

# The Power of Choice

L A S E R S   B Y   T R U M P F

# The Power of Choice

Modern laser technology can achieve outstanding results in almost any manufacturing process while making efficient use of resources. When it comes to developing new products, you can rely on light to provide the right tool for your production environment! To ensure you get exactly the technology and support you need, TRUMPF offers a unique range of lasers and laser systems combined with global application consulting, integration support, and comprehensive after-sales service. Put simply, that's the Power of Choice.



How laser technology from TRUMPF is helping to shape some of the biggest trends in manufacturing and society.

## **Industries and Trends** 4–7



How to find out which laser technology offers the best solution for you.

## **Applications and Technologies** 8–9



How TRUMPF can help you transform a product concept into a manufacturing process.

## **Know-how and Support** 10–11



Learn more about the benefits of each type of laser in the TRUMPF product range.

## Laser Beam Sources 12–33



How to kit out your laser with focusing optics and sensors to make your manufacturing process even simpler and more reliable.

## Components 34–41



How TRUMPF lasers' interfaces and control options ensure smooth integration in your production environment.

## Integration 42–43



How to get the right support from TRUMPF at the right time – and delve even deeper into the world of TRUMPF.

## TruServices. Your Partner in Performance 44–45



Discover the wide variety of TRUMPF laser technologies in our film **"The Power of Choice"**:  
[www.trumpf.info/fmpr6x](http://www.trumpf.info/fmpr6x)



# Your industry, our motivation

TRUMPF lasers are used in a variety of industries, from cutting micrometer-thin shapes out of display glass to welding centimeter-thick metal for wind turbines. As a key technology leader, TRUMPF is continuously investing in research and development for new technologies and potential future applications. We're very much aware of the major trends shaping our society – and they give us the motivation to seek even better solutions for your innovative, efficient, and high-quality production processes.



See the versatility that working with laser tools offers across all industries: [www.trumpf.com/s/kecj9f](http://www.trumpf.com/s/kecj9f)

## Mobility



We may not have reached the stage where our lasers can beam people from one place to another – but they have already proven their ability to support the mobility and logistical

requirements that keep our society moving. That includes making cars more efficient, trains lighter, aircraft safer, and ships more stable. Our lasers are also helping to shape frontline themes such as e-mobility.

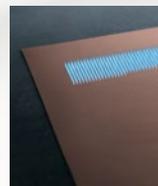
– kg

Lightweight construction with finely rendered laser weld seams leads to reduced fuel consumption and lower CO<sub>2</sub> emissions.

# 13.5 nm

is the wavelength of the EUV light used to produce microchips, delivered by the TRUMPF Laser Amplifier.

## Communication



Effective communication is a must in today's smart world. Our lasers provide solutions for one of the key processes at the heart of modern technical communication systems – chip manufacturing. As part of Industry 4.0, TRUMPF is also pushing ahead with numerous solutions to digitally connect up production environments.

# 100 cm<sup>2</sup>/s

is the ablation rate of our short pulsed lasers, which facilitate the cost-effective production of thin-film solar modules.

## Energy



Is saving energy a key priority for you and your industry, too? Our highly efficient lasers open the door to energy-efficient production and help make your components lighter and tougher.

TRUMPF lasers offer energy-saving solutions in the wind power and photovoltaic sectors, as well as in many other areas.

# $1 \cdot 10^{-12}$ s

Stents cut from nitinol or polymer using pico-second lasers reveal a high-quality, smooth surface which leaves no footholds for deposits to build up. That helps arteries stay open over the long term.

## Health



TRUMPF lasers are used in medical device manufacturing to create precisely rendered microstructures – and the results are already having a major impact on people's health and quality of life. TRUMPF is also working together with the Max Planck Institute to develop atto-second laser technology that could, in the future, be used to detect tumors as small as 1 mm.





# Your needs, our support

Whether you already know exactly what you want or are looking for a tailor-made solution, we're at your side right from the word go. The laser is a unique tool – and we're passionate about the opportunities it offers. TRUMPF has Laser Application Centers (LACs) all over the world ready to cater to your needs. Because we believe you should always be able to find the right partner in the right place – with exactly the right technology to meet your needs.

## Tap into TRUMPF as ...

### ... a project consultant

"We can provide you with advice and support from product conception through to production optimization. If the production process is defined in one of our LACs, then we can help you find an integrator if you need one. We'll work together with you to get the production process up and running, and then optimize it until you are completely satisfied with the results."

Antje Engler, Sales, Detroit



USA:  
Farmington

Switzerland:  
Grüsch & Baar

USA:  
Plymouth



### ... a service partner

"Our tailor-made packages of support and after-sales service help keep your business running smoothly. If something goes wrong, our comprehensive remote services can quickly get things back on track. We also offer an extensive range of on-site training programs, upgrades, and application services."

Bastian Becker, Services, Ditzingen



**... a technology developer**

“We’ve been developing lasers at TRUMPF for more than 40 years. Time and again we have transformed visions into reality with the help of our research partners. And now you can use this extraordinary know-how to gain a competitive edge. Take our innovative ultrashort pulsed lasers, for example. My project partners and I received the ‘German Future Prize’ for our work in this field – and it has already yielded a wealth of successful applications.”



Dirk Sutter, Head of Development Group for Ultrashort Pulsed Lasers, Schramberg



Find out more about how we can assist you with our Laser Application Centers here: [www.trumpf.com/s/7smpv](http://www.trumpf.com/s/7smpv)

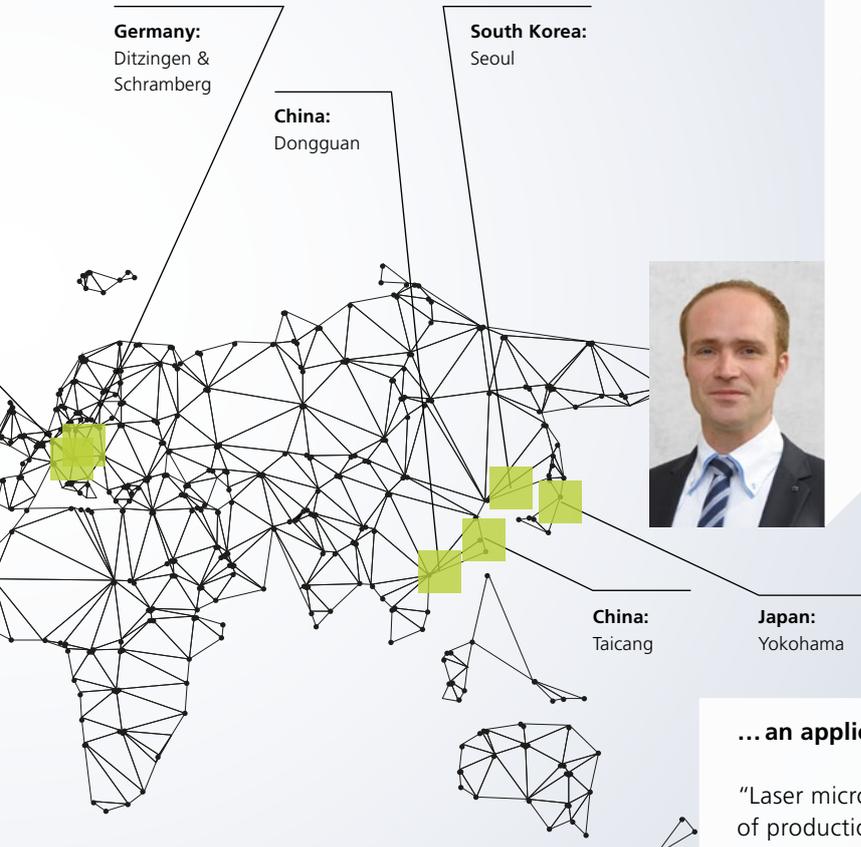


**... an industry sector manager**

“We take a unique industry sector approach that offers you support long before you start using our lasers on your production line. For example, I can give you ideas on how to design your product to make it suitable for laser machining. I specialize in lightweight construction, helping customers from the automotive and other industries to exploit the full potential of laser technology and develop tailor-made solutions.”



Marc Kirchhoff, Industry Manager for Lightweight Construction, Ditzingen



**... an applications specialist**

“Laser microprocessing is currently making its way into the world of production, with more and more customers taking notice of our wide range of ultrashort pulse lasers. My team and I are by your side to provide optimal economic process solutions, from the feasibility study all the way to first-time operation. To support our customer we rely on our broad positioning comprising application consultants, highly qualified application specialists, my many years of experience in the development of laser production systems, and a far-reaching network of globally active integrators.”



