

# Superluminescent Diodes

Since 1992, we have been manufacturing high quality Superluminescent Light Emitting Diodes (SLDs), Gain Chip Modules and Semiconductor Optical Amplifiers (SOAs). Our main products are free space SLD modules and SM and PM fiber pigtailed SLD modules based on a single transverse mode SLD emitters, as well as multimode fiber pigtailed SLD modules in different spectral bands from 650 nm to 1620 nm, including extremely powerful (up to 100 mW) and broadband (up to 100 nm FWHM) models.

The modules are offered in a variety of hermetic packages (TO, DIL14, Butterfly, etc.). Custom performance characteristics and different package types are available upon request. For customers' convenience, modules can be delivered with an appropriate current and temperature controller.



Our products are employed over a wide range of applications including biomedical and industrial optical coherence tomography (OCT), fiberoptic gyros, Bragg Grating sensors, atomic force microscopy, metrology of fiberoptic components (including DWDM components testing) and machine vision.

## Uncooled Single-Mode Free-Space SLDs

Our uncooled single mode free space SLDs are listed in the table below, grouped by spectral band.

Model number	Wavelength (nm)	Spectrum width, FWHM (nm)	Output power, free space (mW)	Package
SLD-260-MP-670	670	7.5	up to 5.0	TO-9
SLD-260-HP-670	670	7.0	up to 15.0	TO-9
SLD-340-MP-795	795	15	20	TO-9
SLD-380-MP-TO56	825	20	5	TO-56
SLD-380-MP-TO9	835	17	20	TO-9
SLD-340-HP-850	850	20	30	TO-56
SLD-340-UHP-840	840	25 – 30	up to 100	TO-9
SLD-340-MP-880	880	40	20	TO-9
SLD-480-MP-920	920	30	20	TO-9
SLD-480-UHP-960	960	45	90	TO-9
SLD-530-UHP-1040	1040	35 – 45	up to 80.0	TO-9

## Uncooled Single-Mode Fiber-Pigtailed SLDs

Our uncooled single mode fiber pigtailed SLDs are listed in the table below, grouped by spectral band.

Model number	Wavelength (nm)	Spectrum width, FWHM (nm)	Output power, SM fiber (mW)	Package
SLD-381 MINIBUT	770 – 860	15 – 20	Up to 2.0	Minibut
SLD-561 MINIBUT	1270 – 1330	20 – 25	Up to 1.0	Minibut

## Temperature-Controlled (Cooled) Single-Mode Free-Space and Fiber-Pigtailed SLDs

Our temperature-controlled (cooled) single mode SLDs are listed in the table below, grouped by spectral band.

Model number	Wavelength (nm)	Spectrum width, FWHM (nm)	Output power, fiber/free space (mW)	Package
SLD-261-MP	660 – 680	7.5	up to 2.0/n.a.	Butterfly, DIL14
SLD-260-HP	660 – 680	7.0	n.a./15.0	TOW
SLD-261-HP	660 – 680	7.0	up to 10.0/n.a.	New! Butterfly

