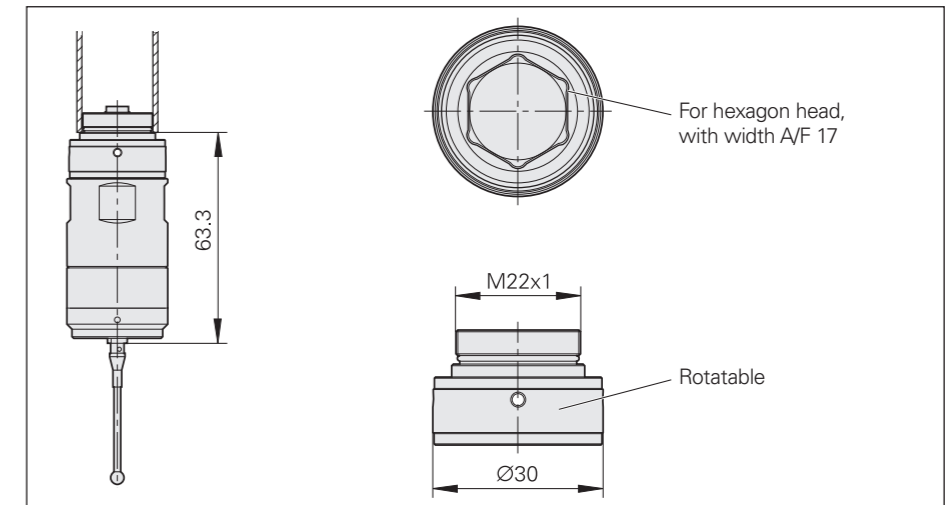
Mounting wrench

For mounting a taper shank to the TS 460, TS 760: ID 1034244-01
 TS 642: ID 519833-01

Mounting base for TS 150/TS 750

ID 1184715-10 axial
 ID 1213408-10 radial
 ID 1279419-09 axial

The mounting base with integrated cable outlet is required for installation of the TS 150 or TS 750.



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 640 transceivers
Thanks to their high IP68 rating, these SE units can be mounted as desired in the working space and can be exposed to coolant. If the SE 660 or SE 661 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.

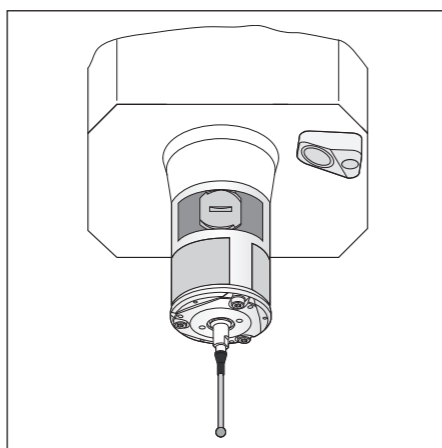
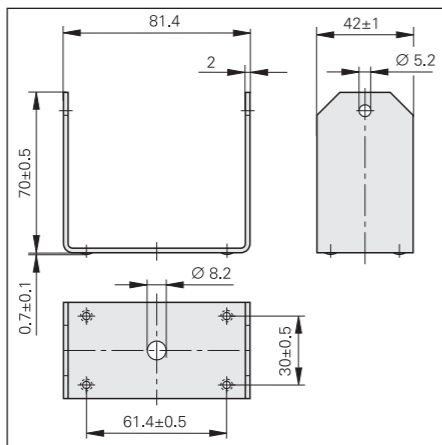
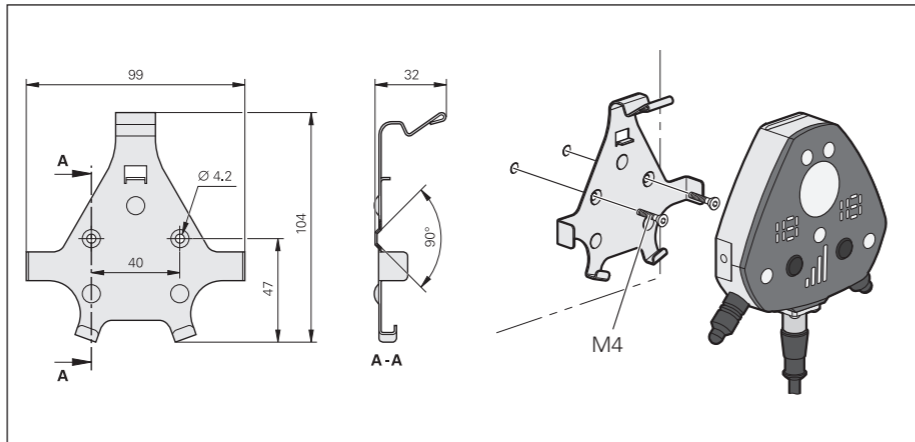
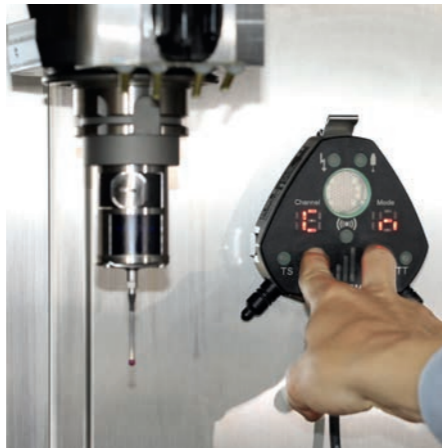
Accessories
Holder for SE 660 and SE 661
ID 744677-01 3-point mounting
ID 1141230-01 Angle bracket

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

Holder for SE 640
ID 370827-01 Angle bracket

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.

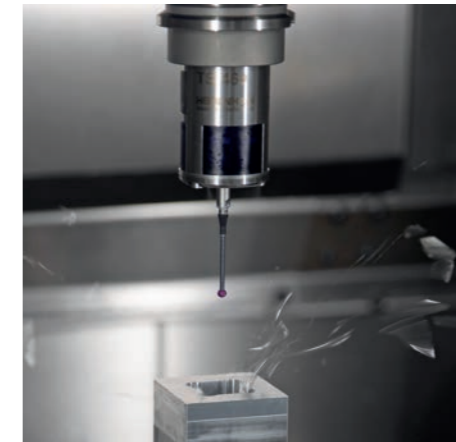


Probing

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 or cooling lubricant 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. In order to use the flushing/blowing feature, the machine and the control must be adapted to this function by the machine manufacturer.



Cleaning with compressed air

Cleaning with cooling lubricant

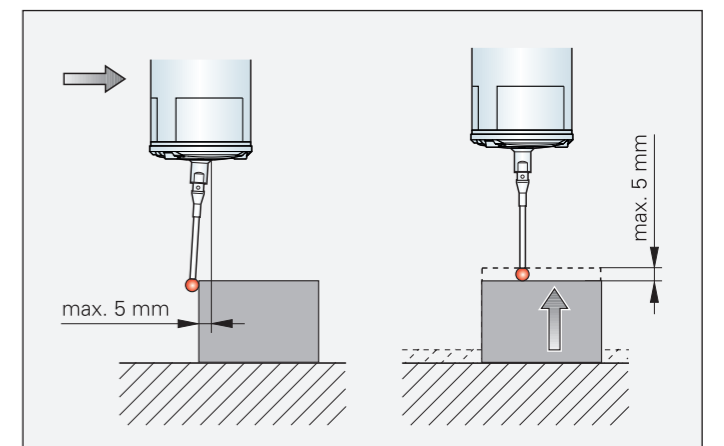
Probing speed

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 speed. The mechanically permissible probing speed 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

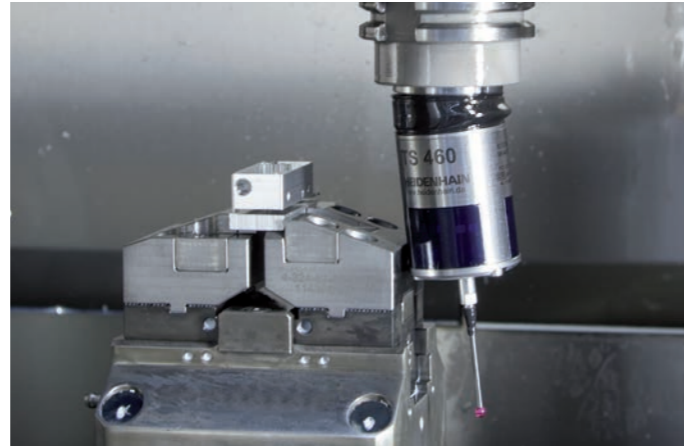


Collision protection and thermal decoupling (option with TS 460)

Damage protection for spindles

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 machine and the cycles must be prepared for this function.



The collision protection adapter protects the spindle and touch probe

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.



Thermal decoupling (with collision protection adapter on the left)

Styli

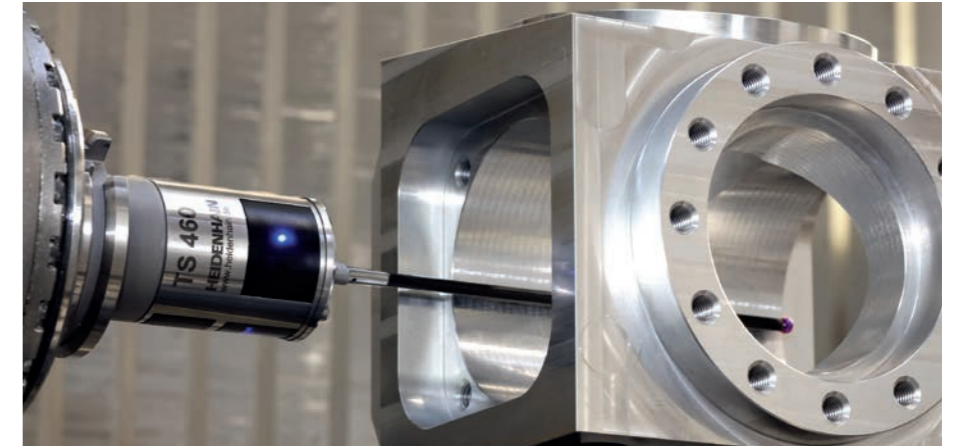
Styli for the TS

HEIDENHAIN offers styli featuring ruby ball tips and a variety of lengths and geometric designs. 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:

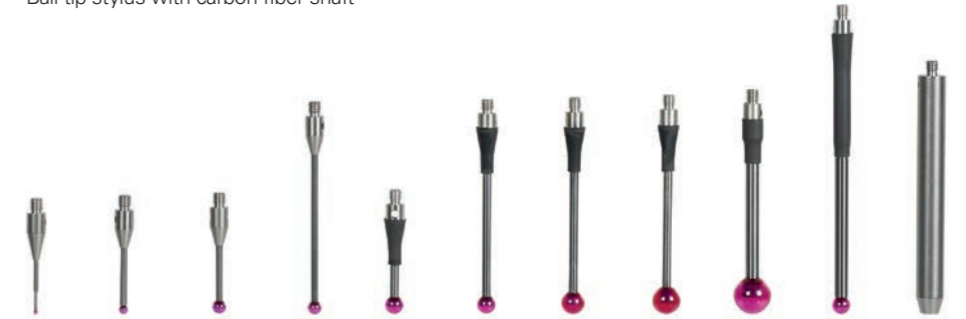
- TS 150: T404
- TS 750: T434
- TS 760: T434
- TS 260: 2 x T404
- TS 460: T404
- TS 642: T404 and T424

By using the coupling joint, the TS 260 can be rotated into position in order to align asymmetric or cuboid probe contacts exactly.