Christoph Neugebauer, LAC-Ditzingen Micro Group Leader

# Your production, our portfolio

## Solid-state lasers



**TruDisk  
14–17**



**TruDiode  
18–21**



**TruFiber  
22–23**



**TruDisk  
Pulse  
24–25**



**TruPulse  
26–27**



**TruMicro  
28–29**

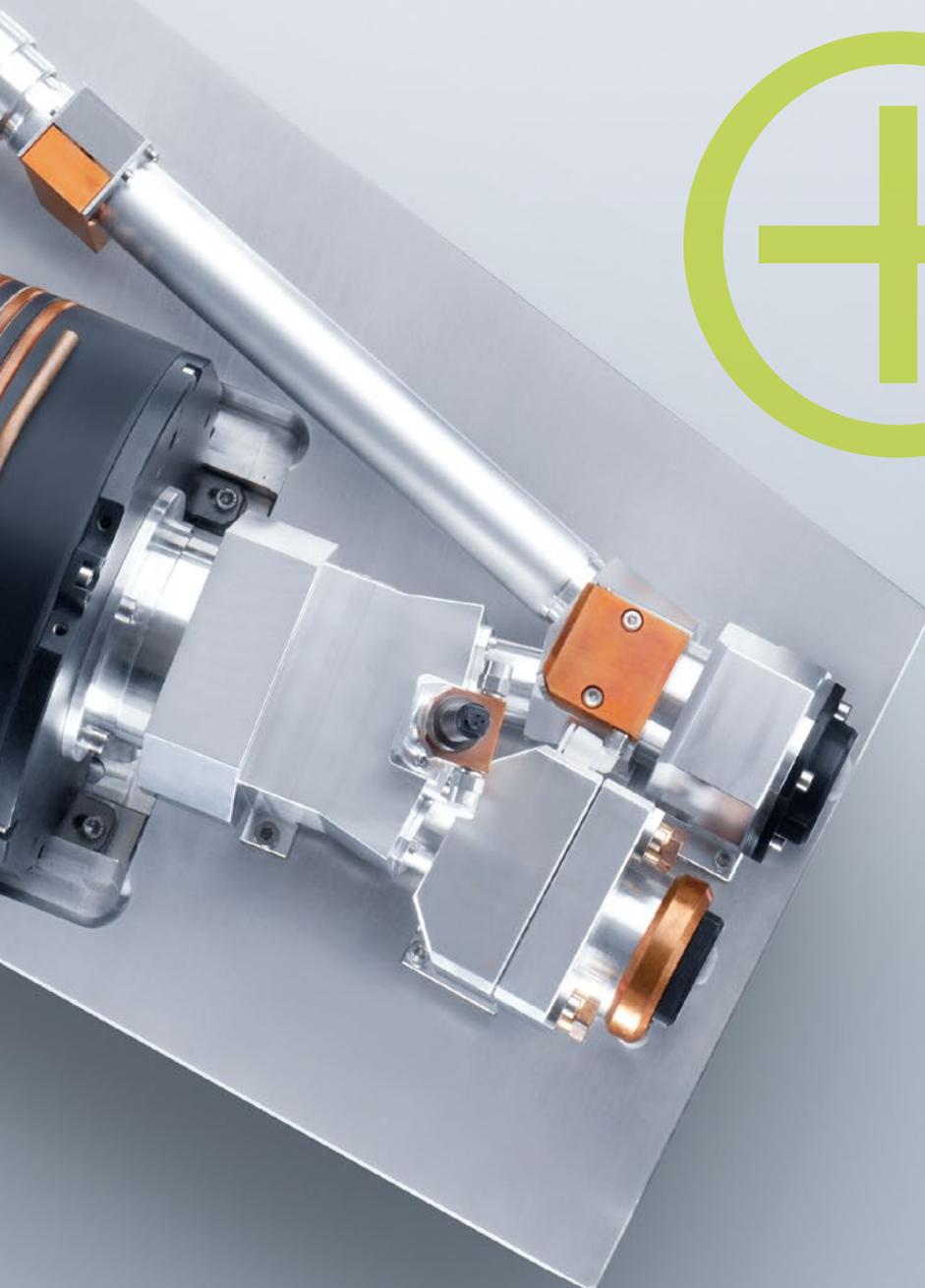


**TruMark  
30–31**

## CO<sub>2</sub> lasers



**TruFlow  
32–33**



### Why choose TRUMPF lasers?

- 1 Innovative solutions
- 2 Maximum precision and quality
- 3 Comprehensive range of products
- 4 Global application consulting
- 5 Many years of experience
- 6 Industry experts
- 7 High availability (remote services)
- 8 On-site service
- 9 Customized services
- 10 Industry 4.0 ready

	TruDisk	TruDiode	TruFiber	TruDisk Pulse	TruPulse	TruMicro	TruMark	TruFlow
Welding	■	■	■					■
Precision welding	■	■	■	■	■			
Deposition welding	■	■						
Brazing	■	■						
Plastic welding		■						
Cutting	■		■	■				■
Precision cutting	■	■	■	■	■	■		
Drilling and ablation				■	■	■	■	
Hardening	■	■						
Additive manufacturing	■	■	■					
Marking						■	■	

# TruDisk

01

## Maximum beam quality

thanks to disk geometry

02

## Optimized for Industry 4.0

with intelligent hardware

03

## Ultracompact and easy to maintain

thanks to its modular design

04

## Flexible cooling concept

Inlet temperature of up to 38°C with integrated cooler



The TruDisk disk laser provides you with immense power coupled with maximum beam quality for manufacturing. It is the ideal partner for high-speed cutting, welding, and surface treatment.

08

## Stable processes

thanks to smart software

07

## Always reproducible results

thanks to 100 % constant power

06

## Resistant to back reflection

thanks to the patented resonator design

05

## Save energy

thanks to the high level of operating efficiency and efficient pulse function



Find out more about the benefits and applications of the disk laser here:  
[www.trumpf.com/s/sik0v2](http://www.trumpf.com/s/sik0v2)

01

## Maximum beam quality

thanks to disk geometry

Using a disk as a laser medium ensures brilliant beam quality – as low as 2 mm-mrad with TruDisk lasers. With a power range of 1 kW to 16 kW, you can achieve optimal results in a wide range of processes, from laser welding and cutting to deposition welding, hardening, and generating of 3D parts.



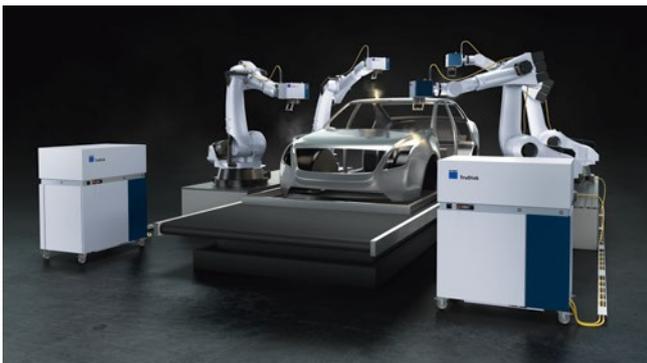
With the disk geometry, maximum power and beam quality are not mutually exclusive.

02

## Optimized for Industry 4.0

with intelligent hardware

The TruDisk is the ideal interface for your smart production: It is capable of synchronized data recording from all sensors and provides high-quality information for virtual analysis. This can be read out via the OPC UA interface on the laser. This enables the laser to create the ideal hardware conditions for services such as Condition Monitoring and Predictive Maintenance.



The TruDisk provides everything needed for smart production.

03

## Ultracompact and easy to maintain

thanks to its modular design

There is nothing smaller: Save space with an installation surface of less than 1 m<sup>2</sup> – including the cooling system! The modular design of the TruDisk also makes it extremely easy to service – individual components can be replaced quickly and easily. This saves time and increases machine availability.



Robust and modular optics setup of the TruDisk.

04

## Flexible cooling concept

Inlet temperature of up to 38°C with integrated cooler

The TruDisk uses a flexible cooling concept. You can choose between the standard variant with integrated heat exchanger and the optional integrated compressor cooler depending on the temperature of your water supply. This does not change the compact installation space of the laser. If a cooling water supply is available, you can forgo using an external cooling unit entirely.



TruDisk with integrated heat exchanger.



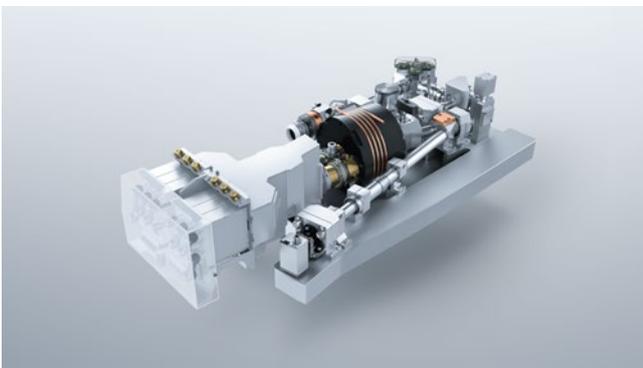
TruDisk with integrated compressor cooler.

