iBeam smart Family
Single-Mode Diode Lasers

Raman Microscopy / Spectroscopy
Interferometry
Engineered for Maximum Performance

The iBeam smart family is the ultimate choice when looking for a high-performance, ultra-reliable OEM diode laser system. Providing wavelengths from the UV to the IR the iBeam smart family serves a variety of demanding applications. The success story of these lasers is based on excellence in all aspects of a modern diode laser: high optical output power, wide wavelength coverage, low noise operation and ultra-stable beam pointing.

The iBeam smart family offers unique features that set the benchmark in the competitive field of compact laser sources. High speed complete on/off modulation (with a true zero-photon off state) from a compact single box unit widely exceeds the performance of any acousto-optical modulation technique. Integration into optical setups is easy with the Feedback Induced Noise Eraser (FINE) function of the iBeam smart series. FINE makes the lasers insensitive to optical back reflections and guarantees a low noise operation even in the case of fiber coupling. Another highlight of the iBeam smart series is the SKILL speckle reduction feature (“Speckle KILLer”), which minimizes and stabilizes the coherence length of the laser at the push of a button.

TOPTICA’s pigtailed diode laser line iBeam smart PT, is the market’s gold standard for long-term power stability and reliability. This is achieved with TOPTICA’s proprietary fiber coupling technology COOLDC (Constant Optical Output Level – Durably Calibrated). In addition TOPTICA’s unique long-life fibers prevent fiber degradation at violet and UV wavelengths.

Using wavelength stabilized laser diodes within the iBeam smart WS, single-frequency operation is added to the series. With linewidths in the 10 MHz range and coherence lengths of several meters, the iBeam smart WS is a compact and cost-effective choice for demanding applications, e.g., Raman, interferometry or diffuse correlation spectroscopy. Please do not hesitate to contact us for customized solutions! We will be happy to modify the parameters of our lasers according to your needs.

Applications
- Microscopy
- Flow Cytometry
- DNA Sequencing
- Microarray Scanners
- Metrology
- Inspection
- Microscopy
- Computer-to-Plate Printing
- Disc Mastering
- Raman Microscopy/Spectroscopy
- Diffuse Correlation Spectroscopy (DSC)
- Interferometry

Contents

Colorful Diode Lasers ........................................................................................................... 3
Unique Features .................................................................................................................... 4

iBeam smart ....................................................................................................................... 6
iBeam smart PT ................................................................................................................... 8
iBeam smart WS ................................................................................................................ 10

Options .............................................................................................................................. 12
Applications ....................................................................................................................... 13
Technical Drawings ........................................................................................................... 14
UNIQUE FEATURES
Powerful, High-Quality, Ultra Reliable

**Complete on/off**

The advanced electronics of the iBeam smart allow a "complete on/off" modulation up to 100 MHz. The hereby increased signal-to-noise ratio is advantageous to all measurement setups. But especially advanced microscopy techniques that require a true "zero photon" dark state will benefit the most from this feature.

- Up to 100 MHz modulation with true "zero photon" off state
- Outstanding rise and fall times with "complete off"
- User configurable

**FINE**

The Feedback Induced Noise Eraser FINE eliminates power instabilities and high noise levels that can be caused by back reflections into the laser. By a simple push of a button ultra-stable operation is established and the need for costly optical isolators is often eliminated.

- Elimination of feedback induced power instabilities
- Intensity noise reduction
- Purely electronic feature – no additional hardware such as optical isolators necessary
- Push of a button functionality

**Digital Modulation**

The digital modulation option adds a 250 MHz, true asynchronous TTL trigger input. The included „Autopulse“ feature enables the laser to operate on self-generated pulses up to 10 MHz.

- 250 MHz digital modulation speed
- Excellent rise and fall times (< 1.5 ns)
- Mixed-mode triggering (analog and digital modulation simultaneously)
- Multi-level triggering

**Analog Modulation**

All iBeam smart models incorporate an analog modulation input, enabling modulation up to 1 MHz.

