# Superlum Broadband Light Sources

## SLD-CS-series Compact High Power Broadband Light Source Modules.

### Technical Product Specification


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Superlum, Unit B3, Fota Point Enterprise Park, Carrigtwohill, Co. Cork, Ireland.
Phone: +353 21 4533666, Fax: +353 21 4533026, Web site: www.superlumdiodes.com, E-mail: sales@superlum.ie.

## Product description

SLD-CS devices are very high power compact broadband SM-fiber light source modules at different wavelengths in the 670-1100 nm spectral range for applications requiring a reliable, powerful, stable and low-noise SLD light source with a broad and flat spectrum and short coherence length.

The light source incorporates a high-precision miniature current and temperature controller that provides a current source for the SLD module and maintains a constant temperature of the SLD. The controller operates from a wide supply voltage range from 9 to 30 V DC. A low-noise DC-DC converter protects the SLD and the controller circuitry from power supply voltage variations (steady state voltage changes, ripple, and noise). The controller has a number of SLD protection features including adjustable overcurrent protection. The main SLD parameters can be monitored via “ANALOG” I/O connector. The overall light source status can be monitored via “LOGIC” I/O connector. The SLD power can be changed either by a potentiometer (customer accessible) or by applying a DC voltage to the appropriate pin of “ANALOG” I/O connector. In the standard version, the SLD can be modulated (ON/OFF) at up to 50 kHz. The modulation frequency can be increased to 100 kHz upon request. The LEDs on the top cover provide a visual indication of the light source status.

Standard models have FC/APC-terminated, 50 cm long single mode fiber pigtail. The fiber is protected by a 3 mm tube. A 900-micron loose tube is available upon request.

The SLD is protected by an appropriate optical isolator in all standard models.

Light source modules must be put onto an appropriate heatsink in order to achieve the widest possible operating temperature range. However, it is also possible to use SLD-CS without a heatsink, although in a limited range of ambient temperatures. Particularly, the maximum operating ambient temperature without a heatsink is +40 °C for all models and up to +50 °C for selected models (free air circulation around the package is required). It may also depend on the isolator used.

### Applications

- Optical Fiber Sensing
- Optical Coherence Tomography
- Optical Metrology
- Testing of Optical Components
- Biomedical Imaging
- Low Coherence Interferometry

### Features

- Ease of use
- Very high power and wide spectrum
- Different center wavelengths in 670-1100 nm window
- Wide range of supply voltage (9-30 V DC)
- External or internal control of SLD power
- Main SLD parameters and overall light source status monitoring capability
- Adjustable overcurrent protection
- Constant power (APC mode); Constant current (ACC mode) upon request
- SMF output (PMF upon request)
- Optically isolated output
- Operating temperature range of 0 °C to +50 °C
- Fast modulation
- Excellent stability
- Low noise

## Mechanical specifications

Drawing of a standard SLD-CS light source is shown in Figure 1.

