EN

Laser. Marking. Solutions.

ACI

Business Fiber TRIM

Laser for trimming electronic resistors

The tolerances of electronic components and the strict criteria with regard to precise switching or tripping distances of sensors require individual options for balancing and adjustment. Laser trimmers from the Business Fiber TRIM product series are correspondingly modified fibre lasers that meet these high quality requirements. They consist of a fully air-cooled supply unit and a compact laser head with an integrated imaging system.

CONTENTS

Resistors and their types

The tolerances of electronic components and the high quality requirements with regard to precise switching or tripping distances of sensors require individual options for balancing and adjustment.
The electronics differentiate between thin-film and thick-film resistors that are available in SMD types 1206, 0805 and smaller and are fitted on the PCB, like the other components. Resistors are often also known as trimmer resistors, as the process of lasering is also referred to as trimming.

Types

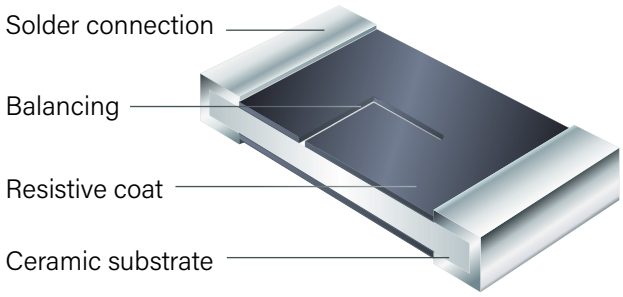
The resistors are SMD resistors which have to be equipped with their carbon film (black side) in the laser direction. In the past, type 1206 was preferred.
Since the decreasing amount of space available on the PCBs and the efforts to standardise stock are resulting in a tendency to favour type 0805 for cost reasons too, the technical circumstances must be considered more than ever before.
Types 1206 and 0612 have the same dimensions, but the solder connections on the 1206 chip are on the narrow side, while those on the 0612 chip are on the wide side.

Factors influencing the resistance value during trimming

The stability and accuracy of the resistance when trimming, and therefore the value of the sensor, depend on various different factors:

- The resistance range to be exceeded (balancing range)
- The chip geometry and the cutting configuration (type and position of the cut)
- The cutting geometry of the resistor (shape of the cut)
- The cutting speed of the laser beam
- The quality of the laser cut

Type	0612	1206	0805	0603
Resistor edge length	1.6 mm	3.2 mm	2.0 mm	1.6 mm
Resistor edge width	3.2 mm	1.6 mm	1.2 mm	0.8 mm



Trimming process

By tilting the scanner mirrors of the laser, individual resistors or partial areas of a switching circuit can be selectively recorded and trimmed. Resistive components are in some cases precisely tailored to the application directly in the switching circuits in which they are implemented. The exact conductance of the resistor is implemented with the passive balancing. Functional parameters of a switching group are realised by means of active balancing.

Material is ablated from the resistive coat without damaging the ceramic substrate by the laser beam or by a targeted laser cut in the resistor material, thereby reducing the specific conductance and increasing the resistance.

The trimming process is stopped in real time by external measuring amplifiers and the properties are monitored. The most recent mirror/position data is automatically saved so that a cut can be resumed from the same position. The aim is to precisely adapt the resistance with minimal deviations.

Benefits
Laser trimming

High-precision results

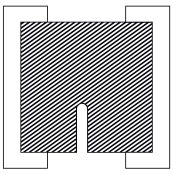
High long-term stability throughout the product life cycle

Cost-effective method of circuit balancing

Simple integration in complex production

Shapes of cuts

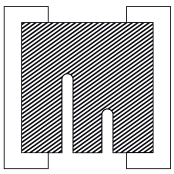
In practice, various cutting geometries are used in order to achieve good linearity of the trimmed area on a specified surface of the resistor. The following cuts have proven to be successful for rectangular resistors.



