



TPS5000

Leica

DL2/3

TDA5005

*Electronic precision theodolites
for industrial applications*

Leica
Geosystems

Leica theodolites – multi-purpose measuring tools

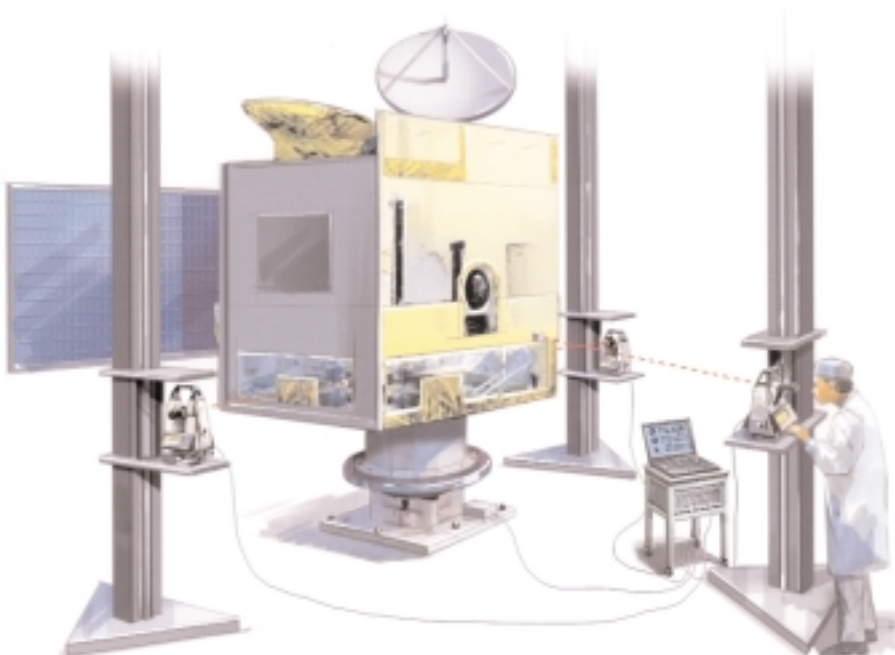


Leica has the solution to your measurement problems. Find out how you can benefit from our know-how and experience in the field of industrial 3-dimensional metrology.



One-man operation with the aid of automatic collimation

The use of Leica total stations can make significant contributions to productivity when assembling large aluminium and steel structures. The most effective results can be achieved by deploying the **remote-controlled measuring system in conjunction with automatic target recognition**, allowing dimensional checks to be performed **by one operator** from the target point location.



Maximum precision

With its **unrivalled precision**, the Leica Auto-Collimation Theodolite is recognised as the industrial standard by leading satellite manufacturers. Assisted by the non-contact measuring method using auto-collimation onto mirror cubes, satellite components can be assembled with extreme precision – unequalled by any other measuring process.

Measurements on the production line

Production line measurements of large components can result in major savings in manufacturing costs. At the same time, it is possible to reduce the number of geometrical checks on the finished component. In this case, **control of repetitive measurements by the operator** during series production is effectively transferred to the Process Automation Module (PAM).



