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PRODUCTS ACROSS ALL INDUSTRIES are made better AND at lower cost with IPG FIBER LASERS
Key Takeaways

1. Global market leader in fiber laser technology across multiple end markets and applications

2. Vertical integration, manufacturing scale and technology driving best-in-class margins

3. Expanding multi-billion dollar addressable market opportunity

4. Industry-leading earnings and cash flow
Revolutionizing the Laser Industry

Traditional Lasers

- Carbon Dioxide (CO₂)
- Lamp-Pumped Nd: YAG

IPG Fiber Lasers

- Ultra High Power Continuous Wave (CW) Lasers
- High Peak Power Lasers with Quasi-CW (QCW) Option
- Adjustable Mode Beam and QCW Lasers
- High Power Nanosecond Pulsed Pico and Femtosecond Pulsed

Traditional Lasers

- Expensive
- Bulky
- Unreliable
- Difficult to Operate

IPG Fiber Lasers

- Higher Productivity
- Compact
- Reliable
- Robust

- Efficient
- Minimal Maintenance
- No Consumables
- Scalable
Industrial Lasers for Materials Processing

Source: Oxford Economics, Optech Consulting and IPG Photonics Corporation
Addressable Market for Laser Sources

$10 billion Market Estimate

Source: Optech Consulting, Strategies Unlimited and IPG Photonics Corporation
Emerging Growth Opportunities

Source: Optech Consulting, Strategies Unlimited and IPG Photonics Corporation
IPG Laser Systems

- Micromachining for Microelectronic and Electronic Parts
- Multi-Axis Workstations for Industrial Parts
- Precision Workstations for Medical Parts
- Robotic Workcells for Larger Parts
Advantages of IPG Fiber Lasers

- Monolithic Design
- Highest Power
- Record Power Efficiency
- Leading-Edge Beam Quality
- Best-In-Class Product Portfolio
- Industry-Leading Reliability
- Modular / Scalable Architecture
- Faster Processing Speed
- Lower Operating Costs
- Easy Systems Integration
- Smallest Footprint
- Efficient Cooling
Broadest Portfolio of Fiber Lasers

ANY WAVELENGTH, MODE OF OPERATION, POWER, BEAM PARAMETERS OR APPLICATION

<table>
<thead>
<tr>
<th>Wave Range</th>
<th>Lasers</th>
<th>Peak Power (Megawatts)</th>
<th>Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>X-Ray</td>
<td>Ultraviolet</td>
<td>~500 fs, &gt;20 MW</td>
<td>Thin metal cutting and drilling, ophthalmic surgery, high precision, scientific</td>
</tr>
<tr>
<td>10 nm - 400 nm</td>
<td>Visible</td>
<td>~2 ps, &gt;10 MW</td>
<td>Black marking, sapphire and glass scribing, solar thin films, OLED film cutting, scientific</td>
</tr>
<tr>
<td>400 nm - 700 nm</td>
<td>Near-Infrared</td>
<td>1-200 ns, &gt;150 kW</td>
<td>Thin-film ablation, low-k and silicon dicing, solar thin films, OLED film cutting, scientific</td>
</tr>
<tr>
<td>1.5 μm</td>
<td>Mid-Infrared</td>
<td>0.05-50 ms, 1 MW</td>
<td>Scribing, thin-film ablation, via drilling and flex cutting, surface preparation, texturing, annealing, marking, drilling and scribing</td>
</tr>
<tr>
<td>10 μm</td>
<td>Far-IR</td>
<td>0.05-50 ms, 23 kW</td>
<td>Cutting, welding, soldering, annealing, micromachining, texturing, annealing, annealing, marking, drilling and scribing</td>
</tr>
</tbody>
</table>

Peak Power (Megawatts)

- **Peak Power:** 120kW
  - **Applications:** cutting, welding, soldering, drilling, brazing
  - **Pulse Duration:** 0.05-50 ms

- **Peak Power:** 23kW
  - **Applications:** cutting, welding, soldering, drilling, brazing, annealing
  - **Pulse Duration:** ~2 ps

- **Peak Power:** >150 kW
  - **Applications:** cutting, welding, low-k and silicon dicing, glass scribing
  - **Pulse Duration:** <500 fs

- **Peak Power:** >10 MW
  - **Applications:** black marking, sapphire and glass scribing, solar thin films, OLED film cutting, scientific
  - **Pulse Duration:** ~2 ps

- **Peak Power:** >20 MW
  - **Applications:** thin metal cutting and drilling, ophthalmic surgery, high precision, scientific
  - **Pulse Duration:** <500 fs

Thick steel cut with a continuous wave laser
Drilling using a quasi-continuous wave laser
Surface Cleaning using a pulsed laser
Micromachining using an ultrafast laser

Throughput | Precision
Laser Applications in Electric Vehicle Manufacturing

Laser Welding, Cutting and Marking of Battery Cells:
- Cap to Can Welding
- Tab to Pole Welding
- Foil Cutting
- Injection Pin Welding
- Tab to Terminal Welding
- Battery Cell Marking
- Pressure Relief Valve Welding

Laser Welding, Cutting and Ablation for Electric Motors:
- Hairpin Welding
- Hairpin Ablation
- Rotor and Stator Stacks Welding
- Electrical Steel Sheet Cutting
IPG Solutions for Electric Vehicle Manufacturers

IPG laser welding technologies enable battery welding that is 10X faster and more reliable than traditional bonding methods.