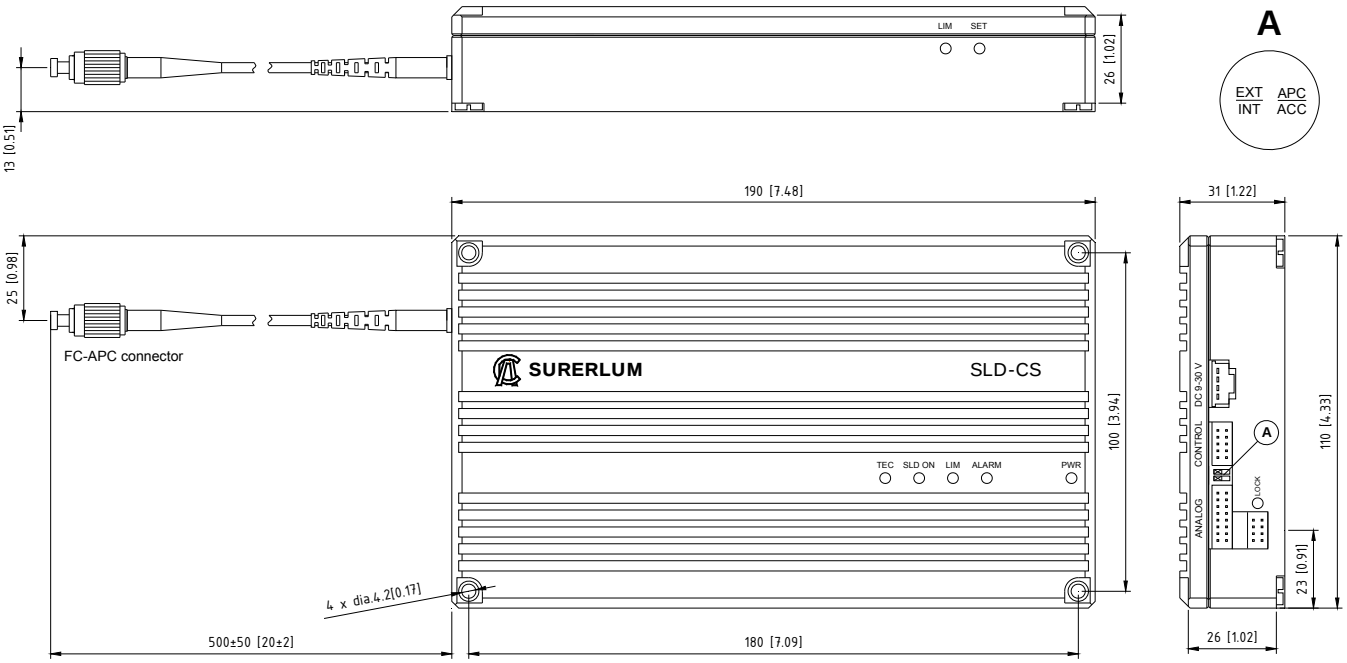


**Figure 1.** Drawing of SLD-CS light source module. All dimensions are in millimeters [inches]. On the front side of the device: “LIM” – potentiometer for setting the SLD current limit, “SET” – potentiometer for setting the SLD power or drive current in the “internal control” mode. Status LEDs on the top side: “TEC” (SLD temperature setpoint is reached), “SLD ON” (SLD is on), “LIM” (drive current limit is reached), “ALARM” (system error occurred), “PWR” (power is on). Operation mode switches on the right side: “EXT/INT” (“external control” mode / “internal control” mode), “APC/ACC” (Automatic Power Control/Automatic Current Control).

## Electrical connections

Electrical connections of the standard SLD-CS light source are shown in Figure 2 (see below). Electrical Inputs/Outputs are described in Table 1 (see below). The DC power input accepts +9 to +30 V / 1.2 A (max) from an external power supply unit.