05

## Save energy

thanks to the high level of operating efficiency and intelligent pulse function

Enjoy the benefits of a high level of operating efficiency and an efficient pulse function. This enables the diode current of the disk laser to be reduced to 0 A, even during extremely short pauses in work. For longer processing breaks, the intelligent energy management of the TruDisk laser ensures consistent energy efficiency in operation – both during laser-on times and laser-off times.



The diode current switches off completely, even during extremely short processing breaks in work. This saves you unnecessary energy costs.

06

## Resistant to back reflection

thanks to the patented resonator design

Thanks to its patented resonator design, your TruDisk can easily handle even strong back reflections. This enables you to process even highly reflective materials, such as copper and other nonferrous metals, without compromises. The disk laser is likewise unaffected by harsh environmental conditions such as cold, heat, dust, high humidity or vibrations, and continues to work reliably in spite of any such conditions.



The TruDisk cuts a wide range of materials and sheet thicknesses.

07

## Always reproducible results

thanks to 100% constant power

With the TruDisk, you can benefit from the highest power stability available on the market – throughout the entire service life of your laser. When using the TruDisk, you can expect 100% constant power right from the first millisecond. This enables you to achieve absolutely reproducible results, around the clock.



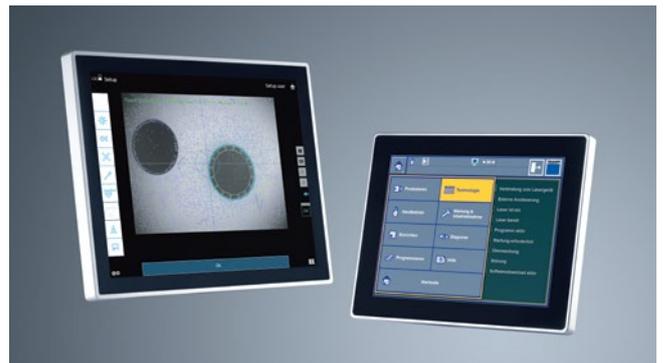
Precisely welded seams on an automobile chassis.

08

## Stable processes

thanks to smart software

This software makes your processing easier and enables you to achieve perfect machining results: TruControl is compatible with all standard fieldbus systems. Precisely program the specific pulse shapes that your application requires. CutAssist and quality data storage are available as software options. They help you to achieve high-precision cutting processes and to record and export all process settings.



Optimize your processing with the appropriate software: This enables you, for instance, to program specific pulse shapes to suit your process.

# TruDiode



01

**100% constant power**

regulated in real time

02

**> 40% efficiency**

with minimal running costs

Compact direct diode lasers are tremendously energy-efficient and produce outstanding results in applications such as deep penetration welding, heat conduction welding, deposition welding, brazing and plastic welding.

05

## Extremely compact

and easy to maintain

04

## Flexible upgrade options

and versatile uses

03

## Always ready for action

throughout its service life



You can find even more information about the TRUMPF diode lasers here: [www.trumpf.com/s/98kd4q](http://www.trumpf.com/s/98kd4q)



01

**100% constant power**

regulated in real time

The power of the TruDiode laser is regulated in real time and is completely independent of the laser’s environment and service life. With its high beam quality and power levels ranging from 150 to 6,000 W, the laser guarantees optimum and reproducible workpiece results from the very first milli-second. All that at a low capital cost and with minimal running costs!



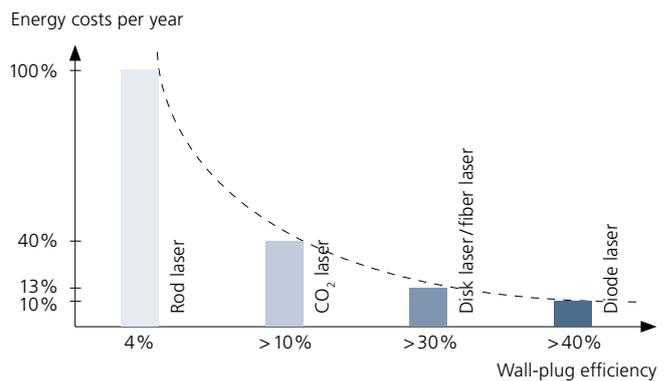
High-quality weld seams: Welding plastic with a TruDiode.

02

**>40% efficiency**

with minimal running costs

TruDiode lasers are extremely energy-efficient and feature very high wall-plug efficiency. The intelligent cooling system with a built-in heat exchanger often eliminates the need for an external cooling solution. You’ll be amazed by the low running costs of your direct diode laser!



Comparing lasers of the same power.



03

## Always ready for action

throughout its service life

Passively cooled diode modules maximize the laser's service life. The diode cooling water is also used to cool the optics and laser light cable – a reliable, noncorroding solution. You also benefit from the wear-free properties of laser machining and a steady, constant application of energy to the workpiece.



Compact 19" version of the TruDiode 301.

04

## Flexible upgrade options

and versatile uses

It's easy to upgrade your TruDiode laser even after it's been installed. For example, you can make on-site adjustments to both the laser power and the number of workstations served by the laser. And the TruDiode is just as versatile when it comes to applications, welding plastics or metals either with or without filler material.



A laser brazed component.

05

## Extremely compact

and easy to maintain

With its modular, space-saving design and a footprint of just 1 m<sup>2</sup>, you'll find it easy to integrate the TruDiode into your existing production systems. The modular design concept means that you can even replace some components yourself – quickly and easily!



Optical arrangement from a TruDiode 6006.

# TruFiber

Designed for precision tasks, fiber lasers can meet your requirements for high process speeds, small kerf widths, and narrow weld seams.

01

**Precise and dynamic**  
thanks to maximum beam quality

04

**Intelligence included**  
as part of the package



02

**100% constant power**  
throughout the laser's entire service life

03

**Perfect edges and curves**  
thanks to assistance software

01

## Precise and dynamic

thanks to maximum beam quality

The best possible fundamental mode beam quality for extremely fine contours: The typical focus diameter is 10 to 50  $\mu\text{m}$ . The beam quality generates a massive power density on the workpiece, which can be translated into high machining speeds, particularly in applications on thin metal sheets. The fundamental mode beam quality also enables more stable locking conditions for materials that are difficult to weld, such as copper. In conjunction with beam oscillation via the scanner optics, this enables high-quality weld seams to be produced.



Optical arrangement in a TruFiber fiber laser.

02

## 100% constant power

throughout the laser's entire service life

The integrated active laser power control ensures stable processes and, as a result, repeatable machining results. Control is performed automatically and in real time – regardless of the ambient conditions – throughout the entire tool life of your laser.



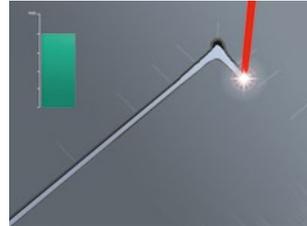
A watch hand cut with precision – thanks to real-time power control.

03

## Perfect edges and curves

thanks to assistance software

The CutAssist option is designed to help you with precision cutting and welding. It automatically adapts the laser parameters to the cutting speed, ensuring high-precision results even for sharp corners and curves without having to search for new parameters.



Untidy edges without in-line tailoring of laser parameters.



Precision laser cutting with CutAssist.

04

## Intelligence included

as part of the package

For installation with 19" housing or as a free-standing variant: Your TruFiber laser includes the TruControl intelligent control system for convenient operation. The package includes: frequency generator, pulse shaping, real-time power control, diverse interfaces, power distribution, performance Level e safety circuit and software. The machining optics can be conveniently cooled via the laser.



Stand-alone version of the TruFiber laser with built-in cooling system.



Are you interested?  
You can find out everything else about the TRUMPF fiber laser here:  
[www.trumpf.com/s/nto43r](http://www.trumpf.com/s/nto43r)

# TruDisk Pulse

The green specialist tool for copper contacts and fine welding seams.

01

## Processing highly reflective materials

with green light and disk technology

04

## Ideal for all surfaces

whether oxidized, sand-blasted, etched or highly polished



02

## Minimal spatter

thanks to uniform heating

03

## Process thin materials

with a precise welding penetration depth

01

## Processing highly reflective materials

with green light and disk technology

Green light is better absorbed than infrared light when machining highly reflective materials such as copper. The improved absorption of green light generally leads to a manifold increase in absorption of the laser power by the workpiece. With a pulse peak power of up to 4 kW, the green pulses enable quick, highly efficient welding processes – a particularly important benefit for the electronics industry. Thanks to the extremely low scattered radiation produced by these pulses, you can almost always work without additional shielding for temperature-sensitive electronic components.