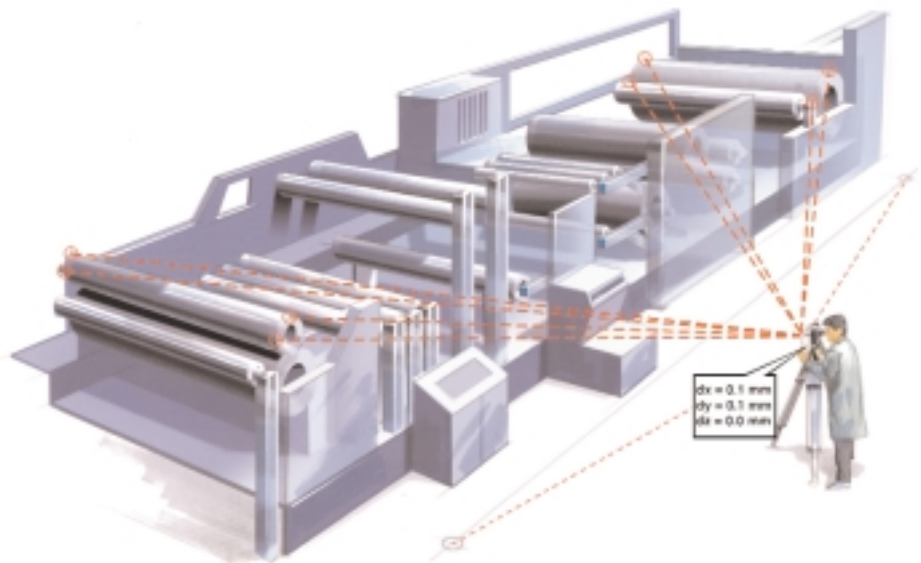
Open system architecture

Rapid and accurate logging of 3-D data is not a problem for Leica theodolites and total stations. This applies equally to the configuration of on-board systems and head-up displays, as well as symmetry measurements carried out during maintenance work. The open system architecture means that units can be used **in conjunction with customised software.**



Automated operation

High production rates demand regular inspections of production tools, including the alignment of rollers or coils. **Rapid and flexible setup** of the theodolites and total stations combined with **automated measurements** means that data can be recorded under a variety of conditions, a benefit which conventional measuring methods have so far been unable to offer with the same degree of precision.



TPS5000 – for industrial 3-D metrology



Component checking in wind-power stations at Tegopi in Portugal



Versatile

Leica theodolites and total stations are used for setting up and checking tools, machinery and components of all kinds.

Mobile

Their mobility and the non-contact measuring principle are ideally suited for use with very large, sensitive or inaccessible objects. 3-D coordinates are defined with great accuracy by means of angular and distance measurements. The calculated coordinates provide the basis for further processing operations, such as the geometrical definition of shape and position.



Alignment operations on the world's largest radio telescope at Green Bank, USA

Proven design

Many industrial customers are impressed by the reliability and accuracy of the measurements:

Aerospace: Alenia, Alcatel, Astrium, Boeing, BAe Systems, Contraves Space, EADS, Eurocopter, Lockheed-Martin, Northrop-Grumman, Raytheon, SpaceLoral Systems

Automotive and construction machinery: Caterpillar, Claas, Freightliner Corp., JCB, Komatsu, IVECO-Pegaso, Michelin, Samsung Heavy Industries, Volvo

Shipbuilding: Astano, Bazan, Astilleros Españoles, Alstom, DCN International, Kockums, Kvaerner, Flensburger Schiffbau, General Electric Boat, Meyer-Werft, Newport News Shipbuilding, Thyssen Nordseewerke

General Industry: ABB Robotics, Alstom, Bombardier Transportation – Adtranz, CERN, DESY, FIAT Ferroviaria, Siemens Transportation, Valmet Papermachines



A complete solution for the University of Vigo, Spain: introduction of systematic inspection measurements in the shipbuilding industry

The software – customised to your requirements

As with your office PC, the TPS5000 range of instruments can be used in conjunction with various software packages for special applications.

Offline or online?

Do the conditions of use preclude the use of a PC? Do you only require 3-D coordinates? Then **offline mode** offers the ideal solution. The **software is integrated into the instrument**, thus reducing the number of ancillary units to a minimum and, in turn, providing maximum flexibility. The data is logged on a PCMCIA card and is evaluated on a PC.

Do you require shape-fit geometries and additional geometrical evaluations? Do you want surface measurements or specific repetitive measurements for series production? Do you want to use the instrument in conjunction with existing software or arrange for the development of special software? With the open system architecture, **online mode allows operation in conjunction with Windows software.**

Offline – optical tooling & alignment

This is the most straightforward method of measuring objects. Whether you are looking for measurements with or without data logging on a PCMCIA card, alignment of rollers, reference lines or reference directions, or 2-dimensional measurement of coordinates along the X and Y axes – the appropriate programs are already integrated in the instrument.

Offline – measuring 3-D coordinates

DCP05 is the first software program integrated in the total station which offers production line 3-D measurements (comparison between nominal and actual values). Thanks to the use of alignments such as “3-2-1” (plane-line-point), the object to be measured no longer needs to be pre-positioned. The data is logged on a PCMCIA card, using Micro-soft Excel for example or the DCP software (industry solution for large scale assemblies).

