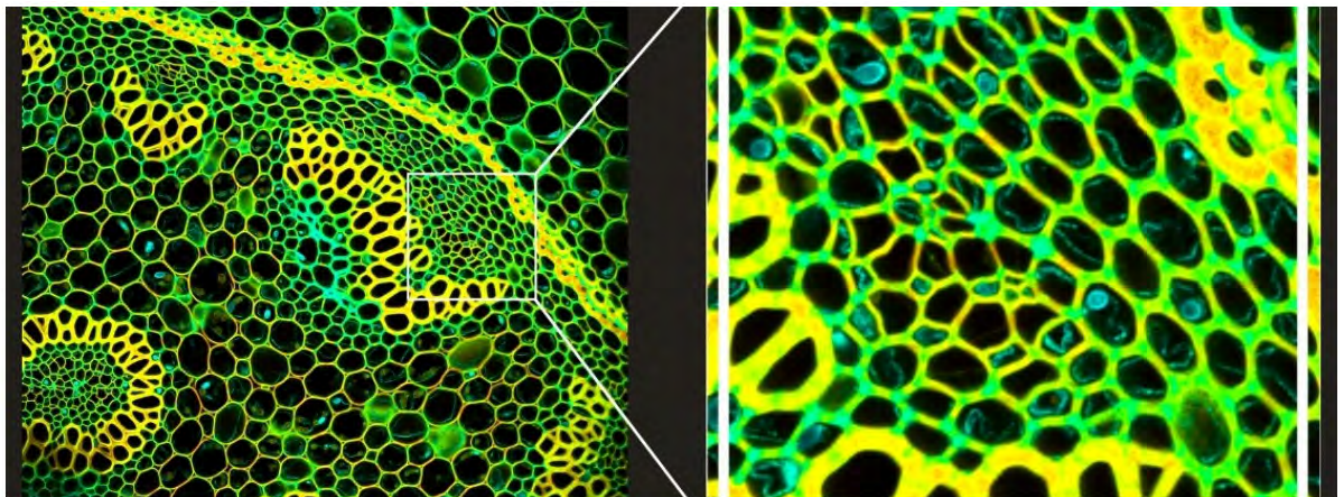




91 Boylston Street, Brookline, MA 02445  
tel: (617)566-3821 fax: (617)731-0935  
www.boselec.com tcspc@boselec.com

# Picosecond Light Sources

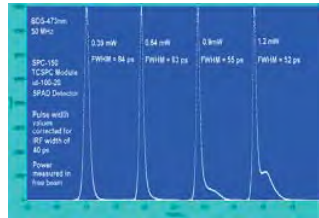
Available with single mode fiber output coupling



From Becker & Hickl GmbH

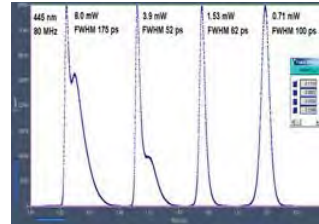


## Picosecond Diode Lasers



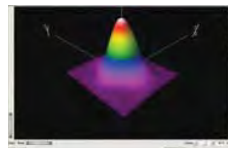
### **New!** BDS-SM series picosecond diode lasers

Small-size OEM Module  
 Dimensions 40 mm x 40 mm x 110 mm  
 Wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785, 1060, 1300 nm  
 Free-beam or single-mode fibre output  
 Pulse width down to 50 ps  
 Pulse repetition rate 50 MHz  
 CW equivalent power 0.25 to 1.2 mW  
 Fast on / off / multiplexing capability  
 All electronics integrated  
 No external driver unit  
 Operation from simple +12 V power supply



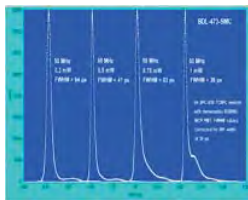
### **New!** BDL-SMN Series Picosecond / CW diode lasers

Wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785, 1060 nm  
 Driver and control electronics integrated laser head  
 Power regulation in ps mode and in CW mode  
 Excellent stability of output power  
 Beam corrector removes astigmatism and makes beam circular  
 Interfaces with commonly used fibre couplers  
 Repetition rate 20, 40, 80 MHz  
 High-Power CW mode  
 Pulse width typically 40 to 80 ps up to 1 mW at 50 MHz  
 Improved pulse shape at high power, typ. 200ps at 5 mW / 50 MHz  
 Fast on / off / multiplexing capability  
 Fast electronic power control  
 Part of the bh modular FLIM systems for laser scanning microscopes  
 The BDL-SMN lasers were designed in cooperation with Lasos GmbH, Jena



### BDL-SMC Series Picosecond / CW diode lasers

Wavelengths 375, 405, 440, 473, 488, 510, 640, 685, 785 nm  
 Driver and control electronics integrated laser head  
 Beam corrector removes astigmatism and makes beam circular  
 Interfaces with commonly used fibre couplers  
 Repetition rate 20, 40, 80 MHz  
 High-Power CW mode  
 Pulse width typically 40 to 80 ps  
 Fast on / off / multiplexing capability  
 Fast electronic power control  
 405 nm: 1 mW from single-mode fibre  
 440, 473, 488, 640 nm: 0.4 mW from single-mode fibre  
 Part of the bh modular FLIM systems for laser scanning microscopes  
 The BDL-SMC lasers were designed in cooperation with Lasos GmbH, Jena



### Single-Mode Fibre Coupling for BDL series lasers

Point-Source fibre coupler and fibre  
 Up to 70% coupling efficiency  
 Fibres with FC output or with collimated output  
 Part of DCS-120 Confocal Scanning FLIM Systems



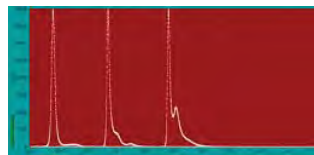
### Easy Power supply and Control

Power supply from simple wall mounted +12V power supply or from DCS box  
 All laser electronics integrated laser head  
 Interfaces directly with GVD-100 scan controller



### BDL-405-SMCP, BDL-440-SMCP, BDL-473-SMCP, BDL-488-SMCP picosecond diode lasers with fibre pigtailed

Single-mode fibre pigtail  
 Single-mode fibre permanently attached to laser  
 No fibre alignment required  
 405 nm, 440 nm, 473 nm, 488 nm, 640 nm  
 Designed in cooperation with Lasos GmbH, Jena



