TL Laser Systems for Tool Measurement

Tool monitoring with a TL laser system is a very flexible solution. The contact-free optical measurement enables you to check even the smallest tools rapidly, reliably and without collision. Even the most sensitive tools are completely secure from damage.

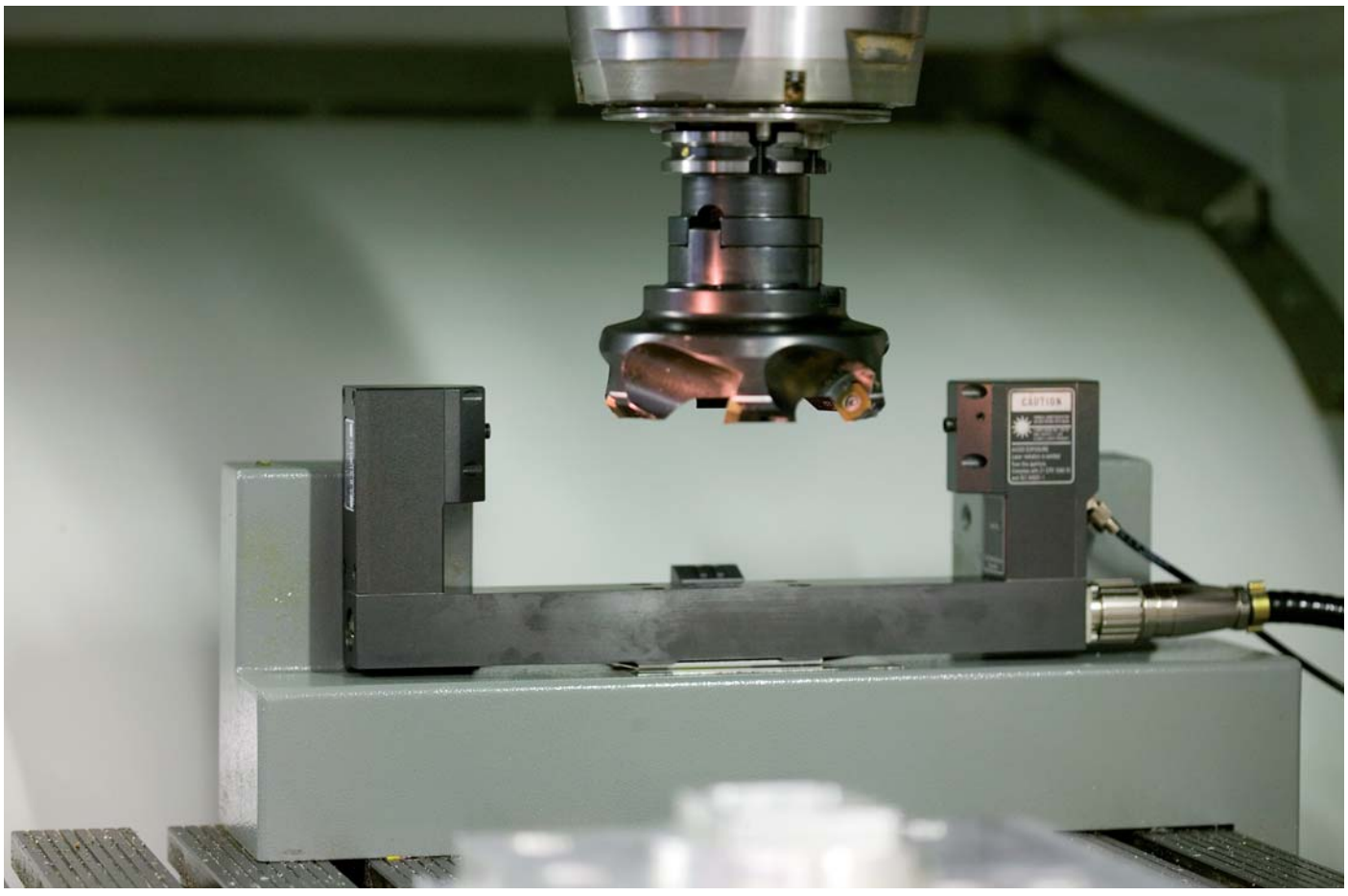
The precise determination of the length and radius at the rated shaft speed ensures your high quality of production. At the same time this integrated tool setting with automatic updating of tool data eliminates the need for separate tool setting, reducing costs and non-productive times.

Tool monitoring occurs at the rated shaft speed in the real clamping system, and as such under real operating conditions. Errors on the tool, spindle and holder can be immediately detected and corrected. Every single tooth is measured at the highest speed. Even the geometry of special tools can automatically be checked on the machine for deviations.