Online – the Axyz software platform

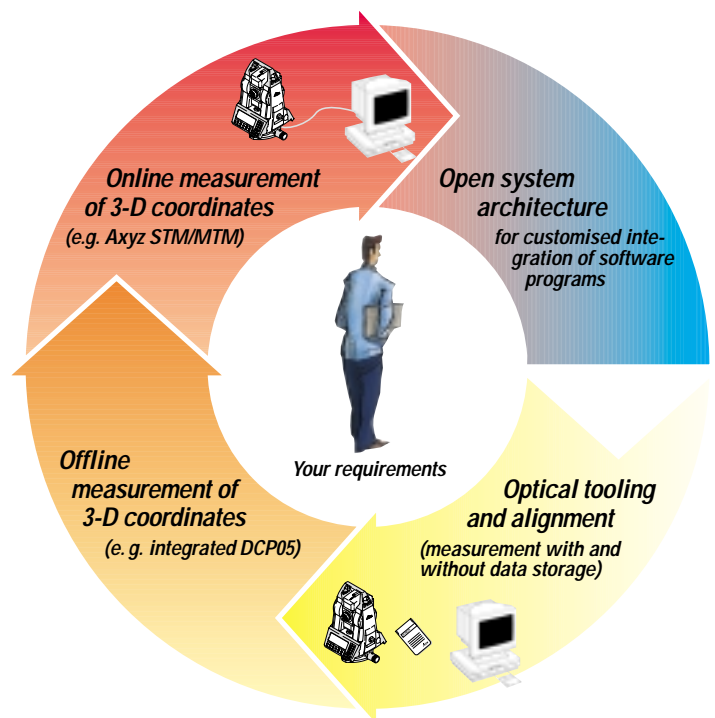
Axyz is a unique, integrated application concept which has been developed for all Leica industrial measurement systems. With Axyz, any combination of instruments can be deployed with unrivalled flexibility.

Axyz MTM (Multiple-Theodolite Module) or Axyz STM (Single-Theodolite Module) link the measuring instruments with the CDM core module. The CDM provides the following functionality:

- Shape-fit geometries
- Geometrical analysis functions
- Alignment functions
- Data management
- Flexible output of reports
- Data import/export.

Extend or convert – no problem with Axyz

You can convert to another Leica measuring system, such as Laser Tracker at any time. The Axyz platform can be used by each system.



PTB-approved

The Physikalisch-Technische Bundesanstalt (PTB) has confirmed the accuracy of the Axyz shape analysis functions. The PTB is the highest technical authority in Germany in the field of metrology.

The Axyz STM and MTM measurement modules

The Axyz MTM Multiple-Theodolite Module allows the use of up to 16 instruments online, whereas the Axyz Single-Theodolite Module is intended for use with one total station.

By combining STM with MTM, you can measure the same object simultaneously using 2 mutually independent total stations – a “2-in-1” system.

Surface measurements with Axyz CAD

This module provides assistance with surface measurements using CAD data, which can be exchanged in VDAFS, IGES, DXF or native CATIA formats.

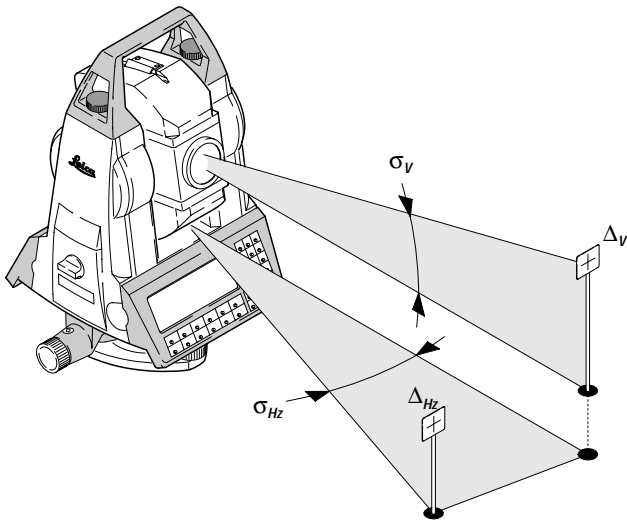
The Axyz PAM Process Automation Module

Axyz now also offers controlled measurement cycles for use with repetitive measurements, during series production for example. This reduces the familiarisation period and allows controlled and automated implementation of specified measurement and analysis processes. Use of menus and interactive features greatly facilitates creation of these processes.