SLD-260-UHP	660 – 680	7.0	n.a./25.0	New! TOW
SLD-261-UHP	660 – 680	7.0	15.0/n.a.	New! Butterfly
SLD-33-MP	770 – 790	50	up to 1.25/4.0	Butterfly/DIL14,TOW
SLD-33-HP	770 – 790	50	up to 25.0/50.0	Butterfly/DIL14,TOW
SLD-34-MP	840 – 860	up to 60	up to 2.5/4.0	Butterfly/DIL14,TOW
SLD-34-HP	810 – 880	30 – 50	up to 16.0/40.0	Butterfly/DIL14,TOW
SLD-35-MP	820 – 870	62	up to 1.25/6.0	Butterfly/DIL14,TOW
SLD-35-HP	825 – 870	62	up to 25.0/50.0	Butterfly/DIL14,TOW
SLD-351UBB	830	85 (6 dB)	10/n.a.	Butterfly
SLD-37-MP	835	50	1.25/6.0	Butterfly/DIL14,TOW
SLD-37-HP	840	50	up to 25.0/50.0	Butterfly/DIL14,TOW
SLD-38-MP	770 – 890	20	up to 3.0/12.0	Butterfly/DIL14,TOW
SLD-38-HP	790 – 860	20	up to 30.0/50.0	Butterfly/TOW
SLD-47-MP	900, 940	up to 75	1.5/5.0	Butterfly/DIL14,TOW
SLD-48-MP-920	920	30	3.0/7.5	New! Butterfly/DIL14,TOW
SLD-47-HP	940	up to 100	up to 10.0/20.0	Butterfly/DIL14,TOW
SLD-471UBB	930	115 (6 dB)	10/n.a.	Butterfly
SLD-48-HP	960	30	up to 30.0/60.0	Butterfly/DIL14,TOW
SLD-48-MP-970	970	30	3.0/7.5	Butterfly/DIL14,TOW
SLD-52	1000, 1020	up to 100	up to 5.0/10.0	Butterfly/DIL14,TOW
SLD-53-MP	1020 – 1060	20 – 70	5.0/10.0	Butterfly/DIL14,TOW
SLD-53-HP	1050	35	up to 30.0/60.0	Butterfly/DIL14,TOW
SLD-54-HP	1060	70	up to 20.0/40.0	Butterfly/DIL14,TOW
SLD-55-MP	1180	30	1.0/n.a.	Butterfly/DIL14,TOW
SLD-56-MP	1270 – 1330	40	up to 2.0/n.a.	Butterfly/DIL14
SLD-56-HP	1270 – 1330	35	up to 30.0/n.a.	Butterfly/DIL14
SLD-57-MP	1270 – 1330	70	1.0/n.a.	Butterfly/DIL14
SLD-57-HP	1280 – 1330	60	up to 10.0/n.a.	Butterfly/DIL14
SLD-661-LP	1370 -1410	85	0.35/n.a.	Butterfly/DIL14
SLD-661-MP	1370 -1410	65	2.05/n.a.	Butterfly/DIL14
SLD-661-HP	1370 -1410	45-60	155/n.a.	Butterfly/DIL14
SLD-761-LP	1560	70 – 100	0.2/n.a.	Butterfly/DIL14
SLD-761-MP	1550	45 – 70	up to 2.0/n.a.	Butterfly/DIL14
SLD-761-HP	1550	45	up to 10.0/n.a.	Butterfly/DIL14

### Multimode Fiber-Pigtailed SLDs

Our multimode SLDs are listed in the table below, grouped by spectral band.

Model number	Wavelength (nm)	Spectrum width, FWHM (nm)	Power ex M fiber(mW)	Package
SLD-M381	840	15	up to 2.0/n.a.	Butterfly
SLD-M341	855	25	n.a./15.0	Butterfly
SLD-M531	1065	40	up to 10.0/n.a.	Butterfly

# Fiber-Coupled Semiconductor Optical Gain and Amplifier Modules

We introduce a new family of products, fiber-coupled Semiconductor Optical Gain and Amplifier modules:

- Broadband gain modules based on double path Superluminescent Light Emitting Diodes (SLDs) gain chips (similar to AR/HR coated laser diode gain chips).
- Traveling wave amplifier modules.

The modules are offered in hermetic packages.

## 1. Broadband Gain Modules

### (1) SOA-371 – Broadband HR/AR Gain Modules at 840nm

#### Features:

- Up to 60 nm tuning range\*
  - PM or SM fiber pigtails
  - PD monitors
  - FC/APC terminated pigtails on request
- \* When used as an active element of an external cavity semiconductor laser.

**Packages:** DIL, DBUT

#### Specifications:

(Nominal Emitter Stabilization Temperature +25 °C)

Mode	Parameter	Min.	Typ.	Max.
SLD-mode (angled fiber cleave)	Output power ex SM fiber at maximum spectral width, mW		1.0	
	Forward current, mA		65	90
	Peak Wavelength, nm		840	
	Spectral width, nm	45	50	
	Residual spectral modulation, %		3.0	6.0
Laser-mode (normal fiber cleave)	Threshold current, mA		40	50
	External slope efficiency, mW/mA	0.25	0.4	
	Output power in SM fiber, mW			10.0
	Forward voltage, V		1.8	2.0
	Operating temperature (case temperature), °C	-55		+70
	Cooler current, A			1.2
	Cooler voltage, V			3.5

### (2) SOA-481 – Broadband HR/AR Modules at 970nm

#### Features:

- Up to 60nm tuning range\*
  - PD monitors
  - PM fiber pigtails
  - FC/APC terminated pigtails on request
- \* When used as an active element of an external cavity semiconductor laser.

