



Touch Probes for Machine Tools

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

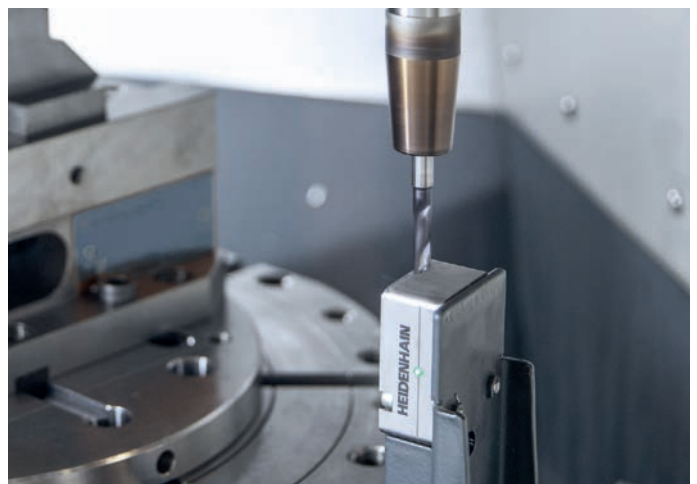
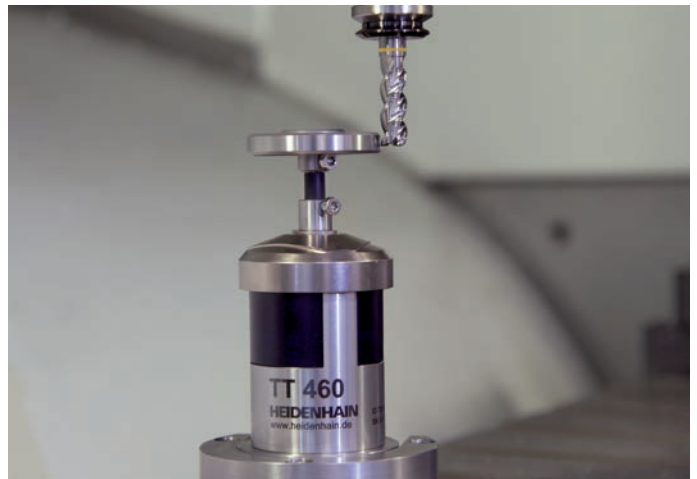
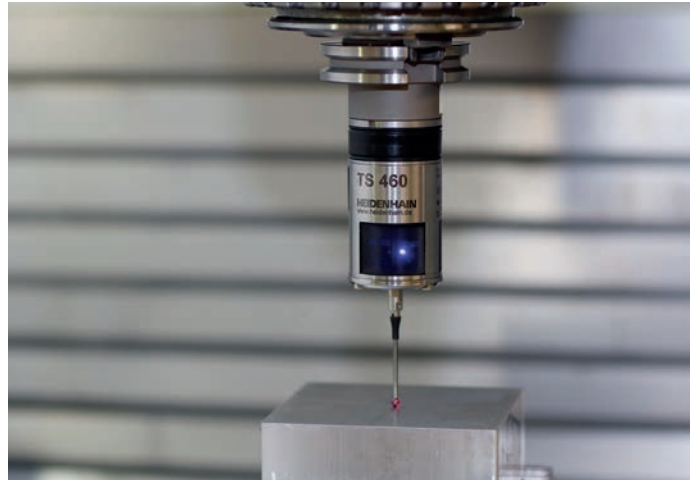
Successful series production hinges on the prevention of scrap or rework and on the attainment of consistently high-quality manufacturing. The tool is a decisive factor in this. Wear or tool breakage that goes undetected for extended periods, especially during unattended operation, results in defective 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.

The **TD 110 tool breakage detector** rapidly detects tool breakage without contact, for greater process reliability, less downtime, and lower system costs.

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:

In-depth descriptions of cables and connectors can be found in the [Cables and Connectors](#) brochure. For information about the EU Data Act, please refer to the [Interfaces of HEIDENHAIN Encoders](#) brochure.

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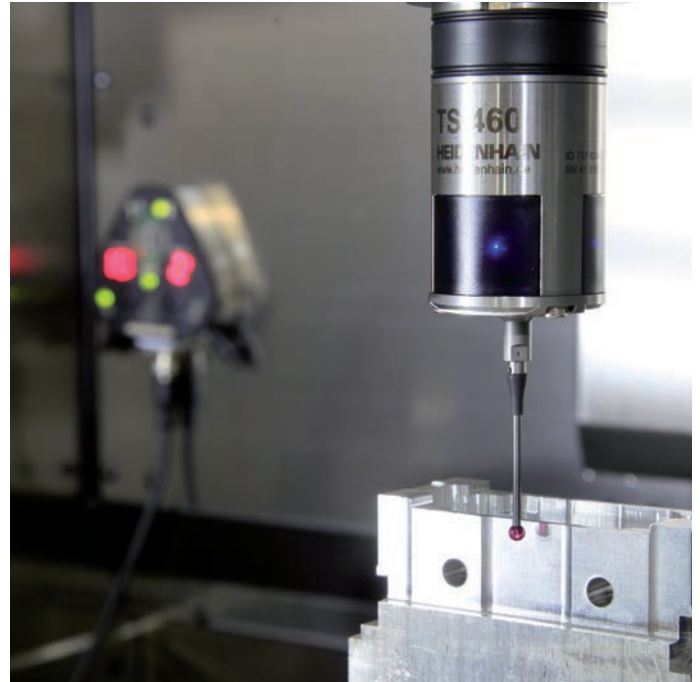
Highly effective and accurate

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

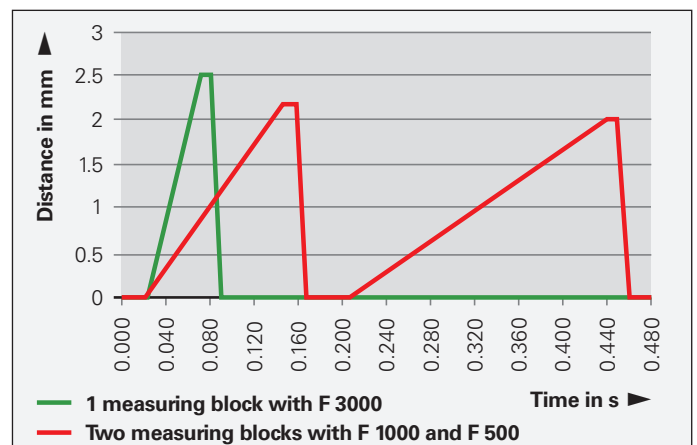
Wear-free optical sensor

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.



Time savings and increased performance

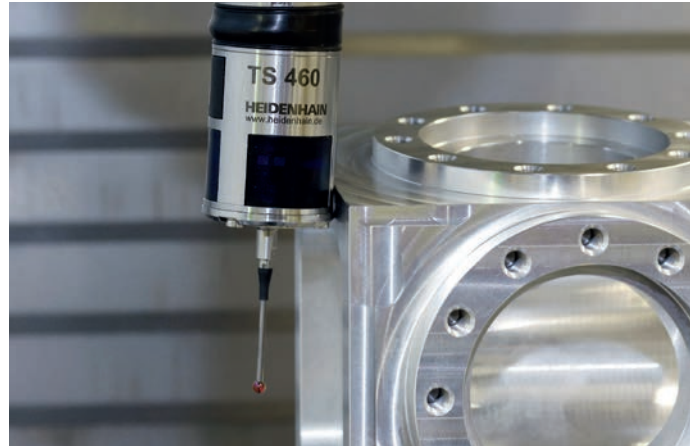
The high probe repeatability of typically $2\sigma < 0.5\text{ }\mu\text{m}$ enables setting up and calibration in just one measuring block with the TS 460. Not only can the second measuring block be omitted, but touch probes from HEIDENHAIN also permit high probing speeds at a consistent level of quality.



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.



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.



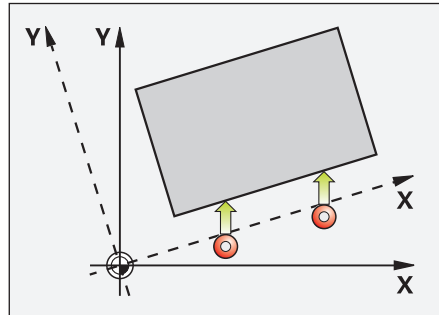
Application examples

Aligning the workpiece and setting the preset

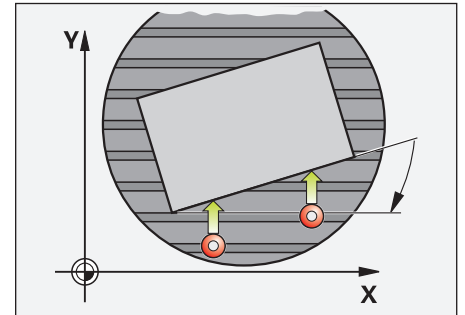
Workpiece alignment

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 forego 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.



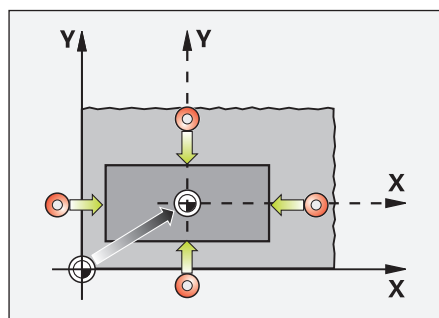
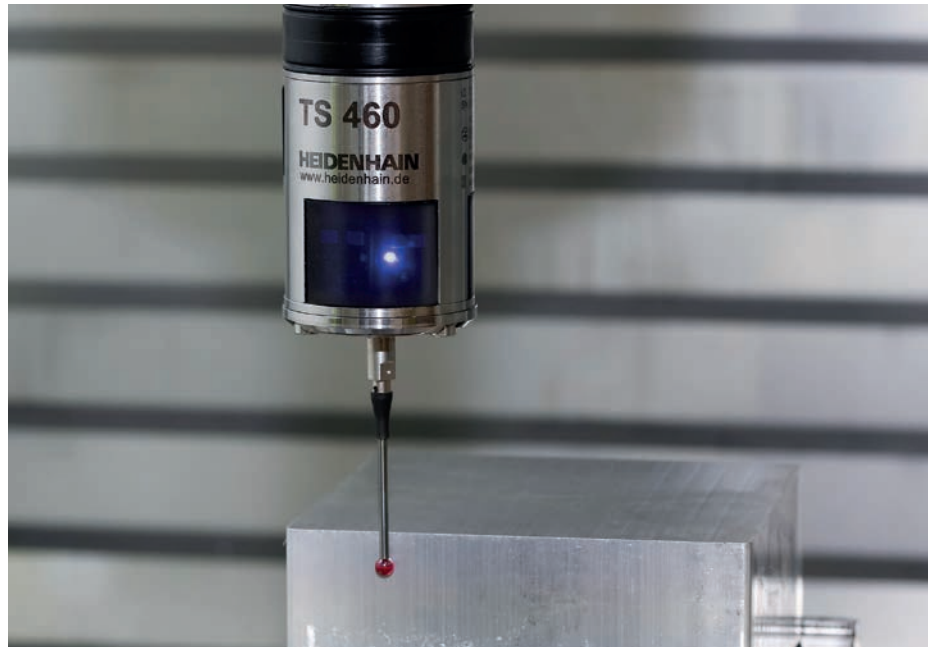
Compensating for misalignment through a basic rotation of the coordinate system



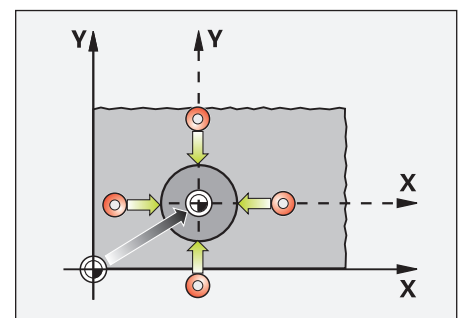
Compensating for misalignment through rotation of a rotary table

Preset setting

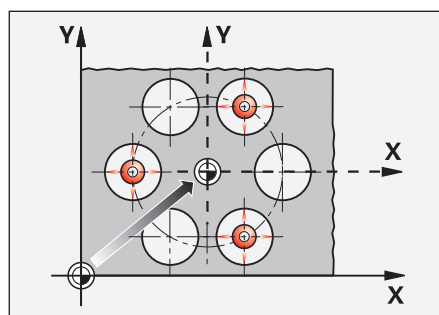
Programs for machining a workpiece are referenced to presets. Finding this point quickly and reliably with a workpiece touch probe reduces nonproductive time and increases machining accuracy. Depending on the probing functions of your CNC, the TS touch probes from HEIDENHAIN enable the automated setting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



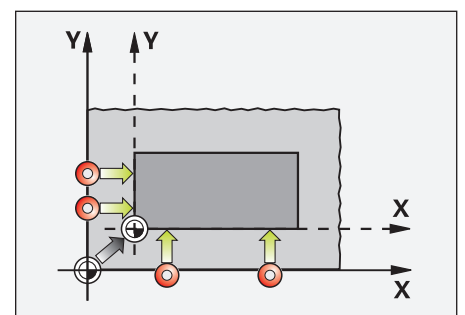
Center of a rectangular stud



Center of a circular stud



Center of a bolt hole circle



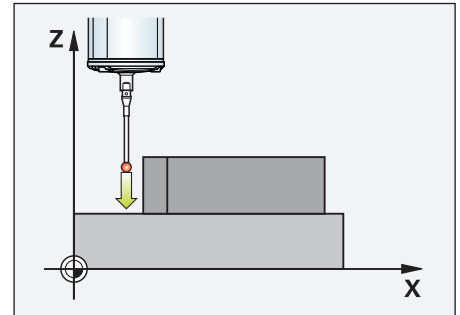
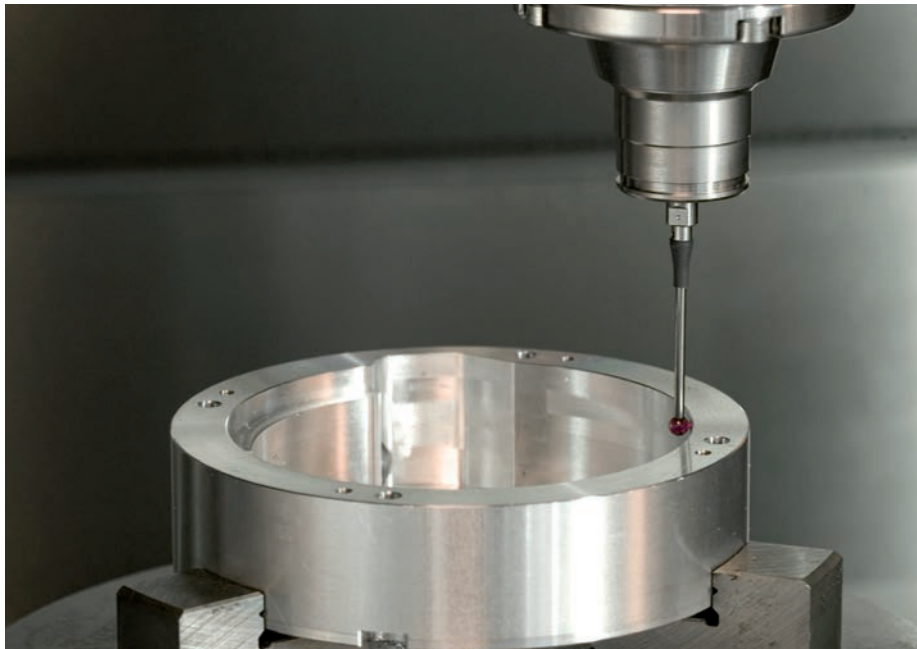
Outside corner

Workpiece measurement

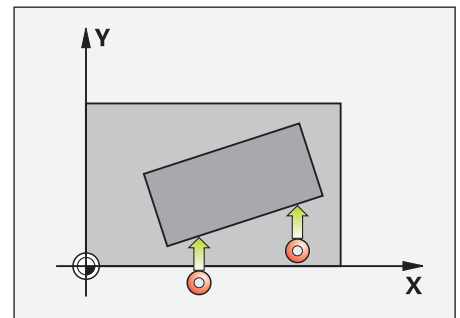
The TS touch probes from HEIDENHAIN are suited for program-controlled workpiece measurement between two machining steps, for example. The resulting position values can be used for tool-wear compensation.

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.