Online – open system architecture

The open system architecture of the instruments and the Axyz module allow online connection to third-party software, including machine control, industrial measurement software packages or customised software solutions.

TPS5000 – mobile – automated – modular



High-precision directional measurement: the instrument measures the directions, preset by the observer, to the target markers. The difference between the sightings produces the horizontal angle Δ_{Hz} and the vertical angle V . Expressed in numerical form: accuracy of angular measurement $1 \sigma = 0.5''$, equivalent to $\Delta = 0.012 \text{ mm}$ at a range of 5 metres.

Our customers provided the challenges and Leica found the solutions. The result is a group of products which sets new standards, particularly in the case of industrial applications.

Leica theodolite systems lead the way in the following areas:

Mobility

- The measuring system can be taken to the object, enabling the measurements to be performed directly on-site.
- The instruments are ready for use within a matter of minutes.
- Interruptions to the production process are kept to a minimum by performing production line measurements.
- A wide range of alignment functions save valuable measuring time, since the object to be measured does not have to be pre-positioned in a specific location.

Automation

- The Automatic Target Recognition (ATR) option simplifies the identification, recording and tracking of a measuring target. In this way, fully-automatic measurement and evaluation processes are possible in batch mode, together with one-man operation using radio remote control.
- In the case of predefined inspection schedules or during series production, the instrument is automatically positioned to the next target using reference data.
- The measurement operation requires significantly fewer manual settings, i. e. the measurements are accelerated and down-times reduced.

Modularity

From the range of Leica theodolites, total stations, software and accessories, it is possible to select a system which corresponds most closely to the requirements of the measurement task.

- As a straightforward angle measuring instrument for determining horizontal and vertical angles, i.e. a theodolite.
- As a combined angle and distance measuring instrument, i.e. a total station.
- Supported by the range of accessories, together with the various software options.

Precision to the highest degree

The hardware for maximum precision

Due to their unrivalled accuracy and precision, Leica instruments have become the industrial standard in many fields of metrology.

The accuracy of angular measurement $1\sigma = 0.15 \text{ mgon (0.5")}$ is equivalent to a transverse deviation of $12 \mu\text{m}$ at a range of 5 m.

The **manufacturing and service test certificates** (angle and distance measurement) prove compliance with the specifications and are indispensable documents in the context of the test equipment inspections required by ISO 9000. All the certificates are **traceable to international standards**.

The integral compensator defines the exact reference to the horizontal. In this way, components or production facilities can be **horizontally aligned with high precision** and any deviation from the horizontal can be measured exactly. In view of this, the instrument can be regarded as a 3-D levelling device.

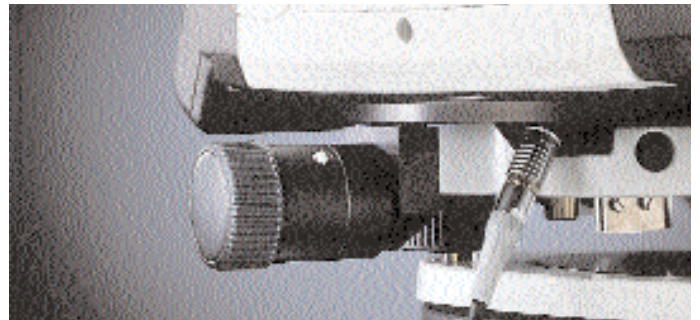
Ergonomics and safety

Leica design is a fusion of functionality and ergonomics. The user maintains a normal stance, which allows concentrated and fatigue-free operation.

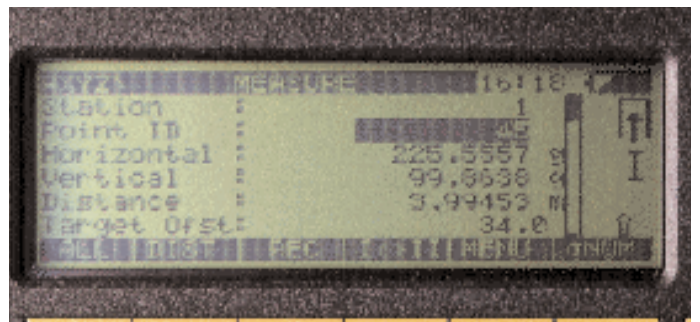
- **Graphics-capable display**, alphanumeric, graphics-capable and illuminated.
- **Fine drives can be positioned freely** for fatigue-free operation.
- **Separate microswitches** for shock-resistant initiation of the measurement. A totally new concept, for which Leica has been granted a patent.
- **Self-checking of the instrument** in terms of readiness for measurement.
- **Built-in adjustment functions** for on-site checking by the operator.