Generally the TS touch probes can be accelerated by up to 10 m/s^2 without any spurious deflections, if the styli listed here are attached directly. Only the T409, with a length of 60 mm, should be accelerated by no more than 8 m/s^2 when oriented horizontally.



Ball-tip stylus with carbon-fiber shaft



Ball-tip styli with steel shaft

| Model | ID | Length | Ball diameter |
|-------|-----------|--------|---------------|
| 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 |

Ball-tip styli with 3 mm steel shaft

| Model | ID | Length | Ball diameter |
|-------|-----------|--------|---------------|
| T434 | 295770-34 | 40 mm | 4 mm |
| T408 | 352776-08 | 40 mm | 8 mm |
| T409 | 352776-19 | 60 mm | 4 mm |

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

Ball-tip styli with carbon-fiber shaft

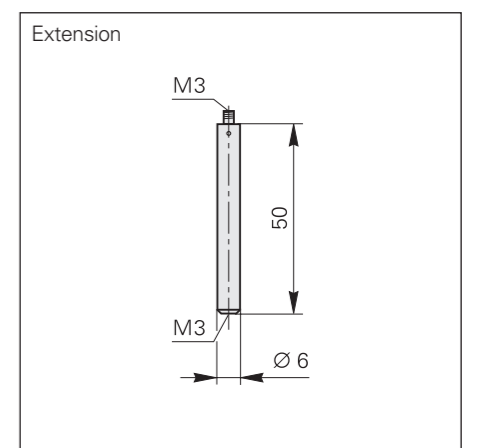
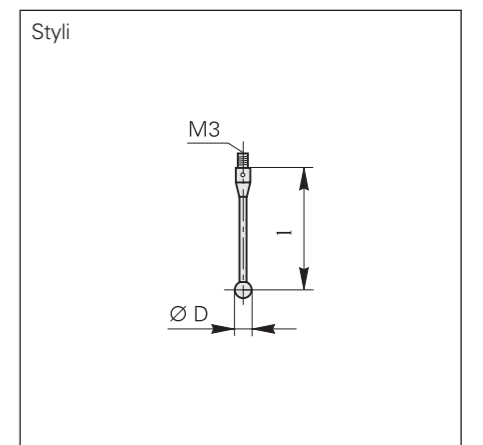
| Model | ID | Length | Ball diameter |
|-------|-----------|--------|---------------|
| T510 | 805228-01 | 100 mm | 5 mm |
| T515 | 805228-02 | 150 mm | 5 mm |
| T520 | 805228-03 | 200 mm | 5 mm |
| T530 | 805228-05 | 300 mm | 5 mm |
| T615 | 805228-10 | 150 mm | 6 mm |
| T610 | 805228-07 | 100 mm |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

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

Stylus extension


| Model | ID | Length | 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).



TS 260, TS 150 and TS 750

Workpiece touch probes

mm

 Tolerancing ISO 8015
 ISO 2768:1989-mH
 ≤ 6 mm: ±0.2 mm



TS 260

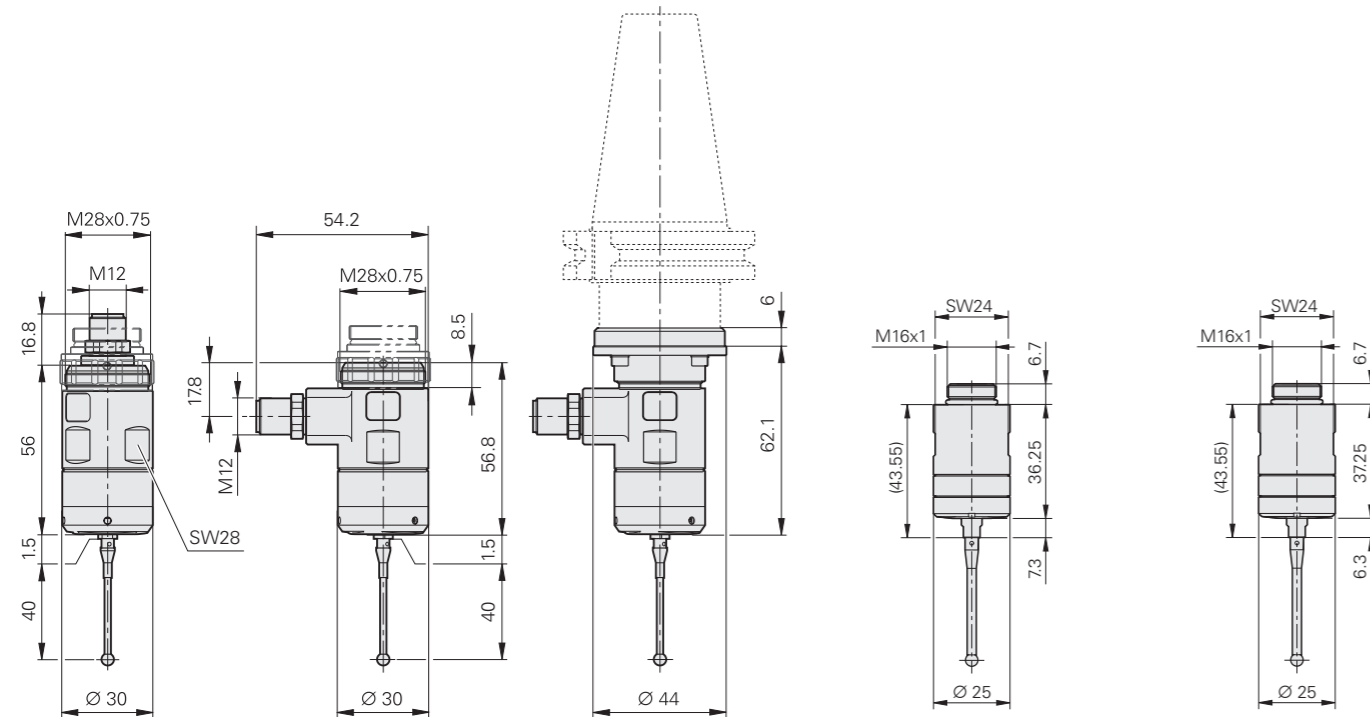
Axial flange socket

Radial flange socket

TS 150

With mounting base

TS 750



| Workpiece touch probe | Cable | | |
|---|---|---------------|---|
| | TS 260 | TS 150 | TS 750 |
| Probe accuracy | ≤ ±5 µm with use of the T404 standard stylus (at a probing speed of 1000 mm/min) | | ≤ ±1 µm with use of the T434 standard stylus (at a probing speed of 500 mm/min) |
| Probe repeatability Repeated probing from one direction | 2 σ ≤ 1 µm Typical values: 2 σ ≤ 0.5 µm | | 2 σ ≤ 0.25 µm |
| Probing force | Axial: ≈ 7 N or 3 N Radial: ≈ 1 N or 0.3 N | | Axial: ≈ 1.5 N Radial: ≈ 0.2 N |
| Deflection of probe contact | ≤ 5 mm in all directions (with stylus length L = 40 mm) | | |
| Deflection forces | Axial: ≈ 8 N or 3 N Radial: ≈ 1 N or 0.3 N | | Axial: ≈ 8 N Radial: ≈ 1 N |
| Probing speed (recommended) | ≤ 3 m/min | | ≤ 1 m/min |
| Protection EN 60529 | IP68 | | |
| Operating temperature | 10 °C to 40 °C | 5 °C to 54 °C | |
| Storage temperature | −20 °C to 70 °C | | |
| Mass without taper shank | ≈ 0.15 kg | ≈ 0.1 kg | |
| Fastening* | <ul style="list-style-type: none"> • With taper shank¹⁾ (only with radial flange socket) • Via M28x0.75 external thread • Via coupling joint with M22x1 external thread | | <ul style="list-style-type: none"> • Base with M22x1 thread and axial cable outlet • Base with three M3 screws and axial cable outlet • Base with four M3 screws and axial cable outlet • Optional: touch-probe extension with M16x1 thread |
| Electrical connection* | 8-pin M12 flange socket, axial or radial | | Two-pole sliding contact on the mounting base |
| Cable length | ≤ 25 m | | |
| Supply voltage²⁾ | DC 10 V to 30 V/≤ 100 mA (without load) | | DC 10 V to 30 V/≤ 85 mA (without load) |
| Output signals²⁾ | <ul style="list-style-type: none"> • Trigger signals S and \bar{S} (square-wave signal and its inverted signal) • Floating trigger output | | |
| HTL signal levels²⁾ | $U_H \geq 20 \text{ V}$ at $-I_H \leq 20 \text{ mA}$ $U_L \leq 2.8 \text{ V}$ at $I_L \leq 20 \text{ mA}$ 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 and TS 750: via UTI 150

TS 460, TS 642 and TS 760

Workpiece touch probes

mm

 Tolerancing ISO 8015
 ISO 2768:1989-mH
 ≤ 6 mm: ±0.2 mm



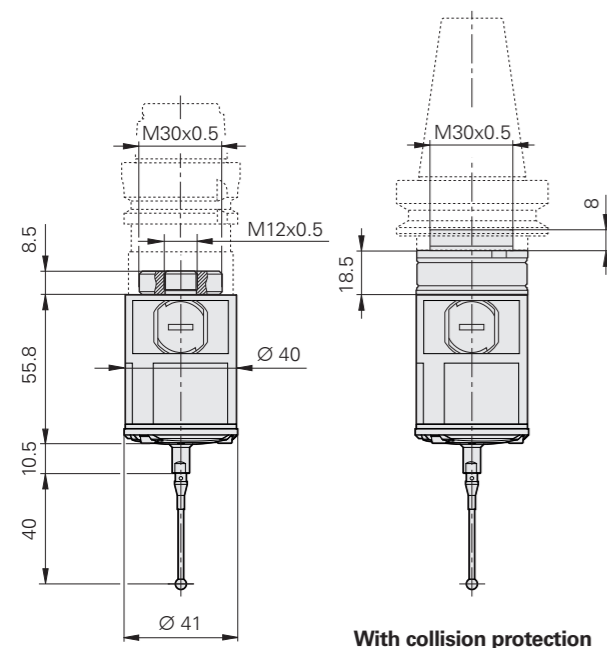
TS 460
 With collision protection



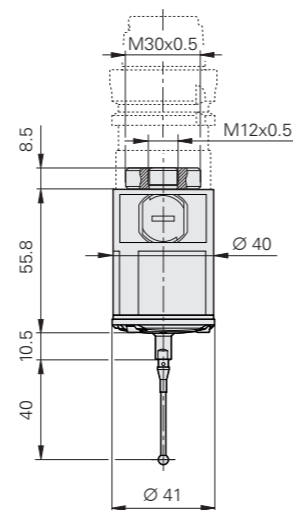
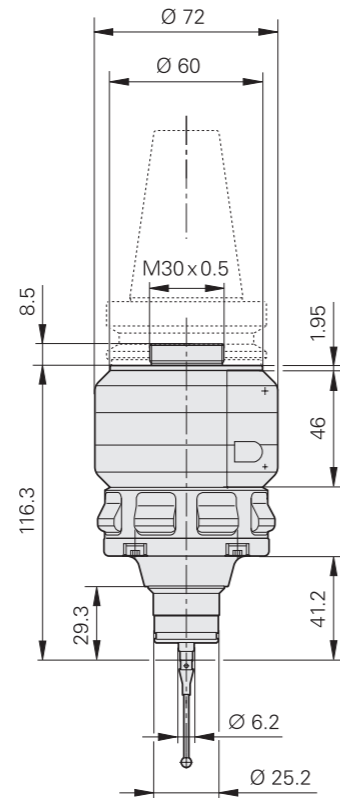
TS 642