These combined technologies create the only battery welding solution with integrated process monitoring, traceability and non-destructive testing.

Safe and reliable production of EV batteries, motors and other components rely on these technologies for their unique ability to deliver:

- Weld quality control and depth consistency
- Spatter-free with porosity-free welds
- High throughput manufacturing and high-quality results

IPG Genesis system for EV, electrified transportation, motive, industrial, and commercial battery applications

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Adjustable Mode Beam (AMB)

- Broadest range of beam profile tune-ability: independent and dynamic control of the size and intensity of the core and ring beams enabling high-quality, high-speed, uniform welding

- Virtually eliminates welding spatter: molten material is deflected towards the bottom of the weld pool which is stabilized with large keyhole openings allowing molten vapor to escape

- Increases welding quality: consistent high weld seam quality, pore and crack free

- High-speed welding for e-Mobility and automotive applications: 300 mm/s or higher speeds welding Al battery enclosures and drivetrains

- Maximizes uptime: less rework of parts, drastically reduces sensor contamination

Any combination of a small-spot high intensity bright core and a larger ring-shaped beam
Using real-time inline coherent imaging (ICI) the LDD-700 weld monitoring system consolidates weld results into concise and actionable quality data from a single system.

**Transverse Profile**
Measures the finished weld bead transverse profile

**Finished Weld Surface**
Measured behind melt pool captures bead height

**Workpiece Height**
Measures distance between material and optics

**Seam Profile**
Looks for joint position on the workpiece

**Keyhole Depth**
Measured inside hole to determine depth in real time

**Unmatched Weld Quality Assurance**
Handheld Laser Welding & Cleaning System

Benefits include:

• Faster than traditional methods for higher welding productivity (less setup and shorter weld time)
• Less heat-induced damage increases application range and decreases scrap (less part distortion and deformation)
• Higher quality results with less finishing required decreases cost-per-part (less post-weld grinding/cleaning)
• Easy to set up (unbox and assemble in minutes)
• Easy to learn and operate enabling manufacturers to solve scarcity of skilled welders (built-in optimized modes and online tutorials)

LightWELD XC model offers pre- and post-weld laser cleaning

• Turnkey system to start welding out-of-the-box
• Removes rust and oil pre-weld for increased weld quality
• Removes soot and weld debris post welding without the use of chemicals or abrasives

Crowds gather to watch live LightWELD XC demonstrations at FABTECH 2021 expo
Ultrafast Fiber Lasers

Ultrafast fiber lasers operate in the range of picoseconds (10-12 seconds) and femtoseconds (10-15 seconds). Balanced throughput, precision and quality are made possible with the shorter pulse durations of ultrafast lasers without undesirable heat effects. This cold processing virtually eliminates heat affected zones, unwanted melting and cracking for consistent, controlled processing of the most sensitive materials.

IPG Ultrafast Product Options:
- Infrared, Green and Ultraviolet Wavelengths
- High Pulse Energies
- Pico to Femtosecond Pulse Durations

IPG Ultrafast Benefits:
- Low Cost & High Efficiency
- Ultra-compact heads
- All-fiber designs
- Easily Integrated
- High Power & High Reliability

Application Examples:
- Ultra-Precise Glass Drilling
- Glass Marking
IPG Vertical Integration

**INTEGRATED SYSTEMS**
- WELDING | ABLATION
- DRILLING | CLADDING
- CUTTING | CLEANING

**Fab Operations**
- Semiconductor wafer growth
- Diode processing, chip mounting & burn-in

**Laser Diode Packaging**
- Up to 120-watts of power

**Optical Preform**
- Silica based glass
- MCVD method
- Dope with rare earth ions

**Deep in Technology**

**DEEP IN EXPERIENCE**

**Process Heads, Monitoring and Switches**
- All fiber beam delivery

**Laser Sources**
- Coupling | Final burn in | Shipment

**Modules**
- Up to 2000 Watts

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• IPG diodes are the lowest cost in the industry, empowering our Customers with the HIGHEST power fiber lasers for the LOWEST cost per watt
• In 2019 IPG transitioned to a new higher power chip reducing cost per watt and the level of required production to support a given level of revenue
## Financial Performance and Target Model

<table>
<thead>
<tr>
<th>GAAP Metrics</th>
<th>2012-17</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
<th>Long-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue Growth</td>
<td>20%</td>
<td>4%</td>
<td>(10%)</td>
<td>(9%)</td>
<td>Double Digit Growth *</td>
</tr>
<tr>
<td>CAGR</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Gross Margin</td>
<td>55%</td>
<td>55%</td>
<td>46%</td>
<td>45%</td>
<td>45%-50% *</td>
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<tr>
<td>Average</td>
<td></td>
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<tr>
<td>Operating Margin</td>
<td>37%</td>
<td>36%</td>
<td>18%</td>
<td>17%</td>
<td>25%-30% *</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Revenue growth and margins can be below long-term targets during periods of macroeconomic weakness that give rise to lower demand for our products
Strong Cash Returns

Operating Cash Flow


Capital Expenditures

2020 Return on Equity ¹

8%

2020 Return on Invested Capital ¹ ²

15%

¹ excludes losses and gains on foreign currency and charges related to Impairment of goodwill and other long-lived assets and an additional inventory charge
² excludes cash
THANK YOU