iBeam smart Family

Single-Mode Diode Lasers

Microscopy

Flow Cytometry

Metrology

Inspection

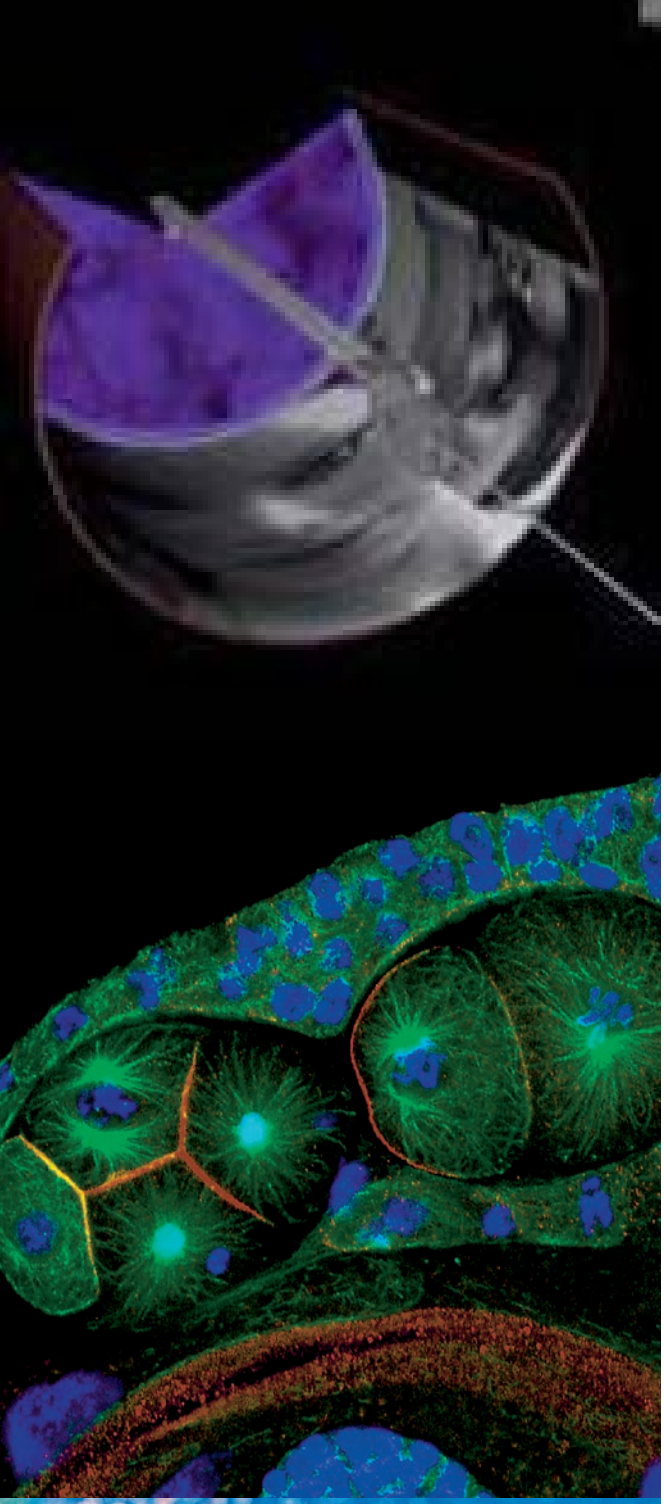
Microlithography

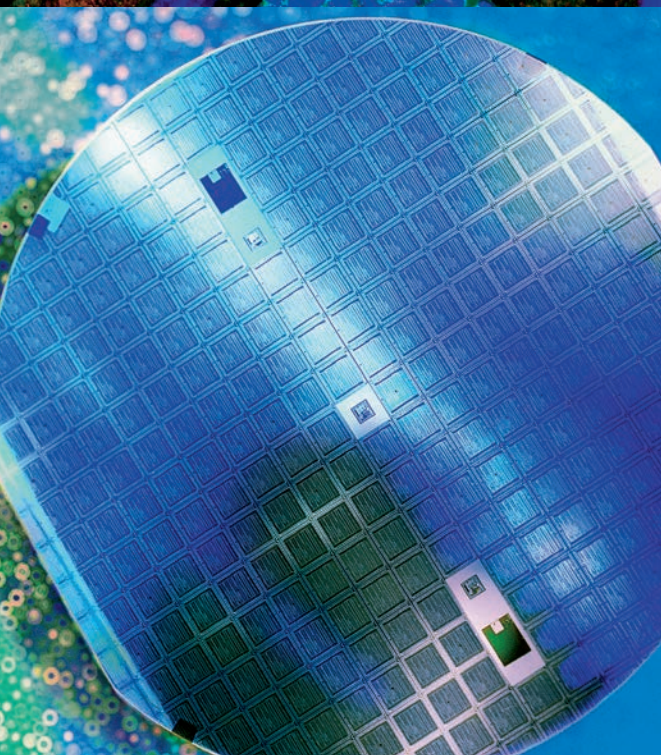
Computer-to-Plate Printing

Raman Microscopy / Spectroscopy

Interferometry

TOPTICA PHOTONICS





Contents

COLORFUL DIODE LASERS

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.