Mobile and convenient: separate positioning of the main instrument and fine drives ensure relaxed and fatigue-free operation.



Simultaneous ranging and measurement from one position: the integral microswitches used during the initiation and recording of measurement ensure that the target remains in view. This is a patented Leica feature.

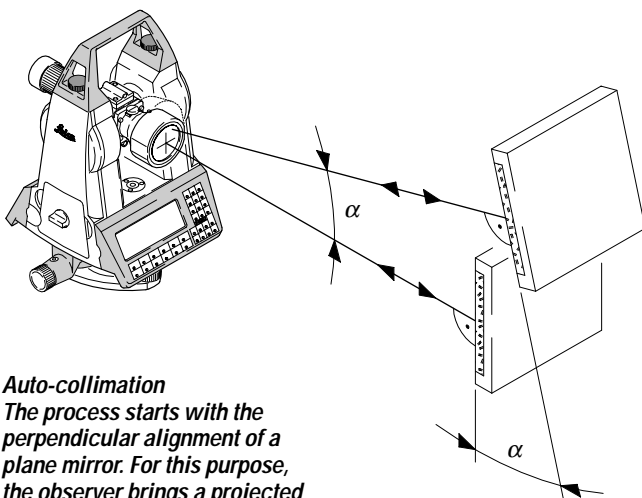
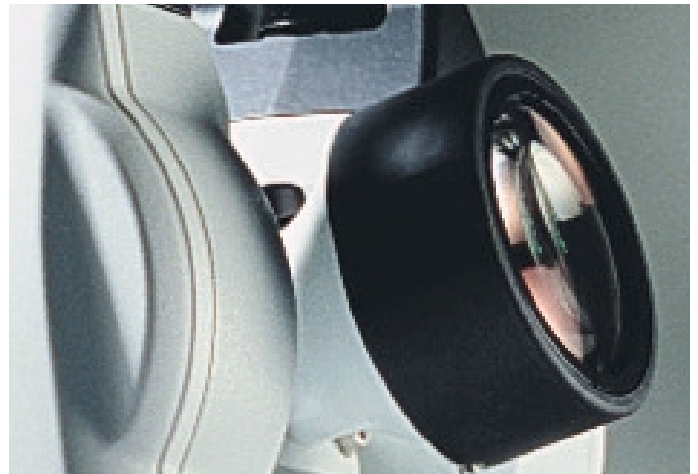


Large and easy to read, the display panel of the TPS5000 series – alphanumeric – graphics-capable – illuminated

The world's most accurate theodolite – the TM5100A



TM5100A



Auto-collimation

The process starts with the perpendicular alignment of a plane mirror. For this purpose, the observer brings a projected reticule into alignment with the standard reticule. Any change in the inclination of the mirror fixed to the object causes the reticules to be displaced with respect to one another. This allows the change in inclination to be precisely measured with the theodolite.

This model features an advanced functionality which is not to be found on other instruments. With a precision telescope and auto-collimation, additional tasks can be performed quickly and easily.

Pan-focal telescope

The TM5100A is fitted with a pan-focal telescope which can be used for **close-range sighting** at distances as low as 0.6 m. The field of view increases in size and the magnification decreases the closer the observer moves to the object. The enhanced clarity resultant simplifies the collimation process. **High-precision control of the focussing lens** increases the range setting, particularly in the immediate foreground and during measurements from just one position.

Auto-collimation

The TM5100A is equipped with an integral auto-collimation device. This can be used for checking deviations from the reference lines in the field of optical tooling and for setting up navigation systems in aerospace applications. More generally, it can be used for detecting small angular variations in the object or angular differences between components. These components can also be **finely adjusted with great precision**.