02

## Minimal spatter

thanks to uniform heating

The optimal input coupling of the green laser beam ensures smooth weld pool dynamics. This makes the TruDisk Pulse ideally suited for machining your electronics and electrical products. The material is heated evenly, and you can consistently achieve a repeatable, almost spatter-free process with an improved tolerance range. This enables you to prevent expensive reject parts or even undetected faults in components as well as short circuits.



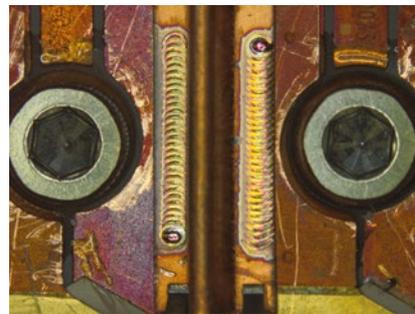
Repeatable results with minimal spatter thanks to green pulses: When carrying out spot welding, the diameter and depth remain reliably consistent throughout.

03

## Machine thin materials

with a precise welding penetration depth

Always maintain complete control: With the TruDisk Pulse, you can carry out welding even in very thin materials – with no risk of heat affecting the substructure. This enables you to, for example, reliably machine electronic components quickly and precisely without causing long-term damage.



The most precise results possible: Laser-welded direct copper bonding. The sensitive ceramic substructure is not affected by this process.

04

## Ideal for all surfaces

whether oxidized, sand-blasted, etched or highly polished

With the green TruDisk Pulse, you always achieve the same high level of quality in your welding results without needing to carry out readjustments, for various copper surfaces: oxidized, sand-blasted, etched or highly polished. The smooth process using green light ensures that you produce very robust copper welds with consistent quality. You can even work without any expensive upstream surface treatment processes such as sand blasting or tinning.



Expect the best results on any copper surfaces.

# TruPulse

Pulsed solid-state lasers emit short, powerful bursts of light. That makes them perfect for spot and seam welding as well as cutting.

01

**Versatile and easy to maintain**  
thanks to its modular design

05

**Welding know-how**  
built in



02

**100% constant power**  
keeps your processes stable

04

**100-fold higher peak pulse power**  
for higher productivity

03

**High-precision 10  $\mu$ s pulses**  
get the job done where others fail

01

## Versatile and easy to maintain

thanks to its modular design

The TruPulse portfolio features a wide range of products – and whichever model you choose can be tailored precisely to your manufacturing environment. Thanks to the modular design of the TruPulse system, all its components can be repaired or replaced on site should the need arise. Equipped with up to six laser fibers, the versatile TruPulse can serve one or more processing stations at a time through energy- or time-sharing configurations.



Thanks to their modular optics system, TruPulse lasers can be adapted to each and every requirement.

02

## 100% constant power

keeps your processes stable

Real-time power control ensures that the output power reaching the workpiece matches your settings perfectly. That creates stable processes and reproducible results over the entire service life of your laser – regardless of the ambient conditions. And that makes the TruPulse the perfect tool for even the trickiest applications.



Stable process parameters are a must when it comes to creating nonporous, heliumtight weld seams in pacemakers.

03

## High-precision 10 $\mu$ s pulses

get the job done where others fail

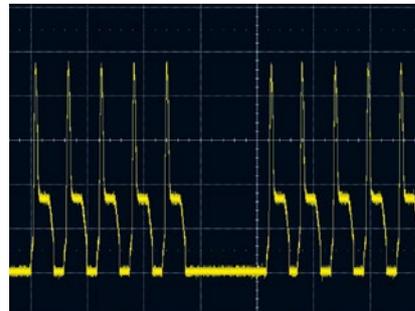
With a pulse rate of 10  $\mu$ s, the laser can closely match the actual pulse shape to the desired pulse shape. That means you always get the graphically programmed shape combined with superior pulse-to-pulse stability. A pulse power of several kilowatts for a few milliseconds makes welding and cutting possible in situations that are beyond the scope of other methods.

04

## 100-fold higher peak pulse power

for higher productivity

The burst function works like a dam: The average power is allowed to build up and can be quickly released at a much higher level. The resulting cluster of laser pulses minimizes your cycle time, enabling you to achieve extremely high productivity. In addition, this often has lower requirements in terms of average power – meaning that you can save money when purchasing a laser.



The burst function minimizes the cycle time and maximizes the productivity of your production process.

05

## Welding know-how

built in

The WeldAssist option recommends the best settings for the welding parameters, pulse shape and focus position depending on the material, thickness and weld depth. That reduces the time required to set up each new application. What's more, the system can store the parameters so that you can use exactly the same weld settings in the future.



Visit our website if you would like to know more about the TruPulse:  
[www.trumpf.com/s/ky1lnq](http://www.trumpf.com/s/ky1lnq)

# TruMicro

Whether you need them for patterning, ablating, cutting or drilling, industry-proven short and ultrashort pulsed lasers are a great addition to your microproduction facilities.

01

## Intelligent laser control

with cutting-edge pulse control

05

## Customized pulses

pulse duration, energy and wavelength for specific applications



02

## No heat transfer

thanks to high-energy ultrashort pulses

04

## Exceptional machining

thanks to reliably high beam quality

03

## Easy integration

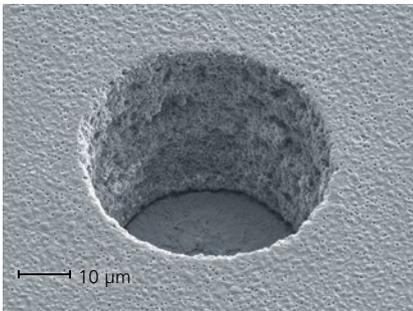
into any production environment

01

## Intelligent laser control

with cutting-edge pulse control

Simply smart: The ultraquick power modulator maintains the power and pulse energy at exactly the required level, regardless of external factors. With pulse picking, switchover with single-pulse precision (pulse on demand) and pulse-specific control of pulse trains (burst), pulse energy, and pulse intensity you always have the pulse you need. For ideal results from complex tasks – around the clock in industrial use.



The TruMicro 5000 features high-precision pulse control – perfect for cleanly cutting a hole in a circuit board.

02

## No heat transfer

thanks to high-energy ultrashort pulses

The high-energy ultrashort laser pulses immediately remove material once they strike the workpiece. Any heat transfer that takes place is either intentional or negligible. Thanks to this “cold machining”, you can machine even temperature-sensitive materials and implement ultrafine and free geometries. The extreme peak intensity of ultrashort pulses enables you to machine any materials, regardless of their reflectivity, hardness or transparency.



With TruMicro you can make the impossible possible!



Its high peak intensities allow you to machine brittle and transparent materials.

03

## Easy integration

into any production environment

TruMicro lasers are designed to integrate easily into your current setup. Compatible with all standard interfaces and bus systems, they slot neatly into your existing production environment. The laser light is guided safely to the workpiece by our special range of beam guidance components and optics that are optimized for the peak intensities of ultra-short pulsed laser technology.

04

## Exceptional machining

thanks to reliable high beam quality

Patented further developments ensure a high beam quality and beam roundness with maximum stability, which is crucial for many applications. The high beam quality remains stable thanks to the disk and fiber architecture, and the intensity distribution across the workpiece remains constant – even at green and ultraviolet wavelengths. The pulse duration is not affected by the repetition rate. All of these features guarantee ideal and stable machining results.

05

## Customized pulses

pulse duration, energy and wavelength for specific applications

The bandwidth of the TruMicro ultrashort pulse laser provides you with maximum productivity and suitability for industrial applications in all wavelengths, from infrared to green to ultraviolet. The various laser parameters, burst function, adjustable pulse duration, and adjustable pulse frequency laser parameters are supplemented by a wide array of software features.



You can find everything you need to know about the TRUMPF short and ultrashort pulse lasers here: [www.trumpf.com/s/ultrashortpulsedlasers](http://www.trumpf.com/s/ultrashortpulsedlasers)

# TruMark

TruMark lasers make it faster and easier than ever to achieve perfect marking results. They can create customized, permanent, high-quality markings on virtually any material.

01

## The freedom to choose

each and every time

04

## Immediate quality control

thanks to image processing



02

## Easy integration and automation

thanks to a broad range of functions

03

## Intuitive operation

through innovative solutions

01

## The freedom to choose

each and every time

You have access to the ideal solution in any laser class – for any materials, machining speeds, wavelengths and component geometries you wish to use. Depending on the application, fiber lasers with high average power or rod lasers with high pulse peak power are used. You can also use TruMark lasers for machining or cleaning surfaces, for example in order to prepare surfaces for welding or adhesive application.



