IPG Photonics’ IX-280-ML
from the World Leader in Fiber Lasers

Applications
Features
Advantages

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The Power to Transform®
Company & Product Overview
IX-280-ML

Leader in Innovation
IPG Photonics is the world leader in high power fiber lasers and amplifiers. Founded in 1990, IPG pioneered the development and commercialization of optical fiber-based lasers for use in a wide range of venues such as materials processing, medical, scientific and other advanced applications. Fiber lasers have revolutionized the industry by delivering superior performance, reliability and usability at a lower cost of ownership compared with conventional lasers, allowing end users to increase productivity and decrease operating costs. IPG is headquartered in Oxford, MA with additional facilities throughout the world.

IX-280-ML System Overview
The IX-280-ML is a high-precision laser processing system that maximizes flexibility by supporting two lasers and beam delivery systems in a single workstation. The lasers may have independent beam delivery systems or be configured to have a coincident delivery point for advanced parts processing.

Applications include R&D, where equipment flexibility is essential and production processing of parts requiring both very fine micromachining and thicker-material machining.

The IX-280-ML lasers and their associated beam delivery systems can be optimized for both tasks, with shared workstation elements for part positioning, control and automation delivering highly precise machining of a vast array of materials. For more information about the IX-280-ML, please contact sales.ipgm@ipgphotonics.com or call 603.518.3200.
High Speed Sapphire Cutting
- Display covers, Lens Covers and Cut-outs for Handheld Devices
- Fast Laser Cutting and Fine Feature Beveling
  Left: 3 mm Thick Sapphire Cut at 8 mm/s

Selective Material Removal
- Patterning, Stripping and Selective Opening of Polymers such as Parylene
  Left: Removal of 10 µm Protective Film with No Conductor Damage

High-Speed Drilling of Ceramics
- Device Packaging and Interposer Applications requiring holes <100 µm Diameter
  Left: 37 µm Diameter Holes Drilled in 380 µm Alumina at 750 holes/sec

Ceramic and Polymer Probe Card Drilling
- Cutting Rectangular and Shaped Holes for Probe Card Guideplates
  Left: 250 µm Silicon Nitride, Wall Thickness 15 µm

Microfluidic Patterning
- Micromachining Trenches, Blind-holes and Through-holes in Glass and Polymers
  Left: Polymer Film Drilled with 2 µm Holes Dimensional Variation <0.2 µm
Fiber Laser Options  
Configuring the IX-280-ML

The IX-280-ML can be configured with virtually any laser compatible with micromachining and is most typically supplied with the following:

- IR QCW Lasers for Cutting and Drilling Thicker Materials including Sapphire, Silicon and Ceramics
- IR, Visible or UV Pulsed Lasers for Patterning and Micromachining
- UV lasers for Patterning and Machining Polymers

IPG’s laser options allow customers to select based on pulse energy, emission wavelength and laser power. Combinations of high pulse energy, high power QCW lasers for thicker material cutting and drilling, paired with either a short-pulse or short-wavelength laser for fine machining work are the most popular selections.

Beam Delivery Options

Three beam delivery alternatives (below) are available for the IX-280-ML, each with a number of user-selectable options. Although numerous combinations of laser type and beam delivery systems are possible, most customers select a thermal cutting/drilling head for the thicker material processing and either a fixed or scanning beam delivery for the “finer” or higher-precision work.

| Thermal Processing Head (IPG Micro Cutting Head) | Cutting and Drilling of Ceramics, Sapphire, Metals |
| Fixed Optics (IPG MicroTech Optics) | Highest Resolution and Accuracy for Micromachining and/or Large-area Patterning |
| Galvanometer Scanner (Analog or Digital Options) | Machining Complex Shapes with High Repetition Rate Lasers |

For many applications it is desirable to have a separate beam delivery system for each laser, however, for advanced processing, IPG offers a dual-beam delivery option that brings both laser sources to the same focal point. The resulting ability to have two laser beams with different wavelength or energy characteristics, illuminating the part either simultaneously, or in a programmed sequence, enables many unique light-material interactions to be achieved.

Please contact IPG with specific application requirements and/or refer to individual datasheets for full laser specifications; contact sales.ipgm@ipgphotonics.com or call 603.518.3200.
System Part-positioning
IX-280-ML

Precision micromachining requires a highly accurate and repeatable part positioning system. The IX-280-ML’s foundation is a table and bridge assembly made of high-density granite that provides mechanical and thermal stability necessary for accurate fine-feature machining.