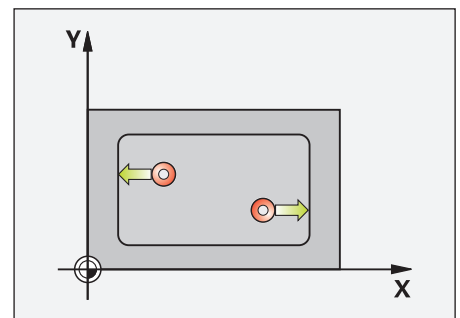
With the aid of external software—for example, FormControl (software package from Blum-Novotest) or digitizing software—you can digitize models or measure free-form surfaces right in the machine tool. In this way, you can immediately detect machining errors and correct them without reclamping. Thanks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



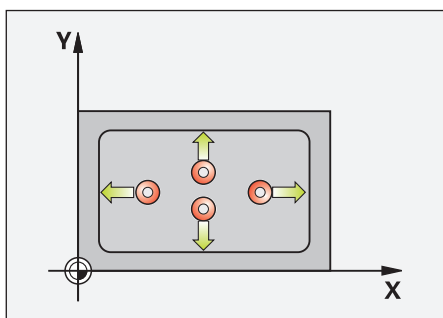
Measuring individual positions in an axis



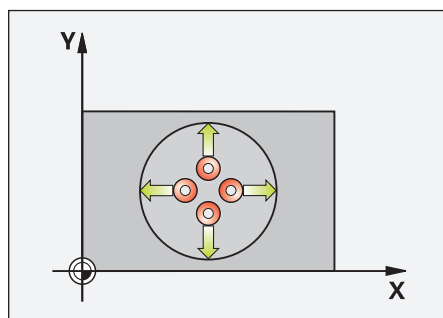
Measuring the angle of a line



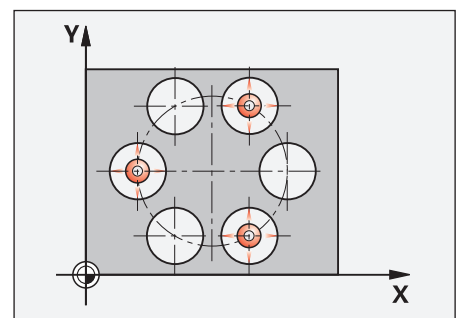
Length measurement



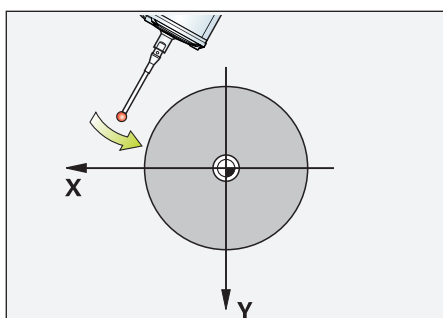
Measuring a rectangular pocket



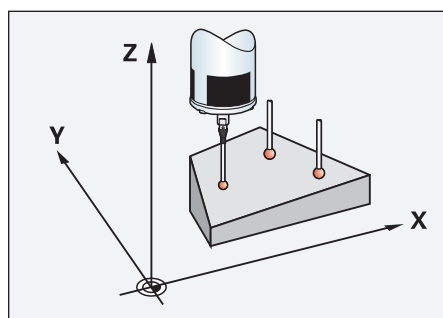
Measuring a circular pocket/hole



Measuring a bolt hole circle



Measuring a diameter



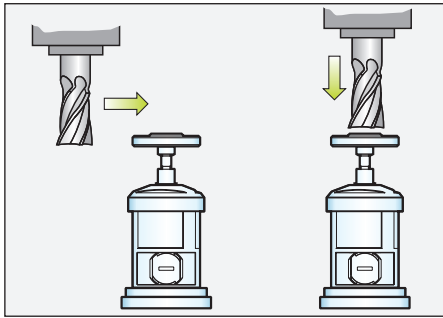
Measuring the angle of a plane

Tool measurement

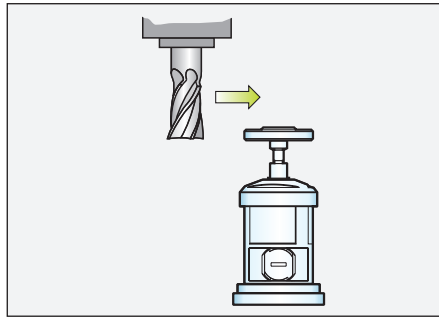
Consistently high machining accuracy requires an exact measurement of tool data and cyclical inspection of tool wear. The TT tool touch probes measure almost any type of tool right on the machine. For milling cutters, length and diameter are

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.

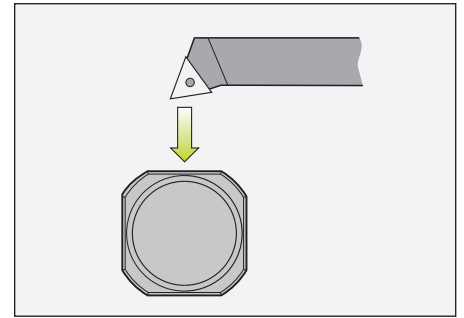
Using a cuboid probe contact, you can also measure lathe tools and check them for wear or breakage. For effective tool-tip radius compensation, you need only add the cutter radius to your entries in the CNC.



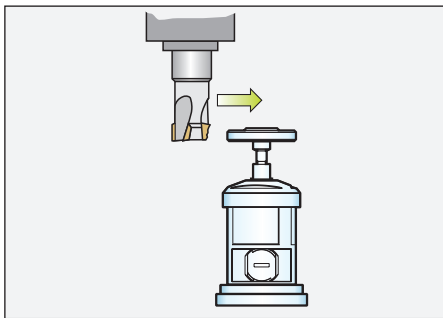
Tool length and radius measurement with stationary or rotating spindle



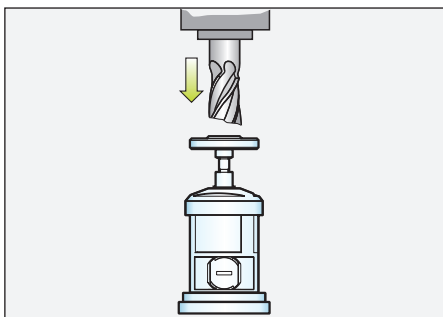
Individual tooth measurement, such as for inspecting indexable inserts (not for brittle materials)



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.

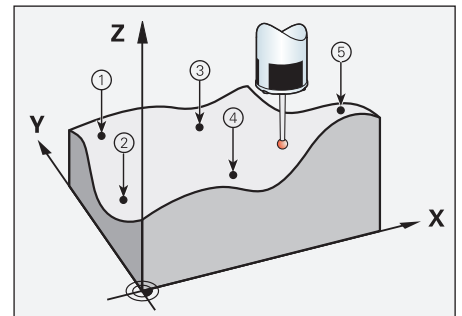
A particularly rigid calibration sphere should be used for kinematics measurements. This helps to reduce deformations that occur as a result of probing forces. The KKH calibration spheres from HEIDENHAIN, which are specially designed for this type of application, exhibit particularly high rigidity and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



Principle of operation

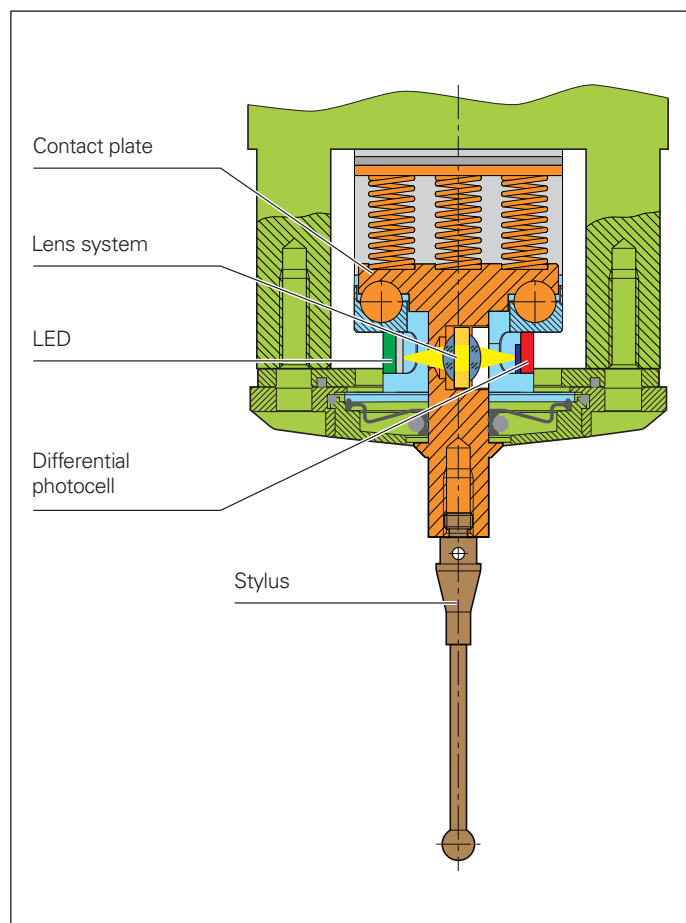
Workpiece touch probes

TS 150, TS 260, TS 460

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.

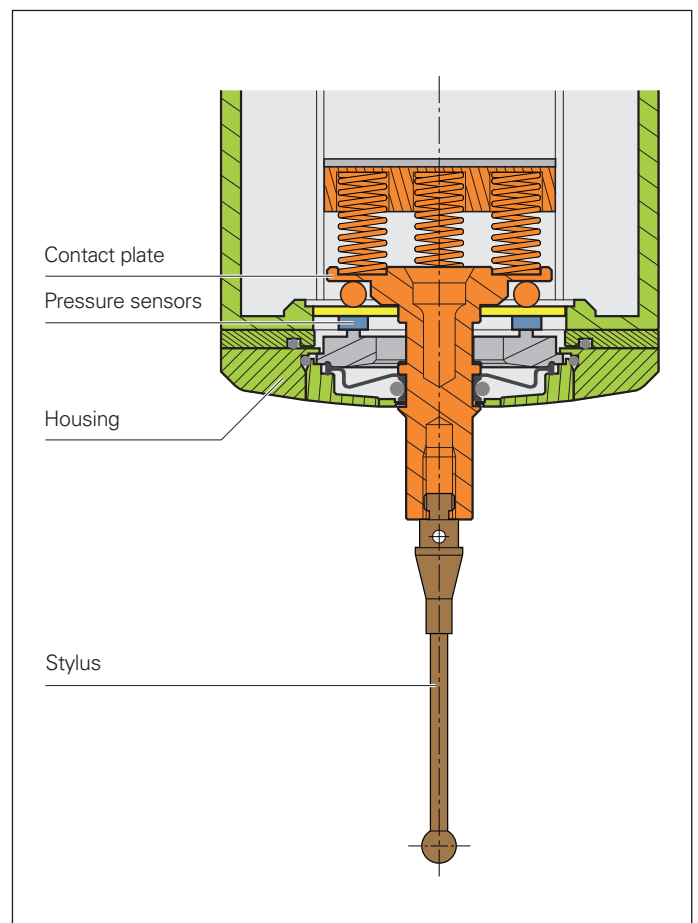
Thanks to the non-contacting optical switch, the sensor is free of wear. As a result, HEIDENHAIN touch probes ensure high long-term stability with constant probe repeatability even after a high number of measuring cycles (e.g., as with in-process applications).



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.



Tool touch probes

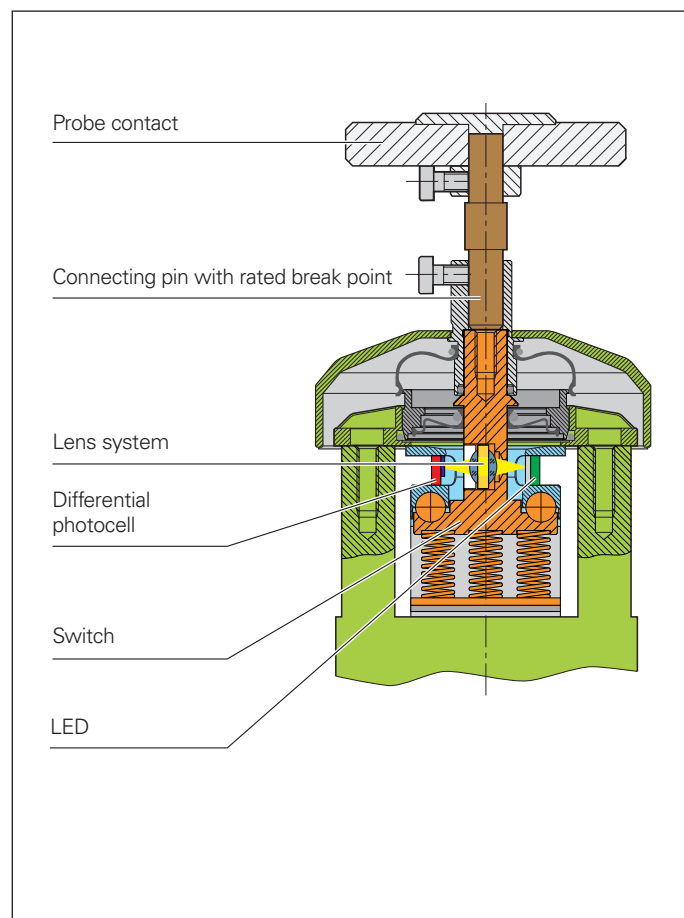
Touch probes from HEIDENHAIN operate with an optical switch as sensor. A lens system collimates the light emitted by an LED and focuses it onto a differential photocell. Upon deflection of the probe contact, the differential photocell produces a trigger signal. The probe contact of the TT is rigidly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

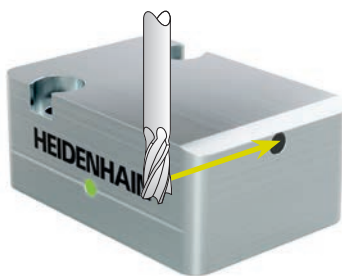
Repeatability

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.



Tool breakage detector



Passing by

The tool passes by the tool breakage detector from the side (three-axis motion). Very short cycle times are possible.



Approaching

The sensor surface of the TD 110 is approached from the front up to the operating distance (two-axis motion). The tool can then be moved away in a vertical upward motion.



Plunging

The tool plunges into the sensor's range from above (two-axis motion). This scenario is especially advantageous if the TD 110 is mounted on the same portal as the spindle.

Supported tools	Passing by	Approaching			Plunging
Type	End mills, drills, taps, thread formers, ball-nose cutters, radius cutters				
Material	Carbide, HSS				
Minimum diameter for nominal scanning distance	0.4 mm	0.5 mm to 1 mm	1 mm	1 mm	
Minimum rotational speed (recommended)	1000 rpm	5000 rpm	1000 rpm	1000 rpm	
Feed rate (Rapid traverse recommended)	≥ 3 m/min	≥ 20 m/min	≥ 3 m/min	≥ 3 m/min	
Operating distance	≤ 0.5 mm (nominal: 0.3 mm)				
Minimum tooth length	2.5 mm				
L-OFFSET	Corner radius or corner chamfer, if > 1 mm				
Breakage criteria	• Complete tool breakage: 2 mm (+ L-OFFSET) • No breakage of individual teeth or cutting inserts				



Passing by

The tool breakage detector is installed in alignment with the tool axis. The tool passes by the sensor parallel to the housing's upper edge (two-axis motion). Very short cycle times are possible.

The machine manufacturer can also adapt the tool inspection cycle to other mounting situations while still supporting the same tools. Standardized instruction sets are used to evaluate the switch signal.



Illustrative videos with the system in action

Supported tools	Passing by	
Type	End mills, drills, taps, thread formers, ball-nose cutters, radius cutters	
Material	Carbide, HSS	
Minimum diameter for nominal scanning distance	0.6 mm to 1 mm	≥ 1 mm
Minimum rotational speed (recommended)	5000 rpm	1000 rpm
Feed rate (Rapid traverse recommended)	≥ 20 m/min	≥ 3 m/min
Operating distance	≤ 0.5 mm (nominal: 0.2 mm)	
Minimum tooth length	2 mm	
L-OFFSET	Note: The tool must be measured all the way to the tip	
Breakage criteria	• Complete breakage: 2 mm • No breakage of individual teeth or cutting inserts	

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.