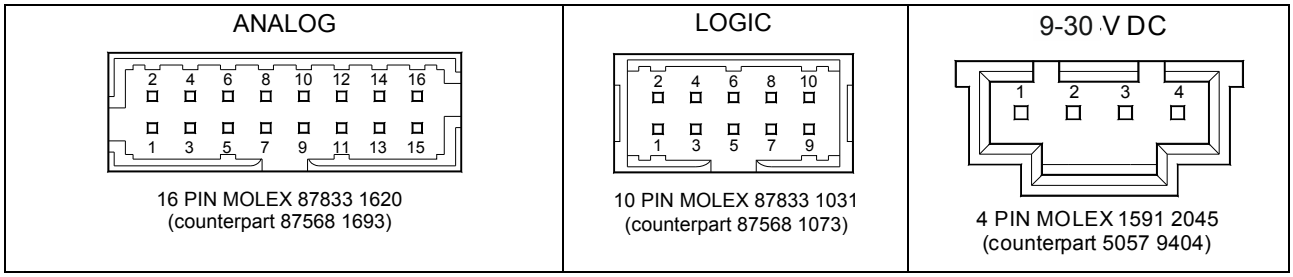


**Figure 2.** Pin configurations for SLD-CS control ports and power supply connectors.

**Table 1. Pin function descriptions.**

| Pin number | Name | IN/OUT | Description/structure |
|---|---|---|---|
| **DC power input (4 pin MOLEX Connector P/N 1591 2045)** | | | |
| 1,2 | +9 to +30 V | IN | +9 to +30 V DC |
| 3,4 | GND | | Power ground |
| ***Attention*: Power ground, Analog ground and case of SLD-CS light source are connected inside the device.** | | | |
| **LOGIC CONTROL (10 pin MOLEX Connector P/N 87833 1031)** | | | |
| 1 | STATUS TEC | OUT | Open collector. Goes to low impedance state when the SLD temperature setpoint is ***NOT*** reached. |
| 3 | STATUS SLD | OUT | Open collector. Goes to low impedance state when SLD is ON. |
| 5 | STATUS LIM | OUT | Open collector. Goes to low impedance state when the SLD current limit is reached. |
| 7 | SLD ON/OFF | IN | SLD ON/OFF; **SLD is ON when 5 V is applied**, **OFF when 0 V is applied**; 200 Ω and LED of optocoupler in series. |
| 9 | ALARM | OUT | Open collector. Goes to low impedance state in case of system error |
| 2,4,6,8,10 | LOGIC GND | | Logic ground. |
| ***Attention*: It is not recommended to connect Logic ground to Analog ground as it may result in increased noise.** | | | |
| **ANALOG CONTROL (16 pin MOLEX Connector P/N 87833 1620)** | | | |
| 1 | +5 V AUX | OUT | +5V DC auxiliary output; 20 mA max. |
| 3 | SLD I LIMIT | OUT | Analog output; Indicates the set SLD current limit. |
| 5 | REF OUT | OUT | Reference voltage output, 4.5 V; R= 50 Ω. |
| 7 | PD OUT | OUT | Analog output; Indicates the back-facet PD monitor current. |
| 9 | SLD I SET | IN | Analog input; the voltage on this pin sets the SLD current (ACC) or sets the PD monitor current (APC)*. |
| 11 | SLD I REAL | OUT | Analog output; Indicates the real SLD current. |
| 13 | SLD I SETC | OUT | Analog output; Indicates the set SLD current. |
| 15 | TEC I | OUT | Analog output; Indicates the TEC current. |
| 2,4,6,8,10,12,14,16 | ANALOG GND | | Analog ground. |
| ***Attention*: Power ground, Analog ground and case of SLD-CS light source are connected inside the device.** | | | |

* To enable this input, the “external control” mode must be selected with the “EXT/INT” operation mode switch.

## Absolute Maximum Ratings

Table 2 (see below) presents absolute maximum ratings of SLD-CS light sources.

**Table 2. Absolute maximum ratings*.**

| Parameter | | Value |
|---|---|---|
| DC supply voltage | | 35 V |
| Optical power | | Depends on SLD and pre-set current limit |
| Voltages -”ANALOG” I/O | “ANALOG” pin 1 | 4.5 V min., 5.5 V max. |
| Voltages - “ANALOG” I/O | “ANALOG” pins except pin 1 | −0.3 to 7 V |
| Voltages - “LOGIC” I/O | Pin 7 SLD ON/OFF | −5 to 5.5 V |
| Voltages - “LOGIC” I/O | Open collectors | 50 V |
| Electric current – “Analog” I/O | “ANALOG” pin 1 | 20 mA |
| Electric current – “Analog” I/O | “ANALOG” pins except pin 1 | 10 mA |
| Electric current – “LOGIC” I/O | Open collectors | 100 mA |
| Electric current – “LOGIC” I/O | Pin 7 SLD ON/OFF | 20 mA |
| Short circuit – “Analog” I/O | | 2 s maximum |
| Operating temperature (case) | | 0 to +50 °C |
| Storage temperature | | -20 to +70 °C, depending on isolator used |