I-cut/plunge cuts

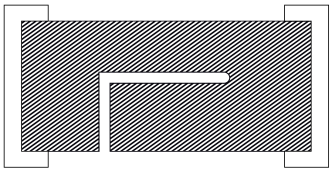
This is a straight cut parallel to the solder connections of the resistor. The cut should be in the centre and start before the active carbon film.
Advantages: Simple, quick cuts
Disadvantages: Low precision due to exponential resistance curve, low long-term stability, risk of hot spots, i.e. at the end of the cut due to the flow of current

Double plunge cuts



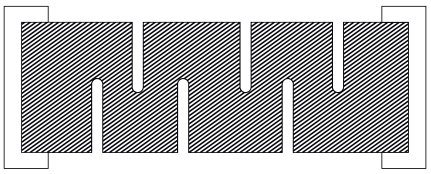
These are two straight cuts parallel to the solder connections of the resistor. The cuts should be around ⅓ and ⅔ of the length of the resistor.
The first cut should be between 50% and 70% of the length of the second cut, as otherwise the precision adjustment effect would be lost. The second cut is initiated by an "upstream signal", which is 10% to 5% before the limit value (known as the "cut-off") is reached.
Advantages: High precision compared to the plunge cut, slower resistance change, also suitable for small resistance geometries (cf. L-cut)
Disadvantages: Slower than the plunge cut, less long-term stability than the L-cut

L-cut



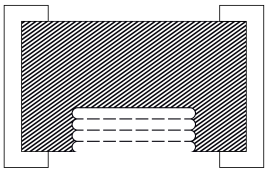
The name comes from the shape of the laser cut. Like the double plunge cut, a cut-off of 10% to 15% should be used here to make the second cut along the length of the resistor. As the resistance changes only minimally along the length of the resistor, the balancing is precise and stable. The L-cut is only considered for resistors with a length of at least 1.5 mm.
Advantages: Good precision and long-term stability
Disadvantages: Can only be used for large resistor geometries (L > 1.5 mm)

M-cut/serpentine cut



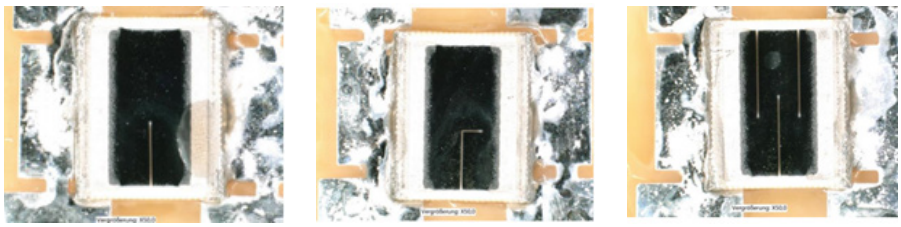
With this type of cut, the resistor is trimmed in a winding pattern. This cut enables a high resistance change, but to the detriment of long-term stability and current noise.
The distance of the laser between the cuts and the termination should not be less than 0.5 mm as otherwise the resistor material could heat up too much.
Advantages: Long trimming path results in good trimmed area
Disadvantages: Low long-term stability; high current noise; risk of hot spots