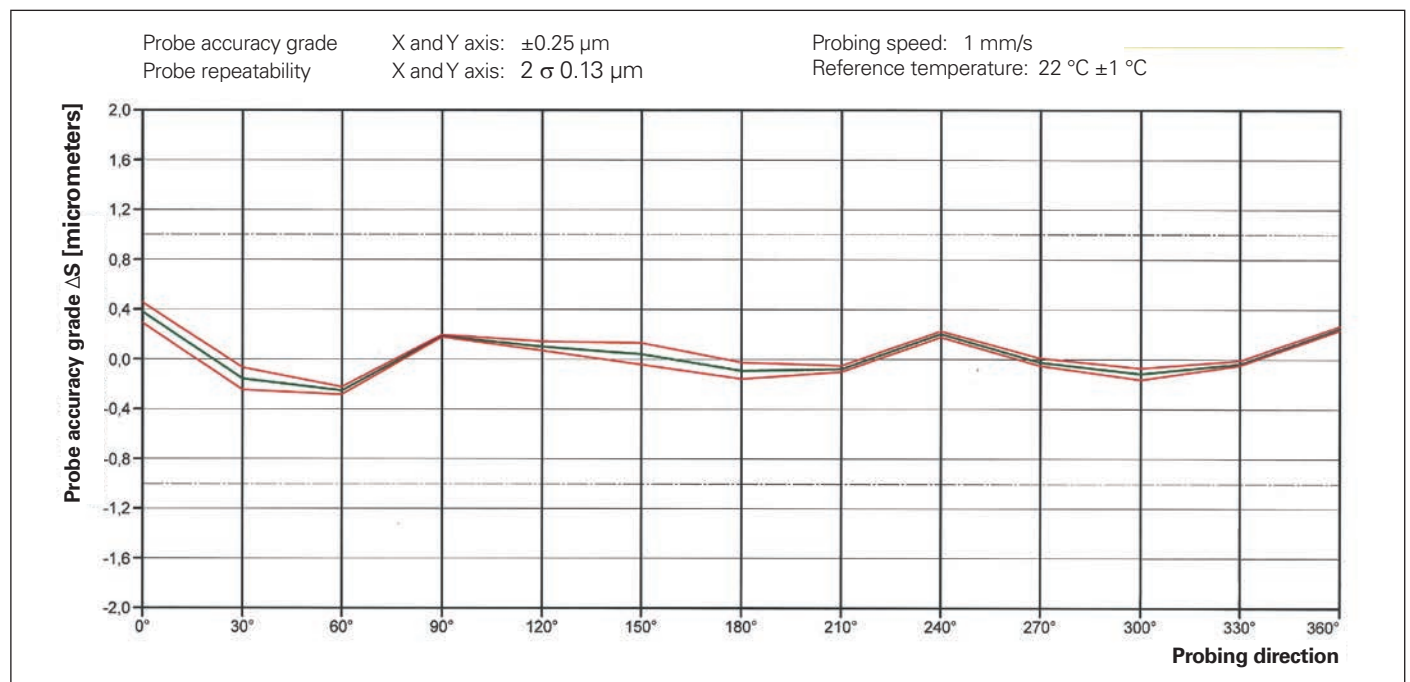
The **TS 760** and **TS 750** touch probes are characterized particularly by high probing accuracy and repeatability. These features, together with the low probing force, make these touch probes suitable for highly demanding measuring tasks on machine tools.

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

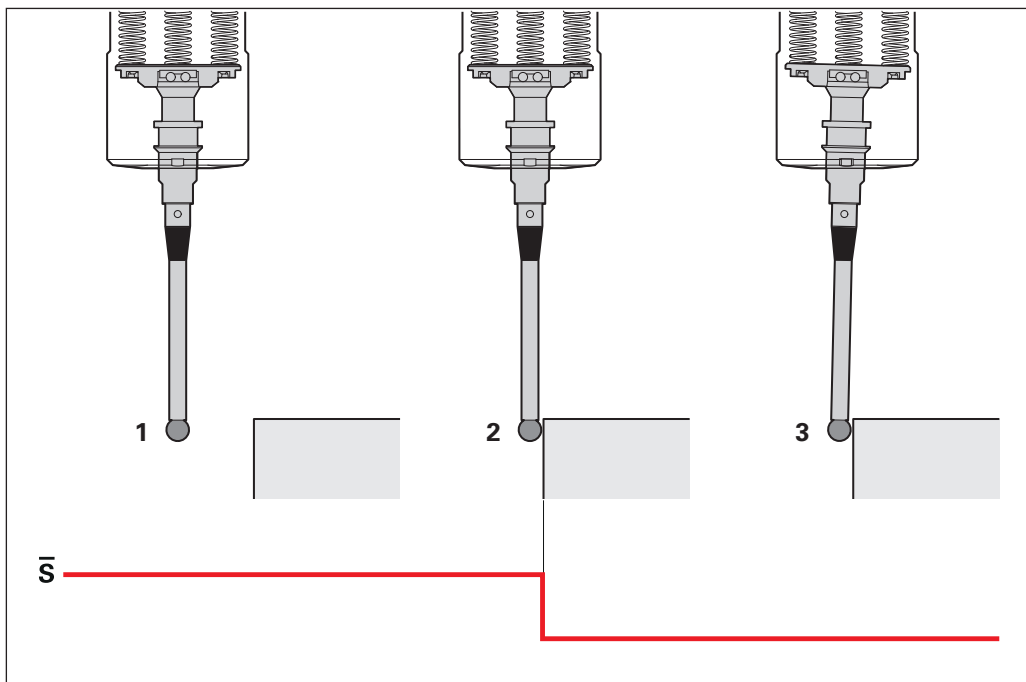
Stylus length and stylus material directly influence the trigger characteristics of a touch probe. Styli from HEIDENHAIN meet highest quality requirements and ensure exceptional probing accuracy.



Excerpt from a calibration chart

3D accuracy of TS 760 and TS 750

The touch probes use high-precision pressure sensors. 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°. The deflection of the stylus is measured by multiple pressure sensors that are intelligently arranged within the stylus holder. The probing forces arise immediately upon the first probing contact. The signals generated by the sensors are processed, and a trigger signal is generated. The relatively low probing forces involved provide high probing accuracy and repeatability, virtually without any effect on the measured object. The deflection forces of the springs only come into play during further deflection until the machine stops moving.



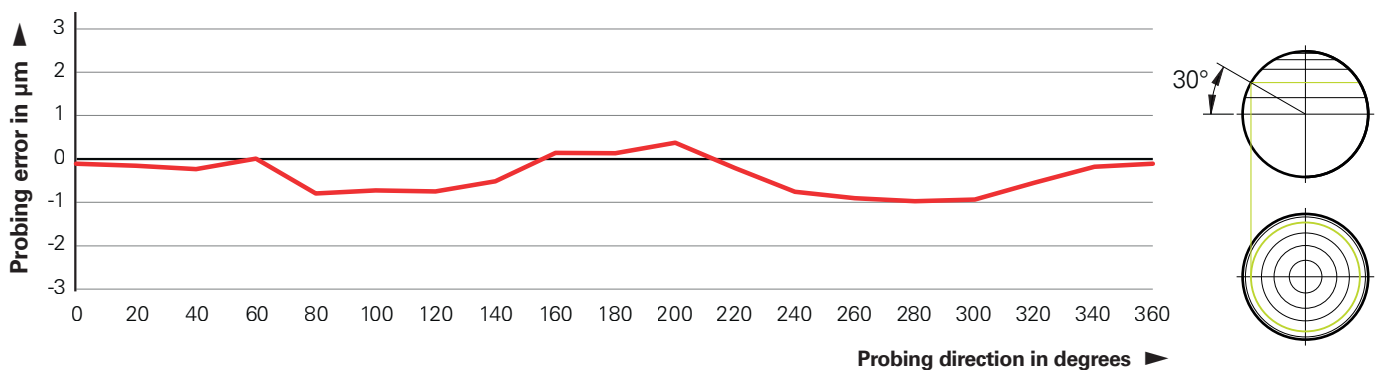
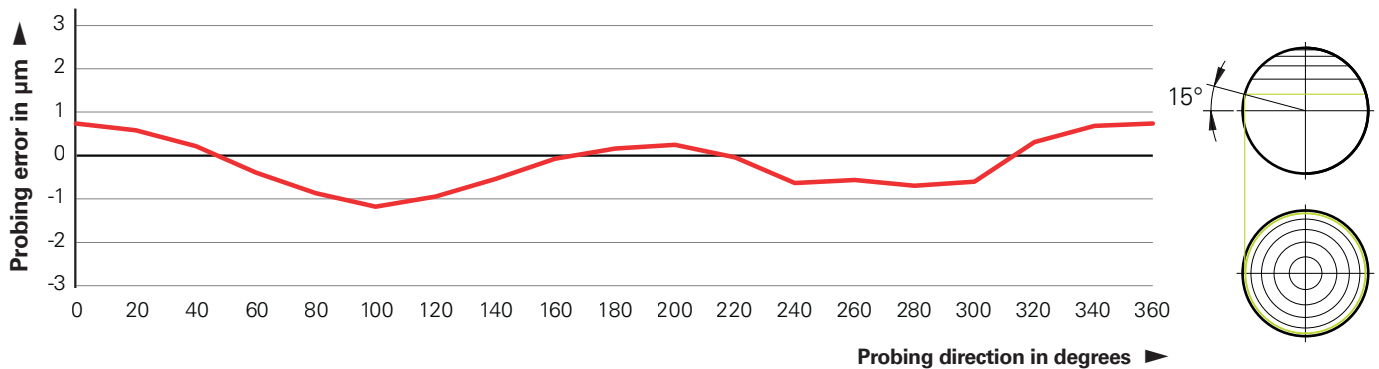
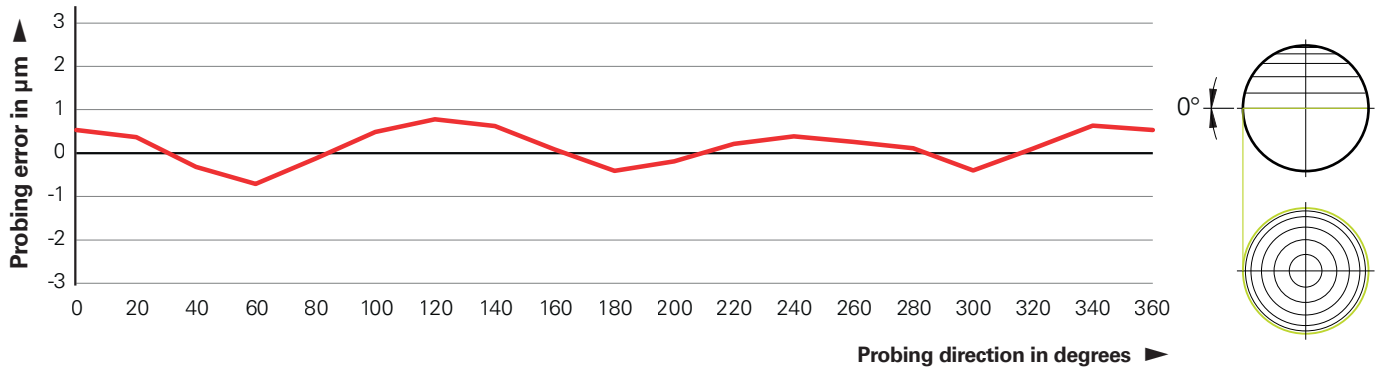
3D probing error

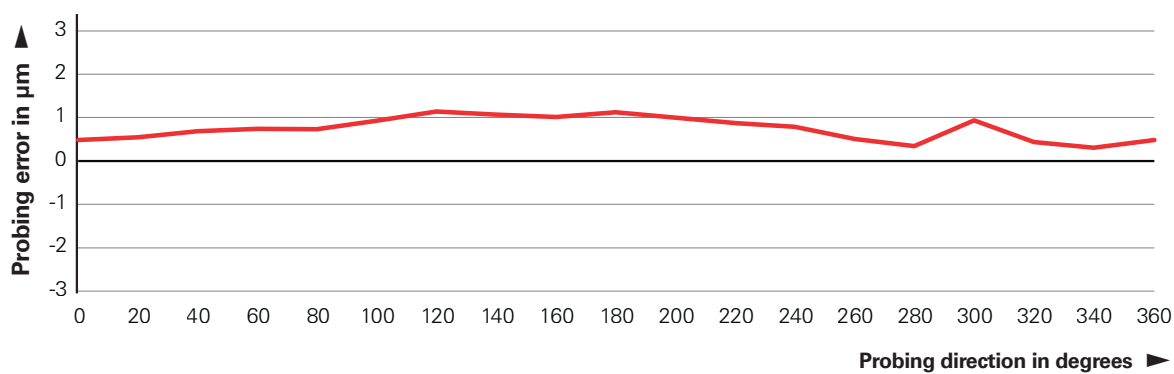
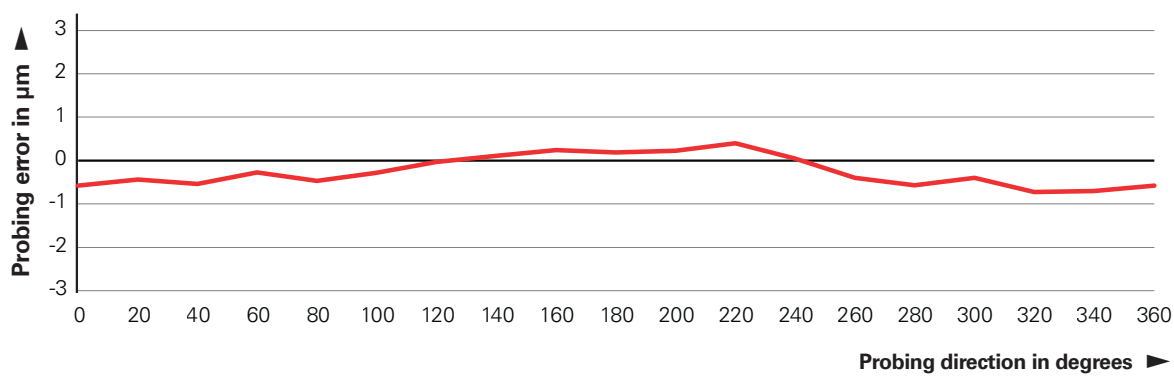
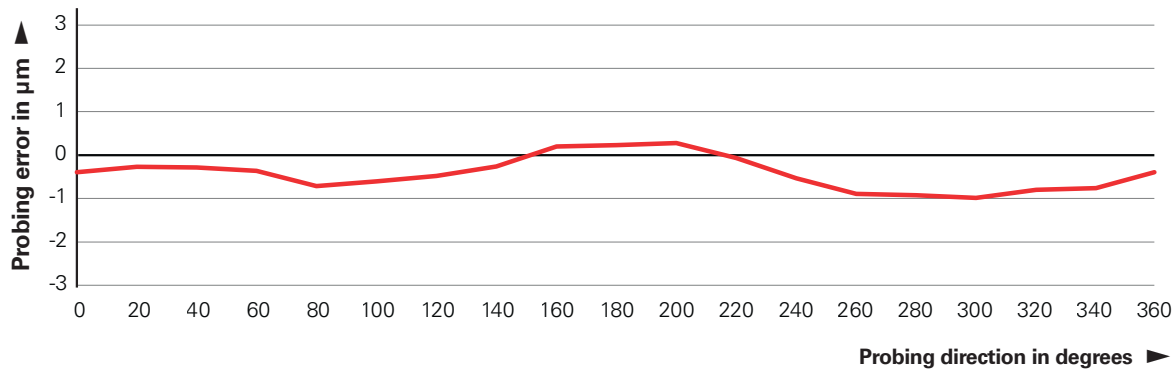
The measurement curves shown demonstrate the outstanding precision of the TS 760. Measured on a high-precision HEIDENHAIN calibration sphere, probing error remains extremely low, at up to only $\pm 3 \mu\text{m}$ over the entire surface of the sphere. As a result, the measuring system delivers excellent repeatability and long-term stability.

Measurements are performed at probing angles ranging from 0° at the equator of the sphere up to 75° . Throughout this range, the TS 760 demonstrates its strength regardless of probing direction or spatial orientation, ensuring precise and reliable probing performance. This allows workpieces and reference features to be measured with confidence, even in demanding manufacturing and quality assurance applications.

An additional 3D calibration can further reduce deviations into the submicron range, depending on the machine. The 3D-ToolComp software option can also be used with the TS 460.

Highly accurate sensing technology, impressive 3D performance, and user-friendly calibration options make HEIDENHAIN touch probes a powerful solution for modern precision measurement tasks.