- No extra hardware (e.g. AOM / AOTF) required
- User configurable (high-/low-active)
- Mixed-mode triggering (analog and digital modulation simultaneously)

**SKILL**

The SKILL function acts as a purely electronic „Speckle KILLer“. By decreasing the longitudinal coherence lengths of the emitted light, the speckle generating mutual interference of wavefronts is reduced. Thus annoying speckle noise on detectors and imaging systems can be lowered to a minimum.

- Reduces speckle patterns
- Optimizes coherence length
- Purely electronic feature
- Integrated in all iBeam smart diode lasers
- Most effective at lower laser power

**COOL**

TOPTICA’s unique COOL technology guarantees a Constant Optical Output Level for the high power, single-mode fiber-coupled laser iBeam smart PT. The special mechanical design leads to outstanding robustness against thermal and mechanical influences. The need for time-consuming single-mode fiber alignment is eliminated, making the iBeam smart PT an „out of the box – ready to use“ laser.

- Factory set to permanent fiber coupling efficiency of higher than 50 %
- Unsusceptible to thermal fluctuations
- Unsusceptible to extensive mechanical disturbances
- Drop shipment warranty
iBeam smart
High-Performance Diode Laser

**Key Features**

- Single-mode, TEM$_{00}$ laser from 375 to 1060 nm
- True one box solution, no control box necessary
- Complete off (zero photon) modulation
- Ultimate long-term power and beam pointing stability
- FINE and SKILL to eliminate noise and speckle
- Analog Modulation up to 1 MHz, Digital Modulation up to 250 MHz
- Fiber coupling with up to 90 % SM/PM fiber coupling efficiency available

**Specifications**

**Optical Specifications**

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>375</th>
<th>395</th>
<th>405</th>
<th>420</th>
<th>445</th>
<th>460</th>
<th>473</th>
<th>488</th>
<th>505</th>
<th>515</th>
<th>633</th>
<th>640</th>
<th>660</th>
<th>685</th>
<th>785</th>
<th>850</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength range (nm)</td>
<td>± 5</td>
<td>± 5</td>
<td>± 4</td>
<td>± 5</td>
<td>± 5</td>
<td>± 4</td>
<td>± 5</td>
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<td>± 4</td>
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<td>± 5</td>
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<td>± 5</td>
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<td>± 5</td>
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<tr>
<td>Output power (mW)</td>
<td>70</td>
<td>120</td>
<td>120</td>
<td>100</td>
<td>150/300</td>
<td>120</td>
<td>100</td>
<td>100/300</td>
<td>150/300</td>
<td>80</td>
<td>100/150</td>
<td>80</td>
<td>130</td>
<td>50</td>
<td>126/250</td>
<td>130</td>
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<tr>
<td>Min. fiber coupled output power (mW)</td>
<td>45</td>
<td>75</td>
<td>100/200</td>
<td>75</td>
<td>65</td>
<td>65</td>
<td>65/130</td>
<td>50</td>
<td>65/100</td>
<td>65</td>
<td>100/130</td>
<td>30</td>
<td>30</td>
<td>80/160</td>
<td>30</td>
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<tr>
<td>Power stability</td>
<td>&lt; 0.5 % (drift over 48 h at room temperature ± 5 °C)</td>
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<tr>
<td>RMS noise</td>
<td>&lt; 0.2 % (10 Hz - 10 MHz)</td>
<td></td>
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<tr>
<td>Beam diameter (typ. @ 1/e²) (mm)</td>
<td>1.3</td>
<td>1.2</td>
<td>1.2</td>
<td>1.2</td>
<td>1.3</td>
<td>1.1</td>
<td>1.3</td>
<td>1.1</td>
<td>1.3</td>
<td>1.1</td>
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<td>1.2</td>
<td>1.2</td>
<td>1.4/0.8</td>
<td>0.6</td>
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<tr>
<td>Beam shape, ellipticity</td>
<td>circular, &lt; 10 %</td>
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<tr>
<td>Typ. divergence (rad)</td>
<td>&lt; 0.6</td>
<td>&lt; 0.6</td>
<td>&lt; 0.6</td>
<td>&lt; 0.6</td>
<td>&lt; 0.6</td>
<td>&lt; 0.7</td>
<td>&lt; 0.7</td>
<td>&lt; 0.8</td>
<td>&lt; 0.7</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
<td>&lt; 1</td>
<td>&lt; 1/16</td>
<td>&lt; 1.7</td>
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<tr>
<td>M²</td>
<td>&lt; 1.2</td>
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</tr>
<tr>
<td>Spatial Mode</td>
<td>TEM$_{00}$</td>
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<tr>
<td>Pointing stability</td>
<td>&lt; 5 µrad/K</td>
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<tr>
<td>Static alignment (mm)</td>
<td>±0.2 mm (xy), ±0.5 mm (angular)</td>
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<tr>
<td>Polarization</td>
<td>Linear, Orientation: vertical (± 3°), Ratio &gt; 100:1 (typ.)</td>
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</tr>
</tbody>
</table>