Shave cut/planing cut

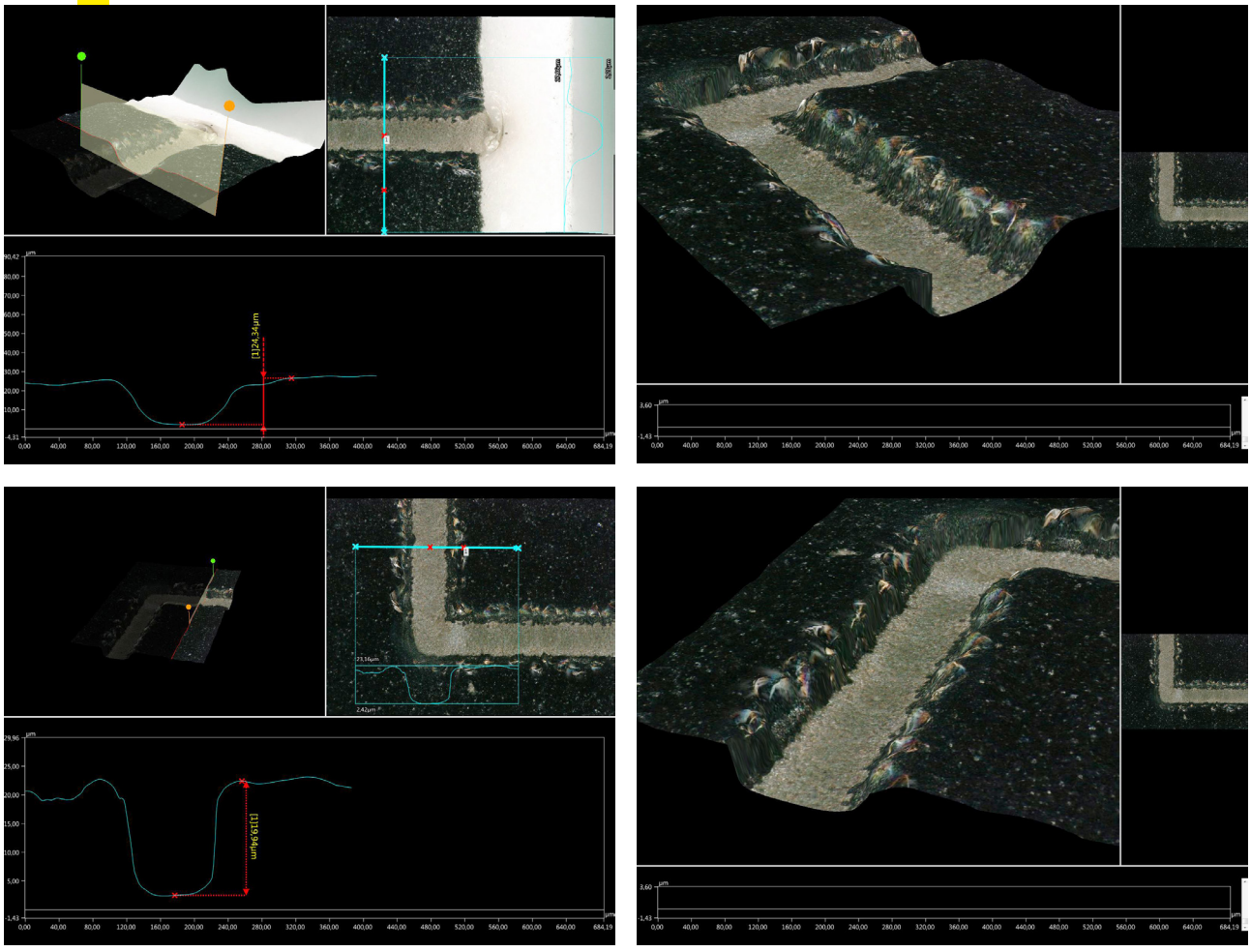


This cut is primarily used for high voltages or large currents on the resistor, as the flow path is optimal.
Advantages: High precision and stability, minimal current noise, can be used at voltages above 150 V, minimal risk of hot spots
Disadvantages: Extremely long trimming process

Individual resistor with I-cut, L-cut and M-cut



3D microscopic images of an L-cut



Positioning and imaging

These typical types of resistors require the starting position of the laser beam to be positioned very precisely, as from a practical point of view this position can no longer be adjusted cost-effectively with existing means.

This required level of precision can be achieved by using an AOI (Automatic Object Identification) imaging system. The AOI system is a compact, autonomous imaging system used for the fully automated detection, identification and measurement of objects, text and codes with complex geometries. For this purpose, the marking area is recorded and analysed online by a camera system. The geometry to be lasered is aligned with the object to be trimmed completely automatically

Applications

Laser trimmers are used in various applications involving thick and thin film technology, passive and active trimming on materials such as silicon wafers or SMD resistors and SMD capacitors.

- Automotive electronics
- Industrial and power electronics
- Automation
- Measuring and control equipment
- Sensors

- Linear and round potentiometers
- Military equipment, aerospace
- Telecommunication
- High-frequency assemblies
- Medical technology, medical sensors