Laser sources, their associated beam delivery systems and a stacked X-Y-Z-Theta stage system mount to the granite base to minimize positional uncertainty and drift. Once a part is mounted on the chuck, the extended travel stages position the part under each beam as required, avoiding the repositioning errors and loading times that are incurred on traditional single-beam units.

While high levels of positioning accuracy are important for some applications, others processes are more concerned with controlling costs. The IX-280-ML offers customers a choice of part-positioning options, allowing the system to be appropriately configured for the task. These selections include standard and high-precision X-Y stages, mapping correction, manual or motorized, standard and high-precision Z-theta stages and analogue or digital galvanometers.

**Example of Placement Accuracy**

A ceramic microelectronic part was machined with ~26,000 features over a period of 8 hours.

To assess overall placement accuracy and tool stability, the Diametric True Position of ~2,600 holes was measured and found to be less than 3.1 microns.

![Graph showing DTP Error of 2600 Points Sampled from 26,000 Hole Part](graph.png)
System Overview
IX-280-ML

Granite Base and Bridge
- Thermal Mass for Temperature Stability
- Good Vibration Performance
- Free Space Delivery Laser Heads Mounted Directly to Granite to Maintain Pointing Stability with BDS and Stages

System Control Electronics
- Expandable up to 12-axis of Motion Control
- Quad Core Processor with Imaged Disk Back-up Protection

Fixed Head/ Galvo
- Free-space or Fiber Beam Delivery
- Two Camera Vision System
- Enclosed Beam Path (Nitrogen Purging for DUV)

User Interface
- Windows-based Graphical User Interface
- Full Integration of Lasers, Vision, Motion Control and Built-in Metrology and Measurements
- Allows Teaching of Complex Functions

Motion System
- Extended Travel X-Y Stages Position the Part under each Laser Beam
- Optional Z-theta Stage for Rotation & Height Correction
- Vacuum “Bed-of-nails” Chucks- Options up to 12 inch (300 mm) Part Holding
- Lathe-stage Option for Machining Cylindrical Parts

The Power to Transform®
System Overview

IX-280-ML

Cutting/Drilling Head
- Fiber Delivery Direct to Cutting/Drilling Head
- Computerized Pneumatic Controls for 2 Process Gasses
- Optional On-axis Camera

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Pulsed and UV Lasers Internally Mounted for Pointing Stability and Space Saving

High-speed Cutting & Drilling
Lasers Optimized for Task
Reduced Part Processing Times

IPG’s Fiber Reliability
Precision Stages
High-res Vision & Alignment

Laser Flexibility
- Two Lasers and BDS UV to IR Wavelength Pulse Duration ps to CW

Cost Effective
- Capability of Two Systems in a Single Tool

Reduced Facilities Cost
- Single-tool Footprint and Services for Two Machining Capabilities

Investment Protection
- Field Upgradeability as Applications Evolve

Worldwide Support
- IPG’s Fiber Laser Reliability
  Service Facilities in 15 Countries

Maximize your Flexibility and ROI with IPG
System Software & Control Interface

The IX-280-ML is operated using IPG’s proprietary Chroma.NET software. Unlike laser machining tools that adapt general purpose automation code, the IX-280-ML takes advantage of the benefits of dedicated software to provide ease of use, single-interface system control and powerful conditional logic processing to deliver unmatched system flexibility and performance.

Chroma.NET is developed from a 20-year history that includes laser systems and modules design, micromachining system control, and operations in a commercial contract manufacturing environment. The powerful control software has been developed to meet the combined goals of maximizing system processing performance and simplifying recipe generation and operator-level controls, while preserving a flexibility that matches the IX-280-ML hardware.

Running on a quad-core processor, the Chroma.NET software provides fully integrated control of up to twelve motion axes, laser units, vision and metrology systems and operator communications. The highly parallel software architecture ensures maximum system throughput. The HMI follows the SEMI E95 standard, enhanced with a highly customizable widget docking system. This gives the product the look and feel of similar tools and the flexibility to adapt the screen layout to each user’s tasks. With four levels of access and control and customer-settable local language settings, training time for new operators is minimized.