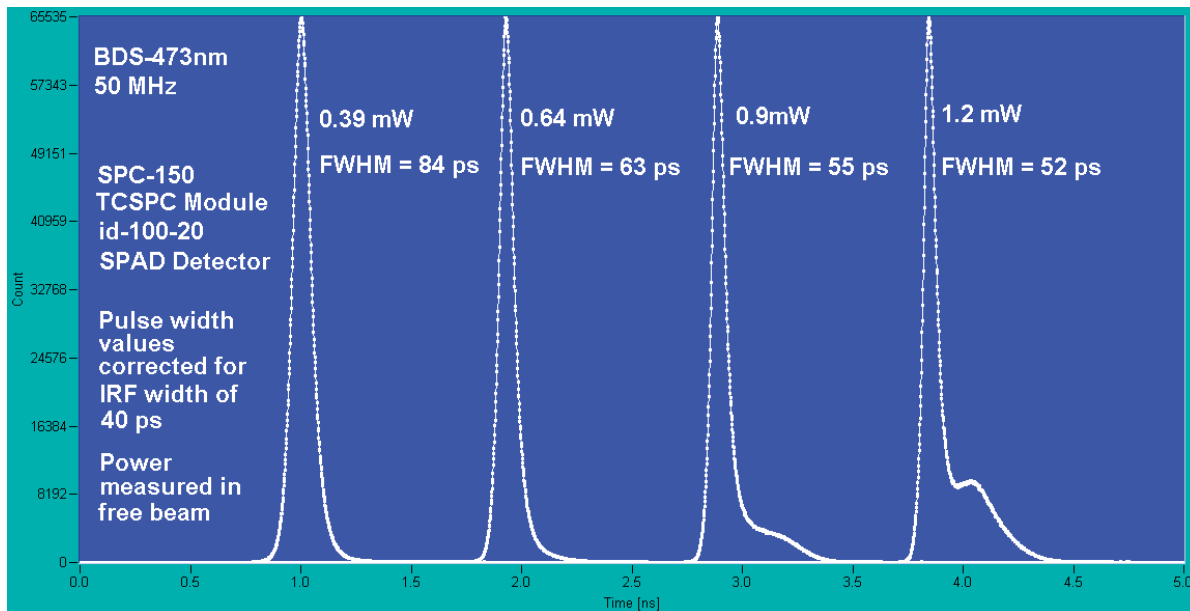
### BHL-600 picosecond diode lasers

Wavelengths from 635 nm to 1300 nm  
 Free-beam output  
 Repetition rate 50 MHz  
 Short pulse width typ. 40 to 50 ps  
 Power typ. 0.3 mW  
 All driver electronics integrated  
 Simple wall mounted +12V power supply

# BDS-473-SM

## 473 nm Picosecond Pulsed Diode Laser

- Small-size OEM Module**
- 40 mm x 40 mm x 110 mm**
- Free-beam or single-mode fibre output**
- Pulse width down to 52 ps**
- Pulse repetition rate 50 MHz**
- CW equivalent power 0.25 to 1.2 mW**
- Fast on / off / multiplexing capability**
- All electronics integrated**
- No external driver unit**
- Simple +12 V power supply**



Designed and manufactured by



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: info@becker-hickl.com  
 www.becker-hickl.com



**LASOS Lasertechnik GmbH**  
 Carl-Zeiss-Promenade 10  
 07745 Jena, Germany  
 Tel. +49 3641 2944-0  
 Fax +49 3641 2944-17  
 info@lasos.com  
 www.lasos.com

# BDS-473-SM

## Optical

Repetition Rate	50 MHz
Wavelength	467 nm to 476 nm, typ. 473 nm
Pulse Width (FWHM, at 1 mW power, 50 MHz)	50 to 90 ps
Average (CW equivalent) Power	0.2 mW to 1.2 mW, adjustable by control voltage
Beam diameter, free beam	0.7 mm, TEM <sub>00</sub> mode
Polarisation	horizontal
Coupling efficiency into single-mode fibre, typically	40%
Reaction time to 'Laser on/off' signal	1 μs
Warm-up time for power and pulse shape stabilisation after power on	1 min <sup>1)</sup>

## Trigger Output

Pulse Amplitude	-1V (peak) into 50 Ω
Pulse Width	5 ns
Leading edge fall time	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

## Control Inputs

Laser ON / Off	TTL / CMOS, 'low' means 'off', internal pull-up
External Power Control	analog input, 0 to + 10V

## Power Supply

Power Supply Voltage	+ 9 V to +15 V
Power Supply Current at 12V	200 mA to 350 mA <sup>2)</sup>

## Mechanical Data

Dimensions	40 mm x 44 mm x 110 mm
Mounting holes	four holes for M3 screws
Heat sink requirements	< 2°C / W <sup>3)</sup>

## Connector Pin Assignment

Connector	3M Shrink Delta Ribbon (SDR), 26 pins
Power supply +12V	18, 19, 20, 21, 22
GND	1, 2, 3, 5, 7, 9, 24, 25, 26
Power control voltage	4
Laser On/OFF	6

## Maximum Values

Power Supply Voltage	0 V to +15 V
Voltage at 'Laser On/Off' control input	-2 V to +7 V
Voltage at 'Laser Power' control input	-12 V to + 12 V
Ambient Temperature	0 °C to 40 °C <sup>3)</sup>

1) Operation below 13 °C ambient temperature may result in extended warm-up time.

2) Depends on case temperature due to laser diode cooling. Cooling current changes with case temperature

3) Laser must be mounted on heat sink. Case temperature must remain below 40°C

## Related Products

BDS-SM picosecond diode lasers, 375nm, 405nm, 445nm, 488nm, 515nm, 640nm

BDL-SMC picosecond and CW diode lasers, 375nm, 504nm, 445nm, 473nm, 488nm, 515nm, 640nm



**Caution: Class 3B laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**

## International Sales Representatives



US:  
**Boston Electronics Corp**  
 tcspc@boselec.com  
 www.boselec.com



UK:  
**Photonic Solutions PLC**  
 sales@psplc.com  
 www.psplc.com



Japan:  
**Tokyo Instruments Inc.**  
 sales@tokyoinst.co.jp  
 www.tokyoinst.co.jp



China:  
**DynaSense Photonics Co. Ltd.**  
 info@dyna-sense.com  
 www.dyna-sense.com



# BDL-SMN

## BDL-SMN Picosecond / CW Diode Laser Family

Free-beam output or single-mode fibre coupling

Beam-profile correction optics

Wavelengths 375 nm, 405 nm, 445 nm, 473 nm, 488 nm, 515 nm, 640 nm, 685 nm, 785 nm