**Electronic Specifications**

**Analog Modulation**

- Max. modulation frequency: 1 MHz
- Analog modulation extinction ratio: 10^6

**Digital Modulation (option)**

- Supported signal levels: TTL
- Max. modulation frequency: 250 MHz (100 MHz with complete off)
- Rise / fall time: < 1.5 ns (10 % - 90 %)
- Modulation extinction ratio: > 1000 : 1 (with complete off)

**Electronic Shutter**

- Rise / fall time: 40 / 10 µs
- Extinction ratio: ∞ (complete off)

**General and Environmental Specifications**

- Qualification: CE marked, Class IIIb qualification, Level 4 ESD protection
- PC interface: RS 232, ≤ 115.200 baud
- DC input: 12 V DC, 2 A
- Power consumption: < 18 W (typ.) − 6 W
- Heat dissipation: < 12 W (baseplate @ 50 °C)
- Warm-up time: < 5 min
- Temperature range: 15 - 40 °C (operation), -10 - 60 °C (storage)
- Relative humidity: < 90 % (non-condensing)
- Dimensions: 40 x 40 x 100 mm³ (H x W x D)
- Weight laser head: < 250 g

*Other wavelengths on request. Static alignment tolerances are relative to reference holes in baseplate. Except for 488, 505 and 515 nm. Please inquire.