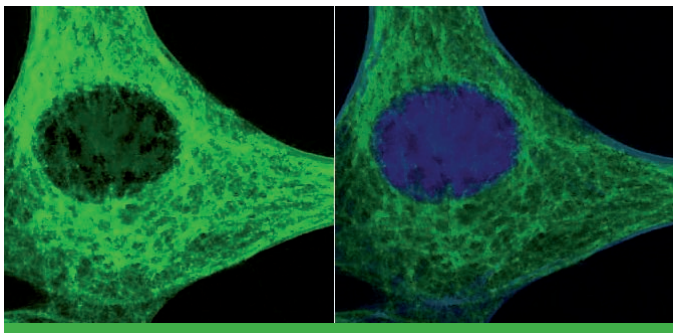
TOPTICA's pigtailed diode laser line iBeam smart PT, is the market's gold standard for long-term power stability and reliability. This is achieved with TOPTICA's proprietary fiber coupling technology COOLDC (Constant Optical Output Level – Dura-Calibrated). In addition TOPTICA's unique long-life fibers 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
- Microlithography
- Computer-to-Plate Printing
- Disc Mastering
- Raman Microscopy / Spectroscopy
- Diffuse Correlation Spectroscopy (DSC)
- Interferometry

UNIQUE FEATURES

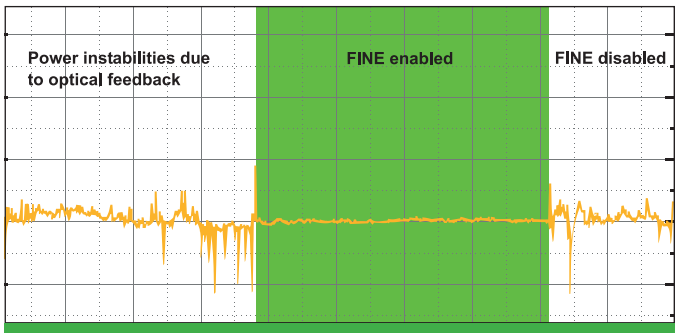
Powerful, High-Quality, Ultra Reliable



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

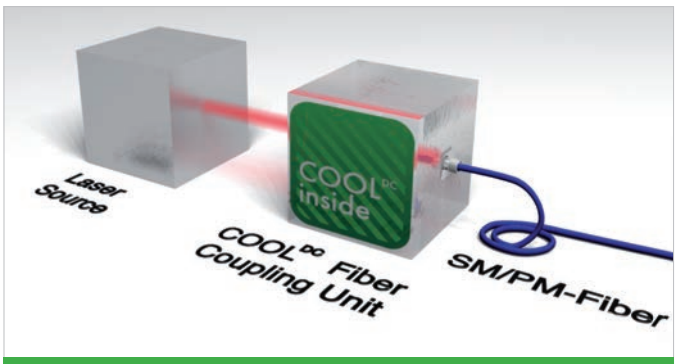
The Feedback Induced Noise Eraser FINE eliminates power instabilities and high noise levels that can be caused by back reflections into the laser. By a simple push of a button ultra-stable operation is established and the need for costly optical isolators is often eliminated.

· 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

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.

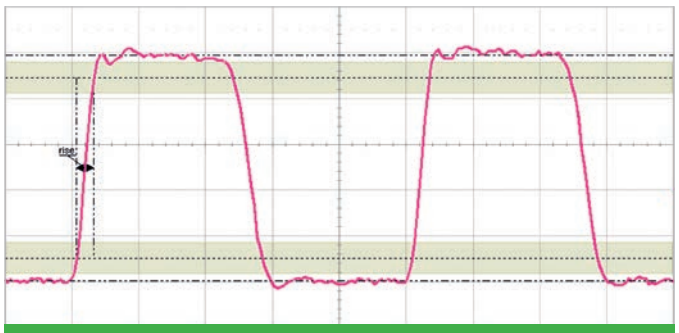
· Reduces speckle patterns
· Optimizes coherence length
· Purely electronic feature
· Integrated in all iBeam smart diode lasers
· Most effective at lower laser power



COOL^{DC}

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.

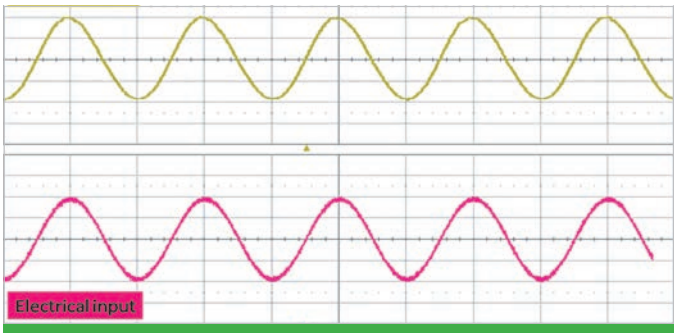
· Factory set to permanent fiber coupling efficiency of higher than 50 %
· Unsusceptible to thermal fluctuations
· Unsusceptible to extensive mechanical disturbances
· Drop shipment warranty



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

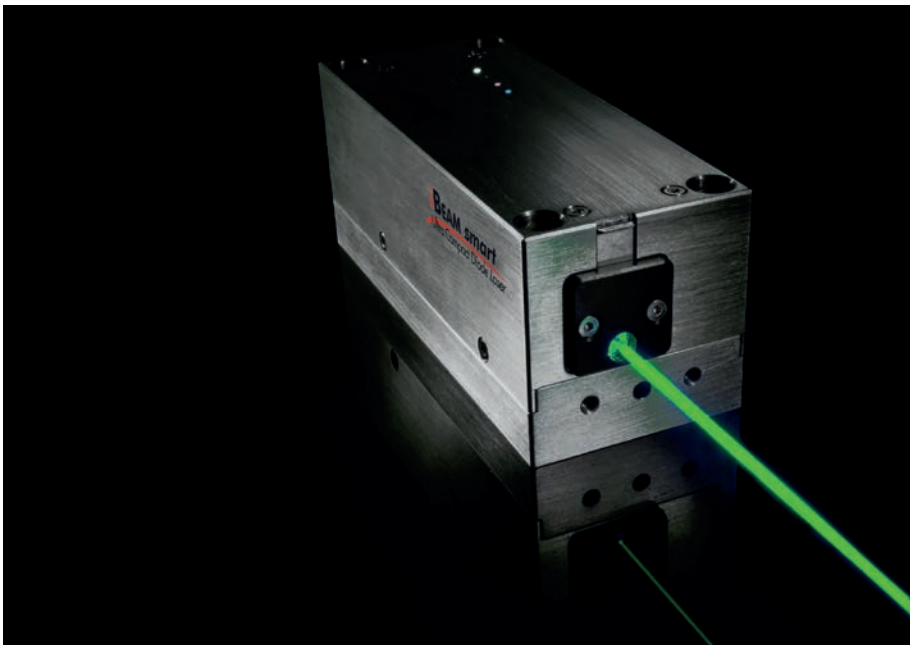
All iBeam smart models incorporate an analog modulation input, enabling modulation up to 1 MHz.