The continual process inspection with monitoring of the tool data detects wear, tooth breakage and tool breakage before damage occurs. This ensures consistent production quality, avoids subsequent damage, and reduces the cost of scrapped or reworked parts. The measuring cycles operate automatically, ensuring optimum monitoring even during unattended operation.

The TL laser systems guarantee reliable tool monitoring, high measuring accuracy, and precise inspection for wear and tear. They offer the following benefits:

- Reduced non-productive times
- Unattended operation
- Less scrap
- Increased productivity
- Consistently high quality of production



Components

TL laser systems
The laser systems are available in different versions for various maximum tool diameters:
- TL Nano
- TL Micro 150
- TL Micro 200
- TL Micro 300

The devices have an integral blowing unit to remove chips and coolant from the tool with a blast of compressed air.

The TL laser systems are optimized to the spindle shaft speed of NC machines for standard spindles and for HSC spindles (over 30000 min^{-1}).

The TL Micro systems are available as versions with cable exits and compressed air connections on the bottom or on the side.

Measuring cycles
The NC control uses measuring cycles to process the output signal of the laser systems and performs the necessary calculations. Measuring cycles for the TNC 426/430 and iTNC 530 controls from HEIDENHAIN are included with the TL laser systems. The measuring cycles contain functions for
- Tool setting with automatic transmission of the data to the tool table
- Inspection of wear and tear with or without correction of the tool data
- Identification with or without correction of the tool data

Compressed air unit
A **DA 301 TL** compressed air unit, specifically designed for these requirements, is necessary for operation of the TL laser systems. It consists of three filter stages (prefilter, fine filter and activated carbon filter), an automatic condensation trap, and a pressure regulator with pressure gauge, as well as three control valves. They activate the sealing unit of the laser optics, supply the laser system with sealing air, and blow the tool clean. The PLC program triggers the control valves.

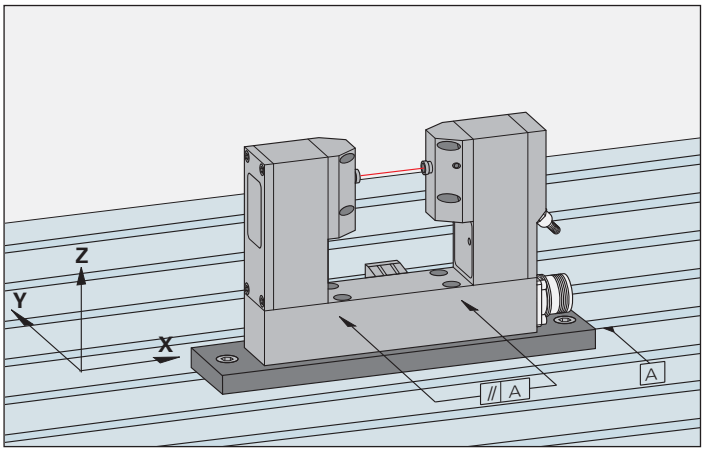
Accessories
A comprehensive series of accessories simplifies the mounting and maintenance of the TL laser systems.

Mounting

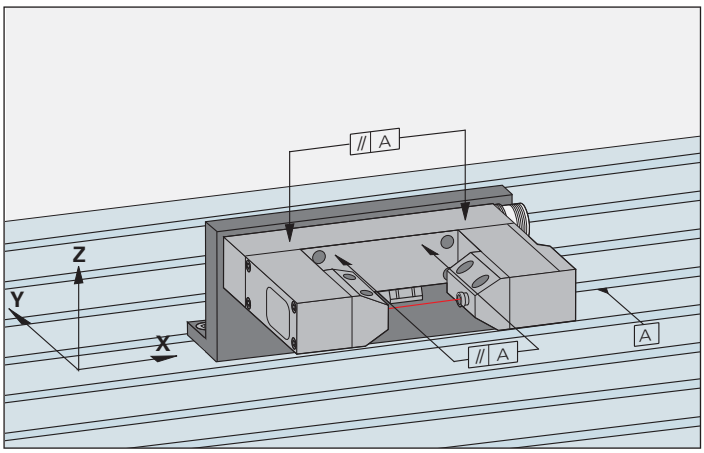
Mounting attitude
The TL laser systems fulfill the requirements for IP 68 and can therefore be fixed directly in the machine's working space. For smooth operation, even with coolant and chips, the transmitter and receiver feature a pneumatically activated sealing system. The additional introduction of sealing air provides a very high degree of protection against contamination.