*** NOTICE:** Stresses beyond those listed under “Absolute Maximum Ratings” may cause permanent damage to the device. This is a stress rating only. Functional operation of devices at these, or any other conditions beyond those indicated in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

## Electrical and Optical Characteristics

SLD is driven in automatic power control mode in all standard SLD-SC light sources. In this mode, the output power is held constant by adjusting the SLD drive current utilizing the SLD back-facet monitor photodiode (PD monitor) for feedback. Optical parameters of standard models are shown in the Table 3 (see below). Standard models are based on the most high-power and wide-spectrum SLD modules at a given wavelength. **Note that any fiber coupled temperature controlled SLD of Superlum may be used in SLD-CS if SLD current does not exceed 400 mA.**

**Table 3. Standard models of SLD-CS light sources – optical performance and other parameters.**

| Model number | Power, mW | | Wavelength, nm | 3 dB spectrum width, nm | | Ripple % | Minimum isolation*, dB |
|---|---|---|---|---|---|---|---|
| | Min. | Typ. | | Min. | Typ. | | |
| SLD-CS-261-HP-SM-670-I | 4.0 | 5.0 | 670 ± 10 | 6.0 | 7.0 | <5 | -30 |
| SLD-CS-331-HP3-SM-785-I | 15.0 | 20.0 | 785 ± 10 | 40 | 45 | <5 | -30 |
| SLD-CS-381-HP3-SM-795-I | 15.0 | 20.0 | 795 ± 5 | 13 | 15 | <5 | -30 |
| SLD-CS-371-HP3-SM-840-I | 15.0 | 20.0 | 840 ± 10 | 45 | 50 | <5 | -30 |
| SLD-CS-341-HP3-SM-840-I † | 20.0 | 25.0 | 840 ± 10 | 20 | 25 | <5 | -30 |
| SLD-CS-341-HP2-SM-880-I | 10.0 | 15.0 | 880 ± 10 | 30 | 40 | <5 | -30 |
| SLD-CS-531-HP3-SM-1050-I | 15.0 | 20.0 | 1050 ± 10 | 30 | 35 | <5 | -30 |
| SLD-CS-541-HP3-SM-1050-I | 10.0 | 15.0 | 1050 ± 10 | 60 | 70 | <5 | -30 |

| **Other parameters (all models)** | |
|---|---|
| Long-term power stability (8 h) ‡ | Better than 5000 ppm after 0.5 h warming-up at +25±0.1 °C case temp |
| Modulation rate | 50 kHz; optional up to 100 kHz (TTL ON/OFF) |
| Weight | 950 g |

* At a mean wavelength.
† Special SLD-341-HP3 selection
‡ Typical performance (depends on the optical isolator used).

Electrical characteristics are shown in Table 4 (see below). Scale factors for the monitoring outputs are listed in Table 5.

**Table 4. Electrical characteristics of SLD-CS sources.**

| Parameter | Note | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| DC supply voltage | | 9 | - | 30 | V |
| DC supply current * | | - | - | 1.2 | A |
| DC supply peak current † | | - | - | 1.2 | A |
| SLD ON/OFF via “LOGIC” I/O | 10 mA min. | 4.0 | 5.0 | 5.5 | V |
| Output power set via “ANALOG” I/O (input, 0-max) | APC mode | 0.0 | - | 4.0 | V |
| SLD drive current set via “ANALOG” I/O (input) ‡ | ACC mode | 0.0 | - | 4.0 | V |
| ANALOG I/O – The set value of SLD current (output) | | 0.0 | - | 4.0 | V |
| ANALOG I/O – The real value of SLD current (output) | | 0.0 | - | 0.4 | V |
| ANALOG I/O – SLD current limit (output) | | 0.0 | - | 4.0 | V |
| ANALOG I/O – TEC current (output) | 0V=-1.5A TEC 3V=1.5A TEC | 0.0 | - | 3.0 | V |
| ANALOG I/O – Real PD monitor current (output) | | 0.0 | - | 4.0 | V |
| ANALOG I/O – Reference voltage for control of SLD current | 10 mA max. | 4.477 | 4.500 | 4.523 | V |
| ANALOG I/O – 5 V DC auxiliary output | 20 mA max. | 4.9 | 5.0 | 5.1 | V |

* Depends on DC voltage applied. DC supply power of up to 11 W should be available to achieve stable operation at extremes of operating temperature range.
† Short-term peak current to assure rapid switching-on at temperature extremes.
‡ Optional only.