All specifications are subject to change without notice.
 Specifications

<table>
<thead>
<tr>
<th>iBeam smart PT</th>
<th>405 445 488 515 640 660 785</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Optical Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>Wavelength (nm)</td>
<td>405 445 488 515 640 660 785</td>
</tr>
<tr>
<td>Wavelength range (nm)</td>
<td>± 4 ± 5 ± 4 ± 5 ± 5 ± 3 ± 5</td>
</tr>
<tr>
<td>Fiber coupled output power (mW)</td>
<td>60 / 120 50 50 / 100 50 80 75 70</td>
</tr>
<tr>
<td>Power stability</td>
<td>± 2 % (WHR over 48 h at room temperature ± 2 °C)</td>
</tr>
<tr>
<td>RMS noise</td>
<td>≤ 2 % (10 Hz - 10 MHz)</td>
</tr>
<tr>
<td>Beam shape, ellipticity</td>
<td>circular, &lt; 10%</td>
</tr>
<tr>
<td>NF</td>
<td>&lt; 1.1</td>
</tr>
<tr>
<td>Polarization ratio (typ.)</td>
<td>&gt; 100 : 1, linear</td>
</tr>
<tr>
<td>Polarization orientation tolerance</td>
<td>± 3°</td>
</tr>
<tr>
<td><strong>Fiber Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>Fiber output connector</td>
<td>FC / AFC (8° angled) standard, others like FC / PC, FC / APC or SC on request</td>
</tr>
<tr>
<td>Fiber cable length (typ.)</td>
<td>2 m</td>
</tr>
<tr>
<td>Fiber cable type</td>
<td>3 mm Kevlar reinforced PVC</td>
</tr>
<tr>
<td>Fiber minimum bend radius</td>
<td>40 mm</td>
</tr>
<tr>
<td>Fiber type</td>
<td>single-mode, polarization maintaining</td>
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<tr>
<td>Fiber numerical aperture (5%) (typ.)</td>
<td>0.06 0.06 0.06 0.09 0.11 0.11 0.12</td>
</tr>
<tr>
<td>Mode field diameter</td>
<td>3.0 µm 3.0 µm 3.5 µm 4.2 µm 4.2 µm 4.2 µm 4.5 µm</td>
</tr>
<tr>
<td><strong>Electronic Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>Analog Modulation</td>
<td></td>
</tr>
<tr>
<td>Maximum analog modulation frequency</td>
<td>1 MHz</td>
</tr>
<tr>
<td>Analog modulation extinction ratio</td>
<td>10%</td>
</tr>
<tr>
<td>Digital Modulation (option)</td>
<td></td>
</tr>
<tr>
<td>Supported digital signal levels</td>
<td>TTL / TTL complete off</td>
</tr>
<tr>
<td>Maximum digital modulation frequency</td>
<td>250 / 100 MHz</td>
</tr>
<tr>
<td>Rise / fall time</td>
<td>&lt; 1.5 µs (10 % - 90 %)</td>
</tr>
<tr>
<td>Digital modulation extinction ratio</td>
<td>&gt; 1000 : 1 / ∞ (with complete off)</td>
</tr>
<tr>
<td><strong>Electronic Shutter</strong></td>
<td></td>
</tr>
<tr>
<td>Rise / fall time</td>
<td>40 / 10 µs</td>
</tr>
<tr>
<td>Extinction ratio (complete off)</td>
<td>&gt; 1000 : 1 / ∞</td>
</tr>
<tr>
<td><strong>General and Environmental Specifications</strong></td>
<td></td>
</tr>
<tr>
<td>Qualification</td>
<td>CE marked, Class IIB qualification, Level 4 ESD protection, RoHS compliant</td>
</tr>
<tr>
<td>PC interface</td>
<td>RS 232, ≤ 115.200 baud</td>
</tr>
<tr>
<td>DC input requirements</td>
<td>12 V DC, &lt; 2 A</td>
</tr>
<tr>
<td>Power consumption</td>
<td>&lt; 18 W (typ. / 6 W)</td>
</tr>
<tr>
<td>Heat dissipation</td>
<td>&lt; 12 W (baseplate &amp; 50 °C)</td>
</tr>
<tr>
<td>Warm-up time</td>
<td>&lt; 5 min</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>15 – 40 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-10 – 60 °C</td>
</tr>
<tr>
<td>Operating relative humidity</td>
<td>&lt; 90 % (non-condensing)</td>
</tr>
<tr>
<td>Dimensions laser head</td>
<td>40 x 40 x 145 mm³ (H x W x D)</td>
</tr>
<tr>
<td>Dimensions laser head with fiber minimum bend radius</td>
<td>40 x 40 x 195 mm³ (H x W x D)</td>
</tr>
<tr>
<td>Weight laser head</td>
<td>&lt; 360 g</td>
</tr>
</tbody>
</table>

Key Features

- Pigtailed diode laser from 405 to 785 nm
- COOL: ultra stable permanent fiber coupling
- FINE: Eliminates noise from optical feedback
- Complete off (zero photon) modulation
- SKILL: Reduces speckle in your application
- Analog Modulation up to 1 MHz, Digital Modulation up to 250 MHz
- FC / AFC fiber connector (others on request)

iBeam smart PT standard wavelengths with highest optical power

- TOPTICA long-life fiber. Minimum degradation at UV / violet wavelengths

Pigtailed High-Performance Diode Laser

Specifications

All specifications are subject to change without notice.

Visible and invisible laser radiation. Avoid direct exposure to beam.


Caution - Class 3B visible and invisible laser radiation when open.
Avoid exposure to the beam.
iBeam smart WS
Wavelength-Stabilized Diode Laser