The TL laser systems can be mounted in both upright and resting positions on or next to the machine table. They must be mounted in a stable enough manner to guarantee high repeatability. The cutting edge should rotate in the appropriate direction for avoiding bothersome reflections and refractions during measurement by the laser beam.

The working space of the machine tool should be limited in order to prevent collision with the laser system during machining.

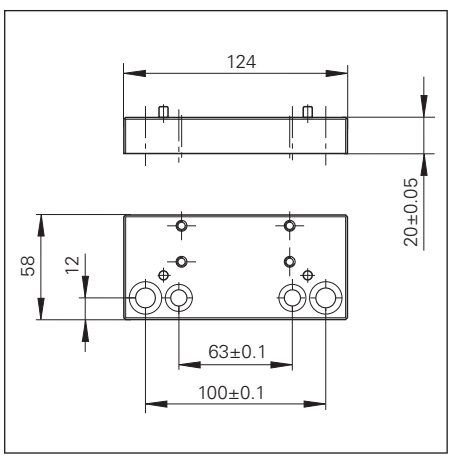


Adjusting the TL
In order to achieve the best possible repeatability, the laser system must be mounted exactly parallel to two NC axes. For upright mounting on the machine table, the horizontal alignment is ensured by the mounting surface. The mounting tolerances are included in the dimension drawings. Deviations in the parallelism are particularly noticeable as linear errors when measuring the length of very different tool diameters. It is therefore recommended that the length of eccentric tools (e.g. end mills, face-milling cutters) be measured on the outside radius outside of the tool axis.



Mounting accessory for TL Micro
The mounting base makes it very easy to install a TL Micro laser system on the machine table. Two stop pins on the base permit you to remove and reinstall the laser system without having to readjust it.

Accessory:
Mounting plate for TL Micro
ID 560028-01

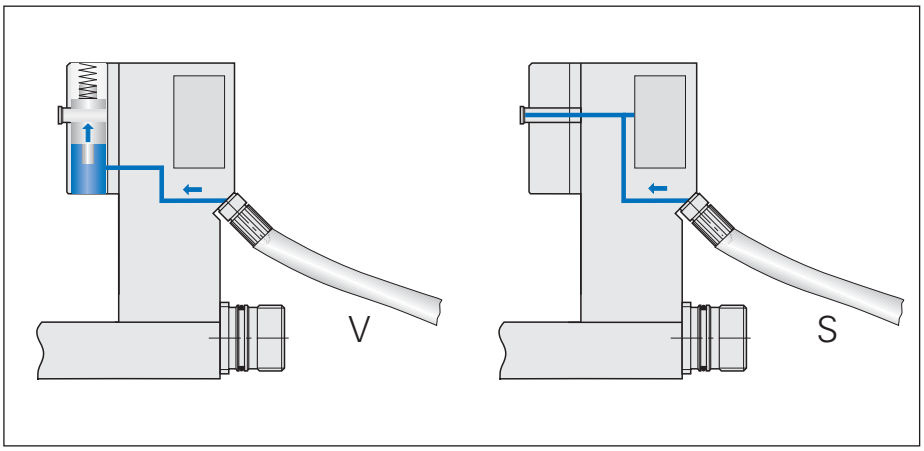


Contamination Protection

The application of laser systems directly on machine tools requires effective measures to protect the sensitive optical system of the laser light barrier.

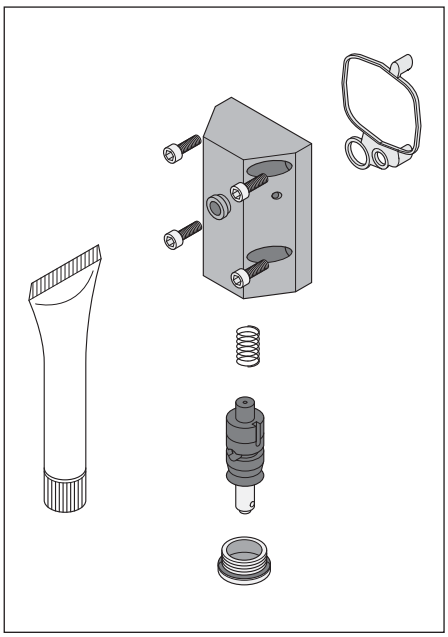
Mechanical protection
The optics of the laser systems are perfectly sealed against coolant and chips by contamination shutters with an integrated mechanical seal system. The seal enables the optical system only for the duration of the measurement. The seal is actuated pneumatically by the DA 301 TL compressed air unit.