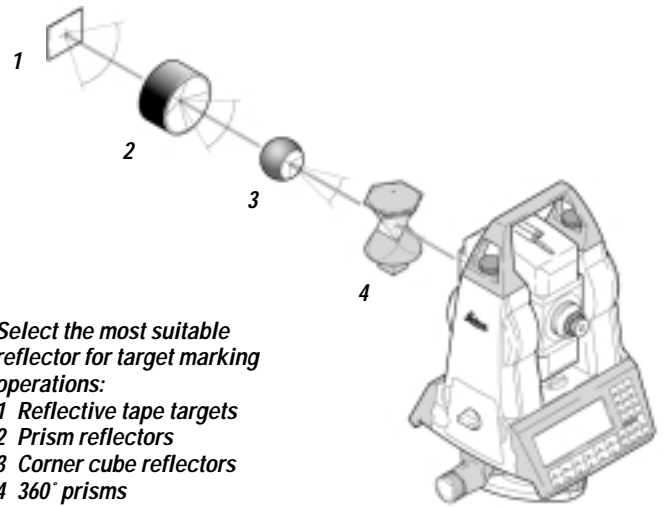
Industrial total stations – the TDM5005 and TDA5005



TDM5005, TDA5005



Instrument with Remote Control



Select the most suitable reflector for target marking operations:
 1 Reflective tape targets
 2 Prism reflectors
 3 Corner cube reflectors
 4 360° prisms

Angle + distance measurement = total station. This facility can be used to measure 3-D coordinates with just one instrument – with an accuracy which conforms to stringent industrial requirements.

The distance measuring device

The standard model TDM5005 Total Station, and the TDA5005 special version are equipped with a distance measuring device. As well as angle measurements, distance measurements to different types of reflectors can also be performed. In a matter of seconds, you can measure distances with a typical accuracy within 0.5 mm over a measuring range of up to 120 metres.

Reflectors

The following types of reflector can be used with the TPS5000 series of total stations:

- 1 **Reflective tape targets** – cost-effective target markers for use with large numbers of measuring points
- 2 **Prism reflectors** – for standard surveying tasks
- 3 **Corner cube reflectors** – for maximum precision requirements
- 4 **360° prisms** – for tracking operations to satisfy low-precision requirements

The “low-cost” tracker

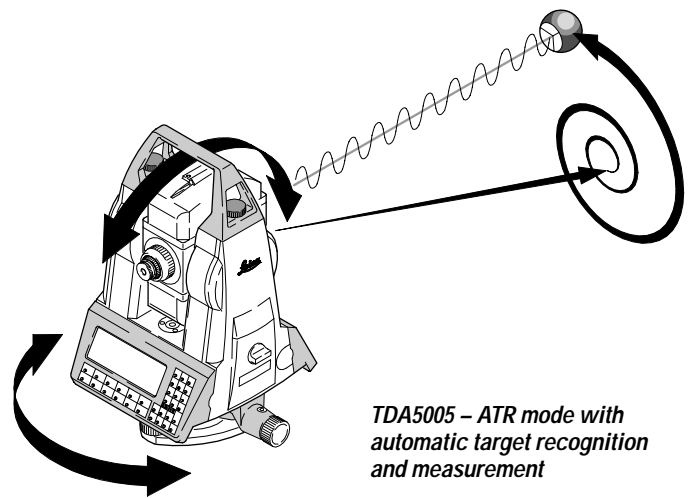
The TDA5005 features **Automatic Target Recognition (ATR)** which is used by the instrument to locate a target (reflector), to centre it and to initiate the measurement of angles and distance. The **lock-in mode** allows tracking to the next measuring point – the same features that are found in a Leica Laser Tracker.