Pulsed and CW operation

Pulse width down to 40 ps

Repetition rate 20-50-80 MHz

Low skew trigger output

Cooled laser diode

Internal power regulation loop

Linear response to power control signal

Fast on / off / multiplexing capability

Synchronisation input

Complete electronics integrated in laser housing

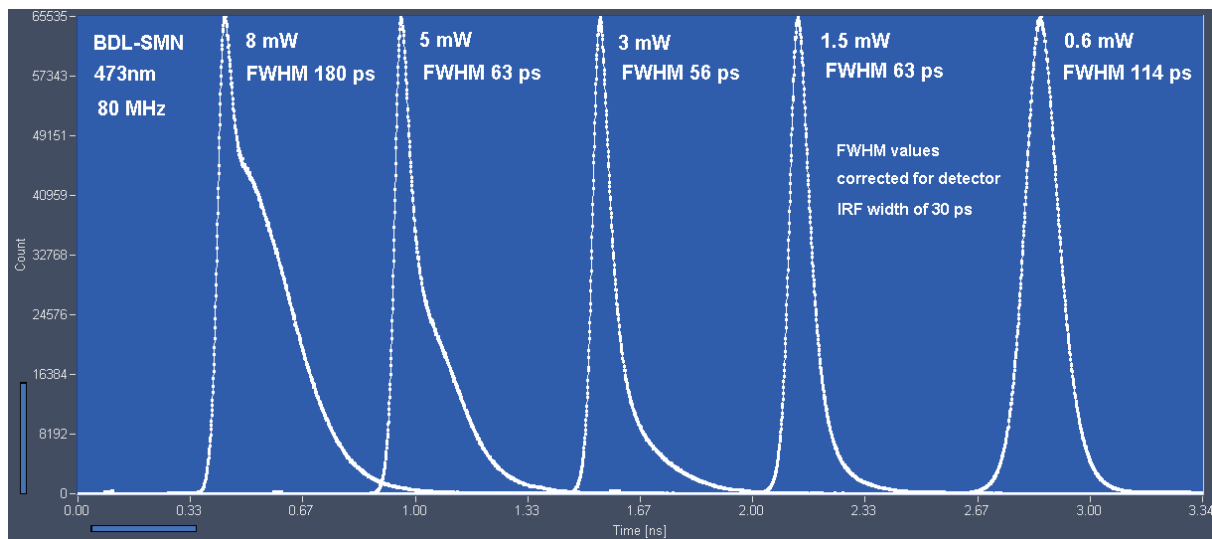
Simple +12V wall-mounted power supply

Luminescence lifetime experiments

Laser scanning microscopy

Fluorescence correlation

Time-correlated single photon counting experiments



Designed and manufactured by



**Becker & Hickl GmbH**  
Nahmitzer Damm 30  
12277 Berlin, Berlin  
Tel. +49 / 30 / 787 56 32  
Fax. +49 / 30 / 787 57 34  
email: info@becker-hickl.com  
www.becker-hickl.com



**LASOS Lasertechnik GmbH**  
Carl-Zeiss-Promenade 10  
07745 Jena, Germany  
Tel. +49 3641 2944-0  
Fax +49 3641 2944-17  
info@lasos.com  
www.lasos.com



# BDL-SMN

### Optical

Repetition Rate	20-50-80 MHz, or CW operation
Wavelength, nm	375, 405, 445, 473, 488, 515, 640, 685, 785, other on request
Pulse width (FWHM, at medium power)	40 to 90 ps <sup>2)</sup>
Pulse width (FWHM, at maximum power)	200 to 300 ps <sup>2)</sup>
Peak Power	40 to 500 mW <sup>1)</sup>
Power control range	20 MHz: 0 to 0.6 mW .... 0 to 2 mW <sup>2)</sup>
(Average CW equivalent power,	50 MHz: 0 to 1.5 mW .... 0 to 5 mW <sup>2)</sup>
adjustable via external power control signal)	80 MHz: 0 to 2.4 mW .... 0 to 8 mW <sup>2)</sup>
	CW mode: 0 to 20 mW .... 0 to 50 mW <sup>2)</sup>
Diameter of laser beam	0.7 mm, TEM <sub>00</sub> mode
Polarisation	horizontal
Fibre coupling	Kineflex system of Qioptiq
Coupling efficiency into single-mode fibre, typically	60%
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 20 ps
Reaction time to 'Laser on' signal (pulsed mode)	3 µs
Reaction time to 'Laser on' signal (CW mode)	3 µs
Power and pulse shape stabilisation after switch-on	2 min <sup>5)</sup>

### Trigger Output

Pulse Amplitude	1 V (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 1 ns
Jitter between Trigger and Optical Pulse	< 10 ps



### Synchronisation Input

Amplitude	+3.3 to +5V into 50 Ω
Duty cycle	10 to 30 %. DC equivalent must be < 2.5V
Frequency	20 to 80 MHz
Switching from internal clock to snc input	Automatic, by average voltage at sync input connector

### Control Inputs

Frequency 20 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 50 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 80 MHz	TTL / CMOS high <sup>3)</sup>
CW operation	TTL / CMOS high <sup>3)</sup>
Laser ON / Off	TTL / CMOS low <sup>3)</sup>
External Power Control	analog input, 0 to + 10V

### Power Supply

Power Supply Voltage	+ 9 V to +12 V
Power Supply Current	300 mA to 1.5 A <sup>4)</sup>
Power Adapter	AC-DC power adapter, with key switch and control box in cable

### Mechanical Data

Dimensions	160 mm x 90 mm x 60 mm
Mounting Thread	two M6 holes

### Maximum Values

Power Supply Voltage	0 V to +15 V
Voltage at Digital Control Inputs	-2 V to +7 V
Voltage at Ext. Bias Input	-12 V to + 12 V
Ambient Temperature	0 °C to 40 °C <sup>5)</sup>

- 1) Typical values, sample tested. Depends on pulse width and selected power.
- 2) Depends on wavelength version.
- 3) All inputs have 10 kΩ pull-up resistors. Open input is equivalent to logic 'high'.
- 4) Dependent on ambient temperature. Cooling current changes due to temperature regulation of laser diode
- 5) Operation below 13 °C may result in extended warm-up time.



**Caution: Class 3B laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**

## International Sales Representatives



US:  
**Boston Electronics Corp**  
 tcspc@boselec.com  
 www.boselec.com



UK:  
**Photonic Solutions PLC**  
 sales@psplc.com  
 www.psplc.com



Japan:  
**Tokyo Instruments Inc.**  
 sales@tokyoinst.co.jp  
 www.tokyoinst.co.jp



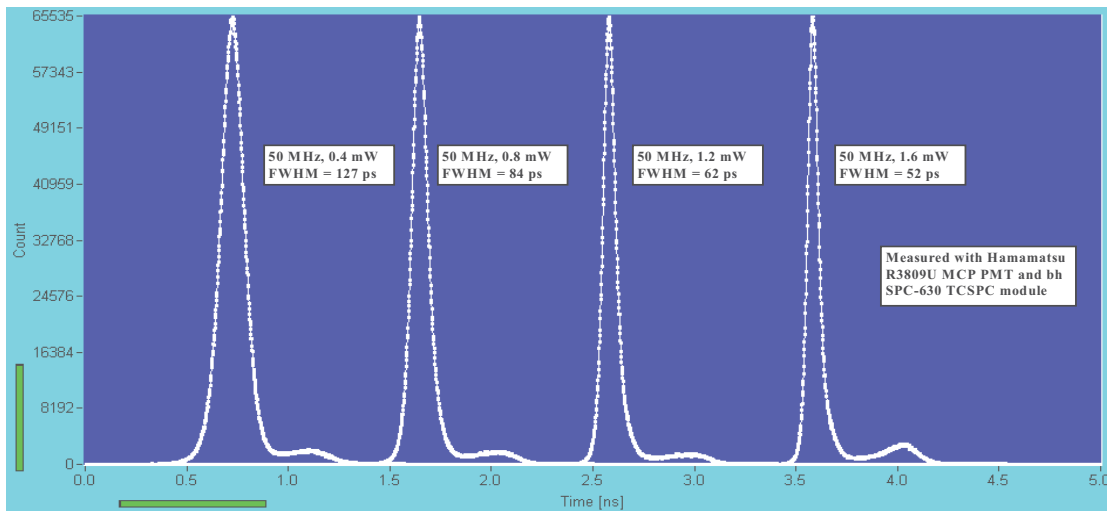
China:  
**DynaSense Photonics Co. Ltd.**  
 info@dyna-sense.com  
 www.dyna-sense.com