**Packages:** cooled DIL, DBUT

#### Specifications:

(Nominal Emitter Stabilization Temperature +25 °C)

Mode	Parameter	Min.	Typ.	Max.
SLD-mode (angled fiber cleave)	Output power ex SM fiber at maximum forward current, mW		1.0	
	Forward current, mA		200	260
	Peak Wavelength, nm		970	
	Spectral width, nm	45	50	
	Residual spectral modulation, %		3.0	6.0
Laser-mode (normal fiber cleave)	Threshold current, mA		100	150
	External slope efficiency, mW/mA	0.05	0.1	
	Output power in SM fiber, mW			10.0
	Forward voltage, V		1.8	2.0
	Operating temperature (case temperature), °C	-55		+70
	Cooler current, A			1.2
	Cooler voltage, V			3.5

### (3) SOA-521 – Broadband HR/AR Gain Modules at 1020 nm

#### Applications:

- spectroscopy
- optical sensors
- optical coherence tomography
- optical metrology
- others

#### Features:

- up to 120 nm tuning range\*

\* When used as an active element of an external cavity semiconductor laser.

**Packages:** DIL, DBUT

#### Specifications:

(Nominal Emitter Stabilization Temperature +25 °C)

Mode	Parameter	Min	Typ.	Max
SLD-mode (angled fiber cleave)	Output power ex SM fiber at maximum forward current, mW		3.0	
	Forward current, mA		200	240
	Peak Wavelength, nm		1020	
	Spectral width, nm	100	110	
	Residual spectral modulation, %		5.0	10.0
Laser-mode (normal fiber cleave)	Threshold current, mA		40	60
	External slope efficiency, mW/mA	0.2	0.3	
	Output power in SM fiber, mW			10.0
	Forward voltage, V		2.0	2.2
	Operating temperature (case temperature), °C	-55		+70
	Cooler current, A			1.2
	Cooler voltage, V			3.5

The following part numbers should be used when ordering:

SOA-521-(a)-(b)-(c),

where:

- (a) – package type,
- (b) – fiber type (SM or PM),
- (c) – PD (if PD monitor is required).

Example: SOA-521-DBUT-SM-PD.

## 2. Traveling Wave Amplifier (TWA) Modules

**(1) SOA-332: Travelling-wave broadband SOA at 785 nm**
**Features:**

- fiber-to-fiber optical gain of more than 20 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 50 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	300
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	13.0
Central wavelength $\lambda_c$ , nm	-	785	-
-3 dB optical gain bandwidth, nm	-	50	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	25
Polarization dependent gain, dB	-	7.0	-

**(2) SOA-382-800: Travelling-wave SOA at 800 nm**
**Features:**

- fiber-to-fiber optical gain of more than 30 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 20 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	200
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	13.0
Central wavelength $\lambda_c$ , nm	-	795	-
-3 dB optical gain bandwidth, nm	-	16	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	30	-
Polarization dependent gain, dB	-	7.0	-

**(3) SOA-352-830: Travelling-wave broadband SOA at 830 nm**
**Features:**

- fiber-to-fiber optical gain of more than 25 dB
- output power of up to 15 dBm
- -3 dB optical gain bandwidth of up to 55 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	200
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	15.0
Central wavelength c, nm	-	830	-
-3 dB optical gain bandwidth, nm	-	55	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	25
Polarization dependent gain, dB	-	7.0	-