Workpiece touch probes

Selection guide

	TS 460	TS 760
Area of application	Machining centers; milling, drilling, and boring machines; lathes with automatic tool changers	
Signal transmission	Radio/infrared	Radio/infrared
Probe repeatability	$2\sigma \leq 1\text{ }\mu\text{m}$	$2\sigma \leq 0.25\text{ }\mu\text{m}$
Supply voltage	Batteries	
Connection over	SE 660, SE 540, ¹⁾ SE 640, ¹⁾ SE 661 ²⁾	SE 660, SE 540, ¹⁾ SE 640, ¹⁾ SE 661 ²⁾
Interface to control	HTL or EnDat 2.2 via the SE	HTL or EnDat 2.2 via the SE

¹⁾ Only for infrared transmission

²⁾ For EnDat



	TS 260	TS 150	TS 750
	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		2 σ ≤ 0.25 μm
	DC 10 V to 30 V	DC 10 V to 30 V (via UTI 150)	
	–	UTI 150	
	HTL and floating switching output		



TS 460 and TS 760

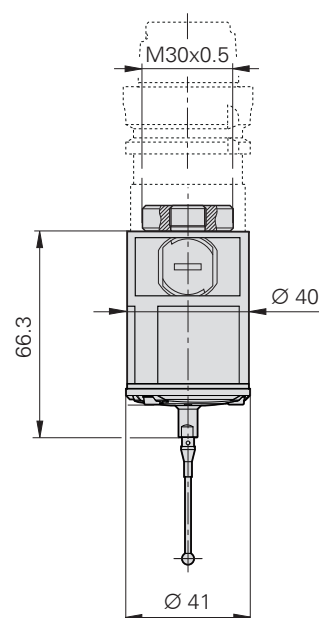
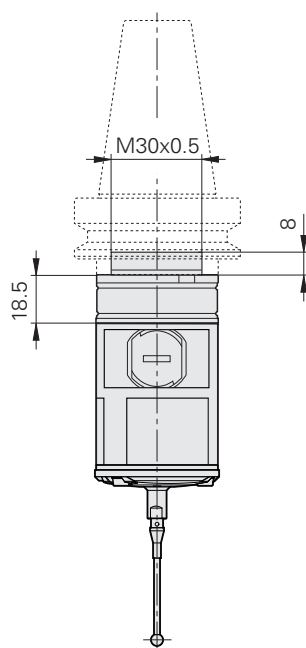
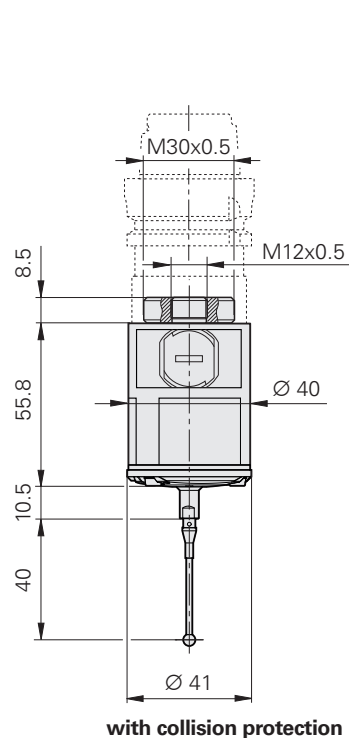


TS 460
with collision
protection



TS 760

Main dimensions (tolerances not shown)



For technical drawings, visit: www.heidenhain.com/documentation



Dimensions (TS 460)
[ID 1207328](http://www.heidenhain.com/documentation)



Dimensions (TS 760)
[ID 1364139](http://www.heidenhain.com/documentation)

Workpiece touch probe	TS 460 (radio and infrared)	TS 760 (radio and infrared)
Probe accuracy	$\leq \pm 5 \mu\text{m}$ with use of the T404 standard stylus (at a probing speed of 1000 mm/min)	$\leq \pm 1 \mu\text{m}$ with use of the T434 standard stylus (at a probing speed of 500 mm/min)
Probe repeatability Repeated probing from one direction	$2 \sigma \leq 1 \mu\text{m}$ Typical values: $2 \sigma \leq 0.5 \mu\text{m}$	$2 \sigma \leq 0.25 \mu\text{m}$
Probing force	Axial: $\approx 7 \text{ N}$; radial: $\approx 1 \text{ N}$	Axial: $\approx 1.5 \text{ N}$; radial: $\approx 0.2 \text{ N}$
Deflection of probe contact	$\leq 5 \text{ mm}$ in all directions (with stylus length $L = 40 \text{ mm}$)	
Deflection forces	Axial: $\approx 8 \text{ N}$; radial: $\approx 1 \text{ N}$	
Probing speed (recommended)	$\leq 3 \text{ m/min}$	$\leq 1 \text{ m/min}$
Collision protection	Optional	–
Integrated workpiece cleaning function	With collision protection: Purge air Without collision protection: Purge air or lubricant	Lubricant and purge air
Protection EN 60529	IP68	
Operating temperature	5°C to 54°C	
Storage temperature	-20°C to 70°C	
Mass without taper shank	$\approx 0.2 \text{ kg}$	
Fastening*	• With taper shank¹⁾ • Via M30x0.5 or M12x0.5 external thread	
Signal transmission	Radio and infrared transmission (selectable) with 360° emission to the SE	
Emission angle of the infrared signal*	0°	
TS switch-on/off	Radio or infrared signal (selectable) from the SE	
Power supply	Two batteries, 1 V to 4 V each; size $1/2 \text{ AA}$ or LR1 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 <i>Power supply</i>); typically 300 h possible with lithium batteries
Transceiver*	• 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	
Interface	HTL or EnDat 2.2 via the SE	

* Please select when ordering

¹⁾ See *Mounting* on page 40

²⁾ With EnDat interface

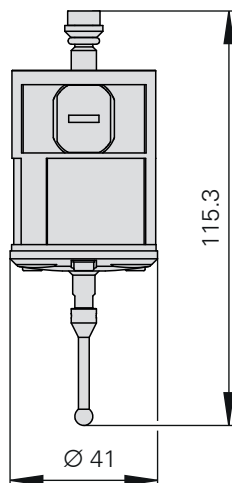
³⁾ Reduced operating time in the presence of high ambient radio traffic or with frequent, short probing intervals

⁴⁾ Via adapter, included in delivery

TS 460 and TS 760 with M4 stylus



Main dimensions of TS 460 and TS 760 (tolerances not shown)



For technical drawings, visit: www.heidenhain.com/documentation



Dimensions (TS 460)
[ID 1514778](#)



Dimensions (TS 760)
[ID 1394546](#)

Workpiece touch probe	TS 460 (radio and infrared)	TS 760 (radio and infrared)
Stylus	Length: 30 mm; ball diameter: 5 mm; thread: M4	
Probe accuracy	$\leq \pm 5 \mu\text{m}$ with use of the T404 standard stylus (at a probing speed of 1000 mm/min)	$\leq \pm 1 \mu\text{m}$ with use of the T434 standard stylus (at a probing speed of 500 mm/min)
Probe repeatability Repeated probing from one direction	$2 s \leq 1 \mu\text{m}$ (for repeated measurement with spindle orientation, typically: $2 \sigma \leq 0.3 \mu\text{m}$)	$2 \sigma \leq 0.25 \mu\text{m}$
3D accuracy	Only with 3D calibration	3 μm
Probing force	Axial: $\approx 7 \text{ N}$; radial: $\approx 1 \text{ N}$	Axial: $\approx 1.5 \text{ N}$; radial: $\approx 0.2 \text{ N}$
Deflection of probe contact	$\leq 5 \text{ mm}$ in all directions (with stylus length $L = 40 \text{ mm}$)	
Deflection force	Axial: $\approx 8 \text{ N}$; radial: $\approx 1 \text{ N}$	
Probing speed (recommended)	$\leq 3 \text{ m/min}$	$\leq 1 \text{ m/min}$
Integrated workpiece cleaning function	Purge air or lubricant through customer-specific interface	
Protection EN 60529	IP68	
Operating temperature	5 °C to 54 °C	
Storage temperature	-20 °C to 70 °C	
Mass without taper shank	$\approx 0.2 \text{ kg}$	
Fastening	Without taper shank: Adjusted using setscrews in the tool holder	
Signal transmission	Radio and infrared transmission (selectable) with 360° emission to the SE	
Transmission angle of infrared signal	0°	
TS switch-on/off	Radio or infrared signal (selectable) from the SE	
Power supply	Two batteries, 1 V to 4 V each; size 1/2 AA or LR1 ¹⁾	
Operating time	Typically 90 h with alkaline batteries (included in delivery); typically 400 h possible with lithium batteries	Typically 65 h with alkaline batteries (included in delivery, see <i>Power supply</i>); typically 300 h possible with lithium batteries
Transceiver*	- 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	
Interface	HTL or EnDat 2.2 via the SE	

* Please select when ordering

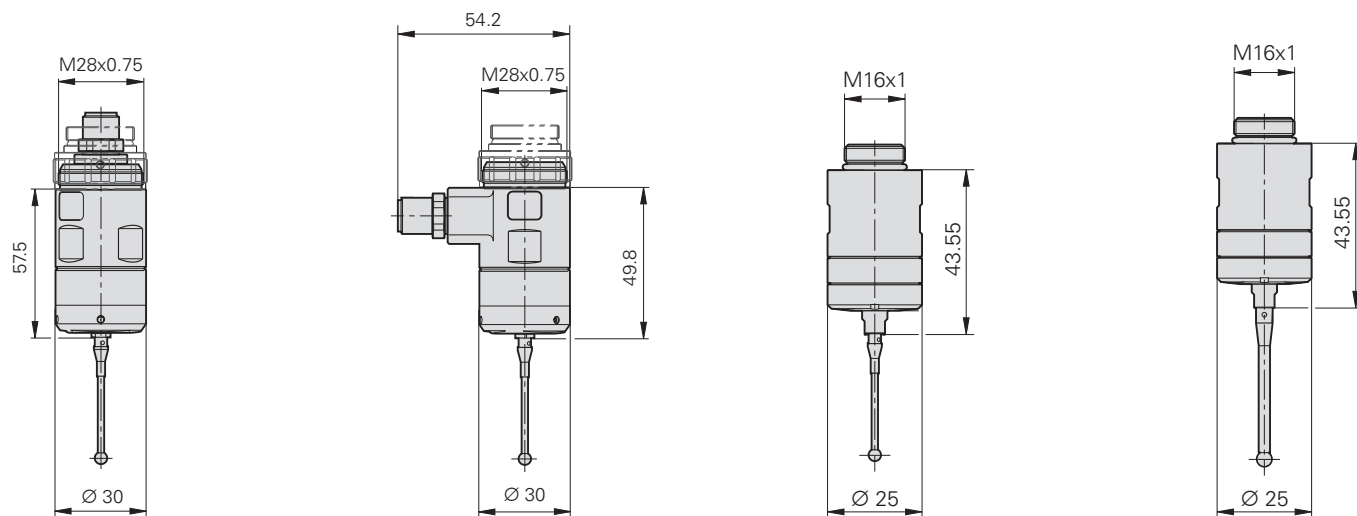
¹⁾ Via adapter, included in delivery

²⁾ With EnDat interface

TS 260, TS 150, and TS 750



Main dimensions (tolerances not shown)



For technical drawings, visit: www.heidenhain.com/documentation



Dimensions (TS 150)
[ID 1198413](#)



Dimensions (TS 260 with axial flange socket)
[ID 738098](#)



Dimensions (TS 750)
[ID 1311157](#)



Dimensions (TS 260 with radial flange socket)
[ID 738344](#)

	Cable		
Workpiece touch probe	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 (when connected)		
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*	• With taper shank¹⁾ (only with radial flange socket) • Via M28x0.75 external thread • Via coupling joint with M22x1 external thread	• 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 voltage ²⁾	DC 10 V to 30 V/≤ 100 mA (without load)	DC 10 V to 30 V/≤ 85 mA (without load)	
Output signal ²⁾	• Trigger signals S and $\overline{S}$ (square-wave signal and its inverted signal) • Floating trigger output		
HTL signal levels ²⁾	U _H ≥ 20 V at −I _H ≤ 20 mA U _L ≤ 2.8 V at I _L ≤ 20 mA at rated voltage of DC 24 V		
Signal transmission	Cable		

* Please select when ordering

¹⁾ See *Mounting* on page 40

²⁾ With the TS 150 and TS 750: via UTI 150

Tool touch probes

Selection guide

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

For fast and reliable tool breakage detection, HEIDENHAIN offers the TD 110 tool breakage sensor. It enables contact-free detection of tools at rapid traverse speed.

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.



	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, SE 661
Interface	HTL, floating trigger signal	HTL, EnDat 2.2 via SE
Repeatability	2 σ ≤ 1 μm	
Minimum tool diameter	3 mm ¹⁾	
Maximum tool diameter	Unlimited	

¹⁾ Probing force must not result in tool damage

TD 110 tool breakage detector

The tool breakage detector can be positioned in the work envelope such that it is easily accessible during tool changes at rapid traverse. The inductive sensor can detect tools as they pass by while they are spinning at their operational speed, or at least at 1000 rpm. Thanks to its rapid scanning technology, even very small tools made of HSS steel or carbide are detected. For use on all controls, the breakage sensor generates a floating trigger signal and an HTL switching signal. The control can evaluate these signals via standardized instruction sets. In addition, an LED indicates whether a tool has been detected. As a result, machines already in use can benefit from automated breakage detection as well.



	Tool breakage detector
	TD 110
	Non-contacting
	Very low
	Breakage detection
	Cable
	HTL, floating trigger signal
	At least 2 mm missing
	0.4 mm (minimum tooth length: 2 mm)
	Unlimited

TT 160 and TT 460

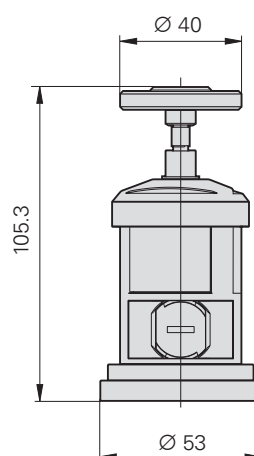
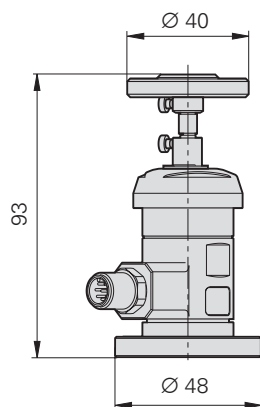


TT 160

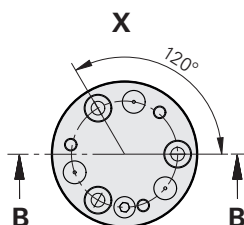
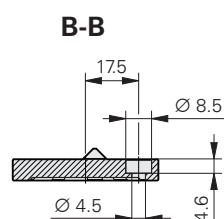
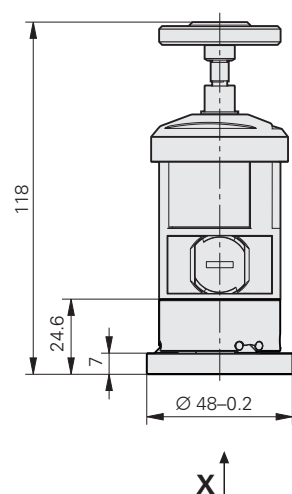


TT 460

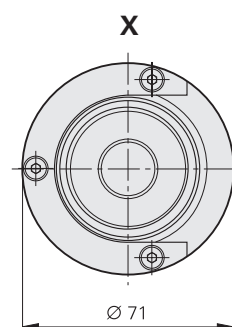
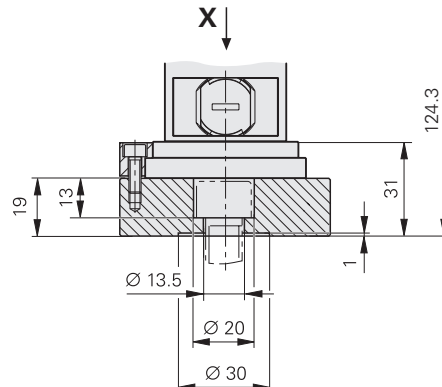
Main dimensions (tolerances not shown)



Quick release with magnetic base



Mounting base



For technical drawings, visit: www.heidenhain.com/documentation



Dimensions (TT 160)
[ID 738165](#)



Dimensions (TT 460)
[ID 1210889](#)

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 Typical values: $2\sigma \leq 1 \mu\text{m}$ 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	Axial: $\approx 8 \text{ N}$ Radial: $\approx 1 \text{ N}$	
Probing speed	$\leq 5 \text{ m/min}$	
Protection EN 60529	IP68 (when the TT 160 is connected)	
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*	- 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	- 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 batteries, 1 V to 4 V each; size $\frac{1}{2}$ AA or 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 32

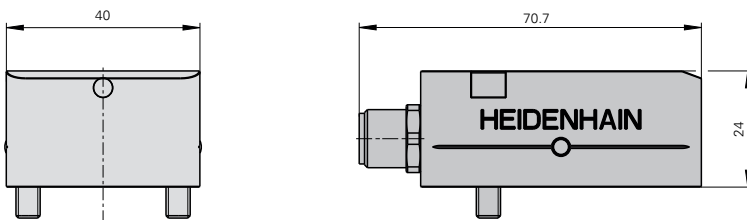
²⁾ Reduced operating time in the presence of high ambient radio traffic or with frequent, short probing intervals

³⁾ With EnDat interface

TD 110 tool breakage detector



Main dimensions (tolerances not shown)