# BDL-405-SMC

## 405 nm Picosecond / CW Diode Laser with Single-Mode Fibre Coupler

**60% coupling efficiency into single-mode fibre**  
**TEM<sub>00</sub> mode**  
**Wavelength 405 nm**  
**Pulsed and CW operation**  
**Pulse width down to 60 ps**  
**Repetition rate 20-50-80 MHz**  
**Low skew trigger output**  
**Extremely low RF noise**  
**Cooled laser diode**  
**Fast on / off / multiplexing capability**  
**Simple + 9 V to +12V wall-mounted power supply**  
**Compact design - no external controller unit**  
**Compatible with all standard 1" footprint fibre couplers**

**Luminescence lifetime experiments**  
**Laser scanning microscopy**  
**Fluorescence correlation**  
**Time-correlated single photon counting experiments**



Designed and manufactured by



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: info@becker-hickl.com  
 www.becker-hickl.com



**LASOS Lasertechnik GmbH**  
 Carl-Zeiss-Promenade 10  
 07745 Jena, Germany  
 Tel. +49 3641 2944-0  
 Fax +49 3641 2944-17  
 info@lasos.com  
 www.lasos.com



Sales Representatives



US Representative:  
**Boston Electronics Corp**  
 tcspc@boselec.com  
 www.boselec.com



UK Representative:  
**Photonic Solutions PLC**  
 sales@psplc.com  
 www.psplc.com

# BDL-405-SMC

## Optical

Repetition Rate	20-50-80 MHz, or CW operation
Wavelength	401 nm to 410 nm, typ. 405 nm
Pulse Width (FWHM, at 1 mW power, 50 MHz)	50 to 90 ps
Peak Power	80 to 500 mW <sup>1)</sup>
Average Power	20 MHz: 0.12 mW to 0.6 mW <sup>2)</sup>
(Average CW equivalent power, user adjustable)	50 MHz: 0.3 mW to 1.6 mW <sup>2)</sup>
	80 MHz: 0.4 mW to 2.4 mW <sup>2)</sup>
	CW mode: 5 mW to 40 mW <sup>2)</sup>
Beam diameter before coupler	0.7 mm, TEM <sub>00</sub> mode
Polarisation	horizontal
Coupling efficiency into fibre, typically	60%
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 20 ps
Reaction time to 'Laser on' signal (pulsed mode)	1 µs
Reaction time to 'Laser on' signal (CW mode)	3 µs
Power and pulse shape stabilisation after switch-on	3 min
Fibre coupler	all 1" footprint couplers: Point Source, Schäfter&Kirchhoff, OZ Optics, Linus

## Trigger Output

Pulse Amplitude	+100 to +300 mV (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

## Control Inputs

Frequency 20 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 50 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 80 MHz	TTL / CMOS high <sup>3)</sup>
CW operation	TTL / CMOS high <sup>3)</sup>
Laser ON / Off	TTL / CMOS low <sup>3)</sup>
External Power Control	analog input, 0 to + 10V

## Power Supply

Power Supply Voltage	+ 9 V to +12 V
Power Supply Current	300 mA to 1 A <sup>4)</sup>
Power Adapter	AC-DC power adapter, with key switch and control box in cable

## Mechanical Data

Dimensions	160 mm x 90 mm x 60 mm
Mounting Thread	two M6 holes

## Maximum Values

Power Supply Voltage	0 V to +15 V
Voltage at Digital Control Inputs	-2 V to +7 V
Voltage at Ext. Bias Input	-12 V to + 12 V
Ambient Temperature	0 °C to 40 °C <sup>5)</sup>

1) Typical values, sample tested. Depends on pulse width and selected power.

2) Recommended power adjust range. Lower power gives broader pulses, higher power gives ringing in pulse shape. Power levels above the given range can be selected, but may impair the lifetime of the laser diode.

3) All inputs have 10 kΩ pull-up resistors. Open input is equivalent to logic 'high'.

4) Dependent on ambient temperature. Cooling current changes due to temperature regulation of laser diode

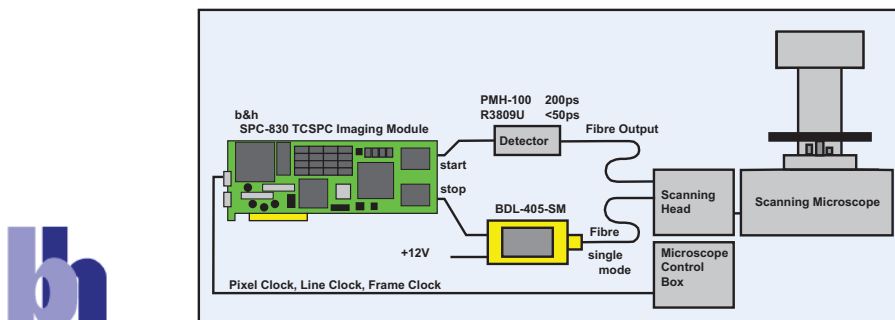
5) Operation below 13 °C may result in extended warm-up time.



**Caution: Class 3B laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**

## Application: TCSPC lifetime imaging with laser scanning microscopes

The BDL-405-SM laser excites the sample with 50 MHz, 75 ps pulses. The microscope scans the sample in y-x direction, and the SPC-830 TCSPC imaging module records the photon distribution versus time and the coordinates of the scanning area. The setup detects single and double exponential lifetimes down to a few 10ps. Typical applications are ion concentration, pH, or oxygen saturation measurements by fluorescence quenching, FRET experiments and distinguishing of autofluorescence components. Please see [www.becker-hickl.com](http://www.becker-hickl.com) for detailed information.