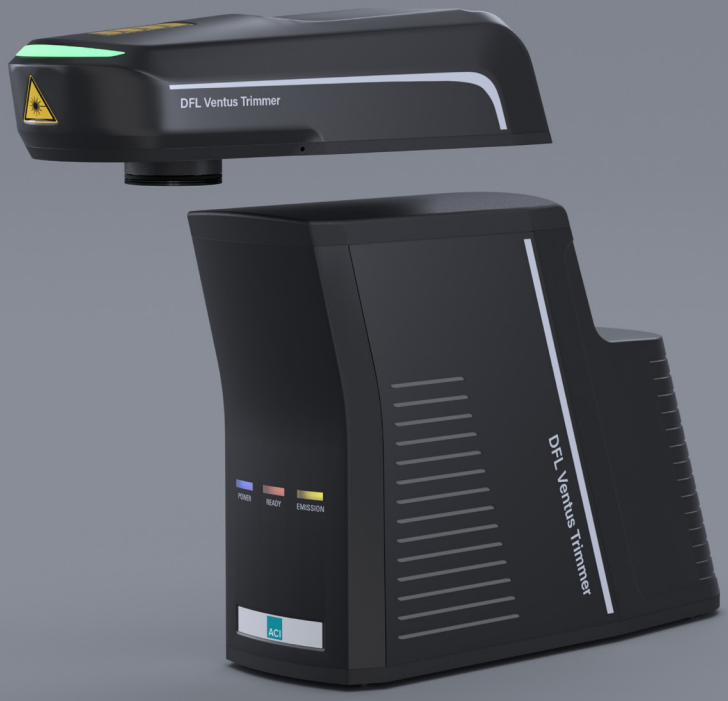
DFL Ventus Trimmer
Industrial design

Laser trimmers

ACI's laser trimmers are MOPA fibre lasers. They differ from lasers designed for marking materials because of the way that the beam is generated for trimming applications, because they have an integrated image detection system (AOI) and because they have extra electronic interfaces to connect the necessary measuring equipment. Laser trimmers are used either as integration systems in existing production lines or in manual workstations.

Benefits of **ACI's laser trimmers**

- **Systems have a long service life**
- **Low maintenance**
- **Fully air-cooled**
- **Highest power and pulse-to-pulse stability**
- **Best price-performance ratio**



DFL Ventus Trimmer

Features/properties

- Laser type: Fibre laser
- Wavelength: IR 1064 nm
- Pulse-synchronous switch-off
- Integrated AOI imaging system with resolution of approx 9 µm/pixel as standard
- Air-cooled
- Compact design
- User-friendly operation