Sealing air
The transmitter and receiver of the laser light barrier are protected by very clean sealing air from the DA 301 TL compressed air unit. It prevents contamination of the optical system by coolant spray.

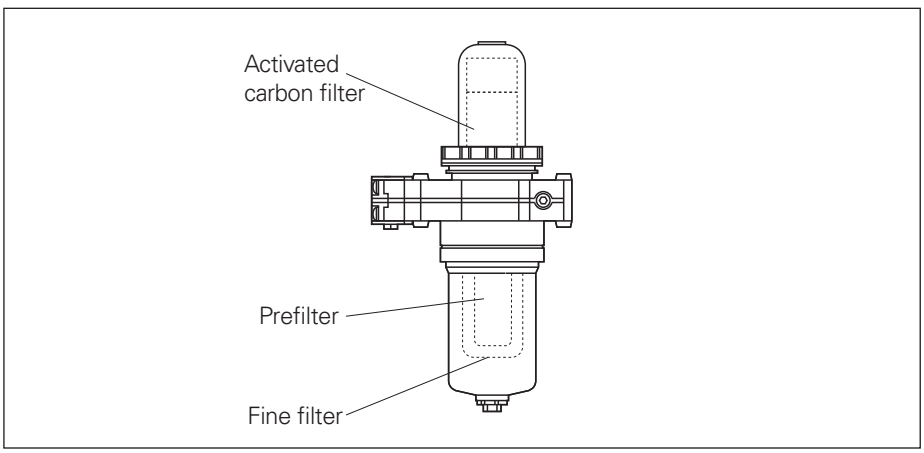


Pneumatic systems in the TL with connections for sealing air (S) and seal control (V)

Accessories
Maintenance kit for protective shutter
ID 560034-01
A maintenance kit consisting of the following items is offered for cleaning the contamination shutters of the laser optics.
- Gasket set
- Sintered sleeves
- Filler plugs
- O-rings
- M3x8 hexagon socket screws
- Special lubricant
- Operating instructions



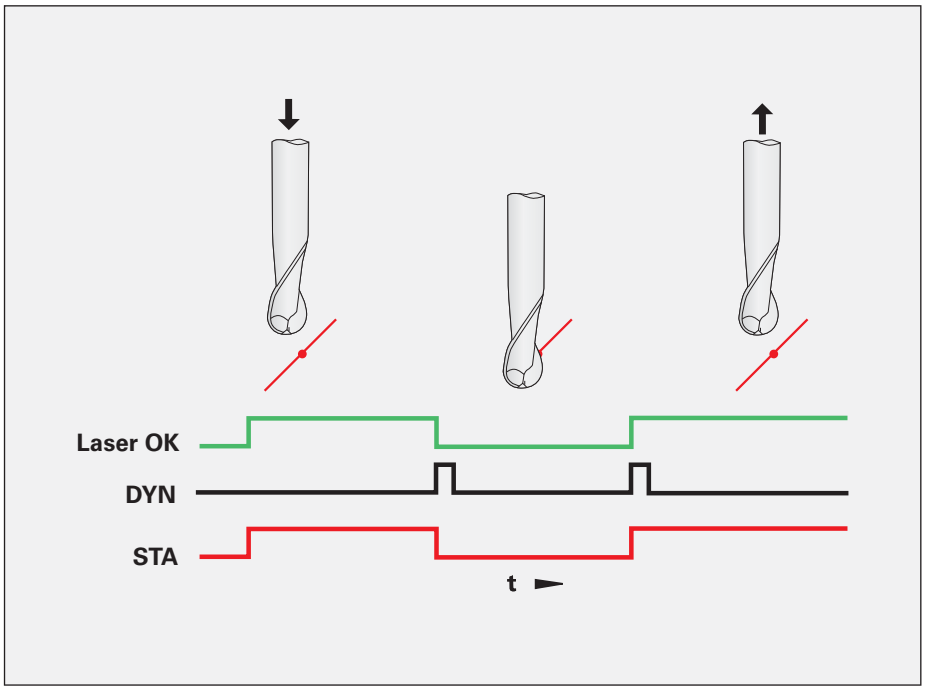
Replacement filters
ID 560036-01
Complete filter set for the DA 301 TL consisting of prefilter, fine filter, and activated carbon filter.