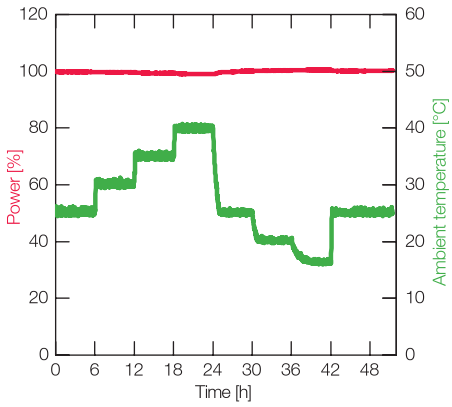
· No extra hardware (e.g. AOM/AOTF) required
· User configurable (high-/low-active)
· Mixed-mode triggering (analog and digital modulation simultaneously)

iBeam smart
High-Performance Diode Laser

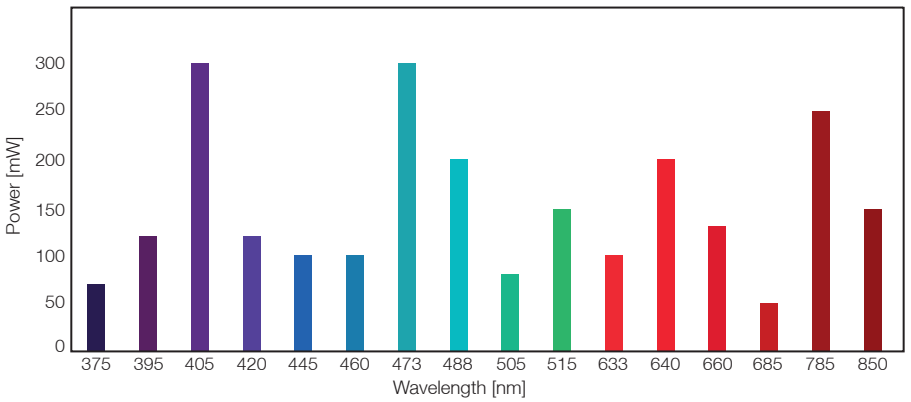
Key Features

- 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

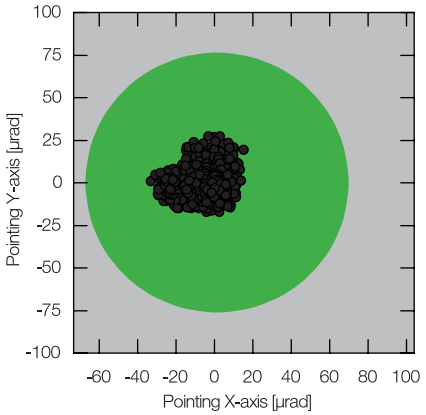




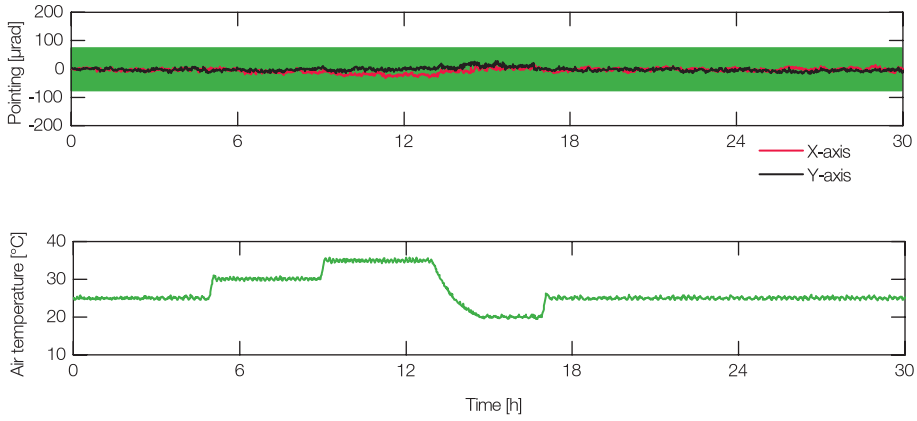
Best power stability (< 0.5 % drift over 48 h) even under changing ambient temperature



iBeam smart standard wavelengths with highest optical power.



Ultimate beam pointing stability – beam stays easily within specification.



Best power stability (< 0.5 % drift over 48 h) even under changing ambient temperature.