TS 760



With collision protection



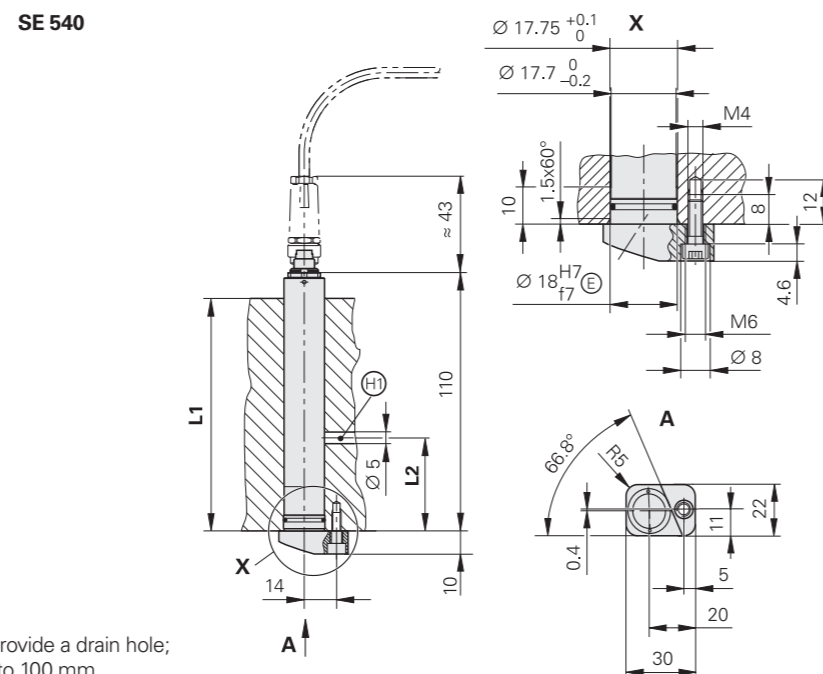
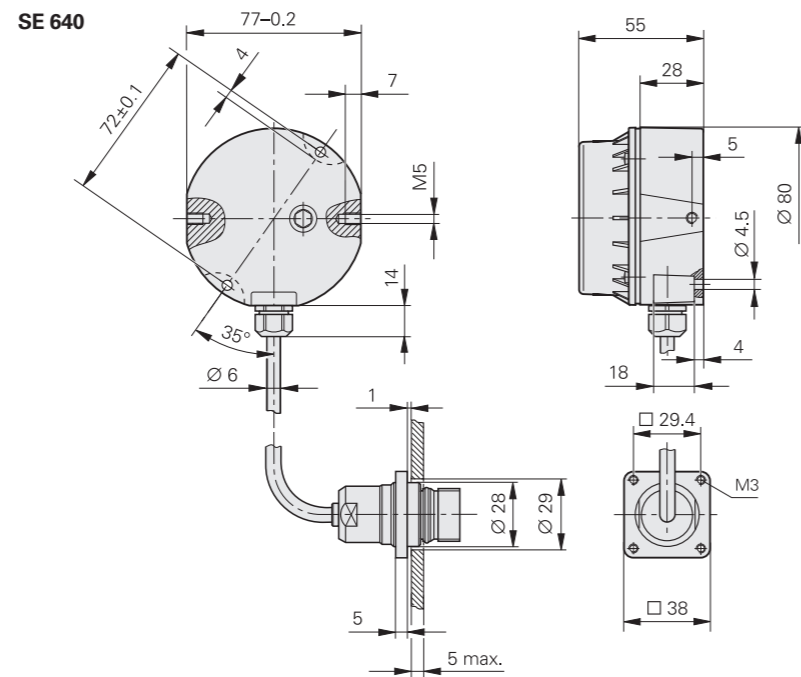
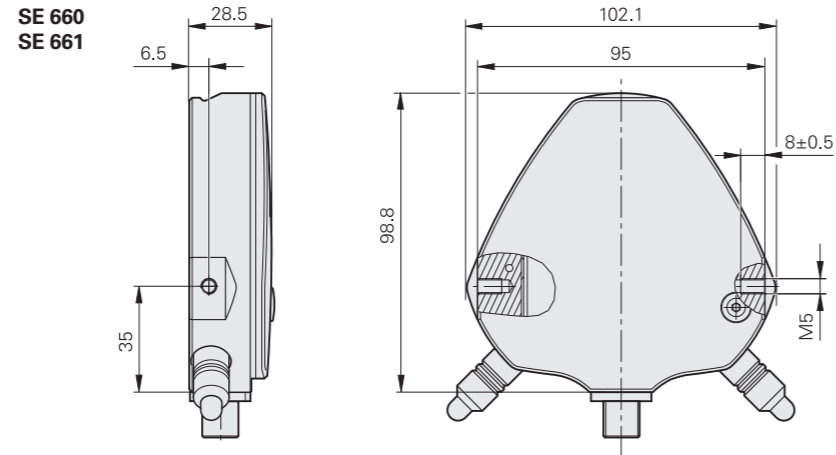
| Workpiece touch probe | TS 460 (radio and infrared) | TS 760 (radio and infrared) | TS 642 (infrared) |
|---|---|--|--|
| Probe accuracy | ≤ ±5 μm with use of the T404 standard stylus (at a probing speed of 1000 mm/min) | ≤ ±1 μm with use of the T434 standard stylus (at a probing speed of 500 mm/min) | ≤ ±5 μm with use of the T404 standard stylus (at a probing speed of 1000 mm/min) |
| Probe repeatability Repeated probing from one direction | 2 σ ≤ 1 μm Typical values: 2 σ ≤ 0.5 μm | 2 σ ≤ 0.25 μm | 2 σ ≤ 1 μm Typical values: 2 σ ≤ 0.5 μm |
| Probing force | Axial: ≈ 7 N; radial: ≈ 1 N | Axial: ≈ 1.5 N; radial: ≈ 0.2 N | Axial: ≈ 7 N; radial: ≈ 1 N |
| Deflection of probe contact | ≤ 5 mm in all directions (with stylus length L = 40 mm) | | |
| Deflection forces | Axial: ≈ 8 N; radial: ≈ 1 N | | |
| Probing speed (recommended) | ≤ 3 m/min | ≤ 1 m/min | ≤ 3 m/min |
| Collision protection | Optional | – | – |
| Integrated workpiece cleaning function | With collision protection: Purge air W/o collision protection: Purge air and lubricant | Purge air and lubricant | |
| Protection EN 60529 | IP68 | | |
| Operating temperature | 5 °C to 54 °C | | 10 °C to 40 °C |
| Storage temperature | –20 °C to 70 °C | | |
| Mass without taper shank | ≈ 0.2 kg | | ≈ 1.1 kg |
| Fastening* | <ul style="list-style-type: none"> With taper shank¹⁾ Via M30x0.5 or M12x0.5 external thread | | <ul style="list-style-type: none"> With taper shank¹⁾ 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 |
| 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 65 h with alkaline batteries (included in delivery, see Power supply); typically 300 h possible with lithium batteries | Typically 400 h with alkaline batteries (included in delivery); typically 800 h possible with lithium batteries |
| Transceiver* | <ul style="list-style-type: none"> SE 661²⁾/SE 660 for radio and infrared transmission SE 640 for infrared transmission SE 540 for infrared transmission; for integration in the spindle head | | SE 540, SE 640 or SE 660 (only infrared) |
| 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 640 and SE 540

Transceivers



| Transceiver | Radio and infrared | | Infrared | |
|--|---|---|--|---|
| | SE 661 | SE 660 | SE 640 | SE 540 |
| Use with | TS 460, TS 760 and TT 460; any number may be connected | TS 460, TS 760 and TT 460; up to four each may be connected (depending on version) | TS 460, TS 642, TS 760 | |
| 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) <ul style="list-style-type: none"> • Activation • Trigger signal • Ready signal • Diagnosis | Square-wave signals (HTL) <ul style="list-style-type: none"> • Start signals R(-TS) and R(-TT) • Ready signals B(-TS) and B(-TT) • Trigger signals S and S̄ • Battery warning W | Square-wave signals (HTL) <ul style="list-style-type: none"> • Start signal R • Ready signal B • Trigger signal S̄ • Battery warning 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 and errors | For touch-probe status |
| Electrical connection* | 8-pin M12 flange socket | 12-pin M12 flange socket | Cable, 0.5 m or 2 m with 7-pin M23 connector | 8-pin M9 flange socket |
| Cable length | ≤ 50 m | ≤ 20 m with adapter cable Ø 6 mm ≤ 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 ≤ 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 load¹⁾ | | | | |
| Infrared | | | | |
| Normal operation | 3.8 W _{eff} (≤ 220 mA _{eff}) | 3.4 W _{eff} (≤ 200 mA _{eff}) | 5.1 W _{eff} (≤ 250 mA _{eff}) | 3.7 W _{eff} (≤ 150 mA _{eff}) |
| Transmission | 12 W _{PK} (≤ 755 mA _{PK}) | 10.7 W _{PK} (≤ 680 mA _{PK}) | 8.3 W _{PK} (≤ 550 mA _{PK}) | 4.3 W _{PK} (≤ 210 mA _{PK}) |
| Radio | 2.4 W _{eff} (≤ 135 mA _{eff}) | 2.1 W _{eff} (≤ 120 mA _{eff}) | – | – |
| 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

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

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 TT 460 is also available with a quick release system.