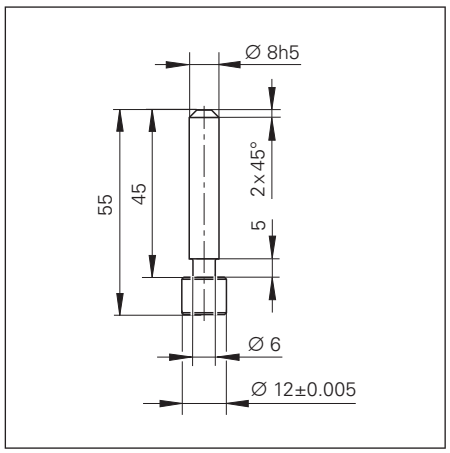
Protective springs
ID 560037-01
Set of spiral springs for protecting the compressed air tubing in the machine envelope
Set: 2 x Ø 6 mm, 1 x Ø 4 mm;
Length each: 1 m

Probing

The TL laser systems operate as high-precision light barriers without any contact. A laser light source (protection class 2 as per IEC 825) emits a laser beam. The opposing receiver unit detects the laser beam and so captures every interruption. For any change in status—such as when a tool interrupts the laser beam or is removed again—the integral electronics generate a trigger pulse for a defined duration. This dynamic signal DYN is transmitted to the NC control, where it is used for capturing the position value. In addition, the laser system outputs the static signal STA for the duration that the laser beam is interrupted.

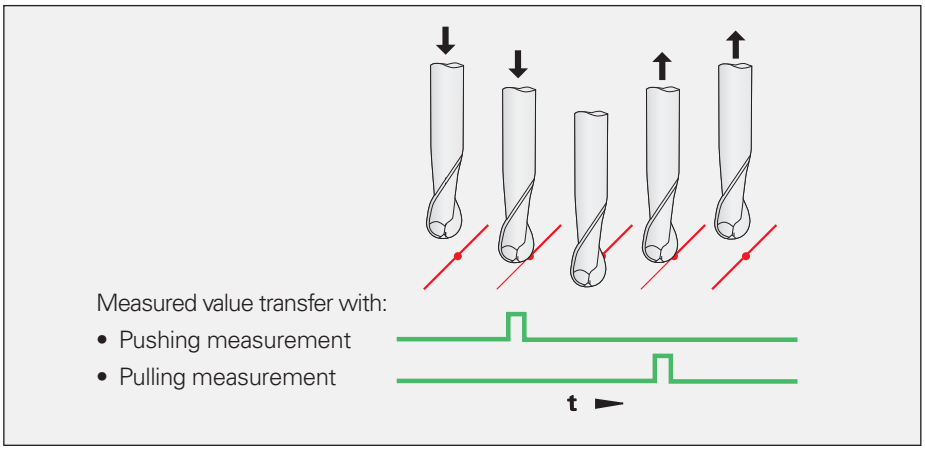


Calibrating
Before measurement with the TL laser system can be started, the system must be calibrated, meaning that the exact position of the trigger points relative to the machine coordinate system must be determined. A reference tool, available as an accessory, is used for this purpose. It has a characteristic shape for calibration, with a cylindrical dowel pin and a stepped inspection diameter for measurement in the positive and negative Z axis directions (for determining the exact position of the center of the laser beam in Z). The reference tool is clamped into the tool holder, and its length, diameter and height are measured very exactly. A cylindrical dowel pin suffices for simple applications. The best possible runout is to be ensured for the calibration measurement.



Accessory:
Reference tool
ID 560032-01

Probing strategies
The mechanical transfer elements influence the accuracy of the measurement. The measured value can be captured either when the tool is moved into the laser beam ("pushing measurement") or when it is removed ("pulling measurement"). The pulling measurement ensures a high degree of protection against the influence of coolant and swarf, while the pushing measurement is the better method for engraving bits and tools with very small shaft diameters.



Operating modes
The operating mode of the laser system is defined over the receiver-enabling inputs 1 and 2 (ENABLE 1/ENABLE 2). The measuring signals automatically put the receiver in the appropriate operating mode.

During **inspection of individual teeth,** each available tooth generates an output pulse of defined duration. The pulse length and the number of teeth define the basic speed. In the event of error—a missing tooth or a tolerance error—the dynamic output signal (DYN) stays at low level for max. 100 seconds.

In the **measuring** mode, every change of light causes an output signal DYN with a defined duration of 20 ms. The positive edge is evaluated. The device is switched between "pushing" and "pulling" measurement over the receiver-enabling input 2 (ENABLE 2).