**(4) SOA-382-840: Travelling-wave high-power SOA at 840 nm**

**Features:**

- fiber-to-fiber optical gain of more than 30 dB
- output power of up to 17 dBm
- -3 dB optical gain bandwidth of up to 25 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	300
Forward voltage, V	-	-	2.3
Output optical power, dBm	-	-	17.0
Central wavelength c, nm	-	840	-
-3 dB optical gain bandwidth, nm	-	25	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	30	-
Polarization dependent gain, dB	-	7.0	-

**(5) SOA-372: Travelling-wave broadband SOA at 850 nm**

**Features:**

- fiber-to-fiber optical gain of up to 25 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 40 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	200
Forward voltage, V	-	-	2.5

Output optical power, dBm	-	-	13.0
Central wavelength $\lambda_c$ , nm	-	850	-
-3 dB optical gain bandwidth, nm	-	40	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	22	-
Polarization dependent gain, dB	-	7.0	-

#### (6) SOA-352-870: Travelling-wave broadband SOA at 870 nm

##### Features:

- fiber-to-fiber optical gain of more than 25 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 60 nm

**Package:** Butterfly (DBUT)

##### Additional & customized:

- PM fiber pigtails
- FC/APC terminated pigtails

##### Specifications:

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	220
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	13.0
Central wavelength $\lambda_c$ , nm	-	870	-
-3 dB optical gain bandwidth, nm	-	58	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	25
Polarization dependent gain, dB	-	7.0	-

#### (7) SOA-382-870: Travelling-wave SOA at 870 nm

##### Features:

- more than 20 dB fiber-to-fiber optical gain
- 10 dBm ASE power while keeping very low spectral ripple
- 20 nm gain bandwidth (-3 dB)

**Package:** butterfly (DBUT)

##### Additional and customized:

- PM fiber pigtails
- FC/APC terminated pigtails

##### Specifications:

(Nominal Emitter Stabilization Temperature +25 °C)

Parameter	Typ.	Max.
Forward current, mA		200
Forward voltage, V		2.2
ASE output power ex SM fiber (Pin=0), dBm	10.0	
Central wavelength $\lambda_c$ , nm	870	
-3 dB optical gain bandwidth, nm	20	
Gain ripple, dB	0.1	0.2
Small signal gain, dB	25	
Saturation output power, dBm	6.0	

#### (8) SOA-472: Travelling-wave broadband SOA at 930 nm

##### Features:

- fiber-to-fiber optical gain of more than 25 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 65 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtailed
- FC/APC terminated pigtailed

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Typ.	Max.
Forward current, mA		200
Forward voltage, V		2.2
Output optical power, dBm		13.0
Central wavelength $\lambda_c$ , nm	930	
-3 dB optical gain bandwidth, nm	65	
Gain ripple, dB	<0.1	
Small signal gain, dB		25
Polarization dependent gain, dB	7.0	

**(9) SOA-482: Travelling-wave high-power SOA at 970 nm**

**Features:**

- fiber-to-fiber optical gain of more than 25 dB
- output power of up to 15 dBm
- -3 dB optical gain bandwidth of up to 40 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtailed
- FC/APC terminated pigtailed

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	220
Forward voltage, V	-	-	2.3
Output optical power, dBm	-	-	15.0
Central wavelength $\lambda_c$ , nm	-	970	-
-3 dB optical gain bandwidth, nm	-	40	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	27
Polarization dependent gain, dB	-	7.0	-

**(10) SOA-522: Travelling-wave broadband SOA at 1010 nm**

**Features:**

- fiber-to-fiber optical gain of up to 24 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 95 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtailed
- FC/APC terminated pigtailed



**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	300
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	13.0
Central wavelength c, nm	-	1010	-
-3 dB optical gain bandwidth, nm	-	95	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	24
Polarization dependent gain, dB	-	7.0	-

**(11) SOA-532: Travelling-wave SOA at 1060 nm**
**Features:**

- fiber-to-fiber optical gain of up to 30 dB
- output power of up to 15 dBm
- -3 dB optical gain bandwidth of up to 35 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	300
Forward voltage, V	-	-	2.3
Output optical power, dBm	-	-	15.0
Central wavelength c, nm	-	1060	-
-3 dB optical gain bandwidth, nm	-	35	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	30
Polarization dependent gain, dB	-	>10	-