Class 3B Laser Product EN 60825-1:2014.
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

Specifications

Specifications iBeam smart													
iBeam smart	375	395	405	420	445	460	473	488	505	515	633	640	647
Optical Specifications													
Center Wavelength Range [1] [nm]	375 ± 3	395 ± 5	405 ± 4	420 ± 5	445 ± 5	460 ± 5	473 ± 5	488 ± 4	505 ± 2	515 ± 5	633 ± 3	640 ± 5	647 ± 3
Output power [mW]	70	120	100 150 300 400	120	100 450	100 450	100 300	100 200 300	80	100 150	100	150 200	150
Min. fiber coupled output power [mW]	45	75	65 100 200 250	75	65 290	65 290	65 200	65 130 200	50	65 100	65-	100 130	100
Power stability	< 0.5 % (drift over 48 h @ room temperature ± 5 °C)												
RMS Noise (10 Hz – 10 MHz) (typ.)	< 0.2 %												
Beam diameter (typ.@1/ e^2)]mm]	1.2	1.2	1.2	1.2	1.3 1.2	1.1 1.2	1.3 1.2	1.2 1.0	1.1	1.1	1.0	1.0 0.8	1.2
Beam shape, ellipticity	Circular, < 10 %												
Typ. Divergence [mrad]	< 0.6	< 0.6	< 0.6	< 0.6	< 0.7	< 0.7	< 0.7	< 0.7	< 0.8	< 0.7	< 1.0	< 1.0	< 1.0
M^2	< 1.2												
Spatial Mode	TEM_{00}												
Pointing stability	< 5 µrad / K												
Static alignment[2]	± 0.2 mm (xy), ± 0.5 mrad (angular)												
Polarization	Linear, Orientation: vertical (± 3°), Ratio > 50:1 (> 100:1 typ.)												
Electronic Specifications													
Analog Modulation													
Max. modulation frequency	1 MHz												
Analog modulation extinction ratio	10^6: 1												
Digital Modulation (option)													
Supported signal levels	TTL / TTL complete off												
Max. modulation frequency	250 MHz / 100 MHz with complete off												
Rise / fall time (10 % - 90 %)	< 1.5 ns												
Modulation extinction ratio	> 1000 : 1 ∞ with complete off[3]												
Electronic Shutter													
Rise / fall time	40 / 10 µs												
Extinction ratio	∞ (complete off)[3]												
General and Environmental Specifications													
Qualification	CE marked, Laser Class IIIb qualification, Level 4 ESD protection, RoHS compliant												
PC interface	RS 232, ≤ 115.200 baud												
DC input	12 V DC, 2A												
Power consumption	< 18 W (typ. < 6 W)												
Heat dissipation	< 18 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 mm^3 (H x W x D)												
Weight	< 250 g												

All specifications are valid for 100 % optical power.
[1]Other wavelengths on request. [2]Static alignment tolerances are relative to reference holes in baseplate. [3]Except for 488, 505 and 515 nm. Please inquire.

All specifications are subject to change without notice.

Class 3B Laser Product EN 60825-1:2014.
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

Specifications

Specifications iBeam smart												
iBeam smart	660	670	685	705	728	785	808	830	850	940	980	1064
Optical Specifications												
Center Wavelength Range [1] [nm]	660 ± 3	670 ± 2	685 ± 5	705 ± 5	728 ± 5	785 ± 5	808 ± 5	830 ± 5	850 ± 5	940 ± 5	980 ± 10	1064 ± 10
Output power [mW]	130 200	10	50	35	35	125 250	150	50	150	300	150	200
Min. fiber coupled output power [mW]	85 130	5	32	20	20	80 200	100	32	100	200	100	130
Power stability	< 0.5 % (drift over 48 h @ room temperature ± 5 °C)											
RMS Noise (10 Hz – 10 MHz) (typ.)	< 0.2 %											
Beam diameter (typ.@1/e^2) [mm]	1.2 0.9	1.2	1.2	1.2	1.2	1.4 0.8	1.2	1.2	1.0	1.2	1.2	1.2
Beam shape, ellipticity	Circular, < 10 %											
Typ. Divergence [mrad]	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.2	< 1.2	< 1.2	< 1.2	< 1.3	< 1.4	< 1.4
M^2	< 1.2											
Spatial Mode	TEM_{00}											
Pointing stability	< 5 µrad / K											
Static alignment[2]	± 0.2 mm (xy), ± 0.5 mrad (angular)											
Polarization	Linear, Orientation: vertical (± 3°), Ratio > 50:1 (> 100:1 typ.)											
Electronic Specifications												
Analog Modulation												
Max. modulation frequency	1 MHz											
Analog modulation extinction ratio	10^6: 1											
Digital Modulation (option)												
Supported signal levels	TTL / TTL complete off											
Max. modulation frequency	250 MHz / 100 MHz with complete off											
Rise / fall time (10 % - 90 %)	< 1.5 ns											
Modulation extinction ratio	> 1000 : 1 ∞ with complete off[3]											
Electronic Shutter												
Rise / fall time	40 / 10 µs											
Extinction ratio	∞ (complete off)[3]											
General and Environmental Specifications												
Qualification	CE marked, Laser Class IIIb qualification, Level 4 ESD protection, RoHS compliant											
PC interface	RS 232, ≤ 115.200 baud											
DC input	12 V DC, 2A											
Power consumption	< 18 W (typ. < 6 W)											
Heat dissipation	< 18 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 mm^3 (H x W x D)											
Weight	< 250 g											

All specifications are valid for 100 % optical power.
[1]Other wavelengths on request. [2]Static alignment tolerances are relative to reference holes in baseplate. [3]Except for 488, 505 and 515 nm. Please inquire.

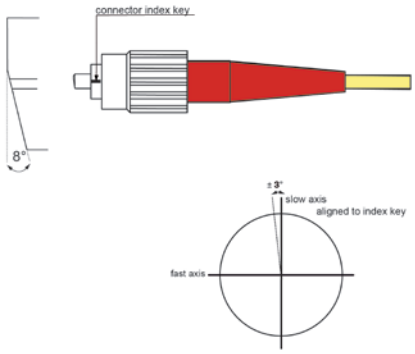
All specifications are subject to change without notice.