In addition to expected functions such as recipe management, power and metrology settings, CAD import, vision and part alignment setup, Chroma.NET supports process recipe variable arithmetic and mathematical operators such as If(), Loop and motion commands.

The use of the Macro language allows the IX-280-ML to be easily adapted to new hardware, materials and processes as applications evolve and brings a level of programmed intelligence to automated system operation that both simplifies operator interaction and maximizes production throughput. For more information on the IX-280-ML, please contact sales.ipgm@ipgphotonics.com or call 603.518.3200.
IPG maintains 14 Applications Centers throughout North America, Europe and Asia. These centers are staffed by PhD Scientists and engineers with expertise in laser-material interactions. In addition to performing internal research, these resources are available to the IPG user community through custom process development contracts. The overriding mission of these groups is to help IPG’s customers.

IPG provides training to IX-280-ML customers in Manchester, NH following factory acceptance and again at the customer’s facility after installation. IPG factory training allows access to product engineers and applications specialists and gives a thorough overall grounding in the system and how it is used in your target application. Customer site training recaps factory training for additional team members and can also cover preventive and first-line maintenance. IPG understands that new applications for the system continue to arise and new employees require training. We are happy to quote follow-on training tailored specifically to meet your organizations’ needs.

As the world leader in fiber lasers, IPG Photonics is your ideal partner to provide service and support for your precision laser cutting system. IPG has over 100 field service engineers, specializing in servicing industrial lasers and laser systems used in 24x7 manufacturing. North American applications and field service offices are located in Oxford, MA, Santa Clara, CA, Novi, MI and Manchester, NH. IPG’s Field Service Team is comprised of experienced and highly-skilled engineers, supported by a global infrastructure including parts warehousing, applications scientists and the design and manufacturing teams that build the products.

IPG understands the rigors of today’s manufacturing line and can provide customer support 24/7 depending on your needs. In addition to warranty coverage, IPG offers support packages ranging from on-demand and hourly paid service to scheduled preventive maintenance and guaranteed response times. Whatever your service preference, IPG has an option to meet your needs. For more information on the IX-280-ML, please contact sales.ipgm@ipgphotonics.com or call 603.518.3200.
# IX-280-ML Specifications

## System Specifications

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>IX-280-ML, WxD, mm</th>
<th>1200 x 1000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>inches</td>
<td>49 x 40</td>
</tr>
<tr>
<td>Laser Rack*</td>
<td>WxD, mm</td>
<td>810 x 560</td>
</tr>
<tr>
<td></td>
<td>inches</td>
<td>32 x 22</td>
</tr>
<tr>
<td>Chiller*</td>
<td>WxD, mm</td>
<td>50 x 370</td>
</tr>
<tr>
<td></td>
<td>inches</td>
<td>20 x 15</td>
</tr>
</tbody>
</table>

Additional 900 mm (36 in.) service access required on all sides

Locate within 6 m (20 ft.) of the workstation

Locate within 3 m (10 ft.) of laser

*Typical requirements; external laser rack and chiller may not be required in all cases. Consult IPG for exact layout details of specific tool configurations.

## Utilities

<table>
<thead>
<tr>
<th>Electrical Power- Workstation</th>
<th>208 V (3 phases, neutral, ground)</th>
<th>5.4 kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical Power-Fiber Laser</td>
<td>200-240 V (Single phase)</td>
<td>14 A</td>
</tr>
<tr>
<td>Process Gas</td>
<td>Up to 3 gasses</td>
<td>2070 kPa (300 psi), 56 l/min. (120 SCFH)</td>
</tr>
<tr>
<td>BDS Purge Gas (UV Lasers)</td>
<td>Nitrogen</td>
<td></td>
</tr>
<tr>
<td>Laser Gas (UV MicroX Lasers only)</td>
<td>Dependent on laser model</td>
<td>Typically Single Pre-mix Tank approx. 100-500 l (3.5-17 cu ft.)</td>
</tr>
<tr>
<td>Compressed Air</td>
<td>Dry, Filtered &lt;1 μm</td>
<td>25 kPa (7.5 Hg), 30 l/min. (1 cfm)</td>
</tr>
<tr>
<td>Vacuum</td>
<td>May be required for part holding</td>
<td>25 kPa (7.5 Hg), 30 l/min. (1 cfm)</td>
</tr>
<tr>
<td>Workstation Ventilation</td>
<td></td>
<td>300-600 l/min (10-20 scfm)</td>
</tr>
<tr>
<td>Process Area Ventilation</td>
<td></td>
<td>300-1200 l/min (10-40 scfm), 5.5 kPa (1.62 in Hg)</td>
</tr>
</tbody>
</table>