Becker & Hickl GmbH  
 Nahmitzer Damm 30  
 12277 Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
<http://www.becker-hickl.com>  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)

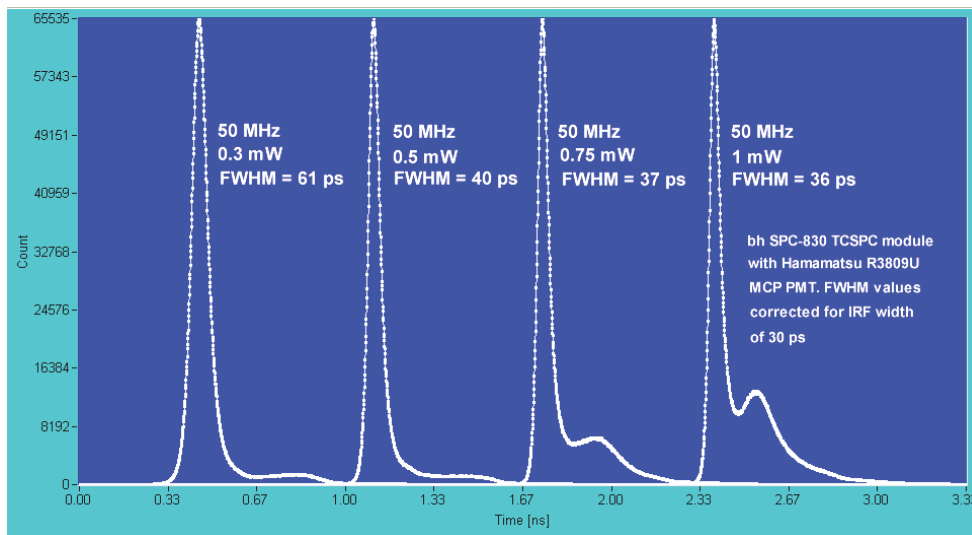


# BDL-440-SMC

## 440 nm Picosecond / CW Diode Laser with Single-Mode Fibre Coupler

- 60% coupling efficiency into single-mode fibre**
- TEM<sub>00</sub> mode**
- Wavelength 440 nm**
- Pulsed and CW operation**
- Pulse width down to 40 ps**
- Repetition rate 20-50-80 MHz**
- Low skew trigger output**
- Extremely low RF noise**
- Cooled laser diode**
- Fast on / off / multiplexing capability**
- Simple + 9 V to +12V wall-mounted power supply**
- Compact design - no external controller unit**
- Compatible with all standard 1" footprint fibre couplers**

- Luminescence lifetime experiments**
- Laser scanning microscopy**
- Fluorescence correlation**
- Time-correlated single photon counting experiments**



**Designed and manufactured by**



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: info@becker-hickl.com  
 www.becker-hickl.com



**LASOS Lasertechnik GmbH**  
 Carl-Zeiss-Promenade 10  
 07745 Jena, Germany  
 Tel. +49 3641 2944-0  
 Fax +49 3641 2944-17  
 info@lasos.com  
 www.lasos.com



**Sales Representatives**



US Representative:  
**Boston Electronics Corp**  
 tcspc@boselec.com  
 www.boselec.com



UK Representative:  
**Photonic Solutions PLC**  
 sales@psplc.com  
 www.psplc.com

# BDL-440-SMC

**Optical**

Repetition Rate	20-50-80 MHz, or CW operation
Wavelength	436 nm to 448 nm, typ. 440 nm
Pulse Width (FWHM, at 1 mW power, 50 MHz)	40 to 90 ps
Peak Power	40 to 250 mW <sup>1)</sup>
Average Power	20 MHz: 0.07 mW to 0.2 mW <sup>2)</sup>
(Average CW equivalent power, user adjustable)	50 MHz: 0.3 mW to 1 mW <sup>2)</sup>
	80 MHz: 0.4 mW to 1.2 mW <sup>2)</sup>
	CW mode: 1 mW to 20 mW <sup>2)</sup>
Beam diameter before coupler	0.7 mm, TEM <sub>00</sub> mode
Polarisation	horizontal
Coupling efficiency into single-mode fibre, typically	60%
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 20 ps
Reaction time to 'Laser on' signal (pulsed mode)	1 µs
Reaction time to 'Laser on' signal (CW mode)	3 µs
Power and pulse shape stabilisation after switch-on	3 min <sup>5)</sup>
Fibre coupler	

all 1" footprint couplers: Point Source, Schäfter&Kirchhoff, OZ Optics, Linus

**Trigger Output**

Pulse Amplitude	+100 to +300 mV (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

**Control Inputs**

Frequency 20 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 50 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 80 MHz	TTL / CMOS high <sup>3)</sup>
CW operation	TTL / CMOS high <sup>3)</sup>
Laser ON / Off	TTL / CMOS low <sup>3)</sup>
External Power Control	analog input, 0 to + 10V

**Power Supply**

Power Supply Voltage	+ 9 V to +12 V
Power Supply Current	300 mA to 1 A <sup>4)</sup>
Power Adapter	AC-DC power adapter, with key switch and control box in cable

**Mechanical Data**

Dimensions	160 mm x 90 mm x 60 mm
Mounting Thread	two M6 holes

**Maximum Values**

Power Supply Voltage	0 V to +15 V
Voltage at Digital Control Inputs	-2 V to +7 V
Voltage at Ext. Bias Input	-12 V to + 12 V
Ambient Temperature	0 °C to 40 °C <sup>5)</sup>

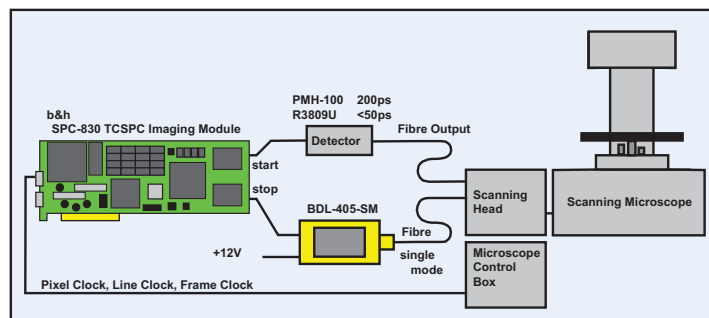
- 1) Typical values, sample tested. Depends on pulse width and selected power.
- 2) Recommended power adjust range. Lower power gives broader pulses, higher power gives ringing in pulse shape. Power levels above the given range can be selected, but may impair the lifetime of the laser diode.
- 3) All inputs have 10 kΩ pull-up resistors. Open input is equivalent to logic 'high'.
- 4) Dependent on ambient temperature. Cooling current changes due to temperature regulation of laser diode
- 5) Operation below 13 °C may result in extended warm-up time.



**Caution: Class 3B laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**

**Application: TCSPC lifetime imaging with laser scanning microscopes**

The BDL-405-SM laser excites the sample with 50 MHz, 75 ps pulses. The microscope scans the sample in y-x direction, and the SPC-830 TCSPC imaging module records the photon distribution versus time and the coordinates of the scanning area. The setup detects single and double exponential lifetimes down to a few 10ps. Typical applications are ion concentration, ph, or oxygen saturation measurements by fluorescence quenching, FRET experiments and distinguishing of autofluorescence components. Please see [www.becker-hickl.com](http://www.becker-hickl.com) for detailed information.