iBeam smart PT

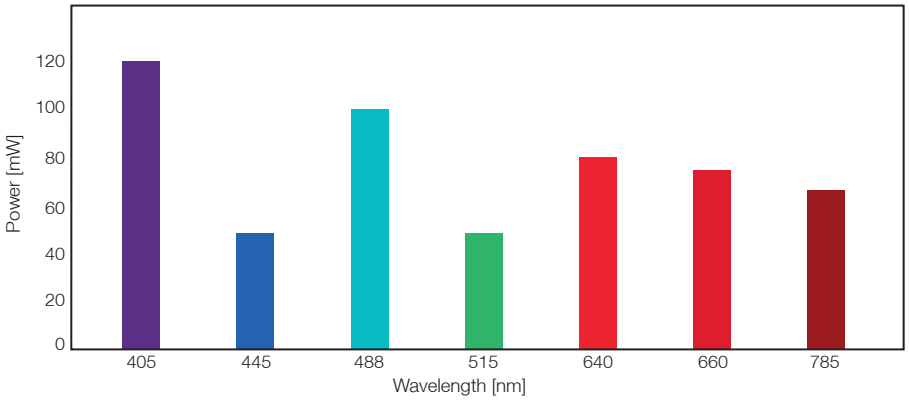
Pigtailed High-Performance Diode Laser

Key Features

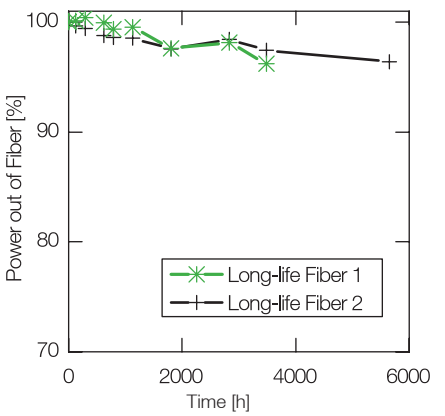
- Pigtailed diode laser from 405 to 785 nm
- COOL^{DC}: ultra stable permanent fiber coupling
- FINE: Eliminates noise from optical feedback
- Complete off (zero photon) modulation
- SKILL: Reduces speckle in your application
- Analog Modulation up to 1 MHz, Digital Modulation up to 250 Mhz
- FC/AFC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



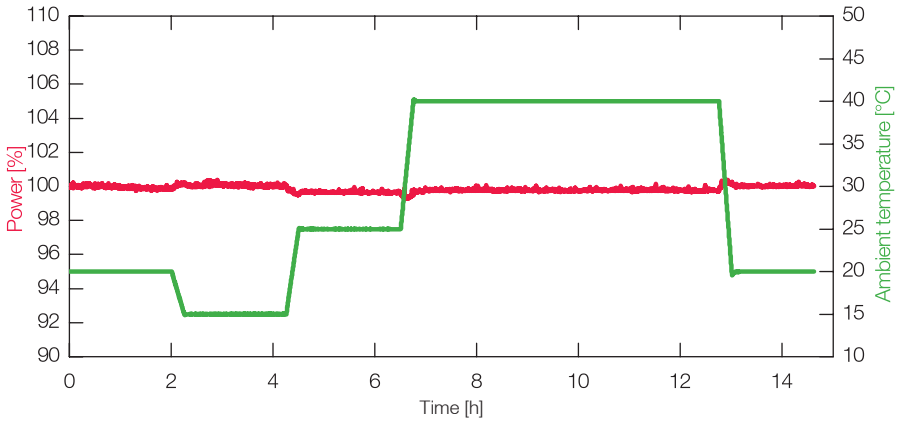
Standard fiber output connector FC/AFC and polarization orientation at fiber connector



iBeam smart PT standard wavelengths with highest optical power



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



Fiber coupled power stability (< 0.5 % drift over 24 h) even under changing ambient temperature

Class 3B Laser Product EN 60825-1:2014.
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

Specifications

Specifications iBeam smart PT											
iBeam smart PT	375	405	445	488	515	633	640	660	728	785	850
Optical Specifications											
Center Wavelength Range (nm)	375 ± 2	405 ± 4	445 ± 5	488 ± 4	515 ± 5	633 ± 5	640 ± 5	660 ± 5	728 ± 5	785 ± 5	850 ± 10
Fiber coupled output power (mW)	30	60 120	50 120	50 100	75	50	80 100	75 100	20	75	75
Power Stability	≤ 2 % (drift over 48 h @ room temperature ± 2 °C)										
RMS Noise (10 Hz – 10 MHz) (typ.)	≤ 0.4 %										
Beam shape, ellipticity	circular, < 10%										
M^2	< 1.1										
Polarization	Linear, slow axis aligned to index key with orientation tolerance of ± 3°, Ratio > 50:1 (> 100:1 typ.)										
Fiber Specifications											
Fiber output connector	FC / AFC (8° angled) standard, others like FC / PC, FC / APC or SC on request										
Fiber cable length (typ.)	2 m										
Fiber cable type	3 mm Kevlar reinforced PVC										
Fiber minimum bend radius	40 mm										
Fiber type	single-mode, polarization maintaining										
Fiber numerical aperture (5 %) (typ.)	0.075	0.075	0.07	0.07	0.1	0.11	0.11	0.11	0.11	0.12	0.12
Mode field diameter (µm) (typ.)	2.8	3.0	3.0	3.5	4.2	4.2	4.2	4.2	4.5	4.5	5.0
Electronic Specifications											
Analog Modulation											
Maximum analog modulation frequency	1 MHz										
Analog modulation extinction ratio	10^6										
Digital Modulation (option)											
Supported digital signal levels	TTL / TTL complete off										
Maximum digital modulation frequency	250 MHz / 100 MHz with complete off										
Rise / fall time	< 1.5 ns										
Digital modulation extinction ratio	> 1000 : 1 / ∞ with complete off[2]										
Electronic Shutter											
Rise / fall time	40 / 10 µs										
Extinction ratio	∞ (complete off)[2]										
General and Environmental Specifications											
Qualification	CE marked, Class IIIb qualification, Level 4 ESD protection, RoHS compliant										
PC interface	RS 232, ≤ 115.200 baud										
DC input requirements	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 laser head	40 x 40 x 145 mm^3 (H x W x D)										
Dimensions laser head with fiber minimum bend radius	40 x 40 x 195 mm^3 (H x W x D)										
Weight laser head	< 360 g										