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.

| Contents | | |
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| Principle of operation | Sensor | 33 |
| Mounting | TT tool touch probe | 34 |
| Probing | | 35 |
| Specifications | TT 160, TT 460 | 36 |

| | TT tool touch probes | |
|-------------------------------------|--|---|
| | TT 160 | TT 460 |
| Probing forces | Axial: 8 N, radial: 1 N | |
| Sensitivity to unclean tools | Very low | |
| Possible measuring cycles | Length, radius, breakage, individual teeth | |
| Signal transmission | Cable | Radio/infrared to SE 660 and SE 661; infrared to SE 640 |
| Interface | HTL | HTL, EnDat 2.2 via SE |
| Repeatability | $2\sigma \leq 1\ \mu\text{m}$ | |
| Minimum tool diameter | 3 mm ¹⁾ | |
| Maximum tool diameter | Unlimited | |

¹⁾ Probing force must not result in tool damage



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 through the transceiver:

- Greatly increased mobility
- Rapid installation at any location
- Deployable on rotary and tilting tables as well

Your benefit is that with the TT 160 or TT 460 tool touch probe, you can have your CNC machine be productive during unattended shifts without expecting scrap or even any loss in accuracy.



Principle of operation Sensor

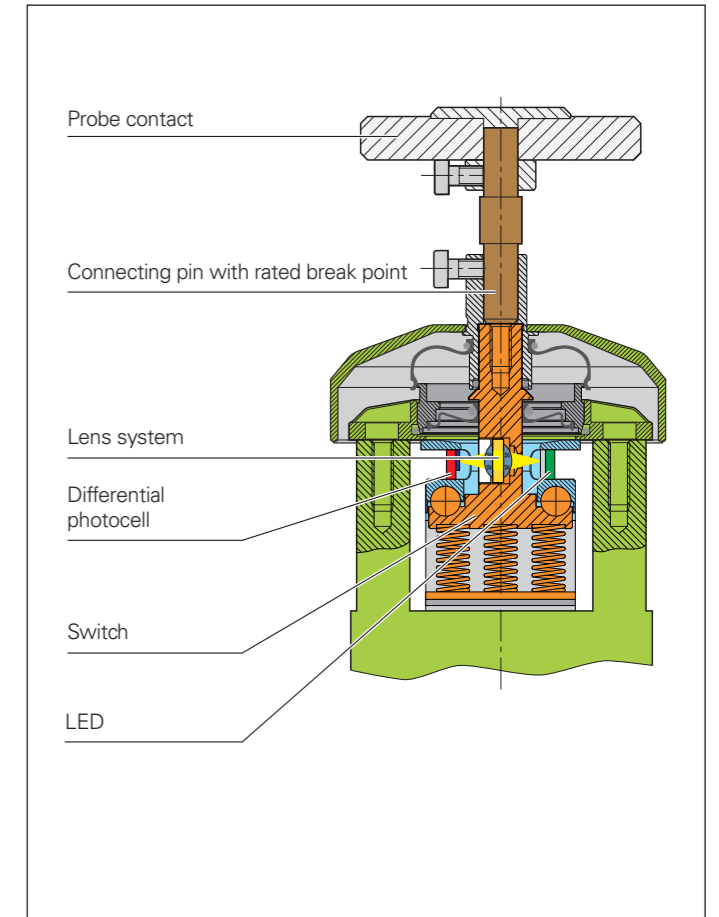
Touch probes from HEIDENHAIN operate with an optical switch as sensor. A lens system collimates the light emitted by an LED and focuses it onto a differential photocell. Upon deflection of the probe contact, the differential photocell produces a trigger signal. The probe contact of the TT is rigidly 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 probing accuracy of a touch probe is measured at HEIDENHAIN on precision measuring machines.



Mounting

TT tool touch probe

The tool touch probes feature an IP68 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 460 is available with a quick release system, which uses a premounted magnetic base for repeated attachment. This reduces the volume of interfering contours in the machine, thus increasing the available working space.

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

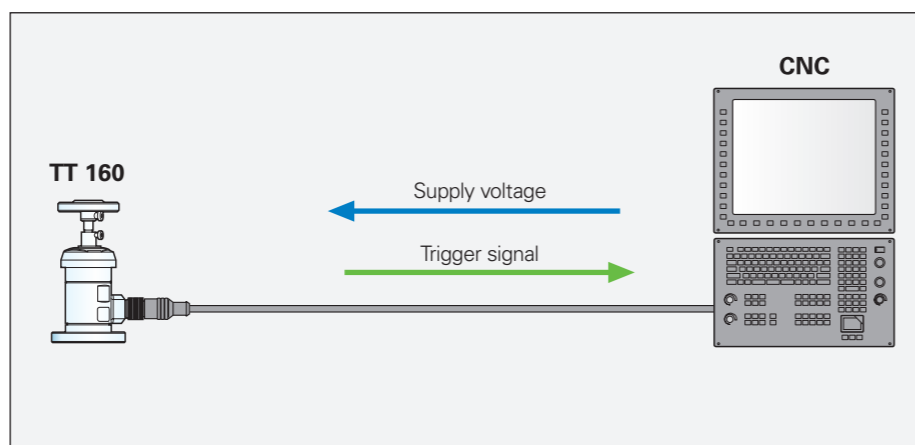
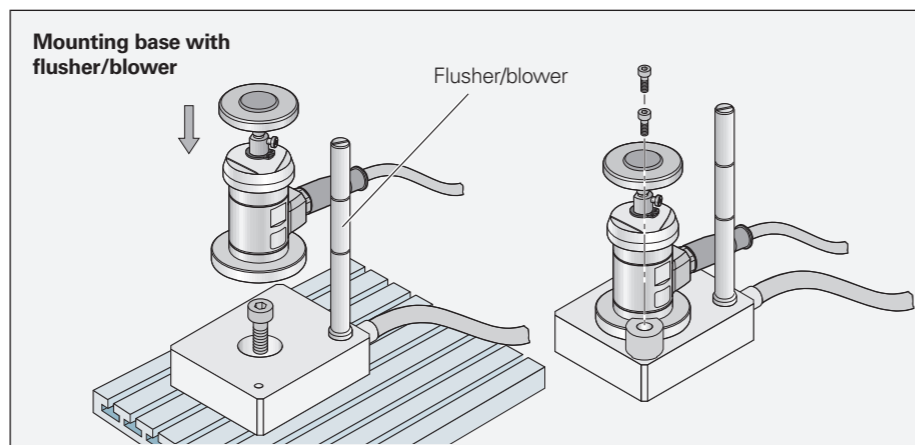
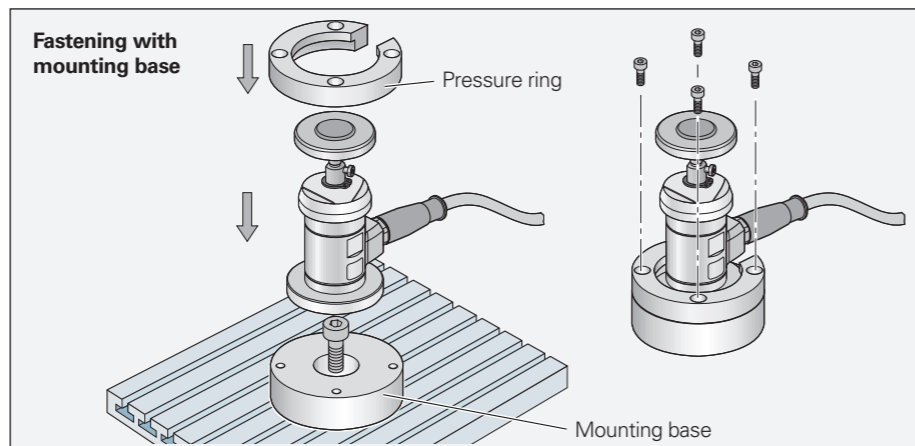
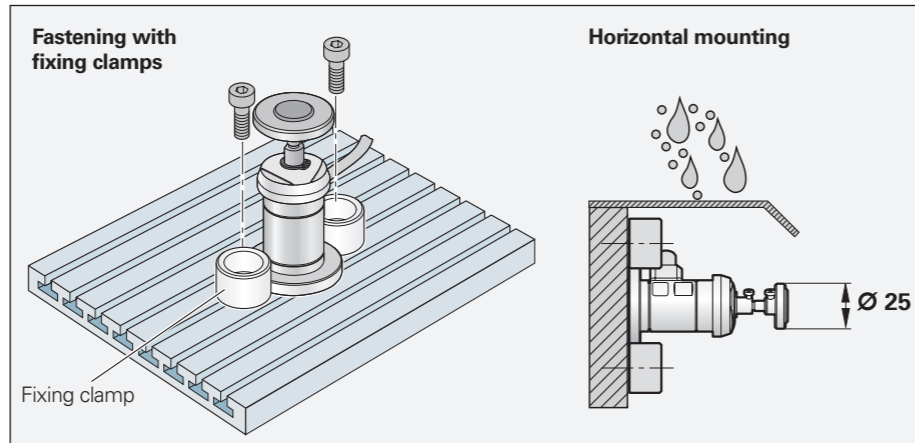
For fastening with a central screw
TT 160: ID 332400-01
TT 460: ID 651586-01

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 clamping it with a screw in the connecting pin.

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

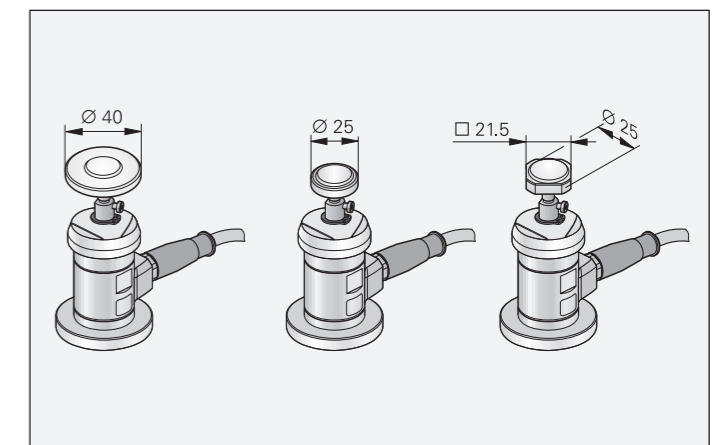
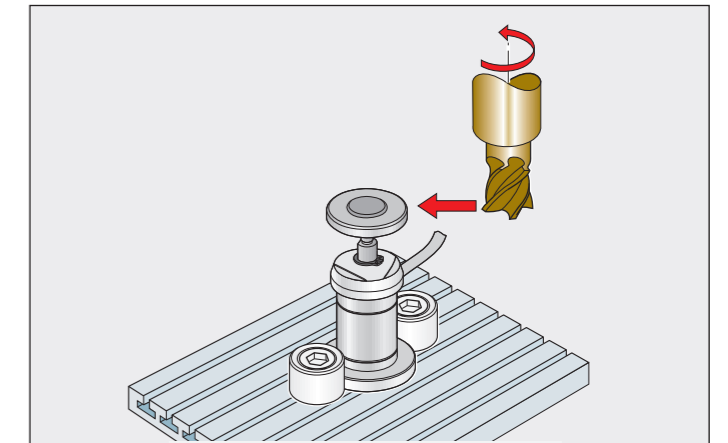
LEDs on the TT 160 additionally indicate deflection of the probe contact. On the TT 460, the state of the touch probe is also shown by LEDs on the SE transceiver. This characteristic is especially useful for testing correct operation, since you can see at a glance whether the TT is currently deflected.