**(12) SOA-542: Travelling-wave broadband SOA at 1060 nm**
**Features:**

- fiber-to-fiber optical gain of up to 25 dB
- output power of up to 13 dBm
- -3 dB optical gain bandwidth of up to 75 nm

**Package:** Butterfly (DBUT)

**Additional & customized:**

- PM fiber pigtails
- FC/APC terminated pigtails

**Specifications:**

(nominal stabilization temperature +25 °C)

Parameter	Min.	Typ.	Max.
Forward current, mA	-	-	220
Forward voltage, V	-	-	2.5
Output optical power, dBm	-	-	13.0
Central wavelength c, nm	-	1060	-
-3 dB optical gain bandwidth, nm	-	75	-
Gain ripple, dB	-	< 0.1	-
Small signal gain, dB	-	-	25

Polarization dependent gain, dB	-	7.0	-
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The following part numbers should be used when ordering:

SOA-542-(a)-(b),

where:

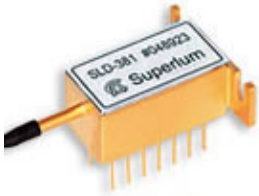
a – package type (DBUT),

b – fiber type (SM or PM).

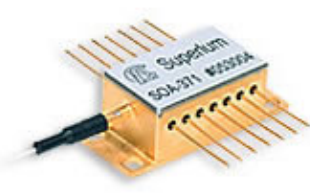
Example: SOA-542-DBUT-SM.

## Packages

### Modules with cooler & thermistor



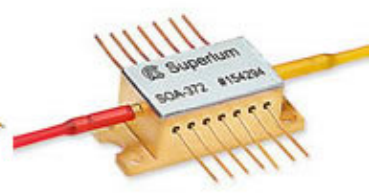
DIL



DBUT



SBUT



DBUT (for SOAs)

### Uncooled modules



TO 56



TO 9



miniBUT

### Free-space modules



TOW 2



TOW 1

### Mounts for modules



DIL mount



m-DBUT mount







DBUT mount





TOW mount

## Broadband Light Sources & BroadLighters

We offer a wide selection of SLD-based broadband light sources. The offerings include both compact light source modules intended for integration into larger systems and benchtop instruments developed for use in industrial and research laboratories. Various designs allow analog or digital control of SLD modules. All sources have integrated high-precision driving electronics to provide stable and reliable performance. All sources are RoHS compliant.

Product series	Picture	Description
SLD-mCS	 <p>SLD-mCS,sCS-series Miniature Broadband Light Source Modules</p>	<p>Miniature single-SLD broadband light sources with analog SLD control. The successor models to the SLD-MS. 9-30 V DC-powered. 50-KHz SLD modulation. Switchable SLD control mode (ACC-APC). Can be built based on any SLD of our drive current does not exceed 400 mA.</p>
SLD-sCS	 <p>SLD-mCS,sCS-series Miniature Broadband Light Source Modules</p>	<p>Miniature single-SLD broadband light sources with analog SLD control. The successor models to the SLD-MS. 9-30 V DC-powered. 50-KHz SLD modulation. Switchable SLD control mode (ACC-APC). Can be built based on any SLD of our drive current does not exceed 400 mA.</p>
SLD-CS	 <p>SLD-CS-series Compact High Power Broadband Light Source Modules.</p>	<p>Compact single-SLD broadband light sources with analog SLD control. 9-30 V DC-powered. 50-kHz SLD modulation. Allows integration of additional components like couplers, optical isolators (including bulky 850-nm ones). Recommended for powerful SLD light sources. APC SLD control as a standard, ACC-APC switchable upon request. The versions based on the most powerful SLDs at different center wavelengths are available as a standard. Can be built based on any SLD of our drive current does not exceed 400 mA.</p>
BLM2-D	 <p>cBLMD-series Compact Broadband Light Source Modules with Extended Bandwidth.</p>	<p>Compact broadband light sources with digital control of SLD modules (USB). 12 V DC-powered. Up to 3 SLDs inside. Allows integration of additional components like couplers, optical isolators (including bulky 850-nm ones). SLD control mode — APC only. The best combination of power and spectrum width in multiple-SLD models. TTL control or remote operation from a PC/laptop via a USB port.</p>