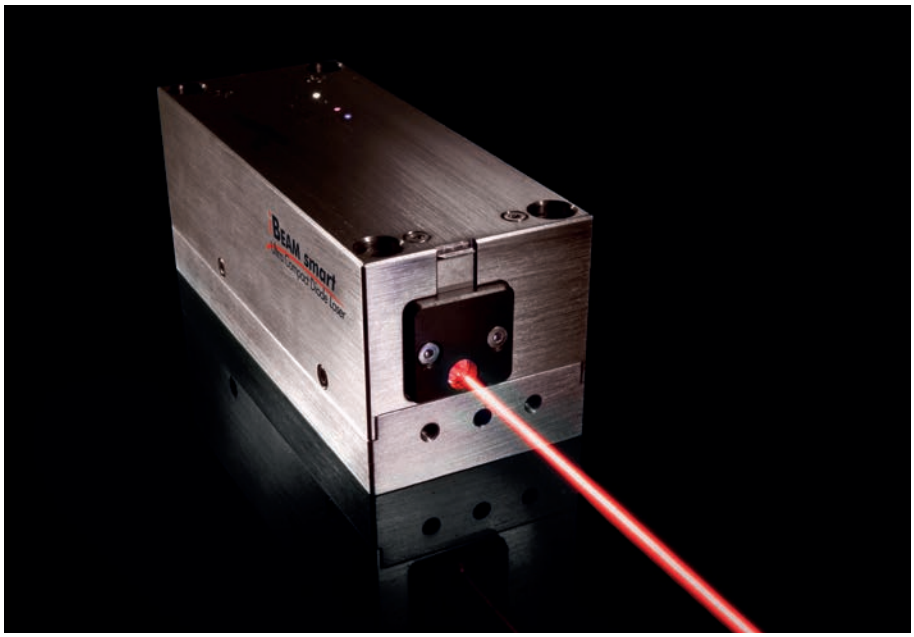
All specifications are valid for 100 % optical power.
[1] Other wavelengths on request (see also iBeam smart wavelength range). [2] Except for 488 and 515 nm. Please inquire.

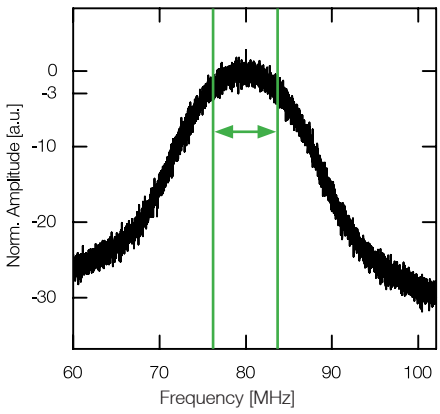
All specifications are subject to change without notice.

iBeam smart WS
Wavelength-Stabilized Diode Laser

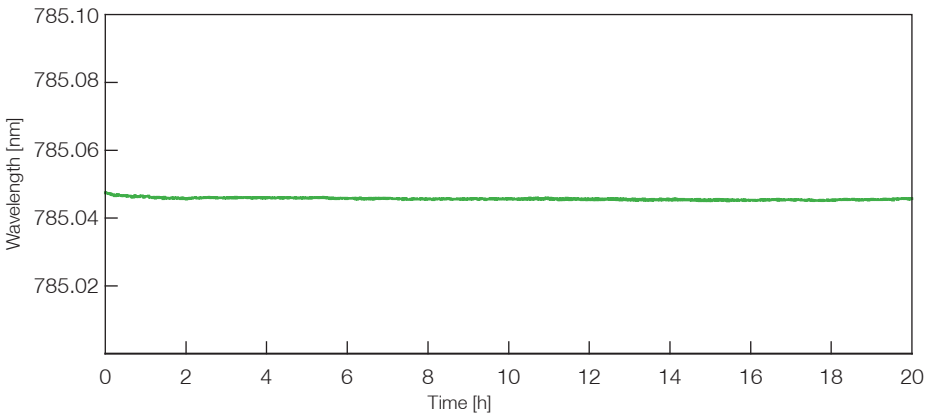
Key Features

- 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

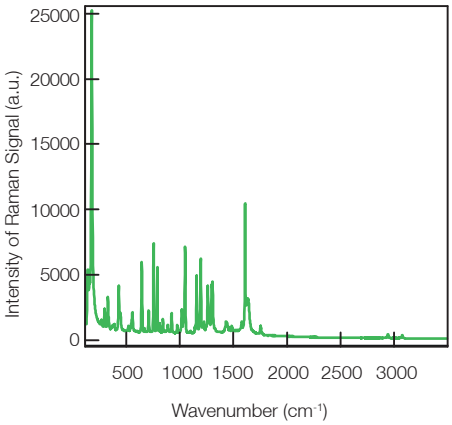




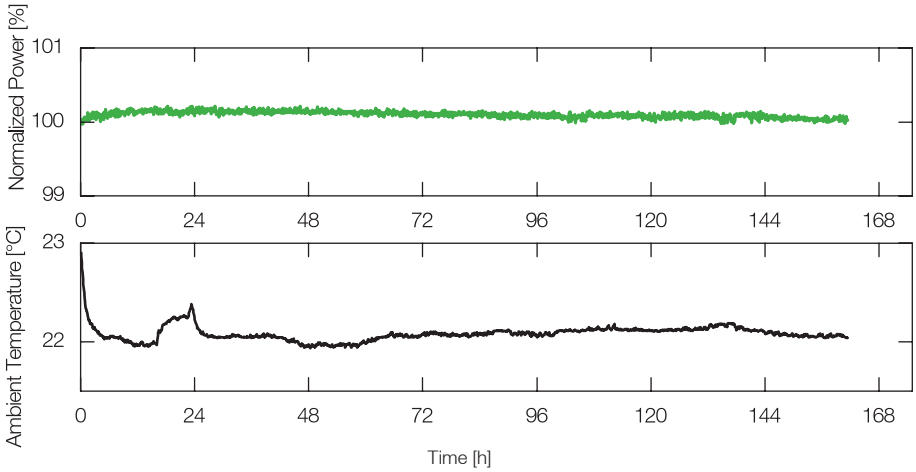
Typical linewidth < 10 MHz



Ultimate wavelength stability, no mode-hopping



iBeam smart WS – best suited for Raman applications



Excellent power stability

Class 3B Laser Product EN 60825-1:2014.
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