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.



Accessories:

Probe contact SC02 Ø 25 mm
ID 574752-01

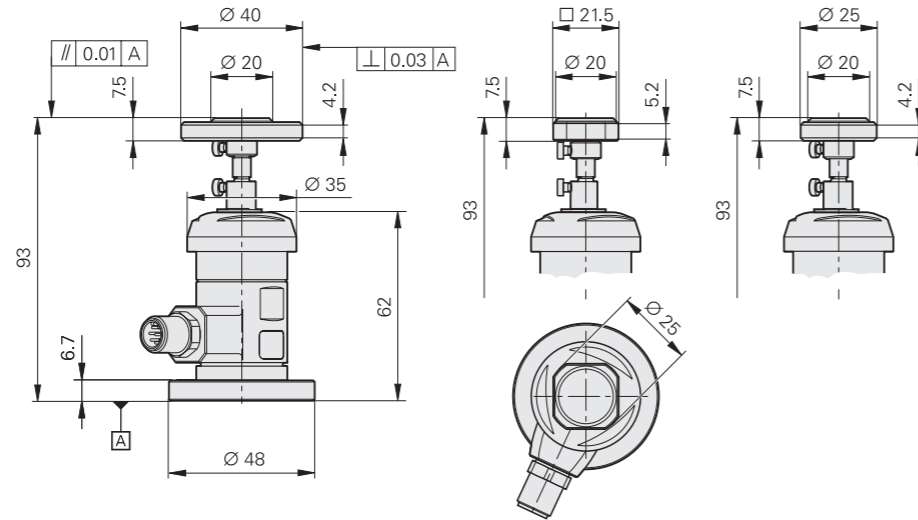
Probe contact SC01 Ø 40 mm
ID 527801-01

Probe contact SC06 cuboid
ID 676497-01

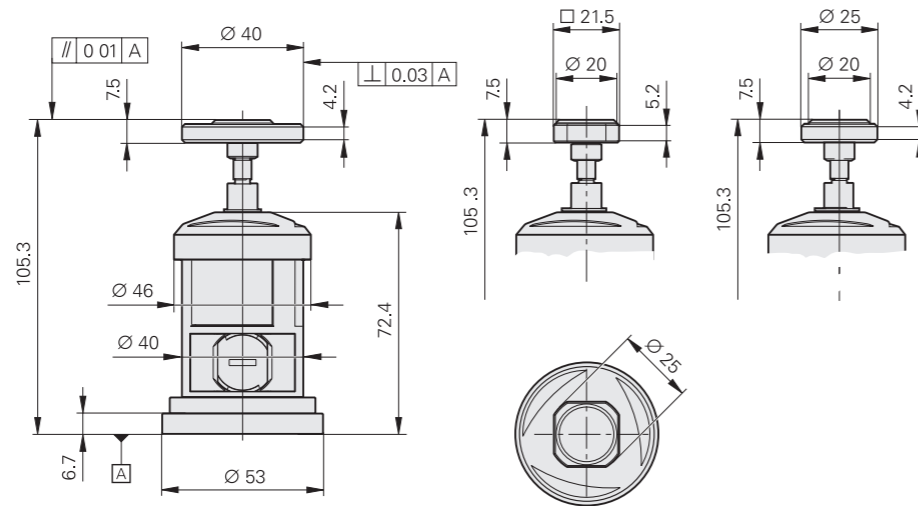
TT 160 and TT 460

Tool touch probes

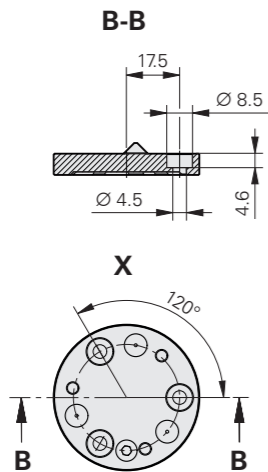
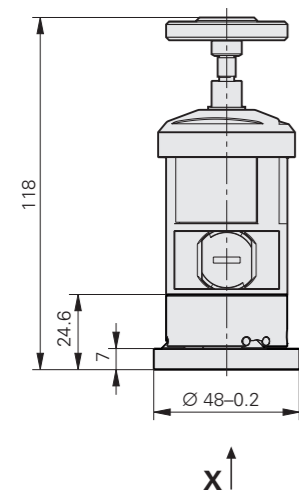
TT 160



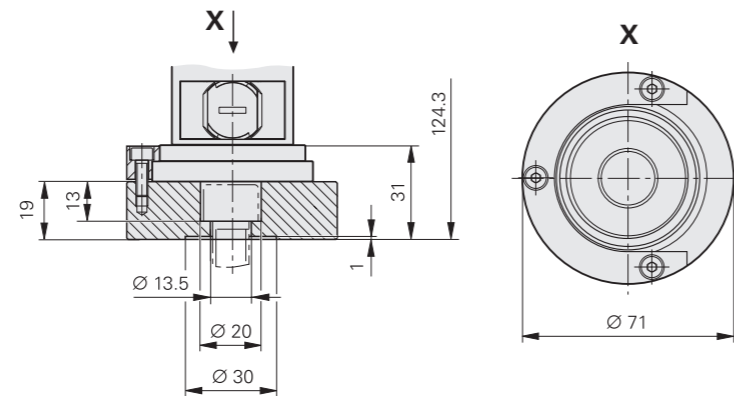
TT 460



Quick release with magnetic base



Mounting base



| Tool touch probe | Cable | Radio and infrared |
|--|---|--|
| | TT 160 | TT 460 |
| Probe accuracy | $\leq \pm 15 \mu\text{m}$ | |
| Probe repeatability Repeated probing from one direction | $2\sigma \leq 1 \mu\text{m}$ at a probing speed of 1 m/min <i>Typical values:</i> $2\sigma \leq 1 \mu\text{m}$ at a probing speed of 3 m/min $2\sigma \leq 4 \mu\text{m}$ at a probing speed of 5 m/min | |
| Deflection of the probe contact | $\leq 5 \text{ mm}$ in all directions | |
| Deflection forces | <i>Axial:</i> $\approx 8 \text{ N}$ <i>Radial:</i> $\approx 1 \text{ N}$ | |
| Probing speed | $\leq 5 \text{ m/min}$ | |
| Protection EN 60529 | IP68 | |
| Operating temperature | 10 °C to 40 °C | |
| Storage temperature | -20 °C to 70 °C | |
| Mass | $\approx 0.3 \text{ kg}$ | $\approx 0.4 \text{ kg}$ |
| Mounting on the machine table* | <ul style="list-style-type: none"> Fastening via fixing clamps (included in delivery) Quick release with magnetic base (included in delivery) Fastening with mounting base (accessory) | |
| Electrical connection* | 8-pin M12 flange socket | <ul style="list-style-type: none"> SE 660¹⁾ for radio and infrared transmission SE 661³⁾ for radio and infrared transmission |
| Signal transmission | Cable | Radio or infrared transmission (selectable) with 360° emission to the SE |
| Cable length | $\leq 25 \text{ m}$ | - |
| 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/ $\leq 100 \text{ mA}$ (without load) | Two rechargeable or nonrechargeable batteries, 1 V to 4 V each; size $\frac{1}{2}$ AA or size LR1 |
| Operating time | - | Typically 90 h ²⁾ with alkaline batteries (included in delivery); 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 and TT 160 touch probes, as well as the SE transceivers, are powered by the control. The cable-bound TS 150 and TS 750 touch probes are 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 760 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, TS 760 and TT 460 touch probes feature intelligent battery management for minimized 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.

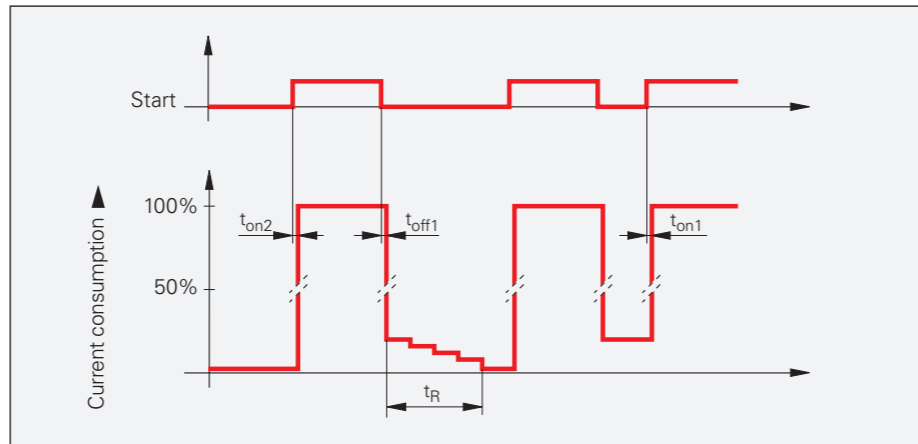
When switched off in infrared transmission, the touch probes go into stand-by mode and, after eight hours, into sleep mode. Longer switch-on times for activation of the touch probe should thus be expected (see *Switching the TS 460/TS 642/TS 760/TT 460 on and off*).

| | Battery size | Operating time ¹⁾ | |
|------------------|------------------------------------|------------------------------|-------------------------|
| | | Lithium battery | Alkaline battery |
| TS 460 TT 460 | 1/2 AA N/LR1/Lady ²⁾ | 400 h – | – 90 h ³⁾ |
| TS 760 | 1/2 AA N/LR1/Lady ²⁾ | 300 h | 65 h ³⁾ |
| TS 642 | C | 800 h | 400 h |
| | A ²⁾ | 400 h | 200 h |

¹⁾ **Please note:** These are approximate values that can vary depending on the manufacturer

²⁾ Via adapter

³⁾ Included in delivery



TS 460/TS 760/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 750, TS 260 or TT 160, a square-wave trigger signal **S** and its inverted signal \bar{S} are generated.

HTL signal levels S, \bar{S}

$$U_H \geq (U_P - 2.2 \text{ V}) \text{ at } -I_H \leq 20 \text{ mA}$$

$$U_L \leq 1.8 \text{ V at } I_L \leq 20 \text{ mA}$$

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).