Remote control

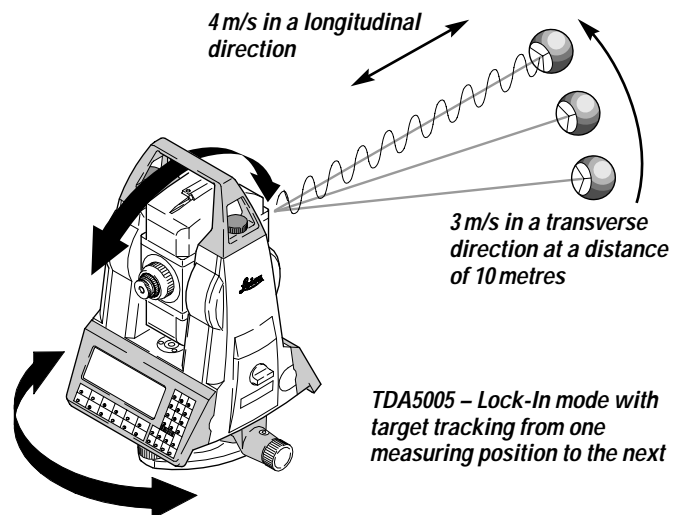
With the aid of a **wireless remote control unit**, the user is able to control the measuring process from the object space by deploying the TDA5005 in **one-man mode** without the need to stand behind the instrument, as was previously required. This means that the user is free to concentrate on production or inspection tasks.

Automated measurement cycles

The automated features incorporated in the TDA5005 simplify adjustment and inspection operations while performing component measurements. In this way, the TDA5005 opens up new possibilities in 3-D coordinate metrology.



TDA5005 – ATR mode with automatic target recognition and measurement



TDA5005 – Lock-In mode with target tracking from one measuring position to the next

Accessories

All the instruments in the TPS5000 series can be fitted with various accessories so that they can be individually adapted to suit the particular tasks or ambient conditions:

1 DL2 diode laser

For target alignment, rapid target location with contact-free marking of target points or as an essential tool for setting out reference points.



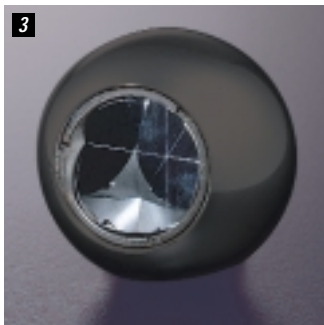
2 Diagonal eyepiece

For observations with very steep lines of sight. The eyepiece can be pivoted in a vertical plane in order to allow optimum viewing at every inclination of the telescope.



3 1.5" Corner Cube Reflector (CCR)

For precision distance measurements. The large spherical surface allows accurate alignment of the reflector. The reflector is attached with magnetic mounts.



4 Reflective tape targets

The inexpensive alternative for many applications. They are used for marking the target points and can be supplied in different versions.



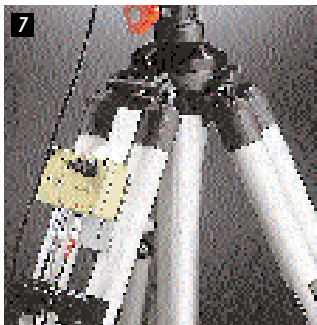
5 Auto-collimation eyepiece

Can be fitted onto theodolites without built in device.



6 PCMCIA memory card

With a capacity of 0.5 or 2.0 MB (4500 to 18 000 data blocks) for use when operating instruments in offline mode.



7 Industrial tripods

Made from aluminum tubing with quick-action connectors and flat, non-slip feet. Includes bracing and height adjustment for setting up instruments at a height of up to 2.8 metres.



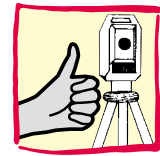
8 RCS1100 remote control unit

Using the RCS1100 remote control unit, operation of the system is, in the truest sense of the word, in the hands of the operator.

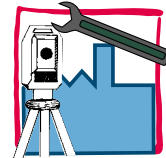
Product support services

A product must be capable of being operated reliably for many years. For this reason, Leica applies the principle of Total Quality Management (TQM), which covers the entire process from product design to

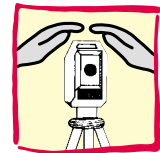
customer support during use. This means that ISO 9001/14001 is not a necessary evil but rather a standard to which Leica aspires – for your ultimate benefit.



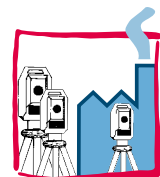
Re-certification



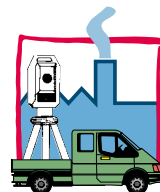
Annual inspection



Maintenance contracts



Standby instruments on loan



Instruments and systems for hire

Training and support

It goes without saying that comprehensive system training is provided. For this purpose, process-orientated training manuals are supplied for use as reference works containing details of typical processes for the principal routine operations.

Your particular application and the Leica systems are coordinated to optimum effect. This not only involves operator training but also incorporates your own internal processes, including quality assurance, production, design, etc. We assist you in deriving the maximum benefit from your system.