Specifications

iBeam smart WS
633-S-WS 638-S-WS 685-S-WS 785-S-WS

Optical Specifications

<table>
<thead>
<tr>
<th>Wavelength (nm)</th>
<th>633</th>
<th>638</th>
<th>685</th>
<th>785</th>
</tr>
</thead>
<tbody>
<tr>
<td>Center wavelength range (± 1 nm)</td>
<td>± 1</td>
<td>± 1</td>
<td>± 1</td>
<td>± 1</td>
</tr>
<tr>
<td>Wavelength stability</td>
<td>&lt; 15 pm</td>
<td>&lt; 15 pm</td>
<td>&lt; 15 pm</td>
<td>&lt; 15 pm</td>
</tr>
<tr>
<td>Spectral linewidth</td>
<td>&lt; 25 MHz</td>
<td>&lt; 25 MHz</td>
<td>&lt; 20 MHz</td>
<td>&lt; 15 MHz</td>
</tr>
<tr>
<td>ASE suppression (typ.)</td>
<td>25 dB</td>
<td>25 dB</td>
<td>25 dB</td>
<td>25 dB</td>
</tr>
<tr>
<td>Max. output power</td>
<td>40/70 mW</td>
<td>30 mW (120 mW (6))</td>
<td>45 mW</td>
<td>120 mW</td>
</tr>
<tr>
<td>Power stability</td>
<td>&lt; 0.5 % (drift over 48 h @ constant ambient)</td>
<td>&lt; 0.5 % (drift over 48 h @ constant ambient)</td>
<td>&lt; 0.5 % (drift over 48 h @ constant ambient)</td>
<td>&lt; 0.5 % (drift over 48 h @ constant ambient)</td>
</tr>
<tr>
<td>Beam diameter (typ. @ 1/e²)</td>
<td>0.6 x 0.9 mm (1)</td>
<td>1.4 mm</td>
<td>1.6 mm</td>
<td>1.2 mm</td>
</tr>
<tr>
<td>Ellipticity</td>
<td>30 % (3)</td>
<td>&lt; 10 %</td>
<td>&lt; 10 %</td>
<td>&lt; 10 %</td>
</tr>
<tr>
<td>Divergence (typ.)</td>
<td>&lt; 2 mrad</td>
<td>&lt; 1 mrad</td>
<td>&lt; 1 mrad</td>
<td>&lt; 1 mrad</td>
</tr>
<tr>
<td>M²</td>
<td>&lt; 1.5</td>
<td>&lt; 1.5 (typ. 1.2)</td>
<td>&lt; 1.5 (typ. 1.2)</td>
<td>&lt; 1.5 (typ. 1.2)</td>
</tr>
<tr>
<td>Polarization ratio (typ.)</td>
<td>&gt; 50 : 1, linear</td>
<td>&gt; 50 : 1, linear</td>
<td>&gt; 50 : 1, linear</td>
<td>&gt; 50 : 1, linear</td>
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<tr>
<td>Polarization orientation tolerance</td>
<td>± 3°</td>
<td>± 3°</td>
<td>± 3°</td>
<td>± 3°</td>
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</table>

General and Environmental Specifications

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Qualification</td>
<td>CE marked, Class IIb qualification, Level 4 ESD protection, RoHS-compliant</td>
<td>CE marked, Class IIb qualification, Level 4 ESD protection, RoHS-compliant</td>
<td>CE marked, Class IIb qualification, Level 4 ESD protection, RoHS-compliant</td>
<td>CE marked, Class IIb qualification, Level 4 ESD protection, RoHS-compliant</td>
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<tr>
<td>DC input requirements</td>
<td>12 V DC, &lt; 2 A</td>
<td>12 V DC, &lt; 2 A</td>
<td>12 V DC, &lt; 2 A</td>
<td>12 V DC, &lt; 2 A</td>
</tr>
<tr>
<td>Power consumption</td>
<td>&lt; 18 W (typ. &lt; 6 W)</td>
<td>&lt; 18 W (typ. &lt; 6 W)</td>
<td>&lt; 18 W (typ. &lt; 6 W)</td>
<td>&lt; 18 W (typ. &lt; 6 W)</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>15 .. 40 °C</td>
<td>15 .. 40 °C</td>
<td>15 .. 40 °C</td>
<td>15 .. 40 °C</td>
</tr>
<tr>
<td>Storage temperature range</td>
<td>-10 .. 60 °C</td>
<td>-10 .. 60 °C</td>
<td>-10 .. 60 °C</td>
<td>-10 .. 60 °C</td>
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<tr>
<td>Operating relative humidity</td>
<td>&lt; 90 % (non-condensing)</td>
<td>&lt; 90 % (non-condensing)</td>
<td>&lt; 90 % (non-condensing)</td>
<td>&lt; 90 % (non-condensing)</td>
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<tr>
<td>Dimensions laser head</td>
<td>40 x 40 x 100 mm³ (H x W x D)</td>
<td>40 x 40 x 100 mm³ (H x W x D)</td>
<td>40 x 40 x 100 mm³ (H x W x D)</td>
<td>40 x 40 x 100 mm³ (H x W x D)</td>
</tr>
</tbody>
</table>