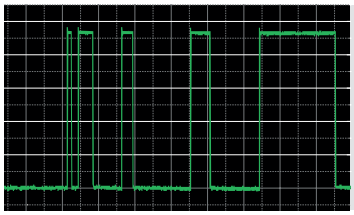
Specifications

Specifications iBeam smart WS												
iBeam smart WS	633	638		660	685	785		808		828	852	
Optical Specifications												
Center wavelength range (nm)	633 ± 1	638 ± 1		660 ± 1	685 ± 1	785 ± 1		808 ± 1		828 ± 1	852 ± 1	
Wavelength stability	< 15 pm											
Spectral linewidth	< 25 MHz											
ASE suppression (typ.)	25 dB											
Polarization	Linear, Orientation tolerance ± 3°, Ratio (typ.) > 50:1											
Optical output power (mW)	70	30	120	35	40	120	250	100	350	70	80 / 250	250
Power stability	≤ 0.5 % (drift over 48 h @ room temperature ± 5 °C)						≤ 2 % (drift over 48 h @ room temperature ± 5 °C)					
Beam shape	elliptical	circular	elliptical	circular	circular	circular	elliptical	circular	elliptical	circular	circular	elliptical
Beam size (typ. @1/e2) (mm)	0.6 x 0,9 [2]	1.4 x 01,4[2]	0.6 x 0,9 [2]	1.6 x 1.6	1.6 x 1.6	1.2 x 1.2	0.6 x 2,2 [2]	1.0 x 1.0	0.7 x 2,2 [2]	1.0 x 1.0	1.1 x 1.1	0.7 x 1,7 [2]
Ellipticity	30% [3]	< 10 %	30% [3]	< 10 %	< 10 %	< 10 %	30% [3]	< 10 %	30% [3]	< 10 %	< 10 %	30% [3]
Divergence (typ.)	< 2	< 1	< 2	< 1	< 1	< 1	< 2	< 1.2	< 2	< 1.2	< 1.2	< 2
M^2	≤ 1.7	≤ 1.5	≤ 1.7	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.7	≤ 1.5	≤ 1.7	≤ 1.5	≤ 1.5	≤ 1.7
M^2 (typ.)	< 1.5	< 1.3	< 1.5	< 1.3	< 1.3	< 1.3	< 1.5	< 1.3	< 1.5	< 1.3	< 1.3	< 1.5
Pointing stabilty (µrad/K)	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Static alignment [4,5]x,y (mm)	± 0.4	± 0.2	± 0.4	± 0.2	± 0.2	± 0.2	± 0.4	± 0.2	± 0.4	± 0.2	± 0.2	± 0.4
Static alignment angular [4] (mrad)	± 1	± 0.5	± 1	± 0.5	± 0.5	± 0.5	± 1	± 0.5	± 1	± 0.5	± 0.5	± 1
General and Environmental Specifications:												
Qualification	CE marked, Laser Class IIIb qualification, Level 4 ESD protection, RoHS compliant											
PC interface	RS 232, ≤ 115.200 baud											
DC Input	12 V DC, 2 A											
Power Consumption	< 18 W (typ. < 6 W)											
Heat dissipation	< 18 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 laser head	40 x 40 x 100 mm3 (H x W x D)											
Weight	< 250 g											

All specifications are valid for 100 % optical power.
[1] Circularisation requires additional external beam shaping.
[2] Beam size at 50 cm behind laser aperture.
[3] Far field, > 150 cm.
[4] Static alignment tolerances are relative to reference holes in base plate.
[5] Central beam aperture, different to drawing of standard iBeam smart.

All specifications are subject to change without notice.

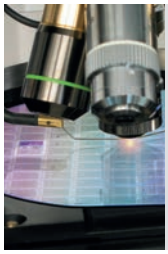
Options

Option	Description	iBeam smart	iBeam smart PT	iBeam smart WS
	**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	**Wavelength Selection** Demanding applications often need very specific wavelengths, e.g. to perfectly match absorbtion 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.	✓		✓

* Some laser characteristics might be influenced (e.g. wavelength stability).

Applications

Application	TEM_{∞}	Power Stability	Pointing Stability	Complete Off	Fast Digital Modulation	Noise < 0.2 %	Wavelength Selection	SM/PM Fiber	FINE/SKILL	Narrow Linewidth	Common Wavelength(s)	iBeam smart	iBeam smart PT	iBeam smart WS
Microscopy	✓	✓	✓	✓				✓	✓		375 nm .. 640 nm	✓	✓	
Flow Cytometry	✓	✓	✓		✓	✓			✓		375 nm .. 640 nm	✓	✓	
DNA Sequencing	✓	✓	✓		✓	✓					375 nm .. 660 nm	✓	✓	
HTS/HCS	✓	✓	✓			✓			✓		375 nm .. 640 nm	✓	✓	
Raman Microscopy/Spectroscopy	✓	✓	✓				✓	✓		✓	785 nm			✓
Diffuse Correlation Spectroscopy	✓	✓	✓					✓		✓	785, 850 nm			✓