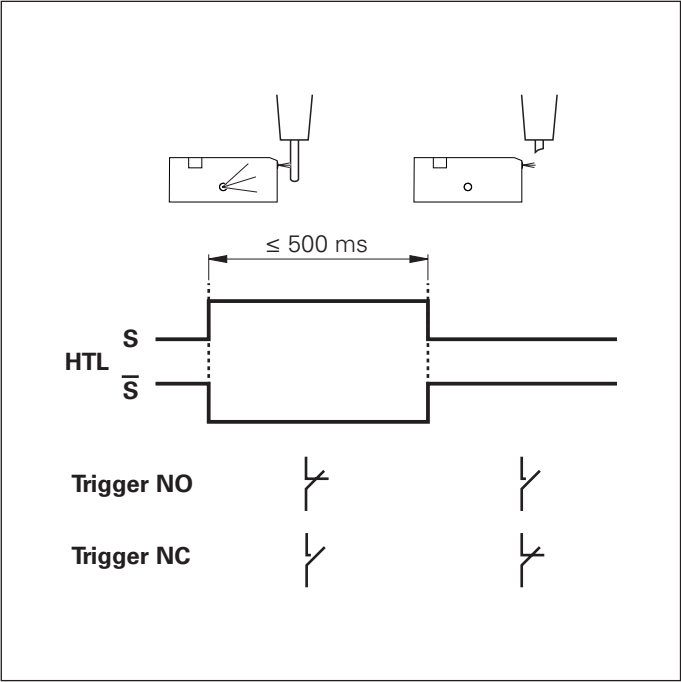
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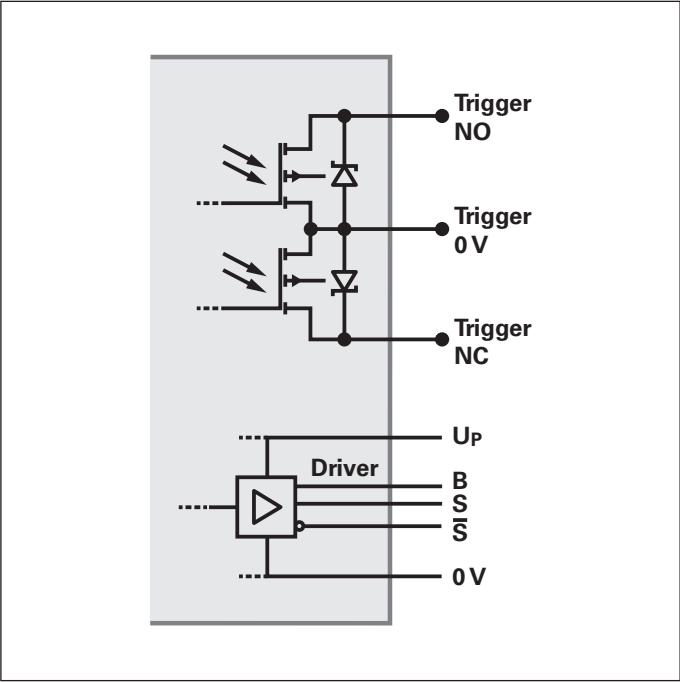
Mating dimensions
[ID 1385957](#)

Specifications	TD 110
Type of mounting	Mounting holes
Electrical connection	8-pin M12 flange socket
Supply voltage	10 V to 30 V
Output signal	HTL (switching signal S, $\bar{S}$) Floating switch outputs (NC, NO)
Cable length	≤ 30 m
Vibration 55 Hz to 2000 Hz Shock 6 ms	≤ 200 m/s ² (EN 60068-2-6) ≤ 300 m/s ² (EN 60068-2-27)
Operating temperature	10 °C to 50 °C
Storage temperature	-20 °C to 70 °C
Protection rating	IP66/68 (when connected)
Mass	≈ 0.24 kg

Signal behavior



Circuit diagram



Transceivers

SE 661, SE 660, SE 640, and SE 540



SE 660
SE 661

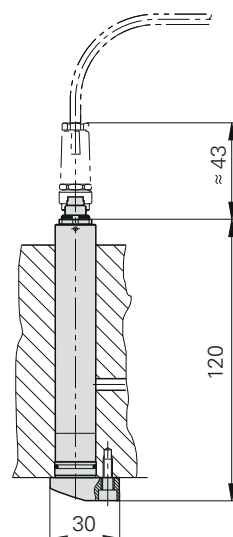
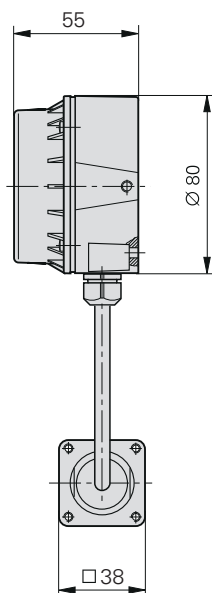


SE 640



SE 540

Main dimensions (tolerances not shown)



For technical drawings, visit: www.heidenhain.com/documentation



Dimensions (SE 640)
[ID 635323](#)



Dimensions (SE 660)
[ID 804767](#)



Dimensions (SE 540)
[ID 676735](#)

	Radio and infrared		Infrared	
Transceivers	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 760	
Signal transmission	Radio or infrared		Infrared	
Area of application	In the working space of the machine			In the location hole of the spindle head
Interface	Serial data (EnDat 2.2) • Activation • Trigger signal • Ready signal • Diagnosis	Square-wave signals (HTL) • Start signals R(-TS), and R(-TT) • Ready signals B(-TS) and B(-TT) • Trigger signals S and $\overline{S}$ • Battery warning $\overline{W}$	Square-wave signals (HTL) • Start signal R • Ready signal B • Trigger signal $\overline{S}$ • 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 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 load ¹⁾				
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 (max. 3.0 s)	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 (when connected)			
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

Accessories

Styli

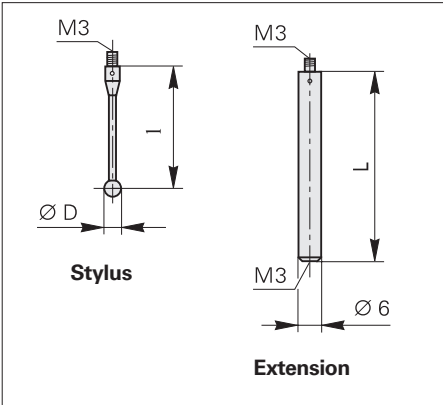
Styli for the TS

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 breaking point protects the touch probe from mechanically induced damage caused by operator error. The following styli are included with the TS touch probes:

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

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/s² 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/s² when oriented horizontally.



Ball-tip styli

Model	ID	Length l	Ø D
Steel shaft			
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

3 mm steel shaft

T434	295770-34	40 mm	4 mm
T408	352776-08	40 mm	8 mm
T409	352776-19	60 mm	4 mm

Carbon-fiber shaft

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 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).

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

Combination with L-shaped stylus

The following components are needed for the combination with an L-shaped stylus:

- Stylus extension (T490/T790)
- Star-type insert
- Stylus (T421/T422/T423/T424)



Transceivers

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

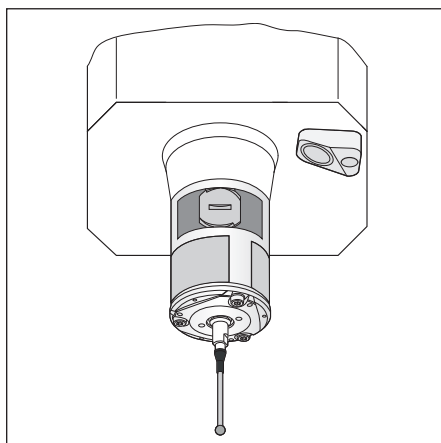
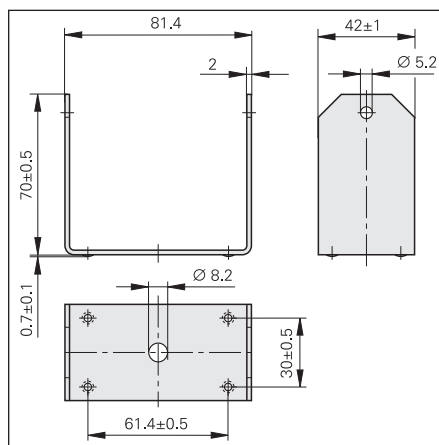
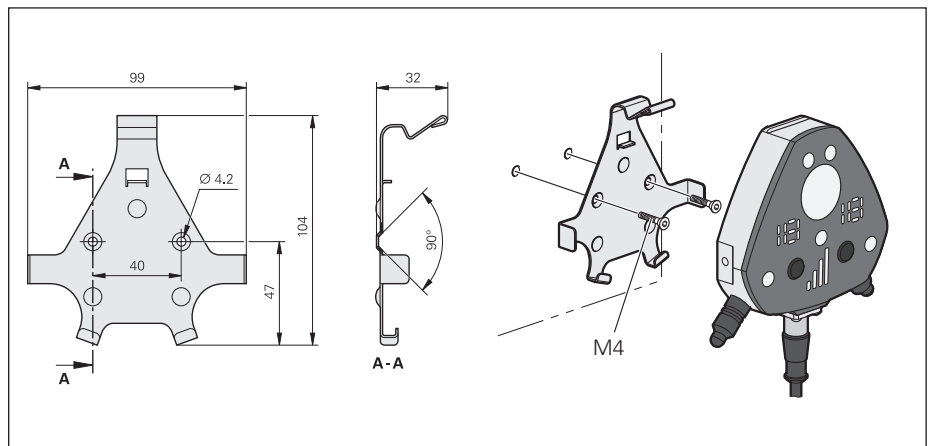
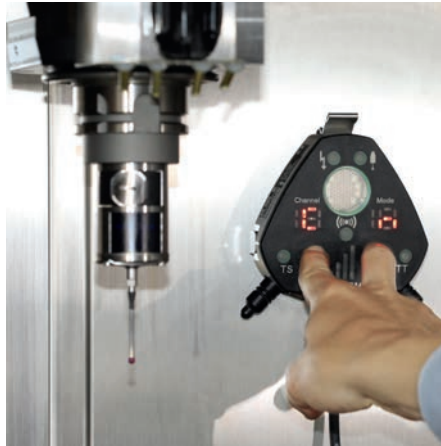
The holder for the SE units is secured to a machine element with two M4 screws, while the SE itself is simply clipped in.

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.

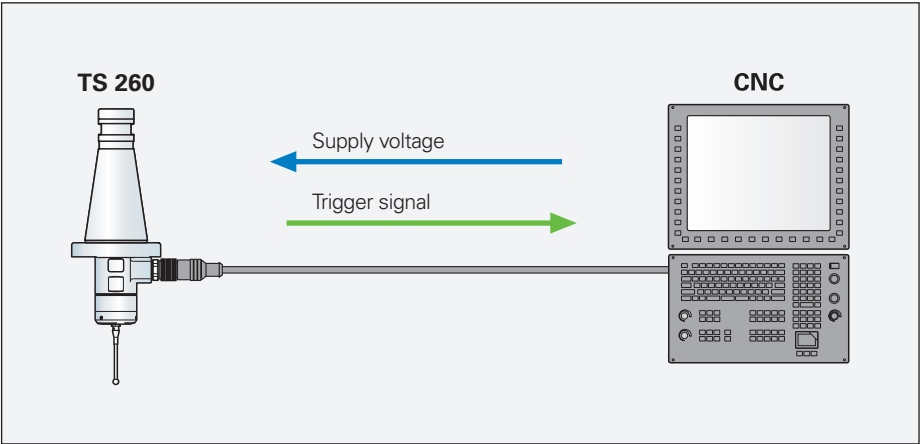


Signal transmission

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

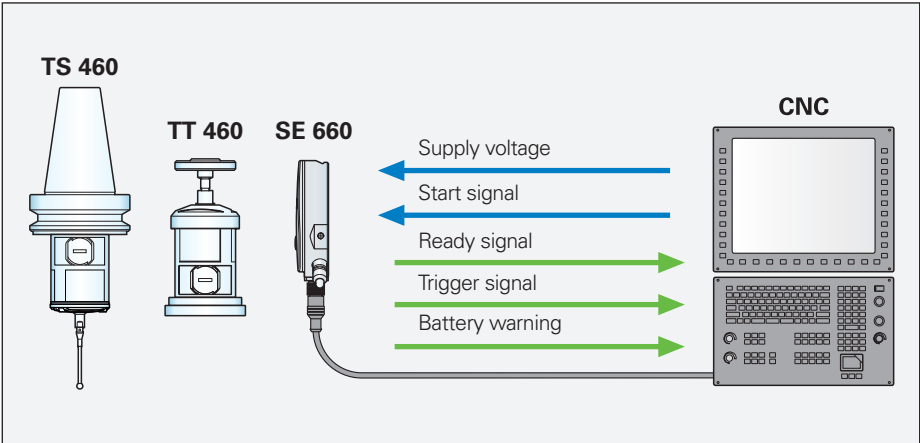
In the case of wireless touch probes, signals are transmitted to the SE transceiver as follows:

- For the **TS 460 and TS 760**, by radio or infrared transmission

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 and TS 760 touch probes.

	SE 660	SE 661	SE 540	SE 640
TS 460 TS 760	Radio/infrared		Infrared	

Signal transmission types and combinations between TS and SE

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.

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 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)

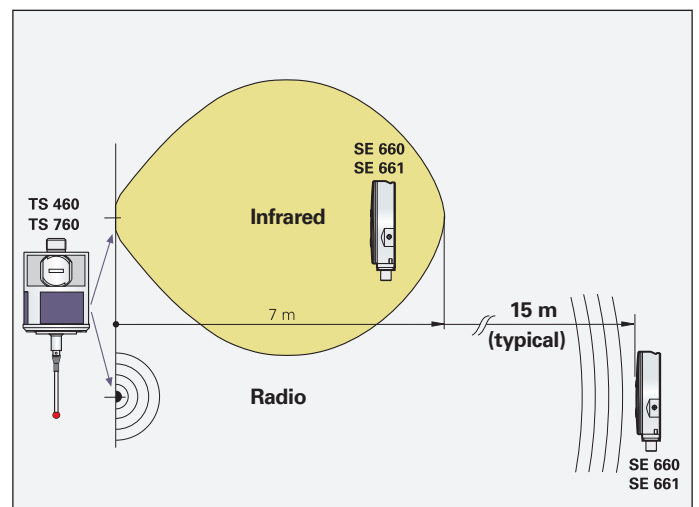
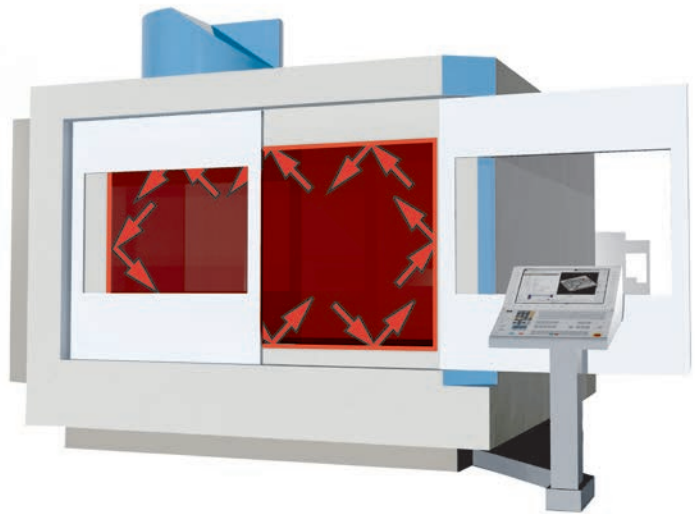
Radio transmission is used not only on large machine tools. The range is usually 15 m, but much larger ranges are possible in practice under ideal circumstances. Radio transmission operates in the free ISM band at 2.4 GHz and features 16 channels. The transmission times for the trigger signal are approximately 10 ms. Each touch probe is uniquely addressed.