Maintenance and service

You are never far away from an authorised Leica service support. The services offered include:

- Re-certification, with reference to international standards
- Annual inspections
- Maintenance contracts tailored to suit your individual requirements
- Standby instruments available on loan while servicing work is in progress or in the event of failures
- Instruments and systems available for hire



Technical data

TPS 5000

Angular measurement	
Standard deviation	0.5", Hz 0.15 mgon
as specified by DIN 18723, 1 σ ¹⁾	0.5", V 0.15 mgon
Units of measurement	360° sexagesimal, 400 gon 360° decimal, 6400 mil
Display (smallest selectable unit)	0.01 mgon; 0.1", 0.00001", 0.00001 mil
Automatic reference to the horizontal	
Working range, longitudinal/lateral	2-axis liquid compensator 3' (0,055 gon)
Setting accuracy	≤ 0.3" (0,1 mgon)
Displays	
	LCD (liquid crystal display) 8 rows of 35 characters each 6 status fields
Logging	
	PCMCIA memory card or via RS232 (0/5 V) interface
Motor and fine drives	
Fine drives	Coarse/fine, motorised, infinite, slip coupling
Motor	
Positioning accuracy	0.7", 0.2 mgon
Speed of rotation	45°/s, 50 gon/s
Power supply	
Plug-in battery pack	12 V/1.8 Ah, rechargeable
External power source	Any 12 V battery, e.g.: GEB70, GEB71 or connection to the system supply
Temperature range	
Measurement	-4 °F to +122 °F, -20 °C to +50 °C
Storage	-40 °F to +158 °F, -40 °C to +70 °C

¹⁾ Producer inspection certificate available as an option

²⁾ In comparison with the Leica Laser Tracker

³⁾ Producer inspection certificate (in accordance with
DIN 55350-18-4.2.2) included with the instrument

⁴⁾ Eyepieces with different magnification factors and diagonal
eyepieces are also available

Automatic Target Recognition, ATR

Laser Class I as defined by IEC 823-1 or EN 60825-1

Laser Class I as defined by FDA 21 CFR Ch. I §1040

TDM/TDA5005

Point accuracy (RMS) ²⁾	≤ 0.3 mm/0.012" (at 20 m/65 ft measuring volume)
Distance measurement (integrated in the TDM5005 and TDA5005)	
Standard deviation (absolute)	1 mm + 2 ppm/0.04" + 2 ppm (1 σ) over the entire measurement range
Typical distance accuracy ³⁾ reflective tape	± 0.5 mm/0.02" (1 σ) (at 120 m/ 365 ft measuring volume)
Corner cube reflector	± 0.2 mm/0.008"
Units of measurement	m, mm, feet, inch
Display	0-5 decimal places, dependent on the selected unit
Reflectors (selectable)	
	Prisms, Corner Cube reflectors (1.5" diameter), Leica reflective tapes, 360° prisms
Measurement range with CCR	
	Approx. 600 m/1975 ft (dependent on atmospheric conditions)
Measurement range with reflective tapes	
	200 m/660 ft (dep. on the size of the tape, max. 60 x 60 mm)
Automatic Target Recognition (integrated in the TDA5005)	
Tracking speed lateral	3 m/s (10 ft/s) at a distance of 10 m/33 ft
longitudinal	4 m/s (13 ft/s)
Measurement range	up to 1000 m/3300 ft (depend- ent on the type of reflector)

TM5100A

Telescope type	Pan-focal alignment telescope
Image	erected
Unobstructed lens diameter	52 mm/2"
Field of vision diameter at 100 m	2.08 m/6.8 ft, non-linear
Shortest target range	0,6 m/2 ft
Focussing	Coarse/fine
Magnification with the FOK53 standard eyepiece ⁴⁾	Dependent on the Focusing distance
Optical sighting tool (dioptr)	Either side of the telescope
Range of inclination, telescope positions I and II	-60 gon (-55°) to +52 gon (47°)



Leica Geosystems AG, Unterentfelden,
Switzerland, has been certified as being
equipped with a quality system which
meets the International Standard of Quality
Management and Quality Systems
(ISO standard 9001) and Environmental
Management Systems (ISO standard 14001).

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