Operating mode	ENABLE 1	ENABLE 2	Function
0	**0**	**0**	Inspection of individual teeth Base speed 3750 min^{-1} 
1	**0**	**1**	Pushing measurement Base speed ≥ 0 min^{-1} 
2	**1**	**0**	*On version for standard machine** Pulling measurement Base speed 600 to 3000 min^{-1} 
			*On version for HSC machines** Inspection of individual teeth Base speed 42000 min^{-1} 
3	**1**	**1**	Pulling measurement Base speed ≥ 3000 min^{-1} 

* Please select when ordering

Optical status indicator
LEDs on the receiver side of the laser system make a rapid diagnosis of the status possible. In this way, the operator sees at a glance whether the laser beam path is OK, whether a dynamic trigger signal is being output, and which operating mode of the laser system is active.

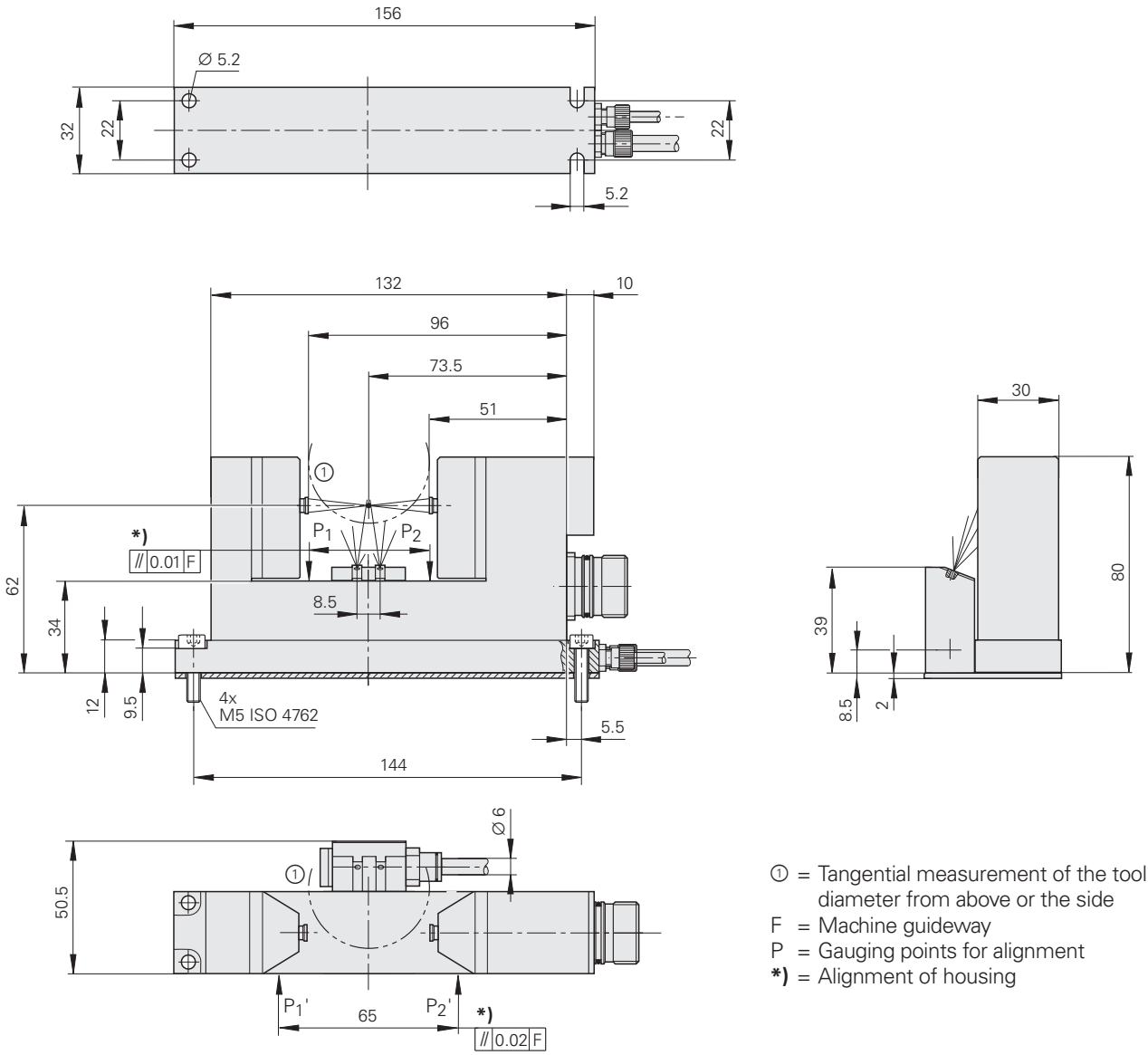
Probing used tools
The optically scanning laser system can of course not distinguish between the actual tool to be measured and any attached chips, coolant coating or falling drops of coolant. In order to avoid faulty measurements, the tool should therefore be cleaned before measuring. This can be done by spinning off any particles at a high rotational velocity or by blowing them off with air. The TL laser systems feature an integral blowing feature for this, which can be used to clean the tool before and during a measuring cycle.