Hybrid technology: signal transmission via radio and infrared signals

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

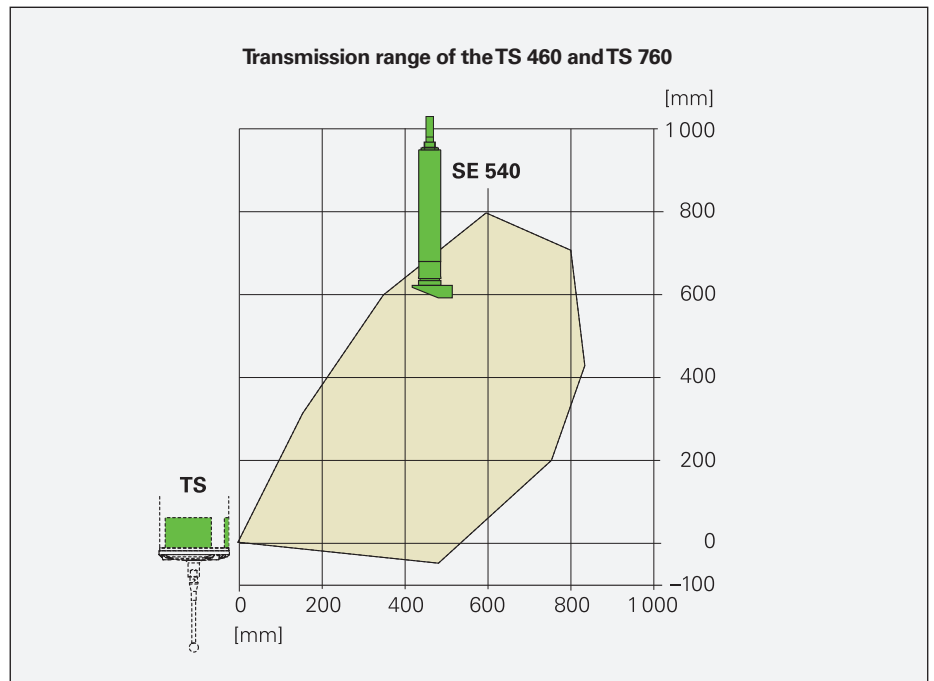
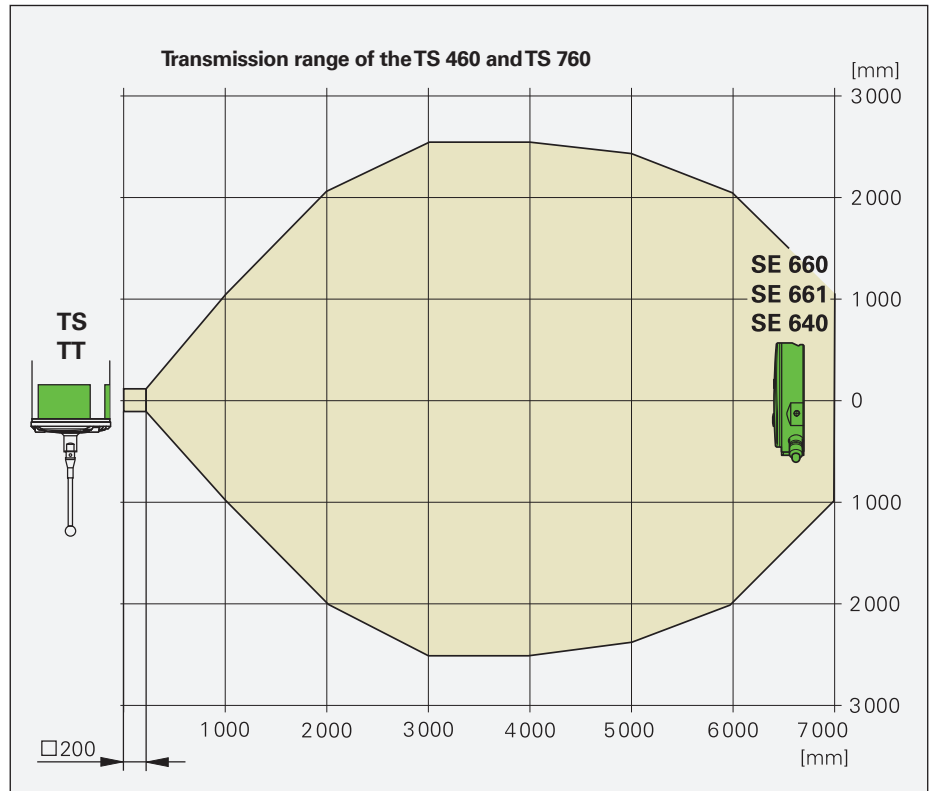
The LEDs and receiver modules for infrared transmission are distributed in such a way that uniform emission is available over the entire circumference (360°). This ensures a 360° emission range for reliable reception without prior spindle orientation.

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.

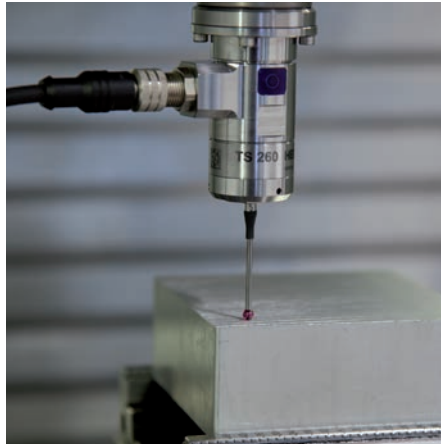


Optical status indicator

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.



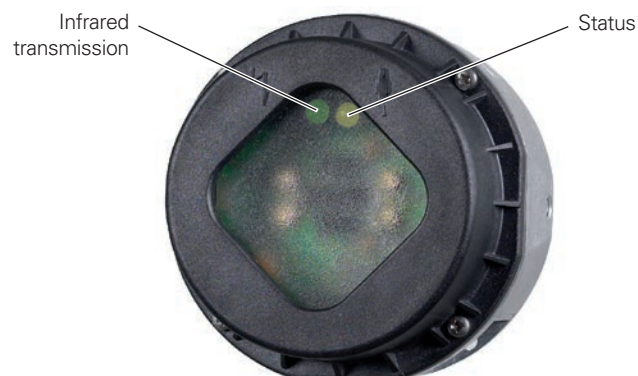
SE 540 transceiver

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 the 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:

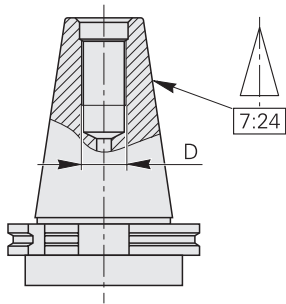
- **Taper shanks** for machining centers and for milling, drilling, and boring machines
- **Tool holders** for special solutions
- **Fastening screw threads** for custom mounting solutions (e.g., on lathes or grinding machines)

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.

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

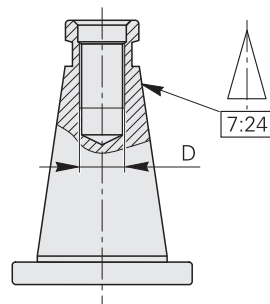




DIN 69871

Taper	D
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

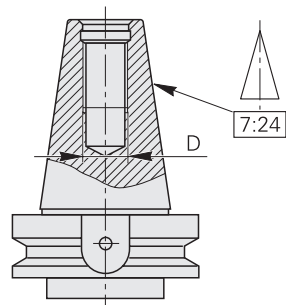
¹⁾ Also available in extended length



DIN 2080¹⁾

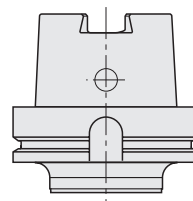
Taper	D
SK-A 40	M16
SK-A 45	M20
SK-A 50	M24
SK-A 50	UNC 1.000-8

¹⁾ Only for TS 260



JIS B 6339

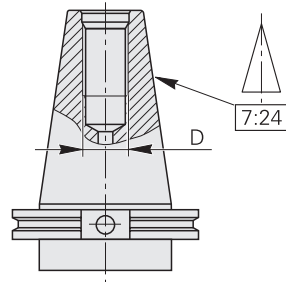
Taper	D
BT/BBT 30	M12
BT/BBT 40	M16
BT/BBT 50	M24



DIN 69893

Taper
HSK-E 25
HSK-E 32
HSK-A 40
HSK-A 50
HSK-A 63 ¹⁾
HSK-B 63
HSK-A 80
HSK-A 100 ¹⁾

¹⁾ Also available in extended length



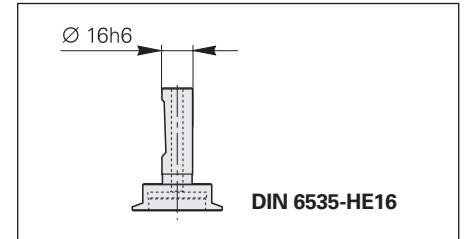
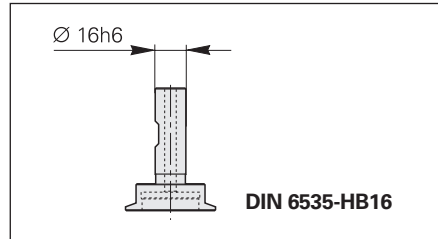
ASME B5.50

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

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 in accordance with 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.

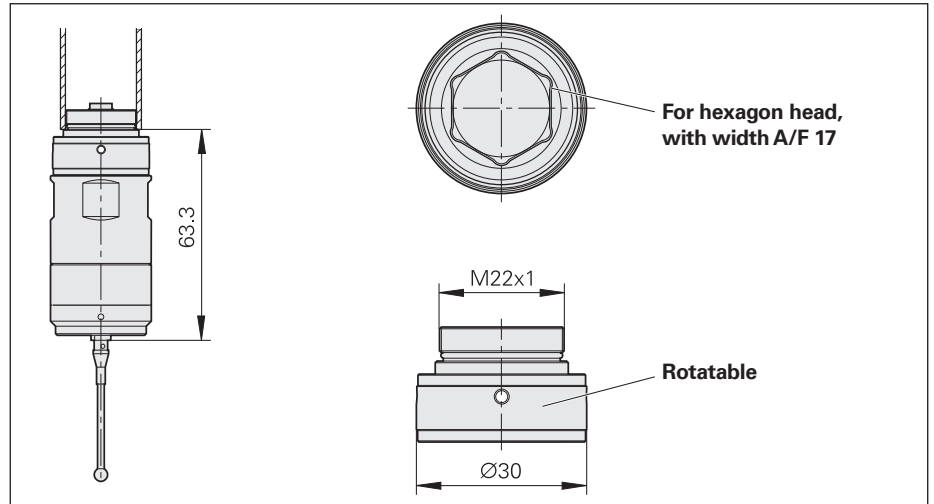
- M16x1 for the TS 150/TS 750
- M28x0.75 for the TS 260
- M12x0.5 for the TS 460/TS 760
- M30x0.5 for the TS 760/TS 460

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.



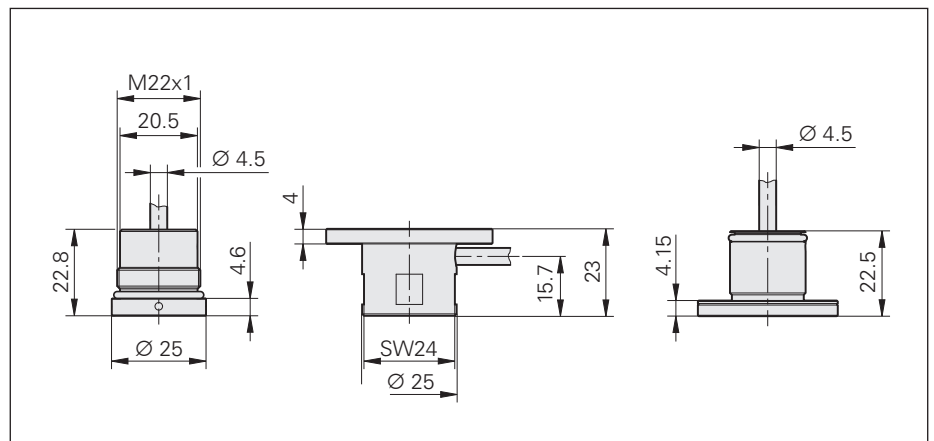
Mounting wrench

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

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.



Tool touch probes

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

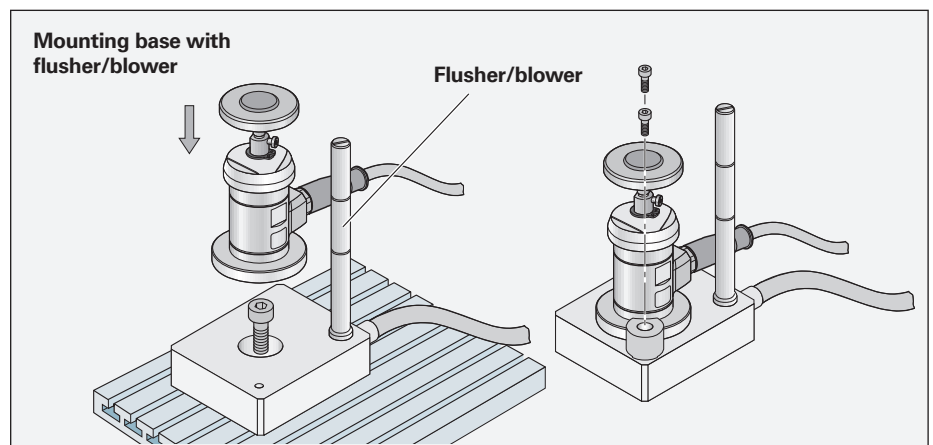
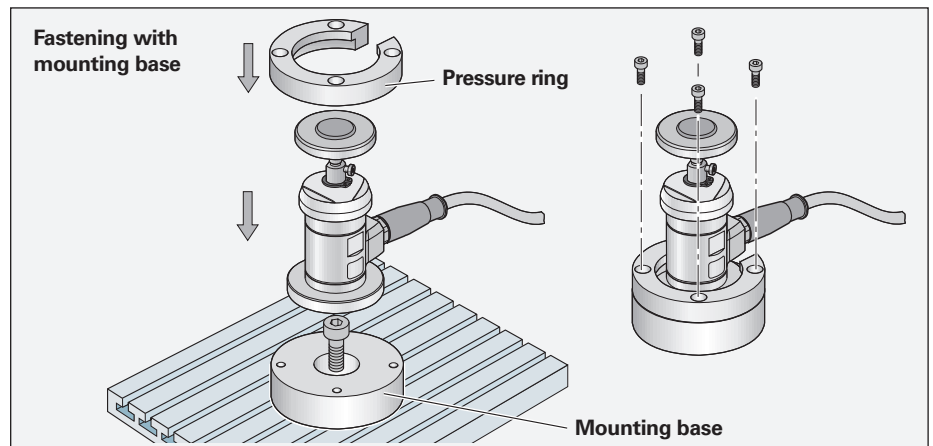
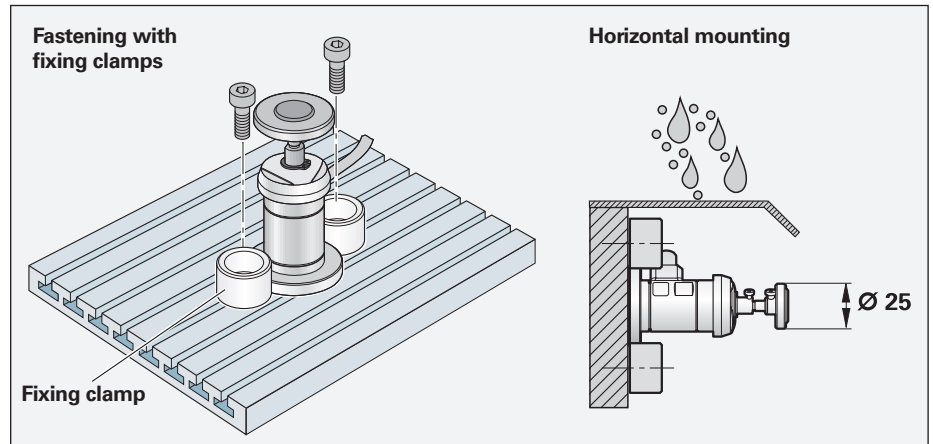
TT 460: ID 651586-01

Mounting base with flusher/blower

For cleaning the tool

Air connection for Ø 4/6 tube

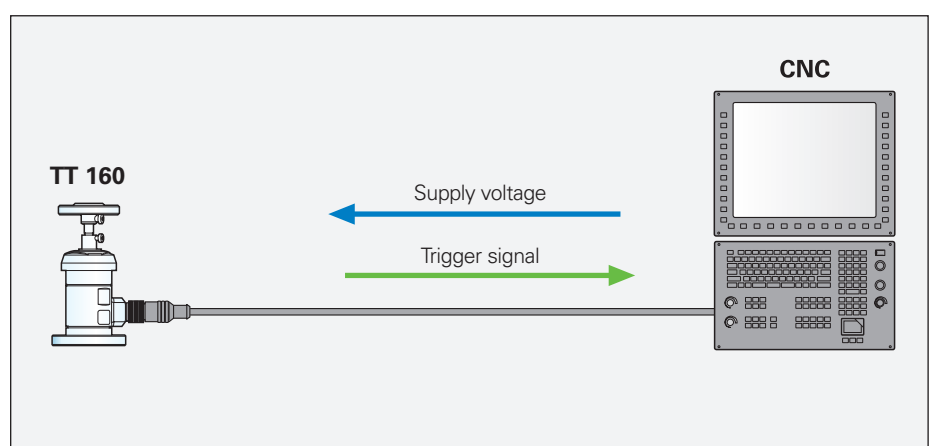
ID 767594-01



Supply voltage and signal transmission

For the TT 160 touch probe, both the power supply 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 36/37).



Probing process

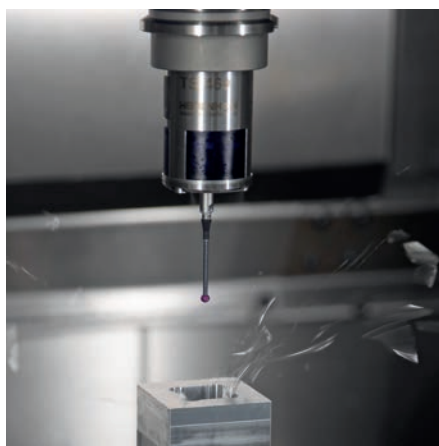
Workpiece touch probes

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

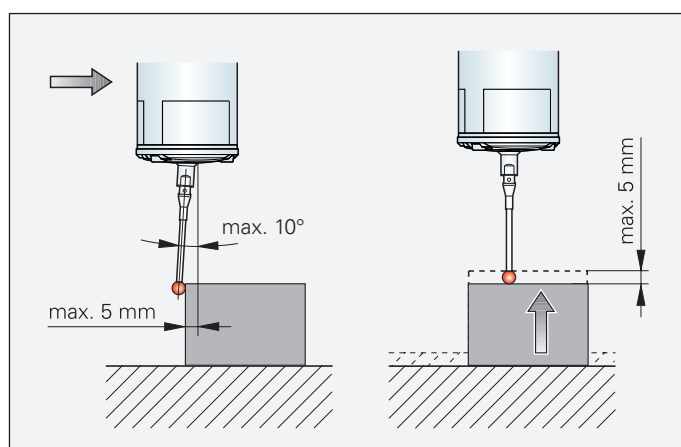
Probing speed

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.