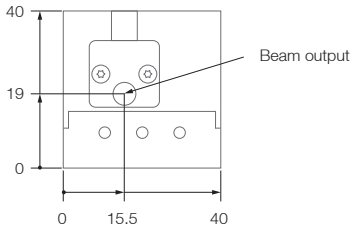


Semicon Inspection	✓	✓	✓		✓	✓	✓	✓	✓		405 nm .. 785 nm	✓	✓	
Metrology/Ellipsometry	✓	✓	✓			✓	✓	✓	✓		375 nm .. 785 nm	✓	✓	
Interferometry	✓	✓	✓			✓	✓			✓	633 nm			✓
Microlithography	✓	✓	✓		✓						375, 405, 445 nm	✓	✓	
Computer-to-Plate (CTP) Printing	✓	✓	✓	✓	✓						405 nm	✓	✓	
Optical Data Storage	✓	✓	✓	✓	✓	✓			✓		405 nm	✓	✓	

Technical Drawings

iBeam smart / iBeam smart WS

FRONT



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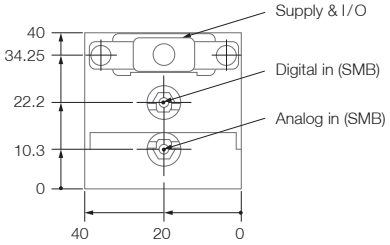

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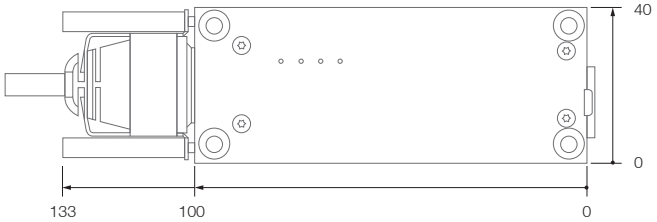
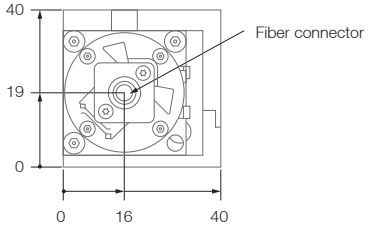


iBeam smart with SmartDock

FRONT



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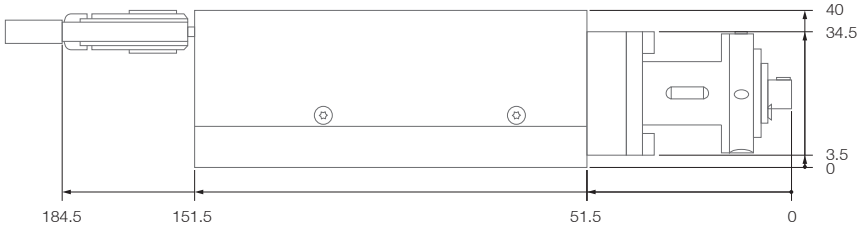

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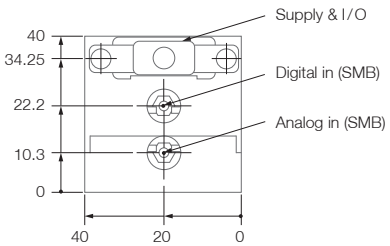

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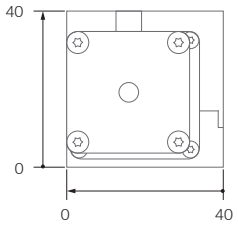
iBeam smart with isolator

FRONT



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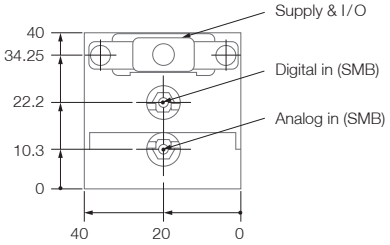
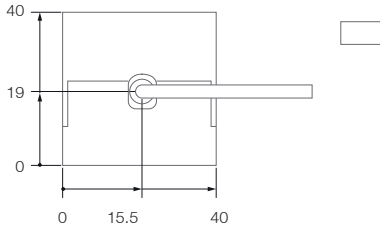


TOP

iBeam smart PT

FRONT



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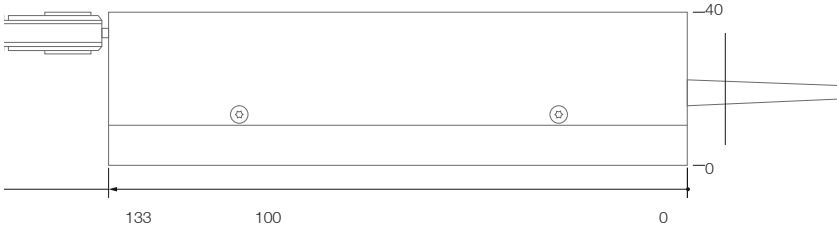

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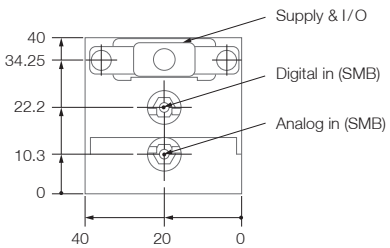

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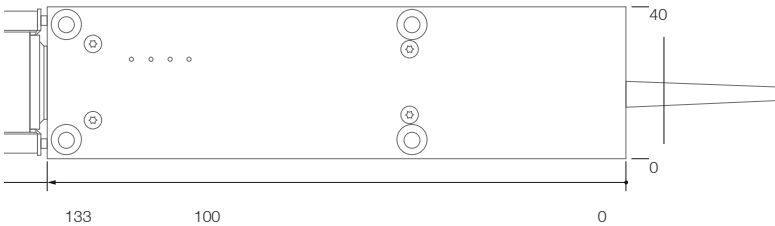

All dimensions given in mm.

Detailed technical drawings are available on our website.

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