The TruMark 5010 is a compact, all-in-one solution.

02

## Easy integration and automation

thanks to a broad range of functions

Whether you're looking to integrate a laser into your production line or install a laser workstation in a stand-alone capacity, TruMark offers you everything you need. Simply choose the optimum solution for your manufacturing environment from a wide range of models, interfaces, and software options. We can cater to everything from a single part to mass production – and we're always on hand to give you the advice you need.



Interface diversity for easy integration.

03

## Intuitive operation

through innovative solutions

TruMark lasers are easy, safe and quick to use, even for less experienced operators. This is ensured by intuitive operating software and innovative solutions for process equipment such as the pilot laser, the focus finder, the navigator or image processing solutions for automatic positioning of markings on the workpiece. These enable you to productively, flexibly, and cost-effectively create first-class markings.



Data Matrix code (DMC) and clear text for permanent traceability.

04

## Immediate quality control

thanks to image processing

Always on the safe side: With the VisionLine image processing package, codes are read out, evaluated and documented immediately after marking. Even the smallest DMC modules of less than 200 µm can be read out quickly and with exceptional resolution thanks to the shortened exposure times.



VisionLine uses image processing to check the quality of the marking.



Everything you want to know about marking using lasers:  
[www.trumpf.com/s/markinglasers](http://www.trumpf.com/s/markinglasers)

# TruFlow

Reliable and robust: CO<sub>2</sub> flow lasers offer an all-round solution for cutting and welding a wide range of materials.

01

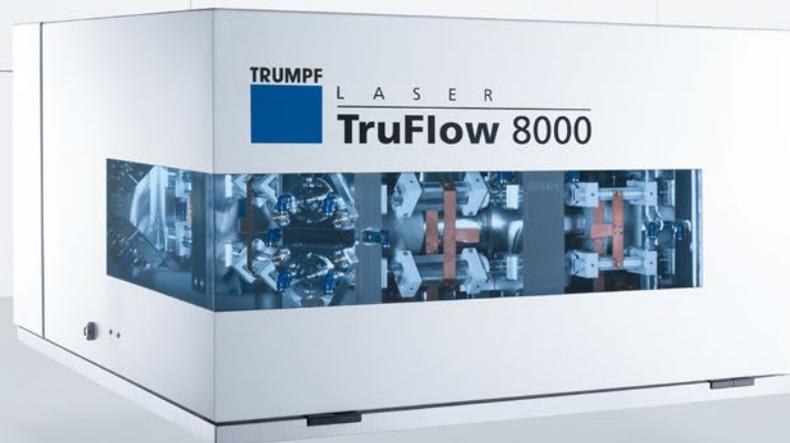
## Maximum stability

thanks to its compact, square design

05

## Reliable laser operation

thanks to continuous monitoring of the mirror



02

## 20% energy savings

thanks to cooling and energy management concepts

04

## Integrated beam guidance

for perfectly aligned laser light

03

## Minimal wear

thanks to superior technology

01

## Maximum stability

thanks to its compact, square design

Every TruFlow resonator undergoes its basic lifetime calibration in the clean room. The resonator's key components are water-cooled, and its compact, square design makes it extremely robust. It is not affected by changes in the ambient temperature. All of the parameters remain constant even at high laser powers – and no other system can match the stability of the TruFlow's beam output angle.



The stable resonator can even be installed on moving gantries.

02

## 20% energy savings

thanks to cooling and energy management concepts

The new and improved cooling system in your TruFlow reduces energy consumption by up to 20% and makes the TRUMPF CO<sub>2</sub> laser one of the most energy-efficient machines in its class. This is boosted even further by the TruFlow's intelligent energy management system.

03

## Minimal wear

thanks to superior technology

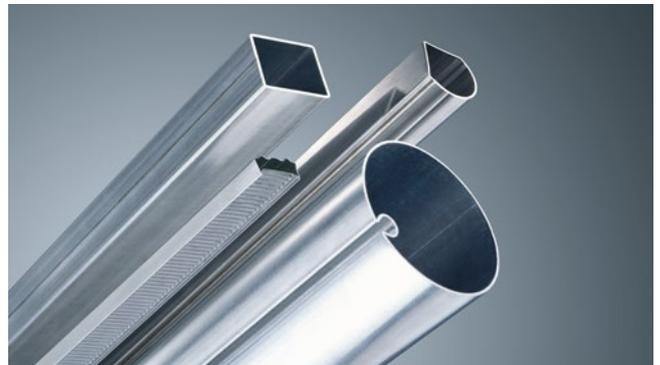
The TruFlow uses a wear-free system of gas circulation and radio-frequency excitation. The magnetically suspended turbo blowers ensure that no damage is caused by power outages or emergency shutdowns. Take advantage of the decades of development that have gone into this all-round laser machining solution.

04

## Integrated beam guidance

for perfectly aligned laser light

The fully encapsulated built-in beam guidance system that comes with your TruFlow prevents any accumulation of dirt that could cause the laser power to drop and the focus geometry to fluctuate. Additional functions for beam widening, pilot laser, and circular polarization are safely and compactly stowed under the hood of the laser machine.



Laser tube welding is also possible thanks to optimized beam guidance and beam shaping.

05

## Reliable laser operation

thanks to continuous monitoring of the mirror

The output mirror is one of the most highly stressed components of your laser. That's why the TruFlow continuously monitors the mirror to check its temperature and detect any contamination. That keeps your laser working smoothly.



A truck axle welded with a CO<sub>2</sub> laser.



You can find more information about the TruFlow here:  
[www.trumpf.com/s/1yiwem](http://www.trumpf.com/s/1yiwem)

# Programmable focusing optics

The processing optics are often the components, which are very close to your processing, when it comes to applying laser technology in your production environment.

01

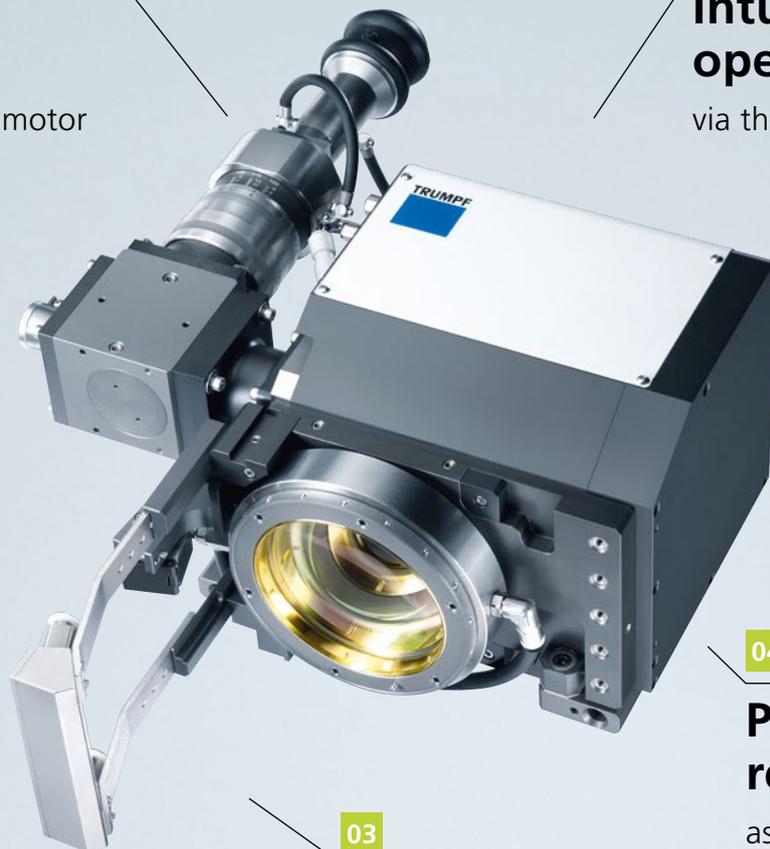
## Fast and accurate

thanks to dynamic motor control

05

## Intuitive operation

via the PFO SmartTeach app



04

## Process reliability

as a control circuit between the laser, PFO, and sensor is possible

02

## On-the-fly capabilities

through real-time synchronization of the scanner and robot

03

## A broad choice

for any application

01

## Fast and accurate

thanks to dynamic motor control

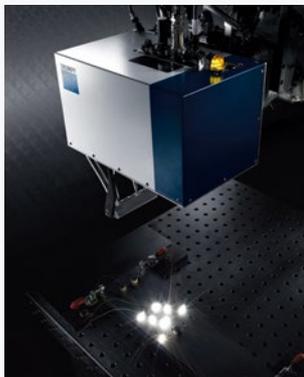
The use of cutting-edge drives in the PFO ensures that you receive your machining results quickly and precisely.