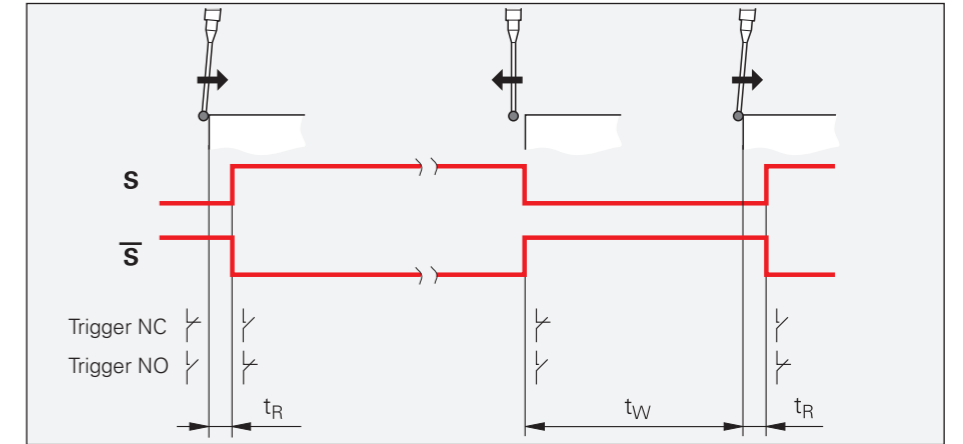
Load capacity of optocoupler

$$U_{max} \leq 15 \text{ V}$$

$$I_{max} \leq 50 \text{ mA}$$

$$\Delta U \leq 1 \text{ V (typically } 0.3 \text{ V at } I = 50 \text{ mA)}$$

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 150/TS 750/TS 260/TT 160

Response time $t_R \leq 10 \mu\text{s}$
Repeat interval $t_W > 25 \text{ ms}$

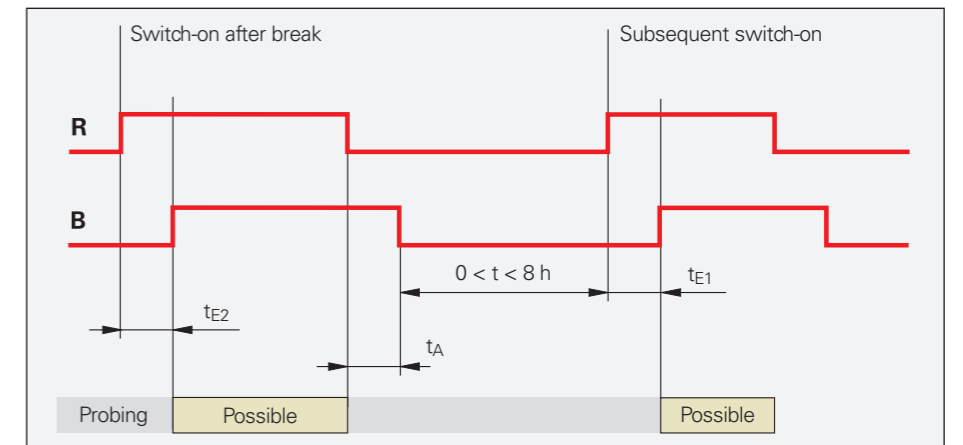
Touch probes with wireless signal transmission

The TS 460, TS 760 and TT 460 touch probes are switched on 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 760/TT 460 on and off

Signal times

Switch-on delay

$$t_{E1} \leq 1000 \text{ ms (typically } 250 \text{ ms)}$$

$$t_{E2} \leq 3000 \text{ ms}$$

Switch-off delay

$$t_A \leq 1000 \text{ ms (typically } 350 \text{ ms)}$$

Further information:

Comprehensive descriptions of general electrical information can be found in the *Interfaces of HEIDENHAIN Encoders* brochure.

Upon deflection of the stylus or probe contact, a square-wave **trigger signal 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.

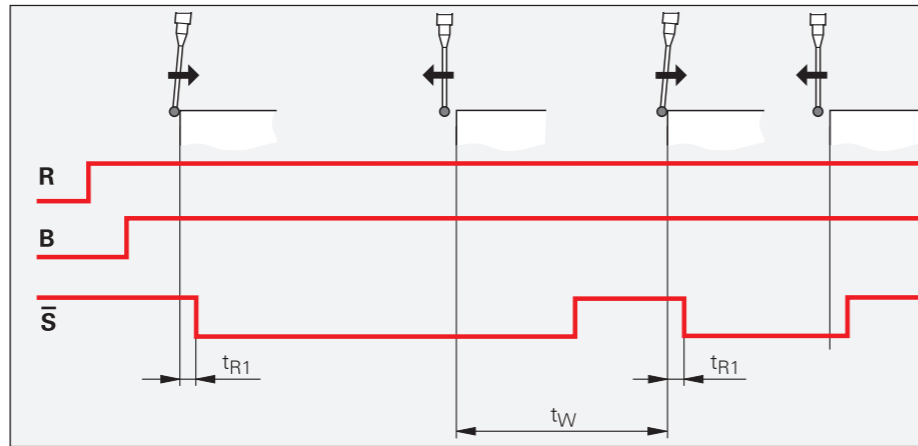
Signal times
 Response time for interrupted signal transmission t_s

- With infrared transmission: ≤ 40 ms
- With radio transmission: ≤ 55 ms

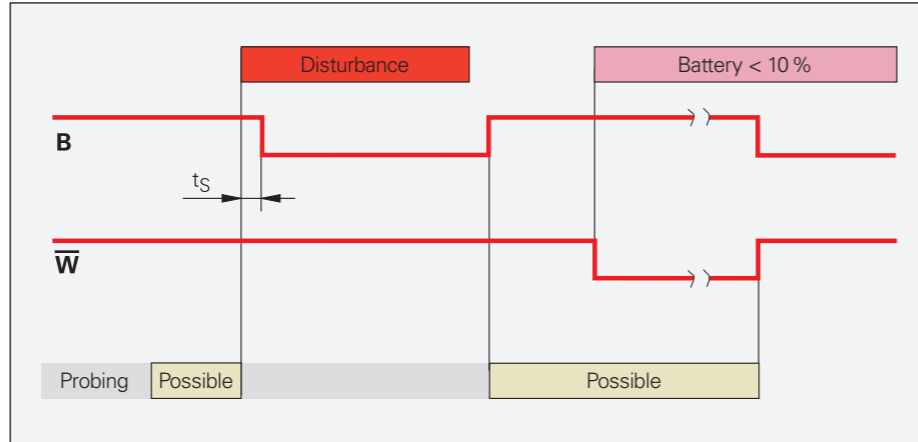
Response time for collision (with collision protection adapter) t_s

- With infrared transmission: ≤ 40 ms
- With radio transmission: ≤ 20 ms

The **battery warning 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 760/TT 460¹⁾



Behavior during disturbance and battery warning

HTL signal levels

R
 $U_H = (10\text{ V} \dots 30\text{ V})$ at $I_H \leq 4\text{ mA}$
 $U_L \leq 2\text{ V}$ at $-I_L \leq 0.2\text{ mA}$

B/S/W
 $U_H \geq (U_P - 2.2\text{ V})$ at $-I_H \leq 20\text{ mA}$
 $U_L \leq 1.8\text{ V}$ at $I_L \leq 20\text{ mA}$

¹⁾ For signal gatings and deviations, see the mounting instructions of the SE

EnDat for touch probes

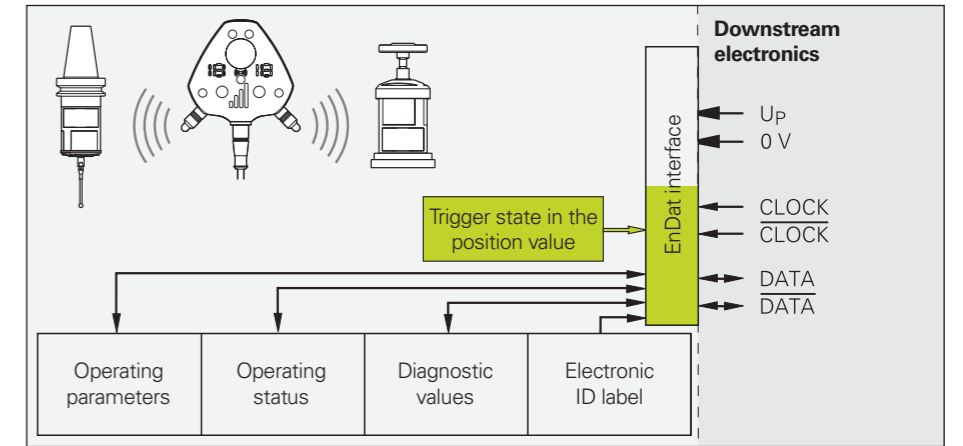
The **TS 460, TS 760** and **TT 460** touch probes feature the **EnDat interface** for touch probes. The EnDat interface from HEIDENHAIN is a digital, bidirectional interface that transmits the trigger status as well as diagnostic information and additional data from the touch probe. Thanks to the interface's 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

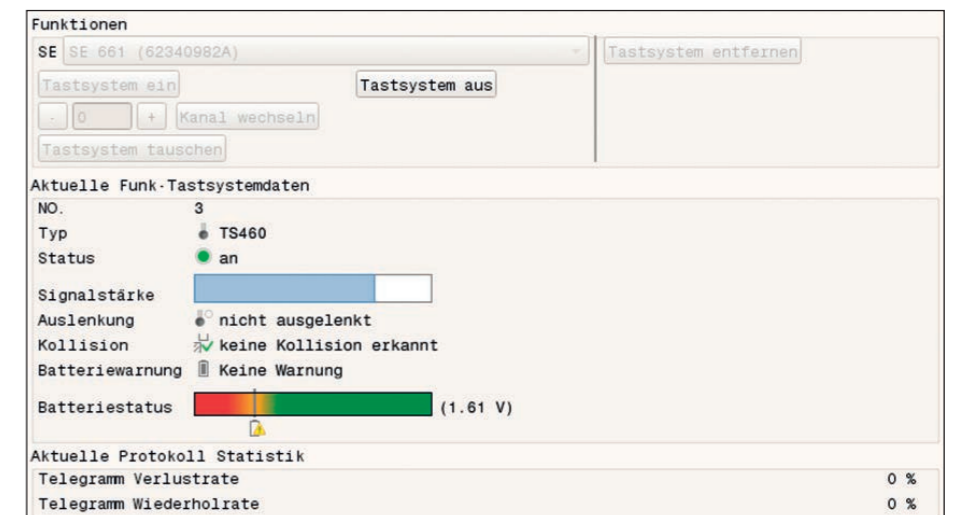


The TS 460, TS 760 and TT 460 touch probes can be connected to the SE 661 through radio and/or infrared transmission. In infrared mode, the probing information, readiness status and battery warning are available. In radio mode, additional data from the touch probe is available. The provision of this 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 downstream 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 speed. Recalibration is therefore unnecessary for probing at different speeds 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 TNC 640 TNC 620 CNC PILOT 640 MANUALplus 620 | Radio/infrared: TS 460 TS 760 TT 460 Via SE 661 | EnDat for touch probes | Only PLB 62xx, UEC 3xx: X112, X113 | Workpiece measurement <ul style="list-style-type: none"> • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement <ul style="list-style-type: none"> • Length, radius • Wear, breakage • Individual teeth | – | |
| HEIDENHAIN TNC 640 TNC 620 TNC 320 TNC 128 CNC PILOT 640 MANUALplus 620 | <i>Cable:</i> TS 260 TS 150/TS 750 with UTI 150 TT 160 <i>Radio/infrared:</i> TS 460, TS 760 TT 460 | HTL | <i>HSCI¹⁾:</i> X112, X113 <i>Others²⁾:</i> X12, X13 | Workpiece measurement <ul style="list-style-type: none"> • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement <ul style="list-style-type: none"> • Length, radius • Wear, breakage • Individual teeth | – | |
| Siemens 828D 840D 840D sl | <i>Infrared:</i> TS 460 TS 642 TS 760 Via SE 640, SE 540 | | X121, X122 or X132 | | | Workpiece measurement <ul style="list-style-type: none"> • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement <ul style="list-style-type: none"> • Length, radius • Wear, breakage |
| Fanuc 0 0i 16 18 21 30 31 32 3xi | | | <i>Recommended:</i> HIGH SPEED SKIP ³⁾ <i>Possible:</i> SKIP (24 V) | | | OEM specific |
| Mitsubishi M70/M700 series M64/M640 series | | | SKIP (24 V) | Basic cycles for <ul style="list-style-type: none"> • Preset setting • Tool length | | |
| Mazak Mazatrol Fusion Mazatrol Matrix Mazatrol Smart Mazatrol Smooth X | | | | | | |

