Modern technology requires efficient electronics in the smallest spaces. Thanks to optical technologies it is possible to organize increasingly smaller electronic components on semiconductor chips.

**DEVELOPMENT OF SEMICONDUCTOR PRODUCTION PROCESSES**

The image of increasingly smaller structures requires light sources with very short wavelengths.

**OPTICAL BEAM PATH**

Extreme ultraviolet (EUV) light, which is already in use and which has a wavelength of only 13.5 nanometers, requires the application of purely reflective optics with extremely accurate geometry.
Ultrashort pulse lasers drill differently sized, accurately shaped injection nozzles that distribute the fuel in the best way possible. Thanks to laser precision machining, up to 30% of fuel can be saved.

The lens focuses pulsed laser beams on a 10-micrometer diameter.

The heating of adjoining material is avoided by laser pulses shorter than 10 picoseconds.

Differently sized injection nozzles ensure an optimum distribution of fuel.
LASER CUTTING

Laser cutting enables very quick processing of materials with a low loss of material, which makes this method extremely energy-efficient.

EFFICIENCY AND PERFORMANCE COMPARISON OF CONVENTIONAL MILLING AND LASER CUTTING

cutting a 5-millimeter-thick steel plate for one meter

<table>
<thead>
<tr>
<th>Cutting Method</th>
<th>Cutting Width (millimeters)</th>
<th>Tool Performance (kilowatts)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional Milling</td>
<td>10</td>
<td>0.4</td>
</tr>
<tr>
<td>Laser</td>
<td>0.4</td>
<td>20</td>
</tr>
</tbody>
</table>

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EFFICIENCY AND PERFORMANCE COMPARISON OF CONVENTIONAL MILLING AND LASER CUTTING

CONVENTIONAL MILLING
Laser cutting a 5-millimeter-thick steel plate for one meter

<table>
<thead>
<tr>
<th>CUTTING WIDTH (millimeters)</th>
<th>TOOL PERFORMANCE (kilowatts)</th>
<th>DURATION PER METER</th>
<th>ENERGY CONSUMPTION (kilowatt hours)</th>
<th>WASTE (grams)</th>
<th>TOTAL ENERGY CONSUMPTION (kilowatt hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 Minutes</td>
<td>0.10</td>
<td>12 Seconds</td>
<td>0.07</td>
<td>390</td>
<td>2.05</td>
</tr>
<tr>
<td>15</td>
<td>0.14</td>
<td></td>
<td></td>
<td>15</td>
<td></td>
</tr>
</tbody>
</table>

LASER CUTTING
Laser cutting enables very quick processing of materials with a low loss of material, which makes this method extremely energy-efficient.

PRODUCTION TECHNOLOGY
SMARTPHONES THANKS TO THE LASER

Hundreds of thousands of smartphones are manufactured daily. Quality and efficiency of production are of crucial importance to the manufacturers in this competitive market. Lasers are the key to success here.

**LASER TYPES**
- fiber laser
- UV solid-state laser
- solid-state laser
- CO₂ laser
- ultrashort pulse laser
- UV excimer laser
- IR diode laser

**MACHINE PROCESS**
- edge
- area
- pattern
- holes

Touchscreen
- cutting of extremely thin, hard cover glass
- cutting of touchscreen foil
- structuring of conducting layers

Screen
- generation of polycrystalline layers
- encapsulation of laminated glasses

Battery
- welding of battery case
- marking logo, data-matrix-code, and serial number

Circuit board
- structuring of conductor tracks
- cutting of foil circuit boards
- drilling of contact holes

Housing
- cutting of housing
- marking logo and serial number
Based on a computer drawing, complex structures can be produced from plastics, ceramics, and metals with the help of selective laser melting. Dentures and implants are among the rapidly growing number of applications.

**GENERAL OPERATING PRINCIPLE**

The digital model of an object is transformed into a model made of a series of thin layers.

1. A layer of powder is applied.
2. The build platform is lowered with every layer.
3. The powder melts in the component’s cross section according to the specifications of the layer model.
4. The application, melting, and lowering repeats itself until the object is finished.
5. At the end, the material that has not melted will be removed. The actual object is all that is left.