02

## On-the-fly capabilities

through real-time synchronization of the scanner and robot

Intelligent, real-time synchronization of the robot, laser, and PFO ensures precise positioning of the laser beam – that's welding on-the-fly at its best!

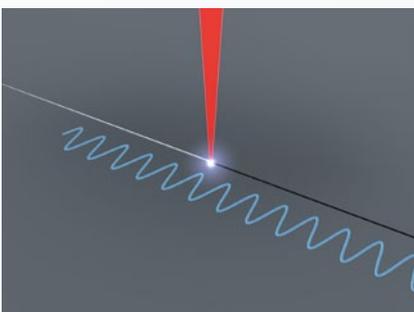


03

## A broad choice

for any application

The PFO portfolio includes focusing optics for any applications that use low-power or high-power lasers from the first to the third dimension, with up to 8 kW in cw mode and significantly higher output powers in pulsed operation. Individual optics are optimized for specific applications. For example, the PFO 1D is optimized for wobble. The ability to specifically adjust the wobble movement leads to optimum weld seam quality.



You can tailor the wobble geometry to meet your specific needs.

04

## Process reliability

as a control circuit between the laser, PFO, and sensor is possible

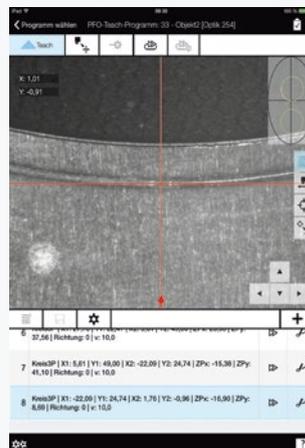
The programmable focusing optics are optionally available fitted with interfaces for TRUMPF sensor solutions such as CalibrationLine and VisionLine. CalibrationLine calibrates the beam position and laser power on the workpiece, while VisionLine detects the position of the workpiece and corrects the beam trajectory. The interaction between the laser, PFO and sensor system enables the adjustment of processes. This significantly increases the process reliability. In addition, external process sensor systems can be connected.

05

## Intuitive operation

via the PFO SmartTeach app

The PFO SmartTeach app enables you to intuitively and extremely quickly adjust laser programs, even while on the move. The camera mounted on the PFO transmits a live image directly to the app, and the app synchronizes your new or modified programs directly with the laser.



The PFO SmartTeach app is available from the Apple App Store. Users of the TruControl software will quickly feel at home with the familiar features.



You can find out more about programmable focusing optics here: [www.trumpf.com/s/bvunme](http://www.trumpf.com/s/bvunme)

# Focusing optics

The modular system for our focusing optics is suitable for any process, whether welding, cutting or surface treatment (e.g. hardening, cleaning or deposition welding). Select the right focusing optics for you from a wide range.

01

## The right optics

for your process

05

## Easy to integrate

into your machining lines



02

## Perfect weld seams

thanks to clever process gas management

03

## Robust and reliable

in everyday industrial settings

04

## Intelligent monitoring

with an overview of all process parameters

01

## The right optics

for your process

Up to 16 kW of output power for a focus diameter of just 10  $\mu\text{m}$  – you can be sure of getting optimum results with the right optics. Plenty of different options are available to ensure you find the best solution for every job, from right-angled optics to bifocal versions. TRUMPF also offers special optics for deposition welding with powder feed and for linear laser spots.

02

## Perfect weld seams

thanks to clever process gas management

The combination of top-quality lenses and protective glass monitoring ensures minimal focus shift and homogeneous welding results. Crossjet – a jet of gas that runs from one side to another in front of the lens protection module – also protects the lenses from contamination, while the patented metal vapor effect nozzle produces more stable welds. That ultimately makes for perfect seams on both sides of the weld.



The supply of shielding gas optimizes the welding result.

03

## Robust and reliable

in everyday industrial settings

TRUMPF focusing optics work consistently over years of operation – more than 10,000 are in industrial use worldwide. They offer impressive service life and reliability.

04

## Intelligent monitoring

with an overview of all process parameters

You can easily set and monitor custom limit values for the required protective gas or compressed air. Lighting and camera monitoring can be integrated, enabling easy integration of the offline and online process monitoring systems.

05

## Easy to integrate

into your machining lines

Thanks to the comprehensive modular system and optional components, a wide range of designs can be implemented. This enables you to customize your machining optics to ideally match your machining environment and your requirements.



BEO D70 processing optics with motorized swivel mount integrated in the TruLaser Station 5005.



You can find more information about TRUMPF focusing optics here:  
[www.trumpf.com/s/typzs8](http://www.trumpf.com/s/typzs8)

01

## Quick joining processes

with seam position control

02

## Improved process capability

thanks to image processing

03

## More good parts

with welding depth monitoring

04

## High-quality weld seams

thanks to temperature control

05

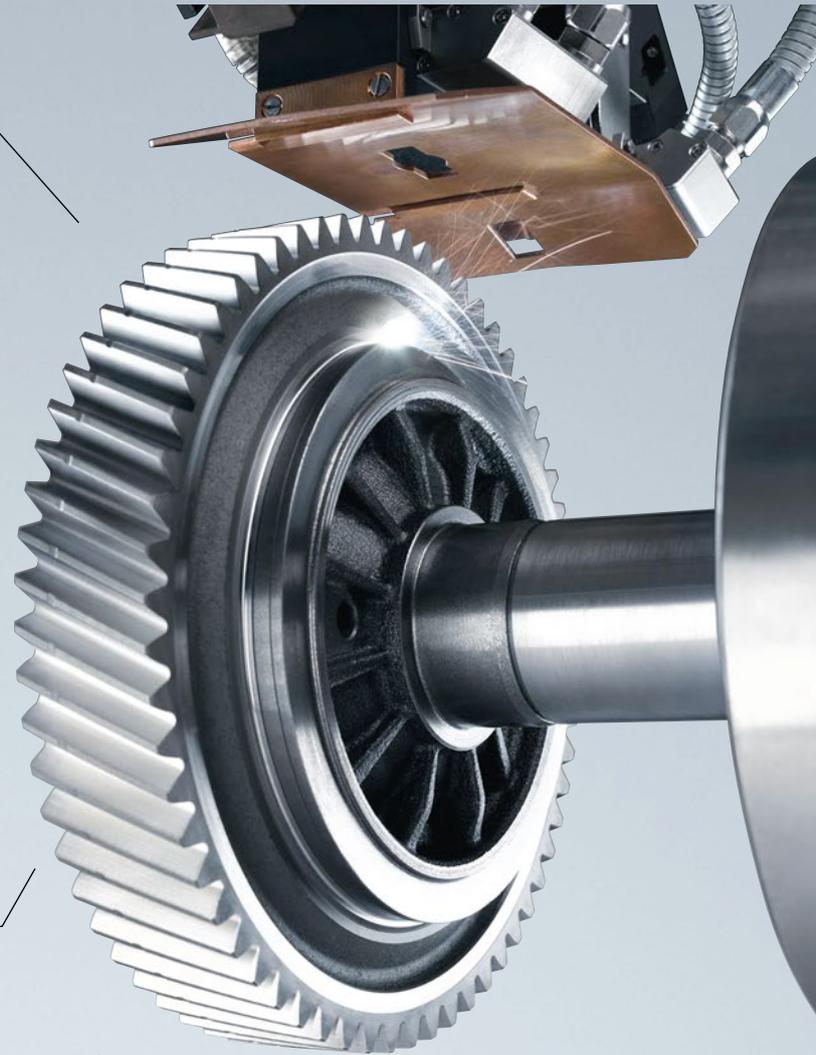
## Controlled meltdown

via melt travel monitoring

06

## High repetition accuracy

with automatic focus and power calibration



# Sensor technology

Stable processes are required for effective laser production. For this reason, sensors monitor or even control the processes. This enables you to work with greater process reliability and save time.



01

## Quick joining processes

with seam position control

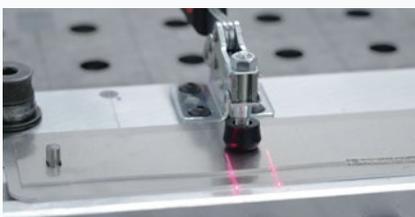
Produce faster than ever before: The seam position control constantly keeps track of the joining point during welding and always positions the laser beam correctly for maximum process speed. This ensures that you are ideally equipped for processes such as continuous tube welding, joining transmission components or laser remote welding for bodywork construction. Online monitoring of the weld seam provides you with an additional benefit in terms of quality assurance.



The seam position control enables you to keep reject parts to a minimum, for instance when welding tubes and profiles.



Additional autonomous x- and z-axes are integrated in the highly precise seam position control system for welding transmission components.