Optical status indicator	LED	Function
Laser ON	●	Input for enabling transmission
Alignment	●	Laser adjustment OK (signal > 95 %)
Laser OK	●	Laser output OK (signal > 75 %)
Output	●	DYN output (signal > 50 %)
Mode	○	Operating mode 0
	●	Operating mode 1
	●	Operating mode 2
	●	Operating mode 3

TL Nano
Laser System for Tool Measurement

mm

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



① = Tangential measurement of the tool diameter from above or the side
F = Machine guideway
P = Gauging points for alignment
***)** = Alignment of housing

Specifications	TL Nano
Tool diameter Central measurement Tangential measurement	 0.03 to 37 mm 0.03 to 44 mm
Repeatability	± 0.2 µm
Spindle speed*	Optimized for individual tooth measurement on standard or HSC spindles (> 30000 min^{-1})
Lasers	Visible red-light laser with beam focused at center of system
Wavelength/Power	630 to 700 nm / < 1 mW
Protection class IEC 825	2
Input signals	Square-wave signals 24 V DC • Enable transmitter ENABLE 0 • Enable 1 receiver ENABLE 1 • Enable 2 receiver ENABLE 2
Output signals	Square-wave signals 24 V DC • Dynamic triggering signal DYN • Static triggering signal STA • Proper laser function LASER OK
Power supply	24 V DC / 160 mA
Electrical connection	M23 coupling (male),12-pin, at side
Mounting	Within the machine work envelope
Protection EN 60529	IP 68 (when connected, with sealing air)
Tool cleaning	Blower
Operating temperature **Storage temperature**	10 °C to 40 °C 0 °C to 50 °C
Weight	Approx. 0.70 kg (including blower)

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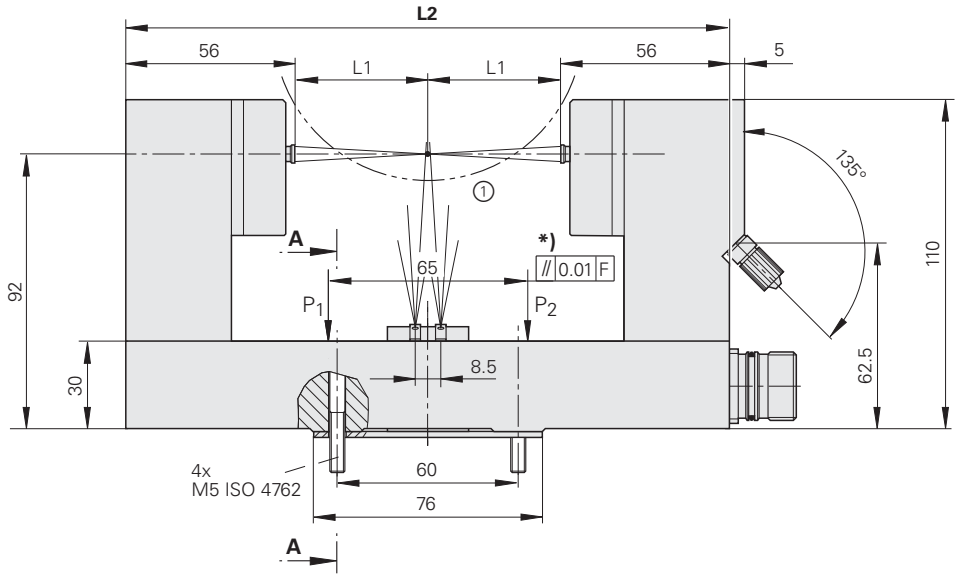
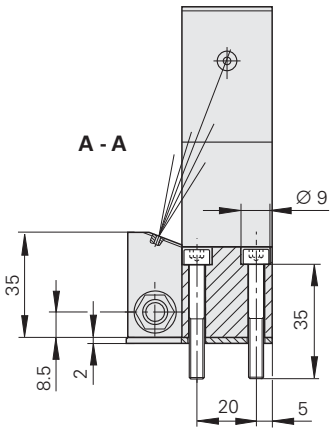
TL Micro