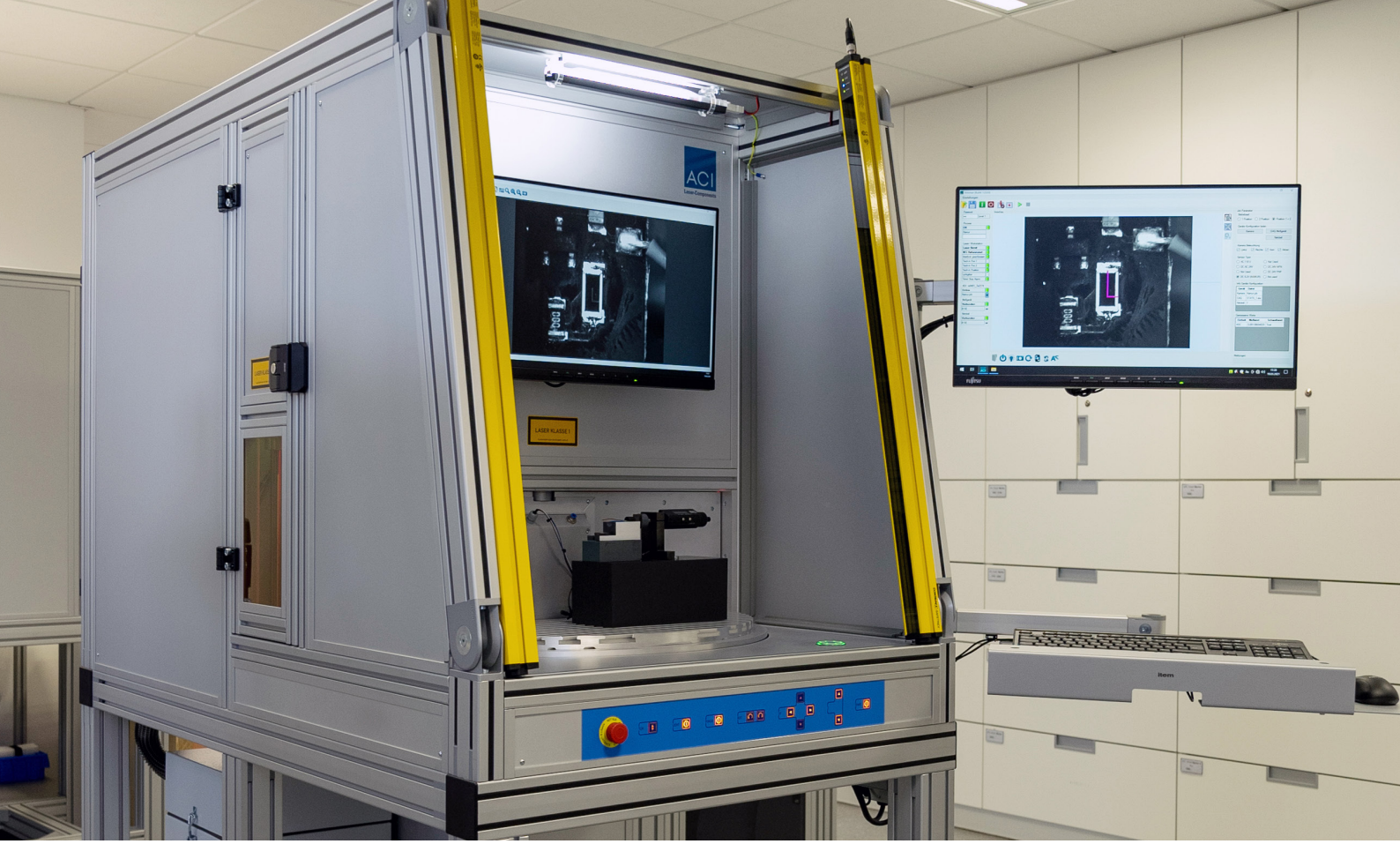
Interface

- Connected to measuring equipment via trimming module interface

Exclusively for **Business Fiber models**

Separable laser head and supply unit

MOPA systems with enhanced adjustability (pulse widths)