¹⁾ When multiple touch probes are operated with the SE 660, a UTI 660 is required

²⁾ If the TS 460, TS 760 and TT 460 are operated together, a UTI 240 is required

³⁾ If the trigger signal S is used, a UTI 491 is required

Signal converters for integration

For adaption of the touch probe signals to the CNC control, a UTI signal converter 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

The UTI 491 signal converter 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 signal converter is required if you want to operate the TS 150 or TS 750 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 signal converter is required for connecting multiple TS 460, TS 760 and TT 460 touch probes to a HEIDENHAIN control that does not support EnDat. The UTI 660 enables you to use up to four TS 460 or TS 760 probes and four TT 460 probes with radio transmission on a control.

ID 1169537-01



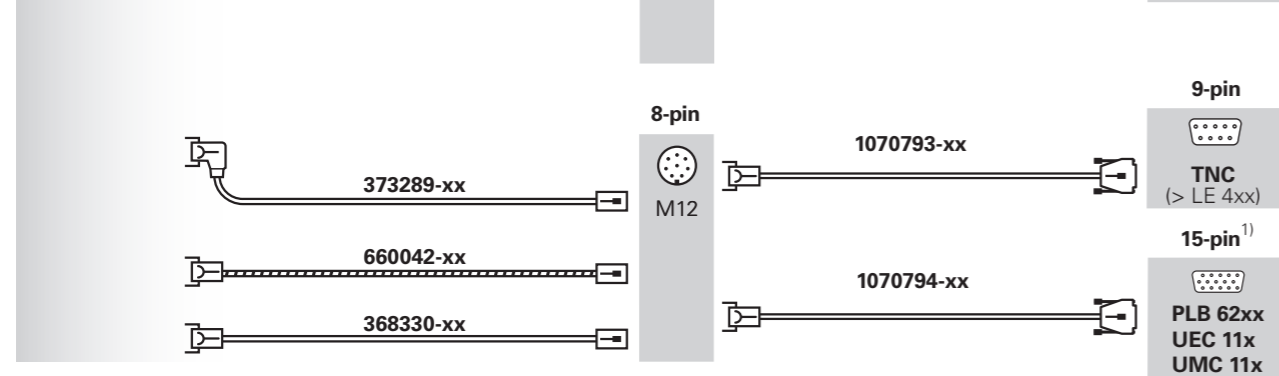
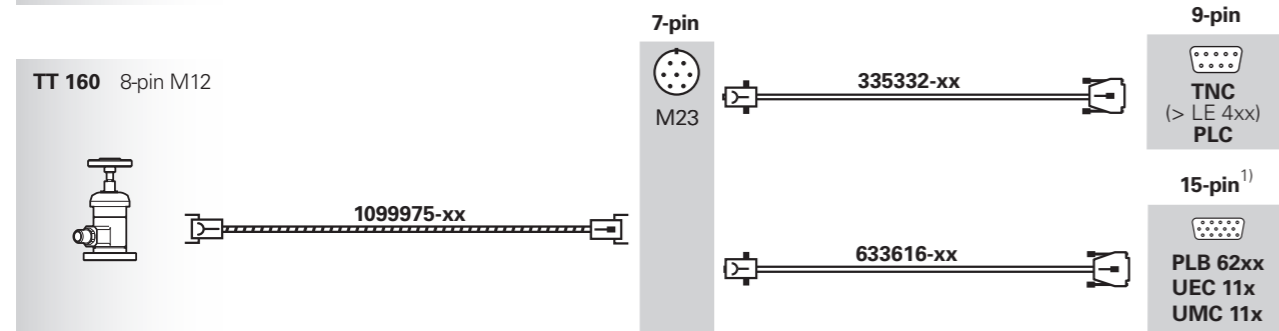
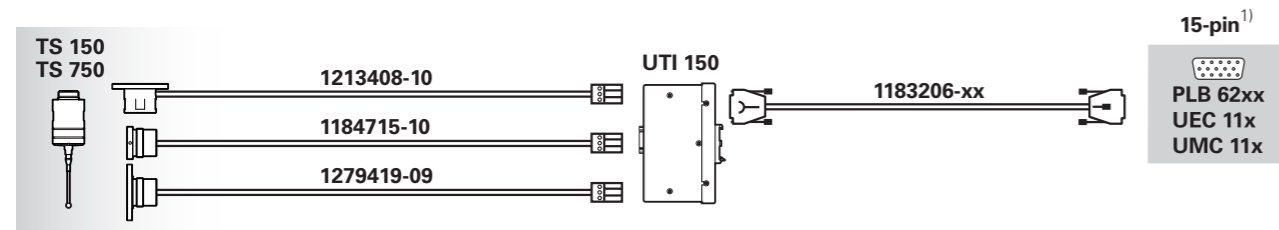
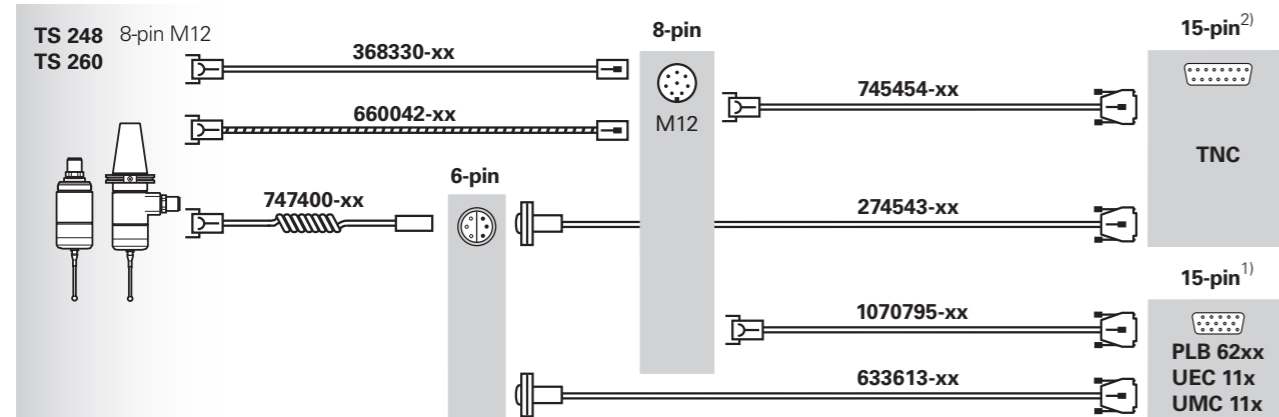
UTI 660

Further information:

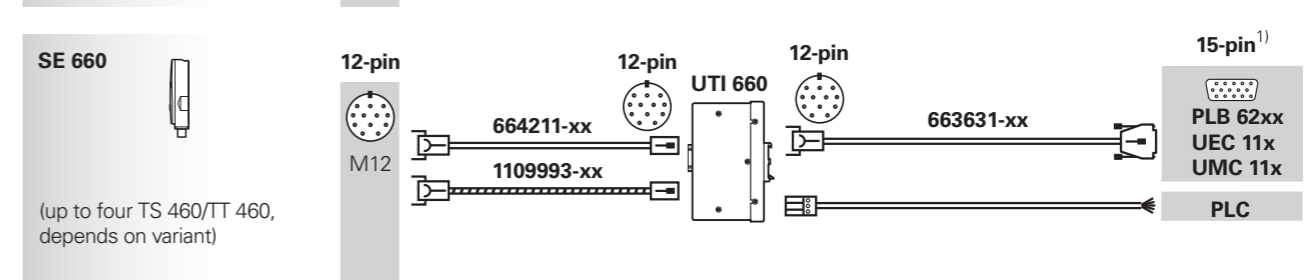
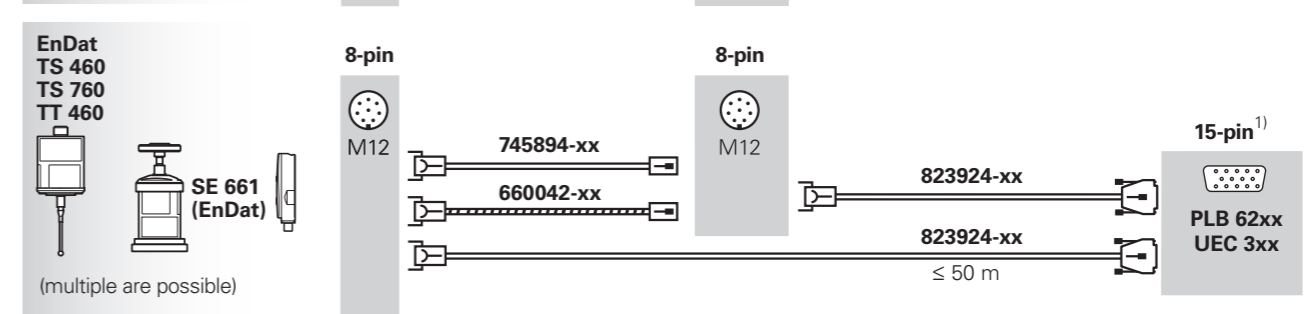
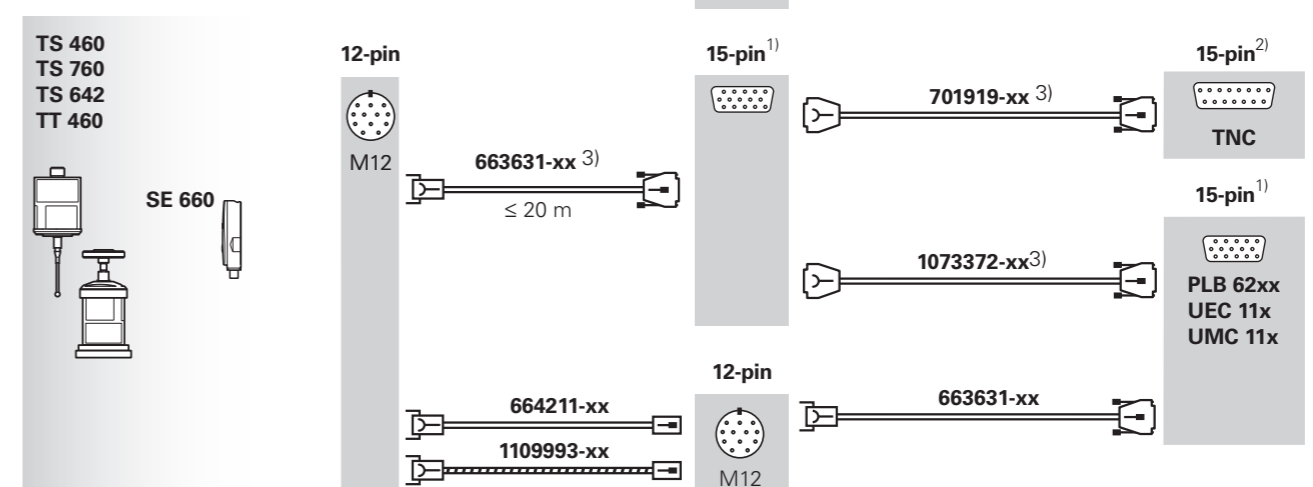
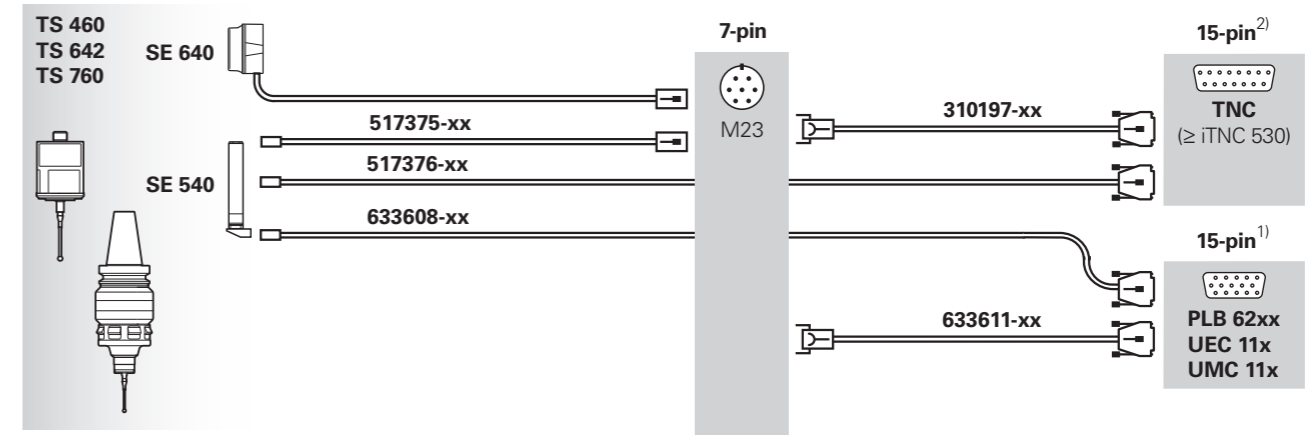
Comprehensive descriptions of cables and connectors can be found in the *Cables and Connectors* brochure.

Cable overviews

Connection to HEIDENHAIN controls



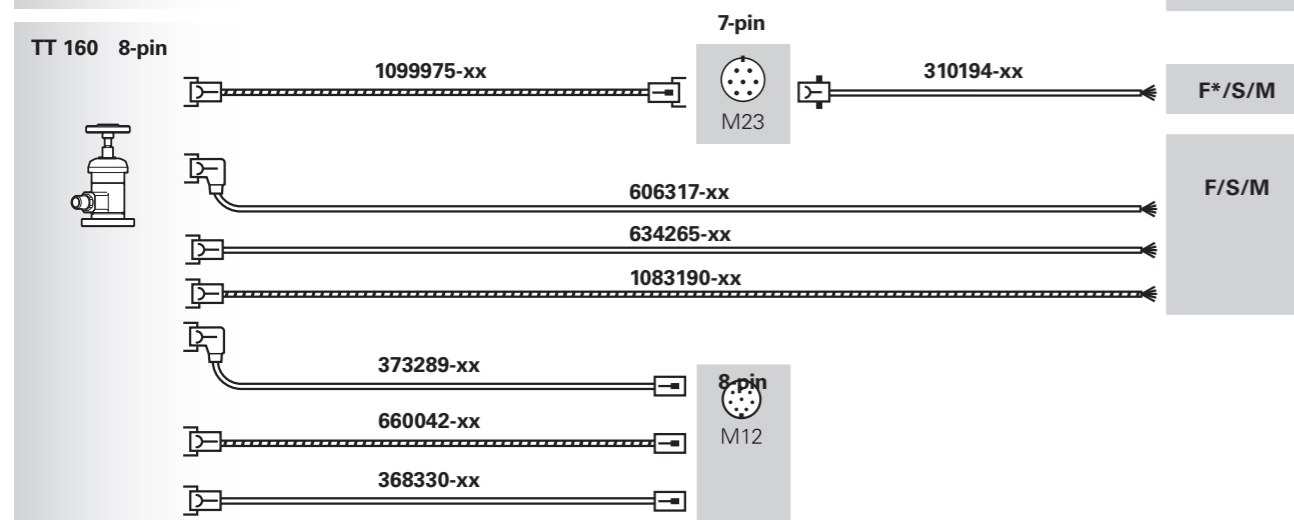
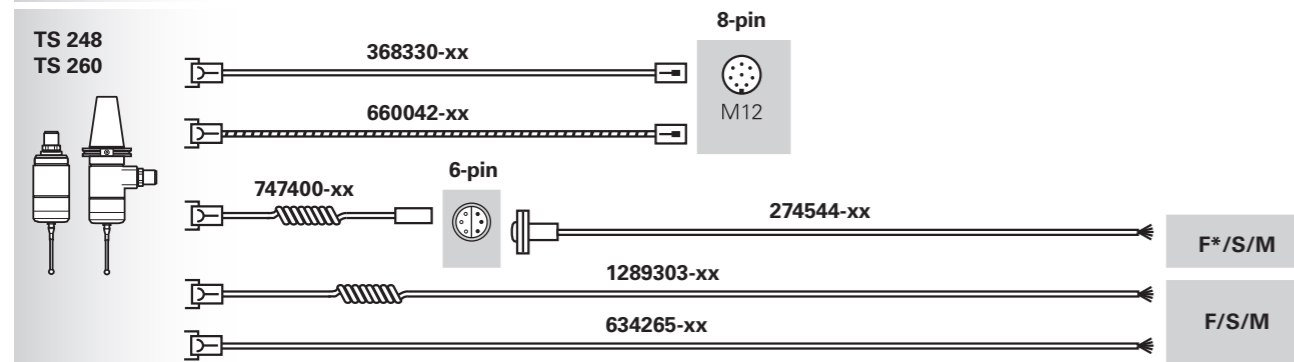
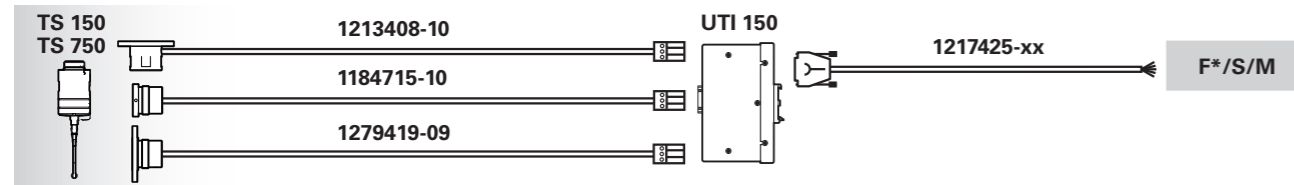
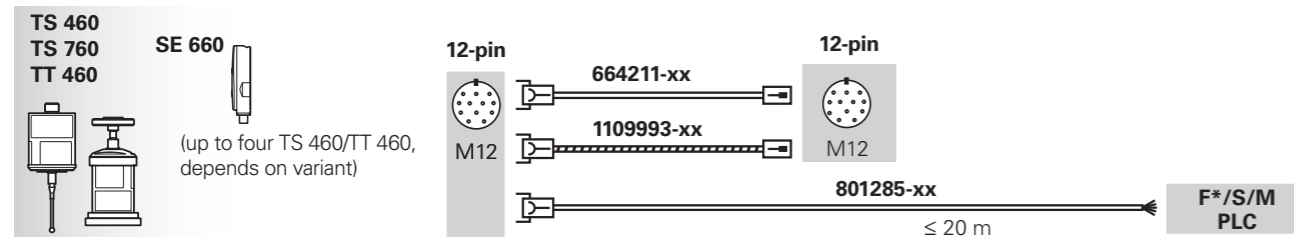
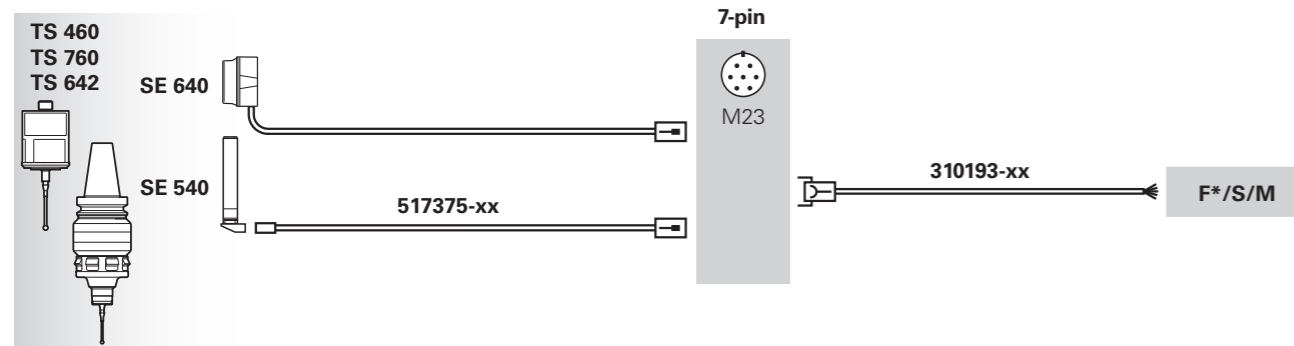
^{1), 2)} Pin layouts are identical



^{1), 2)} Pin layouts are identical

³⁾ If overall length is over 20 m: ID 663631-xx max. 10 m; the rest with ID 701919-xx/1073372-xx

Connection to all other controls



F/S/M = Fanuc/Siemens/Mitsubishi/Mazak, F* Fanuc High-Speed Skip over UTI 491

HEIDENHAIN

Mastering nanometer accuracy



HEIDENHAIN

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