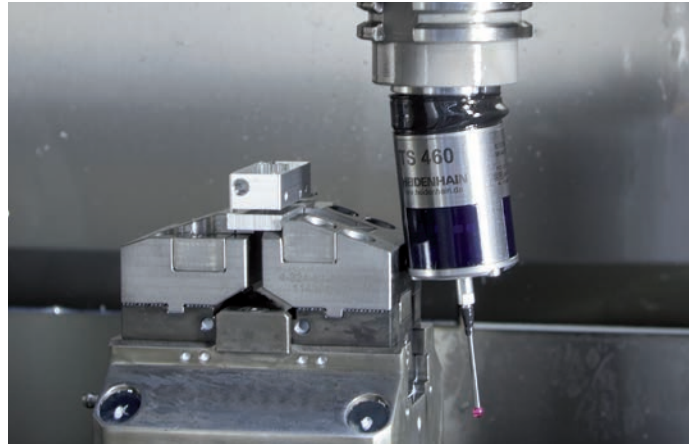
Deflection of the stylus



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 touch probe and spindle

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)

Tool touch probes

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

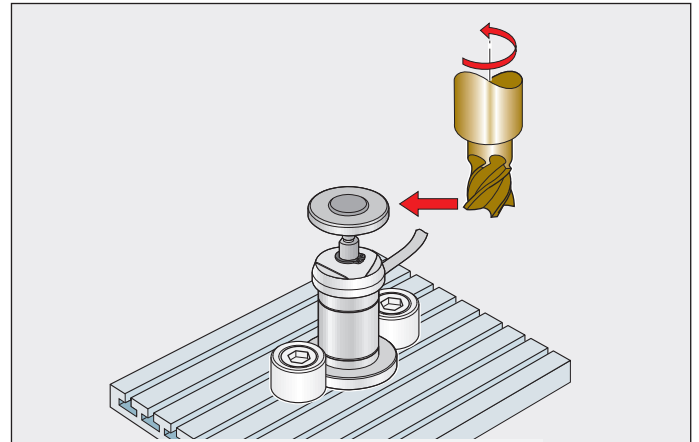
LEDs on the TT 160 additionally indicate deflection of the probe contact. On the TT 460, the state of the touch probe is also shown by LEDs on the SE transceiver. This characteristic is especially useful for testing correct operation. You can see at a glance whether the TT is currently deflected.

Probe contacts

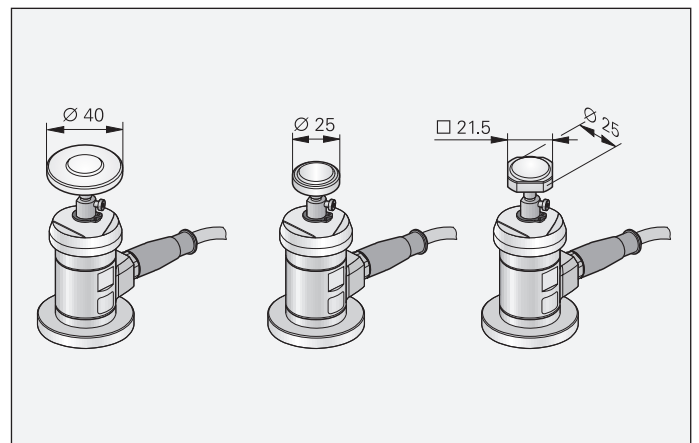
For probing **milling cutters**, the tool touch probes are equipped with a disk-shaped probe contact with a diameter of 40 mm (for example). A disk-shaped probe contact with a diameter of 25 mm is available as an accessory. Due to its low weight, this probe contact is particularly recommended when the 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 SC06 cuboid
ID 676497-01

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 TNC7 TNC7 select TNC7 basic TNC7 go 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 • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement • Length, radius • Wear, breakage • Individual teeth	–
HEIDENHAIN TNC7 TNC7 basic TNC 640 TNC 620 TNC 320 TNC 128 CNC PILOT 640 MANUALplus 620	Cable: TS 260 TS 150/TS 750 with UTI 150 TT 160 TD 110 Radio/infrared: TS 460, TS 760 TT 460 Via SE 660 Infrared: TS 460 TS 760 Via SE 640, SE 540	HTL	HSCI ¹⁾ : X112, X113		Tool breakage detector • Setting up the TD • Breakage detection
			Others ²⁾ : X12, X13		
Siemens 828D 840D 840D sl ONE			X121, X122, or X132		Workpiece measurement • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement • Length, radius • Wear, breakage
Fanuc 0 0i 16 18 21 30 31 32 3xi			Recommended: HIGH SPEED SKIP ³⁾	OEM specific	Workpiece measurement • Workpiece alignment • Preset setting • Workpiece measurement Tool measurement • Length, radius • Wear, breakage
	Possible: SKIP (24 V)				
Mitsubishi M70/M700 series M64/M640 series	SKIP (24 V)	Basic cycles for • 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

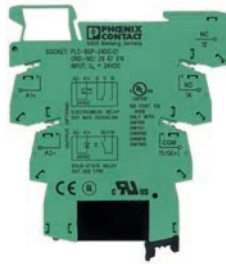
Signal converters for integration

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 1133534-02



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.

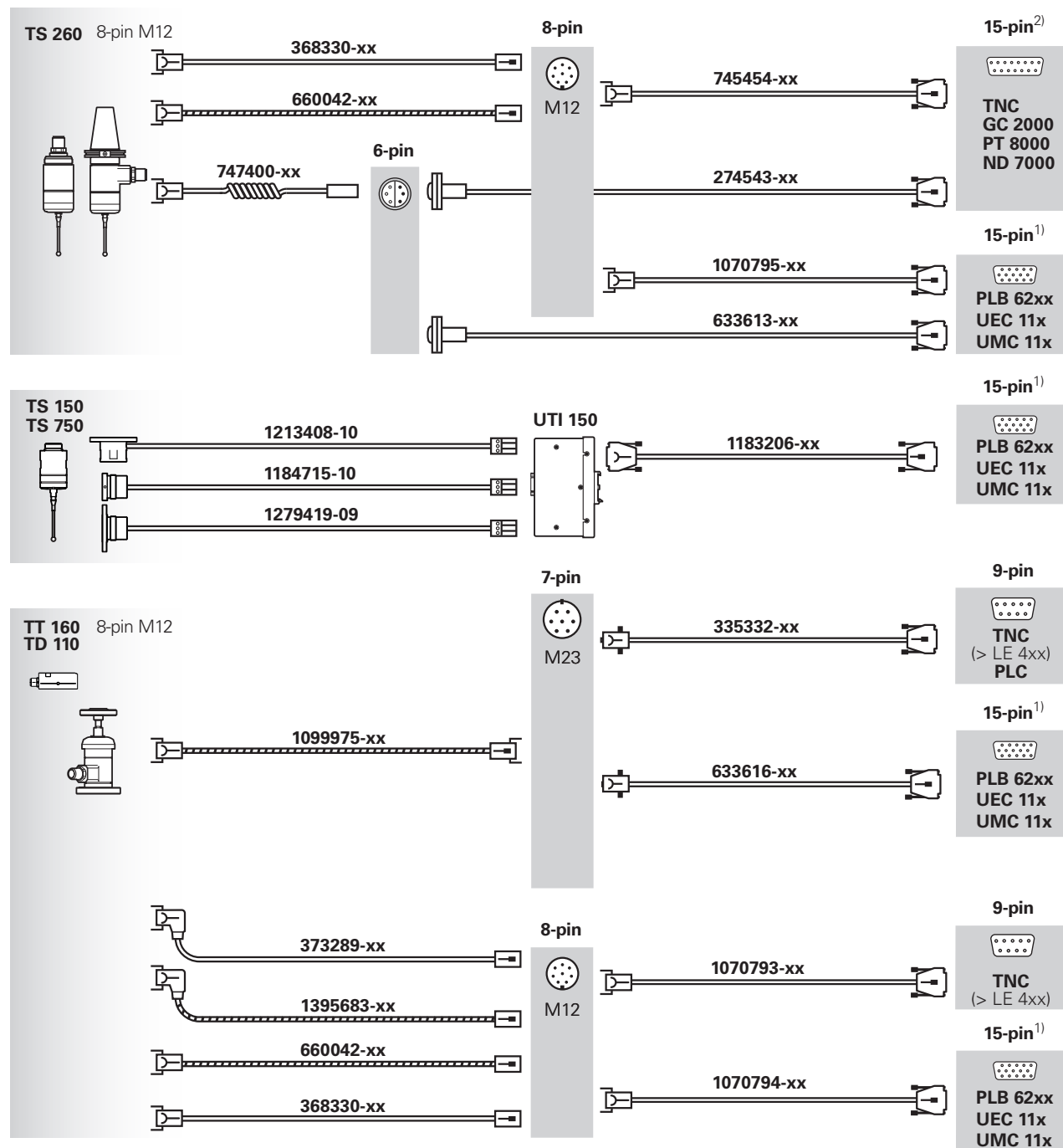
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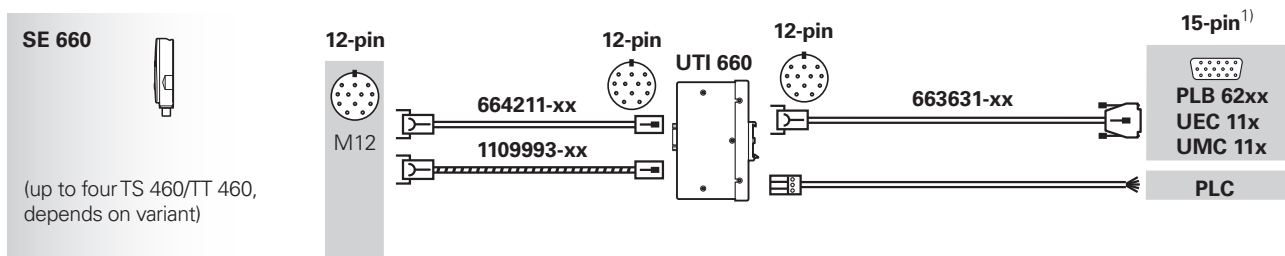
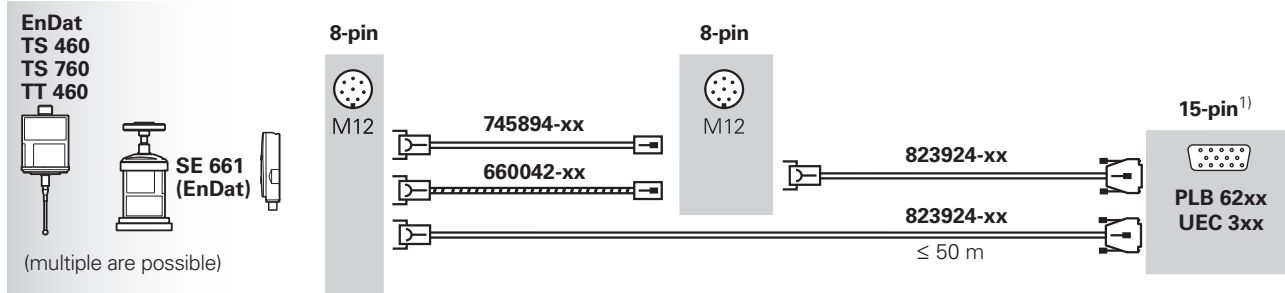
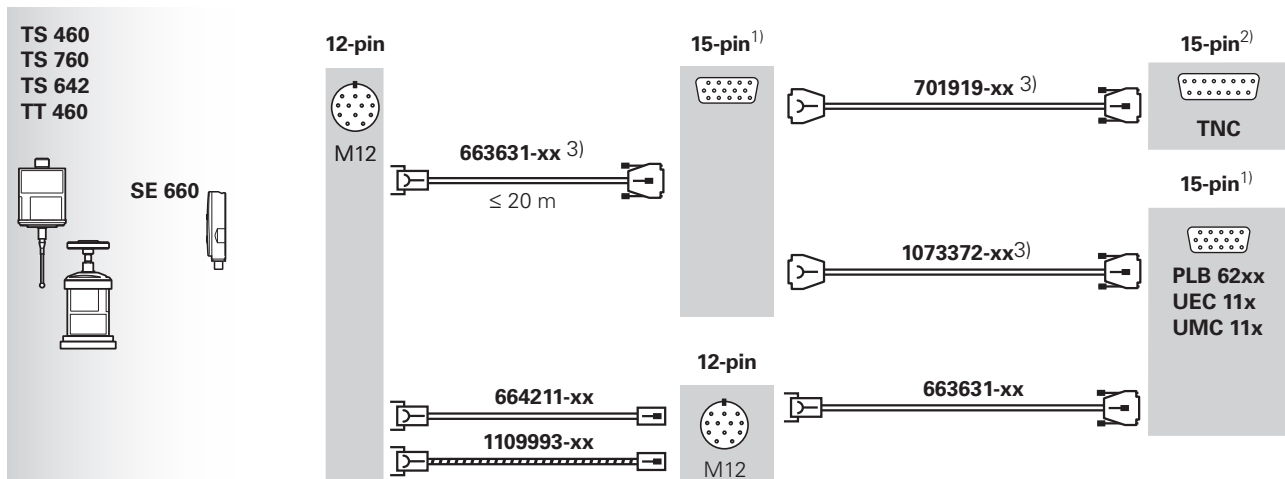
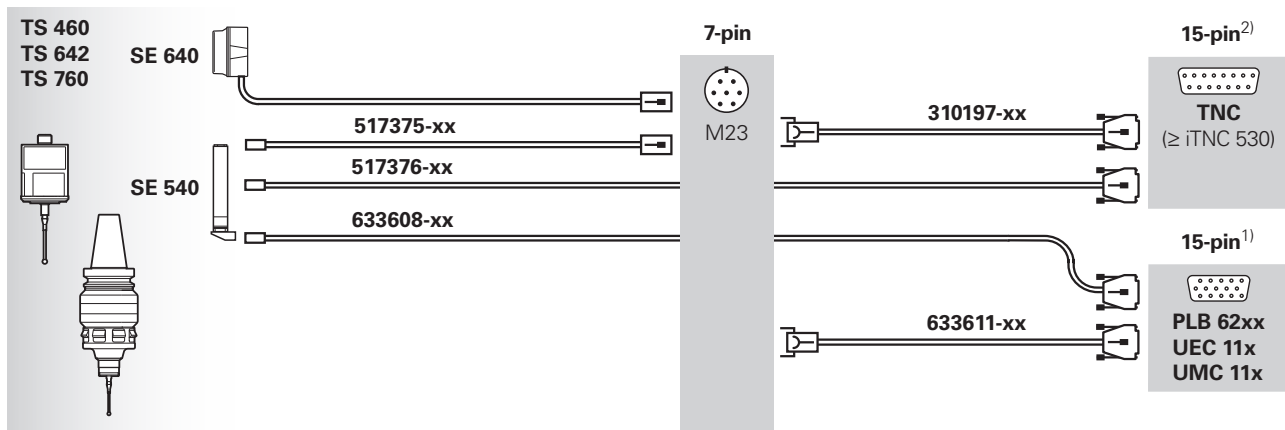
Further information:

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

Connection to HEIDENHAIN controls



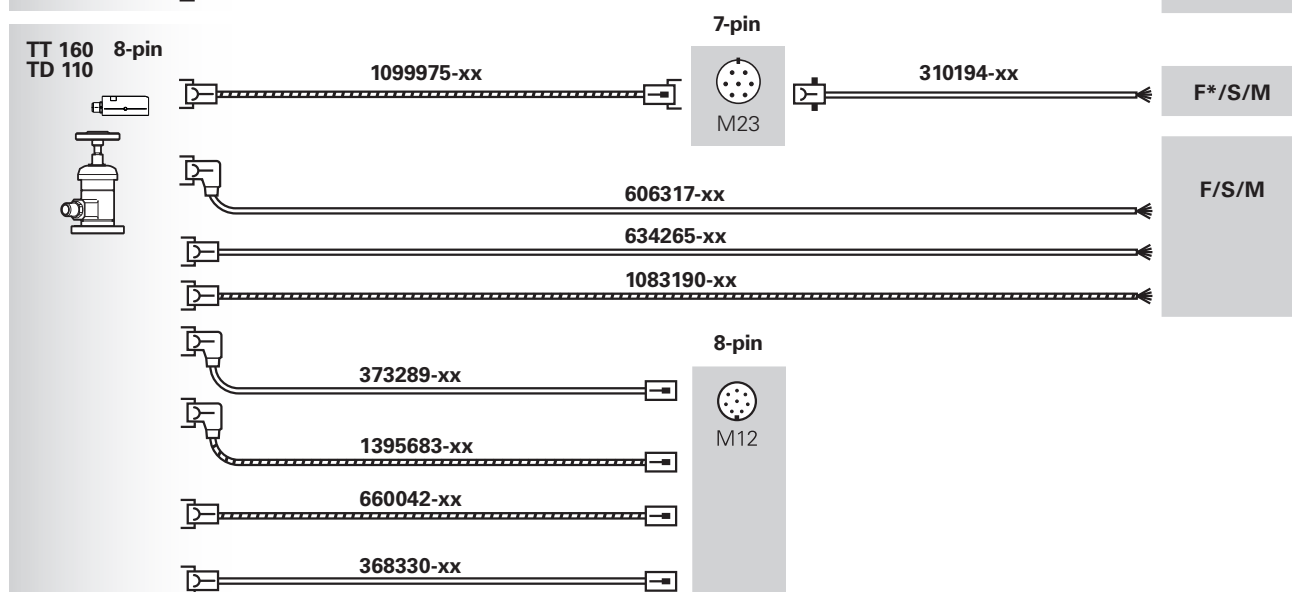
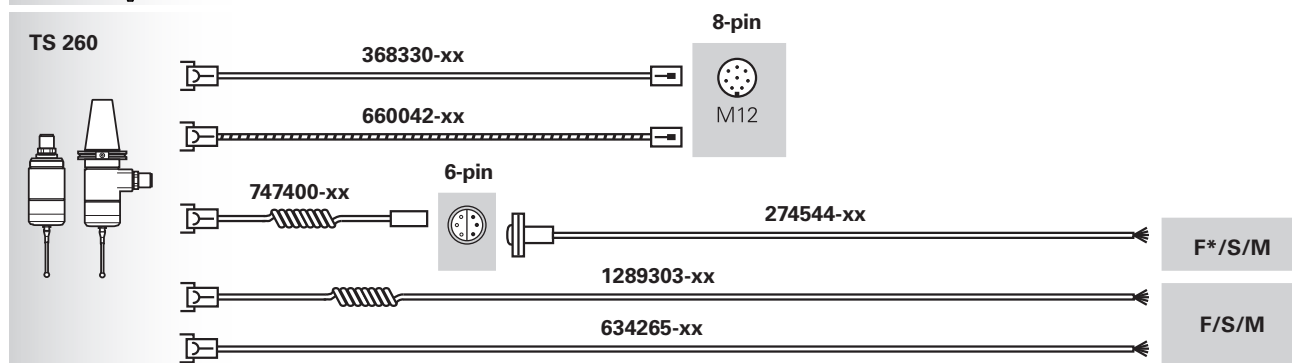
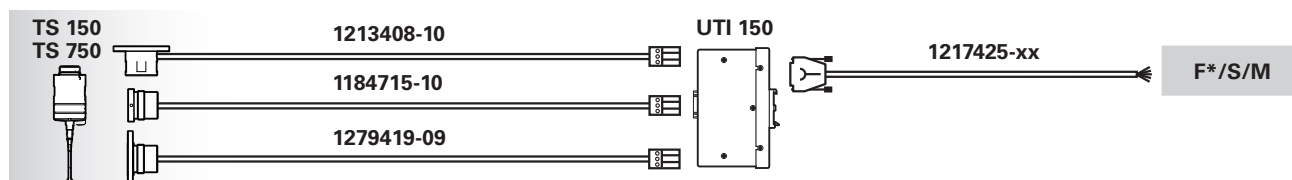
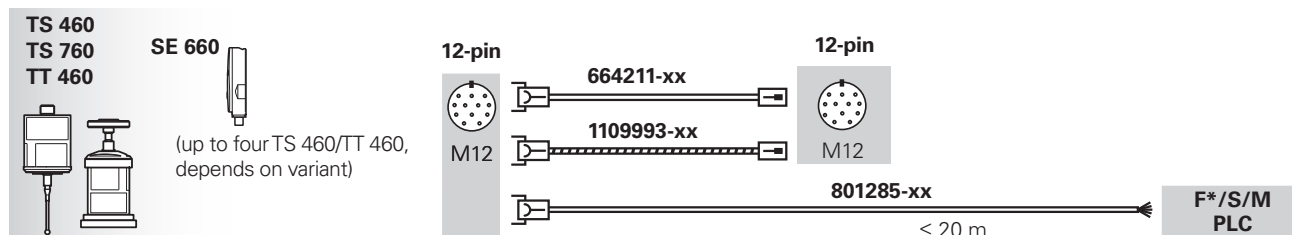
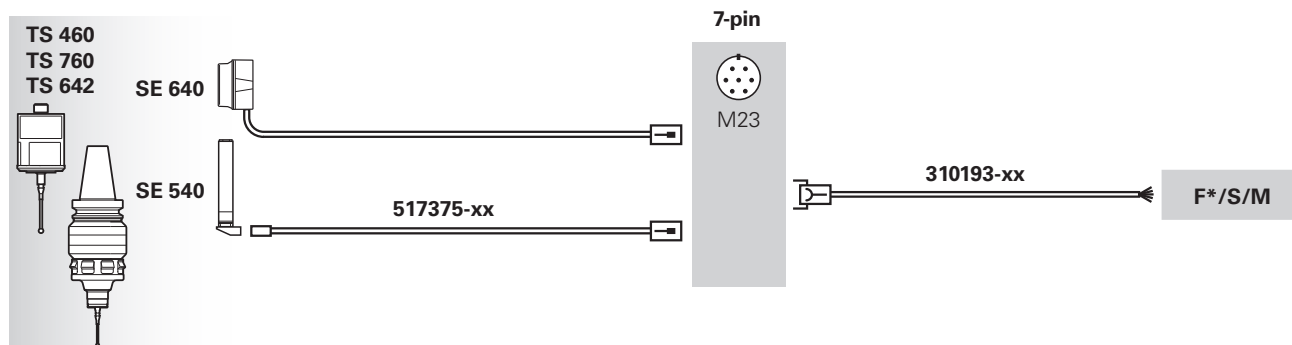
1), 2) Pin layouts are identical



^{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 via UT1 491

Electrical connection

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 760**, and **TT 460** touch probes with wireless transmission are each powered by two 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.

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.

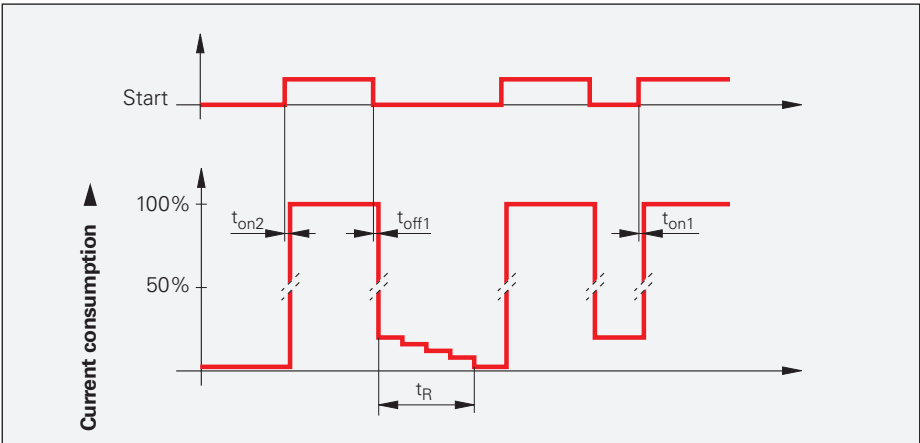
When switched off in infrared transmission, the touch probes go into stand-by mode and, after eight hours, into sleep mode. Longer switch-on times for activation of the touch probe should thus be expected (see *Switching the TS 460/TS 760/TT 460 on and off*).

	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⁾

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

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**, **$\bar{S}$**

$U_H \geq (U_P - 2.2 \text{ V})$ 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).

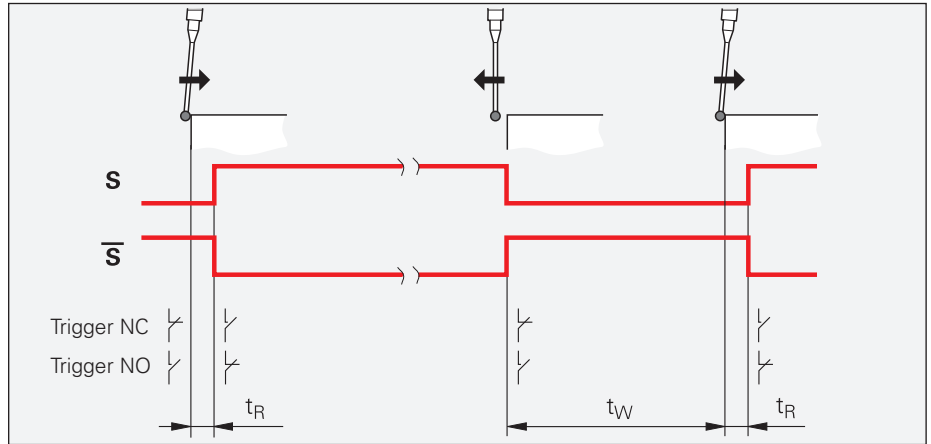
Load capacity of optocoupler

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

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

$\Delta U \leq 1 \text{ V}$ (typically 0.3 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 $t_R \leq 10 \mu\text{s}$

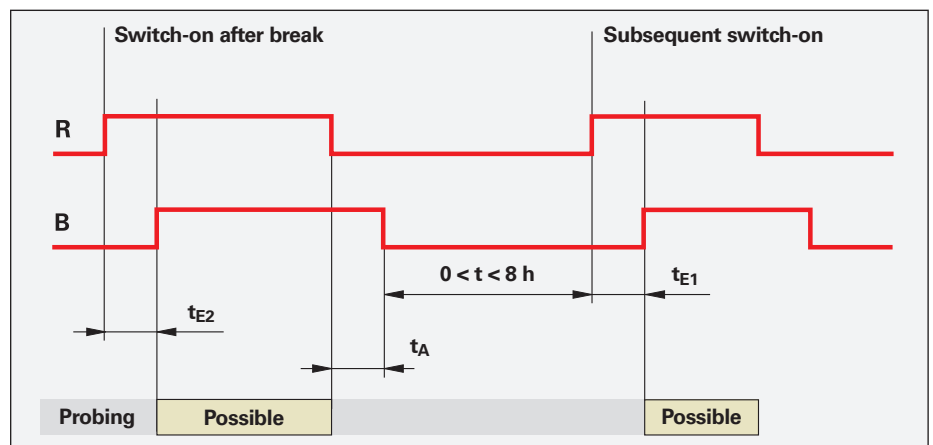
Repeat interval $t_W > 25 \text{ ms}$

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.

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 h), the delay can be up to 3 s .



Switching the TS 460/TS 760/TT 460 on and off

Signal times

Switch-on delay

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

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

Switch-off delay

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

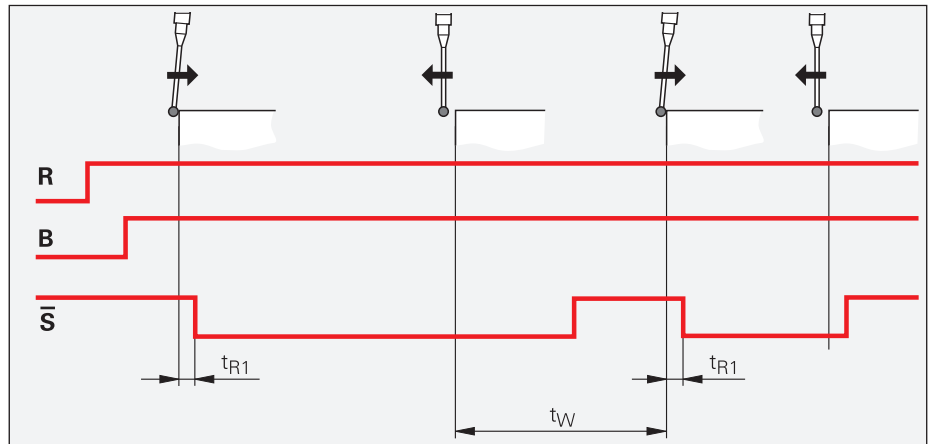
Signal times

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.



Probing with TS 460/TS 760/TT 460¹⁾

Signal times

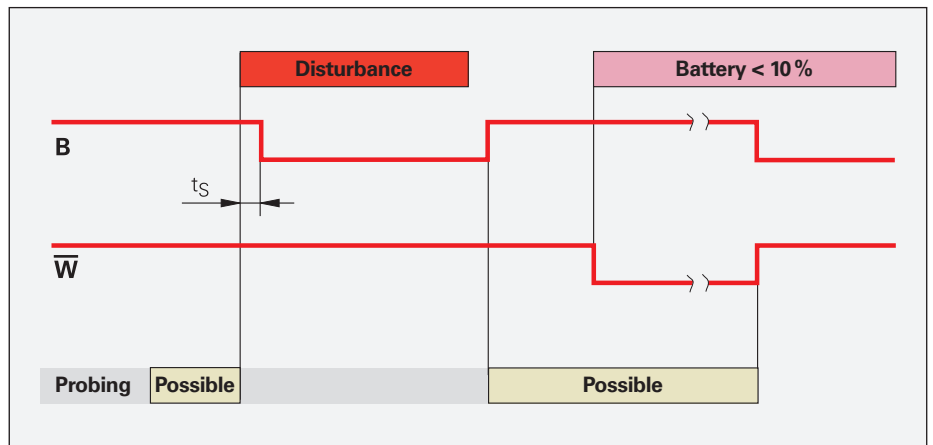
Response time for interrupted signal transmission t_S

- 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.



Behavior during disturbance and battery warning

HTL signal levels

R

$$U_H = (10 \text{ V} \dots 30 \text{ V}) \text{ at } I_H \leq 4 \text{ mA}$$

$$U_L \leq 2 \text{ V at } -I_L \leq 0.2 \text{ mA}$$

B/S/W

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

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

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

EnDat for touch probes

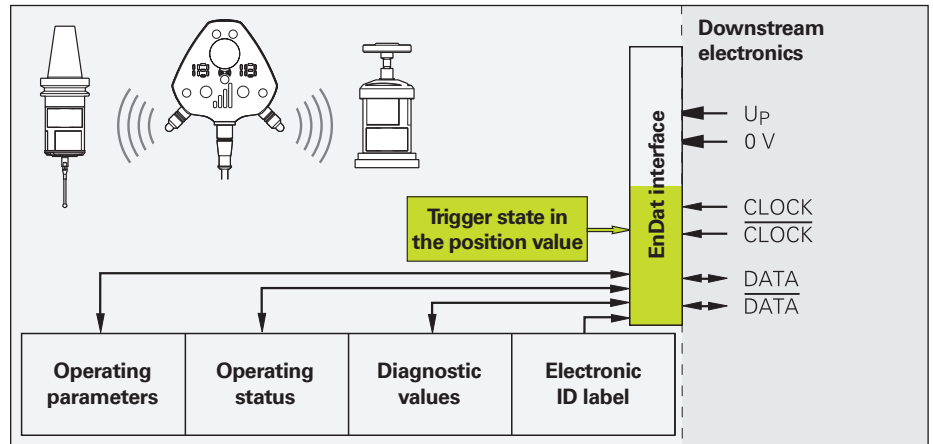
The **TS 460, TS 760, and TT 460** touch probes feature the **EnDat interface** for touch probes. The EnDat interface from HEIDENHAIN is a digital, bidirectional interface that transmits the trigger status as well as diagnostic information and additional data from the touch probe. Thanks to the interface's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

Funktionen	
SE SE 661 (62340982A)	Tastsystem entfernen
Tastsystem ein	Tastsystem aus
- 0 + Kanal wechseln	
Tastsystem tauschen	
Aktuelle Funk-Tastsystemdaten	
NO.	3
Typ	TS460
Status	an
Signalstärke	
Auslenkung	nicht ausgelenkt
Kollision	keine Kollision erkannt
Batteriewarnung	Keine Warnung
Batteriestatus	(1.61 V)
Aktuelle Protokoll Statistik	
Telegramm Verlustrate	0 %
Telegramm Wiederholrate	0 %

HEIDENHAIN

Mastering nanometer accuracy



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DR. JOHANNES HEIDENHAIN GmbH
Dr.-Johannes-Heidenhain-Straße 5
83301 Traunreut, Germany
☎ +49 8669 31-0
☎ +49 8669 32-5061
info@heidenhain.de
www.heidenhain.com



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worldwide