<p>M-S</p>	 <p>M-S-series Broadlighters.</p>	<p>High-power single-SLD benchtop broadband light sources. The instruments have been developed for use in industrial and research laboratories. These light sources are based on the most powerful SLDs of Superlum. Optically isolated, up to 30 mW output power.</p>
<p>M-D, M-T, M-Q</p>	 <p>M-D-, M-T-, and M-Q-series Broadlighters.</p>	<p>Multiple-SLD benchtop broadband light sources with extended bandwidth. The instruments have been developed for use in industrial and research laboratories. More than 20 mW output power, up to 200 nm spectrum width, and more.</p>

# Swept Wavelength Tunable Semiconductor Lasers, Broadsweepers

The Broadsweepers series is a new family of tunable semiconductor lasers intended for applications that require fast and precision wavelength tuning with high sweep-to-sweep reproducibility of the "instantaneous" wavelength. Among all possible applications, the most important are Optical Coherence Tomography (including Full Field OCT), biomedical imaging, interferometry, optical spectroscopy, fiber-optic sensing and optical component characterization.

The optical scheme of the Broadsweeper is based on an external fiber-optic ring cavity and a broadband Semiconductor Optical Amplifier (SOA), working as a gain medium. The wide bandwidth feature of the SOA module and its high fiber-to-fiber gain allow reaching a wavelength tuning range of more than 50 nm at 3 mW of the output power.



*BS-840-1 Tunable Semiconductor Laser.*

The wavelength tuning technique involves the use of an Acousto-Optical Tunable Filter (AOTF) with a very narrow spectral passband ranging from 0.2 to 0.8 nm (FWHM). The AOTF is actively temperature controlled for high spectral stability of laser radiation. Since the laser cavity contains no mechanically moving components, high accuracy of wavelength selectivity and excellent wavelength reproducibility in sweep operation are ensured. Due to the perfect AOTF tuning characteristic, the laser provides k-linear wavelength tuning over a wide spectral range.



*Our acousto-optical tunable filter with fiber-optic delivering system is at the heart of the Broadsweeper.*

As well as the SOA and the AOTF, the other important elements of the laser are a fiber-optic coupler, optical isolator and in-line optical power monitor. All of them feature a unique customized design perfectly fitted for broadband spectral applications. Collimating optics used with the AOTF is relied on high-quality aspherical lens. This optics is aberration-free that allows obtaining not only a well-collimated laser beam required for effective operation of the AOTF but also maximum efficiency of coupling the light into the output optical fiber. The filter and the optics are packaged into one monolithic metal housing, thereby ensuring reliable day-after-day operation without misalignment. The external cavity of the laser uses a PANDA-type polarization maintaining (PM) fiber. This provides a well-defined state of polarization as well as high stability of laser polarization in time and under different ambient conditions. The only front-panel optical port delivers an optical signal with ultra-low amplified spontaneous emission ( $< -50$  dB) and a polarization extinction ratio (PER) of min. 18 dB. Most of the

fiber-optic components are built on the fast-axis-blocked technology that also guarantees high values of the PER at the laser output.

The output polarization is provided in the slow axis of the fiber that is precisely aligned to the connector key.

The laser is housed in a compact metal case suitable for applications on the bench and in the rack. The device has a modular design that incorporates several plug-in modules (power supplies, tunable optical module, current and temperature driving module, central processing unit, etc.) into one single mainframe. Our driving electronics provides precise, reliable and safe control of the laser in all modes of operation. All the necessary laser diode protective measures such as transient suppression, over-temperature protection, open-circuit protection and laser current limit are implemented. The optical power control loop in combination with the very fast laser current source adjusted for automatic-power-control mode allow operation with a flat-top-shaped tuning characteristic at all specified sweep speeds.