**Table 5. Detailed description of analog outputs ("ANALOG" I/O connector)**

| PIN & name | Description | Scale | Voltage | Note |
|---|---|---|---|---|
| Pin 1, +5 V AUX | +5 V DC auxiliary output | - | 5 V | ± 2% |
| Pin 3, SLD I LIMIT | SLD current limit | 1 V= 100 mA | 0 – 4 V | |
| Pin 5, REF OUT | Reference voltage output | - | 4.5 V | ± 0.5% |
| Pin 7, PD OUT | PD monitor photocurrent | 1 V=1 mA | 0 – 4 V | |
| Pin 11, SLD I REAL | Real current through SLD | 1 mV= 1mA | 0 – 0.4 V | |
| Pin 13, SLD I SETC | Set SLD current (ACC) | 1 V= 100 mA | 0 – 4 V | |
| Pin 15, TEC I | TEC current | 0V=-1.5A TEC<br>3V=1.5A TEC | 0 – 3 V | |

## Recommended external control circuits

Standard SLD-CS sources are set to APC mode and "internal" SLD control mode (except in the special cases when other settings are specified in the related documents). ***Note that switching to ACC mode is not possible if not agreed upon before ordering.***

For the SLD-CS module to emit light (1) power must be applied to the power connector; (2) a +5 V TTL signal must be applied to pin 7 of "LOGIC" connector, as suggested in Figure 3; and (3) the SLD temperature must stabilize at a preset value. When power is applied, it takes some time for the temperature to stabilize. Note that a protection circuit prevents the SLD from switching on until its temperature reaches the setpoint. If only power is applied, the light source module powers on, the SLD temperature stabilizes at the preset level, but the SLD remains off.

It is strongly recommended to switch off the SLD when not in use. If the SLD is not in use for a short time, it is recommended to switch it off, but to keep power to the light source. The SLD temperature will be kept at the preset level as long as power to the light source is maintained. It will greatly decrease the SLD switch-on time, given that the process of temperature stabilization inside the package may take seconds (depending on ambient temperature).

In addition, the simple external circuit shown in Figure 4 can be used to monitor the SLD status from a convenient location, while the SLD-CS module itself is out of sight. The external indicating LED in Figure 4 is on when the SLD emits light.

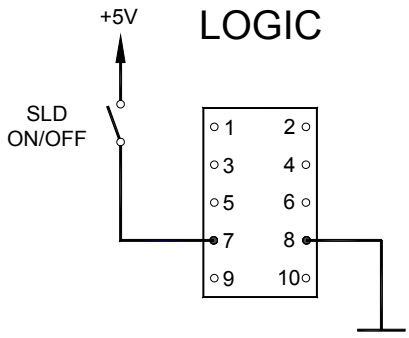


**Figure 3.** External circuit for switching SLD on and off remotely. "LOGIC" – 10 pin I/O connector of SLD-CS source.

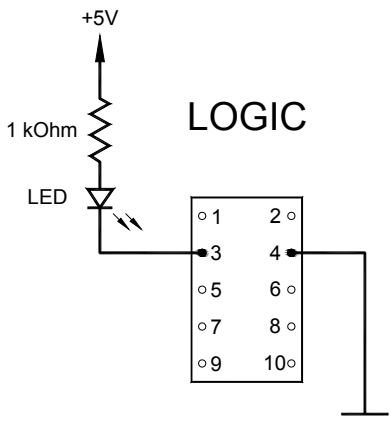


**Figure 4.** External circuit for remote monitoring of SLD status. "LOGIC" – 10 pin I/O connector of SLD-CS source.

SLD emission can be switched on automatically when power is applied to SLD-CS light source module. For this purpose, it is only necessary to connect pin 1 of "Analog Control" connector (+5 V DC auxiliary output) and pin 7 of "Logic Control" connector, and analog and logic grounds by a separate wire.