## Laser Configurations

<table>
<thead>
<tr>
<th>Laser Configurations</th>
<th>Cutting Head</th>
<th>Fixed Beam</th>
<th>Galvanometer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quasi-CW</td>
<td>✓</td>
<td>Focused</td>
<td>Shaped</td>
</tr>
<tr>
<td>Nanosecond Pulsed</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Picosecond Pulsed</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>UV-MicroX</td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Workstation Parameters

- **Workstation**: Fully interlocked CDRH Class 1 system including weldment frame, granite latform with beam delivery support, control electronics, pneumatics & motion and beam delivery systems
- **Work Envelope under Beam**
  - Cutting Head: X: 300 mm (12 in.)
  - Fixed Beam: X: 300 mm (12 in.) Y: 300 mm (12 in.)
  - Galvanometer: X: 300 mm (12 in.) Y: 300 mm (12 in.) with part rotation
    - X: 195 mm (7.6 in.) Y: 300 mm (12 in.) no part rotation
  - Z-travel: 100 mm (4 in.)
# System Specifications

<table>
<thead>
<tr>
<th>Motion Platform</th>
<th>Linear Recirculating Ball Slides; Linear Motors and Encoders</th>
</tr>
</thead>
</table>
| **X, Y Stage:** | **Resolution:** 100 nm  
**Velocity:** 750 mm/sec  
**Accuracy:** ≤ ±5 μm Full Travel (≤ ±2 μm Optional)  
**Bidirectional Repeatability:** 0.9 μm |
| **Z-theta Stage:** | Crossed Roller, Servo Driven  
**Resolution:** Z: 500 nm, Theta 17.5 μrad  
**Travel:** 10 mm  
**Accuracy:** Z: 7 μm, Theta 500 μrad Full Travel |
| Cutting Head Z-stage: | **Bidirectional Repeatability:** Z: ±3.5 μm, Theta ±50 μrad  
**Travel:** 100 mm  
**Velocity:** 12 mm/sec  
**Accuracy:** 8 μm  
**Repeatability:** ±3 μm |

Cutting Head: Focal point cutting and drilling, integrated on-target camera and gas jet assembly with replaceable cover slide; options include lens focal length and nozzle diameter.

Fixed Objective: Imaging, scribing and focal point processing. Integrated video microscope and inspection camera and on-target video camera. Sub-micron imaging objective options.

Galvanometer: Focal point processing. 24-bit resolution scanner with on-target video camera. 100 mm focal length lens supplied as standard (approx. 60x60 mm deflection field). Max F-theta working distance 500 mm. Other lenses available upon request.

Controls/ Interface: 15 in. touch screen video monitor, full-size keyboard and mouse on workstation mounted ergo arm. Chroma.NET proprietary E95 style graphical user interface and parallel processing software running on quad core processor.

Process Gas: Electronically controlled pressure regulator for three process gasses up to 300 psi (2,070 kPa). Third process gas control option.

## Optional Features

| Stage Enhancements | High performance X-Y and Z-Theta stages, stage mapping and correction, lathe stage for parts up to 10 mm dia and custom-designed part holders |
| Galvanometer Temperature Control | Closed-loop galvanometer temperature control for critical accuracy applications |
| UV Fixed Beam Delivery | Beam homogenizer option providing controlled beam energy uniformity over larger field size, “line beam” for high-speed scribing, custom imaging designs |
| Alignment Automation | Functionality for automated part and beam-to-camera alignment, automated vision illumination control and in-process positional adjustment |
| Beam Measurement & Formation | Power meters, beam profilometry, programmable apertures and attenuators, pulse-to-pulse energy monitoring and data logging |
| Light Tower | System status indicator with three light colors; each with off, solid or flashing conditions |
| Power Conditioners | Range of power conditioning units for voltage regulation and improved immunity to mains-borne interference |
| Gas Cabinets | Gas delivery systems to maintain quality of ultra high purity laser gasses (UV MicroX only) |

For more information, please contact sales.ipgm@ipgphotonics.com or call 603.518.3200

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