Additional specifications:

- Standard wavelengths:
  - 633 nm, 638 nm, 685 nm and 785 nm
- High power diode laser (up to 120 mW)
- Narrow linewidth (typ. 10 MHz)
- Fully computer controlled
- Perfect choice for Raman applications
- Ultra compact design 100 x 40 x 40 mm³

Key Features

- Ultimate wavelength stability, no mode-hopping
- Excellent power stability
- Short wavelength: 633 nm, 638 nm, 685 nm and 785 nm
- High power diode laser (up to 120 mW)
- Narrow linewidth (typ. 10 MHz)
- Fully computer controlled
- Perfect choice for Raman applications
- Ultra compact design 100 x 40 x 40 mm³

Typical linewidth < 10 MHz

Excellent power stability

Visible and invisible laser radiation. Avoid direct exposure to beam.


Visible and invisible laser radiation. Avoid direct exposure to beam.

Caution - Class 3B visible and invisible laser radiation when open.

Avoid exposure to the beam.

All specifications are subject to change without notice.

Please enquire for optical specifications.
Options

- **iBeam smart Pulse Option**
  The pulse option enables the user to apply asynchronous, digital modulation signals to the iBeam smart. With optical rise and fall times in the 1 ns range, bandwidths up to 250 MHz can be achieved. The pulse option also provides the “Autopulse” feature. Frequencies up to 10 MHz can be programmed to the iBeam smart, making an external signal generator dispensable.

- **λ±1 nm**
  Demanding applications often need very specific wavelengths, e.g. to perfectly match absorption lines or for consistent results due to high system-to-system repeatability. For such cases TOPTICA offers wavelength selection better than ±1 nm inside the available standard wavelength range.

- **SmartDock**
  Highly efficient (> 60 %) guaranteed, typical > 75 %) fiber-coupling is possible with this add-on fiber-coupler for the iBeam smart. TOPTICA’s patented design allows straight forward alignment, combined with ultra-stable long-term performance.

- **Clean-Up Filter**
  Laser clean-up filters provide high transmission (> 90 %) of designated wavelengths and eliminate unwanted spontaneous emission when spectral purity is critical.

- **External Control Box**
  The CDRH compliant external controller helps scientific customers to easily integrate the laser into their setup. It provides the user with a key switch and access to all important control lines.

- **FiberOut**
  This fiber output collimator with adjustable collimation guarantees excellent beam quality after the fiber. The customer can select from different lenses in order to achieve the beam diameter best suited for his application.

- **Optical Isolator**
  The iBeam smart can be equipped with an external optical isolator. This option is recommended for the iBeam smart WS in order to guarantee stable single-frequency operation.

Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>iBeam smart</th>
<th>iBeam smart PT</th>
<th>iBeam smart WS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microscopy</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Flow Cytometry</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>DNA Sequencing</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>HTS/HCS</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Raman Microscopy/Spectroscopy</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Diffuse Correlation Spectroscopy</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Semiconductor Inspection</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Metrology/Ellipsometry</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Interferometry</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Micro lithography</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Computer-to-Plate (CTP) Printing</td>
<td>✔</td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Optical Data Storage</td>
<td>✔</td>
<td>✔</td>
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</tbody>
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| Common Wavelength(s)              | 375 nm .. 640 nm | 375 nm .. 640 nm | 785 nm         |
|                                   | 405 nm .. 785 nm | 785 nm .. 850 nm | 405 nm         |
Technical Drawings

iBeam smart / iBeam smart WS

iBeam smart with isolator

iBeam smart with SmartDock

iBeam smart PT

Detailed technical drawings are available on our website.