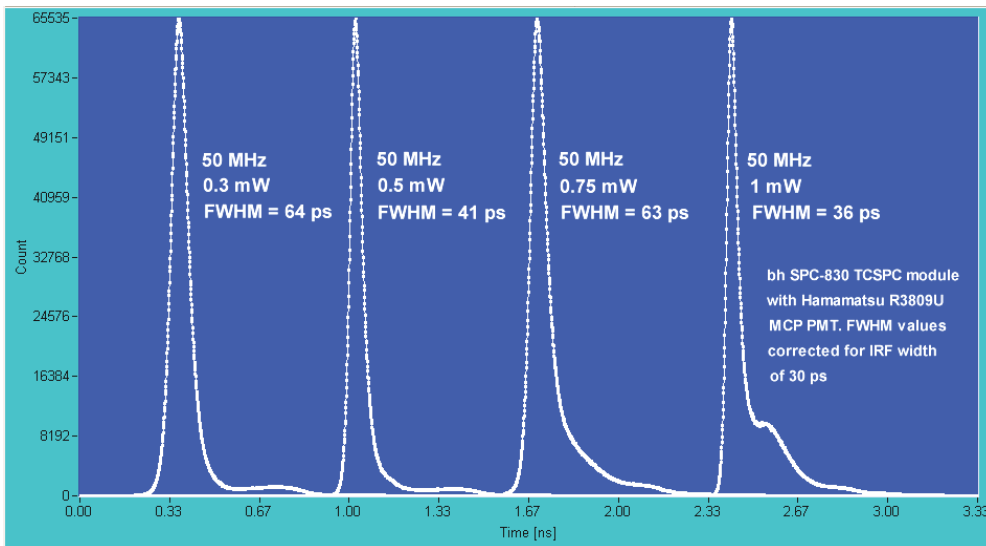
Becker & Hickl GmbH  
 Nahmitzer Damm 30  
 12277 Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
<http://www.becker-hickl.com>  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)

# BDL-473-SMC

## 473 nm Picosecond / CW Diode Laser with Single-Mode Fibre Coupler

- 60% coupling efficiency into single-mode fibre**
- TEM<sub>00</sub> mode**
- Wavelength 473 nm**
- Pulsed and CW operation**
- Pulse width down to 40 ps**
- Repetition rate 20-50-80 MHz**
- Low skew trigger output**
- Extremely low RF noise**
- Cooled laser diode**
- Fast on / off / multiplexing capability**
- Simple + 9 V to +12V wall-mounted power supply**
- Compact design - no external controller unit**
- Compatible with all standard 1" footprint fibre couplers**

- Luminescence lifetime experiments**
- Laser scanning microscopy**
- Fluorescence correlation**
- Time-correlated single photon counting experiments**



**Designed and manufactured by**



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: info@becker-hickl.com  
 www.becker-hickl.com



**LASOS Lasertechnik GmbH**  
 Carl-Zeiss-Promenade 10  
 07745 Jena, Germany  
 Tel. +49 3641 2944-0  
 Fax +49 3641 2944-17  
 info@lasos.com  
 www.lasos.com



**Sales Representatives**



US Representative:  
**Boston Electronics Corp**  
 tcspc@boselec.com  
 www.boselec.com



UK Representative:  
**Photonic Solutions PLC**  
 sales@psplc.com  
 www.psplc.com

# BDL-473-SMC

**Optical**

Repetition Rate	20-50-80 MHz, or CW operation
Wavelength	467 nm to 476 nm, typ. 473 nm
Pulse Width (FWHM, at 1 mW power, 50 MHz)	40 to 90 ps
Peak Power	40 to 250 mW <sup>1)</sup>
Average Power	20 MHz: 0.07 mW to 0.2 mW <sup>2)</sup>
(Average CW equivalent power, user adjustable)	50 MHz: 0.3 mW to 1 mW <sup>2)</sup>
	80 MHz: 0.4 mW to 1.2 mW <sup>2)</sup>
	CW mode: 0.5 mW to 10 mW <sup>2)</sup>
Beam diameter before coupler	0.7 mm, TEM <sub>00</sub> mode
Polarisation	horizontal
Coupling efficiency into single-mode fibre, typically	60%
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 20 ps
Reaction time to 'Laser on' signal (pulsed mode)	1 µs
Reaction time to 'Laser on' signal (CW mode)	3 µs
Power and pulse shape stabilisation after switch-on	3 min <sup>5)</sup>
Fibre coupler	

all 1" footprint couplers: Point Source, Schäfter&Kirchhoff, OZ Optics, Linus

**Trigger Output**

Pulse Amplitude	+100 to +300 mV (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

**Control Inputs**

Frequency 20 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 50 MHz	TTL / CMOS high <sup>3)</sup>
Frequency 80 MHz	TTL / CMOS high <sup>3)</sup>
CW operation	TTL / CMOS high <sup>3)</sup>
Laser ON / Off	TTL / CMOS low <sup>3)</sup>
External Power Control	analog input, 0 to + 10V

**Power Supply**

Power Supply Voltage	+ 9 V to +12 V
Power Supply Current	300 mA to 1 A <sup>4)</sup>
Power Adapter	AC-DC power adapter, with key switch and control box in cable

**Mechanical Data**

Dimensions	160 mm x 90 mm x 60 mm
Mounting Thread	two M6 holes

**Maximum Values**

Power Supply Voltage	0 V to +15 V
Voltage at Digital Control Inputs	-2 V to +7 V
Voltage at Ext. Bias Input	-12 V to + 12 V
Ambient Temperature	0 °C to 40 °C <sup>5)</sup>

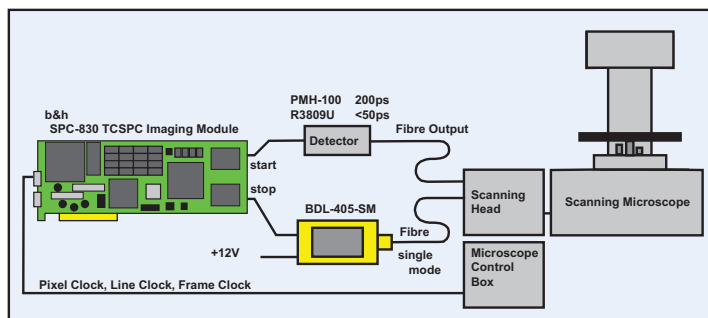
- 1) Typical values, sample tested. Depends on pulse width and selected power.
- 2) Recommended power adjust range. Lower power gives broader pulses, higher power gives ringing in pulse shape. Power levels above the given range can be selected, but may impair the lifetime of the laser diode.
- 3) All inputs have 10 kΩ pull-up resistors. Open input is equivalent to logic 'high'.
- 4) Dependent on ambient temperature. Cooling current changes due to temperature regulation of laser diode
- 5) Operation below 13 °C may result in extended warm-up time.



**Caution: Class 3B laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**

**Application: TCSPC lifetime imaging with laser scanning microscopes**

The BDL-405-SM laser excites the sample with 50 MHz, 75 ps pulses. The microscope scans the sample in y-x direction, and the SPC-830 TCSPC imaging module records the photon distribution versus time and the coordinates of the scanning area. The setup detects single and double exponential lifetimes down to a few 10ps. Typical applications are ion concentration, ph, or oxygen saturation measurements by fluorescence quenching, FRET experiments and distinguishing of autofluorescence components. Please see [www.becker-hickl.com](http://www.becker-hickl.com) for detailed information.