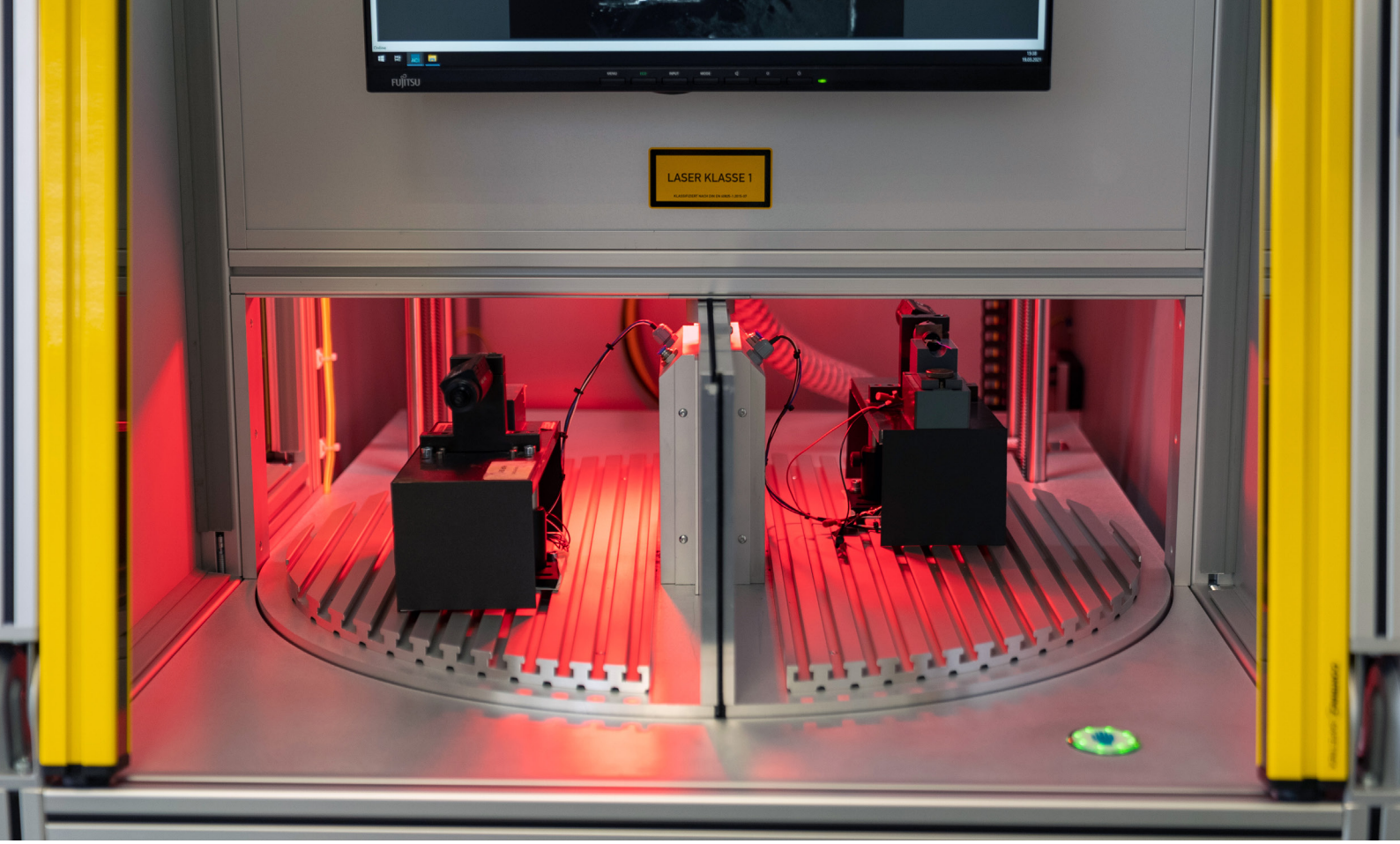
Laser trimming systems

Laser trimmers can be used both as flexible manual workstations as well as integration components for use in automated systems. The laser systems can be adapted to customer-specific requirements accordingly. This means that versions combined with a Workstation Professional or a rotary indexing table are possible. The manual workstations are ESD-compliant. All components are controlled using Magic Mark, ACI's own laser software.

Description of the trimming system

The core of the trimming systems is a laser trimmer equipped with a high-resolution camera system and a quick-switching trimming module interface. Alongside the laser, the following components for the process are: A control PC, the measuring equipment, and the Workstation in the form of a rotary indexing table with x- and z-portal. The entire Workstation is designed as an ergonomic manual Workstation and fulfils the requirements of laser class 1.

Scan now
to watch the video



Laser

Like the marking laser, the laser is equipped with a scanner system which positions the laser beam in the machining plane by means of beam deflection using a mirror galvanometer. The laser features an internal camera system and an imaging system (AOI). The optical resolution of the system is approx. 9 µm/pixel. The resistors to be trimmed have a size in the millimetre range. The laser beam can be positioned with high precision thanks to the automatic image recognition of these resistors in the AOI system's field of view. The scanner system enables typical trim cut geometries to be implemented in the form of I-cuts, L-cuts or M-cuts. The essential system component of the AOI system is the lighting unit. Its four separately switchable lighting segments enable different lighting scenarios.

Measuring equipment

The laser system can be used to trim resistors and therefore balance complete circuits, e.g. sensor circuits. The integrated measuring equipment consists of a power supply unit, switching matrix and measuring device. Depending on the sensor, the specified operating voltage and the associated measuring channel are switched via the switching matrix. The hardware of the measuring equipment and laser is configured and wired so that the measuring equipment monitors the sensor's switching point and suppresses the laser emission with pulse precision as soon as the sensor's specified balancing value is achieved.

Process control – control PC

The entire trimming process is controlled by a complex application-specific program. By selecting the sensor type, the laser, power supply unit, switching matrix and measuring device are fully configured. During the trimming process, the user can monitor the cut in real time thanks to the camera image shown. Once trimming is complete, the sensor balancing value achieved and the trimming status are also displayed and recorded.

Collaborating with ACI Laser
Benefits for customers

We prioritise cultivating excellent working relationships with our customers so we can successfully serve their needs. We offer our customers sustainable solutions based on all-encompassing advice, reliability and stability.

ACI Laser is proud to offer:

- ✓ *German engineering* – development and production drawing on over 20 years' experience
- ✓ Complete solutions from a single source: Laser systems, protective housings, software and accessories
- ✓ Customisable laser systems
- ✓ Plugins for easy addition of software features

Made in Germany

Laser. Marking. Solutions.

We would be happy to advise you.

We guarantee you a tailor-made, all-in-one solution that meets the requirements of your application. Our experienced sales team will provide you with comprehensive, in-depth advice. We look forward to hearing from you.

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Subject to change

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