The laser provides the following modes of operation:

- CW operation at any single wavelength within the full tuning range. The operating wavelength is adjustable from the front panel or from a computer. Under computer control, typical switching between two different wavelengths is done in less than 100 ms. The user can select any wavelength within the full wavelength range with a 50-pm resolution.
- Continuous sweeps over the full tuning range or over the band of interest (within the full tuning range) not shorter than 5 nm. Both the internal triggering and the external triggering are available.
- Continuous switching between any two wavelengths within the full tuning range at a certain repetition frequency. The range of frequencies includes 13 factory-set values. Customized settings for the repetition frequency are possible upon request.

When internally triggered, the device produces synchronizing pulses. BNC-connectors necessary to synchronize the laser with your measuring equipment are located on the rear panel of the device. In the external triggering mode, the device responds to incoming TTL-compatible trigger signals.

The Broadsweeper offers the maximum output power of 3 mW. For powerful applications, the device can additionally be equipped with an optical power booster elevating the power up to 20 mW.

The laser output is performed through the front-panel high precision PM optical socket for an FC/APC connector with the narrow key (2.0 mm). The device is supplied with a PM optical patch cable. An SM optical patch cable is also available on request.

### Remote Control Capability

The device has an RS-232 DTE port for remote control from a computer. The necessary connectivity software is supplied with the instrument.

### Laser Safety Measures

To fulfill the requirements of IEC 60825-1 Ed. 2 2007-03, the instrument is equipped with laser safety measures including: the master key control, remote interlock connection, visual/audible alarm, informational warning stickers, etc.

### Standard Models Available For Ordering

Depending on the spectral band and sweep speed, there are several models of the product to choose from. Refer to the table below for the standard versions of the product.

Model	Tuning Range (nm)	Output Power (mW)	Sweep Speed (nm/s)	Linewidth (nm)
765 – 815 nm Spectral Range				
BS-785-1	50	3	2 – 10,000	0.06
BS-785-1-HP*	50	20	2 – 10,000	0.06
BS-785-2	50	3	100 – 100,000	0.12
BS-785-2-HP*	50	20	100 – 100,000	0.12
805 – 880 nm Spectral Range				

BS-840-1	75	3	2 – 10,000	0.06
BS-840-1-HP*	75	20	2 – 10,000	0.06
BS-840-2	75	3	100 – 100,000	0.12
BS-840-2-HP*	75	20	100 – 100,000	0.12
900 – 980 nm Spectral Range				
BS-930-1	80	3	2 – 10,000	0.09
BS-930-1-HP*	80	20	2 – 10,000	0.09
BS-930-2	80	3	100 – 100,000	0.15
BS-930-2-HP*	80	20	100 – 100,000	0.15
1020 – 1090 nm Spectral Range				
BS-1060-1	70	3	2 – 10,000	0.09
BS-1060-1-HP*	70	20	2 – 10,000	0.09
BS-1060-2	70	3	100 – 100,000	0.15
BS-1060-2-HP*	70	20	100 – 100,000	0.15

\* INCLUDES INTERNAL OPTICAL POWER BOOSTER

#### General Specifications

Power Requirements:	110 VAC or 220 VAC, 50 Hz or 60 Hz
Power Consumption:	20 W / 25 W*
Operating Temperature:	+15 °C to + 30 °C
Storage Temperature:	0 °C to +40 °C
Outline Dimensions (W × H × D):	257 × 170 × 325 mm / 362 × 160 × 326 mm*
Weight:	9 kg / 12 kg*

\* FOR MODELS WITH INTERNAL OPTICAL POWER BOOSTER

#### Product Customization Capabilities

We offer product customization services. A number of the operating characteristics of the product (e.g. the output power level, target wavelengths for the tuning range, the sweep speed limits, etc.) can be modified to meet your requirements.

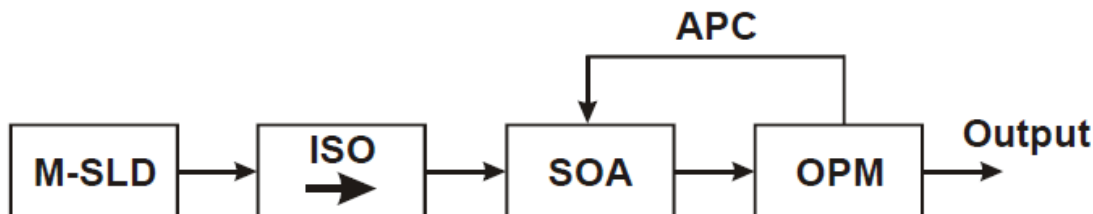
Please contact us for further discussion of your tunable laser requirements.