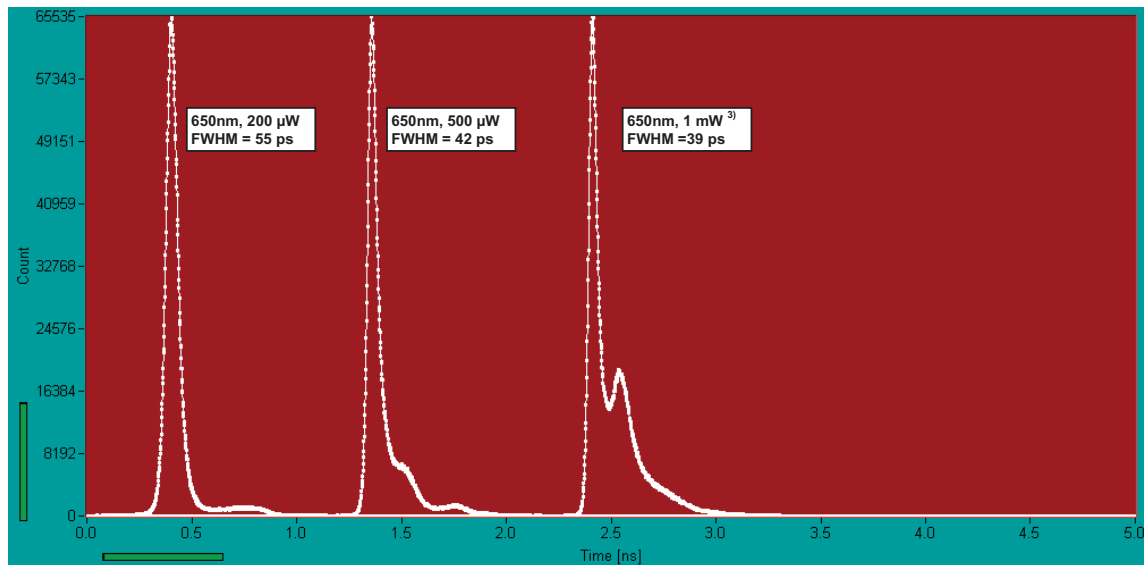


Becker & Hickl GmbH  
 Nahmitzer Damm 30  
 12277 Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
<http://www.becker-hickl.com>  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)

# BHL-600

## Red and NIR Picosecond Diode Laser Modules

**Pulse width down to 50 ps**  
**Average power up to 0.5 mW**  
**Repetition rate 50 MHz**  
**Wavelengths 635 nm to 1300 nm**  
**Low skew trigger output**  
**Extremely low RF noise**  
**Simple +9 V to +12V power supply**  
**Compact design - no external controller unit**  
**Interfaces directly to all bh TCSPC modules**



**Photon migration experiments**  
**Luminescence lifetime of NIR fluorophores**  
**Fluorescence correlation**  
**Testing of optical detectors**  
**Time-correlated single photon counting experiments**



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)  
[www.becker-hickl.com](http://www.becker-hickl.com)



US Representative:  
**Boston Electronics Corp**  
[tcspc@boselec.com](mailto:tcspc@boselec.com)  
[www.boselec.com](http://www.boselec.com)



UK Representative:  
**Photonic Solutions PLC**  
[sales@psplc.com](mailto:sales@psplc.com)  
[www.psplc.com](http://www.psplc.com)

# BHL-600

**Optical**

Repetition Rate	50 MHz
Wavelength	635, 650, 660, 670, 785, 808, 830, 980, 1300 nm <sup>1)</sup>
Average power (adjustable)	0.1 mW to 0.5 mW <sup>2)</sup>
Maximum CW power	1 mW <sup>3)</sup>
Average power for best pulse shape (typical value)	0.2 mW
Minimum pulse width (FWHM)	40 ps to 100 ps <sup>4)</sup>
Pulse Width (FWHM, Power 0.5 mW)	<150 ps <sup>4)</sup>
Peak Power	100 mW <sup>4,5)</sup>
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 10 ps
Power regulation	within 2% <sup>5)</sup>
Collimator focal length	8 mm

**Trigger Output**

Pulse Amplitude	-100 mV (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

**Power Supply**

Power Supply Voltage	+9 V to 12 V
Power Supply Current	100 mA to 200 mA

**Mechanical Data**

Dimensions	110 mm x 66 mm x 38 mm
Mounting Thread	two M6 holes

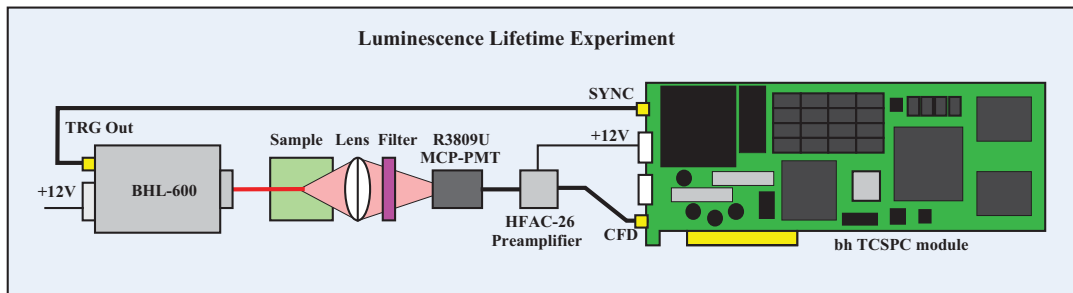
**Maximum Values**

Power Supply Voltage	0 V to +15 V
Ambient Temperature	0 °C to 30 °C
Maximum CW power	1 mW <sup>3)</sup>

- 1) Other wavelengths are available, but pulse width may differ from values given
- 2) Recommended power adjust range. Please note that the pulse width changes with the power. Permanent operation above the given range may impair the lifetime of the laser diode.
- 3) Absolute maximum of CW power. It is not guaranteed that all versions actually reach this power.
- 4) Pulse width varies with wavelength version and power. Please contact bh for detailed information.
- 5) Typical value, sample tested only.
- 6) Power is regulated via internal monitor photodiode. Reflecting the beam back or shining other light into the laser diode may impair power stability or even shutdown the laser.



**Caution: Class 3R laser product. Avoid direct eye exposure. Light emitted by the device may be harmful to the human eye. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**



Becker & Hickl GmbH  
 Nahmitzer Damm 30  
 12277 Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
<http://www.becker-hickl.com>  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)