SLD power can be controlled externally by applying a voltage to pin 9 of “ANALOG” I/O. Figure 5 shows suggested circuit diagrams for “external control” of SLD power by (a) using the 4.5 V DC reference voltage output of SLD-CS module and (b) applying an external DC voltage. The front panel switch “EXT/INT” (See Fig.1) should be switched to “EXT” (“external control” mode). It is recommended that the control mode settings (“external control” or “internal control”) be specified when ordering. Note that changing the output power by the “SET” potentiometer (See Fig.1.) is disabled when the operation mode is changed to “external control” mode. Also note that fast modulation is not possible via pin 9 of “ANALOG” I/O — it is possible only through pin 7 of “LOGIC” I/O.

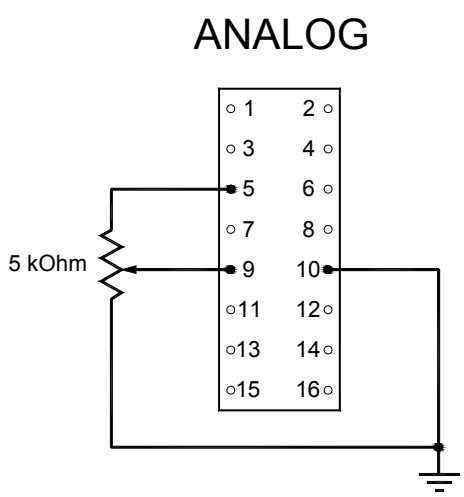


**Figure 5 (a).** External control of output power using 4.5 V DC reference voltage output of SLD-CS.

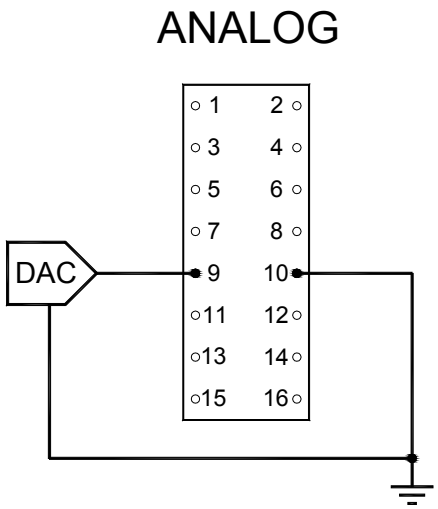


**Figure 5 (b).** External control of output power using external DC voltage.

## Mounting

For the SLD-CS to operate within the specified ambient temperature range, it is required to mount the device to an appropriate heatsink and to provide free air circulation around the top cover. An SLD-CS light source can be used without a heatsink, but this will limit the maximum operating temperature of the device. Free air circulation around the SLD-CS is required in this case, and forced-air (fan) cooling or similar measures are recommended. For selected models, the maximum operating ambient temperature without a heatsink is as high as +50 °C (please contact Superlum for more details).

## Laser hazard classification

All standard SLD-CS sources except models at 680 nm emit invisible light. It may have a potential hazard associated with CLASS 3R or 3B of IEC 60825-1 (Edition 2.0; 2007-03).

The SLD-CS light source is designed for use as a component for integration into photonics equipment and it is, therefore, out of scope of applicable standards related to laser safety, such as IEC 60825-1. Note that any equipment incorporating this component may be subject to these standards. Standard SLD-SC modules do not have *ALL* the laser safety features (like remote interlock, key operated master control, warning signals and labels). However, these features can be implemented using control interfaces.

Please contact Superlum for more details about laser safety issues for each particular model of SLD-SC light source modules.

**Note:** Superlum also offers advanced SLD-CS light source modules providing all basic protection means required for Class 3B Laser Sources.