Laser remote welding. The seam position control system enables you to weld precise fillet seams, even in small flanges.



02

## Improved process capability

thanks to image processing

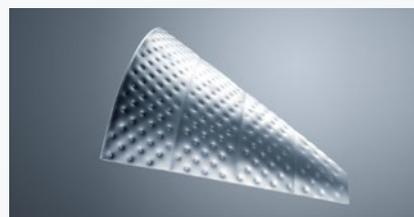
The VisionLine image processing system ensures that you can keep track of your processes. It detects features on components and ensures that welding or marking takes place at the correct place. VisionLine reads out the codes immediately after they are inscribed and evaluates the marking quality. This ensures that the process data is available for your quality assurance processes immediately.



VisionLine checks the quality of codes as well as text and documents them immediately after marking.



The image processing system detects the position of the pins when welding electronic components.



The position of the joining point is reliably detected when welding heat exchangers or others.

The images shown above are examples. The hardware is set up differently depending on the specific application.



03

## More good parts

with weld depth monitoring

Thanks to the weld depth monitoring system, production errors, and cross-section samples are finally a thing of the past. The sensor continuously provides data regarding the weld depth and monitors the set limit values during production. This provides you with a documented 100% check for all components and enables you to automatically discharge NOK parts.



Reliable results for round parts thanks to continuous monitoring of the weld depth.



04

## High-quality weld seams

thanks to temperature control

You can expect consistent and visually appealing results when welding plastic thanks to the temperature control system. This system registers the intensity of the thermal radiation on the surface of the component and adjusts the laser power to comply with the set target temperature. This system also enables you to quickly ramp up the process to reach the target temperature, while maintaining consistent results. The temperature control system is highly integrated and is positioned directly within the scanner. A trend display visualizes changes in the running process, enabling prompt corrective actions.



Best choice for plastic: The temperature control system provides you with visually appealing results.



05

## Controlled meltdown

via melt travel monitoring

The melt travel monitoring system ensures that you maintain control when carrying out laser transmission welding on plastics. The sensor system enables you to always keep track of the lowering of the component and automatically switches the laser off once a defined level of material melting has been achieved. To do this, a commercial inductive melt travel sensor is connected directly to the head of the scanner optics via an analog interface. This enables you to compensate manufacturing tolerances. All relevant data for your quality assurance processes are immediately available to you.



During transmission welding, the melt travel monitoring system constantly keeps track of the component and checks the meltdown of the material.



06

## High repetition accuracy

with automatic focus and power calibration

Sit back and let CalibrationLine check the focus position and laser power on the workpiece – this system makes time-consuming manual checking completely unnecessary. If required, CalibrationLine corrects the focus in the x-, y- and z-direction as well as the laser power. This enables you to make sure that your process specifications are always being complied with and that you always achieve the same results. Testing intervals can be programmed individually to meet the specific needs of your process.



Enjoy the benefit of automatic checking and calibrating of the tool, particularly in applications with high precision requirements, such as laser remote welding as shown here.



If you would like to know more about the benefits of the sensor system, visit this website: [www.trumpf.com/sensorsystem](http://www.trumpf.com/sensorsystem)

# Integration

TRUMPF solid-state lasers for welding, cutting and microprocessing include interfaces to all standard fieldbus systems, making it easy to integrate them into your production line. What's more, TruControl offers you a range of additional options to ensure the perfect control of your production environment.

01

## Save energy

with intelligent energy management

02

## Save your quality data

to the Quality Data Store

03

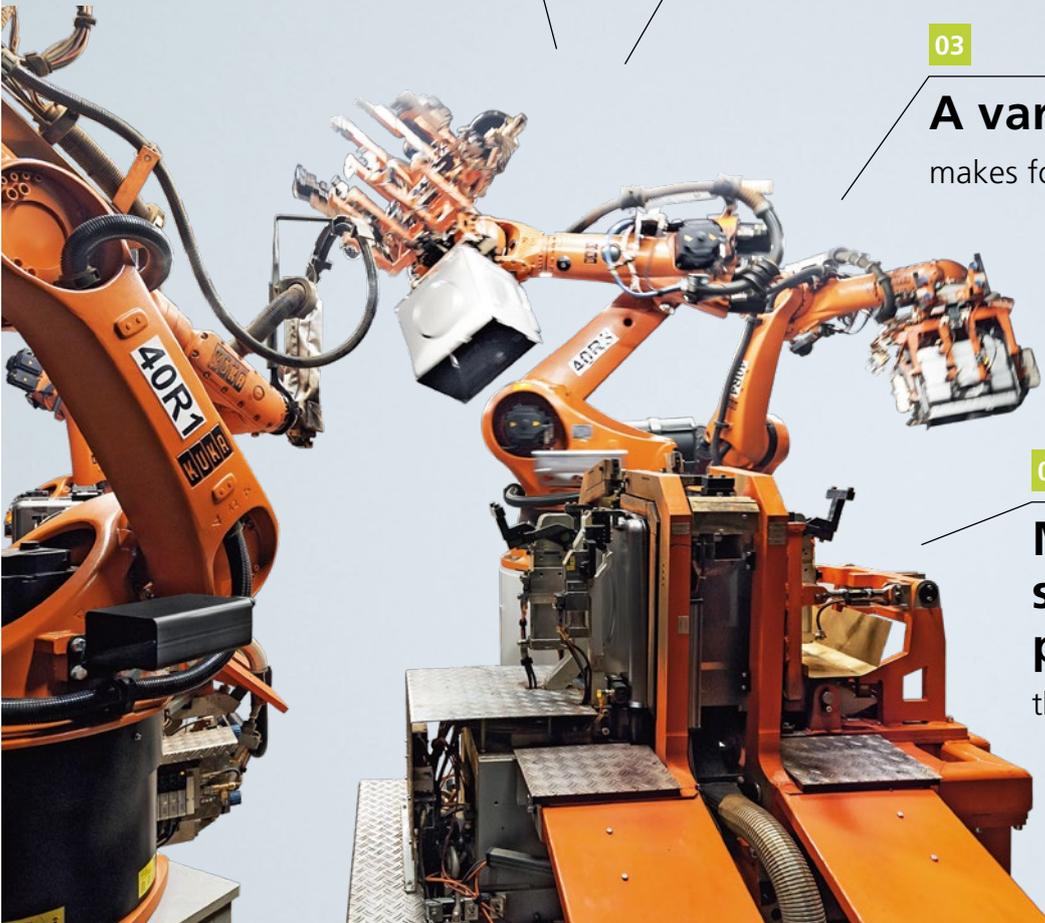
## A variety of interfaces

makes for easy integration

04

## Maximum laser safety and productivity

thanks to Performance Level e

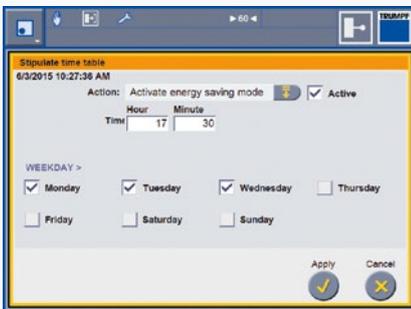


01

## Save energy

with intelligent energy management

TRUMPF lasers are renowned for their outstanding energy efficiency. And you can cut energy consumption even more during idle periods thanks to a choice of four different programmable sleep modes, which gradually scale down the laser's power consumption. TRUMPF lasers can also communicate in the intelligent PROFlenergy network.



Programmable sleep modes for energy-efficient laser operation.

02

## Save your quality data

to the Quality Data Store

The Quality Data Store software module allows you to select relevant laser and processing optics parameters and archive or export them during the laser process. Using unique data such as part numbers and shift information, you can allocate precise laser parameters to each component, even after the process has finished.



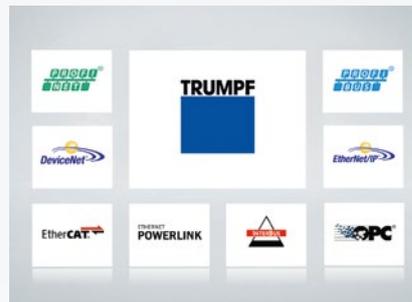
The Quality Data Store helps you match each component to the laser settings used to machine it.

03

## A variety of interfaces

makes for easy integration

Interfaces are the key when it comes to integrating a laser into a machine or production line. That's why TRUMPF solid-state lasers come with interfaces to all standard fieldbus systems. The processes are controlled in real time. The TruControl system manages, controls, and visualizes the interface assignment. Users benefit from a standardized control architecture that is compatible with all laser technologies. The standardized OPC UA communication protocol provides the ability to carry out diagnostics and data connection on customer-owned quality management tools.



Your TRUMPF solid-state laser can communicate with these fieldbus systems.