## Master Oscillator Power Amplifier SLD Systems

Our MOPA-SLD-850 is an ultra-high power SLD-based light source that features both high power levels (tens milliwatts) and an extremely weak sensitivity to optical feedback. This is achieved using a special optical scheme called MOPA (Master Oscillator Power Amplifier). A simplified block diagram of the MOPA scheme is shown in the figure below. A medium-power SLD operating as a master source provides an optical power of 6 – 10 mW with a relatively broad spectrum of 10 – 20 nm centered at 850 nm. After passing through an appropriate optical isolator with an isolation of better than -25 dB, the power is elevated to a high level of 50 mW by a spectrally matched Semiconductor Optical Amplifier (SOA). The key advantage of such an optical configuration is its weak sensitivity to optical feedback, because the input power of 6 – 10 mW makes it possible for the SOA to reach a deep saturation level. In this situation, there is no need to install an optical isolator at the output of the SOA for protection from optical feedback. In addition, this allows eliminating any unwanted power drop related to insertion loss inside the isolator, which frequently reaches 2 dB. Another advantage of the MOPA scheme is that it uses only the polarization maintaining optical fiber — no SM-fiber coupled components are utilized. Most of the fiber-optic components are built on the fast-axis-blocked technology that guarantees high values of the PER (Polarization Extinction Ratio) at the MOPA output (> 18 dB).



MOPA-SLD-850



*Block Diagram of the MOPA Optical Scheme (Simplified).*

*M-SLD – Master SLD.*

*ISO – Isolator.*

*SOA – Semiconductor Optical Amplifier.*

*OPM – Optical Power Monitor.*

*APC – Automatic Power Control.*

The MOPA system is offered in a compact metal case which can be used on a lab bench or in a rack. The instrument consists of a modular mainframe and several plug-in modules (power supplies, optical unit, current and temperature controllers, CPU etc.). Each MOPA system is equipped with a high-precision PM FC/APC optical socket for easy coupling of 2.0-mm narrow-key connectors. The device is supplied with a 1 mPM optical patch cable (other lengths are available upon request).

Our drive electronics includes two independent, high-precision, low-noise, constant-power current & temperature control drivers. The electronics provides safe current and temperature operation of the master SLD and the SOA. All the necessary SLD protective measures are implemented. Among the measures, the most important ones are the soft start, turn-on transient suppression, over temperature protection, open-circuit protection and pumping current limit.



The MOPA-SLD-850 can be operated locally from the front panel, or remotely from a computer with an RS-232 port. It contains minimum front-panel features needed for operation. No adjustments are required to run the device because it is completely pre-set at the factory. The rear panel of the instrument has a digital input to allow the drive current of the SOA to be pulse modulated (switched on or off). The maximum frequency of modulation is 50 kHz.

The device includes a linear power supply capable to operate from 220 VAC or 110 VAC. The required value of the line voltage is pre-set at the factory and should be specified by the customer when placing the order.

SLD-based light sources are excellent high-power speckle-free broadband light sources with a great potential for using in many practical applications such as OCT (Optical Coherence Tomography) Imaging Systems, FOG (Fiber Optic Gyroscopes), optical spectroscopy and the others.

### **Laser Safety Measures**

For added safety, the system is designed to meet the laser safety requirements for class 3B laser products. Accordingly, the instrument incorporates the laser safety measures specified in IEC 60825-1 Ed. 2 2007-03, namely: the master key control, remote interlock connection, visual/audible alarm, information and warning stickers etc.

### **Product Customization Capabilities**

We offer product customization services. A number of the operating characteristics of the product (e.g. the output power level, spectral characteristics etc.) are available for modification according to your specific needs.

Please contact us for further discussion of your requirements.