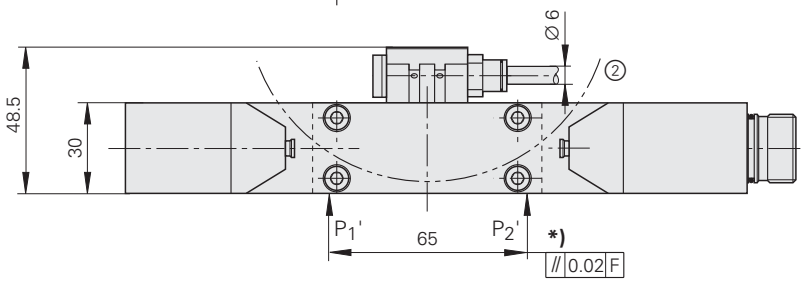
Laser System for Tool Measurement

mm

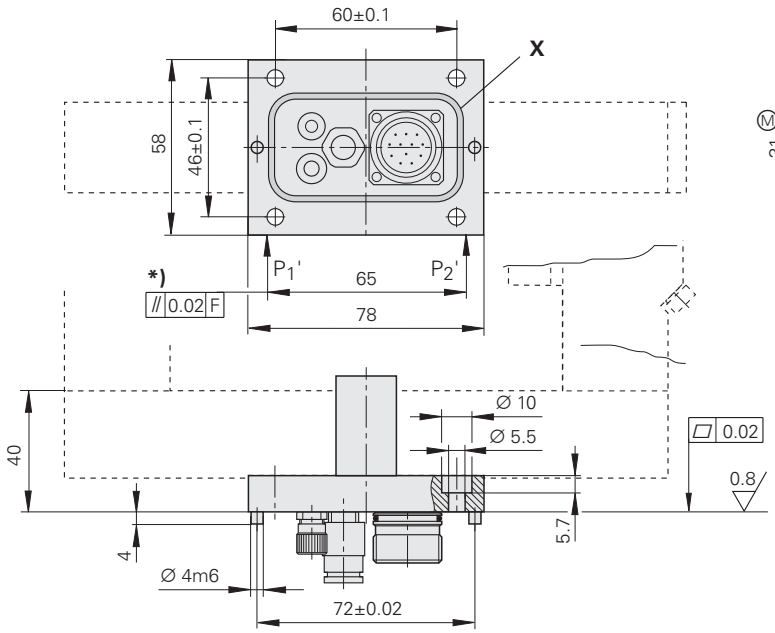
Tolerancing ISO 8015
ISO 2768 - m H
< 6 mm: ±0.2 mm

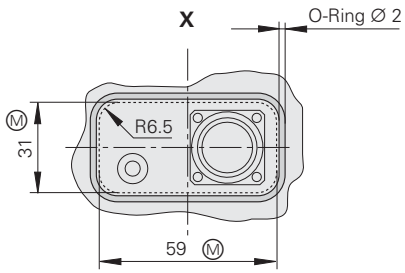






L1	L2	Type
19	150	TL Micro 150
44	200	TL Micro 200
94	300	TL Micro 300





① = Tangential measurement of the tool diameter from above
② = Tangential measurement of the tool diameter from the side
Ⓜ = Cutout for mounting
F = Machine guideway
P = Gauging points for alignment
***)** = Alignment of housing

Specifications	TL Micro 150	TL Micro 200	TL Micro 300
Tool diameter Central measurement Tangential measurement from above Tangential measurement, lateral	 0.03 to 30 mm 0.03 to 30 mm 0.03 to 30 mm	 0.1 to 80 mm 0.1 to 98 mm 0.1 to 122 mm	 0.1 to 180 mm 0.1 to 324 mm 0.1 to 428 mm
Repeatability	± 0.2 µm	± 1 µm	
Spindle speed*	Optimized for individual tooth measurement on standard or HSC spindles (> 30000 min^{-1})		
Lasers	Visible red-light laser with beam focused at center of system		
Wavelength/Power	630 to 700 nm / < 1 mW		
Protection class IEC 825	2		
Input signals	Square-wave signals 24 V DC • Enable transmitter ENABLE 0 • Enable 1 receiver ENABLE 1 • Enable 2 receiver ENABLE 2		
Output signals	Square-wave signals 24 V DC • Dynamic triggering signal DYN • Static triggering signal STA • Proper laser function LASER OK		
Power supply	24 V DC / 160 mA		
Electrical connection*	M23 flange socket (male), 12-pin, either on the side or bottom		
Mounting	Within the machine work envelope		
Protection EN 60529	IP 68 (when connected, with sealing air)		
Tool cleaning	Blower		
Operating temperature **Storage temperature**	10 °C to 40 °C 0 °C to 50 °C		
Weight	Including blower		
Cable outlet on side (approx.)	0.85 kg	0.95 kg	1.15 kg
Cable outlet on bottom (approx.)	0.90 kg	1.00 kg	1.20 kg

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