04

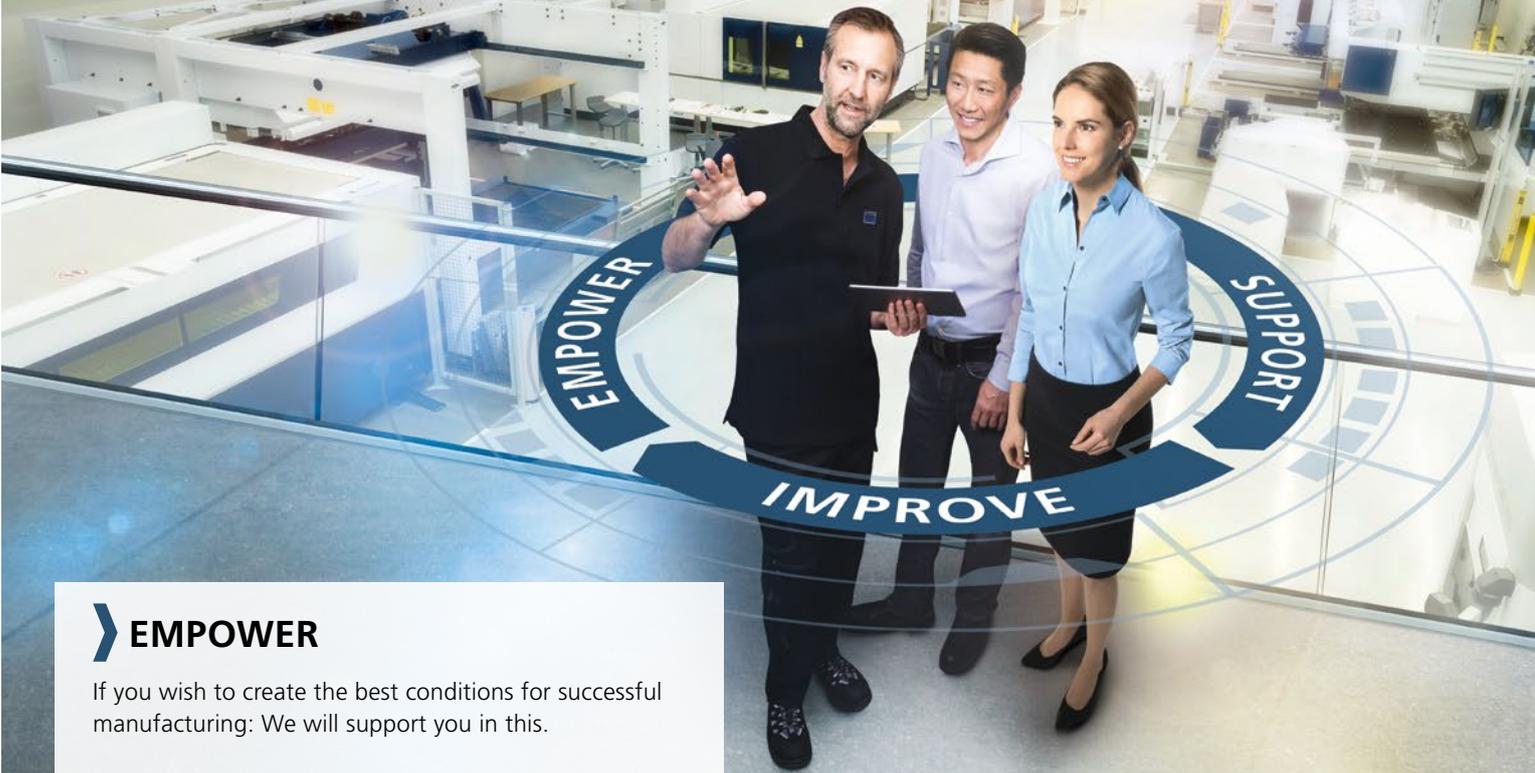
## Maximum laser safety and productivity

thanks to Performance Level e

TRUMPF solid-state lasers are specified as achieving Performance Level e. This represents the highest level of laser safety. Thanks to a uniquely quick deactivation time in the event of a fault, the danger of injury to personnel caused by the laser is reduced to a minimum. This is particularly important for integrating the laser in production plants that involve frequent interaction by the operator (such as for loading and unloading processes). Depending on the plant concept, the safety circuit may be partially opened each time components are loaded and unloaded. In this case, the quick activation and deactivation time of the laser has an extremely positive effect on productivity, especially for short cycle times.

# TruServices. Your Partner in Performance

Your Laser has been designed for high performance. To be successful in the future, you need the right services to keep you on track for the long term. Do you want to create the perfect manufacturing environment or make the best use of your TRUMPF equipment and tailor it to your evolving needs? Whatever the case, we're on hand to help you maximize your added value and lock those benefits in. TRUMPF is the right choice if you're looking for a reliable partner that can support you with a wide range of custom solutions and service packages, ensuring that your manufacturing business continues to be a resounding success.



## **EMPOWER**

If you wish to create the best conditions for successful manufacturing: We will support you in this.

## **SUPPORT**

If flexibility and availability of equipment in day-to-day operations are essential to you: We are there for you.

## **IMPROVE**

If you want to gradually focus your manufacturing on maximum value creation: We will work together to reach your goal.

**TruServices give you exactly the products and services you need for long-term manufacturing success.**

Process Optimization



Your processes are affected by a number of different parameters. The greatest potential for optimization lies in adjusting these parameters, which is why, if you want to increase the efficiency of your production line, it is essential to identify them accurately. With our help, you can uncover the hidden potential of your production process, for example through analyzing your part design, your subprocesses, or even your entire manufacturing line. We will then work together with you to develop selective or holistic solutions, such as those for networked manufacturing, based on these results.

Product Enhancements



Would you like to upgrade your TRUMPF system to meet new requirements – even one you purchased a long time ago? Product enhancements allow you to retrofit your machine with additional functions and new technological developments. That means you can gain the flexibility required to satisfy new customer requirements without having to replace your equipment.

Service Agreements



To give you peace of mind, we have bundled different services together in a variety of service agreements. Select a range of services to suit your needs and budget: Technical hotline, Teleservice, scheduled maintenance, repairs (including replacement parts) – whatever you choose, you will benefit from low-priced packages that require little effort to redeem.

Monitoring & Analysis



Do you like the idea of constantly keeping tabs on the current status and performance of your machine tools, laser system, or entire production facility? TRUMPF offers monitoring and analysis products that take transparency to the next level. Monitoring machine status and processes in real time shows whether the actions you take have the effects you want. Plus, you save time and money by preventing costly machine and plant downtime and identifying potential savings.



You can learn more about our complete and comprehensive package of useful services here: [www.trumpf.com/s/services](http://www.trumpf.com/s/services)

# The passion that drives us

From production and manufacturing technology to laser systems and material processing, we develop highly innovative products and services to meet your needs. Our solutions are superbly reliable and ready for industrial use. We do everything we can to give you a powerful competitive edge, drawing on our expertise, experience, and a genuine passion for what we do.

## Industry 4.0 – solutions for your future

The fourth industrial revolution is changing the world of manufacturing. Is it possible to stay competitive internationally with all this change? Yes – with the opportunities offered by digital networking. With our pragmatic solutions, we will support you every step of the way on your networked manufacturing journey, helping you make your processes more transparent, more flexible and, first and foremost, more cost-effective. This will enable you to make the most of your resources and ensure your production process is fit for the future.

TruConnect is synonymous with Industry 4.0 at TRUMPF. The range of solutions connects man and machine through information while covering all steps of the production process – from quotation through to shipping your parts.



**TruConnect**  
Your Smart Factory



Check out our  
YouTube page:  
[www.youtube.com/  
TRUMPFtube](http://www.youtube.com/TRUMPFtube)



## Lasers for manufacturing technology

Whether on a macro, micro, or nano scale, we can offer you the right laser and the right technology to create an innovative and cost-efficient production environment for any industrial application. We can also provide you with appropriate system solutions, application know-how, and consulting services.



## Power-supply systems for high-tech processes

From semiconductor manufacturing to solar cell production, our MF and RF generators supply electrical power for induction heating, as well as plasma and laser excitation at a clearly defined frequency and output, with high levels of reliability and repeatability.



## Machine tools for flexible sheet metal and pipe work

From laser cutting and punching to bending and laser welding, we provide our customers with tailor-made machines and automation solutions for a versatile array of sheet machining processes. That includes advice, software, and services – in short, everything you need to achieve reliable production of high-quality products.



TRUMPF is certified to ISO 9001  
(Find out more: [www.trumpf.com/s/quality](http://www.trumpf.com/s/quality))



TRUMPF Laser- und Systemtechnik GmbH  
[www.trumpf.com](http://www.trumpf.com)