# BHLP-700

## Red and NIR Picosecond Diode Laser Modules

**Pulse width down to 100 ps**

**Average power up to 10 mW**

**Repetition rate 50 MHz**

**Wavelength 685 nm, 785 nm**

**Low skew trigger output**

**Extremely low RF noise**

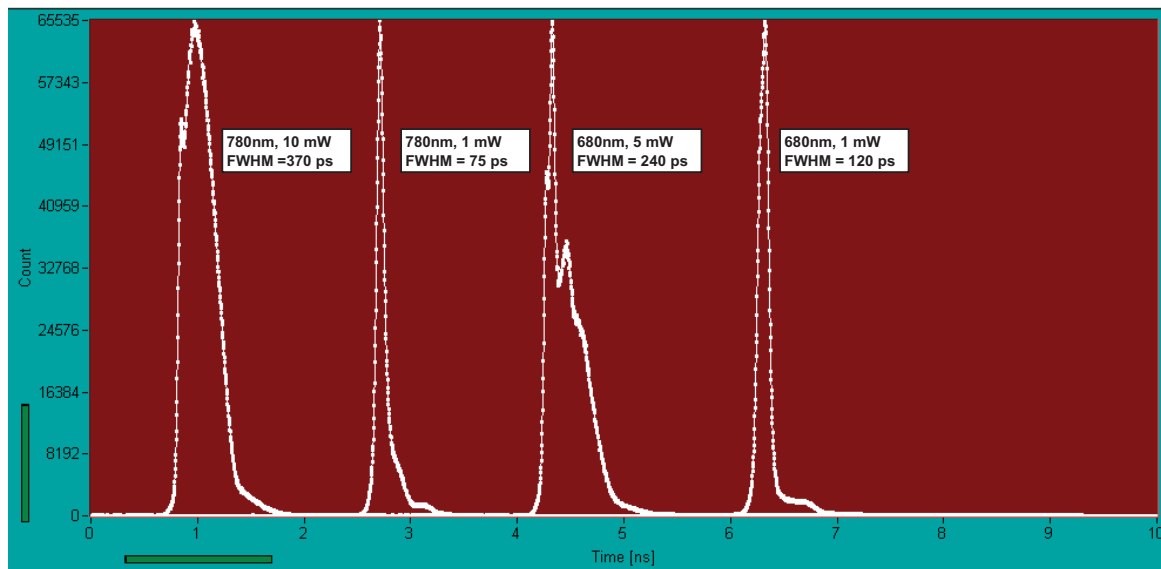
**Cooled laser diode**

**Shutdown / startup within 2 $\mu$ s - fast multiplexing capability**

**Simple +12V power supply**

**Compact design - no external controller unit**

**Interfaces directly to all bh TCSPC modules**



**Diffuse Optical Tomography**

**Luminescence Lifetime of NIR Fluorophores**

**Fluorescence Correlation**

**Time-Related Single Photon Counting**

**Experiments**



**Becker & Hickl GmbH**  
 Nahmitzer Damm 30  
 12277 Berlin, Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)  
[www.becker-hickl.com](http://www.becker-hickl.com)



US Representative:  
**Boston Electronics Corp**  
[tcspc@boselec.com](mailto:tcspc@boselec.com)  
[www.boselec.com](http://www.boselec.com)



UK Representative:  
**Photonic Solutions PLC**  
[sales@psplc.com](mailto:sales@psplc.com)  
[www.psplc.com](http://www.psplc.com)

# BHL P-700

**Optical**

Repetition Rate	50 MHz
Wavelength	685 nm, 785 nm <sup>1)</sup>
Pulse Width (FWHM, Power 1 mW, typical value)	120 ps
Pulse Width (FWHM, Power 5 mW, typical value)	300 ps
Peak Power	300 mW <sup>2)</sup>
Average CW power (adjustable)	0.2 mW to 10 mW <sup>3)</sup>
Stability of Repetition Rate	± 100 ppm
Pulse-to Pulse Jitter	< 10 ps
Power and pulse shape stabilisation after 'Laser on' signal	2 µs
Power and pulse shape stabilisation after switch-on	2 min

**Trigger Output**

Pulse Amplitude	-100 mV (peak) into 50 Ω
Pulse Width	1 ns
Output Impedance	50 Ω
Connector	SMA
Delay from Trigger to Optical Pulse	< 500 ps
Jitter between Trigger and Optical Pulse	< 10 ps

**Control Inputs**

/Laser Off (Shutdwn)	TTL / CMOS low <sup>4)</sup>
Shutdwn delay	<100 ns
Power and pulse shape stabilisation after end of '/Laser Off'	2 us
External Power Control	analog input, 0 to +5 V

**Power Supply**

Power Supply Voltage	+12 V
Power Supply Current	200 mA to 1 A <sup>5)</sup>

**Mechanical Data**

Dimensions	110 mm x 66 mm x 78 mm
Mounting Thread	two M6 holes

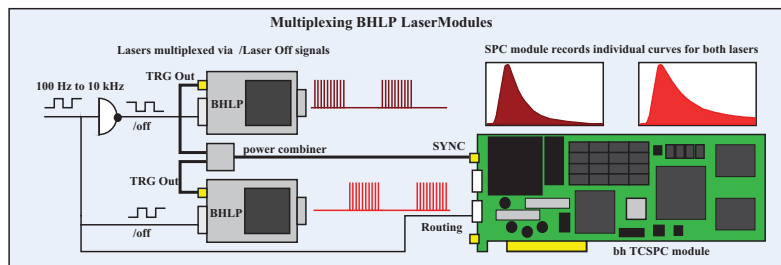
**Maximum Values**

Power Supply Voltage	0 V to +15 V
Voltage at /Laser Off input	-2 V to +7 V
Voltage at Ext. Bias Input	-2V to +7V
Ambient Temperature	0 °C to 30 °C <sup>6)</sup>

- 1) Other wavelengths from 635nm to 1300nm are available. Power and pulse width parameters may differ for wavelengths other than specified above. Please contact bh.
- 2) Typical value, sample tested only.
- 3) Recommended power adjust range. Please note that the pulse width changes with the power. Power levels above the given range can be selected, but may impair the lifetime of the laser diode.
- 4) All inputs have 10 kΩ pull-up resistors. Open input is equivalent to logic 'high'.
- 5) Dependent on ambient temperature. Cooling current changes due to temperature regulation of laser diode
- 6) Operation below 13 °C may result in unstable power or extended warm-up time.



**Caution: Class 3B laser product. Avoid exposure to beam. Light emitted by the device may be harmful to the human eye and skin. Please obey laser safety rules when operating the devices. Complies with US federal laser product performance standards.**



Becker & Hickl GmbH  
 Nahmitzer Damm 30  
 12277 Berlin  
 Tel. +49 / 30 / 787 56 32  
 Fax. +49 / 30 / 787 57 34  
<http://www.becker-hickl.com>  
 email: [info@becker-hickl.com](mailto:info@becker-hickl.com)



This page intentionally blank.



91 Boylston Street, Brookline, MA 02445  
 tel: (617)566-3821 fax: (617)731-0935  
 www.boselec.com tcspc@boselec.com

# Can we send you a *FREE* bound copy of The bh TCSPC Handbook?

**6<sup>th</sup> Edition, 768 pages, 1007 References, December 2014**

**by Wolfgang Becker**

For your copy, tell us something about your interest in TCSPC and give us your name and address below so that we can send it to you.

- I am a TCSPC user now
- I am thinking about using TCSPC in the future
- My interest is microscopy
- My interest is single molecule detection
- My interest is \_\_\_\_\_

Name: \_\_\_\_\_

Company or Institution: \_\_\_\_\_

Address: \_\_\_\_\_




---

Also available useful publications (check the box to request):

- TCSPC for Microscopy**
- TCSPC Systems**
- Photon Counting Detectors for TCSPC**
- Picosecond Lasers for TCSPC**